Minnesota Legislative Commission on Pensions and Retirement

Replication of the July 1, 2017 Actuarial Valuation of the St. Paul Teachers' Retirement Fund Association

Prepared by Deloitte Consulting LLP

February 2018

Contents

Actuarial Valuation Opinion

This report presents the results of the actuarial valuation replication of the St. Paul Teachers' Retirement Fund Association ("SPTRFA") Retirement Plan ("the Plan") as of July 1, 2017 in accordance with Minnesota Statutes, Section 356.214, Subdivision 4, as directed by the Minnesota Legislative Commission on Pensions and Retirement ("LCPR" or "the Commission").

This actuarial valuation replication has been prepared based upon participant data and financial information provided by SPTRFA and their retained actuary as of July 1, 2017. We have analyzed the data and other information provided for reasonableness, but we have not independently audited the data. We have no reason to believe the data or other information provided is not complete and accurate, and know of no further information that is essential to the preparation of the actuarial valuation.

All costs, liabilities, rates of interest, and other factors underlying these actuarial computations have been determined on the basis of the same actuarial assumptions and methods used by the retained actuary; It is our opinion that these assumptions and methods are reasonable (or consistent with authoritative guidance) for the purposes described herein.

Future actuarial measurements may differ significantly from 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 operations 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.

Our scope for this replication report did not include analyzing the potential range of such future measurements, and we did not perform that analysis.

This report is prepared solely for the benefit of the LCPR and the State of Minnesota. This report is not intended for the benefit of any other party and may not be relied upon by any third party for any purpose, and Deloitte Consulting accepts no responsibility or liability with respect to any party other than the LCPR and the State of Minnesota in accordance with its statutory and regulatory requirements.

The undersigned with actuarial credentials collectively meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

To the best of our knowledge, no employee of the Deloitte U.S. Firms (Deloitte & Touche LLP, Deloitte Consulting LLP, Deloitte Financial Advisory Service LLP, and Deloitte Tax LLP) is an officer or director of SPTRFA. In addition, we are not aware of any relationship between the Deloitte U.S. Firms and SPTRFA that may impair or appear to impair the objectivity of the work detailed in this report.

DELOITTE CONSULTING LLP

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Executive Summary

Replication Overview

Process and Scope

This actuarial replication report has been prepared per Minnesota Statute Section 356.214, Subdivision 4. The LCPR has engaged Deloitte Consulting, LLP to perform a replication of the July 1, 2017 actuarial valuation of the St. Paul Teachers' Retirement Fund Association.

The primary purpose of this report is to test the census and financial data, plan provisions, and actuarial assumptions and methods being used by the retained actuary in its July 1, 2017 valuation report by independently performing an actuarial valuation based on the same source data and the statutory plan provisions.

The replication valuation is initially performed without consideration of the retained actuary's report or sample lives. We program the valuation model based on our understanding of applicable assumptions and plan provisions. Once complete, we compare our liability and normal cost results to those of the retained actuary. We also request detailed sample life output to reconcile any differences in the results. If appropriate, we made modifications to our valuation model based on this analysis.

The result of our calculations and the retained actuary's are compared in this report. Because actuarial valuations are complex and rely upon the actuary's chosen actuarial valuation software, differences are expected. Differences greater than 2% of Present Value of Benefits or 5% of Actuarial Accrued Liability are specifically addressed; although some differences that do not meet this threshold are also discussed. We understand, as noted above, that the valuation process is sufficiently complex as to result in variations of this magnitude among actuaries valuing identical benefits and assumptions.

In addition to our independent determination of liabilities and costs, we reviewed the retained actuary's report for completeness and potential improvements. The process by which actuarial valuations are completed is highly technical and not every step can be documented in a valuation report. Where we believe additional documentation may be beneficial to the reader, we've suggested a more robust disclosure. In addition to process oriented commentary, we've considered industry best practices in communicating complex financial concepts to key stakeholders. Additional recommendations have been made based on our research with the goal of providing information that would be valuable to the reader within acknowledged time and resource constraints.

All of the steps above have been completed in accordance with the requirements of Minnesota Statutes and the Standards for Actuarial Work adopted by the LCPR. Our work is also governed by applicable actuarial standards of practice published by the Actuarial Standards Board.

Replication Overview

Summary of Key Findings

In general, we found the actuarial liability and contribution calculations completed by the retained actuary to be consistent with ours within a reasonable threshold. Minor differences are identified below. We are satisfied with the aggregate July 1, 2017 actuarial valuation results as reported by the retained actuary. We believe that they represent a reasonable estimate of the present value of future benefits, accrued liability, and normal cost of the Plan.

The following key findings were identified during the process of our review:

- Census Data: SPTRFA directly provided us with the census data. We made modifications that we deemed necessary and appropriate. Later in the process, we received the retained actuary's modified database, which matched our counts with some small differences in average pay and benefits. Key differences and explanations are noted below

    - The retained actuary uses prior year salary as a minimum salary value for current active participants. This assumption is reasonable, but prevents the valuation salary, individual compensation values, and active liability and normal cost values from being precisely matched based upon the system's data.

    - The actuary does adjust some participant records if known data errors exist. As an example, we found one survivor whose benefit was overstated in the system's data. Based on the retained actuary's data summary they appear to have adjusted the benefit value for this participant. Minor data corrections based on the System's historical data are reasonable but are expected to decrease annually as the retained actuary and system resolve differences. We do note that the number of data questions and corrections appear to have decreased significantly since our 2016 valuation review.

- Plan Provisions: The plan provisions as identified in state statute were programmed into our valuation software and compared to those valued by the retained actuary. All benefits appear consistent.

- Actuarial Assumptions and Methods: The actuarial assumptions and methods prescribed by state statute were programmed into our valuation software along with those assumptions chosen by the Fund and disclosed in the report. The assumptions used in the valuation were based on the 2012 experience study. All assumptions appear consistent with state statute and documented assumptions.

- Actuarial Value of Assets: We calculated the Fund's Actuarial Value of Assets independent of the retained actuary, and our results matched.

