

Cincinnati Retirement System

**Actuarial Valuation
as of December 31, 2018**

Produced by Cheiron

July 2019

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July 3, 2019

Board of Trustees
Cincinnati Retirement System
801 Plum Street
Suite 328
Cincinnati, Ohio 45202

Re: *Cincinnati Retirement System*
Actuarial Valuation as of December 31, 2018

Dear Members of the Board:

At your request, we have conducted our annual actuarial valuation of the Cincinnati Retirement System (CRS or System) as of December 31, 2018. The results of the valuation are contained in this report. The purpose of this report is to present the annual actuarial valuation of the Cincinnati Retirement System. This report is for the use of the Cincinnati Retirement System Board of Trustees and its auditors in preparing financial reports in accordance with applicable law and accounting requirements.

The results of this report are only applicable to the Fiscal Year Ending June 30, 2020 and rely on future plan experience conforming to the underlying assumptions. To the extent that actual plan experience deviates from the underlying assumptions, the results would vary accordingly.

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 assumptions, changes in assumptions, and changes in plan provisions or applicable law.

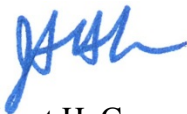
In preparing our report, we relied on information (some oral and some written) supplied by the Cincinnati Retirement System. This information includes, but is not limited to, plan provisions, employee data, and financial information. We performed an informal examination of the obvious characteristics of the data for reasonableness and consistency in accordance with Actuarial Standards of Practice No. 23.

This report was prepared exclusively for the Cincinnati Retirement System for the purpose described herein. Other users of this report are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to such other users.

Board of Trustees
Cincinnati Retirement System
July 3, 2019
Page 2

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinions contained in this report. This report does not address any contractual or legal issues. We are not attorneys, and our firm does not provide any legal services or advice.

Sincerely,
Cheiron



Janet H. Cranna, FSA, FCA, MAAA, EA
Principal Consulting Actuary



Kevin J. Woodrich, FSA, MAAA, EA
Principal Consulting Actuary

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION I – BOARD SUMMARY

Cheiron has performed the actuarial valuation of the Cincinnati Retirement System as of December 31, 2018. The purpose of this report is to disclose the following as of the valuation date:

- 1) The financial condition of the System;
- 2) Past trends in the financial progress of the System;
- 3) Compare the City's current contribution rate of 16.25% of payroll to the Actuarially Determined Contribution (ADC) rate based on this valuation for Fiscal Year Ending June 30, 2020; and
- 4) Provide specific information and documentation required for the System's financial reporting.

An actuarial valuation establishes and analyzes the System's assets and liabilities on a consistent basis and traces the progress of both from one year to the next. It includes measurement of the System's investment performance as well as an analysis of actuarial liability gains and losses.

This report does not include calculations under GASB Statements Nos. 67 and 68 which are provided in separate reports.

Results shown in this report for years prior to December 31, 2018 were provided by the prior actuary.

Valuation Basis

The December 31, 2018 actuarial valuation results were based on the same actuarial methods and assumptions as used in the December 31, 2017 actuarial valuation produced by the prior actuary. The demographic assumptions were based on the January 1, 2012 to December 31, 2016 Experience Study prepared by the prior actuary, which were subsequently approved by the Board of Trustees. An investment return assumption of 7.50% was used as prescribed by item 29 of the Collaborative Settlement Agreement (CSA) signed October 5, 2015. Cheiron has reviewed the demographic and economic assumptions. While we consider these assumptions to be generally reasonable, we have not yet performed our own actuarial experience study.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION I – BOARD SUMMARY

Key Results

The following Table I-1 summarizes the key results of the valuation with respect to the System’s membership, assets and liabilities, and contributions. The results are presented and compared for both the current and prior year.

Table I-1 Key Results			
Valuation as of:	December 31, 2017	December 31, 2018	% Change
<u>Membership Counts</u>			
a) Full Time Actives	3,029	2,951	(2.6%)
b) Part Time Actives ¹	742	1,250	68.5%
c) Terminated Vesteds	211	212	0.5%
d) Members in Pay Status ²	4,233	4,207	(0.6%)
e) Total	8,215	8,620	4.9%
f) Annual Salaries of Full Time Actives	\$ 184,878,822	\$ 195,150,890	5.6%
g) Annual Salaries of DROP Members ²	\$ 7,533,350	\$ 10,971,117	45.6%
h) Annual Retirement Allowances	\$ 162,447,578	\$ 162,721,736	0.2%
<u>Assets and Liabilities</u>			
i) Present Value of Future Benefits	\$ 2,547,123,825	\$ 2,624,124,850	3.0%
j) Actuarial Liability	\$ 2,346,905,865	\$ 2,417,514,740	3.0%
k) Actuarial Value of Assets (AVA)	\$ 1,772,494,062	\$ 1,755,860,803	
l) Unfunded Actuarial Liability (UAL)	\$ 574,411,803	\$ 661,653,937	15.2%
[j] - (k)			
m) Funded Ratio on AVA basis [(k) ÷ (j)]	75.5%	72.6%	(2.9%)
n) Market Value of Assets (MVA)	\$ 1,834,979,000	\$ 1,651,317,000	
o) Funded Ratio on MVA basis [(j) ÷ (n)]	78.2%	68.3%	(9.9%)
<u>City's Actuarially Determined Contribution (ADC)</u>			
	<u>FYE June 30, 2019</u>	<u>FYE June 30, 2020</u>	
p) Gross Normal Cost Rate	12.52%	12.66%	0.14%
q) UAL Amortization Rate	24.19%	25.74%	1.55%
r) Administrative Expenses	0.80%	0.80%	0.00%
s) Expected Employee Contributions	(9.00%)	(9.00%)	0.00%
t) City's ADC as % of Payroll	28.51%	30.20%	1.69%
[(p) + (q) + (r) + (s)]			

¹ As of December 31, 2018, 602 of the 1,250 Part Time actives had reported last pay periods before December 2018.

² Includes 145 and 108 members as of December 31, 2018 and 2017 respectively currently participating in DROP.

**CINCINNATI RETIREMENT SYSTEM
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SECTION I – BOARD SUMMARY

Below we highlight significant results of this valuation.

- The return on the Market Value of Assets was a negative 3.93% for the year ended December 31, 2018 which was significantly lower than the assumed rate of return of 7.50%. The return on the Actuarial Value of Assets was 5.66%.
- The Actuarial Liability increased from \$2,346.9 million as of December 31, 2017 to \$2,417.5 million as of December 31, 2018.
- The funded ratio based on the Actuarial Value of Assets decreased from 75.5% to 72.6% and the Unfunded Actuarial Liability (UAL) increased from \$574.4 million to \$661.7 million. Based on the Market Value of Assets, the funded ratio also decreased from 78.2% to 68.3%.
- In accordance with the Collaborative Settlement Agreement, the City contributes 16.25% of payroll on behalf of full time active members and members participating in the Deferred Retirement Option Program (DROP). The City contributes 3% of payroll for part-time active members. Based on these fixed contribution rates, the UAL will never be paid off and the City's funded ratio is expected to continue to decrease even if assets achieve the assumed rate of return of 7.50%. By comparison, the Actuarially Determined Contribution rate was calculated to be 30.20% of payroll for Fiscal Year ending June 30, 2020. Detailed projections of the System's funded status and contributions are presented later in this section.
- During the year, there was a total actuarial loss of \$71.3 million, consisting of an actuarial asset loss of \$31.7 million, a liability experience loss of \$0.4 million, and a transition loss of \$39.2 million.

Recent Trends

Although most of the attention given to the valuation reflects the most recently computed unfunded actuarial liability, funded ratio, and contribution amounts, each valuation is merely a snapshot of the long-term progress of a pension fund. It is important to take a step back from the current year results and view them in the context of the System's recent history as well as trends expected into the future. Below, we present a series of graphs which display historical trends for key factors in the valuations of the last 10 years.

In reviewing the historic trends over the 10 year period, the declining funded status coupled with significant negative net cash flow highlights the potential risk of running out of assets to pay benefits unless the City increases its current contribution rate.

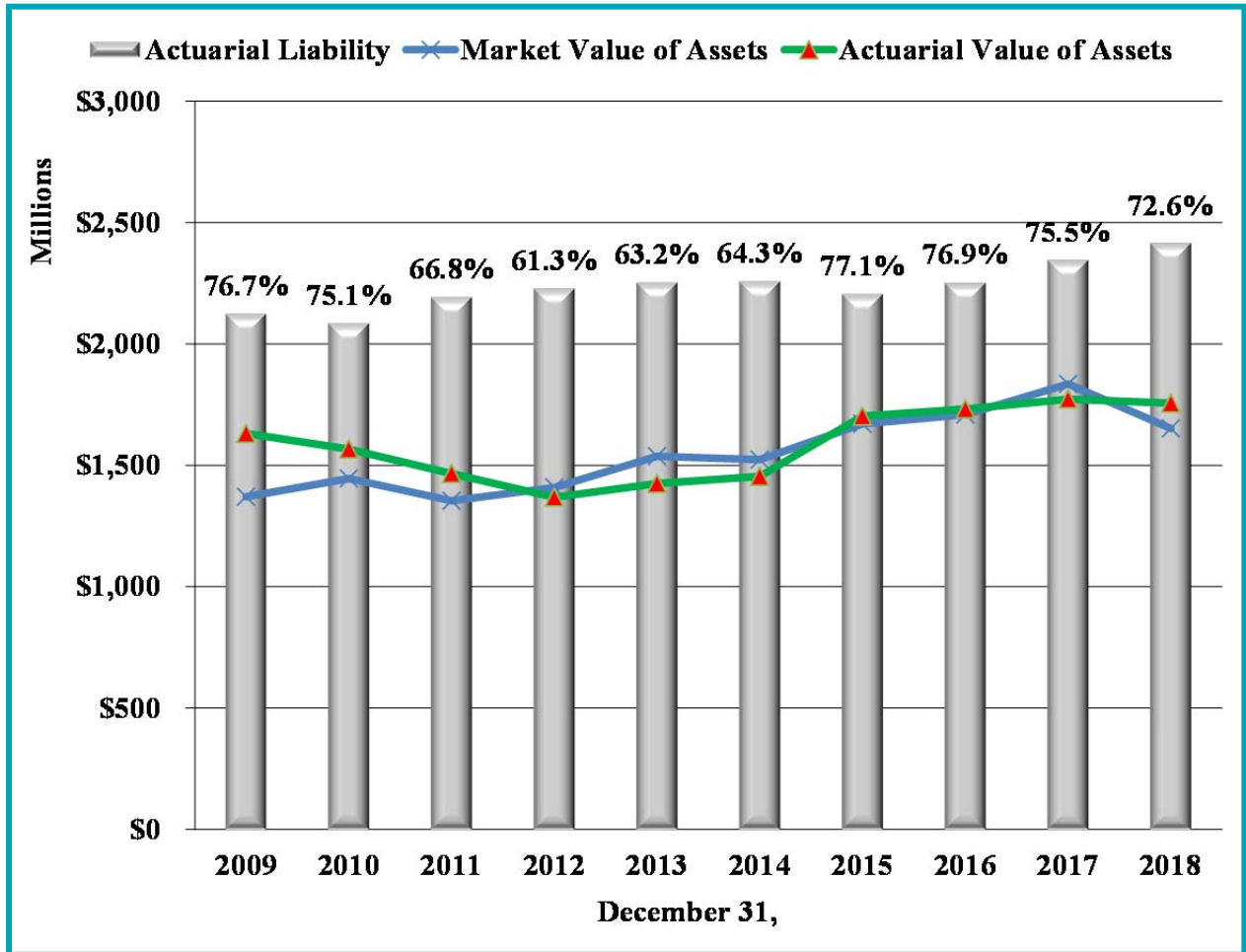
**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION I – BOARD SUMMARY

Assets and Liabilities

The grey bars represent the Actuarial Liability (AL). The blue line is the Market Value of Assets (MVA) and the green line is the Actuarial Value of Assets (AVA). The System’s funded ratio (ratio of actuarial assets to actuarial liability) is shown along the top of the bars.

The sharp increase in the funded ratio from December 31, 2014 to December 31, 2015 was due primarily to \$220 million in additional monies transferred from the healthcare assets to the pension assets as a result of the Collaborative Settlement Agreement. Since December 31, 2015, the funded ratio has been decreasing due to the System’s experience as well as the City not making contributions sufficient to pay off the UAL. As shown later in this report, the City’s current contribution rate of 16.25% is less than the amount necessary to cover the additional benefits being earned by active members (i.e. normal cost) and the interest on the unfunded actuarial liability. This amount is commonly referred to as the Tread Water Cost.



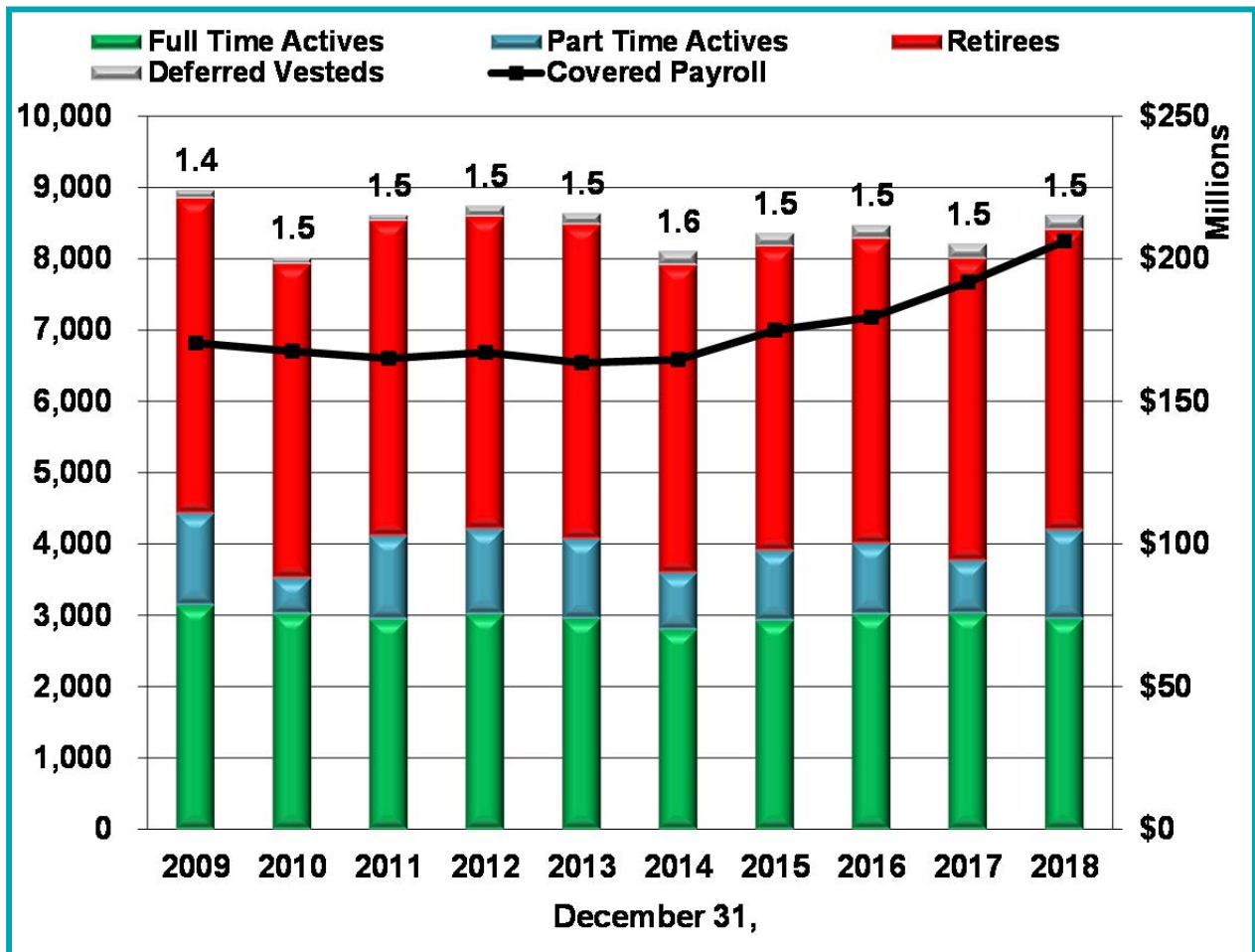
**CINCINNATI RETIREMENT SYSTEM
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SECTION I – BOARD SUMMARY

Membership Trends

The graph below shows the membership counts of the System for the last ten valuations. The numbers which appear at the top of each bar represent the ratio of the number of inactive members, including DROP members, to full time active contributing members at each valuation date, and provide a measure of the maturity of the System. The inactive-to-active ratio has remained stable over the period. As more of the liability moves from actives to inactive, the System matures and is subject to higher risk exposure from market volatility. This is because the impact of investment losses will have to be offset by future contributions. These contributions, in turn, will only be made on behalf of proportionately fewer active members compared to the total number of members.

