CHEIRON
Classic Values, Innovative Advice

California State Teachers' Retirement System

Replication and Peer Review of the June 30, 2019 Actuarial Valuations

Produced by Cheiron

November 2020

TABLE OF CONTENTS

SECTION I – BOARD SUMMARY

<u>Scope of Assignment</u>

Cheiron performed a replication and peer review of the June 30, 2019 actuarial valuations of the CalSTRS Defined Benefit, Defined Benefit Supplement, Cash Balance Benefit, and Medicare Premium Payment Programs. In addition, Cheiron replicated the projections of the Supplemental Benefit Maintenance Account Program to demonstrate its funding sufficiency. The purpose of these replications and peer reviews is to:

- Ensure the Board can rely on the results reported by Milliman,
- Review Milliman's actuarial valuation process compared to actuarial standards of practice,
- Ensure the communication of the actuarial valuation results is complete and accurate, and
- Recommend any changes that would improve the items above.

Our key findings and recommendations are summarized below. In the sections that follow we present the details that explain and support these findings and recommendations. In addition, there are some technical comments and alternatives for Milliman and CalSTRS to consider. These comments and suggestions are not highlighted in this section as they do not materially impact the results of the valuation.

<u>Key Findings and Recommendations</u>

Our primary findings and recommendations are as follows:

- Our independent replication of the four actuarial valuations found no material differences in measures of plan liabilities, Actuarial Value of Assets, and contribution rates (where applicable) from the amounts and rates calculated by Milliman based on the adopted assumptions and methods.

- The four actuarial valuations were supervised and performed by qualified actuaries and in accordance with generally accepted actuarial principles and practices of the California Actuarial Advisory Panel (CAAP), the Public Plan Community of the Conference of Consulting Actuaries, the Actuarial Standards Board, and the American Academy of Actuaries.

- The complexity of the CalSTRS funding plan creates a challenge for communicating the valuation results and how the funding plan affects different components of the Defined Benefit Program. We found some of the exhibits in Milliman's valuation report difficult to follow and suggest that Milliman and CalSTRS staff consider improvements to the communication of this complex structure within the valuation report. We have some suggestions for consideration that we describe below, but recognize the challenge of this communication and that there may be multiple ways to achieve the goal.

SECTION I – BOARD SUMMARY

Table I-1 below summarizes our replication and review of the four actuarial valuations. Additional details are provided in the remaining sections of the report.

Table I-1

Summary of Replication Results			
	Milliman	**Cheiron**	**Difference**
DB Program			
($ Millions)			
Actuarial Obligation			
1990 Benefit Structure	$ 256,530	$ 257,254	0.3%
Pre-2014 New Benefits	44,193	43,785	-0.9%
Post-2014 New Benefits	9,998	9,760	-2.4%
Total Actuarial Obligation	$ 310,721	$ 310,799	0.0%
Actuarial Value of Assets			
1990 Benefit Structure	$ 223,470	$ 222,795	-0.3%
Pre-2014 New Benefits	(28,206)	(28,115)	-0.3%
Post-2014 New Benefits	9,754	10,621	8.9%
Total Actuarial Value of Assets	$ 205,017	$ 205,301	0.1%
State Supplemental Rate	6.311%	6.311%	0.000%
Employer Supplemental Rate	10.400%	10.478%	0.078%
CBB Program			
($ Thousands)			
Actuarial Obligation	$ 293,831	$ 293,799	0.0%
Actuarial Value of Assets	$ 357,273	$ 357,273	0.0%
DBS Program			
($ Thousands)			
Actuarial Obligation	$ 11,126,044	$ 11,128,109	0.0%
Actuarial Value of Assets	$ 13,904,497	$ 13,904,497	0.0%
MPP Program			
($ Millions)			
Actuarial Obligation	$ 288	$ 290	0.6%

SECTION I – BOARD SUMMARY

With the implementation of the CalSTRS funding plan, the purpose of the valuation has changed from just assessing the sufficiency of the statutory contributions to fund the benefits to also determining the State Supplemental Contribution Rate, the Employer Supplemental Contribution Rate, and the 2 percent at 62 members' contribution rate. We believe this change in purpose requires clear communications of the different components of the DB Program, how they add up to the whole, and how each component is funded. Milliman has taken steps to accomplish this objective, but we believe more can be done to improve this communication.

With the new funding plan, we believe the following three key components to the DB Program should be highlighted in the summary of findings section showing how the Actuarial Obligations, assets, Unfunded Actuarial Obligations (UAO), and contributions add up to the total for the DB Program:
- 1990 Benefit Structure
- Pre-2014 New Benefits
- Post-2014 New Benefits

As an example, we believe Milliman should consider including a funded status exhibit such as is shown in Table I-2 below.

Table I-2

Funded Status as of June 30, 2019				
	1990 Benefit Structure	**Pre-2014 New Benefits**	**Post-2014 New Benefits**	**Total**
Actuarial Obligation	$ 256,533	$ 44,191	$ 9,995	$ 310,719
Actuarial Value of Assets	223,470	(28,206)	9,754	205,016
Unfunded Actuarial Obligation	$ 33,063	$ 72,397	$ 241	$ 105,703
Funded Ratio	87.1%	-63.8%	97.6%	66.0%

Dollar amounts in millions

The State Supplemental Contribution Rate is adjusted to pay off the 1990 Benefit Structure UAO and the Employer Supplemental Contribution Rate is adjusted to pay off the Pre-2014 New Benefits UAO. There is no contribution source dedicated to pay off the Post-2014 New Benefits UAO.

SECTION I – BOARD SUMMARY

To better communicate how the components are funded, we believe Milliman should consider showing how the different contribution rates are allocated between the 1990 Benefits and the New Benefits such as is shown in Table I-3.

Table I-3

Allocation of Contribution Rates			
Source of Revenue	**1990 Benefits**	**New Benefits**	**Total**
2% at 60 Members			
Regular (EC §22901)	8.000%	0.000%	8.000%
Supplemental (EC §22901.7)	0.000%	2.250%	2.250%
Total	8.000%	2.250%	10.250%
2% at 62 Members			
Regular (EC §22901)	8.000%	1.000%	9.000%
Supplemental (EC §22901.7)	0.000%	1.205%	1.205%
Total	8.000%	2.205%	10.205%
Employers			
Regular	8.000%	0.000%	8.000%
Sick Leave (EC §22951)	0.000%	0.250%	0.250%
Supplemental (EC §22950.5)	0.000%	10.150%	10.150%
Total Employer	8.000%	10.400%	18.400%
State			
Regular (EC §22955)	0.000%	2.017%	2.017%
Supplemental (EC §22955.1(b))	6.311%	0.000%	6.311%
Total	6.311%	2.017%	8.328%

SECTION I – BOARD SUMMARY

Finally, we also suggest that the statement of changes in program assets be supplemented with an exhibit showing the changes by each separate funding group in a manner similar to Table I-4 shown below.

