

***Actuarial Audit of the
State Teachers
Retirement System
of Ohio***

Submitted To:

Ohio Retirement Study Council

By:

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CONFIDENTIAL

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Ohio Retirement Study Council
88 East Broad Street, Suite 1175
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Ladies and Gentlemen:

We are pleased to present the enclosed report summarizing our findings and recommendations resulting from our independent review of the actuarial methods, procedures, and actuarial assumptions and the resulting actuarially computed contributions and liabilities as shown in the July 1, 2008 Actuarial Pension Valuation report for the State Teachers Retirement System of Ohio (STRS), and the January 1, 2009 Actuarial OPEB Valuation report for STRS.

This report presents an executive summary followed by separate sections discussing in detail our findings, analyses and recommendations. While some issues are discussed at greater length than others, this report is intended to provide a complete and independent third party review of STRS and its operations from an actuarial perspective. All comments and recommendations are intended to be constructive. Our purpose was to identify areas of possible improvement in the system, its operation and/or the actuarial procedures.

We would like to thank the staffs of PricewaterhouseCoopers LLP, "PwC" and of the Retirement System for their cooperation. Their prompt and courteous responses to our questions and requests for information were of valuable assistance to us and greatly appreciated.

In preparing this report, we have relied on the census data and asset information provided by STRS and PwC. We have not audited or verified this data and other information beyond the testing described in this report. If the data or information is inaccurate or incomplete, the results of this report may likewise be inaccurate or incomplete.



Unless otherwise noted, the actuarial assumptions and methods used in this report are those developed by PwC for STRS. The plan provisions utilized were based on the 2008 actuarial valuation, Revised Code Chapter 3307, and the STRS member handbook, with clarifying information from STRS' staff.

Differences between our projections and actual amounts depend on the extent to which future experience conforms to the assumptions used in this report. It is certain that actual experience will not conform exactly to the assumptions used in this report. Actual amounts will differ from projected amounts to the extent that actual experience deviates from expected experience.

This report has been prepared for the internal use of ORSC and STRS, and is only to be relied upon by these entities. We consent to the distribution of this report as provided under the contract for this work. No portion of this report may be disclosed to any other party without Milliman's prior written consent. In the event such consent is given, the report must be provided in its entirety.

Milliman's work product was prepared exclusively for the use or benefit of ORSC and STRS for a specific and limited purpose. It is a complex, technical analysis that assumes a high level of knowledge concerning STRS' operations, and uses data provided by STRS and PwC, which Milliman has not audited. Any third party recipient of Milliman's work product who desires professional guidance should not rely upon Milliman's work product, but should engage qualified professionals for advice appropriate to its own specific needs.

I am a member of the American Academy of Actuaries and meet its Qualification Standards to render this actuarial opinion.

I look forward to having the opportunity to present this report and respond to questions regarding our review and recommendations.

Respectfully submitted,

Glenn D. Bowen, FSA, EA, MAAA

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**Actuarial Audit of the
State Teachers Retirement System of Ohio**

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

This report summarizes the results of an actuarial review of the State Teachers Retirement System of Ohio, "STRS". The purposes of this review are:

- to determine if the data, assumptions and methods are accurate, appropriate and reasonable for funding the benefits promised, and
- to verify through a full replication of the valuation that the data, assumptions and methods were applied accurately.

Overall Assessment

Our overall assessment as a result of our review of PwC's actuarial work for STRS is that all major actuarial functions are being appropriately addressed. PwC has employed generally accepted actuarial practices and principles in studying plan experience, selecting assumptions, computing employer contribution rates, and presenting the results of their work.

Review of Another Actuary's Work

In a system as large and complex as STRS, there are many operational aspects that have a bearing on the actuarial analysis of the plan. The reader should recognize that many of the issues that we reviewed and which we will discuss in this report are subject to opinion and professional preference. No two actuaries (or actuarial firms) are likely to use precisely the same methods and assumptions (and, therefore, arrive at precisely the same conclusions) when presented with the exact same problem and set of historical facts. In completing our review, we have attempted to focus on those aspects of the plan and its actuarial functions that could be meaningfully improved. In presenting our findings in this report, we have tried to limit discussion of aspects which reflect our professional preferences but which would have minimal effect on the results and conclusions presented by the actuary.

By its nature, a review of another professional's work product will tend to focus on those aspects where the reviewer believes some modification in current procedures would be desirable. Hence, a report such as this will devote the vast majority of the presentation to criticism that, even though intended to be constructive, may give the reader the impression that only problems were found. ***Therefore, we would like to state clearly up front that we found the actuarial procedures and practices to be of a high quality and in compliance with all major aspects of the applicable actuarial standards.*** While we will discuss several areas where we believe some modifications in current data collection procedures, actuarial assumptions or methods would be beneficial, that discussion should be considered within the context of an overall favorable report concerning PwC's work.



EXECUTIVE SUMMARY AND RECOMMENDATIONS

Actuarial Valuation Model

STRS is a complex retirement system, offering a Defined Benefit Plan, a Defined Contribution Plan and a Combined Plan with varying contribution rates, accrual rates, actuarial equivalent factors, and optional forms of benefits that members may elect upon retirement.

It is important to note that the actuarial valuation is based on a model that estimates benefits expected to be paid in the future. The determination of the liabilities and contributions are then based on those projections. During this modeling, some estimates or approximations may be made by the actuary due to immateriality, inadequate data, or complexity. The use of such estimates or approximations is generally accepted within the actuarial profession.

A purpose of this audit is to review the valuation model to determine if the results are reasonable and the assumptions, estimates and approximations appropriate. We recommend consideration of several changes in the model that will, in our opinion, improve its “accuracy”. But overall, we believe that the results presented by PwC in the July 1, 2008 and January 1, 2009 Actuarial Valuation Reports are reasonable and appropriate for the intended uses of those reports.

Recommendations

Set forth below are our five major recommendations for possible changes in current procedures resulting from our review. Four would affect the determination of the System’s liabilities and costs and the fifth would affect future Actuarial Experience Reviews.

Recommendation #1: Post-retirement Mortality Assumption

As discussed in *Section III – Actuarial Valuation Assumptions*, actuarial standards indicate that the mortality assumption used in determining pension obligations should provide appropriate margin for future mortality improvements. This can be done either by specifying a “static” mortality table with a margin built in (e.g. – a mortality assumption that generates fewer expected deaths than has occurred in the recent past), or by specifying a “projected” mortality table (e.g. – starting with a mortality assumption that matches current mortality rates and projects annual decreases in mortality rates into each future year modeled in the valuation). PwC used a static mortality table in the July 1, 2008 valuation of STRS. Based on our review of the mortality assumption, we find some age/gender combinations that appear to allow a reasonable margin for future improvement in mortality, while other age/gender combinations that have a negative margin (i.e. – the assumption anticipates a *greater* number of expected deaths than indicated by recent experience). We recommend that the mortality assumption be



EXECUTIVE SUMMARY AND RECOMMENDATIONS

revised to provide sufficient margin across all age and gender combinations, and thus in total.