The black line represents the payroll for active members over the period, and it corresponds with the scale on the right. The payroll for part-time actives of \$8.5 million was not included since the City does not contribute the full 16.25% of payroll for part-time actives.



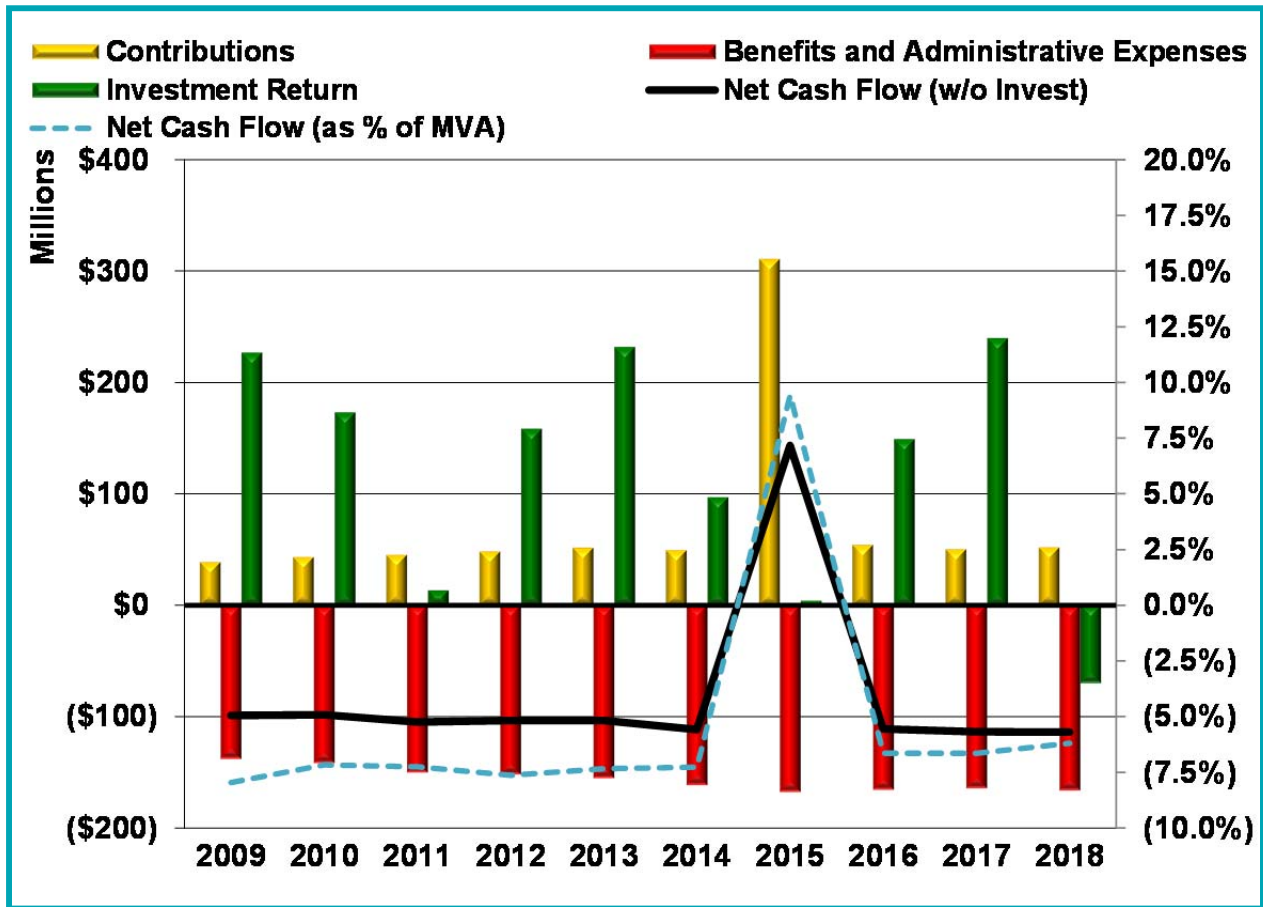
**CINCINNATI RETIREMENT SYSTEM
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SECTION I – BOARD SUMMARY

Cash Flows

The following graph shows the System’s net cash flow (contributions less benefit payments and expenses) at the end of each plan year. For the entire period shown, the net cash flow excluding investments has been negative except for 2015 when \$220 million was transferred into the System pursuant to the Collaborative Settlement Agreement. This illustrates that contributions have not been sufficient to cover benefits and expenses in any years over the past decade. A major implication of a negative cash flow is that the difference each year must be met first from cash generated by investments and then paid out of the principal assets, representing additional risk for the System if investments need to be sold in a down market to cover benefit payments.

The dotted line shows the net cash flow as a percent of the market assets and goes with the axis on the right. For the 10 year period shown the net cash flow as a percent of assets has ranged between -8% and -6%. This indicates that a plan is expected to defund with an increased risk of insolvency if the contributions do not catch up to cover a higher portion of the benefit payments and expenses.



CINCINNATI RETIREMENT SYSTEM
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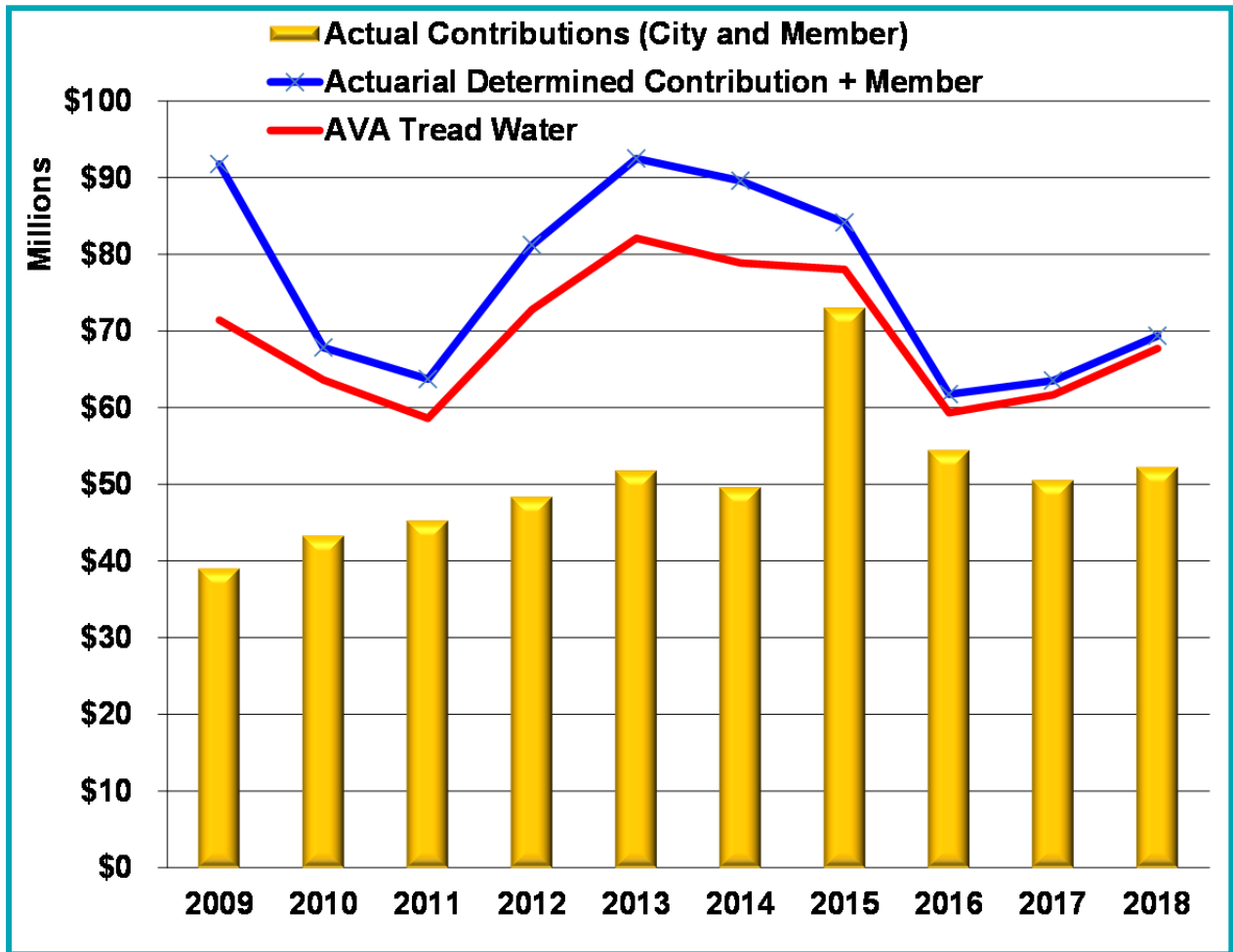
SECTION I – BOARD SUMMARY

Contributions

This graph shows the historical trends for the actual contribution amounts made by both the City and members (yellow bars). The blue line shows the actuarially determined contributions over the period. The actuarially determined contribution is comprised of three components: normal cost which represents the value of the benefits expected to be earned for the upcoming year, assumed administrative expenses and an open 30-year level dollar amortization of any unfunded actuarial liability.

The red line is the **Tread Water** line, which is the normal cost plus the interest on the UAL. The tread water line shows the minimum contributions needed to avoid an increase in the UAL.

The graph shows that not only has the City been making contributions less than the actuarially determined contribution, but that the contributions are significantly below the tread water line. When contributions are lower than the normal cost plus interest on the UAL, the unfunded actuarial liability is expected to grow from one year to the next.



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SECTION I – BOARD SUMMARY

Projected Future Outlook

The analysis of the projected financial trends is perhaps the most important component of the valuation. The graphs presented in this section show the expected progress of the System's funded status over the next 30 years, measured in terms of the expected funded ratios, and the projected contributions made by the members (9% of payroll) and by the City (16.25% of payroll for full time active members and DROP members; 3.0% for part-time members).

While the experience will not conform exactly to the assumptions every year, the trends reflect reasonable expectations. As a result, in addition to the baseline projection, we provided additional **stress testing** based on varying investment returns in the future. These scenarios are shown with Section II.

The projections assume a constant active population. As members retire, terminate and die based on the current valuation assumptions, it is assumed that new members will replace them based on characteristics (age/gender/salary) similar to recent new members.

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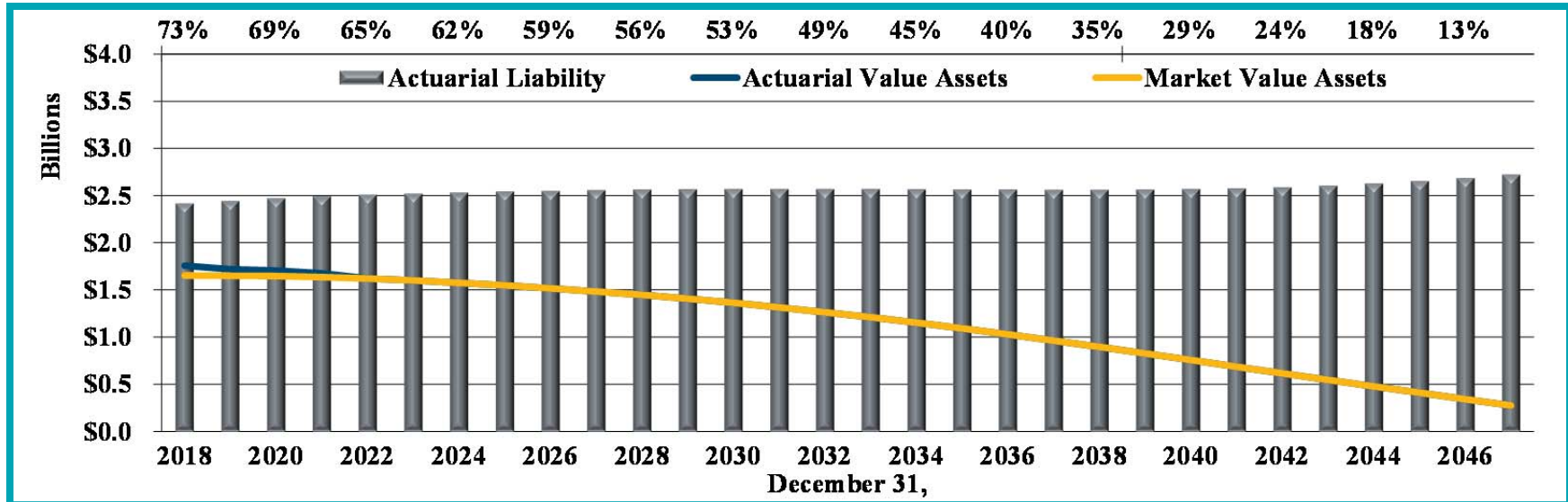
SECTION I – BOARD SUMMARY

Baseline Scenario

The baseline projection shows the outcome if all actuarial assumptions, including the long-term rate of return assumption of 7.50%, are exactly met.

