REPORT TO ORSC

ACTUARIAL AUDIT
FOR THE
STATE TEACHERS RETIREMENT SYSTEM OF OHIO

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Amanda Makarevich, FSA

May 2022

PTA PENSION TRUSTEE ADVISORS

KMS ACTUARIES LLC

May 10, 2022

Ohio Retirement Study Council
Columbus, OH 43215

Re: State Teachers Retirement System of Ohio (STRS) Actuarial Audit of the Pension and Health
Benefits as of June 30, 2021

Dear ORSC Members:

We have completed our actuarial audit of the State Teachers' Retirement System of Ohio (STRS)
pursuant to R.C. §171.04(E). As shown in the attached findings, we have matched actuarial
calculations quite closely and have several related comments. None of the comments reflects a
critical concern. Our audit finds that actuarial calculations were reasonable, consistent and accurate.

The undersigned are members of the American Academy of Actuaries and meet the Qualification
Standards to provide this statement of actuarial opinion.

We are available to answer any questions you may have regarding our findings and
recommendations of the actuarial audit.

Sincerely,

William B. Fornia, FSA   Amanda Makarevich, FSA
President   Consulting Actuary
Pension Trustee Advisors   KMS Actuaries, LLC

cc: State Teachers Retirement System of Ohio

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Section 1 – General Findings

The Ohio Revised Code §171.04(E) require that the Ohio Retirement Study Council (ORSC) contract for an independent audit of the state retirement systems' actuaries not less than once every ten years. ORSC elaborated that the firm conducting the audit is to express an opinion regarding:

— An overall opinion as to the validity, completeness, and appropriateness of the demographic and financial information used by the consulting actuary to meet Ohio State Teachers Retirement System (STRS') financial objectives;
— An overall opinion as to the reasonableness of the consulting actuary's conclusions and the conformance of the consulting actuary's work with generally accepted actuarial standards and practices;
— A detailed description of each audit exception and the estimated effects of each exception on STRS; and
— Detailed recommendations for improvement.

Our opinion is that these standards were met, as will be discussed in the following pages.

STRS provides retirement benefits and health care benefits. Actuarial values were reported through two actuarial reports:

- STRS Actuarial Valuation Report as of June 30, 2021, dated October 2021
- STRS Retiree Health Care Benefits Plan Actuarial Valuation and GASB 74 and 75 Report as of June 30, 2021, dated October 2021

We have duplicated these June 30, 2021 actuarial valuations conducted by Cheiron, STRS' actuary, and the results match quite closely. This match confirms that Cheiron is able to capture the complexity of STRS accurately and that STRS should have confidence in the actuarial calculations provided to them. In addition, we reviewed Segal's March 3, 2017 Quinquennial Actuarial Experience Review for July 1, 2011 to June 30, 2016 and its recommendations. Segal was the STRS actuary prior to the July 1, 2018 actuarial valuation. We found that the assumptions proposed by Segal, adopted by the Board, and utilized by Cheiron were reasonable. Cheiron has performed their July 1, 2016 to June 30, 2021 Quinquennial Actuarial Experience Review on demographic assumptions and recently released their findings. This analysis does not consider that recent development, but a cursory review of the Cheiron analysis indicates that their findings are fairly consistent with our recommendations. We look forward to Cheiron considering our comments when they conduct their review of economic assumptions later this year.

The primary purpose of an actuarial audit is to confirm that there are no significant errors in the actuarial calculations. Based on our replication, we report that **we have found no significant discrepancies and conclude that there are no significant errors**. This is confirmed on the tables and discussion below.
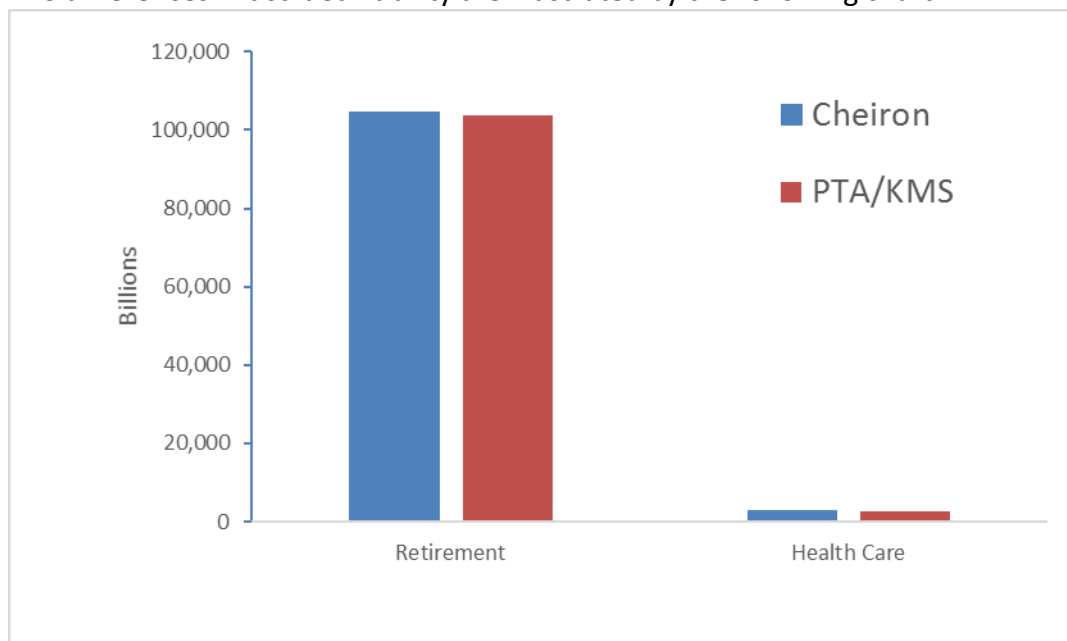
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The following tables summarize the actuarial liabilities and normal costs produced by Cheiron and PTA/KMS actuarial valuations.

