HPOPS®

FOR TODAY & TOMORROW

December 28, 2020

Texas Pension Review Board
P.O. Box 13498 Austin,
TX78711-3498

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EXECUTIVE DIRECTOR
Patrick S. Franey

Dear Sir or Madam:

Pursuant to Section 9G(a) of Article 6243g-4, Texas Revised Civil Statutes (Statute), please find attached the following two documents on behalf of the Houston Police Officers' Pension System (HPOPS) and at the request of the City of Houston (City).

1. Risk Sharing Valuation Study of HPOPS for the year beginning July 1, 2020 and prepared by the pension system actuary, Gabriel, Roeder, Smith & Company (GRS), pursuant to Section 9A of the Statute.

2. Proposed Risk Sharing Valuation Study of HPOPS as of July 1, 2020 and prepared by the City's actuary, Retirement Horizons, Inc. (RHI), pursuant to Section 9A of the Statute.

Pursuant to Section 9A(f) of the Statute, because the difference between the estimated city contribution rates in the risk sharing valuation studies prepared by GRS and RHI is less than two percentage points, the estimated city contribution rate recommended by GRS will be the city contribution rate for the 2022 fiscal year for purposes of Section 9A(a)(5) of the Statute, subject to any applicable restatement under the Statute. Furthermore, the GRS risk sharing valuation study prepared for HPOPS is considered to be the final risk sharing valuation study for the 2022 fiscal year for the purposes of the Statute.

Sincerely,

Patrick S. Franey

Patrick S. Franey
Executive Director

Cc: Tantri Emo
Melissa Dubowski

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Houston Police Officers' Pension System

ACTUARIAL VALUATION REPORT FOR THE YEAR BEGINNING JULY 1, 2020



P: 469.524.0000 | www.grsconsulting.com

October 9, 2020

Board of Trustees
Houston Police Officers' Pension System
602 Sawyer
Suite 300
Houston, TX 77007

Re: Risk Sharing Valuation Study as of July 1, 2020

Dear Members of the Board:

We are pleased to present our Risk Sharing Valuation Study (RSVS, or sometimes referred to as the actuarial valuation in the report) of the Houston Police Officers' Pension System ("HPOPS" or "the System") for the plan year commencing July 1, 2020. This Report describes the current actuarial condition of HPOPS, determines the calculated employer contribution rate (the actuarially determined rate), and analyzes changes in this contribution rate from the prior year. Valuations are prepared annually, as of July 1st, the first day of the HPOPS plan year. This report was prepared at the request of the Board and is intended for use by the HPOPS staff and those designated or approved by the Board. This report may be provided to parties other than HPOPS staff only in its entirety and only with the permission of the Board, or as required by law.

Financing objectives and funding policy

Under the HPOPS statute, the employer contribution rate is determined actuarially, based on the Board's funding policy and the HPOPS governing law. The contribution rate determined by a given actuarial valuation and implemented by the Board becomes effective twelve months after the valuation date, i.e., the rates determined by this July 1, 2020 actuarial valuation will be used by the Board when determining the employer contribution rate for the year beginning July 1, 2021 and ending June 30, 2022.

While inside the RSVS Corridor, the actual City Contribution Rate will be the greater of the Estimated City Contribution Rate determined below and the Corridor Midpoint that was established in the June 30, 2016 RSVS. The Estimated City Contribution Rate (City of Houston) for FY 2022 is 29.22%, which is less than the Corridor Midpoint of 31.92%. Thus, the City Contribution rate for FY 2022 is 31.92%.

The Estimated City Contribution Rate and liabilities are computed using the Ultimate Entry Age Normal (UEAN) actuarial cost method. The Estimated City Contribution Rate is the sum of two pieces: the employer normal cost rate and the amortization rate. The normal cost rate is determined as a percentage of active member payroll, with the employer normal cost being the difference between the total normal cost and the member contribution rate. The amortization rate is determined as a level percentage of active member payroll. It is the amount required to amortize the unfunded actuarial accrued liability (UAAL) over a closed period using the process of "laddering".

The UAAL as of June 30, 2016, as restated in the "Final Risk Sharing Valuation Study as of June 30, 2016" (RSVS Study), which was dated September 28, 2017, is the initial base and is amortized over a closed 30-year period beginning FY2018. Each future valuation will establish either a liability gain layer or a liability loss layer. These layers will represent unexpected increases/decreases in the unfunded actuarial accrued liability (after subtracting out any remaining Legacy Liability or any remaining prior years' liability layers). New loss bases will be amortized over a 30-year period, while new gain bases will be amortized over the remaining amortization period as of one year after the valuation date of the largest remaining loss base (will typically be the initial RSVS base). The amortization of all bases will begin one year after the valuation date using a level percentage of payroll amortization method.

Losses from assets returning 6.72% on an AVA basis compared to the 7.00% assumed were more than offset by the COLA and DROP credit risk sharing provisions. Note that the calculation of the COLA (return on AVA less 5.0% with a minimum of 0.0% and max of 4.0%) means that gains due to asset performance will necessarily result in liability losses due to COLAs being greater than assumed, while asset losses will result in liability gains from COLAs being less than assumed. The impact of the COLAs being different than assumed is larger in magnitude now that the Plan is outside the three-year COLA holiday. Please see Table 6 under Section IV of our Report for a detailed analysis of the change in the estimated City contribution rate from the prior year to this year.

The contribution rate is determined using an actuarial value of assets rather than market value. The actuarial value of assets recognizes 20% of the difference (typically referred to as "five year smoothing") between the market value of assets and the expected actuarial value of assets, based upon the assumed valuation rate of return of 7.00% per annum. There are currently $59.1 million in asset losses being deferred that will be recognized in the future and will present headwinds to the improvement in the funded status absent future asset gains.

Progress toward realization of financing objectives

The funded ratio (the ratio of the actuarial value of assets to the actuarial accrued liability) is a standard measure of a plan's funded status. In the absence of benefit improvements, it should increase over time, until it reaches 100%. The funded ratio as of July 1, 2020 is 82.4% which is up compared to last year's funded ratio of 81.7%. The funded ratio measured on the market value of assets is higher at 81.5% as of July 1, 2020. The funded status alone may not be appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations.

Benefit provisions

The benefit provisions reflected in this valuation are those which were in effect on July 1, 2020. There were no changes in the benefit provisions since the prior valuation. The benefit provisions are summarized in Appendix B of our Report.



Assumptions and methods

Actuarial assumptions and methods are set by the Board of Trustees, based upon recommendations made by the System's actuary. As part of the legislation enacting the 2016 RSVS benefit changes, the investment return assumption (7.0%) was set into statute (Article 6243g-4, Vernon's Texas Civil Statutes). This assumption is now considered a prescribed assumption under the actuarial standards of practice. The assumptions used in this valuation were adopted by the Board based on the recommendations from GRS following the Actuarial Experience Investigation Study for the 5-year period ending June 30, 2017. These assumptions were first used in the June 30, 2018 actuarial valuation. There have been no changes in assumptions or methods since the prior valuation.

The results of the actuarial valuation are dependent upon the actuarial assumptions used. Actual results can and almost certainly will differ, as actual experience deviates from the assumptions. Even seemingly minor changes in the assumptions can materially change the liabilities, calculated contribution rates and funding periods. The actuarial calculations presented in our Report are intended to provide information for rational decision making.

This report was prepared using our proprietary valuation model and related software which in our professional judgment has the capability to provide results that are consistent with the purposes of the valuation. We performed tests to ensure that the model reasonably represents that which is intended to be modeled.

The actuarial assumptions and methods used in this Report all comply with the actuarial standards of practice (ASOPs)and are described in Appendix A of our Report.

Data

Member data for retired, active and inactive members was supplied as of July 1, 2020 by the HPOPS staff. We did not audit this data, but we did apply a number of tests to the data, and we concluded that it was reasonable and consistent with the prior year's data. GRS is not responsible for the accuracy or completeness of the information provided to us.

Asset and all financial information as of July 1, 2020 were supplied to us by the HPOPS staff.

Plan Experience

As part of each valuation, we examine the System's experience relative to the assumptions. The aggregate results of these analyses are disclosed in Tables 5 & 6 under Section IV of our Report.



Actuarial Certification

All of the tables contained in this actuarial valuation report and in the actuarial section of the HPOPS Comprehensive Annual Financial Report (CAFR) were prepared by Gabriel, Roeder, Smith & Company. Historical information for years prior to 2008 was prepared by the prior actuarial firm and was not subjected to our actuarial review. We certify that the information presented herein is accurate and fairly portrays the actuarial position of HPOPS as of July 1, 2020.

All of our work conforms with generally accepted actuarial principles and practices, and to the Actuarial Standards of Practice issued by the Actuarial Standards Board. In our opinion, our calculations also comply with the requirements of State law and the Statements of the Governmental Accounting Standards Board. The undersigned are independent actuaries and consultants. All of the undersigned are Enrolled Actuaries, Members of the American Academy of Actuaries, and meet the Qualification Standards of the American Academy of Actuaries. Finally, all of the undersigned are experienced in performing valuations for large public retirement systems.

Respectfully submitted,
Gabriel, Roeder, Smith & Company

Mark R. Randall, FCA, EA, MAAA
Chief Executive Officer

Joseph P. Newton, FSA, EA, MAAA
Pension Market Leader

Bradley E. Stewart, ASA, EA, MAAA
Consultant

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SECTION I

RISK SHARING VALUATION STUDY

RISK SHARING VALUATION STUDY DISCUSSION

The purpose of the Risk Sharing Valuation Study (RSVS) is to determine the City Contribution Rate for the fiscal year beginning one year after the valuation date. The initial RSVS study was based on the membership and financial information as of the June 30, 2016 valuation, and the results are detailed in the actuarial impact statement dated September 25, 2017. The initial RSVS determined the Corridor and Corridor midpoint to be used in this and all future RSVS studies.

The first exhibit in this section shows the RSVS Corridor. Column 3 shows the Corridor Midpoint, which for fiscal year 2022, is 31.92% of pay. Columns 2 and 4 show the Corridor Minimum and Corridor Maximum respectively. Column 5 shows the actual City Contribution Rate for the fiscal year.

The next exhibit shows the individual pieces and Estimated City Contribution Rate. While only five years of information are shown, this table is intended to show historic information in the future.

The third exhibit shows the Liability Gain/Loss Layers established by each RSVS. Columns 2 and 3 show the original liability layer and any remaining liability layer respectively. Column 4 is the payment on that particular layer for the fiscal year beginning one year after the valuation date. The payment is determined using a level percentage of payroll and the remaining amortization period is shown in column 5. The payments reflect the one year delay between the determination of the payment and the beginning of the fiscal year in which the payment is made. The dollar amounts of the payments are summed and then converted to a percentage of payroll based on the projected payroll for the fiscal year beginning one year after the valuation date.

RISK SHARING VALUATION STUDY
CORRIDOR

Fiscal Year Ending	Corridor Minimum	Corridor Midpoint	Corridor Maximum	City Contribution Rate
(1)	(2)	(3)	(4)	(5)
June 30, 2018	26.77%	31.77%	36.77%	31.77%
June 30, 2019	26.85%	31.85%	36.85%	31.85%
June 30, 2020	26.82%	31.82%	36.82%	31.82%
June 30, 2021	26.84%	31.84%	36.84%	31.84%
June 30, 2022	26.92%	31.92%	36.92%	31.92%
June 30, 2023	26.98%	31.98%	36.98%	
June 30, 2024	27.03%	32.03%	37.03%	
June 30, 2025	27.07%	32.07%	37.07%	
June 30, 2026	27.10%	32.10%	37.10%	
June 30, 2027	27.12%	32.12%	37.12%	
June 30, 2028	27.13%	32.13%	37.13%	
June 30, 2029	27.13%	32.13%	37.13%	
June 30, 2030	27.13%	32.13%	37.13%	
June 30, 2031	27.14%	32.14%	37.14%	
June 30, 2032	27.14%	32.14%	37.14%	
June 30, 2033	27.14%	32.14%	37.14%	
June 30, 2034	27.15%	32.15%	37.15%	
June 30, 2035	27.14%	32.14%	37.14%	
June 30, 2036	27.14%	32.14%	37.14%	
June 30, 2037	27.14%	32.14%	37.14%	
June 30, 2038	27.14%	32.14%	37.14%	
June 30, 2039	27.13%	32.13%	37.13%	
June 30, 2040	27.14%	32.14%	37.14%	
June 30, 2041	27.13%	32.13%	37.13%	
June 30, 2042	27.13%	32.13%	37.13%	
June 30, 2043	27.13%	32.13%	37.13%	
June 30, 2044	27.13%	32.13%	37.13%	
June 30, 2045	27.13%	32.13%	37.13%	
June 30, 2046	27.13%	32.13%	37.13%	
June 30, 2047	27.13%	32.13%	37.13%	

RISK SHARING VALUATION STUDY
ESTIMATED CITY CONTRIBUTION RATE

Fiscal Year Ending	Employer Normal Cost	Amortization Payment	Estimated City Contribution Rate
(1)	(2)	(3)	(4)
June 30, 2018	13.86%	17.91%	31.77%
June 30, 2019	13.85%	17.89%	31.74%
June 30, 2020	13.51%	18.07%	31.58%
June 30, 2021	13.47%	16.14%	29.61%
June 30, 2022	13.48%	15.74%	29.22%

RISK SHARING VALUATION STUDY
LIABILITY GAIN OR LOSS LAYERS

Valuation Year Base Established	Original Layer	Remaining Layer as of Valuation Date	Payment for Fiscal Year 2022	Years Remaining From 7/1/2021
(1)	(2)	(3)	(4)	(5)
July 1, 2020	$ (17,265,778)	(17,265,778)	$ (1,165,060)	26
July 1, 2019	(124,475,264)	(133,188,533)	(8,450,677)	26
July 1, 2018	(28,335,051)	(30,541,778)	(1,937,845)	26
July 1, 2017	12,356,562	13,462,095	837,417	27
July 1, 2016	1,323,312,199	1,371,682,994	87,031,890	26
Total		1,204,149,000	76,315,725	
Projected Payroll for Fiscal Year +1			$ 484,880,823	
Amortization Payments as % of Projected Pay			15.74%	
Single Equivalent Amortization Period from the Valuation Date			27.0	

SECTION II

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Item	July 1, 2020	July 1, 2019
Membership (dollar amounts in thousands)		
• Number of:		
- Active members	5,319	5,282
- Retirees and beneficiaries	4,622	4,494
- Inactive members	49	43
- Total	9,990	9,819
• Total annualized salaries supplied by HPOPS	$ 459,273	$ 442,527
Contribution Rates		
• City Contribution Rate	31.92%	31.84%
• Member	10.50%	10.50%
Assets ($000s)		
• Market value	$ 5,572,476	$ 5,674,647
• Actuarial value	5,631,533	5,434,933
• Estimation of return on market value	1.1%	6.3%
• Estimation of return on actuarial value	6.7%	9.1%
• Employer contribution	$ 149,078	$ 142,429
• Member contribution	$ 49,062	$ 46,896
• Ratio of actuarial value to market value (prior to recognition of POB for July 1, 2017)	101.1%	95.8%
Actuarial Information ($000s)		
• Employer normal cost %	13.48%	13.47%
• Unfunded actuarial accrued liability (UAAL)	$ 1,204,149	$ 1,220,210
• Amortization rate	15.74%	16.14%
• Funding period	27.0 years	28.0 years
• Funded ratio	82.4%	81.7%
Projected employer contribution		
• Fiscal year ending June 30,	2022	2021
• Projected payroll (millions)	$ 484.9	$ 467.2
• Projected employer contribution (millions)	$ 154.8	$ 148.8

SECTION III

DISCUSSION

CONTRIBUTION REQUIREMENTS

- The above Executive Summary shows the City Contribution Rate for FY 2022 to be 31.92% of active member payroll
  - The Estimated City Contribution Rate was 29.22%, a decrease from 29.61% of active member payroll for FY 2021
  - The final City Contribution Rate is the greater of the Estimated City Contribution Rate or the Corridor Midpoint of 31.92%.
  - Losses from assets returning 6.72% on an AVA basis compared to the 7.00% assumed were more than offset by the COLA and DROP credit risk sharing provisions.
  - Rates shown on the Executive Summary are calculated rates for the twelve-month period beginning July 1, 2021, based on current board policy
  - Table 6 under Section IV of our Report reconciles the Estimated City Contribution Rate from the prior valuation date to the current valuation date
- Projected FY 2022 payroll was based on the prior year's annualized salaries of the active members as of July 1, 2020 of $459.3 million rolled forward two years at the 2.75% assumed payroll growth rate.
- There were no changes to the benefit provisions since the previous actuarial valuation
- There were several changes to the demographic actuarial assumptions based on the experience study for the 5-year period ending June 30, 2017 that were first reflected in the July 1, 2018 actuarial valuation. Changes resulting from the experience study included updated mortality tables, minor changes to the retirement rates, and adjustments to the disability rates. There have been no other assumption changes since the July 1, 2017 actuarial valuation.
- The amortization payments are developed based upon the following assumptions:
  - Laddering of bases with initial base set up with the June 30, 2016 RSVS study.
  - 30-year closed funding period for each new loss base with new gains amortized over the remaining period of the largest existing loss base
  - Dollar contribution amounts increase as a level percentage of payroll
  - Total payroll increases 2.75% per year

CALCULATION OF CONTRIBUTION RATES

The funds available to pay benefits come from two sources, contributions and investment income on those contributions (the majority of the funds available to pay benefits typically come from investment income). HPOPS receives contributions from two sources: employer contributions, which are currently based on the funding policy prescribed by statute, and member contributions, which are a percentage of pay. As shown in Table 2 under Section IV of our Report, the Estimated Employer Contribution Rate has two components:

- The normal cost percentage (NC%)
- The amortization percentage (UAAL%)

The normal cost is the present value of the portion of projected benefits that is attributable to service accrued in the current year. The NC% is shown in Table 4 under Section IV of our Report.

