Minnesota
Legislative Commission on Pensions and Retirement

Replication of July 1, 2021
MSRS SERF Actuarial Valuation Report

July 5, 2022

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Retirement planning for employers

July 5, 2022

Minnesota Legislative Commission on Pensions and Retirement
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St. Paul, MN 55155

Attn: Susan Lenczewski, Executive Director

Re: Replication of July 1, 2021 MSRS SERF Actuarial Valuation Report

Commission Members:

This report presents our replication of the July 1, 2021 actuarial valuation report for the Minnesota State Retirement System State Employees Retirement Fund (MSRS SERF). 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.

In our professional opinion, we were able to reasonably match the retained actuary's data inputs, liability calculations, and contribution determinations. We did not find any meaningful differences or deficiencies in their calculations, 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.

Purpose of the Study

This study was prepared at the request of the Legislative Commission on Pensions and Retirement (LCPR). Its sole purpose is to replicate the July 1, 2021 MSRS SERF actuarial valuation calculations for reasonability, accuracy, and compliance with applicable Minnesota Statutes; LCPR standards for 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."

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.

July 5, 2022

Data Used in the Analysis

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

- July 1, 2021 actuarial valuation report prepared by the MSRS SERF's retained actuary;
- July 1, 2021 census data files provided by MSRS, and "scrubbed" census files provided by the retained actuary; and
- July 1, 2021 asset and financial data found in the system's audited financial statements.

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 GRS 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
Consulting Actuary

L/D/C/R:5/mjc/emk/mws

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Executive Summary

This report summarizes our replication of the July 1, 2021 MSRS State Employees Retirement Fund actuarial valuation report. We conclude that the retained actuary reasonably determined the system's July 1, 2021 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.

	MSRS SERF Actuarial Valuation	VIA Replication	Difference[1]
Participant data			
Active members	50,889	50,889	0.0%
Service retirements	39,335	39,335	0.0%
Survivors	4,371	4,371	0.0%
Disability retirements	1,738	1,738	0.0%
Deferred retirements	17,317	17,317	0.0%
Other non-vested terminations	9,562	9,562	0.0%
Total	**123,212**	**123,212**	0.0%
System assets *($1,000's)*			
Market value of assets	$ 17,440,051	$ 17,440,051	0.0%
Actuarial Value of Assets	15,197,610	15,197,610	0.0%
System liabilities *($1,000's)*			
Present Value of Future Benefits (PFVB)	17,729,212	17,744,221	0.1%
Present Value of Future Normal Costs (PVFNC)	2,082,811	2,209,158	6.1%
Actuarial Accrued Liability (AAL)	15,646,401	15,535,063	-0.7%
Normal Cost (NC)	274,885	270,501	-1.6%
System contributions *(% of payroll)*			
Normal cost rate	7.98%	7.81%	-0.17%
UAAL amortization payment	0.83%	0.62%	-0.21%
Expenses	0.32%	0.32%	0.00%
Total required contribution (Chapter 356)	9.13%	8.75%	-0.38%
Statutory contribution rate (Chapter 352)	12.25%	12.25%	0.00%
Contribution sufficiency/(deficiency)	3.12%	3.50%	0.38%

[1] The system contribution comparisons are absolute differences presented as a percent of payroll. All other comparisons are the relative differences between our replication results and the retained actuary.

Process Overview

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 Future Benefits (PVFB), Present Value of Future Normal Costs (PVFNC), Actuarial Accrued Liability (AAL), and Normal Cost (NC) ▪ 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, 2021 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, 2021 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, 2021 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.
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 on page 12 of the July 1, 2021 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 on pages 13, 14 and 15 of the July 1, 2021 actuarial valuation report.

We've also included summary participant statistics for some additional special groups: Military Affairs, Fire Marshals, and Unclassified Plan. These supplementary statistics can be found in **Appendix E**.

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 the 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, 2021 actuarial valuation report, we used the following process:

- Review audited financial data and compare it to the information disclosed in the actuarial valuation report; and
- Replicate the AVA calculations shown in the July 1, 2021 actuarial valuation report.

We found that the asset data used by the retained actuary was consistent with the system's audited asset information. 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 a complex process which involves substantial effort and actuarial programming experience.