Actuarial Liabilities and Normal Cost as of June 30, 2021 ($ in thousands) - Pension Benefits			
	Cheiron	**PTA/KMS**	**% Diff.**
Present Value of Future Benefits	117,307,166	116,367,022	-0.80%
Accrued Liability	104,591,408	103,874,190	-0.69%
Normal Cost	1,344,767	1,308,056	-2.73%

Actuarial Liabilities and Normal Cost as of June 30, 2021 ($ in thousands) - Health Care Benefits			
	Cheiron	**PTA/KMS**	**% Diff.**
Accrued Liability	2,821,322	2,782,265	-1.38%
Normal Cost	38,323	36,653	-4.36%

The grand total actuarial liability calculated by PTA/KMS was within 0.7% of the same calculated by Cheiron. Our grand total normal cost was within 2.8% of that calculated by Cheiron. Both are well within actuarial norms and strong evidence that the Cheiron actuarial valuations are reliable.

The differences in accrued liability are illustrated by the following chart:

Although the match was reasonably close, there is still room for improvement. We make the following recommendations for enhancement in the accuracy of calculations and completeness in the reports:

- Correct minor calculations as discussed in the following pages
- Expand disclosure of methodology and assumptions more rigorously in the next actuarial experience study and valuation reports
- Reconsider certain actuarial assumptions in the next experience study, including:
  - Percentage of employees electing deferred annuities and contribution refunds upon termination
  - Marriage rates
  - Age difference between husbands and wives
  - Number of dependents
  - Annuity option selection
  - Administrative expenses
  - Short-term return on employer assets
  - Gross claim rate derivation
  - Morbidity
  - Health plan participation rates and elections

The first step in the actuarial audit process is to review the actuarial methods, actuarial factors, and actuarial assumptions used in the actuarial valuations.

ACTUARIAL METHODS

Cheiron uses several actuarial methods in determining costs and liabilities for STRS.

— The actuarial funding method is the Individual Entry Age actuarial cost method.
— The actuarial asset valuation method for pension is a four-year smoothed market value.
— The amortization of the unfunded actuarial accrued liability is based on a level payroll, closed period method of 30 years as of July 1, 2015.
— The method of developing the health care claims cost assumptions is not clearly described in the reports.

Actuarial Funding Method

The Individual Entry Age Normal actuarial cost method is used for both actuarial valuations. This method is designed to maintain constant plan costs throughout each employee's career as a portion of pay. We believe this is a reasonable and appropriate method. It is the most common method used by large public pension systems such as STRS. Cheiron is applying the method reasonably, consistently, and accurately.

Actuarial Asset Valuation Method

Cheiron employs a four-year smoothed market value actuarial asset valuation method for the retirement plan actuarial valuation. Unlike actuarial funding methods, actuarial asset valuation methods are not precisely defined. Most actuaries use what could be categorized as a four-year or five-year smoothed market value actuarial asset valuation method as does Cheiron, but might use different methods. We have reviewed the precise provisions of the method that Cheiron employs and find them to be reasonable, consistently applied, and accurate.

The method is a conventional and appropriate application of a four-year smoothed method. They spread any investment gains or losses (relative to the actuarial assumption) over four years and apply a 9% maximum disparity from true market value. This is a reasonable and appropriate method. More common is for funds to use a 20% maximum disparity from true market value. This 9% corridor and four-year smoothing has been in place since 1997. STRS has worked with four actuarial firms (Buck, PriceWaterhouseCoopers, Segal, and now Cheiron) who have each utilized this method.

This narrow corridor means that the STRS funding position and amortization cost is more volatile than it would be if using a more conventional wider corridor. This means that in bad investment years, the costs could increase more rapidly, while in good investment years, the costs could decrease more rapidly. This means that STRS is responding more quickly to market returns. This

corridor was triggered only once in the past ten years, in 2021, when it added $1.9 billion to actuarial value of assets (would have been zero if 20%). This is somewhat unusual to have a corridor this narrow. PERS has a 12% corridor, and the other three Ohio statewide retirement systems have the common 20% corridor. As discussed above, the fact that STRS has a narrower corridor than most means that they may be more responsive to market fluctuations and reflecting the current market conditions. The advantage to this is that it is a truer reflection of the true value of assets. The disadvantage is that the unfunded liabilities and funding periods might be more volatile than they would have been with the typical 20% corridor. As mentioned above, however, this has not been the case. From this point forward, if we were to have a prolonged downturn in investment returns, the STRS actuarial results would respond more quickly than other systems.

We are not concerned with this narrower corridor; only wish to point out the variance from most common practice. We encourage Cheiron to analyze this method concurrent with the next study of economic assumptions and analyze the implications of changing to a wider corridor.

Amortization Method for Determining Funding Amounts

In addition to the Entry Age Normal actuarial cost method, Cheiron and STRS use a conventional method for amortizing components of unfunded liability. The method is a closed period, which decreased from 30 years as of June 30, 2017, to 24 years as of June 30, 2021.

