Teacher Retirement System of Texas

August 31, 2023 Actuarial Valuation

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Janice Ehlert
Senior Pension Advisor
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Re: Actuarial Audit of August 31, 2023 Valuation
Teacher Retirement System of Texas

Dear Members of the Board:

The enclosed report presents the findings from our review of the August 31, 2023 actuarial valuation performed by Gabriel, Roeder, Smith & Company (GRS) for the Teacher Retirement System of Texas (TRS). An overview of our major findings is included in the Executive Summary section of the report. More detailed commentary on our review process is included in the latter sections.

All calculations are based on TRS benefit provisions and the actuarial assumptions adopted by the Board of Trustees. Our actuarial audit uses the same benefit provisions, assumptions and methods as those disclosed in the August 31, 2023 valuation report prepared by GRS. As discussed in our report, we believe the package of actuarial assumptions and methods is reasonable (taking into account the experience of TRS and reasonable expectations for future experience). Nevertheless, the emerging costs will vary from those presented in this report to the extent that actual experience differs from that projected by the actuarial assumptions. Future actuarial measurements may differ significantly from the current measurements presented in this report due to factors such as the following:

- System experience differing from the actuarial assumptions,
- Future changes in the actuarial assumptions,
- Increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as potential additional contribution requirements due to changes in the System's funded status), and
- Changes in the benefit provisions or accounting standards.

Due to the scope of this assignment, we did not perform an analysis of the potential range of such measurements.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by TRS staff. This information includes, but is not limited to, statutory provisions, employee data, and financial information. In our examination of these data, we have found them to be reasonably consistent and comparable with data used for other purposes. Since the actuarial audit results are dependent on the integrity of the data supplied, the results can be expected to differ if the underlying data is incomplete or missing. It should be noted that if any data or other information is inaccurate or incomplete, our calculations may need to be revised.

Our replication of valuation results was developed using models intended for valuations that use standard actuarial techniques. We have reviewed the models, including their inputs, calculations, and outputs for consistency, reasonableness, and appropriateness to the intended purpose and in compliance with generally accepted actuarial practice and relevant actuarial standards of practice. When reviewing the long-term investment return assumption discussed in Section 6, we relied upon a model developed by Milliman colleagues who are credential investment professionals with expertise in capital market modeling.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the Actuarial Standards of Practice promulgated by the Actuarial Standards Board and the applicable Code of Professional Conduct, amplifying Opinions, and supporting Recommendations of the American Academy of Actuaries.

Milliman's work product was prepared exclusively for TRS for a specific and limited purpose. It is a complex, technical analysis that assumes a high level of knowledge concerning TRS operations, and uses TRS data, which Milliman has not audited. It is not for the use or benefit of any third party for any purpose. 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.

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

The signing actuaries are independent of TRS and GRS. We are not aware of any relationship that would impair the objectivity of our work.

We would like to express our appreciation to both the GRS and TRS staff for their assistance in supplying the data and information on which this report is based.

We are members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

We respectfully submit the following report, and we look forward to discussing it with you.

Sincerely,

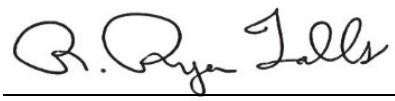

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Table of Contents

1. Summary of the Findings

Purpose and Scope of the Actuarial Audit

In this actuarial audit, we independently calculate the key results from the August 31, 2023 actuarial valuation and review the actuarial assumptions used in the valuation. The purpose of this actuarial audit is to provide an opinion regarding the reasonableness and accuracy of the actuarial assumptions, actuarial cost methods, valuation results, and contribution rates. The following tasks were performed in this actuarial audit:

- An analysis of the appropriateness of the actuarial assumptions;
- A review of the assumptions and methodology of compliance with the funding standards;
- Verification of demographic data;
- Confirmation of the valuation results, including a determination of actuarial accrued liability, normal cost, expected employee contributions, and the effects of any recent legislation;
- Review the actuarial assumptions and methodology for compliance with applicable statutes, TRS' policies, rules and regulations; and for compliance with generally recognized and accepted actuarial principles and practices which are consistent with Actuarial Standards of Practice, the Code of Professional Conduct, Qualifications Standards for Public Statements of Actuarial Opinion of the American Academy of Actuaries, and applicable GASB Statements;
- A determination of the accuracy of funding computations;
- A determination of the appropriateness of recommended employer and employee contribution rates;
- An evaluation of actuarial asset methods;
- An evaluation of the test results and reconciliation of any significant discrepancies between the Contractor's findings, assumptions, methodology, rates, and adjustments and those of TRS's consulting actuary; and
- An assessment of whether the valuation appropriately reflects information required to be disclosed under required reporting standards (GASB, etc.).

Actuarial Audit Conclusion

Based on our review of the census data, experience study documents, liability replications, and actuarial valuation reports, we believe the results of the August 31, 2023 actuarial valuation of TRS are reasonable, based on reasonable assumptions and methods, and the report complies with the Actuarial Standards of Practice.

We offer the following observations and recommendations that we believe could further enhance the actuarial valuations of TRS going forward.

Membership Data

We performed tests on both the raw data supplied by TRS staff and the processed data used by GRS in the valuation. Based on this review, we feel the individual member data used is appropriate and complete. A summary is shown in Exhibit 2-1.

Actuarial Value of Assets

We have reviewed the calculation of the actuarial value of assets used in the August 31, 2023 valuation. We found the calculations to be reasonable and the methodology to be appropriate and in compliance with actuarial standards of practice.

Actuarial Liabilities

Based upon our review of the August 31, 2023 actuarial valuation, we found the valuation results were reasonable based on the data supplied independently by TRS and GRS. The following table shows that our independent calculations are close to those determined by GRS based on the methods and assumptions used in the valuation. Please note that:

- Given the myriad of calculations and differences in actuarial software between firms, we would not expect to match GRS's calculations exactly;
- We found that all significant benefit provisions were accounted for in an accurate manner;
- The actuarial assumptions and methods are being applied correctly; and
- Milliman's total liabilities closely matched those calculated by GRS.

	GRS	Milliman	Ratio of Milliman / GRS
Present Value of Benefits	$ 313.9 billion	$ 311.9 billion	99.4%
Entry Age Accrued Liability	257.5 billion	255.9 billion	99.4%
Entry Age Normal Cost	12.10%	11.97%	98.9%

Funding

We confirmed that the calculations of the Statutory Actuarially Determined Employer Contribution, the Reasonable Actuarially Determined Contribution (Reasonable ADC), and the funding period are reasonable. We also provide some commentary on potential enhancements to the Pension Funding Policy, the discussion of the Funding Period and the Reasonable ADC in the valuation report, and the funding for a system with a fixed contribution rate.

We believe it would enhance the discussion of the TRS financial position by noting the Funding Period based on the market value of assets in the actuarial valuation report, in addition to the period currently shown that is based on the actuarial value of assets.

In order to improve the consistency and transparency of the new calculation of the Reasonable ADC, we encourage GRS to clearly define the level of margin they will add into this calculation when calculating the Reasonable ADC in future years.

Actuarial Assumptions (Economic)

We reviewed the economic assumptions used in the valuation and found them to be consistent with other retirement systems of similar size to TRS. The economic assumptions used in the August 31, 2023 actuarial valuation were adopted based on GRS's Actuarial Experience Study completed in July 2022.

We have the following comments regarding the economic assumptions recommended in the 2022 actuarial experience study:

- Our analysis supports the recommendation to decrease long-term expected rate of return on assets (discount rate) from 7.25% to 7.00%, given TRS's assumptions for inflation and the capital market assumptions used in GRS's analysis. The assumption is also aligned with the expected investment rate of return based on the target asset allocation and the capital market assumptions from Milliman's investment consultants.
- The recommendation to continue the inflation assumption at 2.30% is reasonable based on recent forecasts.
- The recommendation to decrease the total payroll growth assumption from 3.00% to 2.90% is reasonable and supported by historical trends and forecasts.
- The overall package of economic assumptions is reasonable.

Actuarial Assumptions (Demographic)

We completed a high-level review of the valuation assumptions that were adopted based on GRS's 2022 actuarial experience study. Based on this review and our experience working with other large public retirement systems, we believe the demographic assumptions used in the valuation are reasonable. Note that we did not independently replicate the detailed analysis completed by GRS as it was outside the scope of this actuarial audit.

We support the decision to exclude mortality data from fiscal years ending 2020 and 2021 from the analysis of the mortality assumptions to account for abnormal mortality experience during the COVID-19 pandemic.

Reports

GRS's reports meet the applicable Actuarial Standards of Practice. The discussion in Section 8 of this actuarial audit report includes possible enhancements to be considered for future actuarial valuation reports that we believe would improve the overall communication and disclosure. These are possible enhancements to the reporting only and would not impact the results of the actuarial valuation.

2. Membership Data

Audit Conclusion

We performed tests on both the raw data supplied by TRS staff and the processed data used by GRS in the valuation. Based on this review, we feel the individual member data used is appropriate and complete.

Comments

Overall, the data process appears to be thorough and accurate. We would add the following comments:

- **Raw Data:** We were provided with the same data that was given by TRS staff to GRS for use in the actuarial valuation.
- **Completeness:** The data contained all the necessary fields to perform the actuarial valuation.
- **Quality:** Although we did not audit the data at the source, we performed some independent checks to confirm the overall reasonableness of the data. We compared the total retiree and beneficiary benefit amounts on the TRS data with the actual benefit payments made, as reported in TRS's financial statements. We also compared the total active member compensation on the TRS data with the estimated active payroll for the prior year. The payroll for fiscal year end 2023 is consistent with the employee contributions from the Annual Comprehensive Financial Report (ACFR) divided by 8.00%. Based on this analysis, we found the data to be reasonable.
- **Parallel Data Processing:** We performed independent edits on the raw data and then compared our results with the valuation data used by GRS. We found our results to be consistent.

