Deloitte.

Minnesota Legislative Commission on Pensions and Retirement

2008-2014 Experience Study Review of Retirement Systems

Prepared by Deloitte Consulting LLP

May 2016

Contents

Actuarial Opinion

This report presents the results of the actuarial review performed by Deloitte Consulting, LLP of the July 1, 2008 through July 1, 2014 experience studies of selected statewide and major local Minnesota public retirement plans in accordance with Minnesota Statutes, Section 356.214, Subdivision 4, as directed by the Minnesota Legislative Commission on Pensions and Retirement ("LCPR" or "the Commission").

Our review was based on the publicly available experience study reports. In our opinion, the July 1, 2008 through July 1, 2014 experience studies of the plans included in our analysis were performed in substantive compliance with Minnesota Statutes, Section 356.215, with the Standards for Actuarial Work of the Commission, and with the applicable Actuarial Standards of Practice issued by the Actuarial Standards Board.

This report is prepared solely for the benefit and internal use of the LCPR and the State of Minnesota. This report is not intended for the benefit of any other party and may not be relied upon by any third party for any purpose. Deloitte Consulting accepts no responsibility or liability with respect to any party other than the LCPR and the State of Minnesota in accordance with its statutory and regulatory requirements.

The undersigned with actuarial credentials collectively meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

To the best of our knowledge, no employee of the Deloitte U.S. Firms (Deloitte & Touche LLP, Deloitte Consulting LLP, Deloitte Financial Advisory Services LLP, and Deloitte Tax LLP) is an officer or director of the Systems (Minnesota State Retirement System, Minnesota Public Employees Retirement Association and Minnesota Teachers Retirement Association). In addition, we are not aware of any relationship between the Deloitte U.S. Firms and the Systems that may impair or appear to impair the objectivity of the work detailed in this report.

DELOITTE CONSULTING LLP

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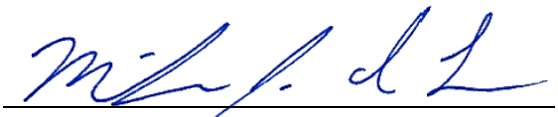

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Executive Summary

Scope

The intent of this report is to perform an actuarial review of the 2008-2014 experience study reports (2015 Studies) prepared for the Minnesota State Retirement System (MSRS) State Employees Retirement Fund, Minnesota Public Employees Retirement Association (PERA) General Employees Retirement Plan and Minnesota Teachers Retirement Association (TRA), as engaged by the Minnesota Legislative Commission on Pensions and Retirement (LCPR) per Minnesota Statute Section 356.214, Subdivision 4. The purpose of this engagement is to review compliance with Minnesota State Statutes, the LCPR's Standards for Actuarial Work (LCPR's Standards) and Actuarial Standards of Practice (ASOPs) as published by the Actuarial Standards Board (ASB), and provide an assessment of the reasonableness, reliability and areas of concern or potential improvement in the specific reports reviewed or the procedures utilized by any particular reporting actuary, and of the reasonableness of any recommended actuarial assumption changes.

Section VI of LCPR's Standards calls for each retained actuary to review the economic and non-economic (or demographic) assumptions relied upon for valuation purposes, and further stipulates certain actuarial methods be followed in analyzing those assumptions. Information that must be included in the experience study report is also identified. Except for the change in the assumption for investment return for TRA, the assumption changes suggested by retained actuaries and reviewed by Deloitte are understood to be effective beginning with each plan's July 1, 2016 actuarial valuations if approved by the LCPR.

As a component of our review we have also considered the results and recommendations of each plan's 2004-2008 experience studies (2009 Studies). The majority of the assumptions analyzed in the 2015 studies are based on sufficient data to be considered fully credible. However, we believe that considering the historical context of data trends can also be beneficial when selecting new assumptions.

In addition to the requirements of the standards, each retained actuary provided commentary regarding the actuarial methods employed in the most recent actuarial valuation. We have provided some commentary on these topics where we believe it to be of value. However we believe that the Systems and the LCPR are currently being provided with sufficient, reliable consulting on this topic separate from the experience study.

Summary of Key Findings

It is our opinion that each of the 2015 Studies included in our analysis was performed in compliance with Minnesota Statutes, Section 356.215, with the Standards for Actuarial Work of the LCPR, and with the applicable Actuarial Standards of Practice.

It is our opinion that the assumption changes recommended in the studies are reasonable and can be relied upon for purposes of measuring plan obligations and determining recommended contributions in the annual valuations. We did not find any issues that rose to the level of serious concern; however, we have made recommendations that in our opinion may lead to more accurate or better understood assumption recommendations in future years.

Economic Assumptions

Investment Return

MSRS & PERA – In each of these 2015 Studies, we noted that the assumption that was chosen was at the maximum end of the range (8.0%) and that the geometric mean expectation is the range's minimum (7.0%). While the retained actuary did not provide support for the specific rate chosen, we were able to support the reasonableness of selecting the top end of the range for this assumption by reviewing historical real returns by investment class, projected returns from other investment consultants, and considering the projections of the plans' investment manager, the State Board of Investment (SBI).

TRA – Investment return assumptions are based primarily on the projections of the plan's investment manager, SBI. We believe this assumption is reasonable.

Non-Economic (Demographic) Assumptions

Mortality

All Plans – The retained actuaries analyzed the experience for each plan on a headcount-weighted basis and have proposed updating to the RP-2014 mortality tables (with modifications) and the MP-2014 mortality improvement scale. The RP-2014 mortality rates are liability-weighted (i.e. the rates were developed by weighting the exposures and deaths by compensation for actives and by benefit amount for retirees). Use of the liability-weighted RP-2014 mortality tables may be reasonable, but we would suggest that the retained actuary consider calculating their actual/expected ("A/E") ratios using liability weighting for consistency with the proposed table. If the data suggests that headcount weighting is more reasonable, then the RPH-2014 tables should be considered.

Additionally, we recommend considering updating to the recently published MP-2015 mortality improvement scale (instead of the MP-2014 mortality improvement scale) which reflects the Society of Actuaries' most recent expectations on mortality improvement.

Economic Assumptions

Actuarial assumptions used in the valuation of retirement benefits are generally broken into two categories: economic and demographic. This section of the report considers only those assumptions we have categorized as economic.

Minnesota Statutes, Section 356.214 and the LCPR's Standards for Actuarial Work require that retained actuaries must evaluate the following economic assumptions:

- Investment return, or the sum of:
  - Inflation
  - Real investment return net of expenses
- Payroll growth, or the sum of:
  - Inflation
  - Real wage growth (or real wage inflation)
  - Membership growth
- Individual compensation increases, or the sum of:
  - Inflation
  - Real wage growth (or real wage inflation)
  - Merit increases

The purpose of this section of our report is to review the economic assumption recommendations made by the retained actuaries, including their methods of testing and recommending assumption changes. The methods were reviewed based on compliance with the LCPR's Standards for Actuarial Work and the Actuarial Standards of Practice discussed below.

Actuarial Standards of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance to actuaries in selecting and recommending economic assumptions. ASOP No. 27 has been restated effective for any actuarial work product with a measurement date on or after September 30, 2014. Because the assumptions resulting from this experience study will be used in actuarial valuations with measurement dates no sooner than July 1, 2015, we consider this Standard applicable.

The following process is set forth by ASOP 27 in selecting an identified economic assumption:

a. Identify any components of the assumption
b. Evaluate relevant data
c. Consider factors specific to the measurement
d. Consider other general factors
e. Select a reasonable assumption

The standard also requires the actuary to review the entire assumption set upon selection of each individual assumption to ensure internal consistency, and make adjustments as necessary.

The standard defines a *reasonable assumption* as follows:

3.6 — Selecting a Reasonable Assumption—Each economic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

a. It is appropriate for the purpose of the measurement;
b. It reflects the actuary's professional judgment;

c. *It takes into account historical and current economic data that is relevant as of the measurement date;*
d. *It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and*
e. *It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed under section 3.5.1, or when alternative assumptions are used for the assessment of risk.*

3.6.1 — Reasonable Assumption Based on Future Experience or Market Data—The actuary should develop a reasonable economic assumption based on the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof.

3.6.2 —Range of Reasonable Assumptions—The actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

Finally, both ASOP 27 and the LCPR's Standards for Actuarial Work provide assumption specific guidance for each of the assumptions above, which will be referenced later in this section. The remainder of this section of our report presents our review of selected economic assumptions to ensure the retained actuaries have followed the ASOP's general guidance and the assumption-specific guidance provided by the ASOP and the LCPR's Standards for Actuarial Work.

Price Inflation

The inflation assumption is not directly used to measure the liabilities of the plans; rather it is a component of several economic assumptions and is required by LCPR's Standards to be specifically disclosed in the actuarial valuation. As noted above, all three of the economic assumptions that must be studied per the LCPR's Standards for Actuarial Work should be developed using inflation as a component.

Actuarial Standards

The **LCPR's Standards for Actuarial Work, Section VI. B. (1)** requires retained actuaries to "*disclose the underlying inflation assumption used to develop the investment return assumption."* For this reason, the retained actuaries must select an inflation assumption.

The Actuarial Standards of Practice are fairly brief in their guidance regarding inflationary data to consider, as noted below:

ASOP No. 27, Section 3.7.1 *– Data –The actuary should review appropriate inflation data. These data may include consumer price indices, the implicit price deflator, forecasts of inflation, yields on government securities of various maturities, and yields on nominal and inflation-indexed debt.*

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Assumption	Current	Recommended
Consumer Price Inflation	3.00%	2.75%

Data Considered:

The retained actuary considered historical Consumer Price Index (CPI) data from the last 60 years, noting that results are heavily influenced by the relatively high inflationary period during the 1970's and early 1980's:

Period	Inflation (CPI)
Last 5 years	1.7%
Last 10 years	2.1%
Last 20 years	2.3%
Last 30 years	2.7%
Last 40 years	3.8%
Last 50 years	4.1%
Last 60 years	3.7%

The retained actuary also considered various projections of inflation, as summarized below:

Source and Metric	Horizon	Projection (Low)	Projection (Mid/Single)	Projection (High)
SBI	30 years		3.00%	
GRS Capital Market Assumptions Modeler	10-20 years	2.11%	2.36%	3.00%
Social Security Trustees Report	75 years	2.00%	2.70%	3.40%
Nominal Treasury Bonds less Treasury Inflation Protected Securities	30 years to maturity		2.35%*	

* As of June 30, 2014

Deloitte's Review:

We note that several measures of historical and forecasted CPI exist. It is our opinion that the measures selected are appropriate for evaluating the assumption.

The retained actuary makes the comment that the steady decrease in rates of inflation is difficult to ignore, and based on the data reviewed above we agree. In the plan's 2009 Study the steady decrease in inflation was also noted. The retained actuary recommended against adjusting this inflation downward in part due to the expectation that recent federal economic stimulus packages would cause inflation to be on the high side of their expected range. Six years of additional data has not shown evidence to suggest this increase in inflation is impending.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

The data considered by the retained actuary is identical to that of MSRS, as is the actuary and their recommendation. Please see our comments regarding the MSRS inflation assumption, all of which also apply here.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Assumption	Current	Recommended
Consumer Price Inflation	3.00%	2.75%

Data Considered:

The retained actuary considered historical Consumer Price Index (CPI-U, US City Average, All Urban Consumers) data from the last 88 years, noting that results are heavily influenced by the relatively high inflationary period from 1973 to 1981:

Period	Inflation (CPI-U)
Last 10 years	2.28%
Last 20 years	2.37%
Last 30 years	2.78%
Last 40 years	4.00%
Last 50 years	4.15%
Last 60 years	3.69%
Last 88 years	2.99%

The retained actuary also considered various projections of inflation, as summarized below:

Source and Metric	Horizon	Projection (Low)	Projection (Mid/Single)	Projection (High)
SBI	30 years		3.00%	
Social Security Trustees Report	75 years	2.00%	2.70%	3.40%
Nominal Treasury Bonds less Treasury Inflation Protected Securities	10 years to maturity		1.68%*	
Nominal Treasury Bonds less Treasury Inflation Protected Securities	20 years to maturity		1.79%*	
Nominal Treasury Bonds less Treasury Inflation Protected Securities	30 years to maturity		1.92%*	

* As of December 31, 2014

Deloitte's Review:

We note that several measures of historical and forecasted CPI exist. It is our opinion that the measures selected are appropriate for evaluating the assumption.