Recommendation #2: Investment Return Assumption

As discussed in *Section III – Actuarial Valuation Assumptions*, we believe that, while the STRS current investment return assumption complies with the requirements of Actuarial Standard of Practice No. 27 (ASOP27), *Selection of Economic Assumptions for Measuring Pension Obligations*, that 8.0% is in the optimistic end of the acceptable range as specified in ASOP27. We believe that a net rate of return assumption of 7.5% will provide an unbiased or more neutral estimate of future returns over the period during which STRS will pay benefits to the current participants. We recommend that STRS consider reducing the current 8.0% investment return assumption.

Recommendation #3: Reflection of Contribution Timing

As discussed in *Section III – Actuarial Valuation Methods and Procedures*, we recommend that the calculation of the Normal Cost Rate be revised to better reflect the actual timing of the receipt of contributions to the System. Currently, this Rate is determined by dividing (a) the amount of the normal cost for the coming plan year by (b) the prior year annualized salaries of active members included in the Actuarial Valuation increased by one-half of a year's assumed payroll growth. The dollar amount of the normal cost for a plan year is being determined as if it would be paid at the beginning of the plan year. Since contributions are received on a monthly basis throughout the plan year, with an average receipt at mid-year, we recommend that the dollar amount of the normal cost applied to determine the Normal Cost Rate be increased by one-half year of interest to reflect this delay in the receipt of contributions after the beginning of the plan year. Also, the prior year annualized salaries used to determine this rate are being increased by one-half year of payroll growth to approximate the payroll upon which contributions will be made. Based on our understanding that teachers' pay increases occur predominantly at the beginning of the school year, we recommend increasing the prior year annualized salary by a full year of payroll growth to better reflect the expected payroll in the upcoming plan year.

Recommendation #4: Service in Multiple Systems

As discussed in *Section I – Data Validity*, in our review of individual member benefit calculations provided to us by the System versus valuation data provided by the System to the actuary for the valuation, we identified one transferred member whose actual benefit calculation was based on service and pay with both OPERS and STRS, but whose valuation liability was based only on the service and pay within STRS. The result was a significant understatement of this member's liability. Due to the large number of members who have earned service in more than one of the five Ohio



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Retirement Systems, we recommend that STRS compile information from the other Ohio Retirement Systems regarding active and inactive members who have service in one or more of those systems and provide information to PwC so that all service and pay may be taken into account in the valuation of such members.

Recommendation #5: Presentation of Proposed Actuarial Assumptions

As discussed in *Section III – Actuarial Valuation Assumptions*, when conducting an experience review, the actuary will tabulate the actual number of occurrences of a particular decrement over the study period, and will compare the actual number of decrements with the number expected based on a combination of the prior census data and actuarial assumption. Dividing the actual occurrences by the expected occurrences results in an actual to expected ratio (“A/E ratio”). Deviations in actual versus expected results (e.g. – A/E ratios above or below 1.0) provide a basis for the actuary to modify assumptions prospectively. Once a new assumption is proposed it is possible to calculate A/E ratios for the prior period as if the new assumption had been in place during the prior period. Calculating A/E ratios on the proposed new assumption is a powerful way to review the appropriateness of the new assumption. We recommend that PwC include A/E ratios in future experience review reports based on both the prior and the proposed new assumptions in order summarize the extent to which the new assumption matches actual experience relative to the prior assumption. Please see our discussion of post-retirement mortality in Section III for more detail.

Impact of Milliman Recommendations

We are not in a position to quantify the potential impact of reflecting the increased liability for members who have service in more than one Ohio retirement system. For the first three recommendations above, we have estimated the impact on the funding period of reflecting each recommendation and have estimated the increased contributions needed to fund the incremental liability on a 30 year basis.

Scenario	Funding Period (years)	Change in Funding Period (years)	Change in ARC as % of Payroll (on 30 year funding basis)
July 1, 2008 valuation report	41.2	--	--
Reflect post-retirement mortality recommendation only	68.9	27.7	1.64%
Reflect investment return recommendation only	infinite	infinite	4.08%
Reflect contribution timing recommendation only	44.1	2.9	0.24%



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The “Change in ARC as a % of Payroll” shown in the far right column is the amount of additional contributions needed to fund the incremental normal cost and unfunded liability attributable to that change on a 30 year basis. It is in addition to the 1.46% of payroll that would be needed to fund the System on a 30-year basis using the results in the July 1, 2008 valuation report. For example, increasing the contribution rate by 1.46% of payroll would reduce the 41.2 year funding period shown in the report to 30 years, and an additional 1.64% of payroll, for a total increase of 3.10% of payroll, would be needed to satisfy the 30-year funding requirement if Milliman's mortality assumption recommendation was adopted.

Please note that the combined impact of adopting more than one of these recommendations would be greater than the arithmetic sum of the results shown above.

Response from STRS and System Actuary

Upon completion of our draft audit report, Milliman requested that STRS and PricewaterhouseCoopers review our report to advise us of any misinterpretations that we may have made in conducting our audit. In conjunction with their review, STRS and PricewaterhouseCoopers provided us with a letter that documented their responses to the five recommendations above. We thank STRS and PricewaterhouseCoopers for their review, and have included the response letter on the following page.



October 30, 2009

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RETIREMENT BOARD CHAIR
MARK H. MEUSER

RETIREMENT BOARD VICE CHAIR
TIM MYERS

EXECUTIVE DIRECTOR
MICHAEL J. NEHF

Dear Mr. Bowen:

We have received and reviewed the draft report for the actuarial audit of STRS Ohio dated October 16, 2009. STRS Ohio greatly appreciates your significant time and effort in preparing the report and recommendations. Milliman's assessment that actuarial procedures and practices are of high quality and in compliance with applicable actuarial standards provides valuable assurance to the STRS Board as well as the Ohio Retirement Study Council.

Representatives of PricewaterhouseCoopers and the STRS Ohio staff have reviewed the recommendations in the draft report and offer the following responses. We hope you will consider including this information in your final written report.

Recommendation #1 Post-retirement Mortality Assumption

STRS Ohio agrees that adjusting the mortality assumption to include a margin for future mortality improvements may be appropriate. We believe this recommendation will best be considered in conjunction with the next scheduled actuarial experience review in 2013.

