June 4, 2019

The Honorable Scott M. Stringer
New York City Comptroller
Office of the New York City Comptroller
One Centre Street
New York, NY 10007

Re: Independent Actuary's Certification Regarding the Funding of the Five Actuarially-Funded New York City Retirement Systems

Dear Comptroller Stringer:

Bolton Partners, Inc. is pleased to present our Independent Actuarial Certification. This is one of the deliverables under our second biennial engagement to serve as Independent Actuary under Section 96 of the New York City Charter. Bolton Partners was hired by the Comptroller to perform an actuarial audit of the following five New York City Retirement Systems (NYCRS):

- New York City Employees' Retirement System (NYCERS)
- Teachers' Retirement System of the City of New York (TRS)
- Board of Education Retirement System of the City of New York (BERS)
- New York City Police Pension Fund (POLICE)
- New York City Fire Pension Fund (FIRE)

Our second engagement encompasses the following:

- Contribution Audits of the computed employer contributions for each System in NYCRS for fiscal year 2018 (including an audit of actuarial accrued liabilities and actuarial valuation of assets);

- Experience Studies for the 4-year and 10-year periods ending June 30, 2017, for each System in NYCRS;

- An Administrative Review of the data gathering and maintenance practices of the Office of the Actuary (OA) and each System in NYCRS; and

- An Independent Actuarial Statement; Bolton Partners, as the independent actuarial auditor, will submit a statement that will briefly describe the scope of the entire engagement, will review the entire engagement and comment on the financial condition and financing progress and policies of each System, and certify that the Systems are being funded on sound actuarial, financial, and legal bases.

This report constitutes the deliverable with respect to the Independent Actuarial Statement for the second engagement. The purpose of this report is to:

- Summarize the findings from the Contribution Audit, the Experience Study and the Administrative Review from the second engagement; and

- Provide each System with a certification of the findings of the second engagement.

The Comptroller's office also asked us to provide recommendations for changes in the audit process, so as to make the audit more useful and to streamline the work. We have addressed our thoughts on this issue at the end of the Summary of Conclusions section below.

A separate certification is provided for each plan. These certifications cover:

- An affirmative statement as to the independence of the actuary,
- Summary of findings from the Contribution Audit, the Experience Study and the Administrative Review,
- Review of the financial objectives and soundness of each plan,
- Assessment regarding the overall quality of valuation data,
- Evaluation of the appropriateness of actuarial assumptions and methods,
- Assessment of the adequacy of the employer contributions to each system,
- Summary of our recommended changes in general and for each system, based on the three major project components, and
- Estimated cost impact of our recommendations.

Summary of Conclusions:

Contribution Audit:

The Contribution Audit involved programming our own independent PROVAL program and comparing sample life results. To ensure our independence, we were not provided with OA's coding for the valuation or coding for the sample lives we received.

We have determined that the FY18 employer contributions for all Systems were reasonable and appropriate. Many of the comments from our first engagement, as well as many from this engagement, have been addressed by OA. Perhaps the most significant of these is the valuation of the subsidized interest rates for TRS and BERS TDAs. We also understand that OA changed the "LAG" method in the 2018 valuation. While we identified some additional issues during the second engagement, all of these issues have a very minor effect on the valuation results.

Key values from our replication work are presented in the following table:

Comparison of OA and Bolton Results ($ Millions)						
System	Category	OA Results	Bolton Results	Percentage Difference	Tolerance Limit	Pass / Fail
NYCERS	PVFB	$ 95,785	$ 96,117	0.35%	4.00%	Pass
	Employer Contribution	$ 3,377	$ 3,405	0.84%	5.00%	Pass
TRS	PVFB	$ 85,762	$ 86,246	0.56%	4.00%	Pass
	Employer Contribution	$ 3,890	$ 3,947	1.47%	5.00%	Pass
BERS	PVFB	$ 6,133	$ 6,166	0.54%	4.00%	Pass
	Employer Contribution	$ 319	$ 323	1.27%	5.00%	Pass
POLICE	PVFB	$ 62,348	$ 62,292	-0.09%	4.00%	Pass
	Employer Contribution	$ 2,415	$ 2,408	-0.30%	5.00%	Pass
FIRE	PVFB	$ 25,154	$ 25,051	-0.41%	4.00%	Pass
	Employer Contribution	$ 1,200	$ 1,188	-1.03%	5.00%	Pass
Total	**PVFB**	**$ 275,182**	**$ 275,872**	**0.25%**		
	Employer Contribution	**$ 11,201**	**$ 11,271**	**0.63%**		

Experience Study:

The Experience Study project was the largest of the three projects. We completed experience tables for all key decrements for each plan and all material participant groups. As with the other projects, this is the second of two biennial projects. We suggested assumption changes which we understand were adopted and would have increased the City contribution for 2018 by $106 million or 1%. The impact varied materially by plan, with the largest effect on the FIRE System.

While we are not suggesting changes to the long-term rate of return or to the inflation assumptions, we are suggesting changes to many of the demographic assumptions. The most significant change is due to a change in the methodology. We suggest changing the basis of the retiree mortality experience analysis from focusing on just lives, to weighting those lives by the liabilities associated with those lives.

Overall, we found that the assumptions chosen by the Office of the Actuary (OA) reasonably model the plans' experience. The relative size of the suggested changes in assumptions and the impact of suggested changes by plan can be found in Sections A-E at the end of this certification.

Administrative Review:

The Administrative Review consisted largely of an update of our 2018 report. As with the 2018 report, the new Administrative Review focused on the Systems' processes for gathering, validating, and maintaining member data, as well as the OA's processes for obtaining and independently validating the member data used in preparing the annual actuarial valuations. We also looked at retirement calculation and certification processes, and reviewed data security measures. Overall, we found that the Systems and the OA have procedures in place that should result in complete and accurate member data for use in the valuations. Several of the Systems have recently implemented, or plan to implement in the near future, new data management systems to further enhance the quality of their member data.