When considering projections for other economic assumptions, namely investment return, the retained actuary considered the actuarial assumptions made by the plan's peers. While we do not believe this consideration is necessary, we did reference the Public Plans Data compiled by the Center for Retirement Research at Boston College[1] to determine whether the average inflation assumption has

[1] Public Plans Data (http://crr.bc.edu/data/public-plans-database)

decreased. We found that between 2001 and 2014 the mean inflation rate assumed decreased by 63 basis points. We noted that the plan's peer group is generally reducing both the inflation and investment return assumption as expected for internal consistency of the economic assumptions, which is a useful data point in considering the proposed changes.

In the plan's 2009 Study lower inflation rates were noted. The retained actuary recommended against adjusting this inflation downward in part due to the expectation that recent federal economic stimulus packages would cause inflation to be on the high side of their expected range. Six years of additional data has not shown evidence to suggest this increase in inflation is impending.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Investment Return

The investment return assumption reflects anticipated returns on the plan's current and future assets. It is also used to calculate the present value of all plan liabilities and generally has the greatest impact of all assumptions reviewed in this report.

Applicable Standards

In selecting or recommending an investment return assumption, ASOP No. 27, Section 3.8 provides actuaries with guidance. The standard recommends the actuary review the investment data as follows.

ASOP No. 27, Section 3.8.1 *— Data—The actuary should review appropriate investment data. These data may include the following:*

a. *current yields to maturity of fixed income securities such as government securities and corporate bonds;*
b. *forecasts of inflation, GDP growth, and total returns for each asset class;*
c. *historical and current investment data including, but not limited to, real and nominal returns, the inflation and inflation risk components implicit in the yield of inflation-protected securities, dividend yields, earnings yields, and real estate capitalization rates; and*
d. *historical plan performance.*

The actuary may also consider historical and current statistical data showing standard deviations, correlations, and other statistical measures related to historical or future expected returns of each asset class and to inflation. Stochastic simulation models or other analyses may be used to develop expected investment returns from this statistical data.

The standards also state the actuary may adjust or customize the data above to reflect asset allocation, investment volatility and investment manager performance among other factors, and that combining estimated components of the investment return assumption and using multiple return rates in lieu of a single rate is also acceptable.

The **LCPR's Standards for Actuarial Work, Section VI. B. (1)** requires the investment return assumption to be based on analysis of the expected return in future years based on the target asset allocation and the capital market assumptions for each of those asset classes. The standards also require the experience study to include capital market assumptions and expected return information provided by the State Board of Investment (SBI), and disclose the underlying inflation assumption used in developing this assumption.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

The following table shows the current investment return assumptions and the retained actuary's proposed investment return assumption for relevant periods of time:

Investment Return	Current	Recommended
Through June 30, 2017	8.0%	Range of 7.0% - 8.0%
Beginning July 1, 2018	8.5%	Range of 7.0% - 8.0%

Data Considered:

The retained actuary considered the following data sources summarizing returns or expected returns of assets held by MSRS and its actual asset allocation as determined by the SBI:

Data Source	Inflation	Real Rate of Return	Expenses	Nominal Rate of Return
SBI Allocation Study (projected)	3.0%	5.36%	(0.11%)	8.25%
MSRS CAFR (Last 20 years)		6.60%		
MSRS CAFR (Last 10 years)				8.40%
Actuarial Valuations (Last 6 years, AVA)				5.70%
Actuarial Valuations (Last 6 years, MVA)				8.30%

The retained actuary also considered capital market expectations of six investment consultants selected from the GRS Capital Market Assumptions Modeler, which assumes asset allocations that are similar but not necessarily equal to SBI's mix. The expected returns were adjusted to reflect MSRS assumptions regarding investment expenses and rate of inflation.

Investment Consultant	Net Rate of Return (1-yr Arithmetic)	Net Rate of Return (20-yr Geometric)	Probability of Exceeding 8.00% (20-yr)	Probability of Exceeding 7.00% (20-yr)
1	6.79%	5.90%	25%	36%
2	7.39%	6.63%	31%	45%
3	7.73%	6.78%	35%	47%
4	8.20%	7.21%	40%	53%
5	8.47%	7.54%	44%	57%
6	8.85%	7.74%	47%	59%
Average	7.91%	6.97%	37%	50%

Finally, the retained actuary indicated that they considered best practices recommended by the Society of Actuary's (SOA) *Report of the Blue Ribbon Panel on Public Pension Plan Funding* in addition to the actuarial standards referenced above.

Deloitte's Review:

The retained actuary considered sufficient applicable data to make an investment return assumption recommendation and disclosed that the recommendation is based on an underlying inflation rate of 2.75% as previously noted in this report.

The retained actuary ultimately provided a range within which they recommend the assumption be made. Our understanding is that the high end of the range is based on the arithmetic mean of expected investment returns (7.91%) and the low end is based on the geometric mean of expected returns (6.97%).

Both of the estimates above were based on an asset allocation mix that is slightly different than that reported by the SBI. Specifically, domestic equities were allocated by the retained actuary evenly between large and small cap stocks while the SBI reported currently managing toward an allocation of 92% and 8% respectively. Similarly, international equities were allocated by the retained actuary evenly between developed and emerging markets while the SBI reported currently managing toward an allocation of 79% and 21% respectively. The retained actuary does not support the difference in asset allocation except to note that the sub-asset classes are not targets and that managers have discretion to actively manage their portfolios between sub-asset classes within the broad target asset classes.

We would find this allocation reasonable absent any information from the SBI regarding investment in sub-asset classes, but given the availability of said information we believe it should be considered. However, given the different ways that stocks can be allocated as "small," "mid," or "large" cap, we have determined that weighting domestic equities as modeled by the retained actuary is reasonable. We believe the same principle may apply to developed and emerging markets, and therefore take no significant issue with the modeled asset allocation.

We also note the plan has elected an 8.00% assumption, which falls at the top end of the retained actuary's range. Selecting an assumption at the top end of a recommended range may be considered somewhat aggressive. In the retained actuary's 20-year geometric projection data considered, we note that the median rate of return is 6.97%, and the likelihood of exceeding 8.00% is only 37%. The retained actuary does make it clear to the plan that while lowering the discount rate 50 basis points (from 8.5% to 8.0%) has decreased the risk of not meeting the investment return assumption, significant risk still exists.

The retained actuary's rationale for providing a range of 7.0% to 8.0% is summarized in the following portion of their report (emphasis original to report):

> *Given that using the expected arithmetic return is expected to result in gains and losses that offset each other over the long term, but recognizing that a level of conservatism may be desirable (which would suggest using the expected geometric return),* ***we suggest that MSRS consider an investment return assumption in the range of 7.00% to 8.00%.***

Based on the data and reasoning indicated by the plan's retained actuary alone, we do not believe the high end of the range (8.0%) is supported. Specifically, we agree with the retained actuary, and the noted recommendation from the SOA's *Report of the Blue Ribbon Panel on Public Pension Plan Funding,* that the geometric median should be followed.

However, we do believe that the range recommended can be supported. The retained actuary's projected investment returns were based on the GRS Capital Market Assumption Modeler. A survey released by Horizon Actuarial Services, LLC provides alternate expected returns by asset classes. The survey provides capital market assumptions specific to projections over 10 years and 20 years. Using the survey's expected returns by asset class for the 20-year horizon, the asset allocation modeled by the retained actuary, and adjusting for inflation differences and expenses, we calculated an expected geometric return of 8.27%. The nominal average returns by asset class for the 20-year horizon that we used in developing that rate are shown below:

Asset Class	Average Nominal Return*
US Equity – Large Cap	9.18%
US Equity – Small/Mid Cap	10.15%
Non-US Equity - Developed	9.80%

Non-US Equity – Emerging	12.26%
US Corporate Bonds – Core	4.58%
US Corporate Bonds – Long Duration	5.27%
US Corporate Bonds – High Yield	6.93%
Non-US Debt – Developed	3.70%
Non-US Debt – Emerging	6.85%
US Treasuries (Cash Equivalents)	3.14%
TIPS (Inflation-Protected)	3.65%
Real Estate	7.42%
Hedge Funds	6.40%
Commodities	6.32%
Infrastructure	8.39%
Private Equity	12.85%
Inflation	2.30%

*Expected return for the 20-year time horizon for those consultants that responded to the survey, as noted in Exhibit 14 of the Horizon Actuarial 2015 Survey of Capital Market Assumptions.

We recognize that the Horizon survey provided investment consultant expectations for a 10-year and 20-year time horizon. The investment return assumption, as noted by the SOA's *Report of the Blue Ribbon Panel on Public Pension Plan Funding*, should be using rates of return that can be achieved over the next 20 to 30-year period. Therefore, we selected the 20-year time horizon for our analysis.

The SBI provided the three main retirement systems with a memo on July 22, 2014 summarizing its asset allocation and capital market assumptions. The memo develops a 30-year expected geometric rate of return of 8.25%. After adjusting for SBI's 3.00% inflationary assumption versus the plan's proposed 2.75% assumption, this expected geometric return should be reduced to 8.00%. This analysis has the benefit of being the expectation of the plan's asset manager and being projected over a longer time horizon than either the GRS Capital Market Assumptions Modeler or the Horizon survey referenced above.

In summary, the data sources that we considered and believe are applicable in determining a range of reasonable investment return assumptions are as follows:

- 6.97% geometric mean return for a 10- to 20-year horizon based on capital market expectations from the GRS Capital Market Assumptions Modeler
- 8.27% geometric mean return for a 20-year horizon based on capital market expectations from the Horizon Actuarial Services, LLC 2015 Survey of Capital Market Assumptions
- 8.00% geometric mean return for a 30+-year horizon based on SBI's capital market expectations

Based on the information above, we believe an investment return range recommendation of 7.0% to 8.0% is reasonable, and the plan selecting an 8.0% investment return from within that range is also reasonable.

We also recommend that the investment return assumption continue to be monitored as the SBI is performing an asset/liability study, which could impact target asset allocation. Additionally, it will be worthwhile to review capital market assumptions to see if the recent downward trends of investment advisors' forecasts for real returns continue.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

The data considered by the retained actuary is identical to that of MSRS, as is the actuary and their recommendation. Please see our comments regarding the MSRS investment return assumption, all of which apply here.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

The following table shows the current investment return assumptions and the retained actuary's proposed investment return assumption for relevant periods of time:

Investment Return	Current	Recommended
Through June 30, 2017	8.0%	8.0%
Beginning July 1, 2018	8.5%	8.0%

Data Considered:

The retained actuary considered the following data sources summarizing returns or expected returns of assets held by TRA and its actual asset allocation as determined by the SBI:

Data Source	Inflation	Real Rate of Return	Expenses	Net Rate of Return
SBI Allocation Study (projected)	3.0%	5.36%	0.11%	8.25%
SBI Returns (last 1 year)				18.60%
SBI Returns (last 3 years)				11.50%
SBI Returns (last 5 years)				14.50%
SBI Returns (last 10 year)				8.40%
SBI Returns (last 20 years)				9.00%
SBI Returns (last 30 years)				10.30%

The retained actuary also considered capital market expectations of the SBI and their target asset allocations to project returns into the future. The results, displayed as real rates of return so that an inflationary adjustment is not needed, are as follows:

Time Span (years)	Mean Real Return	25th Percentile Real Return	Median Real Return	75th Percentile Real Return
1	6.20%	-3.22%	5.36%	14.71%
5	5.53%	1.43%	5.36%	9.44%
10	5.45%	2.57%	5.36%	8.23%
20	5.40%	3.38%	5.36%	7.38%
30	5.39%	3.74%	5.36%	7.01%
50	5.38%	4.10%	5.36%	6.64%

Finally, the retained actuary considered data from the National Association of State Retirement Administrators (NASRA) Public Fund Survey as a comparison of the plan to its peer group, noting that the median investment return assumption decreased from 8.00% to 7.75% in 2012 according to that source. The actuary also notes that the plan has a more aggressive investment mix than the average mix of the Public Fund Survey, which could justify a higher investment return assumption.

Deloitte's Review:

The retained actuary considered adequate historical investment return data, and disclosed that their recommendation is based on an underlying inflation rate of 2.75% as discussed previously in this report.

The projected investment return data relies solely upon the SBI's capital market expectations. Considering only the SBI's expectations has the benefit of being the most applicable single source but lacks the context provided by considering information from other investment consultants, although we do agree with their point that capital market assumptions provided by investment advisors generally provide an outlook of 20 years or less, and therefore, lack the long-term forecast desired for this assumption for an ongoing pension plan. The actuary does provide additional context by providing investment return assumption benchmark data, and reasons why the Plan's actual returns may vary from those surveyed in the Public Fund Survey, namely a more aggressive asset mix.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Real Wage Growth

As noted earlier in this report, the Real Wage Growth, or Real Wage Inflation is added to the inflation assumption (2.75% recommendation by each retained actuary) to determine the assumed Payroll Growth. Real wage growth includes wage growth due to productivity, but excludes individual compensation increases above wage growth, also called "merit" increases. This payroll growth rate is used to amortize each plan's unfunded liability.

