



# Attachment A

California Public Employees' Retirement System  
Actuarial Office

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July 2019

## Miscellaneous Plan of the City of Pasadena (CalPERS ID: 6556986602) Annual Valuation Report as of June 30, 2018

Dear Employer,

Attached to this letter, you will find the June 30, 2018 actuarial valuation report of your CalPERS pension plan. **Provided in this report is the determination of the minimum required employer contributions for Fiscal Year 2020-21.** In addition, the report also contains important information regarding the current financial status of the plan as well as projections and risk measures to aid in planning for the future.

Actuarial valuations are based on assumptions regarding future plan experience including investment return and payroll growth, eligibility for the types of benefits provided, and longevity among retirees. The CalPERS Board of Administration adopts these assumptions after considering the advice of CalPERS actuarial and investment teams and other professionals. Each actuarial valuation reflects all prior differences between actual and assumed experience and adjusts the contribution rates as needed. This valuation is based on an investment return assumption of 7.0% which was adopted by the board in December 2016. Other assumptions used in this report are those recommended in the CalPERS Experience Study and Review of Actuarial Assumptions report from December 2017.

### Required Contributions

The exhibit below displays the minimum required employer contributions and the Employee PEPR Rate for Fiscal Year 2020-21 along with an estimate of the required contribution for Fiscal Year 2021-22. Member contributions other than cost sharing (whether paid by the employer or the employee) are in addition to the results shown below. **The required employer contributions in this report do not reflect any cost sharing arrangement you may have with your employees.**

Fiscal Year	Employer Normal Cost Rate	Employer Amortization of Unfunded Accrued Liability	Employee PEPR Rate
2020-21	10.017%	\$27,226,688	7.00%
<i>Projected Results</i>			
2021-22	10.0%	\$29,994,000	TBD

The actual investment return for Fiscal Year 2018-19 was not known at the time this report was prepared. The projections above assume the investment return for that year would be 7.00 percent. **To the extent the actual investment return for Fiscal Year 2018-19 differs from 7.00 percent, the actual contribution requirements for Fiscal Year 2021-22 will differ from those shown above.** For additional details regarding the assumptions and methods used for these projections please refer to the "Projected Employer Contributions" in the "Highlights and Executive Summary" section. This section also contains projected required contributions through fiscal year 2025-26.

### Changes from previous Year's Valuations

CalPERS continues to strive to provide comprehensive risk assessments regarding plan funding and sustainability consistent with the Board of Administration's pension and investment beliefs. Your report this year includes new metrics on plan maturity in recognition of the fact that most pension plans at CalPERS are maturing as anticipated. As plans mature, they become much more sensitive to risks than plans that are less mature. The "Risk Analysis" section of your report will help you understand how your plan is affected by investment return volatility and other economic assumptions. We have included plan sensitivity analysis with respect to longevity and inflation to further that discussion and encourage you to review our most recent Annual Review of Funding Levels and Risks report on our website that takes a holistic view of the system.

Further descriptions of general changes are included in the "Highlights and Executive Summary" section and in Appendix A, "Actuarial Methods and Assumptions." The effects of the changes on the required contributions are included in the "Reconciliation of Required Employer Contributions" section.

#### **Upcoming Change for June 30, 2019 Valuations**

The CalPERS Board of Administration has adopted a new amortization policy effective with the June 30, 2019 actuarial valuation. The new policy shortens the period over which actuarial gains and losses are amortized from 30 years to 20 years with the payments computed using a level dollar amount. In addition, the new policy removes the 5-year ramp-up and ramp-down on UAL bases attributable to assumption changes and non-investment gains/losses. The new policy removes the 5-year ramp-down on investment gains/losses. These changes will apply only to new UAL bases established on or after June 30, 2019.

Over the past few years, CalPERS adopted measures to strengthen the long-term future of the system. These measures include lowering the discount rate from 7.5% to 7.0% and shortening the amortization period for future unexpected changes in unfunded liability. While these changes can result in short-term increases to required employer contributions, they are not expected to increase the long-term cost of the plan. We firmly believe these changes were necessary in order to maintain the security of promised benefits and to equitably spread benefit costs over the current and future generations.

We understand that you might have some questions about these results. While we are very interested in discussing these results with your agency, in the interest of allowing us to give every public agency their results, we ask that you wait until after August 1, 2019 to contact us with actuarial questions. If you have other questions, you may call the Customer Contact Center at (888)-CalPERS or **(888-225-7377)**.

Sincerely,



SCOTT TERANDO  
Chief Actuary



**Actuarial Valuation  
as of June 30, 2018**

**for the  
Miscellaneous Plan  
of the  
City of Pasadena**

**(CalPERS ID: 6556986602)  
(Valuation Rate Plan ID: 74)**

**Required Contributions  
for Fiscal Year  
July 1, 2020 – June 30, 2021**

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## Actuarial Certification

To the best of our knowledge, this report is complete and accurate and contains sufficient information to disclose, fully and fairly, the funded condition of the Miscellaneous Plan of the City of Pasadena. This valuation is based on the member and financial data as of June 30, 2018 provided by the various CalPERS databases and the benefits under this plan with CalPERS as of the date this report was produced. It is our opinion that the valuation has been performed in accordance with generally accepted actuarial principles, in accordance with standards of practice prescribed by the Actuarial Standards Board, and that the assumptions and methods are internally consistent and reasonable for this plan, as prescribed by the CalPERS Board of Administration according to provisions set forth in the California Public Employees' Retirement Law.

The undersigned is an actuary for CalPERS, a member of the American Academy of Actuaries and the Society of Actuaries and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.



STUART BENNETT, ASA, MAAA  
Senior Pension Actuary, CalPERS

## **Highlights and Executive Summary**

- **Introduction**
- **Purpose of the Report**
- **Required Contributions**
- **Plan's Funded Status**
- **Projected Employer Contributions**
- **Cost**
- **Changes Since the Prior Year's Valuation**
- **Subsequent Events**

## Introduction

This report presents the results of the June 30, 2018 actuarial valuation of the Miscellaneous Plan of the City of Pasadena of the California Public Employees' Retirement System (CalPERS). This actuarial valuation sets the minimum required employer contributions for Fiscal Year 2020-21.

## Purpose of the Report

The actuarial valuation was prepared by the CalPERS Actuarial Office using data as of June 30, 2018. The purpose of the report is to:

- Set forth the assets and accrued liabilities of this plan as of June 30, 2018;
- Determine the minimum required employer contributions for the fiscal year July 1, 2020 through June 30, 2021;
- Provide actuarial information as of June 30, 2018 to the CalPERS Board of Administration and other interested parties.

The pension funding information presented in this report should not be used in financial reports subject to Governmental Accounting Standards Board (GASB) Statement No. 68 for an Agent Employer Defined Benefit Pension Plan. A separate accounting valuation report for such purposes is available from CalPERS and details for ordering are available on our website.

The measurements shown in this actuarial valuation may not be applicable for other purposes. The employer should contact their actuary before disseminating any portion of this report for any reason that is not explicitly described above.

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; changes in actuarial policies; and changes in plan provisions or applicable law.

### California Actuarial Advisory Panel Recommendations

This report includes all the basic disclosure elements as described in the *Model Disclosure Elements for Actuarial Valuation Reports* recommended in 2011 by the California Actuarial Advisory Panel (CAAP), with the exception of including the original base amounts of the various components of the unfunded liability in the Schedule of Amortization Bases shown on page 16.

Additionally, this report includes the following "Enhanced Risk Disclosures" also recommended by the CAAP in the Model Disclosure Elements document and consistent with the recommendations of Actuarial Standards of Practice No. 51:

- A "Scenario Test," projecting future results under different investment income returns.
- A "Sensitivity Analysis," showing the impact on current valuation results using alternative discount rates of 6.0 percent and 8.0 percent.
- A "Sensitivity Analysis," showing the impact on current valuation results using a 1.0 percent plus or minus change in the inflation rate.
- A "Sensitivity Analysis," showing the impact on current valuation results assuming rates of mortality are 10 percent lower or 10 percent higher than our current mortality assumptions adopted in 2017. This type of analysis highlights the impact on the plan of improving or worsening mortality over the long-term.
- Plan maturity measures which indicate how sensitive a plan may be to the risks noted above.