Due to the short amount of time between the First and Second Engagements, our process for the Second Engagement focused on gathering information about any changes in processes or procedures, determining which items identified in the First Engagement are still relevant, and determining if any new recommendations should be made. We had meetings with the OA in January 2019 and each of the Systems individually in February and March 2019.

Additional recommendations:

a. Changes to the Audit Cycle:

Current Audit Cycle:

The City Charter requires an actuarial audit once every two years. In the past (including this report) this was accomplished by hiring an actuarial firm to perform two consecutive biennial audits. Under our contract we reviewed the 2014 and 2016 actuarial reports, one under our "first engagement" and one under our "second engagement." Each engagement covered all five plans and required significant involvement of NYC staff from various agencies. For example, for the second engagement the OA provided us with 89 sample lives to allow us to reasonably review a sample of the large number of combinations of plans/groups/tiers with individual benefit provisions and assumptions. This level of detail helped identify most of the issues we did find but was time consuming for OA staff, as they needed to provide these samples within a fairly narrow window of time.

The first engagement for the Replication Audit and Administrative Review work took up far more time than the second engagement. There was a considerable amount of time spent learning and setting up our valuation models (programming of the plan provisions and assumptions). Most of the issues we discovered in the Replication Audit and Administrative Review were found in the first engagement while the second engagement built off of the first.

The experience study work was materially different between the first and second engagements. Even more than in the other two reviews significant time was spent learning about the plan benefit provisions, assumptions and the underlying quirks of the participant data during the first engagement. This is not surprising since this was the largest of the three projects. While the second engagement also required as much "data work", it was different in that it involved more work in developing appropriate suggested changes to assumptions, reflecting both prior experience and factors that may cause prior experience to not be an appropriate measure of future experience. We also determined the additional cost (in the form of higher annual contributions) of those recommendations, which required a large number of computer runs (about 460). Results for all five plans were reviewed over about a six-month period with Bolton, OA and the Comptroller's office.

Recommendation for a new audit cycle:

We recommend changing the current audit cycle as follows.

- First, the replication audits would be done in four year cycles. The first year would include replications of the POLICE and FIRE Systems. The second year would include replications of the TRS and BERS Systems. Year three would include a replication of the NYCERS System. The fourth year would include an overall replication of all five of the systems, to address the changes made in the prior years.
- Second, the experience study would be divided into four experience studies, one done each year. The first would include only the POLICE and FIRE systems, the second the TRS and BERS systems and the third NYCERS. The fourth year would be an extensive review of the economic assumptions, including an analysis of the effect on the salary assumptions reflected in the prior experience studies as well as the investment return and inflation assumptions. This report would also address any issues that came up in the experience reviews of the systems which are systemic in nature. For example, if issues were discovered in the review of the TRS and BERS systems that also would affect the POLICE and FIRE experience studies, these issues would addressed in the fourth year.
- Third, the current administrative review would be done once in the third year, rather than in the second and fourth year. This would allow the systems more time to implement changes and help in the experience study process by identifying the quirks in the participant data and data gathering processes to be better understood before the experience audit.

This approach would reduce the work required of the OA, as well as the work of the actuarial contractor, while allowing the actuarial contractor more time to study each system, and apply those lessons to both earlier and later reviews.

b. Special mini-annual reviews of economic assumptions:
The actuarial standards require that assumptions be reasonable as of the valuation date. Waiting every four years to do a major review is appropriate for demographic assumptions but may be too long of a period for economic assumptions. We would suggest a quick annual review of the economic assumptions against the trends shown in the annual NASRA discount rate study as well as two investment return comparisons: the expectations from the Systems' investment advisors and a comparison to the annual investment returns by investment category study by Horizon or some other publicly available survey. This is a review that could be done by the OA or the actuarial contractor. The purpose would be simply to ascertain whether there have been any material changes in the market investment return expectations. Similarly, we would suggest that the inflation assumption be checked against the Systems' investment advisors' inflation expectations, the Federal Reserve's expectations and the investment market expectations as measured by the TBI yield curves. Finally, the Social Security Administration's and Bureau of Labor Statistics expectations of the real salary growth could be used to review the OA's real salary growth assumption.

This mini review could be used either to replace the review of the economic assumptions done as part of the actuarial audit or in combination with that audit.

c. ASOP 51 – risk assessments:
The newly adopted Actuarial Standard of Practice (ASOP 51) applies to valuations after November 1, 2018. ASOP 51 provides guidance regarding the assessment and disclosure of pension risk. The standard requires the identification of types of risk that could materially impact pension plans, such as the Systems. Obvious examples are investment risk and plan maturity. By plan maturity, we mean the increase in the ratio of assets and liabilities to payroll, resulting in increasing volatility in the annual contribution amounts. There is no requirement that there be any quantitative assessment of risk included in the report. However, some quantitative assessments are easy and obvious, like the growth of the plan's assets relative to payroll. The significance of various risks can be explained by the plan's actuary.

ASOP 51 also includes a statement that "If, in the actuary's professional judgment, a more detailed assessment would be significantly beneficial for the intended user to understand the risks identified by the actuary, the actuary should recommend to the intended user that such an assessment be performed." ASOP 51 further states that factors that should be considered as part of that judgement include the size of the plan and the level of plan maturity. NYCRS certainly is large enough to support more quantitative risk assessment than most plans. Each of the Systems (except POLICE) have negative cash flow (which we define as benefit payments and expenses in excess of contributions). Both factors (size and maturity) suggest that quantitative projections of risk would be a valuable addition to the Systems' actuarial reports. We suggest that the next actuarial audit report review OA's compliance with ASOP51 and suggest other quantitative projects which might add enough value to the reports' readers to justify the extra work.

d. Overwhelming numbers of tables and assumptions used in the actuarial valuation reports:
The total number of tables and load factors makes the work difficult and the reports long. We recommend that a few groups or assumptions be set aside for the experience study on an eight-year basis and that OA set a specific review period for review of the load factors.

e. Scope of the Administrative Review:
We are of two minds on the best approach to the Administrative Review. Currently, the Administrative Review is a sounding board and a place to document findings but has a limited scope. If the City, OA and the Systems find this useful, it should be continued. If not, it should be ended. However, we also believe that the Administrative Review could be substantially more useful. If the scope were to be expanded and not too duplicative, the logical next step would be to review a sample of the benefit calculations done for each System to better understand any differences between the process to assemble the valuation data and the benefit calculation data, any potential issues with the current valuation data and how the Systems ensure that benefit calculations are correctly done.

f. Other Issues:
We suggest that the following topics be addressed either by the OA or in the next actuarial audit:

(1) Cost allocations between employers,
(2) Compliance with New York funding laws, and
(3) Weighting non-mortality decrements by liabilities.

