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Valuation Methods & Assumptions

OREGON PUBLIC EMPLOYEES RETIREMENT SYSTEM

Presented by:

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July 26, 2019

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Three-Meeting Process – Assumptions & Methods

- April 1: Background on current key assumptions and methods
  - Long-term investment return assumption (assumed rate)
  - Amortization period for unfunded actuarial liability (UAL)
  - Contribution rate collaring policy

- May 31: Economic assumptions, system funding methods
  - Inflation and system payroll growth
  - Assumed rate – data from Treasury's consultant, Milliman's model
  - Actuarial methods, including amortization and collaring policy

- **July 26: Demographic assumptions, Board direction to actuary**
  - **Member-specific assumptions based on study of recent PERS experience**
  - **Review methods for reflecting new legislative provisions**
  - **Assumptions and methods adopted will be used for:**
    - **12/31/2018 actuarial valuation with advisory 2021-2023 contribution rates**
    - **12/31/2019 actuarial valuation with proposed final 2021-2023 contribution rates**

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Today's Agenda

- Background
- Recently passed legislation Senate Bill 1049
- Recap of economic assumptions and actuarial methods
  - Includes long-term investment return assumption
  - Reviewed in detail at last Board meeting
- Projected effects of legislation and investment return
- Overview of demographic assumptions
- Estimated effect of assumptions

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Executive Summary

- Since last meeting, we analyzed PERS member census and are recommending updates to certain demographic assumptions
  - Combined, those recommendations are estimated to have a:
    - "Change" of $0.0 billion the UAL (rounded to the nearest $100 million)
    - 0.3% of payroll increase in the system-average advisory 2021-2023 uncollared rate
- In our financial modeling, SB 1049's most visible impact is reamortization
  - How SB 1049 is implemented in certain areas will affect actuarial calculations
  - Some of those areas have open issues from our perspective
- Callan's and Milliman's capital market outlooks for future investment return are slightly higher than at the last review two years ago
  - We recommend the Board not increase the assumed rate from the current 7.2%
  - The Board should give consideration to decreasing the rate to 7.1% or 7.0%
    - A decrease to 7.1%/7.0% is estimated to increase the:
      - UAL as of December 31, 2018 by $0.9/$1.8 billion
      - System-average advisory 2021-2023 uncollared rate by 0.7%/1.4% of payroll

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Background

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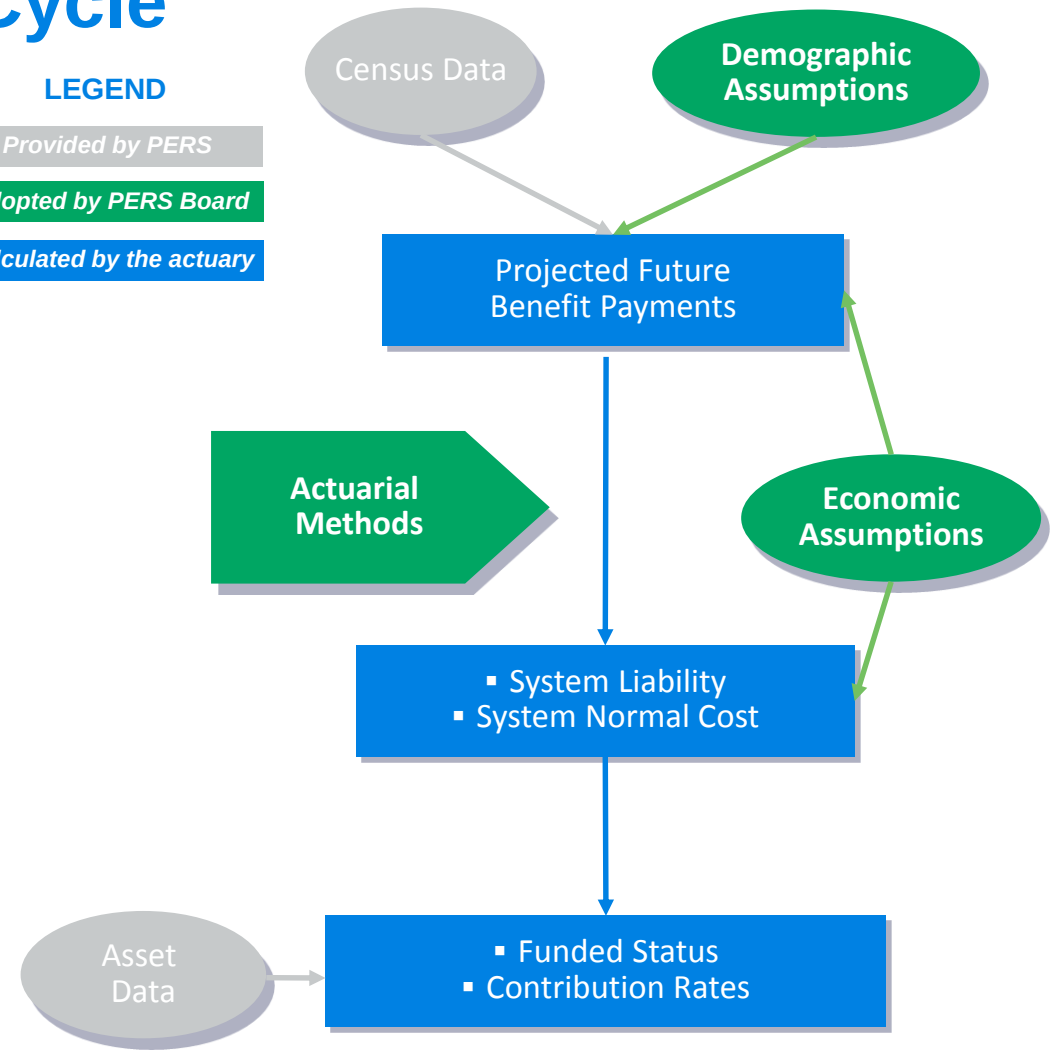
Two-Year Rate-Setting Cycle

- **July 2019: Assumptions & methods adopted by Board in consultation with the actuary**
- October 2019: System-wide 12/31/18 actuarial valuation results
- December 2019: Advisory 2021-2023 employer-specific contribution rates
- July 2020: System-wide 12/31/19 actuarial valuation results
- September 2020: Disclosure & adoption of employer-specific **2021-2023 contribution rates**



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Valuation Process and Timeline

- Actuarial valuations are conducted annually
  - Alternate between “rate-setting” and “advisory” valuations
  - The next valuation as of 12/31/2018 will be advisory
- Board adopts contribution rates developed in rate-setting valuations, and those rates go into effect 18 months subsequent to the valuation date

Valuation Date	Employer Contribution Rates
12/31/2015 →	July 2017 – June 2019
12/31/2017 →	July 2019 – June 2021
12/31/2019 →	July 2021 – June 2023

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Board Objectives - Methods & Assumptions

- Transparent
- Predictable and stable rates
- Protect funded status
- Equitable across generations
- Actuarially sound
- GASB compliant

Some of the objectives can conflict, particularly in periods with significant volatility in investment return or projected benefit levels. Overall system funding policies should seek an appropriate balance between conflicting objectives.

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The Fundamental Cost Equation

- Long-term program costs are the contributions, which are governed by the “fundamental cost equation”:

BENEFITS =

CONTRIBUTIONS +

EARNINGS

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Governance Structure

- Benefits:
  - Plan design set by Oregon Legislature
  - Subject to judicial review
- Earnings:
  - Asset allocation set by OIC
  - Actual returns determined by market
- Contributions:
  - Funding, including methods & assumptions, set by PERS Board
  - Since contributions are the balancing item in the fundamental cost equation, PERS Board policies primarily affect the **timing** of contributions
  - Different actuarial methods and assumptions produce different projected future contribution patterns

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Recent Legislation

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Senate Bill 1049

- Senate Bill 1049 signed into law in June
- The legislation made a number of changes to PERS, many centered on funding/financing of the System's benefits:
  - Redirects portion of member contributions to fund DB benefits
  - Requires a one-time re-amortization of Tier 1/Tier 2 UAL
  - Work after retirement provisions
  - Limits future salary included in Final Average Salary
  - Requires 30 day advance reporting from PERS Board to Legislature on changes to actuarial methods and assumptions
  - Requires study prior to issuing new Pension Obligation Bonds
  - Provides for employee choice in IAP
  - Modifies some provisions for employers making side account deposits, Employer Incentive Fund, School District Fund

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Additional Detail on Key Provisions

- Member redirected contribution
  - Tier 1/Tier 2: 2.5% of salary (3.5% goes to IAP)
  - OPSRP: 0.75% of salary (5.25% goes to IAP)
  - Members with less than $2,500 monthly salary (indexed) exempt
- One-time re-amortization of Tier 1/Tier 2 UAL
  - Board directed to employ 22-year re-amortization for current cycle
  - Choice of future methods reverts to Board
- Work after retirement
  - Removes hours limits, charges contributions on payroll of rehired retirees
  - Applies for a 5-year period
- Limits on future salary
  - Salary for Final Average Salary limited to $195,000 (indexed)

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Considerations for Methods/Assumptions

- How will member redirect interact with employer contribution?
- How will work after retirement changes affect system?
  - Removing hours limits could increase work after retirement
  - Assessing employer contribution on rehired retirees could decrease it
  - Could be a knock-on effect on growth in (non-retired) system payroll
- Limits on future salary
  - Leads to lower future growth in accrued benefit for small portion of members
  - Tier 2 and OPSRP members were already subject to the (higher) federal limit; Tier 1 member previously were not subject to a limit
  - Our understanding is the limit also restricts payroll subject to contributions

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Economic Assumptions and Actuarial Methods

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Economic Assumptions and Actuarial Methods

- At the May 31, 2019 meeting, the Board reviewed
  - Non-investment economic assumptions
  - Actuarial methods
  - Investment return assumption
- Our recommendations regarding economic assumptions and actuarial methods are unchanged since the May meeting

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Economic Assumptions

Details of these recommendations are included in our May 2019 presentation

	12/31/2017 Valuation Assumptions	12/31/2018 Valuation Proposed Assumptions
Inflation	2.5%	2.5%
Real Wage Growth	1.0%	1.0%
System Payroll Growth	3.5%	3.5%
Administrative Expenses:		
- OPSRP	$6.5 million	$8.0 million
- Tier 1/Tier 2	$37.5 million	$32.5 million

No explicit assumption is made for investment-related expenses, which are accounted for implicitly in the analysis of the long-term investment return assumption.