- Liability Results: Our valuation results were reasonably close to the retained actuary's valuation results. We were 1.15% higher on the basis of Present Value of Future Benefits (PVFB) and 0.25% higher on the basis of the Actuarial Accrued Liability (AAL). In general we consider results within 2.0% to be a reasonable replication. We use different actuarial modeling software, which may produce minor differences in results due to a variety of reasons such as rounding method for age and years of service (e.g., exact date, month nearest, month completed, etc.), timing of decrements (beginning of year retirements, middle of year deaths, etc.), and other actuarial calculations. As is typical, differences also exist in how those liabilities are split by decrement and status group. The results in this report reflect the combination of the Basic and Coordinated plans.

- Normal Cost Results: Our valuation results produced a normal cost that is 0.5% lower than that of the retained actuary. As a percent of pay, our normal cost rate was approximately equal to that of the retained actuary. As noted above, differences are expected due to the methods used in the actuarial modeling software. The Normal Cost represents the value of benefits earned during the current period by active participants and may vary due to attribution method – the way in which benefits are allocated across an employee's working lifetime (e.g., partial year or full year in the year of hire and the year of termination or retirement).

- Valuation Report: The actuarial valuation was reviewed in its entirety, and we have found the report to satisfy the requirements of ASOP No. 41 and Minnesota Statutes, Section 356.215.

- We note that the actuary complied with the additional sensitivity disclosure requirement for the Fund's 2017 valuations enacted by the Commission.

Summary of Results

The following table displays a summary of the replication valuation performed by Deloitte as of June 30, 2017.

Table 1

	As of July 1, 2017		
	SPTRFA Valuation	Deloitte Replication Valuation	Percent Difference
Contributions (% of Payroll)			
Statutory Contributions – Chapter 354A	21.64%	21.64%	0.00%
Required Contributions – Chapter 356	22.16%	22.16%	0.00%
Sufficiency / (Deficiency)	(0.52%)	(0.52%)	0.00%
Funding Ratios (Dollars in Thousands)			
Assets			
Current assets (AVA)	$1,038,467	$1,038,467	0.00%
Actuarial accrued liability	$1,611,208	$1,615,193	0.25%
Funding ratio (AVA)	64.45%	64.29%	(0.16%)
Plan Participation			
Active Participants			
Number (including members on leave of absence)	3,550	3,550	0.00%
Projected annual earnings (Dollars in Thousands)	$280,785	$279,664	(0.40%)
Average projected annual earnings	$78,060	$78,779	0.92%
Average age	44.8	44.8	0.00%
Average service	12.7	12.7	0.00%
Service Retirements	3,478	3,478	0.00%
Survivors	343	343	0.00%
Disability Retirements	30	30	0.00%
Deferred Retirements	2,034	2,034	0.00%
Terminated Other Non-Vested	2,945	2,945	0.00%
Total	12,380	12,380	0.00%

Asset Information

Accounting Balance Sheet as of June 30, 2017

Table 2 (Dollars in Thousands)

		Market Value as of June 30, 2017	
		SPTRFA Valuation	Deloitte Replication Valuation
A. Assets			
1. Cash, Equivalents ,Short-Term Securities		$ 32,899	$ 32,899
2. Investments			
a Fixed income		188,598	188,598
b Equity		637,561	637,561
c Real Estate		69,727	69,727
d Alternative		102,628	102,628
3. Other Assets		3,289	3,289
B. Total Assets		$ 1,034,702	$ 1,034,702
C. Amounts Currently Payable		$ 2,453	$ 2,453
D. Assets Available For Benefits			
1. Member Reserves		$ 187,955	$ 187,955
2. Employer Reserves		844,294	844,294
3. Total Assets Available for Benefits		$ 1,032,249	$ 1,032,249
E. Total Amounts Currently Payable and Assets Available for Benfits		$ 1,034,702	$ 1,034,702
F. Determination of Actuarial Value of Assets			
1. Market Value of Assets Available for Benefits (D.3)		$ 1,032,249	$ 1,032,249
2. Unrecognized Asset Returns			
a June 30 ,2017	$ 54,191		
b June 30 ,2016	(77,451)		
c June 30 ,2015	(55,629)		
d June 30 ,2014	95,762		
3. UAR Adjustment: .80*2(a) + .60*2(b) + .40*2(c) + .20*2(d)		(6,218)	(6,218)
4. Actuarial Value of Assets: (F.1 - F.3)		$ 1,038,467	$ 1,038,467
Derivation of Other Assets *			
Accounts Receivable			
Employer Contribution		$ 368	$ 368
Employee Contribution		256	256
Service Purchases Receivable		31	31
Pensions Receivable		10	10
State Contributions		838	838
Real Estate Income Receivable		81	81
Commission Recapture Receivable		1	1
Interest Receivable		617	617
Dividend Receivable		93	93
Misc. Receivable		-	-
Escrow Funds Receivable		-	-
Sale of Securities		941	941
Total Accounts Receivable		$ 3,236	$ 3,236
Fixed Assets		53	53
Total Other Assets		$ 3,289	$ 3,289

Changes in Assets Available for Benefits as of June 30, 2017

Table 3 (Dollars in Thousands)

	SPTRFA	Deloitte Replication Valuation
A. Assets Available at Beginning of Period	$ 959,666	$ 959,666
B. Operating Revenues		
1. Member Contribution	$ 20,146	$ 20,146
2. Employer Contributions	27,543	27,685
3. Supplemental Contributions	10,665	10,665
4. Reemployed Annuitant Employer Contributions*	142	-
5. Investment Income	12,999	12,999
6. Investment Expenses	(4,823)	(4,823)
7. Net Realized Gain/(Loss)	27,933	27,933
8. Other	-	-
9. Net Change in Unrealized Gain/(Loss)	92,610	92,610
10. Total Operating Revenue	$ 187,215	$ 187,215
C. Operating Expenses		
1. Service Retirements	$ 100,965	$ 100,965
2. Disability Benefits	605	605
3. Survivor Benefits	11,201	11,201
4. Refunds	972	972
5. Administrative Expenses	889	889
6. Total Operating Expenses	$ 114,632	$ 114,632
D. Other Changes in Reserves	$ -	$ -
E. Assets Available at End of Period	$ 1,032,249	$ 1,032,249
F. Determination of Current Year Unrecognized Asset Return		
1. Average Balance		
(a) Assets available at BOY	$ 959,666	$ 959,666
(b) Assets available at EOY	1,032,349	1,032,249
(c) Average balance {[(a) + (b) - Net Investment Income] / 2}	$ 931,598	$ 931,598
{Net investment income: B.5 + B.6 + B.7 + B.9}		
2. Expected Return: 8.00% * F.1	74,528	74,528
3. Actual Return	128,719	128,719
4. Current Year Gross Asset Gain/(Loss): F.3 - F.2	$ 54,191	$ 54,191