Certification:
Bolton Partners is pleased to certify that the Systems are being funded in conformity with all applicable actuarial, financial and statutory requirements.

Sections A-E that follow contain the Independent Actuary's Statement for each of the five Systems.

We want to thank Preston Niblack, Rosa Charles and Michael Hecht from the Comptroller's Office and Sherry Chan, Michael Samet and Anderson Huynh at the Office of the Actuary and their colleagues for their assistance in providing us the required data and sample life information, as well as promptly answering our questions regarding sample life calculations and other issues regarding plan provisions, funding methods and assumptions, participant data and practice.

We also want to thank the staffs at each System for providing documents and spending time answering our many questions. Their assistance was crucial to our work.

Finally, we want to thank the members of the Actuarial Audit Oversight Committee for their thoughtful review of our work.

We are available to answer any questions on the material in this report or to provide explanations or further details as appropriate. Tom, Colin, Kevin and Jordan meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained in this report. Tom's and Colin's roles cover all parts of this report. The roles of others are limited to certain parts of our work. Erika's and Kari's roles relate to the Administrative Review. Kevin's role relates to the Experience Study. Jordan's role relates to the Replication work. We are not aware of any direct or material indirect financial interest or relationship, including investments or other services that could create a conflict of interest, which would impair the objectivity of our work or not make our work independent.

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo
Administrative Review Assistant Project Manager

Section A

Independent Actuary's Statement for the New York City Employees' Retirement System (NYCERS)

Bolton Partners was hired by the Comptroller to serve as the Independent Actuary and provide other services related to the review of the funding of NYCERS.

Bolton Partners has completed the second of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2017 (the Experience Study)
- A review of the data gathering and maintenance practices of the OA and NYCERS (the Administrative Review).

Review of Financial Objectives and Soundness of NYCERS and Adequacy of Employer Contributions

Based on the Contribution Audit, the Experience Studies, and the Administrative Review for NYCERS, Bolton Partners certifies that NYCERS is being funded in accordance with Standards of Practice prescribed by the Actuarial Standards Board and in conformity with the applicable New York State and New York City Statutes. Assuming continued funding of NYCERS by the City/Obligors on the basis used in the June 30, 2016 (Lag) Actuarial Valuation, we believe the City's funding objective (that these statutorily required contributions, together with member contributions and assumed investment income will be sufficient to pay benefits when due) will be achieved.

As of June 30, 2016, NYCERS had approximately $79 billion in actuarial liabilities[1] and $55 billion in assets at market value. The FY18 contribution was approximately $3.4 billion. Stating that financial objectives are being met is easy given that the contributions are expected to be enough to pay the normal cost and eventually pay off the unfunded liabilities. The concept of "actuarial soundness" is one we try to avoid. To some it might mean that all benefits are funded at a level where benefits could be settled[2], a level that the plan is not attempting to fund toward. The plan is sound in the sense that if the Actuarially Determined Contribution (ADC) continues to be paid then the plan is expected to become 100% funded at the 7% discount rate. Investments in stocks and other investments will continue to present risks.

Employer Contribution Audit for Fiscal Year 2018 (2016 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2016 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2018. There were no major findings specific to NYCERS.

---

[1] Please note that we use the term "actuarial liabilities" or "liabilities" to refer to the portion of the total present value of future benefits (PVFB) shown in table on page 3 that has been assigned to past service. Necessarily, the actuarial liabilities will be substantially lower than the PVFB for groups that include employees who have not earned all of the benefits that they are expected to receive.

[2] The concept of a "settlement" liability would include determining the amount needed to buy annuities or bonds to defease the liabilities. This could require the use of discount rates similar to the Treasury yield curves, resulting in effective discount rates that are substantially lower than the 7% discount rate and result in larger liability values.

Our replication results for NYCERS were as follows:

Comparison of OA and BP Results ($ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass / Fail
NYCERS	PVFB	$ 95,785	$ 96,117	0.35%	4.00%	Pass
	Employer Contribution	$3,377	$ 3,405	0.84%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2017. New York City Employees' Retirement System (NYCERS) is the most complex of the City's plans due to the eleven contributing employers, with different provisions that result in the division of the members into five separate groups for purposes of the application of actuarial assumptions.

Below is a chart showing some level of detail in the assumption changes for different NYCERS groups:

	General	TRA/TBTA	Sanitation	Corrections
Service Retirement Mortality				
Male Lives	No Change	No Change	No Change	No Change
Male Liabilities	Decrease 11%	Decrease 5%	Decrease 6%	Decrease 11%
Female Lives	Increase 2%	Increase 13%	No Change	No Change
Female Liabilities	Decrease 3%	Increase 12%	Decrease 6%	Decrease 11%
Disabled Retirement Mortality				
Male Lives	Increase 4%	Increase 2%	No Change	Decrease 15%
Male Liabilities	No Change	Increase 3%	No Change	Decrease 29%
Female Lives	No Change	No Change	No Change	No Change
Female Liabilities	No Change	Decrease 10%	No Change	Decrease 23%
Employee Mortality				
Ordinary	Decrease 40%	Decrease 40%	No Change	Reduce 50%
Accidental	N/A	Decrease 40%	No Change	Reduce 50%
Unreduced Retirement Elected				
First Year	No Change	No Change	No Change	No Change
After First Year	No Change	No Change	No Change	No Change
Unreduced Retirement Mandated				
First Year	Decrease 60% Ages Less than 62	Increase 10% <age 62 Decrease 50% age 62-69	Decrease 25%	No Change
After First Year	Decrease 50% Ages Less than 63	Decrease 40% age 64-79	Decrease 50%	No Change
Early Retirement	Increase 75%	No Change	N/A	N/A
Withdrawal	Increase 40%	Increase 10%	No Change	Increase 50%
Disability				
Ordinary	Decrease 30%	No Change	No Change	No Change
Accidental	Decrease 30%	No Change	No Change	Increase 25%
Pay Related				
Merit	No Change	Avg. 58% increase	Avg. Decrease by 27%	No Change
Overtime	Increase 75%	No Change	No Change	Increase 50%
Dual Retirement	Increase 25%	No Change	No Change	Increase 50%
Dual Disability	Increase 25%	No Change	No Change	No Change

