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May 17, 2018

Teachers’ Retirement Board
California State Teachers’ Retirement System

Re: Defined Benefit Supplement Program
Actuarial Valuation as of June 30, 2017

Dear Members of the Board:

At your request, we have performed an actuarial valuation of the Defined Benefit Supplement (DBS) Program of the State Teachers' Retirement Plan as of June 30, 2017. Details about the actuarial valuation are contained in the following report. The major findings of the 2017 Actuarial Valuation are contained in this report. This report reflects the benefit provisions and contribution rates in effect as of the valuation date.

Actuarial Certification

To the best of our knowledge and belief, this report is complete and accurate and contains sufficient information to fully and fairly disclose the funded condition of the DBS Program as of June 30, 2017.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by CalSTRS staff. This information includes, but is not limited to, statutory provisions, employee data, and financial information. In our examination of these data, we have found them to be reasonably consistent and comparable with data used for other purposes. The valuation results depend on the integrity of this information. If any of this information is inaccurate or incomplete our results may be different and our calculations may need to be revised.

All costs, liabilities, rates of interest, and other factors for CalSTRS have been determined on the basis of actuarial assumptions and methods which are individually reasonable (taking into account the experience of CalSTRS and reasonable expectations) and which, in combination, offer a reasonable estimate of anticipated experience affecting CalSTRS. Further, in our opinion, each actuarial assumption used is reasonably related to the experience of CalSTRS and to reasonable expectations which, in combination, represent a reasonable estimate of anticipated experience.

Future actuarial measurements may differ significantly from the current measurements presented in this report 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; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the Plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements. The Teachers’ Retirement Board has sole authority to determine the actuarial assumptions and methods used for the valuation of the DBS Program. The board adopted the actuarial methods and assumptions used in the 2017 valuation.

Actuarial computations presented in this report are for purposes of assessing the funding of the DBS Program. The calculations in the enclosed report have been made on a basis consistent with our understanding of the DBS

Program funding structure. Determinations for other purposes may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes.

Milliman's work is prepared solely for the internal business use of CalSTRS. To the extent that Milliman's work is not subject to disclosure under applicable public records laws, Milliman's work may not be provided to third parties without Milliman's prior written consent. Milliman does not intend to benefit or create a legal duty to any third party recipient of its work product. Milliman's consent to release its work product to any third party may be conditioned on the third party signing a Release, subject to the following exceptions:

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(b) CalSTRS may provide a copy of Milliman's work, in its entirety, to other governmental entities, as required by law.

No third party recipient of Milliman's work product should rely upon Milliman's work product. Such recipients should engage qualified professionals for advice appropriate to their own specific needs.

The consultants who worked on this assignment are pension actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices, including the relevant Actuarial Standards of Practice. We are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

We would like to express our appreciation to the CalSTRS staff who gave substantial assistance in supplying the data on which this report is based. We respectfully submit the following report and we look forward to discussing it with you.

Sincerely,

Nick Collier

Nick J. Collier, ASA, EA, MAAA
Consulting Actuary

Mark C Olleman

Mark C. Olleman, FSA, EA, MAAA
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Section 1 Summary of the Findings

As of June 30, 2017, the Actuarial Value of Assets of the Defined Benefit Supplement (DBS) Program exceeds the Actuarial Obligation by $2,224,206,000. This number is the negative Unfunded Actuarial Obligation (UAO), sometimes referred to as an Actuarial Surplus. Consistent with its policy, the board granted an Additional Earnings Credits of $356,926,000 as of June 30, 2017, as discussed in this report.

($ Thousands)	June 30, 2017	June 30, 2016
Actuarial Balance Sheet		
Actuarial Obligation (before Add'l Credits)	$ 10,045,176	$ 9,804,527
Actuarial Value of Assets	12,269,382	10,943,296
Unfunded Actuarial Obligation / (Actuarial Surplus)	$ (2,224,206)	$ (1,138,769)
Additional Earnings Credit	356,926	0
Additional Annuity Credit	0	0
Final Unfunded Actuarial Obligation / (Actuarial Surplus)	$ (1,867,280)	$ (1,138,769)
Funded Ratio (Assets ÷ Actuarial Obligation)		
Before Additional Credits	**122.14%**	**111.61%**
After Additional Credits	**117.95%**	**111.61%**

The Actuarial Value of Assets for this valuation is the Fair Market Value as provided to us by CalSTRS. The actual return for the year for the DBS Program, as measured using uniform cash flow throughout the year, was about 13.5% net of investment and administrative expenses.

($ Thousands)	Year Ended June 30, 2017	Year Ended June 30, 2016
Additions		
Contributions	$ 263,200	$ 251,393
Earnings	1,479,303	114,835
Total Additions	$ 1,742,503	$ 366,228
Deductions		
Benefits	$ 404,737	$352,606
Expenses	11,680	11,243
Total Deductions	416,417	363,849
Net Increase (Decrease)	$ 1,326,086	$ 2,379
Net Assets		
Beginning of Year	$ 10,943,296	$10,940,917
Transfers In/(Out)	-	-
Net Increase (Decrease)	1,326,086	2,379
End of Year	$ 12,269,382	$ 10,943,296
Estimated Net Rate of Return	13.5%	1.0%

Summary of the Findings (continued)

If the experience had emerged as assumed, the Actuarial Surplus would have increased from $1,138,769,000 to $1,221,330,000. The difference between the actual and expected UAO the actuarial gain or loss for the year.