## Required Contributions

Required Employer Contribution	Fiscal Year 2020-21
<b>Employer Normal Cost Rate</b>	<b>10.017%</b>
<i>Plus, Either</i>	
<b>1) Monthly Employer Dollar UAL Payment</b>	<b>\$ 2,268,891</b>
<i>Or</i>	
<b>2) Annual UAL Prepayment Option*</b>	<b>\$ 26,321,033</b>
<b>Required PEPPRA Member Contribution Rate</b>	<b>7.00%</b>
<p><i>The total minimum required employer contribution is the <b>sum</b> of the Plan's Employer Normal Cost Rate (expressed as a percentage of payroll) <b>plus</b> the Employer Unfunded Accrued Liability (UAL) Contribution Amount (billed monthly in dollars).</i></p> <p><i>* Only the UAL portion of the employer contribution can be prepaid (<b>which must be received in full no later than July 31</b>). Any prepayment totaling over \$5 million requires a 72-hour notice email to <a href="mailto:FCSD_public_agency_wires@calpers.ca.gov">FCSD_public_agency_wires@calpers.ca.gov</a>. Plan Normal Cost contributions will be made as part of the payroll reporting process. If there is contractual cost sharing or other change, this amount will change.</i></p> <p><i>In accordance with Sections 20537 and 20572 of the Public Employees' Retirement Law, if a contracting agency fails to remit the required contributions when due, interest and penalties may apply.</i></p> <p><i>For additional detail regarding the determination of the required contribution for PEPPRA members, see Appendix D. Required member contributions for Classic members can be found in Appendix B.</i></p>	

	Fiscal Year 2019-20	Fiscal Year 2020-21
<b>Normal Cost Contribution as a Percentage of Payroll</b>		
Total Normal Cost	16.911%	17.610%
Employee Contribution <sup>1</sup>	7.665%	7.593%
Employer Normal Cost <sup>2</sup>	9.246%	10.017%
Projected Annual Payroll for Contribution Year	\$ 118,497,280	\$ 119,475,678
<b>Estimated Employer Contributions Based On Projected Payroll</b>		
Total Normal Cost	\$ 20,039,075	\$ 21,039,668
Employee Contribution <sup>1</sup>	9,082,817	9,071,788
Employer Normal Cost <sup>2</sup>	10,956,258	11,967,880
Unfunded Liability Contribution	25,084,564	27,226,688
% of Projected Payroll (illustrative only)	21.169%	22.788%
Estimated Total Employer Contribution	\$ 36,040,822	\$ 39,194,568
% of Projected Payroll (illustrative only)	30.415%	32.805%

<sup>1</sup> For classic members, this is the percentage specified in the Public Employees' Retirement Law, net of any reduction from the use of a modified formula or other factors. For PEPPRA members, the member contribution rate is based on 50 percent of the normal cost. A development of PEPPRA member contribution rates can be found in Appendix D. Employee cost sharing is not shown in this report.

<sup>2</sup> The Employer Normal Cost is a blended rate for all benefit groups in the plan. A breakout of normal cost by benefit group is shown in Appendix D.



## Plan's Funded Status

	June 30, 2017	June 30, 2018
1. Present Value of Projected Benefits	\$ 1,217,998,858	\$ 1,301,428,664
2. Entry Age Normal Accrued Liability	1,074,696,279	1,149,745,884
3. Market Value of Assets (MVA)	\$ 780,285,565	\$ 825,785,242
4. Unfunded Accrued Liability (UAL) [(2) - (3)]	\$ 294,410,714	\$ 323,960,642
5. Funded Ratio [(3) / (2)]	72.6%	71.8%

This measure of funded status is an assessment of the need for future employer contributions based on the selected actuarial cost method used to fund the plan. The UAL is the present value of future employer contributions for service that has already been earned and is in addition to future normal cost contributions for active members. For a measure of funded status that is appropriate for assessing the sufficiency of plan assets to cover estimated termination liabilities, please see "Hypothetical Termination Liability" in the "Risk Analysis" section.

## Projected Employer Contributions

The table below shows the required and projected employer contributions (before cost sharing) for the next six fiscal years. Projected results reflect the adopted changes to the discount rate described in Appendix A, "Actuarial Methods and Assumptions." The projections also assume that all actuarial assumptions will be realized and that no further changes to assumptions, contributions, benefits, or funding will occur during the projection period. The projected normal cost percentages in the projections below do not reflect that the normal cost will decline over time as new employees are hired into PEPRA or other lower cost benefit tiers.

Fiscal Year	Required Contribution	Projected Future Employer Contributions (Assumes 7.00% Return for Fiscal Year 2018-19)				
		2020-21	2021-22	2022-23	2023-24	2024-25
Normal Cost %	10.017%	10.0%	10.0%	10.0%	10.0%	10.0%
UAL Payment	27,226,688	29,994,000	32,425,000	33,856,000	35,523,000	32,948,000
<i>Total as a % of Payroll*</i>	<i>32.8%</i>	<i>34.4%</i>	<i>35.7%</i>	<i>36.1%</i>	<i>36.7%</i>	<i>34.1%</i>
<i>Projected Payroll</i>	<i>119,475,678</i>	<i>122,761,259</i>	<i>126,137,194</i>	<i>129,605,967</i>	<i>133,170,131</i>	<i>136,832,310</i>

\*Illustrative only and based on the projected payroll shown.

Changes in the UAL due to actuarial gains or losses as well as changes in actuarial assumptions or methods are amortized using a 5-year ramp up. For more information, please see "Amortization of the Unfunded Actuarial Accrued Liability" under "Actuarial Methods" in Appendix A. This method phases in the impact of changes in UAL over a 5-year period and attempts to minimize employer cost volatility from year to year. As a result of this methodology, dramatic changes in the required employer contributions in any one year are less likely. However, required contributions can change gradually and significantly over the next five years. In years where there is a large increase in UAL the relatively small amortization payments during the ramp up period could result in a funded ratio that is projected to decrease initially while the contribution impact of the increase in the UAL is phased in.

For projected contributions under alternate investment return scenarios, please see the "Future Investment Return Scenarios" in the "Risk Analysis" section.

## Cost

### Actuarial Cost Estimates in General

What is the cost of the pension plan?

Contributions to fund the pension plan are comprised of two components:

- The Normal Cost, expressed as a percentage of total active payroll.
- The Amortization of the Unfunded Accrued Liability (UAL), expressed as a dollar amount.

For fiscal years prior to FY 2017-18, the Amortization of UAL component was expressed as percentage of total active payroll. Starting with FY 2017-18, the Amortization of UAL component was expressed as a dollar amount and invoiced on a monthly basis. There continues to be an option to prepay this amount during July of each fiscal year.

The Normal Cost component will continue to be expressed as a percentage of active payroll with employer and employee contributions payable as part of the regular payroll reporting process.

The determination of both components requires complex actuarial calculations. The calculations are based on a set of actuarial assumptions which can be divided into two categories:

- Demographic assumptions (which includes mortality rates, retirement rates, employment termination rates and disability rates)
- Economic assumptions (which includes future investment earnings, inflation, salary growth rates)

These assumptions reflect CalPERS best estimate of the future experience of the plan and are long term in nature. We recognize that all the assumptions will not be realized in any given year. For example, the investment earnings at CalPERS have averaged 6.0 percent over the 20 years ending June 30, 2018, yet individual fiscal year returns have ranged from -24.0 percent to +21.7 percent. In addition, CalPERS reviews all the actuarial assumptions on an ongoing basis by conducting in-depth experience studies every four years, with the most recent experience study completed in 2017.

## Changes since the Prior Year's Valuation

### Benefits

The standard actuarial practice at CalPERS is to recognize mandated legislative benefit changes in the first annual valuation following the effective date of the legislation. Voluntary benefit changes by plan amendment are generally included in the first valuation that is prepared after the amendment becomes effective, even if the valuation date is prior to the effective date of the amendment.

This valuation generally reflects plan changes by amendments effective before the date of the report. Please refer to the "Plan's Major Benefit Options" and Appendix B for a summary of the plan provisions used in this valuation. The effect of any mandated benefit changes or plan amendments on the unfunded liability is shown in the "(Gain)/Loss Analysis" and the effect on the employer contribution is shown in the "Reconciliation of Required Employer Contributions." It should be noted that no change in liability or contribution is shown for any plan changes which were already included in the prior year's valuation.

### Actuarial Methods and Assumptions

In December of 2016 the CalPERS Board of Administration lowered the discount rate from 7.50 percent to 7.00 percent using a three-year phase-in beginning with the June 30, 2016 actuarial valuation. The minimum employer contributions for Fiscal Year 2020-21 determined in this valuation were calculated using a discount rate of 7.00 percent, payroll growth of 2.75 percent and an inflation rate of 2.50 percent. The projected employer contributions on Page 5 are calculated under the assumption that the discount rate remains at 7.00 percent going forward and that furthermore the realized rate of return on assets for Fiscal Year 2018-19 is 7.00 percent.

The decision to reduce the discount rate was primarily based on reduced capital market assumptions provided by external investment consultants and CalPERS investment staff. The specific decision adopted by the Board reflected recommendations from CalPERS staff and additional input from employer and employee stakeholder groups. Based on the investment allocation adopted by the Board and capital market assumptions, the reduced discount rate assumption provides a more realistic assumption for the long-term investment return of the fund.

CalPERS has implemented a new actuarial valuation software system for the June 30, 2018 valuation. With this new system we have refined and improved some of our calculation methodology. Any difference in liability between the old software and new software calculations is captured as a method change line item.

## Subsequent Events

The CalPERS Board of Administration has adopted a new amortization policy effective with the June 30, 2019 actuarial valuation. The new policy shortens the period over which actuarial gains and losses are amortized from 30 years to 20 years with the payments computed using a level dollar amount. In addition, the new policy removes the 5-year ramp-up and ramp-down on UAL bases attributable to assumption changes and non-investment gains/losses. The new policy removes the 5-year ramp-down on investment gains/losses. These changes will apply only to new UAL bases established on or after June 30, 2019.