The impact of these changes on the City's contributions to NYCERS is shown in the following chart:

Assumption	Effect on Annual Contribution	Cumulative Contribution ($ in millions)
1. Contribution Determined in 2016 Valuation	N/A	3,405.4
2. Retired Mortality	118.3	3,523.8
3. Active Mortality	4.9	3,528.7
4. Retirement	(207.8)	3,320.9
5. Withdrawal	(24.7)	3,296.2
6. Disability Rates	(7.4)	3,288.8
7. Merit Salary	44.5	3,333.3
8. Overtime	37.5	3,370.8

The overall result of the revisions to the NYCERS assumptions is a slight ($34.6 million) decrease in cost, largely due to the change in the retirement assumptions because employees are retiring later than previously assumed.

Administrative Review

Bolton Partners has performed its Administrative Review of NYCERS. We conducted separate meetings with NYCERS staff and OA staff to discuss member data processes, calculation/certification processes, and data security measures. NYCERS is in the RFP stage of developing a new data management system, since their current system is decades old and does not include recent technological enhancements. It is expected that the new system will allow for secure transmission of member data to the OA via FTP, and that it will have greater capability to flag year-over-year static data changes to reduce the number of questions generated by the OA. The new system is expected to improve efficiency and security, but we found that the member data contained in the current system is of high quality. There are well-defined and well-documented processes in place for collection and validation of the data. We conclude that the data gathering and validation processes at NYCERS and the OA result in data that is of sufficient quality for the actuarial valuations and experience studies. Further, we found that NYCERS and the OA have a solid working relationship, which fosters a spirit of cooperation between them. Details of our specific recommendations can be found in our separate Administrative Review report.

Our key recommendations are:

1. ***Ensure deputies are trained and proficient on senior job roles in their departments. This will aid in succession planning and allow promotion from within the organization.***
2. ***Continue to devote resources to the development and implementation of a new pension management system.***
3. ***Reach out to TRS and BERS about the rollouts of their new pension management systems to learn from their successes and mistakes. This will help NYCERS set appropriate expectations for their own system rollout process.***
4. ***Continue to engage with the OA to understand their data needs.***
5. ***Review and update documentation of policies (particularly records retention). This should be a constant effort as policies evolve and change.***

6. ***Clearly define metrics for measuring the "success" of the pension outreach division (POP). Monitoring these metrics will help NYCERS decide on and devote necessary resources to this division.***

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

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo
Administrative Review Assistant Project Manager

Section B

Independent Actuary's Statement for the Teachers' Retirement System of the City of New York (TRS)

Bolton Partners was hired by the Comptroller to serve as the Independent Actuary and provide other services related to the review of the funding of TRS.

Bolton Partners has completed the first of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (the Contribution Audit)

- The experience of the plan for the 4-year and 10-year periods ending June 30, 2017 (the Experience Study)

- A review of the data gathering and maintenance practices of the OA and TRS (the Administrative Review).

Review of Financial Objectives and Soundness of TRS and Adequacy of Employer Contributions:

Based on the Contribution Audit, the Experience Studies, and the Administrative Review for TRS, Bolton Partners certifies that TRS is being funded in accordance with Standards of Practice prescribed by the Actuarial Standards Board and in conformity with the applicable New York State and New York City Statutes. Assuming continued funding of TRS by the City/Obligors on the basis used in the June 30, 2016 (Lag) Actuarial Valuation, we believe the City's funding objective (that these statutorily required contributions, together with member contributions and assumed investment income will be sufficient to pay benefits when due) will be achieved.

As of June 30, 2016, TRS had approximately $70 billion in liabilities[3] and $44 billion in assets. The FY18 contribution was approximately $3.9 billion. Stating that financial objectives are being met is easy given that the contributions are expected to be enough to pay the normal cost and eventually pay off the unfunded liabilities. The concept of "actuarial soundness" is one we try to avoid. To some it might mean that all benefits are funded at a level where benefits could be settled[4], a level that the plan is not attempting to fund toward. The plan is sound in the sense that if the Actuarially Determined Contribution (ADC) continues to be paid then the plan is expected become 100% funded at the 7% discount rate. Investments in stocks and other investments will continue to present risks.

---

[3] Please note that we use the term "actuarial liabilities" or "liabilities" to refer to the portion of the total present value of future benefits (PVFB) shown in table on page 3 that has been assigned to past service. Necessarily, the actuarial liabilities will be substantially lower than the PVFB for groups that include employees who have not earned all of the benefits that they are expected to receive.

[4] The concept of a "settlement" liability would include determining the amount needed to buy annuities or bonds to defease the liabilities. This could require the use of discount rates similar to the Treasury yield curves, resulting in effective discount rates that are substantially lower than the 7% discount rate and result in larger liability values.

Employer Contribution Audit for Fiscal Year 2018 (2016 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2016 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2018. There were some findings specific to TRS that should be addressed. The most significant is that the subsidized interest rates (and to a lesser extent the annuity conversion factors) associated with the Tax Deferred Annuity (TDA) plan have a cost to the plan. This cost is currently recognized as an actuarial loss each year, and then the cost is funded over future years through higher annual contributions. However, we believe that the better funding approach would be to recognize the value of this subsidized interest credit prior to its payment and reflect it in the annual costs and recommend that the OA adopt this approach. Then, when the payments are made there will be a smaller actuarial gain or loss for the difference between the expected and actual amounts credited, rather than a loss for the total subsidy. We note that the OA is now including in the annual valuation a cost reflecting the value of the subsidy earned in the current year. The BERS plan has this same issue. Our Replication Audit Report has more detail on this issue.