- There was an actuarial gain of $679,365,000 due to the actual investment return being greater than last year's assumed long-term return of 7.25%.
- There was an actuarial gain of $323,511,000 on the actuarial obligation. This consisted of a gain of $346,126,000 primarily due to the current year's interest credits being less than 7.25% during the year, which was partially offset by a loss of $22,615,000 due to the change in the investment return assumption from 7.25% to 7.00%. The Minimum Interest Rate for 2016-2017 was 2.88%.
- The net actuarial gain was $1,002,876,000, which increased the Funded Ratio to 122.14%.
- The Actuarial Obligation increased by $356,926,000 due to Additional Credits adopted effective June 30, 2017.

A summary of the actuarial (gains) and losses for the last two years is shown in the following table.

	June 30, 2017	June 30, 2016
Actuarial (Gain) or Loss		
Investment Return on Assets	$ (679,365)	$ 713,181
Assumption Changes	22,615	0
Interest Credits on Accounts	(346,126)	(360,271)
Total Actuarial (Gain) or Loss	$ (1,002,876)	$ 352,910
Expected UAO at End of Year	(1,221,330)	(1,491,679)
Total Unfunded Actuarial Obligation / (Actuarial Surplus) Before Add'l Credits	$ (2,224,206)	$ (1,138,769)

The board established a policy ("Additional Credit Policy") on June 9, 2006 that was effective for the Additional Earnings Credit and Additional Annuity Credit decisions beginning in 2006. The board's Additional Credit Policy calls for a two-step determination of the allocation as shown in detail in this report. This policy was updated at the board's April 2015 meeting to increase the thresholds needed to be met to grant Additional Earnings Credits and to remove the Additional Annuity Credit.

At the May 2018 meeting, the board granted an Additional Earnings Credits of $356,926,000, pursuant to the board policy.

Summary of the Findings (continued)

The following table shows a history of prior board actions.

($ Thousands) Valuation Date	Funded Ratio	Available Reserves and Unallocated Gains (Losses)	Additional Credits Adopted	Final Gain and Loss Reserve
June 30, 2007	116.4%	$ 954,762	$ 195,223	$ 759,539
June 30, 2008	100.2%	8,769	0	8,769
June 30, 2009	78.0%	(1,453,334)	0	(1,453,334)
June 30, 2010	86.0%	(1,044,262)	0	(1,044,262)
June 30, 2011	103.6%	281,195	0	281,195
June 30, 2012	100.6%	50,527	0	50,527
June 30, 2013	105.8%	788,028	295,872	492,156
June 30, 2014	116.3%	1,820,201	347,846	1,472,355
June 30, 2015	114.5%	1,711,825	324,216	1,387,609
June 30, 2016	111.6%	1,138,769	0	1,138,769
June 30, 2017	118.0%	2,224,206	356,926	1,867,280

Future Funding

As of June 30, 2017, the DBS Program has an Actuarial Surplus (negative UAO), since the value of assets is greater than the current value of the Actuarial Obligation. If all assumptions are met, the funding surplus will slowly grow in the future. If future experience is worse than assumed, a UAO may develop.

There is currently no provision in the Education Code to increase contributions to make up for any future shortfalls, if they were to occur. However, the assumed return on investments exceeds the current Minimum Interest Rate. To the extent that the assets earn more than the accounts are credited in the future, this may be sufficient to make up any potential shortfall.

The actuarially determined contribution in accordance with the funding policy is equal to the actual contributions that will be required to be made to the DBS Program according to the California Education Code.

Conclusion

The DBS Program is currently in a surplus funded position; that is, the assets exceed the value of the Actuarial Obligation based on the actuarial assumptions. Given the current funded position, it is consistent with their policy for the board to grant Additional Credits. However, it should be noted that future experience will not exactly conform to the assumptions. To the extent future experience is worse than assumed, it is possible that a UAO could develop in the future.

The board granted an Additional Earnings Credit of 4.12% to active and inactive member accounts, consistent with its policy. The estimated value of the Additional Earnings Credits is $356,926,000.

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Section 2 Findings of the Actuarial Valuation

An actuarial valuation is performed as of June 30 of each year, the last day of the Program's plan year. The primary purpose of the valuation is to determine the financial condition of the DBS Program through the measurement of the Gain and Loss Reserve. We also describe recent changes in the Program's financial condition and provide additional disclosure information.

The findings have been determined according to actuarial assumptions that were adopted on the basis of recent experience and current expectations of future experience. In our opinion, the assumptions used in the valuation are reasonably related to the past experience of the DBS Program and represent a reasonable estimate of future conditions affecting the Program. Nevertheless, the emerging costs of the Program will vary from those presented in this report to the extent that actual experience differs from that projected by the actuarial assumptions.

Actuarial Value of Assets

The Actuarial Value of Assets for this valuation is the Fair Market Value as reported by CalSTRS. A Statement of Program Assets for the last two plan years is shown in **Table 1**, and the Statement of Change in Program Assets is shown in **Table 2**.

The investment return for 2016-2017 was calculated to be 13.5% net of all investment and administrative expenses and assuming uniform cash flow throughout the year. This is an estimate only for the purpose of comparing investment experience from one year to the next and will likely differ from information provided by your investment advisors.

