

**Minnesota
Legislative Commission on
Pensions and Retirement**

**Replication of July 1, 2020
PERA General Plan Actuarial Valuation Report**

June 24, 2021

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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, 2020 PERA General Plan Actuarial Valuation Report

Commission Members:

This report presents our replication of the July 1, 2020 actuarial valuation report for the Public Employees Retirement Association of Minnesota General Employees Retirement Plan (PERA General Plan). 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, 2020 PERA General Plan 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, 2020 actuarial valuation report prepared by the PERA General Plan's retained actuary;
- July 1, 2020 census data files provided by PERA and "scrubbed" census files provided by the retained actuary; and
- July 1, 2020 asset and financial data provided by PERA.

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.

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Consulting Actuary

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

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Executive Summary

This report summarizes our replication of the July 1, 2020 PERA General Employees Retirement Plan actuarial valuation report. We conclude that the retained actuary reasonably determined the system's July 1, 2020 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.

Our Normal Cost is approximately 5.6% lower than the retained actuary's results. We worked with the retained actuary to understand the difference and determined that the majority of the discrepancy is due to a difference in actuarial valuation software methods. The retained actuary's software calculates benefits at the middle of the year, while ours calculates benefits at the beginning of the year and adjusts for middle of year decrement timing.

	PERA General Plan Actuarial Valuation	VIA Replication	Difference ¹
Participant data			
Active members	153,741	153,741	0.0%
Service retirements	95,830	98,126	2.4%
Survivors	8,981	8,982	0.0%
Disability retirements	3,681	1,385	-62.4%
Deferred retirements	64,672	64,659	0.0%
Other non-vested terminations	79,069	79,070	0.0%
Total	405,974	405,963	0.0%
System assets (\$1,000's)			
Market value of assets	\$ 22,631,459	\$ 22,631,459	0.0%
Actuarial Value of Assets	22,792,333	22,792,333	0.0%
System liabilities (\$1,000's)			
Present Value of Benefits (PVB)	32,507,634	32,562,419	0.2%
Present Value of Future Normal Costs (PVFNC)	3,880,718	3,963,761	2.1%
Actuarial Accrued Liability (AAL)	28,626,916	28,598,658	-0.1%
System contributions (% of payroll)			
Normal cost rate	7.68%	7.25%	-0.43%
UAAL amortization payment	5.27%	5.23%	-0.04%
Expenses	0.18%	0.18%	0.00%
Total required contribution (Chapter 356)	13.13%	12.66%	-0.47%
Statutory contribution rate (Chapter 353)	14.53%	14.53%	0.00%
Contribution sufficiency/(deficiency)	1.40%	1.87%	0.47%

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

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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ 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, 2020 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, 2020 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, 2020 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 the exception of reclassification of Service Retirements vs. Disability Retirements and 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 on page 14 of the July 1, 2020 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 18, 22 and 26 of the July 1, 2020 actuarial valuation report.

During the replication process, GRS discovered a small typo on page 43 of their report. It was originally disclosed that nine years of service was assumed for terminated vested members where this information was not provided by the system. However, the liability calculations actually used six years of service for this purpose. We used six years of service for our liability replication.

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, 2020 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, 2020 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 modeling 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, 2020 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, 2020 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 and AAL within 2% and PVFNC within 5% of the retained actuary's results.

Our Normal Cost is approximately 5.6% lower than the retained actuary's results. We worked with the retained actuary to understand the difference and determined that the majority of the discrepancy is due to a difference in actuarial valuation software methods. The retained actuary's software calculates benefits at the middle of the year, while ours calculates benefits at the beginning of the year and adjusts for middle of year decrement timing.

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 methods and actuarial valuation systems.

Contribution Sufficiency/(Deficiency)

PERA's statutory pension contribution rates are defined in Chapter 353 of Minnesota Statutes, 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, 2020 actuarial valuation report

The tables in Appendix E 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, 2020 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 39 through 69. 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 PERA 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 pages 35-38 of the July 1, 2020 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 the July 1, 2020 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.

Several of the assumptions are no longer in agreement with those described in the 2018 Appendix to the LCPR's Standards for Actuarial Work. We recommend the appendix be updated to be less prescriptive.

