



March 12, 2018

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 was hired to conduct two consecutive biennial actuarial engagements. Bolton Partners, Inc. is pleased to present our Independent Actuarial Certification. This is one of the deliverables under our first 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 initial engagement encompasses the following:

- Contribution Audits of the computed employer contributions for each System in NYCRS for fiscal year 2016 (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, 2015, for each System in NYCRS;
- An initial Administrative Review of the data gathering and maintenance practices of the Office of the Actuary (OA) and each System in NYCRS; and

Bolton Partners, Inc.

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Employee Benefits and Investment Consulting

- 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 first engagement. The purpose of this report is to:

- Summarize the findings from the Contribution Audit, the Experience Study and the Administrative Review from the first engagement; and
- Provide each System with a certification of the findings of the first engagement.

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, if any.

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 FY16 employer contributions for all Systems were reasonable and appropriate. There were some changes we recommended, two of which we repeat here:

- (1) Funding: OA should value the subsidized interest and annuity conversion factors for TRS and BERS TDA (403(b)) in a way that avoids expected losses.
- (2) Disclosure: OA should prepare complete Actuarial Valuation Reports for each System to more easily ensure all the disclosure standards are being followed and are contained in a single document.

As did GRS, we believe that the "LAG" method used to roll the result forward from the valuation date to a fiscal year starting 12 months later could be improved.

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

Comparison of OA and BP Results (\$ Millions)						
System	Category	OA Results	BP Results	Percentage Difference	Tolerance Limit	Pass / Fail
NYCERS	PVFB	\$ 90,534	\$ 90,850	0.35%	4.00%	Pass
	Employer Contribution	\$ 3,365	\$ 3,402	1.08%	5.00%	Pass
TRS	PVFB	\$ 81,378	\$ 80,878	-0.62%	4.00%	Pass
	Employer Contribution	\$ 3,703	\$ 3,619	-2.25%	5.00%	Pass
BERS	PVFB	\$ 5,616	\$ 5,631	0.27%	4.00%	Pass
	Employer Contribution	\$ 266	\$ 269	1.34%	5.00%	Pass
Police	PVFB	\$ 58,258	\$ 58,195	-0.11%	4.00%	Pass
	Employer Contribution	\$ 2,394	\$ 2,386	-0.32%	5.00%	Pass
Fire	PVFB	\$ 22,764	\$ 22,679	-0.37%	4.00%	Pass
	Employer Contribution	\$ 1,054	\$ 1,044	-0.98%	5.00%	Pass
Total	PVFB	\$ 258,550	\$ 258,233	-0.12%		
	Employer Contribution	\$ 10,782	\$ 10,720	-0.57%		

Experience Study:

The Experience Study project was the largest of the three projects we worked on. We completed tables for all key decrements for each plan and all material participant groups. Like the other projects, this is the first of two biennial projects. We are not recommending any assumption changes at this time. It is likely that we will recommend changes after we complete our second and final biennial study.

Overall, we found that the assumptions chosen by the Office of the Actuary (OA) reasonably model the plans' experience. We divided assumptions into significant and minor assumptions. Significant assumptions are those which significantly affect the determination of plan liabilities. This includes the inflation and discount rates, retiree mortality, employee retirement and termination assumptions and salary increase and overtime assumptions. No significant assumptions are far enough from recent experience to currently require revision, in light of the exogenous factors that affected experience including the Fire Department hiring freeze, revisions in data collection procedures and the timing of new union contracts. However, certain assumptions are likely to require revision as part of the next experience study, including the retirement assumptions (for elected, mandated¹ and early retirement), and the employee mortality and disability assumptions.

Some of the BERS results (the smallest of the five plans) showed the greatest deviations between plan experience and assumptions. This may be due to data issues that may be corrected by the next biennial study. We will pay close attention to the experience that deviates the most from the assumption.

Overall, we concluded that the assumptions used in the 2014 Actuarial Valuations were reasonable.

Administrative Review:

The 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 for valuation purposes. We also looked at retirement calculation and certification processes, and reviewed data security measures. Overall, we found that the

¹ Mandated and Elected Retirement are two categories of benefits provided as an option to employees as part of a significant change in benefits as part of Chapter 96 of the law in 1995. Chapter 96 of the laws of 1995, gave employees the option of selecting to join potentially more valuable retirement plans in return for higher employee contributions. For purposes of valuing plan liabilities, different retirement assumptions apply to the employees that elected the improved retirement benefits than those who stayed in the old Plans. The NYCERS data field "Improved Plan Code" was used to distinguish between employees who did not elect the new plans (Mandated) and those who elected the new plans (Elected). Employees hired after 1995 were not given a choice of plans and receive Mandated retirement benefits. The terms Mandated and Elected are used throughout our report to distinguish between these two groups of employees.

Systems and the OA have procedures in place that 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. We will examine the new systems in our next review, to make sure the data quality has not suffered but has instead improved.