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, 2021 actuarial valuation report, Minnesota Statutes, and the LCPR's standards for actuarial work. The primary results we replicated are:

- **Present Value of Future Benefits (PVFB):** plan liability equal to the discounted value of all projected future benefit payments (based on current participant group with projected compensation and service accruals).
- **Normal Cost (NC):** the portion of the PVFB allocated to the valuation year based on current compensation levels.
- **Present Value of Future Normal Costs (PVFNC):** the portion of the PVFB allocated to future years based on the present value of projected participant compensation.
- **Actuarial Accrued Liability (AAL):** the portion of the PFVB allocated to prior years based on each participant's historical and projected compensation.

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 PVFB and AAL within 2% and PVFNC and Normal Cost within 5% of the retained actuary's results.

Results 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.

The tables in **Appendix D** summarize and compare the liability measurements for different membership groups. **Our overall results are very close to those presented in the July 1, 2021 actuarial valuation, and we believe that the retained actuary is reasonably calculating plan liabilities.**

The PVFB, AAL, and NC were all well within our preferred replication margins. The PVFNC calculation was slightly outside our standard 5% threshold, but we believe the results are still reasonable. The PVFNC difference is modest relative to the total plan liability, and the discrepancy has minimal effect on overall plan results and the evaluation of contribution sufficiency.

We've also included liability replication information for the Unclassified Plan in **Appendix E**. We believe that the gross liabilities matched reasonably well for this special group. Note that the net Contingent Liability (account balances minus accrued liability) appears to differ by a greater amount, but that is because it is leveraged since it's the difference between two small numbers.

We have not shown replicated liabilities for the Military Affairs and Fire Marshals special groups in Appendix E since they are such small components of the total plan liability

Contribution Sufficiency/(Deficiency)

MSRS's statutory pension contribution rates are defined in Chapter 352 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:

- **Statutory contributions:** We calculated the estimated dollar value of the statutory normal cost contributions based on the retained actuary's blended statutory normal cost contribution rates applied to our replication of projected payroll. These amounts are added to the statutory supplemental contribution rates to determine the total statutory contribution rate.
- **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. The normal cost and supplemental components of the required contributions were based our replication of the Plan's normal cost, Unfunded Actuarial Accrued Liability, and projected payroll through the statutory June 30, 2048 full funding date.
- **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, 2021 actuarial valuation report

The tables in **Appendix F** summarize and compare our calculations. **Our overall results are 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, 2021 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 on pages 24 through 38. 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 MSRS use the Entry Age Normal level percent of pay actuarial cost method. In this method, the actuarial Present Value of Future Benefits (PVFB) 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 PVFB allocated to the valuation year is called the Normal Cost (NC). The portion of the PVFB 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 pages 18-20 of the July 1, 2021 actuarial valuation report describes the correct contribution calculation process, and our replication calculations (Appendix F 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 the July 1, 2021 actuarial valuation report were based on those developed in the 2014-2018 actuarial experience study dated June 27, 2019. The allowance for Combined Service Annuity assumptions are based on the LCPR prior actuary's report dated October 2016.

Economic assumptions: We verified that the economic assumptions described in the July 1, 2021 actuarial valuation report were based on those developed in the 2019 experience study, with an investment return assumption and discount rate per Minnesota Statute, Section 356.215 Subd.8(a).

Plan Provisions

Minnesota Statutes, Chapter 352 describe the retirement benefits provided to MSRS members, and the primary service annuity formulas. We reviewed the plan provisions summarized in the July 1, 2021 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

	Retained Actuary	System Data	Difference
Active members	**50,889**	**50,889**	**0**
Average age	46.6	46.6	0.0%
Average service	10.74	10.74	0.0%
Average salary	$ 63,231	$ 63,231	0.0%
Service retirements	**39,335**	**39,335**	**0**
Average age	72.8	72.8	0.0%
Average annual annuity	$ 21,068	$ 21,068	0.0%
Survivors	**4,371**	**4,371**	**0**
Average age	75.6	75.6	0.0%
Average annual annuity	$ 18,506	$ 18,506	0.0%
Disability retirements	**1,738**	**1,738**	**0**
Average age	67.8	67.8	0.0%
Average annual annuity	$ 15,544	$ 15,544	0.0%
Deferred retirements	**17,317**	**17,317**	**0**
Average age	51.9	51.9	0.0%
Average annual annuity	$ 8,053	$ 8,053	0.0%
Other non-vested terminations	**9,562**	**9,562**	**0**
Total	**123,212**	**123,212**	**0**