Recommendation #2 Investment Return Assumption

STRS Ohio agrees that its current investment return assumption of 8% may be on the "... optimistic end of the acceptable range ..."; however, it is consistent with the results of an asset allocation study completed by Russell Investment Group and adopted by the Retirement Board in May 2009. According to that report, the mean average 20-year rate of return for STRS Ohio's current asset allocation is 8.1%, including 0.4% return from active management. STRS Ohio has added value from active management over the past twenty years. Moreover, a recent Public Fund Survey conducted by the National Association of State Retirement Administrators and the National Council on Teacher Retirement found that the median investment return assumption for the public funds surveyed is 8%. STRS Ohio will continue to monitor its ability to meet the long-term investment return assumption through periodic asset allocation/liability studies, along with the advice and recommendations of the Retirement Board's investment and actuarial consultants.

(continued)

Recommendation #3 Reflection of Contribution Timing

STRS Ohio and PwC agree that revising the calculation of the Normal Cost Rate to better reflect timing of contributions is appropriate and will take it into consideration for future actuarial valuations.

Recommendation #4 Service in Multiple Systems

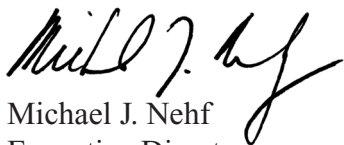
STRS Ohio agrees that including actuarial data for individuals participating in more than one Ohio public retirement system is desirable. However, the refinement in calculating accrued pension liabilities may be relatively small compared to the administrative cost and effort needed to collect and compile the data. While Ohio's public retirement systems regularly cooperate in a variety of projects, sharing active member data is complicated by different fiscal years, varying procedures for collecting contributions and determining service credit, and compatibility of information systems. Additionally, it may not be clear in any given year which retirement system will ultimately pay a person's benefit. STRS Ohio will explore the feasibility of sharing joint member data with other Ohio retirement systems.

Recommendation #5 Presentation of Proposed Actuarial Assumptions

STRS Ohio agrees that actual to expected ratios for proposed new assumptions may be useful and will request this information in the next actuarial experience review scheduled for 2013.

Thank you for the opportunity to review a draft copy of your report. Your conclusion that all major actuarial functions are being appropriately addressed, along with recommendations for improvement, is greatly appreciated.

Respectfully,



Michael J. Nehf
Executive Director

SECTION I – DATA VALIDITY

Background

The member data used by the actuary is one of the basic foundations of an actuarial valuation. It forms the basis for actuarially projecting the benefits provided to members by STRS. Thus an important step in an actuarial audit is reviewing the validity of the member data.

To perform this task, we requested the data STRS provided to PwC for the July 1, 2008 valuation and additional information from STRS regarding members who retired after July 1, 2008. After reviewing this data we then requested thirty individual benefit calculations from STRS that were randomly selected to encompass a wide variety of the benefits STRS members receive. These benefits include service retirement benefits, disability benefits, survivor benefits, and lump sum options in the DB, DC, or Combined Plans. Twenty of the requested calculations were for members whose benefits commenced subsequent to July 1, 2008 (they were reported as active members on the valuation date) and ten of the requested calculations were for members whose benefits commenced prior to July 1, 2008 (they were reported as inactive members on the valuation date).

We requested copies of the actual benefit calculations. This allows us to compare the data that was used to determine the member's benefit (which was presumably subject to careful review by STRS) with the data provided for the actuarial valuation. STRS indicated that it would be very difficult to provide copies of the actual benefit calculations. Instead, they provided the data used to calculate the member's benefit for all thirty requested calculations summarized in a spreadsheet format. Later, we requested and were provided copies of actual benefit calculations for two specific members out of the group of thirty members. This information was the basis for our review.

The purpose of reviewing actual benefit calculations is two-fold. First, we reviewed the benefit calculations for reasonableness, consistency and compliance with the Legislative Code governing STRS as well as the STRS Member Handbook. Second, we reviewed the data used in the benefit calculations for consistency with the valuation data provided to the plan actuary for the July 1, 2008 valuation.

Benefit Calculation Review

For all 30 of the calculations we reviewed, the benefits were computed accurately based on the member data provided to us and were reasonable and consistent with the Legislative Code.



SECTION I – DATA VALIDITY

For the 10 members who retired prior to the valuation date, we also found that the benefit chosen by the member was accurately reflected in the data supplied to the actuary.

For 19 of the 20 calculations for members who began receiving benefits subsequent to July 1, 2008, we found that the final data used for the benefit calculations was reasonably related to the data that had been supplied to the actuary.

In our experience, this degree of matching indicates that high quality data is being provided to the actuary by the System.

However we did note for one member that the Final Average Salary and Total Service used in the actual benefit calculation were \$84,898 and 24.02 years, respectively, and the Final Average Salary and Total Service in the data supplied to the actuary for the July 1, 2008 valuation were \$61,893 and 13.21 years, respectively. STRS informed us that the service difference was due to the member having transferred service from OPERS. In addition, the high earnings used in determining the Final Average Salary were from past years with OPERS. These differences produced a substantial understatement in the member's liability in the valuation.

Recommendation

Based on the data provided by the five Ohio Retirement Systems for the *Report Regarding Service Purchases* dated March 14, 2007 to the Ohio Retirement Study Council, roughly 700 members in other retirement systems transfer service into STRS in a typical year and 500+ members transfer service from STRS to another system in a typical year. (FY 2005 was considered to be a typical year when that report was prepared.) Thus there are a significant number of such transfers each year. Since these transfers increase the number of years of service of the member, in some circumstances the additional service may significantly accelerate the date when the member can retire and the level of health insurance subsidy for which they are eligible in addition to increasing the amount of pension payable to them.

As a result, we recommend that all five of the Ohio Retirement Systems consider the feasibility of identifying members who have service credits under more than one system and share relevant information (e.g., service, earnings, accumulated contributions) regarding those members with the actuary for each system in which that member has participated. If this data were compiled and provided to each of the actuaries, it could be reflected in the annual actuarial valuations for each of the five systems. We also note that there are other types of additional service credits that increase a members' liability, such as purchases of military service or out-of-state service, and we recommend that all such service credits be provided to the actuary for inclusion in the valuation.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Plan Provisions

To the extent possible, we compared the plan provisions used in the valuation programming with the Revised Code Chapter 3307 governing STRS, the Summary Plan Descriptions provided to members, and to the actual retirement calculations described in Section I. We were not provided with “individual test lives” from PwC due to the proprietary nature of their calculations, therefore our review of the detailed programming for the valuation was conducted through correspondence/discussions with PwC. Based on this review, we believe the plan provisions are being applied in the valuation programming in a reasonable and appropriate manner.

Data Editing

In preparing an actuarial valuation, the actuary will review the “raw” data provided by the plan sponsor, and will “edit” the data as needed to complete missing data and/or to remove discrepancies. We requested and received a copy of the edited data from PwC.

Based on our understanding of the data provided to the actuary, we reviewed the data procedures employed by PwC to review the reasonableness of interpretations, estimates and adjustments made in the data editing process. PwC provided us with the following brief explanation of their data editing process:

Our data editing methodology consists of two phases. The first phase considers if the data provided for the current year is consistent with the data provided for the prior year. The second phase considers if the data provided for the current year is internally consistent and reasonable.