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.

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 Kris 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 relates to the Administrative Review. Kevin's role relates to the Experience Study. Kris' 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,

BOLTON PARTNERS, INC.

A handwritten signature in black ink, appearing to read 'T. Lowman', with a long horizontal flourish extending to the right.

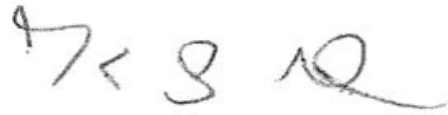
Thomas B. Lowman, FSA, EA, MAAA
Project Manager



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



Kristopher Seets, FSA, 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 first of two biennial reviews of:

- The contribution calculations performed by the Office of the Actuary (OA) (a.k.a. the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2015 (a.k.a. the Experience Study)
- A review of the data gathering and maintenance practices of the Office of the Actuary (OA) and NYCERS (a.k.a. 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, 2014 (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, 2014, the NYCERS plan had approximately \$74 billion in actuarial liabilities² and \$54 billion in assets at market value. The FY16 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 settled³, 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

² 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.

³ 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.

stocks and other investments will continue to present risks.

Employer Contribution Audit for Fiscal Year 2016 (2014 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2014 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2016. There were no major findings specific to NYCERS. Some general observations applicable to NYCERS and the other plans included:

- (1) Consider revising the Lag Method
- (2) Prepare full Actuarial Valuation Reports and cover all ASOP disclosure requirements in those reports.

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	\$ 90,534	\$ 90,850	0.35%	4.00%	Pass
	Employer Contribution	\$ 3,365	\$ 3,402	1.08%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2015. New York City Employees' Retirement System (NYCERS) is the most complex 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. Our observations regarding the significant assumptions include:

- (1) The 7.0% discount rate is reasonable as would be rates between 6.5% and 7.0% and the 2.5% inflation rate is also reasonable as would be rates between 2.0% and 2.5%.
- (2) Generally, the retiree mortality experience was close to expectations. Corrections members might be the exception.
- (3) Employee turnover was generally declining over the last 10 years.
- (4) Retirement experience is complex (some higher than expected and some lower), although generally normal retirement was later than assumed and early retirement (that is retirement with a benefit reduced for early payment) was much more frequent than expected. We direct you to the full experience study for more details.

Administrative Review

Bolton Partners has performed its initial 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 early stages 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.

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,

BOLTON PARTNERS, INC.



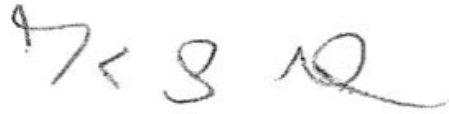
Thomas B. Lowman, FSA, EA, MAAA
Project Manager



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



Erika Bode, CEBS
Administrative Review Project Manager

A handwritten signature in dark ink, appearing to read "K. Binder".

Kevin Binder, FSA, EA
Experience Study Assistant Manager

A handwritten signature in dark ink, appearing to read "K. Seets".

Kristopher Seets, FSA, EA
Replication Assistant Manager

A handwritten signature in dark ink, appearing to read "Kari Szabo".

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) (a.k.a. the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2015 (a.k.a. the Experience Study)
- A review of the data gathering and maintenance practices of the Office of the Actuary (OA) and TRS (a.k.a. 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, 2014 (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, 2014, the TRS plan had approximately \$67 billion in liabilities and \$44 billion in assets. The FY16 contribution was approximately \$3.7 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, 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.

Employer Contribution Audit for Fiscal Year 2016 (2014 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2014 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2016. 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. The BERS plan has this same issue. Our Replication Audit Report has more detail on this issue. Some general observations applicable to TRS and the other plans included:

- (1) Consider revising the Lag Method
- (2) Prepare full Actuarial Valuation Reports and cover all ASOP disclosure requirements in those reports.

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	\$ 81,378	\$ 80,878	-0.62%	4.00%	Pass
	Employer Contribution	\$ 3,703	\$ 3,619	-2.25%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2015.

- (1) The 7.0% discount rate is reasonable as would be rates between 6.5% and 7.0% and the 2.5% inflation rate is reasonable as would be rates between 2.0% and 2.5%.
- (2) Generally, the retiree mortality experience was close to expectations.
- (3) Employee turnover was generally declining over the last 10 years and is now below the assumption. This deserves further review in the next study, to determine whether this pattern of declining turnover is a temporary phenomenon or a long-term change in employee behavior.

- (4) Retirement experience is complex (some higher than expected and some lower). Employees eligible for the "Elected" retirement provisions are retiring at a higher rate than assumed, while those only eligible for "Mandated" are retiring at a lower rate than expected, while overall experience matches assumptions.

Administrative Review

Bolton Partners has performed its initial 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.

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,

BOLTON PARTNERS, INC.



