

May 1, 2020

Representative Jim Hamilton
Chair, Pensions and Local Trends Legislative Finance Subcommittee
Montana House of Representatives
1301 E 6th Ave
Helena, MT 59601

Dear Chair Hamilton,

This letter and the attached report are provided in response to your letter of January 16th, in which you requested a stress test analysis of Montana's major public pension systems. The analysis was informed by the Actuarial Standards Board's recently published guidance on risk reporting, and was created using Pew's stress test methodology as described in our research paper, *Assessing the Risk of Fiscal Distress for Public Pension: State Stress Test Analysis*.¹ This analysis is intended to supplement a more detailed assessment by the plans' actuarial consultant in accordance with HB 715, which calls for a long-term budget stabilization study, including pension stress testing.

The key findings of our analysis include:

- **Reforms passed in 2013 have helped improve the fiscal health of Montana's two largest pension plans.** These reforms included a significant increase in annual pension contributions from the state, participating local governments, and school districts. This change has increased pension assets by more than \$600 million and improved the combined funded ratio for the two plans by approximately 5 percentage points. Also included in the reforms were a reduction in the post-retirement Guaranteed Annual Benefit Adjustment (GABA) for new workers and the introduction of a variable employee contribution rate. Both are adjustable based on the actuarial status of the plan and are estimated to mitigate nearly 20 percent of unexpected costs for new worker benefits if investment returns are lower than expected.
- **However, our central finding is that contribution levels under current policies may be insufficient to improve funded status if long-term investment returns are lower than the plans' average expected rate of 7.6 percent.** For example, if plan assets earn 6.5 percent – the estimated long-term return based on Pew's capital market assumptions and the Montana plans' asset mix – the combined funded levels for the two plans would decline from 72 percent currently to 58 percent by 2039. And if the long-term return is only 5 percent, funded levels would fall to 14 percent within 30 years in the absence of further policy change.
- **The risk of underfunding and, potentially, insolvency is even greater when we account for market volatility.** In a hypothetical asset shock scenario – one in which plans experience an approximate 25 percent investment loss, followed by a short recovery period and then lower returns over the long-term – Montana's largest plans reach insolvency within 30 years. Similarly, stochastic analysis, which accounts for real world market volatility, indicates a 63 percent chance of declining funded ratios and a 6 percent probability of insolvency over the 20-year forecast period without further policy changes. These results reinforce our finding that

¹ Mennis, G., Banta, S., & Draine, D. (2018). *Assessing the Risk of Fiscal Distress for Public Pensions: State Stress Test Analysis*. Harvard Kennedy School Mossavar-Rahmani Center Working Paper.

additional policy reforms may be needed to improve long-term funding and mitigate investment risk for both plans.

All projections and calculations by The Pew Charitable Trusts and The Terry Group are based on assumptions and other data available in public documents. Baseline projections are designed to match as closely as possible, but not replicate, official projections developed by plan actuaries.

We hope this stress test report will be of use in your efforts to inform a broad range of stakeholders on the fiscal condition of Montana's retirement systems; the impact that current economic conditions may have on those systems; and to develop policies that address the associated risks of market and economic uncertainty.

Sincerely,

Greg Mennis

Director

[Strengthening Public Sector Retirement Systems](#)

The Pew Charitable Trusts

Introduction

The Montana state legislature enacted HB 715 in May 2019, which calls for a long-term budget stabilization study, including pension stress testing.¹ This report, prepared by Pew at the request of the Pensions and Local Trends Legislative Finance Subcommittee, was written in support of meeting this requirement, and serves as a supplement to a more detailed assessment by the state plans' actuarial consultant Cavanaugh MacDonald.² The analysis follows the recommendations outlined in Pew's *Foundation for Public Pension Risk Reporting*,³ a framework for public pension risk assessment developed in collaboration with the Harvard Kennedy School of Government.

The Foundation is based on recent research and emerging guidelines in the field, including the Society of Actuaries Blue Ribbon Panel report⁴ and Actuarial Standard of Practice (ASOP) No. 51,⁵ and provides a roadmap for analysis that builds on existing projections from the plan's actuary and investment consultants. The Foundation was designed to provide accessible information to **all stakeholders**, with the specific intent to **inform budget planning and decision making**.

This report focuses primarily on **investment risk**, the risk that investment returns are not as expected.⁶ The analysis examines the projected financial position and cash flows of the two largest plans in Montana – the Public Employees' Retirement System-Defined Benefit Retirement Plan (PERS) and the Teachers' Retirement System of Montana (TRS). On a combined basis, the two plans account for roughly 87 percent of the state's total pension liability and administer benefits for 92 percent of all participants in Montana's defined benefit plans.

Key findings of the analysis include:

- **Reforms passed in 2013 have helped improve the fiscal health of Montana's two largest pension plans.** These reforms included a significant increase in annual pension contributions from the state, participating local governments, and school districts. This change has increased pension assets by more than \$600 million and improved the combined funded ratio for the two plans by approximately 5 percentage points. Also included in the reforms were a reduction in the post-retirement Guaranteed Annual Benefit Adjustment (GABA) for new workers and the introduction of a variable employee contribution rate. Both are adjustable based on the actuarial status of the plan and are estimated to mitigate nearly 20 percent of unexpected costs for new worker benefits if investment returns are lower than expected.
- **However, our central finding is that contribution levels under current policies may be insufficient to improve funded status if long-term investment returns are lower than the plans' average expected rate of 7.6 percent.** For example, if plan assets earn 6.5 percent – the estimated long-term return based on Pew's capital market assumptions and the Montana plans' asset mix – the combined funded levels for the two plans would decline from 72 percent currently to 58 percent by 2039. And if the long-term return is only 5 percent, funded levels would fall to 14 percent within 30 years in the absence of further policy change.
- **The risk of underfunding and, potentially, insolvency is even greater when we account for market volatility.** In a hypothetical asset shock scenario – one in which plans experience an approximate 25 percent investment loss, followed by a short recovery period and then lower

returns over the long-term – Montana’s largest plans reach insolvency within 30 years. Similarly, stochastic analysis, which accounts for real world market volatility, indicates a 63 percent chance of declining funded ratios and a 6 percent probability of insolvency over the 20-year forecast period without further policy changes. These results reinforce our finding that additional policy reforms may be needed to improve long-term funding and mitigate investment risk for both plans.

Overall, our findings align closely with projections made by the plans’ actuary, Cavanaugh MacDonald. Additionally, consistent with their analysis, our results do not account for the as-yet-unknown impact of COVID-19. However, these assessments of downside economic scenarios can provide a blueprint for quantifying potential post-pandemic outcomes. For example, this framework could be used to develop a scenario that includes expected return shortfalls for the current fiscal year, the projected decline in revenue for FY 21 and the likely recessionary period to follow.

Based on the findings summarized above and described in more detail below, policymakers could consider further policy actions, including: lowering the assumed rates of return on investments to more closely align with projected market performance; and committing additional funding, over time, to prevent the risk of rising pension debt.

The remainder of this report is divided into four sections:

- Baseline Projections for Montana’s State Retirement Systems
- Scenario Analysis of Investment Risk
- Simulating Additional Costs of Market Volatility Risk
- Assessing Sensitivity to Lower Discount Rates

Baseline Projections for Montana’s State Retirement Systems

Montana’s pension fiscal metrics and investment practices – key inputs for stress test analysis – track closely with national averages across state retirement systems. For example, the state’s pensions were 73 percent funded in 2018, slightly above the national average of 71 percent. The investment policies of TRS and PERS, the two largest plans, set asset allocation targets that are also similar to national averages.⁷ PERS targets 54 percent in stocks, 26 percent in bonds and cash, and 20 percent in alternative investments while TRS targets 53 percent, 27 percent and 20 percent, respectively. However, the assumed rate of return on these investments is slightly higher than the median for state plans, at 7.50 percent for TRS and 7.65 percent for PERS, respectively.⁸

Contributions to TRS and PERS totaled \$465 million in FY 2019, with \$180 million (39 percent) coming from employees, and \$285 million (61 percent) from the state and other participating employers. All employee contributions and most of the employer annual payments are based on a percentage of current worker payroll that is set in statute. Rates for employers have increased annually since 2014, based on reforms included in 2013 legislation, and will continue to rise through 2024.

A significant portion of the state’s 2019 annual payment of \$92 million was from supplemental contributions from a variety of sources, put in place as part of 2013 reforms. The largest of these was a \$34 million general fund statutory appropriation to PERS,⁹ and a fixed \$25 million appropriation made annually to TRS. Additional details on the plans’ contribution schedule and funding policies, designed to achieve full funding over 30 years, can be found in Appendix 1.

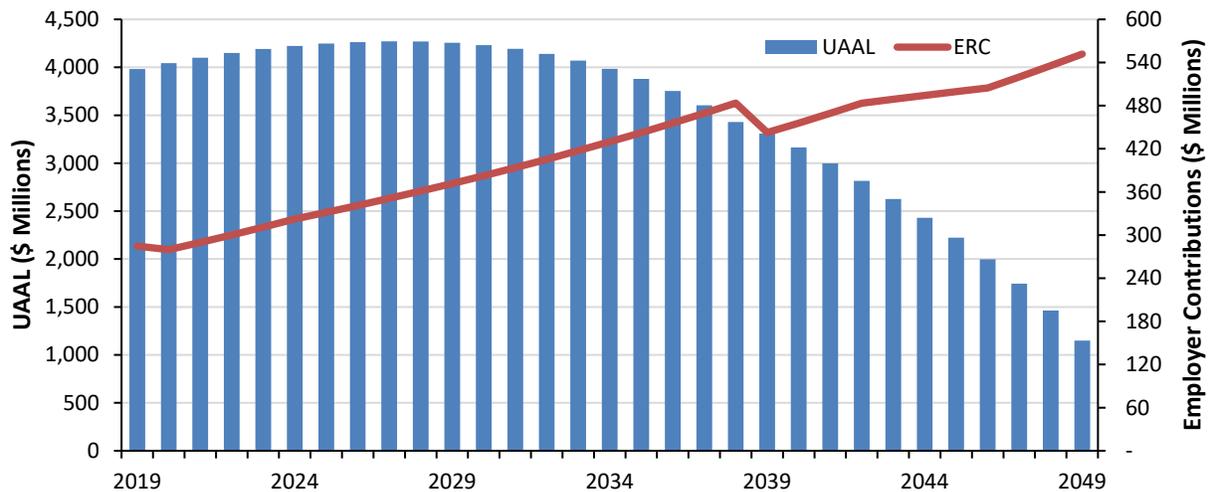
Figure 1 below provides **baseline** 30-year projections for the two plans on a combined basis, based on plan assumptions, including the assumed rate of return for each plan. Under these baseline projections, which do not yet reflect investment results for 2020, the unfunded liability rises gradually until stabilizing in 2027, when contributions become sufficient to begin paying down existing debt. The funded ratio for the two plans combined reaches 96 percent by 2049 (with an unfunded liability of about \$1.1 billion). Looked at separately, TRS reaches full funding in 2046, and PERS is on track to reach that same status by 2062.

The dip in employer contributions in 2039 is the result of the plans’ achieving actuarial targets set out in statute which allow for a reduction in certain employer contributions. If contributions from employers, members, and the state were not reduced upon meeting actuarial targets, full funding could be achieved as early as 2048. As noted above, these projections do not include the recent market impacts related to COVID-19.

FIGURE 1

UAAL and Employer Contributions under a Baseline Scenario, PERS and TRS Combined

PERS and TRS are on track for full funding if current policies are followed and all assumptions met



Source: The Terry Group and The Pew Charitable Trusts

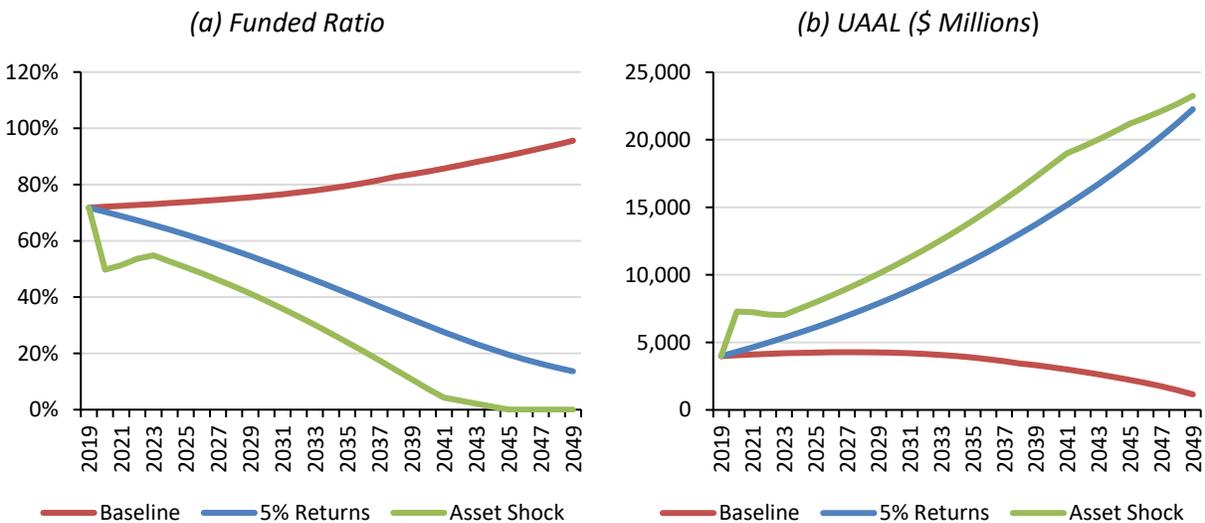
Scenario Analysis of Investment Risk

Financial experts anticipate investments will perform below historical averages going forward, and we project a one-in-four chance that future long-term returns could be as low as 5 percent for the typical public pension fund. For this reason, we conduct a 30-year scenario analysis to examine how plans would perform under a **fixed 5 percent return scenario**, applying a 5 percent rate of return in each year of the forecast period.

In addition, we conduct a second, **asset shock scenario** that consists of an initial investment loss of approximately 25 percent, followed by three years of economic recovery and lower equity returns of 5 percent over the remaining years of the projection period. The purpose of this scenario, which is based on the 2017 “Adverse Scenario” in the Dodd-Frank Act stress tests, is to simulate the effects of a sudden market downturn followed by a recession.¹⁰

Figure 2 below illustrates the impact of both scenarios on the combined financial position of TRS and PERS, revealing that **current contribution levels are insufficient to improve funded levels if long-term investment returns are lower than the expected average rate of 7.6 percent**. In fact, the plans fall to 14 percent funded in the fixed 5 percent return scenario (with insolvency likely to occur in the years following our projection period); and are projected to reach insolvency (on a combined basis) in 2046 under the asset shock scenario.

