GRS Retirement Consulting

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September 11, 2017

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

Re: 2017 Valuation Interest Rate Assumption

Dear Erin:

We are pleased to present our review of the long-term rate of investment return and inflation assumptions for the Minnesota State Retirement System. The purpose of this report is to comply with Actuarial Standards of Practice and to assist MSRS in the selection of appropriate assumptions for funding purposes and Governmental Accounting Standards Board (GASB) Statements Nos. 67 and 68 reporting. This report should not be relied upon for any purpose other than the purpose described herein.

Background

In a 2015 analysis of long-term rate of investment return and inflation assumptions, GRS suggested that an investment return assumption in the range of 7.0% to 8.0% would be reasonable. The current assumed rate, which is mandated by Minnesota Statutes, is 8.0%. This rate was at the upper end of the reasonable range at that time. This report also concluded that the probability of exceeding the current 8.0% assumption over 20 years was only 37%. Please see the report, *Minnesota State Employees Retirement Fund 6-Year Experience Study*, dated June 30, 2015 for additional information.

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

Proposed 2017 legislation that would have changed the statutory interest rate for funding purposes from 8.0% to 7.5% was vetoed by the Governor. Therefore, the 8.0% assumption is currently required to be used for MSRS funding valuations as of July 1, 2017.

If 8.0% is deemed unreasonable for 2017 valuations, we will still comply with statutes and produce the valuation based upon 8.0%, but Actuarial Standards will require us to include a statement indicating that "the prescribed assumption significantly conflicts with what, in our professional judgment, would be reasonable".

On the following pages, we present information that leads us to conclude that 8.0% is outside of a reasonable range as of July 1, 2017.

Inflation

The long-term inflation assumption is a building block for the remaining economic assumptions. The current inflation assumption is 2.75%.

Most of the investment consulting firms, in setting their capital market assumptions, currently assume that inflation will be less than 2.75%. We examined the capital market assumption sets for eight investment consulting firms. The average assumption for inflation was 2.27%, with a range of 2.00% to 2.50%. However, the investment consulting firms typically set their assumptions based on a shorter time horizon, while actuaries must make much longer projections.

The 2017 Social Security Trustees report uses 2.6% as the long-range intermediate price inflation assumption. The low-cost assumption is 3.2%, and the high-cost assumption is 2.0%. (The Social Security program benefits from high inflation through faster earnings and revenue growth.) The long-term intermediate assumption has decreased slightly since 2013, from 2.8% to 2.6%.

Treasury Inflation Protected Securities (TIPS) are government bonds which are adjusted upward or downward for actual changes in inflation. Real yields on TIPS at "constant maturity" are interpolated by the U.S. Treasury from Treasury's daily real yield curve. The spread between yield curve rates and real yield curve rates gives insight into market expectations for inflation. As of June 30, 2014, the spread on a 30-year basis was approximately 2.4%. As of the date of this report, the spread on a 30-year basis was approximately 1.8%.

Since the inflation assumption was set at 2.75%, the Social Security Administration has lowered its inflation assumptions, the TIPS spread has dropped, and the range of inflation assumptions used by investment consulting firms has decreased. It is difficult to ignore the downward trend in inflation statistics. We believe that it is appropriate to recognize this trend in future inflation assumptions. There is very little data that would support an inflation assumption higher than 2.50%. **Based upon the reviewed data, we suggest using an inflation assumption of 2.50%.**

Long-Term Rate of Return on Investments

For purposes of budgeting contributions as a level percentage of payroll, the assumed rate of investment return is used as the discount rate to determine the present value of the System's pension obligations. It is important to note that an actuarial investment return assumption based on expected future experience is a single estimate for all years and therefore implicitly assumes that returns above and below expectations will "average out" over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned.

The review of the investment return assumption in this report are forward-looking measures of likely investment return outcomes for the asset classes in the current investment policy. Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain its own capital market expectations, we request and monitor forward-looking expectations developed by several major investment consulting firms. We update our CMAM on an annual basis.

Many of the investment consultants forecast relatively low returns for the next 10 or so years, followed by higher returns. Keep in mind that the short-term does matter. Any decision made today will be judged in the context of the current environment for many future years. Investment returns realized in the short term have a significant bearing on the long-term average return. A significant portion of liabilities will actually be paid out over the next ten years. Once the money is paid out, it will not be available to participate in the better returns that consultants predict for the longer term future.