The first graph compares the Market Value of Assets (gold line) and the Actuarial or smoothed Value of Assets (blue line) to the System’s Actuarial Liabilities (gray bars). In addition, at the top of the graph, we show the System’s funded ratio on an Actuarial Value of Assets basis (ratio of Actuarial Value of Assets to Actuarial Liabilities). The years shown in the graph signify the valuation date as of December 31 of the labeled year.

The System’s funded ratio on an Actuarial Value of Assets basis is projected to continue to drop over the next 30 years, as the City appropriates less than the actuarially determined contribution amount.

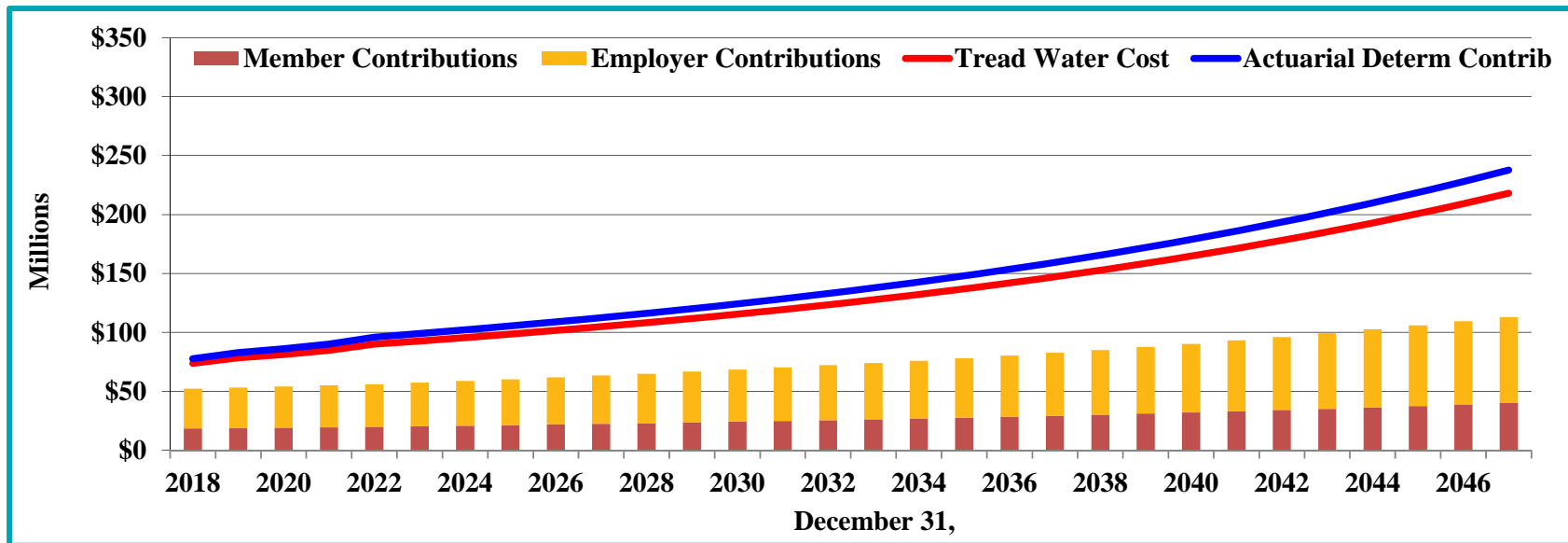


CINCINNATI RETIREMENT SYSTEM
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SECTION I – BOARD SUMMARY

The second graph below shows the projected contributions compared to the actuarial determined contributions shown in dollars. The member contributions are in maroon and the City’s contributions are in gold. Similar to the historical graph before, the red line represents the Tread Water cost necessary to avoid decreasing funded status.

As shown, the total contributions into the System are projected to continue to significantly lag both the actuarially determined contribution amount as well as the Tread Water cost. As a result, the funded status continues to deteriorate despite the assets being assumed to earn 7.5% per year.



Please see Section II for additional scenarios illustrating the sensitivity of these projections under various economic scenarios.

**CINCINNATI RETIREMENT SYSTEM
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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

Actuarial valuations are based on a set of assumptions about future economic and demographic experience. These assumptions represent a reasonable estimate of future experience, but actual future experience will undoubtedly be different and may be significantly different. This section of the report is intended to identify the primary risks to the System, provide some background information about those risks, and provide an assessment of those risks.

Identification of Risks

As we have discussed with the Board, the fundamental risk to the System is that the contributions needed to pay the benefits become unaffordable. While there are a number of factors that could lead to contribution amounts becoming unaffordable, we believe the primary risks are:

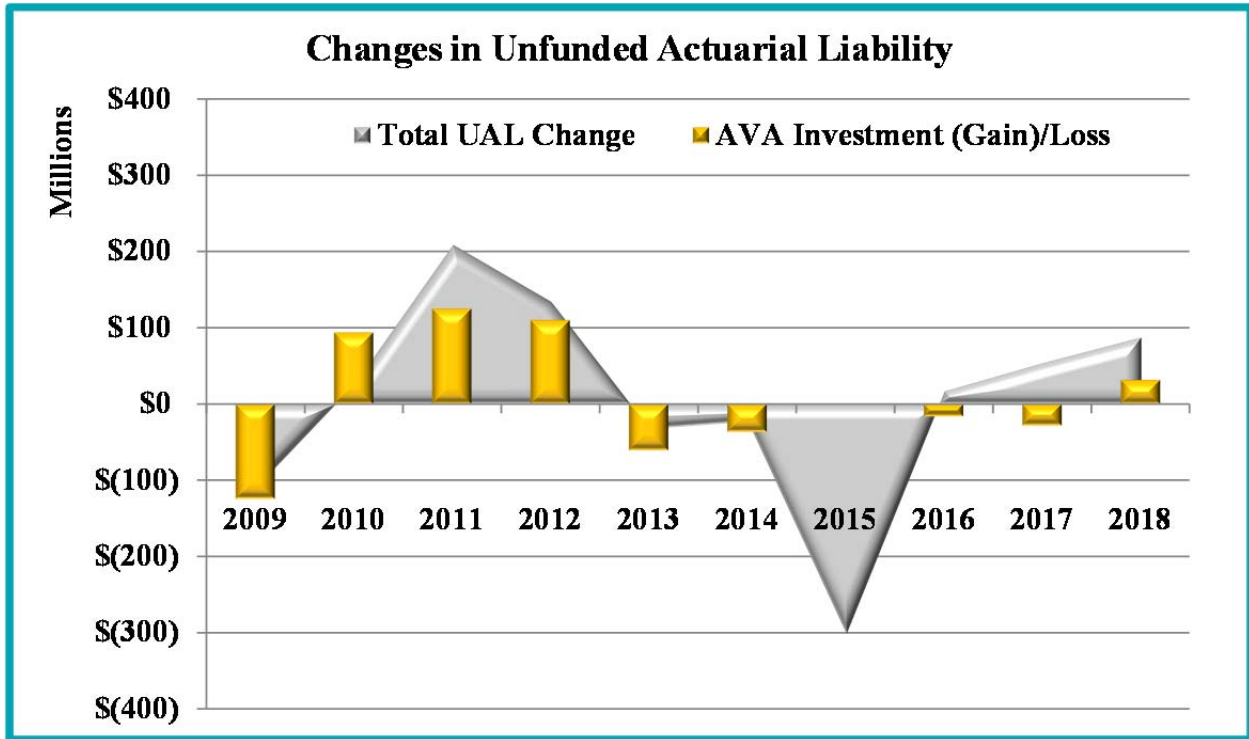
- Investment risk,
- Interest rate risk,
- Longevity and other demographic risks,
- Contribution risk; and
- Assumption change risk.

Other risks that we have not identified may also turn out to be important.

**CINCINNATI RETIREMENT SYSTEM
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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

Investment Risk is the potential for investment returns to be different than expected. Lower investment returns than anticipated will increase the Unfunded Actuarial Liability necessitating higher contributions in the future unless there are other gains that offset these investment losses. The potential volatility of future investment returns is determined by the System’s asset allocation and the affordability of the investment risk is determined by the amount of assets invested relative to the size of the plan sponsor or other contribution base.

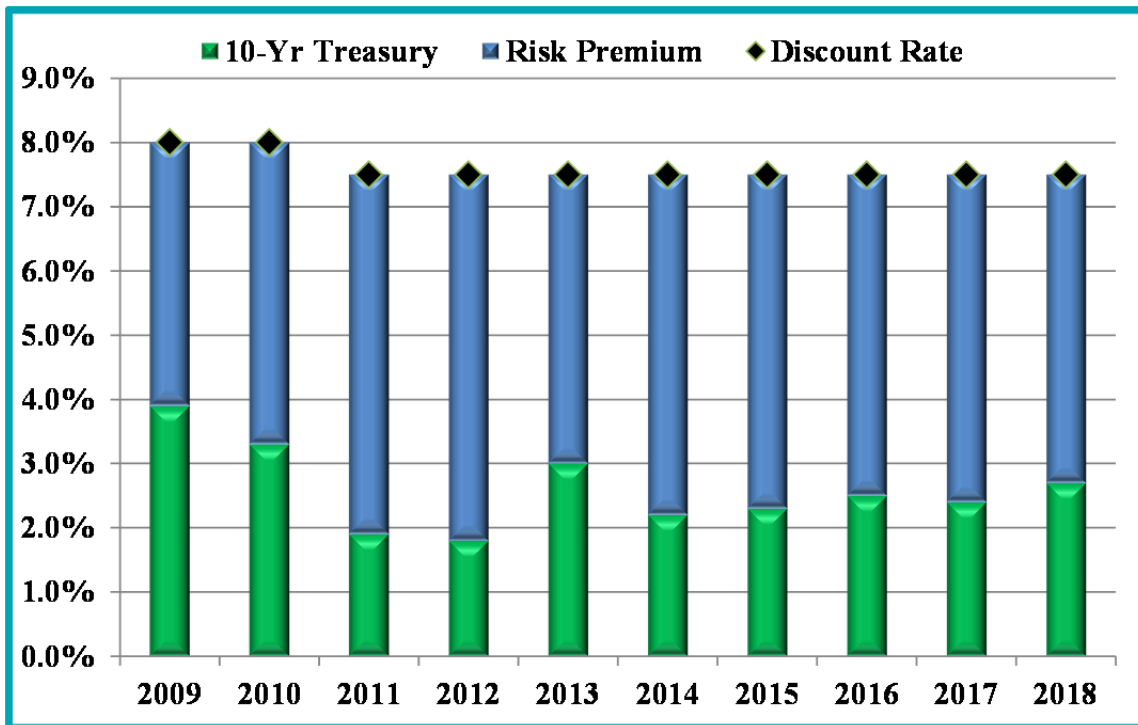


The graph above shows the impact of investment gains and losses on the smoothed Actuarial Value of Assets over the last ten years compared to the System’s total change in UAL.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

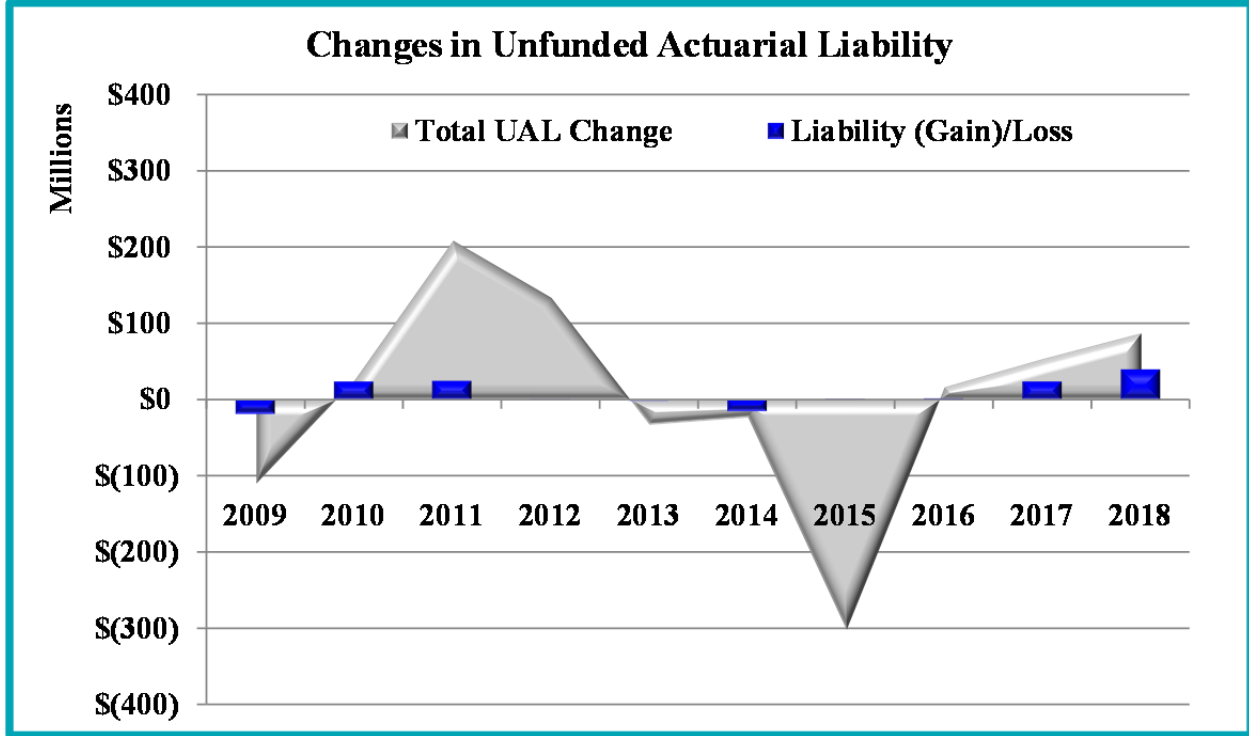
Interest rate risk is the potential for interest rates to be different than expected. For public plans, short term fluctuations in interest rates have little or no effect as the plan’s liability is usually measured based on the expected return on assets. Longer-term trends in interest rates however can have a powerful effect. The chart below shows the yield on a 10-year Treasury security compared to the System’s assumed rate of return. The difference is a simple measure of the amount of investment risk taken. As interest rates have declined, plans faced a choice: maintain the same level of risk and reduce the expected rate of return; maintain the same expected rate of return and take on more investment risk; or some combination of the two strategies.



