# Legislative Council Staff Pension Review Commission

Evaluation of the economic, non-economic, and investment assumptions used to model Colorado PERA's financial situation, as required by Senate Bill 18-200

September 1, 2021

**GRS**

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Legislative Council Staff Pension Review Commission
State of Colorado

**Subject:** **Evaluation of the economic, non-economic, and investment assumptions used to model Colorado PERA's financial situation, as required by Senate Bill 18-200**

**To whom it may concern:**

Gabriel, Roeder, Smith & Company (GRS) has performed an evaluation of the economic, non-economic, and investment assumptions used to model Colorado Public Employee Retirement Association's (PERA) financial situation, as required by Senate Bill 18-200. This report includes a review of the economic and non-economic, and investment assumptions within the context of:

- the Analysis of Actuarial Experience during the Period January 1, 2016 through December 31, 2019;
- the Experience Investigation for the Four-Year Period Ending December 31, 2015;
- the Actuarial Valuation as of December 31, 2020; and the
- Signal Light Analysis based on the Actuarial Valuation as of December 31, 2020.

We have evaluated these assumptions with a particular focus as to whether or not PERA is on track to achieve full funding by 2048. We wish to thank the staff of the Pension Review Commission, PERA and Segal, without whose willing cooperation this review could not have been completed.

*Certification*

All of our work conforms with generally accepted actuarial principles and practices, and to the Actuarial Standards of Practice issued by the Actuarial Standards Board. In our opinion, our calculations also comply with the requirements of Colorado state law and, where applicable, the Internal Revenue Code and ERISA.

The undersigned are independent actuaries and consultants. Joseph Newton and Dana Woolfrey are Enrolled Actuaries and are Members of the American Academy of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries. Finally, all of the undersigned are experienced in performing valuations for large public retirement systems.

Sincerely,

Gabriel, Roeder, Smith & Company

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Pension Market Leader

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# SECTION 1

## EXECUTIVE SUMMARY

# Executive Summary

Gabriel, Roeder, Smith & Company was engaged by the Colorado Legislative Council Staff (LCS) to review economic, non-economic, and investment assumptions used to model PERA's financial situation, as required by Senate Bill 18-200. In particular, GRS has reviewed the assumptions used in the most recent actuarial results as of December 31, 2020. Our findings are presented within the context of our charges from the Scope of Study.

- *An analysis of the validity and appropriateness of the actuarial methods and assumptions adopted by the PERA Board that are used in the actuarial valuations of the financial situation of the Hybrid DB Plan.*
- *Identifying deviations in actuarial methods and assumptions that have resulted in the existing Hybrid DB Plan terms and provisions no longer meeting targets and achieving sustainability that could indicate that assumptions should be changed.*
- *Recommendations for any adjustments that should be considered with respect to the assumptions used to model PERA's financial situation.*
- *An analysis of the calculated normal costs that will cover current pension benefits and the share of contributions going to cover the unfunded liability of PERA.*

GRS finds that many of the key assumptions used in the actuarial valuation are reasonable and appropriate. However, GRS will demonstrate in the Assumption and Method Review section that there are some ongoing concerns with the retirement and termination assumptions as well as the methods used to recognize liabilities associated with the accrual of liabilities for members hired during the year following the valuation (referred to as "new hires"). GRS recommends that the timing of the next experience study be accelerated to 2022 with special attention being paid to these concerns.

- *An analysis of whether or not PERA is on track to achieve full funding by 2048, including the likelihood of achieving full funding, and, if not, recommendations for corrective actions.*

GRS finds the probability of PERA achieving full funding to be in the range of 51%-59%, depending on the starting asset value used.

- *Recommendations about the necessity of continuing the direct distribution to PERA pursuant to Section 24-51-414, C.R.S.*

GRS finds it absolutely necessary to continue the annual $225 million. Discontinuing this amount will increase the number of scenarios needing the maximum contributions and benefit reductions allowed under SB18-200 and further reduce the probability of achieving full funding stated above.

- *Recommendations about the enhancements that PERA could make to the annual analysis that it conducts pursuant to Senate Bill 14-214 to determine whether its model assumptions are meeting targets and achieving sustainability.*

GRS finds the annual analysis prepared by PERA to be thorough and to go beyond most similar reports for peer systems. However, we find the report would be enhanced by a more declarative statement on the objectives laid out in Senate Bill 18-200 and whether or not PERA is on track to meet those objectives.

The report would also benefit from a multiple year gain/loss analysis to display the reliability of the current assumptions and anticipate possible future changes to those assumptions.

- *Any other recommendations the subcommittee could make to PERA regarding assumptions, funding policy, reporting practices, or other operational policies.*

We recommend current and future amortization layers to have the same December 31, 2047 end date as the large original amortization base in order to increase the probability of achieving full funding by the targeted year of 2048. This would be appropriate to continue until the period for new gains and losses is in the range of 15-20 years, at which point continuing to shorten the period would be expected to generate significant volatility.

GRS Recommendations

- Request from PERA for the currently scheduled 2024 Experience Study be accelerated into 2022, for use in the December 31, 2022 Valuation. With emphasis on
  - The withdrawal assumption
  - The retirement assumption and possible other factors that are producing the annual actuarial losses from this source
  - Treatment of new entrants in the determination of the ADC and in projections
- Request PERA shorten amortization periods used for future layers to align with the goal of reaching full funding by 2048.
- Request the signal light report include a historical reconciliation of gains/losses by source.
- Request the valuation and signal light report include a clearer statement, towards the front of the report, on the main goal(s) of the funding policy and the progress towards achieving those goal(s).
- Request more consistent messaging/definitions of the "funding period", especially being distinct from the amortization period.