Table I-4

Statement of Changes in Assets by Funding Group					
	SBMA	1990 Benefit Structure	Pre-2014 New Benefits	Post-2014 New Benefits	Total DB Program
Market Value, 6/30/2018	$ 15,756	$ 216,151	$ (30,122)	$ 9,582	$ 211,367
Contributions					
Members	0	2,741	0	755	3,496
Employers	0	2,722	2,650	110	5,482
State	737	1,705	2,893	0	5,335
Total	$ 737	$ 7,168	$ 5,543	$ 865	$ 14,313
Investment Income					
Net investment Income	1,084	13,974	(1,930)	650	13,778
Net Pension/OPEB Obligation Adjustments	0	805	0	0	805
Net earnings	$ 1,084	$ 14,779	$ (1,930)	$ 650	$ 14,583
Benefits					
Retirement, Disability, Death and Survivors	0	(12,206)	(2,086)	(236)	(14,528)
Refunds	0	(79)	0	4	(75)
Purchasing Power Benefits	(194)	0	0	0	(194)
Total Benefits	$ (194)	$ (12,285)	$ (2,086)	$ (232)	$ (14,797)
Assumption Change Allocation	$ 0	$ 977	$ 0	$ (977)	$ 0
Market Value, 6/30/2019	$ 17,383	$ 226,790	$ (28,595)	$ 9,888	$ 225,466

Amounts in millions

We commend Milliman for the inclusion of deterministic projections at three different rates of investment return in the Summary of Findings section of the report. These projections help the user understand the sensitivity of the supplemental contribution rates and funded status to investment returns.

Milliman includes a risk disclosure section in the report to comply with ASOP No. 51. Milliman identifies future investment returns as the primary risk with payroll variation as a secondary risk.

SECTION I – BOARD SUMMARY

While the projections described above illustrate the sensitivity of CalSTRS to investment returns, there doesn't appear to be any assessment of payroll variations. The risk disclosure section does reference a more comprehensive analysis performed by CalSTRS internal actuarial staff, but we believe at least a simple assessment of payroll variation should be included in the valuation report. In addition, Milliman identifies the Board's limited rate-setting authority as a potential risk, but indicates that it is not currently an issue. It would be valuable for Milliman to explain why it is not currently an issue and what could make it an issue in the future. There are potential issues if the supplemental rates cannot be adjusted sufficiently to fund the benefits, and there is a risk that the unallocated UAO could grow. We encourage Milliman to expand this discussion and illustrate what type of scenario would make it a significant issue. Finally, CalSTRS may want to consider whether the more comprehensive risk analysis should be independently reviewed as well.

We believe exhibits such as these will help the users of the actuarial valuation to better understand the interrelationships between the different funding groups within the CalSTRS Defined Benefit Program.

SECTION II – CERTIFICATION

The purpose of this report is to present the replication and peer review of the June 30, 2019 actuarial valuations of the California State Teachers' Retirement System (CalSTRS). Actuarial valuations were replicated for the Defined Benefit Program, the Defined Benefit Supplement Program, the Cash Balance Benefit Program, and the Medicare Premium Payment Program. In addition, the projections to demonstrate the funding sufficiency of the Supplemental Benefit Maintenance Account Program were replicated and reviewed. This report is for the use of CalSTRS.

In preparing our report, we relied on information, some oral and some written, supplied by CalSTRS. This information includes, but is not limited to: the plan provisions, employee data, and financial information. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standard of Practice No. 23.

The funding ratios in this report are for the purpose of establishing contribution rates. These measures are not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations.

Future actuarial measurements may differ significantly from the current measurements due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; and, changes in plan provisions or applicable law.

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys and our firm does not provide any legal services or advice.

This report was prepared exclusively for CalSTRS for the purposes described herein. Other users of this report are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to any other user.

William R. Hallmark, ASA, EA, FCA, MAAA   Graham A. Schmidt, ASA, EA, FCA, MAAA
Consulting Actuary   Consulting Actuary

SECTION III – DEFINED BENEFIT PROGRAM LIABILITIES

Primary Benefit Structure

After collecting the census data and actuarial assumptions, we programmed our valuation system based on our understanding of the DB Program's provisions and performed calculations based on the Milliman processed data files. We collected sample lives from Milliman to verify their programming and compared it to ours. Table III-1 below compares our independent calculations of the present value of projected benefits and present value of future normal cost to those calculated by Milliman.

Table III-1

Present Value of Projected Benefits			
	Milliman	**Cheiron**	**Percentage Difference**
Present Value of Projected Benefits			
Active	$ 217,734,326,572	$ 219,843,989,995	1.0%
Inactive	6,778,067,347	6,684,352,907	-1.4%
Healthy retiree	155,866,325,787	153,851,234,912	-1.3%
Beneficiary	6,861,613,163	6,764,179,435	-1.4%
Disabled retiree	4,028,007,494	3,970,688,325	-1.4%
Family	672,623,478	670,127,953	-0.4%
MPPP UAO	287,972,785	289,616,057	0.6%
Total Present Value of Benefits	$ 392,228,936,626	$ 392,074,189,584	0.0%
Present Value Future Normal Cost	81,507,701,935	81,275,275,587	-0.3%
Total Actuarial Obligation	**$ 310,721,234,691**	**$ 310,798,913,997**	**0.0%**

All of the differences are within a reasonable range, and the total is a very close match.

SECTION III – DEFINED BENEFIT PROGRAM LIABILITIES

Table III-2 below shows a further breakdown of the Actuarial Obligation for active members by decrement and by benefit formula.

Table III-2

Active Member Actuarial Obligation			
	Milliman	Cheiron	Percentage Difference
2% at 60 Formula			
Service Retirement	$ 130,379,993,725	$ 132,582,430,929	1.7%
Deferred Retirement & Refund	(246,113,543)	(196,690,213)	-20.1%
Death	452,493,554	449,550,087	-0.7%
Disability	2,269,909,850	2,339,139,884	3.0%
Total	$ 132,856,283,586	$ 135,174,430,687	1.7%
2% at 62 Formula			
Service Retirement	$ 3,171,941,497	$ 3,202,575,740	1.0%
Deferred Retirement & Refund	7,278,721	(3,740,356)	-151.4%
Death	20,191,592	21,406,883	6.0%
Disability	170,929,241	174,041,453	1.8%
Total	$ 3,370,341,051	$ 3,394,283,720	0.7%
Active Member Actuarial Obligation	$ 136,226,624,637	$ 138,568,714,407	1.7%

The differences in the total Actuarial Obligation for active members are reasonable. While the percentage differences in the Actuarial Obligation for deferred retirements and refunds are greater than normal, the dollar amounts are relatively small. We believe these differences are primarily due to a technical difference in methodology. We understand that Milliman reconstructs a theoretical member balance based on the contribution rate history rather than using the current member balance, whereas we use the current member balance to determine the present value of future benefits.

Given the variations in service history for many members, neither method is likely to be exactly accurate. While the difference on a percentage basis is significant, the dollar amounts of these differences are not material, and we believe either method should be considered reasonable.

SECTION III – DEFINED BENEFIT PROGRAM LIABILITIES

Table III-3 below compares our independent calculations of the total normal cost by benefit formula and decrement and total normal cost rate to the amounts and rates calculated by Milliman.

Table III-3

	Total Normal Cost		
	Milliman	**Cheiron**	**Percentage Difference**
2% at 60 Formula			
Service Retirement	$ 5,190,517,421	$ 5,067,835,622	-2.4%
Deferred Retirement & Refund	277,206,876	267,236,920	-3.6%
Death	36,023,057	34,342,339	-4.7%
Disability	202,134,123	208,716,700	3.3%
Total Normal Cost	$ 5,705,881,477	$ 5,578,131,581	-2.2%
Estimated Annual Earned Salaries	$ 27,344,234,789	$ 27,371,801,689	0.1%
Total Normal Cost Rate	20.867%	20.379%	-2.3%
2% at 62 Formula			
Service Retirement	$ 900,122,628	$ 910,821,158	1.2%
Deferred Retirement & Refund	57,805,891	57,761,792	-0.1%
Death	6,658,456	6,858,866	3.0%
Disability	48,825,371	48,825,175	0.0%
Total Normal Cost	$ 1,013,412,346	$ 1,024,266,991	1.1%
Estimated Annual Earned Salaries	$ 5,592,080,455	$ 5,598,126,239	0.1%
Total Normal Cost Rate	18.122%	18.297%	1.0%

All of the differences are reasonable.