A sample of the checks performed in phase 1 is as follows:

- Account for the movement of members valued in prior year*
- Check that increases in service fields are reasonable*
- Check that increases in salary fields are reasonable*
- Reconcile account balances from prior year to current year*
- Reconcile retiree benefit amounts from prior year to current year*
- Check that dates of birth unchanged from prior year*

A sample of the checks performed in phase 2 is as follows:

- Service amounts reasonable relative to hire date field*
- Dates of birth reasonable and consistent with status field*
- Salaries data reasonable*
- Account balances reasonable relative to service and salary fields*
- Disability types consistent with hire date*

Given the size and complexity of the data, we do not seek to resolve every issue for every member. Rather we attempt to ensure that there are no systemic issues that affect the data on a large scale.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Overall, we found PwC’s procedures to be reasonable and appropriate for the scope of the project and consistent with Actuarial Standard of Practice 23 - *Data Quality*.

Data Grouping

As commonly done when conducting valuations of large public employee retirement systems, PwC applies a data grouping process to the individual data records to reduce the number of records that must be run through the valuation program. When grouping data, individual records that contain similar characteristics (age, service, salary, benefit amount, form of payment, etc.) are combined into a “grouped” record that will produce an actuarial liability approximately equal to that of the sum of the individual records. We requested and received a copy of the grouped data from PwC.

We found the process used by PwC to group the data to be generally reasonable and appropriate. However, we did find that in PwC’s grouping process for the active data, the salary for males and females with similar demographic characteristics is averaged together. This averaging produced a \$190 million difference in the allocation of male and female total annual salary in the individual active census data versus the grouped active census data. The differences are shown below for both the DB plan and the Combined plan.

DB Plan	Active Count	Total Annual Salaries on Individual Data	Total Annual Salaries on Grouped Data	Difference
Male	48,500	2,837,339,524	2,649,315,538	(188,023,986)
Female	120,514	6,176,798,333	6,364,822,312	188,023,979
Total	169,014	9,014,137,857	9,014,137,850	(7)

Combined Plan	Active Count	Total Annual Salaries on Individual Data	Total Annual Salaries on Grouped Data	Difference
Male	926	41,416,352	38,655,521	(2,760,831)
Female	3,387	132,008,013	134,768,842	2,760,829
Total	4,313	173,424,365	173,424,363	(2)

PwC indicated that they do process the individual data through their valuation system to assure that their grouping methodology does not bias the liability results significantly. We similarly ran the individual data through our system to determine if this methodology produces reasonable results. Our individual census data valuation run produced liabilities that were approximately 0.06% lower than the grouped data valuation run, which indicates that PwC’s grouping methodology did not bias the liability results of the July 1, 2008 valuation.



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Asset Valuation Method

The asset valuation method is a four-year smoothed market value of assets that spreads the difference between the actual investment income and the expected income (based on the valuation interest rate) over a period of four years. The actuarial value of assets is also limited to a minimum of 91% and a maximum of 109% of market value. We find that this method is reasonable and consistent with the guidance provided in Actuarial Standard of Practice 44 - *Selection and Use of Asset Valuation Methods for Pension Valuations*.

General Observations on Procedures

In this section we discuss several observations that focus on the interrelationships between the procedures, methods and assumptions applied in the valuation, and between the measurement of assets and obligations.

Inactive Members – Refund Only

For inactive members that are only due a refund of their member contributions, PwC is using the sum of the member's contribution account plus the 50% employer matching account as the accrued liability for valuation purposes. Presumably, all of the inactive members due a refund only have less than five years of service and would not receive the 50% matching account. We believe PwC's method may slightly overstate this portion the liability, but feel that it is a reasonable estimate considering these inactive members may not be immediately receiving their refund and have left their contributions in the fund accruing interest. Moreover, some of these members may return to active service in the future.

Inactive Members – Eligible for Annuity

For inactive members eligible for a monthly allowance, PwC assumes that 50% of these members will eventually elect to receive a monthly annuity benefit and that 50% will elect to receive their member's contribution account plus the 50% employer matching account immediately. Without any detailed experience information to suggest otherwise, we feel this is a reasonable approach to determining the liability for these members. But it may be appropriate to consider modifying this assumption so that members who do not request a refund within a few years of termination be considered more likely to ultimately receive a monthly annuity benefit than members who have recently terminated as active members.

SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Money Purchase Benefit

Our understanding is that PwC does not value the Money Purchase Benefit for inactive members eligible for a monthly allowance. Members who terminated active membership many years prior to retirement eligibility may receive a significantly larger benefit under the Money Purchase provision than either the normal formula benefit or the refund of member's contribution account plus the 50% employer matching account. Therefore we suggest that PwC consider modifying their valuation programs so that the Money Purchase Benefit provision is taken into account for inactive members assumed to ultimately receive an annuity benefit.

Disability Allowance Plan

The benefit for currently disabled members in the Disability Allowance Plan converts to a service retirement benefit at age 65. PwC does not reflect this change in their valuation coding. We believe this is a reasonable approach as the cost effect of this change in benefits at age 65 should be de minimis.

Reemployed Retirees

For retirees that are reemployed, PwC is using two times the member's contribution account as the accrued liability for valuation purposes. We believe this is a reasonable approach to determining the liability for these members.

Plan Election – Option to Transfer to DB Plan after 5 Years

STRS allows new members to choose between three plans, the Defined Benefit Plan, the Combined Plan and the Defined Contribution Plan. When members who initially selected the Combined Plan or the DC Plan reach 5 years of service, they must permanently elect to remain in those plans or they will transfer to the Defined Benefit Plan. This chance to reconsider the initial election after 5 years is a valuable option for a member, in that unfavorable investment experience during the initial membership period in the Combined or DC Plan can be expected to encourage the member to move to the DB Plan when they reach 5 years of service.

An option such as this is difficult to measure using traditional actuarial procedures for valuing pension plans. PwC does not currently make any special provision to account for the potential cost. The value of this option to transfer to the DB Plan would be expected to increase during periods of adverse investment market conditions. To roughly test the potential additional liabilities associated with this option, we estimated the potential increase in the unfunded actuarial accrued liabilities if all of the active members in the Combined Plan with less than 5 years of service as of the July 1, 2008



SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

valuation date transferred to the DB plan. We found that the impact would be only a few million dollars of increased liability. Given that, and since less than 100% of these members are likely to transfer, we find that the cost of this option is currently insignificant with respect to the total System's liability.

The potential cost of this option is low in part because relatively few new members join the Combined or DC Plans. In the event that a larger portion of members start to elect coverage in those plans, or a choice to rejoin the DB plan is offered after a greater amount of service has elapsed, it is possible that the cost of this option could become material.