# SECTION 2

## REVIEW OF ASSUMPTIONS, METHODS AND DELIVERABLES

# Review of Assumptions

Segal performed an experience study for the four-year ending December 31, 2019 in 2020. Cavanaugh MacDonald Consulting performed an experience study for the period ending December 31, 2015 in 2016. GRS has evaluated the current assumption set based on the information provided in those reports, taking into account not only the information during the last four-year period, but also trends from one experience study to the next. Although GRS has reviewed all assumptions, we have limited commentary to those assumptions with a material impact on contribution rates.

## ECONOMIC ASSUMPTIONS

### Inflation

Economic assumptions are normally defined by an underlying inflation assumption. The current assumption is 2.30%. Based on current forecasts and expectations, we find this assumption to be reasonable.

### Investment Return Assumption

The investment return assumption is comprised of price inflation (2.30%) and real rate of return (4.95%) for a total nominal investment return assumption of 7.25%. GRS evaluated the investment return assumption within the context of the timeframe of the experience study (fall of 2020). Segal used the 2020 Horizon Survey with the PERA asset allocation using the 20-year horizon capital market assumptions to determine a median expected return of 5.10% which supported use of the 4.95% assumption. We find this to be reasonable within the context of the study.

Although we find it to be reasonable within the context of the study, we do observe real return expectations among investment firms have continued to decline since the experience study was performed.

Although there are expected to be downward pressures on the forward-looking market value return expectations, as of the December 31, 2020 valuation report there were substantial deferred investment gains that will put upward pressure on the actuarial or smoothed investment return. In addition, at the time of this report, the market value returns during 2021 were well in excess of the 7.25% assumed return. Based on the data as of December 31, 2020, the plan could earn in the neighborhood of 6.00% market returns over the next decade and still not produce actuarial losses from investment performance as the current UAAL and ADC are based on the smoothed value of assets.

### Member Pay Increase Assumption

The individual salary increase assumption consists of three pieces:
- Price inflation
- Productivity
- Merit and Promotion

We agree with the methodology Segal used to isolate the individual salary increase components, and find this to be the preferable method. In general, the actual merit increases for the most recent study period were greater than previously assumed. The recommended changes moved the assumption less than

halfway between the old assumption and observed experience.  However, given that Cavanaugh MacDonald did not isolate the merit component, it is difficult to know whether this was an ongoing trend.  Given that salary increases sometimes ebb and flow in such a way that long-term trends cannot be identified from four years of data, the recommendation was not unreasonable, but may be a source of further adjustment in a future experience study.

**Payroll Growth**

The payroll growth assumption is important in determining the amount of reliance on future payroll for contributions to help finance the unfunded liability.  A higher payroll growth assumption places more reliance on future payroll vs. current payroll.  In the 2020 Experience Study, the payroll growth assumption was lowered from 3.5% to 3.0%, reducing the amount of reliance on future contributory payroll.  This change was supported by the evidence presented, and we agree with this change.

### DEMOGRAPHIC ASSUMPTIONS

**Experience Study Concepts**

*A/E Ratio*
In looking at plan demographic experience, actuaries frequently develop an "**actual to expected ratio**" or "**A/E ratio**".  For example, the expected number of terminations based on the assumption as compared to the actual number of terminations at a given age or service level.  An actual to expected ratio of 100% would suggest that the assumption was perfectly on target.  An actual to expected of more than 100% would suggest that more terminations occurred than expected and vice versa.

*Amount Weighted vs. Counts Weighted Experience*
We find sometimes that the actual to expected ratio by count can be spot on, but the plan continues to experience gains or losses.  This can be because there are different experience patterns underlying the low and high paid members or because there can be service-related dependencies in age-based assumptions.  The highly paid and higher service members will tend to drive the plan experience as they contribute more to the overall plan liabilities.  Actuaries have found that using amount-weighted (where the amount can be pay, benefit amount, liability or some other metric) is often better at reducing sources of ongoing gain or loss than counts weighted analysis.

*Partial Credibility*
Giving full credibility means setting the recommended assumption based 100% on the observed data, basically the proposed assumption *is* the observed rates.  Giving partial credibility means moving part of the way between the current assumption and the observed data.  Partial credibility is a frequently used technique and is designed to consider that the observed data may be anomalous.  Generally, the amount of credibility reflects the size of the data set (more data = more credible).

For example, a current assumption (presumably based on previous data) was 8% and the data from the new experience study shows 10% to be the actual pattern.  High levels of credibility would set the new proposed assumptions closer to the 10% and low credibility would stay closer to the 8%.

| Previous Assumption | New Observed/Actual Data | New Assumption with 25% Credibility | New Assumption with 50% Credibility | New Assumption with 100% Credibility |
|---|---|---|---|---|
| 8% | 10% | 8.5% | 9.0% | 10% |

**Mortality**

Segal used benefit and credibility weighted experience to determine multipliers based on the PUB 2010 tables (public sector-based tables published by the SOA in 2019). Segal also implemented generational mortality based on a recent mortality improvement scale. This was a much-needed improvement over the prior static methodology and the assumptions appear reasonable based on the data.

**Other Demographic Assumptions and Methods Within a Broader Context**

GRS finds that both mortality and pay increases were appropriately dealt with over the course of the last two experience studies. We find that consideration of both the 2016 and the 2020 experience study is key to assessing the remaining pieces of the demographic assumption set.

Consider first the 2012 through 2015 experience of the School Fund used in making assumption recommendations as part of the 2016 experience study. The exhibit below shows the liability gains and losses associated with different assumptions. A loss indicates that the costs associated with a particular assumption were underestimated for that year and a gain indicates that the costs associated with a particular assumption were overestimated. If an assumption is unbiased, we would expect that over time there would be both gains and losses and these amounts would average out to $0 over time. However, during this time period, PERA realized persistent significant losses associated with the retirement and termination assumptions and persistent significant losses associated with new hire liabilities that were not accounted for during the year. If we aggregate the average losses over the four-year period that are not associated with mortality and pay increases, we find that these remaining demographic items have an average annual loss of 6.0% of payroll. This means that in order to not have had accrued these losses in the UAAL, the actual contributions into PERA would have needed to be 6% of payroll higher during the year. The same exercise for the State Fund produces an average annual loss associated with the remaining demographic items of 5.8% of payroll.

