Minnesota
Legislative Commission on Pensions and Retirement

Replication of July 1, 2019
TRA Actuarial Valuation Report

Prepared by:

VAN IWAARDEN

Experience. Knowledge. Practical Advice.

May 27, 2020

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Retirement planning for employers

May 27, 2020

Minnesota Legislative Commission on Pensions and Retirement
55 State Office Building
100 Rev. Dr. Martin Luther King, Jr. Blvd.
St. Paul, MN 55155

Attn: Susan Lenczewski, Executive Director

Re: Replication of July 1, 2019 TRA Actuarial Valuation Report

Commission Members:

This report presents our replication of the July 1, 2019 actuarial valuation report for the Minnesota Teachers Retirement Association (TRA). It provides various exhibits illustrating the degree to which we were able to replicate both (1) the retained actuary's liability calculations and (2) their use of those liabilities to determine contribution rates and sufficiency.

Purpose of the Study

This study was prepared at the request of the LCPR. Its sole purpose is to replicate the July 1, 2019 TRA actuarial valuation report for reasonability, accuracy, and compliance with applicable Minnesota Statutes, LCPR standards of actuarial work, and relevant Actuarial Standards of Practice (ASOPs).

The report is intended to comply with Minnesota Statute 356.214 Subd. 4(b) which states that the auditing actuary shall:

> "audit the valuation reports submitted by the actuary retained by each governing or managing board or administrative official, and provide an assessment of the reasonableness, reliability, and areas of concern or potential improvement in the specific reports reviewed, the procedures utilized by any particular reporting actuary, or general modifications to standards, procedures, or assumptions that the commission may wish to consider."

A valuation "replication" is similar to a valuation "review" except that a replication focuses on the valuation's technical aspects and less on the presentation of those results.

This report may not be used for any other purpose, and Van Iwaarden Associates is not responsible for the consequences of any unauthorized use. Its content may not be modified, incorporated into or used in other material, or otherwise provided, in whole or in part, to any other person or entity, without our permission.

Data Used in the Analysis

The results and recommendations in this report are based on the following data sources:

- July 1, 2019 actuarial valuation report prepared by TRA's retained actuary;
- July 1, 2019 census data files provided by TRA and "scrubbed" census files provided by the retained actuary; and
- July 1, 2019 asset and financial data provided by TRA.

Although we reviewed all data sources for reasonability, we have not audited the underlying data and are relying on its substantial accuracy. If any data supplied are not accurate and complete, then our conclusions in this actuarial valuation replication may differ significantly.

We wish to thank all the involved parties for providing information in a timely manner and for answering our questions. We are particularly grateful to the staff at Cavanaugh Macdonald Consulting, LLC for their help answering questions about their valuation system's technical calculations.

Actuarial Certification

To the best of our knowledge, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices.

Upon receipt of the report, the LCPR should notify us if you disagree with any information contained in the report or if you are aware of any information that would affect the results that has not been communicated to us. The report will be deemed final and acceptable to the LCPR unless you immediately notify us otherwise.

The undersigned credentialed actuaries are members of the American Academy of Actuaries and meet the Academy's Qualification Standards to render the actuarial opinion contained herein. We are available to answer questions on the material contained in the report or to provide explanations or further detail, as may be appropriate. We are not aware of any financial interest or relationship that could create a conflict of interest or impair the objectivity of our work.

Mark W. Schulte, FSA, EA, MAAA
Consulting Actuary

Emily M. Knutson, FSA, EA, MAAA
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L/D/C/R:5/ms/ek/jvi

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Executive Summary

This report summarizes our replication of the July 1, 2019 TRA actuarial valuation report. We conclude that the retained actuary reasonably determined the system's July 1, 2019 actuarial liabilities and contribution sufficiency/(deficiency).

The next section of this report describes our process for replicating and evaluating the retained actuary's calculations. It is followed by separate sections addressing different components of the replication process (e.g., validating census data and liability calculations), along with appendices that summarize many of the technical calculations.

We did not find any meaningful differences or deficiencies in the retained actuary's data or calculations. Overall liabilities and contributions were matched with sufficient accuracy, and we provide commentary on the few areas where subsets of our results diverged from the retained actuary. In general, these instances were very limited.

The table below provides a summary our of replication results.