Actuarial Balance Sheet

Under the Traditional Unit Credit Actuarial Cost Method, when the assumed investment return is equal to the assumed interest crediting rate, then the Normal Cost is equal to the contributions made during the year and the Actuarial Obligation is equivalent to the current sum of the Members' Account Balances plus a reserve for the present value of the current annuity payments.

Table 3 shows the Actuarial Obligation for this valuation and the prior valuation.

For the purpose of this valuation, the account information was provided to us by CalSTRS, including Additional Earnings Credits granted for 2006, 2007, 2013, 2014, and 2015. No adjustments were needed to these account balances to reflect the Additional Earnings Credits. We checked the information for reasonableness by reviewing the individual member records supplied to us. We independently calculated the value of the annuitized benefits.

Actuarial Balance Sheet (continued)

The excess of the Actuarial Obligation over the Actuarial Value of Assets is called the Unfunded Actuarial Obligation (UAO). If the Actuarial Value of Assets exceeds the Actuarial Obligation, the difference is called the Actuarial Surplus.

If all experience emerged as assumed every year, the DBS Program would have an Actuarial Surplus at the end of each year before any Additional Earnings Credit. This is because the Minimum Interest Rate is less than the assumed earnings rate. In order to retain an Actuarial Surplus, the investment returns over a long period of time must exceed the combination of the Minimum Interest Rates and the Additional Earnings Credits.

Although we expect this to be the case, investment performance for several prior years was below the long-term assumption.

Actuarial Gains and Losses

The Minimum Interest Rate for the year ending on the valuation date was 2.88%. Since the assumed total earnings rate last year was 7.25% per year, the increase in the Actuarial Obligation was less than expected. The total actuarial gain on the Actuarial Obligation was $323,511,000, which also reflects a relatively small increase in the actuarial obligation due to the reduction in the investment return assumption.

Last year, the assumed earnings rate on the invested assets was 7.25% per year. The actual return for the year was about 13.5% (net of investment and administrative expenses and assuming uniform cash flow through the year, which is slightly different than how interest is actually posted), which produced an investment gain of $679,365,000.

The assumed earnings rate is 7.00% in all future years, as adopted by the board in February 2017.

The total actuarial gain due to all causes was $1,002,876,000 as shown in **Table 4**.

Contributions and Normal Costs

Table 4 shows that the Normal Costs of the DBS Program are equal to the actual contributions. They are shown as the actual dollar amount of contributions. The timing in Table 4 is therefore consistent with the fact that contributions are spread over the entire year and correspond to payroll timing. The total contributions of $263,200,000 were made up of $131,578,000 in member contributions and $131,622,000 in employer contributions.

Gain and Loss Reserve

Table 5 shows the derivation of the Gain and Loss Reserve. After each actuarial valuation, the Teachers' Retirement Board decides on the adjustment to the prior year's Gain and Loss Reserve and the Additional Earnings Credit, if any.

This report assumes the Teachers' Retirement Board will allocate any unallocated gain or loss to funding after any Additional Earnings Credits are adopted.

Additional Credits Based on Board Policy

Based on the board's Policy, an Additional Earnings Credit of $356,926,000 was granted as of June 30, 2017.

The board's Policy calls for a two-step determination of the allocation.

The first step in the process allocates the excess of the Actuarial Surplus over 1 times the Standard Deviation of the Expected Long-Term Rate of Return on the investment portfolio, but limited by the long-term assumed rate of earnings.

First Allocation

Long-term Expected Net Investment Return	7.00%
Minimum Interest Rate (year prior to valuation)	2.88
Maximum Available in First Allocation (1)	4.12%
Actuarial Surplus	22.14%
First Threshold (1x Portfolio Std. Deviation)	15.00
Maximum credit such that resulting Funded Ratio is not less than 100% + Std. Deviation (2)	7.20%*
First Allocation [lesser of (1) and (2)]	**4.12%**

** The result is not a simple subtraction of the Actuarial Surplus and the First Threshold, because the maximum credit is determined based on a division of the Actuarial Value of Assets and the Actuarial Obligation with the First Allocation.*

The second step in the process allocates 50% of the remaining Actuarial Surplus over 2 times the Standard Deviation of the Expected Long-Term Rate of Return on the investment portfolio.

Second Allocation

Remaining Actuarial Surplus (3)	17.95%
Second Threshold (2 x Portfolio Std. Deviation)(4)	30.00
Target Second Threshold Surplus [Average of (3) and (4), but not less than Second Threshold]	30.00%
Available for Second Allocation	**0.00%**

The total available is the sum of the two steps, or 4.12% of the Actuarial Obligation for active and inactive member accounts as of June 30, 2017.

Details of the calculation are shown in **Table 6**.

Historical Information

A history of the DBS Program's cash flow and funded status are shown in **Tables 7 and 8**.

Supplemental Information

Supplemental information that is recommended to be disclosed by the California Actuarial Advisory Panel is shown in **Tables 9, 10, and 11**.