School, $ in millions

| Decrement | Actuarial Valuation as of December 31, | | | | | Average as a % of Payroll |
|---|---|---|---|---|---|---|
| | **2015** | **2014** | **2013** | **2012** | **Average** | |
| Age/Service Retirements | ($75) | ($101) | ($47) | ($31) | ($63) | -1.4% |
| Disability Retirements | (9) | (9) | (8) | 5 | (5) | -0.1% |
| Deaths | (63) | (69) | (58) | (31) | (55) | -1.2% |
| Withdrawals | (114) | (125) | (89) | (81) | (102) | -2.2% |
| Pay Increases | 23 | 61 | 145 | 249 | 119 | 2.6% |
| New Hires | (64) | (62) | (89) | (61) | (69) | -1.5% |
| Other | 16 | 37 | 10 | (3) | 15 | 0.3% |
| Total Gain/(Loss) | **($286)** | **($267)** | **($136)** | **$47** | **($161)** | **-4.0%** |
| Payroll | $4,235 | $4,063 | $3,939 | $3,819 | $4,014 | |
| Total Gain/(Loss) as a % of Payroll | **-6.7%** | **-6.6%** | **-3.4%** | **1.2%** | **-4.0%** | |
| | | | | | | |
| Ret/Dis/Withdrawal/New Hires $ | ($261) | ($296) | ($233) | ($168) | ($240) | |
| | | | | | | |
| Ret/Dis/Withdrawal/New Hires % of Pay | -6.2% | -7.3% | -5.9% | -4.4% | **-6.0%** | |

This leads us to expect that the experience study in 2016 would have resulted in recommendations that significantly increased expected costs associated with these assumptions. However, if we look at the impact to the Actuarially Determined Contributions (ADC), the changes to these assumptions results in a reduction of 0.3% for the School Fund ADC and 0.4% for the State Fund ADC. Thus, we would expect that these 2016 assumption changes did not address the persistent demographic losses and that future losses on the order of 6% of pay would continue for these funds.

| | | School | State |
|---|---|---|---|
| 1 | Ret/Dis/Withdrawal/New Hires % of Pay | 6.0% | 5.5% |
| 2 | Change in ADC in 2016 Experience Study from these Sources | -0.4% | -0.3% |
| 3 | Probable Continuing Bias as a % of Payroll (1-2) | 6.4% | 5.8% |

The experience during 2016 through 2019 confirmed this expectation. Annual School Fund liability losses were 6.7% of payroll and State Fund liability losses were 6.0% of payroll.

School, $ in millions

| Decrement | Actuarial Valuation as of December 31, | | | | | Average as a % of Payroll |
|---|---|---|---|---|---|---|
| | **2019** | **2018** | **2017** | **2016** | **Average** | |
| Age/Service Retirements | ($49) | ($97) | ($112) | ($68) | ($82) | -1.7% |
| Disability Retirements | (6) | (5) | (8) | (8) | (7) | -0.1% |
| Deaths | (7) | (71) | (5) | (72) | (39) | -0.8% |
| Withdrawals | (143) | (61) | (163) | (136) | (126) | -2.7% |
| Pay Increases | (301) | (85) | 118 | 210 | (14) | -0.3% |
| New Hires | (99) | (108) | (99) | (86) | (98) | -2.1% |
| Other | (30) | (249) | (46) | (47) | (93) | -2.0% |
| Total Gain/(Loss) | **($635)** | **($676)** | **($314)** | **($207)** | **($458)** | **-9.8%** |
| Payroll | $5,104 | $4,790 | $4,471 | $4,349 | $4,679 | |
| Total Gain/(Loss) as a % of Payroll | **-12.4%** | **-14.1%** | **-7.0%** | **-4.8%** | **-9.8%** | |
| | | | | | | |
| Ret/Dis/Withdrawal/New Hires $ | ($298) | ($270) | ($381) | ($299) | ($312) | |
| Ret/Dis/Withdrawal/New Hires % of Pay | -5.8% | -5.6% | -8.5% | -6.9% | **-6.7%** | |

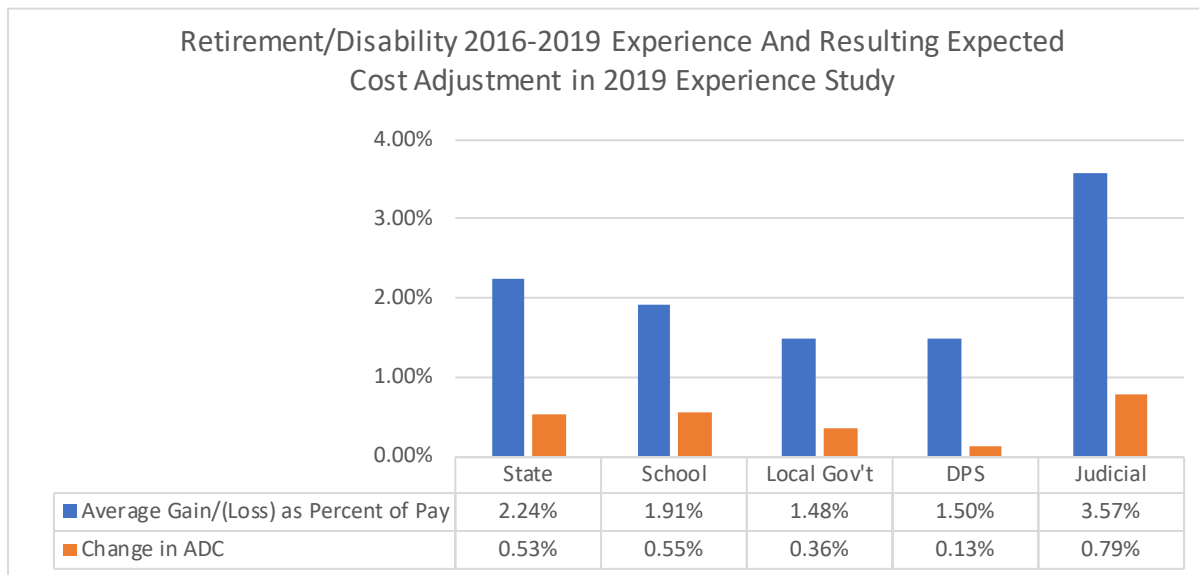| | | School | State |
|---|---|---|---|
| 1 | Probable Continuing Bias as a % of Payroll from 2016 Study | 6.4% | 5.8% |
| 2 | Non-Mortality Demographic Experience 2016-2019 as a % of Payroll | 6.7% | 6.0% |