Members are required to make employee contributions and only the excess of the NC% over the member contribution rate is included in the employer contribution rate.

The actuarial accrued liability (AAL) is the difference between (i) the actuarial present value of all future benefits for the current participants of the fund, including active, inactive and retired members, and (ii) the actuarial present value of future normal costs. Thus the AAL represents the liability associated with past years. The unfunded actuarial accrued liability (UAAL) is the difference between the AAL and the actuarial value of assets (AVA). It is the shortfall/excess between the liability associated with prior years (the AAL) and the assets actually accumulated (the AVA). This shortfall/excess can arise from several sources, including actuarial gains and losses which are caused by differences between actual experience and the plan's assumptions, changes to the plan's actuarial assumptions, and amendments to the benefit provisions.

The UAAL% is the amount required to fund this difference and is developed using the process of laddering with the initial base established in the July 1, 2016 RSVS Study and amortized over a closed 30-year period beginning FY2018 as a level percentage of payroll. Each future valuation will establish either a liability gain layer or a liability loss layer. These layers will represent unexpected increases/decreases in the unfunded actuarial accrued liability (after subtracting out any remaining Legacy Liability or any remaining prior years' liability layers). New loss bases will be amortized over a 30-year period, while new gain bases will be amortized over the remaining amortization period as of one year after the valuation date of the largest remaining loss base (typically, the initial RSVS base). The amortization of all bases will begin one year after the valuation date using a level percentage of payroll amortization method. Item 10a of Table 2 in Section IV of our report shows the UAAL%.

While inside the RSVS Corridor, the actual City Contribution Rate will be the greater of the Estimated City Contribution Rate determined below and the Corridor Midpoint that was established in the June 30, 2016 RSVS.

FINANCIAL DATA AND EXPERIENCE

As of July 1, 2020, HPOPS has a total market value of about $5.57 billion. Financial information was gathered from the HPOPS staff.

Our Report includes a number of Exhibits related to plan assets. Table 8 under Section IV of our Report shows how the total market value is distributed among the various asset classes of investments.

Table 9 under Section IV of our Report shows a reconciliation of the market values between the beginning and end of FY2020.

During FY2020, the dollar-weighted total investment return on the market value of assets (MVA) was 1.09%, net of investment expenses, as shown in Table 11 under Section IV of our Report.

In determining the contribution rates and funded status of the System, an actuarial value of assets (AVA) is used, rather than the market value of assets. The AVA recognizes 20% of the difference between the projected actuarial value (based on last year's annual assumed 7.00% investment return rate) and the market value at the valuation date. This is an approximation of five year smoothing and is intended to help reduce the volatility of the contribution rates from year to year.

The development of the AVA is shown in Table 10 under Section IV of our Report. The AVA as of July 1, 2020 increased to $5.63 billion from $5.43 billion as of the last valuation. This year, the AVA is 101.1% of the MVA compared to 95.8% last year.

In addition to the market return, Table 11 also shows the return on the actuarial value of assets for HPOPS. For FY2020, this return was 6.72%. Because this is less than the assumed 7.00% investment return, an actuarial loss occurred, increasing the unfunded actuarial accrued liabilities of the System by $15 million. Table 13 shows a historical summary of market and actuarial return rates in recent years.

MEMBER DATA

Member data as of July 1, 2020 was supplied electronically by the HPOPS staff. While we did not audit this data, we did perform various tests to ensure that it was internally consistent, consistent with the prior year's data, and was reasonable overall.

Table 19 under Section IV of our Report shows the number of members by category (active, inactive, retired, etc.). Tables 20a-d show active member statistics by Group. Tables 17 and 18 show summaries of certain historical data, including membership statistics.

The number of active and DROP members was 5,319 as of July 1, 2020, up from 5282 as of July 1, 2019.

The total payroll shown on the statistical tables is the amount that was supplied by HPOPS, annualized, if necessary and rolled forward to the current plan year with one year of payroll growth. For the cost calculations, the pay amounts were adjusted in accordance with the actuarial assumptions to reflect one year's salary increase.

Total projected active member payroll increased 3.78% last year, compared with a 3.72% increase the prior year.

The rate of payroll growth is significant because the methodology used in the valuation to amortize the unfunded actuarial accrued liability assumes a growing payroll into the future. If the payroll does not grow at the assumed 2.75% per year average, the current amortization payments may be understated and the funding position of the System will not strengthen over time.

BENEFIT PROVISIONS

Appendix B of our Report includes a summary of the benefit provisions for HPOPS, and a brief summary of the current benefit provisions is provided below.

- *Normal Retirement Eligibility*
  - Sworn Prior to October 9, 2004 – 20 years of service
  - Sworn on or after October 9, 2004 –the Rule of 70 (age plus service greater or equal to 70)
- *Normal Retirement Benefit*
  - Sworn Prior to October 9, 2004 – 2.75% of average direct pay for the first 20 years of service and 2% for each year after 20
  - Sworn on or after October 9, 2004 – 2.25% for the first 20 years of service and 2% for each year after 20 up to a maximum of 80%
- *Normal Form of Payment* is a 100% Joint & Survivor Annuity for married retirees and Life Annuity for unmarried retirees
- *Employee Contributions* – 10.50% for all employees.
  - Contributions of employees in DROP are no longer credited to the DROP account.
- *Post-retirement Cost of Living Adjustments (COLAs)* are granted each year on April 1 and are calculated prospectively at 100% of the 5-year average investment return less 5.0%. However, the COLA can never be less than 0.0% or greater than 4.0%. This COLA is applied to retirement and survivor benefits and is included in the benefit payment made at the end of April.
  - COLA does not apply to DROP benefits.
  - The COLA will begin at age 55 except for line-of-duty survivors and participants or survivors of participants who began receiving benefit prior to June 8, 1995.
- *Insurance Benefit* - Retired members and surviving spouses are entitled to receive an additional stipend of $150.00 per month to help offset the cost of medical insurance premiums

This valuation reflects all benefits offered to HPOPS members. There are no ancillary benefits that might be deemed a HPOPS liability if continued beyond the availability of funding by the current funding source. There were no changes in benefit provisions since the prior valuation.

ACTUARIAL METHODS AND ASSUMPTIONS

Appendix A of our Report includes a summary of the actuarial assumptions and methods used in this valuation. The assumptions used in this valuation were adopted by the Board based on the recommendations from GRS following the Actuarial Experience Investigation Study, dated July 16, 2018, for the 5-year period ending June 30, 2017. These assumptions were first used in the June 30, 2018 actuarial valuation, and there have been no changes since that valuation.

Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions

The determination of the accrued liability and the actuarially determined contribution requires the use of assumptions regarding future economic and demographic experience. Risk measures, as illustrated in this report, are intended to aid in the understanding of the effects of future experience differing from the assumptions used in the course of the actuarial valuation. Risk measures may also help with illustrating the potential volatility in the accrued liability and the actuarially determined contribution that result from the differences between actual experience and the actuarial assumptions.

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 due to changing conditions; 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. The scope of an actuarial valuation does not include an analysis of the potential range of such future measurements.

Examples of risk that may reasonably be anticipated to significantly affect the plan's future financial condition include:

1. Investment risk – actual investment returns may differ from the expected returns;
2. Asset/Liability mismatch – changes in asset values may not match changes in liabilities, thereby altering the gap between the accrued liability and assets and consequently altering the funded status and contribution requirements;
3. Contribution risk – actual contributions may differ from expected future contributions. For example, actual contributions may not be made in accordance with the plan's funding policy or material changes may occur in the anticipated number of covered employees, covered payroll, or other relevant contribution base;
4. Salary and Payroll risk – actual salaries and total payroll may differ from expected, resulting in actual future accrued liability and contributions differing from expected;
5. Longevity risk – members may live longer or shorter than expected and receive pensions for a period of time other than assumed;
6. Other demographic risks – members may terminate, retire or become disabled at times or with benefits other than assumed resulting in actual future accrued liability and contributions differing from expected.

Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions (Continued)

The effects of certain trends in experience can generally be anticipated. For example if the investment return since the most recent actuarial valuation is less (or more) than the assumed rate, the cost of the plan can be expected to increase (or decrease). Likewise, if longevity is improving (or worsening), increases (or decreases) in cost can be anticipated.

The City Contribution Rate shown in the Executive Summary may be considered as a minimum contribution rate that complies with HPOPS Statute. The timely receipt of the actuarially determined contributions is critical to support the financial health of the plan. Users of this report should be aware that contributions made at the actuarially determined rate do not necessarily guarantee benefit security.

PLAN MATURITY MEASURES

Risks facing a pension plan evolve over time. A young plan with virtually no investments and paying few benefits may experience little investment risk. An older plan with a large number of members in pay status and a significant trust may be much more exposed to investment risk. Several generally accepted plan maturity measures are described below and are followed by a table showing a history of the measurements.

RATIO OF MARKET VALUE OF ASSETS TO PAYROLL

The relationship between assets and payroll is a useful indicator of the potential volatility of contributions. For example, if the market value of assets is 2.0 times the payroll, a return on assets 5% different than assumed would equal 10% of payroll. A higher (lower) or increasing (decreasing) level of this maturity measure generally indicates a higher (lower) or increasing (decreasing) volatility in plan sponsor contributions as a percentage of payroll.

RATIO OF ACTUARIAL ACCRUED LIABILITY TO PAYROLL

The relationship between actuarial accrued liability and payroll is a useful indicator of the potential volatility of contributions for a fully funded plan. A funding policy that targets a funded ratio of 100% is expected to result in the ratio of assets to payroll and the ratio of liability to payroll converging over time.

Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions (Continued)

The ratio of liability to payroll may also be used as a measure of sensitivity of the liability itself. For example, if the actuarial accrued liability is 2.5 times the payroll, a change in liability 2% other than assumed would equal 5% of payroll. A higher (lower) or increasing (decreasing) level of this maturity measure generally indicates a higher (lower) or increasing (decreasing) volatility in liability (and also plan sponsor contributions) as a percentage of payroll.

RATIO OF ACTIVES TO RETIREES AND BENEFICIARIES

A young plan with many active members and few retirees will have a high ratio of actives to retirees. A mature open plan may have close to the same number of actives to retirees, resulting in a ratio near 1.0. A super-mature or closed plan may have significantly more retirees than actives, resulting in a ratio below 1.0. For the purposes of this measurement, members of DROP were counted as active members.

RATIO OF NET CASH FLOW TO MARKET VALUE OF ASSETS

A positive net cash flow means contributions exceed benefits and expenses. A negative cash flow means existing funds are being used to make payments. A certain amount of negative net cash flow is generally expected to occur when benefits are prefunded through a qualified trust. Large negative net cash flows as a percent of assets may indicate a super-mature plan or a need for additional contributions.

DURATION OF PRESENT VALUE OF BENEFITS

The duration of the actuarial accrued liability may be used to approximate the sensitivity to a 1% change in the assumed rate of return. For example, duration of 10 indicates that the liability would increase approximately 10% if the assumed rate of return were lowered 1%.

ADDITIONAL RISK ASSESSMENT

Additional risk assessment is outside the scope of the annual actuarial valuation. Additional assessment may include scenario tests, sensitivity tests, stochastic modeling, stress tests, and a comparison of the present value of accrued benefits at low-risk discount rates with the actuarial accrued liability.

Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions (Continued)

	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011
Ratio of the market value of assets to total payroll	11.81	12.48	12.52	10.68	9.73	10.60	10.88	9.63	9.15	9.09
Ratio of actuarial accrued liability to payroll	14.49	14.64	14.74	14.90	14.54	14.05	13.43	12.78	12.18	11.56
Ratio of actives to retirees and beneficiaries	1.15	1.18	1.20	1.22	1.36	1.42	1.54	1.61	1.66	1.72
Ratio of net cash flow to market value of assets*	-2.9%	-2.7%	10.3%	-6.5%	-2.2%	-1.8%	-1.7%	-2.0%	-1.9%	-1.8%
Duration of the actuarial present value of benefits**	15.20	15.11	NA	NA	NA	NA	NA	NA	NA	NA

* The 2018 net cash flow reflects issuance of a $750 million Pension Obligation Bond

**Duration measure not available prior to 2019

SECTION IV

SUPPORTING EXHIBITS

SUMMARY OF COST ITEMS ($000)
TABLE 1

	Valuation as of July 1, 2020		Valuation as of July 1, 2019	
	Cost Item	Cost as % of Pay	Cost Item	Cost as % of Pay
	(1)	(2)	(3)	(4)
1. Participants				
a. Active participants, hired post 10/9/2004	3,230		3,021	
b. Active participants enrolled in DROP	1,673		1,749	
c. Other active participants	416		512	
d. Retirees	3,613		3,512	
e. Disabled retirees	179		175	
f. Beneficiaries	830		807	
g. Inactive, deferred vested	49		43	
h. Total	9,990		9,819	
2. Projected valuation payroll	$ 484,881		$ 467,200	
3. Averages for active members				
a. Average age	41.5		41.6	
b. Average years of service	14.1		14.3	
c. Average pay ($)	$ 91,160		$ 88,451	
4. Present value of future pay	$ 5,095,160		$ 4,887,526	
5. Total normal cost rate	23.98%		23.97%	
6. Present value of future benefits	$ 8,004,231	1650.8%	$ 7,779,460	1665.1%
7. Present value of future normal costs	$ 1,168,549	241.0%	$ 1,124,317	240.6%
8. Actuarial accrued liability (6 - 7)	$ 6,835,682	1409.8%	$ 6,655,143	1424.5%
9. Present actuarial assets	$ 5,631,533	1161.4%	$ 5,434,933	1163.3%
10. Unfunded actuarial accrued liability (UAAL)	$ 1,204,149	248.3%	$ 1,220,210	261.2%
11. Funding period	27.0		28.0	
12. Estimated City Contribution Rate				
a. Normal cost	13.48%		13.47%	
b. Amortization charge	15.74%		16.14%	
c. Total	29.22%		29.61%	
13. Actual City Contribution Rate	31.92%		31.84%	
14. Average estimated return				
a. Based on market value	1.09%		6.29%	
b. Based on actuarial value	6.72%		9.07%	
15. Funded ratio	82.4%		81.7%	

CALCULATION OF ACTUARIALLY DETERMINED CONTRIBUTION RATE ($000)
TABLE 2

		July 1, 2020 (1)	July 1, 2019 (2)
1.	Projected valuation payroll (adjusted for two-year's payroll growth)	$ 484,881	$ 467,200
2.	Present value of future pay	$ 5,095,160	$ 4,887,526
3.	Employer normal cost rate (Table 4)	13.48%	13.47%
4.	Actuarial accrued liability for active members		
	a. Present value of future benefits for active members	$ 3,635,459	$ 3,580,551
	b. Less: present value of future employer normal costs	(633,557)	(611,127)
	c. Less: present value of future employee contributions	(534,992)	(513,190)
	d. Actuarial accrued liability	$ 2,466,910	$ 2,456,234
5.	Total actuarial accrued liability for:		
	a. Retirees and beneficiaries	$ 4,355,518	$ 4,188,042
	b. Inactive participants	13,254	10,867
	c. Active members (Item 4d)	2,466,910	2,456,234
	d. Total	$ 6,835,682	$ 6,655,143
6.	Actuarial value of assets (Table 10)	$ 5,631,533	$ 5,434,933
7.	Unfunded actuarial accrued liability (UAAL) (Item 5d - Item 6)	$ 1,204,149	$ 1,220,210
8.	Funding period	27.0	28.0
9.	Assumed payroll growth rate	2.75%	2.75%
10.	City Contribution Rate		
	a. UAAL amortization payment as % of pay	15.74%	16.14%
	b. Employer normal cost	13.48%	13.47%
	c. Estimated City Contribution Rate (a + b)	29.22%	29.61%
	d. Corridor Midpoint	31.92%	31.84%
	e. City Contribution Rate (greater of c and d)	31.92%	31.84%