	TRA Actuarial Valuation	VIA Replication	Difference
Participant data			
Active members	82,965	82,965	0.0%
Service retirements	61,073	61,046	0.0%
Survivors	5,727	5,714	-0.2%
Disability retirements	485	480	-1.0%
Deferred retirements	15,517	15,518	0.0%
Non-vested terminated members	35,919	35,918	0.0%
Total	**201,686**	**201,641**	0.0%
System assets *($1,000's)*			
Market value of assets	$ 22,872,153	$ 22,872,153	0.0%
Actuarial Value of Assets	22,466,848	22,466,848	0.0%
System liabilities *($1,000's)*			
Present Value of Benefits (PVB)	34,382,729	34,411,760	0.1%
Present Value of Future Normal Costs (PVFNC)	5,136,555	5,105,229	-0.6%
Actuarial Accrued Liability (AAL)	29,246,174	29,306,531	0.2%
System contributions *(% of payroll)*			
Normal cost rate	9.11%	8.84%	-0.27%
UAAL amortization payment	7.77%	7.81%	0.04%
Expenses	0.30%	0.30%	0.00%
Total required contribution (Chapter 356)	17.18%	16.95%	-0.23%
Statutory contribution rate (Chapter 354)	16.27%	16.27%	0.00%
Contribution sufficiency/(deficiency)	-0.91%	-0.68%	0.23%

Process Overview

Pension actuarial calculations involve two main phases:

- Calculating the present value of future retiree benefits (i.e., plan liabilities) for a specific purpose; and
- Using the actuarial liabilities and plan assets to determine various results that fulfill the purpose (e.g., actuarial contributions or accounting disclosures).

The purpose of this report is to replicate (1) the technical calculation of the plan's actuarial liabilities and (2) the contribution rates and sufficiency results based on those liabilities. Note that we are not providing commentary on the presentation/formatting of results in the retained actuary's report since that topic is covered in a separate actuarial valuation *review*.

Our report focuses on replicating the following items:

1. Census data summaries;
2. Market asset data and Actuarial Value of Assets calculations;
3. Calculation of plan liabilities;
4. Calculation of contribution sufficiency/(deficiency); and
5. Confirmation of actuarial assumptions, methods, and plan provisions.

The table below summarizes how our valuation replication report incorporates each of these items.

Census data	▪ Compare participant category counts and summary statistics for the retained actuary vs. system census data files ▪ Compare detailed participant distributions for the retained actuary's census file vs. the valuation report summaries
Plan assets	▪ Compare market asset values in the valuation report to those in the system's audited financial statements ▪ Replicate retained actuary's Actuarial Value of Assets calculations
Plan liabilities	▪ Replicate technical liability calculations, including Present Value of Benefits (PVB), Present Value of Future Normal Costs (PVFNC), and Actuarial Accrued Liability (AAL) ▪ Compare liability calculations for various member status groups
Contribution sufficiency/(deficiency)	▪ Replicate the required normal cost and supplemental contribution rate calculations ▪ Replicate retained actuary's contribution sufficiency/(deficiency) determination
Assumptions, methods, and plan provisions	Verify that the actuarial assumptions, methods, and plan provisions used in the July 1, 2019 actuarial valuation are consistent with applicable Minnesota Statutes, the LCPR's Standards for Actuarial Work, and relevant actuarial standards of practice (ASOPs).

Census Data

Census data is one of the foundational inputs for actuarial calculations. While it is not practical for data to be perfect, it should be reviewed for overall accuracy and reasonability.

Guidance on actuarial data is provided by Actuarial Standard of Practice No. 23, Data Quality (ASOP 23). It provides, in summary, that "The actuary should use available data that, in the actuary's professional judgment, allow the actuary to perform the desired analysis. However, if material data limitations are known to the actuary, the actuary should disclose those limitations and their implications".

To validate the census data used in the July 1, 2019 actuarial valuation report, we used the following process:

- Request separate census files from the retained actuary and the system;
- Compare overall census counts and summary statistics for various member classes (e.g., active members, service retirements, etc.); and
- Prepare detailed participant statistical distribution tables and compare to those in the retained actuary's July 1, 2019 actuarial valuation report.

Overall, we found that the census data used by the retained actuary was consistent with the census data provided by the system. Our census data comparisons and tables can be found in Appendix A. These exhibits are described below, along with some brief commentary.

Summary of participant statistics: This table summarizes and compares participant counts and high-level participant category statistics for the retained actuary and system census files. It shows that the two files were very closely aligned, with only some very slight differences that are likely due to refinements during the retained actuary's data collection process.

Distribution of active members: This table summarizes the retained actuary's active member data by classifying them in various age/service categories, along with the average pay for each classification. We found that this data was consistent with a similar summary table in Appendix A, Table 17 in the July 1, 2019 actuarial valuation report.