Thus, once again, we would expect proposed demographic assumptions in the 2020 experience study that would have resulted in recommendations that significantly increased expected costs associated with these assumptions. It is from this vantage point that we now examine the key remaining demographic assumptions and methods proposed in the 2020 experience study.

**Retirement**

Segal separated experience by eligibility for reduced and unreduced retirements, and in some cases, separated by gender. They used benefit-weighted experience, and proposed rates that were generally midway between actual experience and expected retirements under the old assumption. We agree with this methodology and the assumptions appear reasonable when looking at the experience data in isolation.

However, given the broader context of the recurring retirement losses as well as some observations on the actual experience data, we have some concerns that retirement benefits could be being undervalued. Over the most recent four-year study period, the retirement liability loss for the State Division averaged 2.24% of pay per year. However, in spite of those notable losses, the data supported only very modest changes to the male unreduced retirement rates (none to the female unreduced), and modest changes to the reduced retirement rates. These changes to retirement rates resulted in a marginal increase to the Actuarially Determined Contribution of 0.53% of pay.

The following shows this relationship for each of the divisions:



Retirement/Disability 2016-2019 Experience And Resulting Expected Cost Adjustment in 2019 Experience Study

| | State | School | Local Gov't | DPS | Judicial |
|---|---|---|---|---|---|
| Average Gain/(Loss) as Percent of Pay | 2.24% | 1.91% | 1.48% | 1.50% | 3.57% |
| Change in ADC | 0.53% | 0.55% | 0.36% | 0.13% | 0.79% |

The retirement rates recommended by Segal which produced the bars in orange did appear to give a meaningful amount of weight or credibility to the experience data. What that suggests to us then is that

the reconciled actual to expected experience data on its own may not be able to account for the full extent of the losses. GRS was not able to specifically determine the source of this loss; however, possible causes include mismatch of retirement eligibility determination as administered vs. as measured by the valuation system, service portability provisions, pay spiking and service purchases. We recommend that in an addition to an examination of the retirement rates, Segal work to identify other sources of losses that may be showing up in this category in an upcoming experience study.

## Withdrawal from service before retirement (termination)

**Analysis**:

As was noted, the 2012 through 2015 experience had significant withdrawal liability losses and the 2016 experience study assumption changes did not appear to address these losses. One likely source of this disconnect was that the termination rates were studied using a counts-based analysis which gives equal weight to each member in determining the probability of terminating. A counts-based analysis can provide reliable information in a plan population where the type of employee is fairly homogenous (for example a transit plan that covers bus drivers but not management), but may fail to do so when different behavioral patterns exist between higher and lower-paid employees. As an example, in a plan that covers all school employees there may be very different termination patterns among teachers and paraprofessionals. Teachers may have much less turnover than the overall population and be higher paid (and hence contribute more to the overall liabilities) and paraprofessionals vice versa, but if each contributes equally to the rate setting, the resulting rates may undervalue costs.

Given the observed long-term pattern of losses and knowing that counts based analysis was used in the 2016 experience study, it was not surprising when the 2016-2019 benefit-weighted experience showed that PERA's termination rates needed to be substantially higher. Given the circumstances, we would have liked to have seen significant movement toward 100% actual to expected ratios in setting these new rates. However, Segal only gave minimal credibility to the 2016-2019 experience and made very modest reductions to termination rates.

As an example, the actual to expected ratio for terminations of State and Local Government members with less than five years of service was 69%. We would have expected the proposed actual to expected ratio to move at last 50% of the way towards the 100% to at least 85%. Instead, the proposed rates only moved 19% of the way between 69% and 100%, resulting in a final A/E of 75%. The only instance where a large move was made was on DPS terminations for members with more than five years of service in one of the few instances where terminations were greater than expected.
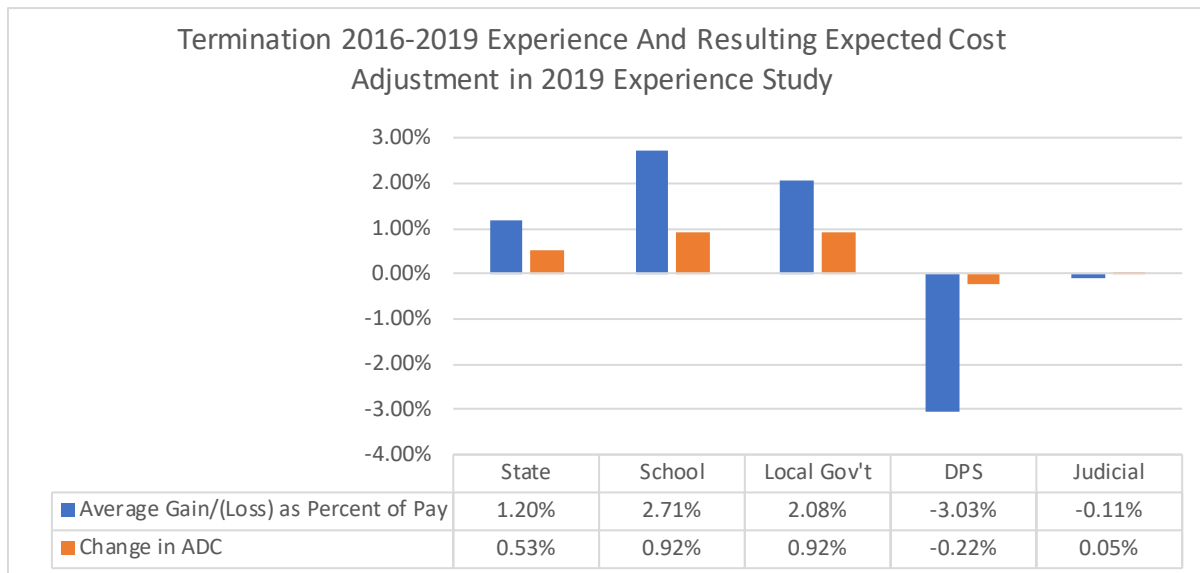
## Actual to Expected Ratios Before and After Assumption Changes and Implied Data Credibility