Actuarial Cost Method

Both the pension and retiree healthcare valuations use the entry age actuarial cost method to determine the cost of benefits accrued during the upcoming year (known as the normal cost) plus the value of benefits accrued for all years of past service (known as the accrued liability) as of the valuation date. The normal cost and accrued liability are the basis for determining the Normal Cost Rate and the Accrued Liability Rate. We find that the actuarial cost method used in both the pension and retiree healthcare valuations is reasonable and consistent with the guidance provided in Actuarial Standard of Practice 4 - *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*.

Determination of Contribution Requirements

Pension Plans

The current contribution rates to STRS total 24%, which comprises a 10% member contribution rate and a 14% employer contribution rate. The Board allocates the total contribution rate between pension benefits and health care benefits. Currently, 1% is allocated toward health care, leaving 23% for pension benefits. To determine the remaining funding period for STRS, contributions are first allocated to the Normal Cost, with any remainder allocated to amortize the Unfunded Accrued Liability. Using the remaining rate that is allocated to the Accrued Liability, an effective remaining amortization period can be determined. This is the expected number of years remaining to pay off any unfunded liabilities of the plan. Using the figures provided in the valuation report, we can reproduce PwC's determination of the Accrued Liability Rate of 8.76% and the effective unfunded liability amortization period of 41.2 years.

SECTION II – ACTUARIAL VALUATION METHODS AND PROCEDURES

Although the use of the cost method is sound overall, we believe that the following two adjustments should be made in the calculation of the Normal Cost Rate:

- 1) The numerator used to calculate the Normal Cost Rate is the “dollar normal cost” payable as of the beginning of the plan year. However, since the employer and member contributions are received on a monthly basis throughout the year, these amounts are not all in the fund earning interest as of July 1. We believe that the dollar normal cost in the numerator of the Normal Cost Rate should be increased by one-half of a year's interest to reflect that on average, contributions are received at mid-year.
- 2) The denominator used to calculate the Normal Cost Rate is the expected payroll during the plan year on which contributions will be made. PwC's development of the expected payroll for the upcoming plan year is based on increasing the prior year's annualized salaries by one-half year of payroll growth. This would be appropriate if raises occurred throughout the year, or on average at mid-year. However for a teachers' retirement system, we believe that a more accurate approach would be to increase the prior year's annualized salary by a full year of payroll growth based on the expectation that salary raises occur predominantly at the beginning of the year.

This revised procedure would increase the Normal Cost Rate by 0.24% of payroll. Such an increase in the Normal Cost Rate would decrease the amount of the overall contribution that remains to be allocated to paying down the unfunded liability. Thus it would increase the funding period reported in the Actuarial Valuation by 2.9 years, from 41.2 years to 44.1 years.

Retiree Healthcare Plan

Using the figures provided in the valuation report, we can reproduce PwC's determination of the Accrued Liability Rate of 4.09%. Based on similar reasoning to that described above, we believe the numerator of the Normal Cost Rate should be increased with one-half year of interest at the valuation rate of 4.9% and the denominator of the Normal Cost Rate should be increased with one-half year of payroll growth (4.5% for the 2008-09 plan year, varying rates thereafter).

SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Selection of Actuarial Assumptions

Choosing actuarial assumptions is highly subjective. It is unlikely that any two actuaries, given the same set of experience statistics, would arrive at exactly the same set of actuarial assumptions for any system as complex as STRS. Even allowing for the minor variations that occur because of the variability of the underlying statistics and possible data anomalies, differences among actuarial approaches will occur in analyzing trends. Some actuaries prefer to match the results of recent experience very closely in setting future assumptions, while other actuaries will use recent experience as a guide but tend to change existing assumptions gradually over time. Valid arguments can be made for either approach.

In many cases of statistical analysis, the greater the volume of data analyzed the more reliable the results. This is not necessarily true in evaluating the experience of the members of a retirement system if this involves extending the study over long periods of time. For example, consider mortality experience. Twenty years ago the mortality rates at each age were considerably higher than the corresponding rates of mortality in more recent years. Thus to include the experience of twenty years ago in a mortality study would produce rates of mortality higher than are currently being experienced and can be expected to be experienced in the future. The use of mortality rates from these prior periods could understate life expectancy and, hence, costs.

We will comment on the demographic and the economic assumptions used in the July 1, 2008 valuation and will make suggestions for future experience studies below.

Information Provided

We were provided with copies of:

- a PowerPoint presentation, *Five Year Experience Review July 1, 2003 – June 30, 2008*, dated November 20, 2008 by PricewaterhouseCoopers (“the PwC PowerPoint”); and,
- a report, *Experience Review for the period July 1, 2003 to June 30, 2007*, dated April 7, 2008 by Buck Consultants (“the Buck Report”).

Demographic experience data tabulations for the fiscal year 2007-08 were not included in the actuarial experience data provided to us, although that data was evidently reflected in the PwC PowerPoint. Hence our detailed analysis was primarily based on the 4-years of experience data tabulations as summarized in the Buck Report.

In the PwC PowerPoint and the Buck Report, we found the methodology and analysis to be generally in accordance with common actuarial techniques. In the PwC PowerPoint, only general descriptions of the recommendations by PwC were provided, such as “reduce retirement rates”. So we used the detailed summaries of the new assumptions



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

appearing in the July 1, 2008 actuarial valuation report to evaluate the new assumptions. Of course, the presentation of the PwC PowerPoint undoubtedly included oral comments that we were not privy to.

We suggest future presentations and reports show the effect of the recommendation on the particular assumption being studied. One common method for displaying this effect is to show actual to expected ratios (“A/E ratios”) based on the recommended rates in addition to the current rates. A/E ratios are a common way to display the percentage of actual decrements to the expected decrements. An A/E ratio greater than one indicates that there were more actual decrements than expected and an A/E ratio less than one indicates there were less actual decrements than expected. A/E ratios were displayed for the current assumptions throughout the Buck Report and we suggest, for comparison purposes, such A/E ratios be applied for the recommended new assumptions as well.

Demographic Assumptions

Overview

We found that the general methodologies used to prepare the experience study were appropriate and that the assumptions developed generally comply with the guidance provided by Actuarial Standard of Practice No. 35 *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*.

The ultimate purpose of any actuarial experience study is to provide a basis for setting the actuarial assumptions for future valuations. We are satisfied that the statistical analysis undertaken in the presentation and the resulting recommendations of PWC are reasonable.

Presentation of Results

We found the data tabulations summarized in the Buck Report very helpful in analyzing the results of the experience review, and recommend that PWC present similar summaries of the data tabulations when they prepare the next experience review. As stated earlier, expanding the data tabulations to provide A/E ratios based on the proposed new assumptions would help users better understand the extent of the assumption changes being recommended.