Distributions of service retirements, survivors, and disability retirements: These tables summarize the retained actuary's inactive member data by classifying them by age and service since retirement/death/disability, along with the average annual benefit for each classification. We found that the data in each of these tables was consistent with similar tables found in Appendix A Tables 18, 19, and 20 in the July 1, 2019 actuarial valuation report.

Plan Assets

Asset data is another of the foundational inputs for actuarial calculations. In addition to the Market Value of Assets, many public sector pension plans also use a smoothed Actuarial Value of Assets (AVA). The purpose of AVA methods is to stabilize contribution rates by smoothing investment returns – generally over a five-year period.

Guidance on asset smoothing methods is provided by Actuarial Standard of Practice No. 44, Selection and Use of Asset Valuation Methods for Pension Plans (ASOP 44). It provides considerations for selecting an actuarial asset method, including:

- Purpose of the measurement;
- Objectives of the employer and/or retirement system;
- Use of different methods/assumptions and adjustment for timing differences; and
- Other considerations such as the plan's expected future cash flows and liquidity needs.

Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions (ASOP 4) also provides guidance, but generally defers to ASOP 44. The specific methodology for determining TRA's AVA is prescribed in Minnesota Statutes, Section 356.215, Subd.1(f).

To validate the asset data and AVA calculations used in the July 1, 2019 actuarial valuation report, we used the following process:

- Request audited financial data from the system and compare it to the information disclosed in the actuarial valuation report; and
- Replicate the AVA calculations shown in the July 1, 2019 actuarial valuation report.

We found that the asset data used by the retained actuary was consistent with the audited asset information provided by the system. We were also able to replicate the AVA calculation prepared by the retained actuary and confirm it follows the methods prescribed in Minnesota Statutes. Our asset data comparison can be found in Appendix B, and the AVA replication can be found in Appendix C.

Plan Liabilities

Actuarial liabilities are calculated by programming actuarial software with a retirement system's data, assumptions, methods, and plan provisions. This is usually a complex process which involves substantial effort and actuarial programming experience. All inputs and parameters must be calibrated correctly, or the modelling software will produce inaccurate results.

For the replication, we independently programmed our valuation software based on our understanding of the data, assumptions, methods, and plan provisions used in the July 1, 2019 actuarial valuation report, Minnesota Statutes, and the LCPR's standards for actuarial work. The primary results we replicated are:

- **Present Value of Benefits (PVB):** projected plan liability equal to the discounted value of all future expected benefit payments
- **Present Value of Future Normal Costs (PVFNC):** discounted value of active member benefits attributable to future service (i.e., not yet earned), when expressed as a level percent of pay
- **Actuarial Accrued Liability (AAL):** portion of the PVB attributable to past service (i.e., benefits already earned); also equal to the PVB minus PVFNC.

The tables in Appendix D summarize and compare these liability measurements for different membership groups. **Our overall results are very close to those presented in the July 1, 2019 actuarial valuation report, and we believe that the retained actuary is reasonably calculating plan liabilities.**

We expect some liability calculation differences even if we used the exact same inputs as the retained actuary. This is because each actuarial software program may have slightly different ways of applying actuarial formulas. As a general rule, we would like to match the overall PVB, PVFNC, and AAL within 2% of the retained actuary's results.

Result for member subgroups or split by benefit source may differ by larger magnitudes depending on how each actuary interprets and programs their actuarial software. We believe these differences are acceptable as long as they are small relative to the overall plan. Our opinion is that any differences between our replicated liabilities and those produced by the retained actuary are reasonable and can be explained by slightly different programming procedures.

Contribution Sufficiency/(Deficiency)

TRA's statutory pension contribution rates are defined in Chapter 354 of Minnesota Statues, but the retained actuary is also required to calculate "required contributions" per Chapter 356 of Minnesota Statutes. The required contribution rates are those which are expected to fully-fund the pension plan by the statutory full funding date.

We replicated the contribution sufficiency/(deficiency) calculations as follows:

- **Required supplemental contribution rate**: We calculated the required supplemental contribution rate based on our replication of the Unfunded Actuarial Accrued Liability and projected payroll through the statutory June 30, 2048 full funding date.
- **Statutory contributions:** We calculated the estimated dollar value of the statutory normal cost contributions based on the blended statutory contribution rates calculated by the retained actuary and applied to our replication of projected payroll. These amounts are added to the statutory supplemental contribution rates.
- **Required contributions:** We calculated the estimated "percent of payroll" and dollar value of the contributions required to fully fund the plan based on the system's stated funding policy. These consist of normal cost contributions plus the required supplemental contribution rate.
- **Contribution sufficiency/(deficiency):** We compare our contribution sufficiency calculation (i.e., difference between the statutory and required contributions) to those determined by the retained actuary in the July 1, 2019 actuarial valuation report.