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Key Actuarial Methods

	12/31/2017 Valuation Methods	12/31/2018 Valuation Proposed Methods
Cost Allocation Method	Entry Age Normal	No change
Shortfall Amortization Method	Level percent of pay, layered fixed periods: Tier 1/Tier 2: 20 years OPSRP: 16 years RHIA/RHIPA: 10 Years	No change to OPSRP and RHIA/RHIPA Current Tier 1/Tier 2 shortfall will be reamortized over 22 years per SB 1049
Rate Collar	Limits change in base contribution rate to larger of 20% of current rate or 3.00% of payroll; Collar widens incrementally when funded status below 70%	No change

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Long-Term Investment Return Assumption

- Uses of the investment return assumption
  - As a discount rate for establishing the:
    - Actuarial accrued liability, which is a net present value
    - Associated unfunded actuarial liability, also called the UAL or actuarial shortfall
  - Guaranteed crediting level for regular Tier 1 active member account balances
  - Annuitization rate for converting member account balances to lifetime money match monthly benefits

Reflecting expectations for investment earnings, the assumption helps set a reasonable and appropriate budgeting glide path for projected employer contribution rates

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Use of the Assumed Rate

The PERS Funding Equation

At the end of each calendar year, the PERS actuaries calculate the system's funded status using the following basic equation:

B	=	C	+	E
BENEFITS		CONTRIBUTIONS		EARNINGS
Present value of earned benefits		*Employer funds to pay for pension benefits*		*Future returns on investment funds*
Set by: Oregon Legislature		Set by: PERS Board		Managed by: Oregon Investment Council

Every two years, the PERS Board adjusts contribution rates so that, over time, contributions will be sufficient to fund the benefits earned, if earnings follow assumptions.

- "B" is predictable with a relatively high degree of certainty
- "E" is the unpredictable **actual** future investment return on PERS assets
- "C" is the balancing item --- it must provide to "B" what "E" fails to cover

- The **assumed rate** is the Board's estimate of "E" to prudently set "C"
- The Board's decision on "E" does **not** affect actual future earnings

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Investment Return 50th Percentile Outlooks

- We applied a standard mean/variance model to calculate 50th percentile return estimates based on capital market outlook assumptions from three sources
  - Milliman
  - Callan – Consultant to OIC
  - 2018 Horizon survey of capital market assumptions (survey of 34 advisors)
- Estimates do not reflect any possible "alpha" due to selected managers potentially outperforming market benchmarks over the long term, net of fees
- Today's speakers are not credentialed investment advisors
  - We are presenting Milliman capital market outlook model results based on assumptions developed by Milliman's credentialed investment professionals

Details on each set of capital market outlook assumptions are in the Appendix

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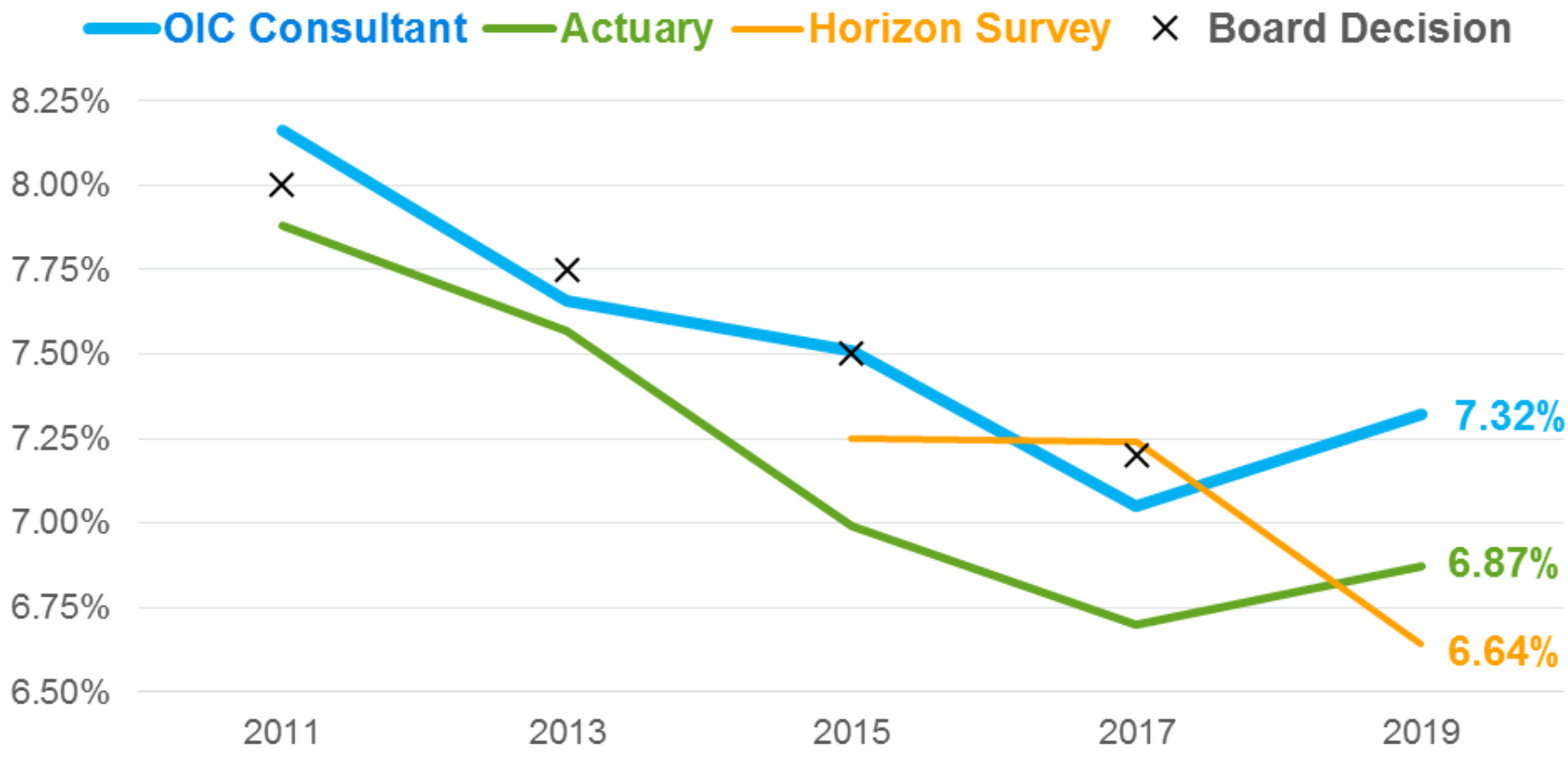
Investment Return 50th Percentile Outlooks

Geometric Returns from Outlook Models



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Investment Return 50th Percentile Outlooks

- Estimates are based on OIC's target long-term asset allocation
  - Current actual allocation differs somewhat from the target allocation
- Callan and Horizon estimates are calibrated over a shorter investment timeframe than Milliman's estimates
  - Also reflect lower level of assumed inflation

	Milliman	Callan	Horizon
Median Annualized Return	**6.87%**	**7.32%**	**6.64%**
Assumed Inflation	2.50%	2.25%	2.24%
Timeframe Modeled	20 years	10 years	10 years

The median returns shown above are geometric annualized average returns over the timeframes indicated above for each provided set of capital market assumptions

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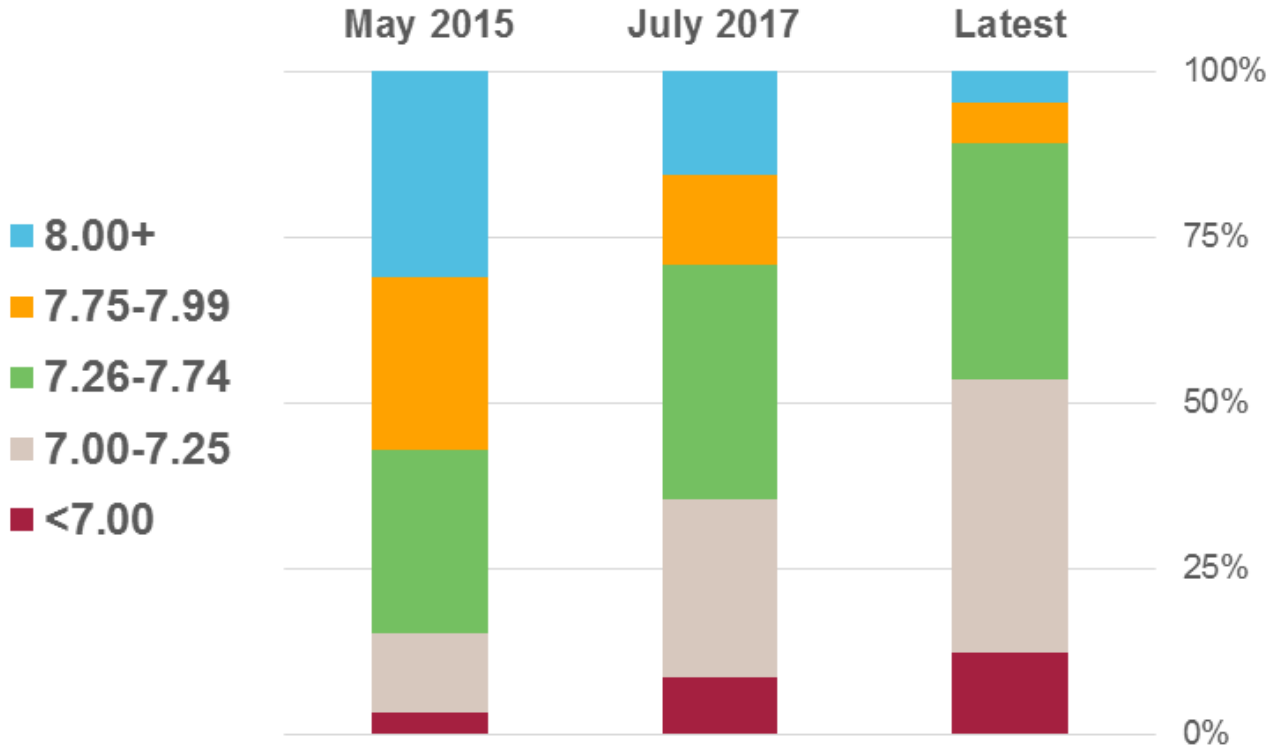
Comparison to Peer Systems

- There is a downward trend in public plan return assumptions, with a current median assumption for large public systems of **7.25%**
- Over 50% of the 129 systems tracked by the NASRA Public Fund Survey reduced their assumption over last 2-3 years



Source: NASRA (April, 2019)

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Effects of Lowering the Assumed Return