FIGURE 2
Funded Ratio and UAAL under Baseline and Two Downside Scenarios, PERS and TRS Combined
Severe financial distress is projected for the two plans under both downside economic scenarios



Source: The Terry Group and The Pew Charitable Trusts

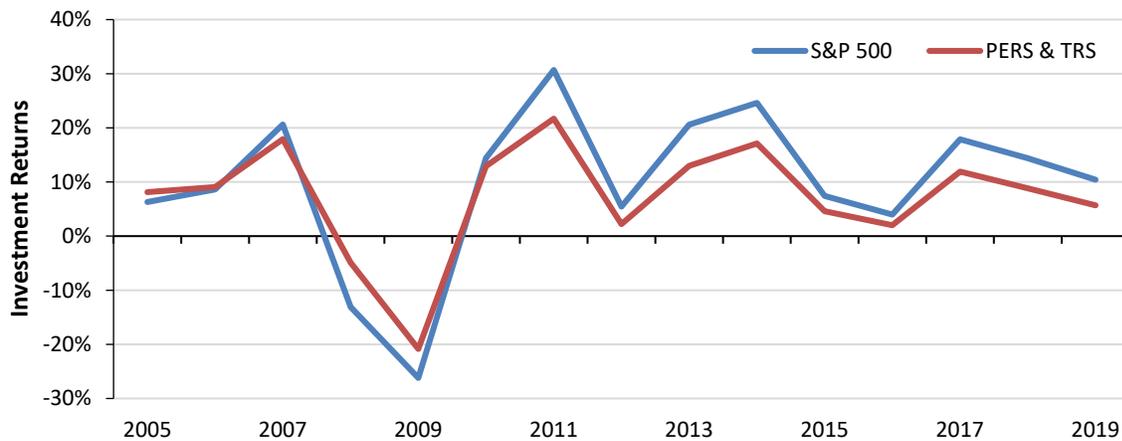
Measuring the Impact of Market Volatility through Stochastic Analysis

Investment risk is significantly amplified when market swings are included in stress test analysis. Between 2000 and 2010, for example, two stock market corrections and recessions had the effect of lowering Montana’s funded ratio from 103 to 70 percent. Volatility can also be a factor even when plan assumptions are met. While returns averaged roughly 8 percent between fiscal years 2012 and 2019, they ranged from 2 percent to 17 percent on an annual basis (see **Figure 3**).

FIGURE 3

Annual Investment Returns for the S&P 500, PERS, and TRS

PERS and TRS investment returns closely follow the stock market and exhibit the same volatility



Note: PERS and TRS assets are reported separately by the Montana State Board of Investments, but their returns have differed by no more than a few basis points on an annual basis. As a result, we plot them together here. All returns are shown on a June 30 fiscal year basis.

Source: The Terry Group and The Pew Charitable Trusts

This section applies stochastic analysis to assess the impact of annual fluctuations in investment returns, or market volatility.¹¹ By generating thousands of forward-looking trials of possible market performance, stochastic analysis allows us to evaluate the probability of various financial outcomes when annual returns are allowed to fluctuate. We specifically focus on three concepts: (1) impacts due to **sequencing of returns**; (2) the **range of possible outcomes** for plan funding; and (3) identifying **specific conditions that can lead to fiscal distress**. We summarize our findings on each of these points below, with reference to the reports done by Montana’s plan actuary, Cavanaugh MacDonald, which examine similar stochastic analyses in greater detail.

Sequencing of Returns

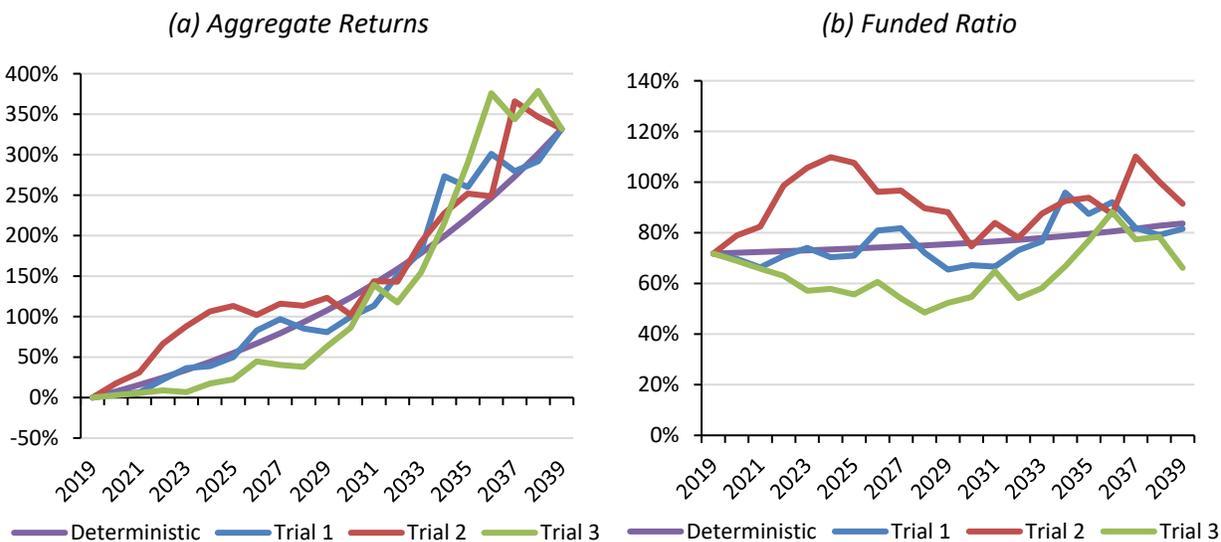
The first takeaway from stochastic analysis is that the order or sequence of returns matters. Even when returns average the target rate over time, sequences in which higher returns occur first will lead to more favorable outcomes for plan funding. The reason is the impact of compounding returns. And when lower returns occur first, this results in a smaller asset base for investment gains later on.

As an example, see **Figure 4a**, which illustrates 4 trials in which TRS and PERS could meet their investment return target over a 20-year timeframe. Each line represents a different sequence of returns, or trial, that meets the weighted average target rate of return of 7.6 percent for the two plans. Returns fluctuate from that assumed rate annually, except for the deterministic trial, in which they are constant at 7.6 percent. In the end, the combined assumed rate of return is achieved in each case; however, as illustrated in **Figure 4b**, outcomes for plan funding vary significantly in each trial due to differences in sequence of returns.

For example, in Trial 2, strong initial investment performance bolsters the plans’ asset bases, propelling them to a healthy combined funded ratio of 91 percent. Conversely, in Trial 3, low returns early in the

forecast period degrade their funded status; the plans finish just 66 percent funded, 6 percentage points below the level at which they started.

FIGURE 4
Cumulative Returns and Funded Ratio for Four Trials Averaging the Assumed Rate of Return
Volatility can have a significant impact on plan funding even when returns are equal in the long run



Note: Shown for PERS and TRS on a combined basis.
 Source: The Terry Group and The Pew Charitable Trusts

The Cavanaugh MacDonald reports for both plans describe the “risk due to return order” in greater detail (pp. 18-19 for PERS, and pp. 17-18 for TRS). Specifically, the reports show that over a 30-year period, differences in the sequence of returns over the first eight years alone could lead to critical differences in plan funding over the long term.

A Wide Range of Possible Outcomes

The analysis above illustrates the impact of market volatility on plan funding using a limited set of simulations, in which 20-year returns meet the combined expected rate of return for TRS and PERS.

Examining the full range of 10,000 stochastic trials produced by Pew’s stress test model provides a more complete picture of the **range of possible outcomes** given the impact of both short-term market volatility and long-term economic trends. **Figure 5** shows the results of that analysis and reinforces the assessment that current contribution levels may not be sufficient to improve funded levels over time. Note that the analysis uses fiscal year 2019 as a starting point for both plans. Thus, the results shown here do not account for the potential impact of the COVID-19 pandemic.

The green line in the figure illustrates the median outcome expected, given Pew’s capital market assumptions: a steady decline in the plans’ combined funded ratio, absent any changes to the current funding policy. This is because our capital market assumptions result in a median 20-year annualized return of just 6.5 percent for the two plans combined.¹² Although this is roughly 1 percentage point lower than current TRS and PERS assumptions, it does align more closely with estimated rates of return published by the state’s investment consultant.¹³

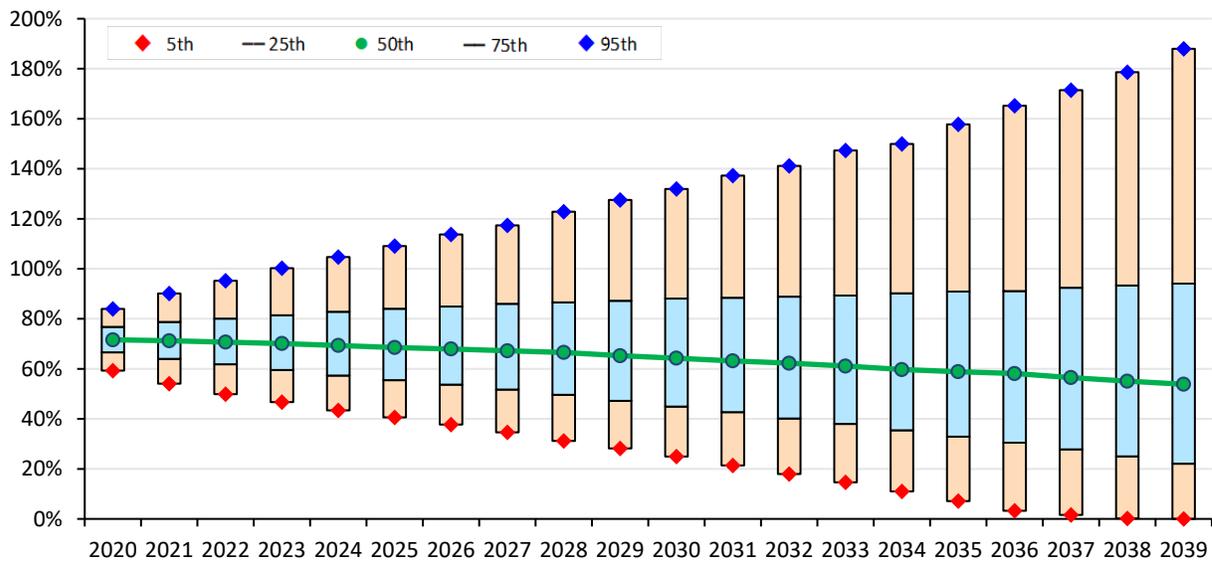
A number of the trials from our stochastic analysis show positive results – for example, in approximately 23 percent of scenarios we see full funding by 2039. But overall, this analysis projects a greater risk of plan underfunding over the next 20 years than in trials that exclude market volatility. In 63 percent of all cases, the plans’ funded ratio drops below its current level of 72 percent. **In 6 percent of cases, both plans go insolvent. And the probability of insolvency for PERS individually is much higher at roughly 12 percent.**

The Cavanaugh MacDonald reports describe stochastic analysis in greater detail and provide the range of possible outcomes over a 30-year period for both plans (pp. 26-27 for PERS, and pp. 25-26 for TRS).

FIGURE 5

Projected Funded Ratio, PERS and TRS Combined

Future funded levels will vary significantly depending on the level of returns and their order



Source: The Terry Group and The Pew Charitable Trusts

Identifying the Potential for Fiscal Distress

Stochastic analysis can also be used to evaluate the budget uncertainty implicit in projections for future plan funding. Specifically, we can examine individual trials to gain a better understanding of the return conditions that can lead to adverse outcomes for both retirement systems and government budgets.

For this analysis, we restrict our focus to one trial, Trial 9223, which simulates two negative asset shocks over a 10-year time period. **Figure 6** illustrates the annual returns and combined plan assets generated by the stress test model for Trial 9223. While the trial simulates a 20-year average annualized return of 5.2 percent (around the 30th percentile), it includes investment losses of at least 15 percent in years 2 and 11 of the trial.

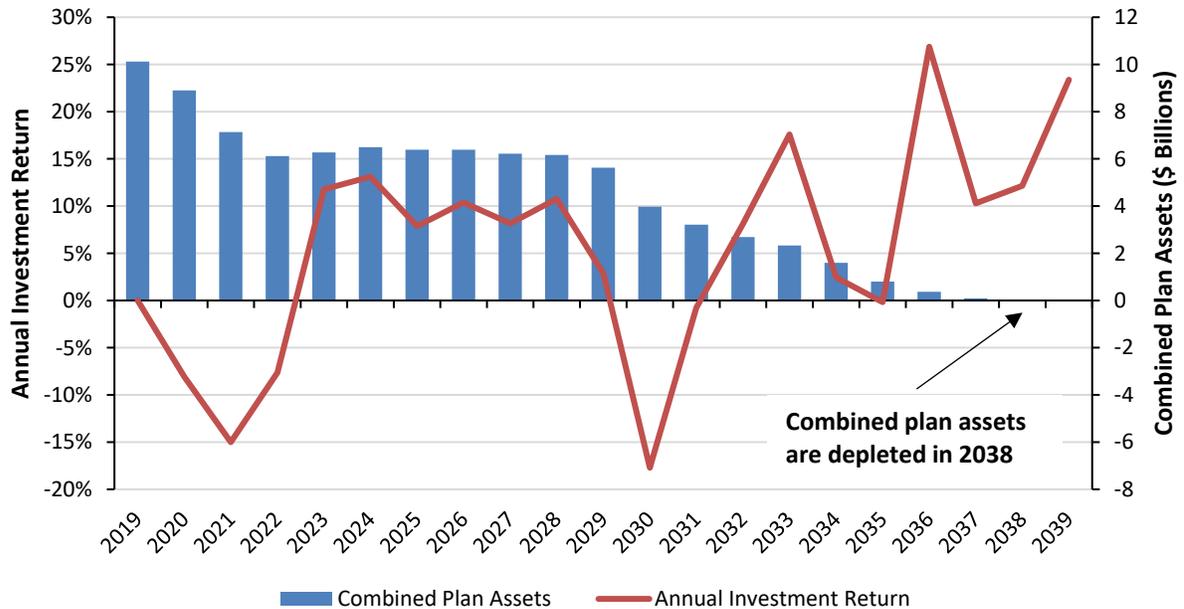
Specifically, Trial 9223 results in the depletion of assets for PERS in 2036, and for TRS in 2038. As such, PAYGO benefit payments – contributions that pay for benefits as they come due, rather than through pre-funding as they are earned – are required for PERS in 2036 and beyond. In 2039, the first year in which all benefits are paid on a PAYGO basis for both plans, **total state and employer contributions rise to 39 percent of payroll, triple their level from just four years before.**

While this reflects a statistical simulation rather than an economic forecast, the scenario does closely mirror the experience of the 2000s, with the Dot-Com Crisis in 2000-2001 followed just six years later by the Great Recession. Examining this scenario helps to demonstrate the need for policymakers to be attentive to and plan for market volatility and the economic cycle.

FIGURE 6

Annual Investment Returns and Combined Plan Assets in Stochastic Trial 9223

Trial 9223 shows how two asset shocks in a span of 10 years could lead to financial distress



Source: The Terry Group and The Pew Charitable Trusts

Measuring the Impact of Investment Risk through Sensitivity Analysis

The final section of this report uses sensitivity analysis to illustrate how lower investment returns would impact reporting of the state’s unfunded pension liability, as well as the normal cost for new benefits accrued. In their annual reporting, plans typically discount future obligations by +/-1 percent the rate of return they expect on investments, as supported by the Government Accounting Standards Board (GASB). In addition, we estimate liabilities based on proposed changes to current actuarial standards, which call for disclosure of plan liabilities at a risk-free or near risk-free rate as an additional reporting method.

Figure 7 below presents the net pension liability of both plans as reflected in the most recent GASB disclosure, along with an estimated calculation based on the definition of a Low-Default-Risk Obligation Measure (LDRM) included in proposed changes to ASOP No. 4, using a discount rate of 3.5 percent.¹⁴

FIGURE 7

Net Pension Liability Sensitivity Analysis to Alternative Investment Return Assumptions

Plan funded levels are sensitive to the assumed rate of return

<i>\$ in Millions</i>	Assumed Returns	High Returns (+1%)	Low Returns (-1%)	LDROM 3.50%
<u>PERS</u>				
Market Value of Assets (MVA)	\$5,903	\$5,903	\$5,903	\$5,903
Total Pension Liability (AAL)	\$7,994	\$7,226	\$8,906	\$13,128
Net Pension Liability (NPL)	\$2,090	\$1,323	\$3,003	\$7,225
Funded Ratio	73.9%	81.7%	66.3%	45.0%
<u>TRS</u>				
Market Value of Assets (MVA)	\$4,220	\$4,220	\$4,220	\$4,220
Actuarial Accrued Liability (AAL)	\$6,149	\$5,554	\$6,858	\$9,954
Net Pension Liability (NPL)	\$1,928	\$1,334	\$2,637	\$5,734
Funded Ratio	68.6%	76.0%	61.5%	42.4%

Note: Assumed returns are 7.65 percent for PERS, and 7.50 percent for TRS. LDROM is the low-default-risk obligation measure, as outlined in proposed changes to ASOP No. 4.