Our replication results for TRS were as follows:

Comparison of OA and BP Results ($ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass/ Fail
TRS	PVFB	$ 85,762	$ 86,246	-0.56%	4.00%	Pass
	Employer Contribution	$ 3,890	$ 3,947	1.47%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2017.

Below is a chart showing in some level of detail the assumption changes for TRS:

	TRS
Service Retirement Mortality	
Male Lives	Decrease 2%
Male Liabilities	Decrease 11%
Female Lives	Increase 8%
Female Liabilities	Increase 2%
Disabled Retirement Mortality	
Male Lives	No Change
Male Liabilities	Decrease 6%
Female Lives	Increase 4%
Female Liabilities	No Change
Employee Mortality	
Ordinary	Increase 25% Women Only
Accidental	N/A
Unreduced Retirement Elected	
First Year	Increase 25%
After First Year	Increase 10%
Unreduced Retirement Mandated	
First Year	Decrease 10%
After First Year	Set to 20%
Early Retirement	Increase 25%
Withdrawal	No Change
Disability	
Ordinary	No Change
Accidental	No Change
Pay Related	
Merit	No Change
Overtime	N/A
Dual Retirement	N/A
Dual Disability	N/A

The impact of these changes on the City's contributions to TRS is shown in the following chart:

Assumption	Effect on Annual Contribution	Cumulative Contribution ($ in millions)
1. Contribution Determined in 2016 Valuation	N/A	3,947,0
2. Retired Mortality	NC	3,947.0
3. Active Mortality	(2.3)	3,944.7
4. Retirement	(19.2)	3,925.5
5. Withdrawal	NC	3,925.5
6. Disability Rates	NC	3,925.5
7. Merit Salary	NC	3,925.5
8. Overtime	NC	3,925.5

Note that the contribution amount decreases by $21.5 million (from $3,947.0 million to $3,925.5 million).

Administrative Review

Bolton Partners has performed its Administrative Review of TRS. We conducted separate meetings with TRS staff and OA staff to discuss member data processes, calculation/certification processes, and data security measures. TRS has completed three of seven expected stages in the rollout of a new data management and plan administration system. The rollout is being done in a measured and intentional way, to make sure that data quality is not compromised. All data changes made in the new system bridge back to the "old" system, which is still being used to generate the valuation data for the OA. The new system is expected to improve efficiency and security, but we found that the member data contained in the current system is of high quality. There are well-defined and well-documented processes in place for collection and validation of the data. We conclude that the data gathering and validation processes at TRS and the OA result in data that is of sufficient quality for the actuarial valuations and experience studies. Further, we found that TRS and the OA have a solid working relationship, which fosters a spirit of cooperation between them. Details of our specific recommendations can be found in our separate Administrative Review report.

Our key recommendations are:

1. ***Continue to explore the use of "voice signatures" for confirming that overseas retirees are still living, and possibly extend the use of this technology to U.S. retirees.***
2. ***Reach out to BERS about the rollout of their new pension management system to learn from their successes and mistakes. This will help TRS set appropriate expectations for the remaining phases of their own system rollout process.***
3. ***Consider providing a test file of data to the OA prior to the live implementation of phase 4 of ASPEN. This could enable TRS to address any timing or data issues that may exist in the new system so when the valuation data requests come in, they're fully prepared.***
4. ***Continue work with CUNY to obtain better, more timely data for their part-time members. Good progress has been made with the data for the full-time members; hopefully now that CUNY better understands what TRS needs, they can make similar improvements for the part-time members.***
5. ***Regularly monitor and update, if necessary, the Summary Plan Descriptions. The SPDs should be updated when significant plan changes occur, and at least every five years.***

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

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo
Administrative Review Assistant Project Manager

Section C

Independent Actuary's Statement for the Board of Education Retirement System of the City of New York (BERS)

Bolton Partners was hired by the Comptroller to serve as the Independent Actuary and provide other services related to the review of the funding of BERS.

Bolton Partners has completed the first of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (the Contribution Audit)

- The experience of the plan for the 4-year and 10-year periods ending June 30, 2017 (the Experience Study)

- A review of the data gathering and maintenance practices of the OA and BERS (the Administrative Review).

Review of Financial Objectives and Soundness of BERS and Adequacy of Employer Contributions

Based on the Contribution Audit, the Experience Studies, and the Administrative Review for BERS, Bolton Partners certifies that BERS is being funded in accordance with Standards of Practice prescribed by the Actuarial Standards Board and in conformity with the applicable New York State and New York City Statutes. Assuming continued funding of BERS by the City/Obligors on the basis used in the June 30, 2016 (Lag) Actuarial Valuation, we believe the City's funding objective (that these statutorily required contributions, together with member contributions and assumed investment income will be sufficient to pay benefits when due) will be achieved.

As of June 30, 2016, BERS had approximately $4.8 billion in liabilities[5] and $3.4 billion in assets. The FY18 contribution was approximately $0.3 billion. Stating that financial objectives are being met is easy given that the contributions are expected to be enough to pay the normal cost and eventually pay off the unfunded liabilities. The concept of "actuarial soundness" is one we try to avoid. To some it might mean that all benefits are funded at a level where benefits could be settled[6], a level that the plan is not attempting to fund toward. The plan is sound in the sense that if the Actuarially Determined Contribution (ADC) continues to be paid then the plan will become 100% funded at the 7% discount rate. Investments in stocks and other investments will continue to present risks.

Employer Contribution Audit for Fiscal Year 2018 (2016 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2016 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2018. There were some findings specific to BERS that should be addressed. The most significant is that the subsidized interest rates (and to a lesser extent the annuity conversion factors) associated with the Tax Deferred Annuity (TDA) plan have a cost to the plan. This cost is currently recognized as an actuarial

[5] Please note that we use the term "actuarial liabilities" or "liabilities" to refer to the portion of the total present value of future benefits (PVFB) shown in table on page 3 that has been assigned to past service. Necessarily, the actuarial liabilities will be substantially lower than the PVFB for groups that include employees who have not earned all of the benefits that they are expected to receive.