The funding period is calculated by subtracting the employer normal cost from the total employer contributions, and then measuring how many years it would require to fully amortize the unfunded retirement liability from these contributions. While this would tend to decrease every year (by one year if all actuarial assumptions are met), there may be years when the period rises.

Many statewide pension systems continue to use an open period to amortize the unfunded liability. The closed period approach tends to be more conservative than the open period approach. As discussed in our 2011 Pension Reform Solutions report, we believe that the closed period is more appropriate.

The other amortization feature being used is to amortize the costs as a constant percentage of payroll. With payroll growing at an assumed rate of 3.00% per year, this maintains steady costs. An alternative would be to amortize costs in constant dollars, which would result in higher costs in early years when expressed as a percentage of pay. We believe this is a reasonable approach for funding, despite the changes in the GASB rules which will not permit this method for GASB determinations. The 3.00% payroll growth rate is reasonable in the aggregate based on a stable population. We note that the number of covered Defined Benefit Plan members has dropped somewhat since 2016, for example, from 169,212 as of June 30, 2016 to 166,427 as of June 30, 2021. While this is only a 1.6% reduction over five years, if the trend continues, it could undermine the benefit of assuming that payroll increases by 3.00%. We recommend that Cheiron explicitly considers this in their next experience study. While 3.00% might be an appropriate price inflation assumption, if population is

forecasted to decline, STRS may wish to adjust its total payroll growth assumption in order to minimize the likelihood of increasing costs.

In conclusion, we find the amortization method reasonable, consistent, and accurate.

ACTUARIAL ASSUMPTIONS

We have reviewed the actuarial assumptions used by the actuary and find them to be reasonable, consistent, and accurate. Cheiron is conducting the Quinquennial Actuarial Experience Review for 2017 through 2021. We encourage Cheiron and the STRS Board to consider our comments in the process of adopting proposed assumption changes.

The actuary uses a large number of actuarial assumptions, including:

— Demographic Assumptions
  - Post-Retirement Mortality
  - Disabled Post-Retirement Mortality
  - Pre-Retirement Mortality
  - Withdrawal from Service Before Retirement
  - Retirement
  - Disability Retirement
  - Other Demographic Assumptions

— Economic Assumptions
  - Investment Return Rate
  - Inflation
  - Wage Inflation
  - Individual Salary Increases

— Post-Employment Healthcare Assumptions
  - Gross Claim Rate Derivation
  - Health Care Cost Trend Rate
  - Morbidity
  - Retiree – Paid Premiums
  - Health Plan Participation Rates and Elections

Detailed comments on each assumption are included below.

DEMOGRAPHIC ASSUMPTIONS

Demographic Experience Since the 2017 Investigation

Experience in the past five years, since the prior experience investigation, indicates that the demographic actuarial assumptions have generated cumulative actuarial gains of 0.2% over five years. This is an indication that the demographic assumptions in aggregate have been a very reasonable measure of anticipated experience.

Demographic Actuarial (Gains)/Losses By Component ($millions)

Source	FY 17	FY 18	FY 19	FY 20	FY 21	Total
Salary/Service Increase	(279)	(181)	(208)	(178)	(237)	(1,083)
Retirement	36	121	207	84	203	651
Retiree Mortality	(27)	9	(153)	(111)	(208)	(490)
All Other	275	165	119	29	85	673
Total (Gain)/Loss	5	114	(35)	(176)	(157)	(249)
Actuarial Liability ($billions)	95	95	96	97	102	102
Gain/Loss as % of FYE Liability	<.1% Loss	0.1% Loss	<.1% Gain	0.2% Gain	0.2% Gain	0.2% Gain

Rates of Post-Retirement Mortality

Actuaries are getting more sophisticated in their techniques for anticipating future mortality improvements. Cheiron is using the more sophisticated method of a "generational" mortality table which assigns different mortality probabilities based not only on age but on generation. For example, an 80-year old retiree in 2022 (born in 1942) would have higher mortality rates than a future 80-year old retiree born in 1987.

Segal in 2017 proposed changing the mortality projection basis from a static projection Scale AA to 2022 to a generational MP-2016 projection scale. This was a substantial enhancement to the actuarial methodology because it recognized future mortality improvement beyond 2022. Mortality improvement projection is a critical issue in the measurement of pension liabilities and costs.

Many trends have contributed to lengthening life expectancies, including:

- Continued eradication of diseases
- Advances in medicine
- Advances in nutrition
- Improved access to medical care

But other trends may suggest that life expectancies may not continue to improve, including:

- Emergence of new diseases including COVID-19 and potential future variants
- Obesity
- Many factors which improved mortality are one-time, and cannot be repeated, for example, smoking cessation trends (one can only quit smoking once)
- More sedentary lifestyles
- Substance abuse
- Climate change

As a result of the uncertainty of these contrary trends, we encourage Cheiron to rigorously study 2020 and 2021 experience and the appropriate application of projection scales. They may choose to incorporate different short-term and long-term mortality improvement scales. The Society of Actuaries has also developed more recent projection scales such as MP-2021.

The table above illustrates that over the five-year period, the retiree mortality assumptions have generated actuarial gains of $490 million, while the current retiree actuarial liability is $69 billion. This is less than 1%. Pending Cheiron's consideration of COVID, we would anticipate that a modest decrease in the retiree mortality rate or additional mortality improvement would be recommended.