The capital market assumptions in the 2017 CMAM are from the following investment consultants (in alphabetical order) BNY Mellon, JPMorgan, Marquette Associates, Mercer, NEPC, PCA, RVK, and Voya. It is important to understand that in general no two investment consultants will utilize the same asset classes. Moreover, there are differences in investment horizons, price inflation, treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages, and other technical issues. We have attempted to align the various assumption sets from the different investment consultants to be as consistent as possible.

Presented below is the current target asset allocation, adopted by the Minnesota State Board of Investment (SBI) in 2016:

Asset Class	Asset Allocation
Domestic Equity	39%
International Equity	19
U.S. Fixed Income	20
Alternative Investments	20
Cash	2

Based upon the target asset allocation as well as background information provided by the SBI for the 2015 experience study, we made the following assumptions about detailed asset classes within the broad target asset classes:

Asset Classes	
Cash	2.00%
US Stock - Large Cap	36.00%
US Stock - Small Cap	3.00%
Int'l Equity	15.00%
Emerging Mkts Eq	4.00%
US Corporate Bonds	13.33%
Government Bonds	6.67%
Real Estate	1.50%
Private Equity	12.50%
Other Alternatives	6.00%
	100.00%

The arithmetic expected return developed from this asset allocation is shown in the table below. The CMAM begins with the nominal expected return net of investment expenses from each consultant (column 2), takes out each consultant's price inflation assumption (column 3) to arrive at the real return (column 4). We then incorporate the proposed price inflation assumption of 2.50% (column 5) to get the adjusted nominal return (column 6). Since administrative expenses paid out of trust assets are reflected in the employer contributions and active management fees are assumed to equal excess manager performance (alpha), no expenses (column 7) are netted out of the return. The final arithmetic expected return is shown in column 8. Note that this return has not yet been adjusted for risk or "volatility drag." We have shown the standard deviation of returns as the investment risk in column 9.

ASOP No. 27 acknowledges that for any given economic assumption, there is a reasonable range of opinions on that assumption. This is evident from the summaries we show from our CMAM.

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)–(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Administrative Expenses	Expected Nominal Return Net of Expenses (6)-(7)		Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		(9)
1	5.51%	2.20%	3.31%	2.50%	5.81%	0.00%	5.81%		11.68%
2	6.94%	2.50%	4.44%	2.50%	6.94%	0.00%	6.94%		13.94%
3	7.01%	2.50%	4.51%	2.50%	7.01%	0.00%	7.01%		13.30%
4	6.53%	2.00%	4.53%	2.50%	7.03%	0.00%	7.03%		12.10%
5	6.82%	2.26%	4.56%	2.50%	7.06%	0.00%	7.06%		11.60%
6	7.42%	2.21%	5.21%	2.50%	7.71%	0.00%	7.71%		14.57%
7	7.78%	2.25%	5.53%	2.50%	8.03%	0.00%	8.03%		15.72%
8	7.91%	2.25%	5.66%	2.50%	8.16%	0.00%	8.16%		12.43%
Average	**6.99%**	**2.27%**	**4.72%**	**2.50%**	**7.22%**	**0.00%**	**7.22%**		**13.17%**

The average expected nominal return from column 8 is 7.22% before adjustment for volatility drag. Note that the expected rate of return shown in the table above represents the average future expected return which is higher than the median future expected. Setting the valuation assumption at the arithmetic expected return means that over time the average accumulated assets are expected to grow at this rate. However, in any given year it is less than 50% likely that this return will be achieved. From the perspective of the Actuarial Standards of Practice, this may be considered a reasonable assumption. Adjusting for volatility (as we do below) is also reasonable, and provides recognition of the effect of volatility on the longer-term returns.

Next we compare the probabilities of achieving returns over a 20-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 8.0% over a 20-year horizon. For comparison purposes, we have also shown the probability of achieving a 7.5% and a 7.0% investment return over a 20-year horizon. Note that the investment horizon for many of the capital market assumption sets is between 5 and 10 years.