1990 Benefit Structure

The State Supplemental Contribution Rate is based on the Unfunded Actuarial Obligation associated with the 1990 Benefit and contribution rate structure. In addition to the different benefit provisions, the Actuarial Obligation for the 1990 Benefit Structure for active members is based on different retirement rates. Once retired, however, the only difference in valuation is due to the differing benefit provisions. Table III-4 below compares our independent calculations of the present value of projected benefits and present value of future normal costs for the 1990 Benefit Structure to those calculated by Milliman.

Table III-4

Present Value of Future Benefits - 1990 Benefit Structure			
	Milliman	**Cheiron**	**Percentage Difference**
Present Value of Benefits			
Active	$ 181,755,759,339	$ 183,217,318,034	0.8%
Inactive	6,540,862,984	6,454,335,401	-1.3%
Healthy retiree	128,425,022,121	126,765,698,784	-1.3%
Beneficiary	6,447,300,555	6,355,665,407	-1.4%
Disabled retiree	3,992,475,927	3,935,687,566	-1.4%
Family	672,623,478	670,127,953	-0.4%
Total Present Value of Benefits	$ 327,834,044,404	$ 327,398,833,145	-0.1%
Present Value Future Normal Cost	71,303,695,359	70,145,109,186	-1.6%
Total Actuarial Obligation	**$ 256,530,349,045**	**$ 257,253,723,959**	**0.3%**

All of the differences are within a reasonable range, and the total is within 0.3%.

SECTION III – DEFINED BENEFIT PROGRAM LIABILITIES

Table III-5 below compares our independent calculations of the total normal cost for the 1990 Benefit Structure by decrement and total normal cost rate to the amounts and rates calculated by Milliman.

Table III-5

Total Normal Cost - 1990 Benefit Structure			
	Milliman	**Cheiron**	**Percentage Difference**
Service Retirement	$ 5,128,540,894	$ 5,004,947,121	-2.4%
Deferred Retirement & Refund	343,312,927	349,795,358	1.9%
Death	38,982,615	38,752,024	-0.6%
Disability	238,148,275	241,914,644	1.6%
Total Normal Cost	$ 5,748,984,711	$ 5,635,409,147	-2.0%
Estimated Annual Earned Salaries	$ 32,713,440,242	$ 32,736,003,176	0.1%
Total Normal Cost Rate	17.574%	17.215%	-2.0%

All of the differences are reasonable.

Pre-2014 Service

The Employer Supplemental Contribution Rate is based on the Unfunded Actuarial Obligation for pre-2014 service that is not attributable to the 1990 Benefit Structure. The applicable Actuarial Obligation is calculated as the total Actuarial Obligation for pre-2014 service less the 1990 Benefit Structure Actuarial Obligation for pre-2014 service.

Table III-6 below compares our independent calculations of the total Actuarial Obligation attributable to pre-2014 service to the amounts calculated by Milliman.

Table III-6

Pre-2014 Service - Actuarial Obligation			
	Milliman	**Cheiron**	**Percentage Difference**
Active Members			
Service Retirement	$ 84,739,358,432	$ 85,256,632,927	0.6%
Deferred Retirement & Refund	1,159,135,366	1,237,159,423	6.7%
Death	351,303,248	348,105,311	-0.9%
Disability	1,877,483,611	1,999,854,642	6.5%
Total Actives	$ 88,127,280,657	$ 88,841,752,303	0.8%
Inactive	6,236,780,490	6,152,030,180	-1.4%
Healthy retiree	151,068,100,405	149,109,576,230	-1.3%
Beneficiary	6,825,231,007	6,728,187,196	-1.4%
Disabled retiree	3,808,394,283	3,755,642,382	-1.4%
Family	651,917,280	649,474,768	-0.4%
MPPP UAO	287,972,785	289,616,057	0.6%
Total Actuarial Obligation	**$ 257,005,676,907**	**$ 255,526,279,116**	**-0.6%**

The difference in the total Actuarial Obligation is reasonable. There are similar differences to other calculations for active member deferred retirement and refunds. In this case, we believe it is most appropriate to use actual member account balances as of the valuation date to project refund benefits. There is also a difference in the obligation for active members due to disability. However, none of the differences constitute a material difference in the calculation of the overall obligation.

SECTION III – DEFINED BENEFIT PROGRAM LIABILITIES

Table III-7 below compares our independent calculations of the 1990 Benefit Structure Actuarial Obligation attributable to pre-2014 service to the amounts calculated by Milliman.

Table III-7

Pre-2014 Service - Actuarial Obligation - 1990 Benefit Structure					Percentage
		Milliman		Cheiron	Difference
Active Members					
Service Retirement	$	68,225,782,922	$	68,889,988,814	1.0%
Deferred Retirement & Refund		1,142,600,393		1,198,379,817	4.9%
Death		341,393,106		347,967,605	1.9%
Disability		1,795,120,078		1,835,678,772	2.3%
Total Actives	$	71,504,896,499	$	72,272,015,008	1.1%
Inactive		6,012,171,707		5,931,990,911	-1.3%
Healthy retiree		124,454,639,010		122,841,419,240	-1.3%
Beneficiary		6,414,264,877		6,322,986,137	-1.4%
Disabled retiree		3,775,252,046		3,722,994,844	-1.4%
Family		651,917,280		649,474,768	-0.4%
Total Actuarial Obligation	$	**212,813,141,419**	$	**211,740,880,908**	-0.5%

The difference in the total Actuarial Obligation is reasonable. There are similar differences to other calculations for active member deferred retirement and refunds. As in the prior exhibit, we believe it is most appropriate to use actual member account balances as of the valuation date to project refund benefits. However, none of the differences constitute a material difference in the calculation of the overall obligation.

Test Cases

As part of our review, we replicated three active member test cases prepared by Milliman to verify programming at an individual level. Table III-8 below compares our independent test case valuation results to the amounts calculated by Milliman.

Table III-8

Test Case Summary			
	Milliman	**Cheiron**	**Difference**
2% at 60, Coverage A			
Present Value of Future Benefits	1,061,110	1,063,466	0.2%
Total Actuarial Obligation	1,033,325	1,036,145	0.3%
Normal Cost	18.17%	17.87%	-1.7%
SubStructure Actuarial Obligations			
1990 Benefits	797,245	772,671	-3.1%
Pre 2014 Service	1,003,992	1,027,117	2.3%
Pre 2014 Service 1990 Benefit Structure	773,046	768,983	-0.5%
2% at 60, Coverage B, Part-time			
Present Value of Future Benefits	208,891	211,905	1.4%
Total Actuarial Obligation	121,636	124,648	2.5%
Normal Cost	18.36%	18.31%	-0.3%
SubStructure Actuarial Obligations			
1990 Benefits	108,781	115,886	6.5%
Pre 2014 Service	74,491	76,899	3.2%
Pre 2014 Service 1990 Benefit Structure	68,989	68,012	-1.4%
2% at 62, Coverage A			
Present Value of Future Benefits	258,403	256,655	-0.7%
Total Actuarial Obligation	28,772	28,166	-2.1%
Normal Cost	15.65%	15.27%	-2.4%
SubStructure Actuarial Obligations			
1990 Benefits	30,368	30,937	1.9%

All of the differences are within our standard tolerance threshold of 5% except for the Actuarial Obligation for the 1990 Benefits for the part-time 2% at 60 test case. For this test case, Milliman assumed the member earned 0.5 years of benefit service for all prior years while we spread the member's current cumulative service over the member's period since hire. As a result, we produce a lower normal cost and higher Actuarial Obligation than Milliman for this particular test case.

