District of Columbia Retirement Board Teachers' Retirement Plan and Police Officers and Firefighters' Retirement Plan

Experience and Assumption Study
July 1, 2015 to June 30, 2020 Experience

Bolton

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The Board of Trustees
District of Columbia Retirement Board
900 7th Street, NW, 2nd Floor
Washington, DC 20001

Re: *District of Columbia Teachers' Retirement Plan and District of Columbia Police Officers and Firefighters' Retirement Plan Experience and Assumption Study*

Dear Trustees,

This report presents the results of our experience study of the District of Columbia Teachers' Retirement Plan and the District of Columbia Police Officers and Firefighters' Retirement Plan (collectively referred to as the Plans) and includes our recommended changes to plan assumptions. These recommendations are based on:

-   Our findings from the study of the demographic and economic experience of the Plans for the period June 1, 2015 through June 30, 2020, and
-   Our expectations, based on professional judgement, estimates inherent in market data, emerging trends, and expert opinions, of future experience

We summarize our recommendations in the *Summary of Recommendations* section and analyze our findings in the *Demographic Assumptions* and *Economic Assumptions* sections. Finally, we present in the *Impact of Changes* section the effect of the proposed changes on plan liabilities, funding levels, and developed contributions, using the October 1, 2020 actuarial valuations as a proxy for the impact upon actual implementation of updated assumptions.

Respectfully submitted,

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Section I. Introduction

This report reviews the actuarial experience of the District of Columbia Teachers' Retirement Plan and the District of Columbia Police Officers and Firefighters' Retirement Plan during the five-year period from July 1, 2015, to June 30, 2020, in order to consider changes in actuarial assumptions. Based on the review of plan experience and considerations regarding future expectations, several changes in actuarial assumptions are recommended for approval by the District of Columbia Retirement Board.

The Board is entrusted with setting the assumptions for the plans it oversees. To keep the actuary's liability and contribution calculations in concert with reality, the assumptions used must be reasonably related to the circumstances surrounding the plans as currently written. Generally, the best way to maintain reasonable assumptions is to periodically review past plan experience in comparison to the assumptions incorporated by the actuary and, as a result of that review and the consideration of future expectations, recommend improvements, where necessary, for use in the valuation process.

Section VI of the report shows the impact of proposed changes to the liabilities, funding levels, and annual contributions had these new assumptions been in place for the October 1, 2020 valuation. Actual changes will first impact the October 1, 2021 valuation, which will develop the contributions for FY2023.

The actual long-term cost of the plans is not dependent on assumptions but rather will be tied to actual plan experience, including changes in plan demographics and fluctuations in the general economy (such as variations in inflation or interest rate levels), which translate into tangible costs for the plan through:

(1) the plan benefits paid (including cost-of-living adjustments (COLAs) on post-retirement benefits as applicable),
(2) the investment return on plan assets, and
(3) the payment of other plan-related expenses.

Despite the lack of influence that assumptions have on long-term plan costs, a current value of expected future plan benefits needs to be calculated regularly (generally, annually) to orderly determine an appropriate amount of money to set aside for prefunding benefits. Such a determination requires the use of assumptions about future events. As actual experience differs from the assumptions, the expected cost of the plans and, consequently, the contributions to fund the plans generally[1] will gradually change. Ideally, the assumptions will closely track actual experience. However, for some assumptions (e.g., investment return), actual experience will commonly and materially vary from the assumption from year to year. As such, reasonable assumptions should not only be appropriate for the purpose of the measurement, but they should also be unbiased in nature such that they balance expected upward and downward deviations in experience.

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[1] If the contribution calculation methodology does not adhere to actuarial principles for developing Actuarially Determined Contributions (ADCs) or if the plan sponsor does not make contributions that align with the ADC, differences between experience and plan assumptions may not impact actual plan contributions.

While the cost of the plan will "self-adjust" to reflect actual experience, it is important to review and reset the assumptions from time to time to:

(1) minimize experience gains and losses,
(2) reduce contribution volatility, and
(3) achieve a better level of intergenerational taxpayer equity.

For some assumptions (e.g., mortality), the experience of the plans alone is insufficient to be statistically significant, and as such, industry tables and experience should be considered when setting those assumptions. Also, certain economic assumptions (i.e., inflation) are not based solely on recent plan experience and require longer periods of experience to be considered in conjunction with future expectations. The three key assumptions tied to the economy are:

(1) Cost of living adjustments (COLAs) on post-retirement benefit
(2) Pay increases
(3) Investment returns

Each of these are tied to inflation in some way so the long-term inflation assumption affects these elements of the study.
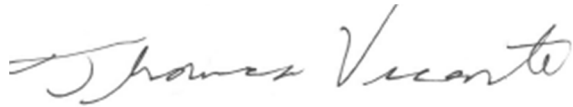
In conducting this experience study, we emphasized the importance of developing assumptions that reflect a best estimate of *future* plan experience. Rather than change every assumption to exactly match actual recent experience, we have analyzed the *trends* inherent in that experience and have developed assumptions that reflect expectations of future experience. Additionally, for some assumptions, even though Police and Fire are in the same plan, this report shows actual experience separately for Fire and Police members since the differences between them and the level of impact of the assumption warranted their independent study.

Bolton has prepared this report exclusively for the Board. The purpose of this report is to provide recommended assumption changes and the impact of those recommendations on plan liabilities and annual contributions. This report may not be used or relied upon by any other party or for any other purpose; Bolton Partners is not responsible for the consequences of any unauthorized use.

This report is based on data provided by the prior actuary, Cavanaugh MacDonald, and the Board (see Section VII for further details). The Board is solely responsible for the validity, accuracy and comprehensiveness of this information. If the data or plan provisions supplied are not accurate and complete, the experience study results may differ significantly from the results that would be obtained with accurate and complete information; such a scenario could require a later revision of this report.

Professional Qualifications

We are available to answer any questions on the material in this report or to provide explanations or further details as appropriate. The undersigned credentialed actuaries meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained in this report. We are not aware of any direct or material indirect financial interest or relationship, including investments or other services that could create a conflict of interest that would impair the objectivity of our work.

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Section II. Summary of Recommendations

The period since 2007 has been an unusual period of time. By early 2020, the economic markets had largely recovered from the implosion of the real estate, debt and equity markets in 2008 and the first quarter of 2009. The recovery had been slow, with both short- and long-term effects on government finances. Then COVID-19 hit. We have tried to consider all of these environments in our review of the five years of demographic and economic pension plan experience from July 1, 2015 through June 30, 2020, and in our recommendations for changes to the assumptions used to determine the pension contributions and funding levels.

Teachers' Retirement Plan

We have the following recommendations related to the demographic assumptions:
- Update longevity (mortality) tables to better match more recent projections
- Reduce assumed retirement rates in earlier and later years of retirement eligibility
- Adjust turnover and disability assumptions to better match experience

We make the following recommendations related to the economic assumptions:
- Reduce the inflation assumption to better match current projections
- Reduce the investment return/discount rate to improve the probability of achieving the expected return
- Reduce the pay increase assumption to better match past patterns and emerging trends
- Reduce the payroll growth assumption to better match current projections

Police Officers and Firefighters' Retirement Plan

We have the following recommendations related to the demographic assumptions:
- Update longevity (mortality) tables to better match more recent projections
- Update retirement assumptions to better match experience
- Adjust turnover and disability assumptions to better match experience

We make the following recommendations related to the economic assumptions:
- Reduce the inflation assumption to better match current projections
- Reduce the investment return/discount rate to improve the probability of achieving the expected return
- Reduce the pay increase assumption to better match past patterns and emerging trends
- Reduce the payroll growth assumption to better match current projections

We discuss the actual experience and the reasons for these recommended assumption changes in Sections III (*Demographic Assumptions*) and IV (*Economic Assumptions*) and show the effect of these changes on the pension funding levels and required contributions in Section VI.

Section III. Demographic Assumptions

This section addresses our review and recommendations regarding all demographic assumptions. The order in which we address these assumptions is generally the order of significance of the assumption in determining plan liabilities.

Changes to assumptions do not imply that prior assumption sets were wrong or that there were errors. Rather, they are meant to keep up with emerging trends and changes in the sponsoring organization.

Mortality

Pension plans pay benefits for life, so estimates of longevity are an important element in assessing the funded status and funding needs of the program. Studies over the last two decades have shown a marked improvement in life expectancy. In addition, more studies have been done allowing us to see differences between different professions and how other factors beyond gender factor into future longevity. While overall life expectancy has improved, the projected rates of future improvements have slowed with the most current improvement scales showing lower rates of improvement than scales developed a few years ago.

The current assumption for both plans is:

Healthy Actives and Retirees (includes Beneficiaries)
The RPH-2014 Blue Collar Mortality Table projected generationally with Scale BB, set back 1 year for males

Disabled Retirees
The RPH-2014 Disabled Mortality Table set back 6 years for males and set forward 7 years for females

The mortality experience over the last five years shows that there were fewer actual deaths than expected for both groups based on the current assumptions. However, the size of the plan population is too small to use for developing a custom set of tables. The comparison of the actual number of retiree deaths to the expected number is as follows:

Teachers (headcount-weighted)

Population	Number of Deaths		Actual/Expected
	Expected	Actual	
Healthy Retirees and Beneficiaries	387	328	85%
Disabled Retirees	19	16	86%

Police & Fire (headcount-weighted)

Population	Number of Deaths		Actual/Expected
	Expected	Actual	
Healthy Retirees and Beneficiaries	141	135	96%
Disabled Retirees	37	23	63%

The above results are based on headcounts (i.e., the number of deaths). Mortality rates also vary by income in that members with larger pensions are generally shown to live longer, on average, than members with lower pensions. The actual-to-expected ratio changes somewhat when weighting mortality experience by benefit amounts. Instead of showing the number of individuals who passed away, the below chart weights the number of individuals by the amount of pensions they were receiving prior to their death:

Teachers (amount-weighted)

Population	Amount-Weighted Deaths		Actual/Expected
	Expected	Actual	
Healthy Retirees and Beneficiaries	6,093,155	5,467,512	90%
Disabled Retirees	374,816	341,700	91%

Police & Fire (amount-weighted)

Population	Amount-Weighted Deaths		Actual/Expected
	Expected	Actual	
Healthy Retirees and Beneficiaries	3,770,730	2,939,500	78%
Disabled Retirees	953,309	707,887	74%

On both a headcount-weighted and amount-weighted basis, healthy and disabled mortality (headcounts and dollars) tended to be lower than expected based on the current tables. This implies that participants are living longer than the current tables would indicate. This finding is in line with more recent large-scale studies that have found that longevity has continued to improve.

As part of the mortality review, we tested several standard tables against the most recent experience. Factors such as the credibility of the plans' experience, geographic area (mid-Atlantic region), and environment (urban setting) were all factored into our process.

In January 2019, the Society of Actuaries (SOA) released new mortality tables based exclusively on the experience of participants in public sector retirement plans. These tables featured versions that were specific to teachers, public safety, and general employees (Pub-2010 mortality tables). In order for the experience for the DCRB plans to be considered statistically credible we would need over 1,000 deaths by gender for each plan. Since membership in the Plans is not large enough to allow us to create a table based solely on experience of the two plans, we recommend using the best available mortality tables that reflect the plan's demographics.

For the Teachers plan, we performed an analysis comparing the actual experience of the group over the last five years to both the Pub-2010 Teachers and General mortality tables. After comparing the actual experience of the Teacher's plan with the expected out comes each of the two tables generated, it was determined that the General employees version of the table would be a better fit for now. The Teachers table indicates that longevity experience would be significantly better than what the actual experience and the General table would show. The Pub-2010 General mortality table provides a more reasonable estimate of future mortality experience when compared to the actual experience while still considering the most recent data. Given that

the population is not fully credible, it is not necessary to use a table that exactly replicates the experience of the population.

We performed a similar analysis for the combined Police and Fire groups. Here we determined that staying with the Pub-2010 Safety table would be the most appropriate approach. Using a small age adjustment provided a strong fit to the actual and projected experience.

The mortality for disabled lives is more difficult to model than that for healthy lives. This is because there is a very small pool of disabled retirees in the plans as well as the fact that the reasons for disability are varied. Different disability types could have vastly different impacts on the longevity of the participant. We are proposing Disability mortality tables that parallel the healthy service retiree mortality tables.