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return 40th	50th	60th	Probability of Exceeding 8.00%	Probability of exceeding 7.50%	Probability of exceeding 7.00%
(1)	(2)	(3)	(4)	(5)	(6)	(6)
1	4.51%	5.17%	5.83%	14.02%	18.65%	24.15%
2	5.26%	6.04%	6.82%	26.39%	31.87%	37.80%
3	5.45%	6.19%	6.94%	27.10%	32.91%	39.21%
4	5.68%	6.35%	7.03%	27.09%	33.51%	40.49%
5	5.79%	6.44%	7.09%	27.36%	34.10%	41.42%
6	5.93%	6.74%	7.55%	34.80%	40.65%	46.74%
7	6.03%	6.90%	7.78%	37.59%	43.13%	48.85%
8	6.75%	7.45%	8.15%	42.08%	49.25%	56.48%
Average	**5.67%**	**6.41%**	**7.15%**	**29.55%**	**35.51%**	**41.89%**

The 50th percentile return is also the geometric average return. This is the expected return adjusted for volatility drag and is a reasonable rate of return for purposes of the valuation. The average of 50th percentile returns for all eight investment consultants is 6.41% per year.

The tables shown above are from GRS' standard model. Next, we developed a revised model that is based on additional capital market assumptions provided to GRS. We adjusted the standard model to exclude assumptions applying to time horizons of less than 10 years. We used Mercer's 20-year capital market assumption set instead of the 10-year set of assumptions. We also included Principal's 20 to 30-year capital market assumptions. The capital market assumptions in this revised model are from the following investment consultants (in alphabetical order) BNY Mellon, JPMorgan, Marquette Associates, Mercer, Principal, and PCA.

In the revised model, the average expected nominal return increases from 7.22% to 7.68%, and the average of 50th percentile returns for the six investment consultants in the revised model increases from 6.41% to 6.85% per year. The probabilities of exceeding 8.00%, 7.50%, and 7.00% are 35%, 41%, and 48%, respectively.

Other Sources of Data

It is our understanding that the Minnesota State Board of Investment's most recent asset allocation study performed by Callan in 2016 resulted in an expected nominal geometric rate of return of 7.30%, comprised of an inflation assumption of 2.25% and a real rate of return assumption of 5.05%.

In May 2016, the Minnesota State Board of Investment (SBI) affirmed that the 8.0% return rate is attainable in the long-term, while acknowledging short term challenges. Some key messages in Mansco Perry III's May 10, 2016 memo to the members of the Investment Advisory Council were:

- "While the proposed asset mix yields a nominal expected return of 7.3%, we do not draw the conclusion that achievement of the current 8.0% nominal return is unattainable given some important differences in the assumptions underlying the numbers. The first important difference is the time horizon. The study is based on a planning period of 10 years which is shorter than the actuarial perspective of 50 years."
- "…Callan's asset class return expectations reflect beta only and do not include the potential for positive active risk and incremental return, or alpha, that the SBI has historically achieved" {Note: Actuarial Standards make it very difficult to allow for the use of expected alpha in determining a reasonable range.}

We note that a real rate of return assumption of 5.05% and an inflation assumption of 2.50% yields an expected nominal geometric rate of return of 7.55%.

Comments and Recommendations

GRS believes the 8.0% statutory rate is outside of the reasonable range for MSRS valuations as of July 1, 2017. We will still comply with statutes and produce the valuation based upon 8.0%, but Actuarial Standards will require us to include a statement indicating that "the prescribed assumption significantly conflicts with what, in our professional judgment, would be reasonable".

We recommend that MSRS consider an investment return assumption in the range of 6.85% to 7.68%. Based on the data reviewed, we are comfortable supporting a 7.5% discount rate, but MSRS should note that the selection of an investment return assumption at the upper end of this range results in a higher risk of increased actuarial contributions in the future, as the rate must be reviewed each year for reasonability based on actuarial standards. A rate near the bottom of the range, such as 7.0%, would be more likely to be sustainable for a longer period.

Our 2017 valuation reports are required to demonstrate the sensitivity of the discount rate assumption by providing key metrics using a discount rate 1% higher and 1% lower than the prescribed rate. We will comment in the reports that the 7.0% discount rate is within a reasonable range, and that the 9.0% discount rate is outside of the reasonable range.

Nothing in this report should be construed as GRS giving investment advice.

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

This report has been prepared by actuaries who have substantial experience valuing public employee retirement systems. To the best of our knowledge and belief, the information contained in this report was performed in accordance with the requirements of Minnesota Statutes 356.215, and the requirements of the Standards of Actuarial Work established by the Legislative Commission on Pensions and Retirements. All calculations have been made in conformity with generally accepted actuarial principles and practices, and with the Actuarial Standards of Practice issued by the Actuarial Standards Board and with applicable statutes.

Respectfully submitted,

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