- A lower investment return assumption would produce higher calculated liabilities and contribution rates
- Liabilities are net present values, as of the valuation date, of a benefit payment projection that stretches far into the future
  - Changing the assumption modifies the projected balance of the fundamental cost equation between future investment earnings and future contributions
    - The actual balance will depend on actual investment earnings, not on the assumed return adopted by the PERS Board
  - The effect of lowering the assumed return to 7.00% is estimated as a 1.4% of payroll increase in the uncollared system average base employer contribution rate, while the effect of lowering the assumed return to 7.10% is estimated as a 0.7% of payroll increase
- For PERS, such an assumption change would also lower benefits for future retirements calculated under Money Match

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Considerations in Setting the Return Assumption

- In our opinion, the current 7.20% long-term future investment return assumption is reasonable based on current data from the capital market outlook models, the guiding principles, and Actuarial Standards of Practice
- Callan, the primary investment consultant to the OIC, currently estimates a long-term return above the current assumption
  - The PERS Board could still elect to reduce the assumption for conservatism, if desired
  - We would not recommend increasing the return assumption at this time, given the uncertainty in future outlooks and the influence of the point-in-time measurement at year-end 2018

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Projected Effects of Legislation and Investment Return Assumption

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Financial Modeling - Effect of SB 1049

- When legislation that became SB 1049 was in process, Milliman prepared financial modeling projections, building on work from the December 2018 Board meeting
- Illustrates effect of:
  - 22 year re-amortization of Tier 1 Tier 2 UAL with December 31, 2019 rate-setting valuation
  - Estimate of work after retirement and redirection provisions
    - Analysis assumes redirected member contributions would serve as an **offset** to employer contribution rates
- While not reflected in the financial modeling, the $195,000 limit on salary would not materially affect depicted results
- See December 2018 Board materials and follow-up Milliman analyses for discussion of modeling basis and assumptions

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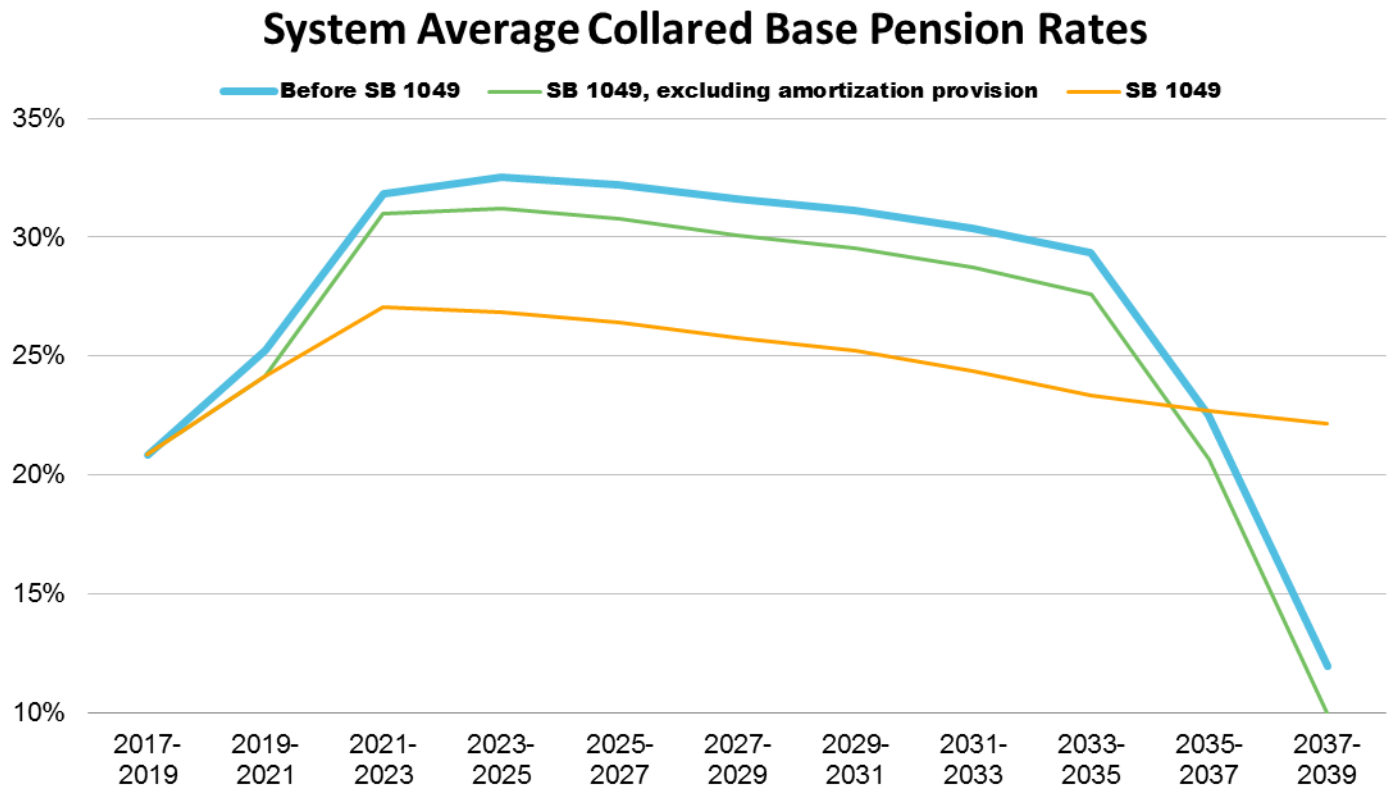
Financial Modeling - Effect of SB 1049

- Assumed rate of 7.2% and actual future returns of +7.20%



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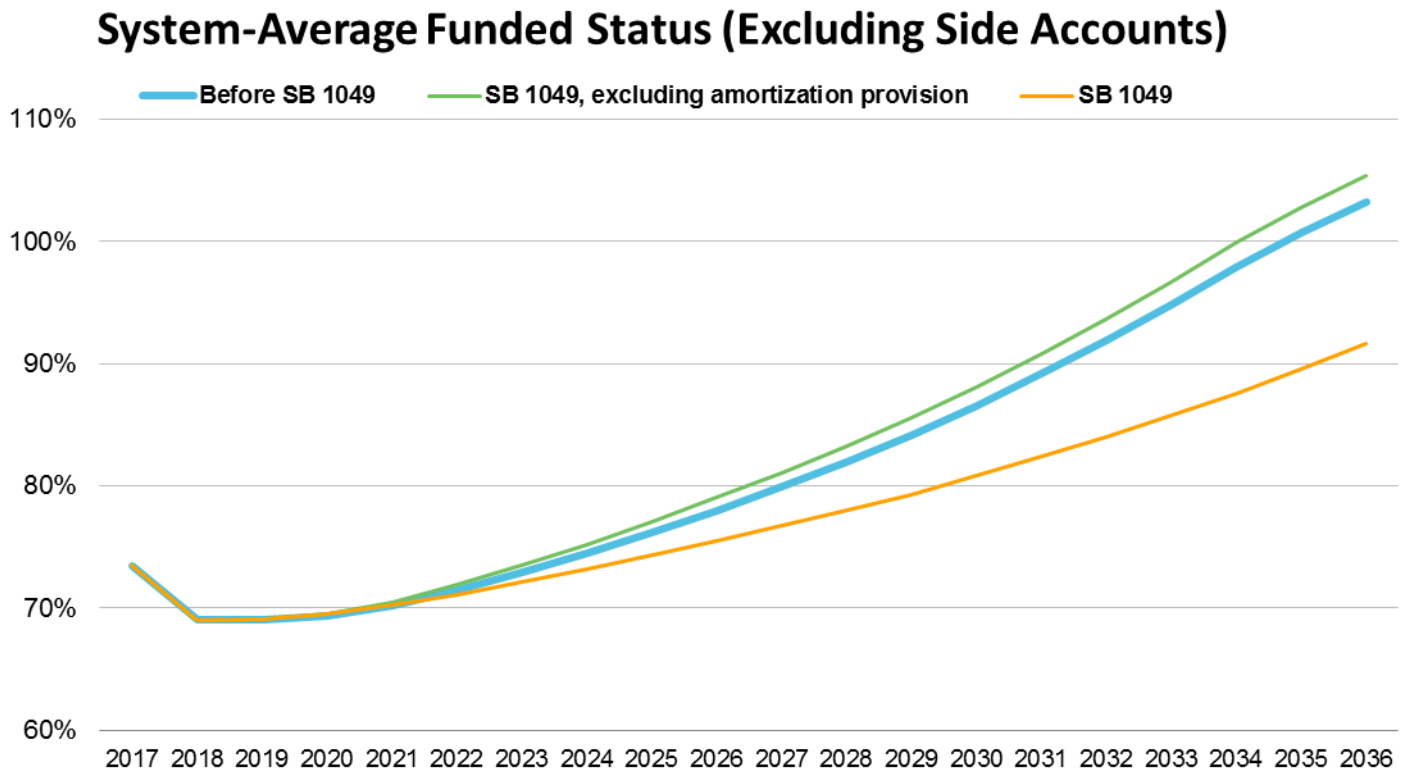

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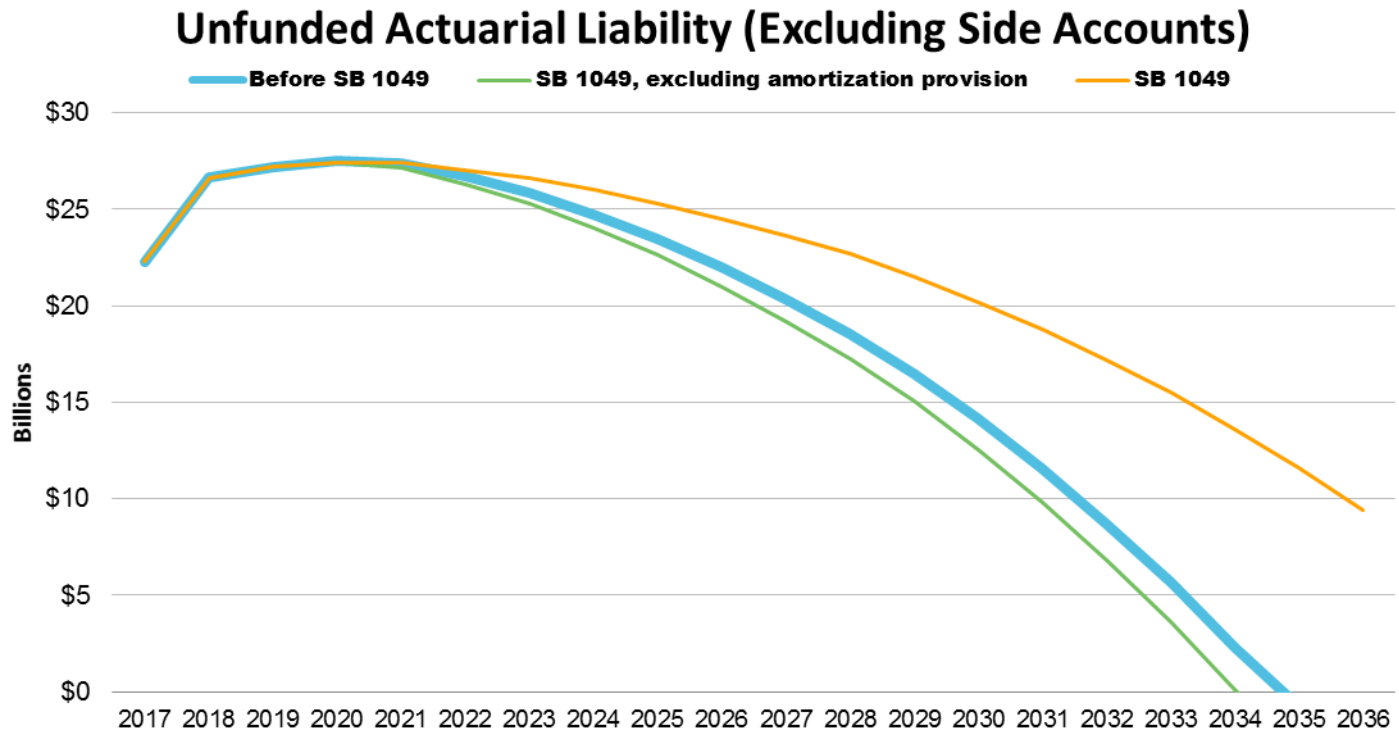