We recommend the Board adopt the following mortality tables for pre-retirement and post-retirement mortality:

Healthy Actives and Retirees
Pub-2010 General Employee and Healthy Retiree for Teacher participants

Pub-2010 Public Safety Employee and Healthy Retiree with male ages set forward 1 year for Police and Fire participants

Disabled Retirees
Pub-2010 General Disabled Retiree for Teacher participants

Pub-2010 Public Safety Disabled Retiree for Police and Fire participants

Contingent/Beneficiaries
Pub-2010 General Contingent Survivor for Teacher participants

Pub-2010 Public Safety Contingent Survivor for Police and Fire participants

As is currently the case, we would use generational tables, which incorporate future mortality improvements. Currently, mortality rates are assumed to improve using the Society of Actuaries' (SOA) Scale BB improvement scale, which is only based on age. The SOA publishes improvement scales annually that are based on the most recent experience, and they project improvements based on both age and calendar year. The latest improvement scale published by the SOA is the MP-2020 Improvement Scale. This scale generally assumes slower declines in mortality rates than previous improvement scales continuing a trend we have seen over the last several years. **We recommend adopting the latest improvement scale available at the time of each annual valuation instead of only changing the improvement scale after an experience study.** The analysis below uses the MP-2020 Improvement Scale.

The actual-to-expected amount-weighted ratios based on experience from the five-year study period and the proposed mortality and mortality improvement tables are presented in the tables below. The actual versus expected ratio now show that our new assumptions will anticipate fewer deaths. This is in keeping with overall trends and helps to prepare the plans for longer term improvement in the future:

Teachers (amount-weighted)

Population	Amount-Weighted Deaths		
	Expected (Proposed)	Actual	Actual/Expected
Healthy Retirees and Beneficiaries	4,747,914	5,467,512	115%
Disabled Retirees	293,565	341,700	116%

Police & Fire (amount-weighted)

Population	Amount-Weighted Deaths		
	Expected (Proposed)	Actual	Actual/Expected
Healthy Retirees and Beneficiaries	2,580,324	2,939,500	114%
Disabled Retirees	969,591	707,887	73%

The following graphs show the amount-weighted mortality rates for the actual experience, as well as the current assumptions and proposed assumptions.

Teachers

Teachers

Disabled Mortality (Amount-Weighted)

Police & Fire

Post-Retirement Mortality (Healthy)

Police & Fire

Post-Retirement Mortality (Disabled)
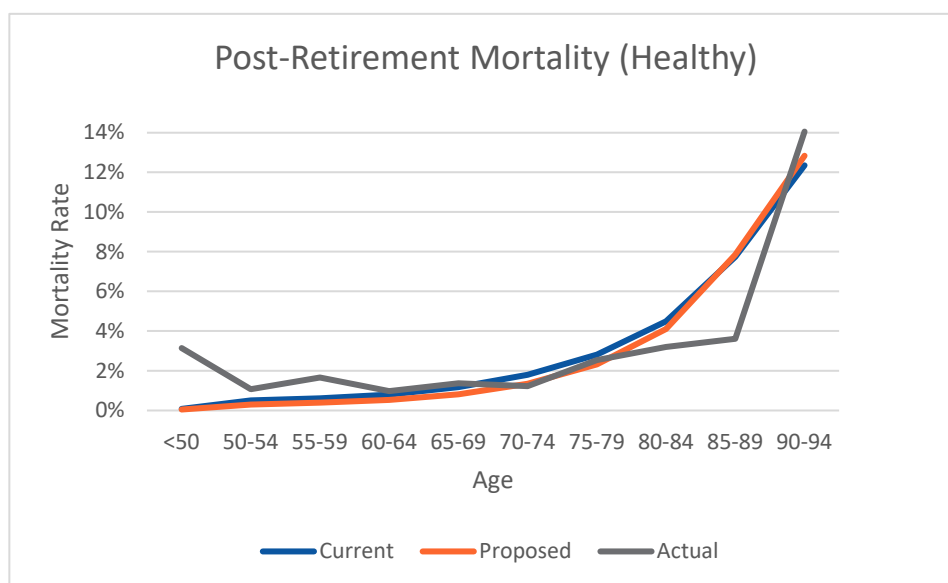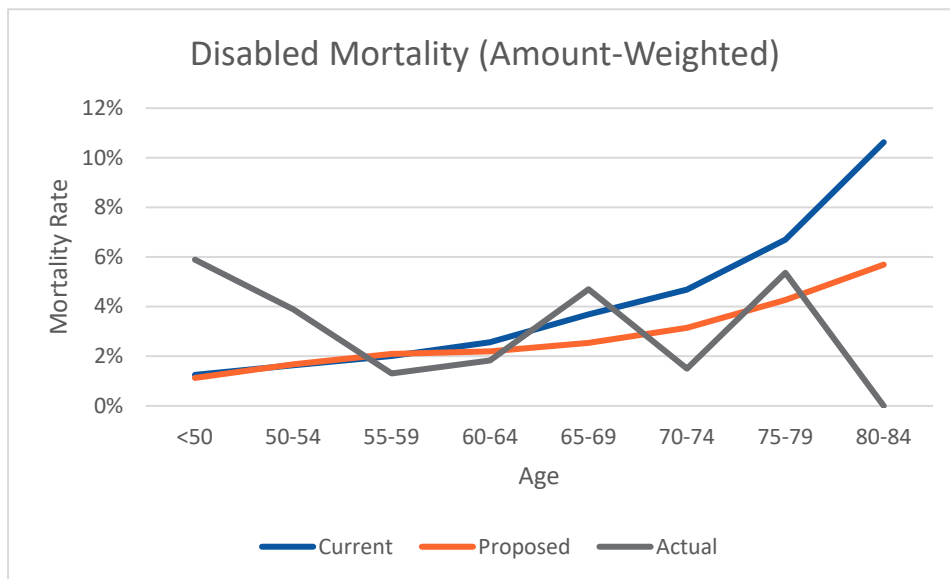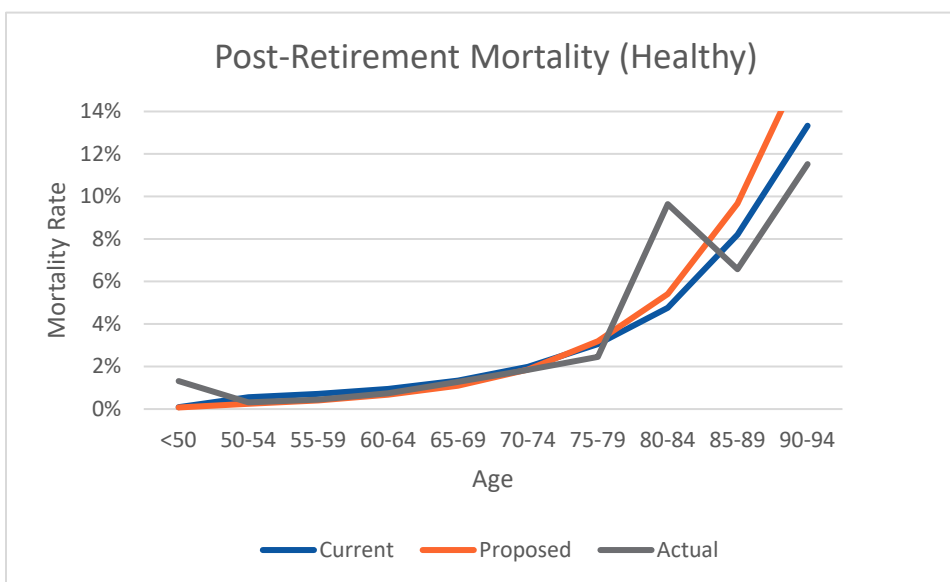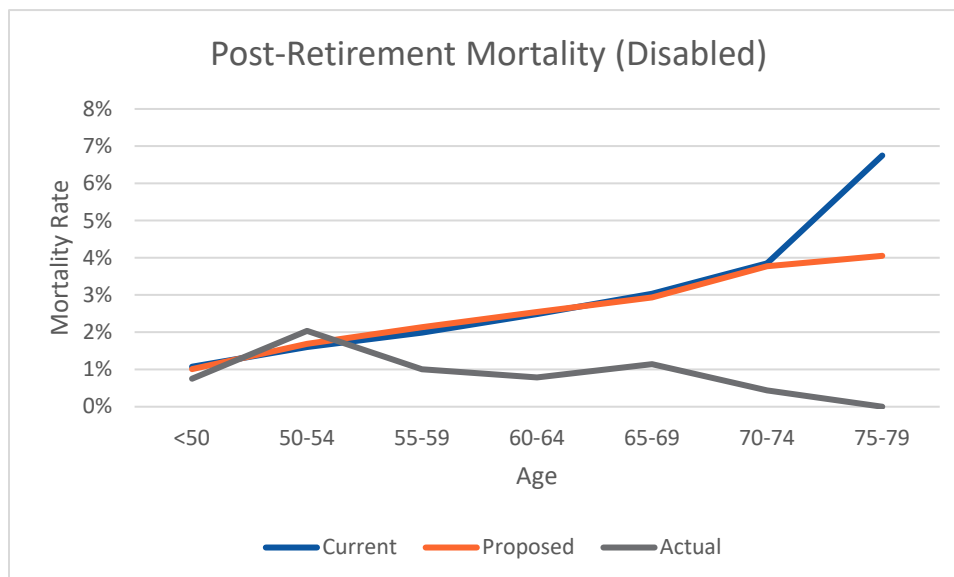
Additional Mortality Assumptions

The Police and Fire plan provides for different benefits for survivors when the death occurs in the line of duty. As a result, there needs to be an assumption as to what proportion of future in service deaths will be considered line of duty deaths. There have been twelve in service deaths over the last five years, which provides for a relatively small sample size to consider.

The current assumption is that 25% of the Police and Fire deaths for active employees are incurred in the line of duty (LOD). The following table shows the total count of duty-related and non-duty related deaths that occurred throughout July 1, 2015, to June 30, 2020:

	Count	Percentage
LOD Deaths	1	8%
Non-LOD Deaths	11	92%

Experience shows there were fewer duty-related deaths than expected for the police and fire employees. We recommend updating this assumption to assume that 20% of the deaths occur in the line of duty to better reflect recent experience.

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Retirement

Retirement patterns have changed over the years and in some plans can have a major impact on the plan costs. Earlier retirements can mean more years of payments, but they may also result in smaller individual payments as the participants forgo additional service credits or a higher pay level.

Teachers

If a participant has worked for at least 5 years as a DCPS teacher, voluntary retirement eligibility is defined as the earlier of the following:

- Age 62
- Age 60 and the completion of 20 years of service
- Age 55 and the completion of 30 years of service
- Any age and the completion of 30 years of service if hired on or after November 1, 1996

If a participant is vested and is involuntarily separated from service, involuntary retirement eligibility is defined as the earlier of the following:

- Any age and the completion of 25 years of service
- Age 50 and the completion of 20 years of service

Involuntary retirement benefits are reduced for ages under 55.

Current retirement assumptions account for both voluntary and involuntary retirements and are based on age and service for those who are eligible for retirement. Below is the current retirement rate assumption table:

Teacher Retirement Rates

Age	Years of Service			
	5 - 19	20 – 24	25 – 29	30+
<50	0%	0%	5%	5%
50 - 54	0%	5%	5%	5%
55 - 56	0%	9%	9%	22%
57	0%	9%	9%	20%
58	0%	10%	10%	20%
59	0%	10%	10%	25%
60	0%	27%	27%	28%
61	0%	25%	25%	28%
62	22%	22%	22%	25%
63	25%	25%	25%	22%
64	20%	20%	20%	25%
65	25%	25%	25%	35%
66	30%	30%	30%	25%
67	25%	25%	25%	25%
68	30%	30%	30%	30%
69	25%	25%	25%	30%
70	30%	30%	30%	30%

Age	Years of Service			
	5 - 19	20 – 24	25 – 29	30+
71	25%	25%	25%	30%
72	35%	35%	35%	30%
73 - 74	35%	35%	35%	35%
>=75	100%	100%	100%	100%

The experience over the last five years shows that:
- Current assumptions projected a higher number of retirements than actually occurred (535 expected vs. 339 actual).
  - There were significantly fewer retirements under involuntary retirement eligibility.

The study showed the following patterns emerging:
- Participants with under 20 years of service tended to delay retirement until age 62.
- Once participants had 20 or more years of service, they tended to retire at age 60.
- Retirement incidence tended to rise after 30 years of service (and age 55 or older).