* The documentation provided for the assets available as of June 30, 2017 did not provide the detailed breakout of the Reemployed Annuitant Employer Contributions. Instead, these contributions appear to be included in the Employer Contributions category as shown in this exhibit.

Membership Data

Membership Data – Active Members

The following table displays the distribution of active participants valued by Deloitte by age and years of service and includes average compensation (in dollars) as of June 30, 2017.

Table 4

Years of Service	Age Group	0 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64	65+	Total
<5	No.	25	222	224	172	143	86	63	48	19	18	1,020
	Avg. Annual Earnings	35,145	47,129	52,698	54,937	55,029	59,584	48,131	38,621	37,439	16,149	50,459
5-9	No.	-	32	179	135	73	54	36	22	7	8	546
	Avg. Annual Earnings		60,054	64,371	72,857	73,603	73,118	74,329	72,614	76,065	36,262	69,051
10-14	No.	-	-	18	161	116	77	48	33	26	7	486
	Avg. Annual Earnings			73,243	79,216	78,618	79,857	77,434	79,084	74,580	48,637	78,113
15-19	No.	-	-	-	30	196	167	95	85	43	11	627
	Avg. Annual Earnings				78,396	83,748	86,133	86,397	85,359	76,149	74,219	84,080
20-24	No.	-	-	-	-	23	182	131	84	61	7	488
	Avg. Annual Earnings					92,605	91,895	89,571	88,146	87,808	83,588	90,022
25-29	No.	-	-	-	-	-	9	78	93	45	7	232
	Avg. Annual Earnings						92,640	96,292	93,092	91,457	98,576	94,001
30-34	No.	-	-	-	-	-	-	18	71	26	6	121
	Avg. Annual Earnings							99,826	97,974	90,446	86,872	96,050
35+	No.	-	-	-	-	-	-	1	4	20	5	30
	Avg. Annual Earnings	-	-					129,371	81,407	104,175	117,978	104,279
Total	No.	25	254	421	498	551	575	470	440	247	69	3,550
	Avg. Annual Earnings	35,145	48,707	58,434	69,036	74,231	81,970	82,461	83,249	82,446	59,767	73,288

Prior Fiscal Year Earnings (thousands) by Years of Service

Years of Service	<5	5-9	10-14	15-19	20-24	25-29	30-34	35+	Total
ALL	51,720	37,563	37,963	52,802	43,661	21,808	11,526	3,128	260,172

Membership Data – Service Retirements

The following table displays the distribution of service retirees valued by Deloitte by age and years retired and includes average annual benefit (in dollars) as of June 30, 2017.

Table 5

Years Retired	Age Group	<45	45-49	50-54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85 – 89	90+	Total
< 5	No.	-	-	1	85	310	370	81	12	8	-	-	867
	Avg. Ben.	-	-	28,825	19,666	25,102	19,526	15,593	2,539	6,663	-	-	20,823
5-9	No.	-	-	-	-	121	359	256	30	7	-	-	773
	Avg. Ben.	-	-	-	-	25,526	28,007	24,375	19,650	8,438	-	-	25,914
10-14	No.	-	-	-	-	-	217	340	130	16	3	1	707
	Avg. Ben.	-	-	-	-	-	36,259	34,010	27,971	20,821	1,367	32,392	33,151
15-19	No.	-	-	-	-	-	-	187	226	103	5	2	523
	Avg. Ben.	-	-	-	-	-	-	31,227	36,050	36,390	19,014	31,934	34,214
20-24	No.	-	-	-	-	-	-	3	117	174	80	8	382
	Avg. Ben.	-	-	-	-	-	-	57,015	39,569	42,685	49,133	56,856	43,490
25-29	No.	-	-	-	-	-	-	-	1	40	56	26	123
	Avg. Ben.	-	-	-	-	-	-	-	67,960	28,878	36,889	32,599	33,630
30-34	No.	-	-	-	-	-	-	-	-	-	42	46	88
	Avg. Ben.	-	-	-	-	-	-	-	-	-	35,515	23,298	29,129
35-40	No.	-	-	-	-	-	-	-	-	-	-	15	15
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	23,488	23,488
40+	No.	-	-	-	-	-	-	-	-	-	-	-	-
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	-	-
Total	No.	-	-	1	85	431	946	867	516	348	186	98	3,478
	Avg. Ben.	-	-	28,825	19,666	25,221	26,583	28,924	33,141	36,712	40,791	28,803	29,638

Total Annual Benefit (thousands) by Years Retired

Years Retired	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-40	40+	Total
ALL	17,991	20,032	23,438	17,894	16,613	4,204	2,651	352	-	103,141

Membership Data – Disability Retirements

The following table displays the distribution of service disability retirements valued by Deloitte by age and years disabled and includes average annual benefit as of June 30, 2017.