SECTION IV – DEFINED BENEFIT PROGRAM ASSETS

The Market Value of Assets for the DB Program is allocated to various components to determine the adequacy of contributions intended to fund those components. There are contributions intended to fund:

- the Supplemental Benefits Maintenance Account (SBMA),
- the ongoing accrual of benefits,
- the Unfunded Actuarial Obligation attributed to the 1990 Benefit Structure, and
- the Unfunded Actuarial Obligation attributed to pre-2014 service other than the 1990 Benefit Structure.

This year, Milliman made an adjustment to the assets reported in the financial statements. The Governmental Accounting Standards Board (GASB) requires the Net Pension Liability and Net OPEB Liability for employees of CalSTRS to be treated as a liability on CalSTRS financial statements along with the recognition of any related deferred inflows and outflows. Since these items represent a component of the present value of future CalSTRS administrative expenses, for purposes of the funding valuation we concur that it is reasonable to reverse these adjustments to the assets of the System and let them be reflected in the administrative expense assumption that reduces the assumed rate of return.

After the SBMA is subtracted, the DB Program assets are split between assets intended to fund the 1990 Benefit Structure and assets intended to fund New Benefits. Table IV-1 on the next page compares our independent allocation to Milliman's allocation.

We calculated a simple estimate of the benefits paid that were attributable to the 1990 Benefit Structure based on the ratio of 1990 Benefits to full benefits for retirees as of the valuation date. This estimate indicated that Milliman's more precise calculation was reasonable, so for the allocation shown in Table IV-1, we used Milliman's calculation of benefits paid attributable to the 1990 Benefit Structure.

SECTION IV – DEFINED BENEFIT PROGRAM ASSETS

Table IV-1

	Milliman			Cheiron		
	1990 Structure	New Benefits	DB Program*	1990 Structure	New Benefits	DB Program*
Market Value, 6/30/2018	$ 216,151	$ (20,540)	$ 195,611	$ 216,151	$ (20,540)	$ 195,611
Member Contributions						
Regular at 8.000%/9.000% (EC §22901)				2,694	55	2,749
Supplemental at 2.250%/1.205% (EC §22901.7)				0	701	701
Other				46	0	46
Total Member Contributions	$ 2,741	$ 755	$ 3,496	$ 2,741	$ 755	$ 3,496
Employer Contributions						
Regular at 8.000%				2,722	(28)	2,694
Sick Leave at 0.250% (EC §22951)				0	84	84
Supplemental at 8.030% (EC §22950.5)				0	2,704	2,704
Total Employer Contributions	$ 2,722	$ 2,760	$ 5,482	$ 2,722	$ 2,761	$ 5,483
State Contributions						
Appropriation at 2.017% (EC §22955)				0	647	647
Supplemental at 5.811% (EC §22955.1(b))				1,705	0	1,705
Senate Bill 90				0	2,246	2,246
Total State Contributions	$ 1,705	$ 2,893	$ 4,598	$ 1,705	$ 2,893	$ 4,598
Investment Income						
Net investment Income	14,218	(1,280)	12,938			12,937
Administrative expenses	(244)	0	(244)			(243)
Net Pension/OPEB Obligation Adjustments	805	0	805			805
Net investment earnings	$ 14,779	$ (1,280)	$ 13,499	$ 14,782	$ (1,282)	$ 13,499
Benefits	$ (12,285)	$ (2,318)	$ (14,603)	$ (12,285)	$ (2,318)	$ (14,603)
Assumption Change Allocation	$ 977	$ (977)	$ 0			
Market Value, 6/30/2019	$ 226,790	$ (18,707)	$ 208,083	$ 225,815	$ (17,731)	$ 208,083

Excludes SBMA

Our allocation matches Milliman's allocation except for the assumption change allocation, which is discussed below. We encourage Milliman to include the breakout of contributions by section of the Education Code in their exhibits similar to the breakout shown above. We believe this breakout makes it clearer which sources of contributions are intended to fund which portions of the benefit obligation. We also encourage Milliman to group investment income and administrative expenses

SECTION IV – DEFINED BENEFIT PROGRAM ASSETS

together into net investment earnings as shown above to make it clearer that they are treated the same in the allocation.

In this valuation, the retirement rates for the 1990 Benefit Structure were changed, increasing the Actuarial Obligation for the 1990 Benefit Structure. Milliman transferred an equivalent amount of assets from the assets intended to fund the New Benefits to the assets intended to fund the 1990 Benefits. We understand the transfer was intended to reflect the situation if the assumption change had always been in effect.

The assets intended to fund the 1990 Benefit Structure are based on accumulated contributions that were fixed percentages of payroll less estimated benefits attributable to the 1990 structure. This assumption change, if it had always been in effect, would not have changed these contribution rates, the estimated benefits paid, or the earnings allocated to the 1990 Benefit Structure. Therefore, the assets available to fund the 1990 Benefit Structure would not have changed if this assumption had always been in effect.

Making such a transfer has the effect of reducing the State Supplemental Contribution while increasing the Employer Supplemental Contribution Rate and the unallocated UAO. We suggest an alternative adjustment to reflect the assumption change in Table IV-2 and the page that follows.

The assets allocated to fund New Benefits are further split between those intended to fund the New Benefits attributable to pre-2014 service and the New Benefits attributable to service in 2014 or later. The Unfunded Actuarial Obligation for New Benefits attributable to pre-2014 service is the responsibility of employers while no entity is responsible for any Unfunded Actuarial Obligation for New Benefits attributable to 2014 or later service.

Table IV-2 on the following page compares our independent division of the assets intended to fund the New Benefits to Milliman's division. Since the total allocation for New Benefits differs as described in Table IV-1 on the prior page, the allocations to pre- and post-2014 service also differ. Again, the primary difference is the treatment of the assumption change.

SECTION IV – DEFINED BENEFIT PROGRAM ASSETS

Table IV-2

	Milliman New Benefits			Cheiron New Benefits		
	Pre-2014	Post 2014	Total	Pre-2014	Post 2014	Total
Market Value, 6/30/2018	$ (30,122)	$ 9,582	$ (20,540)	$ (30,122)	$ 9,582	$ (20,540)
Contributions						
Member	755		755	755		755
Employer	2,760		2,760	2,761		2,761
State	2,893		2,893	2,893		2,893
Total Contributions	$ 6,408	$ 0	$ 6,408	$ 6,409	$ 0	$ 6,409
Normal Cost for New Benefits						
Full Normal cost at 20.181%	(6,797)	6,797	0	(6,797)	6,797	0
1990 Normal cost at 17.613%	5,932	(5,932)	0	5,932	(5,932)	0
Total for new benefits	$ (865)	$ 865	$ 0	$ (865)	$ 865	$ 0
Net Investment Earnings	$ (1,930)	$ 650	$ (1,280)	$ (1,967)	$ 685	$ (1,282)
Benefits	$ (2,086)	$ (232)	$ (2,318)	$ (2,086)	$ (232)	$ (2,318)
Assumption Change Allocation	$ 0	$ (977)	$ (977)	$ 134	$ (134)	$ 0
Market Value, 6/30/2019	$ (28,595)	$ 9,888	$ (18,707)	$ (28,496)	$ 10,765	$ (17,731)

The post-2014 assets for New Benefits are allocated contributions equal to the normal cost for New Benefits, and the pre-2014 assets for New Benefits are credited with the remainder of the contributions for New Benefits.