The following table shows the expected teacher retirements during the experience period using the current retirement assumption table:

Expected Teacher Retirements

Age	Years of Service				Total Expected
	5-19	20 – 24	25 – 29	30+	
<50	0	0	2	0	2
50 - 54	0	12	13	3	28
55 - 56	0	8	9	20	37
57	0	5	3	10	19
58	0	6	5	8	20
59	0	4	7	9	21
60	0	12	18	13	43
61	0	8	13	12	33
62	31	8	7	12	58
63	27	7	8	9	50
64	15	6	6	10	36
65	17	6	6	11	39
66	19	4	7	6	35
67	10	2	5	6	23
68	10	3	3	5	21
69	7	2	2	5	15
70	6	2	2	5	14
71	3	1	1	2	7
72	3	2	1	2	9
73 - 74	2	2	2	2	8
>=75	3	0	6	8	17
Total Expected	**152**	**101**	**124**	**158**	**535**

The following table shows the actual teacher retirements that occurred during the experience period:

Actual Teacher Retirements

Age	Years of Service 5 - 19	20 – 24	25 – 29	30+	Total Actual
<50	0	0	0	0	0
50 - 54	0	5	7	1	13
55 - 56	0	6	8	14	28
57	0	2	2	13	17
58	0	2	4	13	19
59	0	2	4	7	13
60	2	7	12	14	35
61	2	5	10	6	23
62	20	11	1	8	40
63	17	1	2	7	27
64	5	3	4	8	20
65	7	4	3	7	21
66	6	2	5	3	16
67	8	1	4	5	18
68	4	3	1	3	11
69	4	3	1	0	8
70	5	2	2	4	13
71	2	0	0	1	3
72	1	2	1	1	5
73 - 74	0	1	0	4	5
>=75	1	0	0	3	4
Total Actual	**84**	**62**	**71**	**122**	**339**

The following table shows the ratio of actual teacher retirements to expected teacher retirements during the experience period:

Ratio Of Actual To Expected Teacher Retirements

| Age | Years of Service | | | | Actual/ Expected |
	5 - 19	20 – 24	25 – 29	30+	
<50	0%	0%	0%	0%	0%
50 - 54	0%	42%	53%	36%	47%
55 - 56	0%	71%	89%	72%	76%
57	0%	39%	58%	130%	92%
58	0%	34%	74%	159%	97%
59	0%	45%	58%	76%	63%
60	0%	58%	67%	104%	81%
61	0%	61%	80%	49%	70%
62	65%	135%	15%	65%	69%
63	63%	15%	26%	82%	54%
64	32%	52%	71%	84%	55%
65	42%	70%	48%	67%	54%
66	32%	56%	72%	50%	46%
67	78%	50%	84%	87%	79%
68	40%	91%	37%	56%	52%
69	59%	150%	67%	0%	54%
70	88%	95%	111%	83%	90%
71	62%	0%	0%	48%	41%
72	32%	82%	71%	48%	55%
73 - 74	0%	48%	0%	163%	60%
>=75	33%	0%	0%	38%	24%
Total Actual	**55%**	**61%**	**57%**	**77%**	**63%**

Accounting for the plan's experience and looking at other long-term trends we developed an age and service based set of assumptions that creates a better model compared to the actual data. We recommend the following proposed retirement rates for teachers:

Proposed Teacher Retirement Rates

Age	Years of Service						
	5	6 - 19	20	21 - 24	25-29	30	31+
<=50	0%	0%	0%	0%	5%	20%	15%
50 - 59	0%	0%	5%	5%	5%	20%	15%
60 - 61	0%	0%	20%	15%	15%	20%	15%
62	20%	20%	20%	15%	15%	20%	15%
63 - 74	20%	15%	15%	15%	15%	20%	15%
75+	100%	100%	100%	100%	100%	100%	100%

The following table reflects the expected teacher retirements using the proposed retirement rates:

Expected Teacher Retirements Using Proposed Rates

Age	Years of Service							Total Expected	Actual / Expected
	5	6-19	20	21-24	25-29	30	31+		
<50	0	0	1	2	4	0	0	6	16%
51-59	0	0	5	15	24	23	24	91	98%
60-61	0	0	5	8	17	7	9	46	127%
62	2	26	3	3	5	3	5	47	85%
63-74	4	66	6	15	24	6	29	151	98%
75+	1	2	0	0	6	2	6	17	24%
Total Expected	**7**	**95**	**20**	**43**	**79**	**41**	**73**	**358**	**95%**
Actual / Expected	89%	97%	81%	92%	96%	98%	95%	95%	

Police & Fire

Normal retirement under the Police and Fire plan are based on a member's tier. Tiers are defined as the following:

- Tier 1: hired before February 15, 1980
- Tier 2: hired from February 15, 1980 through November 9, 1996
- Tier 3: hired on or after November 10, 1996

Optional retirement is defined as:
- Tier 1: 20 years of police officer or firefighter service
- Tier 2: Age 50 and the completion of 25 years of police officer or firefighter service
- Tier 3: 25 years of police officer or firefighter service

Tier 1 participants were not modeled specifically due to the small size of the population (2 active participants as of 7/1/2020). Therefore, we do not recommend making any changes to the retirement rates for Tier 1 participants.

Mandatory retirement for both police officers and firefighters is age 60, regardless of whether they meet the years of service requirement (unless otherwise permitted). Note that the data showed there were a fair number of participants working past age 60.

Current retirement assumptions are based on age and service for those who are eligible for retirement.

Below are the current retirement rate assumption tables:

Police (Tier 2) Retirement Rates

Age	Years of Service												
	<=24	25	26	27	28	29	30	31	32	33	34	35	>=36
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50 - 64	0%	22%	38%	35%	34%	28%	38%	32%	28%	35%	35%	18%	16%
>=65	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Police (Tier 3) Retirement Rates

Age	Years of Service												
	<=24	25	26	27	28	29	30	31	32	33	34	35	>=36
<=39	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40 - 64	0%	22%	38%	35%	34%	28%	38%	32%	28%	35%	35%	18%	16%
>=65	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Fire (Tier 2) Retirement Rates

Age	Years of Service										
	<=24	25	26	27	28	29	30	31	32	33	>=34
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50 - 59	0%	12.5%	15%	12%	20%	20%	22%	40%	45%	50%	40%
>=60	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Fire (Tier 3) Retirement Rates

Age	Years of Service										
	<=24	25	26	27	28	29	30	31	32	33	>=34
<=39	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
40 - 59	0%	12.5%	15%	12%	20%	20%	22%	40%	45%	50%	40%
>=60	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

The experience over the last five years shows that:

- The current Police retirement assumptions understate actual retirements, particularly at earlier ages. There is significant retirement activity when members first become eligible to retire that is not being accounted for in the current assumptions.
- The current Fire retirement assumptions slightly overstate actual retirements. There are not a significant number of retirements when members first become eligible and participants remain in the plan longer after retirement eligibility.

The following tables shows the expected police and fire retirements during the experience period using the current retirement assumption tables:

Expected Police Retirements

Age	Years of Service													Total Expected
	<=24	25	26	27	28	29	30	31	32	33	34	35	>= 36	
<=49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 - 64	0	84	127	121	102	69	35	13	6	7	5	1	4	574
>= 65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Expected	0	84	127	121	102	69	35	13	6	7	5	1	4	574

Expected Fire Retirements

Age	Years of Service											Total Expected
	<=24	25	26	27	28	29	30	31	32	33	>= 34	
<=49	0	0	0	0	0	0	0	0	0	0	0	0
50 - 59	0	12	23	18	18	20	22	21	19	15	5	174
>= 60	0	0	0	0	2	5	10	7	5	10	13	52
Total Expected	0	12	23	18	20	25	32	28	24	25	18	226

The following tables show the actual police and fire retirements that occurred during the experience period:

Actual Police Retirements

Age	Years of Service													Total Actual
	<=24	25	26	27	28	29	30	31	32	33	34	35	>= 36	
<=49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 - 64	0	187	126	123	107	81	31	17	4	5	5	2	7	695
>= 65	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Actual	0	187	126	123	107	81	31	17	4	5	5	2	7	695

Actual Fire Retirements

Age	Years of Service											Total Actual
	<=24	25	26	27	28	29	30	31	32	33	>= 34	
<=49	0	0	0	0	0	0	0	0	0	0	0	0
50 - 59	0	16	16	31	27	24	43	13	8	11	4	193
>= 60	0	0	0	0	0	0	5	2	0	4	6	17
Total Actual	0	16	16	31	27	24	48	15	8	15	10	210

The following tables show the ratio of actual retirements to expected retirements during the experience period:

Ratio Of Actual To Expected Police Retirements

Age	Years of Service													Total
	<=24	25	26	27	28	29	30	31	32	33	34	35	>= 36	
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50-64	0%	223%	100%	102%	105%	118%	88%	126%	71%	71%	110%	159%	162%	121%
>= 65	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	0%	223%	100%	102%	105%	118%	88%	126%	71%	71%	110%	159%	162%	121%

Ratio Of Actual To Expected Fire Retirements

Age	Years of Service											Total
	<=24	25	26	27	28	29	30	31	32	33	>= 34	
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50 - 59	0%	129%	70%	170%	147%	119%	194%	61%	41%	76%	77%	111%
>= 60	0%	0%	0%	0%	0%	0%	50%	29%	0%	40%	46%	33%
Total	0%	129%	70%	170%	132%	95%	149%	53%	33%	61%	55%	93%

Accounting for the plan's experience and looking at other long-term trends, we developed an age and service based set of assumptions that creates a better model compared to the actual data.

We recommend the following proposed retirement rates for police and fire:

Proposed Police (Tier 2) Retirement Rates

Age	Years of Service						
	<=24	25	26	27	28	29	>=30
<=49	0%	0%	0%	0%	0%	0%	0%
50 - 61	0%	50%	25%	25%	30%	35%	30%
>=62	100%	100%	100%	100%	100%	100%	100%

Proposed Police (Tier 3) Retirement Rates

Age	Years of Service						
	<=24	25	26	27	28	29	>=30
<62	0%	50%	25%	25%	30%	35%	30%
>=62	100%	100%	100%	100%	100%	100%	100%

Proposed Fire (Tier 2) Retirement Rates

Age	Years of Service						
	<=24	25	26	27	28	29	>=30
<=49	0%	0%	0%	0%	0%	0%	0%
50 - 61	0%	15%	15%	15%	25%	25%	40%
>=62	100%	100%	100%	100%	100%	100%	100%

Proposed Fire (Tier 3) Retirement Rates

Age	Years of Service						
	<=24	25	26	27	28	29	>=30
<62	0%	15%	15%	15%	25%	25%	40%
>=62	100%	100%	100%	100%	100%	100%	100%

The following tables reflect the expected police and fire retirements using the proposed retirement rates:

Expected Police Retirements Using Proposed Rates

Age	Years of Service													Total
	<=24	25	26	27	28	29	30	31	32	33	34	35	>= 36	
<=49	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 - 61	0	191	111	121	108	93	28	13	6	5	4	2	6	686
>= 62	0	0	0	0	2	2	1	1	1	2	1	0	12	22
Total	0	191	111	121	110	95	29	14	7	7	5	2	18	708

Expected Fire Retirements Using Proposed Rates

Age	Years of Service											Total
	<=24	25	26	27	28	29	30	31	32	33	>= 34	
<=49	0	0	0	0	0	0	0	0	0	0	0	0
50 - 61	0	15	23	23	24	27	44	24	19	14	8	219
>= 62	0	0	0	0	0	0	2	0	1	4	5	12
Total	0	15	23	23	24	27	46	24	20	18	13	231

The following tables show the ratio of actual retirements to expected retirements using the proposed rates:

Ratio of Actual to Expected Police Retirements Using Proposed Rates

Age	Years of Service													Total
	<=24	25	26	27	28	29	30	31	32	33	34	35	>= 36	
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50 - 61	0%	98%	114%	102%	98%	86%	107%	136%	70%	93%	105%	95%	35%	100%
>= 62	0%	0%	0%	0%	50%	50%	100%	0%	0%	0%	100%	0%	42%	41%
Total	0%	98%	114%	102%	97%	85%	107%	126%	60%	68%	104%	95%	40%	98%

Ratio of Actual to Expected Fire Retirements Using Proposed Rates

Age	Years of Service											Total
	<=24	25	26	27	28	29	30	31	32	33	>=34	
<=49	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
50 - 61	0%	108%	70%	136%	115%	91%	108%	63%	43%	93%	83%	93%
>= 62	0%	0%	0%	0%	0%	0%	50%	0%	0%	50%	60%	50%
Total	0%	108%	70%	136%	115%	91%	105%	63%	40%	83%	75%	91%

Note that most of the discrepancy in the difference between the actual and expected retirements for the Fire group occur at 32 years of service. We believe this is an anomaly caused by there being relatively few data points at that service level.

Termination of Employment

Termination assumptions are designed to capture the rate and pattern at which active members leave employment with the sponsor for reasons other than retirement, disability or death. A high level of turnover means that relatively few members will reach retirement age and that there will be fewer retirees with large pensions. A good turnover assumption helps to keep costs stable in the long run.