Our results did not match exactly; however, this is understandable since GRS, as the retained actuary, has more extensive data-editing procedures. Overall, each data key component matched closely, and we believe the individual member data used by GRS was appropriate for valuation purposes.

A summary of the data in aggregate is shown in Exhibit 2-1. The "Milliman" column reflects the TRS data after adjustments by Milliman. The "GRS" column reflects the actual data used in GRS's valuation.

In addition to the total statistics, we reviewed individual data and summaries by tier. In our opinion, there was a very close match between the data provided by TRS and the valuation data used by GRS.

Exhibit 2-1
Member Statistics as of August 31, 2023

	GRS	Milliman	Ratio of Milliman / GRS
Retirees			
Total number	489,921	489,860	100.0%
Annual payments	$ 12,349,109,350	$ 12,348,533,830	100.0%
Active			
Total number	953,295	953,285	100.0%
Average age	44.7	44.8	100.2%
Average service	10.3	10.3	100.0%
Average salary	$ 57,102	$ 57,102	100.0%
Inactive			
Total number			
Vested	134,100	134,100	100.0%
Nonvested	424,658	424,658	100.0%
Accumulated contributions			
Vested	$ 5,012,472,668	$ 5,012,472,668	100.0%
Nonvested	1,138,614,072	1,138,612,102	100.0%

Parallel Data Processing Detail

TRS provided Milliman with two data files. The first file was for annuitants. The second file was for people who could become eligible for future benefits, but are not currently receiving benefits (non-annuitants file).

In addition to the files that TRS provided to Milliman, GRS provided Milliman the processed data files containing the final data used in GRS's actuarial valuation. GRS provided an Actives file, a Terms (both vested and non-vested) file, and Retirees file. GRS assigned valuation status to the non-annuitants data based on the TRS-provided census data as follows:

- Employees with an active status in the TRS file and fiscal year end 2023 pay were placed in the GRS Actives file.
- Those without an active status or who did not have fiscal year end 2023 pay in the TRS file were considered to be terminated and placed in the GRS Terms file.

Our analysis showed that approximately 99% of records had the same status between the TRS and GRS files we received.

The GRS Retirees file contained the records in the TRS file for annuitants. GRS excluded members with no further benefits due, such as those with a closed payment status or only a lump sum benefit.

We compared the data in the TRS files to those used by GRS on both an individual and an aggregate level. We found the data to be consistent between the two sets of files. We only compared fields that were directly used in the valuation. Differences on an individual level are to be expected in some records with a plan of this size. We found no differences on an individual level that would have a noticeable effect on the valuation results.

For active members, we compared the following fields: Date of Birth, Sex, Position, Tier, Account Balance, Years of Service, and Salary. Over 99% of all fields for active members matched on an individual level.

For terminated employees, we compared the following fields: Date of Birth, Sex, Position, Tier, Account Balance, Years of Service and Final Average Salary. Over 99% of all fields for terminated members matched on an individual level.

For retired members and beneficiaries, we compared the following fields: Option Code, Date of Retirement, Monthly Benefit, Sex, Date of Birth, Years of Service, Option Factor, Guarantee Expiration Date, and Status (Retired, Beneficiary, or Deceased). Over 99% of all fields for retired members and beneficiaries matched on an individual level.

Our independent edits on the raw data provided by TRS resulted in data consistent with the final data provided by GRS.

3. Actuarial Value of Assets

Actuarial Audit Conclusion

We have reviewed the calculation of the actuarial value of assets (AVA) used in the August 31, 2023 valuation. We found the calculations to be reasonable and the methodology to be appropriate and in compliance with actuarial standards of practice.

Comments

The method used to determine the actuarial value of assets smooths investment gains and losses by reflecting at least 20% of the difference between the market value and the expected actuarial value of assets each year. We believe the use of an asset smoothing method is appropriate, and we generally recommend this to most of our clients. One of the primary benefits of using an asset smoothing method is to reduce the year-to-year contribution rate volatility for systems where the contribution rates are set based on the funded status. While the TRS contribution rate does not change each year based on the actuarial valuation, smoothing is still used for the calculation of the Actuarially Determined Employer Contribution (ADEC), Reasonable Actuarially Determined Contribution (Reasonable ADC), and Unfunded Actuarial Accrued Liability (UAAL) to inform discussions with stakeholders.

For TRS, the AVA is calculated based on the difference between the actual market value of assets (MVA) and the expected AVA each year, based on a projection of the beginning of year AVA. The method recognizes the cumulative returns relative to expectations over a minimum rate of 20% per year. Each year a new base is established that reconciles: (1) the cumulative difference between the expected AVA and the actual MVA, and (2) the deferred bases from prior years. If the current year's base is of the opposite sign to the deferred bases from prior years, then it is offset against the prior deferred bases. Any remaining bases are recognized at a minimum of 20%.

The methodology is subtly different from a more typical five-year asset smoothing method. In our experience, it is more common to calculate gains and losses on a market-value basis, create bases for the actuarial gains or losses, and then recognize those gains or losses over a five-year period. Bases are not typically combined in advance of their recognitions. While the methodology is subtly different, the methodology used by GRS is unbiased in that gains and losses are treated equally and will result in values generally similar to those calculated with other five-year smoothing methods. Further, the offsetting of gains and losses will provide smoother year-to-year values in certain cases and is a method that some of our clients have recently adopted.

As of the August 31, 2023 actuarial valuation, the AVA is higher than the MVA due to unrecognized losses. The AVA is 106.7% of the MVA. When that AVA exceeds the MVA, the investment returns on a market-value basis will need to exceed the assumed rate of 7.00% in order for the AVA to grow at the assumed rate of 7.00%. Table 5b of the actuarial valuation report provides the detailed development of years to fund the Unfunded Actuarial Accrued Liability. In this chart, the AVA is assumed to grow at 7.00% per year, which will require greater than 7.00% growth in the MVA.

We confirmed that the market value of assets, contributions, benefit payments, and administrative expenses used to calculate the AVA on Table 4 of the August 31, 2023 actuarial valuation report are consistent with the amounts shown in the August 31, 2023 Annual Comprehensive Financial Report's (ACFR) Changes in Fiduciary Net Position exhibit.

When a smoothing method is applied, the actuarial value of assets will deviate from the market value of assets. Many public retirement systems apply a corridor; that is, the actuarial value of assets is not allowed to deviate from the market value by more than a certain percentage. The purpose of a corridor is to keep the actuarial value of assets within a reasonable range of the market value. The current asset method does not apply a corridor limiting the actuarial value of assets. Given the fact that any specific base created will be fully recognized over a maximum of five years, we believe it is reasonable not to have a corridor.

The Conference of Consulting Actuaries Public Plans Committee has a paper on model actuarial funding policies which include guidelines for asset smoothing. In our opinion, TRS's method of smoothing with a minimum of 20% recognition, without a corridor, falls in the "Acceptable Practices" category (the second highest level) under these guidelines.

4. Actuarial Liabilities

Actuarial Audit Conclusion

We independently calculated the normal cost and actuarial liabilities of TRS. We found that all significant benefit provisions were accounted for in an accurate manner, the actuarial assumptions and methods are being applied correctly, and that our total liabilities closely matched those calculated by GRS.

Replication Process

We independently calculated the liabilities for all members based on the following:

- **Data:** We used the same data used by GRS in its valuation. As discussed in Section 2, we confirmed that this data was consistent with the data provided by TRS staff.
- **Assumptions:** We used the assumptions disclosed in the August 31, 2023 actuarial valuation report. This information was provided to us electronically by GRS. We confirmed the assumptions were consistent with those adopted based on the recent experience study report.
- **Methods:** We used the actuarial methods disclosed in the August 31, 2023 actuarial valuation report. This was supplemented by discussions between GRS and Milliman on the technical application of these methods.
- **Benefits:** We obtained this information from the TRS website and the relevant law.

We then performed a full replication of the actuarial valuation as of August 31, 2023. Based on our valuation, we completed a detailed comparison of the Present Value of Benefits (PVB), Actuarial Accrued Liability (AAL) and Entry Age Normal Cost (EANC) rates computed in our independent valuation and the amounts reported by GRS. The results for each group were reasonable.

Comments

Note that there will always be differences in the calculated liabilities when different software is used by different actuaries; however, the results should not deviate significantly. Our findings show a high level of consistency between our independent results and the valuation, which should provide assurance that the results of the valuation reasonably reflect the aggregate liabilities of TRS based on the assumptions and methods.

In addition to reviewing the liabilities in total, we also received selected results from a number of individuals included in the valuation. We were able to match closely on these individuals.

We also looked at the normal cost rate (the allocated cost of benefits earned during the year). In the many actuarial audits we have performed, this is typically the area where we see the greatest differences. The overall match was close. Based on these results, we feel that GRS's calculated normal cost rates are reasonable.