Rates of Disabled Post-Retirement Mortality

Segal had proposed a standard table for disabled retirees. We expect that Cheiron will include this in their experience study and possibly make minor modifications in this table. This is not a particularly critical assumption, as many more retirees are non-disabled than disabled.

Rates of Pre-Retirement Mortality

The pre-retirement mortality assumption also appears reasonable. Very few active members die, so the use of a standard mortality table is generally appropriate.

Withdrawal from Service before Retirement

We concur that the withdrawal tables developed by Segal and used by Cheiron are reasonable, consistent, and accurate. Cheiron uses a table based on service for individuals with less than five years of service and one based on age thereafter. We find that this is a sound methodology

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because individuals do have higher likelihood of termination during their first few years of employment than later in their careers.

The 2017 Segal experience study appropriately balanced prior assumptions with more recent experience and considered the credibility of the data effectively. It appears that Cheiron has taken a similar approach.

Retirement

We concur that the retirement tables used by Cheiron are reasonable, consistent, and accurate. Varying retirement rates are used for (1) retirements prior to July 1, 2015, (2) retirements for grandfathered employees retiring after June 30, 2015, and (3) retirements for non-grandfathered employees retiring after June 30, 2015. The first table is for the most part irrelevant as of now, and when Segal conducted the 2011-2016 experience study, they had only two years of experience to measure when developing these assumptions. Cheiron's 2022 experience study would likely result in some changes to these assumptions. Note from the table at the beginning of this section that the five-year experience is a loss of $651 million. This probably indicates that members are retiring a bit earlier than anticipated. As Cheiron conducted the 2016-2021 experience study, they did review this and their suggestions seem very reasonable.

Other Demographic Assumptions

We reviewed the other demographic assumptions which could be analyzed by Cheiron. We find their study reasonable, consistent, and accurate. These assumptions include:

Disability Rates – Segal recommended and Cheiron uses an assumption for disability retirement which is 0.01% at ages under 30, increasing to a still-small 0.25% at age 60 and above. This is based on five-year experience where less than 1,000 teachers retired from disability. This is consistent with national experience for teacher retirement systems. Cheiron did analyze this in its 2022 investigation and made adjustments as we would have recommended.

Marriage Rates – Cheiron assumes 60% of future female retirees and 80% of future male retirees would be married. Current retirees use actual marriage data at the time of valuation. We support this approach.

Age Difference between Husbands and Wives – Segal recommended and Cheiron assumes female retirees are one year younger than their husbands and that male retirees are 3 years older than their wives. We find this reasonable. Many retirement systems use three years as a widely established norm. Given the large volume of STRS data available, we recommend that Cheiron continue to make detailed analyses in future experience studies as did Segal.

Number of Dependents – Cheiron assumes that the spouse is the only dependent for the survivor benefit in the retirement plan. For the health valuation, Cheiron assumes that of those future

retirees who elect to continue health coverage, 20% have an eligible spouse who also opts for health coverage at that time. We recommend that this assumption be analyzed in the future experience studies.

Lump Sum Selection – Cheiron assumes that half of terminating members of the Defined Benefit Plan are assumed to elect a deferred termination benefit and half are assumed to take an immediate lump-sum. This was not explicitly studied by Segal in 2017. We recommend that Cheiron include this in a more robust manner in future experience studies. This assumption has a very modest impact on actuarial valuation results and other approaches are likely reasonable. Other approaches may also consider the eligibility for additional benefits, such as retiree health coverage.

Retirement Age for Inactive Vested Participants – For the pension valuation, Cheiron assumes that 5% of these members elect to retire at each early retirement age through age 64, then 100% retire at age 65 or the first age at which unreduced retirement benefits are available. This was consistent with the Segal experience investigation and seems reasonable. For the health valuation, 100% are assumed to retire at age 62 or the first age at which unreduced benefits are available. We would recommend reviewing this assumption and considering making it consistent between the valuations.

Retiree Health Participation – Based on Segal's recommendations from their 2017 investigation, Cheiron assumes 75% of future eligible service retirees, 65% of future eligible disabled retirees, and 30% of inactive vested participants who do not cash out are assumed to elect health coverage at retirement. This is reasonable at this time, and an important assumption. We see that Cheiron did analyze this thoroughly in the 2022 experience investigation and make changes based on recent experience.

ECONOMIC ASSUMPTIONS

Investment Return Rate

Segal in 2017 recommended a decrease from 7.75% to 7.00% for the investment return rate. This assumption change was a bit "ahead of the curve" with respect to rates used by most systems in 2017, when 7.50% was the rate most commonly used. Today, however, 7.00% is the median return according to the Public Funds Survey.

STRS did not lower the rate from 7.75% to 7.00% at that time. Rates assumed were as follows:

- Lowered from 7.75% to 7.45% for the actuarial valuation as of June 30, 2017.
- Remained at 7.45% for the actuarial valuations as of June 30, 2018, 2019, and 2020.
- Lowered from 7.45% to 7.00% for the actuarial valuation as of June 30, 2021.

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Actuaries are required under their standards of practice to opine if they believe that the rate is not reasonable. Even though experience investigations are typically conducted only every five years, this standard applies each year.

A 7.00% rate would be among the lowest rates used by the statewide systems in Ohio. The other systems' expected rates are:

- Ohio Police and Fire Pension Fund – 7.50% (reduced from 8.00% effective 2022)
- School Employees Retirement System of Ohio – 7.00%
- Ohio Public Employees Retirement System – 6.90% (reduced from 7.20% effective 2022)
- Ohio Highway Patrol Retirement System – 7.25%

Of course, a simple comparison of what other systems are using is helpful, but it is not a sufficient criterion for establishing an assumed rate of investment return.