If the new retirement assumptions for the 1990 Benefit Structure had always been in place, the normal cost for the 1990 Benefit Structure would have been higher, and the normal cost for New Benefits would have been lower. Consequently, a transfer of assets from post-2014 New Benefits to pre-2014 New Benefits is needed to reflect the situation if the new retirement assumptions had always been in place. The transfer amount theoretically should equal the accumulated value of the change in New Benefit normal costs since 2014. This amount can be estimated by the change in the Actuarial Obligation for post-2014 benefits under the 1990 Benefit Structure, which we calculate as $134 million. Milliman's calculation of $977 million represents the change in 1990 Actuarial Obligation for pre- and post-2014 service, but we suggest the transfer from post-2014 New Benefits should just be for post-2014 service. Under this approach, the unallocated UAO would not change due to the assumption change.

As a result, we conclude the Market Value of Assets available for New Benefits should be $977 million higher than what Milliman reports, and the Market Value of Assets for 1990 Benefits should be $977 million lower. The Market Value of Assets available to fund Pre-2014 New Benefits should be $134 million higher than what Milliman reports, and the Market Value of Assets

available to fund Post-2014 New Benefits should be $843 million higher than Milliman reports. Since there is no source to fund any UAO that develops for Post-2014 New Benefits, this $843 million difference could become significant in the future. We also note, however, that in the context of the whole DB Program, the differences are not material.

Finally, there is also a difference in the way we allocated investment earnings compared to Milliman's methodology. We allocated investment earnings in each of the asset breakouts based on the estimated return net of administrative expenses for the DB Program after the SBMA was subtracted. The SBMA is allocated investment earnings based on the assumed return regardless of the actual return, so the remainder of the fund has a different return.

Milliman allocates investment earnings at different rates of return for the 1990 Benefit Structure and the New Benefits. For FYE 2019, the difference between the actual return and the assumed return was very small, so these differences are negligible. However, we suggest that Milliman and CalSTRS review these procedures and consider using the same return net of administrative expenses for all of the separate asset divisions.

Actuarial Value of Assets

Milliman calculates an Actuarial Value of Assets for the DB Program as a whole based on a three-year asymptotic smoothing method. Table IV-3 compares our independent calculation of the Actuarial Value of Assets to Milliman's calculation.

SECTION IV – DEFINED BENEFIT PROGRAM ASSETS

Table IV-3

Development of Actuarial Value of Assets			
	Milliman	**Cheiron**	**Difference**
Actuarial Value at Beginning of Year	$ 206,207	$ 206,207	$ 0
Contributions	14,313	14,313	0
Benefits	(14,798)	(14,798)	(0)
Expected Return	14,339	14,418	(79)
Method Change	805	805	(0)
Expected Actuarial Value at End of Year	$ 220,866	$ 220,945	$ (79)
Market Value	$ 225,466	$ 225,466	$ 0
Difference	$ 4,600	$ 4,521	$ 79
Recognized gain or loss	$ 1,533	$ 1,507	$ 26
Actuarial Value at End of Year	$ 222,399	$ 222,452	$ (53)
Ratio of Actuarial Value to Market Value	98.640%	98.663%	-0.023%
Actuarial value for 1990 Benefit Structure	$ 223,470	$ 222,795	$ 674
Actuarial value for Pre-2014 New Benefits	$ (28,206)	$ (28,115)	$ (91)

The difference between our calculations of the actuarial value for the DB Program is a slight difference in our calculation of the expected return. We assume all cash flows except the method change occur in the middle of the year. The differences for the 1990 Benefit Structure and the Pre-2014 New Benefits are due to different market values for these groups and the slightly different ratio of actuarial value to market value.

Milliman uses the ratio of the actuarial value to market value to determine the actuarial value for certain other divisions of the assets. However, this methodology is not consistent for all divisions of assets. As a result, the ratio of the Actuarial Value of Assets to the Market Value of Assets differs slightly for the 1990 Benefit Structure. This difference is not material, but Milliman may want to consider applying the same ratio across all divisions of the assets.

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

State Supplemental Contribution Rate

The State Supplemental Contribution Rate is intended to pay off the Unfunded Actuarial Obligation for the 1990 Benefit Structure by June 30, 2046. Adjustments to this rate are, however, limited to 0.5% of payroll. Table V-1 below compares our independent calculation of the State Supplemental Contribution Rate to the rate calculated by Milliman.

Table V-1

State Supplemental Contribution Rate for 1990 Benefit Structure			
	Milliman	**Cheiron**	**Difference**
Measures as of June 30, 2019			
Actuarial Obligation for 1990 Benefits	$ 256,533	$ 257,254	$ (721)
AVA for 1990 Benefits	223,469	222,795	673
Unfunded AO for 1990 Benefits	$ 33,064	$ 34,458	$ (1,394)
FYE 2020 Expected UAO Payment		1,524	
Expected UAO as of June 30, 2020		$ 35,294	
FYE 2021 UAO Rate Needed on State Payroll	5.951%	6.107%	-0.156%
1990 Normal Cost Rate	17.822%	17.215%	0.607%
Revenue for 1990 Benefits	16.000%	16.000%	0.000%
NC Funding Deficit as % of Employer Payroll	1.822%	1.215%	0.607%
NC Funding Deficit as % of State Payroll	1.950%	1.301%	0.649%
Unconstrained State Supplemental Rate	7.901%	7.408%	0.493%
Current Rate	5.811%	5.811%	0.000%
State Supplemental Rate for Next FY	**6.311%**	**6.311%**	**0.000%**

Given the differences in our measures of the Actuarial Obligation and Actuarial Value of Assets for 1990 Benefits that were discussed in the previous sections, we start with an Unfunded Actuarial Obligation that is $1.4 billion larger than Milliman's.

Milliman projects the UAO one year to when the new State Supplemental Rate would become effective and determines the contribution rate as a percent of payroll needed to pay off the UAO by June 30, 2046. Our independent calculation is 0.16% of pay higher than Milliman's calculation, which is not a significant difference. We suggest that Milliman show a little more information about this projection to make the calculation more transparent. At a minimum, it would be useful to show the expected payment during the year and the projected amount of the UAO when the new rate commences.

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

In addition to the UAO amortization, in order to pay off the UAO, the State Supplemental Rate also covers the deficit between the normal cost rate for the 1990 Benefits and the other contribution rates intended to pay for the 1990 Benefits. For this calculation, Milliman anticipates increases in the normal cost rate for 1990 Benefits due to mortality improvements, resulting in an average normal cost rate of 17.822% during the amortization period compared to 17.574% for FYE 2020. Our calculation uses our independently calculated normal cost rate of 17.215% for FYE 2020. The difference in these normal cost rates accounts for most of the difference in our calculations of the unconstrained State Supplemental Rate.

The use of the average 1990 normal cost rate anticipating improvements in mortality is a conservative approach for the State Supplemental Contribution Rate. The Education Code requires the rate to be set sufficient "to eliminate the remaining Unfunded Actuarial Obligation." Since the rate pays a portion of the normal cost in addition to the Unfunded Actuarial Obligation, it is not unreasonable to anticipate changes in the normal cost rate. However, we also believe it would be reasonable to use the current normal cost rate and not anticipate these increases.

After applying the 0.5% of pay limit on changes to the State Supplemental Contribution Rate, there is no difference in the rate for the next fiscal year.

Employer Supplemental Contribution Rate

The Employer Supplemental Contribution Rate is intended to pay off the Unfunded Actuarial Obligation for pre-2014 service by June 30, 2046. There is some overlap between the Employer Supplemental Contribution Rate and the State Supplemental Contribution Rate as the State Supplemental Contribution Rate pays off the portion of the Unfunded Actuarial Obligation for pre-2014 service that is attributable to the 1990 Benefit Structure. Table V-2 on the next page compares our independent calculations of the Unfunded Actuarial Obligation for pre-2014 service to Milliman's calculation as well as the division between 1990 Benefits and New Benefits.