Economic assumptions: We verified that the economic assumptions described in the July 1, 2020 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 353 describe the retirement benefits provided to PERA members, and the primary service annuity formulas. We reviewed the plan provisions summarized in the July 1, 2020 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. The notable differences are reasonable and the actuary’s data updates appear appropriate.

Summary of Participant Statistics

	Retained Actuary	System Data	Difference
Active members	153,741	153,741	0
Average age	46.3	46.3	0.0%
Average service	9.54	9.58	0.3%
Average salary	\$ 41,298	\$ 40,986	-0.8%
Service retirements²	95,830	98,126	2,296
Average age	73.1	73.1	0.0%
Average yearly annuity	\$ 14,921	\$ 14,914	0.0%
Survivors	8,981	8,982	1
Average age	76.4	76.4	0.0%
Average yearly annuity	\$ 15,893	\$ 15,892	0.0%
Disability retirements²	3,681	1,385	(2,296)
Average age	68.3	59.7	-12.5%
Average yearly annuity	\$ 14,065	\$ 13,148	-6.5%
Deferred retirements	64,672	64,659	(13)
Average age	50.6	50.6	0.0%
Other non-vested terminations	79,069	79,070	1
Average age	50.9	48.8	-4.1%
Total	405,974	405,963	(11)

² PERA reclassifies disabled members as service retirees once they reach Normal Retirement Age. Therefore, the retained actuary adjusted the status for 2,296 service retirees to be disabled retirees based on their historical classification as disabled retirees.

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 14 from the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years of Service as of June 30, 2020									Total
	<3	3-4	5-9	10-14	15-19	20-24	25-29	30-34	35+	
<25	7,650	560	68							8,278
Avg pay	\$17,861	\$28,196	\$32,462							\$18,680
25-29	7,872	2,970	1,625	12						12,479
Avg pay	\$29,059	\$39,238	\$43,945	\$42,192						\$33,432
30-34	6,496	3,286	4,467	863	21					15,133
Avg pay	\$31,969	\$44,798	\$52,097	\$53,635	\$50,734					\$41,958
35-39	6,179	3,110	4,698	2,492	814	41				17,334
Avg pay	\$29,983	\$44,661	\$53,842	\$62,930	\$61,871	\$62,526				\$45,394
40-44	4,957	2,672	4,186	2,373	1,962	757	16			16,923
Avg pay	\$30,420	\$39,516	\$49,268	\$60,752	\$70,230	\$69,555	\$72,250			\$47,177
45-49	3,954	2,193	4,046	2,579	2,039	1,893	480	18		17,202
Avg pay	\$28,766	\$38,484	\$43,196	\$52,782	\$65,502	\$74,373	\$70,918	\$66,250		\$47,588
50-54	3,311	1,866	3,701	3,175	2,615	2,256	1,568	704	31	19,227
Avg pay	\$31,261	\$39,131	\$41,087	\$45,600	\$54,777	\$66,819	\$73,217	\$71,791	\$67,424	\$48,619
55-59	2,931	1,658	3,184	3,138	3,330	3,045	2,041	1,654	641	21,622
Avg pay	\$26,840	\$37,187	\$39,905	\$41,993	\$46,369	\$54,985	\$67,095	\$75,270	\$71,644	\$47,561
60-64	2,271	1,250	2,371	1,987	2,482	2,655	1,960	1,226	1,066	17,268
Avg pay	\$23,057	\$33,260	\$38,386	\$42,533	\$45,191	\$47,972	\$54,852	\$68,866	\$74,295	\$45,178
65-69	1,231	523	974	699	652	624	456	266	283	5,708
Avg pay	\$14,736	\$22,093	\$28,973	\$36,860	\$41,017	\$43,464	\$48,960	\$60,128	\$73,351	\$34,447
70+	694	362	611	315	218	128	91	60	88	2,567
Avg pay	\$10,288	\$14,744	\$15,569	\$23,980	\$28,006	\$40,567	\$39,928	\$54,085	\$60,629	\$20,668
Total	47,546	20,450	29,931	17,633	14,133	11,399	6,612	3,928	2,109	153,741
Avg pay	\$26,978	\$39,196	\$45,042	\$49,809	\$54,160	\$59,116	\$63,583	\$71,257	\$72,691	\$42,953