The tables in Appendix E summarize and compare our calculations. **Our overall results are very close to those calculated by the retained actuary, and we believe that the retained actuary is reasonably calculating the contribution sufficiency/(deficiency).**

Assumptions, Methods, and Plan Provisions

The retained actuary's July 1, 2019 actuarial valuation report contains a detailed description of the actuarial assumptions, methods, and plan provisions used to prepare their results. These items are summarized in their report's Appendices B and C. We do not reprint all the assumptions, methods, and plan provisions in this replication report, but we do provide a high-level commentary below.

Actuarial Methods
Actuarial Cost Method: Minnesota Statutes, Section 356.215 Subd.1(b) and (d) require that TRA use the Entry Age Normal level percent of pay actuarial cost method. In this method, the actuarial Present Value of Benefits (PVB) for each individual is allocated as a level percent of pay from entry age (hire age, for most employees) to decrement age (e.g., expected age at termination or retirement). The portion of the PVB allocated to the valuation year is called the Normal Cost (NC). The portion of the PVB allocated to past years is called the Actuarial Accrued Liability (AAL). The retained actuary documents using this cost method in their report, and the closeness of our replication liabilities (Appendix D) indicate that it was applied appropriately.
Asset valuation method: The asset valuation method is used to smooth market fluctuations over time to create contribution stability. Minnesota Statutes, Section 356.215 Subd.1(f) requires using an Actuarial Value of Assets that smooths investment gains and losses over a five-year period. We confirmed that the retained actuary described and used the statutory asset smoothing method, and our replication calculations can be found in Appendix C of this report.
Contribution method: The contribution method specifies a process for funding the current year incurred liabilities (the Normal Cost) plus paying down/amortizing a portion of unfunded past liabilities (the Unfunded Actuarial Accrued Liability, or UAAL amortization). These contribution parameters are defined in Minnesota Statutes, Section 356.215 Subd. 5 and Subd. 11. They specify that (1) the Normal Cost must be expressed as a level percent of payroll and (2) the required supplemental contribution must be calculated by amortizing the UAAL as a level percent of projected payroll over the closed period ending June 30, 2048. We confirmed that Appendix C of the July 1, 2019 actuarial valuation report describes the correct contribution calculation process, and our replication calculations (Appendix E of this report) indicate that the retained actuary applied the methods and assumptions appropriately.

Assumptions, Methods, and Plan Provisions *(continued)*

Actuarial Assumptions

Demographic assumptions: We verified that the demographic assumptions described in Appendix C of the July 1, 2019 actuarial valuation report were based on those developed in the 2008-2014 actuarial experience study, which were the most recently approved assumptions at the time the valuation report was prepared. We also confirmed that the mortality assumption agrees with the tables described in the 2018 Appendix to the LCPR's Standards for Actuarial Work.

Economic assumptions: We verified that the economic assumptions described in Appendix C of the July 1, 2019 actuarial valuation report were based on those developed in the 2008-2014 experience study, with later updates from an economic experience study completed in 2017. These include:

- 7.50% investment return assumption and discount rate per Minnesota Statute, Section 356.215 Subd.8(a); and
- 2.50% price inflation assumption, 3.0% payroll growth rate, and salary increase rates per the 2018 Appendix to the LCPR's Standards for Actuarial Work.

Please note that a new experience study covering the period 2014-2018 was completed in 2019 and it recommends assumption changes to be reflected in the July 1, 2020 actuarial valuation report.

Plan Provisions

Minnesota Statutes, Chapter 354 describe the retirement benefits provided to TRA members, and the primary service annuity formulas for Coordinated and Basic members are described in Section 354.44. We reviewed the plan provisions summarized in Appendix B of the July 1, 2019 actuarial valuation report and believe they are consistent with our understanding of the benefits described in Minnesota Statutes.

Appendix A – Census Data Comparisons

The exhibits below compare the participant counts and certain data statistics between the "raw" system data and the "scrubbed" actuarial data.