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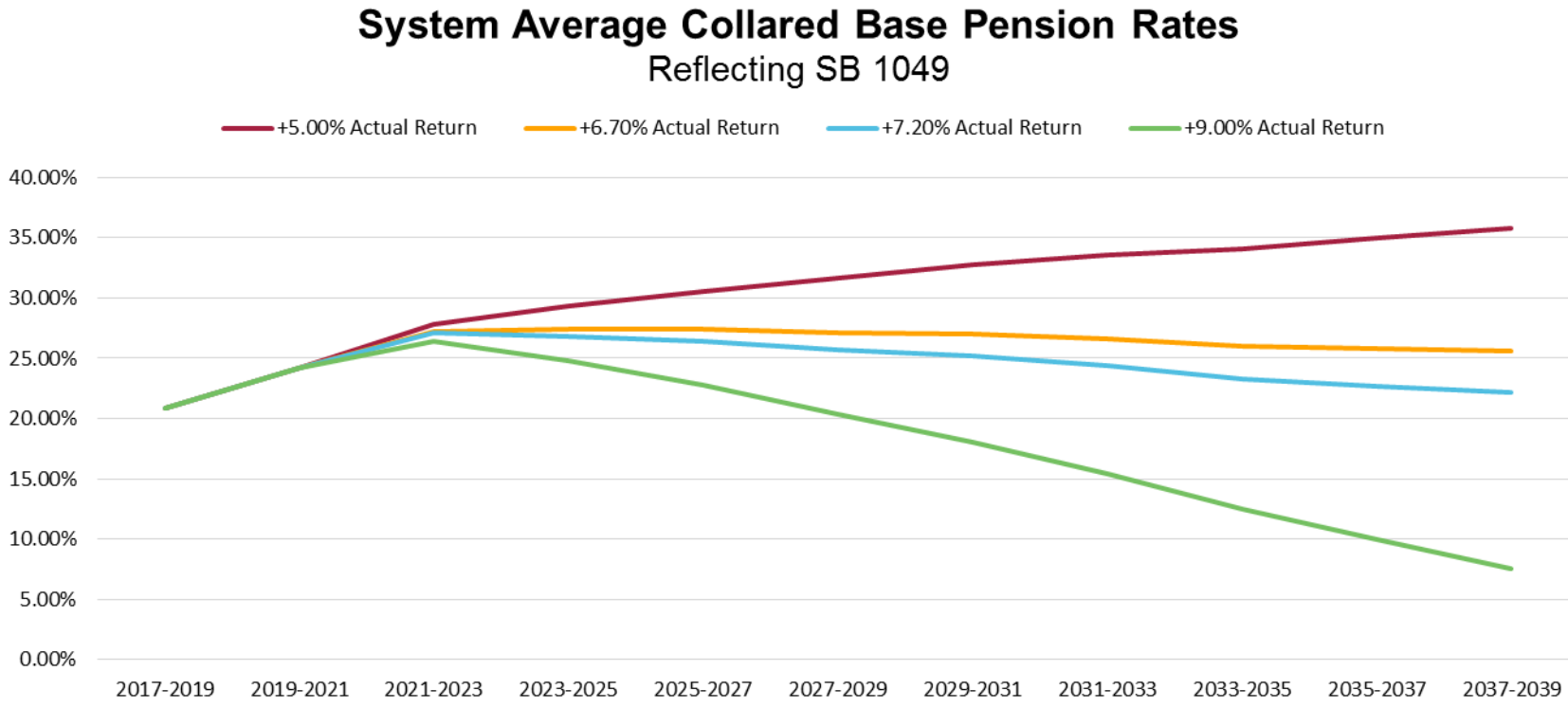
Financial Modeling - Effect of SB 1049

- Assumed rate of 7.2% and varying actual steady future returns



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Overview of Demographic Assumptions

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Demographic Assumptions

- We have statistically analyzed member census data provided by PERS
  - Four years of data analyzed for most demographic assumptions
  - Eight years of data analyzed for individual member salary increase assumptions
- Recommended assumptions were developed based on the statistical analysis
- Full details of the analysis are in our formal experience study report

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Summary of Demographic Assumptions

- Update mortality assumptions: use newly issued base tables specific to public plans
  - Also incorporate most recent data in assumption for projected future mortality improvement
- Adjust likelihood of retirement assumption at some ages where recent experience differed from current assumption
- Increase merit portion of individual member salary assumption for two of three groups
- Adjust pre-retirement termination assumptions for two groups
- Adjust disability incidence assumptions
- Updates to assumed final average salary adjustments for factors such as unused vacation and sick leave for most groups for members eligible under those provisions
- Updates to assumed lump sum and service purchase election rates
- Adjustments to post-retirement medical program assumptions
  - Participation levels (RHIA & RHIPA)
  - Healthcare inflation assumption for RHIPA program

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Mortality Assumption

- For each group, the mortality assumption consists of two parts:
  1) A ***base table*** – for a given age, lists a probability of death at that age
  2) A ***projection scale*** – modifies base table entries to reflect anticipated continued mortality improvement over time
     - Reflects common-sense understanding that a new retiree today has a longer life expectancy than a new retiree 25 years ago…and that a new retiree 25 years from now is reasonably anticipated to have a longer life expectancy than a new retiree today
- We are recommending base table and projection scale updates:
  - Combined effect was decrease in liability of less than $150 million
- New recommended "Pub-2010" base tables reflect the Society of Actuaries (SOA) Public Plans Mortality Study published in January 2019

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Mortality Assumption

- ORS 238.607: adopted actuarial equivalency factors *must use the best actuarial information on mortality available at the time*
  - We separately reviewed police and fire mortality per ORS 238.608
- We matched PERS experience to the SOA's Public Plans ("Pub-2010") base tables
  - PERS was one of the systems that contributed data to the study; in general new tables fit experience well
  - Calibrated to PERS experience as needed with "set-backs" or other adjustments to standard table
- For mortality improvement projection scale, maintained approach adopted in prior experience study of using a projection scale based on 60-year average annual improvement from Social Security mortality experience
  - Updated to reflect most recent information available at the time (through 2015)
- Recommended assumptions produce results similar to prior assumptions

Technical details on our recommendation and more information on the mortality assumption are in our formal Experience Study report

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Mortality Assumption

- Illustrative effect of assumption changes for non-disabled retiree:

Future Life Expectancy (in years)	Retires at Age 60 in 2019			Retires at Age 60 in 2039		
	Current	New	Change	Current	New	Change
School District Male	28.3	27.8	-0.5	29.6	29.0	-0.5
General Service Male	26.9	26.9	0.0	28.4	28.4	0.0
Police & Fire Male	26.9	25.7	-1.2	28.4	27.1	-1.3
School District Female	29.9	29.9	0.0	31.2	31.1	-0.1
General Service Female	28.1	28.6	0.5	29.5	29.9	0.4
Police & Fire Female	28.1	28.6	0.5	29.5	29.9	0.4

- The table above has three assumed preconditions, all of which serve to increase the life expectancy:
  - The individual is assumed to have already survived to age 60
  - The individual is assumed to have served in PERS-covered employment
  - The individual is assumed to not be disabled as of age 60

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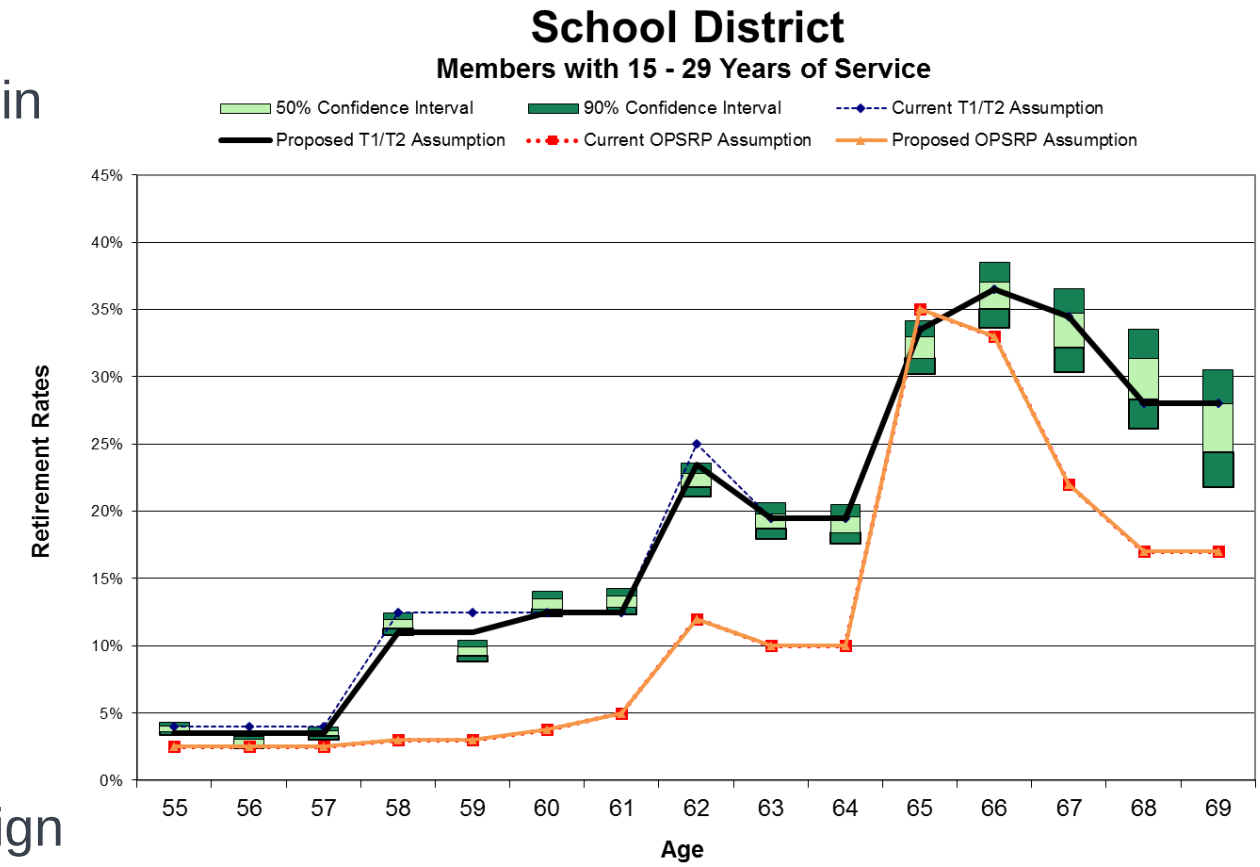
Rate of Retirement Assumption