Teachers

Current teacher termination assumptions, which vary based on age, service, and gender, are displayed below:

Teacher Termination Rates

Current Assumption (Males Only)							Current Assumption (Females Only)					
	Service							Service				
Age	0	1	2	3	4	>=5	Age	0	1	2	3	4	>=5
<=25	25%	25%	26%	26%	18%	18.0%	<=25	23%	23%	23%	23%	16%	18.0%
26	25%	25%	26%	26%	18%	17.6%	26	23%	23%	23%	23%	16%	17.6%
27	25%	25%	26%	26%	18%	17.2%	27	23%	23%	23%	23%	16%	17.2%
28	25%	25%	26%	26%	18%	16.8%	28	23%	23%	23%	23%	16%	16.8%
29	25%	25%	26%	26%	18%	16.4%	29	23%	23%	23%	23%	16%	16.4%
30	25%	25%	26%	26%	18%	16.0%	30	23%	23%	23%	23%	16%	16.0%
31	25%	25%	26%	26%	18%	15.2%	31	23%	23%	23%	23%	16%	14.8%
32	25%	25%	26%	26%	18%	14.4%	32	23%	23%	23%	23%	16%	13.6%
33	25%	25%	26%	26%	18%	13.6%	33	23%	23%	23%	23%	16%	12.4%
34	25%	25%	26%	26%	18%	12.8%	34	23%	23%	23%	23%	16%	11.2%
35	25%	25%	26%	26%	18%	12.0%	35	23%	23%	23%	23%	16%	10.0%
36	25%	25%	26%	26%	18%	12.0%	36	23%	23%	23%	23%	16%	9.6%
37	25%	25%	26%	26%	18%	12.0%	37	23%	23%	23%	23%	16%	9.2%
38	25%	25%	26%	26%	18%	12.0%	38	23%	23%	23%	23%	16%	8.8%
39	25%	25%	26%	26%	18%	12.0%	39	23%	23%	23%	23%	16%	8.4%
40	25%	25%	26%	26%	18%	12.0%	40	23%	23%	23%	23%	16%	8.0%
41	25%	25%	26%	26%	18%	11.2%	41	23%	23%	23%	23%	16%	7.7%
42	25%	25%	26%	26%	18%	10.4%	42	23%	23%	23%	23%	16%	7.4%
43	25%	25%	26%	26%	18%	9.6%	43	23%	23%	23%	23%	16%	7.1%
44	25%	25%	26%	26%	18%	8.8%	44	23%	23%	23%	23%	16%	6.8%
>= 45	25%	25%	26%	26%	18%	8.0%	>= 45	23%	23%	23%	23%	16%	6.5%

The following table shows, by service, the expected number of terminations using the current assumptions, the actual number of terminations, and the actual-to-expected ratios using the current assumption.

Teacher Termination Statistics (Current Assumptions)

| Service | Current Assumption Terminations | | |
	Actual Terminations	Expected Terminations	Actual / Expected
0	123	125	98.8%
1	761	789	96.5%
2	641	700	91.5%
3	460	569	80.9%
4	278	333	83.4%
5	232	193	119.9%
6	159	167	95.1%
7	166	141	118.0%
8	138	114	121.0%
9	107	88	121.3%
>= 10	497	575	86.5%
Total	**3,562**	**3,794**	**93.9%**

The experience shows that:
- In general, the current termination assumptions are close but do overstate actual terminations slightly.
- Actual terminations differ significantly for years of service from 5 years through 9 years.
- The termination patterns are more linked to service levels than to age.

We recommend that the termination assumption be based on service and gender and have select rates through 9 years of service and an ultimate rate starting at 10 years of service:

Teacher Proposed Termination Rates

| Proposed Assumption | | |
Service	Male	Female
0	25.0%	23.0%
1	26.0%	22.0%
2	22.0%	22.0%
3	20.0%	19.0%
4	14.7%	13.4%
5	14.7%	13.4%
6	13.0%	11.2%
7	13.0%	11.2%
8	13.0%	11.2%
9	13.0%	11.2%
>=10	9.4%	5.8%

The following table shows, by service, the expected number of terminations using the proposed assumptions, the actual number of terminations, and the actual-to-expected ratios using the proposed assumption. Presented beneath the table is a graph of the rates of termination based on actual experience, the current termination assumptions, and the proposed termination assumptions.

Teacher Termination Statistics (Proposed Assumptions)

| Service | Proposed Assumption Terminations | | |
	Actual Terminations	Expected Terminations	Actual / Expected
0	123	125	98.8%
1	761	772	98.6%
2	641	650	98.6%
3	460	461	99.7%
4	278	278	100.0%
5	232	232	100.0%
6	159	176	90.5%
7	166	154	107.6%
8	138	132	104.4%
9	107	108	99.2%
>= 10	497	497	100.0%
Total	**3,562**	**3,585**	**99.4%**

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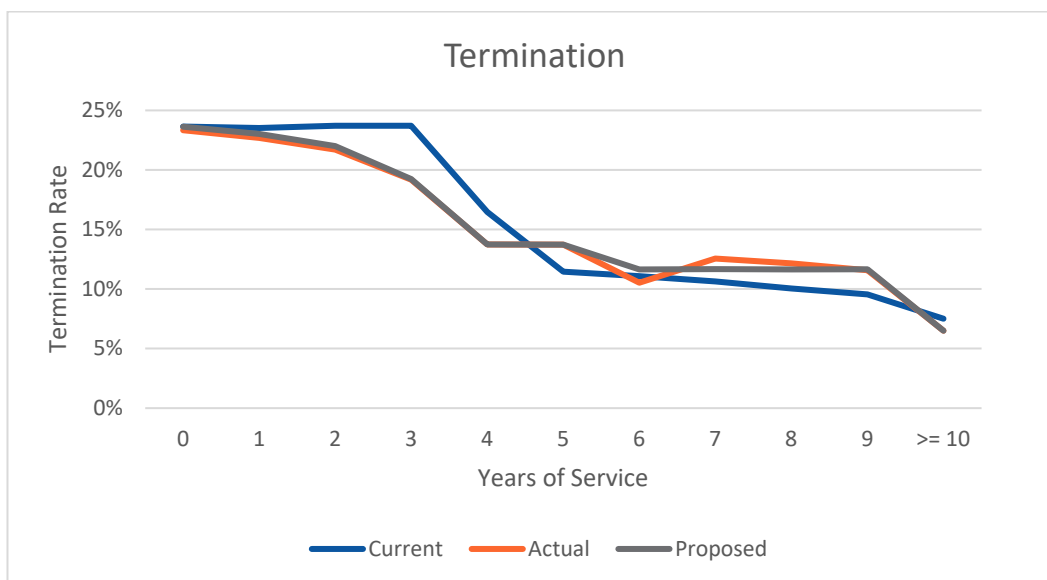
Police & Fire
Current termination assumptions, which vary based on age, service, and gender (for just Police), are displayed below:

Police Termination Rates

| | Current Assumption (Males Only) | | | | | | | Current Assumption (Females Only) | | | | | |
| | Service | | | | | | | Service | | | | | |
Age	0	1	2	3	4	>=5	Age	0	1	2	3	4	>=5
<=25	13%	10%	7%	6%	6%	5.00%	<=25	11%	11%	8%	5%	5%	5.0%
26	13%	10%	7%	6%	6%	4.85%	26	11%	11%	8%	5%	5%	4.9%
27	13%	10%	7%	6%	6%	4.70%	27	11%	11%	8%	5%	5%	4.8%
28	13%	10%	7%	6%	6%	4.55%	28	11%	11%	8%	5%	5%	4.7%
29	13%	10%	7%	6%	6%	4.40%	29	11%	11%	8%	5%	5%	4.6%
30	13%	10%	7%	6%	6%	4.25%	30	11%	11%	8%	5%	5%	4.5%
31	13%	10%	7%	6%	6%	3.95%	31	11%	11%	8%	5%	5%	4.3%
32	13%	10%	7%	6%	6%	3.65%	32	11%	11%	8%	5%	5%	4.1%
33	13%	10%	7%	6%	6%	3.35%	33	11%	11%	8%	5%	5%	3.9%
34	13%	10%	7%	6%	6%	3.05%	34	11%	11%	8%	5%	5%	3.7%
35	13%	10%	7%	6%	6%	2.75%	35	11%	11%	8%	5%	5%	3.5%
36	13%	10%	7%	6%	6%	2.50%	36	11%	11%	8%	5%	5%	3.1%
37	13%	10%	7%	6%	6%	2.25%	37	11%	11%	8%	5%	5%	2.7%
38	13%	10%	7%	6%	6%	2.00%	38	11%	11%	8%	5%	5%	2.3%
39	13%	10%	7%	6%	6%	1.75%	39	11%	11%	8%	5%	5%	1.9%
>= 40	13%	10%	7%	6%	6%	1.50%	>= 40	11%	11%	8%	5%	5%	1.5%

Fire Termination Rates

Age	Current Assumption Service					
	0	1	2	3	4	>=5
<=25	7.5%	7.5%	5%	4%	4%	3.00%
26	7.5%	7.5%	5%	4%	4%	2.92%
27	7.5%	7.5%	5%	4%	4%	2.84%
28	7.5%	7.5%	5%	4%	4%	2.76%
29	7.5%	7.5%	5%	4%	4%	2.68%
30	7.5%	7.5%	5%	4%	4%	2.60%
31	7.5%	7.5%	5%	4%	4%	2.44%
32	7.5%	7.5%	5%	4%	4%	2.28%
33	7.5%	7.5%	5%	4%	4%	2.12%
34	7.5%	7.5%	5%	4%	4%	1.96%
35	7.5%	7.5%	5%	4%	4%	1.80%
36	7.5%	7.5%	5%	4%	4%	1.72%
37	7.5%	7.5%	5%	4%	4%	1.64%
38	7.5%	7.5%	5%	4%	4%	1.56%
39	7.5%	7.5%	5%	4%	4%	1.48%
40	7.5%	7.5%	5%	4%	4%	1.40%
41	7.5%	7.5%	5%	4%	4%	1.36%
42	7.5%	7.5%	5%	4%	4%	1.32%
43	7.5%	7.5%	5%	4%	4%	1.28%
44	7.5%	7.5%	5%	4%	4%	1.24%
45	7.5%	7.5%	5%	4%	4%	1.20%
46	7.5%	7.5%	5%	4%	4%	1.20%
47	7.5%	7.5%	5%	4%	4%	1.20%
48	7.5%	7.5%	5%	4%	4%	1.20%
49	7.5%	7.5%	5%	4%	4%	1.20%
50	7.5%	7.5%	5%	4%	4%	1.20%
51	7.5%	7.5%	5%	4%	4%	1.12%
52	7.5%	7.5%	5%	4%	4%	1.04%
53	7.5%	7.5%	5%	4%	4%	0.96%
54	7.5%	7.5%	5%	4%	4%	0.88%
55	7.5%	7.5%	5%	4%	4%	0.80%
56	7.5%	7.5%	5%	4%	4%	0.76%
57	7.5%	7.5%	5%	4%	4%	0.72%
58	7.5%	7.5%	5%	4%	4%	0.68%
59	7.5%	7.5%	5%	4%	4%	0.64%
>= 60	7.5%	7.5%	5%	4%	4%	0.60%

The following table shows, by service, the expected number of terminations using the current assumptions, the actual number of terminations, and the actual-to-expected ratios using the current assumption.

Police Termination Statistics (Current Assumptions)

Service	Current Assumption Terminations		
	Actual Terminations	Expected Terminations	Actual / Expected
0	67	92	73.1%
1	85	102	83.3%
2	78	69	112.7%
3	62	56	109.9%
4	60	45	133.0%
5	31	19	163.1%
6	24	18	132.5%
7	20	16	123.3%
8	12	13	89.8%
9	15	16	92.6%
>= 10	216	186	115.9%
Total	**670**	**634**	**105.7%**

The experience shows that:
- In general, the current termination assumptions understate actual terminations.
- Actual terminations differ significantly for years of service from 5 years through 9 years.
- The termination patterns are more linked to service levels than to age.

Fire Termination Statistics (Current Assumptions)

Service	Current Assumption Terminations		
	Actual Terminations	Expected Terminations	Actual / Expected
0	22	17	127.5%
1	27	27	101.4%
2	13	17	77.4%
3	12	11	109.9%
4	7	10	69.2%
5	9	5	175.3%
6	5	5	92.1%
7	5	4	115.4%
8	8	9	88.7%
9	5	8	65.6%
>= 10	48	78	61.9%
Total	**161**	**191**	**84.4%**

The experience shows that:
- In general, the current termination assumptions overstate actual terminations.
- Actual terminations differ significantly for years of service from 5 years through 9 years.
- The termination patterns are more linked to service levels than to age.