Exhibit 4-1
Actuarial Present Value of Future Benefits

(in millions of dollars)

Liabilities by Benefit Type		GRS		Milliman	Ratio of Milliman / GRS
Retirees					
Service Retirement	$	121,228.7		120,451.1	99.4%
Disability Retirement		1,253.1		1,254.4	100.1%
Death Benefits		1,134.4		1,112.7	98.1%
Present Survivor Benefits		372.3		372.2	100.0%
		123,988.5		**123,190.4**	99.4%
Active		**179,676.7**		**178,528.2**	99.4%
Inactive					
Deferred Annuities		7,103.1		7,032.2	99.0%
Refunds		1,138.6		1,138.6	100.0%
Future Survivor Benefits		1,995.8		1,995.3	100.0%
		10,237.5		**10,166.1**	99.3%
Grand Total	**$**	**313,925.0**	**$**	**311,884.6**	99.4%

Exhibit 4-2
Entry Age Accrued Liability (Level % of Salary)

(in millions of dollars)

Liabilities by Benefit Type	GRS	Milliman	Ratio of Milliman / GRS
Retirees			
Service Retirement	$ 121,228.7	120,451.1	99.4%
Disability Retirement	1,253.1	1,254.4	100.1%
Death Benefits	1,134.4	1,112.7	98.1%
Present Survivor Benefits	372.3	372.2	100.0%
	123,988.5	**123,190.4**	99.4%
Active	**123,317.2**	**122,528.7**	99.4%
Inactive			
Deferred Annuities	7,103.1	7,032.2	99.0%
Refunds	1,138.6	1,138.6	100.0%
Future Survivor Benefits	1,995.8	1,995.3	100.0%
	10,237.5	**10,166.1**	99.3%
Grand Total	**$ 257,543.3**	**$ 255,885.2**	99.4%

Exhibit 4-3
Entry Age Normal Cost (Level % of Salary)

Normal Cost	GRS	Milliman	Ratio of Milliman / GRS
Active	**12.10%**	**11.97%**	**98.9%**

5. Funding

Actuarial Audit Conclusion

We confirmed that the calculations of the Statutory Actuarially Determined Employer Contribution, the Reasonable Actuarially Determined Contribution (Reasonable ADC), and the funding period are reasonable. We also provide some commentary on potential improvements to the Pension Funding Policy, the discussion of the Funding Period and the Reasonable ADC in the valuation report, and the funding for a system with a fixed contribution rate.

TRS Board Pension Funding Policy

The TRS Board most recently adopted the Pension Funding Policy on December 2019. The purpose of the Pension Funding Policy is to develop a policy that details a plan for achieving a funded ratio of the system that is equal to or greater than 100 percent. The primary concepts in the Pension Funding Policy are:

- The TRS Board of Trustees supports contribution and benefit policies that will systematically decrease the UAAL over time in order to achieve a funded ratio of the system that is equal to or greater than 100 percent.
- A declining UAAL over time will evidence that contribution and benefit policies are being implemented consistent with achieving a funded ratio of 100%.
- After the phase-in of all scheduled contribution rate increases, if the annual valuation projects that the UAAL will not begin to decline by the fifth year following the valuation, then TRS will request contribution rate increases sufficient to begin to reduce the UAAL as part of the next Legislative Appropriation Request.
- The Board will evaluate methods of financing benefit enhancement proposals for consistency with the goal of a declining UAAL.

This Pension Funding Policy is structured around a simple goal of reducing the UAAL. At the same time, there are certain aspects of the Policy that could theoretically extend the period until the UAAL is reduced and eventually eliminated.

The Reasonable ADC calculated in accordance with this Pension Funding Policy (described more below) is essentially a “tread water” contribution rate that is designed to maintain the current UAAL, especially if it were recalculated and contributed every year. Note that the current State contribution rate is less than this tread water contribution rate. If the State increased the contribution rate to the Reasonable ADC in the first year and maintained the same contribution rate, it would accelerate the elimination of the UAAL compared to the current contribution rate.

Funding Period

The Funding Period for TRS is defined as the expected number of years until the UAAL is expected to be eliminated based on the statutory contributions. Table 5b in the actuarial valuation report presents the calculation of the Funding Period of 29 years as of August 31, 2023. The underlying methodology for Table 5b uses an open group projection of the liability, the current actuarial value of assets, projected contributions, and the current assumed rate of return (7.00%). We were able to replicate this Funding Period calculation as part of the actuarial audit.

The actuarial value to market value is 106.7%, which means there is a deferred loss of $12.5 billion that will be reflected over the next few years. We feel that further consideration should be given to whether actuarial value of assets alone provides an appropriate basis for the calculation of the Funding Period. This circumstance could

lead to a misunderstanding if a stakeholder assumed that the fund's actual return on assets needed to be 7.00% on average throughout the projection period to pay off the unfunded liability over the funding period. In fact, in this situation, the average return of the fund would need to be notably greater than 7.00% on a market value basis over the stated funding period.

The Executive Summary of the valuation report provides the UAAL and Funded Ratio based on the market value of assets (MVA). We believe it would enhance the discussion of the TRS financial position by also noting the Funding Period based on the MVA in the actuarial valuation report. We note that this amount had been included for a period in previous actuarial valuation reports. Based on our estimates, with an assumption of 7.00% earnings each year on a market value basis and contributions equal to the statutory contributions, the Funding Period as of August 31, 2023 based on the MVA was roughly 40 years. This means that based on the current contribution rate the UAAL on a market value basis would be projected to gradually grow in dollar terms each year for the next 20 years before it starts to decrease.

Actuarially Determined Contributions

The retained actuary presents two actuarially determined contribution rates in the 2023 actuarial valuation report. This section of the report will review the calculation of these contribution amounts, review the purpose of these amounts in the actuarial valuation, and discuss the usefulness of these amounts for the TRS Board in their oversight of the pension fund.

As additional context for this section, it is important to note that the Actuarial Standards Board recently adopted updates to Actuarial Standard of Practice No. 4 (ASOP 4) that governs actuarial valuations of defined benefit pension plans. The recent updates included a requirement to present a "Reasonable Actuarially Determined Contribution" as part of the actuarial valuation. Among other requirements, this actuarially determined contribution should be "expected to fully amortize the unfunded actuarial accrued liability within a reasonable time period or reduce the unfunded actuarial accrued liability by a reasonable amount within a sufficiently short period." Recent changes to ASOP 4 were effective for all actuarial valuations with measurement dates after February 15, 2023, so the August 31, 2023 actuarial valuation was the first valuation for TRS where the new standard was effective.

Statutory Actuarially Determined Employer Contribution (Statutory ADEC)

The Statutory ADEC, according to the actuarial valuation report, is the level percentage of payroll contribution that will cover the normal cost and amortize the UAAL over the funding period presented in the valuation, but not less than the contribution rate needed to produce a 30-year funding period.

Prior to the August 31, 2023 actuarial valuation, this was the only actuarially determined contribution that was reported in the actuarial valuation report. Additionally, this Statutory ADEC is calculated to be consistent with Section 821.006 of the Texas Government Code which prohibits the adoption of TRS benefit improvements and contribution reductions while the funding period exceeds 30 years.

The effective statutory State/employer contribution rate for FY2024 is 9.40% of pay (in addition to the 0.08% of pay contribution for rehired retirees) and this rate is scheduled to increase for the last time in FY2025 to 9.46% of pay. These statutory contribution rates produce the Funding Period of 29 years as of August 31, 2023. Coincidentally, a contribution rate of 9.40% of pay (without the scheduled increase) also produces a Funding Period of 29 years and is the Statutory ADEC presented by GRS in the actuarial valuation report. We believe this calculation of the Statutory ADEC is reasonable.

Reasonable Actuarially Determined Contribution (Reasonable ADC)

The Reasonable ADC, according to the actuarial valuation report, is the larger of the actual contribution rate being received or the minimum contribution rate needed to cover normal cost plus interest of the UAAL, thus eliminating

negative amortization. The contribution rate is assumed to change (if necessary) on September 1 following the next legislative session.

The August 31, 2023 actuarial valuation report indicates that the Reasonable ADC is 10.39% of pay, beginning on September 1, 2025, which coincides with the next September 1 following the next legislative session. This Reasonable ADC was presented for the first time in the 2023 actuarial valuation and was an important enhancement to the actuarial valuation because the prior Statutory ADEC would most likely not have satisfied the "reasonable actuarially determined contribution" disclosure requirement of ASOP 4.

Below is an excerpt from a table provided to Milliman by GRS during the actuarial audit that develops the Reasonable ADC of 10.39% of pay. This table is provided in a very similar format to Table 5b in the actuarial valuation report. It should be noted that 18.72% in the table is 8.25% (member rate) plus 0.08% (rehired retirees) plus 10.39% (Reasonable ADC).

As of Aug 31,	Payroll For Next FY	Contribution as % of Payroll	Normal Cost and Admin as % of Payroll	Net Amortization [c - d] * b	UAAL BOY	Interest	Net Principal Contribution e - g	Funding Period
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
2023	$57,785	17.73%	12.24%	$3,172	$57,880	$3,942	($770)	24
2024	59,461	17.79%	12.17%	3,343	58,650	3,990	(647)	23
2025	61,185	18.72%	12.13%	4,034	59,297	4,012	22	22
2026	62,960	18.72%	12.09%	4,176	59,274	4,006	170	21
2027	64,785	18.72%	12.05%	4,321	59,104	3,989	332	20
2028	66,664	18.72%	12.01%	4,470	58,772	3,960	510	19
2029	68,597	18.72%	11.97%	4,629	58,262	3,919	710	18

Source: GRS as part of actuarial audit, amounts in millions

We believe that 10.39% of pay is a reasonable calculation of the Reasonable ADC and it is expected to reduce the UAAL by $22 million from August 31, 2024 to August 31, 2025 which can be considered a "reasonable amount" to reduce the UAAL in accordance with ASOP 4.