- The likelihood that an eligible member retires in a given year
- Structure:
  - School District
  - Other General Service
  - Police & Fire
  - Divided into 3 service bands
  - Tier 1/Tier 2 vs. OPSRP
- Modifications made to assumptions at certain ages to more closely align with recent experience
  - Typically, lowering assumptions at some earlier retirement ages



Example shown above. Recommendations for other groups shown in detailed Experience Study report.

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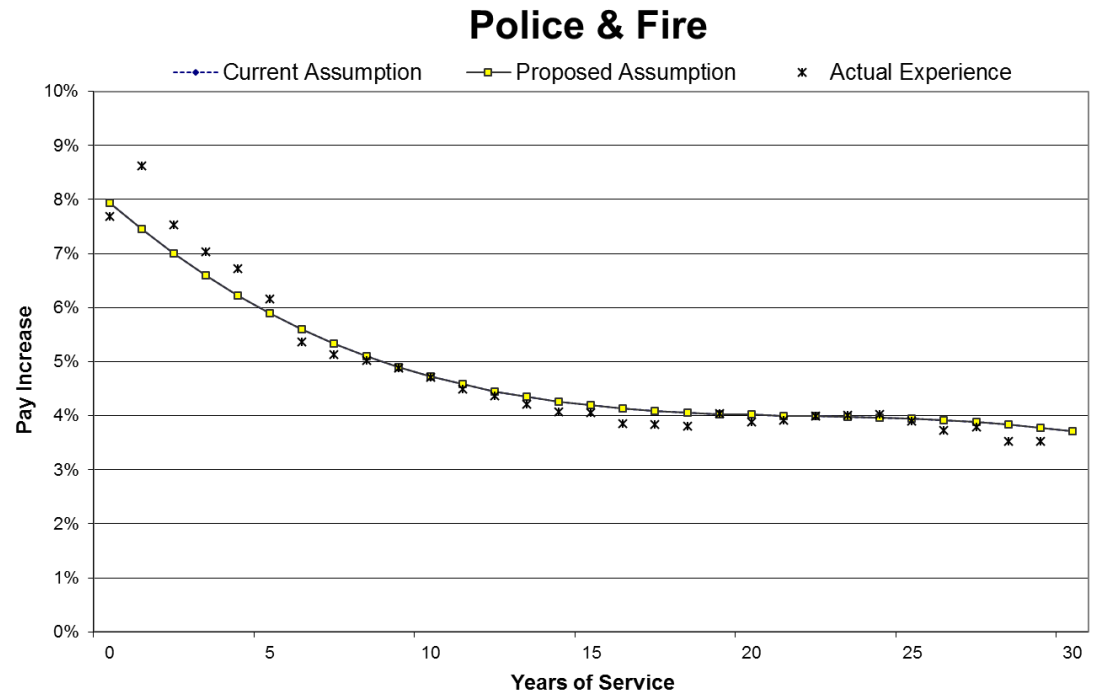
Individual Member Salary Increase Assumption

- Reflects combined effects of merit/longevity, general wage growth and inflation assumptions
  - Analyzed eight years of individual pay increases, then back out assumed inflation and general wage growth to isolate the merit/longevity component
- Structure:
  - School District
  - Other General Service
  - Police & Fire
- Police & Fire matched current assumption well



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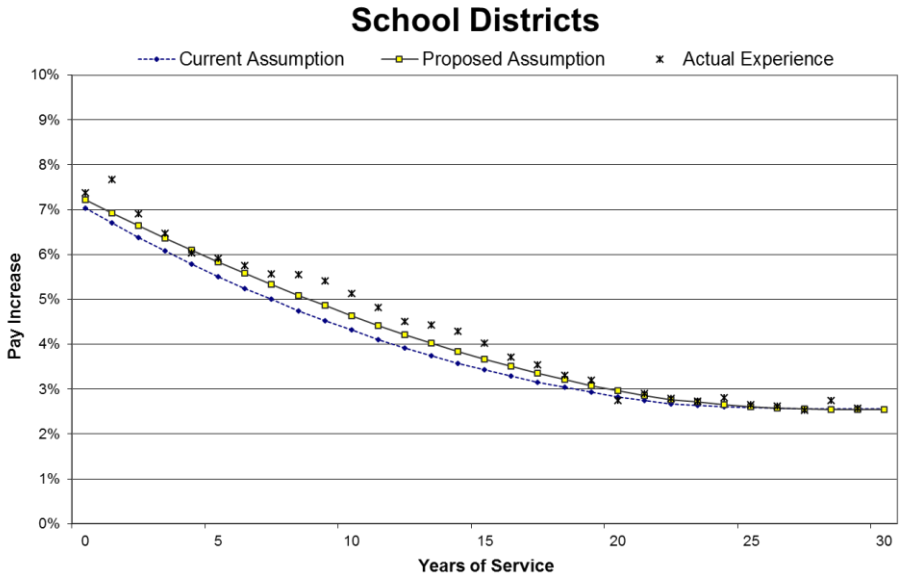
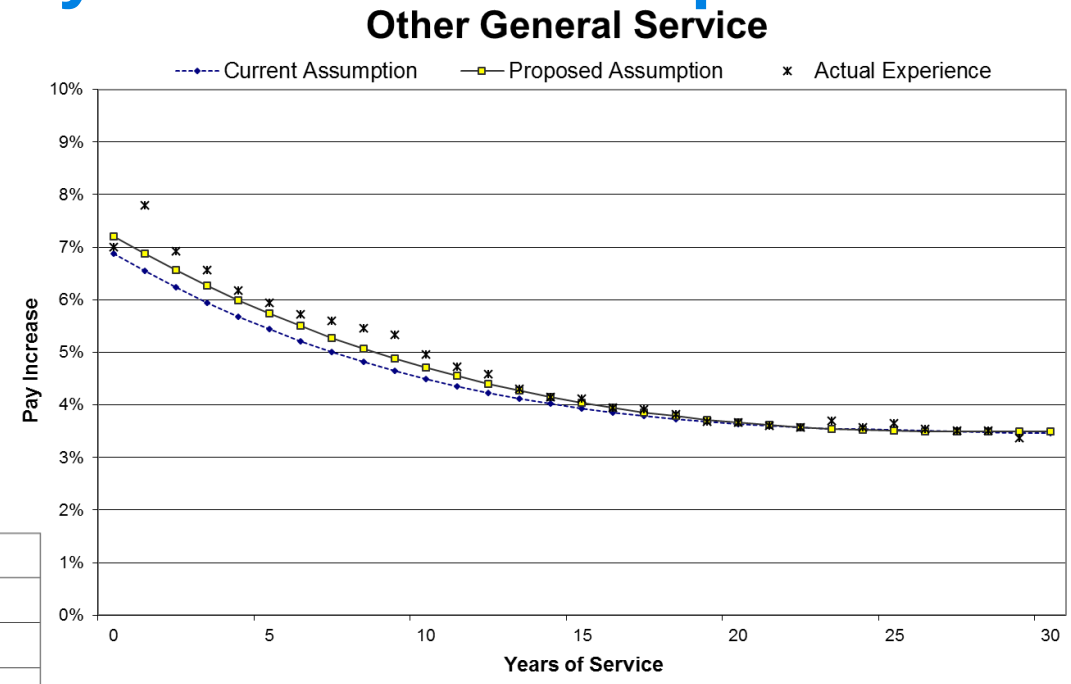
Individual Member Salary Increase Assumption

- School District and Other General Service had higher increases than assumed





- Assumptions updated reflecting a blend of current assumption and recent observed experience

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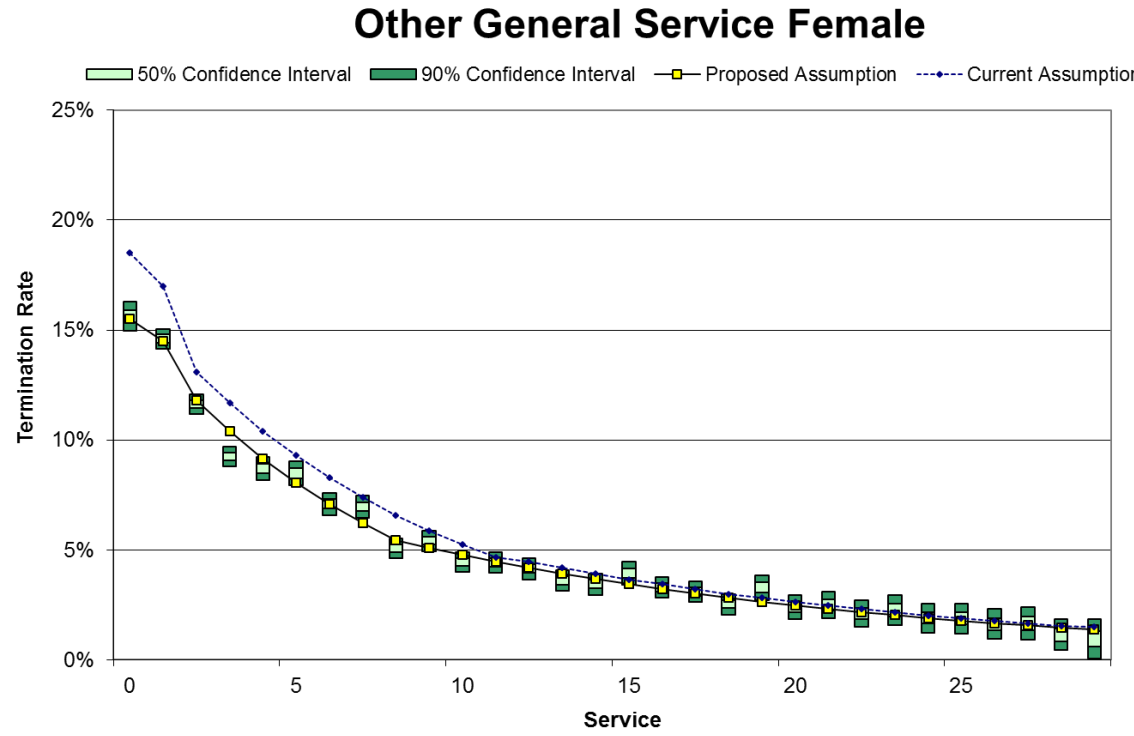
Pre-Retirement Employment Termination Assumption