We recommend that the termination assumption be based on service only and have select rates through 9 years of service and an ultimate rate starting at 10 years of service:

Police Proposed Termination Rates

	Proposed Assumption	
Service	Male	Female
0	9.0%	10.0%
1	9.0%	7.0%
2	8.0%	7.0%
3	8.0%	5.0%
4	8.0%	3.8%
5	6.2%	3.8%
6	4.1%	2.7%
7	4.1%	2.7%
8	2.7%	2.7%
9	2.7%	2.7%
>=10	2.0%	2.0%

Fire Proposed Termination Rates

	Proposed Assumption	
Service	Male	Female
0	9.0%	16.0%
1	7.0%	12.0%
2	4.2%	2.1%
3	4.2%	2.1%
4	3.4%	2.1%
5	3.4%	1.8%
6	3.4%	2.3%
7	1.7%	2.3%
8	1.7%	2.3%
9	1.7%	2.3%
>=10	1.0%	0.5%

The following table shows, by service, the expected number of terminations using the proposed assumptions, the actual number of terminations, and the actual-to-expected ratios using the proposed assumption. Presented beneath each table is a graph of the rates of termination based on actual experience, the current termination assumptions, and the proposed termination assumptions.

Police Termination Statistics (Proposed Assumptions)

| Service | Current Assumption Terminations | | |
	Actual Terminations	Expected Terminations	Actual / Expected
0	67	65	103.3%
1	85	88	97.1%
2	78	77	100.9%
3	62	69	89.6%
4	60	54	111.6%
5	31	30	103.2%
6	24	21	115.0%
7	20	20	98.5%
8	12	13	93.6%
9	15	17	88.1%
>= 10	216	222	97.4%
Total	**670**	**675**	**99.2%**
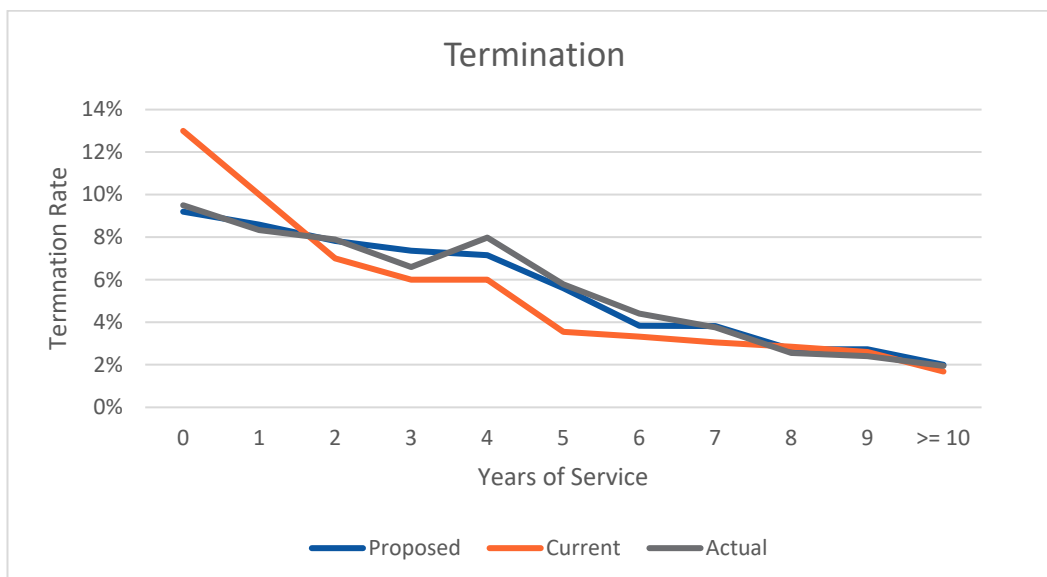
Termination

Fire Termination Statistics (Proposed Assumptions)

Service	Proposed Assumption Terminations		
	Actual Terminations	Expected Terminations	Actual / Expected
0	22	23	96.2%
1	27	27	98.9%
2	13	13	99.4%
3	12	11	111.5%
4	7	8	85.1%
5	9	6	138.8%
6	5	8	63.0%
7	5	3	155.9%
8	8	8	105.5%
9	5	7	75.5%
>= 10	48	50	96.8%
Total	**161**	**164**	**98.4%**
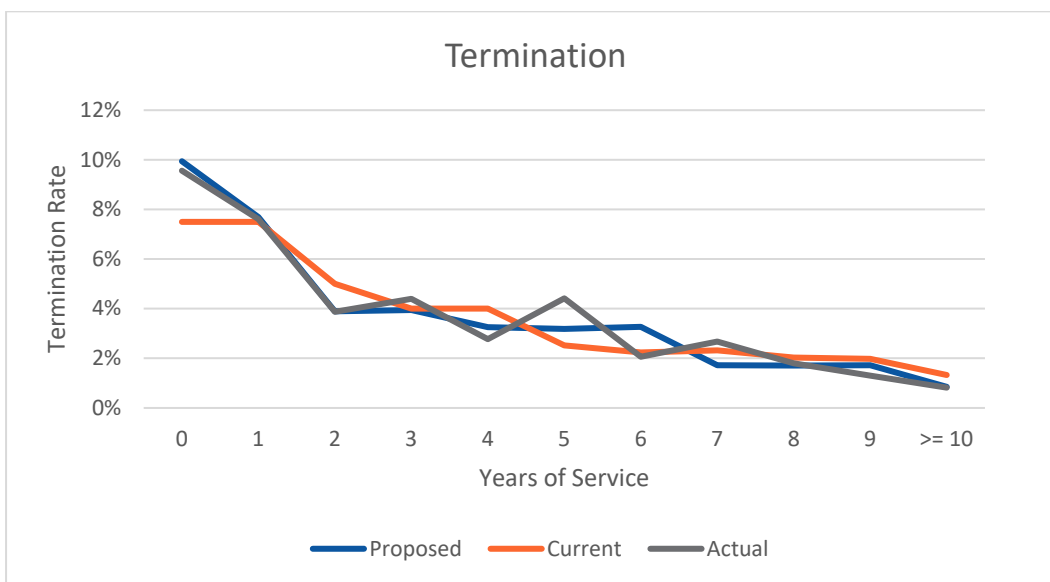
Termination

Additional Termination Assumptions

Terminating members are permitted to withdraw their employee contributions from the plan. This withdrawal is in lieu of any future benefits. We reviewed the plan data over the last five years to ascertain how frequently this occurred and whether there were any notable patterns in who withdrew their contributions.

For Teachers and Firefighters, currently 15% of the vested members who terminate are assumed to elect to withdraw their contributions. For Police Officers, currently 25% of the vested members who terminate are assumed to elect to withdraw their contributions.

The following table shows the total experience of vested participants who withdrew contributions from July 1, 2015, to June 30, 2020:

Return Of Contributions (ROC) Statistics

	Teachers		Police		Fire		Total	
	Count	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Vested, no ROC	1,063	80%	286	85%	64	77%	1,413	81%
Vested, ROC	261	20%	49	15%	19	23%	329	19%

We recommend updating this assumption to assume that 20% of the vested members who terminate elect to withdraw their contributions for Teachers, Police, and Fire.

Disability Incidence

Both plans have special retirement benefits for members who become disabled while in active service. Therefore, it is appropriate to value these benefits although the incidence of disability retirements is relatively rare.
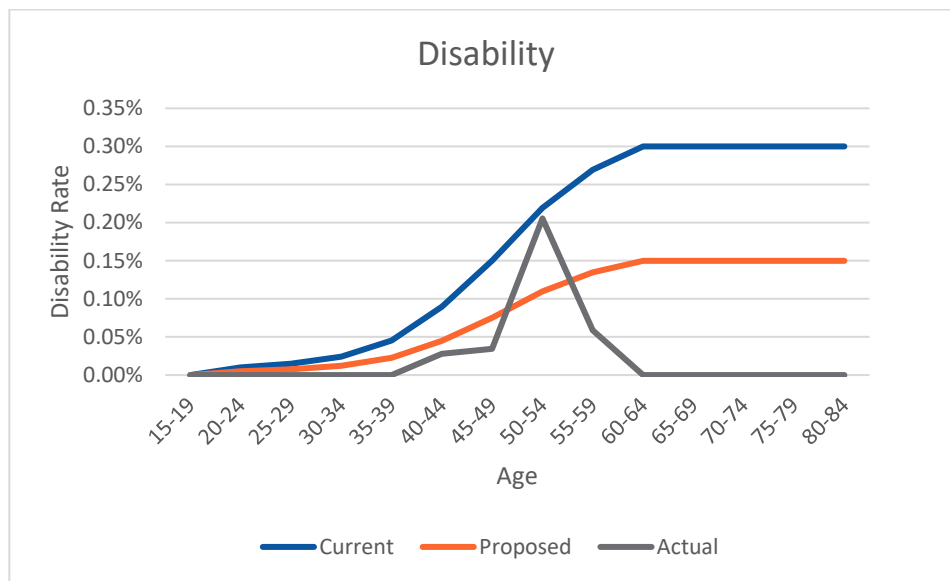
Teachers

Current disability assumptions are based on age. Overall, actual disabilities were significantly less than current expected disabilities. For this reason, we recommend that the current rates be reduced to more closely reflect experience. The current and proposed disability incidence rates at a few sample ages are presented below:

Teacher Disability Rates

Age	Current Rates	Proposed Rates
30	0.02%	0.010%
40	0.07%	0.035%
50	0.02%	0.010%
60	0.03%	0.015%

Experience from July 1, 2015, through June 30, 2020, is as follows. Presented beneath the table is a graph of the rates of disability based on actual experience, the current disability assumptions, and the proposed disability assumptions.

Teacher Disability Statistics

|		Disability Rates				
Age	Exposures	Actual	Expected from Current Assumptions	Actual / Expected (Current Rates)	Expected from Proposed Assumptions	Actual / Expected (Proposed Rates)
15-19	0	0	0	100%	0	100%
20-24	309	0	0	100%	0	100%
25-29	3,531	0	1	0%	0	100%
30-34	5,116	0	1	0%	1	0%
35-39	4,309	0	2	0%	1	0%
40-44	3,605	1	3	33%	2	17%
45-49	2,915	1	4	25%	2	13%
50-54	1,945	4	4	100%	2	50%
55-59	1,702	1	5	20%	2	10%
60-64	1,359	0	4	0%	2	0%
65-69	550	0	2	0%	0	100%
70-74	137	0	0	100%	0	100%
75-79	15	0	0	100%	0	100%
80-84	3	0	0	100%	0	100%
Total	**25,496**	**7**	**26**	**27%**	**12**	**58%**

Disability

Police & Fire

Current disability assumptions are based on age and gender (Police). Overall, actual disabilities were significantly less than our current expected disabilities. For this reason, we recommend that the current rates be reduced to better reflect experience. We also recommend unisex rates for Police as there is not enough credible data to require a separate assumption for males and females. The current and proposed disability incidence rates at a few sample ages are presented below:

Police Disability Rates

Age	Current Rates		Proposed Rates
	Male	Female	
30	0.110%	0.100%	0.083%
40	0.230%	0.300%	0.173%
50	0.420%	0.600%	0.315%
60	0.510%	1.000%	0.383%

Fire Disability Rates

Age	Current Rates	Proposed Rates
30	0.180%	0.135%
40	0.300%	0.225%
50	0.400%	0.300%
60	0.500%	0.375%

Experience from July 1, 2015, through June 30, 2020, is as follows. Presented beneath each table is a graph of the rates of disability based on actual experience, the current disability assumptions, and the proposed disability assumptions.:

Police Disability Statistics

Age	Exposures	Actual	Expected from Current Assumptions	Actual / Expected (Current Rates)	Expected from Proposed Assumptions	Actual / Expected (Proposed Rates)
15-19	0	0	0	100%	0	100%
20-24	520	1	0	0%	0	100%
25-29	2,461	3	2	150%	2	150%
30-34	2,844	2	4	50%	3	67%
35-39	2,740	5	5	100%	4	125%
40-44	2,466	6	7	86%	5	120%
45-49	3,661	11	14	79%	10	110%
50-54	2,563	7	12	58%	8	88%
55-59	802	1	4	25%	3	33%
60-64	139	2	1	200%	1	200%
65-69	0	0	0	100%	0	100%
70-74	0	0	0	100%	0	100%
75-79	0	0	0	100%	0	100%
80-84	0	0	0	100%	0	100%
Total	**18,196**	**38**	**50**	**76%**	**34.77**	**109%**