Longevity and other demographic risks are the potential for mortality or other demographic experience to be different than expected. Generally, longevity and other demographic risks emerge slowly over time and are often dwarfed by other changes, particularly those due to investment returns. The following graph shows the demographic gains and losses over the last ten years compared to the total change in the UAL for each year.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK



Contribution risk is the potential for actual future contributions to deviate from expected future contributions. There are different sources of contribution risk ranging from the sponsor choosing to not make contributions in accordance with the funding policy to material changes in the contribution base (e.g., covered employees, covered payroll, sponsor revenue) that affect the amount of contributions the plan can collect.

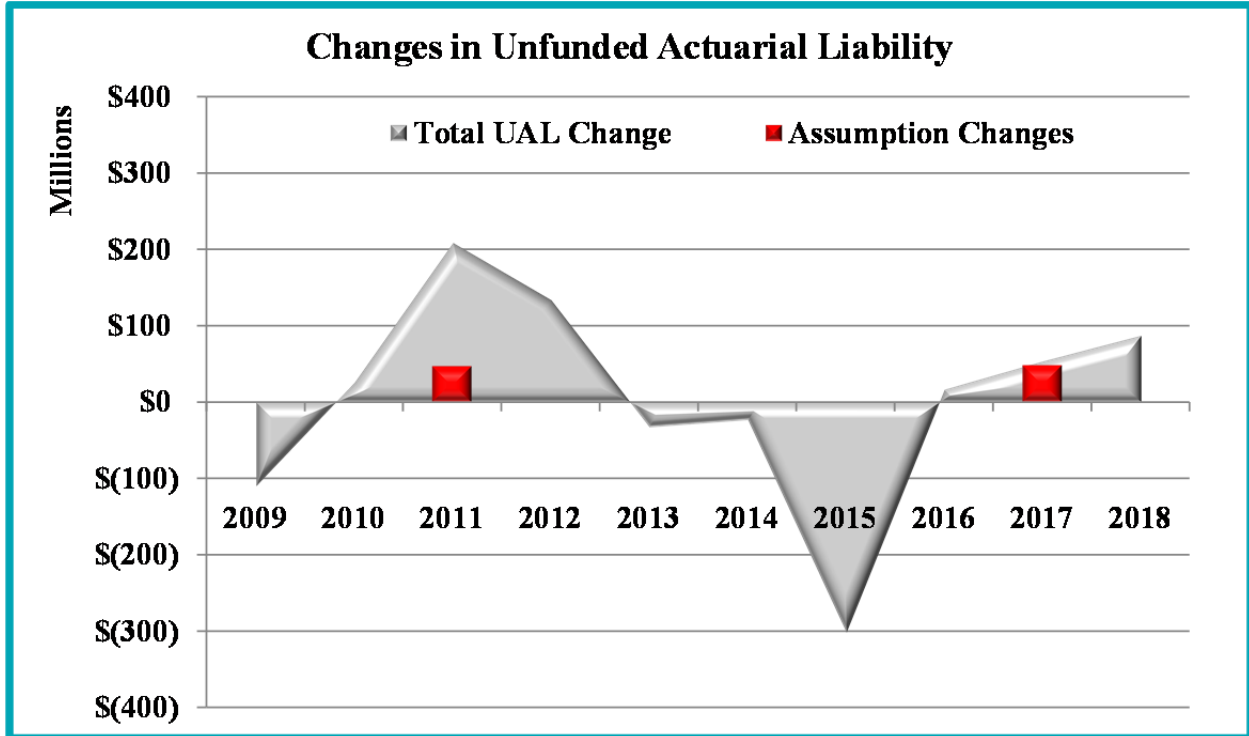
The normal cost plus the interest on the UAL is referred to as the “Tread Water Cost” because if contributions are less than the Tread Water Cost, the UAL is expected to grow; and if contributions are greater than the Tread Water Cost, the UAL is expected to decline. For this System, the City has consistently contributed less than the Tread Water Cost which has added to the growing UAL. The graph on page 7 in the Board Summary illustrates this.

Assumption change risk is the potential for the environment to change such that future valuation assumptions are different than the current assumptions. For example, declines in interest rates over the last three decades resulted in higher investment returns for fixed income investments, but lower expected future returns necessitating either a change in investment policy, a reduction in discount rate, or some combination of the two. Assumption change risk is an extension of the other risks identified, but rather than capturing the risk as it is experienced, it captures the cost of recognizing a change in environment when the current assumption is no longer reasonable.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

As shown in the following graph, the assumption changes in 2011 and 2017 had a significant impact on the measure of the UAL. It is important to note that these changes include a downward revision to the estimate of future investment earnings and ultimately costs will be determined by actual investment earnings. With the continued low interest rate environment, we are continuing to see investment consultants reduce their capital market assumptions. As a result, future expectations of investment returns may continue to decline necessitating further reductions in the discount rate.



Plan Maturity Measures

The future financial condition of a mature pension plan is more sensitive to each of the risks identified above than a less mature plan. Before assessing each of these risks, it is important to understand the maturity of this System compared to other plans and how the maturity has changed over time.

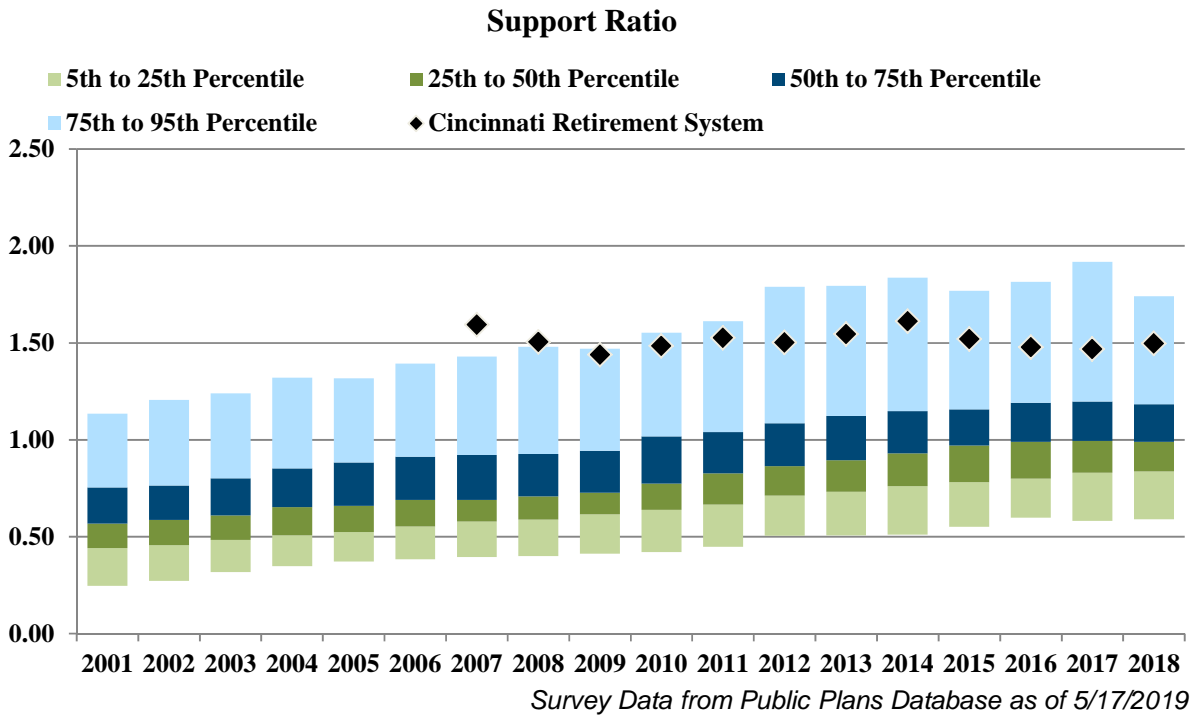
Plan maturity can be measured in a variety of ways, but they all get at one basic dynamic - the larger the plan is compared to the contribution or revenue base that supports it; the more sensitive the plan will be to risk. The measures below have been selected as the most important in understanding the primary risks identified for this System.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

Inactives per Active (Support Ratio)

One simple measure of plan maturity is the ratio of the number of inactive members (those receiving benefits or entitled to a deferred benefit) to the number of active members. The revenue base supporting the plan is usually proportional to the number of active members, so a relatively high number of inactives compared to actives indicate a larger plan relative to its revenue base as well.



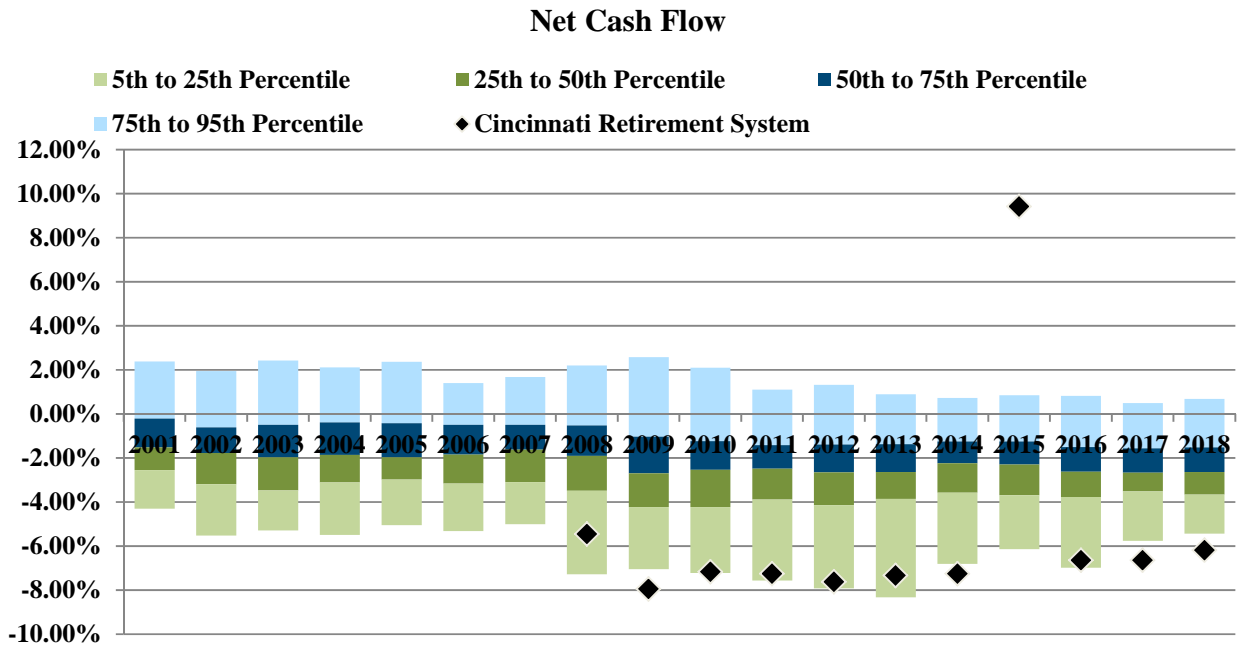
The graph above shows the distribution from the 5th to 95th percentile of support ratios for the plans in the Public Plans Database. The black diamond shows how the Cincinnati Retirement System compares to the other plans. No information was available for years before 2007. Whereas the support ratios for the plans as a whole have increased over the period as they mature, Cincinnati’s support ratio has remained relatively stable over the last ten years. However, it does still remain in the upper quartile.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

Net Cash Flow

The net cash flow of the plan as a percentage of the beginning of year assets indicates the sensitivity of the plan to short-term investment returns. Net cash flow is equal to contributions less benefit payments and administrative expenses. Mature plans can have large amounts of benefit payments compared to contributions, particularly if they are well funded. Investment losses in the short-term are compounded by the net withdrawal from the plan leaving a smaller asset base to try to recover from the investment losses. Large negative cash flows can also create liquidity issues.



Survey Data from Public Plans Database as of 5/17/2019

The graph above shows how Cincinnati Retirement System’s negative net cash flow as a percent of assets has compared to the other public plans in the database. With the exception of 2015, which reflects the large amount of monies transferred pursuant to the Collaborative Settlement Agreement, the System has been amongst the top 5 percentile in having the largest negative cash flow. This higher negative cash flow subjects the System to a higher amount of investment risk since assets must earn more to avoid the System’s assets from decreasing from one year to the next.

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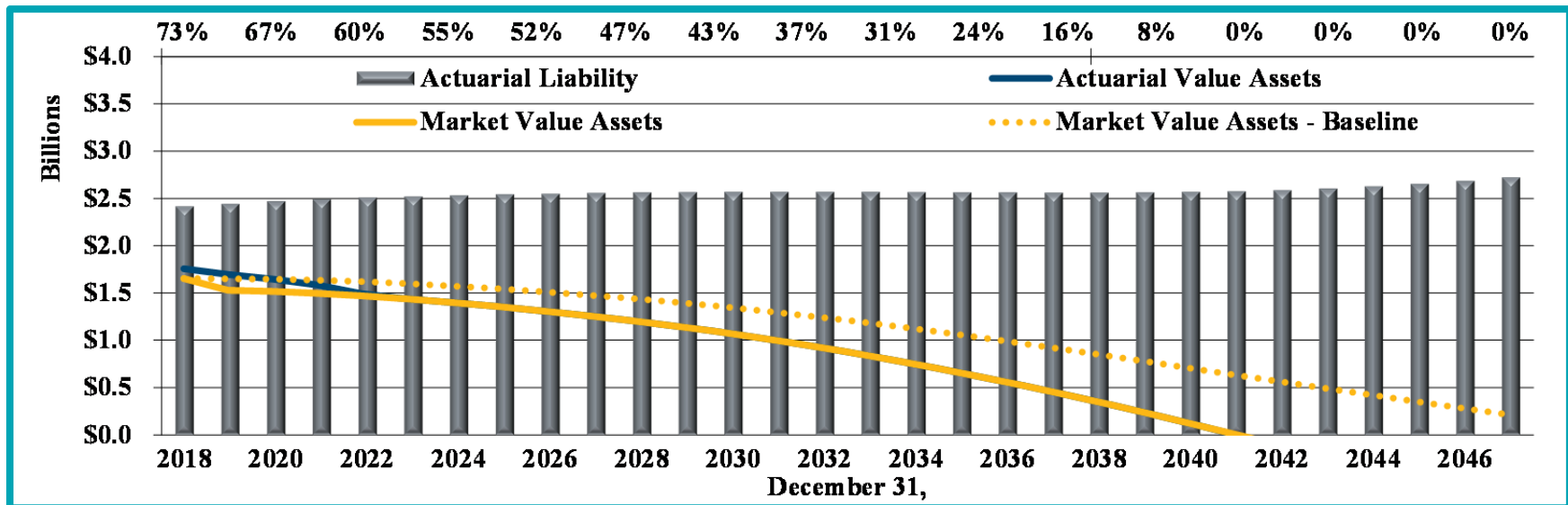
SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

Deterministic Scenarios/Stress Testing

We developed several hypothetical scenarios to illustrate the impact actual investment returns may have on future funded status and contribution rates. The scenarios are balanced between positive and negative scenarios and are intended to illustrate the importance of both the return itself as well as the timing of such returns.