We noted that the Reasonable ADC could have been three basis points (or, 0.03% of pay) lower, still satisfied the stated definition of the Reasonable ADC, and resulted in an expected reduction in the UAAL from August 31, 2024 to August 31, 2025 of $3 million. In order to improve the consistency and transparency of this new calculation, we encourage GRS to clearly define the level of margin they will add into this calculation when calculating the Reasonable ADC in future years. For example, will the Reasonable ADC always be three basis points more than the minimum calculated rate, will the Reasonable ADC be the rate that produces an expected reduction in the UAAL of at least $20 million, etc.? Every basis point in the Reasonable ADC represents an additional $6 million of additional contributions that will potentially be included in the next Legislative Appropriation Request.

Note that the contribution rate required to prevent the UAAL from growing on a market value basis would be 11.94%, when combined with the 8.25% member contribution rate and the 0.08% amount for rehired retirees, for a total of 20.27% of pay being contributed.

Contribution Adequacy

The primary inputs to whether a system's fixed-rate contributions are adequate over the long term are as follows:

- Governance structure for adjusting the fixed rate
- Whether the assumed rate of return is reasonable given the system's target asset allocation

- Actuarial Cost Method (i.e., Entry Age)
- Benefit policy

A necessary ingredient for proper governance of a fixed-rate system is the acknowledgement that the "fixed" rate is not truly fixed. Adjustments may need to be made periodically if the system is to be funded adequately. A better name could be a "sticky" rate system in that the rate does not automatically change every year, but rather remains stable until circumstances warrant a change.

One fundamental equation applies for any retirement system no matter if it is maintained by an employer, an individual, or a government for all its citizens. It applies to defined contribution plans, defined benefit plans, and hybrids. The contributions (C) combined with investment income (I) into the system must ultimately equal the benefit payments (B) and expenses (E) paid out of the system. This results in the equation of C + I = B + E.

In a defined benefit program, "B" is typically defined for each member. A retirement system should be designed to meet the obligations of the benefits that have been promised to employees. For large public defined benefit systems, the "E" portion of the equation is typically very small relative to benefits and generally cannot be easily altered in a meaningful way. The "I" for investment income is variable and unknown in advance, so with B and E difficult to change, the C portion of the equation, contributions, will generally need to be adjusted in order for the equation to balance when investment income fluctuates. For this reason, the system's contribution rate will likely not be truly fixed over the long run. The contribution rate needs be able to adjust if the system's funding becomes inadequate.

We comment on the reasonableness of the assumed rate of return, as well as other economic assumptions, in the Actuarial Assumptions (Economic) section of this report.

For fixed-rate systems, we have found that long-term sustainability is promoted through some combination of the following best practices:

- Seek a cushion above a 100% funded ratio before making permanent increases to benefit levels.
- Do not automatically reduce contribution rates when favorable experience emerges.
- Consider de-risking measures once funding targets are met.
- Take swift action when conditions change dramatically, but do not overreact to every minor change.

Ultimately, contributing sponsors and employees alike benefit from the ability to budget for a stable contribution rate.

Actuarial Cost Method

TRS uses the Entry Age Actuarial Cost Method. We agree that it is appropriate for valuing the costs and liabilities of TRS and is the cost method that we usually recommend.

Purpose of a Cost Method: The purpose of any cost method is to allocate the cost of future benefits to specific time periods. Most public plans follow one of a group of generally accepted funding methods, which allocate the cost over the members' working years. In this way, benefits are financed during the time in which services are provided.

Most Common Public Plan Cost Method (Entry Age): The most common cost method used by public plans is the Entry Age Actuarial Cost Method. The focus of the Entry Age Cost Method is the level allocation of costs over the member's working lifetime. For a public plan, this means current taxpayers are expected to pay their fair share of the pensions of the public employees who are currently providing services. Current taxpayers are not expected to pay for services received by a past generation, nor are they expected to pay for the services that will be received by a future generation. The cost method does not anticipate increases or decreases in allocated costs.

According to the Public Plans Database, over 90% of the retirement systems surveyed were using the Entry Age Actuarial Cost Method for their FY2022 actuarial valuations. We believe that the use of this cost method is reasonable.

For GASB Statements No. 67 and No. 68, the Entry Age Actuarial Cost Method is the only permissible cost method for financial reporting purposes.

6. Actuarial Assumptions (Economic)

Actuarial Audit Conclusion

We reviewed the economic assumptions used in the valuation and found them to be reasonable. The economic assumptions used were adopted based on GRS's Actuarial Experience Study completed in July 2022.

We have the following comments regarding the economic assumptions in the 2022 experience study:

- Our analysis supports the recommendation to decrease long-term expected rate of return on assets (discount rate) from 7.25% to 7.00%, given TRS's assumptions for inflation and the capital market assumptions used in GRS's analysis.
- The recommendation to maintain the inflation assumption at 2.30% is reasonable based on recent forecasts..
- The recommendation to decrease the total payroll growth assumption from 3.00% to 2.90% is reasonable and supported by historical trends and forecasts.
- The overall package of economic assumptions is in line with what we recommend to our retained clients.

The purpose of the actuarial valuation is to analyze the resources needed to meet the current and future obligations of the System. To provide the best estimate of the long-term funded status of the System, the actuarial valuation should be predicated on methods and assumptions that will estimate the future obligations of the System in a reasonable manner.

An actuarial valuation uses various methods and two different types of assumptions: economic and demographic. Economic assumptions are related to the general economy and its long-term impact on the System, or to the operation of the System itself. Demographic assumptions are based on the emergence of the specific experience of the System's members. This section of the report will focus on the economic assumptions. The next section will address the demographic assumptions.

Actuarial Standard of Practice No. 27: Selection of Economic Assumptions

The Actuarial Standards Board has adopted Actuarial Standard of Practice (ASOP) No. 27, Selection of Economic Assumptions for Measuring Pension Obligations. The most recent version of the standard was effective August 1, 2021. The standard provides guidance to actuaries giving advice on selecting economic assumptions for measuring obligations under defined benefit plans, such as TRS.

Note that in 2023, the Actuarial Standards Board approved an exposure draft of a revision to ASOP 27. That draft combined economic and demographic assumptions. When the proposed revision to ASOP 27 is adopted, it is expected that there will be a single standard for pension assumptions and ASOP No. 35 (Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations) will be repealed.

As the future is unknown, the best an actuary can do is to use professional judgment to estimate possible future outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment. The actuary should consider a number of factors, including the purpose and nature of the measurement, and appropriate recent and long-term historical economic data. ASOP 27 explicitly advises the actuary not to give undue weight to recent experience.

Each economic assumption should individually satisfy ASOP 27. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period.

After completing the selection process, the actuary should review the set of economic assumptions for consistency. This may entail the actuary using the same inflation component in each of the economic assumptions selected.

An actuary's estimate with respect to a particular measurement of pension obligations may change from time to time due to changing conditions or emerging plan experiences. Even if assumptions are not changed, we believe that the actuary should be satisfied that each of the economic assumptions selected for a particular measurement complies with Actuarial Standard of Practice No. 27, unless that assumption has been prescribed by someone with the authority to do so.

Economic Assumptions

Based on the information and economic environment present as of the date of GRS's analysis, we believe the economic assumptions used by GRS in the August 31, 2023 actuarial valuation are reasonable. We believe that the recommendation in the 2022 actuarial experience study to lower the investment rate of return assumption to 7.00% was an appropriate recommendation.

The Board should be aware that the measured liabilities and normal cost are directly impacted by these important assumptions. The most critical assumption in determining the present value of benefits is the total investment return assumption.

In our opinion, the package of economic assumptions recommended in the 2022 actuarial experience study is reasonable. The following portion of this report discusses four of the key economic assumptions (inflation, general wage inflation, payroll increase assumption and investment rate of return).

Inflation

Use in the Valuation: Inflation, as referred to here, means price inflation. The inflation assumption has an indirect impact on the results of the actuarial valuation through the development of the assumptions for investment return and wage growth.

There is expected to be a long-term relationship between inflation and the investment return assumption. The basic principle is that the investors demand a "real return" – the excess of actual investment returns over inflation. If inflation rates are expected to be high, investors will demand expected investment returns that are also expected to be high enough to exceed inflation, while lower inflation rates will result in lower demanded expected investment returns, at least in the long run.

Historical Perspective: There are numerous ways to review historical data, with significantly differing results. GRS points to this by showing many different lengths of historical period for the national Consumer Price Index, US City Average, All Urban Consumers (CPI-U) as published by the Bureau of Labor Statistics, ending with August 31, 2021, the end date of the experience study period. Inflation has averaged more than 2.3% on an annualized basis since August 31, 2021; however, we do not believe adding the experience of the last two years would meaningfully change the historical perspective.

Forecasts of Inflation: In addition to the historical information GRS provided, GRS discussed forecasts from investment consulting firms, the Social Security administration, survey data, and the stated policy of the Federal Reserve.

Another forecast for consideration is what financial markets anticipate. The U.S. Treasury issues inflation indexed bonds (TIPS), making it possible to determine the approximate rate of inflation anticipated by the financial markets by comparing the yields on inflation indexed bonds with traditional fixed government bonds. As of February 2024, market prices suggested investors expected inflation to be about 2.30% over the next 20 years and 2.20% over the next 30 years. It should be noted that the implied inflation forecasts as of the actuarial valuation date of August 31, 2023 were very similar. This lends more support to the 2.30% assumption.

Peer System Comparison: Although assumptions should not be set based on what other systems are doing, it is informative to see how TRS compares.

According to the Public Plans database (a survey of approximately 200 large municipal and statewide systems), the average inflation assumption for the systems in the database has been steadily declining. As of 2022, the average assumption was 2.52% and 2.50% was the median and most common assumption.