Disability

Fire Disability Statistics

Age	Exposures	Actual	Disability Rates Expected from Current Assumptions	Actual / Expected (Current Rates)	Expected from Proposed Assumptions	Actual / Expected (Proposed Rates)
15-19	0	0	0	100%	0	100%
20-24	469	0	0	100%	0	100%
25-29	752	1	1	100%	1	100%
30-34	1,605	1	3	33%	3	33%
35-39	1,510	4	4	100%	3	133%
40-44	1,261	1	4	25%	3	33%
45-49	1,527	8	6	133%	4	200%
50-54	1,078	4	4	100%	3	133%
55-59	506	0	2	0%	2	0%
60-64	58	1	0	0%	0	100%
65-69	1	0	0	100%	0	100%
70-74	0	0	0	100%	0	100%
75-79	0	0	0	100%	0	100%
80-84	0	0	0	100%	0	100%
Total	**8,767**	**20**	**25**	**80%**	**18.81**	**105%**
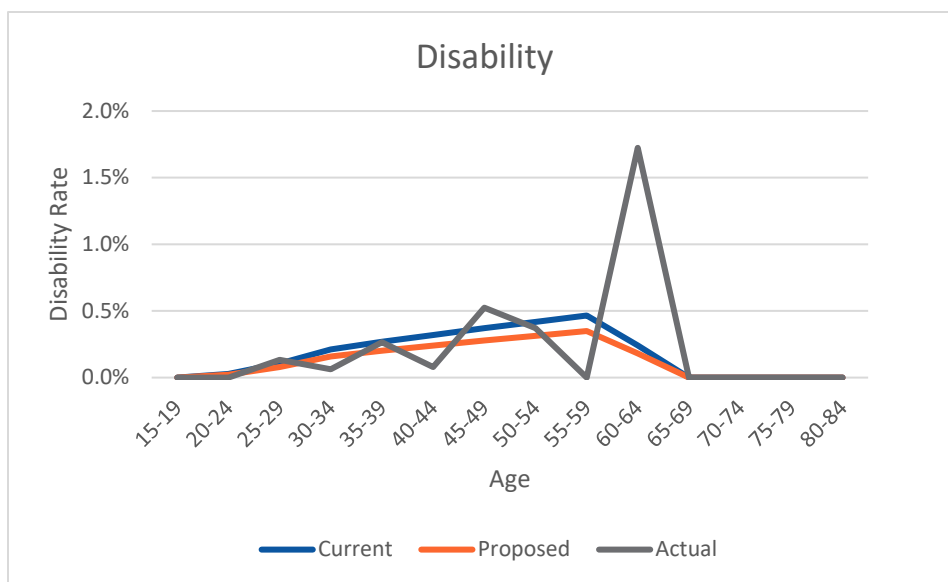
Additional Disability Assumptions

The Police and Fire plan provides a different benefit for members whose disability is from accidents that occur while performing services as a police officer or firefighter. As a result, the plan has developed assumptions around how many of the disabilities that do occur are to be considered line of duty related.

It is currently assumed that 75% of the disabilities are due to accidents in the line of duty (LOD) and the percent of disability is assumed to be 100%. The following table shows the total count of duty-related and non-duty related disability retirements that occurred throughout July 1, 2015, to June 30, 2020:

	Police		Fire		Total	
	Count	Percentage	Count	Percentage	Count	Percentage
LOD Disabilities	20	53%	12	60.0%	32	55%
Non-LOD Disabilities	18	47%	8	40.0%	26	45%

Experience shows there were fewer duty-related disabilities than expected for both police and fire members. We recommend updating this assumption to assume that 60% of the disabilities are due to accidents in the line of duty. We do not recommend any changes to the percent of disability.

Marriage Assumptions

The plan provides survivor benefits to eligible spouses/domestic partners and dependent children. Up to date information on marital status or the number and age of dependent children is not typically available for active members. Accordingly, assumptions are set to properly value these survivor benefits.

The current assumptions are:

Percent Married
Teachers: 64%
Police and Fire: 80%

Spouse Age Difference
Wife 3 years younger than husband

Dependent Children
Active members are assumed to have one dependent child aged 10

The active data received for the valuation contains values for spouse or domestic partner date of birth. One issue with relying on this data is that the percentages could be understated if the participant is married but the spouse/domestic partner data of birth is not on file. Because we do not have exact data to base an assumption on, we recommend using the MetLife 2021 "US Employee Benefit Trends Study." This study shows that 64% (55% married, 9% single living with partner) of employees surveyed were either married or had domestic partners.

We recommend updating the percent married assumption to 65% for Teachers, Police, and Fire. We do not recommend making any changes to the spouse age difference and dependent children assumption.

Unused Sick Leave and Military Service Credit

The plan provides for eligible participants to use unused sick leave and purchased military service credit towards credited service. There is currently no unused sick leave assumption and Police and Fire members are assumed to have 0.40 years of military service at retirement.

We analyzed the service for about 5,400 retired participants to determine the average portion of credited service that is attributable to unused sick leave and military service credit. The results are in the following table:

	Average Military Service	Average Unused Sick Service	Total
Teacher	n/a	0.22	0.22
Police	0.72	0.38	1.10
Fire	0.38	0.55	0.93

We recommend assuming additional service at retirement for unused sick leave and military service credit is 0.25 years for Teachers and 1.00 year for Police and Fire.

Section IV. Economic Assumptions

Inflation

The inflation assumption is at the heart of the economic assumptions, as it is used as a starting point for all other economic assumptions, including the Cost-of-Living Adjustment (COLA), pay improvement and investment return assumptions. Thus, our economic experience analysis starts with the inflation assumption. The current inflation assumption is 3.50%.

Unlike demographic assumptions where recent past experience is often a good predictor of future experience, economic assumptions, and particularly the investment return and inflation assumptions, typically reflect future expectations more than past experience. In order to review the current assumption, we analyzed inflation from two perspectives:

- Past experience – based on the Consumer Price Index for all Urban Consumers (CPI-U) over the last 10, 20, 30 and 40 years.

- Current expectations of future experience – based on investment experts' analysis, the Social Security Administration reports, and the Federal Reserve forecasts of future expected inflation.

Past Experience

We reviewed the recent experience in developing our recommendation for the inflation assumption. Presented below are the average annual increases in the CPI-U, over multiple time periods (ending with the annual average for calendar year 2020):

	Averaging Period			
	10 years	20 years	30 years	40 years
CPI-U Annual Average	1.74%	2.04%	2.25%	2.81%

Experts' Inflation Expectations

Next, we considered the inflation assumption built into investment return assumptions. The 2021 edition of the *Horizon Survey of Capital Market Assumptions* (Horizon Survey), which encompasses capital market assumptions from 39 investment advisors, shows an average 10-year future expected inflation rate of 2.12% and a 20-year rate of 2.23%[2].

The December 2020 forecast of the Federal Reserve Bank was 1.9%. The September 2020 report from the Social Security Trustees indicated a forecast of 2.40%

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[2] When considering all 39 survey respondents. The rates are 2.14% and 2.23%, respectively, when considering only the 24 survey respondents who provided both a 10-year and 20-year inflation expectation.

Recommended Inflation Assumption

The past experience, the average of the expectations of the 39 investment managers represented in the Horizon Survey, and recent Social Security Administration and Federal Reserve expectations are all lower than the current inflation assumption, and as such, a decrease in the assumption likely is warranted. **We recommend decreasing the current 3.50% assumption for CPI increases to 3.00%.** A further reduction could be supported, however, we recommend maintaining some conservativeness in this assumption.

Cost of Living Adjustments

Each year on March 1, benefits which have been paid for at least twelve months preceding March 1 may be increased. The increase is equal to the annual increase in the Consumer Price Index (CPI-U). COLAs are included in benefit payments on and after April1. If a member's retirement is effective March 1 of the preceding year, the COLA amount is prorated.

- For Teachers hired on or after November 1, 1996 the COLA is limited to no more than 3.00% per year.

- For Police and Fire hired on or after November 10, 1996 the COLA is limited to no more than 3.00% per year.

- Police and Fire hired prior to February 15, 1980 receive equalization pay which is defined as the percentage increase in active employees' salary. Equalization increases are not paid to survivors.

We recommend decreasing the COLA assumption to 3.00%. This recommendation continues to align the COLA assumption with the inflation assumption, which is an appropriate relationship since expected future inflation rates are low, and resultingly, CPI increases above the 3.00% cap are expected to be infrequent. Given that both the recommended inflation and COLA assumptions are slightly higher than the aforementioned past experience and experts' expectations of future experience, this 3.00% assumption is still somewhat conservative.

Investment Return / Discount Rate

The single assumption that has the largest effect on the determination of plan liabilities, funding levels and actuarially determined contributions (ADCs) is the investment return / discount rate assumption. This is not only an assumption about future expected returns on plan assets but also generally is the basis for setting the discount rate used to measure pension plan liabilities. The Board sets this assumption, and it is the actuary's duty to provide information to the Board to help set all assumptions. Actuaries are also required to comply with Actuarial Standards of Practice No. 27 *Selection of Economic Assumptions for Measuring Pension Obligations* (ASOP 27) when setting the investment return / discount rate assumption that they recommend and use for the actuarial reports. The Board currently uses a 6.50% long term assumed rate of return.

The most common way to set this assumption is to look at the investment mix and expected future returns. We reviewed the recent presentation by Meketa, the Board's investment advisor, and analyzed expected returns of the current aggregate investment mix of the plans using the Horizon Survey capital market assumptions. Based on this analysis, a reasonable discount rate might fall in the range of 5.80% to 7.92% (see the Appendix for additional details). Additionally, the Meketa analysis produced a projected 20-year return of 6.92%; which is supportive of continuing to use the 6.50% rate. However, the Meketa analysis placed a likelihood of achieving the 6.50% actuarial assumption over 20 years at 55.1% based on the target asset allocation (and 52% at the current asset allocation, given the underweight to private market investments).

As a comparator we present the NASRA survey (published in August 2021) of discount rates shown below. These rates tend to be higher than those used by the District plans although there has been a clear trend to lower nominal investment return assumptions across the NASRA universe over the last 10 years.

Distribution of Nominal Investment Return Assumptions
FY 01 to present
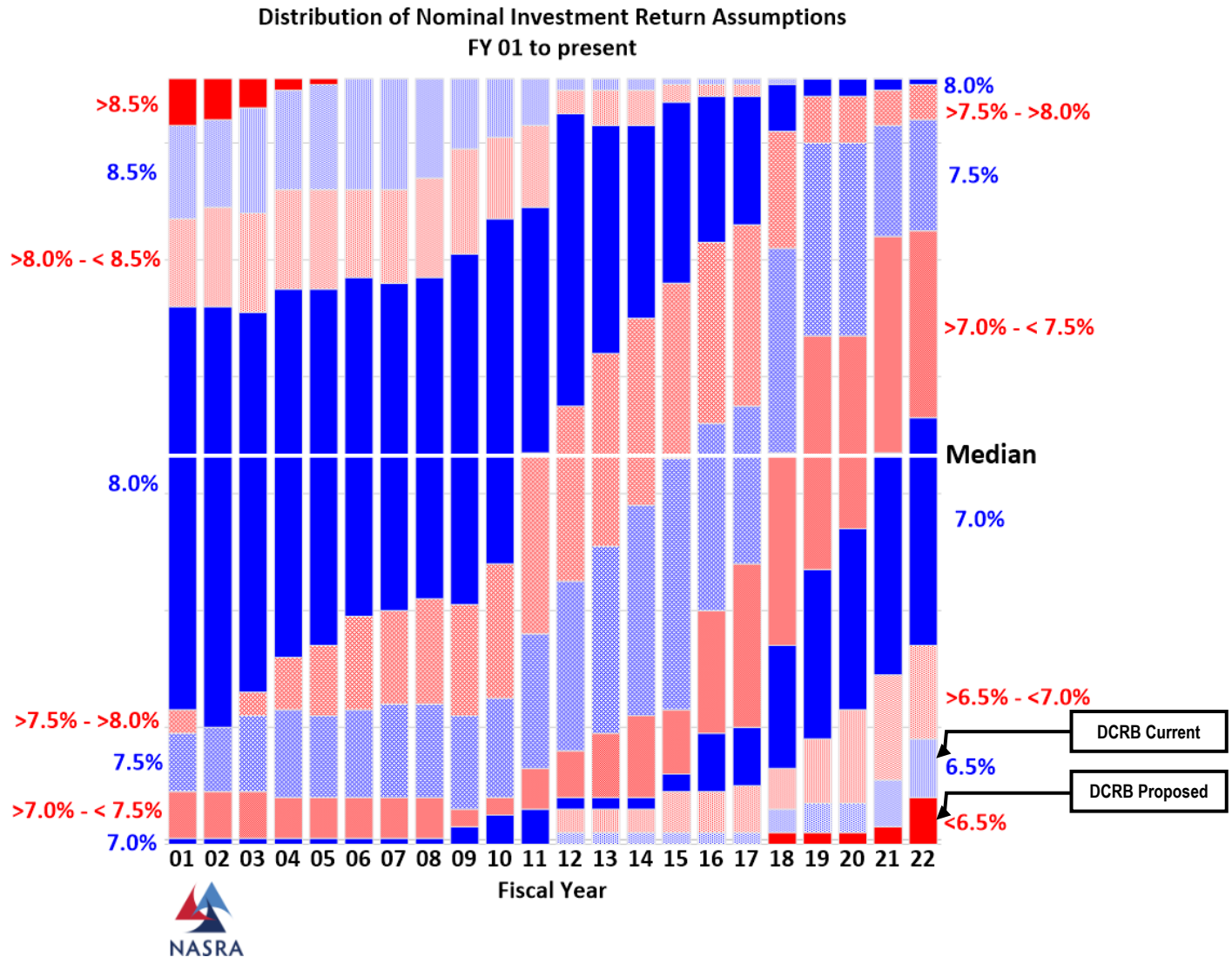
Note that the investment mix at DCRB, in the aggregate, is more conservative than investment allocations for many other public sector plans, and therefore, results in lower expected returns