Table 6

Years Disabled	Age Group	< 45	45 – 49	50 – 54	55 – 59	60 – 64	65-69	70-74	75-79	80-84	85-89	90+	Total
<5	No.	1	1	3	2	4	-	-	-	-	-	-	11
	Avg. Ben.	3,490	34,015	22,199	19,568	30,799	-	-	-	-	-	-	24,221
5-9	No.	-	1	3	2	7	-	-	-	-	-	-	13
	Avg. Ben.	-	7,875	13,960	8,936	24,686	-	-	-	-	-	-	18,495
10-14	No.	-	-	-	1	2	-	-	-	-	-	-	3
	Avg. Ben.	-	-	-	24,916	8,852	-	-	-	-	-	-	14,206
15-19	No.	-	-	-	-	1	1	-	-	-	-	-	2
	Avg. Ben.	-	-	-	-	28,002	9,869	-	-	-	-	-	18,936
20-24	No.	-	-	-	1	-	-	-	-	-	-	-	1
	Avg. Ben.	-	-	-	5,694	-	-	-	-	-	-	-	5,694
25-29	No.	-	-	-	-	-	-	-	-	-	-	-	-
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	-	-
30-34	No.	-	-	-	-	-	-	-	-	-	-	-	-
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	-	-
35-39	No.	-	-	-	-	-	-	-	-	-	-	-	-
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	-	-
40+	No.	-	-	-	-	-	-	-	-	-	-	-	-
	Avg. Ben.	-	-	-	-	-	-	-	-	-	-	-	-
Total	No.	1	2	6	6	14	1	-	-	-	-	-	30
	Avg. Ben.	3,490	20,945	18,079	14,603	24,408	9,869	-	-	-	-	-	19,768

Total Annual Benefit (thousands) by Years Disabled

Years Retired	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-40	40+	Total
ALL	266	240	43	38	6	-	-	-	-	593

Membership Data – Survivors

The following table displays the distribution of survivors valued by Deloitte by age and years since death and includes average benefits (in dollars) as of June 30, 2017.

Table 7

Years Since Death	Age Group	< 45	45 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85 – 89	90+	Total
<5	No.	5	-	1	4	4	9	15	13	29	11	3	94
	Avg. Annual Benefit	22,513	-	1,940	35,870	26,743	23,825	37,075	39,707	47,551	37,429	23,194	37,361
5-9	No.	2	-	-	1	4	-	2	-	-	-	-	9
	Avg. Annual Benefit	7,493	-	-	296	13,800	-	25,454	-	-	-	-	13,488
10-14	No.	-	3	2	1	-	4	5	3	1	1	-	20
	Avg. Annual Benefit	-	730	824	18,540	-	42,819	23,233	16,965	65,158	40,687	-	23,328
15-19	No.	1	-	-	-	5	4	14	10	5	-	-	39
	Avg. Annual Benefit	18,039	-	-	-	8,248	27,725	21,832	30,941	27,732	-	-	23,689
20-24	No.	-	-	-	-	1	2	6	21	17	5	1	53
	Avg. Annual Benefit	-	-	-	-	49,403	26,646	42,743	41,136	44,673	46,305	54,745	42,806
25-29	No.	-	-	-	-	-	2	4	4	22	13	5	50
	Avg. Annual Benefit	-	-	-	-	-	42,270	16,187	30,737	36,885	40,215	49,161	37,046
30-34	No.	-	-	-	-	-	1	1	6	11	17	21	57
	Avg. Annual Benefit	-	-	-	-	-	27,895	24,598	28,936	26,356	35,810	32,401	31,670
35-39	No.	-	-	-	-	-	1	-	2	1	3	7	14
	Avg. Annual Benefit	-	-	-	-	-	20,582	-	21,887	17,625	22,664	26,054	23,739
40+	No.	-	-	-	-	-	-	-	-	-	4	3	7
	Avg. Annual Benefit	-	-	-	-	-	-	-	-	-	31,333	23,718	28,070
Total	No.	8	3	3	6	14	23	47	59	86	54	40	343
	Avg. Annual Benefit	18,199	730	1,196	27,053	18,058	29,692	29,248	35,266	40,247	37,200	32,602	33,466

Total Annual Benefit (thousands) by Years Since Member Death

Years Retired	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-40	40+	Total
ALL	3,512	121	467	924	2,269	1,852	1,805	332	196	11,479

Funding Status

Determination of Unfunded Actuarial Accrued Liability (UAAL) and Supplemental Contribution Rate

Table 8 (Dollars in Thousands)

	Actuarial Present Value of Projected Benefits		Actuarial Present Value of Future Normal Costs		Actuarial Accrued Liability	
	SPTRFA Valuation	Deloitte Replication Valuation	SPTRFA Valuation	Deloitte Replication Valuation	SPTRFA Valuation	Deloitte Replication Valuation
1. Determination of Actuarial Accrued Liability (AAL)						
a. Active Members						
i. Retirement annuities	$ 635,767	$ 652,810	$ 172,486	$ 202,837	$ 463,281	$ 449,973
ii. Disability benefits	13,751	12,491	5,338	5,520	8,413	6,971
iii. Survivor spouse and child benefits	9,245	10,834	3,207	4,020	6,038	6,814
iv. Vested Withdrawals	36,648	39,408	41,163	34,770	(4,515)	4,638
v. Refund liability due to death or withdrawal	2,989	864	14,099	6,490	(11,110)	(5,626)
vi. Total	$ 698,400	$ 716,407	$ 236,293	$ 253,637	$ 462,107	$ 462,770
b. Deferred retirements	77,599	78,521	-	-	77,599	78,521
c. Former members without vested rights	2,812	2,851	-	-	2,812	2,851
d. Annuitants	1,068,690	1,071,051	-	-	1,068,690	1,071,051
f. Total	$ 1,847,501	$ 1,868,830	$ 236,293	$ 253,637	$ 1,611,208	$ 1,615,193
2. Determination of Unfunded Actuarial Accrued Liability (UAAL)						
a. Actuarial accrued liability					$ 1,611,208	$ 1,615,193
b. Current assets (AVA)					1,038,467	1,038,467
c. Unfunded actuarial accrued liability					$ 572,741	$ 576,726
3. Determination of Supplemental Contribution Rate						
a. Present value of future payrolls through the amortization date of June 30, 2042					$ 4,440,299	$ 4,471,695
b. Supplemental contribution rate					12.90%	12.90%