For inactive employers the new amortization policy imposes a maximum amortization period of 15 years for all unfunded accrued liabilities effective June 30, 2017. Furthermore, the plan actuary has the ability to shorten the amortization period on any valuation date based on the life expectancy of plan members and projected cash flow needs to the plan. The impact of this has been reflected in the current valuation results.

The contribution requirements determined in this actuarial valuation report are based on demographic and financial information as of June 30, 2018. Changes in the value of assets subsequent to that date are not reflected. Investment returns below the assumed rate of return will increase the required contribution, while investment returns above the assumed rate of return will decrease the required contribution.

This actuarial valuation report reflects statutory changes, regulatory changes and CalPERS Board actions through January 2019. Any subsequent changes or actions are not reflected.

## **Assets**

- **Reconciliation of the Market Value of Assets**
- **Asset Allocation**
- **CalPERS History of Investment Returns**

## Reconciliation of the Market Value of Assets

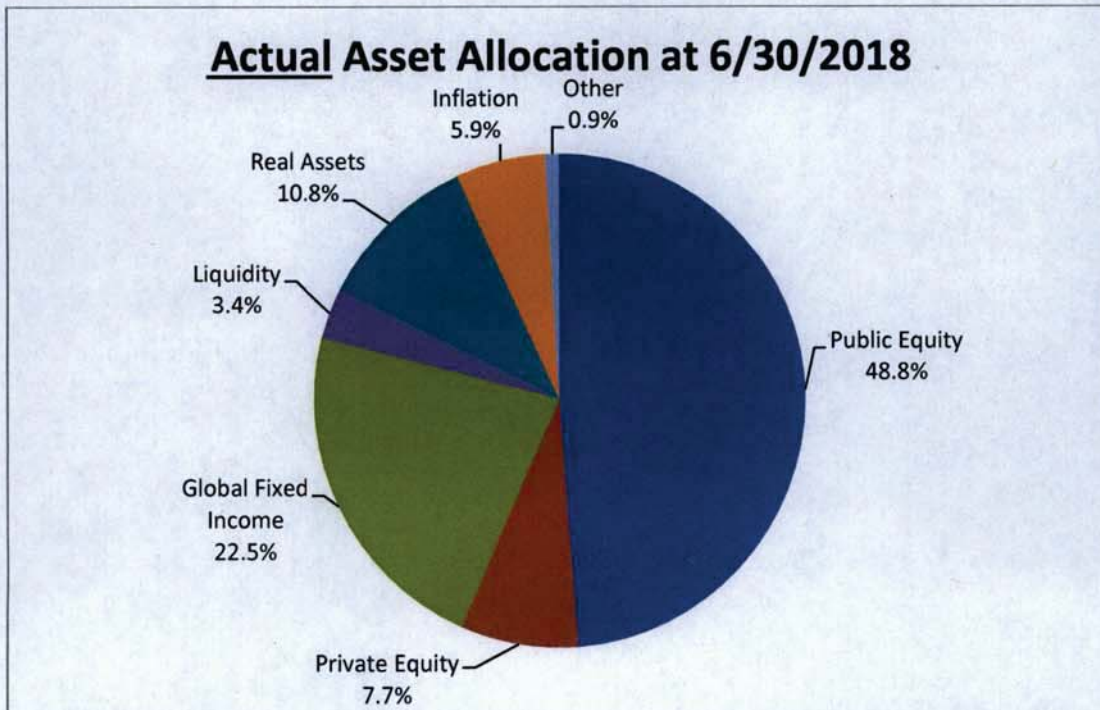
1. Market Value of Assets as of 6/30/17 including Receivables	\$	780,285,565
2. Change in Receivables for Service Buybacks		(249,438)
3. Employer Contributions		27,112,138
4. Employee Contributions		8,481,519
5. Benefit Payments to Retirees and Beneficiaries		(54,683,635)
6. Refunds		(680,615)
7. Transfers		(1,921)
8. Service Credit Purchase (SCP) Payments and Interest		591,822
9. Miscellaneous Adjustments		1
10. Net Investment Return		64,929,807
11. Market Value of Assets as of 6/30/18 including Receivables	\$	<u>825,785,242</u>

## Asset Allocation

CalPERS adheres to an Asset Allocation Strategy which establishes asset class allocation policy targets and ranges, and manages those asset class allocations within their policy ranges. CalPERS Investment Belief No. 6 recognizes that strategic asset allocation is the dominant determinant of portfolio risk and return. On December 19, 2017, the CalPERS Board of Administration adopted changes to the current asset allocation as shown in the Policy Target Allocation below expressed as a percentage of total assets.

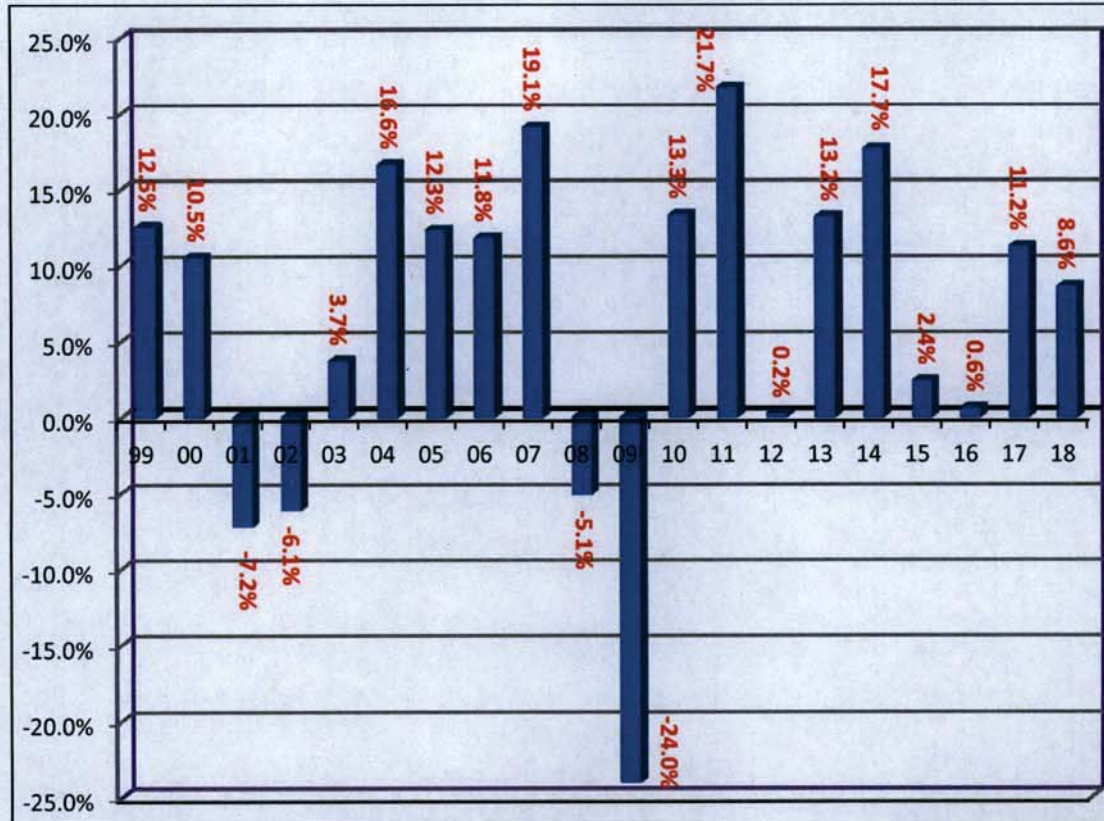
The asset allocation and market value of assets shown below reflect the values of the Public Employees' Retirement Fund (PERF) in its entirety as of June 30, 2018. The assets for City of Pasadena Miscellaneous Plan are part of the PERF and are invested accordingly.

(A) Asset Class	(B) Market Value (\$ Billion)	(C) Policy Target Allocation
Public Equity	171.8	49.0%
Private Equity	27.2	8.0%
Global Fixed Income	79.1	22.0%
Liquidity	11.8	3.0%
Real Assets	38.1	12.0%
Inflation Sensitive Assets	20.8	6.0%
Other	3.1	0.0%
<b>Total Fund</b>	<b>\$351.9</b>	<b>100.0%</b>



## CalPERS History of Investment Returns

The following is a chart with the 20-year historical annual returns of the Public Employees Retirement Fund for each fiscal year ending on June 30. Beginning in 2002, the figures are reported as gross of fees.



The table below shows historical geometric mean annual returns of the Public Employees Retirement Fund for various time periods ending on June 30, 2018 (figures are reported as gross of fees). The geometric mean rate of return is the average rate per period compounded over multiple periods. It should be recognized that in any given year the rate of return is volatile. The portfolio has an expected volatility of 11.4 percent per year based on the most recent Asset Liability Modelling study. The volatility is a measure of the risk of the portfolio expressed in the standard deviation of the fund's total return distribution, expressed as a percentage. Consequently, when looking at investment returns, it is more instructive to look at returns over longer time horizons.