Conclusion: We believe that a 2.30% assumption is reasonable for an actuarial valuation of a retirement system.

General Wage Inflation

Use in the Valuation: Estimates of future salaries are based on two types of assumptions. Rates of increase in the general wage level of the membership are directly related to inflation, while individual salary increases due to promotion and longevity (referred to as the merit scale) occur even in the absence of inflation. This section will address the general wage inflation assumption (inflation plus productivity increases). The merit, promotion, and longevity increase assumption is discussed in Section 7 of this report (demographic assumptions).

On page 1 of the 2022 experience study report, GRS states that the general wage inflation assumption is 0.60% above the inflation rate of 2.30%. This meant an assumption of 2.90% for the August 31, 2023 actuarial valuation report. This growth includes increases in wages due to productivity. Note that the ultimate salary increase assumption for long-service employees is 2.95%, reflecting a total productivity, merit, and promotion component of 0.65%.

Historical Perspective: As with inflation, historical measures for general wage inflation vary widely depending upon the data source, consideration of mean vs. median, and how far back it is measured. We have used statistics from the Social Security Administration on the National Average Wage. Using this data implies real wage growth of about 0.6% over the past 50 years.

Forecasts for Future Wage Growth: Wage inflation has been projected by the Office of the Chief Actuary of the Social Security Administration. In the 2023 Trustees Report, the long-term ultimate annual increase in the National Average Wage was estimated to be 1.14% higher than the Social Security intermediate ultimate inflation assumption of 2.40% per year.

Conclusion: We believe that the current estimate of 0.60% is a reasonable estimate of future real wage growth.

Payroll Increase Assumption

The payroll growth assumption is important because it establishes how fast the payroll and resulting contributions are expected to increase each year in the future in the development of the years to fund the Unfunded Actuarial Accrued Liability (i.e., the Funding Period). The current payroll increase assumption is equal to the general wage inflation assumption of 2.90%, reflecting 2.30% for inflation. We typically set the payroll increase assumption equal to the general wage inflation assumption, unless there is a specific circumstance that would call for an alternative assumption. Therefore, we agree with this assumption.

GRS provides important sensitivity information on this assumption on Table 5a of the actuarial valuation report by providing the Funding Period based on four levels of future payroll growth.

Investment Return (Discount Rate)

Use in the Valuation: The investment return assumption is one of the primary determinants in the calculation of the required contribution levels for TRS's benefits, providing a discount of the estimated future benefit payments to reflect the time value of money. This assumption has a direct impact on the calculations of actuarial accrued liabilities, normal cost rate, and the actuarially determined contributions.

The discount rate is the rate used to discount future benefit payments into an actuarial present value. The traditional actuarial approach used for public sector funding sets the discount rate equal to the expected investment return. Under current standards set by the GASB, the "discount rate" should reflect the long-term expected rate of return on pension fund investments to the extent that the pension fund's assets are expected to be sufficient to pay benefits.

The recent recommendation for the net investment return assumption of 7.00% per year includes two components: (1) inflation of 2.30%, and (2) a net real rate of return equal to 4.70%. This approach of splitting the net return into separate pieces is called the "building block" method.

GRS's Approach to Long-term Expected Investment Return: The Board elected to decrease the investment return assumption from 7.25% in the 2021 actuarial valuation to 7.00% for the 2022 actuarial valuation.

To develop an analytical basis for assessing the investment return assumption, GRS used long-term assumptions developed by Aon (TRS's investment consultant). GRS used Aon's capital market assumptions team for each of the asset classes in which the fund is invested based on the current target asset allocation. Each asset class assumption is based on a consistent set of underlying assumptions, including an inflation assumption. These assumptions are not based on historical returns, but instead are based on a forward-looking capital market economic model.

Based on the target allocation and Aon's investment return assumptions for each of the asset classes, the 50th percentile geometric annual return was 6.90% over a ten-year horizon and 7.23% over a 30-year horizon. We agree that the geometric annual return is the appropriate measure. GRS studied the capital market assumptions from 12 additional independent sources and found lower results for the ten-year horizon and similar results over 30 years. This is a reasonable approach and similar to what we typically use in our analyses.

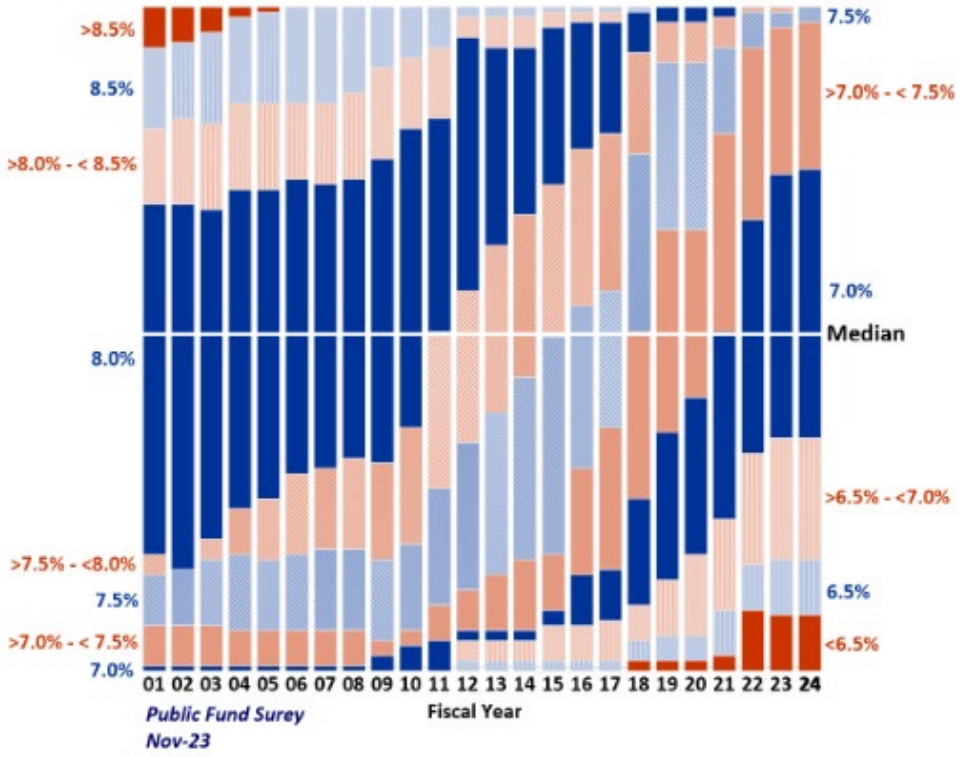
Milliman's Capital Market Assumptions: To develop an analytical basis for independently assessing the investment return assumption, we compared the 7.00% assumption to the long-term assumptions developed by Milliman's capital market assumptions team. The team developed assumptions for each of the asset classes in which the plan is invested based on the current target asset allocation in TRS's Investment Policy Statement effective October 1, 2023. Each asset class assumption is based on a consistent set of underlying assumptions, including the inflation assumption. These assumptions are not based on historical returns, but instead are based on a forward-looking capital market economic model.

Note that the target asset allocation in the Investment Policy Statement effective October 1, 2023 is different than the one studied in the 2022 experience study. It is important to review the investment return assumption every year and this is particularly so when the target asset allocation is modified.

Based on the target allocation and Milliman investment return assumptions for each of the asset classes, our 50th percentile average annual return in Milliman's capital market model was 6.98% over a ten-year horizon as of June 30, 2023 and 6.99% over a ten-year horizon as of December 31, 2023.

Assumptions Used by Other Systems: To provide some additional perspective on this assumption, the chart below shows the assumptions used by over 120 of the largest US public sector systems in a regularly updated survey published by the National Association of State Retirement Administrators (NASRA). As can be seen from the chart, the trend over time has been for systems to lower their investment return assumptions. The median investment return assumption for fiscal year 2023 was 7.00%, the most common was 7.00%, and the average was 6.93%.

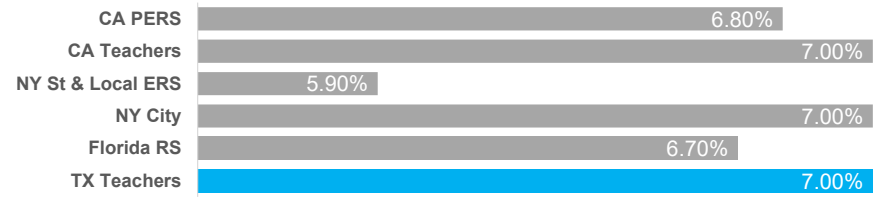
NASRA Public Fund Survey



Jumbo System Comparison: In addition to looking at 120 large systems, we compared TRS's assumption to those of other jumbo systems. As with the broader survey, there is a significant downward trend over time with these very large systems.

Assumptions in 2010:

Assumptions in 2023:



Conclusion: We find the 7.00% expected return assumption is reasonable for funding and financial reporting purposes.

7. Actuarial Assumptions (Demographic)

Actuarial Audit Conclusion

We completed a high-level review of the valuation assumptions that were adopted based on GRS's 2022 actuarial experience study. Based on this review, we believe the demographic assumptions used in the valuation are reasonable. Note that we did not independently replicate the detailed analysis completed by GRS as it was outside the scope of this actuarial audit.

Overview of Actuarial Experience Studies

Actuarial experience studies of demographic experience involve a detailed comparison of actual and expected experience. If the actual experience differs significantly from the overall expected results, or if the actual pattern does not follow the expected pattern, new assumptions are considered. Recommended revisions normally are not an exact representation of the experience during the observation period. Judgment is required to predict future experience from past trends and current evidence, including a determination of the amount of weight to assign to the most recent experience.