Determination of Contribution Sufficiency

Table 9 (Dollars in Thousands)

	Percent of Payroll		Dollar Amount	
	SPTRFA Valuation	Deloitte Replication Valuation	SPTRFA Valuation	Deloitte Replication Valuation
1. Statutory contributions – Chapter 354A				
a. Employee contributions	7.50%	7.50%	$21,069	$20,975
b. Employer contributions				
(1) Regular	6.50%	6.50%	18,265	18,178
(2) Additional	3.84%	3.84%	10,782	10,739
c. Supplemental contributions				
(1) 1996 Legislation	0.30%	0.30%	838	838
(2) 1997 Legislation	1.01%	1.01%	2,827	2,827
(3) 2014 Legislation	2.49%	2.49%	7,000	7,000
d. Total	21.64%	21.64%	$60,781	$60,557
2. Required contributions – Chapter 356				
a. Normal Cost				
i. Retirement benefits	6.62%	7.20%	$18,596	$20,124
ii. Disability benefits	0.19%	0.19%	535	519
iii. Surviving spouse and child benefits	0.12%	0.14%	336	383
iv. Vested withdrawals	1.48%	1.18%	4,157	3,306
v. Refund liability due to death or withdrawal	0.52%	0.23%	1,463	641
vi. Total	8.93%	8.93%	$25,087	$24,974
b. Supplemental contribution amortization of Unfunded Actuarial Accrued Liability by June 30, 2042	12.90%	12.90%	36,221	36,069
c. Allowance for administrative expenses	0.33%	0.33%	927	927
d. Total	22.16%	22.16%	$62,235	$61,970
3. Contribution Sufficiency/(Deficiency): (1d) – (2d)	(0.52%)	(0.52%)	($1,454)	($1,413)

Actuarial Methods and Assumptions

Statement of Actuarial Methods

The actuarial cost method below is documented by the retained actuary, and we agree with its application without any changes. It is documented here for illustrative purposes only, and reflect exactly what was provided in the retained actuary's report.

Actuarial Cost Method

An Actuarial Cost Method is a set of techniques used by the actuary to develop contribution levels under a retirement plan. The Actuarial Cost Method used in this valuation for all purposes is the Entry Age Actuarial Cost Method. Under this Method, a Normal Cost is developed by amortizing the actuarial value of benefits expected to be received by each active participant (as a level percentage of pay) over the total working lifetime of that participant, from hire to termination. Years of Service for valuation purposes was provided by the Retirement Fund. Age as of the valuation date was calculated based on the dates of birth provided by the Retirement Fund. Entry Age for valuation purposes was calculated as the age on the valuation date minus the years of service on the valuation date.

To the extent that current assets and future Normal Costs do not support participants' expected future benefits, an Unfunded Actuarial Accrued liability ("UAAL") develops. The UAAL is amortized over the closed statutory amortization period ending June 30, 2042 using level percent-of-payroll assuming payroll increases of 4.00% per annum. The total contribution developed under this method is the sum of the Normal Cost and the payment toward the UAAL.

Current Actuarial Assumptions

The following assumptions were used in valuing the liabilities and benefits under the plan. All assumptions are prescribed by Statutes, the LCPR, or the Board of Trustees. The assumptions are based on the experience study dated June 15, 2012 and Deloitte's Combined Service Annuity study dated October 2016.

Demographic Assumptions	
1. Mortality Rates	
a. Healthy	Male: RP-2000 Combined Mortality Table for males projected with Scale AA to 2020 set back 1 year Female: RP-2000 Combined Mortality Table for females projected with Scale AA to 2020 set back 3 years
b. Disabled	Male: RP-2000 Disabled Life Mortality Table for males Female: RP-2000 Disabled Life Mortality Table for females
2. Disability Rates	Age-related rates based on experience; see table of sample rates
3. Termination Rates	Rates vary by service based on actual plan experience, as shown in the rate table
4. Retirement Rates	Rates vary by age based on actual plan experience, as shown in the rate table
Economic Assumptions	
1. Investment Return Rate	8.00%
2. Cost-of-Living Increases	1.00% per year through 2041; 2.00% beginning 2042; 2.50% beginning 2052
3. Wage Inflation	4.00% per year
4. Future Salary Increases	In addition to the age-based rates shown in the sample rate tables below, during the first 15 years of employment, a service-based component of 0.20% x (15-T), where T is completed years of service, is included in the salary increase used
5. Asset Value	The actuarial value of assets is smoothed by using a five-year average market value
Other Assumptions	
1. Marital Status	It is assumed that 75% of male members and 60% of female members have an eligible spouse. The male spouse is assumed to be two years older than the female spouse. Married members are assumed to have two dependent children.
2. Deferred Benefit Commencement	Basic Plan members who terminate vested are assumed to commence benefits at age 61. Coordinated Plan members are assumed to commence benefits at age 62. If the member is already past the assumed deferral age, the member is assumed to commence benefits one year from the valuation date.
3. Administrative Expenses	Prior year administrative expenses (excluding investment expenses) are expressed as a percentage-of-payroll and then applied to current projected payroll