History of CalPERS Geometric Mean Rates of Return and Volatilities					
	1 year	5 year	10 year	20 year	30 year
Geometric Return	8.6%	7.9%	5.7%	6.0%	8.3%
Volatility	-	6.9%	12.9%	11.1%	10.1%

## **Liabilities and Contributions**

- **Development of Accrued and Unfunded Liabilities**
- **(Gain) / Loss Analysis 06/30/17 - 06/30/18**
- **Schedule of Amortization Bases**
- **Amortization Schedule and Alternatives**
- **Reconciliation of Required Employer Contributions**
- **Employer Contribution History**
- **Funding History**



## Development of Accrued and Unfunded Liabilities

	June 30, 2017	June 30, 2018
1. Present Value of Projected Benefits		
a) Active Members	\$ 521,285,479	544,596,446
b) Transferred Members	44,449,971	47,706,723
c) Terminated Members	27,281,216	28,407,893
d) Members and Beneficiaries Receiving Payments	624,982,192	680,717,602
e) Total	\$ 1,217,998,858	1,301,428,664
2. Present Value of Future Employer Normal Costs	\$ 76,831,643	84,546,243
3. Present Value of Future Employee Contributions	\$ 66,470,936	67,136,537
4. Entry Age Normal Accrued Liability		
a) Active Members [(1a) - (2) - (3)]	\$ 377,982,900	392,913,666
b) Transferred Members (1b)	44,449,971	47,706,723
c) Terminated Members (1c)	27,281,216	28,407,893
d) Members and Beneficiaries Receiving Payments (1d)	624,982,192	680,717,602
e) Total	\$ 1,074,696,279	1,149,745,884
5. Market Value of Assets (MVA)	\$ 780,285,565	825,785,242
6. Unfunded Accrued Liability (UAL) [(4e) - (5)]	\$ 294,410,714	323,960,642
7. Funded Ratio [(5) / (4e)]	72.6%	71.8%

## (Gain)/Loss Analysis 6/30/17 – 6/30/18

To calculate the cost requirements of the plan, assumptions are made about future events that affect the amount and timing of benefits to be paid and assets to be accumulated. Each year, actual experience is compared to the expected experience based on the actuarial assumptions. This results in actuarial gains or losses, as shown below.

<b>1. Total (Gain)/Loss for the Year</b>	
a) Unfunded Accrued Liability (UAL) as of 6/30/17	\$ 294,410,714
b) Expected Payment on the UAL during 2017-18	17,406,947
c) Interest through 6/30/18 $[\.0725 \times (1a) - ((1.0725)^{\frac{1}{2}} - 1) \times (1b)]$	20,724,815
d) Expected UAL before all other changes $[(1a) - (1b) + (1c)]$	297,728,582
e) Change due to plan changes	0
f) Change due to assumption change	30,078,986
g) Change due to method change	7,002,646
h) Expected UAL after all other changes $[(1d) + (1e) + (1f) + (1g)]$	334,810,214
i) Actual UAL as of 6/30/18	<u>323,960,642</u>
j) Total (Gain)/Loss for 2017-18 $[(1i) - (1h)]$	\$ (10,849,572)
<b>2. Contribution (Gain)/Loss for the Year</b>	
a) Expected Contribution (Employer and Employee)	\$ 36,419,440
b) Interest on Expected Contributions	1,297,106
c) Actual Contributions	35,593,657
d) Interest on Actual Contributions	1,267,695
e) Expected Contributions with Interest $[(2a) + (2b)]$	37,716,546
f) Actual Contributions with Interest $[(2c) + (2d)]$	<u>36,861,352</u>
g) Contribution (Gain)/Loss $[(2e) - (2f)]$	\$ 855,194
<b>3. Asset (Gain)/Loss for the Year</b>	
a) Market Value of Assets as of 6/30/17	\$ 780,285,565
b) Prior Fiscal Year Receivables	(1,683,632)
c) Current Fiscal Year Receivables	1,434,194
d) Contributions Received	35,593,657
e) Benefits and Refunds Paid	(55,364,250)
f) Transfers, SCP Payments and Interest, and Miscellaneous Adjustments	589,903
g) Expected Int. $[\.0725 \times (3a + 3b) + ((1.0725)^{\frac{1}{2}} - 1) \times ((3d) + (3e) + (3f))]$	55,765,505
h) Expected Assets as of 6/30/18 $[(3a) + (3b) + (3c) + (3d) + (3e) + (3f) + (3g)]$	816,620,941
i) Market Value of Assets as of 6/30/18	<u>825,785,242</u>
j) Asset (Gain)/Loss $[(3h) - (3i)]$	\$ (9,164,301)
<b>4. Liability (Gain)/Loss for the Year</b>	
a) Total (Gain)/Loss (1j)	\$ (10,849,572)
b) Contribution (Gain)/Loss (2g)	855,194
c) Asset (Gain)/Loss (3j)	<u>(9,164,301)</u>
d) Liability (Gain)/Loss $[(4a) - (4b) - (4c)]$	\$ (2,540,465)

## **Schedule of Amortization Bases**

On the next page is the schedule of the plan's amortization bases. Note that there is a two-year lag between the valuation date and the start of the contribution fiscal year.

- The assets, liabilities, and funded status of the plan are measured as of the valuation date: June 30, 2018.
- The required employer contributions determined by the valuation are for the fiscal year beginning two years after the valuation date: Fiscal Year 2020-21.

This two-year lag is necessary due to the amount of time needed to extract and test the membership and financial data, and the need to provide public agencies with their required employer contribution well in advance of the start of the fiscal year.

The Unfunded Accrued Liability (UAL) is used to determine the employer contribution and therefore must be rolled forward two years from the valuation date to the first day of the fiscal year for which the contribution is being determined. The UAL is rolled forward each year by subtracting the expected payment on the UAL for the fiscal year and adjusting for interest. The expected payment on the UAL for a fiscal year is equal to the Expected Employer Contribution for the fiscal year minus the Expected Normal Cost for the year. The Employer Contribution for the first fiscal year is determined by the actuarial valuation two years ago and the contribution for the second year is from the actuarial valuation one year ago. Additional discretionary payments are reflected in the Expected Payments column in the fiscal year they were made by the agency.

### Schedule of Amortization Bases

Reason for Base	Date Established	Ramp Up/Down 2020-21	Escalation Rate	Amortization Period	Balance 6/30/18	Expected Payment 2018-19	Balance 6/30/19	Expected Payment 2019-20	Balance 6/30/20	Scheduled Payment for 2020-21
ASSUMPTION CHANGE	06/30/03	No Ramp	2.750%	5	\$17,703,486	\$2,962,490	\$15,878,307	\$3,041,470	\$13,843,667	\$3,100,729
METHOD CHANGE	06/30/04	No Ramp	2.750%	6	\$(1,650,933)	\$(246,544)	\$(1,511,471)	\$(253,137)	\$(1,355,427)	\$(257,977)
BENEFIT CHANGE	06/30/05	No Ramp	2.750%	6	\$3,105,449	\$463,757	\$2,843,117	\$476,158	\$2,549,593	\$485,262
BENEFIT CHANGE	06/30/06	No Ramp	2.750%	7	\$15,800,672	\$2,138,882	\$14,694,242	\$2,196,221	\$13,451,050	\$2,237,330
ASSUMPTION CHANGE	06/30/09	No Ramp	2.750%	11	\$44,514,357	\$4,504,931	\$42,970,425	\$4,626,552	\$41,192,612	\$4,705,082
SPECIAL (GAIN)/LOSS	06/30/09	No Ramp	2.750%	21	\$28,416,930	\$1,950,479	\$28,388,524	\$2,003,693	\$28,303,085	\$2,029,200
SPECIAL (GAIN)/LOSS	06/30/10	No Ramp	2.750%	22	\$9,161,337	\$613,230	\$9,168,301	\$629,974	\$9,158,432	\$637,746
ASSUMPTION CHANGE	06/30/11	No Ramp	2.750%	13	\$18,493,291	\$1,684,124	\$18,045,750	\$1,729,709	\$17,519,727	\$1,757,540
SPECIAL (GAIN)/LOSS	06/30/11	No Ramp	2.750%	23	\$(6,871,294)	\$(449,261)	\$(6,887,566)	\$(461,537)	\$(6,892,278)	\$(467,052)
PAYMENT (GAIN)/LOSS	06/30/12	No Ramp	2.750%	24	\$809,664	\$51,784	\$812,774	\$53,200	\$814,638	\$53,816
(GAIN)/LOSS	06/30/12	No Ramp	2.750%	24	\$18,846,870	\$1,205,398	\$18,919,277	\$1,238,363	\$18,962,654	\$1,252,689
(GAIN)/LOSS	06/30/13	100% →	2.750%	25	\$109,941,697	\$5,829,494	\$111,607,541	\$7,486,295	\$111,676,185	\$7,575,776
ASSUMPTION CHANGE	06/30/14	100% →	2.750%	16	\$58,738,834	\$3,231,480	\$59,507,883	\$4,425,856	\$59,095,294	\$5,619,324
(GAIN)/LOSS	06/30/14	100% →	2.750%	26	\$(96,744,495)	\$(3,856,575)	\$(99,527,337)	\$(5,283,123)	\$(101,029,346)	\$(6,680,756)
(GAIN)/LOSS	06/30/15	80% ↗	2.750%	27	\$31,595,092	\$852,552	\$32,924,862	\$1,313,979	\$33,870,412	\$1,771,561
ASSUMPTION CHANGE	06/30/16	60% ↗	2.750%	18	\$18,048,861	\$340,588	\$18,959,975	\$699,828	\$19,563,265	\$1,065,119
(GAIN)/LOSS	06/30/16	60% ↗	2.750%	28	\$46,411,073	\$644,031	\$48,993,658	\$1,323,555	\$51,054,118	\$2,006,358
ASSUMPTION CHANGE	06/30/17	40% ↗	2.750%	19	\$17,590,526	\$(1,017,090)	\$19,873,949	\$375,390	\$20,876,819	\$761,282
(GAIN)/LOSS	06/30/17	40% ↗	2.750%	29	\$(36,182,835)	\$0	\$(38,715,633)	\$(537,882)	\$(40,869,338)	\$(1,086,375)
METHOD CHANGE	06/30/18	20% ↗	2.750%	20	\$7,002,646	\$(117,693)	\$7,614,574	\$(120,929)	\$8,272,684	\$154,241
ASSUMPTION CHANGE	06/30/18	20% ↗	2.750%	20	\$30,078,986	\$(824,980)	\$33,037,881	\$(847,667)	\$36,227,366	\$675,446
(GAIN)/LOSS	06/30/18	20% ↗	2.750%	30	\$(10,849,572)	\$0	\$(11,609,042)	\$0	\$(12,421,675)	\$(169,653)
<b>TOTAL</b>					<b>\$323,960,642</b>	<b>\$19,961,077</b>	<b>\$325,989,989</b>	<b>\$24,115,968</b>	<b>\$323,863,537</b>	<b>\$27,226,688</b>