Table 1
Statement of Program Assets

($ Thousands)	June 30, 2017	June 30, 2016
Invested Assets		
Cash	$ 29,127	$ 9,581
Debt Securities	2,105,947	2,314,506
Equity Securities	6,704,218	5,826,798
Alternative Investments	3,520,122	2,885,389
Derivative Instruments	183	4,110
Total Investments	$ 12,359,597	$ 11,040,384
Receivables	(31,027)	(35,074)
Liabilities	(59,188)	(62,014)
Fair Market Value of Net Assets	$ 12,269,382	$ 10,943,296

Table 2
Statement of Change in Program Assets

($ Thousands)	Year Ended June 30, 2017	Year Ended June 30, 2016
Additions		
Contributions		
Members	$ 131,578	$ 125,747
Employers	131,622	125,646
Total Contributions	263,200	251,393
Net Earnings	1,479,303	114,835
Total Additions	$ 1,742,503	$ 366,228
Deductions		
Benefit Payments		
Retirement, Death and Survivor	$ 383,828	$ 332,845
Refunds of Member Contributions	20,909	19,761
Total Benefits	404,737	352,606
Expenses	11,680	11,243
Total Deductions	$ 416,417	$ 363,849
Net Increase (Decrease)	$ 1,326,086	$ 2,379
Fair Market Value of Net Assets		
Beginning of Year	$ 10,943,296	$ 10,940,917
Accounting Adjustments (GASB 68)	0	0
Adjustment for Prior Year Fair Value Accrual	0	0
Transfers In/(Out)	0	0
Net Increase (Decrease)	1,326,086	2,379
End of Year	$ 12,269,382	$ 10,943,296
Estimated Net Rate of Return	13.5%	1.0%

- assuming uniform cash flow through the year
- net of investment and administrative expenses

Table 3
Actuarial Balance Sheet

($ Thousands)	June 30, 2017		June 30, 2016
	Without Additional Credits	With Additional Credits Adopted	
Total Requirements			
Actuarial Obligation			
Retirees and Beneficiaries	$ 1,381,932	$ 1,381,932	$ 1,200,485
Inactive Members	643,897	670,426	614,304
Active Members	8,019,347	8,349,744	7,989,738
Total Requirements	$ 10,045,176	$ 10,402,102	$ 9,804,527
Total Resources			
Actuarial Value of Assets	$ 12,269,382	$ 12,269,382	$10,943,296
Unfunded Actuarial Obligation or (Actuarial Surplus)	(2,224,206)	(1,867,280)	(1,138,769)
Total Resources	$ 10,045,176	$ 10,402,102	$ 9,804,527
Funded Ratio	122.14%	117.95%	111.61%

Table 4
Actuarial Gains and Losses*

($ Thousands)

	Actuarial Obligation	Actuarial Value of Assets	Unfunded Actuarial Obligation
Balance at June 30, 2016	$ 9,804,527	$ 10,943,296	$ (1,138,769)
Expected Changes			
Actual Contributions/Normal Cost	263,200	263,200	0
Actual Benefits Paid	(404,737)	(404,737)	0
Expected Earnings / Credits	705,697	788,258	(82,561)
Expected Balance at June 30, 2017	$ 10,368,687	$ 11,590,017	$ (1,221,330)
Actuarial Gains or Losses			
(Gain)/Loss on Actuarial Obligation	(323,511)**		
Gain/(Loss) on Assets		679,365	
Net (Gain) or Loss on UAO			(1,002,876)
Actual Balance at June 30, 2017	$ 10,045,176	$ 12,269,382	$ (2,224,206)

** Prior to Additional Credits.*

*** Includes impact of change in assumptions.*

Table 5
Gain and Loss Reserve

($ Thousands)	June 30, 2017		June 30, 2016
	Without Additional Credits	With Additional Credits Adopted	
Unfunded Actuarial Obligation or (Actuarial Surplus) (prior to any additional earnings)	$ (2,224,206)	$ (2,224,206)	$ (1,138,769)
Additional Earnings Credit	0	356,926	0
Unfunded Actuarial Obligation or (Actuarial Surplus)	(2,224,206)	(1,867,280)	(1,138,769)
Gain and Loss Reserve			
Beginning of Year	$ 1,138,769	$ 1,138,769	$ 1,387,609
Allocated to Funding	1,085,437	728,511	(248,840)
End of Year Gain and Loss Reserve	2,224,206	1,867,280	1,138,769
Unallocated Gains and (Losses)	$ 0	$ 0	$ 0

($ Thousands) Valuation Date	Available Reserves and Unallocated Gains (Losses)	Additional Credits Adopted	Final Gain and Loss Reserve
June 30, 2004	$ 168,630	$ 0	$ 168,630
June 30, 2005	266,978	0	266,978
June 30, 2006	423,269	88,201	335,068
June 30, 2007	954,762	195,223	759,539
June 30, 2008	8,769	0	8,769
June 30, 2009	(1,453,334)	0	(1,453,334)
June 30, 2010	(1,044,262)	0	(1,044,262)
June 30, 2011	281,195	0	281,195
June 30, 2012	50,527	0	50,527
June 30, 2013	788,028	295,872	492,156
June 30, 2014	1,820,201	347,846	1,472,355
June 30, 2015	1,711,825	324,216	1,387,609
June 30, 2016	1,138,769	0	1,138,769
June 30, 2017	2,224,206	356,926	1,867,280