4. Refund of Contributions	All employees withdrawing after becoming eligible for a deferred benefit take the larger of their contributions accumulated with interest or the value of their deferred benefit. Account balances for deferred members accumulate interest until the assumed benefit commencement date and are discounted back to the valuation date.
5. Allowance for Combined Service Annuity	20.0% load on liabilities for former, vested members 9.0% load on liabilities for former, non-vested members
6. Missing Salary and Salary Minimums	Active members with reported salaries of $100 or less were assumed to have the average non-zero active salary. Active members with salaries less than those reported at the prior valuation date are valued using their prior salary amount. Active members who have been hired within one year of the valuation date have had their pay annualized by dividing by months of service credited, not to exceed the average non-zero active salary. For members on leave of absence at valuation date who were not on leave at the prior valuation date, the prior year's valuation pay was used.
7. Missing Data for Deferred Vested Members	Deferred vested members without a reported benefit and without salary information were assumed to have a final average salary of $40,000
8. Decrement Timing	Retirement and Termination: the retained actuary assumed end of valuation year – consistent with retirements and terminations occurring at the end of the school year. This valuation assumes mid-year decrements to best approximate the retained actuary's assumption using our valuation software. Death and Disability: middle of valuation year
9. Eligibility Testing	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur
10. Service Credit Accruals	It is assumed that members accrue one year of service credit per year. Exact fractional service is used to determine the amount of benefit payable.
11. Valuation of Future Post-Retirement Benefit Increases	If the plan has reached the funding ratio threshold required to pay a different benefit increase, Minnesota Statutes require the benefit increase rate to be reflected in the liability calculations. If the plan has not yet reached the funding ratio threshold required to pay a benefit increase, Minnesota Statutes require a projection to be performed to determine the expected attainment of the funding ratio thresholds, and the expected payment of benefit increases must be reflected in the liability calculations.
12. Supplemental Contributions	1996 legislation provides for a variable amortization aid contribution paid annually on July 15. We assumed the annual amortization aid contribution will equal $838,000, which was the actual contribution for the most recent fiscal year. Additionally, according to 1997 legislation, annual supplemental contributions currently equal to $2,827,000 are scheduled to be paid on October 1. According to 2014 legislation, the State of Minnesota will make annual additional supplemental contributions of $7,000,000 on October 1. The contributions described herein will continue until the plan is 100% funded or until June 30, 2042, whichever occurs earlier.
13. Projected Annual Payroll Calculation	The census data as of July 1, 2017 reflects retirements and terminations occurring during the months of May and June; however, it does not necessarily reflect the replacements hired to fill their positions who may have hire dates in August and September. We assumed that May and June retirements are replaced by members coming in at the B.A. entry salary level of $44,759; and the Projected Annual Payroll for the fiscal year ending June 30, 2018 includes this replacement salary amount.

14. Sample Rate Tables

Termination Rates		
Service	**Males**	**Females**
Less than 1	40.00%	40.00%
1	18.00%	18.00%
2	14.00%	14.00%
3	10.00%	10.00%
4	6.00%	6.70%
5	5.00%	5.90%
6	4.50%	5.10%
7	4.10%	4.30%
8	3.70%	3.50%
9	3.30%	3.10%
10	2.90%	2.70%
11	2.50%	2.30%
12	2.00%	1.90%
13	2.00%	1.50%
14	2.00%	1.30%
15 or more	2.00%	1.30%

Disability Rates	
Age	**Unisex**
20	0.02%
25	0.02%
30	0.03%
35	0.03%
40	0.03%
45	0.05%
50	0.10%
55	0.20%
60	0.40%

	Annuitant Mortality Rates			
	Retirement		Disability	
Age	Male	Female	Male	Female
20	0.02%	0.01%	2.26%	0.75%
25	0.03%	0.01%	2.26%	0.75%
30	0.04%	0.02%	2.26%	0.75%
35	0.06%	0.03%	2.26%	0.75%
40	0.09%	0.04%	2.26%	0.75%
45	0.11%	0.06%	2.26%	0.75%
50	0.14%	0.09%	2.90%	1.15%
55	0.21%	0.15%	3.54%	1.65%
60	0.43%	0.31%	4.20%	2.18%
65	0.85%	0.60%	5.02%	2.80%

Ultimate Rate of Salary Increases			
Age	Salary Increase Rate	Age	Salary Increase Rate
<22	5.90%	41	4.95%
23	5.85%	42	4.90%
24	5.80%	43	4.85%
25	5.75%	44	4.80%
26	5.70%	45	4.75%
27	5.65%	46	4.70%
28	5.60%	47	4.65%
29	5.55%	48	4.60%
30	5.50%	49	4.55%
31	5.45%	50	4.50%
32	5.40%	51	4.45%
33	5.35%	52	4.40%
34	5.30%	53	4.35%
35	5.25%	54	4.30%
36	5.20%	55	4.25%
37	5.15%	56	4.20%
38	5.10%	57	4.15%
39	5.05%	58	4.10%
40	5.00%	59	4.05%
		60 & Over	4.00%

Retirement Rates						
	Basic Members		Coordinated Members			
Age	Eligible for Rule of 90	Not Eligible for Rule of 90	Male Eligible for Rule of 90	Female Eligible for Rule of 90	Male Not Eligible for Rule of 90	Female Not Eligible for Rule of 90
55	50%	8%	35%	35%	7%	5%
56	50%	13%	35%	35%	7%	5%
57	40%	13%	35%	35%	7%	5%
58	40%	18%	35%	35%	7%	5%
59	35%	18%	35%	35%	7%	5%
60	35%	20%	35%	35%	11%	8%
61	35%	20%	35%	35%	15%	11%
62	35%	40%	35%	35%	19%	14%
63	35%	40%	35%	35%	23%	19%
64	40%	40%	35%	40%	27%	24%
65	50%	50%	35%	50%	31%	35%
66	30%	50%	35%	50%	35%	35%
67	30%	50%	35%	50%	35%	35%
68	30%	50%	35%	50%	35%	35%
69	30%	50%	35%	50%	35%	35%
70 & Over	100%	100%	100%	100%	100%	100%

15. Changes in Actuarial Assumptions

The Combined Service Annuity (CSA) loads on liabilities were changed per our October 2016 study.

The assumed cost-of-living adjustments were changed from 1.00% per year through 2054; 2.00% beginning 2055; 2.50% beginning 2066 to 1.00% per year through 2041; 2.00% beginning 2042; 2.50% beginning 2052.

Plan Provisions Summary – Basic Members

This summary of provisions reflects our understanding of the of applicable Statutes for purposes of preparing this valuation, and are consistent with the provisions used in the valuation prepared by SPTRFA's retained actuary. The provisions summarized below are not intended to provide a basis for administering the Plan.