ACTUARIAL PRESENT VALUE OF FUTURE BENEFITS ($000)
TABLE 3

		July 1, 2020 (1)	July 1, 2019 (2)
1.	Active members, hired post 10/9/2004		
	a. Retirement benefits	$ 1,212,242	$ 1,073,371
	b. Deferred termination benefits	1,443	0
	c. Refunds	7,109	9,157
	d. Death benefits	75,787	69,070
	e. Disability benefits	55,202	49,841
	f. Total	$ 1,351,783	$ 1,201,439
2.	Active members enrolled in DROP		
	a. Retirement benefits	$ 1,932,545	$ 1,973,219
	b. Deferred termination benefits	0	0
	c. Refunds	0	0
	d. Death benefits	35,143	37,222
	e. Disability benefits	0	0
	f. Total	$ 1,967,688	$ 2,010,441
3.	Other active members		
	a. Retirement benefits	$ 302,474	$ 352,007
	b. Deferred termination benefits	112	194
	c. Refunds	179	237
	d. Death benefits	12,417	14,867
	e. Disability benefits	806	1,366
	f. Total	$ 315,988	$ 368,671
4.	Members in Pay Status		
	a. Service retirements	$ 3,851,966	$ 3,705,055
	b. Disability retirements	120,450	118,441
	c. Beneficiaries	383,102	364,546
	d. Total	$ 4,355,518	$ 4,188,042
5.	Inactive members	$ 13,254	$ 10,867
6.	Total actuarial present value of future benefits	$ 8,004,231	$ 7,779,460

ANALYSIS OF NORMAL COST RATE
TABLE 4

		July 1, 2020 (1)	July 1, 2019 (2)
1.	Gross normal cost rate		
	a. Retirement benefits	20.03%	20.03%
	b. Deferred termination benefits	0.02%	0.00%
	c. Refunds	0.26%	0.32%
	d. Disability benefits	1.24%	1.24%
	e. Death benefits	1.59%	1.59%
	f. Total	23.14%	23.18%
2.	Plus: Administrative expenses as percentage of payroll	0.84%	0.79%
3.	Less: member contribution rate	10.50%	10.50%
4.	Employer normal cost rate (Item 1f + Item 2 - Item 3)	13.48%	13.47%

CALCULATION OF TOTAL ACTUARIAL GAIN OR LOSS
TABLE 5

1. Unfunded actuarial accrued liability (UAAL) as of July 1, 2019	$	1,220,210
2. Total normal cost for year		108,991
3. Actuarially calculated contribution requirement		(190,400)
4. Interest on UAAL for one year		85,415
5. Interest on Item 2 and Item 3 for one-half year		(2,801)
6. Actuarially expected UAAL as of July 1, 2020 (1+2+3+4+5)	$	1,221,415
7. Actual UAAL as of July 1, 2020		1,204,149
8. Actuarial gain/(loss) for the period (6 - 7)	$	17,266
SOURCE OF GAINS/(LOSSES)		
9. Asset gain/(loss) (See Table 12)	$	(14,764)
10. Impact of contributions different than actuarially determined		7,740
11. COLA & DROP credit different than assumed		26,185
12. Changes Due to Experience Study		-
13. Other liability gain/(loss) for the period		(1,895)
14. Actuarial gain/(loss) for the period	$	17,266

Note: Dollar amounts in $000

CHANGE IN CALCULATED CONTRIBUTION RATE SINCE THE PRIOR VALUATION TABLE 6

1.	Estimated City Contribution Rate as of July 1, 2019		29.61%
2.	Change in Contribution Rate During Year		
	a. Change in Employer Normal Cost	0.01%	
	b. Assumption changes	0.00%	
	c. Recognition of prior asset losses (gains)	(1.29%)	
	d. Actuarial (gain) loss from current year asset performance	1.48%	
	e. COLA & DROP credit different than assumed	(0.32%)	
	f. Actuarial (gain) loss from other liability sources	0.04%	
	g. Impact of City contributing different than actuarially determined	(0.16%)	
	h. Effect of Payroll growing slower than Payroll Growth Rate	(0.15%)	
	i. Total Change		(0.39%)
3.	Estimated City Contribution Rate as of July 1, 2020		29.22%

NEAR TERM OUTLOOK
TABLE 7

Valuation as of July 1,	Unfunded Actuarial Accrued Liability (UAAL, in 000s)	Funded Ratio	City Contribution Rate	Actuarial Value of Assets (in 000s)	For Fiscal Year Ending June 30,	Covered Compensation	Employer Contributions	Employee Contributions	Benefit Payments, Refunds, and Administrativ	Net External Cash Flow
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2020	$ 1,204,149	82.4%	31.84%	$ 5,631,533	2021	$ 471,903	$ 150,254	$ 49,550	$ 399,436	$ (199,632)
2021	1,214,521	82.7%	31.92%	5,803,530	2022	484,881	154,774	50,912	432,484	(226,797)
2022	1,213,436	83.1%	31.98%	5,958,784	2023	498,215	159,329	52,313	467,997	(256,355)
2023	1,209,371	83.4%	32.03%	6,093,828	2024	511,916	163,967	53,751	503,735	(286,017)
2024	1,201,936	83.8%	32.07%	6,207,341	2025	525,994	168,686	55,229	538,952	(315,037)
2025	1,175,997	84.3%	32.10%	6,313,461	2026	540,458	173,487	56,748	573,495	(343,260)
2026	1,154,992	84.7%	32.12%	6,398,587	2027	555,321	178,369	58,309	607,042	(370,364)
2027	1,129,591	85.1%	32.13%	6,462,266	2028	570,592	183,331	59,912	639,895	(396,651)
2028	1,099,538	85.5%	32.13%	6,503,672	2029	586,284	188,373	61,560	672,681	(422,748)
2029	1,064,550	86.0%	32.13%	6,521,248	2030	602,407	193,553	63,253	705,987	(449,181)
2030	1,024,263	86.4%	32.14%	6,512,761	2031	618,973	198,938	64,992	520,957	(257,027)

The projections assume the current funding policy and that all assumptions are met, including earning 7% on the actuarial value of assets

STATEMENT OF PLAN NET ASSETS ($000)
TABLE 8

	July 1, 2020 (1)	July 1, 2019 (2)
A. ASSETS		
1. Current Assets		
a. Cash and short term investments		
1) Cash on hand	$ 482	$ 239
2) Short term investments	938,097	922,917
b. Accounts Receivable		
1) Members	2,428	2,083
2) Investments	15,425	8,438
3) Due from Brokers	8,024	3,976
4) Other	3	17
c. Total Current Assets	$ 964,459	$ 937,670
2. Long Term Investments		
a. Fixed Income	$ 666,192	$ 958,756
b. Equity Securities	2,034,415	1,895,645
c. Alternative Investments	1,908,257	1,884,663
d. Foreign Currency Contracts	0	0
e. Total long term investments	$ 4,608,864	$ 4,739,064
3. Other Assets		
a Collateral on securities lending	$ 34,741	$ 64,316
b. Furniture, fixtures and equipment, net	0	0
c. City of Houston Contribution Receivable	7,372	6,321
d. Accrued interest on note receivable	0	0
e. Total other assets	$ 42,113	$ 70,637
4. Prepaid Management Fees	0	0
5. Total Assets	$ 5,615,436	$ 5,747,371
B. LIABILITIES		
1. Current Liabilities		
a. Foreign Currency Contracts	$ 0	$ 0
b. Due to Brokers	6,809	7,090
c. Securities Lending Collateral	34,741	64,316
d. Accrued Professional and Investment Fees	1,148	1,092
e. Other Liabilities	262	226
2. Total Liabilities	42,960	72,724
3. Net Assets Held in Trust	$ 5,572,476	$ 5,674,647
C. ASSET ALLOCATION FOR CASH & LONG TERM INVESTMENTS		
1. Current Assets	17.3%	16.5%
2. Fixed Income	12.0%	16.9%
3. Equity Securities	36.5%	33.4%
4. Alternative Investments	34.2%	33.2%
5. Total	100.0%	100.0%

RECONCILIATION OF PLAN NET ASSETS ($000)
TABLE 9

			Year Ending July 1, 2020 (1)	Year Ending July 1, 2019 (2)
1.	a.	Market value of assets at beginning of year	$ 5,674,647	$ 5,486,613
	b.	Adjustment	0	1
	c.	Adjusted Market value of assets	$ 5,674,647	$ 5,486,614
2.	Revenue for the year			
	a.	Contributions		
		i. Member contributions	$ 49,062	$ 46,896
		ii. Employer contributions	149,078	142,429
		iii. Total	$ 198,140	$ 189,325
	b.	Net investment income		
		i. Dividends	$ 25,197	$ 28,926
		ii. Short Term Investments	13,077	20,654
		iii. Fixed Income	27,142	25,677
		iv. Net appreciation (depreciation) on investments	3,478	278,112
		v. Securties lending income	248	394
		vi. Securties lending expense	(62)	(98)
		vii. Less investment expenses	(7,910)	(13,499)
		viii. Other	23	0
	c.	Total revenue	$ 259,333	$ 529,491
3.	Expenditures for the year			
	a.	Refunds	$ 2,209	$ 2,278
	b.	Benefit payments	355,373	335,600
	c.	Administrative and miscellaneous expenses	3,922	3,580
	d.	Total expenditures	$ 361,504	$ 341,458
4.	Increase in net assets (Item 2c - Item 3d)		$ (102,171)	$ 188,033
5.	Market value of assets at end of year (Item 1c + Item 4)		$ 5,572,476	$ 5,674,647

DEVELOPMENT OF ACTUARIAL VALUE OF ASSETS ($000)
TABLE 10

	Year Ending June 30, 2020
1. Actuarial value of assets at beginning of year (prior to adjustment)	$ 5,434,933
2. Net new investments	
a. Contributions	$ 198,140
b. Benefits and refunds paid	(357,582)
c. Administrative expenses	(3,922)
d. Subtotal	$ (163,364)
3. Assumed investment return rate for fiscal year	7.00%
4. Assumed investment return rate for fiscal year (Item 1 + Item 2 / 2) x Item 3	$ 374,728
5. Expected Actuarial Value at end of year (Item 1+ Item 2 + Item 4)	$ 5,646,297
6. Market value of assets at end of year	$ 5,572,476
7. Difference (Item 6 - Item 5)	$ (73,821)
8. Development of amounts to be recognized as of June 30, 2020:	

Fiscal Year End	Remaining Deferrals of Excess (Shortfall) of Investment Income	Offsetting of Gains/(Losses)	Net Deferrals Remaining	Years Remaining	Recognized for this valuation	Remaining after this valuation
	(1)	(2)	(3) = (1) + (2)	(4)	(5) = (3) / (4)	(6) = (3) - (5)
2016	$ 0	$ 0	$ 0	1	$ 0	$ 0
2017	147,790	(147,790)	0	2	0	0
2018	91,924	(91,924)	0	3	0	0
2019	0	0	0	4	0	0
2020	(313,535)	239,714	(73,821)	5	(14,764)	(59,057)
Total	$ (73,821)	$ 0	$ (73,821)		$ (14,764)	$ (59,057)

9. Actuarial value of plan assets, end of year (Item 6 - Item 8)	$ 5,631,533
10. Asset gain (loss) for year (Item 9 - Item 5)	$ (14,764)
11. Asset gain (loss) as % of actual actuarial assets	(0.26%)
12. Ratio of actuarial value to market value	101.1%

Notes: Remaining deferrals in Column (1) for prior years are from last year's report column (6). The number in the current year is the difference between the remaining deferrals in for prior years and the total Excess/(Shortfall) return shown in Item 7.
Column 2 is a direct offset of the current year's excess/(shortfall) return against prior years' excess/(shortfall) of the opposite type.

ESTIMATION OF DOLLAR-WEIGHTED INVESTMENT RETURN ($000)
TABLE 11

Item	Market Value	Actuarial Value
(1)	(2)	(3)
1. Assets as of July 1, 2019	$ 5,674,647	$ 5,434,933
2. Contributions during FY2020	198,140	198,140
3. Benefit payments made during FY2020	355,373	355,373
4. Refunds of contributions during FY2020	2,209	2,209
5. Administrative Expenses during FY2020	3,922	3,922
6. Investment return during FY2020	61,193	359,964
7. Assets as of July 1, 2020: (1 + 2 - 3 - 4 - 5 + 6)	5,572,476	5,631,533
8. Approximate rate of return on average invested assets		
a. Net investment income	61,193	359,964
b. Net investment return FY 2020	1.09%	6.72%

INVESTMENT EXPERIENCE GAIN OR LOSS ($000)
TABLE 12

Item	Valuation as of 6/30/2020	Valuation as of 6/30/2019
(1)	(2)	(3)
1. Actuarial assets, prior valuation	$ 5,434,933	$ 5,128,835
2. Total contributions since prior valuation	198,140	189,325
3. Benefits and refunds since prior valuation	(357,582)	(337,878)
4. Administrative expenses since prior valuaton	(3,922)	(3,580)
5. Assumed net investment income		
a. Beginning assets	380,445	359,019
b. Contributions	6,935	6,626
c. Benefits and refunds paid	(12,515)	(11,826)
d. Administrative expenses	(137)	(125)
e. Total	374,728	353,694
6. Expected actuarial assets (Sum of Items 1 through 5)	5,646,297	5,330,396
7. Actual actuarial assets, this valuation	5,631,533	5,434,933
8. Asset gain (loss) since prior valuation (Item 7 - Item 6)	(14,764)	104,537

Note: Dollar amounts in $000

HISTORY OF INVESTMENT RETURNS
TABLE 13

For Fiscal Year Ending	Market Value [1]	Actuarial Value	For Fiscal Year Ending	Market Value [1]	Actuarial Value
(1)	(2)	(3)	(4)	(5)	(6)
June 30, 1979 [2]	7.90%	N/A	June 30, 2000 [2]	14.80%	15.58%
June 30, 1980 [2]	7.80%	N/A	June 30, 2001 [2]	(3.96%)	11.02%
June 30, 1981 [2]	11.50%	N/A	June 30, 2002	(8.80%)	5.25%
June 30, 1982 [2]	0.30%	N/A	June 30, 2003 [2]	4.15%	2.80%
June 30, 1983 [2]	44.20%	N/A	June 30, 2004 [2]	21.68%	6.09%
June 30, 1984 [2]	(7.70%)	N/A	June 30, 2005	13.40%	3.63%
June 30, 1985 [2]	24.80%	N/A	June 30, 2006	11.20%	8.93%
June 30, 1986 [2]	26.70%	N/A	June 30, 2007	17.80%	13.93%
June 30, 1987 [2]	14.80%	N/A	June 30, 2008	0.24%	12.47%
June 30, 1988 [2]	(0.80%)	N/A	June 30, 2009	(18.55%)	4.15%
June 30, 1989 [2]	12.80%	N/A	June 30, 2010	13.47%	4.43%
June 30, 1990 [2]	13.80%	N/A	June 30, 2011	20.99%	7.16%
June 30, 1991 [2]	1.89%	N/A	June 30, 2012	2.83%	6.32%
June 30, 1992 [2]	11.19%	N/A	June 30, 2013	7.88%	6.58%
June 30, 1993 [2]	14.74%	N/A	June 30, 2014	17.27%	8.53%
June 30, 1994 [2]	2.61%	N/A	June 30, 2015	0.82%	6.65%
June 30, 1995 [2]	12.12%	N/A	June 30, 2016	(3.19%)	4.43%
June 30, 1996 [2]	17.44%	N/A	June 30, 2017	16.96%	8.99%
June 30, 1997 [2]	17.15%	N/A	June 30, 2018	9.77%	9.46%
June 30, 1998 [2]	14.26%	(0.46%)	June 30, 2019	6.29%	9.07%
June 30, 1999 [2]	15.02%	15.37%	June 30, 2020	1.09%	6.72%
			Average Return - last 5 years	5.96%	7.72%
			Average Return - last 10 years	7.80%	7.38%
			Average Return - since 1979	9.19%	

[1] Dollar-weighted return.
[2] Gross return.