In an experience study, the actuary first determines the number of actual occurrences (i.e., deaths, terminations, retirements, etc.) that occurred during the experience period. Then the actuary determines the number that were expected to occur, based on the current actuarial assumptions. A comparison of the "actual occurrences" to the "expected occurrences" can determine the appropriateness of a particular assumption and is generally referred to as a "headcount-weighted" experience analysis. Selecting an assumption based on a headcount-weighed analysis is consistent with determining the *expected number of occurrences* in the actuarial valuation.

An actuary can enhance the "headcount-weighted" analysis by considering an "amount-weighted" experience analysis. An amount-weighted analysis will generally use an amount that is relevant to the plan, such as benefits or liabilities, to "weight" the occurrences reviewed as part of the analysis. By weighting the data, the actuary gives more weight to members who have larger benefits (and thus have larger liabilities). The Retirement Plans Experience Committee (RPEC) of the Society of Actuaries has found that retirees with larger benefits tend to have lower morality than similarly situated retirees with smaller benefits. Our experience has supported that finding. Selecting an assumption based on an amount-weighted analysis is consistent with *minimizing actuarial gains and losses* associated with a particular assumption in the actuarial valuation.

We noted that GRS used an "amount-weighted" approach when analyzing most of the assumptions in the most recent experience study. We believe this is an appropriate approach because it minimizes the unexpected changes in the UAAL in the actuarial valuation. GRS may want to consider expanding the discussion of each assumption in the experience study report to also provide the actual number of occurrences observed during the experience period. Even though the "amount-weighted" method is preferred for setting the assumption, the actual number of occurrences can provide more context to the magnitude and scope of each assumption included in the study.

We did not independently perform the detailed calculations of the actual and expected rates by GRS, but we reviewed the assumptions based on our experience with similar systems.

Actuarial Standard of Practice No. 35: Selection of Demographic Assumptions

Actuarial Standard of Practice No. 35 (ASOP 35) governs the selection of demographic and other noneconomic assumptions for measuring pension obligations. ASOP 35 states that the actuary should use professional judgment to estimate possible future outcomes based on past experience and future expectations, and select assumptions based upon application of that professional judgment. The actuary should select reasonable demographic assumptions in light of the particular characteristics of the defined benefit plan that is the subject of the measurement. A reasonable assumption is one that is expected to appropriately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period.

Note that in 2023, the Actuarial Standards Board approved an exposure draft of a revision to ASOP 27. That draft combined economic and demographic assumptions. When the proposed revision to ASOP 27 is adopted, it is expected that there will be a single assumption standard for pensions and ASOP No. 35 (Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations) will be repealed; however, this change is not expected to affect the guidance included in the standard.

Post-Retirement Mortality

Mortality rates are used to project the length of time benefits will be paid to current and future retirees and beneficiaries. The selection of a mortality assumption affects plan liabilities because the estimated value of retiree benefits depends on how long the benefit payments are expected to continue. There are clear differences in the mortality rates by gender, job categorization, non-annuitant versus annuitant, and non-disabled versus disabled retired members.

Note that GRS excluded data from fiscal years ending 2020 and 2021 from its analysis. We support the decision to exclude that data due to the COVID-19 pandemic. There is reason to believe that those two years were anomalous with respect to mortality and not predictive of future mortality.

The Retirement Plans Experience Committee (RPEC) of the Society of Actuaries published a study in October 2023 regarding mortality. Based on data from the Centers for Disease Control and Prevention (CDC), the RPEC published actual-to-expected death ratios (A/E ratios) by gender and age bands by year for the periods between April 2020 through June 2023. Here are the results for Ages 65 and above:

Total A/E Ratios by Year and Gender for the United States for ages 65 and above:

Year	Females	Males
2020[1]	120.9%	123.5%
2021	111.6%	115.2%
2022	107.8%	108.2%
2023[2]	99.3%	98.9%

As can be seen in the table above, mortality was significantly higher than previously projected for 2020-22, but has returned to approximate long-term expectations in 2023. In addition, the excess mortality was not spread uniformly throughout the country, making it difficult to isolate the impact of COVID-19.

We reviewed GRS results for the probability of death for healthy and disabled retired members outside of the pandemic years and found them to be reasonable. We note that the updated tables recommended in the 2022 actuarial experience study resulted in slightly longer life expectancies for current retirees in the August 31, 2023 actuarial valuation than those implied by the assumptions used for the August 31, 2022 actuarial valuation.

The RPEC issued the “Pub-2010” family of static base mortality tables in 2019. The 2010 in the title refers to the central year of collected study data. These are the first tables published by the RPEC based solely on public sector experience. The RPEC created separate tables for public safety, teachers, and general employees. Teachers have longer life expectancies than the other two categories of these tables for both females and males.

[1] *Beginning April 1, 2020.*

[2] *Ending June 30, 2023*

Mortality Improvement Scale

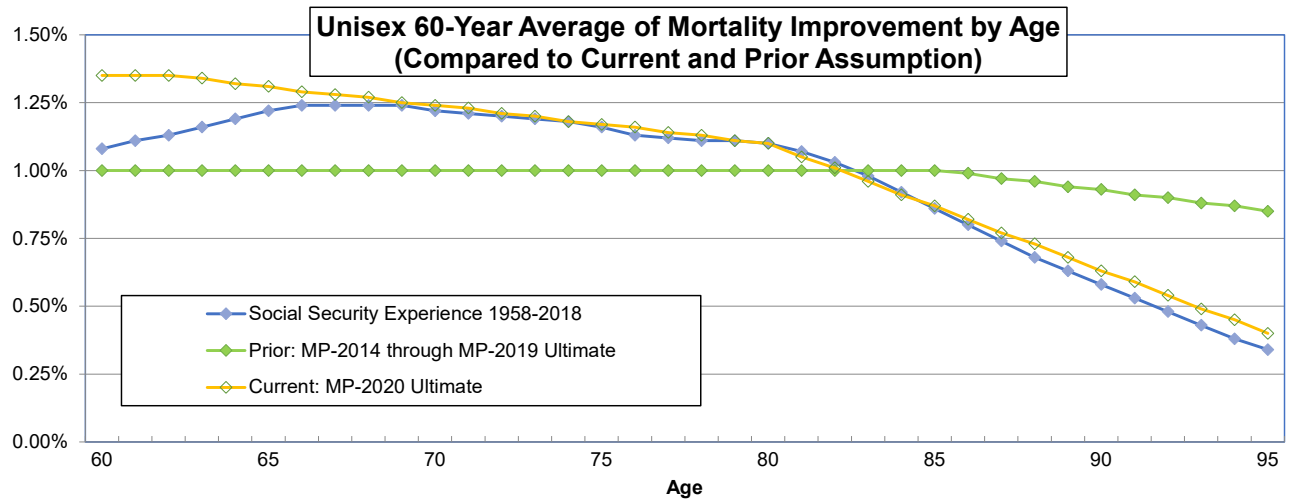
It is difficult to predict how much future mortality will improve compared to mortality today. The Society of Actuaries (SoA) has created very precise projections of mortality improvement in "MP" tables that were updated each year from 2014 through 2021. The valuation uses the ultimate mortality improvement rates from the MP-2020 table, a variation of the tables created by the SoA. While the annual updates made by the SoA may be reasonable, the precision can cause volatility in the annual calculations of contribution rates and actuarial liabilities if updated tables are used each year. The SoA's calculations feature a two-dimensional assumption to allow for varying improvements by age and calendar year. We do not believe that the additional complexity of those tables leads to a materially better prediction of life expectancies in the context of pension funding.

In our opinion, the improvement scale used in the valuation will serve to reduce volatility from changes in the mortality improvement assumption, and therefore lead to more stable long-term pension funding and liability calculations, while providing a reasonable estimate of the long-term pension liability in accordance with the Actuarial Standards of Practice (ASOPs). We have recommended a similar approach to mortality improvement to many of our public sector clients.

The SoA's tables have short-term and long-term components to them, sometimes called a select and ultimate period. The short-term numbers have changed each year that the tables have been produced and also vary by male and female. The "ultimate" (after the select period that varies by year) projection scales were unchanged from MP-2014 through MP-2019 and used unisex (combined male and female) rates. Prior to the 2022 experience study, GRS used the ultimate rates that did not change from 2014 through 2019.

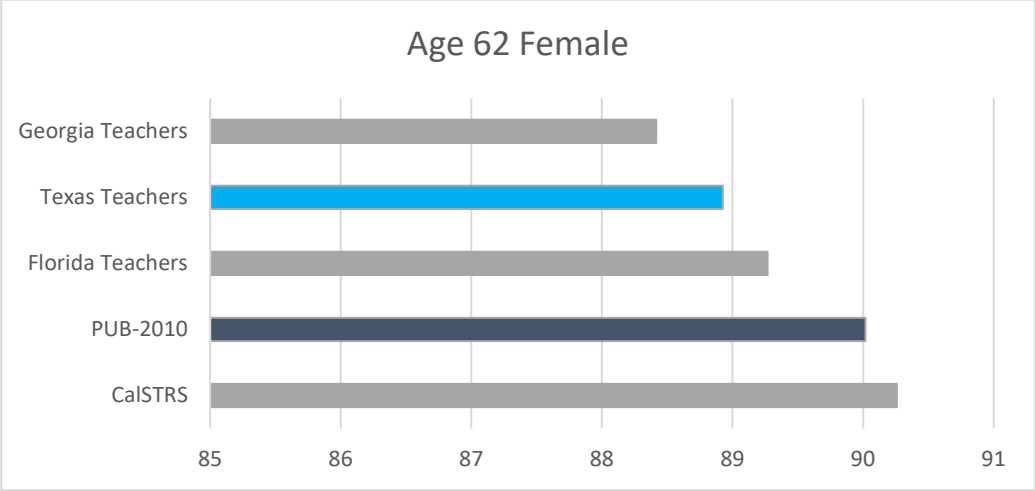
With the 2022 experience study, GRS recommended a move to the ultimate scale from MP-2020. As indicated in the experience study, this change did result in more variety in the improvement by age, but did not result in significantly different measured liabilities for the system. We believe that it makes sense to update to MP-2020 both because it was the most recent table at the time the experience study was published and it is a better match for data from the Social Security Administration (SSA) website.