| State and Local Government (Non-Troopers) | | | |
|---|---|---|---|
| | Former A/E | Final A/E | Implied Credibility |
| 0-5 Years Service | 69% | 75% | 19% |
| Age-Based 5 Years+ Females | 59% | 69% | 24% |
| Age-Based 5 Years+ Males | 67% | 75% | 24% |
| School | | | |
| | Former A/E | Final A/E | Implied Credibility |
| 0-5 Years Service | 72% | 80% | 29% |
| Age-Based 5 Years+ Females | 46% | 57% | 20% |
| Age-Based 5 Years+ Males | 53% | 63% | 21% |
| DPS | | | |
| | Former A/E | Final A/E | Implied Credibility |
| 0-5 Years | 90% | 98% | 80% |
| Age-Based 5 Years+ Females | 118% | 102% | 89% |
| Age-Based 5 Years+ Males | 148% | 109% | 81% |
| Troopers | | | |
| | Former A/E | Final A/E | Implied Credibility |
| Age-Based | 52% | 62% | 21% |
| Judicial | | | |
| | Former A/E | Final A/E | Implied Credibility |
| Age-based | 69% | 76% | 23% |

To add more confidence in making a bigger move on termination rates based on the observed termination data, the actuary can also consider other peer retirement systems.  In looking at the probability of achieving retirement eligibility (essentially not terminating) as compared to other similar statewide systems, there is further evidence that the observed or actual termination data can be reasonably relied upon, rather than continuing to rely upon the prior assumption.  As shown in the following exhibit, the probabilities in the experience study data more closely resembled the assumptions used by peer systems. While the new assumption moved in the right direction, there appears to remain a rather significant gap to make up.

Probability of Achieving Retirement Eligibility Still Employed
Female, School, Age 30 with 5 Years of Service
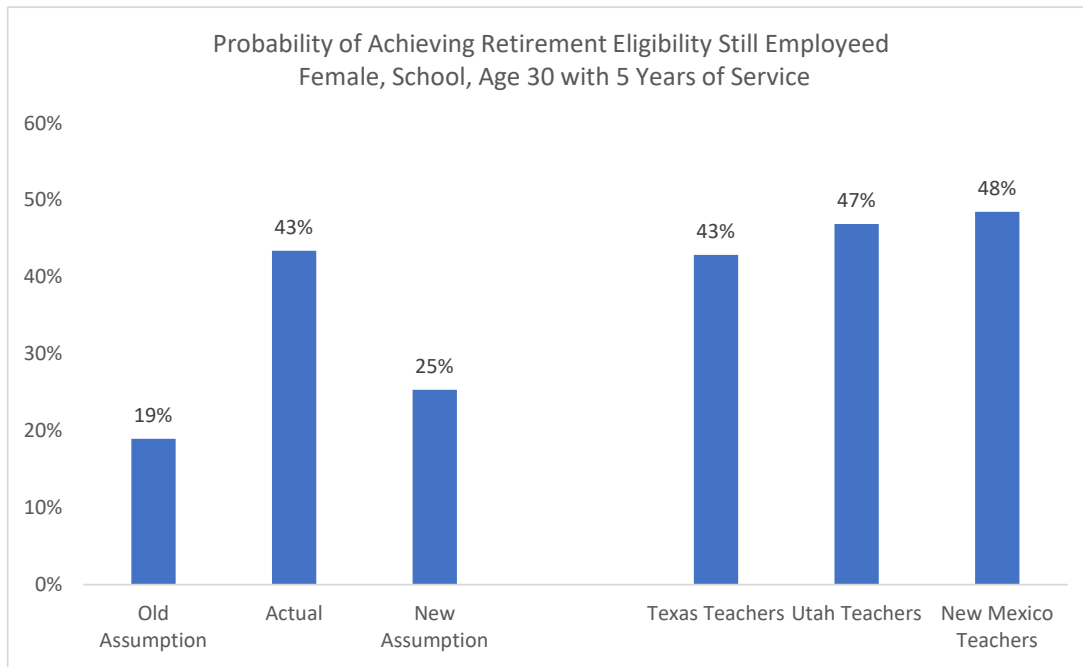
Similar to our discussion on retirement, the changes to the ADC due to termination seemed small in the context of the magnitude of the termination liability losses as a percentage of pay over the experience period. Over the most recent four-year study period, the liability loss for the State Division averaged 1.20% of pay per year. The changes to termination rates resulted in an increase to the Actuarially Determined Contribution of 0.53% of pay.