HISTORICAL SOLVENCY TEST ($000)
TABLE 14

	Aggregated Accrued Liabilities for				Portions of Accrued Liabilities Covered by Reported Assets		
Valuation Date	Active Members Contributions	Retirees Beneficiaries and Vested Terminations[1]	Members (City Financed Portion)	Actuarial Value of Assets	(5)/(2)	[(5)-(2)]/(3)	[(5)-(2)-(3)]/(4)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
July 1, 2001	138,248	707,152	1,461,027	2,226,307	100%	100%	95%
July 1, 2002	145,255	718,779	1,729,696	2,337,157	100%	100%	85%
July 1, 2003	153,634	838,090	1,883,014	2,394,411	100%	100%	74%
July 1, 2004	153,088	995,841	2,190,295	2,466,070	100%	100%	60%
July 1, 2005	249,804	1,259,243	1,883,927	2,508,794	100%	100%	53%
July 1, 2006	262,514	1,421,330	1,949,301	2,681,375	100%	100%	51%
July 1, 2007	275,990	1,575,900	2,005,790	3,004,927	100%	100%	57%
July 1, 2008	294,678	1,726,121	2,058,165	3,337,612	100%	100%	64%
July 1, 2009	312,489	1,872,226	2,183,786	3,430,946	100%	100%	57%
July 1, 2010	149,252	1,998,683	2,084,797	3,526,703	100%	100%	66%
July 1, 2011	160,828	2,146,222	2,181,093	3,718,052	100%	100%	65%
July 1, 2012	167,739	2,320,239	2,259,195	3,888,504	100%	100%	62%
July 1, 2013	163,660	2,501,745	2,344,556	4,070,951	100%	100%	60%
July 1, 2014	162,982	2,834,747	2,366,263	4,342,936	100%	100%	57%
July 1, 2015	157,344	3,131,654	2,417,132	4,550,620	100%	100%	52%
July 1, 2016	151,259	3,381,371	2,548,761	4,758,079	100%	100%	48%
July 1, 2017	158,648	3,812,704	2,246,942	4,868,614	100%	100%	40%
July 1, 2018	166,807	4,033,323	2,263,742	5,128,835	100%	100%	41%
July 1, 2019	179,254	4,198,909	2,276,980	5,434,933	100%	100%	46%
July 1, 2020	194,868	4,368,772	2,272,042	5,631,533	100%	100%	47%

Note: Dollar amounts in $000

[1] Column (3) included AAL for DROP participants until 2000, now in Column (4)

SCHEDULE OF FUNDING PROGRESS ($000)
TABLE 15

Date	Actuarial Value of Assets (AVA)	Actuarial Accrued Liability (AAL)	Unfunded Actuarial Accrued Liability (UAAL) (3) - (2)	Funded Ratio (2)/(3)	Annual Payroll	UAAL as % of Payroll (4)/(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
July 1, 2001	2,226,307	2,306,427	80,120	96.5%	264,226	30.3%
July 1, 2002	2,337,157	2,593,730	256,573	90.1%	286,150	89.7%
July 1, 2003	2,394,411	2,874,738	480,327	83.3%	300,405	159.9%
July 1, 2004	2,466,070	3,339,224	873,154	73.9%	329,840	264.7%
July 1, 2005	2,508,794	3,392,974	884,180	73.9%	321,057	275.4%
July 1, 2006	2,681,375	3,633,145	951,770	73.8%	327,080	291.0%
July 1, 2007	3,004,927	3,857,680	852,753	77.9%	336,029	253.8%
July 1, 2008	3,337,612	4,078,963	741,351	81.8%	351,525	210.9%
July 1, 2009	3,430,946	4,368,501	937,556	78.5%	366,924	255.5%
July 1, 2010*	3,526,703	4,232,732	706,029	83.3%	377,779	186.9%
July 1, 2011	3,718,052	4,488,142	770,090	82.8%	388,409	198.3%
July 1, 2012	3,888,504	4,747,173	858,669	81.9%	389,884	220.2%
July 1, 2013	4,070,951	5,009,961	939,010	81.3%	391,957	239.6%
July 1, 2014	4,342,936	5,363,992	1,021,056	81.0%	399,447	255.6%
July 1, 2015	4,550,620	5,706,130	1,155,510	79.7%	406,233	284.4%
July 1, 2016**	4,758,079	6,081,392	1,323,313	78.2%	424,300	311.9%
July 1, 2017	4,868,614	6,218,293	1,349,679	78.3%	440,614	306.3%
July 1, 2018	5,128,835	6,463,872	1,335,037	79.3%	438,396	304.5%
July 1, 2019	5,434,933	6,655,143	1,220,210	81.7%	454,696	268.4%
July 1, 2020	5,631,533	6,835,682	1,204,149	82.4%	471,903	255.2%

* Change to Projected Unit Credit cost method. Prior results were provided based on Entry Age Normal.

** Change to Ultimate Entry Age Normal cost method and benefit changes to all groups.

HISTORICAL CITY CONTRIBUTION RATES
TABLE 16

Valuation Date	Calculated Contribution Rate	Time Period for Contribution Rate	Actual Contribution Rate	
(1)	(2)	(3)	(4)	
July 1, 1990	14.20%	July 1, 1991 through June 30, 1993	14.3%	
July 1, 1992	19.00	July 1, 1993 through June 30, 1994	19.0	
July 1, 1993	18.00	July 1, 1994 through June 30, 1995	18.0	
July 1, 1994	18.00	July 1, 1995 through June 30, 1996	18.0	
July 1, 1995	17.40	July 1, 1996 through June 30, 1997	16.2	
July 1, 1996	16.20	July 1, 1997 through June 30, 1998	16.2	
July 1, 1997	16.80	July 1, 1998 through June 30, 1999	15.2	
July 1, 1998	16.20	July 1, 1999 through June 30, 2000	12.4	
July 1, 1999	16.30	July 1, 2000 through June 30, 2001	12.2	
July 1, 2000	11.30	July 1, 2001 through June 30, 2002	12.4	
July 1, 2001	20.50	July 1, 2002 through June 30, 2003	12.1	
July 1, 2002	24.40	July 1, 2003 through June 30, 2004	12.2	
July 1, 2003	28.50	July 1, 2004 through June 30, 2005	11.3	
July 1, 2004	31.20	July 1, 2005 through June 30, 2006	16.5	
July 1, 2005	34.00	July 1, 2006 through June 30, 2007	17.7	
July 1, 2006	34.00	July 1, 2007 through June 30, 2008	18.7	
July 1, 2007	32.10	July 1, 2008 through June 30, 2009	19.3	
July 1, 2008	30.91	July 1, 2009 through June 30, 2010	19.9	
July 1, 2009	31.73	July 1, 2010 through June 30, 2011	20.7	
July 1, 2010	32.04	July 1, 2011 through June 30, 2012	21.4	
July 1, 2011	32.68	July 1, 2012 through June 30, 2013	24.0	
July 1, 2012	34.50	July 1, 2013 through June 30, 2014	26.4	
July 1, 2013	36.01	July 1, 2014 through June 30, 2015	28.8	
July 1, 2014	38.18	July 1, 2015 through June 30, 2016	33.8	
July 1, 2015	39.59	July 1, 2016 through June 30, 2017	32.9	
July 1, 2016	31.77	July 1, 2017 through June 30, 2018	32.1	*
July 1, 2017	31.74	July 1, 2018 through June 30, 2019	32.2	
July 1, 2018	31.58	July 1, 2019 through June 30, 2020	32.5	
July 1, 2019	29.61	July 1, 2020 through June 30, 2021	N/A	
July 1, 2020	29.22	July 1, 2021 through June 30, 2022	N/A	

* Excludes proceeds from $750 million Pension Obligation Bond as the amount was included in assets to calculate the rate.

HISTORICAL ACTIVE PARTICIPANT DATA
TABLE 17

Valuation Date (1)	Active Count (2)	Average Age (3)	Average Svc (4)	Covered Payroll (5)	Average Salary (6)	Percent Changes (7)
1990	4,073	36.2	N/A	$126,665[1]	$31,099	4.0%
1992	4,120	36.8	N/A	$143,020	$34,714	11.6%
1993	4,498	36.7	N/A	$159,321	$35,420	2.0%
1994	4,705	36.8	N/A	$162,143	$34,462	-2.7%
1995	4,921	36.9	N/A	$174,761	$35,513	3.0%
1996[2]	4,395	35.1	N/A	$150,903	$34,335	-3.3%
1997	4,282	35.5	N/A	$149,631	$34,944	1.8%
1998	4,247	35.9	N/A	$153,479	$36,138	3.4%
1999	4,253	36.3	N/A	$187,967[3]	$44,196[3]	22.3%[3]
2000	4,137	36.7	N/A	$179,415	$43,368	-1.9%
2001[4]	5,325	40.2	N/A	$264,226[5]	$49,620[5]	14.4%[5]
2002	5,352	40.7	N/A	$286,150	$53,466	7.8%
2003	5,387	41.3	N/A	$300,405	$55,765	4.3%
2004	5,225	41.7	N/A	$329,840	$63,127	13.2%
2005	4,867	42.0	N/A	$321,057[6]	$65,966[6]	4.5%[6]
2006	4,785	42.3	N/A	$327,080	$68,355	3.6%
2007	4,879	42.1	N/A	$336,029	$68,873	0.8%
2008	5,065	42.0	15.7	$351,525	$69,403	0.8%
2009	5,245	41.8	15.4	$366,924	$69,957	0.8%
2010	5,347	41.9	15.3	$377,779	$70,652	1.0%
2011	5,312	42.3	15.7	$388,409	$73,119	3.5%
2012	5,326	42.5	15.7	$389,884	$73,204	0.1%
2013	5,364	42.6	15.7	$391,957	$73,072	-0.2%
2014	5,343	42.6	15.7	$399,447	$74,761	2.3%
2015	5,261	42.8	15.9	$406,233	$77,216	3.3%
2016	5,261	42.6	15.7	$418,252	$79,500	3.0%
2017	5,164	41.7	14.5	$417,320	$80,813	1.7%
2018	5,226	41.6	14.4	$438,396	$83,887	3.8%
2019	5,282	41.6	14.3	$454,696	$86,084	2.6%
2020	5,319	41.5	14.1	$471,903	$88,720	3.1%

[1] Reflects the November 1, 1990 pay increase.

[2] For the July 1, 1996 to July 1, 2000 valuations, includes those participants currently accruing benefits (i.e. excludes current DROP participants).

[3] Definition of covered payroll changed from base pay to total direct pay less overtime.

[4] Beginning July 1, 2001, includes active participants eligible for DROP.

[5] Beginning July 1, 2001, the definition of total direct pay changed from the average of the last 26 pay periods to the highest bi-weekly pay period.

[6] Beginning October 9, 2004, pensionable pay is the total of the last 26 pay periods, excluding CMEPP and SOSP.

RETIREES, BENEFICIARIES, AND DISABLED PARTICIPANTS ADDED TO AND REMOVED FROM ROLLS

TABLE 18

	Added to Rolls		Removed from Rolls		Rolls-End of Year			
Valuation July 1,	Number	Annual Allowances	Number	Annual Allowances	Number	Annual Allowances	% Increase in Annual Allowances	Average Annual Allowances
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1995	893	$ 19,109	36	$ 602	2,335	$ 48,624	65.0%	$ 20,824
1996 *	182	3,481	29	618	2,488	52,772	8.5%	21,211
1998	159	3,483	28	589	2,619	63,957	21.2%	24,420
1999	150	3,770	46	1,001	2,723	70,432	10.1%	25,866
2000	233	6,421	36	857	2,920	76,401	8.5%	26,165
2001 **	131	3,755	1,250	33,892	1,801	54,006	(29.3%)	29,987
2002	104	2,809	46	1,113	1,859	55,013	1.9%	29,593
2003	106	2,967	47	1,109	1,918	61,531	11.8%	32,081
2004	220	9,172	33	1,014	2,105	70,307	14.3%	33,400
2005	353	15,962	55	1,776	2,403	86,933	23.6%	36,177
2006	254	10,195	66	2,197	2,549	96,812	11.4%	37,980
2007	175	8,056	49	1,809	2,717	105,481	9.0%	38,823
2008	149	11,889	57	1,995	2,809	115,375	9.4%	41,073
2009	154	9,639	63	2,275	2,900	122,738	6.4%	42,324
2010	165	8,891	56	2,355	3,009	129,274	5.3%	42,963
2011	171	10,567	59	2,218	3,121	137,623	6.5%	44,096
2012	180	11,934	71	2,820	3,230	146,737	6.6%	45,429
2013	183	11,674	64	2,345	3,349	156,066	6.4%	46,601
2014	217	13,857	63	2,627	3,503	167,296	7.2%	47,758
2015	288	16,132	65	2,762	3,726	180,666	8.0%	48,488
2016	259	16,357	77	3,291	3,908	193,733	7.2%	49,573
2017	460	26,911	95	4,139	4,273	216,505	11.8%	50,668
2018	221	14,138	98	4,370	4,396	226,273	4.5%	51,473
2019	189	12,198	91	4,344	4,494	234,127	3.5%	52,098
2020	236	14,280	108	4,943	4,622	243,464	4.0%	52,675

* From June 30, 1996 through June 30, 2001 includes DROP participants.

** Beginning July 1, 2001 excludes active participants eligible for DROP.

Note: Dollar amounts in $000

MEMBERSHIP DATA
TABLE 19

	July 1, 2020 (1)	July 1, 2019 (2)	July 1, 2018 (3)
1. Active members			
a. Number	5,319	5,282	5,226
b. Number in DROP	1,673	1,749	1,795
c. Total payroll	$ 471,903,477	$ 454,696,012	$ 438,395,640
Payroll in DROP	$ 175,558,515	$ 177,645,844	$ 177,140,744
d. Average salary	88,720	86,084	83,887
e. Average age	41.5	41.6	41.6
f. Average service	14.1	14.3	14.4
2. Inactive participants			
a. Vested	49	43	29
b. Total annual benefits (deferred)	$ 1,533,356	$ 1,210,454	$ 758,742
c. Average annual benefit	31,293	28,150	26,164
3. Service retirees			
a. Number	3,613	3,512	3,425
b. Total annual benefits	$ 197,500,986	$ 190,276,099	$ 184,074,752
c. Average annual benefit	54,664	54,179	53,744
d. Average age	65.8	65.5	65.0
4. Disabled retirees			
a. Number	179	175	169
b. Total annual benefits	$ 8,261,132	$ 8,123,143	$ 7,858,761
c. Average annual benefit	46,152	45,893	46,502
d. Average age	58.1	56.7	57.0
5. Beneficiaries and spouses			
a. Number	830	807	773
b. Total annual benefits	$ 37,702,031	$ 35,727,748	$ 33,580,922
c. Average annual benefit	45,424	44,382	43,442
d. Average age	70.1	69.9	69.3

DISTRIBUTION OF ACTIVE MEMBERS BY AGE AND BY YEARS OF SERVICE
ACTIVE MEMBERS SWORN PRIOR TO OCTOBER 9, 2004 AND NOT CURRENTLY IN DROP
TABLE 20a

Attained Age	0-4 No. & Avg. Comp.	5-9 No. & Avg. Comp.	10-14 No. & Avg. Comp.	15-19 No. & Avg. Comp.	20-24 No. & Avg. Comp.	25-29 No. & Avg. Comp.	30-34 No. & Avg. Comp.	35 & Over No. & Avg. Comp.	Total No. & Avg. Comp.
Under 25									
25-29									
30-34									
35-39				4					4
				115,341					115,341
40-44				174	1				175
				105,877	140,626				106,075
45-49				158	4				162
				103,347	96,071				103,168
50-54				60	4	1			65
				102,319	111,177	95,714			102,763
55-59				8					8
				101,071					101,071
60-64				1	1				2
				95,007	115,195				105,101
65 & Over									
Total				405	10	1			416
				$ 104,335	$ 108,481	95,714			$ 104,414

Average:

Age	45.8
Service	18.2
Salary	$104,413

DISTRIBUTION OF ACTIVE MEMBERS BY AGE AND BY YEARS OF SERVICE
ACTIVE MEMBERS SWORN AFTER OCTOBER 9, 2004
TABLE 20b

Attained Age	0-4 No. & Avg. Comp.	5-9 No. & Avg. Comp.	10-14 No. & Avg. Comp.	15-19 No. & Avg. Comp.	20-24 No. & Avg. Comp.	25-29 No. & Avg. Comp.	30-34 No. & Avg. Comp.	35 & Over No. & Avg. Comp.	Total No. & Avg. Comp.
Under 25	126								126
	52,761								52,761
25-29	616	71							687
	64,738	74,630							65,760
30-34	379	376	54						809
	67,369	79,828	93,674						74,915
35-39	162	191	502						855
	69,904	81,067	93,416						86,202
40-44	55	65	298						418
	68,834	80,742	93,696						88,410
45-49	20	33	159		1				213
	69,339	79,987	92,882		98,075				88,698
50-54	1	24	78	1	2				106
	87,921	80,949	91,735	87,763	110,334				89,570
55-59	1		15						16
	74,058		90,517						89,488
60-64									
65 & Over									
Total	1,360	760	1,106	1	3				3,230
	$ 65,234	$ 79,774	93,269	87,763	106,248				$ 78,300

Average:

Age	34.9
Service	7.0
Salary	$78,300

DISTRIBUTION OF ACTIVE MEMBERS BY AGE AND BY YEARS OF SERVICE
CURRENT DROP MEMBERSHIP
TABLE 20c

Attained Age	0-4 No. & Avg. Comp.	5-9 No. & Avg. Comp.	10-14 No. & Avg. Comp.	15-19 No. & Avg. Comp.	20-24 No. & Avg. Comp.	25-29 No. & Avg. Comp.	30-34 No. & Avg. Comp.	35 & Over No. & Avg. Comp.	Total No. & Avg. Comp.
Under 25									
25-29									
30-34									
35-39									
40-44					22				22
					107,963				107,963
45-49					281	47			328
					105,861	107,572			106,107
50-54					273	446	31		750
					104,909	105,645	109,899		105,553
55-59					68	173	100	74	415
					103,060	103,944	103,290	105,013	103,832
60-64					12	30	24	68	134
					104,417	101,622	100,631	102,569	102,176
65 & Over					2	2	3	17	24
					100,176	95,593	97,674	102,875	101,394
Total					658	698	158	159	1,673
					$ 105,203	$ 105,152	$ 104,077	$ 103,739	$ 104,936

Average:

Age	53.1
Service	26.9
Salary	$104,936

DISTRIBUTION OF ACTIVE MEMBERS BY AGE AND BY YEARS OF SERVICE
TOTAL ACTIVE AND DROP MEMBERS
TABLE 20d

Attained Age	0-4 No. & Avg. Comp.	5-9 No. & Avg. Comp.	10-14 No. & Avg. Comp.	15-19 No. & Avg. Comp.	20-24 No. & Avg. Comp.	25-29 No. & Avg. Comp.	30-34 No. & Avg. Comp.	35 & Over No. & Avg. Comp.	Total No. & Avg. Comp.
Under 25	126								126
	$ 52,761								$ 52,761
25-29	616	71							687
	$ 64,738	$ 74,630							$ 65,760
30-34	379	376	54						809
	$ 67,369	$ 79,828	$ 93,674						$ 74,915
35-39	162	191	502	4					859
	$ 69,904	$ 81,067	$ 93,416	$ 115,341					$ 86,338
40-44	55	65	298	174	23				615
	$ 68,834	$ 80,742	$ 93,696	$ 105,877	$ 109,383				$ 94,136
45-49	20	33	159	158	286	47			703
	$ 69,339	$ 79,987	$ 92,882	$ 103,347	$ 105,697	$ 107,572			$ 100,155
50-54	1	24	78	61	279	447	31		921
	87,921	80,949	$ 91,735	$ 102,081	$ 105,038	$ 105,623	$ 109,899		$ 103,517
55-59	1		15	8	68	173	100	74	439
	74,058		$ 90,517	$ 101,071	$ 103,060	$ 103,944	$ 103,290	$ 105,013	$ 103,259
60-64				1	13	30	24	68	136
				$ 95,007	$ 105,246	$ 101,622	$ 100,631	$ 102,569	$ 102,219
65 & Over					2	2	3	17	24
					100,176	95,593	$ 97,674	$ 102,875	$ 101,394
Total	1,360	760	1,106	406	671	699	158	159	5,319
	$ 65,234	$ 79,774	$ 93,269	$ 104,294	$ 105,257	$ 105,138	$ 104,077	$ 103,739	$ 88,720

Average:	
Age	41.5
Service	14.1
Salary	$88,720

APPENDIX A

SUMMARY OF ACTUARIAL ASSUMPTIONS AND METHODS

SUMMARY OF ACTUARIAL ASSUMPTIONS AND METHODS

The following methods and assumptions were used in preparing the July 1, 2020 actuarial valuation report.

1. Valuation Date

   The valuation date is as of July 1st, the first day of each plan year. This is the date as of which the actuarial present value of future benefits and the actuarial value of assets are determined.

2. Actuarial Cost Method

   The Ultimate Entry Age Normal (UEAN) actuarial cost method allocates the System's actuarial present value of future benefits to various periods based upon service. The portion of the present value of future benefits allocated to years of service prior to the valuation date is the actuarial accrued liability, and the portion allocated to years following the valuation date is the present value of future normal costs. The normal cost is determined for each active member as the level percent of payroll necessary to fully fund the expected benefits to be earned over the career of each individual active member. Under UEAN, the normal cost calculation is done assuming all members earn benefits that would be applicable to a newly hired member so that the normal cost should remain fairly stable as the relative distribution of active employees in different benefit groups changes. The normal cost is partially funded with active member contributions with the remainder funded by employer contributions.

   An unfunded accrued liability exists in the amount equal to the excess of accrued liability over valuation assets. The amortization period of the System is the number of years required to fully amortize the unfunded accrued liability, on an actuarial value of asset basis, with the expected amount of employer contributions in excess of the employers' portion of the normal cost.

   The contribution rate determined by this valuation will not be effective until one year later, but the determination of the rate does not reflect this deferral. It is assumed that there will be no change in the employer normal cost rate due to the deferral, and it is assumed that payments are made uniformly throughout the year.

3. Actuarial Value of Assets

   The actuarial value of assets is equal to the market value of assets less a five-year phase in of the excess (shortfall) between expected investment return and actual income. The actual calculation is based on the difference between actual market value and the expected actuarial value of assets each year, and recognizes the cumulative excess return (or shortfall) over at a minimum rate of 20% per year. Each year a base is set up to reflect this difference. If the current year's base is of opposite sign to the deferred bases then it is offset dollar for dollar against the deferred bases. Any remaining bases are then recognized over the remaining period for the base (5 less the number of years between the bases year and the valuation year). This is intended to ensure the smoothed value of assets will converge towards the market value in a reasonable amount of time. Expected earnings are determined using the assumed investment return rate and the beginning of year actuarial value of assets (adjusted for receipts and disbursements during the year). The returns are computed net of investment expenses.

   The actuarial value of assets was set equal to the market value of assets as of July 1, 2016.

4. Economic Assumptions

a. Investment return: 7.00% per year, compounded annually, composed of an assumed 2.75% inflation rate and a 4.25% net real rate of return. This rate represents the assumed return, net of all investment expenses.

b. Cost of Living Adjustment (COLA): Monthly benefits for participants receiving payments are increased each April 1 by the five-year average investment return minus 5.00%, with a minimum of 0.00% and a maximum of 4.00%. For this valuation, the annual COLA is assumed to be 2.00%.

c. Salary increase rate: A service-related component, plus a 2.75% inflation and productivity component, as follows:

Years of Service	Service-related Component	Total Annual Rate of Increase Including 2.00% Inflation & Productivity Component
(1)	(2)	(3)
1	0.00%	2.75%
2	20.00%	22.75%
3	3.00%	5.75%
4	3.00%	5.75%
5	3.00%	5.75%
6	6.00%	8.75%
7	6.00%	8.75%
8	2.00%	4.75%
9	2.00%	4.75%
10	2.00%	4.75%
11	6.00%	8.75%
12	1.00%	3.75%
13	5.00%	7.75%
14	1.00%	3.75%
15	1.00%	3.75%
16	1.00%	3.75%
17	5.00%	7.75%
18 and Over	0.00%	2.75%

d. Payroll growth rate: In the amortization of the unfunded actuarial accrued liability, payroll is assumed to increase 2.75% per year. This increase rate is solely due to the effect of inflation on salaries, with no allowance for future membership growth.

5. Demographic Assumptions

a. Retirement Rates

	Service		
Age	<25	25 - 29	30+
40-49	3.0%	3.0%	9.0%
50-54	4.0%	6.0%	10.0%
55-59	6.8%	10.2%	17.0%
60-64	9.6%	14.4%	24.0%
65 +	100.0%	100.0%	100.0%

For members hired after October 9, 2004, 3% per year the member's first retirement eligibility exceeds 45 is added to the retirement rate at first eligibility up to a maximum increase of 30% at age 55. For members in DROP as of July 1, 2016, retirement rates are multiplied by 110% to reflect that future employee contributions are no longer credited to the DROP balance.

b. DROP Participation

100% of eligible active participants are assumed to elect the DROP.

c. DROP Entry Date

Active members (not already in DROP) are assumed to take advantage of the DROP and enter when first eligible. Participants are assumed to elect the maximum duration for the back DROP, up to 20 years.

d. DROP Interest Credit

Interest in the amount of 65% of the five-year average investment return, with a minimum of 2.50%, will be credited to existing DROP accounts on a monthly basis. For this actuarial valuation, the drop interest credit is assumed to be 5.10%.

e. Withdrawal of DROP and PROP Balances

Members are assumed to withdraw balances in equal annual installments over 10 years.

f. Mortality rates (for active and retired members)

- Healthy retirees - The Gender-distinct RP-2014 Healthy Annuitant Mortality Tables with Blue Collar Adjustment for Males and no collar adjustment for Females. The rates are projected from the 2006 central rates to 2018 using scale MP-2017, and thereafter on a fully generational basis by the ultimate values of scale MP-2014 to account for future mortality improvements.

- Disabled males and females – The Gender-distinct RP-2014 Disabled Retiree Mortality Tables are used without adjustment. The rates are projected on a fully generational basis by the ultimate values of scale MP-2014 to account for future mortality improvements.

- Active members - The Gender-distinct RP-2014 Employee Mortality Tables with Blue Collar Adjustment. The rates are projected on a fully generational basis by the ultimate values of scale MP-2014 to account for future mortality improvements.

Sample rates are shown below for 2020:

Age	Healthy Retired Males	Healthy Retired Females	Disabled Males	Disabled Females	Healthy Active Males	Healthy Active Females
(1)	(2)	(3)	(4)	(5)	(6)	(7)
25	0.08%	0.03%	0.80%	0.22%	0.06%	0.02%
30	0.11%	0.07%	0.75%	0.28%	0.06%	0.02%
35	0.15%	0.12%	0.86%	0.37%	0.06%	0.03%
40	0.21%	0.17%	1.04%	0.51%	0.08%	0.04%
45	0.28%	0.22%	1.60%	0.85%	0.12%	0.07%
50	0.41%	0.27%	1.92%	1.12%	0.21%	0.12%
55	0.61%	0.38%	2.20%	1.36%	0.34%	0.18%
60	0.89%	0.58%	2.50%	1.60%	0.57%	0.26%
65	1.34%	0.85%	2.98%	1.96%	1.01%	0.39%
70	2.04%	1.31%	3.80%	2.66%	1.63%	0.66%
75	3.25%	2.16%	5.11%	3.86%	2.63%	1.11%
80	5.42%	3.69%	7.21%	5.75%	4.24%	1.86%

g. Termination Rates and Disability Rates

Termination rates (for causes other than death, disability or retirement) are a function of the member's service and are not applied after a member becomes eligible for a retirement benefit. Disability rates are age-based and not applied for members in the DROP or those members eligible to back DROP. All disabilities are assumed to be duty-related. Rates at selected ages and service levels are shown below.

Termination		
Service	Male	Female
1	2.71%	2.71%
3	1.95%	1.95%
5	1.40%	1.40%
7	1.01%	1.01%
9	0.72%	0.72%
11	0.52%	0.52%
13	0.37%	0.37%
15	0.27%	0.27%
17	0.19%	0.19%
19	0.14%	0.14%
20 +	0.10%	0.10%

Age Based Rates of Disability		
Age	Male	Female
20	0.1149%	0.1149%
25	0.1145%	0.1145%
30	0.1197%	0.1197%
35	0.1321%	0.1321%
40	0.1516%	0.1516%
45	0.1785%	0.1785%
50	0.2126%	0.2126%
55	0.2538%	0.2538%
60	0.3023%	0.3023%

1% is also added to the rates above during the period that members hired post-2004 would have been eligible to retire under pre-2004 retirement eligibilities, but are not yet eligible.

6. Other Assumptions

a. Percent married: 90% of employees are assumed to be married. (No beneficiaries other than the spouse assumed.)

b. Valuation payroll: To determine the amortization rate, the payroll used is the amount budgeted by the City for the fiscal year following the valuation date increased by one year of payroll growth.

c. Age difference: Male members are assumed to be three years older than their spouses, and female members are assumed to be three years younger than their spouses.

d. Percent electing annuity on death (when eligible): All of the spouses of vested, married participants are assumed to elect an annuity.

e. Percent electing deferred termination benefit: 50% of vested terminating members are assumed to elect a refund rather than take a deferred benefit at age 60.

f. There will be no recoveries once disabled.

g. No surviving spouse will remarry.

h. Assumed age for commencement of deferred benefits: Members electing to receive a deferred benefit are assumed to commence receipt at the first age at which unreduced benefits are available.

i. Administrative expenses: Administrative expenses are accounted for as an explicit component on the normal cost rate.

j. Pay increase timing**:** Beginning of (fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.

k. Decrement timing: Decrements of all types are assumed to occur mid-year.

l. Eligibility testing: Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.

m. Decrement relativity: Decrement rates are converted to probabilities in order to account for multiple decrements.

n. Incidence of Contributions**:** Contributions are assumed to be received continuously throughout the year based upon the computed percent of payroll shown in our Report, and the actual payroll payable at the time contributions are made.

o. Benefit Service: All members are assumed to accrue one year of service each year**.** Exact fractional service is used to determine the amount of benefit payable.

7. Participant Data

Participant data was supplied in electronic files. There were separate files for (i) active members, (ii) inactive members, and (iii) members and beneficiaries receiving benefits.

The data for active members included birth date, gender, most recent hire date, salary paid during last fiscal year, hours worked by the employee, and employee contribution amounts. For retired members and beneficiaries, the data included date of birth, gender, amount of monthly benefit, and date of retirement. Also included was the member's Group and for members participating in DROP, their account balances and monthly DROP income.

All healthy and disabled retirees are assumed to have 100% joint and survivor annuities, prorated by the 90% marriage assumption and reflecting the three year spousal age differential described above. All beneficiaries are assumed to have life annuity only benefits.

Salary supplied for the current year was based on the earnings for the year preceding the valuation date. This salary was adjusted by the salary increase rate for one year.

In fiscal years when a 27th pay period occurs the individual pays for employees who were employed throughout the year will be adjusted by multiplying their reported pay by the ratio of 26/27. In years that have only 26 pay periods no adjustment would be needed.

Assumptions were made to correct for missing, bad, or inconsistent data. These had no material impact on the results presented.

APPENDIX B

SUMMARY OF PLAN PROVISIONS

SUMMARY OF PLAN PROVISIONS

Covered Members

All police officers sworn before September 1, 1975 are covered under Plan 1, except those who elected by December 31, 1981 to participate in Plan 3.

All police officers sworn on or after September 1, 1975, but before September 1, 1981 are covered under Plan 2, except those who elected by December 31, 1981 to participate in Plan 3 and those Plan 1.

All other police officers are covered by Plan 3, except those from Police Cadet Classes 70 and 71 who elected to pay additional contributions and transfer to Plan 1.

Final Compensation

Prior to November 28, 1998	Monthly base salary paid to the participant in his/her last month of service. For any participant from a position held for less than 3 years, final compensation is the average monthly base salary for the 3 years prior to retirement.
After November 28, 1998 but prior to July 1, 2001	Monthly total direct pay less overtime paid to the participant in his/her last month of service. For any participant from a position held for less than 3 years, final compensation is the average monthly base pay for the 3 years prior to retirement plus the other current components of total direct pay.
After July 1, 2001 but prior to October 9, 2004	Highest biweekly pay period (excluding overtime) during the last 26 pay periods annualized. Amounts not paid on a biweekly basis are deducted from period paid. Annual amounts are divided by 26 and added to the highest pay period, including motorcycle allowances.
On or after October 9, 2004	Average of the last three years of compensation (excluding exempt time, overtime and strategic officer staffing pay). This average will be phased in beginning with the pay period ending after October 9, 2004 until the new definition is fully phased in after 78 pay periods.