Table 6
Additional Credits Based on Board Policy

	June 30, 2017	**June 30, 2016**
Funded Ratio before Additional Credits	122.14%	111.61%
Actuarial Surplus	22.14%	11.61%
First Threshold	15.00%	15.00%
Second Threshold	30.00%	30.00%
First Allocation		
Long-term Net Investment Return	7.00%	7.25%
Minimum Interest Rate (MIR) (year prior to valuation)	2.88	3.15
Maximum Available in First Allocation (1)	4.12%	4.10%
First Threshold (1 x Std. Deviation of Portfolio Return)	15.00	15.00
Maximum credit such that resulting Funded Ratio is not less than 100% + Std. Deviation (2)	7.20%*	0.00%*
First Allocation [lesser of (1) and (2)]	**4.12%**	**0.00%**

** The result is not a simple subtraction of the Actuarial Surplus and the First Threshold, because the maximum credit is determined based on a division of the Actuarial Value of Assets and the Actuarial Obligation with the First Allocation.*

Second Allocation		
Remaining Actuarial Surplus after First Allocation	$1,867,280	$1,138,769
Total Actuarial Obligation after First Allocation	$10,402,102	$9,804,527
Remaining Actuarial Surplus % (3)	17.95%	11.61%
Second Threshold (2 x Std. Deviation of Portfolio Return) (4)	30.00%	30.00%
Target Second Threshold Surplus [Average of (3) and (4), but not less than Second Threshold]	30.00%	30.00%
Maximum Credit to meet Target Surplus	$0	$0
Non-Retired Actuarial Obligation	$8,663,244	$8,604,042
Available for Second Allocation	**0.00%**	**0.00%**
Additional Earnings Credit based on Policy		
As a percentage of Actuarial Obligation (actives and inactives only) as of the valuation date	4.12%	0.00%
As a dollar amount ($ Thousands)	**$ 356,926**	**$ 0**

Table 7
History of Cash Flow

($ Thousands)

		Expenditures During the Year					Fair Market
Year End	Contributions for the Year	Benefit Payments	Contribution Refunds	Expenses	Total	External Cash Flow	Value of Assets
2002	$ 487,185	$ 0	$ 4,982	$ 255	$ 5,237	$ 481,948	$ 660,148
2003	604,853	0	17,102	580	17,682	587,171	1,311,269
2004	691,081	41,991	3,078	1,206	46,275	644,806	2,203,682
2005	669,706	75,426	8,599	1,740	85,765	583,941	3,023,177
2006	703,104	97,997	14,032	1,952	113,981	589,123	3,951,327
2007	749,844	97,221	18,026	2,464	117,711	632,133	5,381,585
2008	802,380	139,435	17,716	2,903	160,054	642,326	5,636,113
2009	822,010	156,458	29,823	3,385	189,666	632,344	5,145,981
2010	796,743	223,733	13,673	6,113	243,519	553,224	6,412,180
2011	410,820	249,949	25,956	6,140	282,045	128,775	8,054,962
2012	102,570	223,411	24,436	6,886	254,733	(152,163)	8,042,090
2013	160,771	279,284	25,131	7,568	311,983	(151,212)	8,983,919
2014	159,663	300,031	23,960	8,385	332,376	(172,713)	10,493,062
2015	216,128	300,058	19,473	8,145	327,676	(111,548)	10,940,917
2016	251,393	332,845	19,761	11,243	363,849	(112,456)	10,943,296
2017	263,200	383,828	20,909	11,680	416,417	(153,217)	12,269,382

Table 8
Schedule of Funding Progress

($ Thousands)

Year End	Actuarial Value of Assets	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio Assets/AAL	Estimated Covered Payroll	Coverage Ratio UAAL/Pay
2002	$ 660,148	$ 711,440	$ 51,292	93%	$ 21,732,000	0%
2003	1,311,269	1,358,635	47,366	97%	22,654,000	0%
2004	2,203,682	2,035,052	(168,630)	108%	22,589,000	(1)%
2005	3,023,177	2,756,199	(266,978)	110%	23,257,000	(1)%
2006	3,951,327	3,616,259	(335,068)	109%	24,240,000	(1)%
2007	5,381,585	4,622,046	(759,539)	116%	25,906,000	(3)%
2008	5,636,113	5,627,344	(8,769)	100%	27,118,000	0%
2009	5,145,981	6,599,315	1,453,334	78%	27,327,000	5%
2010	6,412,180	7,456,442	1,044,262	86%	26,274,000	4%
2011	8,054,962	7,773,767	(281,195)	104%	25,536,000	(1)%
2012	8,042,090	7,991,563	(50,527)	100%	25,091,000	(0)%
2013	8,983,919	8,491,763	(492,156)	106%	24,994,000	(2)%
2014	10,493,062	9,020,707	(1,472,355)	116%	25,805,000	(6)%
2015	10,940,917	9,553,308	(1,387,609)	115%	27,143,000	(5)%
2016	10,943,296	9,804,527	(1,138,769)	112%	28,788,000*	(4)%
2017**	12,269,382	10,402,102	(1,867,280)	118%	29,971,000*	(6)%

** Covered payroll estimated for active members with a non-zero DBS account.*
*** Results include Additional Earnings Credits adopted at the May 2018 Teachers' Retirement Board meeting.*

Table 9
Reconciliation of Changes in Unfunded Actuarial Obligation

($ Thousands)