An adjustment could also be made for membership growth as noted by one retained actuary. However, each retained actuary assumes zero membership growth. Based on the Bureau of Labor and Statistics – Employment Projections[2] for state and local government, which projects annual growth of less than 0.5% for the period 2014-2024, we agree that an assumption of no membership growth is reasonable.

Applicable Standards:

The section of ASOP No. 27 addressing payroll growth provides the actuary with general guidance but is far from prescriptive:

ASOP No. 27, Section 3.11.3 *— Rate of Payroll Growth—As a result of terminations and new participants, total payroll generally grows at a different rate than does a participant's salary or the average of all current participants combined. As such, when a payroll growth assumption is needed, the actuary should use an assumption that is consistent with but typically not identical to the compensation increase assumption. One approach to setting the payroll growth assumption may be to reduce the compensation increase assumption by the effect of any assumed merit increases. The actuary should apply professional judgment in determining whether, given the purpose of the measurement, the payroll growth assumption should be based on a closed or open group and, if the latter, whether the size of that group should be expected to increase, decrease, or remain constant.*

The **LCPR's Standards for Actuarial Work, Section VI. B. (3)** states only that pay should be annualized in year of hire when making the determination of payroll growth.

[2] www.bls.gov/news.release/ecopro.t02.htm

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Assumption	Current	Recommended
Real Wage Growth	**0.75%**	**0.75%**
Inflation (see prior section)	3.00%	2.75%
Payroll Growth (for amortization)	3.75%	3.50%

Data Considered:

The retained actuary measured the difference between National Average Earnings ("NAE"), also known as National Average Wages ("NAW"), and Consumer Price Inflation over the past fifty years, and considered the following summary data:

Time Period	NAE	CPI	Wage Inflation (NAE – CPI)
Last 50 years	4.8%	4.1%	0.7%
Last 10 years	2.8%	2.4%	0.4%

The retained actuary also noted that during the prior fifty years, annual wage inflation over 10-year periods varied from a minimum of -0.9% to a maximum of 1.6%.

Consideration of projected wage inflation was also given to the assumptions used in the 2014 Social Security Trustees Report, summarized below:

Data Source	Low	Mid	High
2014 Social Security Trustees Report	0.5%	1.1%	1.8%

Deloitte's Review:

The data considered by the retained actuary is reasonable and sufficient. Because all plan participants are employed in the same industry and geographical region (the public sector in Minnesota), consideration could be given to data more specific than national averages. However, we do not believe considering data of this type is necessary and may not be more accurate or appropriate.

The real wage growth assumption was decreased 0.75% following the 2009 Studies. This relatively large shift during a short period of time makes us hesitant to suggest additional adjustments absent overwhelming information.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

The data considered by the retained actuary is identical to that of MSRS, as is the actuary and their recommendation. Please see our comments regarding the MSRS real wage growth assumption, all of which apply here.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Assumption	Current	Recommended
Real Wage Growth	**0.75%**	**0.75%**
Inflation (see prior section)	3.00%	2.75%
Payroll Growth (for amortization)	3.75%	3.50%

Data Considered:

The retained actuary measured the difference between NAW and Consumer Price Inflation over the past sixty years. The data was reviewed in a number of ways, but a summary is provided below:

Time Period	NAW	CPI	Wage Inflation (NAE – CPI)
Last 10 years	2.8%	2.4%	0.4%
Last 20 years	3.4%	2.4%	1.0%
Last 30 years	3.7%	2.9%	0.8%
Last 40 years	4.5%	4.2%	0.3%
Last 50 years	4.8%	4.1%	0.7%
Last 60 years	4.5%	3.7%	0.8%

The retained actuary also analyzed average TRA starting teacher salaries for the past 30 years and compared the effective increase in starting salaries to inflation. On this basis, real wage inflation was 0.25%, significantly lower than the national average of 0.80%. They note that this trend has been noted nationally, and reflects a shift in total compensation among teachers from salary to benefits compensation.

Consideration of projected wage inflation was also given to the assumptions used in the 2014 Social Security Trustees Report, summarized below:

Data Source	Low	Mid	High
2014 Social Security Trustees Report	0.5%	1.1%	1.8%

Deloitte's Review:

The data considered by the retained actuary is reasonable and sufficient. Based on their analysis of historical wage inflation in the Minnesota teaching industry, an argument could be made that a lower wage inflation rate should be used. However, the actuary believes the recent trend of lower compensation inflation due to higher benefit inflation is unlikely to continue over the next 30 to 50 years. We are inclined to agree with this viewpoint, as a continuation of this trend would result in a total compensation mix that is disproportionately weighted toward benefits.

The real wage growth assumption was decreased a total of 0.75% following the 2009 Studies. This relatively large shift during a short period of time makes us hesitant to suggest additional adjustments absent overwhelming information.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Merit Scale

In practice, actuaries typically do not apply merit increases directly to participant salaries. Instead, the actuary applies a total wage scale, or what the LCPR's actuarial standards refer to as '"individual compensation increases." This total wage scale is comprised of inflation, real wage growth and a merit scale. Therefore, in order to test the merit scale historically, the actuary must account for differences between assumed and actual inflation and real wage growth during the period analyzed.

Given that there are several components upon which this assumption is built, it has been common for the merit scale assumption to be regularly adjusted, including in the 2009 Studies. Even after attempting to adjust for differences between expected and actual inflation and real wage growth, volatility remains, particularly at low service levels. Therefore, it is reasonable for each retained actuary to recommend adjustments in their individual compensation increase tables.

Applicable Standards

In selecting or recommending a total wage scale, ASOP No. 27, Section 3.10 provides actuaries with guidance. The standard recommends the actuary review the compensation data as follows.

ASOP No. 27, Section 3.10.1*— Data—The actuary should review available compensation data. These data may include the following:*

a. the plan sponsor's current compensation practice and any anticipated changes in this practice;
b. current compensation distributions by age or service;
c. historical compensation increases and practices of the plan sponsor and other plan sponsors in the same industry or geographic area; and
d. historical national wage increases and productivity growth.

The actuary should consider available plan-sponsor-specific compensation data, but the actuary should carefully weigh the credibility of these data when selecting the compensation increase assumption.

The **LCPR's Standards for Actuarial Work, Section VI. B. (2)** is more prescriptive regarding this assumption, similar to other demographic assumptions. It states:

> *Individual compensation increases for the year must be measured by the percentage change in compensation for members active on both valuation dates. These percentage changes must be aggregated. They may be averaged by five year age and service groups similar to those displayed in the actuarial valuation reports. Increases or decreases in excess of a specified percentage may be discarded from the study in order to prevent unusual changes in compensation from influencing the results of the study.*

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Years of Service	Total Salary Increase - Current	Total Salary Increase - Proposed
1	10.50%	14.00%
2	8.10%	11.50%
3	6.90%	6.25%
4	6.20%	5.50%
5	5.70%	5.25%
6	5.30%	5.15%

7	5.00%	5.00%
8	4.70%	4.75%
9	4.50%	4.50%
10	4.40%	4.25%
11	4.20%	4.20%
12	4.10%	4.15%
13	4.00%	4.10%
14	3.80%	4.05%
15	3.70%	4.00%
16	3.60%	3.95%
17	3.70%	3.90%
18	3.50%	3.85%
19	3.50%	3.80%
20	3.50%	3.75%
21	3.50%	3.70%
22	3.50%	3.65%
23	3.50%	3.60%
24	3.50%	3.55%
25	3.50%	3.50%
26	3.50%	3.50%
27	3.50%	3.50%
28	3.50%	3.50%
29	3.50%	3.50%
30	3.50%	3.50%
31+	3.50%	3.50%

Data Considered:

The retained actuary followed the process of determining individual compensation increases outlined by the standards above for the prior six years of experience and also backed out adjusted price and wage inflation during the study period. The results are summarized below:

Time Period	Net Expected (E)	Net Actual (A)	Net (E) – (A)
2008-2009	0.96%	3.55%	(2.59%)
2009-2010	1.01%	(0.32%)	1.33%
2010-2011	0.93%	0.63%	0.30%
2011-2012	0.88%	0.36%	0.52%
2012-2013	0.91%	1.75%	(0.84%)
2013-2014	0.97%	2.66%	(1.69%)
All Years	0.94%	1.43%	(0.49%)

Deloitte's Review:

During the review period expected net merit scale increases were 0.49% lower than experienced. The retained actuary has recommended rates that would reduce this difference to 0.05%, setting future net merit increases approximately equal to that observed during the review period. The adjustment is not uniform, but instead targets differences at various years of service.

The adjustments made at each service level appear reasonable based on experience during the prior six years. Our only comment is that the review period may not necessarily be a good indicator of future experience given the economic environment. However, the retained actuary did adjust for inflation and real wage inflation to account for this factor.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Years of Service	Total Salary Increase – Current	Total Salary Increase - Proposed
1	12.03%	11.50%
2	8.90%	8.50%
3	7.46%	7.00%
4	6.58%	6.00%
5	5.97%	5.50%
6	5.52%	5.20%
7	5.16%	4.90%
8	4.87%	4.80%
9	4.63%	4.70%
10	4.42%	4.50%
11	4.24%	4.25%
12	4.08%	4.10%
13	3.94%	4.00%
14	3.82%	3.90%
15	3.70%	3.90%
16	3.60%	3.85%
17	3.51%	3.80%
18	3.50%	3.75%
19	3.50%	3.75%
20	3.50%	3.75%
21	3.50%	3.75%
22	3.50%	3.70%
23	3.50%	3.60%
24	3.50%	3.60%
25	3.50%	3.60%
26	3.50%	3.50%
27	3.50%	3.50%
28	3.50%	3.50%
29	3.50%	3.50%
30	3.50%	3.50%
31+	3.50%	3.50%

Data Considered:

The retained actuary followed the process of determining individual compensation increases outlined by the standards above for the prior six years of experience, and adjusted for price and wage inflation during the study period. The results are summarized below:

Time Period	Net Expected (E)	Net Actual (A)	Net (E) – (A)
2008-2009	1.24%	3.22%	(1.98%)
2009-2010	1.19%	1.26%	(0.07%)
2010-2011	1.09%	0.89%	0.20%
2011-2012	1.03%	0.73%	0.30%
2012-2013	1.03%	0.57%	0.46%
2013-2014	1.12%	1.23%	(0.11%)
All Years	1.12%	1.33%	(0.21%)

Deloitte's Review:

During the review period expected net merit scale increases were 0.21% lower than experienced. The retained actuary has recommended rates that would reduce this difference to 0.04%, setting future net merit increases approximately equal to that observed during the review period. The adjustment is not uniform, but instead targets differences at various years of service.

The adjustments made at each service level appear reasonable based on experience during the prior six years. Our only comment is that the review period may not necessarily be a good indicator of future experience given the economic environment. However, the retained actuary did adjust for inflation and real wage inflation to account for this factor.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

The retained actuary recommends "minor changes to the merit salary scale at certain durations to better fit the observed experience, as well as a 0.25% increase in the merit scale at all service durations." The actuary is a bit more specific in recommending a reduction in merit scale under five years of service and an increase at certain points between 20 and 25 years of service.

Data Considered:

The retained actuary followed the process of determining individual compensation increases outlined by the standards above for the prior six years of experience. No adjustment was made for price inflation and general wage inflation, but the actuary notes that due to differences in these components during the study period, they would expect actual increases to be 1.5% to 2.0% lower than expected. The results are summarized below:

Time Period	Expected (E)	Actual (A)	(E) – (A)
2008-2009	5.52%	6.19%	(0.67%)
2009-2010	5.56%	1.18%	4.38%
2010-2011	5.52%	3.24%	2.18%
2011-2012	5.49%	2.38%	3.11%

2012-2013	5.49%	2.06%	3.43%
2013-2014	5.52%	3.87%	1.65%
All Years	5.52%	3.13%	2.39%

Deloitte's Review:

The 0.25% increase in merit scale at all ages is recommended to prevent the ultimate merit increase (previously 3.50%) from being less than the overall wage growth assumption (previously 3.75%). We agree that a negative ultimate merit scale is inappropriate, but also note that if the change in inflation adjustment is approved the ultimate merit scale would be 0%. In either scenario we agree with the actuary that a 0.25% increase is appropriate.