Segal used a robust forward-looking "building block" method, where they developed an inflation assumption, a real return assumption and an assumption for expenses. Each of these components was calculated independently, then summed (net of expenses) to develop the net investment return assumption.

Their 7.00% net investment return assumption recommendation was comprised of 2.50% inflation plus 4.50% real return net of administrative expenses. Inflation is discussed in the section below, so we will focus on the real return component and the administrative expense component.

Based on our experience, investment consultants continue to pare back their expectations for future returns. This is partially a consequence of continued low inflation expectations and short-term fixed income rates, but can also be on a real return basis. Consequently, we would expect that it is likely that in the next experience study, Cheiron would possibly suggest another drop in net return assumption or maintain the 7.00% rate until conditions change.

In particular, recent inflation hints that the continuing decline in expected rates of return may be tapering. We trust that Cheiron rigorously analyzes both the expected real return as well as the inflation assumption.

According to state data from the Public Funds Survey as of March, 2022, the average real rate of return assumption for 119 state systems, 47 of which disclosed this, is 4.53%. Although not specifically asked, this is presumably after reduction for administrative expenses in most responses.

The 4.50% real rate currently used by STRS is the lowest rate used by the statewide systems in Ohio. The other systems' expected real rates of return are:

- Ohio Police and Fire Pension Fund – 5.25% (possibly to be reduced effective 2022)
- School Employees Retirement System of Ohio – 4.60%
- Ohio Public Employees Retirement System – 4.70% (possibly to be reduced effective 2022)
- Ohio Highway Patrol Retirement System – 4.75%

Administrative Expenses – STRS' anticipated administrative expenses are incorporated into its valuation by reducing the assumed rate of return by 0.20%. The investment return rate is thus assumed to be net of administrative expenses. Segal incorporated a thorough analysis of this assumption, including a look at asset classes such as real estate and alternatives where returns are sometimes calculated net of their investment expenses. We recommend that Cheiron also incorporates a robust expense assumption in the 2022 experience investigation.

Health Care Plan Rate of Investment Return – Cheiron uses the same 7.00% investment return assumption for the healthcare valuation as is the assumed return from plan assets. This is appropriate because the plan is fully funded and expected to remain so.

Inflation

We reviewed the development of the 2.50% inflation rate developed by Segal and used by Cheiron. We find that the assumption is very reasonable. The Segal investigation considered forward looking data such as the yields on inflation-indexed treasury bonds and economist forecasts to the extent that they are not purely short term. We expect that Cheiron will continue to use a robust analysis as did Segal. This is particularly valuable in the current environment, where headline inflation is high, but the bond markets continue to anticipate modest long-term inflation.

According to the Public Funds Survey data cited above as of March, 2022, the median inflation assumption for those who reported their inflation rate is 2.55%.

A 2.50% rate is consistent with the other statewide systems in Ohio. The other systems' expected inflation rates are:

- Ohio Police and Fire Pension Fund – 2.75% (possibly to be reduced effective 2022)
- School Employees Retirement System of Ohio – 2.40%
- Ohio Public Employees Retirement System – 2.50%
- Ohio Highway Patrol Retirement System – 2.50%

Wage Inflation

Cheiron proposes a real wage inflation, or payroll growth rate, of 0.50%. When added to 2.50% inflation, this results in a total payroll growth assumption of 3.00%. We find this to be reasonable, consistent, and accurate. Segal provided a robust analysis in support of this assumption in its experience study. We expect Cheiron to conduct a similar analysis and note

that 0.50% is typical and reasonable. As mentioned above, however, this wage inflation assumption is also used for the amortization policy. The active member population has declined from 175,065 in 2006 to 169,212 in 2016 to 166,427 in 2021. If the population continues to decline, this 3.00% assumption may no longer be appropriate.

Individual Salary Increases

Segal analyzed individual salary increase rates, and made recommendations for minor reduction. We found this to be appropriate and expect that Cheiron will make a similarly robust analysis. In particular, it is critical to analyze *real* (inflation-adjusted) salary growth as did Segal. Inflation averaged only 1.80% during the five-year period, compared with a previously assumed rate of 2.75%. With such a large disparity between 2.75% and 1.80%, it was particularly appropriate that Segal reflected this gap between actual and expected inflation. As we would have recommended, we see that Cheiron did use this methodology in its experience study and not merely study nominal salary growth.

POST-EMPLOYMENT HEALTHCARE ASSUMPTIONS

Gross Claim Rate Derivation

It is common practice for actuaries to project future claim costs by measuring past experience and adjusting it to reflect the effects of inflation and plan design. Cheiron did this based on Calendar Year (CY) 2020 and CY 2021 projected premiums provided by STRS developed by its vendors (Wakely, Aetna, AultCare, and Paramount). Cheiron thoroughly documented this process in the actuarial valuation report. Based on our review of certain calculations, we find that the health care claim cost assumption is reasonable.