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 2020 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 18 from the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Retired as of June 30, 2020							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<50								
Avg benefit								
50-54	2	10						12
Avg benefit	\$11,269	\$8,154						\$8,673
55-59	535	1,307	37	1				1,880
Avg benefit	\$18,090	\$12,651	\$12,343	\$13,582				\$14,193
60-64	1,466	5,495	2,489	74	12			9,536
Avg benefit	\$17,866	\$16,623	\$14,245	\$21,617	\$37,152			\$16,258
65-69	2,029	11,754	8,277	2,552	191	11		24,814
Avg benefit	\$15,955	\$15,292	\$15,946	\$13,637	\$31,870	\$34,677		\$15,531
70-74	263	3,643	11,313	6,021	2,715	166	10	24,131
Avg benefit	\$13,430	\$13,781	\$14,663	\$15,220	\$14,947	\$42,494	\$41,572	\$14,890
75-79	67	541	2,648	5,635	4,293	2,159	18	15,361
Avg benefit	\$10,091	\$9,913	\$11,658	\$12,969	\$14,360	\$15,473	\$44,502	\$13,400
80-84	17	194	586	1,216	3,708	3,540	1,027	10,288
Avg benefit	\$6,826	\$5,961	\$8,929	\$10,070	\$11,443	\$15,278	\$21,438	\$13,344
85-89	5	52	185	304	665	2,620	2,294	6,125
Avg benefit	\$8,265	\$6,114	\$5,790	\$6,035	\$8,808	\$13,487	\$21,687	\$15,381
90+	3	5	39	72	168	416	2,980	3,683
Avg benefit	\$6,837	\$2,257	\$5,538	\$5,717	\$6,706	\$10,752	\$20,073	\$17,941
Total	4,387	23,001	25,574	15,875	11,752	8,912	6,329	95,830
Avg benefit	\$16,560	\$14,989	\$14,514	\$13,583	\$13,460	\$15,119	\$20,983	\$14,921

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 22 of the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Since Death as of June 30, 2020							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<45	16	94	51	23	7	10	2	203
Avg benefit	\$6,074	\$8,157	\$4,968	\$5,219	\$4,331	\$10,305	\$14,583	\$6,896
45-49	8	22	21	15	5	4	7	82
Avg benefit	\$7,395	\$9,734	\$8,447	\$6,271	\$3,915	\$8,925	\$14,705	\$8,573
50-54	18	53	42	26	13	7	6	165
Avg benefit	\$11,310	\$8,223	\$6,323	\$5,093	\$8,814	\$9,568	\$7,007	\$7,642
55-59	31	104	82	36	12	8	15	288
Avg benefit	\$10,351	\$11,931	\$7,636	\$8,789	\$4,324	\$13,466	\$12,887	\$9,921
60-64	64	220	184	81	40	20	15	624
Avg benefit	\$12,463	\$13,348	\$11,724	\$9,565	\$8,689	\$15,461	\$11,434	\$12,011
65-69	95	344	264	159	87	43	36	1,028
Avg benefit	\$12,373	\$13,149	\$12,020	\$12,341	\$12,045	\$16,753	\$20,236	\$12,968
70-74	104	394	340	201	123	55	48	1,265
Avg benefit	\$13,505	\$13,127	\$13,462	\$12,819	\$12,646	\$21,231	\$20,741	\$13,794
75-79	105	343	319	199	126	77	114	1,283
Avg benefit	\$13,879	\$14,623	\$13,461	\$12,392	\$13,139	\$16,527	\$20,588	\$14,426
80-84	87	365	336	181	162	108	172	1,411
Avg benefit	\$13,908	\$15,119	\$15,806	\$17,167	\$15,275	\$20,935	\$25,853	\$17,242
85-89	60	279	276	183	146	118	219	1,281
Avg benefit	\$18,351	\$18,633	\$21,101	\$16,943	\$20,040	\$19,786	\$23,717	\$20,046
90+	38	195	240	209	179	135	355	1,351
Avg benefit	\$25,378	\$21,633	\$21,488	\$18,808	\$21,538	\$21,818	\$24,361	\$21,998
Total	626	2,413	2,155	1,313	900	585	989	8,981
Avg benefit	\$14,043	\$14,604	\$14,764	\$14,152	\$15,643	\$19,358	\$23,154	\$15,893

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 26 of the July 1, 2020 actuarial report. We find that the entries compare well to those in the actuarial valuation report.