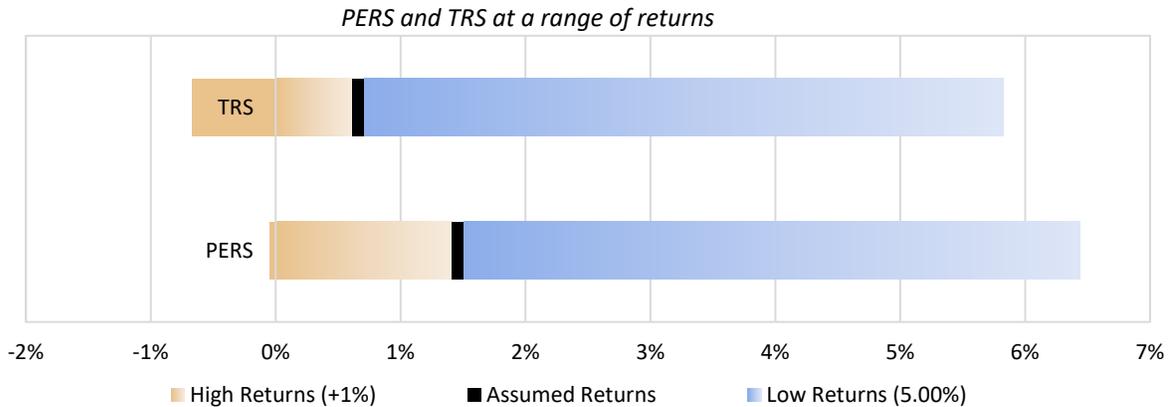
Source: The Terry Group and The Pew Charitable Trusts

Sensitivity analysis can also reveal how changes to the assumed rate of return impact the normal cost of new benefits. **Figure 8** below presents the employer normal cost for new hires in the most recent tier of both plans, based on their 2019 actuarial valuations. The cost is calculated at the plans' respective assumed rates of return, as well as rates one percent higher than the current assumption and 5 percent. The normal cost is an estimate of the contributions needed to finance annual benefit accruals by current employees. While normal costs are captured as part of full actuarial projections, it is useful to assess them separately given their significance as the core, ongoing cost of financing pension benefits. In addition, analyses like these can be especially informative when comparing the cost of different benefit structures – for example, in assessing plan reform options.

FIGURE 8

Employer Normal Cost for New Employees (Based on 2019 AVs)

Cost of financing new benefits significantly higher when returns are expected to be less



		<i>Assumed Returns</i>	<i>Low Returns</i>	<i>Change</i>
<i>PERS</i>	Total Normal Cost	9.08%	14.26%	5.18%
	Employee Contribution	7.62%	7.82%	0.20%
	Employer Normal Cost	1.46%	6.44%	4.98%
<i>TRS</i>	Total Normal Cost	9.42%	14.80%	5.38%
	Employee Contribution	8.76%	8.98%	0.22%
	Employer Normal Cost	0.66%	5.82%	5.16%

Note: Assumed returns are 7.65 percent for PERS, and 7.50 percent for TRS.

Source: The Terry Group and The Pew Charitable Trusts

The results indicate that employer costs for the most recent tier of benefits could increase by approximately 5 percent of payroll in a low return scenario for both PERS and TRS. If plan assumptions are met, employee contributions are expected to pay for the bulk of benefits earned by members in the current tier; however, plan sponsors bear the primary risk of any shortfalls, including those due to lower-than expected investment performance or demographic factors.

It is important, however, to note that key benefit provisions are scheduled to change for plan participants if plan funding sufficiently increases, per reforms adopted in 2013. Specifically, the employee contribution rate will drop by 1 percent of salary, and the Guaranteed Annual Benefit Adjustment will increase up to a maximum of 1.5 percent. These provisions amount to a form of risk-sharing, and since a low return scenario delays the onset of these benefit changes, plan sponsors are effectively protected from nearly 20 percent of investment risk in the above analysis.

¹ House Bill No. 715 is available at <https://leg.mt.gov/bills/2019/billhtml/HB0715.htm>.

² Cavanaugh MacDonald’s PERS Risk Analysis Report, TRS Risk Analysis Report. Available here: <https://leg.mt.gov/content/Publications/fiscal/2021-Interim/May-2020/2020-ASOP-51-Risk-Report-MT-PERS.pdf> <https://leg.mt.gov/content/Publications/fiscal/2021-Interim/May-2020/2020-ASOP-51-Risk-Report-MT-TRS.pdf>

³ The Pew Charitable Trusts. (2018). The Foundation for Public Pension Risk Reporting. Available at <https://www.hks.harvard.edu/centers/mrcbg/programs/pension2018>.

⁴ Society of Actuaries. (2014). Report of the Blue Ribbon Panel on Public Pension Plan Funding. Available at <https://www.soa.org/Files/Newsroom/brp-report.pdf>.

⁵ Actuarial Standards Board. (2017). Actuarial Standard of Practice No. 51: Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions. Available at <http://www.actuarialstandardsboard.org/asops/assessment-disclosure-risk-associated-measuring-pension-obligations-determining-pension-plan-contributions-3/>.

⁶ We also typically assess contribution risk – the risk that contributions fall short of the rate required to meet the funding objective. However, Montana uses a statutorily fixed contribution rate rather than setting an actuarially sufficient contribution rate each budget cycle. Given the fact that contribution risk is typically greater with actuarial funding policies – where required contributions can spike in a downturn when revenue is also declining – our analysis here focuses on investment risk alone.

⁷ The Pew Charitable Trusts. (2019). State Pension Funds Reduce Assumed Rates of Return. Available at https://www.pewtrusts.org/-/media/assets/2020/01/state_public_pension_funds_lower_assumed_rates_of_returns_final_2020.pdf.

⁸ See a summary of findings for the National Association of State Retirement Administrator’s (NASRA’s) Public Fund Survey, published December 2019. Available at: <https://www.nasra.org/publicfundsurvey>.

⁹ Public Employees’ Retirement Board Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 2019, p. 74. Available at: <http://mpera.mt.gov/Portals/175/documents/2019CAFR.pdf>.

¹⁰ The shock and ensuing recovery are based on the “Adverse Scenario” in the 2017 Dodd-Frank Act stress tests conducted by the Federal Reserve Board (Fed). We modify the scenario beyond the 12 quarters in the Fed guidance by (1) extending the recovery through year 4, and (2) applying 5 percent returns in years 5 through 30 to replicate the effect on long-term returns (beyond the initial shock and recovery) that also fall short of the investment return target.

¹¹ Stochastic simulations are used in Pew’s stress test analysis to model the probabilities of various financial outcomes given specified means and standard deviations of economic variables and market returns. Our stress test model generates 10,000 runs for each simulation, which yields a distribution of investment returns for each year. For more information, see: Mennis, Greg, Susan Banta and David Draine. (2018). Assessing the Risk of Fiscal Distress for Public Pensions: State Stress Test Analysis. Mossavar-Rahmani Center for Business and Government Working Paper Series, no. 92. Available at https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP_92_final.pdf.

¹² For a detailed description of Pew’s capital market assumptions, see Mennis et al. (2018).

¹³ See board documents from the Montana Board of Investments October 8th, 2019 meeting, p. 83. Available at <https://investmentmt.com/Portals/96/shared/Meetings/docs/2019/2019OCTfinal.pdf?ver=2019-10-03-161443-817>.

¹⁴ Actuarial Standards Board. (2019). Proposed Revision of Actuarial Standard of Practice (ASOP) No. 4. Available at <http://www.actuarialstandardsboard.org/asops/measuring-pension-obligations-and-determining-pension-plan-costs-or-contributions-second-exposure-draft/>. The LDROM, formerly called the Investment Risk Defeasement Rate, is a market-based liability measure consistent with financial economic theory, which holds that future obligations should be discounted at a rate reflecting their probability of being met. Currently, plans discount liabilities at the rate of return they expect on investments – a practice with a basis in public finance.

Appendix 1: PERS and TRS Contribution Policies

Contributions to TRS and PERS totaled \$465 million in FY 2019, with \$180 million (39 percent) coming from employees, and \$285 million (61 percent) from the state as well as local governments, school districts, and universities participating in these systems. **Appendix Figure 1** below shows contributions for PERS and TRS through 2024. Employee contributions are currently set at 7.9 percent and 8.15 percent of pay for PERS and TRS, respectively; this includes a 1 percentage point increase in contributions applied to all members who were previously paying less than that, which was included in a set of 2013 reforms to address underfunding, outlined in MCA 19-3-315 and MCA 19-20-608. These employee supplemental contributions are eliminated once specific actuarial targets are achieved for each plan. For PERS, this would be once the amortization period falls to 25 years or fewer without the supplemental contribution. For TRS, this would be once the three-year average funded ratio is above 90 percent and the amortization period is below 15 years.

APPENDIX FIGURE 1

Contribution Rates, 2019-2024

State and Employer Contributions are set to increase through 2024

		Members	State and Employers	Additional State
PERS	2019	7.90%	8.67%	\$ 31,958,000
	2020	7.90%	8.77%	\$ 32,277,580
	2021	7.90%	8.87%	\$32,600,356
	2022	7.90%	8.97%	\$32,926,359
	2023	7.90%	9.07%	\$33,255,623
	2024	7.90%	9.17%	\$33,588,179
TRS	2019	8.15%	11.46%	\$25,000,000
	2020	8.15%	11.56%	\$25,000,000
	2021	8.15%	11.66%	\$25,000,000
	2022	8.15%	11.76%	\$25,000,000
	2023	8.15%	11.86%	\$25,000,000
	2024	8.15%	11.96%	\$25,000,000

Source: Public Employees' Retirement System of the State of Montana and Teachers' Retirement System of the State of Montana

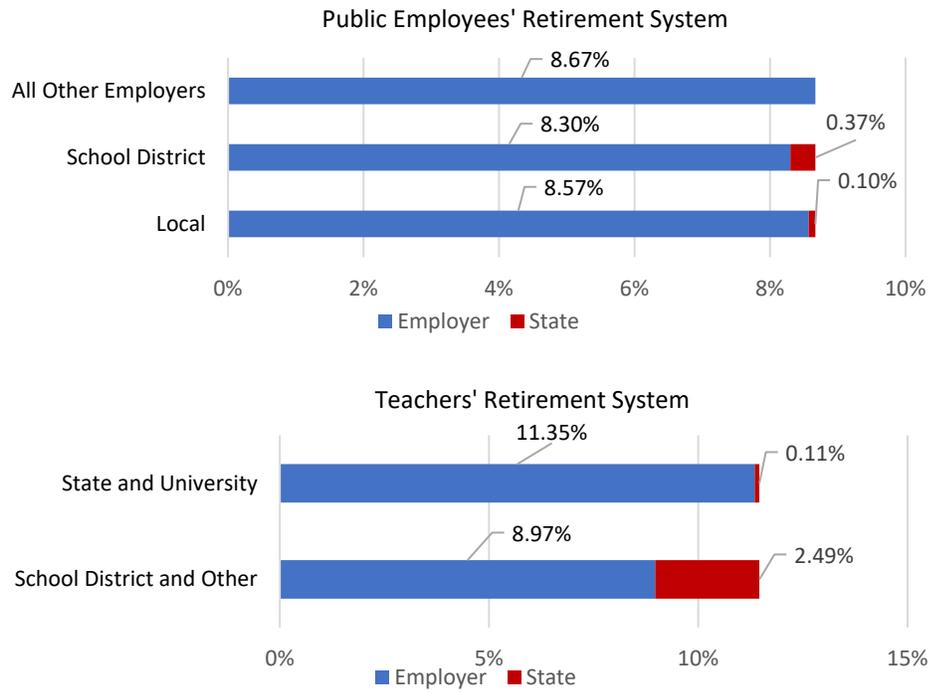
In 2019, the state and employers contributed 8.67 percent and 11.46 percent of pay for PERS and TRS, respectively. These rates are set to increase by 0.10 percentage points each year until FY 2024, also as a result of the 2013 reforms, and may decrease to original rates pursuant to the requirements outlined in MCA 19-3-316 and MCA 19-20-609. **Appendix Figure 2** illustrates how employers and the state split contributions. For PERS, the state contributes 0.37 percent of school district payroll and 0.10 percent of local payroll; for TRS, the state makes contributions equal to 0.11 percent of state and university payroll and 2.49 percent of school district and other employer payroll. It is also important to note that .04% of PERS payroll is diverted to the DB education fund, and the TRS contribution includes a 4.72% contribution of MUS-RP payroll.

The state also makes additional statutory general fund contributions to PERS and TRS. In 2019, the state contributed an additional \$34 million to PERS (set to increase 1 percent each year) and a fixed \$25 million to TRS. These contributions, along with the state's contributions on behalf of employers, totaled \$92 million in 2019.

APPENDIX FIGURE 2

State and Employer Contribution Rates, PERS and TRS, 2019

The state and participating employers split statutory contribution rates



Source: Public Employees' Retirement System of the State of Montana and Teachers' Retirement System of the State of Montana

Appendix 2: Stress Test Model Output

Exhibit	Plans Included	Description
1	PERS & TRS	30-year projections: expected (7.59%) returns
2	PERS & TRS	30-year projections: fixed 5% returns scenario
3	PERS & TRS	30-year projections: asset shock scenario
4	PERS	30-year projections: expected (7.65%) returns
5	PERS	30-year projections: fixed 5% returns scenario
6	PERS	30-year projections: asset shock scenario
7	TRS	30-year projections: expected (7.50%) returns
8	TRS	30-year projections: fixed 5% returns scenario
9	TRS	30-year projections: asset shock scenario
10	PERS & TRS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios and stochastic trials
11	PERS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios and stochastic trials
12	TRS	Comparison of key fiscal metrics at 5-, 10-, and 20-year intervals across all scenarios and stochastic trials

Notes and Disclosures

The information in this report is based on the valuation results of the Public Employees' Retirement System (PERS) and the Teachers' Retirement System (TRS) as of June 30, 2019. The return of 7.59 percent is based on the average return between the PERS (7.65%) and TRS (7.50%) plans weighted by 2019 liabilities. Projections are based on a roll-forward model using publicly available actuarial data and assumptions.