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 on page 12 from the July 1, 2021 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years of Service as of June 30, 2021									
Age	**<3**	**3-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25-29**	**30-34**	**35+**	**Total**
<25	1,139	39								1,178
Avg pay	$32,360	$47,381								$32,857
25-29	2,428	914	397	1						3,740
Avg pay	$41,422	$50,249	$54,257	$57,316						$44,946
30-34	2,017	1,299	1,767	176	3					5,262
Avg pay	$47,645	$55,568	$59,667	$63,333	$77,183					$54,180
35-39	1,729	1,214	2,169	1,118	233	4				6,467
Avg pay	$51,226	$61,749	$66,066	$69,620	$70,837	$66,894				$62,075
40-44	1,270	957	1,742	1,161	815	277	2			6,224
Avg pay	$55,427	$63,876	$69,059	$73,331	$75,499	$75,690	$50,174			$67,410
45-49	1,051	650	1,311	922	786	662	86	3		5,471
Avg pay	$55,781	$65,218	$69,447	$75,129	$77,153	$81,540	$76,181	$76,088		$69,957
50-54	1,037	666	1,323	974	777	932	522	162	4	6,397
Avg pay	$55,014	$65,175	$68,860	$72,604	$74,727	$80,455	$84,001	$81,707	$106,095	$70,788
55-59	854	542	1,274	975	862	965	647	756	292	7,167
Avg pay	$51,406	$62,169	$68,417	$71,962	$72,887	$76,943	$81,515	$82,594	$77,836	$71,147
60-64	525	405	967	825	681	781	577	669	700	6,130
Avg pay	$50,114	$63,647	$66,449	$69,979	$70,896	$73,473	$79,170	$80,252	$77,180	$70,658
65-69	190	146	361	325	261	304	198	186	311	2,282
Avg pay	$40,527	$57,464	$70,485	$67,400	$75,227	$74,464	$80,107	$77,914	$75,508	$69,916
70+	91	39	78	71	64	70	32	29	97	571
Avg pay	$24,410	$36,063	$55,873	$63,827	$65,907	$75,828	$71,293	$69,538	$78,248	$59,425
Total	12,331	6,871	11,389	6,548	4,482	3,995	2,064	1,805	1,404	50,889
Avg pay	$47,709	$59,834	$66,199	$71,548	$74,059	$77,541	$80,942	$80,944	$77,102	$64,552

Note that the average pay in this table does not match the average pay for active members on the prior page because the amounts shown above include data adjustments as described in the assumption section of the 2021 valuation report.

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 on Page 13 from the July 1, 2021 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years Retired as of June 30, 2021							
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<50			7	7				14
Avg benefit			$8,049	$2,764				$5,406
50-54	1	3	3	3				10
Avg benefit	$841	$2,823	$6,254	$2,951				$3,692
55-59	210	385	25	4				624
Avg benefit	$19,346	$18,177	$12,674	$1,185				$18,241
60-64	784	1,825	944	32				3,585
Avg benefit	$21,842	$22,725	$17,784	$9,817				$21,115
65-69	1,223	4,705	3,095	1,081	20	2		10,126
Avg benefit	$21,685	$21,577	$21,972	$19,102	$14,368	$20,747		$21,432
70-74	235	1,950	4,868	3,102	1,091	19	2	11,267
Avg benefit	$23,082	$21,465	$21,303	$22,818	$18,272	$11,585	$11,742	$21,473
75-79	40	236	1,192	2,661	1,902	753	7	6,791
Avg benefit	$27,359	$20,211	$19,730	$21,029	$21,411	$18,769	$20,832	$20,666
80-84	10	43	150	557	1,438	1,264	299	3,761
Avg benefit	$15,280	$16,561	$17,814	$18,918	$18,934	$20,883	$21,247	$19,689
85-89		6	34	54	234	919	747	1,994
Avg benefit		$20,274	$11,988	$15,150	$15,483	$19,970	$25,471	$21,239
90+	1	2	6	12	33	154	955	1,163
Avg benefit	$28,195	$26,155	$23,123	$12,680	$9,327	$19,565	$23,154	$22,188
Total	2,504	9,155	10,324	7,513	4,718	3,111	2,010	39,335
Avg benefit	$21,728	$21,574	$20,886	$21,196	$19,522	$19,980	$23,712	$21,068