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

Table V-2

Unfunded Actuarial Obligation for Pre-2014 Service						
	Milliman		Cheiron		Difference	
Measures as of June 30, 2019						
Actuarial Obligation for Pre-2014 Service	$	257,003	$	255,526	$	1,477
AVA for Pre-2014 Service		154,663		154,893		(231)
Unfunded AO for Pre-2014 Service	$	102,340	$	100,633	$	1,707
Actuarial Obligation for Pre-2014 1990 Benefits	$	212,812	$	211,741	$	1,071
AVA for Pre-2014 1990 Benefits		182,869		183,009		(140)
Unfunded AO for Pre-2014 1990 Benefits	$	29,943	$	28,732	$	1,211
Actuarial Obligation for Pre-2014 New Benefits	$	44,191	$	43,785	$	406
AVA for Pre-2014 New Benefits		(28,206)		(28,115)		(91)
Unfunded AO for Pre-2014 New Benefits	$	72,397	$	71,901	$	496

The differences in calculations have been discussed above in Sections III and IV.

Table V-3 on the following page compares our calculation of the Employer Supplemental Rate to Milliman's calculation. This calculation is for illustrative purposes only as the Board does not set this rate until the next actuarial valuation.

The top portion of this exhibit calculates the Employer Supplemental Rate that would be needed to pay off the UAO for pre-2014 service attributable to New Benefits. Our calculation of the UAO rate needed matches Milliman's calculation very closely. As with the State Supplemental Rate calculation, we encourage Milliman to disclose additional information about the projection of the UAO to June 30, 2020.

The Employer Supplemental Rate is reduced from the UAO amortization rate by the surplus of other contribution rates for New Benefits over the normal cost rate for New Benefits. The difference between our independent calculation of the supplemental rate needed to pay off the Pre-2014 New Benefits UAO and Milliman's calculation is due to a difference in how member contributions and the normal cost offsets are calculated. Our calculation uses the rates from the current valuation. Milliman, instead estimates the average rates throughout the projection period.

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

Table V-3

Employer Supplemental Contribution Rate for Pre-2014 Service			
	Milliman	**Cheiron**	**Difference**
UAO for Pre-2014 New Benefits as of June 30, 2019	$ 72,397	$ 71,901	$ 496
FYE 2020 Expected UAO Payment		4,690	
Expected UAO as of June 30, 2020		$ 72,955	
FYE 2021 UAO Rate Needed	12.065%	12.042%	0.023%
Revenue for Pre-2014 New Benefits UAO (Before Supplemental Rate)			
Member Rate	2.226%	2.242%	-0.016%
Employer Base Rate	0.250%	0.250%	0.000%
State Base Rate on Employer Payroll	1.884%	1.883%	0.001%
Total New Benefits Contribution Rate	4.360%	4.375%	-0.015%
Total Normal Cost Rate	19.660%	20.026%	-0.366%
1990 Normal Cost Rate	17.822%	17.215%	0.607%
New Benefits Normal Cost Rate	1.838%	2.811%	-0.973%
Net Revenue for Pre-2014 New Benefits UAO	2.522%	1.564%	0.958%
Employer Supplemental Rate Needed for Pre-2014 New Benefits UAO	**9.543%**	**10.478%**	**-0.935%**
UAO for Pre-2014 Service as of June 30, 2019	$ 102,340	$ 100,633	$ 1,707
FYE 2020 Expected UAO Payment	5,003	5,114	(111)
Expected UAO as of June 30, 2020	$ 104,329	$ 102,388	$ 1,942
FYE 2021 UAO Rate Needed	17.079%	16.538%	0.540%
Revenue for Pre-2014 UAO (Before Supplemental Rate)			
Member Rate	10.226%	10.242%	-0.016%
Employer Base Rate	8.250%	8.250%	0.000%
State Base Rate on Employer Payroll	1.884%	1.883%	0.001%
State Supplemental Rate on Employer Payroll	5.979%	5.891%	0.088%
Normal Cost Rate	-19.660%	-20.026%	0.366%
Net Revenue for Pre-2014 UAO	6.679%	6.241%	0.438%
Employer Supplemental Rate Needed for Pre-2014 Total UAO	**10.400%**	**10.297%**	**0.103%**
Unconstrained Employers Supplemental Rate	10.400%	10.478%	-0.078%
Current Rate	10.150%	10.150%	0.000%
Employer Supplemental Rate for Next FY	10.400%	10.478%	-0.078%

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

There are different member rates and different normal cost rates for members under the 2 percent at 60 formula and the 2 percent at 62 formula. In computing its average rates, Milliman anticipates a decline in the members covered by the 2 percent at 60 formula and an increase in the members covered by the 2 percent at 62 formula.

This anticipated transition results in lower average member rates and a lower total normal cost rate. The total normal cost rate and the 1990 normal cost rate are increased for anticipated improvements in mortality. The net impact of using these averages is to increase the anticipated surplus over the normal cost rate for New Benefits, and reduce the supplemental rate needed for Pre-2014 New Benefits UAO. In the year that this rate would be effective, however, the actual surplus over the New Benefits normal cost would be lower and the payment on the UAO would not be what is anticipated by the amortization.

While Milliman's interpretation of the statute is reasonable, it would also be reasonable to treat the payment on the UAO as a level percentage of pay and let the Employer Supplemental Rate have a declining trend as future normal cost rates decline. This approach would also be more conservative and provide marginally greater protection of the funding of New Benefits.

The middle portion of Table V-3 on the preceding page calculates the Employer Supplemental Rate that would be needed to pay off the UAO for pre-2014 service, including the portion attributable to 1990 Benefits. Milliman refers to this rate as the minimum contribution required. The difference between our calculation of the UAO for pre-2014 service discussed in Sections III and IV above result in a difference of about 0.5% of pay in the UAO rate needed.

The UAO rate needed is offset by the surplus of pre-2014 rates over the normal cost rate. The differences between our calculation and Milliman's calculation are the same as discussed for the top section of this exhibit. With these two differences offsetting each other, the difference between our calculations of the Employer Supplemental Rate Needed for pre-2014 Total UAO is only 0.1% of pay.

The rationale for this minimum contribution rate appears to be the requirement that the Employer Supplemental Rate pay off the total UAO for pre-2014 service even though the State Supplemental Rate is required to pay off the portion attributable to 1990 Benefits. However, this minimum creates some dynamics that may not be intended.

One impact of this minimum is that any limitation to the increase in the State Supplemental Rate is immediately passed through as an increase in the minimum Employer Supplemental Rate. For example, the State Supplemental Rate for the next fiscal year was reduced from about 7.9% of pay to 6.3% of pay due to the 50 basis point limit on rate increases. This reduction of 1.6% increases the minimum Employer Supplemental Rate by a similar amount (adjusted for the difference between State payroll and employer payroll). As a result, the Employer Supplemental Rate is effectively frontloaded until the State Supplemental Rate catches up to the amount needed to pay off the 1990 UAO. If this minimum is maintained, it may make sense to use the unconstrained State Supplemental Rate in the Employer Supplemental Rate minimum calculation to avoid this dynamic.

SECTION V – DB PROGRAM SUPPLEMENTAL CONTRIBUTION RATES

Another potential reason not to require this minimum is that the Employer Supplemental Contributions are only allocated to pay the Pre-2014 New Benefits UAO. Increasing the Employer Supplemental Contribution Rate will pay off the Pre-2014 New Benefits UAO more quickly, but will not affect the Pre-2014 UAO for 1990 Benefits. If a shortfall persists for the Pre-2014 UAO for 1990 Benefits, the minimum rate as currently calculated would create a surplus for the Pre-2014 New Benefits to offset the shortfall until the State's funding of the 1990 Benefits eliminated the shortfall.