Exhibit 1

Montana Retirement System 30-Year Projections

Plans included: Public Employees' Retirement System and Teachers' Retirement System
 State contribution policy at assumed rate of return (7.59%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	2,126	14,106	212	1,046	(867)	14,496	10,124	450	746	(867)	10,453	4,043	61	3%	72%	-4%	280	N/A	13%
2021	2,199	14,496	218	1,074	(922)	14,866	10,453	466	770	(922)	10,766	4,100	56	3%	72%	-4%	290	4%	13%
2022	2,274	14,866	224	1,100	(969)	15,221	10,766	482	792	(969)	11,071	4,150	50	2%	73%	-5%	300	4%	13%
2023	2,351	15,221	231	1,126	(1,016)	15,562	11,071	501	814	(1,016)	11,371	4,191	42	2%	73%	-5%	311	4%	13%
2024	2,431	15,562	238	1,150	(1,060)	15,890	11,371	521	836	(1,060)	11,667	4,223	31	1%	73%	-5%	322	4%	13%
2025	2,513	15,890	245	1,174	(1,104)	16,204	11,667	537	857	(1,104)	11,957	4,247	24	1%	74%	-5%	332	3%	13%
2026	2,599	16,204	252	1,196	(1,146)	16,506	11,957	554	878	(1,146)	12,243	4,263	16	1%	74%	-5%	341	3%	13%
2027	2,687	16,506	259	1,218	(1,186)	16,797	12,243	572	898	(1,186)	12,527	4,271	8	0%	75%	-5%	351	3%	13%
2028	2,779	16,797	267	1,239	(1,224)	17,080	12,527	590	919	(1,224)	12,811	4,269	(2)	0%	75%	-5%	361	3%	13%
2029	2,873	17,080	275	1,259	(1,259)	17,355	12,811	608	939	(1,259)	13,100	4,256	(13)	0%	75%	-5%	372	3%	13%
2030	2,971	17,355	284	1,279	(1,293)	17,625	13,100	628	960	(1,293)	13,395	4,230	(25)	-1%	76%	-5%	383	3%	13%
2031	3,072	17,625	292	1,299	(1,325)	17,892	13,395	648	982	(1,325)	13,700	4,192	(38)	-1%	77%	-5%	394	3%	13%
2032	3,176	17,892	301	1,319	(1,354)	18,158	13,700	668	1,004	(1,354)	14,018	4,139	(53)	-2%	77%	-5%	405	3%	13%
2033	3,284	18,158	311	1,338	(1,382)	18,425	14,018	690	1,028	(1,382)	14,354	4,071	(69)	-2%	78%	-5%	417	3%	13%
2034	3,396	18,425	320	1,358	(1,407)	18,696	14,354	711	1,053	(1,407)	14,711	3,984	(86)	-3%	79%	-5%	430	3%	13%
2035	3,511	18,696	330	1,378	(1,430)	18,974	14,711	734	1,079	(1,430)	15,095	3,879	(105)	-3%	80%	-5%	443	3%	13%
2036	3,631	18,974	341	1,399	(1,451)	19,262	15,095	758	1,108	(1,451)	15,510	3,753	(126)	-3%	81%	-5%	456	3%	13%
2037	3,754	19,262	352	1,420	(1,469)	19,564	15,510	782	1,139	(1,469)	15,961	3,603	(149)	-4%	82%	-4%	469	3%	13%
2038	3,882	19,564	363	1,443	(1,486)	19,884	15,961	807	1,173	(1,486)	16,456	3,429	(174)	-4%	83%	-4%	483	3%	12%
2039	4,014	19,884	374	1,465	(1,500)	20,224	16,456	753	1,208	(1,500)	16,916	3,308	(121)	-3%	84%	-5%	443	-8%	11%
2040	4,151	20,224	387	1,490	(1,511)	20,590	16,916	777	1,243	(1,511)	17,425	3,165	(143)	-3%	85%	-4%	456	3%	11%
2041	4,292	20,590	399	1,516	(1,519)	20,986	17,425	801	1,281	(1,519)	17,988	2,997	(167)	-4%	86%	-4%	469	3%	11%
2042	4,438	20,986	412	1,557	(1,526)	21,429	17,988	827	1,324	(1,526)	18,613	2,815	(182)	-4%	87%	-4%	483	3%	11%
2043	4,589	21,429	426	1,592	(1,531)	21,915	18,613	835	1,371	(1,531)	19,289	2,627	(189)	-4%	88%	-4%	489	1%	11%
2044	4,745	21,915	440	1,630	(1,533)	22,452	19,289	843	1,422	(1,533)	20,020	2,431	(195)	-4%	89%	-4%	494	1%	10%
2045	4,907	22,452	454	1,675	(1,535)	23,046	20,020	861	1,477	(1,535)	20,823	2,223	(209)	-4%	90%	-3%	500	1%	10%
2046	5,073	23,046	469	1,721	(1,536)	23,701	20,823	878	1,538	(1,536)	21,703	1,997	(225)	-4%	92%	-3%	505	1%	10%
2047	5,246	23,701	485	1,772	(1,538)	24,420	21,703	906	1,605	(1,538)	22,677	1,743	(254)	-5%	93%	-3%	520	3%	10%
2048	5,425	24,420	501	1,832	(1,541)	25,212	22,677	935	1,679	(1,541)	23,749	1,463	(280)	-5%	94%	-3%	536	3%	10%
2049	5,609	25,212	518	1,894	(1,545)	26,079	23,749	965	1,761	(1,545)	24,930	1,149	(314)	-6%	96%	-2%	552	3%	10%

Exhibit 2

Montana Retirement System 30-Year Projections

Plans included: Public Employees' Retirement System and Teachers' Retirement System
 State contribution policy at 5% returns

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	2,126	14,106	212	1,046	(867)	14,496	10,124	450	489	(867)	10,196	4,300	318	15%	70%	-4%	280	N/A	13%
2021	2,199	14,496	218	1,074	(922)	14,866	10,196	466	492	(922)	10,231	4,634	334	15%	69%	-4%	290	4%	13%
2022	2,274	14,866	224	1,100	(969)	15,221	10,231	482	493	(969)	10,237	4,984	350	15%	67%	-5%	300	4%	13%
2023	2,351	15,221	231	1,126	(1,016)	15,562	10,237	501	492	(1,016)	10,214	5,348	364	15%	66%	-5%	311	4%	13%
2024	2,431	15,562	238	1,150	(1,060)	15,890	10,214	521	490	(1,060)	10,165	5,725	377	16%	64%	-5%	322	4%	13%
2025	2,513	15,890	245	1,174	(1,104)	16,204	10,165	537	487	(1,104)	10,085	6,119	394	16%	62%	-6%	332	3%	13%
2026	2,599	16,204	252	1,196	(1,146)	16,506	10,085	554	482	(1,146)	9,975	6,531	412	16%	60%	-6%	341	3%	13%
2027	2,687	16,506	259	1,218	(1,186)	16,797	9,975	572	475	(1,186)	9,836	6,962	430	16%	59%	-6%	351	3%	13%
2028	2,779	16,797	267	1,239	(1,224)	17,080	9,836	590	468	(1,224)	9,669	7,411	449	16%	57%	-6%	361	3%	13%
2029	2,873	17,080	275	1,259	(1,259)	17,355	9,669	608	458	(1,259)	9,477	7,878	468	16%	55%	-7%	372	3%	13%
2030	2,971	17,355	284	1,279	(1,293)	17,625	9,477	628	448	(1,293)	9,260	8,365	487	16%	53%	-7%	383	3%	13%
2031	3,072	17,625	292	1,299	(1,325)	17,892	9,260	648	437	(1,325)	9,020	8,872	507	17%	50%	-7%	394	3%	13%
2032	3,176	17,892	301	1,319	(1,354)	18,158	9,020	668	424	(1,354)	8,758	9,400	527	17%	48%	-8%	405	3%	13%
2033	3,284	18,158	311	1,338	(1,382)	18,425	8,758	690	411	(1,382)	8,477	9,948	549	17%	46%	-8%	417	3%	13%
2034	3,396	18,425	320	1,358	(1,407)	18,696	8,477	711	396	(1,407)	8,177	10,519	570	17%	44%	-8%	430	3%	13%
2035	3,511	18,696	330	1,378	(1,430)	18,974	8,177	734	381	(1,430)	7,862	11,112	593	17%	41%	-9%	443	3%	13%
2036	3,631	18,974	341	1,399	(1,451)	19,262	7,862	758	365	(1,451)	7,533	11,729	617	17%	39%	-9%	456	3%	13%
2037	3,754	19,262	352	1,420	(1,469)	19,564	7,533	782	348	(1,469)	7,193	12,371	642	17%	37%	-9%	469	3%	13%
2038	3,882	19,564	363	1,443	(1,486)	19,884	7,193	807	331	(1,486)	6,845	13,040	668	17%	34%	-9%	483	3%	12%
2039	4,014	19,884	374	1,461	(1,499)	20,220	6,845	833	313	(1,499)	6,491	13,729	690	17%	32%	-10%	498	3%	12%
2040	4,151	20,220	387	1,480	(1,510)	20,578	6,491	859	295	(1,510)	6,136	14,442	712	17%	30%	-10%	513	3%	12%
2041	4,292	20,578	399	1,502	(1,517)	20,962	6,136	887	278	(1,517)	5,783	15,179	737	17%	28%	-10%	529	3%	12%
2042	4,438	20,962	412	1,527	(1,521)	21,380	5,783	915	260	(1,521)	5,438	15,942	764	17%	25%	-10%	545	3%	12%
2043	4,589	21,380	426	1,554	(1,523)	21,837	5,438	945	243	(1,523)	5,102	16,735	793	17%	23%	-11%	561	3%	12%
2044	4,745	21,837	440	1,586	(1,521)	22,341	5,102	975	227	(1,521)	4,782	17,559	824	17%	21%	-11%	579	3%	12%
2045	4,907	22,341	454	1,621	(1,518)	22,899	4,782	1,006	211	(1,518)	4,481	18,417	858	17%	20%	-11%	596	3%	12%
2046	5,073	22,899	469	1,661	(1,514)	23,515	4,481	1,039	196	(1,514)	4,202	19,313	896	18%	18%	-11%	615	3%	12%
2047	5,246	23,515	485	1,706	(1,510)	24,197	4,202	1,072	183	(1,510)	3,947	20,250	937	18%	16%	-10%	633	3%	12%
2048	5,425	24,197	501	1,757	(1,506)	24,949	3,947	1,107	170	(1,506)	3,718	21,231	982	18%	15%	-10%	653	3%	12%
2049	5,609	24,949	518	1,814	(1,502)	25,779	3,718	1,143	159	(1,502)	3,517	22,262	1,031	18%	14%	-10%	673	3%	12%

Exhibit 3

Montana Retirement System 30-Year Projections

Plans included: Public Employees' Retirement System and Teachers' Retirement System
 State contribution policy under an asset shock return scenario

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	2,126	14,106	212	1,046	(867)	14,496	10,124	450	(2,497)	(867)	7,209	7,287	3,305	155%	50%	-4%	280	N/A	13%
2021	2,199	14,496	218	1,074	(922)	14,866	7,209	466	874	(922)	7,627	7,239	(48)	-2%	51%	-6%	290	4%	13%
2022	2,274	14,866	224	1,100	(969)	15,221	7,627	482	1,025	(969)	8,164	7,057	(182)	-8%	54%	-6%	300	4%	13%
2023	2,334	15,221	229	1,108	(1,016)	15,542	8,164	498	873	(1,016)	8,520	7,022	(34)	-1%	55%	-6%	309	3%	13%
2024	2,396	15,542	234	1,130	(1,060)	15,847	8,520	514	373	(1,060)	8,347	7,500	477	20%	53%	-6%	319	3%	13%
2025	2,459	15,847	239	1,152	(1,103)	16,135	8,347	527	395	(1,103)	8,166	7,968	469	19%	51%	-7%	326	2%	13%
2026	2,524	16,135	245	1,172	(1,145)	16,406	8,166	540	385	(1,145)	7,947	8,459	491	19%	48%	-7%	333	2%	13%
2027	2,591	16,406	250	1,191	(1,184)	16,663	7,947	554	373	(1,184)	7,690	8,973	514	20%	46%	-8%	341	2%	13%
2028	2,660	16,663	256	1,209	(1,221)	16,908	7,690	568	360	(1,221)	7,397	9,511	537	20%	44%	-8%	349	2%	13%
2029	2,733	16,908	262	1,228	(1,255)	17,143	7,397	582	344	(1,255)	7,069	10,074	563	21%	41%	-9%	357	2%	13%
2030	2,807	17,143	268	1,245	(1,287)	17,369	7,069	597	327	(1,287)	6,707	10,662	588	21%	39%	-10%	365	2%	13%
2031	2,884	17,369	274	1,261	(1,317)	17,587	6,707	613	309	(1,317)	6,311	11,277	614	21%	36%	-11%	374	2%	13%
2032	2,963	17,587	281	1,277	(1,345)	17,800	6,311	628	288	(1,345)	5,883	11,917	641	22%	33%	-11%	383	2%	13%
2033	3,044	17,800	288	1,292	(1,370)	18,010	5,883	645	266	(1,370)	5,424	12,586	669	22%	30%	-12%	392	2%	13%
2034	3,127	18,010	295	1,307	(1,393)	18,218	5,424	661	243	(1,393)	4,935	13,284	698	22%	27%	-13%	402	2%	13%
2035	3,212	18,218	302	1,322	(1,414)	18,428	4,935	678	218	(1,414)	4,417	14,011	728	23%	24%	-15%	411	2%	13%
2036	3,299	18,428	310	1,337	(1,433)	18,642	4,417	696	192	(1,433)	3,872	14,771	759	23%	21%	-17%	421	2%	13%
2037	3,389	18,642	317	1,353	(1,449)	18,864	3,872	714	164	(1,449)	3,300	15,563	792	23%	17%	-19%	431	2%	13%
2038	3,482	18,864	325	1,369	(1,464)	19,095	3,300	732	136	(1,464)	2,704	16,390	827	24%	14%	-22%	442	2%	13%
2039	3,577	19,095	334	1,380	(1,475)	19,334	2,704	751	106	(1,475)	2,086	17,247	857	24%	11%	-27%	452	2%	13%
2040	3,674	19,334	342	1,392	(1,483)	19,585	2,086	770	75	(1,483)	1,448	18,137	889	24%	7%	-34%	463	2%	13%
2041	3,775	19,585	351	1,405	(1,488)	19,854	1,448	850	44	(1,488)	854	19,000	863	23%	4%	-44%	534	15%	14%
2042	3,878	19,854	360	1,421	(1,490)	20,145	854	1,258	24	(1,490)	647	19,498	499	13%	3%	-27%	934	75%	24%
2043	3,983	20,145	370	1,438	(1,489)	20,463	647	1,266	14	(1,489)	437	20,026	528	13%	2%	-35%	933	0%	23%
2044	4,092	20,463	379	1,459	(1,486)	20,816	437	1,272	3	(1,486)	226	20,589	563	14%	1%	-49%	929	0%	23%
2045	4,204	20,816	389	1,482	(1,480)	21,207	226	1,276	(7)	(1,480)	15	21,191	602	14%	0%	-90%	924	-1%	22%
2046	4,318	21,207	400	1,509	(1,474)	21,642	15	1,471	(13)	(1,474)	0	21,642	450	10%	0%	-14%	1,110	20%	26%
2047	4,436	21,642	410	1,540	(1,467)	22,124	0	1,481	(14)	(1,467)	0	22,124	483	11%	0%	n/a	1,109	0%	25%
2048	4,557	22,124	421	1,574	(1,461)	22,659	0	1,475	(14)	(1,461)	0	22,659	535	12%	0%	n/a	1,093	-1%	24%
2049	4,682	22,659	433	1,614	(1,455)	23,251	0	1,469	(15)	(1,455)	0	23,251	592	13%	0%	n/a	1,077	-2%	23%

Exhibit 4

Montana Retirement System 30 Year Projections

Plans included: Public Employees' Retirement System
 State contribution policy at assumed rate of return (7.65%)