- The likelihood that a member leaves employment in a given year prior to retirement eligibility for reasons other than death or disability
- We recommend adjustments to the assumption for two of five groups for relatively minor, but statistically significant, differences between the current assumption and observed experience



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Final Average Salary Adjustments

- In the valuation, we apply assumptions regarding the increase in final average salary for Tier 1/Tier 2 members attributable to:
  - Unused sick leave
  - Lump sum distribution of vacation pay (only affects Tier 1)
- Only relevant when benefits are calculated using Full Formula or Formula Plus Annuity
- We recommend some adjustments to more closely track recent experience:

Unused Sick Leave	Current Assumption	Proposed Assumption
State GS Male	6.25%	**7.00%**
State GS Female	3.75%	3.75%
School District Male	7.50%	**7.75%**
School District Female	5.75%	5.75%
Local GS Male	4.75%	**5.25%**
Local GS Female	3.25%	**3.50%**
State Police & Fire	4.75%	**4.00%**
Local Police & Fire	7.25%	7.25%
Inactive Members	3.25%	3.25%

Tier 1 Vacation Cash Out	Current Assumption	Proposed Assumption
State GS	2.00%	**2.25%**
School District	0.25%	0.25%
Local GS	2.75%	**3.25%**
State Police & Fire	2.50%	**2.75%**
Local Police & Fire	3.75%	**4.25%**

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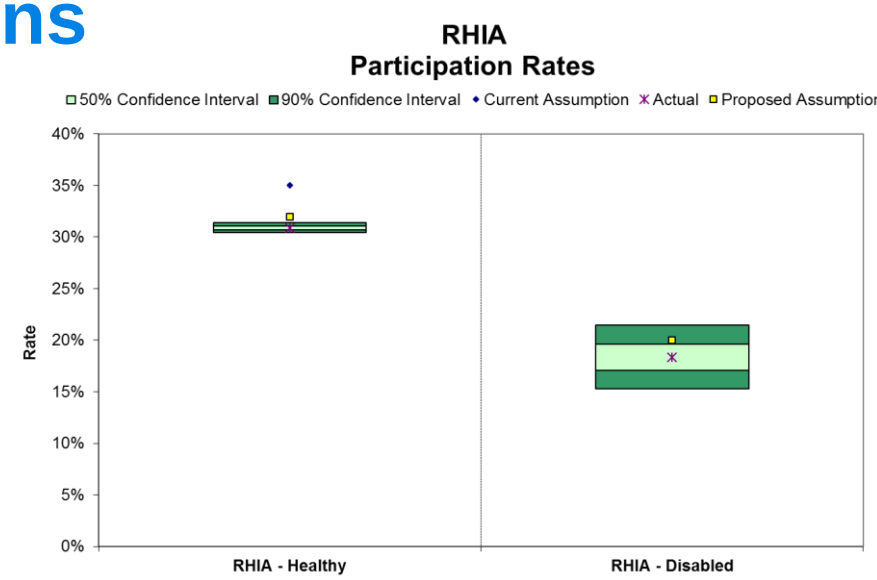
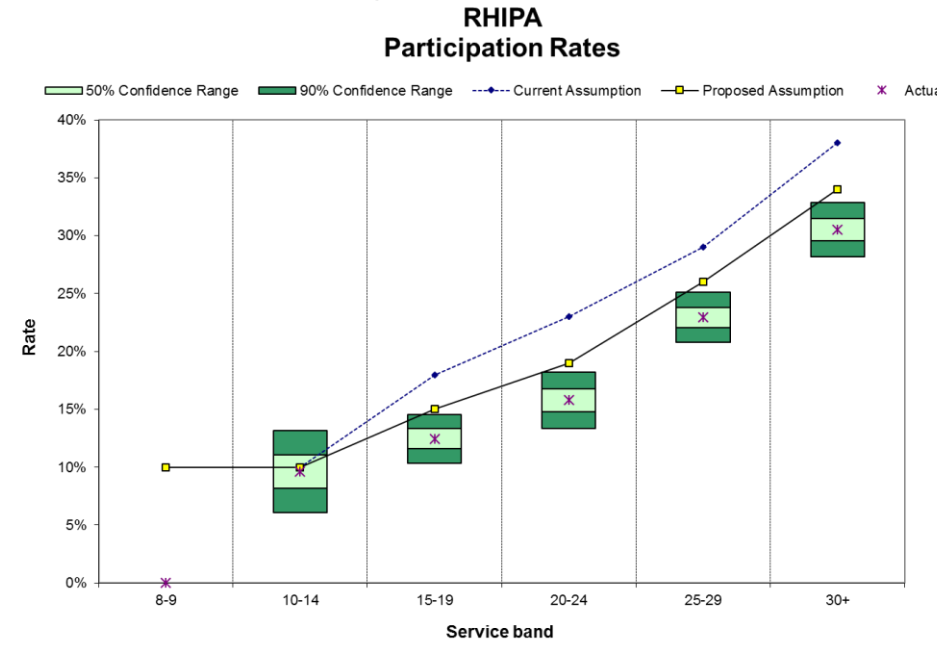
RHIA and RHIPA Assumptions

- Updates to retiree healthcare participation:
  - Healthy RHIA: Lower participation rates
  - Disabled RHIA: No change
  - RHIPA: Lower rates in most categories
- Health care cost trend assumption applied to RHIPA full subsidy amount was also updated
  - Based on analysis by Milliman health actuaries





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Estimated Effect of Assumption Changes

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Preliminary Effect of Changes – Liability

- Estimated effect on combined Tier 1, Tier 2, and OPSRP liabilities based on preliminary valuation work
  - Illustrated for three different investment return assumptions

12/31/2018 Accrued Liability	Assumed Return 7.2%	Assumed Return 7.1%	Assumed Return 7.0%
Current assumptions*	$86.6 B		
Mortality	($0.1 B)		
Merit	$0.0 B		
Other demographic assumptions	$0.1 B		
Revised assumptions (before assumed return)	$86.6 B	$86.6 B	$86.6 B
Assumed return	$0.0 B	$0.9 B	$1.8 B
Revised assumptions	$86.6 B	$87.5 B	$88.4 B

**Includes reduction of less than $0.1 billion for SB 1049*

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Preliminary Effect of Changes – Uncollared Rates

- Estimated impact on uncollared system-average advisory pension rates for 2021-2023 based on preliminary valuation work

	Assumed Return 7.2%		Assumed Return 7.1%		Assumed Return 7.0%	
	UAL	Normal Cost	UAL	Normal Cost	UAL	Normal Cost
Mortality	(0.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%
Merit	0.0%	0.2%	0.0%	0.2%	0.0%	0.2%
Other demographic assumptions	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Assumed return	0.0%	0.0%	0.4%	0.3%	0.8%	0.6%
Total	**0.0%**	**0.3%**	**0.4%**	**0.6%**	**0.8%**	**0.9%**
Combined Total	**0.3%**		**1.0%**		**1.7%**	

Changes shown are stated as a percent of payroll and exclude changes for the RHIA & RHIPA retiree healthcare programs

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Agenda Items – Remaining 2019 Meetings

- Needed action before completion of actuarial valuations:
  - Adoption of assumptions and methods for use in the following valuations:
    - December 31, 2018 “advisory” valuation that estimates 2021-2023 rates
    - December 31, 2019 valuation that calculates recommended 2021-2023 rates
- October meeting:
  - Presentation of system-level December 31, 2018 actuarial valuation results
  - Adoption of actuarial equivalency factors effective January 1, 2020
- December meeting:
  - Acceptance of the December 31, 2018 actuarial valuation report and employer-specific advisory 2021-2023 contribution rates
  - Financial modeling over the next twenty years under a variety of possible future scenarios for actual investment return

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Appendix

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Certification

This presentation discusses actuarial methods and assumptions for use in the valuation of the Oregon Public Employees Retirement System ("PERS" or "the System"). For the most recent complete actuarial valuation results, including cautions regarding the limitations of use of valuation calculations, please refer to our formal Actuarial Valuation Report as of December 31, 2017 ("the Valuation Report") published on September 28, 2018. The Valuation Report, including all supporting information regarding data, assumptions, methods, and provisions, is incorporated by reference into this presentation. The statements of reliance and limitations on the use of this material is reflected in the actuarial report and still apply to this presentation. The Valuation Report, along with prior presentations to the PERS Board, including the April 2019 and May 2019 presentations to the PERS Board, and the full Experience Study report should be referenced for additional detail on the assumptions, methods, and plan provisions underlying this presentation.

This presentation also summarizes a limited number of high-level preliminary results based on information provided for the December 31, 2018 actuarial valuation. These results are preliminary in nature, are shown here only for illustrating the effect of assumption changes, and should not be relied upon for other purposes. Final results will be published in the December 31, 2018 Actuarial Valuation Report to be published later this year, which will also document the member census data underlying the results.

In preparing this presentation, we relied, without audit, on information (some oral and some in writing) supplied by the System's staff as well as capital market expectations provided by Callan and information presented to the Oregon Investment Council. This information includes, but is not limited to, statutory provisions, employee data, and financial information. We found this information to be reasonably consistent and comparable with information used for other purposes. The results depend on the integrity of this information. If any of this information is inaccurate or incomplete our results may be different and our calculations may need to be revised.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. While we have illustrated scenarios with differing future investment future returns to illustrate the System's sensitivity to investment risk, due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements. Our annual financially modeling presentation to the PERS Board should be referenced for additional analysis of the potential variation in future measurements. Our forthcoming December 31, 2018 Actuarial Valuation Report will provide additional discussion of the System's risks. The PERS Board has the final decision regarding the appropriateness of the assumptions.