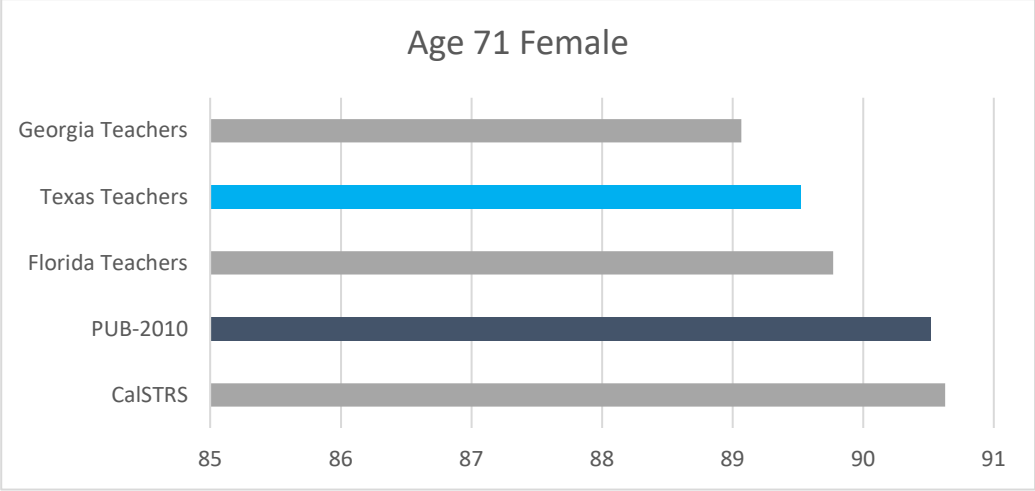
The SSA provides historical rates of death since 1900. From that data, Milliman calculated historical mortality improvement. The chart below shows the unisex average rates of mortality improvement by age from the SSA data for the 60-year period ending 2018. It compares that data to the improvement scales used by GRS prior to the 2022 experience study and afterwards. The following data is compiled on a unisex basis. As can be seen in the chart below, the new mortality improvement assumption is a much better match to the SSA data for ages 65 and older.



Post-Retirement Mortality – Life Expectancy Comparison

We also compared TRS's mortality rates with those from other teacher retirement systems and found them to be reasonably consistent with the assumptions used in those other systems. The graph shows the expected lifetime (represented by average projected age at death) for a TRS female (light blue bar) along with other retirement systems (grey bars). We also included the base life expectancy under the Pub-2010 Teacher's mortality table for healthy retired females (dark blue bar). We applied the most recent projection scale (MP-2021) from the RPEC to the Pub-2010 table for purposes of this example.





The graph shows that for members retiring today, TRS has life expectancies similar to other large teacher systems in the southern United States.

Merit, Promotion, and Longevity Salary Increases

We reviewed the individual salary increase assumptions due to merit (longevity and promotion). These increases are in addition to the assumed increases due to general wage inflation. For TRS, the general wage inflation is assumed to equal 2.90% based on CPI plus 0.60% for real wage growth. GRS assumes that members with more than 25 years of service will receive nominal increases equal to 2.95% per year, an ultimate increase of 0.65% above inflation.

We looked at the magnitude of the assumed increases and they are in line with what we have seen with other systems.

Even though a salary increase assumption may be reasonable for future salary increases, actual pay increases can be significantly impacted from one year to the next based on outside factors such as the availability of funds in the most recent budget cycle for the employer. As a result, the actual salary increases can have a notable impact on the actuarial accrued liability for the active members. For example, GRS noted in the valuation report that the UAAL increased by approximately $2 billion more than expected because of higher-than-expected salary increases for continuing active employees. It is important to note that higher than expected salary increases will increase the UAAL, but they will also increase the contributions that the plan is expected to receive. For a plan with a fixed contribution rate like TRS, the increase in the UAAL and the increase in the future expected contributions largely offset each other in the calculation of the Funding Period. In other words, significant differences between expected and actual salary increases will generally not have a major impact on the period of time until the plan is expected to be fully-funded.

In total, we believe that the assumptions for merit salary increases are reasonable and consistent with the results of the experience study.

Rates of Service Retirement

We reviewed the rates of service retirement. The current assumptions vary by age and are separate for early retirement and normal retirement. There is also an increased retirement rate upon first reaching unreduced retirement eligibility for those in Tier 3 or Tier 5. There is a higher retirement factor tied to how long after rule of 80 the member attains unreduced eligibility. This serves to make retirement when first attaining unreduced retirement more likely for those with more service at that age, and this makes intuitive sense, as the longer service employees will have a higher income replacement.

Retirement decisions are very dependent upon benefit provisions, making comparisons to other systems less meaningful than it is for other demographic assumptions. The service retirement assumptions used by GRS appear to be aligned with experience where available. Note that retirement rates are hard to predict for new tiers, since there is generally no relevant experience on which to base the assumptions.

Rates of Disability Retirement

We reviewed the rates of disability retirement. The current assumptions start lower and increase with age. The low probabilities (relative to termination and service retirement) are supported by the data, and based on GRS's analysis, the disability assumptions appear reasonable.

Rates of Termination (Refund and Vested Termination)

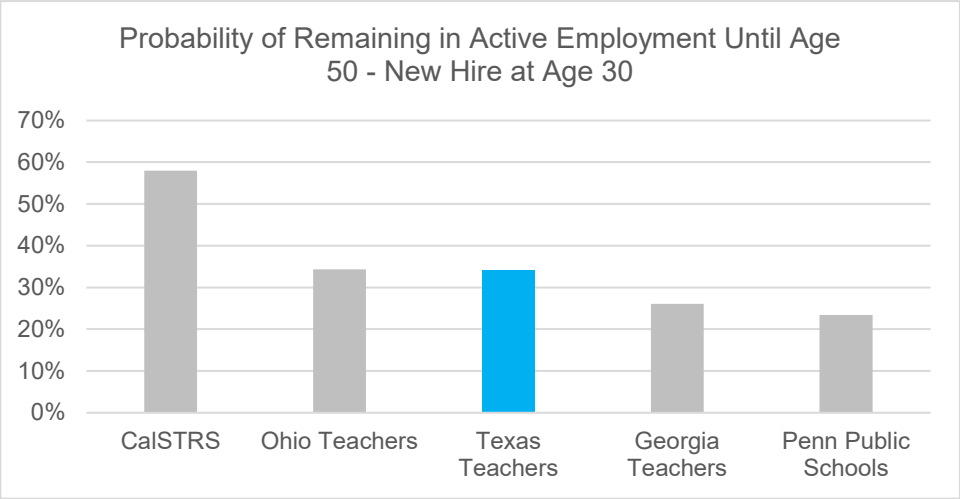
We reviewed the rates of termination of employment. The current assumption varies by length of service and length of time until unreduced retirement. We agree that these factors are generally the most significant in projecting termination rates. With the 2022 experience study, GRS recommended a change to unisex termination rates where they previously had been sex distinct. The data appeared to support that change and we have seen that with other systems.

GRS uses an assumption that no terminations take place after eligibility for unreduced retirement. We agree that such terminations are rare and that this is a reasonable assumption.

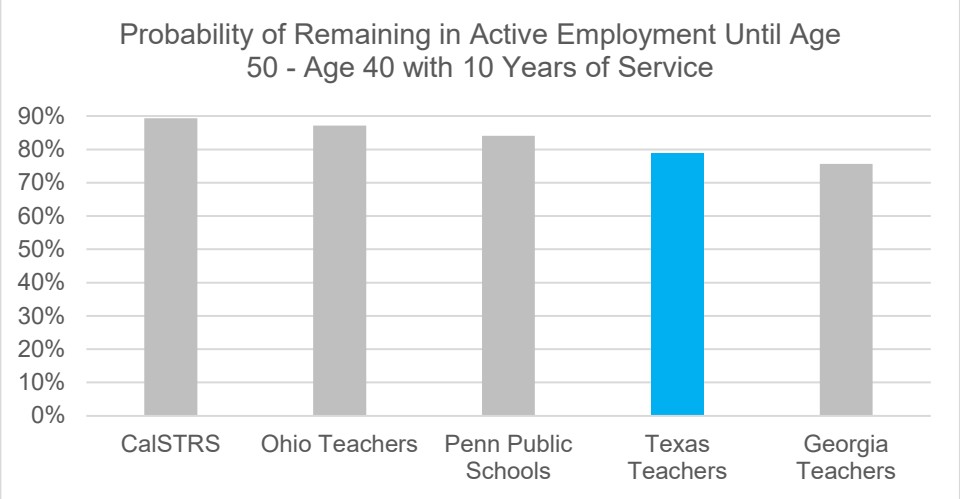
Based on GRS's analysis, the termination rates are aligned with actual experience, and the assumptions appear reasonable. GRS assumes that the member will take the more valuable of a refund of contributions or the deferred annuity option upon terminating employment. This is somewhat conservative (more likely to result in future actuarial gains than losses) but is aligned with intuition and it is an assumption we use for some of our clients.