While the current analysis supports the continued use of the 6.50% long term rate of return, lower capital market expectations make it more risky than it had been in the recent past with the likelihood of achieving the targeted return declining from 68% in 2016 to 55% today. **We recommend reducing the investment return/discount rate assumption to 6.25%.**

Administrative Expenses

The current assumption for the amount of administrative (non-investment) expenses for the contribution year is set as a percentage of payroll for each plan – 1.20% for the Teachers and 2.10% for the Police and Firefighters. Over the last three years, the reported administrative expenses have averaged 0.80% of pay for the Teachers and 2.21% for the Police and Firefighters. Both groups showed a sharp decline in both the nominal expense amount as well as the expenses as a percentage of payroll in the fiscal year ending September 30, 2019.

Based on the recency of this change in the level of expense, we do not recommend any change to these assumptions at this time.

Pay Increases

All plan benefits are based in part on the wages received by the plan members. This makes the level of future pay an important consideration in valuing plan liabilities. In looking at the plan data we notice that past periods have been marked by several years where the pay increase rates were relatively low, but with one year that showed a spike in the rates. Our understanding is this pattern is a result of the timing of the collective bargaining process and the settling of contracts with some level of retroactive adjustments. The impact of this pattern, from an actuarial perspective is that there will be several years where the level of pay increases is materially lower than the assumed rates and then a single year where the increases exceed the assumed levels. It is difficult to time that pattern or to anticipate the specific level of any spike. As a result, our approach is to use a pay increase rate table that is reflective of the anticipated average increase over future years, knowing that there will be some years the assumption will seem high with other years the assumption will seem low.

The current pay increase assumption is based on service levels. In completing our analysis, we also found a pattern where pay increases followed the service levels and so continued that approach to this assumption.
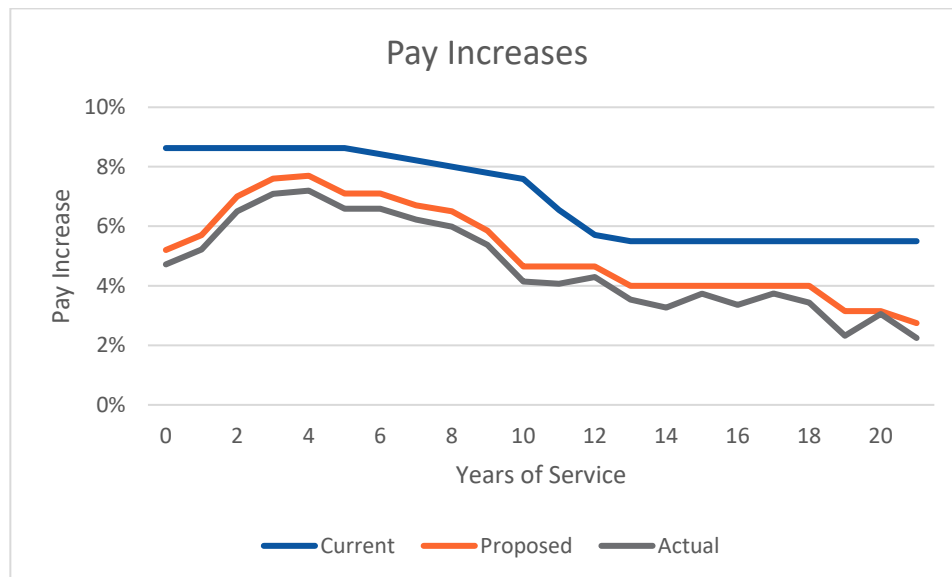
Teachers

The analysis below is based on pay for the fiscal years beginning on July 1, 2015, 2016, 2017, 2018, and 2019. Actual pay raises were varied throughout the five-year period. The graph following the table illustrates the actual average pay increases and expected pay increases under both current and proposed assumptions.

Teacher Pay Increase Statistics

Yeas of Service	Current Assumptions	Actual	Actual / Expected	Proposed Assumptions	Actual / Expected (Proposed Rates)
0	8.63%	4.72%	55%	5.20%	91%
1	8.63%	5.22%	60%	5.70%	92%
2	8.63%	6.50%	75%	7.00%	93%
3	8.63%	7.09%	82%	7.60%	93%
4	8.63%	7.20%	83%	7.70%	94%
5	8.63%	6.59%	76%	7.10%	93%
6	8.42%	6.59%	78%	7.10%	93%
7	8.21%	6.22%	76%	6.70%	93%
8	8.00%	5.99%	75%	6.50%	92%
9	7.79%	5.37%	69%	5.85%	92%
10	7.59%	4.14%	55%	4.65%	89%
11	6.54%	4.07%	62%	4.65%	88%
12	5.71%	4.29%	75%	4.65%	92%
13	5.50%	3.53%	64%	4.00%	88%
14	5.50%	3.27%	59%	4.00%	82%
15	5.50%	3.74%	68%	4.00%	93%

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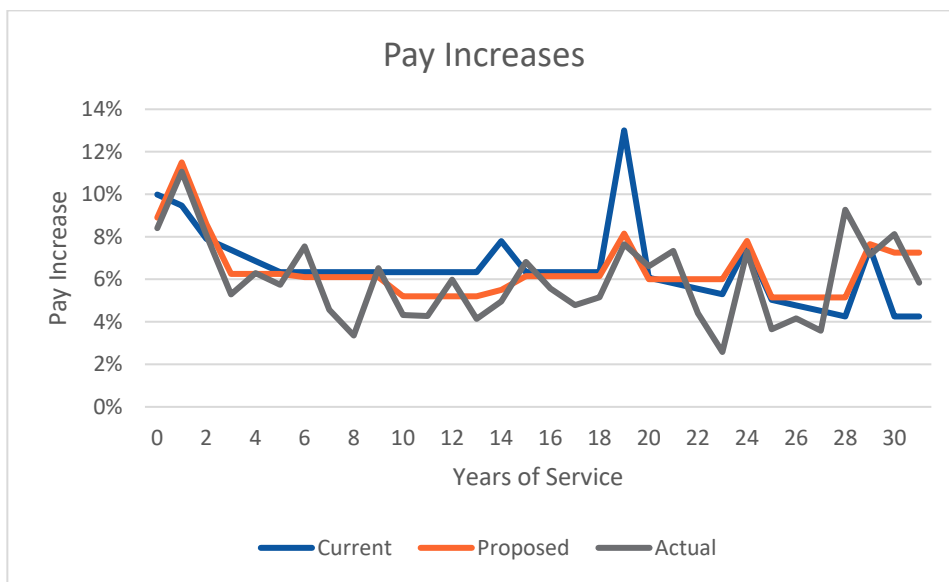|					Actual / Expected (Proposed Rates)
Pay Increases (Teacher Only)					
Yeas of Service	Current Assumptions	Actual	Actual / Expected	Proposed Assumptions	
16	5.50%	3.36%	61%	4.00%	84%
17	5.50%	3.74%	68%	4.00%	94%
18	5.50%	3.44%	62%	4.00%	86%
19	5.50%	2.32%	42%	3.15%	74%
20	5.50%	3.05%	55%	3.15%	97%
>=21	5.50%	2.25%	41%	2.75%	82%

Police

The analysis below is based on pay for the fiscal years beginning on July 1, 2015, 2016, 2017, 2018, and 2019. Actual pay raises were varied throughout the five-year period. The graph following the table illustrates the actual average pay increases and expected pay increases under both current and proposed assumptions. Note that there are a number of sharp increases in certain years. Our understanding is that these are associated with longevity increases and have maintained that pattern.

Police Pay Increase Statistics

Years of Service	Current Assumptions	Actual	Actual / Expected	Proposed Assumptions	Actual / Expected (Proposed Rates)
0	9.98%	8.41%	84%	8.90%	94%
1	9.46%	11.06%	117%	11.50%	96%
2	7.90%	8.07%	102%	8.60%	94%
3	7.38%	5.29%	72%	6.25%	85%
4	6.86%	6.29%	92%	6.25%	101%
5	6.33%	5.74%	91%	6.25%	92%
6	6.33%	7.55%	119%	6.10%	124%
7	6.33%	4.57%	72%	6.10%	75%
8	6.33%	3.36%	53%	6.10%	55%
9	6.33%	6.52%	103%	6.10%	107%
10	6.33%	4.32%	68%	5.20%	83%
11	6.33%	4.27%	67%	5.20%	82%
12	6.33%	5.98%	94%	5.20%	115%
13	6.33%	4.14%	65%	5.20%	80%
14	7.79%	4.96%	64%	5.50%	90%
15	6.33%	6.81%	108%	6.15%	111%
16	6.33%	5.57%	88%	6.15%	91%
17	6.33%	4.78%	76%	6.15%	78%
18	6.33%	5.16%	81%	6.15%	84%
19	13.01%	7.65%	59%	8.15%	94%
20	6.07%	6.62%	109%	6.00%	110%
21	5.81%	7.34%	126%	6.00%	122%
22	5.55%	4.40%	79%	6.00%	73%
23	5.29%	2.58%	49%	6.00%	43%
24	7.59%	7.30%	96%	7.80%	94%
25	5.03%	3.65%	73%	5.15%	71%
26	4.77%	4.16%	87%	5.15%	81%
27	4.51%	3.58%	79%	5.15%	69%
28	4.25%	9.27%	218%	5.15%	180%
29	7.48%	7.14%	95%	7.65%	93%

| Pay Increases (Police Only)					
Years of Service	Current Assumptions	Actual	Actual / Expected	Proposed Assumptions	Actual / Expected (Proposed Rates)
30	4.25%	8.12%	191%	7.25%	112%
31+	4.25%	5.84%	137%	7.25%	81%

Fire

The analysis below is based on pay for the fiscal years beginning on July 1, 2015, 2016, 2017, 2018, and 2019. Actual pay raises were varied throughout the five-year period. The graph following the table illustrates the actual average pay increases and expected pay increases under both current and proposed assumptions. Similar to the Police, the pattern of longevity increases creates several years with sharp increases in pay rates.