Salary Increases

For the next experience review, we suggest reviewing increases in salaries by length of service rather than solely by age. In our experience, service (possibly combined with age) may be a better indicator of salary increases than solely age. For example, the



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

rate of salary increases provided to members who recently joined the system between ages 40 and 50 may be significantly larger than the increases provide to members the same age who joined 20 or more years ago. Separating long service members from newly hired members when tabulating experience data would allow consideration of this alternative approach for structuring the salary growth assumption. Reflecting the impact of members' service on salary increases may improve the accuracy of the estimated liabilities and cost of the system.

Withdrawal

The withdrawal assumption is split into members terminating prior to completion of 5 years (non-vested terminations) and subsequent to the completion of 5 years (vested terminations). For the next experience review, we suggest tabulating the data into smaller groups to see if there are significantly different rates of termination within each of these categories. For example, terminations among very short service members is often much higher than terminations among members with 3 or 4 years of service. Reflecting such differences, if they exist, in the actuarial assumptions may improve the accuracy of the estimated liabilities and cost of the system.

Annuitant Mortality Assumption

Mortality rates have been decreasing (life expectancy has been increasing) for several centuries, and this trend has continued in recent years. As a result, *ASOP 35 – Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations* and the *Society of Actuaries Retirement Plans Experience Committee* recommend that actuaries make provision in their assumption regarding annuitant mortality for the likelihood of continued improvements in the future. We are concerned that the new mortality assumption for service retirees may not adequately provide for such continuing improvements in mortality.

The Buck Report indicates that there were significantly fewer deaths among service retirees than anticipated by the prior actuarial assumption regarding service retiree mortality. As a result, PWC proposed a new service retiree mortality assumption that significantly reduced the number of expected deaths. As indicated earlier, PWC did not present data in the PwC PowerPoint indicating the A/E ratio (actual to expected ratio) based on the proposed new assumption. So we estimated the A/E ratio for the new service mortality assumption, based on the data shown in the Buck Report. We have summarized below the resulting estimates.



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Estimated Actual to Expected Ratios for the Proposed New Service Retiree Mortality Assumption

Average Age	Males			Females		
	Actual Deaths	Estimated Expected Deaths	A/E Ratio	Actual Deaths	Estimated Expected Deaths	A/E Ratio
55	41	70	59%	44	52	85%
60	170	189	90%	154	185	83%
65	256	304	84%	287	375	77%
70	410	444	92%	397	521	76%
75	647	620	104%	677	730	93%
80	900	787	114%	893	898	100%
85	773	682	113%	1,399	1,237	113%
90	529	472	112%	1,777	1,435	124%
Over 92	312	277	113%	1,938	1,509	129%
Total	4,038	3,844	105%	7,566	6,941	109%

Based on these estimates, we are concerned that the mortality rates among males 75 and under and among females 85 and under may be too high; i.e., they assume that more service retirees will die at these ages than indicated by actual recent experience. Moreover, we believe that the 5-year data is statistically significant since the number of deaths over the entire 5-year experience study period totals roughly 5,000 male deaths and 10,000 female deaths (note, we were not provided data for the fifth year, fiscal 2007-08).

At ages 80 and above among males and 85 and above among females, the proposed new service retiree mortality assumption anticipates fewer deaths than indicated by recent experience, which provides some margin for future improvement in longevity at those ages. But at younger ages, we are concerned that the proposed new assumption may not adequately provide for future life expectancies among young service retirees, nor for current active members who will retire in the future.

In order to estimate the potential impact on the long-term cost of STRS of modifying the service retiree mortality assumption to fully reflect recent experience and to allow for future improvements in mortality, we developed an alternative service mortality assumption. We did so by developing a table that roughly replicated the actual mortality experience summarized in the 4-year Buck Report for each age group, and then used the projection scale AA developed by the *Society of Actuaries Retirement Plans Experience Committee* to make provision for future mortality improvements. (Note we would have preferred to use the experience data for the entire 5-year study period, but we did not receive the final year's data, fiscal 2007-08.)



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Our analysis indicates that the adoption of a modified service retiree mortality assumption that reflects actual recent experience and makes provision for future mortality improvements based on the recommendation of the Society of Actuaries could increase the Unfunded Actuarial Accrued Liability by approximately \$2.3 billion, and the Annual Required Contribution based on a 30-year funding period by approximately 1.64% of payroll.

Disabilities among Active Members

We noticed that the data tabulations shown for the active member disabilities in the Buck Report improperly compared the number of active member disabilities among members with five or more years of service with the number of all active members including those with less than five years of service. PwC confirmed that Buck had made its analysis on that basis. PwC indicates that for 2007-08 it properly compared the number of active member disabilities among members with five or more years of service with the number of active members including only those with five or more years of service. Unfortunately when PwC did the analysis presented in the PwC PowerPoint, they did not recognize the mistake in Buck's tabulations for the four-year period from 2003 to 2007 when they were creating tabulations for the combined 5-year period. As a result, the disability rates among active members are understated by roughly 40%. We believe this is a de minimis issue since disability represents a small amount of the overall liability and since members who would otherwise be projected to exit service due to disability are simply reallocated to another decrement (withdrawal, retirement, death) and benefit therein.

Economic Assumptions

Overview

We found that the general methodologies shown in the PwC PowerPoint and the Buck Report were appropriate and that the assumptions developed generally comply with the guidance provided by Actuarial Standard of Practice No. 27 *Selection of Economic Assumptions for Measuring Pension Obligations*.

Investment Return

Milliman develops long-term capital market expected returns based on current yields and valuation levels, published surveys of expert forecasts of real GDP growth and inflation, and historical risk measures of asset class return volatility and covariance. These capital market assumptions underlie the "building block" method used in our expected return based on the guidance in Actuarial Standard of Practice No. 27 (ASOP27), *Selection of Economic Assumptions for Measuring Pension Obligations*. The building block method in our model considers asset allocation, expected return and



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

variance of each class, and correlation and covariance between asset classes. We then analyze the output ranges and adjust for expected investment expenses in order to arrive at our recommended investment return assumption.

The expected geometric mean return from the building block method does not change based on the compounding period under consideration, however the expected range of results around the mean shrinks significantly as the time frame is increased. The following table shows Milliman's expected 25th, 50th and 75th percentile returns for a 1 year, 20 year and a 75 year period.

Expected Investment Returns for various time horizons prior to reflecting expenses			
	1 year period	20 year period	75 year period
75 th percentile return	16.50%	9.52%	8.58%
50 th percentile return	7.58%	7.58%	7.58%
25 th percentile return	(0.64%)	5.69%	6.60%

The percentile return refers to the likelihood that we expect the actual return over the period to be less than the stated result, for example over a 20 year period we expect that the return will be less than 5.69% in 25 out of 100 cases.