Service Retirement

Eligibility

▸ Sworn prior to October 9, 2004	20 years of service.
▸ Sworn on or after October 9, 2004	The age at which the sum of age and years of service is at least 70 (Rule of 70).

Benefit

Prior to November 1, 1955	$75 per month plus $2 per month for each year of service in excess of 25 years.
After November 1, 1955 but prior to January 13, 1968	30% of final compensation plus 1 % of final compensation for each year of service in excess of 20 years.
After January 13, 1968 but prior to July 1, 1986	Plans 1 and 2: 30% of final compensation plus 2% of final compensation for each year of service in excess of 20 years. Plan 3: 2% of final compensation for each year of service up to 40 years, reduced 0.42% for each month benefit commencement precedes age 55.
After July 1, 1986 but prior to July 1, 1988	2% of final compensation for each year of service up to 40 years.
After July 1, 1988 but prior to September 1, 1997	45% of final compensation plus 2% of final compensation for each year of service in excess of 20 years; maximum 80% of final compensation. Benefit based on prior formula is payable until July 1, 1991 and recomputed benefit is payable thereafter
After September 1, 1997 but prior to July 1, 2001	50% of final compensation plus 2% of final compensation for each year of service in excess of 20 years; maximum 80% of final compensation.
After July 1, 2001 but prior to October 9, 2004	55% of final compensation plus 2% of final compensation for service in excess of 20 years. The Pension System recomputed the benefit of each person who retired before July 1, 2001. The retiree's benefit was increased by the result of multiplying the difference between 55% and the percentage used at the time of retirement in computing the retiree's benefit for the first 20 years of service by the base salary of the retiree at the time of retirement. Retroactive cost-of-living increases were not applied to the increased benefit. This recomputed benefit is effective for all payments on or after July 1, 2001.

▸ After October 9, 2004	Participants sworn prior to October 9, 2004 will receive the highest of the following alternatives using Final Average Compensation effective after October 9, 2004, from October 9, 2004 through October 7, 2007: 1) 2.75% of Final Average Compensation for each of the first 20 years of service plus 2% of Final Average Compensation for each year of service in excess of 20 years, with a maximum of 80% of Final Average Compensation. 2) Benefit participant would have received had participant retired or entered the DROP immediately before October 9, 2004 3) Benefit calculated using a sliding average of the pay received for the pay periods elapsed since October 9, 2004.
	New participants after October 9, 2004: 2.25% of Final Average Compensation for each of the first 20 years of service plus 2% of Final Average Compensation for each year of service in excess of 20 years, with a maximum of 80% of Final Average Compensation.
Additional Benefits	An extra monthly benefit of $150.00 is payable for life. Effective November 28, 1998, a $5,000 lump sum is payable upon retirement for members sworn prior to October 9, 2004.
Terminated Vested Pension Benefit	
Eligibility	Sworn in before October 9, 2004 and more than 10 but less than 20 years of service. Termination on or after November 28, 1998.
Benefit	
▸ Sworn prior to October 9, 2004	2.75% of final average compensation times years of service. This benefit commences at age 60 or at termination of service if later.
▸ Sworn on or after October 9, 2004	2.25% of final average compensation times years of service. This benefit commences at the age at which the sum of age and years of service is at least 70 (Rule of 70) or at termination of service if later.
Deferred Retirement Option Plan (DROP)	
Eligibility	20 years of service and sworn in prior to October 9, 2004.
Benefit	
▸ After September 1, 1995 but prior to September 1, 1997	Eligible participants may elect to participate in the DROP until they leave active service. The member's retirement pension will be calculated based on service and earnings at the time the DROP is elected.

	A notional account will be maintained for each DROP participant. This account will be credited with the following amounts while the member is participant of the DROP: – The member's monthly retirement pension, including applicable cost-of-living adjustments, – The member's contribution to the Pension System, limited to 8.75% of pay, and – Investment earnings/losses at the rate of the Pension System's earnings/losses averaged over a five-year period. Effective July 1, 2001, this rate is subject to a minimum of 0%. A benefit equal to the DROP account balance is paid at the time the member leaves active service. The payment is made as a single lump sum. If a DROP participant suffers an on-duty disability resulting in the inability to perform his/her usual and customary duties as a police officer or dies in the line of duty, he (or his survivors) are allowed to revoke the DROP election and to receive the more generous on-duty disability or death benefits.
After September 1, 1997 but prior to December 1, 1998	The Pension System recomputed the benefit of each person who entered the DROP before September 1, 1997. The benefit was increased in the same manner as the retiree's benefit.
After December 1, 1998 but prior to July 1, 2001	The Pension System recomputed the benefit of each person who entered the DROP before December 1, 1998. The benefit was recalculated based on Total Direct Pay less overtime upon entry to the DROP. This recomputed benefit is effective for all payments on or after December 1, 1998.
After July 1, 2001 but prior to October 9, 2004	The Pension System recomputed the benefit of each person who entered the DROP before July 1, 2001. The member's benefit was increased by the result of multiplying the difference between 55% and the percentage used at the time of DROP entry in computing the member's benefit for the first 20 years of service by the base salary of the member at the time of DROP entry. Retroactive cost-of-living increases were applied to the increased benefit. The account balance for each participant was recomputed as if this new benefit had been effective since DROP entry.
After October 9, 2004	A minimum of 3.00% interest will be credited to existing DROP accounts with a maximum of 7.00%. If the actuary certifies that past service costs are fully funded, the credit may be as high as 10.00%.
After July 1, 2016	Participants may participate in the DROP for a maximum of 20 years. Cost of living adjustments will not be granted while still active, and the member's contributions to the Pension System will no longer be credited to the DROP account. DROP accounts will be credited with interest equal 65% of the five-year average investment return, with a minimum of 2.50%.

Benefit Recalculation	Effective July 1, 2001, monthly benefit at retirement will be recalculated to be the greater of (i) current monthly benefit, or (ii)monthly benefit based on service at DROP entry and Final Compensation at retirement date. The recalculation provision was discontinued effective July 1, 2016.
Back DROP Option	Effective on July 1, 2001, a back DROP option is available for all eligible participants. The DROP account is recalculated under the option based on what the account balance would have been had the participant elected the DROP earlier than he/she actually did. The initial DROP entry date cannot be backdated prior to September 1, 1995 or prior to 20 years of credited service, and must be on the first of the month selected. The Back DROP provision was discontinued effective July 1, 2016.
Postretirement Option Plan (PROP)	
Eligibility	Retired from DROP and sworn in prior to October 9, 2004.
Benefit	
▸ After November 28, 1998 but prior to July 1, 2001	A retired member is allowed to leave all or a portion of their DROP account in the System. These accounts are credited every calendar year with the 30-year Treasury bond rate as of June of the preceding year.
▸ After July 1, 2001	The interest rate earned on PROP accounts will be the same as the interest rate credited to DROP accounts, including a minimum credited rate of 0%.
Partial Lump Sum Optional Payment (PLOP)	
Eligibility	Participant on or after October 9, 2004.
Benefit	
▸ After October 9, 2004	Up to 20% of the actuarial value of the accrued pension at retirement.
Disability Retirement	
Eligibility	Effective July 1, 2001, a disabled participant is eligible for Disability Retirement as defined below: – Disability is defined as “unable to perform his/her usual and customary duties as a police officer”.

Benefit	
▸ Duty-connected	The service retirement benefit accrued to date of disability. For participants before October 9, 2004, the disability benefit is 2.75% of final average pay times years of service with a minimum of 55% of final average pay. For participants after October 9, 2004, the disability benefit is 2.25% of final average pay times years of service with a minimum of 45% of final average pay.
Additional Benefits	For participants before October 9, 2004, an education allowance equal to 100% of final compensation less disability benefit is payable for up to four years for off-duty or duty-related disability. Proportionate members injured while on-duty as a municipal worker will receive immediate off-duty benefit upon Board approval.
Survivor Benefits	
Eligibility	Surviving spouses and dependent children and parents of participants, including surviving spouses of retired or disabled participants who were not married at the time of retirement or disability, provided the spouse was married to the participant for at least 5 years at the time of death.
Benefit	
▸ Prior to September 1, 1997	If duty-connected: monthly lifetime benefit equal to 100% of final compensation at date of death. If not duty-connected: monthly lifetime benefit equal to 100% of the service retirement benefit the participant had accrued at the time of death. Spouse's benefit upon death after retirement: monthly lifetime benefit equal to actual benefit payable at time of death. Dependent children's benefit if no surviving spouse: the benefit that would have been payable to the spouse is divided equally among the dependent children. If there is a surviving spouse, the dependent children of Plan 1and Plan 2 participants receive $25 per month. Dependent children include unmarried children who are under age 18, and for Plan 3, full-time students under age 22, or permanently disabled children.

	Dependent parent's income if no surviving spouse or children, but there is a dependent parent: the benefit that would have been payable to the spouse will be paid to the dependent parent.
▸ After September 1, 1997 but prior to July 1, 2001	The Pension System recomputed the benefit of each survivor whose original benefit was computed prior to September 1, 1997. The benefit was increased in the same manner as the retiree's benefit.
▸ After July 1, 2001	The Pension System recomputed the benefit of each survivor whose original benefit was computed prior to July 1, 2001. The benefit was increased in the same manner as the retiree's benefit.
Additional Benefits	Effective December 1, 1998, a $5,000 lump sum is paid upon the death of an active member who was sworn in prior to October 9, 2004. Effective July 1, 2001, an extra monthly benefit of $150.00 is payable for life. Children receiving equivalent of the spouse's benefit do not receive this additional benefit.

Benefit Adjustments

Cost-of-Living	
▸ Prior to October 9, 2004	Monthly benefits for participants receiving payments are increased each April 1 by 2/3 of the increase in the Consumer Price Index for All Urban Consumers (CPI-U) for the preceding calendar year. Effective September 1, 1997 this increase is subject to a minimum of 3.0% per year compounded and a maximum increase of 8.0% per year compounded.
▸ Between October 9, 2004 and July 1, 2016	Monthly benefits for participants receiving payments are increased each April 1 by 80% of the increase in the Consumer Price Index for All Urban Consumers (CPI-U) for the preceding year, with a minimum of 2.4% and a maximum of 8%.
▸ After July 1, 2016	Monthly benefits for participants receiving payments are increased each April 1 by 100% of the five-year average investment return minus 5.00%, with a minimum of 0.00% and a maximum of 4.00%. Members will receive their COLA once they reach age 55.

Service Adjustments	Effective November 28, 1998, participants with previous service with the City in non-classified positions may use that service to satisfy the service requirement of 20 years for retirement purposes only. Effective July 1, 2001, participants who have service credit in more than one City of Houston Pension Plan may use their combined service to qualify for DROP participation. Effective July 1, 2001, participants involuntarily transferred to the System from the Houston Municipal Employees System will receive service under this plan for years worked while serving as a City Marshall, Airport Police or Park Police.

Contributions

Employee Contributions	
▸ Prior to December 1, 1998	Each participant contributes 8.75% of base salary.
▸ After December 1, 1998 but before October 9, 2004	Each participant contributes 8.75% of average total direct pay less overtime.
After October 9, 2004	Each participant contributes 9.00% of pay. The additional 0.25% will be credited to the Plan's general fund. 8.75% of pay is used for purposes of crediting eligible DROP accounts
– Members sworn in prior to October 9, 2004	
– Others	Each participant contributes 10.25% of pay, which will be credited to the Plan's general fund.
▸ After July 1, 2016	Each participant contributes 10.50% of pay, which will be credited to the Plan's general fund.
Refunds	Contributions are refunded without interest.

Employer Contribution	The City of Houston will contribute the City Contribution Rate which will consistent of a normal cost contribution and a fixed layer closed amortization schedule with each new loss layer having a 30 year period. Each layer will be assumed to begin with the fiscal year beginning 12 months after the valuation date.

GLOSSARY

GLOSSARY

Actuarial Accrued Liability (AAL): That portion, as determined by a particular Actuarial Cost Method, of the Actuarial Present Value of Future Plan Benefits which is not provided for by future Normal Costs. It is equal to the Actuarial Present Value of Future Plan Benefits minus the actuarial present value of future Normal Costs.

Actuarial Assumptions: Assumptions as to future experience under the Fund. These include assumptions about the occurrence of future events affecting costs or liabilities, such as:

- mortality, withdrawal, disablement, and retirement;
- future increases in salary;
- future rates of investment earnings and future investment and administrative expenses;
- characteristics of members not specified in the data, such as marital status;
- characteristics of future members;
- future elections made by members; and
- other relevant items.

Actuarial Cost Method or ***Funding Method:*** A procedure for allocating the Actuarial Present Value of Future Benefits to various time periods; a method used to determine the Normal Cost and the Actuarial Accrued Liability. These items are used to determine the ADC.

Actuarial Gain or ***Actuarial Loss:*** A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. Through the actuarial assumptions, rates of decrements, rates of salary increases, and rates of fund earnings have been forecasted. To the extent that actual experience differs from that assumed, Actuarial Accrued Liabilities emerge which may be the same as forecasted, or may be larger or smaller than projected. Actuarial gains are due to favorable experience, e.g., the Fund's assets earn more than projected, salaries do not increase as fast as assumed, members retire later than assumed, etc. Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, actuarial losses are the result of unfavorable experience, i.e., actual results that produce actuarial liabilities which are larger than projected. Actuarial gains will shorten the time required for funding of the actuarial balance sheet deficiency while actuarial losses will lengthen the funding period.

Actuarially Equivalent: Of equal actuarial present value, determined as of a given date and based on a given set of Actuarial Assumptions.

Actuarial Present Value (APV): The value of an amount or series of amounts payable or receivable at various times, determined as of a given date by the application of a particular set of Actuarial Assumptions. For purposes of this standard, each such amount or series of amounts is:

a. adjusted for the probable financial effect of certain intervening events (such as changes in compensation levels, marital status, etc.)

b. multiplied by the probability of the occurrence of an event (such as survival, death, disability, termination of employment, etc.) on which the payment is conditioned, and

c. discounted according to an assumed rate (or rates) of return to reflect the time value of money.

Actuarial Present Value of Future Plan Benefits: The Actuarial Present Value of those benefit amounts which are expected to be paid at various future times under a particular set of Actuarial Assumptions, taking into account such items as the effect of advancement in age and past and anticipated future compensation and service credits. The Actuarial Present Value of Future Plan Benefits includes the liabilities for active members, retired members, beneficiaries receiving benefits, and inactive, non-retired members either entitled to a refund or a future retirement benefit. Expressed another way, it is the value that would have to be invested on the valuation date so that the amount invested plus investment earnings would be provide sufficient assets to pay all projected benefits and expenses when due.

Actuarial Valuation: The determination, as of a valuation date, of the Normal Cost, Actuarial Accrued Liability, Actuarial Value of Assets, and related Actuarial Present Values for a plan. An Actuarial valuation for a governmental retirement system typically also includes calculations of items needed for compliance with GASB 25, such as the funded ratio and the ADC.

Actuarial Value of Assets or ***Valuation Assets:*** The value of the Fund's assets as of a given date, used by the actuary for valuation purposes. This may be the market or fair value of plan assets, but commonly actuaries use a smoothed value in order to reduce the year-to-year volatility of calculated results, such as the funded ratio and the ADC.

Actuarially Determined: Values which have been determined utilizing the principles of actuarial science. An actuarially determined value is derived by application of the appropriate actuarial assumptions to specified values determined by provisions of the law.

Amortization Method: A method for determining the Amortization Payment. The most common methods used are level dollar and level percentage of payroll. Under the Level Dollar method, the Amortization Payment is one of a stream of payments, all equal, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the Amortization payment is one of a stream of increasing payments, whose Actuarial Present Value is equal to the UAAL. Under the Level Percentage of Pay method, the stream of payments increases at the assumed rate at which total covered payroll of all active members will increase.

Amortization Payment: That portion of the pension plan contribution or ADC which is designed to pay interest on and to amortize the Unfunded Actuarial Accrued Liability.

Annual Determined Contribution (ADC): The employer's periodic required contributions, expressed as a dollar amount or a percentage of covered plan compensation, determined under GASB 25. The ADC consists of the Employer Normal Cost and the Amortization Payment.

Closed Amortization Period: A specific number of years that is counted down by one each year, and therefore declines to zero with the passage of time. For example if the amortization period is initially set at 30 years, it is 29 years at the end of one year, 28 years at the end of two years, etc. See Funding Period and Open Amortization Period.