Summary of Participant Statistics

	System Data	Retained Actuary	Difference
Active members	**82,965**	**82,965**	**-**
Average age	43.2	43.2	0.0%
Average service	11.96	11.96	0.0%
Average salary	$ 60,187	$ 60,187	0.0%
Service retirements	**61,046**	**61,073**	**27**
Average age	73.6	73.6	0.0%
Average monthly annuity	$ 2,343	$ 2,343	0.0%
Survivors	**5,714**	**5,727**	**13**
Average age	81.1	81.2	0.0%
Average monthly annuity	$ 2,366	$ 2,386	0.8%
Disability retirements	**480**	**485**	**5**
Average age	58.0	58.0	0.1%
Average monthly annuity	$ 1,796	$ 1,803	0.4%
Deferred retirement	**15,518**	**15,517**	**(1)**
Average age	48.4	48.4	0.0%
Other non-vested terminations	**35,918**	**35,919**	**1**
Average age	46.9	46.9	0.0%
Total	**201,641**	**201,686**	**45**

Appendix A – Census Data Comparisons *(continued)*

Distribution of Active Member Data

The table below summarizes the retained actuary's active member data by age and years of service, and it also includes the average earnings for each grouping. It can be compared to the similar summary table in Appendix A, Table 17 from the July 1, 2019 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years of Service at July 1, 2019										
Age	**<3**	**3-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35-39**	**40+**	**Total**
<25	2,626	84									**2,710**
Avg pay	$31,344	$46,374									**$ 31,810**
25-29	4,010	3,175	2,092								**9,277**
Avg pay	$35,312	$47,107	$52,309								**$43,182**
30-34	2,158	1,763	5,517	1,211							**10,649**
Avg pay	$34,954	$48,509	$ 55,920	$66,086							**$51,600**
35-39	1,824	1,174	2,934	4,750	1,265						**11,947**
Avg pay	$31,458	$51,500	$58,050	$69,581	$78,181						**$60,062**
40-44	1,566	874	1,788	2,365	4,185	1,306					**12,084**
Avg pay	$27,206	$50,781	$58,697	$68,727	$79,021	$83,917					**$65,771**
45-49	1,214	576	1,381	1,431	2,117	4,020	873				**11,612**
Avg pay	$26,260	$51,025	$57,815	$67,338	$76,409	$82,880	$86,917				**$69,608**
50-54	957	449	1,009	1,079	1,309	2,201	3,041	557			**10,602**
Avg pay	$24,441	$46,867	$55,723	$65,292	$73,901	$80,833	$85,639	$86,621			**$71,160**
55-59	711	306	685	775	1,055	1,248	1,595	1,727	168		**8,270**
Avg pay	$20,800	$41,831	$51,283	$63,532	$71,941	$78,366	$83,649	$85,665	$86,181		**$70,314**
60-64	563	196	421	476	565	643	622	373	263	70	**4,192**
Avg pay	$15,756	$37,754	$46,281	$59,071	$71,067	$76,728	$80,999	$87,766	$87,249	$85,608	**$63,316**
65-69	409	71	117	106	113	106	100	53	34	47	**1,156**
Avg pay	$7,410	$24,100	$35,093	$58,347	$68,225	$74,178	$77,070	$90,815	$83,134	$91,523	**$43,472**
70+	267	30	43	23	22	12	20	14	8	27	**466**
Avg pay	$5,936	$17,294	$21,410	$39,812	$76,962	$74,560	$70,278	$94,731	$104,811	$97,584	**$27,324**
Total	**16,305**	**8,698**	**15,987**	**12,216**	**10,631**	**9,536**	**6,251**	**2,724**	**473**	**144**	**82,965**
Avg pay	**$29,615**	**$47,906**	**$55,602**	**$67,481**	**$76,526**	**$81,437**	**$84,662**	**$86,295**	**$86,871**	**$89,784**	**$60,523**

Appendix A – Census Data Comparisons *(continued)*

Distribution of Service Retirements

The table below summarizes the retained actuary's service retirement data by age and years since retirement, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table in Appendix A, Table 18 from the July 1, 2019 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Years Since Retirement at July 1, 2019								
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<55	3							**3**
Avg benefit	$28,627							**$28,627**
55-59	565	944	3					**1,512**
Avg benefit	$39,965	$33,196	$40,239					**$35,739**
60-64	928	3,616	1,893	10				**6,447**
Avg benefit	$32,641	$34,231	$29,168	$31,934				**$32,512**
65-69	584	4,309	5,963	3,181	70		1	**14,108**
Avg benefit	$22,099	$23,854	$26,728	$25,498	$35,163		$1,708	**$25,421**
70-74	80	850	4,224	5,421	4,245	421	6	**15,247**
Avg benefit	$14,632	$20,595	$23,425	$26,784	$25,161	$32,163	$10,165	**$25,135**
75-79	5	76	614	2,183	4,275	3,539	80	**10,772**
Avg benefit	$38,816	$21,748	$20,531	$22,907	$25,254	$28,794	$32,916	**$25,711**
80-84	1	13	67	267	1,334	3,410	1,765	**6,857**
Avg benefit	$1,772	$20,950	$18,552	$17,593	$23,160	$33,795	$35,041	**$31,238**
85-89		3	15	32	118	1,026	2,772	**3,966**
Avg benefit		$11,579	$10,903	$12,605	$21,215	$34,296	$37,798	**$36,074**
90+			3	8	19	80	2,051	**2,161**
Avg benefit			$28,592	$25,920	$21,124	$34,455	$36,150	**$35,906**
Total	**2,166**	**9,811**	**12,782**	**11,102**	**10,061**	**8,476**	**6,675**	**61,073**
Avg benefit	**$31,038**	**$28,271**	**$25,642**	**$25,395**	**$24,951**	**$31,693**	**$36,474**	**$28,121**