Fire Pay Increase Statistics

					Actual / Expected (Proposed Rates)
Pay Increases (Fire Only)					
Years of Service	**Current Assumptions**	**Actual**	**Actual / Expected**	**Proposed Assumptions**	
0	7.38%	4.99%	68%	5.50%	91%
1	7.38%	6.74%	91%	7.25%	93%
2	7.38%	6.64%	90%	7.15%	93%
3	7.38%	7.33%	99%	7.85%	93%
4	7.38%	6.35%	86%	6.05%	105%
5	7.38%	5.54%	75%	6.05%	92%
6	7.38%	5.49%	74%	6.05%	91%
7	7.38%	5.10%	69%	6.05%	84%
8	7.38%	3.72%	50%	6.05%	61%
9	7.38%	5.76%	78%	6.05%	95%
10	7.38%	8.87%	120%	6.05%	147%
11	7.38%	4.82%	65%	6.05%	80%
12	7.38%	4.94%	67%	6.05%	82%
13	7.38%	5.79%	78%	6.05%	96%
14	7.38%	6.82%	92%	7.30%	93%
15	9.46%	4.40%	46%	4.85%	91%
16	5.55%	5.15%	93%	4.85%	106%
17	5.55%	5.24%	94%	4.85%	108%
18	5.55%	2.98%	54%	4.85%	61%
19	5.55%	5.81%	105%	6.30%	92%
20	9.46%	5.87%	62%	4.25%	138%
21	5.55%	3.64%	66%	4.25%	86%
22	5.55%	4.21%	76%	4.25%	99%
23	5.55%	1.61%	29%	4.25%	38%
24	5.55%	4.72%	85%	5.20%	91%
25	9.46%	6.14%	65%	4.80%	128%
26	5.55%	3.66%	66%	4.80%	76%
27	5.55%	3.08%	55%	4.80%	64%
28	5.55%	4.96%	89%	4.80%	103%
29	5.55%	5.49%	99%	6.00%	91%
30	9.46%	3.48%	37%	4.50%	77%
>=31	5.55%	4.29%	77%	4.50%	95%

Pay Increases
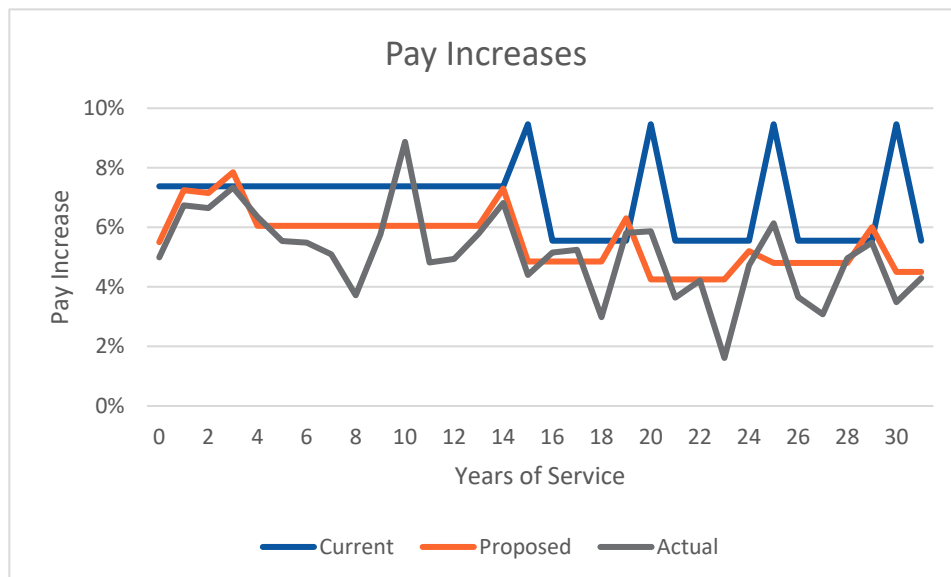
Overall Pay Growth Assumption

The current assumption is that the average payroll for each plan will be 4.25% higher than the prior year.

We recommend reducing this assumption to 4.00%, primarily due to the decrease in the inflation assumption from 3.50% to 3.00% This assumption is also supported by average historical total payroll growth over the last 5 years, which is equal to 3.56%. A further reduction could be supported, however, we recommend maintaining some conservativeness in this assumption.

This assumption is used primarily in the determination of the contribution amount. The annual actuarial valuation computes a contribution rate that is a percentage of each plan's annual payroll. The valuation completed as of 9/30/XX is used to set the contribution for the fiscal year ending 9/30/XX+2. In order to estimate the dollar amount of contribution for that fiscal year, an estimate of the payroll for that year is needed. The overall pay growth assumption is used to estimate that payroll.

Section V. Actuarial Methods and Assumptions

Valuation Cost Method

The DCRB valuations are completed using the Entry Age Normal cost method. This method is very commonly used in the public sector and is geared toward providing a cost that is level with respect to payroll. The method is also considered a best practice method in the Conference of Consulting Actuaries (CCA) White Paper on Actuarial Funding Policies and Practices for Public Pension Plans[3]. The method fits within the District's budgeting methodology and we recommend no change.

Asset Smoothing Method

The plans use a five-year smoothing period for recognizing actuarial returns that are over or under the assumed return level. While smoothing the returns, the actuarial value of assets is constrained to an 80% to 120% corridor around the market value of plan assets. This method meets the applicable Actuarial Standards of Practice and is considered a best practice in the CCA White Paper. It also has done a good job of smoothing out the effects of investment market fluctuations on plan costs. We recommend no change to the method.

Amortization of Unfunded Actuarial Accrued Liability

Currently the plan amortizes any unfunded liability on a level dollar basis. The initial unfunded/(surplus) liability was established as of October 1, 2017 and amortized over a closed 15 year period. All assumption changes, method changes and experience gains or losses for the October 1, 2017 valuation and subsequent valuations will be amortized over a closed 20 year period as of the date of each valuation. The amortization period and approach is a CCA White Paper best practice for amortizing any unfunded liabilities, so we do not recommend any changes if there are unfunded liabilities (liability exceed assets).

We do propose one change to the current methodology. The White Paper suggest that in the case where there is a net surplus (assets exceed liabilities), the net amount be amortized over an open 30 year period and all previously established amortization bases be eliminated. This keeps the surplus from being used up too quickly and causing unforeseen budgetary stress for the plan sponsor.

The cost information shown in the next section adopts this methodology.

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[3] The CCA White Paper is available at https://www.ccactuaries.org/docs/default-source/papers/cca-ppc_actuarial-funding-policies-and-practices-for-public-pension-plans.pdf?sfvrsn=6397cc76_6,

Section VI. Impact of Changes

The analysis below reflects the impact of the proposed changes on the October 1, 2020 valuations results. Please note that these results are for illustrative purposes only as the October 1, 2020 valuation has been finalized. These results were used to determine the FY2022 Actuarially Determined Contribution (ADC). This analysis shows what the resulting ADC would have been if these proposed changes were implemented.

($ in thousands)

Teachers	Actuarial Accrued Liability	Total Normal Cost	Unfunded Accrued Liability	Funded Ratio	FY2022 ADC
A. Current Assumptions	2,640,803	82,614	209,728	92.1%	70,524
B. Proposed Assumptions	2,562,375	74,504	131,300	94.9%	54,647
C. Dollar Difference (B. – A.)	(78,427)	(8,110)	(78,427)		(15,877)
D. Percentage Difference (C. / A.)	(3.0%)	(9.8%)	(37.4%)		(22.5%)

Police	Actuarial Accrued Liability	Total Normal Cost	Unfunded Accrued Liability	Funded Ratio	FY2022 ADC
A. Current Assumptions	4,179,114	132,655	(436,129)	110.4%	68,786
B. Proposed Assumptions	4,163,104	129,677	(452,139)	110.9%	83,861
C. Dollar Difference (B. – A.)	(16,010)	(2,978)	(16,010)		15,075
D. Percentage Difference (C. / A.)	(0.4%)	(2.2%)	(3.7%)		21.9%

Fire	Actuarial Accrued Liability	Total Normal Cost	Unfunded Accrued Liability	Funded Ratio	FY2022 ADC
A. Current Assumptions	1,844,730	71,566	(216,040)	111.7%	42,180
B. Proposed Assumptions	1,764,115	63,805	(296,655)	116.8%	33,958
C. Dollar Difference (B. – A.)	(80,615)	(7,761)	(80,615)		(8,222)
D. Percentage Difference (C. / A.)	(4.4%)	(10.8%)	(37.3%)		(19.5%)

Total	Actuarial Accrued Liability	Total Normal Cost	Unfunded Accrued Liability	Funded Ratio	FY2022 ADC
A. Current Assumptions	8,664,647	286,835	(442,441)	105.1%	181,490
B. Proposed Assumptions	8,489,594	267,986	(617,493)	107.3%	172,466
C. Dollar Difference (B. – A.)	(175,052)	(18,849)	(175,052)		(9,024)
D. Percentage Difference (C. / A.)	(2.0%)	(6.6%)	(39.6%)		(5.0%)

Section VII. Data, Methods and Assumptions Applied in the Experience Study

We used participant data initially prepared for the actuarial valuations for the years beginning:

- July 1, 2015
- July 1, 2016
- July 1, 2017
- July 1, 2018
- July 1, 2019
- July 1, 2020

The data files as of July 1, 2015, 2016, 2017 and 2018 were provided by Cavanaugh MacDonald. Data files as of July 1, 2019, and 2020 were provided directly by DCRB. Additional clarifications and information were supplied by DCRB where it was not clear as to certain data elements. Bolton did not audit the information but did review the data files for reasonableness.

We determined, for each year, the actual incidence of each demographic assumption, based on the participant's age nearest birthday and years of service as of the beginning of the year and compared that to the expected incidence, determined using the same factors.

Appendix

As an independent review of this assumption, we used the Capital Market Assumptions (CMAs) provided in Horizon Actuarial Services' *Survey of Capital Market Assumptions – 2020 Edition* to develop an expected portfolio geometric return based on the policy targets. Although this survey was developed for Taft-Hartley plans, the long-term investment approach and relative size of these funds is consistent with the DCRB plans.

DCRB	Policy Target	Horizon Mapping
Growth		
US Public Equity	20.00%	US Equity – Large Cap
Private Equity	9.00%	Private Equity
Developed Mkt Equity (non-US)	16.00%	Non-US Equity – Developed
Emerging Market Equity	10.00%	Non-US Equity - Emerging
Total Growth	55.00%	
Rate Sensitive		
Cash Equivalents	1.00%	US Treasuries
Investment Grade Bonds	7.00%	US Bonds – Core
Long-term Govt Bonds	3.00%	US Treasuries
TIPS	4.00%	TIPS (inflation protected)
Total Rate Sensitive	15.00%	
Real Assets		
Infrastructure	6.00%	Infrastructure
Real Estate	7.00%	Real Estate
Natural Resources	2.00%	Commodities
Total Real Assets	15.00%	
Credit		
High Yield Bonds	2.00%	US Corp Bond – High Yield
Bank Loans	2.00%	Private Debt
Private Debt	3.00%	Private Debt
Foreign Bonds	2.00%	Non US Debt-Developed
Emerging Market Bonds	4.00%	Non-US Debt - Emerging
Total Credit	13.00%	
Absolute Return		
Global Macro Hedge Funds	2.00%	Hedge Funds

Using this mapping, we calculated DCRB's expected geometric returns to be 6.02% and 6.86% for short-term [5-10 year] and long-term [20+ years] time horizons, respectively.

Some plan sponsors prefer a more conservative assumption for their funding valuations since contribution requirements increase following years in which investment returns do not meet the assumption. As such, they set the discount rate assumption lower than the expected investment return to increase the probability that the fund's return will meet or exceed the discount rate. From a fiduciary standpoint, the number one goal of a pension system is to adequately and

systematically fund the plan to ensure that promised benefits can be paid in full. Achieving this goal often entails the consideration of supporting, and sometimes competing, objectives, such as mitigating undo pressure on the sponsor, participants, or other stakeholders and balancing contribution development and volatility with intergenerational equity.

The table below summarizes Horizon's CMAs and our derivation of DCRBs portfolio return. In our calculations, to convert between the portfolio arithmetic (A) and geometric (G) return, we used the formula (mentioned in ASOP 27) $G \approx A - V/2$, where V is the portfolio variance.

Horizon Asset Class	Target Allocation	Arithmetic Return		St. Dev
		10 Year	20 Year	
US Equity - Large Cap	20.0%	7.05%	7.96%	16.42%
Non-US Equity-Developed	16.0%	7.97%	8.79%	18.32%
Non-US Equity Emerging	10.0%	10.01%	10.78%	24.33%
US Corp Bonds – Core	7.00%	2.25%	3.38%	5.52%
US Corp Bonds – High Yield	2.0%	4.26%	5.46%	9.88%
Non-US Debt Developed	2.0%	1.63%	2.53%	7.18%
Non-US Debt Emerging	4.0%	4.86%	5.99%	11.26%
US Treasuries (Cash Equity)	4.0%	1.13%	1.91%	1.30%
TIPS	4.0%	1.77%	2.56%	5.64%
Real Estate	7.0%	7.06%	7.65%	17.62%
Hedge Funds	2.0%	4.79%	5.71%	8.09%
Commodities	2.0%	4.43%	5.45%	17.31%
Infrastructure	6.0%	7.77%	8.09%	17.04%
Private Equity	9.0%	11.23%	12.27%	22.25%
Private Debt	5.0%	7.10%	7.52%	11.42%
Total	**100.00%**			
Portfolio Arithmetic Return		**6.78%**	**7.62%**	
Portfolio Variance				1.52%
Portfolio Standard Deviation				12.30%
Portfolio Geometric Return (Net of Investment expenses)		**6.02%**	**6.86%**	

Using the calculated portfolio standard deviation of 12.30%, we estimated the 25th, 35th, 50th, 65th, and 75th percentiles for the portfolio geometric return for both the 10-year and 20-year investment horizons.

Discount Rate