The bottom section of Table V-3 calculates the Employer Supplemental Contribution Rate for the next fiscal year as the greater of the rates calculated in the sections above subject to a maximum change of 1.0% of pay. The differences between our independent calculations and Milliman's calculations in the first two sections of the exhibit effectively offset each other such that the final Employer Supplemental Contribution Rates match very closely.

SECTION VI – CBB, DBS, AND MPP PROGRAMS

After collecting the census data and actuarial assumptions, we programmed our valuation system based on our understanding of the Plan's provisions and performed calculations based on the scrubbed data files provided by Milliman. Table VI-1 below compares our independent calculation of the Unfunded Actuarial Obligation to Milliman's calculation for the Cash Balance Benefit Program. The calculations match very closely.

Table VI-1

CBB Actuarial Obligation				
	Milliman		**Cheiron**	**Percentage Difference**
Actuarial Obligation				
Active	$ 158,841	$	158,841	0.0%
Inactive	124,541		124,541	0.0%
Retiree	10,449		10,417	-0.3%
Total Actuarial Obligation	$ 293,831	$	293,799	0.0%
Market/Actuarial Value of Assets	357,273		357,273	0.0%
Unfunded Actuarial Obligation	$ (63,442)	$	(63,474)	0.0%

Amounts in thousands

As is discussed in the CBB valuation report, there is no provision in the Education Code for the CBB plan to increase contributions to make up for any future shortfalls. As of the valuation date there was a surplus and granting additional earnings credits would be consistent with the Board's current policy. However, Milliman reasonably warned that a UAO may develop – especially as a result of the volatile markets observed in early 2020 – and recommended the Board should consider whether additional earnings credits should be granted.

Table VI-2 on the following page compares Milliman's calculation of the additional earnings credits under the Board's policy to our independent calculation. The calculations match very closely with the only difference due to the slightly different measure of Actuarial Obligation for retirees. The table provides more detail than is in Table 6 in the valuation report. We suggest that Milliman consider adding this detail to more clearly communicate the calculation.

SECTION VI – CBB, DBS, AND MPP PROGRAMS

Table VI-2

CBB Program - Additional Credits Based on Board Policy		Milliman	Cheiron
First Allocation			
1.	Long-term Expected Net Investment Return	6.50%	6.50%
2.	Minimum Interest Rate (year prior to valuation)	2.89%	2.89%
3.	Maximum Available in First Allocation [1. - 2.]	3.61%	3.61%
4.	Non-Retiree Actuarial Obligation		$ 283,382
5.	Retiree Actuarial Obligation		10,417
6.	Total Actuarial Obligation		$ 293,799
7.	Assets		357,273
8.	Funded Ratio	121.59%	121.60%
9.	First Threshold (100% + Portfolio STD)	111.00%	111.00%
10.	Maximum Increase in Actuarial Obligation [(8. ÷ 9.) - 1]		9.55%
11.	Maximum Credit [10. x 6. ÷ 4.]	9.89%	9.90%
12.	First Allocation [Lesser of 3. and 11.]	3.61%	3.61%
Second Allocation - Amounts After First Allocation			
13.	Non-Retiree Actuarial Obligation [4. x (1 + 12.)]		$ 293,612
14.	Retiree Actuarial Obligation		10,417
15.	Total Actuarial Obligation [13. + 14.]	$ 304,061	$ 304,029
16.	Assets		357,273
17.	Funded Ratio [16. ÷ 15.]	117.50%	117.51%
18.	Second Threshold [100% + 2 x Portfolio STD]	122.00%	122.00%
19.	Target Funded Ratio [Max((17. + 18.) ÷ 2, 18.]	122.00%	122.00%
20.	Maximum Increase in Actuarial Obligation [Max((17. ÷ 19.) - 1,0)]		0.00%
21.	Available for Second Allocation [20. x 15. ÷ 13.]	0.00%	0.00%
Additional Earnings Credits Based on Board Policy			
22.	Additional Earnings Credit Percentage [(1 + 12.) x (1 + 21.) - 1	3.61%	3.61%
23.	Additional Earnings Credit Amount [22. x 4.]	$ 10,230	$ 10,230

Milliman includes a risk disclosure section in the report in compliance with ASOP No. 51. Milliman identifies future investment returns as the primary risk and assesses that if additional earnings credits are adopted and the investment return for the next year is -12% or less, the surplus

SECTION VI – CBB, DBS, AND MPP PROGRAMS

would be eliminated. This information is useful and might warrant being highlighted in the summary of findings section of the report. We would also encourage Milliman to provide additional risk information to help inform the Board's decision whether or not to grant additional earnings credits. Such information could include the level of investment returns over the next five years, for example, that would exhaust the surplus if additional earnings credits are granted versus if additional earnings credits are not granted.

Table VI-3 below compares our independent calculation of the Unfunded Actuarial Obligation to Milliman's calculation for the Defined Benefit Supplement Program. The calculations match very closely.

Table VI-3

DBS Actuarial Obligation			
	Milliman	**Cheiron**	**Percentage Difference**
Actuarial Obligation			
Active	$ 8,666,542	$ 8,666,542	0.0%
Inactive	766,654	766,654	0.0%
Retiree	1,692,848	1,694,913	0.1%
Total Actuarial Obligation	$ 11,126,044	$ 11,128,109	0.0%
Market/Actuarial Value of Assets	13,904,497	13,904,497	0.0%
Unfunded Actuarial Obligation	**$ (2,778,453)**	**$ (2,776,388)**	**-0.1%**

Amounts in thousands

As is discussed in the DBS valuation report, there is no provision in the Education Code for the DBS plan to increase contributions to make up for any future shortfalls. As of the valuation date there was a surplus and granting additional earnings credits would be consistent with the Board's current policy. However, Milliman reasonably warned that a UAO may develop – especially as a result of the volatile markets observed in early 2020 – and recommended the Board should consider whether additional earnings credits should be granted.

Table VI-4 on the following page compares Milliman's calculation of the additional earnings credits under the Board's policy to our independent calculation. The calculations match very closely with the only difference due to the slightly different measure of Actuarial Obligation for retirees. The table provides more detail than is in Table 6 in the valuation report. We suggest that Milliman consider adding this detail to more clearly communicate the calculation.

SECTION VI – CBB, DBS, AND MPP PROGRAMS

Table VI-4

DBS Program - Additional Credits Based on Board Policy		
	Milliman	**Cheiron**
First Allocation		
1. Long-term Expected Net Investment Return	7.00%	7.00%
2. Minimum Interest Rate (year prior to valuation)	2.89%	2.89%
3. Maximum Available in First Allocation [1. - 2.]	4.11%	4.11%
4. Non-Retiree Actuarial Obligation		$ 9,433,196
5. Retiree Actuarial Obligation		1,694,913
6. Total Actuarial Obligation		$ 11,128,109
7. Assets		13,904,497
8. Funded Ratio	124.97%	124.95%
9. First Threshold (100% + Portfolio STD)	113.10%	113.10%
10. Maximum Increase in Actuarial Obligation [(8. ÷ 9.) - 1]		10.48%
11. Maximum Credit [10. x 6. ÷ 4.]	12.38%	12.36%
12. First Allocation [Lesser of 3. and 11.]	4.11%	4.11%
Second Allocation - Amounts After First Allocation		
13. Non-Retiree Actuarial Obligation [4. x (1 + 12.)]		$ 9,820,900
14. Retiree Actuarial Obligation		1,694,913
15. Total Actuarial Obligation [13. + 14.]	$ 11,513,748	$ 11,515,813
16. Assets		13,904,497
17. Funded Ratio [16. ÷ 15.]	120.76%	120.74%
18. Second Threshold [100% + 2 x Portfolio STD]	126.20%	126.20%
19. Target Funded Ratio [Max((17. + 18.) ÷ 2, 18.]	126.20%	126.20%
20. Maximum Increase in Actuarial Obligation [Max((17. ÷ 19.) - 1,0)]		0.00%
21. Available for Second Allocation [20. x 15. ÷ 13.]	0.00%	0.00%
Additional Earnings Credits Based on Board Policy		
22. Additional Earnings Credit Percentage [(1 + 12.) x (1 + 21.) ·	4.11%	4.11%
23. Additional Earnings Credit Amount [22. x 4.]	$ 387,704	$ 387,704