In order to develop the core health care claims cost assumption, Cheiron took the following steps:
- Average the 2020 and 2021 premium rates STRS pays its vendors,
- Average Wakely's projected 2019 and 2020 Employer Group Waiver Program Recoveries that STRS is expected to receive for CY 2020 and CY 2021 prescription filled dates,
- Reflect an estimate of the Rx rebates PPPM for the Non-Medicare population-based on actual 2018 Non-Medicare Rx rebates,
- Add a children load of 3.1% for Medical and 1.9% for Rx to Non-Medicare claims and expenses.

We have reviewed the resulting gross rates and find them reasonable, appropriately calculated, and accurate. We recommend that Cheiron study the children load in the 2022 experience investigation.

Health Care Cost Trend Rate

To properly measure future liabilities, actuaries apply trend rates (health inflation) to the base claim costs described above. Standard practice is to use prevailing national trend rates and grade down to an ultimate trend rate that is slightly higher than prevailing CPI rates. In this case, the ultimate

trend rate is 4.00%. Cheiron used the Society of Actuaries (SOA) Long-Run Medical Cost Trend Model version 2020_b.

We find this approach reasonable and the trend rates which it produces reasonable. COVID has had a profound effect on healthcare costs. We encourage Cheiron to consider this carefully in the next experience investigation. This might lead to basing projections on long run trends, extrapolating from 2026 forward, leaving the intervening turbulence (years 2022 -2025) mostly unspecified.

Morbidity

In a health insurance valuation, morbidity is sometimes defined as the difference in claims costs at different ages. Morbidity rates are also known as aging factors. They are used to transform average health cost assumptions to health care cost assumptions which vary by age and gender. Cheiron did not disclose in the valuation report what data was used for development of aging factors.

We encourage Cheiron to review these factors in the next experience study to the extent data is available. At the very least, we would recommend that the experience study report discloses the process used for choice of these aging factors. We reviewed the aging factors developed by Cheiron and found them appropriate.

Retiree Contributions

The true measure of a plan's liability is the difference between total claims costs and the amount that retirees contribute to offset those total costs. In developing the Plan's liability, Cheiron used the specific STRS subsidy provisions. We reviewed the methodology used by Cheiron and found it appropriate. However, additional detail could be provided directly in the report as we found it necessary to reference the retiree benefit booklets provided on the STRS website for clarification of the retiree contribution provisions. For clarity and transparency, we recommend that this information be included in the actuarial valuation report.

Health Plan Participation Rates and Elections

Based on the Segal experience investigation, Segal recommended that the assumption be that 75% of future eligible service retirees, 65% of future eligible disabled retirees, and 30% of inactive vested participants who do not cash out are assumed to elect health coverage at retirement. Cheiron adopted Segal's recommended assumption. We recommend that Cheiron demonstrate a rigorous analysis of these assumptions in the next experience investigation.

DISCLOSURE OF ACTUARIAL ASSUMPTIONS AND METHODOLOGY

Cheiron's disclosure of actuarial assumptions (and methods) was robust, particularly given the complexity of STRS.

If STRS were ever to change actuaries from Cheiron, based on our experience with the audit, the new actuary would be able to confirm the reasonableness of Cheiron's calculations.

Section 3 – Audit of Compilation of Actuarial Valuations

The cornerstone of an actuarial audit is a replication of the actuarial valuation. As mentioned above, we matched quite closely the costs and liabilities developed by Cheiron for the retirement system. Consequently, we conclude that the valuation results are reasonable, consistent, and accurate.

The following table summarizes the present value of future benefits, actuarial liability and normal cost for the Pension Benefits produced by Cheiron and PTA/KMS actuarial valuations.

Table 3.1
Pension Benefits Liabilities as of June 30, 2021

Actuarial Liabilities and Normal Cost as of June 30, 2021 ($ in thousands)					
STRS		Cheiron		PTA/KMS	% Diff.
	Defined Benefit	Combined	Total		
Present Value of Future Benefits					
Active Members	45,245,074	604,064	45,849,138	45,238,799	-1.33%
Reemployed Retiree Benefits	281,192	0	281,192	281,192	0.00%
Inactive Benefits					
(i) Deferred Annuity	1,563,705	17,903	1,581,608	1,560,574	-1.33%
(ii) Contribution Refund	395,303	1,336	396,639	396,639	0.00%
Retiree & Beneficiary Benefits					
(i) Annuity & Pension Reserve Fund	67,988,885	44,808	68,033,693	67,721,730	-0.46%
(ii) Survivor's Benefit Fund	1,164,896	0	1,164,896	1,168,088	0.27%
Total	116,639,055	668,111	117,307,166	116,367,022	-0.80%
Accrued Liability					
Active Members	30,373,530	333,380	30,706,910	30,311,596	-1.29%
Reemployed Retiree Benefits	281,192	0	281,192	281,192	0.00%
Inactive Benefits	1,959,007	19,240	1,978,247	1,965,246	-0.66%
Retiree & Beneficiary Benefits	69,153,781	44,808	69,198,589	68,889,818	-0.45%
Defined Benefit Plan Actuarial Liability	101,767,510	397,428	102,164,938	101,447,852	-0.70%
Defined Contribution Account Balances	2,426,470	0	2,426,470	2,426,338	-0.01%
Total	104,193,980	397,428	104,591,408	103,874,190	-0.69%
Normal Cost	1,324,603	20,164	1,344,767	1,308,056	-2.73%

The defined contribution account balances disclosed by PTA/KMS are based on the file entitled "NRS FYE 2021 BALANCES.txt" provided directly by STRS.

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The following table summarizes the actuarial liability and normal cost for the retiree health benefits produced by Cheiron and PTA/KMS actuarial valuations.