The graphs on the following pages show the projections under each of these theoretical scenarios. The asset/liability graphs include a gold dotted line representing the baseline market value of assets and the contribution graphs include a blue dotted line representing the baseline ADC projections to facilitate the comparison between the particular scenario and the projections assuming all assumptions are met. The baseline projections are shown in the Board Summary.

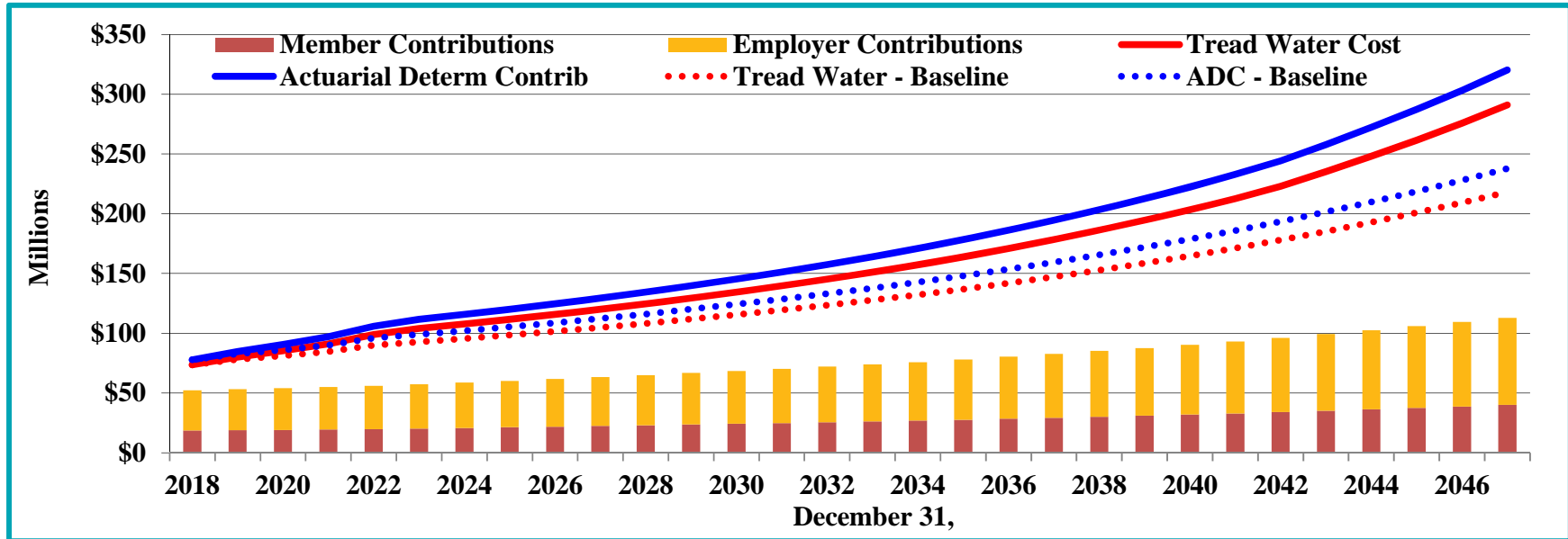
Investment Return of 0% for 2019 followed by 7.5% per year thereafter



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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

As illustrated above, one year of a flat return (0%) followed by a 7.5% return per year thereafter has a significant impact on the solvency projection of the System. This one year of underperformance results in the System being projected to go insolvent in 2041 assuming that the City does not adjust contributions and/or benefits.

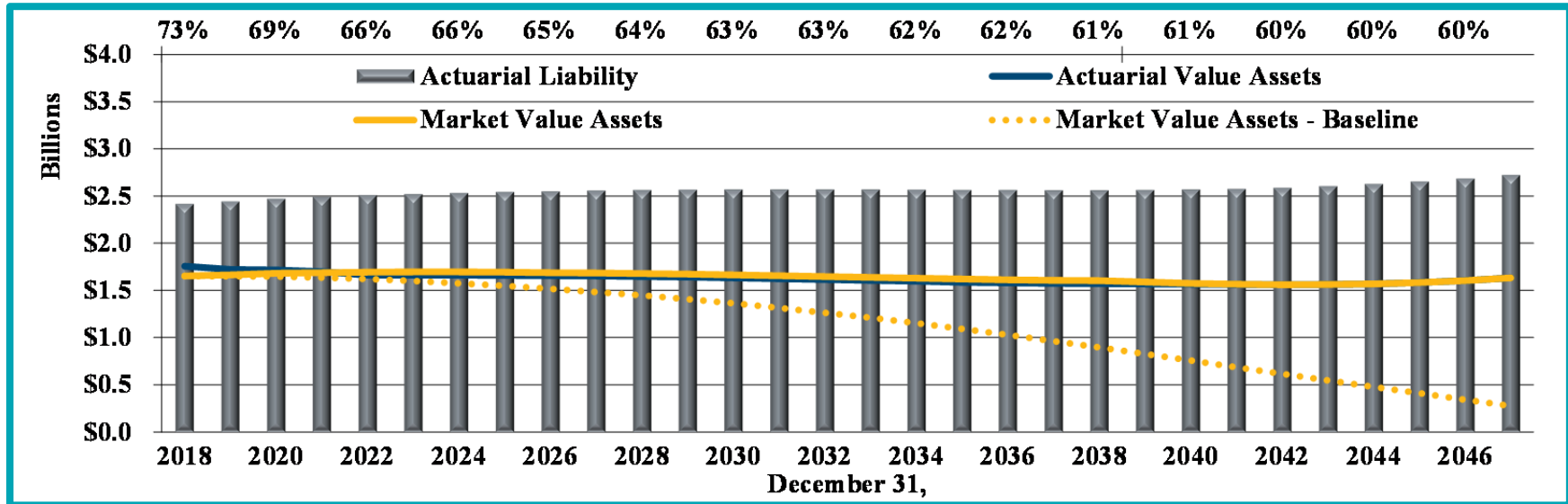


Similarly, both the Actuarial Determined Contribution and Tread Water Cost increase significantly over the next 30 years for just this one year of unfavorable return. The contributions (bars) are the same as the baseline since the City’s contributions are made based on a fixed rate.

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SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

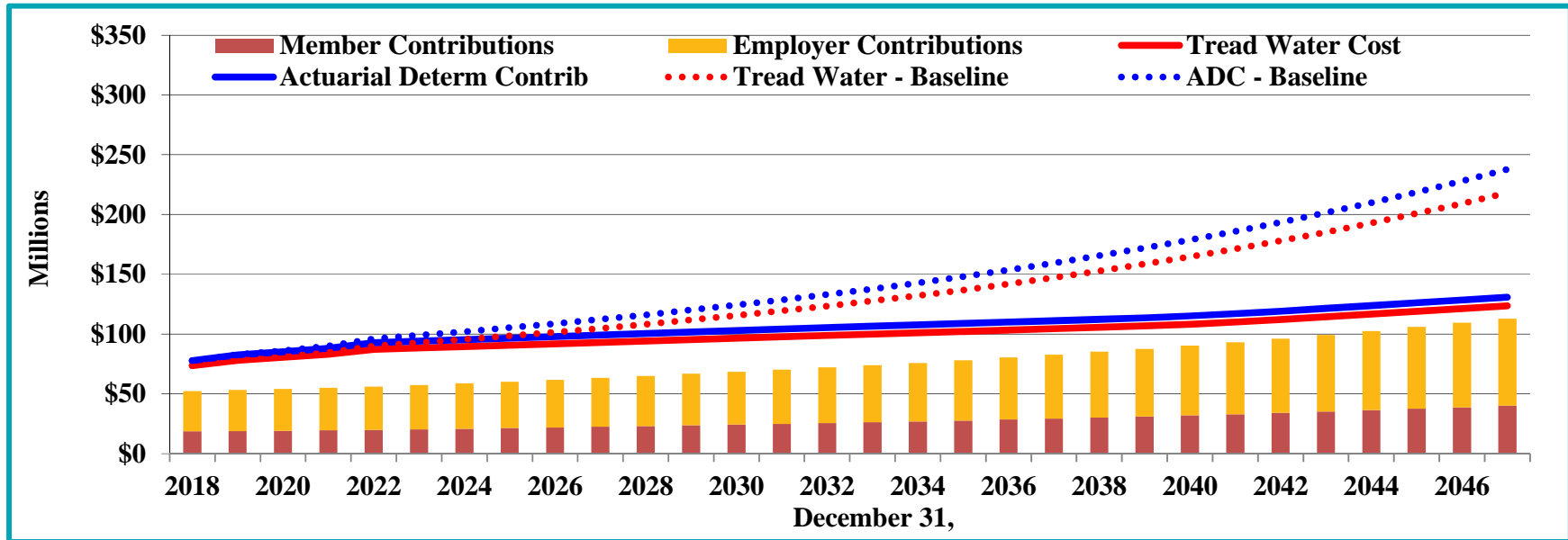
Investment Return of 8.5% per year



Conversely, the chart above shows the impact on the System’s projected assets if all future years’ investment returns are 8.5% per year. As shown, the assets remain relatively stable over the entire period rather than depreciate over the period if the assets were to just return the assumed 7.5% per year.

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ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

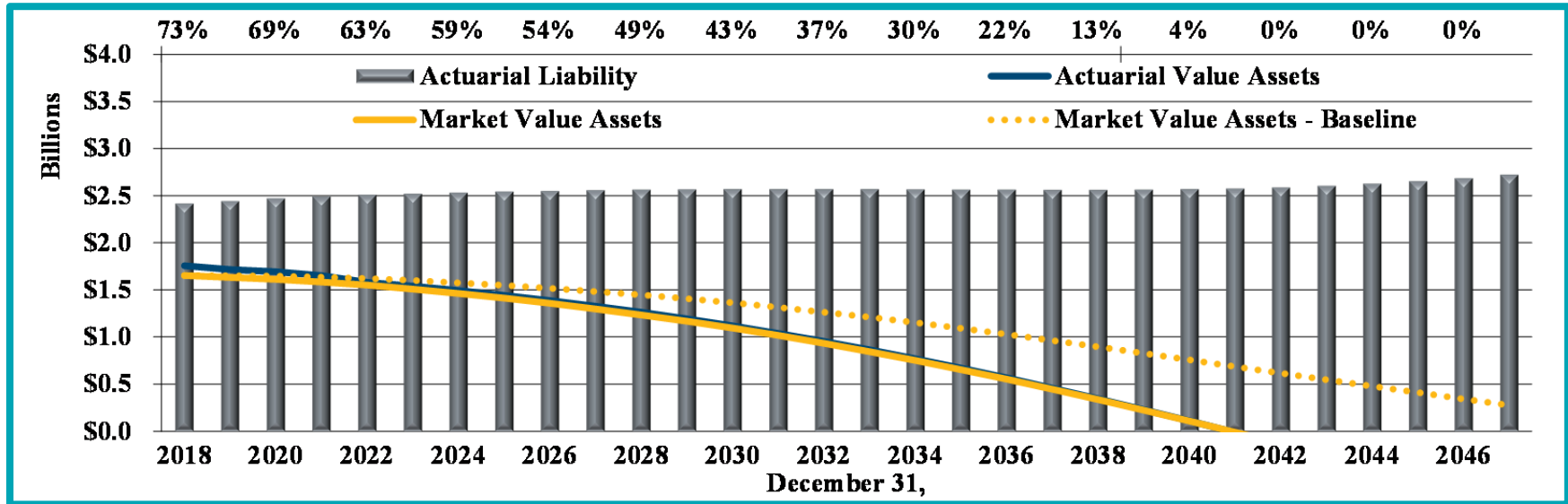


As anticipated, both the Actuarial Determined Contribution and Tread Water Cost are materially lower than if the assets were to return the assumed 7.5% per year.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK

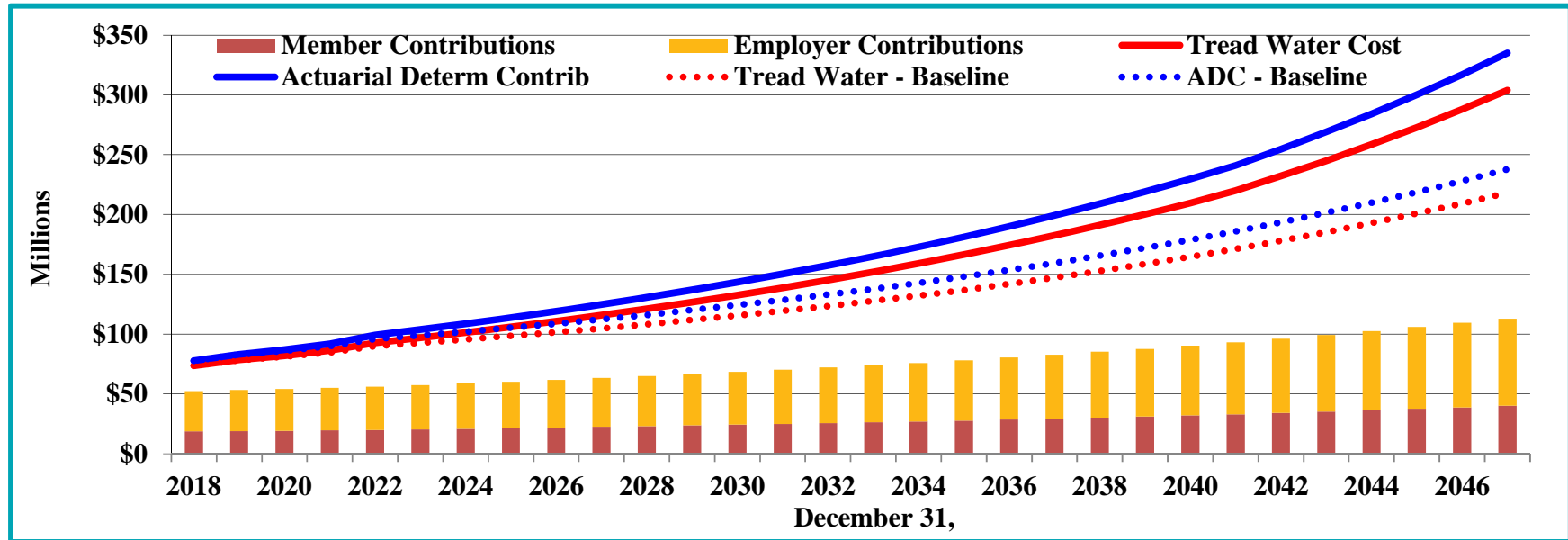
Investment Return of 6.5% per year



If the assets were to return 6.5% per year (1% less than the assumed 7.5%), the System’s assets would be projected to be depleted by 2041.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION II – IDENTIFICATION AND ASSESSMENT OF RISK



As anticipated, both the Actuarial Determined Contribution and Tread Water Cost are materially higher than if the assets were to return the assumed 7.5% per year.