[6] The concept of a "settlement" liability would include determining the amount needed to buy annuities or bonds to defease the liabilities. This could require the use of discount rates similar to the Treasury yield curves, resulting in effective discount rates that are substantially lower than the 7% discount rate and result in larger liability values.

loss each year, and then the cost is funded over future years through higher annual contributions. However, we believe that the better funding approach would be to recognize the value of this subsidized interest credit prior to its payment and reflect it in the annual costs and recommend that the OA adopt this approach. Then, when the payments are made there will be a smaller actuarial gain or loss for the difference between the expected and actual amounts credited, rather than a loss for the total subsidy. We note that the OA is now including in the annual valuation a cost reflecting the value of the subsidy earned in the current year. The TRS plan has this same issue.

Our replication results for BERS were as follows:

Comparison of OA and BP Results ($ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass/Fail
BERS	PVFB	$ 6,133	$ 6,166	0.54%	4.00%	Pass
	Employer Contribution	$ 319	$ 323	1.27%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2017. BERS is the smallest of the New York City retirement plans. The difference between assumptions and experience of the five plans is the largest for BERS. However, we had concerns regarding the reliability of the underlying data, particularly regarding the deaths of retired participants, so we made fewer suggestions regarding revisions to the assumptions than might appear warranted based on the results of our analysis. We found the data in the most recent year to be significantly more reliable and suggest that the next auditing actuary more closely review the BERS experience. We also suggest that the OA or the next auditing actuary consider which assumptions (if any) should reflect differences between part-time and full-time, in light of BERS recently including that indicator in the participant data.

Below is a chart showing in some level of detail the assumption changes for BERS:

	BERS
Service Retirement Mortality	
Male Lives	No Change
Male Liabilities	No Change
Female Lives	No Change
Female Liabilities	No Change
Disabled Retirement Mortality	
Male Lives	No Change
Male Liabilities	No Change
Female Lives	No Change
Female Liabilities	No Change
Employee Mortality	
Ordinary	Decrease 33%
Accidental	N/A
Unreduced Retirement Elected	
First Year	Decrease 15%
After First Year	Decrease 25%
Unreduced Retirement Mandated	
First Year	Decrease 33%
After First Year	Decrease 35%
Early Retirement	Increase 25%
Withdrawal	Increase 40%
Disability	
Ordinary	No Change
Accidental	Decrease 25% for men Increase 25% for women
Pay Related	
Merit	No Change
Overtime	N/A
Dual Retirement	N/A
Dual Disability	N/A

The impact of these changes on the City's contributions to BERS is shown in the following chart:

Assumption	Effect on Annual Contribution	Cumulative Contribution ($ in millions)
1. Contribution Determined in 2016 Valuation	N/A	$322.7
2. Retired Mortality	NC	$322.7
3. Active Mortality	$0.2	$322.9
4. Retirement	$(23.9)	$299.0
5. Withdrawal	$(3.7)	$295.3
6. Disability Rates	NC	$295.3
7. Merit Salary	NC	$295.3
8. Overtime	NC	$295.3

Note that the contribution amount decreases by $27.4 million, from $322.7 million to $295.3 million.

Administrative Review

Bolton Partners has performed its initial Administrative Review of BERS. We conducted separate meetings with BERS staff and OA staff to discuss member data processes, calculation/certification processes, and data security measures. BERS went live with a new data management system in June 2017. In conjunction with the implementation of the new system, historical member data was thoroughly reviewed and scrubbed for accuracy and completeness. The new system allows for secure transmission of member data to the OA via FTP, which was not a capability of the prior system. We found that the member data contained in the new system is substantially improved over what had been provided to the OA previously. Additional upgrades are planned for the new system to further improve workflow and efficiency. There are plans in place to create new documentation of all processes in place for collection and validation of the data, to tie in with the new system. We conclude that the data gathering and validation processes at BERS and the OA result in data that is of sufficient quality for the actuarial valuations and experience studies. Further, we found that BERS and the OA have a solid working relationship, which fosters a spirit of cooperation between them. Details of our specific recommendations can be found in our separate Administrative Review report.

Our key recommendations are:

1. ***Reach out to TRS about their preparation of their members for electronic statement delivery. TRS had a very successful implementation of electronic statement delivery that was well-received by members. BERS has concerns about member satisfaction related to electronic statements, and TRS likely experienced similar concerns and handled them well.***
2. ***Work with entities that provide member data to BERS to correct data errors at the source. BERS is considering adding staff to their quality assurance division to handle these errors, but unless the errors can be eliminated at the source, the internal data validation will become cumbersome.***
3. ***Continue to devote the necessary resources to the "Velocity" upgrades to the CPMS system. As upgrades are completed, ensure that documentation of policies and procedures keeps pace.***

4. ***As additional staff is added, consider devoting staff to outreach for terminated non-vested members due refunds five years after their termination date. BERS has expressed their desire to be more proactive in their outreach to these members, but has not had sufficient staff to take this on.***

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

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England

Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode

Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo

Kari Szabo
Administrative Review Assistant Project Manager

Section D

Independent Actuary's Statement for the New York City Police Pension Fund (POLICE)

Bolton Partners was hired by the Comptroller to serve as the Independent Actuary and provide other services related to the review of the funding of POLICE.

Bolton Partners has completed the first of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (the Contribution Audit)

- The experience of the plan for the 4-year and 10-year periods ending June 30, 2017 (the Experience Study)

- A review of the data gathering and maintenance practices of the OA and POLICE (the Administrative Review).