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	1,269	7,957	128	596	(470)	8,211	5,903	243	439	(470)	6,116	2,095	41	3%	74%	-4%	143	N/A	11%
2021	1,313	8,211	132	614	(501)	8,455	6,116	252	454	(501)	6,321	2,134	39	3%	75%	-4%	149	4%	11%
2022	1,359	8,455	135	632	(533)	8,690	6,321	262	469	(533)	6,519	2,171	36	3%	75%	-4%	154	4%	11%
2023	1,407	8,690	139	649	(564)	8,914	6,519	271	483	(564)	6,710	2,204	33	2%	75%	-4%	160	4%	11%
2024	1,456	8,914	143	665	(594)	9,128	6,710	282	497	(594)	6,895	2,234	30	2%	76%	-5%	167	4%	11%
2025	1,507	9,128	147	680	(623)	9,333	6,895	291	510	(623)	7,073	2,260	27	2%	76%	-5%	172	3%	11%
2026	1,560	9,333	152	695	(651)	9,528	7,073	300	523	(651)	7,244	2,284	24	2%	76%	-5%	177	3%	11%
2027	1,615	9,528	156	709	(679)	9,715	7,244	310	535	(679)	7,410	2,305	20	1%	76%	-5%	182	3%	11%
2028	1,671	9,715	161	723	(705)	9,893	7,410	320	547	(705)	7,572	2,321	17	1%	77%	-5%	188	3%	11%
2029	1,730	9,893	165	736	(729)	10,066	7,572	330	559	(729)	7,732	2,334	12	1%	77%	-5%	193	3%	11%
2030	1,790	10,066	170	748	(752)	10,233	7,732	341	571	(752)	7,892	2,341	7	0%	77%	-5%	199	3%	11%
2031	1,853	10,233	175	760	(773)	10,395	7,892	352	582	(773)	8,052	2,343	2	0%	77%	-5%	205	3%	11%
2032	1,918	10,395	181	772	(793)	10,555	8,052	363	594	(793)	8,216	2,339	(4)	0%	78%	-5%	211	3%	11%
2033	1,985	10,555	186	784	(811)	10,714	8,216	375	606	(811)	8,385	2,329	(10)	-1%	78%	-5%	218	3%	11%
2034	2,054	10,714	192	796	(828)	10,874	8,385	387	619	(828)	8,562	2,312	(18)	-1%	79%	-5%	225	3%	11%
2035	2,126	10,874	198	808	(843)	11,036	8,562	400	632	(843)	8,750	2,286	(25)	-1%	79%	-5%	232	3%	11%
2036	2,200	11,036	204	820	(857)	11,204	8,750	413	646	(857)	8,952	2,252	(34)	-2%	80%	-5%	239	3%	11%
2037	2,277	11,204	211	832	(869)	11,378	8,952	426	661	(869)	9,170	2,208	(44)	-2%	81%	-5%	246	3%	11%
2038	2,357	11,378	218	846	(879)	11,563	9,170	440	678	(879)	9,409	2,154	(54)	-2%	81%	-5%	254	3%	11%
2039	2,440	11,563	225	858	(887)	11,759	9,409	375	693	(887)	9,590	2,169	15	1%	82%	-5%	206	-19%	8%
2040	2,525	11,759	232	871	(893)	11,970	9,590	387	707	(893)	9,790	2,180	10	0%	82%	-5%	213	3%	8%
2041	2,613	11,970	240	886	(898)	12,198	9,790	399	722	(898)	10,013	2,184	5	0%	82%	-5%	219	3%	8%
2042	2,705	12,198	248	902	(901)	12,447	10,013	412	739	(901)	10,264	2,183	(1)	0%	82%	-5%	226	3%	8%
2043	2,800	12,447	256	921	(902)	12,722	10,264	426	759	(902)	10,546	2,176	(7)	0%	83%	-5%	233	3%	8%
2044	2,898	12,722	265	941	(902)	13,026	10,546	440	780	(902)	10,864	2,161	(14)	0%	83%	-4%	240	3%	8%
2045	2,999	13,026	274	966	(901)	13,365	10,864	454	805	(901)	11,222	2,143	(19)	-1%	84%	-4%	247	3%	8%
2046	3,104	13,365	283	992	(898)	13,743	11,222	469	833	(898)	11,627	2,117	(26)	-1%	85%	-4%	255	3%	8%
2047	3,213	13,743	293	1,021	(894)	14,163	11,627	484	864	(894)	12,081	2,082	(34)	-1%	85%	-4%	263	3%	8%
2048	3,325	14,163	303	1,058	(891)	14,633	12,081	500	899	(891)	12,589	2,044	(39)	-1%	86%	-3%	271	3%	8%
2049	3,441	14,633	313	1,094	(887)	15,153	12,589	517	938	(887)	13,157	1,996	(48)	-1%	87%	-3%	279	3%	8%

Exhibit 5

Montana Retirement System 30 Year Projections

Plans included: Public Employees' Retirement System

State contribution policy at 5% returns

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	1,269	7,957	128	596	(470)	8,211	5,903	243	286	(470)	5,962	2,249	195	15%	73%	-4%	143	N/A	11%
2021	1,313	8,211	132	614	(501)	8,455	5,962	252	288	(501)	6,001	2,454	206	16%	71%	-4%	149	4%	11%
2022	1,359	8,455	135	632	(533)	8,690	6,001	262	289	(533)	6,019	2,671	216	16%	69%	-5%	154	4%	11%
2023	1,407	8,690	139	649	(564)	8,914	6,019	271	289	(564)	6,016	2,898	227	16%	67%	-5%	160	4%	11%
2024	1,456	8,914	143	665	(594)	9,128	6,016	282	289	(594)	5,992	3,136	238	16%	66%	-5%	167	4%	11%
2025	1,507	9,128	147	680	(623)	9,333	5,992	291	287	(623)	5,947	3,386	250	17%	64%	-6%	172	3%	11%
2026	1,560	9,333	152	695	(651)	9,528	5,947	300	284	(651)	5,879	3,649	263	17%	62%	-6%	177	3%	11%
2027	1,615	9,528	156	709	(679)	9,715	5,879	310	280	(679)	5,790	3,925	276	17%	60%	-6%	182	3%	11%
2028	1,671	9,715	161	723	(705)	9,893	5,790	320	275	(705)	5,679	4,214	289	17%	57%	-7%	188	3%	11%
2029	1,730	9,893	165	736	(729)	10,066	5,679	330	269	(729)	5,549	4,516	302	17%	55%	-7%	193	3%	11%
2030	1,790	10,066	170	748	(752)	10,233	5,549	341	262	(752)	5,400	4,833	316	18%	53%	-7%	199	3%	11%
2031	1,853	10,233	175	760	(773)	10,395	5,400	352	254	(773)	5,232	5,163	330	18%	50%	-8%	205	3%	11%
2032	1,918	10,395	181	772	(793)	10,555	5,232	363	245	(793)	5,047	5,508	345	18%	48%	-8%	211	3%	11%
2033	1,985	10,555	186	784	(811)	10,714	5,047	375	235	(811)	4,846	5,868	360	18%	45%	-9%	218	3%	11%
2034	2,054	10,714	192	796	(828)	10,874	4,846	387	225	(828)	4,630	6,244	376	18%	43%	-9%	225	3%	11%
2035	2,126	10,874	198	808	(843)	11,036	4,630	400	214	(843)	4,400	6,636	392	18%	40%	-10%	232	3%	11%
2036	2,200	11,036	204	820	(857)	11,204	4,400	413	202	(857)	4,158	7,046	409	19%	37%	-10%	239	3%	11%
2037	2,277	11,204	211	832	(869)	11,378	4,158	426	190	(869)	3,905	7,473	427	19%	34%	-11%	246	3%	11%
2038	2,357	11,378	218	846	(879)	11,563	3,905	440	177	(879)	3,644	7,919	446	19%	32%	-11%	254	3%	11%
2039	2,440	11,563	225	853	(887)	11,755	3,644	454	164	(887)	3,376	8,379	460	19%	29%	-12%	262	3%	11%
2040	2,525	11,755	232	862	(892)	11,957	3,376	469	151	(892)	3,103	8,854	475	19%	26%	-13%	270	3%	11%
2041	2,613	11,957	240	872	(896)	12,174	3,103	485	137	(896)	2,829	9,345	491	19%	23%	-13%	278	3%	11%
2042	2,705	12,174	248	884	(897)	12,409	2,829	501	123	(897)	2,557	9,853	508	19%	21%	-14%	287	3%	11%
2043	2,800	12,409	256	898	(897)	12,667	2,557	517	110	(897)	2,287	10,380	527	19%	18%	-15%	296	3%	11%
2044	2,898	12,667	265	914	(894)	12,952	2,287	534	97	(894)	2,024	10,928	548	19%	16%	-16%	306	3%	11%
2045	2,999	12,952	274	933	(889)	13,270	2,024	552	84	(889)	1,771	11,499	571	19%	13%	-17%	315	3%	11%
2046	3,104	13,270	283	955	(883)	13,625	1,771	570	71	(883)	1,529	12,096	597	19%	11%	-18%	325	3%	10%
2047	3,213	13,625	293	981	(876)	14,023	1,529	589	60	(876)	1,302	12,721	625	19%	9%	-19%	336	3%	10%
2048	3,325	14,023	303	1,010	(868)	14,468	1,302	609	48	(868)	1,092	13,376	656	20%	8%	-20%	346	3%	10%
2049	3,441	14,468	313	1,044	(859)	14,966	1,092	629	38	(859)	900	14,066	690	20%	6%	-21%	357	3%	10%

Exhibit 6

Montana Retirement System 30 Year Projections

Plans included: Public Employees' Retirement System
 State contribution policy under an asset shock return scenario

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	1,269	7,957	128	596	(470)	8,211	5,903	243	(1,483)	(470)	4,193	4,018	1,964	155%	51%	-4%	143	N/A	11%
2021	1,313	8,211	132	614	(501)	8,455	4,193	252	519	(501)	4,463	3,992	(26)	-2%	53%	-6%	149	4%	11%
2022	1,359	8,455	135	632	(533)	8,690	4,463	262	612	(533)	4,804	3,886	(106)	-8%	55%	-6%	154	4%	11%
2023	1,395	8,690	138	636	(564)	8,900	4,804	269	525	(564)	5,034	3,866	(20)	-1%	57%	-6%	159	3%	11%
2024	1,432	8,900	141	651	(593)	9,099	5,034	277	221	(593)	4,939	4,159	293	20%	54%	-6%	164	3%	11%
2025	1,470	9,099	144	665	(623)	9,285	4,939	284	235	(623)	4,836	4,449	290	20%	52%	-7%	168	2%	11%
2026	1,509	9,285	147	678	(651)	9,459	4,836	291	229	(651)	4,706	4,754	305	20%	50%	-7%	172	2%	11%
2027	1,549	9,459	150	691	(677)	9,622	4,706	298	222	(677)	4,549	5,074	320	21%	47%	-8%	176	2%	11%
2028	1,590	9,622	153	702	(702)	9,775	4,549	306	213	(702)	4,365	5,409	336	21%	45%	-9%	180	2%	11%
2029	1,634	9,775	156	714	(726)	9,919	4,365	314	204	(726)	4,157	5,762	353	22%	42%	-9%	184	2%	11%
2030	1,678	9,919	160	724	(747)	10,055	4,157	321	193	(747)	3,924	6,131	369	22%	39%	-10%	189	2%	11%
2031	1,724	10,055	163	734	(768)	10,184	3,924	330	181	(768)	3,666	6,518	387	22%	36%	-11%	193	2%	11%
2032	1,771	10,184	167	743	(786)	10,308	3,666	338	167	(786)	3,385	6,923	404	23%	33%	-12%	198	2%	11%
2033	1,819	10,308	171	752	(803)	10,427	3,385	347	153	(803)	3,081	7,346	423	23%	30%	-13%	203	2%	11%
2034	1,869	10,427	175	760	(819)	10,543	3,081	355	137	(819)	2,755	7,788	442	24%	26%	-15%	208	2%	11%
2035	1,919	10,543	179	769	(832)	10,658	2,755	364	121	(832)	2,408	8,250	462	24%	23%	-17%	213	2%	11%
2036	1,972	10,658	183	777	(844)	10,774	2,408	374	103	(844)	2,041	8,734	484	25%	19%	-20%	218	2%	11%
2037	2,025	10,774	188	785	(855)	10,893	2,041	383	84	(855)	1,654	9,240	506	25%	15%	-23%	223	2%	11%
2038	2,081	10,893	192	794	(863)	11,017	1,654	393	65	(863)	1,248	9,768	529	25%	11%	-28%	229	2%	11%
2039	2,137	11,017	197	797	(870)	11,141	1,248	403	44	(870)	826	10,315	547	26%	7%	-37%	234	2%	11%
2040	2,196	11,141	202	801	(874)	11,270	826	413	23	(874)	389	10,881	566	26%	3%	-56%	240	2%	11%
2041	2,255	11,270	207	805	(876)	11,407	389	484	3	(876)	0	11,407	526	23%	0%	-101%	305	27%	14%
2042	2,317	11,407	212	810	(875)	11,555	0	882	(7)	(875)	0	11,555	148	6%	0%	n/a	699	129%	30%
2043	2,380	11,555	218	817	(873)	11,717	0	880	(7)	(873)	0	11,717	162	7%	0%	n/a	692	-1%	29%
2044	2,445	11,717	224	826	(869)	11,897	0	876	(7)	(869)	0	11,897	180	7%	0%	n/a	683	-1%	28%
2045	2,511	11,897	229	836	(863)	12,100	0	870	(8)	(863)	0	12,100	203	8%	0%	n/a	672	-2%	27%
2046	2,580	12,100	235	849	(855)	12,329	0	863	(8)	(855)	0	12,329	230	9%	0%	n/a	659	-2%	26%
2047	2,650	12,329	242	864	(846)	12,589	0	854	(8)	(846)	0	12,589	260	10%	0%	n/a	645	-2%	24%
2048	2,722	12,589	248	883	(836)	12,884	0	844	(8)	(836)	0	12,884	295	11%	0%	n/a	629	-2%	23%
2049	2,796	12,884	255	904	(826)	13,217	0	834	(8)	(826)	0	13,217	333	12%	0%	n/a	613	-3%	22%

Exhibit 7

Montana Retirement System 30 Year Projections

Plans included: Teachers' Retirement System

State contribution policy at assumed rate of return (7.5%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow	Employer Contribution			
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	857	6,149	84	450	(397)	6,285	4,220	207	307	(397)	4,337	1,948	20	2%	69%	-5%	137	N/A	16%
2021	885	6,285	86	459	(420)	6,410	4,337	213	315	(420)	4,445	1,965	17	2%	69%	-5%	141	3%	16%
2022	914	6,410	89	468	(436)	6,531	4,445	220	323	(436)	4,552	1,979	14	2%	70%	-5%	146	3%	16%
2023	944	6,531	92	477	(452)	6,648	4,552	230	331	(452)	4,661	1,987	8	1%	70%	-5%	151	3%	16%
2024	974	6,648	95	485	(466)	6,762	4,661	239	339	(466)	4,772	1,989	2	0%	71%	-5%	156	3%	16%
2025	1,006	6,762	97	493	(481)	6,871	4,772	247	347	(481)	4,885	1,986	(3)	0%	71%	-5%	160	3%	16%
2026	1,039	6,871	100	501	(495)	6,978	4,885	254	355	(495)	4,999	1,979	(8)	-1%	72%	-5%	164	3%	16%
2027	1,073	6,978	103	509	(507)	7,083	4,999	262	363	(507)	5,117	1,966	(13)	-1%	72%	-5%	169	3%	16%
2028	1,107	7,083	107	516	(519)	7,186	5,117	270	371	(519)	5,239	1,947	(19)	-2%	73%	-5%	174	3%	16%
2029	1,143	7,186	110	524	(531)	7,289	5,239	279	380	(531)	5,368	1,922	(25)	-2%	74%	-5%	178	3%	16%
2030	1,181	7,289	113	531	(541)	7,393	5,368	287	390	(541)	5,503	1,889	(32)	-3%	74%	-5%	183	3%	16%
2031	1,219	7,393	117	539	(551)	7,497	5,503	296	400	(551)	5,648	1,849	(40)	-3%	75%	-5%	189	3%	15%
2032	1,259	7,497	120	546	(561)	7,603	5,648	305	410	(561)	5,802	1,800	(49)	-4%	76%	-5%	194	3%	15%
2033	1,300	7,603	124	554	(570)	7,711	5,802	315	422	(570)	5,969	1,742	(58)	-4%	77%	-4%	199	3%	15%
2034	1,342	7,711	128	562	(579)	7,822	5,969	325	434	(579)	6,149	1,673	(69)	-5%	79%	-4%	205	3%	15%
2035	1,385	7,822	132	570	(587)	7,938	6,149	335	448	(587)	6,345	1,593	(80)	-6%	80%	-4%	211	3%	15%
2036	1,430	7,938	136	579	(594)	8,059	6,345	345	462	(594)	6,558	1,501	(92)	-6%	81%	-4%	217	3%	15%
2037	1,477	8,059	140	588	(601)	8,186	6,558	356	478	(601)	6,791	1,395	(106)	-7%	83%	-4%	223	3%	15%
2038	1,525	8,186	145	597	(607)	8,321	6,791	367	496	(607)	7,046	1,275	(120)	-8%	85%	-4%	230	3%	15%
2039	1,574	8,321	149	607	(613)	8,465	7,046	378	515	(613)	7,327	1,139	(136)	-9%	87%	-3%	236	3%	15%
2040	1,626	8,465	154	618	(617)	8,620	7,327	390	536	(617)	7,635	985	(153)	-9%	89%	-3%	243	3%	15%
2041	1,678	8,620	159	630	(621)	8,788	7,635	402	559	(621)	7,975	813	(172)	-10%	91%	-3%	250	3%	15%
2042	1,733	8,788	164	654	(625)	8,981	7,975	414	585	(625)	8,349	632	(181)	-10%	93%	-3%	258	3%	15%
2043	1,789	8,981	169	671	(628)	9,193	8,349	409	612	(628)	8,743	451	(181)	-10%	95%	-3%	256	-1%	14%
2044	1,847	9,193	175	689	(631)	9,426	8,743	404	641	(631)	9,156	270	(181)	-10%	97%	-3%	254	-1%	14%
2045	1,908	9,426	180	708	(634)	9,681	9,156	407	672	(634)	9,601	80	(190)	-10%	99%	-2%	252	-1%	13%
2046	1,970	9,681	186	729	(638)	9,958	9,601	409	705	(638)	10,077	(119)	(199)	-10%	101%	-2%	250	-1%	13%
2047	2,034	9,958	192	751	(644)	10,257	10,077	422	741	(644)	10,596	(339)	(219)	-11%	103%	-2%	257	3%	13%
2048	2,100	10,257	198	775	(651)	10,579	10,596	435	780	(651)	11,160	(581)	(242)	-12%	105%	-2%	265	3%	13%
2049	2,168	10,579	205	800	(658)	10,926	11,160	448	822	(658)	11,772	(847)	(266)	-12%	108%	-2%	273	3%	13%