Due to the long-term nature of the pension obligation, we look to the results compounded over a 75 year period to recommend an investment return assumption for valuation purposes. The current 8.0% assumption is in the middle of the third quartile of our results for a 75 year period, and thus we view this assumption as somewhat optimistic over a very long time horizon (e.g. – it is somewhat more likely that investment losses will occur in the future as opposed to investment gains relative to the 8.0% long-term return assumption). We believe that an assumption of 7.5% would better reflect expected investment returns net of plan expenses and provide a more neutral, or unbiased, expectation of future results.

Our analysis indicates that the adoption of a 7.5% net return assumption could increase the Unfunded Actuarial Accrued Liability by approximately \$5.3 billion, and the Annual Required Contribution based on a 30-year funding period by approximately 4.08% of payroll.

OPEB Assumptions

Many of the assumptions used in the pension valuation are also used in the valuation of other postemployment benefits (OPEB). Three additional assumptions used in the January 1, 2009 OPEB valuation are discussed below.



SECTION III – ACTUARIAL VALUATION ASSUMPTIONS

Healthcare Trend

The Society of Actuaries (SOA) has recently developed a Long-Run Medical Cost Trend Model that can be applied in the development of medical trend schedules used in projecting per capita claim costs and premiums in OPEB valuations. The model's baseline projections are based on an econometric analysis of historical US medical expenditures and the judgments of experts in the field, and the model can be modified for the particular plan being valued. We compared the results of the SOA model to trend rates used in the January 1, 2009 OPEB valuation, and find that there is a difference in the shape of the curve (the trend table used by PwC starts higher and grades to the ultimate rate very quickly whereas the SOA trend table starts lower but grades to the ultimate rate much more slowly) but only a minor difference in the cumulative projected cost increases. We believe the trend table applied in the January 1, 2009 OPEB valuation is reasonable and appropriate.

Investment Return

Under GASB 43, the investment return assumption is dependent on the funding of the plan. For OPEB plans that are on a path to full funding via the annual contribution of a GASB-compliant Annual OPEB Cost (AOC), the investment return assumption is based on the asset allocation in the same manner as for a pension fund. For OPEB plans that operate on a pay-as-you-go basis, the investment return is based on the general assets of the plan sponsor. For OPEB plans that are being partially pre-funded (in excess of pay-as-you-go but less than the full AOC), the investment return assumption is blended to reflect the amount of pre-funding occurring.

The “full-funding” assumption used is 8.0%, the same rate for the pension plans. Please see our comments above on this rate. The “pay-as-you-go” rate used is 4.0%, which we believe is a reasonable rate for this purpose. The resulting blended rate of 4.9% based on the partial pre-funding is a reasonable result as well.

Election Rates

Not every member who is receiving a pension benefit will elect to participate in the retiree healthcare plan. We typically expect that election rates will decrease as contributions required of the retiree and/or spouse increase. Due to the recent effective date of GASB 43, the election rate assumption was reviewed at a high-level only. Based on our comparison of current in-pay membership counts in the pension and OPEB plans, we believe that the retiree coverage and the spousal coverage election rates used in the January 1, 2009 valuation are reasonable.



SECTION IV – ACTUARIAL VALUATION REPORT

We have reviewed the July 1, 2008 actuarial valuation report and offer the following suggestions for inclusion in future valuation reports.

Variability of Future Results

Pension plan management is a long-term proposition and the development of actuarial costs and liabilities is dependent upon a combination of the data, plan provisions, actuarial assumptions and actuarial methods employed in the valuation. The actuarial liabilities and costs are not meant to be precise results but rather best estimates that are within a reasonable range of results.

Actuarial Standard of Practice No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions* (“ASOP 4”), addresses this issue in Section 4, *Communications and Disclosures*. Per ASOP 4, actuarial communications should contain statements appropriate for the intended audience that indicate that future actuarial measurements may differ significantly from the current measurement. The following sample communication is provided in Section 4.1(I) of ASOP 4:

“Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan’s funded status); and changes in plan provisions or applicable law.”

We recommend that a similar communication be included in future actuarial valuation reports.

Summary of Plan Provisions

We have reviewed the summary of plan provisions contained in the actuarial valuation report and find that it is consistent with the Revised Code Chapter 3307 governing STRS. The report appropriately and concisely summarizes the many benefit provisions available to STRS members. We suggest that the summary of plan provisions in future valuation reports be expanded slightly to contain a description of the following plan provisions:

- a description of the Money Purchase Plan benefit available to members in the Defined Benefit plan, and
- a description of the Partial Lump Sum Option available to members in the Defined Benefit and Combined Plans.



SECTION IV – ACTUARIAL VALUATION REPORT

Summary of Actuarial Assumptions

We suggest that the summary of actuarial assumptions in future valuation report be expanded to include the following assumptions:

- The retirement rates used for the Combined Plan. The rates used are slightly different than those for the Defined Benefit Plan. The Combined Plan uses the rates for those under 25 years of service for all ages.
- The assumed form of payment election assumptions used for the various benefits for both the Defined Benefit and Combined Plans.
- The assumed number of dependents for the survivor benefit.

SECTION V – PARALLEL VALUATION

Our approach to performing a parallel valuation is two-fold. First, we calculate and compare actuarial calculations for selected individual sample members with those produced by the System actuary. Second, we run the full census data through our valuation software to compare overall valuation results. Below we discuss some important differences between the actuarial valuation programs used by PwC and Milliman, then we present the results of our parallel valuation.

Differences between PwC's and Milliman's Actuarial Software

Both the pension and retiree healthcare valuations use the entry age actuarial cost method to determine annual contribution requirements and the effective unfunded accrued liability funding period. Although actuaries are well versed in the standard actuarial cost methods available, there are differences in interpretation and implementation from firm to firm such that no two actuarial valuation software programs perform calculations exactly the same way. As shown below, the results of our parallel valuation are similar, however there are differences in PwC's and Milliman's software methodology affecting the normal cost and accrued liability calculations that give the appearance of discrepancies that may be misleading. Overall, we are comfortable that while the normal cost and accrued liability calculations produced by PwC's and Milliman's actuarial valuation software differ somewhat, the values produced by PwC are reasonable and comply with relevant actuarial standards. Discussed below are two specific differences in our software systems that make direct comparison of results difficult.

First, PwC's system applies decrements at the beginning of year, meaning that the assumptions used for withdrawal, retirement, disability, etc. are assumed to occur at the beginning of the valuation year. Milliman's system applies decrements at the middle of the year, assuming that participants terminate, retire, die, become disabled, etc. throughout the valuation year (or on average, at mid-year). Both approaches provide a reasonable basis for actuarial calculations and both are generally acceptable practices; the difference is one of "actuarial style." Milliman's actuarial software does not allow us to precisely emulate the beginning-of-year approach used by PwC, so this difference in approaches causes some differences in our results.