Appendix A – Census Data Comparisons *(continued)*

Distribution of Survivors

The table below summarizes the retained actuary's survivor data by age and years since death, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table in Appendix A, Table 19 from the July 1, 2019 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Years Since Death at July 1, 2019								
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<45	19	48	37	16	2	3		**125**
Avg benefit	$20,921	$20,753	$13,392	$13,824	$3,232	$11,757		**$17,217**
50-55	4	23	21	14	5	3	1	**71**
Avg benefit	$18,892	$16,970	$19,755	$11,746	$8,164	$24,719	$34,158	**$16,821**
50-55	16	39	29	10	5	4	2	**105**
Avg benefit	$28,538	$14,746	$11,755	$19,057	$15,845	$34,796	$25,608	**$17,455**
55-59	9	56	36	13	8	1	4	**127**
Avg benefit	$21,200	$21,226	$16,069	$11,547	$23,490	$3,936	$27,434	**$18,974**
60-64	26	94	56	46	16	9	3	**250**
Avg benefit	$21,531	$21,803	$17,913	$15,619	$18,700	$17,925	$7,113	**$19,251**
65-69	53	166	125	63	28	13	7	**455**
Avg benefit	$22,225	$22,195	$23,164	$20,340	$17,989	$16,277	$12,616	**$21,633**
70-74	60	317	235	142	69	27	15	**865**
Avg benefit	$23,049	$23,416	$22,364	$22,846	$20,122	$18,664	$18,889	**$22,522**
75-79	89	327	269	171	104	58	46	**1,064**
Avg benefit	$30,033	$25,487	$27,408	$27,396	$26,853	$26,416	$19,251	**$26,574**
80-84	95	320	265	170	111	64	70	**1,095**
Avg benefit	$34,621	$30,964	$33,223	$32,229	$31,804	$30,061	$31,045	**$32,062**
85-89	62	237	227	150	98	69	97	**940**
Avg benefit	$39,066	$35,007	$37,224	$36,339	$38,771	$39,181	$32,789	**$36,493**
90+	24	127	142	128	71	55	83	**630**
Avg benefit	$44,287	$38,759	$39,030	$40,757	$35,075	$37,587	$38,883	**$38,935**
Total	**457**	**1,754**	**1,442**	**923**	**517**	**306**	**328**	**5,727**
Avg benefit	**$29,952**	**$27,234**	**$28,539**	**$29,038**	**$29,243**	**$30,576**	**$30,654**	**$28,626**

Appendix A – Census Data Comparisons *(continued)*

Distribution of Disability Retirements

The table below summarizes the retained actuary's disability retirement data by age and years since disability retirement, and it also includes the average annual pension benefit for each grouping. It can be compared to the similar summary table in Appendix A, Table 20 from the July 1, 2019 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Years Since Disability Retirement at July 1, 2019								
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<45	1	12	7	1				**21**
Avg benefit	$23,679	$12,036	$9,363	$2,709				**$11,255**
45-49		26	11	5	2			**44**
Avg benefit		$22,039	$12,786	$5,963	$4,845			**$17,117**
50-54	3	33	14	9	5	3		**67**
Avg benefit	$21,385	$26,103	$14,449	$9,837	$7,211	$6,787		**$18,997**
55-59	4	50	41	19	3	3	1	**121**
Avg benefit	$29,236	$26,617	$20,188	$15,334	$14,226	$6,563	$2,991	**$21,754**
60-64	5	77	74	32	17	5	5	**215**
Avg benefit	$17,012	$26,806	$25,781	$19,330	$13,640	$20,578	$10,633	**$23,551**
65+		16		1				**17**
Avg benefit		$31,291		$33,165				**$31,402**
Total	**13**	**214**	**147**	**67**	**27**	**11**	**6**	**485**
Avg benefit	**$22,295**	**$25,581**	**$21,388**	**$15,882**	**$11,863**	**$12,995**	**$9,359**	**$21,633**

Appendix B – Market Value of Assets Comparison

The exhibit below compares the market value of assets from the system's CAFR to the amounts used by the retained actuary (see Section II, Table 1 in the July 1, 2019 valuation report). We find that the entries compare well, which indicates that the market asset data used in the valuation report was correct. All amounts shown are in $1,000's.