## **Amortization Schedule and Alternatives**

The amortization schedule on the previous page shows the minimum contributions required according to CalPERS amortization policy. There has been considerable interest from many agencies in paying off these unfunded accrued liabilities sooner and the possible savings in doing so. As a result, we have provided alternate amortization schedules to help analyze the current amortization schedule and illustrate the advantages of accelerating unfunded liability payments.

Shown on the following page are future year amortization payments based on 1) the current amortization schedule reflecting the individual bases and remaining periods shown on the previous page, and 2) alternate "fresh start" amortization schedules using two sample periods that would both result in interest savings relative to the current amortization schedule. Note that the payments under each alternate scenario increase by 2.75 percent per year.

The Current Amortization Schedule typically contains individual bases that are both positive and negative. Positive bases result from plan changes, assumption changes or plan experience that result in increases to unfunded liability. Negative bases result from plan changes, assumption changes or plan experience that result in decreases to unfunded liability. The combination of positive and negative bases within an amortization schedule can result in unusual or problematic circumstances in future years such as:

- A positive total unfunded liability with a negative total payment,
- A negative total unfunded liability with a positive total payment, or
- Total payments that completely amortize the unfunded liability over a very short period of time

In any year where one of the above scenarios occurs, the actuary will consider corrective action such as replacing the existing unfunded liability bases with a single "fresh start" base and amortizing it over a reasonable period.

The Current Amortization Schedule on the following page may appear to show that, based on the current amortization bases, one of the above scenarios will occur at some point in the future. It is impossible to know today whether such a scenario will in fact arise since there will be additional bases added to the amortization schedule in each future year. Should such a scenario arise in any future year, the actuary will take appropriate action based on guidelines in the CalPERS amortization policy.

## Amortization Schedule and Alternatives

Date	<u>Current Amortization Schedule</u>		<u>Alternate Schedules</u>			
	Balance	Payment	15 Year Amortization		10 Year Amortization	
			Balance	Payment	Balance	Payment
6/30/2020	323,863,537	27,226,688	323,863,537	29,210,456	323,863,537	39,932,267
6/30/2021	318,370,480	29,993,642	316,318,454	30,013,743	305,227,727	41,030,404
6/30/2022	309,630,748	32,424,602	307,414,289	30,839,121	284,151,488	42,158,740
6/30/2023	297,764,633	33,855,944	297,033,054	31,687,197	260,432,752	43,318,105
6/30/2024	283,587,294	35,522,669	285,047,876	32,558,595	233,854,448	44,509,353
6/30/2025	266,693,469	32,948,363	271,322,355	33,453,956	204,183,427	45,733,360
6/30/2026	251,279,960	33,586,980	255,709,878	34,373,940	171,169,311	46,991,028
6/30/2027	234,126,915	31,805,403	238,052,890	35,319,223	134,543,265	48,283,281
6/30/2028	217,616,035	32,680,048	218,182,103	36,290,502	94,016,680	49,611,071
6/30/2029	199,044,653	33,578,751	195,915,663	37,288,491	49,279,756	50,975,376
6/30/2030	178,243,651	34,502,164	171,058,245	38,313,924		
6/30/2031	155,031,390	29,109,836	143,400,091	39,367,557		
6/30/2032	135,772,139	28,354,046	112,715,979	40,450,165		
6/30/2033	115,946,533	25,033,933	78,764,121	41,562,545		
6/30/2034	98,167,487	23,560,215	41,284,979	42,705,515		
6/30/2035	80,668,336	21,414,713				
6/30/2036	64,163,569	17,852,764				
6/30/2037	50,187,977	15,861,114				
6/30/2038	37,294,271	13,746,415				
6/30/2039	25,685,466	12,097,890				
6/30/2040	14,969,295	11,003,162				
6/30/2041	4,635,386	4,794,881				
6/30/2042						
6/30/2043						
6/30/2044						
6/30/2045						
6/30/2046						
6/30/2047						
6/30/2048						
6/30/2049						
<b>Total</b>		<b>560,954,223</b>		<b>533,434,930</b>		<b>452,542,985</b>
<b>Interest Paid</b>		<b>237,090,686</b>		<b>209,571,393</b>		<b>128,679,448</b>
<b>Estimated Savings</b>				<b>27,519,293</b>		<b>108,411,238</b>

## Reconciliation of Required Employer Contributions

### Normal Cost (% of Payroll)

1. For Period 7/1/19 – 6/30/20	
a) Employer Normal Cost	9.246%
b) Employee Contribution	7.665%
c) Total Normal Cost	16.911%
2. Changes since the prior year annual valuation	
a) Effect of changes in demographics results	(0.134%)
b) Effect of plan changes	0.000%
c) Effect of changes in assumptions	0.729%
d) Effect of method changes	0.104%
e) Net effect of the changes above [sum of (a) through (d)]	0.699%
3. For Period 7/1/20 – 6/30/21	
a) Employer Normal Cost	10.017%
b) Employee Contribution	7.593%
c) Total Normal Cost	17.610%
Employer Normal Cost Change [(3a) – (1a)]	0.771%
Employee Contribution Change [(3b) – (1b)]	(0.072%)

### Unfunded Liability Contribution (\$)

1. For Period 7/1/19 – 6/30/20	25,084,564
2. Changes since the prior year annual valuation	
a) Effect of (gain)/loss during prior year <sup>1</sup>	(169,653)
b) Effect of plan changes	0
c) Effect of changes in assumptions <sup>2</sup>	675,446
d) Changes to prior year amortization payments <sup>3</sup>	1,482,090
e) Effect of changes due to Fresh Start	0
f) Effect of elimination of amortization base	0
g) Effect of method change <sup>2</sup>	154,241
h) Net effect of the changes above [sum of (a) through (g)]	2,142,124
3. For Period 7/1/20 – 6/30/21 [(1) + (2h)]	27,226,688

The amounts shown for the period 7/1/19 – 6/30/20 may be different if a prepayment of unfunded actuarial liability is made or a plan change became effective after the prior year's actuarial valuation was performed.

<sup>1</sup> The unfunded liability contribution for the (gain)/loss during the year prior to the valuation date is 20 percent of the "full" annual requirement due to the 5-year ramp. Increases to this amount that occur during the ramp period will be included in line d) in future years. This line item also captures the impact of any additional discretionary payment during the fiscal year.

<sup>2</sup> The unfunded liability contribution for the change in assumptions or method is 20 percent of the "full" annual requirement due to the 5-year ramp. Increases to this amount that occur during the ramp period will be included in line d) in future years.

<sup>3</sup> Includes changes due to 5-year ramp, payroll growth assumption, and re-amortization under new discount rate.

## Employer Contribution History

The table below provides a recent history of the required employer contributions for the plan, as determined by the annual actuarial valuation. It does not account for prepayments or benefit changes made during a fiscal year.

Fiscal Year	Employer Normal Cost	Unfunded Rate	Unfunded Liability Payment (\$)
2013 - 14	7.652%	9.725%	N/A
2014 - 15	7.606%	11.613%	N/A
2015 - 16	7.834%	13.242%	N/A
2016 - 17	8.079%	14.791%	N/A
2017 - 18	7.986%	N/A	18,895,540
2018 - 19	8.384%	N/A	21,920,840
2019 - 20	9.246%	N/A	25,084,564
2020 - 21	10.017%	N/A	27,226,688

## Funding History

The table below shows the recent history of the actuarial accrued liability, the market value of assets, the funded ratio and the annual covered payroll.