Termination 2016-2019 Experience And Resulting Expected Cost Adjustment in 2019 Experience Study

|  | State | School | Local Gov't | DPS | Judicial |
|---|---|---|---|---|---|
| Average Gain/(Loss) as Percent of Pay | 1.20% | 2.71% | 2.08% | -3.03% | -0.11% |
| Change in ADC | 0.53% | 0.92% | 0.92% | -0.22% | 0.05% |

The low final actual to expected ratios following the modest assumption changes, in combination with the magnitude of the changes to expected plan costs in relation to observed losses as a percentage of pay, lead us to believe that further termination losses could be in store for the State, School and Local Government Plans. In the next experience study, we recommend assessing the termination assumption from this vantage point. We recommend obtaining a full 10 years of experience for the study and giving full credibility to the experience.

## Recognition of New Hire Liabilities

Each year new members are hired and become participants in the Association. These members, on average, have accrued a half year of service at the time they first appear in the valuation data and accordingly, have an actuarial accrued liability associated with that half year of service. The current valuation approach does not recognize those costs until the new member shows up in the following year's valuation data and results in persistent liability losses each year. Although this may be a fairly typical approach by actuaries, it does create a drag on the unfunded liabilities and does hinder the meeting of funding objectives, especially for Plans financed through payroll contributions. The association-wide losses associated with this item average $220 million per year. We recommend that, as a benefit accrual during the year, these costs be recognized in the normal cost amounts (both for ADC and projection purposes).

## Remaining Bias Associated with Retirement, Termination and New Hire Liabilities

GRS has shown that a bias existed in the assumptions set in 2016, and that a bias likely continues to exist in the assumption set recommended in 2020. The question then becomes "how much bias remains?" As indicated earlier, it is our expectation that mortality and pay increases have been appropriately addressed. If, for the School Fund, we then compare the average losses as a percent of payroll to the corrective action taken with the 2020 Experience Study, we find that the remaining probable biases are 1.34%, 1.77% and 2.09% for retirement, termination and new hire liabilities, respectively and 5.20% in total. In other words, barring large changes in behavior, we would expect the School Fund to continue to experience demographic losses approximately equal to 5.2% of payroll year. This value is 4.8% of payroll Association wide, or almost $500 million annually.

| School, $ in millions<br>Decrement | Average G/(L)<br>2016-2019 | As a % of Payroll | Change in 2020<br>Experience Study | Probable<br>Remaining Bias? |
|---|---|---|---|---|
| Retirements (Service/Disability) | ($88) | -1.89% | 0.55% | -1.34% |
| Deaths | (39) | -0.83% | 0.83% | - |
| Withdrawals | (126) | -2.69% | 0.92% | -1.77% |
| Pay Increases | (14) | -0.31% | 0.31% | - |
| New Hires | (98) | -2.09% | - | -2.09% |
| Total Gain/(Loss) | ($458) | -7.81% | 2.61% | -5.20% |

It should be noted that the Signal Light report based on the valuation as of December 31, 2020 did acknowledge some of this probable remaining bias. Starting at the bottom of page 18 of the Signal Light report, Segal provided some scenarios reflecting recent experience. To accomplish this, they used termination probabilities, retirement rates, and salary increases consistent with actual recent observed experience. The following table shows the results included in the Signal Light report of this alternative approach.

| | State | | School | |
|---|---|---|---|---|
| Assumption Set | Current | Recent Experience | Current | Recent Experience |
| Probability 100% Funding by 2048 | 62% | 58% | 56% | 49% |
| Year Projected for Full Funding | 2041 | 2042 | 2043 | 2048 |

As noted earlier, we do not think that the observed retirement data accounts for all of the bias associated with that assumption. In addition, no provision is made for new hire liabilities. As such, it is likely that roughly half of the remaining bias is addressed using this approach. Although it does not fully address the outstanding items, we do commend Segal on the increased transparency created by including this analysis.

GRS has demonstrated a likely bias in retirement and termination assumptions as well as the lack of recognition of new hire costs during the fiscal year they are incurred.  Although GRS believes there is an outstanding bias in the demographic assumptions, it should be noted that any incorporation of additional change to these assumptions that increased expected cost would not have resulted in a different funding outcome for the plan in 2022.  The assumption set, as it is, along with the Automatic Adjustment Provisions resulted in the maximum increase in contributions and the maximum reduction in the Annual Increase in 2022.  Looking forward to the actuarial valuation as of December 31, 2021, a wide range of investment outcomes will result in no adjustment during 2023.  However, due to deferred investment gains that will be phased in over the next couple years, it is likely that the current assumption set will produce an adjustment based on the December 31, 2022 valuation such that contributions are reduced and the Annual Increase is increased which would be detrimental to the chances of reaching full funding in 2048 if it is found at a later time that the actuarial assumptions need to be strengthened.

GRS recommends accelerating the regularly scheduled experience study into 2022 to modify assumptions for first use in the December 31, 2022 valuation with particular focus on the retirement, termination and new hires.  GRS recommends using 10 years of termination data and giving full credibility to the observed experience.

# Review of Projection Model

GRS examined the projection model used in the Signal Light report and in producing the funding periods shown on page 113 of the valuation report.  GRS has the following recommendations to improve the model.