Exhibit 8

Montana Retirement System 30 Year Projections

Plans included: Teachers' Retirement System

State contribution policy at 5% returns

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	857	6,149	84	450	(397)	6,285	4,220	207	204	(397)	4,233	2,052	123	14%	67%	-5%	137	N/A	16%
2021	885	6,285	86	459	(420)	6,410	4,233	213	204	(420)	4,230	2,180	128	15%	66%	-5%	141	3%	16%
2022	914	6,410	89	468	(436)	6,531	4,230	220	203	(436)	4,218	2,313	133	15%	65%	-5%	146	3%	16%
2023	944	6,531	92	477	(452)	6,648	4,218	230	203	(452)	4,198	2,450	136	14%	63%	-5%	151	3%	16%
2024	974	6,648	95	485	(466)	6,762	4,198	239	201	(466)	4,173	2,589	139	14%	62%	-5%	156	3%	16%
2025	1,006	6,762	97	493	(481)	6,871	4,173	247	200	(481)	4,138	2,733	144	14%	60%	-6%	160	3%	16%
2026	1,039	6,871	100	501	(495)	6,978	4,138	254	198	(495)	4,096	2,882	149	14%	59%	-6%	164	3%	16%
2027	1,073	6,978	103	509	(507)	7,083	4,096	262	195	(507)	4,046	3,037	155	14%	57%	-6%	169	3%	16%
2028	1,107	7,083	107	516	(519)	7,186	4,046	270	193	(519)	3,990	3,197	160	14%	56%	-6%	174	3%	16%
2029	1,143	7,186	110	524	(531)	7,289	3,990	279	190	(531)	3,927	3,362	165	14%	54%	-6%	178	3%	16%
2030	1,181	7,289	113	531	(541)	7,393	3,927	287	186	(541)	3,860	3,533	171	14%	52%	-6%	183	3%	16%
2031	1,219	7,393	117	539	(551)	7,497	3,860	296	183	(551)	3,787	3,709	177	14%	51%	-7%	189	3%	15%
2032	1,259	7,497	120	546	(561)	7,603	3,787	305	179	(561)	3,711	3,892	182	14%	49%	-7%	194	3%	15%
2033	1,300	7,603	124	554	(570)	7,711	3,711	315	175	(570)	3,630	4,080	188	14%	47%	-7%	199	3%	15%
2034	1,342	7,711	128	562	(579)	7,822	3,630	325	171	(579)	3,547	4,275	195	15%	45%	-7%	205	3%	15%
2035	1,385	7,822	132	570	(587)	7,938	3,547	335	167	(587)	3,462	4,476	201	15%	44%	-7%	211	3%	15%
2036	1,430	7,938	136	579	(594)	8,059	3,462	345	162	(594)	3,375	4,684	208	15%	42%	-7%	217	3%	15%
2037	1,477	8,059	140	588	(601)	8,186	3,375	356	158	(601)	3,288	4,898	215	15%	40%	-7%	223	3%	15%
2038	1,525	8,186	145	597	(607)	8,321	3,288	367	153	(607)	3,201	5,120	222	15%	38%	-7%	230	3%	15%
2039	1,574	8,321	149	607	(613)	8,465	3,201	378	149	(613)	3,115	5,350	230	15%	37%	-7%	236	3%	15%
2040	1,626	8,465	154	618	(617)	8,620	3,115	390	145	(617)	3,032	5,588	238	15%	35%	-7%	243	3%	15%
2041	1,678	8,620	159	630	(621)	8,788	3,032	402	141	(621)	2,954	5,834	246	15%	34%	-7%	250	3%	15%
2042	1,733	8,788	164	643	(624)	8,971	2,954	414	137	(624)	2,881	6,090	256	15%	32%	-7%	258	3%	15%
2043	1,789	8,971	169	656	(626)	9,170	2,881	427	133	(626)	2,815	6,355	265	15%	31%	-7%	265	3%	15%
2044	1,847	9,170	175	672	(627)	9,389	2,815	441	130	(627)	2,758	6,631	276	15%	29%	-7%	273	3%	15%
2045	1,908	9,389	180	688	(629)	9,629	2,758	454	127	(629)	2,711	6,918	287	15%	28%	-6%	281	3%	15%
2046	1,970	9,629	186	706	(631)	9,890	2,711	468	125	(631)	2,673	7,217	299	15%	27%	-6%	289	3%	15%
2047	2,034	9,890	192	726	(634)	10,174	2,673	483	123	(634)	2,645	7,529	312	15%	26%	-6%	298	3%	15%
2048	2,100	10,174	198	747	(638)	10,481	2,645	498	122	(638)	2,626	7,855	326	16%	25%	-5%	307	3%	15%
2049	2,168	10,481	205	770	(643)	10,813	2,626	513	121	(643)	2,617	8,196	341	16%	24%	-5%	316	3%	15%

Exhibit 9

Montana Retirement System 30 Year Projections

Plans included: Teachers' Retirement System

State contribution policy under an asset shock return scenario

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2020	857	6,149	84	450	(397)	6,285	4,220	207	(1,014)	(397)	3,016	3,269	1,341	156%	48%	-5%	137	N/A	16%
2021	885	6,285	86	459	(420)	6,410	3,016	213	355	(420)	3,164	3,247	(22)	-3%	49%	-7%	141	3%	16%
2022	914	6,410	89	468	(436)	6,531	3,164	220	413	(436)	3,360	3,171	(76)	-8%	51%	-7%	146	3%	16%
2023	938	6,531	91	471	(452)	6,642	3,360	228	349	(452)	3,486	3,156	(15)	-2%	52%	-7%	150	3%	16%
2024	963	6,642	93	479	(466)	6,748	3,486	237	152	(466)	3,408	3,340	184	19%	51%	-7%	154	3%	16%
2025	989	6,748	96	486	(481)	6,849	3,408	243	160	(481)	3,330	3,519	179	18%	49%	-7%	158	2%	16%
2026	1,015	6,849	98	494	(494)	6,947	3,330	249	156	(494)	3,241	3,706	186	18%	47%	-7%	161	2%	16%
2027	1,042	6,947	101	500	(507)	7,041	3,241	256	151	(507)	3,142	3,900	194	19%	45%	-8%	165	2%	16%
2028	1,070	7,041	103	507	(518)	7,133	3,142	262	146	(518)	3,031	4,101	202	19%	42%	-8%	169	2%	16%
2029	1,099	7,133	106	514	(529)	7,224	3,031	269	141	(529)	2,912	4,312	211	19%	40%	-9%	173	2%	16%
2030	1,129	7,224	108	521	(539)	7,314	2,912	276	134	(539)	2,783	4,531	219	19%	38%	-9%	177	2%	16%
2031	1,160	7,314	111	527	(549)	7,403	2,783	283	128	(549)	2,645	4,758	227	20%	36%	-10%	181	2%	16%
2032	1,192	7,403	114	534	(558)	7,492	2,645	290	121	(558)	2,498	4,995	236	20%	33%	-10%	185	2%	16%
2033	1,225	7,492	117	540	(567)	7,583	2,498	298	113	(567)	2,343	5,240	246	20%	31%	-11%	189	2%	15%
2034	1,258	7,583	120	547	(575)	7,675	2,343	306	106	(575)	2,179	5,496	255	20%	28%	-11%	194	2%	15%
2035	1,292	7,675	123	553	(582)	7,770	2,179	314	97	(582)	2,009	5,761	265	21%	26%	-12%	198	2%	15%
2036	1,328	7,770	126	560	(589)	7,868	2,009	322	89	(589)	1,831	6,037	276	21%	23%	-13%	203	2%	15%
2037	1,364	7,868	130	567	(595)	7,970	1,831	330	80	(595)	1,647	6,324	287	21%	21%	-14%	208	2%	15%
2038	1,401	7,970	133	575	(600)	8,078	1,647	339	71	(600)	1,456	6,622	298	21%	18%	-16%	213	2%	15%
2039	1,440	8,078	137	583	(605)	8,192	1,456	348	61	(605)	1,260	6,932	311	22%	15%	-18%	218	2%	15%
2040	1,479	8,192	140	591	(609)	8,315	1,260	357	51	(609)	1,059	7,256	323	22%	13%	-20%	224	2%	15%
2041	1,519	8,315	144	601	(612)	8,447	1,059	366	42	(612)	854	7,593	337	22%	10%	-23%	229	2%	15%
2042	1,561	8,447	148	610	(615)	8,590	854	376	31	(615)	647	7,944	351	22%	8%	-28%	235	2%	15%
2043	1,604	8,590	152	621	(616)	8,747	647	386	21	(616)	437	8,310	366	23%	5%	-36%	240	2%	15%
2044	1,647	8,747	156	633	(617)	8,919	437	396	11	(617)	226	8,692	382	23%	3%	-51%	246	2%	15%
2045	1,692	8,919	160	646	(617)	9,107	226	406	0	(617)	15	9,092	400	24%	0%	-94%	252	2%	15%
2046	1,739	9,107	164	660	(619)	9,312	15	609	(5)	(619)	0	9,312	221	13%	0%	-65%	451	79%	26%
2047	1,786	9,312	169	675	(621)	9,535	0	627	(6)	(621)	0	9,535	223	12%	0%	n/a	465	3%	26%
2048	1,835	9,535	173	692	(625)	9,775	0	631	(6)	(625)	0	9,775	240	13%	0%	n/a	464	0%	25%
2049	1,885	9,775	178	710	(629)	10,034	0	635	(6)	(629)	0	10,034	259	14%	0%	n/a	463	0%	25%

Exhibit 10

State
 Montana
Plans Included
 Public Employees' Retirement System
 Teachers' Retirement System

Metrics	State Policy (Current Contribution Policy)									State Policy (Current Contribution Policy)								
	Deterministic 7.59%			Deterministic 5%			Deterministic 9%			Stochastic Run - Baseline CMA								
	Current Plan Assumptions			Low Return			High Return			25th Percentile			50th Percentile			75th Percentile		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	11,667	13,100	16,916	10,165	9,477	6,491	12,553	15,410	24,089	9,084	8,058	4,832	10,967	11,248	10,752	13,115	15,076	17,011
Actuarial Accrued Liability (AAL)	15,890	17,355	20,224	15,890	17,355	20,220	15,890	17,355	20,229	15,840	17,090	19,305	15,832	17,162	19,303	15,842	17,124	19,386
Accrued Liability at 4% Discount Rate (DR)	24,283	26,522	30,907	24,273	26,514	30,892	24,273	26,514	30,905	24,197	26,109	29,491	24,185	26,218	29,489	24,200	26,160	29,616
Unfunded Actuarial Accrued Liability (UAAL)	4,223	4,256	3,308	5,725	7,878	13,729	3,337	1,946	(3,861)	6,756	9,032	14,473	4,864	5,914	8,551	2,727	2,048	2,375
Unfunded Liability at 4% DR	12,616	13,423	13,991	14,108	17,037	24,401	11,720	11,105	6,815	15,113	18,050	24,659	13,217	14,971	18,737	11,085	11,085	12,605
Funded Ratio	73.4%	75.5%	83.6%	64.0%	54.6%	32.1%	79.0%	88.8%	119.1%	57.3%	47.2%	25.0%	69.3%	65.5%	55.7%	82.8%	88.0%	87.7%
Funded Ratio at 4% Discount Rate	48.0%	49.4%	54.7%	41.9%	35.7%	21.0%	51.7%	58.1%	77.9%	37.5%	30.9%	16.4%	45.3%	42.9%	36.5%	54.2%	57.6%	57.4%
AAL Compound Annual Growth Rate	2.4%	2.1%	1.8%	2.4%	2.1%	1.8%	2.4%	2.1%	1.8%	2.3%	1.9%	1.6%	2.3%	2.0%	1.6%	2.3%	2.0%	1.6%
Change in AAL from Prior Year (%)	2.1%	1.6%	1.7%	2.1%	1.6%	1.7%	2.1%	1.6%	1.7%	1.9%	1.4%	1.2%	1.9%	1.4%	1.3%	1.9%	1.4%	1.3%
Unfunded Liability / Own Source Revenue at 4% DR	266%	230%	159%	298%	292%	277%	247%	190%	77%	321%	313%	281%	282%	256%	213%	235%	191%	143%
Cash Flow Measures																		
Benefit Payments	1,060	1,259	1,500	1,060	1,259	1,499	1,060	1,259	1,500	1,060	1,253	1,474	1,060	1,255	1,474	1,060	1,254	1,477
Total Contributions	521	608	753	521	608	833	521	552	706	512	576	776	512	578	728	508	545	703
Negative Operating Cash Flow	539	651	747	539	651	667	539	707	795	547	678	698	548	677	746	552	709	774
Benefit Payments / Beginning of Period MVA	9.3%	9.8%	9.1%	10.4%	13.0%	21.9%	8.8%	8.5%	6.6%	11.2%	14.8%	26.5%	9.8%	11.0%	13.5%	8.4%	8.6%	9.0%
Operating Cash Flow to Assets Ratio	-4.7%	-5.1%	-4.5%	-5.3%	-6.7%	-9.7%	-4.5%	-4.8%	-3.5%	-5.8%	-8.0%	-12.5%	-5.1%	-6.0%	-6.8%	-4.4%	-4.8%	-4.7%
Change in MVA from Prior Year (%)	2.6%	2.3%	2.8%	-0.5%	-2.0%	-5.2%	4.3%	4.0%	5.3%	-3.8%	-4.9%	-13.2%	1.6%	-1.1%	-1.5%	4.0%	2.8%	4.0%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,739	5,843	8,805	4,739	5,843	8,805	4,707	5,770	8,770	4,683	5,856	8,812	4,710	5,818	8,842
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.2%	4.2%	4.2%	4.1%	4.3%	4.3%	4.2%	4.3%	4.3%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.5%	4.4%	4.2%	4.4%	4.3%	4.2%	4.4%	4.4%	4.1%
Employer Contributions / OSR	6.8%	6.4%	5.0%	6.8%	6.4%	5.7%	6.8%	5.7%	4.7%	6.7%	6.1%	5.5%	6.8%	6.0%	5.0%	6.7%	5.7%	4.7%
Total Contributions / OSR	11.0%	10.4%	8.5%	11.0%	10.4%	9.5%	11.0%	9.4%	8.0%	10.9%	10.0%	8.9%	10.9%	9.9%	8.3%	10.8%	9.4%	8.0%
Payment and Contribution Measures																		
Employer Contributions (ERC)	322	372	443	322	372	498	322	332	411	317	353	479	317	354	436	314	332	419
Change in ERC from Prior Year (%)	3.6%	2.9%	-8.4%	3.6%	2.9%	3.0%	3.6%	-8.0%	2.9%	2.7%	2.5%	5.5%	2.7%	2.6%	2.8%	1.7%	1.4%	1.9%
Employee Contributions (EEC)	199	237	310	199	237	334	199	220	294	195	223	297	195	224	292	194	213	284
Payroll	2,431	2,873	4,014	2,431	2,873	4,014	2,431	2,873	4,014	2,390	2,704	3,566	2,383	2,747	3,586	2,392	2,725	3,609
Employer Contribution / Payroll	13.3%	12.9%	11.0%	13.3%	12.9%	12.4%	13.3%	11.6%	10.2%	13.3%	13.1%	13.4%	13.3%	12.9%	12.2%	13.1%	12.2%	11.6%
Employee Contribution / Payroll	8.2%	8.2%	7.7%	8.2%	8.2%	8.3%	8.2%	7.6%	7.3%	8.2%	8.2%	8.3%	8.2%	8.2%	8.1%	8.1%	7.8%	7.9%
Total Contributions / Payroll	21.4%	21.2%	18.8%	21.4%	21.2%	20.7%	21.4%	19.2%	17.6%	21.4%	21.3%	21.8%	21.5%	21.1%	20.3%	21.2%	20.0%	19.5%
Normal Cost	238	275	374	238	275	374	238	275	374	234	259	333	233	263	335	234	261	337
Normal Cost (4% DR)	487	564	767	487	564	767	487	564	767	479	531	681	477	539	685	479	535	690
Net amortization \$	(24)	22	132	(112)	(217)	(514)	27	116	570	(173)	(308)	(564)	(70)	(94)	(210)	62	125	169
Net amortization \$ (4% DR)	(462)	(486)	(572)	(507)	(611)	(874)	(434)	(463)	(363)	(537)	(645)	(846)	(482)	(539)	(684)	(416)	(435)	(502)
Net amortization \$ / Payroll	-1.0%	0.8%	3.3%	-4.6%	-7.5%	-12.8%	1.1%	4.0%	14.2%	-7.2%	-11.4%	-15.8%	-3.0%	-3.4%	-5.8%	2.6%	4.6%	4.7%
Net amortization \$ / Payroll (4% DR)	-19.0%	-16.9%	-14.3%	-20.9%	-21.3%	-21.8%	-17.9%	-16.1%	-9.0%	-22.5%	-23.9%	-23.7%	-20.2%	-19.6%	-19.1%	-17.4%	-16.0%	-13.9%
Investment Performance																		
Compounded Annual Growth - From Start Date	7.59%	7.59%	7.59%	5.01%	5.01%	5.01%	9.02%	9.01%	9.01%	3.0%	4.0%	4.8%	6.5%	6.5%	6.5%	9.9%	8.9%	8.2%
Compounded Annual Growth - Segments	7.59%	7.59%	7.59%	5.01%	5.01%	5.01%	9.02%	9.01%	9.01%	3.0%	5.1%	5.6%	6.5%	6.5%	6.5%	9.9%	7.9%	7.4%