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 on page 14 of the July 1, 2021 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years Since Death as of June 30, 2021							
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<45	12	46	38	12	2		2	112
Avg benefit	$11,221	$5,655	$5,693	$11,219	$5,580		$17,637	$7,073
45-49	3	10	12	15	1			41
Avg benefit	$10,234	$5,842	$5,631	$12,428	$27,606			$9,042
50-54	12	24	19	8	5	3	1	72
Avg benefit	$9,628	$8,608	$9,188	$7,016	$11,050	$5,100	$3,699	$8,709
55-59	20	43	33	19	8	4	1	128
Avg benefit	$10,908	$13,328	$10,886	$10,252	$10,344	$5,652	$2,695	$11,354
60-64	30	83	72	43	19	4	9	260
Avg benefit	$13,447	$15,413	$14,157	$11,954	$11,534	$12,122	$6,866	$13,636
65-69	47	174	136	91	40	22	14	524
Avg benefit	$18,218	$18,490	$18,246	$16,591	$14,243	$10,309	$7,476	$17,110
70-74	84	200	163	124	110	34	18	733
Avg benefit	$17,404	$19,712	$19,295	$17,998	$15,048	$16,227	$12,113	$18,017
75-79	70	210	162	135	97	49	31	754
Avg benefit	$19,409	$20,825	$19,278	$16,151	$16,456	$16,459	$14,811	$18,431
80-84	53	149	156	111	79	60	61	669
Avg benefit	$19,388	$21,120	$22,638	$19,239	$19,044	$19,121	$20,946	$20,584
85-89	42	132	139	98	64	52	55	582
Avg benefit	$23,129	$22,893	$23,255	$21,889	$23,327	$24,325	$18,633	$22,600
90+	12	72	91	88	88	54	77	482
Avg benefit	$19,464	$19,955	$23,294	$28,319	$23,598	$23,365	$19,305	$23,044
Total	385	1,143	1,021	744	513	282	269	4,357
Avg benefit	$17,693	$18,824	$19,070	$18,522	$18,111	$18,955	$17,377	$18,565

Note that the survivor count and average benefit in this table does not match the information on page 9 because 14 survivors with a certain and life option but with a certain end date prior to the valuation were excluded as described in the assumption section of the 2021 valuation report.

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 on page 15 of the July 1, 2021 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

	Years Disabled as of June 30, 2021							
Age	**<1**	**1-4**	**5-9**	**10-14**	**15-19**	**20-24**	**25+**	**Total**
<45	2	5	1	3	1			12
Avg benefit	$4,004	$8,538	$4,912	$3,394	$1,772			$5,630
45-49	5	11	3	2	1			22
Avg benefit	$10,895	$9,045	$6,154	$5,733	$2,512			$8,473
50-54	5	10	9	8	7	2		41
Avg benefit	$19,050	$14,657	$11,380	$6,124	$6,059	$7,204		$10,977
55-59	10	51	46	34	17	5	1	164
Avg benefit	$17,074	$16,906	$11,014	$10,939	$9,940	$4,415	$3,842	$12,844
60-64	11	92	121	55	47	18	11	355
Avg benefit	$22,303	$17,717	$16,280	$16,017	$12,050	$8,133	$11,011	$15,662
65-69	1	45	116	112	91	49	19	433
Avg benefit	$13,910	$16,788	$15,926	$18,723	$13,348	$12,350	$11,668	$15,601
70-74	1		39	141	141	53	26	401
Avg benefit	$5,207		$18,086	$17,060	$17,382	$17,030	$17,061	$17,240
75+				30	86	97	97	310
Avg benefit				$16,581	$14,896	$16,121	$16,845	$16,052
Total	35	214	335	385	391	224	154	1,738
Avg benefit	$16,941	$16,525	$15,388	$16,424	$14,651	$14,528	$15,742	$15,544

Appendix B – Market Value of Assets Comparison

The exhibit below compares the market value of assets from the system's annual financial report to the amounts used by the retained actuary (see page 9 in the July 1, 2021 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
Assets in Trust		
Cash, equivalents, short term securities	268,962	268,962
Fixed income	3,951,958	3,951,958
Equity and private equity	13,180,842	13,180,842
Other	1,123,913	1,123,913
Total Assets in Trust	**18,525,675**	**18,525,675**
Assets Receivable	34,429	34,429
Amounts Payable	(1,120,053)	(1,120,053)
Net Assets Held in Trust for Pension Benefits	**17,440,051**	**17,440,051**

Appendix C – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's July 1, 2021 AVA calculation (see page 11 in the July 1, 2021 valuation report) 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.