Definition of "Success"

 The signal light report defines success as:
- o Funded ratio as of 2048 is >=100%; and
- o Funded ratio *continues* to be >=100% through 2070
- o The funded ratio never drops below 0%

The following shows four scenarios in which the requirements for success are not met even though full funding is met at or before 2048 because they do not remain above 100% for the remainder of the period:

## Projected Funded Ratios
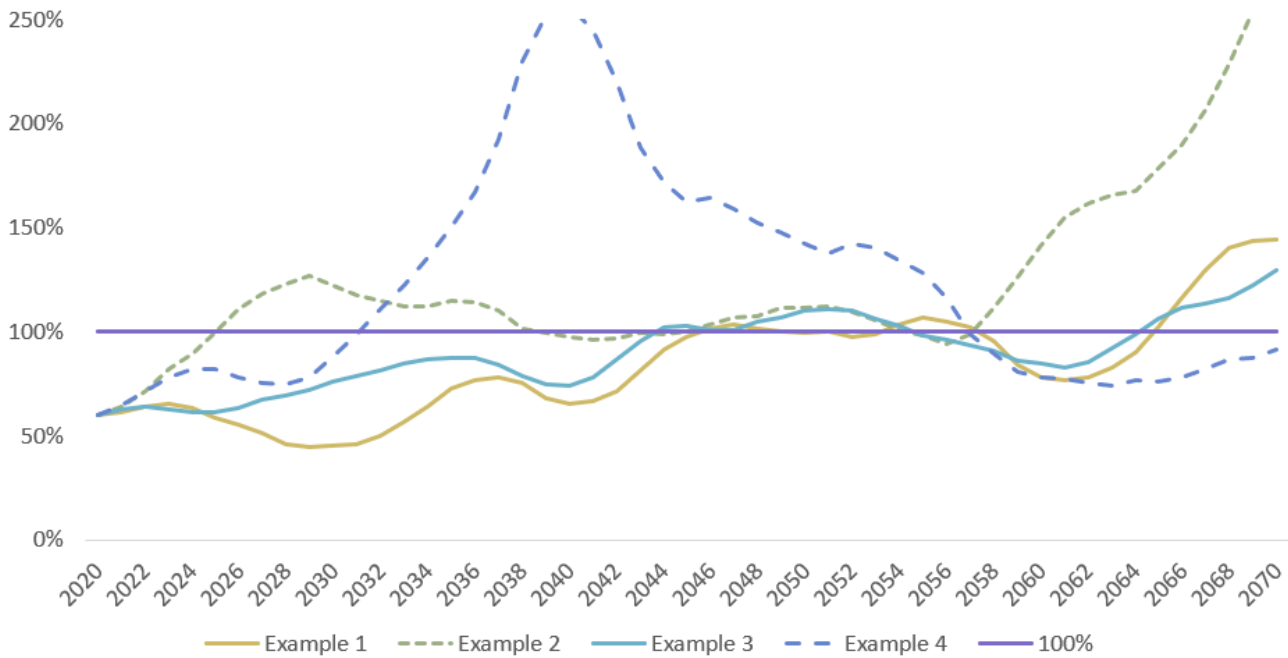


GRS finds that requiring the funded ratio to continue to be above 100% through 2070 is quite conservative with the question of reaching full funding in 2048. Natural dips above and below 100% funding following attainment of full funding are to be expected and not an indication that the plan is not reaching its funding goals. GRS would instead recommend a more straightforward definition of success. Even if the goal is to ensure a spike in one way or another doesn't impact the results, something such as reaching full funding for 2 consecutive years on or before 2048 would be a sufficient definition. Also, it is important to remember the actuarial model utilizes a four-year smoothed version of the asset values, so the definition of full funding already has protections against short term investment spikes. Changing this definition notably increases the chances of considering a scenario a success and is closer to how the actual scenario would play out in real time. The following shows the increase in probability of full funding using the Segal projection model but assuming this definition of success is changed:

|  | State | School | Local | Judicial | DPS |
|---|---|---|---|---|---|
| Funding Period in Signal Light Report | 20 | 22 | 8 | 7 | 7 |
| Signal Light Report, probability fully funded by 2048 | 62% | 56% | 64% | 76% | 85% |
| % of scenarios that achieve 100% funded status for two consecutive years on or before 2048 | 67% | 64% | 79% | 87% | 91% |

<u>True Path Dependency</u>

SB18-200 improved the responsiveness of plan funding and benefits to plan experience, and in turn, improved the plan resiliency; however, the projection model does little to account for this. In spite of references to modeling "path dependency", Segal only models the most recent AAP adjustment, and does not take into account possible future changes in contributions or benefits depending on future actuarial results. In this case, "path dependency" means modeling stochastic projection returns on a static liability model. We believe this should be incorporated into the projection model to give a more dynamic probability of funding success.

<u>Use of Smoothed Value of Assets</u>

Current projection results assume that assumed investment returns are applied to the market value of assets. The UAAL, funded ratio, and ADC in the annual valuation are all based on a smoothed value of assets and GRS believes it would be more appropriate to start from the smoothed value of assets for the projection communications as well. Using a smoothed value of results would lessen the year to year volatility of results and present a better gage of whether the Association is on track to achieve full funding. Currently the Signal Light report uses capital market assumptions that were produced in 2019 to develop the stochastic return assumptions. We think continuing to use consistent assumptions between experience studies is appropriate and can help the report user isolate changes due to plan experience. However, using a market value of assets as of December 31, 2020 (which reflects substantial market value returns in 2019 and 2020), but using capital market assumptions developed in 2019, may overstate the amount of funding period improvement due to short term investment performance. Using the smoothed or actuarial value of assets for projection purposes would better justify using consistent assumptions for the stochastic projections between experience studies and would allow for better consistency of the message from year to year.

<u>Payroll Growth and Reliance on New Hire Data</u>

The projection model, similar to many actuarial projection models in use, develops an estimate of what future new hires will look like and uses that information to build payroll, liabilities and normal costs for new hires replacing current actives as they terminate and retire. In the current model, we find that there is a significant disparity between the Board approved payroll growth and population growth assumptions and the projected payroll that is produced by the projection model. For example, the average payroll growth for the School Fund between the valuation and 2048 is 3.1% per year. However, with Board approved payroll growth of 3.0% and population growth of 1.0%, we would expect this growth in the projection to be 4.0%. We recommend that Segal examine the data and process used to develop the new entrant profile and make adjustments to their model to better reflect the expected payroll growth of the overall population adopted by the Board.