Year End	Beginning of Year UAO	Expected Earnings/ Credits	(G)/L on Actuarial Obligation	(G)/L on Assets	Additional Credits	End of Year UAO
2011	$ 1,044,262	$ 75,709	$ (363,073)*	$ (1,038,093)	$ 0	(281,195)
2012	(281,195)	(21,089)	(214,512)	466,269	0	(50,527)
2013	(50,527)	(3,789)	(246,009)	(487,703)	295,872	(492,156)
2014	(492,156)	(36,912)	(285,294)	(1,005,839)	347,846	(1,472,355)
2015	(1,472,355)	(110,427)	(360,887)	231,844	324,216	(1,387,609)
2016	(1,387,609)	(104,070)	(360,271)*	713,181	0	(1,138,769)
2017**	(1,138,769)	(82,561)	(323,511)*	(679,365)	356,926	(1,867,280)

** Includes impact of changes in assumptions.*
*** Results include Additional Earnings Credits adopted at the May 2018 Teachers' Retirement Board meeting.*

Table 10
Changes in Economic Assumptions

Year	Price Inflation	Wage Inflation	Investment Return
2011	3.00%	3.75%	7.50%
2012	3.00%	3.75%	7.50%
2013	3.00%	3.75%	7.50%
2014	3.00%	3.75%	7.50%
2015	3.00%	3.75%	7.50%
2016	2.75%	3.50%	7.25%
2017	2.75%	3.50%	7.00%

Table 11
Smoothing and Volatility Ratios

Year	Asset Smoothing Ratio AVA/MVA	Asset Volatility Ratio MVA/Payroll	Liability Volatility Ratio AAL/Payroll
2002	100%	3.0%	3.3%
2003	100%	5.8%	6.0%
2004	100%	9.8%	9.0%
2005	100%	13.0%	11.9%
2006	100%	16.3%	14.9%
2007	100%	20.8%	17.8%
2008	100%	20.8%	20.8%
2009	100%	18.8%	24.1%
2010	100%	24.4%	28.4%
2011	100%	31.5%	30.4%
2012	100%	32.1%	31.9%
2013	100%	35.9%	34.0%
2014	100%	40.7%	35.0%
2015	100%	40.3%	35.2%
2016	100%	38.0%	34.1%
2017*	100%	40.9%	34.7%

** Results include Additional Earnings Credits adopted at the May 2018 Teachers' Retirement Board meeting.*

Appendix A Provisions of Governing Law

All of the actuarial calculations contained in this report are based upon our understanding of the Defined Benefit Supplement (DBS) Program of the State Teachers' Retirement Plan as contained in Part 13 of the California Education Code. The provisions used in this valuation are summarized below for reference purposes.

Membership

Eligibility Requirement:	All members of the Defined Benefit Program who perform creditable service and earn creditable compensation after December 31, 2000.
Member:	An eligible employee with creditable service subject to coverage in the DBS Program.

Account Balance

Account Balance:	Nominal accounts established for the purpose of determining benefits payable to the Member. Accounts are credited with Contributions, a Minimum Interest Rate (MIR) and Additional Earnings Credits.
Contributions:	One-quarter (2% of compensation) of the DB Program Member contributions on creditable compensation was allocated to the Member's DBS Account through December 31, 2010. Member and employer contributions will be credited to the Member's DBS Account for creditable compensation that is not credited to the DB Program.
Minimum Interest Rate:	Annual rate determined for the plan year by the board in accordance with federal laws and regulations. The MIR is equal to the average of the yields on 30-year Treasuries for the 12 months ending in February preceding the beginning of the plan year, rounded to the next highest 0.01%.
Additional Earnings Credit:	Annual rate determined for the plan year by the board pursuant to earnings credit policy adopted at the April 2015 meeting.
Additional Annuity Credit:	No longer applies, per the board annuity credit policy adopted at the April 2015 meeting.

Normal Retirement

Eligibility Requirement:	Receipt of a corresponding benefit under the DB Program.
Benefit:	The DBS Account Balance at the benefit effective date subject to limits imposed under Internal Revenue Code Section 415.
Form of Payment:	The normal form of payment is a lump sum distribution. Annuity options are available if the DBS Account equals or exceeds $3,500.

Early Retirement

Eligibility Requirement:	Same as Normal Retirement.
Benefit and Form:	Same as Normal Retirement.

Late Retirement

Benefit and Form:	Same as Normal Retirement. Contributions and earnings continue to be credited to the Account Balances until distributed.

Deferred Retirement

Benefit:	A Member must receive a DBS benefit when the corresponding benefit is received under the DB Program.

Disability Benefit

Eligibility Requirement:	Receipt of a corresponding benefit under the DB Program.
Benefit:	The DBS Account Balance at the date the disability benefit becomes payable. An annuity benefit is discontinued upon the termination of the corresponding DB Program benefit.
Form of Payment:	Same as Normal Retirement.

Death before Retirement

Eligibility Requirement:	Deceased Member has a DBS Account Balance.
Benefit:	The DBS Account Balance at the date of death, plus minimum interest credited through the date of payment, payable to the designated beneficiary.
Form of Payment:	Same as Normal Retirement, except annuity options are limited to a Period Certain Annuity.

Death after Retirement

Eligibility Requirement:	The deceased Member was receiving an annuity.
Benefit:	According to the terms of the annuity elected by the Member.