Review of Financial Objectives and Soundness of POLICE and Adequacy of Employer Contributions

Based on the Contribution Audit, the Experience Studies, and the Administrative Review for POLICE, Bolton Partners certifies that POLICE is being funded in accordance with Standards of Practice prescribed by the Actuarial Standards Board and in conformity with the applicable New York State and New York City Statutes. Assuming continued funding of POLICE by the City/Obligors on the basis used in the June 30, 2016 (Lag) Actuarial Valuation, we believe the City's funding objective (that these statutorily required contributions, together with member contributions and assumed investment income will be sufficient to pay benefits when due) will be achieved.

As of June 30, 2016, the POLICE plan had approximately $50 billion in liabilities[7] and $33 billion in assets. The FY18 contribution was approximately $2.4 billion. Stating that financial objectives are being met is easy given that the contributions are expected to be enough to pay the normal cost and eventually pay off the unfunded liabilities. The concept of "actuarial soundness" is one we try to avoid. To some it might mean that all benefits are funded at a level where benefits could be settled[8], a level that the plan is not attempting to fund toward. The plan is sound in the sense that if the Actuarially Determined Contribution (ADC) continues to be paid then the plan will become 100% funded at the 7% discount rate. Investments in stocks and other investments will continue to present risks.

Employer Contribution Audit for Fiscal Year 2018 (2016 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2016 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2018. There were some findings specific to POLICE that should be addressed. The most significant is the Overtime assumptions. Our Replication Audit Report has more detail on this issue.

---

[7] Please note that we use the term "actuarial liabilities" or "liabilities" to refer to the portion of the total present value of future benefits (PVFB) shown in table on page 3 that has been assigned to past service. Necessarily, the actuarial liabilities will be substantially lower than the PVFB for groups that include employees who have not earned all of the benefits that they are expected to receive.

[8] The concept of a "settlement" liability would include determining the amount needed to buy annuities or bonds to defease the liabilities. This could require the use of discount rates similar to the Treasury yield curves, resulting in effective discount rates that are substantially lower than the 7% discount rate and result in larger liability values.

Our replication results for Police were as follows:

Comparison of OA and BP Results ($ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass/Fail
POLICE	PVFB	$ 62,348	$ 62,292	-0.09%	4.00%	Pass
	Employer Contribution	$ 2,415	$ 2,408	-0.30%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2017. Please note that the WTC accidental disability assumption is declining in significance as the number of members eligible for the benefit decreases.
Below is a chart showing in some level of detail the assumption changes for POLICE:

	Police[9]
Service Retirement Mortality	
Male Lives	No Change
Male Liabilities	Decrease 9%
Female Lives	No Change
Female Liabilities	Decrease 9%
Disabled Retirement Mortality	
Male Lives	Decrease 3%
Male Liabilities	Decrease 15%
Female Lives	Decrease 3%
Female Liabilities	Decrease 15%
Employee Mortality	
Ordinary	No Change
Accidental	No Change
Unreduced Retirement	
First Year	Decrease 30%
After First Year	No Change
Early Retirement	N/A
Withdrawal	Decrease 25%
Disability	
Ordinary	Decrease 20%
Accidental	Decrease 30% Non-WTC Decrease 40% WTC
Pay Related	
Merit	Increase 15%
Overtime	Increase 15%
Dual Retirement	Increase 15%
Dual Disability	No Change

[9] Most current employees are in Tier II, virtually no Tier III employees are eligible to retire.

The impact of these changes on the City's contributions to POLICE is shown in the following chart:

Assumption	Effect on Annual Contribution	Cumulative Contribution ($ in millions)
1. Contribution Determined in 2016 Valuation	N/A	$2,408.2
2. Retired Mortality	$86.7	2,494.9
3. Active Mortality – N/C	N/C	2,494.9
4. Retirement	(25.7)	2,469.1
5. Withdrawal	4.0	2,473.2
6. Disability Rates	(120.2)	2,353.0
7. Merit Salary	27.6	2,380.6
8. Overtime	40.2	2.420.7

Note that the contribution amount increases by $12.6 million (0.5%) from $2,408.2 million to $2,420.7 million.

Administrative Review

Bolton Partners has performed its Administrative Review of POLICE. We conducted separate meetings with POLICE staff and OA staff to discuss member data processes, calculation/certification processes, and data security measures. POLICE has begun development of a new data management system in a four-stage process. It is expected that the new system will be fully implemented by 2024 and will allow for multiple tiers of benefits and will provide online access and transaction capabilities for members. The new system is expected to improve efficiency and security, but we found that the member data contained in the current system is of high quality. There are well-defined and well-documented processes in place for collection and validation of the data. We conclude that the data gathering and validation processes at POLICE and the OA result in data that is of sufficient quality for the actuarial valuations and experience studies. Further, we found that POLICE and the OA have a solid working relationship, which fosters a spirit of cooperation between them. Details of our specific recommendations can be found in our separate Administrative Review report.

Our key recommendations are:

1. ***Explore ways to accelerate the process of clearing the backlog of calculations that require reprocessing. In June 2017 there were approximately 5,400 calculations, and by March 2019 there were still approximately 4,100.***
2. ***If budget permits, plan to perform vulnerability testing on a regular basis. With the COPS2.0 system upgrades, members will be allowed to access and upload documents electronically and it will be imperative that the system is secure to protect sensitive member data.***
3. ***Reach out to TRS and BERS about the rollouts of their new pension management systems to learn from their successes and mistakes. This will help POLICE set appropriate expectations for their own system rollout.***
4. ***Ensure documentation on processes and procedures keeps pace with the development of COPS2.0.***

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

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England

Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode

Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo

Kari Szabo
Administrative Review Assistant Project Manager

Section E

Independent Actuary's Statement for the New York City Fire Pension Fund (FIRE)

Bolton Partners was hired by the Comptroller to serve as the Independent Actuary and provide other services related to the review of the funding of FIRE.

Bolton Partners has completed the first of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2017 (the Experience Study)
- A review of the data gathering and maintenance practices of the OA and FIRE (the Administrative Review).