Decrements: Those causes/events due to which a member's status (active-inactive-retiree-beneficiary) changes, that is: death, retirement, disability, or termination.

Defined Benefit Plan: A retirement plan that is not a Defined Contribution Plan. Typically a defined benefit plan is one in which benefits are defined by a formula applied to the member's compensation and/or years of service.

Defined Contribution Plan: A retirement plan, such as a 401(k) plan, a 403(b) plan, or a 457 plan, in which the contributions to the plan are assigned to an account for each member, and the plan's earnings are allocated to each account, and each member's benefits are a direct function of the account balance.

Employer Normal Cost: The portion of the Normal Cost to be paid by the employers. This is equal to the Normal Cost less expected member contributions.

Experience Study: A periodic review and analysis of the actual experience of the Fund which may lead to a revision of one or more actuarial assumptions. Actual rates of decrement and salary increases are compared to the actuarially assumed values and modified as deemed appropriate by the Actuary.

Funded Ratio: The ratio of the actuarial value of assets (AVA) to the actuarial accrued liability (AAL). Plans sometimes calculate a market funded ratio, using the market value of assets (MVA), rather than the AVA.

Funding Period or ***Amortization Period:*** The term "Funding Period" is used it two ways. In the first sense, it is the period used in calculating the Amortization Payment as a component of the ADC. This funding period is chosen by the Board of Trustees. In the second sense, it is a calculated item: the number of years in the future that will theoretically be required to amortize (i.e., pay off or eliminate) the Unfunded Actuarial Accrued Liability, based on the statutory employer contribution rate, and assuming no future actuarial gains or losses.

GASB: Governmental Accounting Standards Board.

GASB 67 and ***GASB 68***: Governmental Accounting Standards Board Statements No. 67 and No. 68. These are the governmental accounting standards that set the accounting rules for public retirement systems and the employers that sponsor or contribute to them. Statement No. 68 sets the accounting rules for the employers that sponsor or contribute to public retirement systems, while Statement No. 67 sets the rules for the systems themselves.

Normal Cost: That portion of the Actuarial Present Value of pension plan benefits and expenses which is allocated to a valuation year by the Actuarial Cost Method. Any payment in respect of an Unfunded Actuarial Accrued Liability is not part of Normal Cost (see Amortization Payment). For pension plan benefits which are provided in part by employee contributions, Normal Cost refers to the total of employee contributions and employer Normal Cost unless otherwise specifically stated. Under the entry age normal cost method, the Normal Cost is intended to be the level cost (when expressed as a percentage of pay) needed to fund the benefits of a member from hire until ultimate termination, death, disability or retirement.

Open Amortization Period: An open amortization period is one which is used to determine the Amortization Payment but which does not change over time. In other words, if the initial period is set as 30 years, the same 30-year period is used in determining the Amortization Period each year. In theory, if an Open Amortization Period is used to amortize the Unfunded Actuarial Accrued Liability, the UAAL will never completely disappear, but will become smaller each year, either as a dollar amount or in relation to covered payroll.

Unfunded Actuarial Accrued Liability: The excess of the Actuarial Accrued Liability over the Actuarial Value of Assets. This value may be negative in which case it may be expressed as a negative Unfunded Actuarial Accrued Liability, also called the Funding Surplus.

Valuation Date or Actuarial Valuation Date: The date as of which the value of assets is determined and as of which the Actuarial Present Value of Future Plan Benefits is determined. The expected benefits to be paid in the future are discounted to this date.

City of Houston
HPOPS
Proposed Risk Sharing
Valuation Study
As of July 1, 2020

November 25, 2020

November 25, 2020

Ms. Tantri Emo
Director, Finance Department
City of Houston
611 Walker
Houston, TX 77002

Re: HPOPS Proposed Risk Sharing Valuation Study as of July 1, 2020

Dear Tantri:

Texas Revised Statutes article 6243g-4 (the Article) sets forth requirements for a Risk Sharing Valuation Study (RSVS) of the Houston Police Officers' Pension System (HPOPS). The purpose of this study is to determine the City Contribution Rate for the following fiscal year. Retirement Horizons Inc. (RHI) was engaged by the City of Houston to perform this proposed Risk Sharing Valuation Study as of July 1, 2020 as the Municipal Actuary. This report provides the results of the Study and is organized as follows:

- Section 1 – Risk Sharing Valuation Study Results
- Section 2 – Actuarial Exhibits
- Section 3 – Summary of Plan Provisions
- Section 4 – Actuarial Methods and Assumptions
- Section 5 – Summary of Valuation Data
- Section 6 – Data Sources
- Section 7 – ASOP 51 Assessment and Disclosure of Risk

RHI received Actuarial Data as defined in Section 1-a of the Article and required by Section 9A(a) of the Article. RHI conducted our proposed RSVS using the Actuarial Data provided and plan provisions as summarized in this report. The analysis presented in this report is based on the interest rate assumption and actuarial cost and asset methods prescribed by the Article. All other actuarial methods and assumptions summarized in this report were adopted in conjunction with the 2018 HPOPS Actuarial Experience Study as required by the Article.

As described in the Article, results of the Risk Sharing Valuation Study performed by the HPOPS actuary will be compared to the results in this report. If the City Contribution Rates differ by greater than two percentage points, then RHI will attempt to reconcile the results with the HPOPS actuary, or a mathematical average will be used. If the results are within two percentage points, then the HPOPS actuary's results will be used.

The actual costs, City Contribution Rates, and other results could be materially different from those described in this report in the future if actual plan experience differs significantly from the underlying valuation basis. Differences could occur for a number of reasons such as plan experience differing from the underlying demographic and economic assumptions or changes in plan provisions. Due to the limited scope of this report, analysis of the potential range of such future measurements has not been performed.

The results in this report and any measures of funded status are predicated on the notion of the Fund's ongoing operation and should not be relied upon for assessing the sufficiency of plan assets for settlement of plan termination liabilities.

The information contained in this report was prepared as requested by the City of Houston and solely for the purpose of satisfying the RSVS requirements of the Article, and should not be used for any other purpose. As significantly different results from those contained in this report may be needed for other purposes, this report should only be provided to other parties in its entirety.

The signing actuary for this report is a member of the Society of Actuaries and other professional actuarial organizations and meets the "Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion." The undersigned is available to answer questions regarding the information contained in this report or to provide further explanations or details as needed.

Respectfully submitted by Retirement Horizons Inc.



David A. Sawyer, FSA EA MAAA
Senior Consulting Actuary

Corridor Midpoint

The table below contains the Corridor Midpoint, along with the corresponding Minimum and Maximum Contribution Rates using a 5% Corridor Margin as specified in the Article. Based on RHI's proposed 2020 RSVS results, the City Contribution Rate for FY 2022 would be 30.45% of pensionable payroll. If the Fund Actuary's results are within 2 percentage points of 30.45%, then Fund Actuary's results will be used, along with the Corridor methodology, to determine the Final City Contribution Rate.

FY	Corridor Midpoint	Corridor Minimum	Corridor Maximum	RHI Calculated City Contribution Rate	Final City Contribution Rate *
2018	31.77%	26.77%	36.77%	32.18%	31.77%
2019	31.85%	26.85%	36.85%	32.48%	31.85%
2020	31.82%	26.82%	36.82%	32.24%	31.82%
2021	31.84%	26.84%	36.84%	29.86%	31.84%
2022	31.92%	26.92%	36.92%	30.45%	
2023	31.98%	26.98%	36.98%		
2024	32.03%	27.03%	37.03%		
2025	32.07%	27.07%	37.07%		
2026	32.10%	27.10%	37.10%		
2027	32.12%	27.12%	37.12%		
2028	32.13%	27.13%	37.13%		
2029	32.13%	27.13%	37.13%		
2030	32.13%	27.13%	37.13%		
2031	32.14%	27.14%	37.14%		
2032	32.14%	27.14%	37.14%		
2033	32.14%	27.14%	37.14%		
2034	32.15%	27.15%	37.15%		
2035	32.14%	27.14%	37.14%		
2036	32.14%	27.14%	37.14%		
2037	32.14%	27.14%	37.14%		
2038	32.14%	27.14%	37.14%		
2039	32.13%	27.13%	37.13%		
2040	32.14%	27.14%	37.14%		
2041	32.13%	27.13%	37.13%		
2042	32.13%	27.13%	37.13%		
2043	32.13%	27.13%	37.13%		
2044	32.13%	27.13%	37.13%		
2045	32.13%	27.13%	37.13%		
2046	32.13%	27.13%	37.13%		
2047	32.13%	27.13%	37.13%		
2048	14.17%	9.17%	19.17%		

Risk Sharing Valuation Study Results

City Contribution Rate

The City Contribution Rate is equal to the sum of the Employer Normal Cost and the Amortization Rate from any Liability Layers. Below are the results from RHI's preliminary RSVS measurements.

FY	Employer Normal Cost	Liability Layer Amortization Rate	Estimated City Contribution Rate
2018	13.24%	18.94%	32.18%
2019	13.74%	18.74%	32.48%
2020	13.58%	18.66%	32.24%
2021	13.50%	16.36%	29.86%
2022	13.55%	16.90%	30.45%
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Actuarial Exhibits

2.1. Fair Value of Assets

	July 1, 2019	July 1, 2020
A. Fair Value of Plan Assets		
1. Cash & Short Term Investments	$ 923,156,000	$ 938,579,000
2. Fixed Income	958,756,000	666,192,000
3. Equity Securities	1,895,645,000	2,034,415,000
4. Alternative Investments	1,884,663,000	1,908,257,000
5. Accrued City Contributions	6,321,000	7,372,000
6. Accrued Member Contributions	2,083,000	2,428,000
7. Other Receivables	12,431,000	23,452,000
8. Liabilities	(72,724,000)	(42,960,000)
9. Other	64,316,000	34,741,000
10. Total Fair Value	$ 5,674,647,000	$ 5,572,476,000

B. Change in Fair Value	Change
1. Contributions	
a. Members	$ 49,062,000
b. City	149,078,000
c. Total	$ 198,140,000
2. Disbursements	
a. Benefit Payments	$ (357,582,000)
b. Administrative Expenses	(3,922,000)
c. Total	$ (361,504,000)
3. Investment Return	
a. Interest and Dividends	$ 65,416,000
b. Realized and Unrealized Gain/(Loss)	3,687,000
c. Plan Investment Expenses	(7,910,000)
d. Total Return	$ 61,193,000
4. Net Change	$ (102,171,000)
5. Average Rate of Return	
a. Average Asset Value	$ 5,592,965,000
b. Income Net of Investment Expenses	$ 61,193,000
c. Annual Rate of Return - Net of Investment Expenses	1.09%
d. Annual Rate of Return - Gross	1.24%

Actuarial Exhibits

2.2. Actuarial Value of Assets

1. Actuarial Value of Assets, beginning of prior year	$ 5,434,932,401
2. Net Cash Flow	
a. Contributions	$ 198,140,000
b. Benefit Disbursements	(357,582,000)
c. Administrative Expenses	(3,922,000)
d. Net Cash Flow [2.a. + 2.b. + 2.c.]	$ (163,364,000)
3. Expected Investment Return [1. x 0.07] + [2.d. x 0.035]	$ 374,727,528
4. Expected Actuarial Value of Assets at end of year [1. + 2.d. + 3.]	$ 5,646,295,929
5. Market Value of Assets at end of year	$ 5,572,476,000
6. Difference [5. - 4.]	$ (73,819,929)

7. Development of Actuarial Value of Assets, end of year

Fiscal Year End	Remaining Deferrals of Excess (Shortfall) of Investment Income	Offsetting of Gains/(Losses)	Net Deferrals Remaining	Years Remaining	Recognized for This Valuation	Remaining after This Valuation
2015	N/A	N/A	N/A		N/A	N/A
2016	N/A	N/A	N/A	1	N/A	N/A
2017	147,790,268	(147,790,268)	-	2	-	-
2018	91,924,331	(91,924,331)	-	3	-	-
2019	-	-	-	4	-	-
2020	(313,534,528)	239,714,599	(73,819,929)	5	(14,763,986)	(59,055,943)
Total	$ (73,819,929)	$ -	$ (73,819,929)		$ (14,763,986)	$ (59,055,943)

8. Actuarial Value of Assets as of July 1, 2020 (5. - 7.)	$ 5,631,531,943
9. Rate of Return on Actuarial Value of Assets (Net of Investment Expenses)	6.7%

Actuarial Exhibits

2.3. Actuarial Accrued Liability

	July 1, 2019		July 1, 2020
A. Discount Rate	7.0%		7.0%
B. Actuarial Accrued Liability			
1. Actives	$2,528,306,995		$2,527,361,850
2. Terminated Vesteds	$10,730,118		$13,267,505
3. Disableds	$118,307,075		$120,782,817
4. Retirees & Beneficiaries	$4,063,261,690		$4,256,491,853
5. Total	$6,720,605,878		$6,917,904,025
C. Change in Actuarial Accrued Liability		2020 Fiscal Year	
1. Benefits Accumulated		$108,170,029	
2. Benefits Paid		($357,582,000)	
3. Decrease in Discount Period		$461,860,634	
4. Plan Experience		($15,150,516)	
5. Net Change		$197,298,147	
D. Actuarial Value of Assets	$5,434,932,401		$5,631,531,943
E. Unfunded Actuarial Liability	$1,285,673,477		$1,286,372,082
F. Total Normal Cost % of Payroll[1]	24.00%		24.05%
G. Member Contribution % of Payroll	10.50%		10.50%
H. Employer Normal Cost Rate [F - G]	13.50%		13.55%

[1] Includes administrative expense load equal to 0.80% of payroll for July 1, 2019 RSVS and 0.84% of payroll for July 1, 2020 RSVS.

2.4. Liability Layers

Valuation Date Base Established	Initial Amount of Liability Layer (BOY)	Remaining Liability to be Amortized as of 7/1/2020	Remaining Amortization Period as of 7/1/2020		Amortization Amount for FY 2022
7/1/2016	$1,401,245,799	$1,456,610,359	26	$	92,438,075
7/1/2017	($6,122,894)	($6,678,561)	26	$	(411,123)
7/1/2018	($49,006,657)	($52,911,188)	26	$	(3,262,504)
7/1/2019	($101,233,226)	($108,319,552)	26	$	(6,690,099)
7/1/2020	($2,328,976)	($2,328,976)	26	$	(152,978)
Total		$1,286,372,082		$	81,921,370
Projected Payroll for FY 2022				$	484,880,823
Amortization Amount as a % of FY 2022 Payroll					16.90%

Summary of Plan Provisions

Eligibility and Participation

Any police officer shall automatically become a participant in the plan upon graduation from the police academy.

Final Average Pay (FAP)

The average of the 78 bi-weekly payroll periods of salary prior to termination of employment or DROP date, before reduction for pre-tax employee contributions and salary deferrals but excluding overtime, executive level pay, strategic officer staffing program pay, motorcycle allowance, clothing allowance and mentor pay.

Credited Service

Elapsed time from date of hire, for all periods of service classified as full-time, fully paid, active duty employment with the City of Houston Police Department, but excluding any period of DROP participation.

Retirement Benefit

Eligibility

- Sworn prior to October 9, 2004 — Earlier of 20 years of service or the age at which the member attains both age 60 and at least 10 years of service.
- Sworn after October 9, 2004 — Rule of 70, when age plus service total at least 70.

Amount

- Sworn prior to October 9, 2004 — Accrued benefit of 2.75% of FAP times credited service up to 20 years of service, plus 2.0% of FAP for credited service in excess of 20 years. In addition, the member will receive a $5,000 lump sum.
- Sworn after October 9, 2004 — Accrued benefit of 2.25% of FAP times credited service up to 20 years of service, plus 2.0% of FAP for credited service in excess of 20 years, up to a maximum of 80% of FAP.

Termination Benefit

Eligibility — Termination of employment prior to satisfying the retirement eligibility requirements.

Amount — Less than 10 years of service: Lump Sum refund of member contributions without interest.

At least 10 but less than 20 years of service:

Choice of

- Refund of contributions without interest, or
- Monthly benefit determined as set forth above payable at normal retirement age

On-Duty Disability

Eligibility	No age or service requirements.
Amount	Officers who are not capable of performing their normal and customary police officer duties receive the greater of their accrued retirement benefit or 45% of FAP (100% of FAP for officers with a Catastrophic Disability). If sworn prior to October 9, 2004, the benefit is the greater of the accrued retirement benefit or 55% of FAP, and the member will receive a $5,000 lump sum.