	Retained Actuary	System Financials
Cash and short-term investments		
Cash	$ 11,076	$ 11,076
Building account cash	47	47
Short term investments	654,048	654,048
Total cash and short term investments	665,171	665,171
Accounts receivable	22,324	22,324
Investments (at fair value)		
Bond pool	4,630,885	4,630,885
Alternative investment pool	3,311,887	3,311,887
Domestic stock pool	9,561,812	9,561,812
Broad international stock fund	4,678,182	4,678,182
	22,182,766	22,182,766
Securities lending collateral	1,692,432	1,692,432
Buildings		
Land	171	171
Building & equipment net of depreciation	5,710	5,710
Total buildings	5,881	5,881
Capital assets net of depreciation	13,262	13,262
Total Assets	**$ 24,581,836**	**$ 24,581,836**
Current liabilities		
Accounts payable	$ 8,551	$ 8,551
Accrued compensated absences	87	87
Accrued expenses - building	30	30
Bonds payable	643	643
Bond interest payable	5	5
Securities lending collateral	1,692,432	1,692,432
Total current liabilities	1,701,748	1,701,748
Long term liabilities		
Accrued compensated absences	776	776
Bonds payable	3,256	3,256
Total long term liabilities	4,032	4,032
Total Liabilities	**$ 1,705,780**	**$ 1,705,780**
Net position restricted for pensions	**$ 22,876,056**	**$ 22,876,056**
Earnings Limitation Savings Account (ELSA) accounts payable	(3,903)	(3,903)
Net position restricted for pensions after ELSA adjustment	**$ 22,872,153**	**$ 22,872,153**

Appendix C – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's January 1, 2019 AVA calculation to our replication. The calculations match and are consistent with relevant Minnesota Statutes, Section 356.215, Subd.1(f) so we believe they were prepared correctly. All amounts shown are in $1,000's.

	Original amounts	Unrecognized percent	Retained Actuary	VIA Match
1. Market value of assets available for benefits			**22,872,153**	**22,872,153**
2. Determination of average asset balance				
a. Total assets at beginning of year			22,362,087	22,362,087
b. Total assets at end of year			22,876,056	22,876,056
c. Net investment income for fiscal year			1,579,099	1,579,099
d. Average balance (a. + b. - c.)/2			21,829,522	21,829,522
3. Expected return (7.50% x 2.d.)			1,637,214	1,637,214
4. Actual return			1,579,099	1,579,099
5. Current year asset gain/(loss) (4. - 3.)			(58,115)	(58,115)
6. Unrecognized asset returns	Original amounts	Unrecognized percent	Unrecognized amounts	Unrecognized amounts
a. FYE 2019	(58,115)	80%	(46,492)	(46,492)
b. FYE 2018	398,058	60%	238,835	238,835
c. FYE 2017	1,342,126	40%	536,850	536,850
d. FYE 2016	(1,619,440)	20%	(323,888)	(323,888)
e. Total unrecognized amount			405,305	405,305
7. AVA at end of year (1. - 6.f.)			**22,466,848**	**22,466,848**

Appendix D – Plan Liability Replications

The exhibits below compare our replication of the plan liabilities to those calculated by the retained actuary. We believe that the overall closeness of the results indicates the July 1, 2019 actuarial valuation report liabilities are reasonable. There are a couple of small benefit subclasses with larger differences (e.g., active deferred retirements and refunds), but these are very small relative to the overall plan and we believe they're due to different benefit classification interpretations. All amounts shown are in $1,000's.