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Milliman's work product was prepared exclusively for Oregon PERS for a specific and limited purpose. It is a complex, technical analysis that assumes a high level of knowledge concerning PERS' operations, and uses PERS' data, which Milliman has not audited. It is not for the use or benefit of any third party for any purpose. To the extent that Milliman's work is not subject to disclosure under applicable public records laws, Milliman's work may not be provided to third parties without Milliman's prior written consent. Milliman does not intend to benefit or create a legal duty to any third party recipient of its work product. 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 pension actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel. The signing actuaries are independent of the plan sponsors. We are not aware of any relationship that would impair the objectivity of our work.

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

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Appendix
Data

Except where noted, our analysis of demographic assumptions was based on data for the experience period from January 1, 2015 to December 31, 2018 as provided by the Oregon Public Employees Retirement System (PERS). PERS is solely responsible for the validity, accuracy and comprehensiveness of this information; the results of our analysis can be expected to differ and may need to be revised if the underlying data supplied is incomplete or inaccurate.

Member data was summarized according to the actual and potential member decrements during each year. Actual and potential decrements were grouped according to category of employment, sex, age, and/or service depending on the demographic assumption.

Where possible, we attempted to identify decrements that were spread across two calendar years (for example, if a member retired in one year, but didn't commence benefits until January 1 of the following year) so that we could reflect these decrements as individual events.

In order to capture experience across a broader range of budget, collective bargaining, and economic cycles, our analysis of salary increases covered observed salary experience from 2010 through 2018 as provided by PERS.

Our analysis focused on observed salary levels during consecutive calendar years for members who remained in active employment across both years, so that the observed change in salary would not be influenced by the reduced number of months worked during a year in which the member decrements. Similarly, we focused on experience above the 5th percentile and below the 95th percentile of observed salary increases in order to avoid the potential distorting effect of including extreme salary changes that likely resulted from unusual events.

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Appendix
Actuarial Basis

Capital Market Assumptions - Milliman

For assessing the expected portfolio return under Milliman's capital market assumptions, we considered the Oregon PERS Fund to be allocated among the model's asset classes as shown below. This allocation is based on the Oregon Investment Council's Statement of Investment Objectives and Policy Framework for the Oregon PERS Fund, as revised April 2018, and changes adopted in April 2019.

	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
US Large/Mid-Cap Equity	7.35%	6.30%	15.50%	16.17%
US Small Cap Equity	8.35%	6.68%	19.75%	1.35%
US Micro-Cap Equity	8.86%	6.79%	22.10%	1.35%
Non-US Developed Equity	8.30%	6.91%	17.95%	13.47%
Emerging Markets Equity	10.35%	7.69%	25.35%	4.23%
Non-US Small Cap Equity	8.81%	7.25%	19.10%	1.92%
Private Equity	11.95%	8.33%	30.00%	17.50%
US Core Fixed Income	4.14%	4.07%	3.90%	9.60%
US Short-Term Bonds	3.70%	3.68%	2.10%	9.60%
US Bank/Leveraged Loans	5.40%	5.19%	6.85%	3.60%
High Yield Bonds	6.13%	5.74%	9.35%	1.20%
Real Estate	6.19%	5.55%	12.00%	10.00%
Global REITs	8.29%	6.69%	19.30%	2.50%
Timber	6.36%	5.61%	13.00%	1.13%
Farmland	6.87%	6.12%	13.00%	1.13%
Infrastructure	7.51%	6.67%	13.85%	2.25%
Commodities	5.34%	3.79%	18.70%	1.13%
Hedge Fund of Funds - Diversified	4.28%	4.06%	6.90%	1.50%
Hedge Fund Event-Driven	5.89%	5.59%	8.10%	0.37%
US Inflation (CPI-U)		2.50%	1.65%	**N/A**
Fund Total (reflecting asset class correlations)	**7.55%**	**6.91%***	**12.14%**	**100.00%**

* Reflects 0.10% average reduction to model passive investment expenses. The model does not try to assess the actual investment expenses for active management. The model's 20-year annualized geometric median is **6.87%**.

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Appendix
Actuarial Basis
Capital Market Assumptions - Callan

For assessing the expected portfolio return under Callan's capital market assumptions, we applied the assumptions shown below provided by Callan.

	10-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
Broad US Equity	7.15%	17.97%	**16.25%**
Global ex-US Equity	7.25%	21.10%	**16.25%**
OIC Private Equity	9.18%	26.30%	**17.50%**
Private Real Estate	7.03%	12.21%	**12.50%**
US Fixed Income	3.75%	3.75%	**20.00%**
Diversifying Strategies	6.15%	10.97%	**7.50%**
Illiquid Alternatives	7.38%	12.56%	**7.50%**
Risk Parity	6.50%	11.00%	**2.50%**
Inflation	2.25%	1.50%	**N/A**
Fund Total (reflecting asset class correlations)	**7.39%***	**12.49%**	**100.00%**

* 10-year annualized geometric median is **7.32%**.

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Appendix
Actuarial Basis

Capital Market Assumptions - Horizon

For assessing the expected portfolio return under an additional set of capital market assumptions, we applied the assumptions from the 2018 Survey of Capital Market Assumptions published by Horizon Actuarial Services, LLC. According to the survey report, the 10-year return assumptions shown below represent an average of the expectations for 34 investment advisors responding to the survey.

	10-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
US Equity – Large Cap	6.07%	16.39%	**16.17%**
US Equity – Small/Mid Cap	6.57%	20.20%	**5.20%**
Non-US Equity – Developed	6.71%	18.67%	**15.40%**
Non-US Equity – Emerging	7.64%	24.89%	**4.24%**
US Corporate Bonds – Core	3.37%	5.71%	**14.40%**
US Corporate Bonds – High Yield	4.78%	10.24%	**4.80%**
US Treasuries (Cash Equivalents)	2.48%	2.74%	**4.80%**
Real Estate	5.90%	13.86%	**12.25%**
Hedge Funds	4.96%	7.87%	**1.87%**
Commodities	3.97%	17.60%	**1.12%**
Infrastructure	6.56%	14.74%	**2.25%**
Private Equity	8.33%	22.16%	**17.50%**
Inflation	2.24%		**N/A**
Fund Total (reflecting asset class correlations)	**6.70%***		**100.00%**

* 10-year annualized geometric median is **6.64%**.

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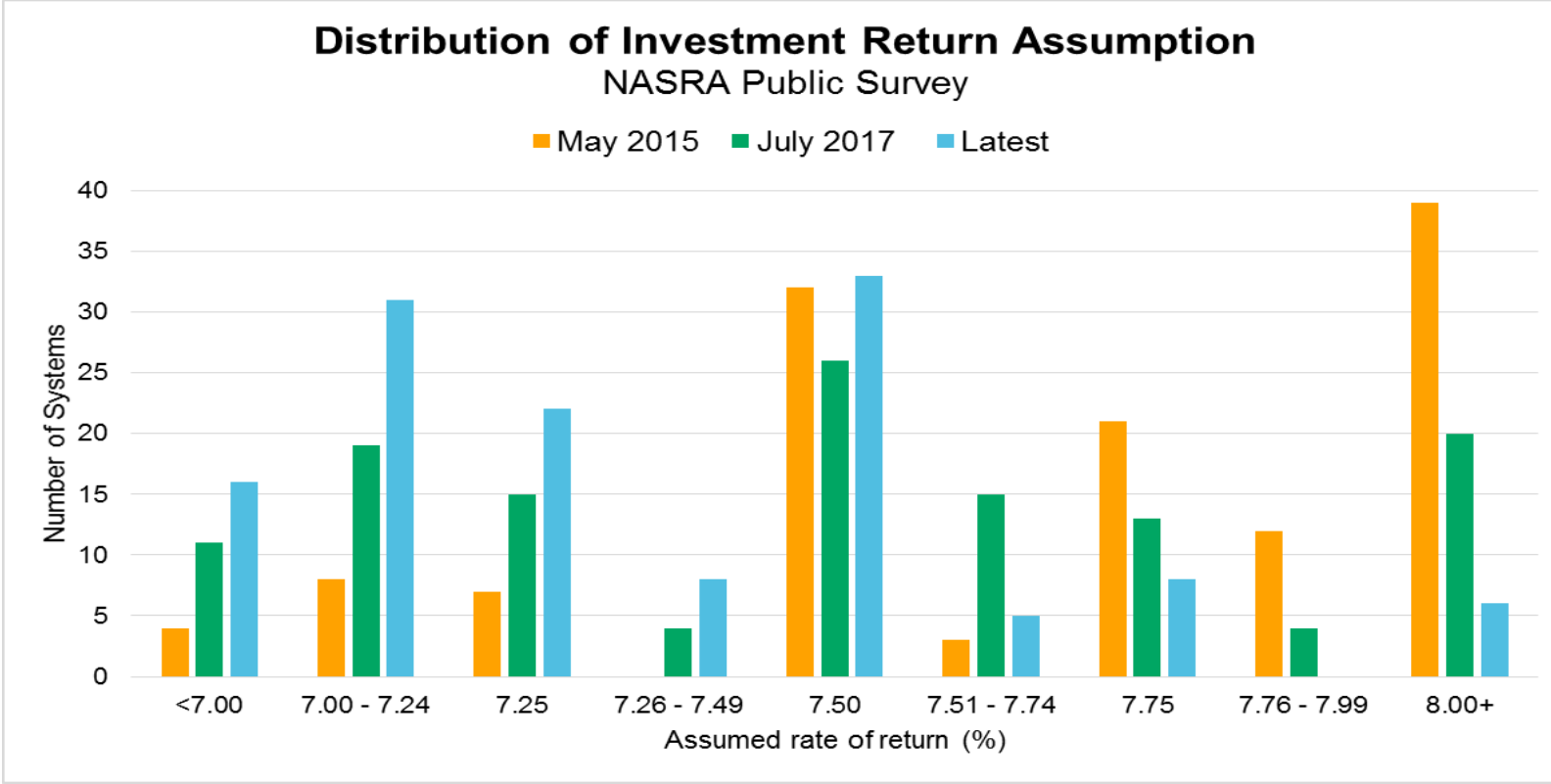
Comparison to Peer Systems

- There is a downward trend in public plan return assumptions, with a current median assumption for large public systems of **7.25%**
- Over 50% of the 129 systems tracked by the NASRA Public Fund Survey reduced their assumption over last 2-3 years



Source: NASRA (April, 2019)