Second, the development of the entry age normal cost by each valuation system differs. PwC's system generates a level percentage of pay normal cost for each benefit that accrues only over the time period when that specific benefit could become payable. A simple example is that the liability for a refund of member contributions that occurs for members with less than five years of service is spread over only five years. Thus under PwC's methodology, the normal cost as a percentage of payroll will vary somewhat over the working lifetime of a member. On the other hand, Milliman's valuation system spreads the normal cost for all benefits over the member's entire career - from entry age to the final assumed retirement age. So referring back to the previous example,



SECTION V – PARALLEL VALUATION

Milliman's software would spread the normal cost associated with the refund of member contributions over the entire working career of the member, a much longer period of time for a young employee. Under our approach the normal cost rate as a percentage of payroll will remain constant over the member's working lifetime. Due to this difference in methodology, our valuation systems develop entry age normal costs that differ somewhat. Therefore, the results shown below should not be construed as suggesting an incorrect determination of the normal costs by PwC. We show them only to disclose the results of our attempt to replicate PwC's results. In our judgment, PwC's results are appropriate and reasonable.

Individual Sample Member Liability Calculations

As noted above, our approach involves first attempting to replicate the actuarial calculations for selected individual sample members. This allows us to understand the actuary's valuation programming on a micro basis and enables us to customize our valuation programming to perform similar calculations as much as possible. Unfortunately, PwC did not provide us with detailed individual sample member liability calculations due to the proprietary nature of their calculations. Thus we do not have as detailed an understanding of their calculations as we would prefer. PwC did provide us with total liability results for seven selected members. Based on the results of the full parallel valuation runs set forth below we believe that PwC has appropriately reflected all major benefits available to members of STRS, but since we could not test our calculations in detail at an individual member level it was difficult to determine where our differences might lie.

Full Parallel Valuation Runs - Pension

The following table compares the results of our parallel replication valuation of the Defined Benefit, Combined, and Defined Contribution Plans by various participant groups. PwC's figures are the present values as shown in the valuation report or as otherwise provided to us by PwC. Milliman's figures represent our replication of PwC's numbers using the census data as edited for valuation purposes and provided to us by PwC.

Milliman's figures should not replace the results reported in the Actuarial Valuation. Our calculations are appropriate only for actuarial review purposes and are not suitable for other purposes.

SECTION V – PARALLEL VALUATION

STRS Defined Benefit, Combined and Defined Contribution Plans
Comparison of Present Values as of July 1, 2008
(\$ Amounts in Thousands)

	<u>PwC Valuation</u>	<u>Milliman's Calculation</u>	<u>Percentage Difference</u>
<u>Active Defined Benefit Plan Members</u>			
Number	169,014	169,014	0.0%
Annualized Salaries	\$9,014,138	\$9,014,140	0.0%
Present Value of:			
Benefits	45,520,176	45,926,087	0.9%
Earnings	84,677,935	88,380,476	4.4%
Accrued Liability	33,413,339	32,799,398	-1.8%
Normal Cost Rate	14.23%	15.80%	11.1%
<u>Active Combined Plan Members</u>			
Number	4,313	4,313	0.0%
Annualized Salaries	\$173,424	\$173,424	0.0%
Present Value of:			
Benefits	165,758	159,534	-3.8%
Earnings	2,234,969	2,366,517	5.9%
Accrued Liability	58,083	55,792	-3.9%
Normal Cost Rate	4.96%	4.80%	-3.1%
<u>Inactive Members</u>			
Number	148,559	148,559	0.0%
Present Value of Benefits	\$1,459,523	\$1,451,244	-0.6%
<u>"In Pay" Members</u>			
Number	126,506	126,506	0.0%
Present Value of Benefits	\$51,874,103	\$51,794,267	-0.2%
<u>Reemployed Retirees</u>			
Number	21,467	21,467	0.0%
Present Value of Benefits	\$320,073	\$320,073	0.0%
<u>Defined Contribution Account Balances</u>	\$307,227	N/A*	0.0%
<u>Total</u>			
Present Value of:			
Benefits	\$99,646,860	\$99,958,432 **	0.3%
Accrued Liability	87,432,348	86,728,001 **	-0.8%

* We could not verify the DC account balances for members in the DC plan.

** Includes DC account balances from valuation report



SECTION V – PARALLEL VALUATION

Due to the difference in entry age normal cost development between PwC's and Milliman's valuation software described above, we believe that the best way to look at the results above is how close is our replication of the present value of future benefits (PVB). In total, we could replicate PVB in the valuation report within 0.3%. On subplan basis we only differ on PVB by more than one percent in the determination of the PVB for active Combined Plan members. Since the active Combined Plan PVB is a very small portion of the total PVB (less than 0.2% of total PVB), we did not see the need to investigate this particular difference any further with PwC.

In summary, since differences in actuarial values of 1% or more are possible solely due to differences in the underlying actuarial systems, we view the results above as a successful replication by Milliman of PwC's results.

Full Parallel Valuation Runs – Retiree Healthcare

The following table compares the results of our parallel replication valuation of the Retiree Healthcare Plan by various participant groups. PwC's figures are the present values as shown in the valuation report or as otherwise provided to us by PwC. Milliman's figures represent our replication of PwC's numbers using the census data as edited for valuation purposes and provided to us by PwC.

Milliman's figures should not replace the results reported in the Actuarial Valuation. Our calculations are appropriate only for actuarial review purposes and are not suitable for other purposes.

SECTION V – PARALLEL VALUATION

STRS Retiree Healthcare Plan
Comparison of Present Values as of January 1, 2009
(\$ Amounts in Thousands)

	<u>PwC Valuation</u>	<u>Milliman's Calculation</u>	<u>Percentage Difference</u>
<u>Active Members</u>			
Number	173,327	173,327	0.0%
Projected Membership Payroll	\$10,505,428	\$10,505,428 *	0.0%
Present Value of:			
Benefits	11,754,940	11,908,242	1.3%
Accrued Liability	6,700,202	6,791,655	1.4%
Normal Cost Rate	3.57%	3.86%	8.2%
<u>Inactive Members</u>			
Number	18,300	18,300	0.0%
Present Value of Benefits	\$132,765	\$81,482	-38.6%
<u>"In Pay" Members</u>			
Number	121,639	121,639	0.0%
Present Value of Benefits	\$6,580,756	\$6,279,894	-4.6%
<u>Total</u>			
Present Value of:			
Benefits	\$18,468,461	\$18,269,618	-1.1%
Accrued Liability	13,413,723	13,153,031	-1.9%

* We strictly used PwC's determination of projected membership payroll

As was the case with the pension plans, we believe that the best way to look at the results above is how closely we could replicate PVB. In total, we replicated PVB by within 1.1%. As discussed in the prior section, since differences in actuarial values of 1% or more are possible solely due to differences in the underlying actuarial systems, we view the results above as a successful replication by Milliman of PwC's results.