1. Plan year	July 1 through June 30
2. Statutory Contributions	Shown as a percent of salary: After June 30, / Member / Employer Regular / Employer Additional 2016 / 10.00% / 9.75% / 3.64% 2017 / 10.00% / 10.00% / 3.64%
3. Participants	Professional Educators first employed prior to July 1, 1978 by schools in the City of St. Paul or St. Paul College whose position requires a license from the Minnesota Department of Education, who are not covered under the Social Security Act
4. Accredited service	Service which has been verified and accredited by the Association for the purpose of determining contributions and benefits (may include service earned while working outside of St. Paul Public Schools, previous St. Paul service, military service and governmental service)
5. Allowable St. Paul Service	Service earned as a licensed educator in the St. Paul Public Schools, in the St. Paul College, or as an employee of the Association. Also includes service credited after receipt of payment as required, for licensed educators on leave
6. Salary	Total compensation excluding lump sum payments for unused leave at termination and employer-paid insurance coverage
7. Average salary	Average of the highest five years of salary during the last 10 years of St. Paul service while making contributions or while disabled
8. Retirement	
a. Normal retirement	
i. Age/service requirements	Attainment of age 65 and 5 years of Accredited Service
ii. Amount	2.50% of Average Salary for each year of Accredited Service
b. Early retirement benefit	
i. Age/service requirements	Attainment of age 55 and 5 years of Accredited Service
ii. Amount	The greater of (a) or (b): (a.) 2.00 percent of Average Salary per year of Accredited Service, subject to a maximum of 40 years with a 0.25% reduction for each month the member is under age 65. If the member has 25 years of Accredited Service, the reduction is taken from age 60, therefore no reduction is required if the member is age 60 or older. No reduction is taken if age plus years of Accredited Service totals at least 90. (b.) 2.50 percent of Average Salary per year of Accredited Service, subject to a maximum of 40 years, reduced for each month the member is under age 65 using linear interpolation of the table listed below.

Age at Retirement	Under Age 62 or Less Than 30 Years of Service	Age 62 or Older with 30 Years of Service
55	0.5376	
56	0.5745	
57	0.6092	
58	0.6419	
59	0.6726	
60	0.7354	
61	0.7947	
62	0.8507	0.8831
63	0.9035	0.9246
64	0.9533	0.9635
65	1.0000	1.0000

9. Disability	
a. Age/service requirements	Total and permanent disablement before attaining age 65 and 5 years of Accredited Service
b. Amount	If the member is under age 65, 75 percent of the member's annual contract salary less any Social Security and Workers' Compensation benefits payable until age 65. At age 65, a normal retirement benefit is calculated using the projected service and average salary as if the member had continued to teach in their position held at the time of disability. Members age 65 or older at time of disability receive a normal retirement benefit.
10. Death	
a. Active Survivor Benefit (Family Benefit)	
i. Age/service requirements	Active member with three years of Accredited Service
ii. Amount	• Children's Benefit: 25 percent of the maximum Bachelor of Arts salary for the year in which the member died for each eligible child up to a maximum of two. Benefits are paid until the child attains age 18, or 22 for full-time students. • Spousal Benefit: 15 percent of the maximum Bachelor of Arts salary for an eligible spouse who has legal custody of an eligible child. Spousal benefits cease when the spouse remarries, dies, or elects the regular survivor benefit. Electing the regular survivor benefit does not disqualify the child from receiving the family benefit.
b. Survivor Benefit (Active or Retired Member)	

i. Age/service requirements	Active member or retired member with five years of Accredited Service. A surviving spouse must have been married to the member for three years at the earlier of his death or retirement.
ii. Amount	Retirement benefit earned at the time of death or retirement, whichever is earlier, reduced by the use of one hundred percent joint survivorship tables, based on the ages of the member and survivor at the time of retirement
11. Withdrawal	
a. Refund of contributions	
i. Age/service requirements	Termination or death where no annuity is payable, or prior to age 55, if a refund of contributions is chosen in lieu of an annuity
ii. Amount	Member contributions with 6.00 percent interest accrued before July 1, 2011 with 4.00 percent accrual thereafter
b. Deferred annuity	
i. Age/service requirements	5 years of Accredited Service
ii. Amount	Benefit computed under law in effect at termination and payable as a normal or early retirement benefit. For members hired on or before June 30, 2006, the benefit is augmented at 3.00 percent compounded annually from the 1st of the month following termination until the January 1st after turning age 55 and then augmented at 5.00 percent compounded annually from that date to July 1, 2012. For members hired after June 30, 2006, the benefit is augmented at 2.50 percent compounded annually from the 1st of the month following termination to July 1, 2012. Augmentation for all members, regardless of hire date, changed to 2.00 percent as of July 1, 2012 for the portion of benefit deferral which occurs after June 30, 2012.
12. Reemployed Annuitants	The School District shall make the regular employer contribution and additional employer contribution, plus a supplemental contribution equal to 2.5% of salary, on behalf of any retired member who is reemployed by the School District. Reemployed annuitants do not accrue additional benefits.
13. Normal Form of Retirement Benefits	Unreduced annuity payments made until the death of the member, with a 100 percent Joint & Survivor adjusted pension payable to the surviving beneficiary
14. Benefit Increases	If the Accrued Liability Funding Ratio, based on Actuarial Value of Assets, as determined by the two consecutive and most recent actuarial valuations are: Less than 80 percent for two consecutive years, the COLA: 1.00 percent Between 80 percent and 90 percent for two consecutive years, the COLA: 2.00 percent If at least 90 percent for two consecutive years, the COLA: 2.50 percent

Plan Provisions Summary – Coordinated Members

This summary of provisions reflects our understanding of the of applicable Statutes for purposes of preparing this valuation, and are consistent with the provisions used in the valuation prepared by SPTRFA's retained actuary. The provisions summarized below are not intended to provide a basis for administering the Plan.