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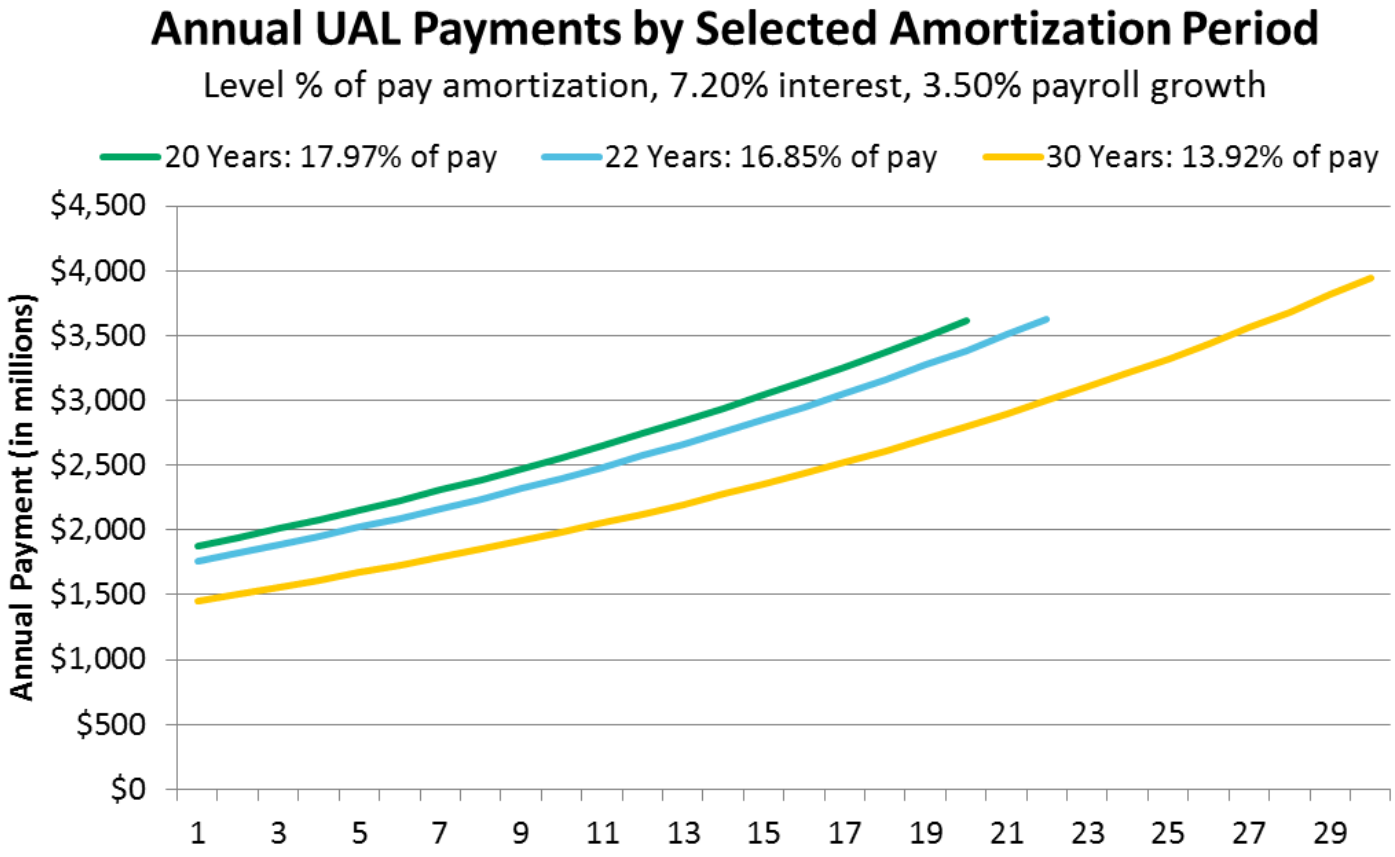
Illustration of UAL Amortization Periods



Current policy

- Tier 1 / Tier 2: **20 years**
- OPSRP: **16 years**

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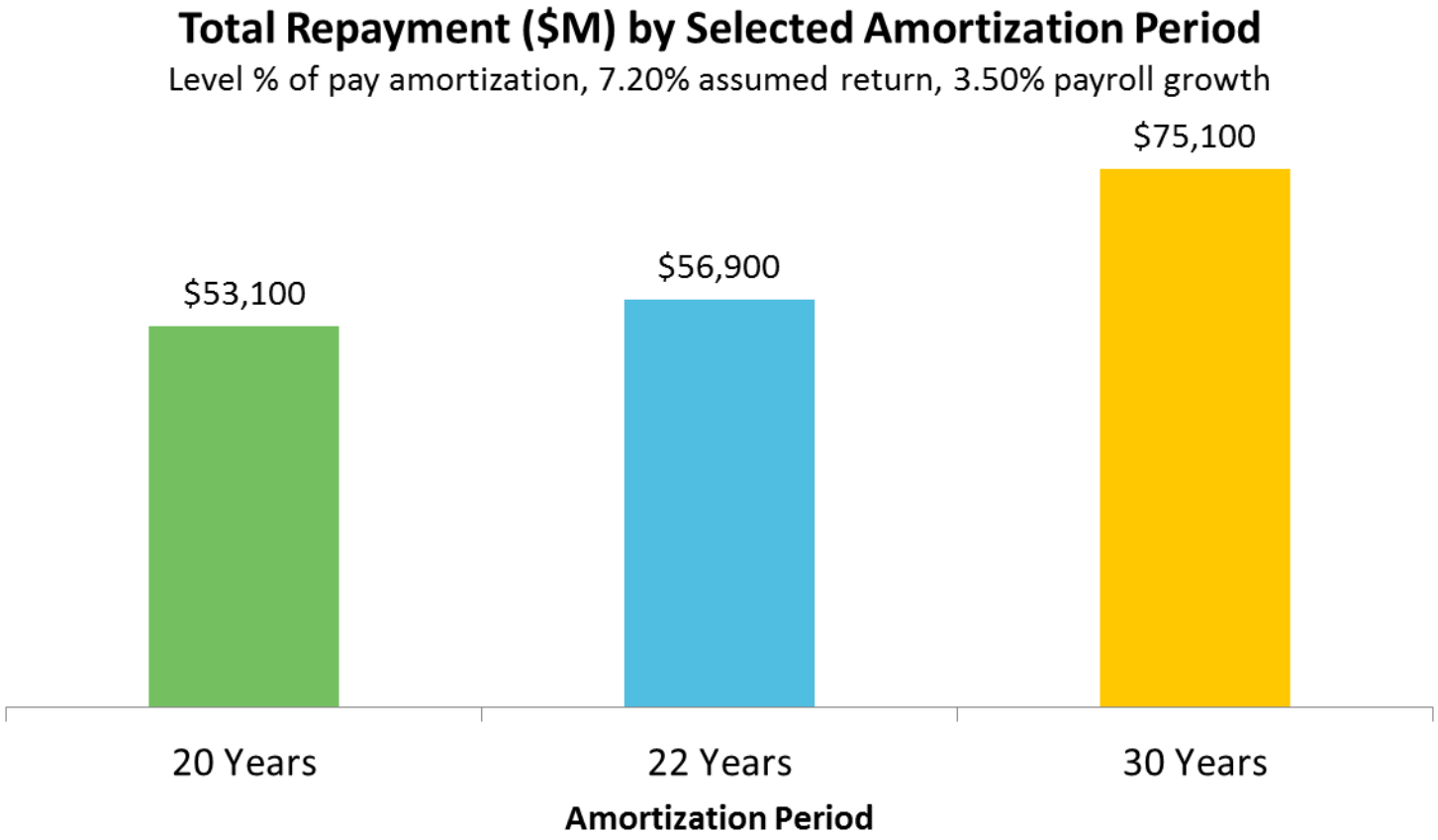

Current policy

- Tier 1 / Tier 2: **20 years**
- OPSRP: **16 years**

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Effects of Lowering the Assumed Return

- Lowering the assumption to 7.10% or 7.00% would affect the Money Match calculation for a member age 59½ with a $135,000 member account balance as of 6/30/2019 as shown:

	Starting Benefit Under Assumed Rate*		
Benefit Commencement	**7.20%**	**7.10%**	**7.00%**
7/1/2019	$1,909		
12/1/2019	$1,973		
1/1/2020		$1,971	$1,951
2/1/2020		$1,985	$1,965
3/1/2020		$1,999	$1,979

** Illustration uses 2018 actuarial equivalency mortality in calculation of all benefits*

- At a 7.00% assumption, it would take about three months without retirement for the December 2019 initial benefit level to be reached
  - At a 7.10% assumed return, it would take about one month
  - Illustration ignores Full Formula "floor", which may mitigate any benefit decrease

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Mortality Assumption

	Current Assumption	Proposed Changes
Healthy Retired	RP 2014 Generational, with unisex Social Security scale (1953-2013 experience) Healthy Annuitant, Sex distinct	Pub-2010 Generational, with unisex Social Security scale (1955-2015 experience) Healthy Retiree, Sex distinct
▪ School district male	White collar, set back 1 year	Teachers, no set back
▪ Other GS male	50% blue/50% white collar, set back 1 year	General Employees, set back 1 year
▪ P&F male	50% blue/50% white collar, set back 1 year	Public Safety, no set back
▪ School district female	White collar, set back 1 year	Teachers, no set back
▪ Other GS female	50% blue/50% white collar, no set back	General Employees, no set back
▪ P&F female	50% blue/50% white collar, no set back	Public Safety, set back 1 year
Disabled Retired	RP 2014 Disabled, Generational with unisex Social Security scale (1953-2013) Sex distinct	Pub-2010 Disabled, Generational with unisex Social Security scale (1955-2015) Sex distinct
▪ P&F male	Disabled Retiree, no set back	50% Public Safety/50% Non-Safety, no set back
▪ Other male	Disabled Retiree, no set back	Non-Safety, set forward 2 years
▪ P&F female	Disabled Retiree, no set back	50% Public Safety/50% Non-Safety, no set back
▪ Other female	Disabled Retiree, no set back	Non-Safety, set forward 1 year
Non-Retired Mortality	RP 2014 Generational, with unisex Social Security scale (1953-2013) Employee (Non-Annuitant), Sex distinct	Pub-2010 Generational, with unisex Social Security scale (1955-2015) Employee (Non-Annuitant), Sex distinct
▪ School district male	White collar, set back 1 year	Teachers, no set back, scaled 120%
▪ Other GS male	50% blue/50% white collar, set back 1 year	General Employees, set back 1 year, scaled 115%
▪ P&F male	50% blue/50% white collar, set back 1 year	Public Safety, no set back, not scaled
▪ School district female	White collar, set back 1 year	Teachers, no set back, not scaled
▪ Other female	50% blue/50% white collar, no set back 50% blue/50% white collar, no set back	General Employees, no set back, scaled 125% Public Safety, set back 1 year, not scaled

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