Table 3.2
Retiree Health Benefits Liabilities as of June 30, 2021

Actuarial Liabilities and Normal Cost as of June 30, 2021 ($ in thousands)			
	Cheiron	**PTA/KMS**	**% Diff.**
Accrued Liability			
Active Members	1,137,505	1,098,426	-3.44%
Inactive Members	2,990	2,910	-2.67%
Retirees, Spouses and Beneficiaries	1,680,827	1,680,929	0.01%
Total	2,821,322	2,782,265	-1.38%
Normal Cost	38,323	36,653	-4.36%

Summary of Deviation of Results

	Pension Benefits Valuation Results	Retiree Health Valuation Results
Accrued Liability	-0.69%	-1.38%
Normal Cost	-2.73%	-4.36%

Actuaries generally use a 5% deviation as an acceptable range of error. As the total actuarial liabilities and normal costs deviations calculated by PTA/KMS were well within this "margin of error," we are completely satisfied that the numbers are appropriate.

Although we did match quite closely, there are several areas which we would encourage Cheiron to explore further:

— In valuing the pension and retiree health benefits, the following are a few items we uncovered that could be corrected, but overall would be immaterial to the valuation results:

1. In the pension valuation, ensure that all members who would have been eligible to retire as of July 1, 2015 (the definition of grandfathered per the report) have been properly identified so that the appropriate retirement rates and benefit formulas may be applied. Cheiron indicated that only those members with a grandfathered flag in the data were considered grandfathered, but there were a

number of other members that would have been eligible to retire at July 1, 2015 that did not have this grandfathered indicator in the data.

2. Verify that the non-Medicare subsidy for 2022 and beyond is being applied correctly. According to the report, a subsidy of 2.055% per year of service to a maximum of 30 years applies in 2021, and in 2022 and beyond, a subsidy of 2.1% per year of service to a maximum of 30 years applies. However, our calculations indicate that the 2.055% subsidy may have been applied for 2022 and beyond.

3. Ensure that the correct retirement rates for members who have more than 30 years of service but are not eligible for unreduced retirement prior to age 65 are applied in the healthcare valuation. The report indicates that "two times 25-29 years of service rates" should be used under these circumstances, but we were only able to come close to matching the healthcare test lives within a reasonable margin when using the rates provided in the table for 29-34 and 35+ years of service for both reduced and unreduced retirement eligibility.

4. In the healthcare valuation, the report states that the trend rate for Limited Medicare is 6% for 2036 and beyond. However, the assumption tables we received have 4% for this trend rate, and we prepared our results using 4% as we were able to match more closely with this rate and it is consistent with the ultimate trend rate for all other benefits. It appears 6% may just be a typo in the report.

5. Disclose that the assumption that 50% of terminating individuals elect deferred annuities, and that 50% elect a refund of contributions also applies to members in the Combined Plan. This is consistent with our results, but the report only refers to the assumption applying to the Defined Benefit Plan.

6. For the Combined Plan, explicitly state which active benefits are included in the valuation and which are assumed to be funded fully by member contributions and therefore not generate any liability. Our results valued only retirement and termination benefits. Inclusion of death and disability benefits resulted in large discrepancies between our results and Cheiron's, so we conclude that these benefits are not considered. The report indicates that member contributions and investment earnings are used in the funding of death and disability benefits, but it is unclear to what extent this is assumed.

7. We were unable to closely match the disability benefits in the pension valuation sample lives. Given that our level of discrepancy was consistent between all of the benefit formulas, we believe that there may have been a minor error with the post-retirement mortality assumption. However, we were not able to verify this

with the information provided in the sample lives. The difference was still immaterial overall as disability is a small percentage of total benefits.

8. We were also unable to replicate the death benefit in the healthcare valuation. Given that the gross benefit and participant net to zero or close to it in the test lives, this had no effect on our results.

STRS provided us with the system data for all active members and pensioners. Detailed data layouts that identified all the data elements used by Cheiron were provided for the pension valuation. Cheiron also provided us with the data files they utilized in performing the valuations. In performing our replication, we utilized the data files provided by Cheiron.

The following tables summarize the demographic statistics for the pension benefits and retiree health benefits valuations produced by Cheiron and PTA/KMS actuarial valuations:

Table 3.3
Active Members as of June 30, 2021 ($ in thousands)

STRS	Male			Female			Total		
	Cheiron	PTA/KMS	% Diff.	Cheiron	PTA/KMS	% Diff.	Cheiron	PTA/KMS	% Diff.
Number of Members	45,769	45,769	0.00%	120,658	120,658	0.00%	166,427	166,427	0.00%
Annual Salaries	3,265,627	3,265,627	0.00%	7,805,368	7,805,367	0.00%	11,070,995	11,070,994	0.00%
Average Annual Salary	71	71	0.00%	65	65	0.00%	67	67	0.00%
Average Age	45.23	45.23	0.00%	43.82	43.82	0.00%	44.20	44.20	0.00%
Average Service	13.74	13.74	0.00%	13.52	13.52	0.00%	13.60	13.60	0.00%

Table 3.4
Inactive Members as of June 30, 2021

STRS	Male			Female			Total		
	Cheiron	PTA/KMS	% Diff.	Cheiron	PTA/KMS	% Diff.	Cheiron	PTA/KMS	% Diff.
Eligible for Allowances	4,944	4,944	0.00%	15,569	15,569	0.00%	20,513	20,513	0.00%
Eligible for Refunds Only	51,452	51,452	0.00%	92,256	92,256	0.00%	143,708	143,708	0.00%
Total	56,396	56,396	0.00%	107,825	107,825	0.00%	164,221	164,221	0.00%