1. Plan year	July 1 through June 30
2. Statutory Contributions	Shown as a percent of salary:

After June 30,	Member	Employer Regular	Employer Additional
2016	7.50%	6.25%	3.84%
2017	7.50%	6.50%	3.84%

3. Participants	Professional educators in the public schools of the City of St. Paul, excluding charter schools, whose position requires a license from the Minnesota Department of Education, and who are covered under the Social Security Act and make contributions to the St. Paul Teachers' Retirement Fund Association, are covered under the Coordinated Plan.
4. Allowable Service	Service earned as a licensed educator in the St. Paul Public Schools, in the St. Paul College, or in certain charter schools, or as an employee of the Association. Also includes service credited after receipt of payment as required, for licensed educators on leave. Service is granted on a proportional basis for part-time teachers.
5. Salary	Total compensation excluding lump sum payments for unused leave at termination and employer-paid insurance coverage
6. Average Salary	Average of the highest five successive years of salary while making contributions. In cases where the Allowable Service is less than five years, Average Salary is based on the Allowable Service years
7. Retirement	
a. Normal retirement	
i. Age/service requirements	Three years of Allowable Service. The eligibility age is 65 for those hired before July 1, 1989 and the earlier of eligibility for full Social Security retirement benefits to a maximum of age 66 for those hired on or after July 1, 1989. A Proportionate Retirement Annuity is available at Normal Retirement Age with one year of Allowable Service.
ii. Amount	1.70 percent of Average Salary for each year of Allowable Service rendered before July 1, 2015 and 1.90 percent of Average Salary for each year of Allowable Service rendered after June 30, 2015
b. Early retirement benefit	
i. Age/service requirements	Attainment of age 55 and 3 years of Allowable Service
ii. Amount	Members hired before July 1, 1989 are eligible for the greater of the following benefits. Members hired after July 1, 1989 are eligible for the benefits shown in item (b): (a.) For the first ten years of Allowable Service, 1.20 percent of Average Salary for each year of Allowable Service rendered prior to July 1, 2015, plus 1.40 percent of Average Salary for each year of Allowable Service rendered

after June 30, 2015. Additionally, for each subsequent year of Allowable Service in excess of ten years, 1.70 percent of Average Salary for each year rendered prior to July 1, 2015, plus 1.90 percent of Average Salary for each year rendered after June 30, 2015. There is a reduction of 0.25 percent for each month the member is under age 65, or under age 62 with 30 years of Allowable Service. No reduction applies if the age plus years of service totals at least 90.

(b.) 1.70 percent of Average Salary per year of Allowable Service rendered before July 1, 2015 and 1.90 percent of Average Salary for each year of service rendered after June 30, 2015 reduced for each month the member is under the Normal Retirement Age using linear interpolation of the factors in the table listed below.

	Under Age 62 or Less Than 30 Years of Service		Age 62 or Older with 30 Years of Service	
Age at Retirement	Age 65 NRA	Age 66 NRA	Age 65 NRA	Age 66 NRA
55	0.5376	0.4592		
56	0.5745	0.4992		
57	0.6092	0.5370		
58	0.6419	0.5726		
59	0.6726	0.6062		
60	0.7354	0.6726		
61	0.7947	0.7354		
62	0.8507	0.7947	0.8831	0.8389
63	0.9035	0.8507	0.9246	0.8831
64	0.9533	0.9035	0.9635	0.9246
65	1.0000	0.9533	1.0000	0.9635
66		1.0000		1.0000

8. Disability

a. Age/service requirements

Total and permanent disablement and three years of Allowable Service with service earned within the current fiscal year and at least two years of Allowable Service since the last interruption in service

b. Amount

Calculated as a normal retirement benefit payable for life without reduction for early commencement. At normal retirement age, the benefit converts from a disability benefit to a retirement benefit. The disability benefit is reduced by any Workers' Compensation benefits payable.

9. Survivor Benefit (Active Members)

a. Age/service requirements

Active member with three years of Allowable service. A surviving spouse is defined as the person legally married to the member at the time of death. If none, a dependent child who is the legal child of the member, who is less than 20 years of age and unmarried.

b. Amount	Retirement benefit earned at the time of death with choices for either a reduced for 100 percent joint survivorship, or 5-, 10-, 15-, or 20-year term certain. The benefit is available immediately upon application. Actuarial reductions assuming 2.5% augmentation for the calculation of the survivorship portion of a 100 percent joint and survivor benefit are actuarially determined based on the member's and survivor's ages at the death of the member. Early retirement reductions apply to the survivor benefit based on the member's age when deceased. If the deceased member had not yet attained age 55 at time of death, the additional early retirement reduction from age 55 to the age of the member at death applies at only one-half of the actuarial rate.
10. Withdrawal	
a. Refund of contributions	
i. Age/service requirements	Termination or death where no annuity is payable or a refund of contributions is chosen in lieu of an annuity
ii. Amount	Member contributions with 6.00 percent interest accrued until July 1, 2011 with 4.00 percent accrual thereafter
b. Deferred annuity	
i. Age/service requirements	Three years of Allowable Service
ii. Amount	Benefit computed under law in effect at termination and payable as a normal or early retirement benefit. For members hired on or before June 30, 2006, the benefit is augmented at 3.00 percent compounded annually from the 1st of the month following termination until the January 1st after turning age 55 and then augmented at 5.00 percent compounded annually from that date to July 1, 2012. For members hired after June 30, 2006, the benefit is augmented at 2.50 percent compounded annually from the 1st of the month following termination to July 1, 2012. Augmentation for all members, regardless of hire date, changed to 2.00 percent as of July 1, 2012 for the portion of benefit deferral which occurs after June 30, 2012.
11. Reemployed Annuitants	The School District shall make the regular employer contribution and additional employer contribution, plus a supplemental contribution equal to 2.5% of salary, on behalf of any retired member who is reemployed by the School District. Reemployed annuitants do not accrue additional benefits.
12. Normal Form of Retirement Benefits	Straight life annuity. Actuarially equivalent options are available to provide post-retirement beneficiary or survivor benefits.
13. Benefit Increases	If the Accrued Liability Funding Ratio, based on Actuarial Value of Assets, as determined by the two consecutive and most recent actuarial valuations are: Less than 80 percent for two consecutive years, the COLA: 1.00 percent Between 80 percent and 90 percent for two consecutive years, the COLA: 2.00 percent If at least 90 percent for two consecutive years, the COLA: 2.50 percent