We compared TRS's termination rates for Tier 5 with those from other large teacher systems and found them to be reasonably consistent. Because some systems base this assumption on service only and some by a combination of age and service, comparing among systems can pose some issues. In addition, termination rates are affected by the specific benefit provisions of the retirement system. To best compare, we used two sample members, both hired at age 30. For one of the sample members, we assumed no current service, and for the other we assumed 10 years of current service. For both, we compared the probability of remaining employed to age 50 (first eligibility for retirement for some retirement systems).

The results for new hires are as follows:



The results for members with 10 years of service are as follows:



Timing of People Leaving Employment

GRS applies an assumption that active members in the data file at the beginning of year who terminate employment prior to retirement do so at the beginning of the year, that people who retire from the system do so at the end of the year, and that those members leaving employment through death and disability leave throughout the year.

GRS explains that it receives two data files, one for retirees and one for active members (and inactive members not retired). Most of the retirements and turnover occur in the summer and all service is earned in whole years. Members who retire in a given summer are typically moved from the active data file to the retiree data file, meaning that there will be few retirements until the following summer. In the active data file, GRS only knows whether or not the member earned a year of service in the fiscal year that just ended. Therefore, if someone is going to terminate employment prior to retirement and before the next valuation, it will likely happen in the summer immediately prior to the valuation date. The assumed termination rate used at the beginning of the first year of employment is zero.

In our experience, this timing assumption is unusual, but it is very sensible given the manner in which the data files are provided and the turnover patterns for school systems. We do not recommend any change in this methodology but do recommend that GRS discuss its rationale in the experience study or in the actuarial valuation report.

8. GRS Reports

Actuarial Audit Conclusion

ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, and ASOP No. 41, *Actuarial Communications*, provide guidance for measuring pension obligations and communicating the results. These Standards list specific elements to be included, either directly or by references to prior communication, in pension actuarial communications. The GRS reports meet the applicable Standards. We have included possible enhancements to be considered for future actuarial valuation reports that we believe would improve the overall communication and disclosure. These are possible enhancements to the communication only and would not impact the results of the valuation.

Comments

Following our review of the GRS actuarial valuation report, we have the following comments and possible enhancements for future actuarial valuation reports:

Certification Letter

The *Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States* define a "Statement of Actuarial Opinion" as an opinion expressed by an actuary who is subject to the *Code of Professional Conduct* by virtue of membership in a U.S.-based actuarial organization, where such opinion is expressed in the course of performing Actuarial Services and intended by that actuary to be relied upon by the person or organization to which the opinion is addressed. We believe it would be clearer that this requirement is satisfied if it was stated in the second paragraph of the Certification Letter of future actuarial valuation reports that Joseph Newton of GRS is qualified to give a "Statement of Actuarial Opinion" (which we believe he is).

In the middle of page 2 of the Certification Letter, the valuation report references the Pension Funding Policy by highlighting the statements with quotation marks and italics. The stated concepts are consistent with the Pension Funding Policy, but these statements are not direct quotes. For clarity, we recommend that GRS either update future actuarial valuation reports to provide direct quotes from the Pension Funding Policy or remove the quotation marks and italics.

On the bottom of page 2 of the Certification Letter, the valuation report refers to the "financing objectives of the Statute". We recommend clarifying which Statute is being referenced by this statement in future actuarial valuation reports, because it may not be clear to every reader of the valuation report.

On the top of page 3 of the Certification Letter, the valuation report states: "a contribution rate increase of 0.93% of payroll is necessary beginning in Fiscal Year 2025 for the UAAL to be expected to begin decreasing". Following correspondence during the actuarial audit, GRS indicated that this contribution rate increase is consistent with the calculation of the Reasonable ADC and that there is a typo in the statement. As a result, we believe that the stated contribution rate is correct, but the statement of the timing should be updated in the next actuarial valuation report to refer to Fiscal Year 2026.

Low-Default-Risk Obligation Measure

The discussion of the Low-Default-Risk Obligation Measure (LDROM) in the 2023 actuarial valuation report is a new disclosure resulting from the updated guidance in ASOP 4.

The discussion in the valuation report clearly states that the measurement date, actuarial cost method and assumptions used to calculate the LDROM are the same as for the funding valuation unless otherwise noted. GRS confirmed this procedure in correspondence during the actuarial audit. However, the measurement itself is labeled as "LDROM measure of benefits earned as of the measurement date". This label suggests that the

method used to calculate the LDROM only considered accrued benefits for plan members. To avoid any confusion about how the LDROM was calculated, we recommend that GRS consider changing the label for the LDROM to be more consistent with the methods used to calculate the amount.

We also have comments regarding GRS's description of the LDROM. GRS states that "The traditional model based on expected portfolio returns expects lower costs but with higher risk, which creates less certainty and a possibility of higher costs. The LDROM model creates higher expected costs but more predictability when compared to the traditional model."

We encourage GRS to define more clearly what is meant by "traditional model", "LDROM model" and "costs". We believe that when referencing "the traditional model", GRS is referencing the idea of investing in a diversified portfolio and discounting based on expected portfolio returns. This manner of investing decreases expected contributions but with higher risk by creating less certainty in future investment returns and a possibility of higher contributions in the future. We believe GRS is referencing investing in low-default-risk investments when referencing "the LDROM model". This approach to investing results in lower expected investment returns and higher expected contributions, but more predictability when compared to investments in a diversified portfolio.

It should be noted that neither a model nor an asset allocation is expected to directly impact the level of benefits paid.

The 5.15% discount rate that GRS used to calculate the LDROM was based on the intermediate FTSE Pension Liability Index as of August 31, 2023. We believe that GRS's use of the FTSE index is reasonable and in compliance with actuarial standards of practice, but we note that the FTSE index can be expected to change every month and that the LDROM will tend to be significantly more volatile than the "traditional model" that is based on an investment rate of return assumption that typically does not change on an annual basis. Over the past four years, the index GRS is using has been as low as 2.31% and as high as 6.01%. Over that same period, the investment rate of return assumption has been either 7.25% or 7.00%, a much narrower range. Note the type of volatility seen is not specific to the FTSE Index but would be present in other low-default-risk measures.

Development of Years to Fund the Unfunded Actuarial Accrued Liability (Table 5a)

Table 5a of the actuarial valuation report presents many of the key results from the actuarial valuation, including the Funding Period of 29 years based on the valuation assumption that the total payroll grows at 2.90% per year. This payroll growth assumption is important because it establishes how fast the payroll and resulting contributions are expected to increase each year in the future.

GRS enhanced Table 5a by also providing the funding period based on three additional levels of future payroll growth. We agree with GRS's approach as these additional results provide helpful insights into sensitivity of the Funding Period to the rate at which the payroll grows in the future.

Presentation of Trend Tables

The actuarial valuation report includes many tables that are intended to present the historical or future anticipated trends from year to year. In most of these tables, the data is presented with the earliest year at the top of the table and the year increasing at the table progresses down the page. We noted that Table 11b and Table 14a are presented with the latest year at the top of the table and the year decreasing at the table progresses down the page. In order to improve the readability and consistency of the trend tables presented in the actuarial valuation report, we recommend that these tables be updated so that all of the tables present the trend information in a similar sequential manner.

Summary of Benefit Provisions of the Retirement Fund (Appendix 1)

A common theme throughout the TRS benefits handbook and other system literature is the concept of "tiers." The GRS report does not define the tiers, but we believe defining them could clarify the communication. For instance, GRS discloses early retirement assumptions and factors that determine the amount of benefits payable prior to normal retirement. To enhance clarity of the valuation report, we would recommend that early retirement assumptions and factors, as well as other benefit provisions, be disclosed by tier.

Actuarial Assumptions and Methods (Appendix 2)

The description of the mortality assumptions indicates that the mortality rates are projected on a fully generational basis by the long-term rates of the scale "UMP 2021". Based on a review of the experience study report, it is clear that GRS is using the ultimate rates of the most recently published MP projection scale. However, the abbreviation used in the actuarial valuation report is not a generally accepted abbreviation of the underlying assumption table. To clarify the description of the assumption in the actuarial valuation report, we recommend clearly stating the name of the mortality projection table and how it is used in the actuarial valuation.

The Rates of Disability Retirement are adjusted when a member is eligible for Rule of 80 but are not yet eligible for unreduced retirement. To clarify description of the assumption in the actuarial valuation report, we recommend clarifying that the stated rates are adjusted by adding 1% to the rates.

The GRS actuarial valuation software can only incorporate a maximum age of 74 when calculating the plan liability for active and inactive members (i.e., all plan members except annuitants). As a result, an active or inactive plan member that is over age 74 is assumed to be age 74 for purposes of calculating the plan liability. This procedure is reasonable and should not have a material impact on the actuarial valuation results. However, we recommend stating the assumption that all active and inactive members are included in the actuarial valuation with a maximum age of 74.

The experience study report describes an assumption titled "Average Survivor Benefit Liability" but this assumption is not stated in the actuarial valuation report. If this assumption is utilized in the actuarial valuation report then we recommend including this assumption in description of the assumptions in the actuarial valuation report.

Definition of Terms (Glossary)

The Glossary includes a definition for Actuarial Value of Assets that does not directly align with the method used in the actuarial valuation. For consistency, we encourage GRS to review the definition of Actuarial Value of Assets in the Glossary to ensure that the definition is consistent with the other descriptions of Actuarial Value of Assets throughout the valuation report.