Off-Duty Disability

Eligibility	No age or service requirements.
Benefit	Officers who are not capable of performing their normal and customary police officer duties receive the greater of their accrued retirement benefit or 22.5% of FAP (27.5% of FAP if sworn prior to October 9, 2004, plus $5,000 lump sum).

Active Member Death

Eligibility	No age or service requirements.
Duty Related Benefit	100% of Final Average Pay (FAP). In addition, if the member was sworn before October 9, 2004, a $5,000 lump sum will be paid, divided equally among eligible survivors.
Non-Duty Related Benefit	Greater of the accrued retirement benefit or Off-Duty Disability benefit. In addition, if the member was sworn before October 9, 2004, a $5,000 lump sum will be paid, divided equally among eligible survivors.
Allocation to Beneficiaries	The benefit amount above is payable to a surviving spouse, or allocated 50% to the surviving spouse with the remaining 50% divided equally among any eligible children, or otherwise paid to any eligible parents.

Retired Member Death

Eligibility	Retired and receiving monthly pension.
Amount	100% of monthly pension the retired member was receiving. The benefit is paid for at least five years following the member's retirement date, even if the beneficiary dies.
Allocation to Beneficiaries	The benefit amount above is payable to a surviving spouse, or allocated 50% to the surviving spouse with the remaining 50% divided equally among any eligible children, or otherwise paid to any eligible parents.

Summary of Plan Provisions

Supplemental Annuity

An extra monthly benefit of $150 is payable for life to any retired or disabled member or to an eligible survivor of a deceased member.

Cost of Living Adjustment

The five-year investment return less 5%. The COLA will be no less than 0% nor greater than 4%. Only retired members or survivors who are age 55 or older, received benefits prior to June 8, 1995, or survivors of members who died in the line of duty will be eligible for the COLA.

DROP

Upon reaching retirement eligibility, members sworn prior to October 9, 2004 may enter the Deferred Retirement Option Plan (DROP). The member's monthly annuity (without COLA) is added to a notional account. Interest is credited on the account using 65% of the 5-year compound average of the Fund's rate of return, with a minimum of 2.5%. Members may remain in DROP for a maximum of 20 years.

PROP

Members sworn prior to October 9, 2004 may have participated in the Post Retirement Option Plan (PROP) at or after service retirement and prior to July 1, 2017. No new amounts are credited to PROP after that date. Account balances are credited with interest at the same rate credited to DROP balances.

PLOP

Members sworn after October 9, 2004 are eligible for the Partial Lump Sum Option Plan (PLOP) at service retirement eligibility. The member receives a reduced monthly benefit plus a lump sum of up to 20% of the value of the unreduced annuity.

Contribution Rates

Members

10.50% of pensionable pay.

City

The City Contribution Rate from the RSVS applied to pensionable payroll.

Actuarial Methods and Assumptions

Actuarial Cost Methods

Measurement Date	Census data as of July 1, 2020 for all members. Impact of plan changes measured on future accruals only; no impact to accruals through the valuation date, including for back-DROP accruals based on dates before the valuation date.
Actuarial Value of Assets	Fair market value of assets as of June 30, 2020, less a five-year phase-in of the excess (shortfall) between expected investment return and actual income. The calculation is based on the difference between actual fair market value and the expected actuarial value of assets each year. The cumulative excess return (shortfall) is recognized at a minimum rate of 20% per year. Gains may be used to offset outstanding losses, and vice versa, to accelerate the amortization. Expected earnings are based on the assumed rate of return on investments and are net of investment expenses. The smoothing method was reset as of July 1, 2016.
Actuarial Cost Method	The Ultimate Entry Age Normal Actuarial Cost Method A method under which the actuarial present value of all potential future projected benefits of each individual included in the valuation is calculated, based on the underlying demographic and economic assumptions. The *normal cost* is calculated as the average uniform percentage of payroll which, if applied to the compensation of each participant during the entire period of anticipated covered service, would meet the cost of all benefits payable based on benefits provisions for new hires. The portion of the actuarial present value of future benefits not provided for at the valuation date by the present value of future normal costs is called the *actuarial accrued liability*.

Key Economic Assumptions

Interest Rate	7.0% as prescribed by the Article.
Inflation	2.25%.
Wage Inflation	2.75%.
Payroll Growth	2.75%.

Actuarial Methods and Assumptions

Individual Pay Increase Rate — A service-related assumption:

Service	*Rate*
1	2.75%
2	22.75%
3	5.75%
4	5.75%
5	5.75%
6	8.75%
7	8.75%
8	4.75%
9	4.75%
10	4.75%
11	8.75%
12	3.75%
13	7.75%
14	3.75%
15	3.75%
16	3.75%
17	7.75%
18+	2.75%

DROP Interest Crediting Rate — 5.10%.

COLA — 2.00%

Actuarial Methods and Assumptions

Demographic Assumptions

Mortality Rates

- Healthy retirees — The 2006 base mortality rates from the RP-2014 Healthy Mortality Tables with Blue Collar Adjustment for male rates and no collar adjustment for female rates. These rates are projected to 2018 using Scale MP-2017 and then into the future on a fully generational basis by the ultimate rates of scale MP-2017.

- Disabled males and females — The RP-2014 Disabled Retiree Mortality Tables projected on a fully generational basis by the ultimate rates of scale MP-2017.

- Active members — The RP-2014 Healthy Mortality Tables with Blue Collar adjustment projected on a fully generational basis by the ultimate rates of scale MP-2017.

Retirement Rates

	Service		
Age	***<25***	***25 - 29***	***30+***
40 - 49	3.0%	3.0%	9.0%
50 - 54	4.0%	6.0%	10.0%
55 - 59	6.8%	10.2%	17.0%
60 - 64	9.6%	14.4%	24.0%
65+	100.0%	100.0%	100.0%

For members sworn after October 9, 2004, rates in the first year of eligibility were increased by 30%, less 3% for each year below age 55. For members currently in DROP, the rates above were multiplied by 1.1.

Eligible members are assumed to enter DROP at first eligibility and remain in DROP until retirement or reaching the maximum 20 years in DROP. The retirement rates are set to 100% after 20 years in DROP.

Disability Rates

Age	Males	Females
20	0.1149%	0.1149%
25	0.1145%	0.1145%
30	0.1197%	0.1197%
35	0.1321%	0.1321%
40	0.1516%	0.1516%
45	0.1785%	0.1785%
50	0.2126%	0.2126%
55	0.2538%	0.2538%
60	0.3023%	0.3023%

1% is added to rates above for post-2004 hires after 20 years of service.

Percentage of Deaths and Disabilities in the Line of Duty

- Deaths 100%
- Disabilities 100%

Termination Rates

Sample Rates

Service	Termination Rate
1	2.71%
3	1.95%
5	1.40%
7	1.01%
9	0.72%
11	0.52%
13	0.37%
15	0.27%
17	0.19%
19	0.14%
20+	0.10%

For participants with at least 10 years of service but less than 20 years, 50% are assumed to elect a contribution refund, and 50% are assumed to elect a deferred monthly benefit. A commencement age of 60 was used for members hired prior to 2004, and a commencement age of 55 was used for members hired in 2004 and later.

Actuarial Methods and Assumptions

Percentage married	90% of participants are assumed to be married. No beneficiaries other than the spouse assumed.
Age difference	Husbands assumed to be three years older than wives.
Child Beneficiaries	Child beneficiaries are assumed to receive payments until age 24.
Development of Valuation Pay	Valuation pay is projected by increasing the maximum of the past five years of pay or $31,000 with the nominal individual pay increase rate. Historical valuation pay for years before data was available was regressed with the nominal individual pay increase rate.
Payment of DROP Balances	Installments over 10 years. The value of the DROP balance is multiplied by a factor which reflects the difference between the assumed DROP interest crediting rate and the interest rate assumption (0.9310 at 5.10% DROP interest crediting and 7.0% interest).
Administrative Expenses	0.84% of payroll
Funding Policy	The City is assumed to contribute the City Contribution Rate from the prior year's RSVS after application of the Corridor. The actuarially determined City Contribution Rate is measured as the normal cost rate, plus the administrative expenses rate, plus 30-year amortization rate of the Unfunded Actuarial Accrued Liability (UAAL) from the initial RSVS, plus the amortization rates of all subsequently-determined Liability Layers, less the member contribution rate, adjusted with interest to mid-year. The closed amortization rates for the Liability Layers are calculated as a level percent of pay. The initial amortization period for a Liability Loss Layer is 30 years. The initial amortization period for a Liability Gain Layer is equal to the remaining amortization period for the largest remaining Liability Loss Layer.
Benefits Not Valued	Due to limitations of the data received, no adjustment has been made for the difference between pay based on the classified position and executive level pay.

Summary of Valuation Data

	July 1, 2019	July 1, 2020
A. Active Members Not in DROP		
1. Number	3,533	3,646
2. Prior Year Annualized Pay	$269,635,200	$288,413,588
3. Valuation payroll	$287,984,095	$296,344,962
4. Average pay	$81,513	$81,279
5. Average age	36.1	36.1
6. Average service	8.2	8.3
B. Active Members in DROP		
1. Number	1,749	1,673
2. Prior Year Annualized Pay	$172,891,332	$170,859,869
3. Valuation payroll	$177,651,860	$175,558,515
4. Average pay	$101,573	$104,936
5. Average age	52.7	53.1
6. Average service	26.5	26.9
C. Terminated Vested		
1. Number	43	49
2. Total benefits	$1,210,456	$1,533,357
3. Average Annual benefits	$28,150	$31,293
D. Disabled		
1. Number	174	179
2. Total benefits	$8,123,142	$8,261,133
3. Average Annual benefits	$46,685	$46,152
E. Retired		
1. Number	3,512	3,613
2. Total benefits	$190,276,122	$197,501,009
3. Average Annual benefits	$54,179	$54,664
F. Beneficiaries		
1. Number	808	830
2. Total benefits	$35,727,744	$37,702,032
3. Average Annual benefits	$44,218	$45,424

Notes:

1. DROP Balance values and data for non-vested terminated members are not shown.

Data Sources

Data and inputs used in this report were provided from the following sources:

- Individual census data as of July 1, 2020 was originally provided by the HPOPS actuary on October 1, 2020.
- The HPOPS financial statement was provided on October 22, 2020.
- The provisions of the Article are contained in the enrolled text of Senate Bill 2190, which was signed by the Governor on May 31, 2017.

ASOP 51 Assessment and Disclosure of Risk

The measurement of Pension Obligations and Actuarially Determined Contributions requires assumptions about future economic and demographic variables. The events and anomalies identified below are some of the risks associated with these measurements and how they may impact the pension obligations, funded status, and the adequacy of the funding policy. The assessment and disclosure of these risks and the actual future results may reasonably be expected to differ.

Investment Risk - As the return on the plan trust assets is subject to market return, should the actual rate of return be lower than the expected return the cost of the plan will rise and vice versa.

Asset/Liability Mismatch Risk - The changes in assets are not directly tied to the changes in the value of liabilities in magnitude or direction.

Longevity and other Demographic Risks - Cessation from employment due to termination, disability, death, or retirement may not directly align with the assumptions used to value the Actuarial Accrued Liability (AAL). Actual demographic experience of the plan population may increase or decrease the future measurement of the AAL.

Payroll Risk – The funded status and future Actuarially Determined Contributions Rates (ADCR) are subject to payroll risk. Payroll lower than expected can result in future increases in the ADCR required to amortize the Unfunded Actuarial Accrued Liability and vice versa.

Contribution Risk - The City and members are assumed to make the statutorily required contributions and this valuation has not considered the possibility of unpaid contributions. If contributions are less than expected, the funded status will likely decrease over time. Due to the all the risks mentioned above, even making the statutorily required contributions does not fully guarantee the benefit security.

Understand that the above risks may not be independent of one another. Thus, it is important to discuss any known upcoming changes in the City's financials and the impact on the Fund to better identify associated risks. Any impending changes should be discussed as soon as possible, so corresponding measures may be taken to align the pension plan liabilities with these variations.

Also understand that this valuation did not assess the likelihood or consequences of potential future changes in applicable law that would impact future benefits or funding of the plan. Should applicable law be changed, these changes will be addressed in separate actuarial communications.

ASOP 51 Assessment and Disclosure of Risk

Historical Results

The following information summarizes some of the historical RSVS measurements. This information may be helpful in better understanding the risks of sponsoring this defined benefit pension plan.

Actuarial Liabilities and Assets

The numerical results in this section provides funded status progress since July 1, 2017. The large increase for the fiscal year ending June 30, 2018 was accentuated by the deposit of $750 million of Pension Obligation Bonds. In addition, over this period the favorable investment returns exceeded any unexpected growth in the Actuarial Accrued Liability (AAL) due to experience and assumption changes resulting in a reduction in the Unfunded AAL over this period.

Cash Flows

Negative cash flows indicate benefit payments and expenses exceed the contributions coming into the trust. This may require liquidation of higher returning investments at inopportune times impacting the investment return. Except in 2018, when the proceeds from the Pension Obligation Bonds were deposited, the cash flows have been negative. Negative cash flows are common for mature plans like HPOPS.

Rates of Return

The trust assets are invested in a diversified portfolio. The results of the RSVS assume the trust earns 7% per year over the long-term future, but actual annual returns will differ from the 7% assumption. The historical returns provide information on how these returns have differed from the assumption in recent years. As noted above, returns above the 7% assumption reduce the long-term cost and vice versa.

Maturity Measures

The last section summarizes several maturity measures related to payroll and the inactive members. The ratio of the asset measure to payroll provides information on contribution volatility as it relates to asset returns. The higher the ratio, the larger the increase/decrease in contributions (as a % of payroll) are for unfavorable/favorable investment experience compared to the 7% return assumption.

The ratio of the number of active members to the number of inactive members is important measure of the plan maturity. This ratio will typically decrease as the plan matures over time. As the ratio of active to inactive members decreases, larger increases in contribution rates (as a % of payroll) are typically required to amortize the same percentage increase in UAAL. The ratio of inactive AAL to total AAL is a similar measure of the plan maturity. As the percentage of the inactive member AAL increases, larger increases in contribution rates are typically required to amortize the same percentage increase in UAAL. As plans mature, the contribution volatility for these mature plans becomes more dependent on the investment returns than contribution amounts.

ASOP 51 Assessment and Disclosure of Risk

Historical Results

The table below shows historical measures from the prior Risk Sharing Valuation Studies. This information demonstrates trends in the Plan's funded status, information on the cash flows, volatility of the asset returns and several maturity measures.

($1,000)

Actuarial Liabilities and Assets (BOY - 7/1)	**2017**	**2018**	**2019**	**2020**
Fair Value of Assets (FVA)	$ 5,182,230 [1]	$ 5,486,613	$ 5,674,647	$ 5,572,476
Actuarial Value of Assets (AVA)	$ 4,868,614 [1]	$ 5,128,835	$ 5,434,932	$ 5,631,532
Actuarial Accrued Liability (AAL)	$ 6,282,613	$ 6,507,022	$ 6,720,606	$ 6,917,904
Funded Status (AVA/AAL)	77.5%	78.8%	80.9%	81.4%
Unfunded AAL (AAL - AVA)	$ 1,413,999	$ 1,378,187	$ 1,285,674	$ 1,286,372
Total Normal Cost as % of Payroll	24.24%	24.08%	24.00%	24.05%
Cash Flows (EOY - 6/30)				
Contributions (City + Member)	$ 173,909	$ 932,397 [1]	$ 189,325	$ 198,140
Disbursements	$ (464,667)	$ (366,041)	$ (341,458)	$ (361,504)
Positive/(Negative) Cash Flows	$ (290,758)	$ 566,356	$ (152,133)	$ (163,364)
- as % of Fair Value of Assets	-5.6%	10.3%	-2.7%	-2.9%
Rates of Return (EOY - 6/30)				
Assumed Rate	7.0%	7.0%	7.0%	7.0%
AVA	8.7%	9.5%	9.1%	6.7%
FVA	17.0%	9.8%	6.3%	1.1%
Maturity Measures (BOY - 7/1)				
Payroll	$ 381,943	$ 430,990	$ 446,629	$ 467,257
- FVA/Payroll	13.6	12.7	12.7	11.9
- AVA/Payroll	12.8	11.9	12.2	12.1
- AAL/Payroll	16.5	15.1	15.1	14.8
- UAAL/Payroll	3.7	3.2	2.9	2.8
Inactive Member Measures				
- # of Actives/# of Inactives	120.9%	118.9%	116.4%	113.9%
- Inactive AAL/Total AAL	60.7%	61.7%	62.4%	63.5%

[1] Amounts include proceeds from the Pension Obligation Bond.