## GRS' Estimated Probabilities of Achieving Full Funding Prior to 2048

GRS created a modified version of the PERA valuation model and has estimated the impact on the stated probabilities of achieving full funding period to 2048. The adjusted model accounts for the following:

- recognition of the bias associated with retirement, termination and new hire losses and make changes to the assumption as of 2022

- allowing future valuations to determine and incorporate future AAP Assessments and their impact on benefits and contributions on a dynamic basis
- total payroll growth consistent with the payroll growth and population growth assumptions (and associated liabilities and normal costs)
- definition of success = two consecutive years of full funding prior to 2048; and
- a lognormal distribution of annual investment returns with a mean of 7.25% (equal to the investment return assumption) and a standard deviation of 12.8% (disclosed in the 2019 Asset Allocation Study).

Based on these adjustments, GRS has determined the following probabilities of achieving full funding by 2048.

| | Projected from Market Assets as of December 31, 2020 | Projected from Smoothed Assets as of December 31, 2020 |
|---|---|---|
| Total PERA | 59% | 51% |
| School Division Only | 57% | 47% |

As shown, Association wide, even projected from the smoothed value of assets (ignoring the current deferred investment gains) the probability of achieving full funding by 2048 is 51%. Viewing the School Division on its own, however, does not achieve the 50% threshold on that same basis, but does if even a third of the deferred gains are taken in to account.

GRS' Estimated Probabilities of Negative Outcomes

While the probability model can show distributions of positive outcomes, it can also be used to show likelihoods of negative outcomes. For example, for PERA as a whole, the probability of future AAP Assessments pushing the contributions up to the highest allowable under SB 18-200 is 64%. There is a 52% probability of at some point before 2048 the ADC exceeding the highest allowable contribution by more than 1% of payroll. Thus, there is approximately the same probability of achieving full funding prior to 2048 as there is of having a contribution amount that is not meeting the ADC.

The way that SB18-200 is designed, with shared responsibility among the State, employers, employees and annuitants, discontinuing the $225 million produces minor impact to the probabilities of full funding shown above. However, the responsibility is shifted to the other stakeholders through increased likelihood of higher contributions and lower benefit increases. Without the annual $225 million commitment, the probability of future AAP Assessments pushing the contributions up to the highest allowable under SB 18-200 increases from 64% to 75%.

These types of probabilities are achievable because there is a limit to how high contributions can go in the Statute. If stakeholders are uncomfortable with these probabilities, then the Statute should be changed to either remove the ultimate limit (the limit in the annual amount of change can remain), or at least more allowable steps could be incorporated. In that case in may be preferable to add the same number of additional steps to the upside and the downside, meaning allow for COLAs to go down further, but also make allowance for COLAs to go back up further than the current 1.5% limit. This risk and reward symmetry may be seen as a more reasonable alternative than only allowing more steps in one direction.

# Review of Board Funding Policy

It is our understanding that the intent of SB18-200 was to target full funding of all unfunded liabilities by 2048. The current funding policy adopted by PERA does amortize the main, original amortization base by 2048, but future gains and losses will be amortized over new 30-year periods that will extend past 2048. GRS believes that the Board funding policy could be revised to be better reflective of the goals of SB18-200 while at the same time balancing concerns of short-term volatility. For example, the amortization policy could be revised such that the amortization of the current unfunded liability and any new UAAL that is created in the future would use a closed amortization ending in 2048. This would be the case for new amortization layers until the amortization period reaches 15 or 20 years at which time industry best practices recommend any new unfunded liabilities could use a new 15 or 20-year amortization.

# Review of Communications

The annual actuarial valuation serves many purposes, but we feel there are two primary questions that the valuation report answers that the reader should be able to quickly and easily answer:

1. Is an AAP Adjustment triggered due to the results?
2. Is the Association on target to reach full funding in 2048?

We feel that these questions can be answered based on the information provided, however, the information available to answer the questions is diffuse and sometimes conflicting. For example, based on the "Effective Amortization Period", the very first actuarial information provided in the report, the reader might think that the Association is not on track to reach full funding by 2048. However, based on a very in-depth reading of the report, GRS would say that based on the assumptions in place, PERA is on track to reach full funding, based on the funding periods provided on page 113 and based on the probabilities of achieving full funding in the Signal Light report.

The first result is:
- an algebraic result;
- does not take into account the reduced cost of new hire benefits;
- does not take into account DC payroll contributions; and
- is based on the actuarial value of assets.

The second is:
- based on a projection model;
- which does take into account the reduced cost of new hire benefits;
- which does take into account DC payroll contributions; and
- is projected based on the market value of assets.

GRS recommends that all results communicated be based on a single consistent projection model with:

- consistent treatment of new hire normal costs;
- consistent usage of population growth and payroll growth
- consistent usage of DC payroll contributions;
- the Actuarial Value as asset starting point; and
- that reflects the policies in place (AAP).

If for some reason, the Board desires alternate results that are not consistent with that projection model and the question of whether the Association is on track to reach full funding by 2048, they should be identified as alternate results and deemphasized in comparison to the main determination of the funding period.

The answers to the two primary questions should be stated early in the report, easily identifiable to the reader.  For example, statements such as:

> *"SB18-200 declares a goal to achieve full funding by 2048. As of this report, the Association is on target to do so."*

> *"SB18-200 outlines when the contribution rates and cost of living increases will be modified, and per those provisions, as of this valuation, the AAP Adjustment results will increase employer and employee contributions by 0.5% of payroll and reduce the AI Cap by 0.25% from 1.25% to 1.00% as of July 1, 2022.*

At this time, it is not clear to us whether the answer to the first question involves the overall Association (where overfunding of one fund could offset underfunding of another), or achieving full funding for each of the individual funds.  This should be ascertained, and if based on the Association, there should be provision of key Association-wide results (such as a funding period and Signal Light probabilities).