The actuary notes that because the study period includes the Great Recession in the United States, it is difficult to view the observed salary experience as credible. We would agree with this assessment generally, and may also agree that the recommended adjustments below five years of service and between 20 and 25 years of service are appropriate. However, because the retained actuary did not show detailed comparisons of actual versus expected salary increases by service band, we are unable to validate those recommendations.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Demographic Assumptions

Minnesota Statute Section 356.215 and the LCPR's Standards for Actuarial Work, Section VI. C. (1) stipulate that demographic assumptions must be set at levels consistent with those determined in the most recent quadrennial experience study completed, including:

- Retirement
- Withdrawal
- Disability
- Mortality
- Other relevant demographic and economic assumptions

The purpose of this section of our report is to review the demographic assumption recommendations made by the retained actuaries, including their methods of testing and recommended assumption changes. The methods were reviewed based on compliance with the LCPR's Standards for Actuarial work and the Actuarial Standards of Practice discussed below.

The **LCPR's Standards for Actuarial Work, Section VI. C.** describes how the experience must be analyzed including how years of age and service should be rounded and how ratios of actual to expected events must be calculated. Additionally, this standard states that new assumption recommendations should be determined based on the ratios of actual to expected decrements and the Actuary's professional judgment regarding future experience, stating that *if any recommended new assumptions do not follow directly from past experience, the additional reasons for the recommended new assumptions must be clearly explained in the report of the experience study.*

Actuarial Standard of Practice No. 35, Selection of Demographic and other Noneconomic Assumptions for Measuring Pension Obligations, provides guidance to actuaries in selecting demographic and other assumptions not covered by ASOP No. 27. ASOP No. 35 has been restated effective for any actuarial work product with a measurement date on or after June 30, 2015. Because the assumptions resulting from this experience study will be used in actuarial valuations with measurement dates no sooner than July 1, 2015, we consider this standard applicable.

As set forth by ASOP 35, the actuary should follow the process below for selecting demographic assumptions, as applicable:

a. Identify the types of assumptions
b. Consider the relevant assumption universe
c. Consider assumption formats
d. Select the specific assumptions
e. Select a reasonable assumption

The standard defines a *reasonable assumption* as follows:

3.3.5 — Selecting a Reasonable Assumption—Each demographic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

a. It is appropriate for the purpose of the measurement;
b. It reflects the actuary's professional judgment;
c. It takes into account historical and current demographic data that is relevant as of the measurement date;
d. It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data (if any), or a combination thereof; and

e. *It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included (as discussed in section 3.10.1), and disclosed under section 4.1.1 or when alternative assumptions are used for the assessment of risk.*

3.4 — Range of Reasonable Assumptions—The actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions equally reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

The standard also discusses consistency among selection of demographic assumptions and requires the actuary to review the combined effect of all non-prescribed assumptions selected by the actuary (both demographic assumptions selected in accordance with this standard and economic assumptions selected in accordance with ASOP No. 27).

3.7 — Consistency among Demographic Assumptions Selected by the Actuary for a Particular Measurement—With respect to any particular measurement, each demographic assumption selected by the actuary should be consistent with the other assumptions selected by the actuary unless the assumption, considered individually, is not material (see section 3.10.2). For example, if an employer's business is in decline and the effect of that decline is reflected in the turnover assumption, it should also be reflected in the retirement assumption.

Finally, both ASOP 35 and the LCPR's Standards for Actuarial Work provide assumption specific guidance for each of the assumptions above, which will be referenced later in this section. The remainder of this section of our report presents our review of recommended demographic assumptions to ensure the retained actuaries have followed the ASOP's general guidance and the assumption-specific guidance provided by the ASOP and the LCPR's Standards for Actuarial Work.

We have reviewed the assumptions for reasonableness within the context of the standards and statutes above.

Retirement

Actuarial Standards:

Actuarial Standard of Practice No. 35 Section 3.5.1 *— Retirement—The actuary should take into account factors such as the following:*

a. *employer-specific or job-related factors such as occupation, employment policies, work environment, unionization, hazardous conditions, and location of employment;*
b. *the plan design, where specific incentives may influence when participants retire;*
c. *the design of, and date of anticipated payment from, social insurance programs (for example, Social Security or Medicare); and*
d. *the availability of other employer-sponsored postretirement benefit programs (for example, postretirement health coverage or savings plan).*

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Currently the plan is using four sets of unisex age-based retirement rates. Determination of which set of rates apply to each participant is based on date of hire, years of service, and age. The retained actuary

is recommending minor adjustments to the age-based rates for each group to better align with experience of the plan. For the most part these adjustments reduce the rates slightly.

For Tier 1 and Tier 2 Reduced Early Retirements, which currently use the same age-based rates, the retained actuary is proposing distinct rates for each Tier due to the variance in early retirement patterns between the two groups.

The retained actuary is also recommending the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year, the same as members younger than age 71.

In addition to the assumptions for retirement from active status, the assumptions related to retirement from deferred status (specifically assumptions regarding whether a deferred vested participant will elect a refund or a deferred annuity and the age at which those who elect a deferred annuity are expected to retire) were reviewed and the retained actuary is not recommending any changes.

Data Considered:

The retained actuary followed the process of determining retirement experience by the standards above for the prior six years for the applicable age groups in each type of retirement. The results are summarized below:

Type of Retirement	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Unreduced (Normal) Retirement	1,695	6,466	87%	91%
Rule of 90 (Unreduced) Early Retirement	2,841	17,395	71%	87%
Tier 1 Reduced Early Retirement	1,641	25,176	86%	95%
Tier 2 Reduced Early Retirement	2,141	35,425	62%	83%

In the Unreduced (Normal) Retirement group, ages 65 through 70 were considered, but ages 71 and greater were not included. The retained actuary had the following explanation for this age group:

The current assumption ends at age 71; in other words, we assume all members currently under the age of 71 will retire by the age of 71. However, for members currently age 71 or older, we assume retirement one year after the valuation date (effectively 18 months due to mid-year decrementing), as required by the Minnesota Standards for Actuarial Work. As such, there are no exposures for ages over 71 since the valuation assumption is all of these members work until the next valuation date and then retire. During the six year period, there were 199 actual retirements at ages 71 or older, including 52 actual retirements at age 71. We believe assuming 100% retirement at age 71 is an appropriately conservative approach.

For the assumptions related to retirement from deferred status, the retained actuary did not provide any specific data, but commented that experience other than expected could only result in a very small gain and thus they recommend no changes to these assumptions.

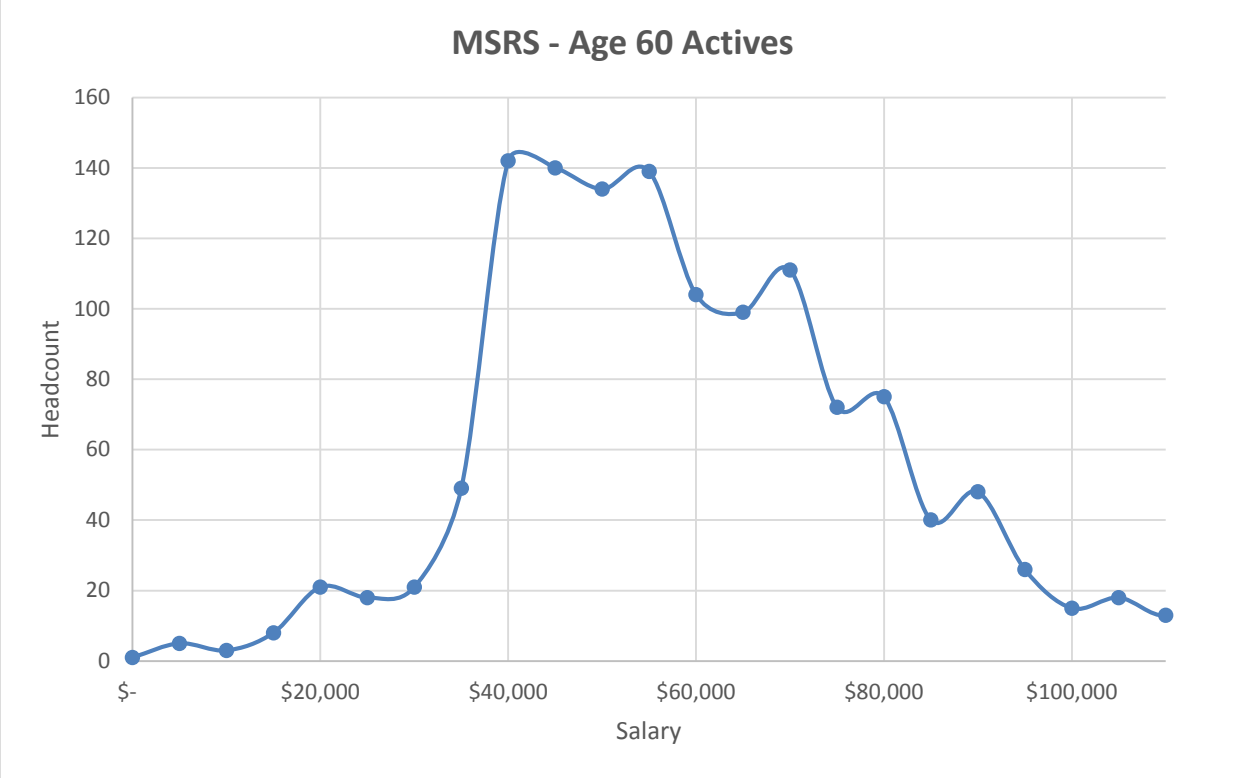
Deloitte's Review:

The proposed retirement rates for each age under each type of retirement appear to be reasonably consistent with the experience reviewed. We do note though that the rates were determined on a population-weighted basis and do not include an analysis of the liability-weighted experience. The retained actuary may have considered liability weighting in their analysis and determined that population

weighting was appropriate, but this is not completely clear. The following excerpt from the withdrawal section of the study mentions death and disability as having been considered for liability weighting, but does not explicitly mention the retirement assumption:

The liability weighted rates were found to be more highly correlated with withdrawal than with other decrements. This makes some intuitive sense, since termination decisions are often made based on how much the member has to gain or lose if they change jobs, whereas death and disability is typically not a decision at all, but rather an event that happens to someone.

Liability-weighted assumptions should be considered when decrement rates are correlated to benefit levels and the participant group is non-homogenous in its benefit level distribution. In order to determine if the participant group is homogenous, we considered the distribution of the compensation of all active employees at a single age. The following graph shows the compensation distribution at age 60 (rounded to the nearest $5,000). Note that we excluded participants with less than three years of service from this analysis because they would not be retirement eligible.



The general shape of this distribution is close to the standard bell shape that would be expected in a homogenous population, however there are several relative maximums in number of employees at various salaries. This may imply a sufficiently heterogeneous population for which liability weighting the assumption could be a better fit. Since we did not perform a detailed analysis, we cannot conclude that liability weighting would have a measurable impact on the assumption, but we do recommend it be considered in future experience studies.

Finally, we believe the retained actuary's recommendation that current participants over age 70 be assumed to decrement in 6 months from the valuation date instead of 18 months from the valuation date is reasonable. While the actuary has not provided analysis to demonstrate that the revised assumption will increase the accuracy of projecting retirement rates, the proposed method is common and is believed to have a minimal impact on liabilities.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Currently the plan is using four sets of unisex age-based retirement rates. Determination of which set of rates apply to each participant is based on date of hire, years of service, and age. The retained actuary is recommending minor adjustments to the age-based rates for each group to better align with experience of the plan. For the most part these adjustments reduce the rates slightly.

For Tier 1 and Tier 2 Reduced Early Retirements, which currently use the same age-based rates, the retained actuary is proposing distinct rates for each Tier due to the variance in early retirement patterns between the two groups.

Additionally, the retained actuary is recommending the Minnesota Standards for Actuarial Work be modified to remove the requirement that members currently over age 70 delay retirement one year and instead assume these members retire mid-year, the same as members younger than age 71.

In addition to the assumptions for retirement from active status, the assumptions related to retirement from deferred status (specifically assumptions regarding whether a deferred vested participant will elect a refund or a deferred annuity and the age at which those who elect a deferred annuity are expected to retire) were reviewed and the retained actuary is not recommending any changes.

Data Considered:

The retained actuary followed the process of determining retirement experience by the standards above for the prior six years for the applicable age groups in each type of retirement. The results are summarized below:

Type of Retirement	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Unreduced (Normal) Retirement	4,389	21,584	84%	91%
Rule of 90 (Unreduced) Early Retirement	4,672	27,506	72%	84%
Tier 1 Reduced Early Retirement	5,395	68,372	87%	91%
Tier 2 Reduced Early Retirement	8,131	119,705	66%	83%

In the Unreduced (Normal) Retirement group, ages 65 through 70 were considered, but age 71 and greater were not included. The retained actuary had the following explanation for this age group:

The current assumption ends at age 71; in other words, we assume all members currently under the age of 71 will retire by the age of 71. However, for members currently age 71 or older, we assume retirement one year after the valuation date (effectively 18 months due to mid-year decrementing), as required by the Minnesota Standards for Actuarial Work. As such, there are no Exposures for ages over 71 since the valuation assumption is all of these members work for an additional year and then retire. During the six-year period, there were 1,200 actual retirements at ages 71 and older including 231 actual retirements at age 71. We believe assuming 100% retirement at age 71 is an appropriately conservative approach.