Table 3.5
Retirees and Beneficiaries as of June 30, 2021 ($ in thousands)

SERVICE RETIREES	STRS		
	Cheiron	PTA/KMS	% Diff.
Number of Members	133,532	133,532	0.00%
Annual Allowance	6,267,659	6,258,153	-0.15%
Average Allowance	46.94	46.87	-0.15%

SURVIVORS & BENES	STRS		
	Cheiron	PTA/KMS	% Diff.
Number of Members	18,600	18,600	0.00%
Annual Allowance	556,845	555,520	-0.24%
Average Allowance	29.94	29.87	-0.24%

DISABILITY RETIREES	STRS		
	Cheiron	PTA/KMS	% Diff.
Number of Members	4,789	4,789	0.00%
Annual Allowance	184,917	184,576	-0.18%
Average Allowance	38.61	38.54	-0.18%

TOTAL	STRS		
	Cheiron	**PTA/KMS**	**% Diff.**
Number of Members	156,921	156,921	0.00%
Annual Allowance	7,009,421	6,998,249	-0.16%
Average Allowance	44.67	44.60	-0.16%

Members in Retiree Health Care Benefits Valuation as of June 30, 2021

Status	Number		
	Cheiron	**PTA/KMS**	**% Diff.**
Active Members	166,424	166,424	0.00%
Retired	93,045	93,045	0.00%
Surviving Spouse	4,237	4,237	0.00%
Disabled	3,277	3,277	0.00%
Spouse of Retiree	12,605	12,605	0.00%
Term Vested	20,430	20,430	0.00%
Grand Total	300,018	300,018	0.00%

ACTUARIAL REPORT

We found the Cheiron actuarial valuation reports and Segal's experience study report to be very well written, and focusing on important issues. Actuarial Standard of Practice (ASOP) No. 41 provides extensive guidance to actuaries regarding actuarial communications. We find that the Cheiron reports fully comply with the guidance of ASOP 41.

We would recommend a few modifications to enhance the completeness of the actuarial valuation reports. These include items discussed in Section 3 as well as the following:

- Table IV-1 identifies the account balances for Defined Contribution Accounts. But the entire $2,426,469,723 is listed as an actuarial liability in the Defined Benefit Plan column. No value is listed for the Combined column. This amount is also listed as an asset in Table III-1, but in that table it is listed in a column labeled "Defined Contribution." This amount flows through as both an asset and liability, which is appropriate, as it is a defined contribution account balance, but the labelling of it as part of the Defined Benefit Plan in Table IV-1 is not strictly correct. We recommend either a footnote explaining that the amount is included in that column (along with an NA in the Combined column) or including a third column labelled "Defined Contribution" with that $2,426,469,723 value.

- We recommend that Cheiron includes the following in the pension benefits and retiree health benefits valuation reports:

    o Rationale for economic and demographic assumptions under the guidance of ASOP 27 and ASOP 35, respectively.
    o Breakout of liabilities by pre-65 and post-65 health care benefits.

Additionally, the reports generally are consistent with Government Finance Officers' guidelines for reporting. The Cheiron signers of the reports are qualified actuaries and compliant for their continuing professional development education as of 2021.

The Segal actuarial experience study and report were similarly comprehensive, complete, and clear.

ACTUARIAL AUDIT PROCESS

Cheiron has been very cooperative in sharing of individual calculations supporting the calculations reported in the actuarial valuation report. However, rather than Cheiron providing complete detailed numbers for specified individuals, only a limited amount of information was provided, particularly in the case of the pension valuation. The inactive test lives for the pension valuation only provided results for the present value of future benefits, accrued liability, and first year

expected benefit payments without any further detail. The active pension test lives had slightly more detail as the present value of future benefits, accrued liability, and normal cost were broken out by benefits attributed to individual decrements, but still lacked details for individual benefits. As a consequence of this lack of information, (1) we cannot confirm that Cheiron is properly making the calculations, only that our calculations match within a reasonable margin, and (2) the audit process is much more tedious, time-consuming and drawn out than necessary. The test lives provided for the healthcare valuation, however, were more detailed. As a result, it was easier to replicate individual benefits and identify small errors as mentioned above.

We understand that there may be sound business, competitive, or legal reasons for Cheiron to have a non-disclosure policy. We also understand that at some other major actuarial firms (some of which do not consult to public pensions) have a similar policy. However, it is important to point out that this policy can make actuarial audits more problematic, lengthy and dubious than normal, as indicated in the previous paragraph. It would probably be helpful if future auditors were aware of the limits on shared information in advance. This issue is not unique to STRS and Cheiron. Actuarial firms are more often taking this approach of limiting detailed information that is shared. While most of the more than 20 audits that we have conducted in the last 20 years have not had this issue, many of the ones we have conducted in the last five years do have this issue.

CONCLUSIONS

We found Cheiron's work to be strong. It was reasonable, consistent, and accurate. We do not believe that any methods, assumptions, or calculations are erroneous to the level of necessary recalculations.

Cheiron, the ORSC, and the STRS staff were fully cooperative and responsive, which assisted in the process. Finally, we wish to reaffirm that the work done by Cheiron was reasonable, consistent, and accurate.