Milliman includes a risk disclosure section in the report to comply with ASOP No. 51. Milliman identifies future investment returns as the primary risk and assesses that if additional earnings credits are adopted and the investment return for the next year is -15% or less, the surplus would

SECTION VI – CBB, DBS, AND MPP PROGRAMS

be eliminated. This information is useful and might warrant being highlighted in the summary of findings section of the report. We would also encourage Milliman to provide additional risk information to help inform the Board's decision whether or not to grant additional earnings credits. Such information could include the level of investment returns over the next five years, for example, that would exhaust the surplus if additional earnings credits are granted versus if additional earnings credits are not granted.

Table VI-5 below compares our independent calculation of the Actuarial Obligation to Milliman's calculation for the Medicare Premium Payment Program. The calculations match very closely.

Table VI-5

MPPP Actuarial Obligation			
	Milliman	**Cheiron**	**Percentage Difference**
Actuarial Obligation			
Medicare Part A	$ 286.5	$ 287.9	0.5%
Medicare Part B	1.7	1.9	14.2%
Total Actuarial Obligation	$ 288.2	$ 289.9	0.6%
THBF Assets	0.2	0.2	0.0%
Unfunded Actuarial Obligation	**$ 288.0**	**$ 289.7**	**0.6%**
Guaranteed Funding from Future Employer Contributions	288.0	289.7	0.6%
Effective Unfunded Actuarial Obligation	**$ 0.0**	**$ 0.0**	

Amounts in millions

The MPP Program is funded on a "pay-as-you-go" basis, with a portion of contributions that would have otherwise been credited to the DB Program being diverted to the Teachers' Health Benefit Fund (THBF) to make the ongoing MPP Program payments. Also, beginning in 2008, DB Program assets in the amount of the MPP Program Unfunded Actuarial Obligation are allocated for purposes of paying the MPP Program benefits, resulting in an ongoing effective Unfunded Actuarial Obligation of $0.

We commend Milliman for showing a sensitivity analysis in their valuation report, via a projection of the MPP Program costs under multiple scenarios: their "Best Estimate" scenario, as well as a scenario that reflects a more conservative set of assumptions (i.e., higher MPP Program participation rates and lower discount rates). As above, we note that the California Actuarial Advisory Panel supports the use of such sensitivity analysis, but also suggests other forms of

SECTION VI – CBB, DBS, AND MPP PROGRAMS

disclosure, such as stochastic or probabilistic analysis, which may provide a more robust understanding of the potential outcomes for the MPP Program funding requirements.

SECTION VII – SUPPLEMENTAL BENEFIT MAINTENANCE ACCOUNT PROGRAM

The Supplemental Benefits Maintenance Account (SBMA) provides a purchasing power floor for CalSTRS retirees. The current purchasing power level is 85%, and Milliman performs a projection to assess whether current SBMA assets plus future SBMA contributions and interest are sufficient to pay all expected SBMA benefits at the 85% purchasing power level through June 30, 2089. We developed an independent SBMA model using the same assumptions as Milliman, and Table VII-1 below compares our independent calculations to those of Milliman.

Table VII-1

SBMA Modeling		
	Milliman	**Cheiron**
Sufficient at 85% level through FYE 2089	✔	✔
Projected Surplus on Closed Group Basis as of June 30, 2019	$ 11.0B	$ 11.6B
Maximum Purchasing Power through FYE 2089	92%	92%
Depletion Period if inflation = 3.75%	<35 years	32 years

The projected SBMA benefits each year are equal to 85% of the original benefit increased for inflation since commencement minus the benefits paid by the regular DB program. Consequently, the SBMA benefit amounts have a high degree of leverage and very minor differences in the calculation or assumptions can produce significantly different results over a 70-year period. Given this sensitivity, our independent modeling results match Milliman's calculations very closely.

APPENDIX A – GLOSSARY OF TERMS

1. **Actuarial Obligation**

   The Actuarial Obligation is the difference between the present value of future benefits and the present value of total future normal costs. This is also referred to by some actuaries as the "accrued liability" or "actuarial accrued liability." The Actuarial Obligation represents the amount of assets a plan should have as of a valuation date according to the actuarial cost method.

2. **Actuarial Assumptions**

   Estimates of future experience with respect to rates of mortality, disability, turnover, retirement rate or rates of investment income, and salary increases. Demographic actuarial assumptions (rates of mortality, disability, turnover, and retirement) are generally based on past experience, often modified for projected changes in conditions. Economic assumptions (price inflation, wage inflation, and investment income) are generally based on expectations for the future that may differ from the Plan's past experience.

3. **Actuarial Cost Method**

   A mathematical budgeting procedure for allocating the dollar amount of the present value of future benefits between future normal cost and Actuarial Obligation.

4. **Actuarial Gain (Loss)**

   The difference between actual experience and the anticipated experience based on the actuarial assumptions during the period between two actuarial valuation dates.

5. **Actuarial Present Value**

   The amount of funds currently required to provide a payment or series of payments in the future. It is determined by discounting future payments at the discount rate and by probabilities of payment.

6. **Actuarially Determined Contribution**

   The payment to the Plan as determined by the actuary using a contribution allocation procedure. It may or may not be the actual amount contributed to the Plan.

7. **Amortization Method**

   A method for determining the amount, timing, and pattern of payment of the Unfunded Actuarial Obligation.

APPENDIX A – GLOSSARY OF TERMS

8. **Asset Valuation Method**

    The method used to develop the Actuarial Value of Assets from the Market Value of Assets typically by smoothing investment returns above or below the assumed rate of return over a period of time.

9. **Contribution Allocation Procedure**

    A procedure typically using an actuarial cost method, an asset valuation method, and an amortization method to develop the actuarially determined contribution.

10. **Discount Rate**

    The rate of interest used to discount future benefit payments to determine the actuarial present value. For purposes of determining an actuarially determined contribution, the discount rate is typically based on the long-term expected return on assets.

11. **Funded Status or Funding Ratio**

    Either the Market or Actuarial Value of Assets divided by the Actuarial Obligation. For purposes of this report, the Funded Status represents the proportion of the actual assets as of the valuation date compared to the assets expected by the actuarial cost method. These measures are for contribution budgeting purposes and are not appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations.

12. **Normal Cost**

    The portion of the present value of future benefits allocated to the current year by the actuarial cost method.

13. **Present Value of Future Benefits**

    The actuarial present value of all benefits both earned as of the valuation date and expected to be earned in the future by current plan members based on current plan provisions and actuarial assumptions.

14. **Unfunded Actuarial Obligation (UAO)**

    The Unfunded Actuarial Obligation is the difference between Actuarial Obligation and either the Market or the Actuarial Value of Assets. This value is sometimes referred to as "unfunded actuarial accrued liability." It represents the difference between the actual assets and the amount of assets expected by the actuarial cost method as of the valuation date.