The scenarios shown above represent deterministic projections. These types of projections show the financial impact on the System under a set of fixed returns. Alternatively, stochastic projections graph the probability of the key metrics such as funded status based on a large number of scenarios (e.g. 1,000) based on the expected long-term return and risk characteristics of the portfolio. Whereas we have not included a stochastic analysis in this report, we would be happy to share this analysis if requested.

More Detailed Assessment

A more detailed assessment is always valuable to enhance the understanding of the risks identified above. While more detail would provide some additional value, we do not believe it is necessary to perform an in-depth analysis every year. We recommend the Board review the analysis provided above annually and consider a more detailed analysis periodically and when there is a substantial change in the financial position or maturity of the System.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION III – ASSETS

The System uses and discloses two different asset measurements which are presented in this section of the report: market value and actuarial value of assets. The market value represents the value of the assets if they were liquidated on the valuation date. The actuarial value of assets is a value that smooths annual investment returns to reduce annual investment volatility and is used in determining the actuarial determined contribution.

In this section, we present detailed information on the System's assets including:

- Statement of the cash flow during the year,
- Disclosure of investment performance for the year, and
- Development of the actuarial value of assets.

Changes in Market Value

The components of asset change from one year to the next include contributions (both City and Member), benefit payments, expenses and investment income (realized and unrealized.)

The specific changes during 2018 are presented below:

CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018

SECTION III – ASSETS

**Table III-1
Reconciliation of the Market Value of Assets**

Market Value of Assets - December 31, 2017	\$ 1,834,979,000
<u>Additions</u>	
Contributions	
Employer	\$ 33,127,000
Member	19,172,000
Total Contributions	\$ 52,299,000
Investment Income	
Net Appreciation (Depreciation) in Fair Value of Investments	\$ (88,282,000)
Interest	4,602,000
Dividends	21,430,000
Other	53,000
Total Investment Income	\$ (62,197,000)
Investment Expenses	\$ (7,742,000)
Total Additions	\$ (17,640,000)
<u>Deductions</u>	
Benefits Paid	\$ 164,124,000
Net Transfers	451,000
Administrative Expenses	1,447,000
Total Deductions	\$ 166,022,000
Net Increase(Decrease)	\$ (183,662,000)
Market Value of Assets - December 31, 2018	\$ 1,651,317,000

Investment Performance

The following table calculates the investment gain/loss and the return for the plan year on a Market Value basis. The return is an appropriate measure for comparing the actual asset performance to the long-term 7.50% assumption.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION III – ASSETS

Table III-2 Market Value Investment Gains/(Losses)	
Market Value of Assets - December 31, 2017	\$ 1,834,979,000
Contributions	\$ 52,299,000
Benefits Paid	(164,124,000)
Net Transfers	(451,000)
Administrative Expenses	(1,447,000)
Expected Investment Earnings (7.50%)	133,435,909
Expected Market Value of Assets - December 31, 2018	\$ 1,854,691,909
Investment Gain / (Loss)	\$ (203,374,909)
Market Value of Assets - December 31, 2018	\$ 1,651,317,000
Return	(3.93%)

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION III – ASSETS

Actuarial Value of Assets

To determine on-going funding requirements, most pension systems utilize an actuarial value of assets that differs from the market value of assets. The actuarial value of assets represents an asset value based on averaging or smoothing year-to-year market value returns for purposes of reducing contribution volatility. For this System, the actuarial value of assets recognizes a portion of the difference between the actual market value of assets and the expected market value of assets. The amount recognized each year is 20% of the difference between actual market value and expected market value. The expected market value is determined using the System's actual cash flows and assumed actuarial rate of return. The actuarial value of assets is constrained so that it cannot exceed 120% of the market value and cannot be less than 80% of the market value. The asset valuation method is described more fully in Appendix B.

The following table illustrates the calculation of the actuarial value of assets for the December 31, 2018 valuation.

Table III-3 Development of December 31, 2018 Actuarial Value of Assets					
a)	Market Value of Assets - December 31, 2018				\$ 1,651,317,000
b)	Deferred Gains or (Losses)				
	<u>Plan Year</u>	<u>Market Value Gain or (Loss)</u>	<u>Percent Recognized</u>	<u>Percent Deferred</u>	<u>Amount Deferred</u>
	2018	\$ (203,374,909)	20%	80%	\$ (162,699,927)
	2017	115,796,462	40%	60%	69,477,877
	2016	28,104,012	60%	40%	11,241,605
	2015	(112,816,788)	80%	20%	(22,563,358)
	2014	(9,439,600)	100%	0%	<u>0</u>
				Total Deferred:	\$ (104,543,803)
c)	Preliminary Actuarial Value of Assets - December 31, 2018 [(a) - (b)]				\$ 1,755,860,803
d)	Corridor for Actuarial Value of Assets				
				80% of Market Value of Assets	\$ 1,321,053,600
				120% of Market Value of Assets	\$ 1,981,580,400
e)	Actuarial Value of Assets - December 31, 2018				\$ 1,755,860,803
f)	Actuarial Value of Assets as a % of Market Value of Assets [(e) ÷ (a)]				106%

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION III – ASSETS

Asset Gains / (Losses) on Actuarial Value Basis

The following table calculates the actuarial investment gain/loss and the return for the plan year on an Actuarial Value basis. This actuarial gain/loss is one component of the System’s overall actuarial experience gain/loss.

Despite the unfavorable investment return on market value, the Actuarial Value of Assets returned 5.66% for the year primarily due to the continued recognition of the net investment gains attributable to prior years. This resulted in a \$31.7 million actuarial investment loss when compared to the 7.50% expected return as shown below.

Table III-4 Actuarial Value Investment Gains/(Losses)	
Actuarial Value of Assets - December 31, 2017	\$ 1,772,494,062
Contributions	\$ 52,299,000
Benefits Paid	(164,124,000)
Net Transfers	(451,000)
Administrative Expenses	(1,447,000)
Expected Investment Earnings (7.50%)	128,749,539
Expected Actuarial Value of Assets - December 31, 2018	\$ 1,787,520,601
Investment Gain / (Loss)	\$ (31,659,798)
Actuarial Value of Assets - December 31, 2018	\$ 1,755,860,803
Return	5.66%

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION III – ASSETS

Investment Performance

The market value of assets (MVA) returned (3.93%) during 2018, which is significantly less than the assumed 7.50% return. A return of 5.66% on the actuarial value of assets (AVA) is primarily the result of the asset smoothing method being utilized for the calculation of the actuarial value of assets. Since only 20% of this year’s loss from the performance of the System is recognized in a given year, in periods of very unfavorable performance, the AVA can lag significantly behind the MVA. In a period of positive returns, the AVA does not increase as rapidly as the MVA.

**Table III-5
Annual Rates of Return**

<u>Plan Year</u>	<u>Investment Return Assumption</u>	<u>Market Value</u>	<u>Actuarial Value</u>
2009	8.00%	18.93%	0.16%
2010	8.00%	13.11%	2.07%
2011	7.50%	0.88%	0.24%
2012	7.50%	12.06%	0.25%
2013	7.50%	16.99%	12.11%
2014	7.50%	6.46%	10.18%
2015	7.50%	(0.11%)	7.51%
2016	7.50%	9.24%	8.50%
2017	7.50%	14.51%	9.19%
2018	7.50%	(3.93%)	5.66%
10-Year Compound Average		8.56%	5.50%
5-Year Compound Average		5.03%	8.20%

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION IV – LIABILITIES

In this section, we present detailed information on System liabilities including:

- **Disclosure** of System liabilities at December 31, 2017 and December 31, 2018, and
- Statement of **changes** in these liabilities during the year.

Disclosure

Two types of liabilities are calculated and presented in this report. Each type is distinguished by the people ultimately using the figures and the purpose for which they are using them.

- **Present Value of Benefits:** Used for analyzing the financial outlook of the System. This represents the amount of money needed today to fund all future benefits and expenses of the System, assuming members continue to accrue benefits and all assumptions are met.
- **Actuarial Liability:** Used for funding calculations and GASB disclosures. This liability is calculated taking the present value of benefits above and subtracting the present value of future member contributions and future employer normal costs under an acceptable actuarial funding method. This method is referred to as the **Entry Age Normal** funding method.

None of the liability figures disclosed in this report is meant to be a measure of the System's settlement liability.

The following table discloses each of these liabilities for the current and prior valuations. With respect to each disclosure, a subtraction of the appropriate value of the System's assets yields, for each respective type, a **net surplus** or an **unfunded liability**.

CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018

SECTION IV – LIABILITIES

Table IV-1		
Liabilities/Net (Surplus)/Unfunded		
	December 31, 2017	December 31, 2018
Present Value of Benefits		
Active Participants (Full Time)	\$ 769,904,306	\$ 785,370,105
Active Participants (Part Time)	3,651,051	4,268,483
Deferred Vesteds	24,460,141	25,398,297
Retirees	1,749,108,327	1,809,087,965
Present Value of Benefits (PVB)	\$ 2,547,123,825	\$ 2,624,124,850
City's Normal Cost*	\$ 7,987,000	\$ 8,704,000
Actuarial Liability		
Active Participants (Full Time)	\$ 569,686,346	\$ 578,759,995
Active Participants (Part Time)	3,651,051	4,268,483
Deferred Vesteds	24,460,141	25,398,297
Retirees	1,749,108,327	1,809,087,965
Actuarial Liability (AL)	\$ 2,346,905,865	\$ 2,417,514,740
Actuarial Value of Assets (AVA)	1,772,494,062	1,755,860,803
Net (Surplus)/Unfunded (AL – AVA)	\$ 574,411,803	\$ 661,653,937
Funded Status (AVA basis)	75.5%	72.6%

* Includes administrative expense and net of Employee Contributions

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION IV – LIABILITIES

Changes in Liabilities

Each of the liabilities disclosed in the prior table are expected to change at each valuation. The components of that change, depending upon which liability is analyzed, can include:

- New hires since the last valuation
- Benefits accrued since the last valuation
- Plan amendments changing benefits
- Passage of time which adds interest to the prior liability
- Benefits paid to retirees since the last valuation
- Members retiring, terminating, or dying at rates different than expected
- A change in actuarial or investment assumptions
- A change in the actuarial funding method

Unfunded liabilities will change because of all of the above and due to changes in the System’s assets resulting from the following:

- Employer contributions less than the full actuarial contribution
- Investment earnings different than expected
- A change in the method used to measure system assets

In each valuation, we report on those elements of change that are of particular significance, potentially affecting the long-term financial outlook of the System. Below we present key changes in liabilities since the last valuation.

Table IV-2 Change in Liabilities		
	Present Value of Benefits	Actuarial Liability
Liabilities as of 12/31/2017	\$ 2,547,123,825	\$ 2,346,905,865
Liabilities as of 12/31/2018	\$ 2,624,124,850	\$ 2,417,514,740
Liability Increase (Decrease)	\$ 77,001,025	\$ 70,608,875
Change Due to:		
Assumption Change	\$ 0	\$ 0
Plan Changes	0	0
Transition	34,749,084	39,235,817
Actuarial (Gain)/Loss	NC	342,488
Benefits Accumulated and Other Sources	42,251,941	31,030,570

NC = not calculated

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION IV – LIABILITIES

This was Cheiron’s first valuation for the Cincinnati Retirement System. In accordance with professional standards, Cheiron replicated the liabilities shown in the December 31, 2017 valuation report. Cheiron's replicated liabilities were \$39.2 million higher than the prior actuary, which represents a 1.6% increase in total liabilities. This is within typical professional standards of 5%. Differences should be anticipated due to valuation software capabilities.

Table IV-3 shows the components of the actuarial liability experience gain/(loss).

Table IV-3			
Sources of Actuarial Liability (Gain)/Loss			
(\$ in Thousands)			
Source	(Gain) / Loss	% of	
	Amount	Liability	
1. Salary	\$ 4,261.1	0.2%	
2. Active experience (retirements, termination, etc.)	(11,610.5)	(0.6%)	
3. New entrants	4,596.4	0.2%	
4. Inactive experience	(919.5)	0.1%	
5. Rehired inactives	38.9	0.0%	
6. Benefit payments different than expected	(68.6)	0.0%	
7. Miscellaneous	4,044.7	0.2%	
8. Total Liability (Gain) / Loss	\$ 342.5	0.1%	

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION V – CONTRIBUTIONS

In the process of evaluating the financial condition of any pension system, the actuary analyzes the assets and liabilities to determine what level (if any) of contributions is needed to properly maintain the funding status of the system. Typically, the actuarial process will use a funding technique that will result in a pattern of contributions that is both stable and predictable.

For this system, the funding method employed is the **Entry Age Actuarial Cost Method**. Under this method, there are three key components to calculating the Actuarially Determined Contribution (ADC): the **normal cost rate**, the **unfunded actuarial liability rate** (UAL rate), and the **administrative expense rate**. The normal cost rate represents the value of benefits being earned by the active members, as a percent of pay, for the upcoming year. The City's normal cost rate is calculated by taking the total normal cost rate less the member contribution rate of 9%. Based on the Board's funding benchmark, the unfunded actuarial liability rate represents the amount necessary, as a level dollar amount, to pay off the unfunded liability over an open 30-year period. The final piece of the ADC is the administrative expense rate of 0.80% of pay.

However, the City does not contribute based on the Actuarially Determined Contribution rate, nor should the ADC rate be construed as a recommended contribution rate. In accordance with the Collaborative Settlement Agreement, the City currently contributes 16.25% of pay for full-time active and DROP members. A contribution totaling 3.00% of pay is made on behalf of part-time actives.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION V – CONTRIBUTIONS

Table V-1 Development of Actuarially Determined Contribution Rate		
	December 31, 2017 (for Fiscal Year ending June 30, 2019)	December 31, 2018 (for Fiscal Year ending June 30, 2020)
1. Actuarial Liability		
a. Active Employees (Full Time)	\$ 569,686,346	\$ 578,759,995
b. Active Employees (Part Time)	3,651,051	4,268,483
c. Vested Terminated Members	24,460,141	25,398,297
d. Retired Members and Inactive Members	<u>1,749,108,327</u>	<u>1,809,087,965</u>
e. Total Present Value	\$ 2,346,905,865	\$ 2,417,514,740
2. Actuarial Value of Assets	<u>\$ 1,772,494,062</u>	<u>\$ 1,755,860,803</u>
3. Unfunded Actuarial Liability (UAL) (1) - (2)	\$ 574,411,803	\$ 661,653,937
4. Gross Normal Cost Rate	12.52%	12.66%
5. UAL Amortization Payment		
a. 30-Year UAL Amortization Payment ¹	N/A	\$ 54,033,434
b. Total Active Payroll ²	N/A	209,951,226
c. Total Amortization Payment (as % of Payroll) [5a. ÷ 5b.]	24.19%	25.74%
6. Administrative Expenses	0.80%	0.80%
7. Expected Employee Contributions	(9.00%)	(9.00%)
8. City's Actuarial Determined Contribution Rate [4. + 5c. + 6. + 7.]	28.51%	30.20%
9. City's Estimated ADC in Dollars [5b. x 8.]	\$ 52,709,000	\$ 63,405,000

¹ Adjusted with interest to mid-year.