Termination from the Program

Eligibility Requirement:	Termination of all CalSTRS-covered employment.
Benefit:	Lump-sum distribution of the DBS Account Balance as of the date of distribution. The benefit is payable six months from the termination of creditable service.

Appendix B Actuarial Methods and Assumptions

This section of the report discloses the actuarial methods and assumptions used in this Actuarial Valuation. These methods and assumptions have been chosen on the basis of recent experience of the DBS Program and on current expectations as to future economic conditions. The assumptions were reviewed and changed for the June 30, 2016 Actuarial Valuation as a result of the 2016 Experience Analysis. Please refer to that Experience Analysis report dated December 30, 2016 for the data and rationale used in the selection and recommendation of each assumption.

The assumptions are intended to estimate the future experience of the members of the DBS Program and of the DBS Program itself in areas that affect the projected benefit flow and anticipated investment earnings. Any variations in future experience from that expected from these assumptions will result in corresponding changes in estimated costs of the DBS Program's benefits.

Actuarial Cost Method

The accruing costs of all benefits are measured by the Traditional Unit Credit Actuarial Cost Method. Under this method, the projected benefits of each individual member are allocated by a consistent formula to valuation years. The actuarial present value of future projected benefits allocated to the current year is called the Normal Cost. The actuarial present value of future projected benefits allocated to periods prior to the valuation year is called the Actuarial Obligation.

The Actuarial Obligation is equal to the accumulated account balances and the Normal Cost is equal to the total annual contribution.

Asset Valuation Method

The assets are valued at Fair Market Value.

Actuarial Assumptions

The Actuarial Standards Board has adopted Actuarial Standard of Practice No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. This Standard provides guidance on selecting economic assumptions under defined benefit retirement programs such as the System. In our opinion, the economic assumptions have been developed in accordance with the Standard.

The Actuarial Standards Board has adopted Actuarial Standard of Practice No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. This Standard provides guidance on selecting demographic assumptions under defined benefit retirement programs such as the System. In our opinion, the demographic assumptions have been developed in accordance with the Standard.

The assumptions are intended to estimate the future experience of the members of the DBS Program and of the System itself in areas that affect the projected benefit flow and anticipated investment earnings. Any variations in future experience from that expected from these assumptions will result in corresponding changes in estimated costs of the Program's benefits.

The demographic assumptions are listed in **Table B.1** and illustrated at selected ages and duration combinations in **Table B.2**.

Table B.1
List of Major Valuation Assumptions

I. Economic Assumptions

A.	Investment Return (net of investment and administrative expenses)	7.00%
B.	Interest on Member Accounts	7.00%
C.	Wage Growth	3.50%
D.	Inflation	2.75%
E.	Standard Deviation of Portfolio	15.00%

II. Demographic Assumptions

A. Mortality[1]

Retired & Beneficiary	- Male	2016 CalSTRS Retired Male	Table B.2
	- Female	2016 CalSTRS Retired Female	Table B.2
Disabled	- Male	RP-2014 Disabled Retiree Male set back 2 years	Table B.2
	- Female	RP-2014 Disabled Retiree Female set back 2 years (select rates in first three years for both Males and Females)	Table B.2

1. All tables use 110% of the MP-2016 Ultimate Projection Scale. The combined base tables and projection scale specified contain a margin for expected future mortality improvement.

Note: Assumptions for active members do not apply to the DBS Program valuation, as each active and inactive member's liabilities are equal to the member's account balance.

Table B.2
Mortality as of June 30, 2017

	Retired Members and Beneficiaries[1]		Disabled Members (After Year 3)[1]	
Age	**Male**	**Female**	**Male**	**Female**
50	0.240%	0.133%	1.848%	1.043%
55	0.354	0.211	2.149	1.305
60	0.474	0.280	2.437	1.541
65	0.674	0.422	2.836	1.841
70	1.079	0.696	3.517	2.390
75	1.936	1.280	4.637	3.400
80	3.553	2.455	6.420	5.036
85	6.831	4.896	9.326	7.483
90	13.161	9.948	14.127	11.045
95	22.456	18.616	21.090	16.322

Select rates for disability:	Male	Female
First year of disability	4.0%	3.0%
Second year of disability	3.5	2.5
Third year of disability	3.0	2.0

1. *Projected improvement based on 110% of the MP-2016 Ultimate Projection Scale. Projection scale does not apply to select minimum rates.*

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Appendix C Valuation Data

The membership data for this actuarial valuation was supplied by CalSTRS. Although we did not audit this data, we compared the data for this and the prior valuation and tested for reasonableness, as well as for consistency with prior periodic reports from the CalSTRS staff. Based on these tests, we believe the data to be sufficiently accurate for the purposes of this valuation. Since the valuation results are dependent on the integrity of the data supplied, the results can be expected to differ if the underlying data is incomplete or missing. It should be noted that if any data or other information is inaccurate or incomplete, our calculations may need to be revised.

Tables C.1 through **C.4** summarize the census data used in this valuation.

Table C.1
Summary of Statistical Information

	June 30, 2017	June 30, 2016
Number of Members		
Active Members[1]	445,935	438,537
Inactive Members [1]	131,823	130,456
Annuitants	63,416	58,880
Total Membership in Valuation	641,174	627,873
Active Members Statistics[1]		
Earned Salaries ($ millions)	$ 31,136	$ 29,826
Average Salary	$ 69,822	$ 68,013
Average Age	45.3 years	45.4 years
Average Service	12.1 years	12.1 years

1. Active member statistics include all active members in the DB Program, as they are eligible to participate in the DBS Program.