Valuation Date	Accrued Liability	Market Value of Assets (MVA)	Unfunded Liability	Funded Ratio	Annual Covered Payroll
06/30/11	\$ 819,326,665	\$ 592,157,276	\$ 227,169,389	72.3%	\$ 110,571,480
06/30/12	852,217,331	579,464,081	272,753,250	68.0%	105,200,914
06/30/13	882,571,786	641,332,816	241,238,970	72.7%	104,378,040
06/30/14	956,141,980	737,836,011	218,305,969	77.2%	103,616,666
06/30/15	982,773,869	734,946,333	247,827,536	74.8%	104,325,149
06/30/16	1,026,335,679	719,443,542	306,892,137	70.1%	107,586,597
06/30/17	1,074,696,279	780,285,565	294,410,714	72.6%	108,837,570
06/30/18	1,149,745,884	825,785,242	323,960,642	71.8%	110,137,195



## **Risk Analysis**

- **Future Investment Return Scenarios**
- **Discount Rate Sensitivity**
- **Mortality Rate Sensitivity**
- **Inflation Rate Sensitivity**
- **Maturity Measures**
- **Hypothetical Termination Liability**

## Future Investment Return Scenarios

Analysis was performed to determine the effects of various future investment returns on required employer contributions. The projections below provide a range of results based on five investment return scenarios assumed to occur during the next four fiscal years (2018-19, 2019-20, 2020-21 and 2021-22). The projections also assume that all other actuarial assumptions will be realized and that no further changes to assumptions, contributions, benefits, or funding will occur.

For fiscal years 2018-19, 2019-20, 2020-21, and 2021-22 each scenario assumes an alternate fixed annual return. The fixed return assumptions for the five scenarios are 1.0 percent, 4.0 percent, 7.0 percent, 9.0 percent and 12.0 percent.

These alternate investment returns were chosen based on stochastic analysis of possible future investment returns over the four-year period ending June 30, 2022. Using the expected returns and volatility of the asset classes in which the funds are invested, we produced five thousand stochastic outcomes for this period based on the recently completed Asset Liability Management process. We then selected annual returns that approximate the 5<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 95<sup>th</sup> percentiles for these outcomes. For example, of all the 4-year outcomes generated in the stochastic analysis, approximately 25 percent of them had an average annual return of 4.0 percent or less.

Required contributions outside of this range are also possible. In particular, whereas it is unlikely that investment returns will average less than 1.0 percent or greater than 12.0 percent over this four-year period, the possibility of a single investment return less than 1.0 percent or greater than 12.0 percent in any given year is much greater.

Assumed Annual Return From 2018-19 through 2021-22	Projected Employer Contributions			
	2021-22	2022-23	2023-24	2024-25
<b>1.0%</b>				
Normal Cost	10.0%	10.0%	10.0%	10.0%
UAL Contribution	\$31,219,000	\$36,091,000	\$41,173,000	\$47,695,000
<b>4.0%</b>				
Normal Cost	10.0%	10.0%	10.0%	10.0%
UAL Contribution	\$30,607,000	\$34,277,000	\$37,589,000	\$41,796,000
<b>7.0%</b>				
Normal Cost	10.0%	10.0%	10.0%	10.0%
UAL Contribution	\$29,994,000	\$32,425,000	\$33,856,000	\$35,523,000
<b>9.0%</b>				
Normal Cost	10.2%	10.5%	10.7%	10.9%
UAL Contribution	\$29,658,000	\$31,483,000	\$32,017,000	\$32,435,000
<b>12.0%</b>				
Normal Cost	10.2%	10.5%	10.7%	10.9%
UAL Contribution	\$29,048,000	\$29,589,000	\$28,086,000	\$25,629,000

The projected normal cost percentages do not reflect that the normal cost will decline over time as new employees are hired into PEPRA or other lower cost benefit tiers. In addition, the projections above reflect the recent changes to the amortization policy effective with the June 30, 2019 valuation. The projections above do incorporate the impact of the CalPERS risk mitigation policy which reduces the discount when investment returns are above specified trigger points.

## Discount Rate Sensitivity

Shown below are various valuation results as of June 30, 2018 assuming alternate discount rates. Results are shown using the current discount rate of 7.0 percent as well as alternate discount rates of 6.0 percent and 8.0 percent. The rates of 6.0 percent and 8.0 percent were selected since they illustrate the impact of a 1 percent increase or decrease to the 7.0 percent assumption. This analysis shows the potential plan impacts if the PERF were to realize investment returns of 6.0 percent or 8.0 percent over the long-term.

This type of analysis gives the reader a sense of the long-term risk to required contributions. For a measure of funded status that is appropriate for assessing the sufficiency of plan assets to cover estimated termination liabilities, please see "Hypothetical Termination Liability" at the end of this section.

Sensitivity Analysis				
As of June 30, 2018	Plan's Normal Cost	Accrued Liability	Unfunded Accrued Liability	Funded Status
7.0% (current discount rate)	17.610%	\$1,149,745,884	\$323,960,642	71.8%
6.0%	22.174%	\$1,296,545,077	\$470,759,835	63.7%
8.0%	14.145%	\$1,027,814,919	\$202,029,677	80.3%

## Mortality Rate Sensitivity

The following table looks at the change in the June 30, 2018 plan costs and funded ratio under two different longevity scenarios, namely assuming rates of mortality are 10 percent lower or 10 percent higher than our current mortality assumptions adopted in 2017. This type of analysis highlights the impact on the plan of improving or worsening mortality over the long-term.

As of June 30, 2018	Current Mortality	10% Lower Mortality Rates	10% Higher Mortality Rates
a) Accrued Liability	\$1,149,745,884	\$1,174,016,747	\$1,127,422,855
b) Market Value of Assets	\$825,785,242	\$825,785,242	\$825,785,242
c) Unfunded Liability (Surplus) [(a)-(b)]	\$323,960,642	\$348,231,505	\$301,637,613
d) Funded Status	71.8%	70.3%	73.2%

A 10 percent increase (decrease) in assumed mortality rates over the long-term would result in approximately a 1.4 percentage point increase (decrease) to the funded ratio.

## Inflation Rate Sensitivity

The following analysis looks at the change in the June 30, 2018 plan costs and funded ratio under two different inflation rate scenarios, namely assuming the inflation rate is 1 percent lower or 1 percent higher than our current valuation inflation rate assumption of 2.50%, while holding the discount rate fixed at 7.0%. This type of analysis highlights the impact on the plan of increased or decreased inflation over the long-term.

As of June 30, 2018	Current Inflation Rate	-1% Inflation Rate	+1% Inflation Rate
a) Accrued Liability	\$1,149,745,884	\$1,080,131,423	\$1,198,560,117
b) Market Value of Assets	\$825,785,242	\$825,785,242	\$825,785,242
c) Unfunded Liability (Surplus) [(a)-(b)]	\$323,960,642	\$254,346,181	\$372,774,875
d) Funded Status	71.8%	76.5%	68.9%

A decrease of 1 percent in the inflation rate assumption (2.50 percent to 1.50 percent) reduces the Accrued Liability by 6.1 percent. However, a 1 percent increase in the inflation rate (2.50 percent to 3.50 percent) increases the Accrued Liability by 4.2 percent.

## Maturity Measures

As pension plans mature they become much more sensitive to risks than plans that are less mature. Understanding plan maturity and how it affects the ability of a pension plan to tolerate risk is important in understanding how the plan is impacted by investment return volatility, other economic variables and changes in longevity or other demographic assumptions. One way to look at the maturity level of CalPERS and its plans is to look at the ratio of a plan's retiree liability to its total liability. A pension plan in its infancy will have a very low ratio of retiree liability to total liability. As the plan matures, the ratio starts increasing. A mature plan will often have a ratio above 60-65 percent. For both CalPERS and other retirement systems in the United States, these ratios have been steadily increasing in recent years.

<b>Ratio of Retiree Accrued Liability to Total Accrued Liability</b>	<b>June 30, 2017</b>	<b>June 30, 2018</b>
1. Retiree Accrued Liability	624,982,192	680,717,602
2. Total Accrued Liability	1,074,696,279	1,149,745,884
3. Ratio of Retiree AL to Total AL [(1) / (2)]	58%	59%

Another way to look at the maturity level of CalPERS and its plans is to look at the ratio of actives to retirees. A pension plan in its infancy will have a very high ratio of active to retired members. As the plan matures, and members retire, the ratio starts declining. A mature plan will often have a ratio near or below one. The average support ratio for CalPERS public agency plans is 1.25.

<b>Support Ratio</b>	<b>June 30, 2017</b>	<b>June 30, 2018</b>
1. Number of Actives	1,411	1,409
2. Number of Retirees	1,660	1,706
3. Support Ratio [(1) / (2)]	0.85	0.83

The actuarial calculations supplied in this communication are based on various assumptions about long-term demographic and economic behavior. Unless these assumptions (terminations, deaths, disabilities, retirements, salary growth, and investment return) are exactly realized each year, there will be differences on a year-to-year basis. The year-to-year differences between actual experience and the assumptions are called actuarial gains and losses and serve to lower or raise required employer contributions from one year to the next. Therefore, employer contributions will inevitably fluctuate, especially due to the ups and downs of investment returns.