Age	Years Disabled as of June 30, 2020							Total
	<1	1-4	5-9	10-14	15-19	20-24	25+	
<45	2	7	8	3				20
Avg benefit	\$15,007	\$6,288	\$7,343	\$2,965				\$7,084
45-49	2	20	19	1	3			45
Avg benefit	\$21,975	\$12,852	\$9,669	\$12,676	\$3,482			\$11,285
50-54	9	43	35	17	10			114
Avg benefit	\$15,284	\$11,147	\$9,421	\$6,887	\$4,628			\$9,737
55-59	28	134	87	59	28	5	7	348
Avg benefit	\$20,524	\$15,737	\$11,276	\$9,156	\$7,166	\$5,647	\$7,280	\$12,886
60-64	25	213	193	126	89	38	22	706
Avg benefit	\$21,860	\$17,081	\$15,355	\$11,522	\$9,861	\$6,517	\$6,836	\$13,988
65-69	168	570	57	48	11	8	3	865
Avg benefit	\$14,099	\$14,629	\$16,563	\$10,999	\$8,845	\$7,959	\$9,909	\$14,300
70-74		120	592	13	3	7	15	750
Avg benefit		\$11,216	\$13,942	\$12,412	\$8,008	\$40,536	\$26,166	\$13,948
75+	1		66	400	205	104	57	833
Avg benefit	\$11,866		\$9,956	\$13,844	\$16,284	\$18,375	\$24,005	\$15,395
Total	235	1,107	1,057	667	349	162	104	3,681
Avg benefit	\$15,801	\$14,645	\$13,596	\$12,530	\$13,165	\$15,644	\$19,152	\$14,065

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 11 in the July 1, 2020 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.

	<u>Retained Actuary</u>	<u>System Financials</u>
Assets in Trust		
Cash, equivalents, short term securities	968,024	968,024
Fixed income	4,605,517	4,605,517
Equity	13,486,107	13,486,107
Private Markets	3,536,096	3,536,096
Other	5,997	5,997
Total Assets in Trust	22,601,741	22,601,741
Assets Receivable	39,659	39,659
Amounts Payable	(9,941)	(9,941)
Net Assets Held in Trust for Pension Benefits	22,631,459	22,631,459

Appendix C – Actuarial Value of Assets Replication

The exhibit below compares the retained actuary's July 1, 2020 AVA calculation (see page 13 in the July 1, 2020 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		22,631,459	22,631,459
2. Determination of average asset balance			
a. Total assets at beginning of year		22,440,968	22,440,968
b. Total assets at end of year		22,631,459	22,631,459
c. Net investment income for fiscal year		931,041	931,041
d. Average balance (a. + b. - c.)/2		22,070,693	22,070,693
3. Expected return (7.50% x 2.d.)		1,655,302	1,655,302
4. Actual return		931,041	931,041
5. Current year asset gain/(loss) (4. - 3.)		(724,261)	(724,261)
6. Unrecognized asset returns	Original amounts	Unrecognized percent	Unrecognized amounts
a. FYE 2020	(724,261)	80%	(579,409)
b. FYE 2019	(44,547)	60%	(26,728)
c. FYE 2018	479,963	40%	191,985
d. FYE 2017	1,266,388	20%	253,278
e. FYE 2016	(1,484,753)	0%	N/A
f. Total unrecognized amount			(160,874)
7. AVA at end of year (1. - 6.f.)		22,792,333	22,792,333