				Retained Actuary	VIA Match
1.	**Market value of assets available for benefits**			17,440,051	17,440,051
2.	Determination of average asset balance				
	a. Total assets at beginning of year			13,855,691	13,855,691
	b. Total assets at end of year			17,440,051	17,440,051
	c. Net investment income for fiscal year			4,098,129	4,098,129
	d. Average balance (a. + b. - c.)/2			13,598,806	13,598,806
3.	Expected return (7.50% x 2.d.)			1,019,910	1,019,910
4.	Actual return			4,098,129	4,098,129
5.	Current year asset gain/(loss) (4. - 3.)			3,078,219	3,078,219
6.	Unrecognized asset returns	Original amounts	Unrecognized percent	Unrecognized amounts	Unrecognized amounts
	a. FYE 2021	3,078,219	80%	2,462,575	2,462,575
	b. FYE 2020	(445,017)	60%	(267,010)	(267,010)
	c. FYE 2019	(31,034)	40%	(12,414)	(12,414)
	d. FYE 2018	296,451	20%	59,290	59,290
	e. FYE 2017		0%	N/A	-
	f. Total unrecognized amount			2,242,441	2,242,441
7.	**AVA at end of year (1. - 6.f.)**			**15,197,610**	**15,197,610**

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, 2021 actuarial valuation report liabilities are reasonable. There are a couple of small benefit subclasses with larger differences (e.g., survivor benefits, Unclassified Plan contingent liability), but these are very small relative to the overall plan. All amounts shown are in $1,000's.

Present Value of Benefits (PVB) Liability	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 6,613,799	$ 6,603,654	$ (10,145)	-0.2%
Disability benefits	174,547	175,794	1,247	0.7%
Survivor benefits	82,818	88,093	5,275	6.4%
Deferred retirements	341,423	360,241	18,818	5.5%
Refunds	43,499	45,244	1,745	4.0%
Subtotal	$ 7,256,086	$ 7,273,026	$ 16,940	0.2%
Deferred retirements	895,204	897,919	2,715	0.3%
Former members without vested rights	11,758	11,553	(205)	-1.7%
Benefit recipients (retirees and survivors)	9,563,516	9,558,762	(4,754)	0.0%
Contingent actuarial accrued liability - UNCL Plan	2,648	2,961	313	11.8%
Total	**$ 17,729,212**	**$ 17,744,221**	**$ 15,009**	**0.1%**

Present Value of Future Normal Costs (PVFNC)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 1,522,993	$ 1,630,583	$ 107,590	7.1%
Disability benefits	69,328	74,577	5,249	7.6%
Survivor benefits	24,420	27,386	2,966	12.1%
Deferred retirements	342,563	358,542	15,979	4.7%
Refunds	123,507	118,070	(5,437)	-4.4%
Total	**$ 2,082,811**	**$ 2,209,158**	**$ 126,347**	**6.1%**

Actuarial Accrued Liability (AAL)	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 5,090,806	$ 4,973,071	$ (117,735)	-2.3%
Disability benefits	105,219	101,217	(4,002)	-3.8%
Survivor benefits	58,398	60,707	2,309	4.0%
Deferred retirements	(1,140)	1,699	2,839	N/A[2]
Refunds	(80,008)	(72,826)	7,182	-9.0%
Subtotal	$ 5,173,275	$ 5,063,868	$ (109,407)	-2.1%
Deferred retirements	895,204	897,919	2,715	0.3%
Former members without vested rights	11,758	11,553	(205)	-1.7%
Benefit recipients (retirees and survivors)	9,563,516	9,558,762	(4,754)	0.0%
Contingent actuarial accrued liability - UNCL Plan	2,648	2,961	313	11.8%
Total	**$ 15,646,401**	**$ 15,535,063**	**$ (111,338)**	**-0.7%**

[2] The percent difference is not shown in situations comparing negative and positive liability amounts.