### Asset Volatility Ratio (AVR)

Plans that have higher asset-to-payroll ratios experience more volatile employer contributions (as a percentage of payroll) due to investment return. For example, a plan with an asset-to-payroll ratio of 8 may experience twice the contribution volatility due to investment return volatility than a plan with an asset-to-payroll ratio of 4. Shown below is the asset volatility ratio, a measure of the plan's current volatility. It should be noted that this ratio is a measure of the current situation. It increases over time but generally tends to stabilize as the plan matures.

### Liability Volatility Ratio (LVR)

Plans that have higher liability-to-payroll ratios experience more volatile employer contributions (as a percentage of payroll) due to investment return and changes in liability. For example, a plan with a liability-to-payroll ratio of 8 is expected to have twice the contribution volatility of a plan with a liability-to-payroll ratio of 4. The liability volatility ratio is also included in the table below. It should be noted that this ratio indicates a longer-term potential for contribution volatility. The asset volatility ratio, described above, will tend to move closer to the liability volatility ratio as the plan matures.

<b>Contribution Volatility</b>		<b>June 30, 2017</b>		<b>June 30, 2018</b>
1. Market Value of Assets without Receivables	\$	778,601,933	\$	824,351,049
2. Payroll		108,837,570		110,137,195
3. Asset Volatility Ratio (AVR) [(1) / (2)]		7.2		7.5
4. Accrued Liability	\$	1,074,696,279	\$	1,149,745,884
5. Liability Volatility Ratio (LVR) [(4) / (2)]		9.9		10.4

## Hypothetical Termination Liability

The hypothetical termination liability is an estimate of the financial position of the plan had the contract with CalPERS been terminated as of June 30, 2018. The plan liability on a termination basis is calculated differently from the plan's ongoing funding liability. For this hypothetical termination liability calculation, both compensation and service are frozen as of the valuation date and no future pay increases or service accruals are assumed. This measure of funded status is not appropriate for assessing the need for future employer contributions in the case of an ongoing plan, that is, for an employer that continues to provide CalPERS retirement benefits to active employees.

A more conservative investment policy and asset allocation strategy was adopted by the CalPERS Board for the Terminated Agency Pool. The Terminated Agency Pool has limited funding sources since no future employer contributions will be made. Therefore, expected benefit payments are secured by risk-free assets and benefit security for members is increased while limiting the funding risk. However, this asset allocation has a lower expected rate of return than the PERF and consequently, a lower discount rate assumption. The lower discount rate for the Terminated Agency Pool results in higher liabilities for terminated plans.

The effective termination discount rate will depend on actual market rates of return for risk-free securities on the date of termination. As market discount rates are variable the table below shows a range for the hypothetical termination liability based on the lowest and highest interest rates observed during an approximate 2-year period centered around the valuation date.

<b>Market Value of Assets (MVA)</b>	<b>Hypothetical Termination Liability<sup>1,2</sup> @ 2.50%</b>	<b>Funded Status</b>	<b>Unfunded Termination Liability @ 2.50%</b>	<b>Hypothetical Termination Liability<sup>1,2</sup> @ 3.25%</b>	<b>Funded Status</b>	<b>Unfunded Termination Liability @ 3.25%</b>
\$825,785,242	\$1,884,332,618	43.8%	\$1,058,547,376	\$1,726,790,777	47.8%	\$901,005,535

<sup>1</sup> The hypothetical liabilities calculated above include a 5 percent contingency load in accordance with Board policy. Other actuarial assumptions can be found in Appendix A.

<sup>2</sup> The current discount rate assumption used for termination valuations is a weighted average of the 10-year and 30-year U.S. Treasury yields where the weights are based on matching asset and liability durations as of the termination date. The discount rates used in the table are based on 20-year Treasury bonds, rounded to the nearest quarter percentage point, which is a good proxy for most plans. The 20-year Treasury yield was 2.91 percent on June 30, 2018, and was 2.83 percent on January 31, 2019.

In order to terminate the plan, you must first contact our Retirement Services Contract Unit to initiate a Resolution of Intent to Terminate. The completed Resolution will allow the plan actuary to give you a preliminary termination valuation with a more up-to-date estimate of the plan liabilities. CalPERS advises you to consult with the plan actuary before beginning this process.

## **Plan's Major Benefit Provisions**

### Plan's Major Benefit Options

Shown below is a summary of the major optional benefits for which your agency has contracted. A description of principal standard and optional plan provisions is in the following section of this Appendix.

Member Category	Benefit Group						
	Misc	Misc	Misc	Misc	Misc	Misc	Misc
<b>Demographics</b>							
Actives	No	Yes	No	Yes	Yes	No	No
Transfers/Separated	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Receiving	Yes	Yes	Yes	Yes	No	Yes	No
<b>Benefit Provision</b>							
Benefit Formula	2% @ 55	2.5% @ 55	2% @ 55	2.5% @ 55	2% @ 62	2% @ 55	2% @ 55
Social Security Coverage	No	No	No	No	No	Yes	No
Full/Modified	Full	Full	Full	Full	Full	Modified	Full
Employee Contribution Rate	8.00%	8.00%	8.00%	8.00%	6.25%	7.00%	7.00%
Final Average Compensation Period	One Year	One Year	Three Year	Three Year	Three Year	Three Year	Three Year
Sick Leave Credit	Yes	Yes	Yes	Yes	Yes	No	No
Non-Industrial Disability	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Industrial Disability	No	No	No	No	No	No	No
Pre-Retirement Death Benefits							
Optional Settlement 2	Yes	Yes	Yes	Yes	Yes	No	No
1959 Survivor Benefit Level	Level 4	Level 4	Level 4	Level 4	Level 4	No	Level 4
Special	No	No	No	No	No	No	No
Alternate (firefighters)	No	No	No	No	No	No	No
Post-Retirement Death Benefits							
Lump Sum	\$500	\$500	\$500	\$500	\$500	\$500	\$500
Survivor Allowance (PRSA)	Yes	Yes	No	No	No	No	No
COLA	2%	2%	2%	2%	2%	2%	2%

### Plan's Major Benefit Options

Shown below is a summary of the major optional benefits for which your agency has contracted. A description of principal standard and optional plan provisions is in the following section of this Appendix.

Member Category	Benefit Group				
	Misc	Misc	Misc	Misc	Misc
<b>Demographics</b>					
Actives	No	No	No	No	No
Transfers/Separated	No	No	No	No	No
Receiving	Yes	Yes	Yes	Yes	Yes
<b>Benefit Provision</b>					
Benefit Formula	2% @ 60	2% @ 60	2% @ 60	2% @ 60	2% @ 60
Social Security Coverage	No	Yes	No	No	No
Full/Modified	Full	Modified	Full	Full	Full
Employee Contribution Rate	7.00%	7.00%	8.00%	8.00%	8.00%
Final Average Compensation Period	Three Year	Three Year	Three Year	One Year	Three Year
Sick Leave Credit	No	No	No	No	No
Non-Industrial Disability	Standard	Standard	Standard	Standard	Standard
Industrial Disability	No	No	No	No	No
Pre-Retirement Death Benefits					
Optional Settlement 2	No	No	No	No	No
1959 Survivor Benefit Level	No	No	Level 4	Level 4	Level 4
Special	No	No	No	No	No
Alternate (firefighters)	No	No	No	No	No
Post-Retirement Death Benefits					
Lump Sum	\$500	\$500	\$500	\$500	\$500
Survivor Allowance (PRSA)	No	No	No	Yes	No
COLA	2%	2%	2%	2%	2%



## **Appendices**

- **Appendix A – Actuarial Methods and Assumptions**
- **Appendix B – Principal Plan Provisions**
- **Appendix C – Participant Data**
- **Appendix D – Normal Cost by Benefit Group and PEPRA Member Contribution Rates**
- **Appendix E – Glossary of Actuarial Terms**

## **Appendix A**

### **Actuarial Methods and Assumptions**

- **Actuarial Data**
- **Actuarial Methods**
- **Actuarial Assumptions**
- **Miscellaneous**

## Actuarial Data

As stated in the Actuarial Certification, the data which serves as the basis of this valuation has been obtained from the various CalPERS databases. We have reviewed the valuation data and believe that it is reasonable and appropriate in aggregate. We are unaware of any potential data issues that would have a material effect on the results of this valuation, except that data does not always contain the latest salary information for former members now in reciprocal systems and does not recognize the potential for unusually large salary deviation in certain cases such as elected officials. Therefore, salary information in these cases may not be accurate. These situations are relatively infrequent, however, and when they do occur, they generally do not have a material impact on the required employer contributions.

## Actuarial Methods

### Actuarial Cost Method

The actuarial cost method used is the Entry Age Normal Cost Method. Under this method, projected benefits are determined for all members and the associated liabilities are spread in a manner that produces level annual cost as a percentage of pay in each year from the member's entry age to their assumed retirement age on the valuation date. The cost allocated to the current fiscal year is called the normal cost.

The actuarial accrued liability for active members is then calculated as the portion of the total cost of the plan allocated to prior years. The actuarial accrued liability for members currently receiving benefits and for members entitled to deferred benefits is equal to the present value of the benefits expected to be paid. No normal costs are applicable for these participants.