Present Value of Benefits (PVB) Liability	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 14,023,219	$ 14,208,726	$ 185,507	1.3%
Disability benefits	333,229	332,466	(763)	-0.2%
Survivor benefits	109,128	110,560	1,432	1.3%
Deferred retirements	403,267	324,803	(78,464)	-19.5%
Refunds	15,051	13,296	(1,755)	-11.7%
Subtotal	$ 14,883,894	$ 14,989,851	$ 105,957	0.7%
Deferred retirements	648,370	642,667	(5,703)	-0.9%
Former members without vested rights	95,067	95,067	-	0.0%
Benefit recipients (retirees and survivors)	18,755,398	18,684,175	(71,223)	-0.4%
Total	**$ 34,382,729**	**$ 34,411,760**	**$ 29,031**	**0.1%**

Present Value of Future Normal Costs (PVFNC)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 4,261,384	$ 4,409,249	$ 147,865	3.5%
Disability benefits	139,981	140,801	820	0.6%
Survivor benefits	41,235	42,485	1,250	3.0%
Deferred retirements	503,871	347,134	(156,737)	-31.1%
Refunds	190,084	165,560	(24,524)	-12.9%
Subtotal	$ 5,136,555	$ 5,105,229	$ (31,326)	-0.6%
Deferred retirements	-	-	-	0.0%
Former members without vested rights	-	-	-	0.0%
Benefit recipients (retirees and survivors)	-	-	-	0.0%
Total	**$ 5,136,555**	**$ 5,105,229**	**$ (31,326)**	**-0.6%**

Actuarial Accrued Liability (AAL)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 9,761,835	$ 9,799,477	$ 37,642	0.4%
Disability benefits	193,248	191,665	(1,583)	-0.8%
Survivor benefits	67,893	68,075	182	0.3%
Deferred retirements	(100,604)	(22,331)	78,273	-77.8%
Refunds	(175,033)	(152,264)	22,769	-13.0%
Subtotal	$ 9,747,339	$ 9,884,622	$ 137,283	1.4%
Deferred retirements	648,370	642,667	(5,703)	0.0%
Former members without vested rights	95,067	95,067	-	0.0%
Benefit recipients (retirees and survivors)	18,755,398	18,684,175	(71,223)	0.0%
Total	**$ 29,246,174**	**$ 29,306,531**	**$ 60,357**	**0.2%**

Appendix E – Contribution Sufficiency/(Deficiency) Replication

The exhibit below compares our replication of the contribution calculations to the retained actuary's results. We begin by replicating the Supplemental Contribution Rate and then determine the Contribution Sufficiency/(Deficiency). We believe that the overall closeness of the results indicates the July 1, 2019 actuarial valuation report calculations are reasonable. All amounts shown are in $1,000's.

Supplemental Contribution Rate	**Retained Actuary**	**VIA Replication**	**$ Difference**
Determination of UAAL			
Actuarial Accrued Liability (AAL)	$ 29,246,174	$ 29,306,532	$ 60,358
Current assets (AVA)	22,466,848	22,466,848	-
Unfunded Actuarial Accrued Liability (UAAL)	$ 6,779,326	$ 6,839,684	$ 60,358
Determination of supplemental contribution rate			
Present value of future payrolls through the June 30, 2048 amortization date	$ 87,220,442	87,583,596	$ 363,154
Supplemental contribution rate	**7.77%**	**7.81%**	

Contribution Sufficiency/(Deficiency)	**Retained Actuary**		**VIA Replication**		**Difference**
Projected annual payroll for FY2019-2020		$ 5,340,671		$ 5,330,015	$ (10,656)
Statutory contributions - Chapter 354	**% of Payroll**	**$ Amount**	**% of Payroll**	**$ Amount**	**$ Difference**
Employee contributions	7.50%	$ 400,553	7.50%	$ 399,751	$ (802)
Employer contributions	8.11%	433,135	8.11%	432,264	(871)
Supplemental contributions					
1993 legislation	0.09%	5,000	0.09%	5,000	-
1996 legislation	0.06%	3,256	0.06%	3,256	-
1997 legislation	0.24%	12,954	0.24%	12,954	-
2014 legislation	0.27%	14,377	0.27%	14,377	-
Total statutory contributions	**16.27%**	**$ 869,275**	**16.27%**	**$ 867,602**	**$ (1,673)**
Required contributions - Chapter 356					
Normal cost					
Retirement benefits	7.61%	$ 406,432	7.62%	406,293	$ (139)
Disability benefits	0.23%	12,284	0.23%	12,230	(54)
Survivor benefits	0.08%	4,272	0.08%	4,145	(127)
Deferred retirement benefits	0.85%	45,396	0.62%	33,092	(12,304)
Refunds	0.34%	18,158	0.29%	15,285	(2,873)
Total normal cost	9.11%	$ 486,542	8.84%	$ 471,045	$ (15,497)
Supplemental contribution to amortize the UAAL by June 30, 2048	7.77%	414,970	7.81%	416,274	1,304
Allowance for expenses	0.30%	16,022	0.30%	15,990	(32)
Total required contribution for fiscal year ending June 30, 2020	**17.18%**	**$ 917,534**	**16.95%**	**$ 903,309**	**$ (14,225)**