Note: Dollar Figures in Millions

Exhibit 10

State
 Montana
Plans Included
 Public Employees' Retirement System
 Teachers' Retirement System

Metrics	State Policy (Current Contribution Policy)					
	Deterministic			Deterministic		
	"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario		"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario	
	2024	2029	2039	2024	2029	2039
Balance Sheet Measures						
Market Value of Assets (MVA)	9,853	8,998	5,247	8,347	7,069	2,086
Actuarial Accrued Liability (AAL)	15,851	17,162	19,377	15,847	17,143	19,334
Accrued Liability at 4% Discount Rate (DR)	24,215	26,218	29,602	24,208	26,189	29,535
Unfunded Actuarial Accrued Liability (UAAL)	5,998	8,164	14,130	7,500	10,074	17,247
Unfunded Liability at 4% DR	14,362	17,220	24,355	15,860	19,120	27,449
Funded Ratio	62.2%	52.4%	27.1%	52.7%	41.2%	10.8%
Funded Ratio at 4% Discount Rate	40.7%	34.3%	17.7%	34.5%	27.0%	7.1%
AAL Compound Annual Growth Rate	2.4%	2.0%	1.6%	2.4%	2.0%	1.6%
Change in AAL from Prior Year (%)	2.0%	1.4%	1.3%	2.0%	1.4%	1.3%
Unfunded Liability / Own Source Revenue at 4% DR	303%	295%	277%	352%	344%	328%
Cash Flow Measures						
Benefit Payments	1,060	1,255	1,476	1,060	1,255	1,475
Total Contributions	515	585	754	514	582	751
Negative Operating Cash Flow	545	671	722	545	673	724
Benefit Payments / Beginning of Period MVA	10.6%	13.6%	25.8%	12.4%	17.0%	54.5%
Operating Cash Flow to Assets Ratio	-5.5%	-7.3%	-12.6%	-6.4%	-9.1%	-26.8%
Change in MVA from Prior Year (%)	-1.1%	-2.5%	-8.2%	-2.0%	-4.4%	-22.9%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,511	5,562	8,381
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	3.3%	3.8%	4.0%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.0%	4.4%	4.1%
Employer Contributions / OSR	6.7%	6.1%	5.2%	7.1%	6.4%	5.4%
Total Contributions / OSR	10.9%	10.0%	8.6%	11.4%	10.5%	9.0%
Payment and Contribution Measures						
Employer Contributions (ERC)	319	358	454	319	357	452
Change in ERC from Prior Year (%)	3.1%	2.4%	2.4%	3.0%	2.4%	2.4%
Employee Contributions (EEC)	196	226	300	196	225	298
Payroll	2,399	2,745	3,592	2,396	2,733	3,577
Employer Contribution / Payroll	13.3%	13.1%	12.6%	13.3%	13.1%	12.6%
Employee Contribution / Payroll	8.2%	8.2%	8.3%	8.2%	8.2%	8.3%
Total Contributions / Payroll	21.5%	21.3%	21.0%	21.5%	21.3%	21.0%
Normal Cost	235	263	335	234	262	334
Normal Cost (4% DR)	480	539	686	480	536	683
Net amortization \$	(133)	(250)	(584)	(242)	(389)	(811)
Net amortization \$ (4% DR)	(516)	(618)	(872)	(573)	(690)	(990)
Net amortization \$ / Payroll	-5.5%	-9.1%	-16.3%	-10.1%	-14.2%	-22.7%
Net amortization \$ / Payroll (4% DR)	-21.5%	-22.5%	-24.3%	-23.9%	-25.3%	-27.7%
Investment Performance						
Compounded Annual Growth - From Start Date	4.5%	4.7%	4.9%	2.3%	3.6%	4.3%
Compounded Annual Growth - Segments	4.5%	5.0%	5.0%	2.3%	5.0%	5.0%

Note: Dollar Figures in Millions

Exhibit 11

State
Montana
Plans Included
Public Employees' Retirement System

Metrics	State Policy (Current Contribution Policy)									State Policy (Current Contribution Policy)								
	Deterministic 7.65%			Deterministic 5%			Deterministic 9%			Stochastic Run - Baseline CMA								
	Current Plan Assumptions			Low Return			High Return			25th Percentile			50th Percentile			75th Percentile		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	6,895	7,732	9,590	5,992	5,549	3,376	7,392	9,006	13,301	5,347	4,752	2,344	6,482	6,580	5,674	7,752	8,841	9,879
Actuarial Accrued Liability (AAL)	9,128	10,066	11,759	9,128	10,066	11,755	9,128	10,066	11,761	9,094	9,892	11,081	9,091	9,912	11,116	9,095	9,921	11,183
Accrued Liability at 4% Discount Rate (DR)	14,033	15,474	18,077	14,033	15,474	18,071	14,033	15,474	18,080	13,981	15,206	17,035	13,975	15,238	17,089	13,981	15,252	17,192
Unfunded Actuarial Accrued Liability (UAAL)	2,234	2,334	2,169	3,136	4,516	8,379	1,737	1,060	(1,540)	3,747	5,140	8,737	2,609	3,332	5,442	1,342	1,080	1,305
Unfunded Liability at 4% DR	7,138	7,742	8,487	8,040	9,925	14,695	6,641	6,468	4,779	8,634	10,455	14,691	7,494	8,658	11,415	6,229	6,411	7,313
Funded Ratio	75.5%	76.8%	81.6%	65.6%	55.1%	28.7%	81.0%	89.5%	113.1%	58.8%	48.0%	21.2%	71.3%	66.4%	51.0%	85.2%	89.1%	88.3%
Funded Ratio at 4% Discount Rate	49.1%	50.0%	53.0%	42.7%	35.9%	18.7%	52.7%	58.2%	73.6%	38.2%	31.2%	13.8%	46.4%	43.2%	33.2%	55.4%	58.0%	57.5%
AAL Compound Annual Growth Rate	2.8%	2.4%	2.0%	2.8%	2.4%	2.0%	2.8%	2.4%	2.0%	2.7%	2.2%	1.7%	2.7%	2.2%	1.7%	2.7%	2.2%	1.7%
Change in AAL from Prior Year (%)	2.4%	1.7%	1.7%	2.4%	1.7%	1.7%	2.4%	1.7%	1.7%	2.2%	1.5%	1.1%	2.2%	1.5%	1.2%	2.2%	1.5%	1.2%
Unfunded Liability / Own Source Revenue at 4% DR	151%	132%	96%	170%	170%	167%	140%	111%	54%	183%	181%	168%	160%	149%	130%	133%	110%	83%
Cash Flow Measures																		
Benefit Payments	594	729	887	594	729	887	594	729	887	593	725	868	593	726	869	593	726	871
Total Contributions	282	330	375	282	330	454	282	273	375	276	310	436	275	308	392	270	283	368
Negative Operating Cash Flow	312	399	512	312	399	432	312	456	512	317	415	432	319	418	476	323	442	503
Benefit Payments / Beginning of Period MVA	8.8%	9.6%	9.4%	9.9%	12.8%	24.3%	8.4%	8.4%	7.0%	10.8%	14.4%	30.8%	9.3%	10.9%	14.8%	8.0%	8.4%	9.1%
Operating Cash Flow to Assets Ratio	-4.7%	-5.3%	-5.4%	-5.2%	-7.0%	-11.9%	-4.4%	-5.2%	-4.0%	-5.8%	-8.3%	-15.4%	-5.0%	-6.3%	-8.1%	-4.4%	-5.1%	-5.3%
Change in MVA from Prior Year (%)	2.8%	2.1%	1.9%	-0.4%	-2.3%	-7.4%	4.3%	3.5%	4.7%	-2.8%	-5.4%	-16.7%	1.7%	-1.0%	-3.2%	4.5%	2.4%	3.6%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,739	5,843	8,805	4,739	5,843	8,805	4,709	5,769	8,720	4,688	5,804	8,791	4,699	5,846	8,836
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.2%	4.2%	4.2%	4.1%	4.2%	4.2%	4.2%	4.3%	4.3%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.5%	4.3%	4.2%	4.4%	4.3%	4.2%	4.4%	4.4%	4.0%
Employer Contributions / OSR	3.5%	3.3%	2.3%	3.5%	3.3%	3.0%	3.5%	2.6%	2.3%	3.5%	3.2%	3.1%	3.5%	3.1%	2.6%	3.4%	2.8%	2.4%
Total Contributions / OSR	5.9%	5.6%	4.3%	5.9%	5.6%	5.2%	5.9%	4.7%	4.3%	5.9%	5.4%	5.0%	5.9%	5.3%	4.5%	5.7%	4.8%	4.2%
Payment and Contribution Measures																		
Employer Contributions (ERC)	167	193	206	167	193	262	167	154	206	163	182	268	162	180	227	159	163	209
Change in ERC from Prior Year (%)	3.9%	3.0%	-18.7%	3.9%	3.0%	3.1%	3.9%	-17.9%	3.0%	2.7%	2.8%	9.6%	2.2%	3.0%	2.9%	0.1%	0.6%	1.9%
Employee Contributions (EEC)	115	137	168	115	137	193	115	119	168	113	128	167	112	127	166	111	120	159
Payroll	1,456	1,730	2,440	1,456	1,730	2,440	1,456	1,730	2,440	1,429	1,619	2,119	1,426	1,630	2,139	1,429	1,637	2,157
Employer Contribution / Payroll	11.4%	11.2%	8.5%	11.4%	11.2%	10.7%	11.4%	8.9%	8.5%	11.4%	11.3%	12.7%	11.4%	11.1%	10.6%	11.1%	10.0%	9.7%
Employee Contribution / Payroll	7.9%	7.9%	6.9%	7.9%	7.9%	7.9%	7.9%	6.9%	6.9%	7.9%	7.9%	7.9%	7.9%	7.8%	7.7%	7.8%	7.3%	7.4%
Total Contributions / Payroll	19.3%	19.1%	15.4%	19.3%	19.1%	18.6%	19.3%	15.8%	15.4%	19.3%	19.1%	20.6%	19.3%	18.9%	18.3%	18.9%	17.3%	17.1%
Normal Cost	143	165	225	143	165	225	143	165	225	140	155	195	140	156	197	141	156	199
Normal Cost (4% DR)	296	342	465	296	342	465	296	342	465	291	320	404	290	322	408	291	324	411
Net amortization \$	(25)	(7)	(9)	(78)	(152)	(368)	4	21	242	(119)	(201)	(374)	(54)	(81)	(190)	21	44	60
Net amortization \$ (4% DR)	(295)	(318)	(427)	(322)	(394)	(577)	(280)	(330)	(296)	(342)	(409)	(529)	(308)	(350)	(458)	(272)	(297)	(342)
Net amortization \$ / Payroll	-1.7%	-0.4%	-0.4%	-5.4%	-8.8%	-15.1%	0.2%	1.2%	9.9%	-8.3%	-12.4%	-17.7%	-3.8%	-5.0%	-8.9%	1.5%	2.7%	2.8%
Net amortization \$ / Payroll (4% DR)	-20.2%	-18.4%	-17.5%	-22.1%	-22.8%	-23.6%	-19.2%	-19.1%	-12.1%	-23.9%	-25.3%	-25.0%	-21.6%	-21.5%	-21.4%	-19.0%	-18.1%	-15.9%
Investment Performance																		
Compounded Annual Growth - From Start Date	7.65%	7.65%	7.65%	5.00%	5.00%	5.00%	9.00%	9.00%	9.00%	3.0%	4.0%	4.8%	6.5%	6.5%	6.5%	10.0%	9.0%	8.2%
Compounded Annual Growth - Segments	7.65%	7.65%	7.65%	5.00%	5.00%	5.00%	9.00%	9.00%	9.00%	3.0%	5.1%	5.5%	6.5%	6.5%	6.5%	10.0%	8.0%	7.5%