### Amortization of Unfunded Actuarial Accrued Liability

The excess of the total actuarial accrued liability over the market value of plan assets is called the unfunded actuarial accrued liability (UAL). Funding requirements are determined by adding the normal cost and an amortization payment toward the unfunded liability. The unfunded liability is amortized as a "level percent of pay". Commencing with the June 30, 2013 valuation, all new gains or losses are amortized over a fixed 30-year period with a 5-year ramp up at the beginning and a 5-year ramp down at the end of the amortization period. All changes in liability due to plan amendments (other than golden handshakes) are amortized over a 20-year period with no ramp. Changes in actuarial assumptions or changes in actuarial methodology are amortized over a 20-year period with a 5-year ramp up at the beginning and a 5-year ramp down at the end of the amortization period. Changes in unfunded accrued liability due to a Golden Handshake will be amortized over a period of five years. A summary of the current policy is provided in the table below:

Driver	Source				
	(Gain)/Loss		Assumption/Method Change	Benefit Change	Golden Handshake
	Investment	Non-investment			
Amortization Period	30 Years	30 Years	20 Years	20 Years	5 Years
Escalation Rate					
- Active Plans	2.75%	2.75%	2.75%	2.75%	2.75%
- Inactive Plans	0%	0%	0%	0%	0%
Ramp Up	5	5	5	0	0
Ramp Down	5	5	5	0	0

The 5-year ramp up means that the payments in the first four years of the amortization period are 20 percent, 40 percent, 60 percent and 80 percent of the "full" payment which begins in year five. The 5-year ramp down means that the reverse is true in the final four years of the amortization period.

Exceptions for Inconsistencies:

An exception to the amortization rules above is used whenever their application results in inconsistencies. In these cases, a "fresh start" approach is used. This means that the current unfunded actuarial liability is projected and amortized over a set number of years. For example, a fresh start is needed in the following situations:

- When a positive payment would be required on a negative unfunded actuarial liability (or conversely a negative payment on a positive unfunded actuarial liability); or
- When there are excess assets, rather than an unfunded liability. In this situation, a 30-year fresh start is used.

It should be noted that the actuary may determine that a fresh start is necessary under other circumstances. In all cases of a fresh start, the period is set by the actuary at what is deemed appropriate; however, the period will not be greater than 30 years.

Exceptions for Inactive Plans:

The following exceptions apply to plans classified as Inactive. These plans have no active members and no expectation to have active members in the future.

- Amortization of the unfunded liability is on a "level dollar" basis rather than a "level percent of pay" basis. For amortization layers, which utilize a ramp up and ramp down, the "ultimate" payment is constant.
- Actuarial judgment will be used to shorten amortization periods for Inactive plans with existing periods that are deemed too long given the duration of the liability. The specific demographics of the plan will be used to determine if shorter periods may be more appropriate.

**Asset Valuation Method**

It is the policy of the CalPERS Board of Administration to use professionally accepted amortization methods to eliminate a surplus or an unfunded accrued liability in a manner that maintains benefit security for the members of the System while minimizing substantial variations in required employer contributions. On April 17, 2013, the CalPERS Board of Administration approved a recommendation to change the CalPERS amortization and rate smoothing policies. Beginning with the June 30, 2013 valuations that set the employer contribution for Fiscal Year 2015-16, CalPERS employs a policy that amortizes all gains and losses over a fixed 30-year period. The increase or decrease in the rate is then spread directly over a 5-year period. This method is referred to as "direct rate smoothing." CalPERS no longer uses an actuarial value of assets and only uses the market value of assets. The direct rate smoothing method is equivalent to a method using a 5-year asset smoothing period with no actuarial value of asset corridor and a 25-year amortization period for gains and losses.

**PEPRA Normal Cost Rate Methodology**

Per Government Code Section 7522.30(b) the "normal cost rate" shall mean the annual actuarially determined normal cost for the plan of retirement benefits provided to the new member and shall be established based on actuarial assumptions used to determine the liabilities and costs as part of the annual actuarial valuation. The plan of retirement benefits shall include any elements that would impact the actuarial determination of the normal cost, including, but not limited to, the retirement formula, eligibility and vesting criteria, ancillary benefit provisions, and any automatic cost-of-living adjustments as determined by the public retirement system.

Each non-pooled plan is stable with a sufficiently large demographic representation of active employees. It is preferable to determine normal cost using a large active population ongoing so that this rate remains relatively stable. The total PEPR normal cost will be calculated using all active members within a non-pooled plan until the number of members covered under the PEPR formula meets either:

1. 50 percent of the active population, or
2. 25 percent of the active population and 100 or more PEPR members

Once either of the conditions above is met for a non-pooled plan, the total PEPR normal cost will be based on the active PEPR population in the plan.

Accordingly, the total normal cost will be funded equally between employer and employee based on the demographics of the employees of that employer.

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## Actuarial Assumptions

In 2017, CalPERS completed its most recent asset liability management study incorporating actuarial assumptions and strategic asset allocation. In December 2017, the CalPERS Board of Administration adopted relatively modest changes to the asset allocation that reduced the expected volatility of returns. The adopted asset allocation was expected to have a long-term blended return that continued to support a discount rate assumption of 7.00 percent. The Board also approved several changes to the demographic assumptions that more closely aligned with actual experience.

On December 21, 2016, the CalPERS Board of Administration lowered the discount rate from 7.50 percent to 7.00 percent using a three-year phase-in beginning with the June 30, 2016 actuarial valuations. The minimum employer contributions for Fiscal Year 2020-21 determined in this valuation were calculated using a discount rate of 7.00 percent. The decision to reduce the discount rate was primarily based on reduced capital market assumptions provided by external investment consultants and CalPERS investment staff. The specific decision adopted by the Board reflected recommendations from CalPERS staff and additional input from employer and employee stakeholder groups. Based on the investment allocation adopted by the Board and capital market assumptions, the reduced discount rate schedule provides a more realistic assumption for the long-term investment return of the fund.

Notwithstanding the Board's decision to phase into a 7.0 percent discount rate, subsequent analysis of the expected investment return of CalPERS assets or changes to the investment allocation may result in a change to this discount rate schedule.

For more details and additional rationale for the selection of the actuarial assumptions, please refer to the CalPERS Experience Study and Review of Actuarial Assumptions report from December 2017 that can be found on the CalPERS website under: "Forms and Publications". Click on "View All" and search for Experience Study.

All actuarial assumptions (except the discount rates used for the hypothetical termination liability) represent an estimate of future experience rather than observations of the estimates inherent in market data.

### **Economic Assumptions**

#### **Discount Rate**

The prescribed discount rate assumption, adopted by the Board on December 21, 2016, is 7.00 percent compounded annually (net of investment and administrative expenses) as of June 30, 2018.

#### **Termination Liability Discount Rate**

The current discount rate assumption used for termination valuations is a weighted average of the 10-year and 30-year U.S. Treasury yields where the weights are based on matching asset and liability durations as of the termination date.

The hypothetical termination liabilities in this report are calculated using an observed range of market interest rates. This range is based on the lowest and highest 20-year Treasury bond observed during an approximate 2-year period centered around the valuation date. The 20-year Treasury bond has a similar duration to most plan liabilities and serves as a good proxy for the termination discount rate. The 20-year Treasury yield was 2.83 percent on June 30, 2018.

**Salary Growth**

Annual increases vary by category, entry age, and duration of service. A sample of assumed increases are shown below. Wage inflation assumption in the valuation year (2.75% for 2018) is added to these factors for total salary growth.

**Public Agency Miscellaneous**

Duration of Service	(Entry Age 20)	(Entry Age 30)	(Entry Age 40)
0	0.0850	0.0775	0.0650
1	0.0690	0.0635	0.0525
2	0.0560	0.0510	0.0410
3	0.0470	0.0425	0.0335
4	0.0400	0.0355	0.0270
5	0.0340	0.0295	0.0215
10	0.0160	0.0135	0.0090
15	0.0120	0.0100	0.0060
20	0.0090	0.0075	0.0045
25	0.0080	0.0065	0.0040
30	0.0080	0.0065	0.0040

**Public Agency Fire**

Duration of Service	(Entry Age 20)	(Entry Age 30)	(Entry Age 40)
0	0.1700	0.1700	0.1700
1	0.1100	0.1100	0.1100
2	0.0700	0.0700	0.0700
3	0.0580	0.0580	0.0580
4	0.0473	0.0473	0.0473
5	0.0372	0.0372	0.0372
10	0.0165	0.0165	0.0165
15	0.0144	0.0144	0.0144
20	0.0126	0.0126	0.0126
25	0.0111	0.0111	0.0111
30	0.0097	0.0097	0.0097

**Public Agency Police**

Duration of Service	(Entry Age 20)	(Entry Age 30)	(Entry Age 40)
0	0.1027	0.1027	0.1027
1	0.0803	0.0803	0.0803
2	0.0628	0.0628	0.0628
3	0.0491	0.0491	0.0491
4	0.0384	0.0384	0.0384
5	0.0300	0.0300	0.0300
10	0.0145	0.0145	0.0145
15	0.0150	0.0150	0.0150
20	0.0155	0.0155	0.0155
25	0.0160	0.0160	0.0160
30	0.0165	0.0165	0.0165