Appendix D – Plan Liability Replications *(continued)*

Normal Cost	Retained Actuary	VIA Replication	$ Difference	% Difference
Active members				
Retirement annuities	$ 208,747	$ 207,148	$ (1,599)	-0.8%
Disability benefits	8,267	8,225	(42)	-0.5%
Survivor benefits	3,100	3,316	216	7.0%
Deferred retirements	39,614	38,226	(1,388)	-3.5%
Refunds	15,157	13,586	(1,571)	-10.4%
Total	**$ 274,885**	**$ 270,501**	**$ (4,384)**	**-1.6%**

Appendix E – Special Groups

The exhibits below compare our replication of the participant counts for the Military Affairs and Fire Marshals special groups to those calculated by the retained actuary. Because of the limited number of participants, the liability was not replicated.

Military Affairs

	Retained Actuary	VIA Replication
Number of active members	7	7
Average age	37.9	37.9
Average service	6.8	6.8

Fire Marshals

	Retained Actuary	VIA Replication
Number of active members	13	13
Average age	55.2	55.2
Average service	14.2	14.2

Unclassified Plan

The exhibit below compares our replication of the Unclassified Plan contingent liability to those calculated by the retained actuary.

	Retained Actuary	VIA Replication
Number of active members	1,151	1,151
Average age	43.5	44.2
Average service	8.6	8.6
Average Unclassified Plan account balance	$163,483	$163,483

		Retained Actuary	VIA Replication	$ Difference	% Difference
1.	Number of active members	1,151	1,151	-	0.0%
2.	Account balances for active eligible members	$ 188,168	$ 188,169	$ 1	0.0%
3.	Accrued liability for active members	190,816	191,130	314	0.2%
4.	Contingent liability (3. - 1.)	$ 2,648	$ 2,961	$ 313	11.8%

Appendix F – 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, 2021 actuarial valuation report calculations are reasonable. All amounts shown are in $1,000's.

Supplemental Contribution Rate	Retained Actuary	VIA Replication	$ Difference	% Difference
1. Determination of Unfunded Actuarial Accrued Liability (UAAL)				
a. Actuarial accrued liability	$ 15,646,401	$ 15,535,063	$ (111,338)	-0.7%
b. Current assets (AVA)	15,197,610	15,197,610	-	0.0%
c. Unfunded actuarial accrued liability	$ 448,791	$ 337,453	$ (111,338)	-24.8%
2. Determination of Supplemental Contribution Rate				
a. Present value of future payrolls through the amortization date of June 30, 2048	$ 54,210,819	$ 54,473,952	$263,133	0.5%
b. Supplemental contribution rate: (1.c. / 2.a.)	0.83%	0.62%		

	Retained Actuary	VIA Replication	$ Difference
Projected annual payroll for FY2021-2022	$3,444,663	$3,461,383	$ 16,720

	% of Payroll	$ Amount	% of Payroll	$ Amount	$ Difference
1. Statutory Contributions - Chapter 352					
a. Employee contributions	6.00%	$ 206,680	6.00%	$ 207,683	$ 1,003
b. Employer contributions	6.25%	215,291	6.25%	216,336	1,045
c. Total	12.25%	$ 421,971	12.25%	$ 424,019	$ 2,048
2. Required Contributions - Chapter 356					
a. Normal cost					
i. Retirement benefits	6.06%	$ 208,747	5.98%	$ 207,148	$ (1,599)
ii. Disability benefits	0.24%	8,267	0.24%	$ 8,225	(42)
iii. Survivors	0.09%	3,100	0.10%	$ 3,316	216
iv. Deferred retirement benefits	1.15%	39,614	1.10%	$ 38,226	(1,388)
v. Refunds	0.44%	$ 15,157	0.39%	$ 13,586	$ (1,571)
vi. Total	7.98%	$ 274,885	7.81%	$ 270,501	$ (4,384)
b. Supplemental Contribution Amortization of Unfunded Actuarial Accrued Liability by June 30, 2048	0.83%	$ 28,591	0.62%	$ 21,442	$ (7,149)
c. Allowance for Expenses	0.32%	11,023	0.32%	$ 11,076	53
d. Total	9.13%	$ 314,499	8.75%	$ 303,019	$ (11,480)
3. Contribution Sufficiency/(Deficiency)	3.12%	$ 107,472	3.50%	$ 121,000	$ 13,528