Review of Financial Objectives and Soundness of FIRE and Adequacy of Employer Contributions

Based on the Contribution Audit, the Experience Studies, and the Administrative Review for FIRE, Bolton Partners certifies that FIRE is being funded in accordance with Standards of Practice prescribed by the Actuarial Standards Board and in conformity with the applicable New York State and New York City Statutes. Assuming continued funding of FIRE by the City/Obligors on the basis used in the June 30, 2016 (Lag) Actuarial Valuation, we believe the City's funding objective (that these statutorily required contributions, together with member contributions and assumed investment income will be sufficient to pay benefits when due) will be achieved.

As of June 30, 2016, the FIRE plan had approximately $21 billion in liabilities[10] and $11 billion in assets. The FY18 contribution was approximately $1.2 billion. Stating that financial objectives are being met is easy given that the contributions are expected to be enough to pay the normal cost and eventually pay off the unfunded liabilities. The concept of "actuarial soundness" is one we try to avoid. To some it might mean that all benefits are funded at a level where benefits could be settled[11], a level that the plan is not attempting to fund toward. The plan is sound in the sense that if the Actuarially Determined Contribution (ADC) continues to be paid then the plan will become 100% funded at the 7% discount rate. Investments in stocks and other investments will continue to present risks.

Employer Contribution Audit for Fiscal Year 2018 (2016 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2016 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2018. There were some findings specific to FIRE that should be addressed. The most significant is the Overtime assumptions. Our Replication Audit Report has more detail on this issue.

---

[10] Please note that we use the term "actuarial liabilities" or "liabilities" to refer to the portion of the total present value of future benefits (PVFB) shown in table on page 3 that has been assigned to past service. Necessarily, the actuarial liabilities will be substantially lower than the PVFB for groups that include employees who have not earned all of the benefits that they are expected to receive.

[11] The concept of a "settlement" liability would include determining the amount needed to buy annuities or bonds to defease the liabilities. This could require the use of discount rates similar to the Treasury yield curves, resulting in effective discount rates that are substantially lower than the 7% discount rate and result in larger liability values.

Our replication results for Police were as follows:

Comparison of OA and BP Results ($ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass/Fail
FIRE	PVFB	$ 25,154	$ 25,051	-0.41%	4.00%	Pass
	Employer Contribution	$ 1,200	$ 1,188	-1.03%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2017. Please note that we suggested smaller increases in the compensation and overtime assumptions than warranted by experience because of significant changes in the overtime procedures which are expected to substantially reduce overtime. We also understand that pay increases are expected to be lower than in the last few years because of increases in the number of firefighters (which also is likely to reduce overtime).

Below is a chart showing in some level of detail the assumption changes for FIRE:

	Fire[12]
Service Retirement Mortality	
Male Lives	No Change
Male Liabilities	Decrease 9%
Female Lives	No Change
Female Liabilities	Decrease 9%
Disabled Retirement Mortality	
Male Lives	No Change
Male Liabilities	Decrease 17%
Female Lives	No Change
Female Liabilities	Decrease 17%
Employee Mortality	
Ordinary	Decrease 50%
Accidental	Decrease 50%
Unreduced Retirement	
First Year	Decrease 50%
After First Year	Decrease 25%
Early Retirement	N/A
Withdrawal	No Change
Disability	
Ordinary	Reduce 75%
Accidental	Increase non-WTC 15%
Pay Related	
Merit	Avg. Increase 33%
Overtime	Increase 33%
Dual Retirement	Increase 33%
Dual Disability	Increase 33%

[12] Most current employees are in Tier II, virtually no Tier III employees are eligible to retire.

The impact of these changes on the City's contributions to FIRE is shown in the following chart:

Assumption	Effect on Annual Contribution	Cumulative Contribution ($ in millions)
1. Contribution Determined in 2016 Valuation	N/A	$1,188.0
2. Retired Mortality	$50.0	1,238.0
3. Active Mortality	(4.9)	1,233.2
4. Retirement	2.2	1,235.3
5. Withdrawal – N/C	N/C	1,235.3
6. Disability Rates	18.4	1,258.1
7. Merit Salary	36.6	1,294.7
8. Overtime	42.8	1.337.5

Note that the contribution amount increases by $149.5 million (12.6%) from $1,188.0 million to $1,337.5 million.

Administrative Review

Bolton Partners has performed its Administrative review of FIRE. We conducted separate meetings with FIRE staff and OA staff to discuss member data processes, calculation/certification processes, and data security measures. FIRE now has corpus funding and has moved to a new location which is better suited to their needs, hired more staff and posted several other job openings. The existing data management system works very well for maintaining member data and performing retirement calculations. We found that the member data contained in the system is of good quality. There are well-defined and well-documented processes in place for collection and validation of the data. We conclude that the data gathering and validation processes at FIRE and the OA result in data that is of sufficient quality for the actuarial valuations and experience studies. Further, we found that FIRE and the OA have a solid working relationship, which fosters a spirit of cooperation between them. Details of our specific recommendations can be found in our separate Administrative Review report.

Our key recommendations are:

1. ***Prioritize hiring IT staff, so that FIRE will be less dependent on outside entities (FDNY and an outside vendor) for IT needs and e-UPS updates. FDNY IT staff has been more responsive to FIRE's needs since the corpus funding was installed, but FIRE's IT needs require staff devoted full time to making upgrades.***
2. ***Create a more formal process/priority schedule for e-UPS system upgrades.***
3. ***Consider moving active members' files to offsite storage once they have been digitized. It is redundant and takes up office space unnecessarily to have paper files onsite if the information is available to staff electronically.***
4. ***Continue to devote resources to training process documentation. As new staff is hired this will become increasingly important.***

5. ***Create a website for FIRE pension, even if only at first for general information and documents. Currently, such information is only available on the Comptroller's website, which makes it difficult to find.***

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

Sincerely,

Thomas B. Lowman, FSA, EA, MAAA
Project Manager

Colin England
Colin England, FSA, EA, MAAA
Experience Study Project Manager and Assistant Project Manager

Erika Bode
Erika Bode, CEBS
Administrative Review Project Manager

Kevin Binder, FSA, EA
Experience Study Assistant Manager

Jordan McClane, ASA, EA
Replication Assistant Manager

Kari Szabo
Administrative Review Assistant Project Manager