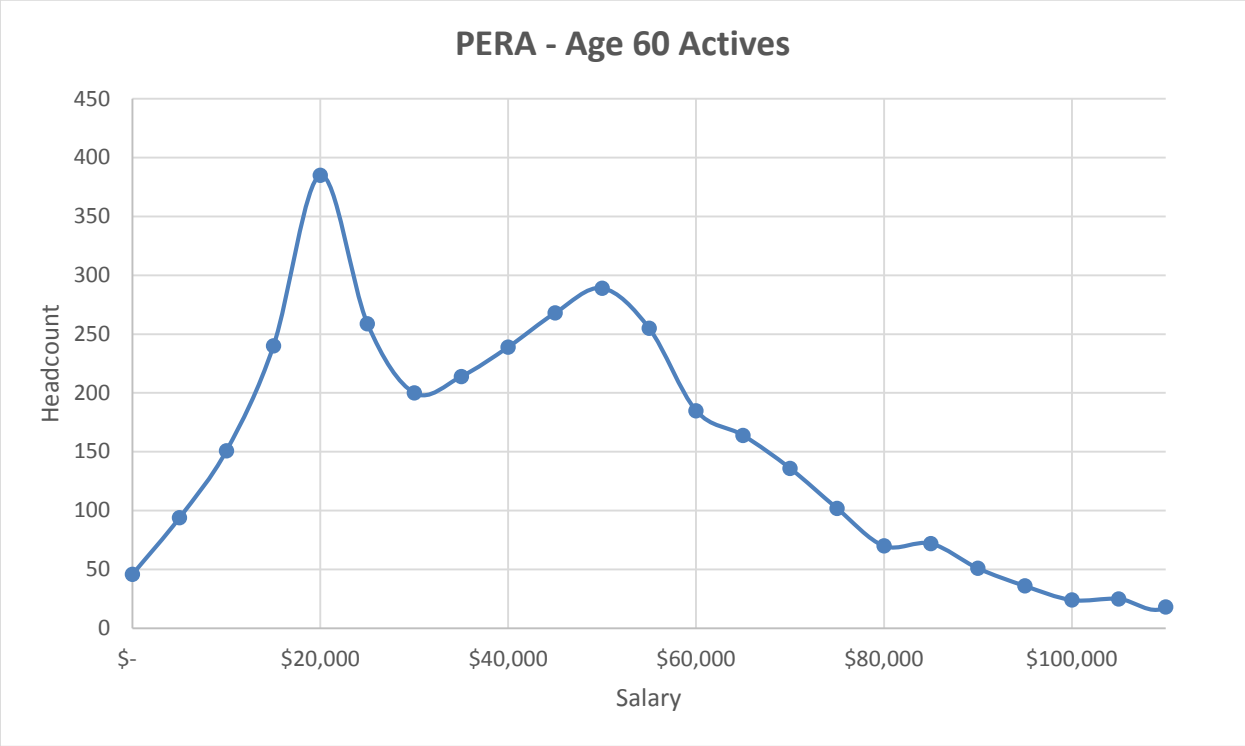
For the assumptions related to retirement from deferred status, the retained actuary did not provide any specific data, but commented that experience other than expected could only result in a very small gain and thus they recommend no changes to these assumptions.

Deloitte's Review:

The proposed retirement rates for each age under each type of retirement appear to be reasonably consistent with the experience reviewed. We do note though that the rates were determined on a population-weighted basis and do not include an analysis of the liability-weighted experience. The retained actuary may have considered liability weighting in their analysis and determined that population weighting was appropriate, but this is not completely clear. The following excerpt from the withdrawal section of the study mentions death and disability as having been considered for liability weighting, but does not explicitly mention the retirement assumption:

The liability weighted rates were found to be more highly correlated with withdrawal than with other decrements. This makes some intuitive sense, since termination decisions are often made based on how much the member has to gain or lose if they change jobs, whereas death and disability is typically not a decision at all, but rather an event that happens to someone.

Liability-weighted assumptions should be considered when decrement rates are correlated to benefit levels and the participant group is non-homogenous in its benefit level distribution. In order to determine if the participant group is homogenous, we considered the distribution of the compensation of all active employees at a single age. The following graph shows the compensation distribution at age 60 (rounded to the nearest $5,000). Note that we excluded participants with less than three years of service from this analysis because they would not be retirement eligible.



This graph shows two clear relative maximums in number of employees at salary levels of approximately $20,000 and $50,000 instead of a standard bell shape (one relative maximum) as would be expected in a homogenous population. This may imply a sufficiently heterogeneous population for which liability weighting the assumption could be a better fit. Since we did not perform a detailed analysis, we cannot

conclude that liability weighting would have a measurable impact on the assumption, but we do recommend it be considered in future experience studies.

Finally, we believe the retained actuary's recommendation that current participants over age 70 be assumed to decrement in 6 months from the valuation date instead of 18 months from the valuation date is reasonable. While the actuary has not provided analysis to demonstrate that the revised assumption will increase the accuracy of projecting retirement rates, the proposed method is common and is believed to have a minimal impact on liabilities.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Currently the plan is using four sets of unisex age-based retirement rates. Determination of which set of rates apply to each participant is based on date of hire, years of service, and age. The retained actuary is recommending minor adjustments to the age-based rates for each group to better align with experience of the plan.

For Tier 1 and Tier 2 Reduced Early Retirements, which currently use the same age-based rates, the retained actuary is proposing distinct rates for each Tier due to the variance in early retirement patterns between the two groups.

In addition to the assumptions for retirement from active status, the assumptions related to retirement from deferred status (specifically assumptions regarding whether a deferred vested participant will elect a refund or a deferred annuity and the age at which those who elect a deferred annuity are expected to retire) were reviewed, and the retained actuary is not recommending any changes.

Data Considered:

The retained actuary followed the process of determining retirement experience by the standards above for the prior six years for the applicable age groups in each type of retirement. The results are summarized below:

Type of Retirement	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Tier 1 Unreduced Retirement (Normal or Rule of 90 Early Retirement)	4,543	15,380	68%	84%
Tier 2 Unreduced Retirement (Normal Retirement)	414	1,723	67%	69%
Tier 1 Reduced Early Retirement	3,665	28,126	141%	112%
Tier 2 Reduced Early Retirement	2,609	39,896	57%	78%

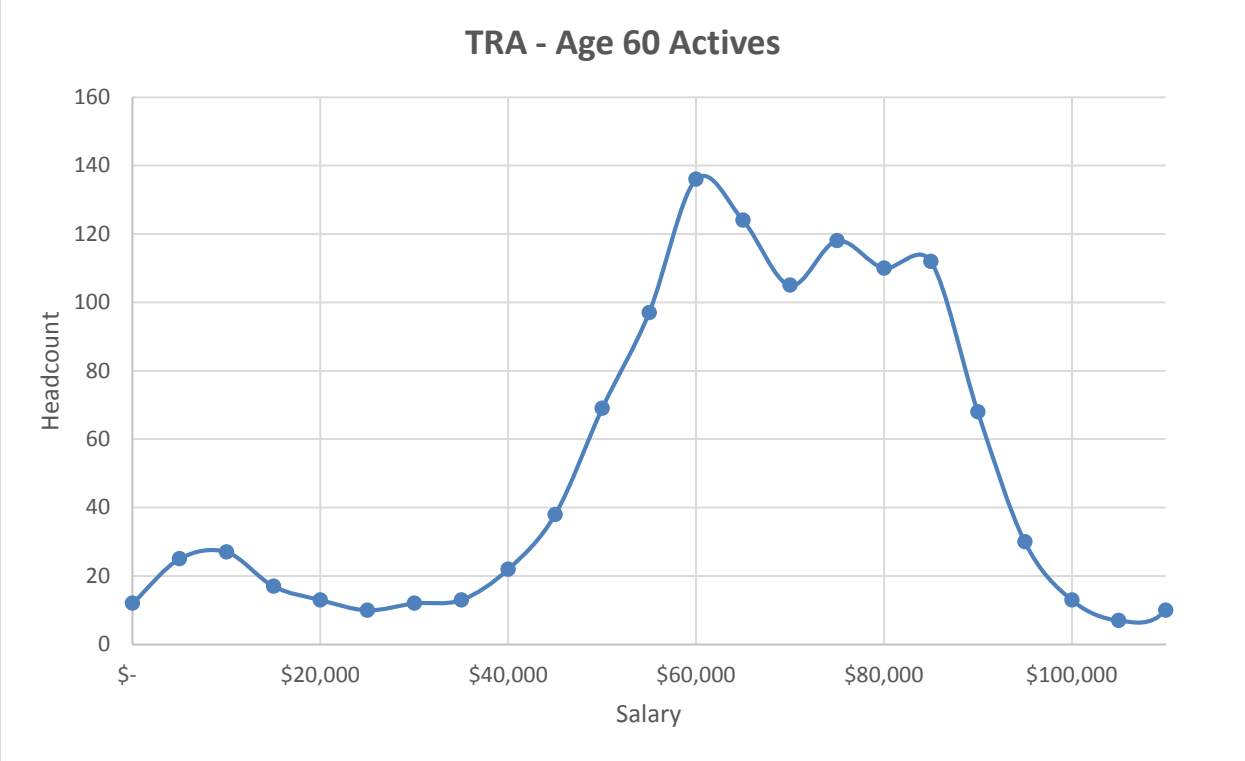
For Tier 2 participants, the retained actuary mentioned the limited number of exposures in the group (which implies the likelihood for higher volatility in the experience) for unreduced retirement and commented that "the assumption will need to be fine-tuned as additional years of experience unfold and are evaluated".

For the assumptions related to retirement from deferred status, the retained actuary did not provide any specific data, but commented that experience other than expected could only result in a minor cost impact and thus they recommend no changes to these assumptions.

Deloitte's Review:

The proposed retirement rates for each age under each type of retirement appear to be reasonably consistent with the experience reviewed. For the Tier 2 unreduced retirement assumption, the actual/expected ratio is 31% under 100%. Although this is a large variance, the proposed rates are between the current assumption and the actual experience. Because exposure is limited for this group, it is reasonable that the retained actuary did not apply full credibility to the experience over just the review period. We also note that the rate of 100% retirement at age 71 (as required by the Minnesota Standards for Actuarial Work) is much higher than actual experience. Removing age 71 from the analysis would bring the actual/expected ratio for the proposed assumption up 8% to 77%.

Consistent with the other plans, the proposed retirement rates were determined on a population-weighted basis and do not include an analysis of the liability-weighted experience. Upon discussion with the retained actuary, it was indicated that since this was a homogenous group of employees, liability-weighting the assumption would have a negligible effect on the liability. To corroborate the homogeneity of the group, we considered the compensation of active employees at a single age. The following graph shows the compensation distribution at age 60 (rounded to the nearest $5,000). Note that we excluded participants with less than three years of service from this analysis because they are not eligible for retirement.



This graph appears to be relatively similar to a standard bell shape (one relative maximum) as would be expected in a homogenous population, outside of a somewhat large number of participants with pay under $20,000 (and thus smaller benefits than higher earners at the same age). This data seems to generally support the retained actuary's assertion that the population is homogenous, in which case liability weighting the assumption is probably unnecessary.

Since we did not perform a detailed analysis, we cannot say that liability weighting would have a measurable impact on the assumption, but we do recommend it be considered in future experience studies.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Withdrawal

Actuarial Standards:

Actuarial Standard of Practice No. 35 Section 3.5.2 *— Termination of Employment—The actuary should take into account factors such as the following:*

a. employer-specific or job-related factors such as occupation, employment policies, work environment, unionization, hazardous conditions, and location of employment; and
b. plan provisions, such as early retirement benefits, vesting schedule, or payout options.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Currently the plan is using a sex distinct withdrawal assumption that is service-based for the first three years of employment and age-based after three years of service. The retained actuary is recommending adoption of a sex distinct, service-based withdrawal assumption due to the strong correlation between withdrawal and years of service.

Data Considered:

The retained actuary followed the process of determining withdrawal experience by the standards above for the prior six years at each year of service from 1 to 29 and aggregated those with 30 or more years of service. In the exhibits, expected withdrawals were re-categorized on a service basis to show the strong correlation to service. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Males	6,601	89,136	104%	109%
Females	10,871	116,454	108%	109%

For this assumption, the retained actuary included experience on a population-weighted basis as well as on a liability-weighted basis after determining that the liability-weighted rates were highly correlated with withdrawal. In determining their proposed assumption, it appears that the retained actuary attempted to select rates which were between the population-weighted and liability-weighted rates of experience with the liability-weighted experience generally being slightly lower than the population-weighted experience.