² Adjusted with interest to mid-year based on General Wage Inflation of 3.75%.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION VI – ACCOUNTING STATEMENT INFORMATION

Table VI-1 shows the history of gains and losses and Table VI-2 shows the Schedule of Funding Progress.

Table VI - 1							
Gain or (Loss) for Year Ending December 31,							
(\$ in Thousands)							
Type of Activity	2012	2013	2014	2015	2016	2017	2018
Investment Income	\$ (109,967)	\$ 60,722	\$ 36,688	\$ 413	\$ 16,400	\$ 28,361	\$ (31,660)
Combined Liability Experience	(493)	1,134	15,199	(777)	(1,424)	(23,609)	(342)
Total Gain (Loss)	\$ (110,460)	\$ 61,856	\$ 51,887	\$ (364)	\$ 14,976	\$ 4,752	\$ (32,002)
Non-Recurring Items	0	0	0	345,573	(27,754)	(48,308)	(39,236)
Composite Gain (Loss) during Year	\$ (110,460)	\$ 61,856	\$ 51,887	\$ 345,209	\$ (12,778)	\$ (43,556)	\$ (71,238)

Table VI - 2							
Schedule of Funding Progress							
(\$ in Thousands)							
Actuarial Valuation Date	(a) Actuarial Value of Assets	(b) Entry Age Actuarial Liability	(b) - (a) Unfunded Actuarial Liability	(a) ÷ (b) Funded Ratio	(c) Covered Payroll	[(b) - (a)] ÷ (c) UAL as a % of Covered Payroll	
12/31/2012	\$ 1,367,695	\$ 2,229,818	\$ 862,123	61.3%	\$ 167,148	515.8%	
12/31/2013	1,424,933	2,254,121	829,188	63.2%	163,477	507.2%	
12/31/2014	1,453,922	2,259,822	805,900	64.3%	164,575	489.7%	
12/31/2015	1,703,002	2,207,484	504,482	77.1%	174,963	288.3%	
12/31/2016	1,732,053	2,252,875	520,822	76.9%	179,463	290.2%	
12/31/2017	1,772,494	2,346,906	574,412	75.5%	191,806	299.5%	
12/31/2018	1,755,861	2,417,515	661,654	72.6%	206,122	321.0%	

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

SECTION VI – ACCOUNTING STATEMENT INFORMATION

Additional information as of December 31, 2018:

Valuation Date	December 31, 2018
Actuarial Cost Method	Entry Age
Amortization Method	Level Dollar Open
Amortization Period	30 Years
Asset Valuation Method	Five Year Smoothed Market Value
Actuarial Assumptions	
Investment Return (includes inflation)	7.50%
Projected Salary Increases (includes inflation)	3.75% - 7.50%
Inflation	2.75%
Cost-of-Living Adjustments	3.00%

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

The data for this valuation was provided electronically by the Cincinnati Retirement System staff. Cheiron did not perform a formal audit of the data. However, we did perform checks of the data for reasonableness and consistency in accordance with Actuarial Standards of Practice No. 23 – Data Quality.

Data reported in this Appendix is as of December 31, 2018.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

Status Reconciliation of Participating Members

	Active Full-Time	Active Part-Time	Terminated Vested	Retired	Disabled	Beneficiary	Total
As of December 31, 2017	3,029	742	211	3,420	176	637	8,215
New Hires	182	682					864
To Active Part-Time	(32)	32					0
To Active Full-Time	50	(49)	(1)				0
Terminated Vested	(25)	(3)	28				0
Terminated Non-Vested	(60)	(114)	(2)				(176)
Refund of Contributions	(55)	(39)	(10)				(104)
Retired	(114)	(1)	(10)	125			0
Disabled	(1)				1		0
Deceased with Beneficiary	(3)			(35)	(3)	41	0
Deceased without Beneficiary	(8)		(1)	(91)	(10)	(53)	(163)
Corrections	(12)		(3)	(3)		2	(16)
As of December 31, 2018	2,951	1,250	212	3,416	164	627	8,620

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

Active Member Count by Age and Service as of December 31, 2018										
Age	Years of Service									Total Count
	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40 & Over	
Under 25	44	5	0	0	0	0	0	0	0	49
25-29	155	25	10	0	0	0	0	0	0	190
30-34	170	85	45	12	0	0	0	0	0	312
35-39	163	85	63	53	9	0	0	0	0	373
40-44	104	69	66	67	31	5	0	0	0	342
45-49	72	69	73	89	61	37	0	0	0	401
50-54	67	55	52	75	76	146	18	0	0	489
55-59	45	32	51	71	71	164	27	0	0	461
60-64	35	23	33	41	33	68	18	0	2	253
65-69	5	5	8	16	10	11	4	2	0	61
70 & Over	0	1	5	3	4	4	1	1	1	20
Total Count	860	454	406	427	295	435	68	3	3	2,951

Average Service: 13.27

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

Average Compensation of Active Members by Age and Service as of December 31, 2018											
Age	Years of Service									Avg. Comp.	
	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40 & Over		
Under 25	\$45,606	\$43,594	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$45,400
25-29	52,398	53,260	50,622	0	0	0	0	0	0	0	52,418
30-34	62,907	61,564	60,109	58,149	0	0	0	0	0	0	61,955
35-39	59,086	68,289	63,407	64,375	67,713	0	0	0	0	0	62,873
40-44	61,587	67,268	67,578	73,407	70,786	64,217	0	0	0	0	67,077
45-49	62,028	67,692	71,570	71,257	67,224	79,216	0	0	0	0	69,165
50-54	71,621	65,905	64,260	65,265	73,415	74,838	74,206	0	0	0	70,555
55-59	66,310	72,970	68,336	64,799	65,258	72,328	76,819	0	0	0	69,358
60-64	79,563	65,480	71,270	63,895	68,757	71,777	69,008	0	79,747	0	70,410
65-69	69,040	78,302	60,296	63,744	61,019	62,052	52,500	100,784	0	0	64,644
70 & Over	0	62,409	82,394	60,329	57,688	52,089	48,984	73,128	64,449	0	64,052
Average	60,741	65,681	66,412	67,180	68,567	73,131	72,220	91,566	74,648	0	66,132

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

Summary of Inactive Membership Data as of December 31, 2018				
Group	Count		Total Annual Benefit	Average Annual Benefit
Retirees	3,416	\$	145,410,281	\$ 42,567
Disableds	164	\$	2,739,120	\$ 16,702
Survivor	<u>627</u>	\$	<u>14,572,335</u>	<u>\$ 23,241</u>
Total	4,207	\$	162,721,736	\$ 38,679

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX A – MEMBERSHIP INFORMATION

Annual Benefits by Age as of December 31, 2018			
Attained Age	Number of Members	Total Annual Benefits	Average Annual Benefit
< 40	4	\$ 111,013	\$ 27,753
40 - 44	2	25,741	12,870
45 - 49	9	252,771	28,086
50 - 54	63	2,491,360	39,545
55 - 59	263	11,528,264	43,834
60 - 64	645	26,307,097	40,786
65 - 69	944	39,530,007	41,875
70 - 74	822	33,623,112	40,904
75 - 79	510	19,151,948	37,553
80 - 84	426	14,753,412	34,632
85 - 89	288	9,097,518	31,589
90 - 94	169	4,534,009	26,828
95 - 99	56	1,182,976	21,125
100+	6	132,506	22,084
Total	4,207	\$ 162,721,736	\$ 38,679

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX B – ACTUARIAL ASSUMPTIONS AND METHODS

A. Actuarial Assumptions

Rationale for Economic and Demographic Assumptions

The actuarial assumptions were adopted by the Board of Trustees on March 1, 2018 upon the recommendation of the prior actuary, based on an experience study performed for the period January 1, 2012 to December 31, 2016. The results of this study were presented in a report dated February 27, 2018 and are incorporated into this report by reference. An investment return assumption of 7.50% was used as prescribed by item 29 of the Collaborative Settlement Agreement (CSA) signed October 5, 2015.

Cheiron has reviewed the assumptions. While we consider these assumptions to be generally reasonable, we have not yet performed our own actuarial experience study.

1. Investment Rate of Return

7.50% per year, net of investment *expenses*

2. Inflation Assumption

2.75% per annum

3. Expenses

Estimated budgeted administrative expenses of 0.80% of payroll are added to the normal cost rate

4. Salary Increases

Salary increases are assumed to vary by service. Representative rates are as follows:

Service	Annual Increase
0	7.50%
5	5.00
10	4.50
15	4.00
21+	3.75

5. Mortality Rates

Active Members: RP-2014 Employees Mortality Table with generational projections using scale MP-2017

Healthy Inactive Members: RP-2014 Mortality Table with generational projections using Scale MP-2017, set forward 2 years for both males and females

Disabled Inactive Members: RP-2014 Disabled Retiree Mortality Table with generational projections using scale MP-2017

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX B – ACTUARIAL ASSUMPTIONS AND METHODS

6. Retirement Rates

Age	Annual Rates of Retirement Groups C, E and F ¹				
	5 Years of Service	6 – 24 Years of Service	25 – 29 Years of Service	30 Years of Service	31+ Years of Service
50-54				55.0%	30.0%
55			6.0%	55.0	30.0
56			8.0	55.0	30.0
57			10.0	55.0	30.0
58			10.0	55.0	30.0
59			10.0	55.0	30.0
60	25.0%	25.0%	25.0	55.0	25.0
61	25.0	18.0	18.0	55.0	25.0
62	25.0	18.0	18.0	55.0	25.0
63	25.0	18.0	18.0	55.0	25.0
64	25.0	18.0	18.0	55.0	25.0
65	25.0	18.0	18.0	55.0	25.0
70	100.0	100.0	100.0	100.0	100.0

¹ For purposes of valuing CSA Employee members eligible for DROP benefits, an additional 10% is added to rates for 30 years of service and an additional 5% is added to rates for 31+ years of service

Age	Annual Rates of Retirement Group G				
	5 Years of Service	6 – 14 Years of Service	15 – 29 Years of Service	30 Years of Service	31+ Years of Service
57			6.0%	6.0%	6.0%
58			6.0	6.0	6.0
59			8.0	8.0	8.0
60			8.0	8.0	8.0
61			10.0	10.0	10.0
62			10.0	25.0	25.0
63			10.0	25.0	18.0
64			10.0	25.0	18.0
65			10.0	25.0	18.0
66			10.0	25.0	18.0
67	25.0%	25.0%	25.0	25.0	18.0
68	25.0	18.0	18.0	18.0	18.0
69	25.0	18.0	18.0	18.0	18.0
70	100.0	100.0	100.0	100.0	100.0

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX B – ACTUARIAL ASSUMPTIONS AND METHODS

7. Termination Rates

Sample termination rates are as follows:

Age	Annual Rates of Termination			
	<1 Year of Service	1 – 2 Years of Service	3 – 4 Years of Service	5+ Years of Service
20	22.00%	10.00%	8.00%	4.00%
25	22.00	10.00	8.00	4.00
30	22.00	10.00	8.00	4.00
35	22.00	10.00	4.00	4.00
40	22.00	10.00	4.00	2.75
45	22.00	10.00	4.00	1.25
50	22.00	10.00	4.00	1.25
55	22.00	10.00	4.00	1.25
60	22.00	10.00	4.00	1.25
65	22.00	10.00	4.00	1.25
70	22.00	10.00	4.00	1.25

60% of vested members who terminate elect to leave their contributions in the plan in order to be eligible for a benefit at their normal retirement; 40% of members elect to withdraw their contributions

8. Disability Rates

Sample disability rates are as follows:

Age	Annual Rates of Disability ¹
20	0.005%
25	0.010%
30	0.015%
35	0.025%
40	0.045%
45	0.075%
50	0.135%
55	0.210%
60	0.250%
65	0.250%

¹ Rates are 0% when member is eligible for normal retirement

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX B – ACTUARIAL ASSUMPTIONS AND METHODS

9. Part-time Active Members

All part-time active members are assumed to receive a refund of their employee contributions with interest upon leaving the System

10. DROP Participation

60% of eligible CSA Employee members eligible for DROP benefits are assumed to decline participation and 40% are assumed to elect participation. Those electing to participate are assumed to remain in DROP for three years

11. DROP Crediting Rate

3.25% per annum

12. Percent Married

80% of members are assumed to be married for the purpose of valuing pre-retirement survivor benefits

13. Spouse Age Difference

Unless otherwise reported in the data, the male spouse is assumed to be three years older than the female spouse

14. Changes Since Last Valuation

None

APPENDIX B – ACTUARIAL ASSUMPTIONS AND METHODS

B. Methods

1. Actuarial Funding Method

The funding method for the valuation of liabilities used for this valuation is the Entry Age Normal (EAN) method. Under this funding method, a normal cost rate is determined as a level percentage of pay for each active member. The normal cost rate multiplied by payroll equals the total normal cost for each member. The normal cost contributions (Employer and Member) will pay for projected benefits at retirement for each active member.

The actuarial liability is the difference between the present value of future benefits and the present value of future normal costs. The difference between this actuarial liability and the actuarial value of assets is the unfunded actuarial liability (UAL).

The portion of the actuarial liability in excess of plan assets, the UAL, is amortized to develop an additional cost that is added to each year's employer normal cost. Under this funding method, actuarial gains and losses are directly reflected in the size of the unfunded actuarial liability. The amortization method is described below.

2. Amortization Method

The actuarially determined contribution (ADC) is determined as the sum of (a) the employer normal cost rate, (b) the administrative expense rate, and (c) the UAL rate. Based on the Board's funding benchmark, the UAL rate represents the amount necessary to amortize the UAL over a 30 year open period as a level dollar amount.

3. Actuarial Value of Assets

The actuarial value of assets recognizes a portion of the difference between the actual market value of assets and the expected market value of assets, based on the assumed valuation rate of return. The amount recognized each year is 20% of the difference between actual market value and expected market value. In addition, the actuarial value of assets cannot be less than 80%, or more than 120%, of the market value of assets.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

1. Membership

All employees of the City of Cincinnati shall be members of the System except for the following:

- Members of the Police and Fireman’s Disability and Pension Fund of Ohio,
- Elected City officials,
- Employees for whom the City contributes to the Ohio Public Employees Retirement System,
- Members of the faculties, teaching staffs, research staffs, and administrative staff of the University of Cincinnati appointed to positions covered by the Teachers Insurance and Annuity Association Social Security Plan,
- Persons becoming employees after June 1, 1961, who are employed in any of the following employment classifications: bricklayer, carpenter, carpenter foreman, cement finisher, electrician, electrician foreman, painter, painter foreman, plasterer, plumber, sign painter, steamfitter and pipefitter, tinsmith, or composition roofer,
- Persons hired as police recruits who are not currently enrolled as a member of the System prior to their date of hire, and
- Current contributing members of the Ohio School Employees Retirement System (SERS) or the Ohio State Teachers Retirement System (STRS) who are hired by the City on a seasonal, temporary, or part-time basis.