Table C.2
Age and Service Distribution
All Active Members

Total

	Years of Service					
Age	1 & Under	Greater than 1 & Under 5	5-9	10-14	15-19	20-24
Less than 25	5,365	1,832				
25 to 30	11,733	22,523	2,579	1		
30 to 35	6,996	19,724	17,724	3,920	5	
35 to 40	5,131	12,701	15,820	24,471	4,018	3
40 to 45	3,979	9,022	9,923	18,265	24,174	2,701
45 to 50	3,334	7,535	7,928	12,167	20,156	16,197
50 to 55	2,362	5,335	5,567	8,328	12,070	11,776
55 to 60	1,681	4,080	4,378	6,645	9,316	8,545
60 to 65	1,085	2,823	2,944	4,310	6,384	5,642
65 to 70	550	1,346	1,370	1,727	2,390	1,980
70 and over	271	789	709	584	637	550
Age Unknown	-	-	-	-	-	-
Total	42,487	87,710	68,942	80,418	79,150	47,394

	Years of Service					
Age	25-29	30-34	35-39	40-44	45 & Over	Total
Less than 25						7,197
25 to 30						36,836
30 to 35						48,369
35 to 40						62,144
40 to 45	11					68,075
45 to 50	1,184	2				68,503
50 to 55	9,258	1,047	3			55,746
55 to 60	8,667	6,231	662	3		50,208
60 to 65	4,614	2,913	1,596	83	1	32,395
65 to 70	1,314	645	335	237	25	11,919
70 and over	385	251	149	98	120	4,543
Age Unknown	-	-	-	-	-	-
Total	25,433	11,089	2,745	421	146	445,935

Table C.3
Inactive Members

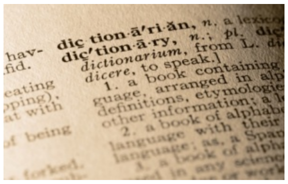
Fiscal Year Ending June 30	Number	Account Balances[1]
2007	80,071	$158,169,000
2008	89,201	200,750,000
2009	99,654	249,838,000
2010	112,556	303,047,000
2011	121,653	356,289,000
2012	127,763	403,271,000
2013	130,776	444,279,000
2014	129,961	468,268,000
2015	129,698	496,059,000
2016	130,456	525,465,000
2017	131,823	551,790,000

1. Does not include Additional Earnings Credits.

Table C.4
Annuitants

Fiscal Year Ending June 30	Number	Accounts at Retirement
2007	13,561	$ 133,216,000
2008	17,897	206,275,000
2009	23,002	312,732,000
2010	30,028	472,547,000
2011	36,066	627,629,000
2012	41,991	783,543,000
2013	46,927	926,192,000
2014	50,852	1,042,152,000
2015	54,742	1,163,868,000
2016	58,880	1,305,902,000
2017	63,416	1,472,730,000

Appendix D Glossary



The following definitions are largely excerpts from a list adopted by the major actuarial organizations in the United States. In some cases, the definitions have been modified for specific applicability to the CalSTRS DBS Program. Defined terms are capitalized throughout this Appendix.

Account Balance
The nominal account amount of an individual's benefit as of a specific date, determined in accordance with the terms of the Plan. The Account Balance is accumulated with contributions and interest.

Actuarial Assumptions
Assumptions as to the occurrence of future events affecting pension costs, such as mortality, withdrawal, disability and retirement, changes in compensation, rates of investment earnings and asset appreciation or depreciation, procedures used to determine the Actuarial Value of Assets and other relevant items.

Actuarial Cost Method
A procedure for determining the Actuarial Present Value of pension plan benefits and expenses and for developing an actuarially equivalent allocation of such value to time periods, usually in the form of a Normal Cost and an Actuarial Obligation.

Actuarial Equivalent
Of equal Actuarial Present Value, determined as of a given date with each value based on the same set of Actuarial Assumptions.

Actuarial Gain or Loss
A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions during the period between two Actuarial Valuation dates, as determined in accordance with a particular Actuarial Cost Method.

Actuarial Obligation
That portion, as determined by a particular Actuarial Cost method, of the Actuarial Present Value of pension plan benefits and expenses which is not provided for by future Normal Costs.

Actuarial Present Value
The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions.

Actuarial Surplus
The excess, if any, of the Actuarial Value of Assets over the Actuarial Obligation.

Actuarial Valuation
The determination, as of a Valuation Date, of the Normal Cost, Actuarial Obligation, Actuarial Value of Assets and related Actuarial Present Values for a pension plan.

Actuarial Value of Assets
The value of cash, investments and other property belonging to a pension plan, as used by the actuary for the purpose of an Actuarial Valuation.

Normal Cost	The Actuarial Present Value of benefits expected to accrue in the plan year subsequent to the valuation date. The Normal Cost is equivalent to the expected Member and Employer contributions for the next year.
Traditional Unit Credit Actuarial Cost Method	A method under which the Actuarial Obligation is equal to the Actuarial Present Value of benefits for service accrued to the valuation date.
Unfunded Actuarial Obligation	The excess, if any, of the Actuarial Obligation over the Actuarial Value of Assets.
Valuation Date	June 30, 2017.