Note: Dollar Figures in Millions

Exhibit 11

State
 Montana
 Plans Included
 Public Employees' Retirement System

Metrics	State Policy (Current Contribution Policy)					
	Deterministic			Deterministic		
	"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario	"Asset Shock" Economic Scenario	"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario	"Asset Shock" Economic Scenario
	2024	2029	2039	2024	2029	2039
Balance Sheet Measures						
Market Value of Assets (MVA)	5,815	5,280	2,668	4,939	4,157	826
Actuarial Accrued Liability (AAL)	9,101	9,931	11,168	9,099	9,919	11,141
Accrued Liability at 4% Discount Rate (DR)	13,992	15,266	17,168	13,987	15,248	17,127
Unfunded Actuarial Accrued Liability (UAAL)	3,286	4,651	8,500	4,159	5,762	10,315
Unfunded Liability at 4% DR	8,176	9,986	14,500	9,048	11,091	16,301
Funded Ratio	63.9%	53.2%	23.9%	54.3%	41.9%	7.4%
Funded Ratio at 4% Discount Rate	41.6%	34.6%	15.5%	35.3%	27.3%	4.8%
AAL Compound Annual Growth Rate	2.7%	2.2%	1.7%	2.7%	2.2%	1.7%
Change in AAL from Prior Year (%)	2.2%	1.5%	1.1%	2.2%	1.5%	1.1%
Unfunded Liability / Own Source Revenue at 4% DR	173%	171%	165%	201%	199%	194%
Cash Flow Measures						
Benefit Payments	593	726	870	593	726	870
Total Contributions	278	315	405	277	314	403
Negative Operating Cash Flow	316	411	466	316	412	467
Benefit Payments / Beginning of Period MVA	10.1%	13.4%	29.0%	11.8%	16.6%	69.7%
Operating Cash Flow to Assets Ratio	-5.4%	-7.6%	-15.5%	-6.3%	-9.4%	-37.4%
Change in MVA from Prior Year (%)	-0.9%	-2.8%	-11.1%	-1.9%	-4.8%	-33.8%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,511	5,562	8,381
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	3.3%	3.8%	4.0%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.0%	4.4%	4.1%
Employer Contributions / OSR	3.5%	3.2%	2.7%	3.6%	3.3%	2.8%
Total Contributions / OSR	5.9%	5.4%	4.6%	6.2%	5.6%	4.8%
Payment and Contribution Measures						
Employer Contributions (ERC)	165	185	235	164	184	234
Change in ERC from Prior Year (%)	3.3%	2.4%	2.4%	3.2%	2.4%	2.4%
Employee Contributions (EEC)	113	130	170	113	129	169
Payroll	1,434	1,641	2,147	1,432	1,634	2,137
Employer Contribution / Payroll	11.5%	11.3%	10.9%	11.5%	11.3%	11.0%
Employee Contribution / Payroll	7.9%	7.9%	7.9%	7.9%	7.9%	7.9%
Total Contributions / Payroll	19.4%	19.2%	18.8%	19.4%	19.2%	18.9%
Normal Cost	141	157	198	141	156	197
Normal Cost (4% DR)	292	324	410	291	323	408
Net amortization \$	(90)	(169)	(401)	(154)	(251)	(534)
Net amortization \$ (4% DR)	(327)	(394)	(564)	(360)	(436)	(632)
Net amortization \$ / Payroll	-6.3%	-10.3%	-18.7%	-10.7%	-15.3%	-25.0%
Net amortization \$ / Payroll (4% DR)	-22.8%	-24.0%	-26.3%	-25.1%	-26.7%	-29.6%
Investment Performance						
Compounded Annual Growth - From Start Date	4.5%	4.7%	4.9%	2.2%	3.6%	4.3%
Compounded Annual Growth - Segments	4.5%	5.0%	5.0%	2.2%	5.0%	5.0%

Note: Dollar Figures in Millions

Exhibit 12

State
Montana
Plans Included
Teachers' Retirement System

Metrics	State Policy (Current Contribution Policy)									State Policy (Current Contribution Policy)								
	Deterministic 7.50%			Deterministic 5%			Deterministic 9%			Stochastic Run - Baseline CMA								
	Current Plan Assumptions			Low Return			High Return			25th Percentile			50th Percentile			75th Percentile		
	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039	2024	2029	2039
Balance Sheet Measures																		
Market Value of Assets (MVA)	4,772	5,368	7,327	4,173	3,927	3,115	5,161	6,404	10,789	3,729	3,386	2,339	4,504	4,646	4,838	5,358	6,173	7,609
Actuarial Accrued Liability (AAL)	6,762	7,289	8,465	6,762	7,289	8,465	6,762	7,289	8,468	6,743	7,205	8,180	6,745	7,227	8,180	6,747	7,226	8,205
Accrued Liability at 4% Discount Rate (DR)	10,240	11,040	12,821	10,240	11,040	12,821	10,240	11,040	12,825	10,212	10,913	12,389	10,216	10,945	12,389	10,219	10,943	12,427
Unfunded Actuarial Accrued Liability (UAAL)	1,989	1,922	1,139	2,589	3,362	5,350	1,600	886	(2,321)	3,014	3,820	5,841	2,241	2,581	3,342	1,389	1,052	596
Unfunded Liability at 4% DR	5,468	5,673	5,494	6,068	7,113	9,706	5,079	4,636	2,036	6,484	7,527	10,049	5,712	6,299	7,550	4,861	4,770	4,818
Funded Ratio	70.6%	73.6%	86.5%	61.7%	53.9%	36.8%	76.3%	87.9%	127.4%	55.3%	47.0%	28.6%	66.8%	64.3%	59.1%	79.4%	85.4%	92.7%
Funded Ratio at 4% Discount Rate	46.6%	48.6%	57.1%	40.7%	35.6%	24.3%	50.4%	58.0%	84.1%	36.5%	31.0%	18.9%	44.1%	42.4%	39.1%	52.4%	56.4%	61.2%
AAL Compound Annual Growth Rate	1.9%	1.7%	1.6%	1.9%	1.7%	1.6%	1.9%	1.7%	1.6%	1.9%	1.6%	1.4%	1.9%	1.6%	1.4%	1.9%	1.6%	1.5%
Change in AAL from Prior Year (%)	1.7%	1.4%	1.7%	1.7%	1.4%	1.7%	1.7%	1.4%	1.8%	1.6%	1.2%	1.4%	1.6%	1.3%	1.4%	1.6%	1.3%	1.4%
Unfunded Liability / Own Source Revenue at 4% DR	115%	97%	62%	128%	122%	110%	107%	79%	23%	138%	131%	115%	121%	108%	86%	103%	81%	55%
Cash Flow Measures																		
Benefit Payments	466	531	613	466	531	613	466	531	613	466	529	605	466	529	605	466	529	606
Total Contributions	239	279	378	239	279	378	239	279	331	236	267	351	236	268	339	237	264	329
Negative Operating Cash Flow	227	252	235	227	252	235	227	252	282	230	262	254	230	261	266	230	265	277
Benefit Payments / Beginning of Period MVA	10.0%	10.1%	8.7%	11.1%	13.3%	19.1%	9.4%	8.7%	6.0%	12.0%	14.9%	23.8%	10.4%	11.4%	12.6%	9.1%	9.0%	8.3%
Operating Cash Flow to Assets Ratio	-4.9%	-4.8%	-3.3%	-5.4%	-6.3%	-7.3%	-4.6%	-4.1%	-2.8%	-5.9%	-7.4%	-10.0%	-5.1%	-5.6%	-5.6%	-4.5%	-4.5%	-3.8%
Change in MVA from Prior Year (%)	2.4%	2.5%	4.0%	-0.6%	-1.6%	-2.7%	4.2%	4.7%	6.1%	-3.9%	-4.9%	-8.0%	0.7%	0.1%	1.0%	4.0%	4.7%	4.7%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,739	5,843	8,805	4,739	5,843	8,805	4,683	5,763	8,749	4,718	5,841	8,814	4,723	5,856	8,818
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.3%	4.3%	4.2%	4.1%	4.2%	4.2%	4.2%	4.3%	4.3%	4.3%	4.3%	4.3%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.5%	4.4%	4.1%	4.3%	4.4%	4.2%	4.6%	4.3%	4.2%	4.5%	4.5%	4.1%
Employer Contributions / OSR	3.3%	3.1%	2.7%	3.3%	3.1%	2.7%	3.3%	3.1%	2.3%	3.3%	3.0%	2.5%	3.3%	2.9%	2.4%	3.3%	2.9%	2.3%
Total Contributions / OSR	5.1%	4.8%	4.3%	5.1%	4.8%	4.3%	5.1%	4.8%	3.8%	5.0%	4.6%	4.0%	5.0%	4.6%	3.8%	5.0%	4.5%	3.7%
Payment and Contribution Measures																		
Employer Contributions (ERC)	156	178	236	156	178	236	156	178	205	154	171	222	154	172	212	154	170	206
Change in ERC from Prior Year (%)	3.4%	2.8%	2.9%	3.4%	2.8%	2.9%	3.4%	2.8%	2.8%	2.7%	2.3%	4.2%	2.8%	2.3%	2.6%	2.8%	2.0%	1.8%
Employee Contributions (EEC)	84	100	142	84	100	142	84	100	126	82	95	129	83	96	127	83	94	123
Payroll	974	1,143	1,574	974	1,143	1,574	974	1,143	1,574	959	1,089	1,434	961	1,102	1,441	962	1,102	1,448
Employer Contribution / Payroll	16.0%	15.6%	15.0%	16.0%	15.6%	15.0%	16.0%	15.6%	13.0%	16.0%	15.7%	15.5%	16.0%	15.6%	14.7%	16.0%	15.4%	14.2%
Employee Contribution / Payroll	8.6%	8.8%	9.0%	8.6%	8.8%	9.0%	8.6%	8.8%	8.0%	8.6%	8.8%	9.0%	8.6%	8.7%	8.8%	8.6%	8.6%	8.5%
Total Contributions / Payroll	24.6%	24.4%	24.0%	24.6%	24.4%	24.0%	24.6%	24.4%	21.0%	24.6%	24.5%	24.5%	24.6%	24.3%	23.5%	24.6%	24.0%	22.7%
Normal Cost	95	110	149	95	110	149	95	110	149	93	105	136	93	106	137	93	106	137
Normal Cost (4% DR)	191	222	302	191	222	302	191	222	302	188	211	275	188	214	276	188	214	277
Net amortization \$	1	29	141	(34)	(65)	(147)	23	95	327	(59)	(99)	(191)	(14)	(19)	(36)	37	71	137
Net amortization \$ (4% DR)	(167)	(168)	(144)	(185)	(218)	(298)	(155)	(133)	(67)	(198)	(232)	(309)	(174)	(191)	(233)	(147)	(145)	(147)
Net amortization \$ / Payroll	0.1%	2.5%	9.0%	-3.4%	-5.7%	-9.3%	2.4%	8.3%	20.8%	-6.1%	-9.1%	-13.3%	-1.5%	-1.7%	-2.5%	3.8%	6.4%	9.4%
Net amortization \$ / Payroll (4% DR)	-17.1%	-14.7%	-9.2%	-19.0%	-19.1%	-18.9%	-15.9%	-11.6%	-4.3%	-20.6%	-21.4%	-21.6%	-18.1%	-17.3%	-16.2%	-15.3%	-13.2%	-10.1%
Investment Performance																		
Compounded Annual Growth - From Start Date	7.50%	7.50%	7.50%	5.00%	5.00%	5.00%	9.00%	9.00%	9.00%	3.0%	4.0%	4.7%	6.4%	6.4%	6.4%	9.7%	8.8%	8.1%
Compounded Annual Growth - Segments	7.50%	7.50%	7.50%	5.00%	5.00%	5.00%	9.00%	9.00%	9.00%	3.0%	5.0%	5.5%	6.4%	6.4%	6.4%	9.7%	7.8%	7.4%

Note: Dollar Figures in Millions

Exhibit 12

State
 Montana
 Plans Included
 Teachers' Retirement System

Metrics	State Policy (Current Contribution Policy)					
	Deterministic			Deterministic		
	"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario	"Asset Shock" Economic Scenario	"Low-for-long" Economic Scenario	"Asset Shock" Economic Scenario	"Asset Shock" Economic Scenario
	2024	2029	2039	2024	2029	2039
Balance Sheet Measures						
Market Value of Assets (MVA)	4,038	3,718	2,579	3,408	2,912	1,260
Actuarial Accrued Liability (AAL)	6,750	7,231	8,210	6,748	7,224	8,192
Accrued Liability at 4% Discount Rate (DR)	10,223	10,952	12,434	10,220	10,941	12,408
Unfunded Actuarial Accrued Liability (UAAL)	2,712	3,513	5,631	3,340	4,312	6,932
Unfunded Liability at 4% DR	6,185	7,234	9,855	6,812	8,029	11,148
Funded Ratio	59.8%	51.4%	31.4%	50.5%	40.3%	15.4%
Funded Ratio at 4% Discount Rate	39.5%	33.9%	20.7%	33.3%	26.6%	10.2%
AAL Compound Annual Growth Rate	1.9%	1.6%	1.5%	1.9%	1.6%	1.4%
Change in AAL from Prior Year (%)	1.6%	1.3%	1.4%	1.6%	1.3%	1.4%
Unfunded Liability / Own Source Revenue at 4% DR	131%	124%	112%	151%	144%	133%
Cash Flow Measures						
Benefit Payments	466	529	606	466	529	605
Total Contributions	237	270	349	237	269	348
Negative Operating Cash Flow	229	259	257	229	260	258
Benefit Payments / Beginning of Period MVA	11.4%	13.9%	22.3%	13.4%	17.5%	41.6%
Operating Cash Flow to Assets Ratio	-5.6%	-6.8%	-9.5%	-6.6%	-8.6%	-17.7%
Change in MVA from Prior Year (%)	-1.2%	-2.1%	-4.9%	-2.2%	-3.9%	-13.5%
Own Source Revenue (OSR)	4,739	5,843	8,805	4,511	5,562	8,381
OSR Compound Annual Growth Rate	4.3%	4.3%	4.2%	3.3%	3.8%	4.0%
Change in OSR from Prior Year (%)	4.5%	4.4%	4.1%	4.0%	4.4%	4.1%
Employer Contributions / OSR	3.3%	3.0%	2.5%	3.4%	3.1%	2.6%
Total Contributions / OSR	5.0%	4.6%	4.0%	5.3%	4.8%	4.2%
Payment and Contribution Measures						
Employer Contributions (ERC)	154	173	219	154	173	218
Change in ERC from Prior Year (%)	2.9%	2.3%	2.4%	2.9%	2.3%	2.4%
Employee Contributions (EEC)	83	97	130	83	96	130
Payroll	965	1,104	1,446	963	1,099	1,440
Employer Contribution / Payroll	16.0%	15.7%	15.2%	16.0%	15.7%	15.2%
Employee Contribution / Payroll	8.6%	8.8%	9.0%	8.6%	8.8%	9.0%
Total Contributions / Payroll	24.6%	24.4%	24.2%	24.6%	24.5%	24.2%
Normal Cost	94	106	137	93	106	137
Normal Cost (4% DR)	189	214	277	189	213	276
Net amortization \$	(43)	(81)	(184)	(88)	(138)	(278)
Net amortization \$ (4% DR)	(190)	(224)	(308)	(214)	(254)	(358)
Net amortization \$ / Payroll	-4.4%	-7.3%	-12.7%	-9.1%	-12.6%	-19.3%
Net amortization \$ / Payroll (4% DR)	-19.7%	-20.3%	-21.3%	-22.2%	-23.1%	-24.8%
Investment Performance						
Compounded Annual Growth - From Start Date	4.4%	4.7%	4.8%	2.2%	3.6%	4.3%
Compounded Annual Growth - Segments	4.4%	5.0%	5.0%	2.2%	5.0%	5.0%

Note: Dollar Figures in Millions