Members of the System are divided into the following groups:

Group	Criteria
A, B	Any member who has retired prior to 7/1/2011
C	Any member who, as of June 30, 2011, was an active or deferred vested member and had either: a) Completed at least 30 years of service, or b) Reached age 60 and completed at least 5 years of service
D	Any active member who, between July 1, 2011 and December 31, 2013: 1) Either a) Completed at least 30 years of service, or b) Reached age 60 and completed at least 5 years of service; and 2) Retired prior to January 1, 2014
E	Any active member who: 1) Between July 1, 2011 and December 31, 2013 either: a) Completed at least 30 years of service, or b) Reached age 60 and completed at least 5 years of service; and 2) Retires on or after January 1, 2014

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

F	Any active member whose most recent membership enrollment date was prior to January 1, 2010 and who is not in groups A through E Any deferred vested member whose most recent membership enrollment date was prior to January 1, 2010, is not in groups A through E, and has at least five years of service prior to the date separated from employment
G	Any member whose most recent membership enrollment date is on or after January 1, 2010, or Any member rehired on or after January 1, 2010, who has fewer than five years of service as of June 30, 2011, or Any retiree of the System who is receiving service retirement allowance and is re-employed on or after April 1, 2013

Members in the System are further classified as follows:

Class	Criteria
CSA Retiree (CSA participants corresponding to Retirees Class)	Group A and B members and their designated optionees
CSA Employee (CSA participants corresponding to Current Employees Class)	Group C, D, E and F members (and their designated optionees) that were vested and employed on July 1, 2011
CMC Employee (Non-CSA participants)	Group E and F members (and their designated optionees) that were either vested or employed on July 1, 2011 and no break in employment service since January 1, 2010 and prior to becoming vested
Non-CSA	Group G members and their designated optionees

2. Service Retirement Benefit

Groups A, B, C and D

Normal Retirement Eligibility Age 60 with 5 years of service or 30 years of service

Early Retirement Eligibility Age 55 with 25 years of service

Benefit Formula Multiplier Members hired prior to July 12, 1998 were given a one-time irrevocable option to choose either the benefit formula using a 2.22% multiplier or the benefit formula using a 2.50% multiplier. For members hired on or after July 12, 1998, benefits are calculated using a 2.50%

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

Average Highest Compensation	multiplier Average of the highest three consecutive years of compensation
Years of Service	Years or fractional years of full-time service rendered to the plan sponsor
Benefit	a) An annuity which is actuarially equivalent to the accumulated contributions of the member at the time of retirement b) A pension which together with the annuity produces a total annual retirement allowance equal to the product of the applicable benefit formula multiplier, the member's average highest compensation and the number of years of service Early Retirement Benefit is actuarially reduced from normal retirement age

Group E

Normal Retirement Eligibility	Age 60 with 5 years of service or 30 years of service
Early Retirement Eligibility	Age 55 with 25 years of service

Retirement benefit is composed of as many as three components:

Part A Benefit

For service earned through December 31, 2013

Part B Benefit

For service earned on and after January 1, 2014 up to a combined (Part A and Part B) 20 years of service

Part C Benefit

For service earned on and after January 1, 2014 in excess of a combined (Part A and Part B) 20 years of service

Benefit Formula Multiplier

Part A Benefit

Members hired prior to July 12, 1998 were given a one-time irrevocable option to choose either the benefit formula using a 2.22% multiplier or the benefit formula using a 2.50% multiplier. For members hired on or after July 12, 1998, benefits are calculated using a 2.50% multiplier

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

Part B Benefit

Members hired prior to July 12, 1998 were given a one-time irrevocable option to choose either the benefit formula using a 2.22% multiplier or the benefit formula using a 2.50% multiplier. For members hired on or after July 12, 1998, benefits are calculated using a 2.50% multiplier

Part C Benefit

2.20% multiplier

Average Highest
Compensation

Part A Benefit

Average of the highest three consecutive years of compensation

Part B Benefit

Average of the highest five consecutive years of compensation

Part C Benefit

Average of the highest five consecutive years of compensation

Years of Service

Years or fractional years of full-time service rendered to the plan sponsor

Benefit

a) An annuity which is actuarially equivalent to the accumulated contributions of the member at the time of retirement

b) A pension which together with the annuity produces a total annual retirement allowance equal to the sum of Part A, Part B and Part C benefits each of which is the product of the applicable benefit formula multiplier, the applicable average highest compensation and the applicable number of years of service

Early Retirement Benefit is actuarially reduced from normal retirement age

Group F

Normal Retirement Eligibility

Age 60 with 5 years of service or 30 years of service

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

Early Retirement Eligibility Age 55 with 25 years of service

Retirement benefit is composed of as many as three components:

Part A Benefit

For service earned through June 30, 2011

Part B Benefit

For service earned on and after July 1, 2011 up to a combined (Part A and Part B) 20 years of service

Part C Benefit

For service earned on and after July 1, 2011 in excess of a combined (Part A and Part B) 20 years of service

Benefit Formula Multiplier

Part A Benefit

Members hired prior to July 12, 1998 were given a one-time irrevocable option to choose either the benefit formula using a 2.22% multiplier or the benefit formula using a 2.50% multiplier. For members hired on or after July 12, 1998, benefits are calculated using a 2.50% multiplier

Part B Benefit

Members hired prior to July 12, 1998 were given a one-time irrevocable option to choose either the benefit formula using a 2.22% multiplier or the benefit formula using a 2.50% multiplier. For members hired on or after July 12, 1998, benefits are calculated using a 2.50% multiplier

Part C Benefit

2.20% multiplier

Average Highest
Compensation

Part A Benefit

Average of the highest three consecutive years of compensation

Part B Benefit

Average of the highest five consecutive years of compensation

Part C Benefit

Average of the highest five consecutive years of compensation

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

Years of Service	Years or fractional years of full-time service rendered to the plan sponsor
Benefit	<p>a) An annuity which is actuarially equivalent to the accumulated contributions of the member at the time of retirement</p> <p>b) A pension which together with the annuity produces a total annual retirement allowance equal to the sum of Part A, Part B and Part C benefits each of which is the product of the applicable benefit formula multiplier, the applicable average highest compensation and the applicable number of years of service</p> <p>Early Retirement Benefit is actuarially reduced from normal retirement age</p>
<i>Group G</i>	
Normal Retirement Eligibility	Age 67 with 5 years of service or age 62 with 30 years of service
Early Retirement Eligibility	Age 57 with 15 years of service
Benefit Formula Multiplier	Benefit is calculated using a 2.20% multiplier for all years of service up to 30 years and a 2.00% multiplier for all service in excess of 30 years
Average Highest Compensation	Average of the highest five consecutive years of compensation
Years of Service	Years or fractional years of full-time service rendered to the plan sponsor
Benefit	<p>a) An annuity which is actuarially equivalent to the accumulated contributions of the member at the time of retirement</p> <p>b) A pension which together with the annuity produces a total annual retirement allowance equal to the product of the applicable benefit formula multiplier, the member's average highest compensation and the number of years of service</p> <p>Early Retirement Benefit is actuarially reduced from normal retirement age</p>

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

All Groups

In no event shall the retirement allowance be greater than 90% of a member's average highest compensation.

In no event shall the retirement allowance be greater than that permitted by Section 415 of the Internal Revenue Code.

The average highest compensation used in the calculation of benefits depends on which benefit formula applies to the member. The formula that uses the 2.22% multiplier includes overtime compensation and the lump sum payment for unused vacation and sick-pay. The formulas that use all other multipliers do not include overtime or the lump sum payment.

3. Disability Retirement Benefit

Eligibility	5 years of service
Benefit	90% of normal retirement benefit at disability date but not less than the smaller of: a) 25% of average highest compensation b) 90% of the retirement benefit the member would have become entitled to had he continued in service to normal retirement age without further change in average highest compensation

4. Deferred Vested Retirement Benefit

Eligibility	5 years of service
Benefit	Normal retirement benefit beginning at normal retirement age

5. Pre-retirement Death Benefit

- 1) Contributions with interest
- 2) Survivor Benefits according to the type of survivors if member has at least 18 months of service

6. Post-retirement Death Benefit

- 1) \$5,000 lump sum for Groups A and B
- 2) If no Joint and Survivor Option is selected, balance of member contributions not received back in retirement benefit payments prior to death

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

7. Optional Forms of Benefit

- 1) Joint and 100% Survivor Payment
- 2) Joint and 50% Survivor Payment
- 3) 66 2/3% Joint and Survivor Payment
- 4) 80% Joint and Survivor Payment

8. Cost-of-Living Adjustments (COLA)

Groups A and B

3% simple COLA based on the member's benefit on January 1, 2016 including all previously granted COLAs. Effective January 1, 2016, the COLA will be suspended for a 3-year period

In the 3rd year of the COLA suspension (calendar year 2018), members will receive a one-time payment that is the lesser of 3% of their base pension benefit or \$1,000. This payment will be made on January 1, or the anniversary date of the member's retirement according to when the member normally receives a COLA

Groups C, D, E, F and G

3% simple COLA based on the initial gross monthly benefit with a 3-year delay following each member's date of retirement

Poverty Exception

Any member of the Retirees Class or Current Employees Class who retired or retires with at least 5 years of service and whose household income is below 150% of federal poverty guidelines will receive a 3% compounding COLA until such time income exceeds 150% of federal poverty guidelines, at which time the member will receive a 3% simple COLA

9. Contributions

Members

Each member, commencing January 1, 1978, contributes at a rate of 7.0% of the salary used to compute retirement benefits until retirement. Beginning January 1, 2010, the employee contribution rate was increased 0.5% per year over 4 years to reach 9.0% of pay. The CSA establishes that the contribution rate for members shall not exceed 9.0% of pay for the term of the agreement

Employers

The sponsoring employer makes annual contributions based on members' salaries so that, when members become eligible for benefits, reserves will have been accumulated to provide the pension and other benefits payable by the plan on account of creditable service

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX C – SUMMARY OF PLAN PROVISIONS

10. Deferred Retirement Option Plan (DROP)

Eligibility	Current Employees Class members with at least 30 years of service
Maximum Participation Period	5 years
Minimum Participation Period	Participation in DROP for less than 2 years results in forfeiture of all interest earnings credited to the member's DROP account
Benefit	Monthly pension benefit calculated as if eligible member actually retired on their DROP effective date, including any adjustments for an assigned optionee. The monthly pension benefit will be contributed to the member's DROP account in the CRS Pension Trust and paid out as a lump sum upon termination from the DROP
Employee Contributions	Members continue to contribute 9.0% of pay while participating in DROP. 75% of the contribution is credited to the member's DROP account and the remaining 25% of the contribution is paid to the CRS Pension Trust to offset the costs of administering the DROP
Employer Contributions	Employer contributions to the CRS Pension Trust continue to apply in the same manner as for other actively employed members who are not participating in the DROP. Employer contributions are not credited to the member's DROP account
Interest	DROP account balances are credited each month at a rate equal to the 10-year U.S. Treasury Note Business Day Series adjusted quarterly with a cap of 5% but not less than 0%

11. Changes Since Last Valuation

None

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX D – GLOSSARY OF TERMS

1. Actuarial Assumptions

Assumptions as to the occurrence of future events affecting pension costs, such as: mortality, withdrawal, disability, and retirement; changes in compensation; inflation; rates of investment earnings, and asset appreciation or depreciation; and other relevant items.

2. Actuarial Cost Method

A procedure for determining the Actuarial Present Value of pension plan benefits and expenses and for developing an allocation of such value to each year of service, usually in the form of a Normal Cost and an Actuarial Liability.

3. Actuarial Gain/(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, as determined in accordance with a particular Actuarial Cost Method.

4. Actuarial Liability

The portion of the Actuarial Present Value of Projected Benefits which will not be paid by future Normal Costs. It represents the value of the past Normal Costs with interest to the valuation date.

5. Actuarial Present Value (Present Value)

The value as of a given date of a future amount or series of payments. The Actuarial Present Value discounts the payments to the given date at the assumed investment return and includes the probability of the payment being made. As a simple example: assume you owe \$100 to a friend one year from now. Also, assume there is a 1% probability of your friend dying over the next year, in which case you won't be obligated to pay him. If the assumed investment return is 10%, the actuarial present value is:

$$\frac{\text{Amount}}{\text{Payment}} \times \frac{\text{Probability of}}{(1 - .01)} \times \frac{1}{(1 + \text{Investment Return})} = \$90$$

6. Actuarial Valuation

The determination, as of a specified date, of the Normal Cost, Actuarial Liability, Actuarial Value of Assets, and related Actuarial Present Values for a pension plan.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX D – GLOSSARY OF TERMS

7. Actuarial Value of Assets

The value of cash, investments and other property belonging to a pension plan as used by the actuary for the purpose of an Actuarial Valuation. The purpose of an Actuarial Value of Assets is to smooth out fluctuations in market values. This way long-term costs are not distorted by short-term fluctuations in the market.

8. Actuarially Equivalent

Of equal Actuarial Present Value, determined as of a given date with each value based on the same set of Actuarial Assumptions.

9. Amortization Payment

The portion of the pension plan contribution which is designed to pay interest and principal on the Unfunded Actuarial Liability in order to pay for that liability in a given number of years.

10. Entry Age Normal Cost Method

A method under which the Actuarial Liability is calculated as the Actuarial Present Value of the Projected Benefits allocated to periods prior to the valuation year.

11. Funded Ratio

The ratio of the Actuarial Value of Assets to the Actuarial Liabilities.

12. Investment Return Assumption

The assumed interest rate used for projecting dollar related values in the future.

13. Mortality Table

A set of percentages which estimate the probability of death at a particular point in time. Typically, the rates are annual and based on age and sex.

14. 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.

**CINCINNATI RETIREMENT SYSTEM
ACTUARIAL VALUATION AS OF DECEMBER 31, 2018**

APPENDIX D – GLOSSARY OF TERMS

15. Projected Benefits

Those pension plan benefit amounts which are expected to be paid in the future under a particular set of Actuarial Assumptions, taking into account such items as the effect of advancement in age and increases in future compensation and service credits.

16. Unfunded Actuarial Liability

The excess of the Actuarial Liability over the Actuarial Value of Assets.



Classic Values, Innovative Advice