Deloitte's Review:

During the review period, the total actual number of withdrawals was very close to the expected number of withdrawals for each gender as indicated above. However, a review the variances at each year of service shows that actual/expected ratios under the current assumption varies significantly, being very high at lower years of service and very low at higher years of service.

Under the proposed assumption, the actual/expected ratios are a bit higher in aggregate for each gender, but the standard deviation for individual years of service is much lower. Additionally, as the rates were selected considering both the population-weighted and liability-weighted experience, the rates are slightly lower than they would be on a liability-weighted basis only. Thus, since the actual number of withdrawals considered in calculating the actual/expected ratios are based solely on headcount, the ratios appear a bit higher under the proposed assumption. This variance is still within a reasonable range.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Currently the plan is using a sex distinct withdrawal assumption that is service-based for the first three years of employment and age-based after three years of service. The retained actuary is recommending adoption of a sex distinct, service-based withdrawal assumption due to the strong correlation between withdrawal and years of service.

Data Considered:

The retained actuary followed the process of determining withdrawal experience by the standards above for the prior six years at each year of service from 1 to 29 and aggregated those with 30 or more years of service. In the exhibits, expected withdrawals were re-categorized on a service basis to show the strong correlation to service. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Males	17,726	184,736	128%	111%
Females	45,448	414,645	145%	113%

For this assumption, the retained actuary included experience on a population-weighted basis as well as on a liability-weighted basis after determining that the liability-weighted rates were highly correlated with withdrawal. In determining their proposed assumption, it appears that the retained actuary attempted to select rates which were between the population-weighted and liability-weighted rates of experience with the liability-weighted experience generally being slightly lower than the population-weighted experience.

Deloitte's Review:

Considering the trend of the actual experience, which shows a high number of withdrawals at lower years of service, tapering off as years of service increases, we agree that updating to a service-based table is a reasonable basis for this assumption.

As the rates were selected considering both the population-weighted and liability-weighted experience, the rates are slightly lower than they would be on a liability-weighted basis only. Thus, since the actual number of withdrawals considered in calculating the actual/expected ratios are based solely on headcount, the ratios appear a bit higher under the proposed assumption. This variance is still within a reasonable range.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Currently the plan is using a sex distinct withdrawal assumption that is service-based for the first three years of employment and age-based after three years of service. The retained actuary is recommending adoption of a sex distinct, service-based withdrawal assumption due to the strong correlation between withdrawal and years of service.

Data Considered:

The retained actuary followed the process of determining withdrawal experience by the standards above for the prior six years individually by gender. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actuals/Expecteds	
			Current Assumption	Proposed Assumption
Males	6,372	98,476	93%	100%
Females	18,726	271,468	92%	100%

In determining what rates would be a good fit for this assumption, the retained actuary excluded the experience from fiscal year 2010 since this year had "materially different" experience from the other years in review. The retained actuary indicated verbally that, although fiscal 2010 was excluded in determining the best fit assumption, the experience was included in the calculation of the actual/expected ratios.

Deloitte's Review:

Considering the trend of the actual experience, which shows a high number of withdrawals at lower years of service, tapering off as years of service increases, we agree that updating to a service-based table is a reasonable basis for this assumption.

Unlike the proposed withdrawal assumptions for the MSRS and PERA plans, the proposed assumption for the TRA plan was not determined using liability-weighting. Upon discussion with the retained actuary, it was indicated that since this was a homogenous group of employees, liability-weighting the assumption would have a negligible effect on the liability. We did not perform a detailed analysis to confirm the homogeneity of this group, but would recommend that liability weighting be considered in future experience studies.

We also note that the actual withdrawal incidences listed in the "current assumption" table differ slightly from the actual withdrawal incidences listed in the "proposed assumption" table. Since this is the actual experience value, it would seem that these numbers should be equal. After discussions with the retained actuary, it is our understanding that this is due to certain participants not fitting into the listed age brackets.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Disability

Actuarial Standards:

Actuarial Standard of Practice No. 35 Section 3.5.4 *— Disability and Disability Recovery—The actuary should take into account factors such as the following:*

a. *the plan's definition of disability (for example, whether the disabled person is eligible for Social Security benefits); and*
b. *the potential for recovery. For example, if the plan requires continued disability monitoring and if the plan's definition of disability is very liberal, an assumption for rates of recovery may be appropriate. Alternatively, the probability of recovery may be reflected by assuming a lower incidence of disability than the actuary might otherwise assume.*

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Currently the plan is using a sex-distinct, age-based disability assumption. The retained actuary is recommending adoption of a unisex, age-based disability assumption with lower rates of disability incidence at all ages in comparison to the current assumption.

Data Considered:

The retained actuary followed the process of determining disability experience by the standards above for the prior six years in five-year age bands from age 20 to age 64. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Males	234	126,226	56%	85%
Females	252	155,948	62%	81%

Deloitte's Review:

During the review period expected disability incidence was much lower than expected for both males and females under the current assumptions. The retained actuary has recommended unisex rates which would reduce this difference by about one-half for each gender. Although the actual/expected ratios under the proposed assumption are still showing a 15%-19% variance from 100%, the trend of the assumption is consistent with experience. Considering the low number of incidences each year, it is reasonable for the assumption to be selected without applying full credibility to the experience of the review period.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Currently the plan is using a sex-distinct, age-based disability assumption. The retained actuary is recommending lower rates of disability incidence at all ages in comparison to the current assumption.

Data Considered:

The retained actuary followed the process of determining disability experience by the standards above for the prior six years in five-year age bands from age 20 to age 64. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Males	414	252,046	51%	78%
Females	490	554,516	48%	80%

Deloitte's Review:

During the review period expected disability incidence was approximately half of what was expected for both males and females under the current assumptions. The retained actuary has recommended lower rates of disability which would reduce this difference by approximately 30%. Although the actual/expected ratios under the proposed assumption are still showing a 20%-22% variance from 100%, the trend of the assumption is consistent with experience. Considering the low number of incidences each year, it is reasonable for the assumption to be selected without applying full credibility to the experience of the review period.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Currently the plan is using a unisex, age-based disability assumption. The retained actuary is recommending to continue using the current assumption.

Data Considered:

The retained actuary followed the process of determining disability experience by the standards above for the prior six years individually. Since this is a unisex assumption, the full results of the study are shown in aggregate for both genders. The actuary also provide the actual/expected ratio for each gender individually in order to confirm that the unisex table is still reasonable. The results are summarized below:

Gender	Actual	Exposure	Ratio of Actual/Expected – Current Assumption
Males and Females	303	453,642	88%
Males	Not provided	Not provided	91%
Females	Not provided	Not provided	87%

Deloitte's Review:

This assumption was updated from a sex-distinct table to a unisex table in the last experience study which appears to still be a reasonable choice. Based on the information provided, the actual incidence of disability has been slightly higher than expected in some years and slightly lower in other years. Considering the low number of incidences each year, it is reasonable for the assumption to be selected without applying full credibility to the experience of the review period.

Overall, we find the retained actuary's method and assumption recommendation to be reasonable and justified.

Mortality

Actuarial Standards:

Actuarial Standard of Practice No. 35 Section 3.5.3 *— Mortality and Mortality Improvement—The actuary should take into account factors such as the following in the selection of mortality and mortality improvement assumptions:*

a) the possible use of different assumptions before and after retirement (for example, in some small plan cases a reasonable model for mortality may be to assume no mortality before retirement);
b) the use of a different assumption for disabled lives, which in turn may depend on the plan's definition of disability and how it is administered; and
c) the use of different assumptions for different participant subgroups and beneficiaries.

The actuary should reflect the effect of mortality improvement both before and after the measurement date. With regard to mortality improvement, the actuary should do the following:

i. adjust mortality rates to reflect mortality improvement before the measurement date. For example, if the actuary starts with a published mortality table, the mortality rates may need to be adjusted to reflect mortality improvement from the effective date of the table to the measurement date. Such an adjustment is not necessary if, in the actuary's professional judgment, the published mortality table reflects expected mortality rates as of the measurement date.
ii. include an assumption as to expected mortality improvement after the measurement date. This assumption should be disclosed in accordance with section 4.1.1, even if the actuary concludes that an assumption of zero future improvement is reasonable as described in section 3.3.5. Note that the existence of uncertainty about the occurrence or magnitude of future mortality improvement does not by itself mean that an assumption of zero future improvement is a reasonable assumption.

Background on Recent National Mortality Studies

In October 2014, the Society of Actuaries published several reports of the Retirement Plans Experience Committee ("RPEC"). The RP-2014 Mortality Tables Report[3] reflects observed data for single-employer defined benefit pension plans covering the years 2004 – 2008 (central year, 2006). The RPEC observed that this data was relatively consistent with the data underlying the RP 2000 mortality tables (that is, from 1990 – 1994, central year 1992) adjusted for longevity improvements using MP-2014[4]. The rates in the RP-2014 tables were developed on a liability weighted basis (i.e. exposures and deaths were weighted by compensation for actives and by benefit amount for retirees).

As a supplement to the RP-2014 Mortality Tables Report, the Society of Actuaries also published the Supplement to the RP-2014 Mortality Tables Report, RPH-2014 Headcount-Weighted Tables[5]. The rates in these tables, denoted RPH-2014 (for Retirement Plans by Headcount), were calculated using the same underlying datasets and methods as those used in the development of the corresponding RP-2014 tables, but with exposures and deaths weighted by headcount rather than by amount.

The RPEC's Mortality Improvement Scale MP-2014 Report[6] reflects data from the Social Security Administration through 2009. As discussed in the report, the historical data was graduated and then projected from the resulting smoothed 2007 values to reach an ultimate rate of 1%[7] after 20 years (from

[3] Mortality Improvement Scale MP-2014 Report (www.soa.org/Research/Experience-Study/pension/research-2014-mp.aspx)
[4] Mortality Improvement Scale MP-2014 Report (www.soa.org/Research/Experience-Study/pension/research-2014-mp.aspx)
[5] https://www.soa.org/Files/Research/Exp-Study/research-2014-rp-supplement.pdf
[6] www.soa.org/Research/Experience-Study/pension/research-2014-mp.aspx
[7] The ultimate rate is actually 1% at ages up to 85, then grading down to 0.85% at 95 and 0% at 110.

2007[8]). As discussed in the RPEC's Mortality Improvement Scale MP-2014 Report[9], we believe this is a reasonable ultimate rate and convergence period.

In October 2015, the Society of Actuaries issued an updated mortality improvement scale, MP-2015 which is discussed in the RPEC's Mortality Improvement Scale MP-2015 Report[10]. MP-2015 reflects 2010 and 2011 data which indicates slightly lower actual mortality improvement rates for those years than estimated by MP-2014.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

The following table shows the current mortality assumptions and the retained actuary's proposed mortality assumptions for each group of participants:

Participant Group	Current Assumption	Assumption Proposed by the Retained Actuary
Healthy Male Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment	RP-2014 Male Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set forward two years
Healthy Female Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment	RP-2014 Female Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014
Disabled Male Retirees	RP-2000 disabled mortality table	RP-2014 Male Disabled Mortality Table, adjusted for mortality improvements using projection scale MP-2014. Rates are set forward two years
Disabled Female Retirees	RP-2000 disabled mortality table set forward five years	RP-2014 Female Disabled Mortality Table, adjusted for mortality improvements using projection scale MP-2014. Rates are set forward four years
Male Active Members	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment, set forward three years	RP-2014 Male Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set forward one year
Female Active Members	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back one year	RP-2014 Female Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014

[8] To avoid so-called edge effect distortions, the last two years of actual data (2008 and 2009) were replaced with the first two years of smoothed data.

[9] www.soa.org/Research/Experience-Study/pension/research-2014-mp.aspx

[10] https://www.soa.org/Research/Experience-Study/Pension/research-2015-mp.aspx

Retained Actuary's Results:

The following table contains the results of the plan's experience over the last six years including the ratio of actual experience over expected experience under the current assumption and under the retained actuary's proposed assumption.

Participant Group	Deaths	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Healthy Male Retirees	2,403	72,510	100%	101%
Healthy Female Retirees	1,936	73,566	91%	105%
Disabled Male Retirees	209	4,705	82%	105%
Disabled Female Retirees	178	5,433	82%	100%
Male Active Members	230	126,323	103%	107%
Female Active Members	159	156,128	69%	106%

The retained actuary made the following comments regarding the study:

We did not find a published standard table that fit the observed experience at all ages. We focused on cohorts of members that represented a large percentage of counts and liability for each group. For post-retirement mortality, this group included the retirees in the 60 to 89 age group (92% of the total); for post-disability mortality, this group included disabled retirees in the 50 to 79 age group (90% of the total). As such, we recommend adoption of the RP-2014 mortality tables, with age adjustments in order to produce a better fit to observed experience.