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, 2020 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	\$ 12,712,929	\$ 12,702,971	\$ (9,958)	-0.1%
Disability benefits	301,682	297,813	(3,869)	-1.3%
Survivor benefits	167,932	163,083	(4,849)	-2.9%
Deferred retirements	824,909	857,557	32,648	4.0%
Refunds	91,078	121,321	30,243	33.2%
Subtotal	\$ 14,098,530	\$ 14,142,745	\$ 44,215	0.3%
Deferred retirements	2,012,753	2,015,520	2,767	0.1%
Former members without vested rights	30,274	29,984	(290)	-1.0%
Benefit recipients (retirees and survivors)	16,366,077	16,374,170	8,093	0.0%
Total	\$ 32,507,634	\$ 32,562,419	\$ 54,785	0.2%
Present Value of Future Normal Costs (PVFNC)	Retained Actuary	VIA Replication	\$ Difference	% Difference
Active members				
Retirement annuities	\$ 2,613,738	\$ 2,744,085	\$ 130,347	5.0%
Disability benefits	106,017	107,815	1,798	1.7%
Survivor benefits	47,382	44,673	(2,709)	-5.7%
Deferred retirements	841,308	756,876	(84,432)	-10.0%
Refunds	272,273	310,312	38,039	14.0%
Subtotal	\$ 3,880,718	\$ 3,963,761	\$ 83,043	2.1%
Deferred retirements	-	-	-	0.0%
Former members without vested rights	-	-	-	0.0%
Benefit recipients (retirees and survivors)	-	-	-	0.0%
Total	\$ 3,880,718	\$ 3,963,761	\$ 83,043	2.1%
Actuarial Accrued Liability (AAL)	Retained Actuary	VIA Replication	\$ Difference	% Difference
Active members				
Retirement annuities	\$ 10,099,191	\$ 9,958,886	\$ (140,305)	-1.4%
Disability benefits	195,665	189,998	(5,667)	-2.9%
Survivor benefits	120,550	118,410	(2,140)	-1.8%
Deferred retirements	(16,399)	100,681	117,080	N/A ³
Refunds	(181,195)	(188,991)	(7,796)	4.3%
Subtotal	\$ 10,217,812	\$ 10,178,984	\$ (38,828)	-0.4%
Deferred retirements	2,012,753	2,015,520	2,767	0.1%
Former members without vested rights	30,274	29,984	(290)	-1.0%
Benefit recipients (retirees and survivors)	16,366,077	16,374,170	8,093	0.0%
Total	\$ 28,626,916	\$ 28,598,658	\$ (28,258)	-0.1%

³ The percent difference is not shown in situations comparing negative and positive liability amounts.

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, 2020 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	\$ 28,626,916	\$ 28,598,658	\$ (28,258)	-0.1%
b. Current assets (AVA)	22,792,333	22,792,333	-	0.0%
c. Unfunded actuarial accrued liability	\$ 5,834,583	\$ 5,806,325	\$ (28,258)	-0.5%
2. Determination of Supplemental Contribution Rate				
a. Present value of future payrolls through the amortization date of June 30, 2048	\$ 110,807,906	\$ 111,004,824	\$196,918	0.2%
b. Supplemental contribution rate: (1.c. / 2.b.)	5.27%	5.23%		

	Retained Actuary	VIA Replication	\$ Difference		
Projected annual payroll for FY2020-2021	\$6,907,861	\$6,920,137	\$ 12,276		
	% of Payroll	\$ Amount	% of Payroll	\$ Amount	\$ Difference
1. Statutory Contributions - Chapter 353					
a. Employee contributions	6.50%	\$ 449,035	6.50%	\$ 449,809	\$ 774
b. Employer contributions	7.50%	518,113	7.50%	519,010	897
c. Employer supplemental contributions	0.30%	21,000	0.30%	21,000	-
d. State contributions	0.23%	16,000	0.23%	16,000	-
e. Total	14.53%	\$1,004,148	14.53%	\$1,005,819	\$ 1,671
2. Required Contributions - Chapter 356					
a. Normal cost					
i. Retirement benefits	5.41%	\$ 373,713	5.26%	\$ 363,929	\$ (9,784)
ii. Disability benefits	0.19%	13,138	0.18%	12,506	(632)
iii. Survivors	0.09%	6,217	0.08%	5,557	(660)
iv. Deferred retirement benefits	1.48%	102,247	1.20%	82,931	(19,316)
v. Refunds	0.51%	\$ 35,232	0.53%	36,591	\$ 1,359
vi. Total	7.68%	\$ 530,547	7.25%	\$ 501,514	\$ (29,033)
b. Supplemental Contribution Amortization of Unfunded Actuarial Accrued Liability by June 30, 2048	5.27%	\$ 364,044	5.23%	\$ 361,971	\$ (2,073)
c. Allowance for Expenses	0.18%	12,434	0.18%	12,456	22
d. Total	13.13%	\$ 907,025	12.66%	\$ 875,942	\$ (31,083)
3. Contribution Sufficiency/(Deficiency)	1.40%	\$ 97,123	1.87%	\$ 129,878	\$ 32,755