In order to show the fit for the six-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates for 2014 projected backwards to the mid-point of the study using projection scale MP-2014.

Deloitte's Review:

In accordance with ASOP 35 Section 3.5.3, the retained actuary considered the mortality for participants in post-retirement status, disabled retirement status, and pre-retirement (active) status. Within each of these participant groups, male and female experience and future expectations were considered separately.

We would expect the mortality assumption to be based on recent tables and to reflect the employee base covered under the plan to the extent that such plan experience is credible. The retained actuary has recommended that the plan use the RP-2014 Mortality Tables (with modifications as mentioned in the table above) and the MP-2014 Mortality Improvement Scale for each participant group.

The retained actuaries have reflected the population of the plan by recommending the White Collar alternative, as published by the RPEC, and also by setting forward the rates by zero to four years in order to better match experience for each group. The credibility analysis follows a methodology published by the Society of Actuaries[11] and is consistent with the discussion of credible mortality experience in a practice note published by the American Academy of Actuaries[12]. Based on those analyses, the recommended collar and set forward adjustments to reflect plan experience are reasonable.

[11] www.soa.org/files/research/projects/research-2008-benjamin.pdf

[12] See also Appendix 2 in the Selecting and Documenting Mortality Assumptions for Pensions practice note as published, in 2011, by the American Academy of Actuaries, www.actuary.org/files/publications/PC_update_mortalityPN_111021.pdf

We do note that the A/E ratios calculated by the retained actuary (shown in the table above) are headcount-weighted, whereas the RP-2014 mortality tables were developed using liability weighting. We would suggest that in future studies the retained actuary consider calculating their A/E ratios using liability weighting for consistency with the selected base table. If the data suggests that headcount weighting is more reasonable, then the retained actuary may want to consider RPH-2014 tables as the base table to adjust for experience.

This experience study was published prior to the release of the updated MP-2015 mortality improvement scale. Because the SOA has produced this improvement scale based on two more years of available data, and this information is available prior to approval by the Commission, we recommend that the actuary consider updating to the MP-2015 improvement scale for the July 1, 2016 actuarial valuation. While we recommend updating to this most recent improvement scale, we do not believe it is necessary to change the improvement scale annually if future updates are provided by the SOA; however, it would be prudent to monitor these updates in case there is any significant change in their recommendations. Changing from the MP-2014 improvement scale to the MP-2015 improvement scale would increase mortality expectations slightly, which would slightly reduce the A/E ratio for each group of participants.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

The following table shows the current mortality assumptions and the retained actuary's proposed mortality assumptions for each group of participants:

Participant Group	Current Assumption	Assumption Proposed by the Retained Actuary
Healthy Male Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment	RP-2014 Male Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set forward two years.
Healthy Female Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back two years	RP-2014 Female Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are multiplied by a factor of 0.90.
Disabled Male Retirees	RP-2000 disabled mortality table, set back four years	RP-2014 Male Disabled Mortality Table, adjusted for mortality improvements using projection scale MP-2014. Rates are set forward one year.
Disabled Female Retirees	RP-2000 disabled mortality table set forward seven years	RP-2014 Female Disabled Mortality Table, adjusted for mortality improvements using projection scale MP-2014. Rates are set forward six years.
Male Active Members	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment, set forward five years	RP-2014 Male Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set forward one year.
Female Active Members	RP-2000 employee generational mortality table projected with	RP-2014 Female Employee Mortality Table, adjusted for white

	mortality improvement scale AA, white collar adjustment, set back three years	collar and mortality improvements using projection scale MP-2014. Rates are set back one year.

Retained Actuary's Results:

The following table contains the results of the plan's experience over the last six years including the ratio of actual experience over expected experience under the current assumption and under the retained actuary's proposed assumption.

Participant Group	Deaths	Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Healthy Male Retirees	4,471	123,034	100%	101%
Healthy Female Retirees	5,656	240,257	101%	108%
Disabled Male Retirees	247	7,057	85%	102%
Disabled Female Retirees	320	9,480	83%	103%
Male Active Members	418	252,046	65%	100%
Female Active Members	509	554,516	79%	102%

The retained actuary made the following comments regarding the study:

We did not find a published standard table that fit the observed experience at all ages. We focused on cohorts of members that represented a large percentage of counts and liability for each group. For post-retirement mortality, this group included the retirees in the 60 to 89 age group (92% of the total); for post-disability mortality, this group included disabled retirees in the 50 to 79 age group (92% of the total). As such, we recommend adoption of the RP-2014 mortality tables, with adjustments in order to produce a better fit to observed experience when possible. In some cases, even after adjustments, the fit was not uniform and we put more credibility on the rates in the published table than the plan's experience over the past six years.

In order to show the fit for the six-year period of the study, New Sample Rates and New Expected Deaths were determined using the proposed mortality rates for 2014 projected backwards to the mid-point of the study using projection scale MP-2014.

Deloitte's Review:

In accordance with ASOP 35 Section 3.5.3, the retained actuary considered the mortality for participants in post-retirement status, disabled retirement status, and pre-retirement (active) status. Within each of these participant groups, male and female experience and future expectations were considered separately.

We would expect the mortality assumption to be based on recent tables and to reflect the employee base covered under the plan to the extent that such plan experience is credible. The retained actuary has recommended that the plan use the RP-2014 Mortality Tables (with modifications as mentioned in the table above) and the MP-2014 Mortality Improvement Scale for each participant group.

The retained actuaries have reflected the population of the plan by recommending the White Collar alternative for healthy participants and the disabled mortality table for disabled participants, as published by the RPEC, and also by adjusting the rates using a set forward, set back, or adjustment factor in order to better match experience for each group. The credibility analysis follows a methodology published by the Society of Actuaries[13] and is consistent with the discussion of credible mortality experience in a

[13] www.soa.org/files/research/projects/research-2008-benjamin.pdf

practice note published by the American Academy of Actuaries[14]. Based on those analyses, the recommended collar and other adjustments to reflect plan experience are reasonable.

We note that the A/E ratios calculated by the retained actuary (shown in the table above) are headcount-weighted, whereas the RP-2014 mortality tables were developed using liability weighting. We would suggest that in future studies the retained actuary consider calculating their A/E ratios using liability weighting for consistency with the selected base table. If the data suggests that headcount weighting is more reasonable, then the retained actuary may want to consider RPH-2014 tables as the base table to adjust for experience.

This experience study was published prior to the release of the updated MP-2015 mortality improvement scale. Because the SOA has produced this improvement scale based on two more years of available data, and this information is available prior to approval by the Commission, we recommend that the actuary consider updating to the MP-2015 improvement scale for the July 1, 2016 actuarial valuation. While we recommend updating to this most recent improvement scale, we do not believe it is necessary to change the improvement scale annually if future updates are provided by the SOA; however, it would be prudent to monitor these updates in case there is any significant change in their recommendations.

Changing from the MP-2014 improvement scale to the MP-2015 improvement scale would increase mortality expectations slightly, which would slightly reduce the A/E ratio for each group of participants.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

The following table shows the current mortality assumptions and the retained actuary's proposed mortality assumptions for each group of participants:

Participant Group	Current Assumption	Assumption Proposed by the Retained Actuary
Healthy Male Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back two years	RP-2014 Male Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set back three years. Rates at ages before 70 are multiplied by 0.80 and rates at ages over 70 are multiplied by 1.478 with some blending of rates around age 70 to maintain a smooth set of rates
Healthy Female Retirees	RP-2000 annuitant generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back three years	RP-2014 Female Healthy Annuitant Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set back three years. Rates at ages before 75 are multiplied by 0.85 and rates at ages over 75 are multiplied by 1.362 with some blending of rates around age 75 to maintain a smooth set of rates

[14] See also Appendix 2 in the Selecting and Documenting Mortality Assumptions for Pensions practice note as published, in 2011, by the American Academy of Actuaries, www.actuary.org/files/publications/PC_update_mortalityPN_111021.pdf

Disabled Male Retirees	RP-2000 disabled mortality table	RP-2014 Male Disabled Mortality Table, without generational improvement
Disabled Female Retirees	RP-2000 disabled mortality table	RP-2014 Female Disabled Mortality Table, without generational improvement
Male Active Members	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back five years	RP-2014 Male Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set back six years.
Female Active Members	RP-2000 employee generational mortality table projected with mortality improvement scale AA, white collar adjustment, set back seven years	RP-2014 Female Employee Mortality Table, adjusted for white collar and mortality improvements using projection scale MP-2014. Rates are set back five years.

Retained Actuary's Results:

The following table contains the results of the plan's experience over the last six years including the ratio of actual experience over expected experience under the current assumption and under the retained actuary's proposed assumption.

Participant Group	Actual Deaths	Actual Exposure	Ratio of Actual/Expected	
			Current Assumption	Proposed Assumption
Healthy Male Retirees	2,619	120,076	88%	100%
Healthy Female Retirees	2,981	161,114	94%	98%
Disabled Male Retirees	34	1,002	97%	126%
Disabled Female Retirees	79	2,557	165%	188%
Male Active Members	75	120,490	66%	93%
Female Active Members	167	355,385	77%	96%

Regarding the healthy retiree mortality, the retained actuaries were unable to find a standard published table that would closely match the plan's experience at all ages so they recommended the most recently published tables with white collar and set back adjustments and also multiplied the rates by varying factors at different ages.

Additionally for the healthy retirees, the retained actuary excluded one year of experience (2009 for males, 2010 for females) in determining what assumptions would be a good fit. For each gender, the years removed had unusually few deaths which the retained actuary believes to be an aberration. The retained actuary indicated verbally that, although these years were excluded in determining the best fit assumptions, they were included in the calculation of the actual/expected ratios.

For the active and disabled mortality assumptions, the retained actuary commented that although the actual/expected ratios are not as close to 100% as one might expect, they have little effect on the liability due to the few number of deaths which actually occur in these groups each year. The recommended mortality table (RP-2014) was chosen for consistency with the retiree assumptions and adjusted for a better fit.

Deloitte's Review:

In accordance with ASOP 35 Section 3.5.3, the retained actuary considered the mortality for participants in post-retirement status, disabled retirement status, and pre-retirement (active) status. Within each of

these participant groups, male and female experience and future expectations were considered separately.

We would expect the mortality assumption to be based on recent tables and to reflect the employee base covered under the plan to the extent that such plan experience is credible. The retained actuary has recommended that the plan use the RP-2014 Mortality Tables (with modifications as mentioned in the table above) and the MP-2014 Mortality Improvement Scale for each participant group.

The retained actuaries have reflected the population of the plan by recommending the White Collar alternative for healthy participants and the disabled mortality table for disabled participants, as published by the RPEC, and also by adjusting the rates using a set forward, set back, or adjustment factor in order to better match experience for each group. The credibility analysis follows a methodology published by the Society of Actuaries[15] and is consistent with the discussion of credible mortality experience in a practice note published by the American Academy of Actuaries[16]. Based on those analyses, the recommended collar and other adjustments to reflect plan experience are reasonable.

We note that the A/E ratios calculated by the retained actuary (shown in the table above) are headcount-weighted, whereas the RP-2014 mortality tables were developed using liability weighting. We would suggest that in future studies the retained actuary consider calculating their A/E ratios using liability weighting for consistency with the selected base table. If the data suggests that headcount weighting is more reasonable, then the retained actuary may want to consider RPH-2014 tables as the base table to adjust for experience.

As noted by the actuary, the A/E ratios for active and disabled mortality assumptions are not as close to 100% as one might expect. This is especially apparent for the disabled female retirees where the A/E ratio is 188%. The actuaries are not able to distinguish disabled retirees in the data once the member reaches normal retirement age; therefore, the actuary was only able to analyze the mortality experience of a small group of disabled retirees. The number of deaths from this small group of exposure lives is well below the threshold to be fully credible; therefore, the actuary used the standard disabled lives mortality table published by RPEC without adjustment. Given the insufficient credibility of the data, we believe this is a reasonable approach.

This experience study was published prior to the release of the updated MP-2015 mortality improvement scale. Because the SOA has produced this improvement scale based on two more years of available data, and this information is available prior to approval by the Commission, we recommend that the actuary consider updating to the MP-2015 improvement scale for the July 1, 2016 actuarial valuation. While we recommend updating to this most recent improvement scale, we do not believe it is necessary to change the improvement scale annually if future updates are provided by the SOA; however, it would be prudent to monitor these updates in case there is any significant change in their recommendations.

Changing from the MP-2014 improvement scale to the MP-2015 improvement scale would increase mortality expectations slightly which would slightly reduce the A/E ratio for each group of participants.

As a matter of transparency and accuracy, we note that the retained actuary appears to lose some actual and expected decrements when grouping by age band as compared to groupings by fiscal year. We discussed this difference with the retained actuary who indicated the cause is likely decrements that fall outside the range of considered age bands when creating those summaries. We recommend this be adjusted so that counts match in future years.

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[15] www.soa.org/files/research/projects/research-2008-benjamin.pdf

[16] See also Appendix 2 in the Selecting and Documenting Mortality Assumptions for Pensions practice note as published, in 2011, by the American Academy of Actuaries, www.actuary.org/files/publications/PC_update_mortalityPN_111021.pdf

Other Assumptions

Minnesota Statute Section 356.215 also stipulates that other assumptions must be set at levels consistent with those determined in the most recent quadrennial experience study completed, including:

- Pay increases due to merit and seniority
- Retirement
- Withdrawal
- Disability
- Mortality
- **Other relevant demographic and economic assumptions**

The purpose of this section of our report is to review the other relevant assumptions studied by the retained actuaries.

None of the assumptions below were directly addressed by TRA's retained actuary, except in their statement that all less critical miscellaneous assumptions are confirmed to be reasonable and should be maintained. As noted in our statement of scope, we do not believe that these assumptions are required to be analyzed and documented in this experience study.

Marital Status

It is common for actuaries to make an assumption regarding the marital status of plan participants for use in assuming future benefit eligibility and election. Like the inflation assumption, the marital status assumption is often a component of several other assumptions.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Marital Status	Current	Observed	Recommended
Male Participants	85%	78%	80%
Female Participants	70%	61%	65%

Basis and Deloitte Review:

The retained actuary considered the martial status of healthy retirees during the review period, totaling 7,414 new retirees. Based on the observed data and its consistency with the prior study, the retained actuary recommends moving the assumption in the direction of the observed rates. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Marital Status	Current	Observed	Recommended
Male Participants	75%	80%	80%
Female Participants	70%	72%	70%

Basis and Deloitte Review:

The retained actuary considered the martial status of healthy retirees during the review period, totaling 16,580 new retirees. Based on the quantity of the observed data, the retained actuary recommends moving the assumption in the direction of the observed rates for male participants and leaving the female rates unchanged. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Recommendation, Basis and Deloitte Review:

The retained actuary stated that the data they are provided does not include marital status unless a joint and survivor annuity has been elected. It was also explained in the report that this assumption would not have a material effect on the liability as it is only relevant for pre-retirement death benefits. Therefore, this assumption was not studied and the retained actuary recommends no change to the assumption below:

Marital Status	Current
Male Participants	85%
Female Participants	65%

Since no supporting data was provided, we cannot comment on the reasonableness of this assumption; however, we agree that this assumption does not have a material effect on the liabilities.

Age of Survivor

Future Joint & Survivor annuity payment amounts are based in part on the age of the survivor. Because valuation mortality and interest rates are not equal to those used to calculate optional forms of payment, the age of survivors impacts liability amounts.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Age of Survivor	Current	Observed	Recommended
Male Participants	3 years younger	2.64 years younger	3 years younger
Female Participants	2 years older	1.88 years older	2 years older

Basis and Deloitte Review:

The retained actuary notes that observation during the review period rounds to the current assumption, therefore recommending no change. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Age of Survivor	Current	Observed	Recommended
Male Participants	3 years younger	2.95 years younger	3 years younger
Female Participants	2 years older	1.65 years older	2 years older

Basis and Deloitte Review:

The retained actuary notes that observation during the review period rounds to the current assumption, therefore recommending no change. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Age of Survivor	Current	Observed	Recommended
Male Participants	2 years younger	2.3 years younger	2 years younger
Female Participants	2 years older	1.4 years older	2 years older

Basis and Deloitte Review:

The retained actuary notes that records with an age difference of 20 years or more were excluded under the assumption that most of those reflected a child, not a spouse, beneficiary. Observation during the review period is reasonably close to the current assumption, therefore the retained actuary is recommending no change. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Form of Payment

In cases where participants receive no subsidy among payment forms and valuation actuarial equivalence matches that of optional payment forms, this assumption is not necessary. However, because valuation mortality and interest rates are not equal to those used to calculate optional forms of payment and because the plan subsidizes pop-up benefits, this assumption impacts liabilities.

Minnesota State Retirement System (MSRS)

Retained Actuary's Recommendation:

Form of Payment - Male	Current	Observed	Recommended
Life Annuity	25%	17%	20%
15-year Certain & Life	0%	1%	0%
50% Joint & Survivor	15%	13%	15%
75% Joint & Survivor	10%	15%	15%
100% Joint & Survivor	50%	54%	50%

Form of Payment - Female	Current	Observed	Recommended
Life Annuity	60%	43%	45%
15-year Certain & Life	0%	2%	0%
50% Joint & Survivor	15%	16%	15%
75% Joint & Survivor	0%	11%	10%
100% Joint & Survivor	25%	28%	30%

Basis and Deloitte Review:

A total of 5,150 new married retirees are included in the data above (2,985 male and 2,165 female). Given the sample size we have no issue with the recommended assumption change. The reduction in Life Annuity election among female participants is noteworthy, but is directionally consistent with male participants. We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Public Employees Retirement Association of Minnesota (PERA)

Retained Actuary's Recommendation:

Form of Payment - Male	Current	Observed	Recommended
Life Annuity	40%	27%	30%
15-year Certain & Life	5%	9%	10%
50% Joint & Survivor	15%	17%	15%
75% Joint & Survivor	10%	10%	10%
100% Joint & Survivor	30%	36%	35%

Form of Payment - Female	Current	Observed	Recommended
Life Annuity	70%	60%	60%
15-year Certain & Life	5%	9%	10%
50% Joint & Survivor	5%	11%	10%
75% Joint & Survivor	5%	3%	5%
100% Joint & Survivor	15%	17%	15%

Basis and Deloitte Review:

A total of 12,441 new married retirees are included in the data above (5,024 male and 7,417 female). We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Teachers Retirement Association of Minnesota (TRA)

Retained Actuary's Recommendation:

Form of Payment - Male	Current	Observed	Recommended
Life Annuity	19.25%	21.5%	20%
50% Joint & Survivor	8.50%	10%	10%
75% Joint & Survivor	12.75%	9%	10%
100% Joint & Survivor	59.50%	60%	60%

Form of Payment - Female	Current	Observed	Recommended
Life Annuity	48.00%	43%	45%
50% Joint & Survivor	13.00%	14%	13.5%
75% Joint & Survivor	6.50%	7%	6.5%
100% Joint & Survivor	32.50%	37%	35%

Basis and Deloitte Review:

A total of 14,542 new married retirees are included in the data above (4,305 male and 10,237 female). We find the retained actuary's method and assumption recommendation to be reasonable and justified.

Actuarial Equivalent Optional Form Factors

As noted above, the mortality and interest rate basis for optional payment forms impacts liability calculations for all participants electing a benefit other than the life annuity.

Minnesota State Retirement System (MSRS)

The retained actuary recommends updating the interest rate, mortality tables, and benefit increase assumption to be consistent with above-referenced assumption changes. This recommendation is required for internal consistency with prior valuations, and we agree with the recommendation.

Public Employees Retirement Association of Minnesota (PERA)

The retained actuary recommends updating the interest rate, mortality tables, and benefit increase assumption to be consistent with above-referenced assumption changes. This recommendation is required for internal consistency with prior valuations, and we agree with the recommendation.

Teachers Retirement Association of Minnesota (TRA)

The retained actuary did not address these factors in their review.

Combined Service Annuity

The Combined Service Annuity factors are applied to each of the studied plans to reflect that active and vested terminated participants have some probability of having accrued a vested benefit in another State pension plan. This assumption was last analyzed in 2001 and set in 2002.

Each retained actuary recommends reviewing and updating this assumption, and due to the time lapse since the prior study, we agree.

Funding Policy

As previously mentioned, we do not view a commentary on each plan's funding policy as the primary focus of this report. We have reviewed the educational information and recommendations of the retained actuaries pertaining to funding policy, and find the information to be accurate, reasonable, and helpful to any Board or Commission member or stakeholder new to pension funding.

We are also aware that the Systems, their retained actuaries, and the LCPR are engaged in conversations regarding changes in funding policy. As a benefit to that ongoing discussion we have summarized our thoughts on key components of funding policy below. But due to the lack of experience to review, we view this information as complementary to the 2015 Studies performed by the retained actuaries and not a criticism or review thereof.

Asset Valuation Method

Per Minnesota Statute 356.215(f) the actuarial value of assets used for determining funded ratios and contribution rates is based on a five-year smoothing. This method is extremely common among public sector pension plans.

Retirement systems in Minnesota are not bound by this single metric in setting actual contribution rates however. The 2015 Omnibus Pension Bill provided systems with additional latitude when setting contribution rates, namely consideration of Market Value of Assets in calculating funded ratios and contribution sufficiency/(deficiencies). This is in line with recently released Government Accounting Standards Board requirements that Market Value of Assets be used in reporting pension liabilities.

Similar to the retained actuaries, we see value in both the Market Value and Actuarial Value being calculated by the Systems. We would not recommend either be the sole metric for making funding decisions.

Actuarial Funding (Cost) Method

As required by State Statute, pension plans in the State of Minnesota use the Entry Age Normal cost method, which is the standard in the public sector. This method has the disadvantage of being difficult to communicate but the advantage of providing level (dollar or percentage of payroll, depending on the plan) contributions throughout a participant's working lifetime. We see no reason to consider a change to this method but other cost methods may also be acceptable.

Amortization Period

Among the funding policy components, the way in which unfunded actuarial accrued liability (UAAL) is currently being amortized by plans in the State of Minnesota may be the most uncommon. More common methods include layered amortizations, discussed below, rolling amortizations over a shorter period, and aggregate funding. Minnesota State Statute 356.215 establishes a full funding date, thereby defining the period over which the UAAL is amortized. If all valuation assumptions are met and recommended contributions are made, each plan would be fully funded on this date.

However, State Statute also lays out a method by which the full funding date is recalculated when assumption or benefit changes occur. Finally, historical practice has been to reset this full funding date to

30 years out, even when significant assumption or benefit changes have not occurred, in an effort to minimize contribution volatility.

As an alternative, each retained actuary suggests consideration of a 'layered' amortization policy. This approach would continue to use closed amortization periods, but a new amortization base would be established for each year of actuarial losses, possibly with several bases set up each year for different types of actuarial losses/(gains). We agree that this type of policy would be appropriate and avoid the need to reset the amortization period. Appropriate consideration should be given when selecting the periods to balance the goals of contribution stability and intergenerational equity.

Valuation of Post-Retirement Benefit Increases

In our presentation to the LCPR on October 13, 2015 we presented the Commission with an alternative to funding post-retirement benefit increases, frequently referred to as COLA's. In short, we recommend setting each plan's actuarially determined contribution rate based on the liability without consideration for COLA increases from 1%/2% levels to the higher 2.5% level. This change would prevent current employees and employers from taking on additional responsibility for funding the higher COLA rates as appears to have been the goal when the shared compromise was originally agreed upon.

Our recommendation would only apply to the determination of actuarial funding rates and the contribution sufficiency/(deficiency). It would not impact the method for determining if the 90% threshold has been reached for paying the higher COLA rates.

Cost Impact

The **LCPR's Standards for Actuarial Work, Section VI. E.** states:

> *For any assumption change adopted by the Fund and presented to the Commission for review, the cost impact shall be quantified for each change in assumption by showing the change in the dollar amount of the UAAL, the change in the Actuarial Liability Funded Ratio, the change in the normal cost rate and the change in the UAAL contribution rate. The cost impact of the assumption changes shall be reported in the following order:*
>
> *A. Mortality*
> *B. Retirement*
> *C. Termination of employment*
> *D. Disability*
> *E. Salary increases*
> *F. Rate of return*
> *G. Other*
> *H. Payroll Growth*

Minnesota State Retirement System (MSRS)

The retained actuary did not include a cost impact analysis in their report. A separate analysis was provided to the Commission; however, it did not follow the specific guidelines of the LCPR Standards by providing the cost impact for each assumption change in the order noted.

Public Employees Retirement Association of Minnesota (PERA)

The retained actuary did not include a cost impact analysis in their report. A separate analysis was provided to the Commission; however, it did not follow the specific guidelines of the LCPR Standards by providing the cost impact for each assumption change in the order noted.

Teachers Retirement Association of Minnesota (TRA)

The retained actuary did include a cost impact analysis in their report; however, it did not follow the specific guidelines of the LCPR Standards by providing the cost impact for each assumption change in the order noted.