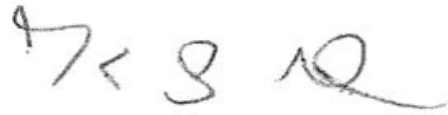
Thomas B. Lowman, FSA, EA, MAAA
Project Manager



Colin England, FSA, EA, MAAA
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Assistant Project Manager



Erika Bode, CEBS
Administrative Review Project Manager



Kevin Binder, FSA, EA
Experience Study Assistant Manager



Kristopher Seets, FSA, 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) (a.k.a. the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2015 (a.k.a. the Experience Study)
- A review of the data gathering and maintenance practices of the Office of the Actuary (OA) and BERS (a.k.a. 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, 2014 (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, 2014, the BERS plan had approximately \$4.3 billion in liabilities and \$3.3 billion in assets. The FY16 contribution was approximately \$0.27 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, 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 2016 (2014 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2014 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2016. 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 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. The TRS plan has this same issue. Our Replication Audit Report has more detail on this issue. Some general observations applicable to BERS and the other plans included:

- (1) Consider revising the Lag Method
- (2) Prepare full Actuarial Valuation Reports and cover all ASOP disclosure requirements in those reports.

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	\$ 5,616	\$ 5,631	0.27%	4.00%	Pass
	Employer Contribution	\$ 266	\$ 269	1.34%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2015. Board of Education Retirement System of the City of New York (BERS) is the smallest of the New York City (NYC) retirement plans. The difference between assumptions and experience of the five plans is the largest for BERS. Our observations include:

- (1) The 7.0% discount rate is reasonable as would be rates between 6.5% and 7.0% and the 2.5% inflation rate is also reasonable as would be rates between 2% and 2.5%.
- (2) All assumptions should be reviewed considering the improved data available for fiscal 2017.
- (3) Retiree mortality and employee turnover and normal retirement experience is well below the assumption and changes should be considered with the next study. Early retirement experience is higher than expected, as experienced with the other plans.

However, while retirement experience has been consistently lower than expected over the last decade, the employee turnover experience has decreased from being higher than expected more than 5 years ago to significantly lower than expected in the most recent period.

- (4) We recommend considering whether certain assumptions, such as withdrawal and salary improvement, should vary based on part-time or full-time status, which will become available with the revised data.
- (5) BERS data needs to be reviewed more thoroughly in the next study.

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 will allow 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 current system is of adequate quality, but we expect that we will see substantial improvement in our next review. 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. However, our Experience Study work did find indicators of data issues which may relate to the prior system and will follow up on in our next study. 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.

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,

BOLTON PARTNERS, INC.



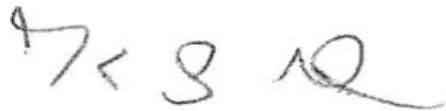
Thomas B. Lowman, FSA, EA, MAAA
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Erika Bode, CEBS
Administrative Review Project Manager



Kevin Binder, FSA, EA
Experience Study Assistant Manager



Kristopher Seets, FSA, EA
Replication Assistant Manager



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) (a.k.a. the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2015 (a.k.a. the Experience Study)
- A review of the data gathering and maintenance practices of the Office of the Actuary (OA) and POLICE (a.k.a. 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, 2014 (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, 2014, the POLICE plan had approximately \$47 billion in liabilities and \$32 billion in assets. The FY16 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, 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 2016 (2014 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2014 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2016. 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. Some general observations applicable to POLICE and the other plans included:

- (1) Consider revising the Lag Method
- (2) Expand current POLICE Actuarial Valuation Reports and cover all ASOP disclosure requirements in a single report.

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	\$ 58,258	\$ 58,195	-0.11%	4.00%	Pass
	Employer Contribution	\$ 2,394	\$ 2,386	-0.32%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2015. Our observations include:

- (1) The 7.0% discount rate is reasonable as would be rates between 6.5% and 7.0% and the 2.5% inflation rate is also reasonable as would be rates between 2.0% and 2.5%.
- (2) Retiree mortality experience is almost exactly in line with assumptions. Employee mortality, while not a significant assumption, has also been close to that assumed.
- (3) Employee turnover experience has decreased over the last 10 years and is now well below the assumption and changes should be considered in the next study.
- (4) The ordinary and retirement overtime experience has been higher than assumed while disability overtime has been lower than assumed. The salary improvement has been lower than expected. Whether these are temporary or permanent changes should be reviewed in the next study.

Administrative Review

Bolton Partners has performed its initial 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 is in the procurement process for developing a new data management system. It is expected that the new system 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.

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,

BOLTON PARTNERS, INC.



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

A handwritten signature in dark ink, appearing to read 'K. Binder'.

Kevin Binder, FSA, EA
Experience Study Assistant Manager

A handwritten signature in dark ink, appearing to read 'K. Seets'.

Kristopher Seets, FSA, EA
Replication Assistant Manager

A handwritten signature in dark ink, appearing to read '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) (a.k.a. the Contribution Audit)
- The experience of the plan for the 4-year and 10-year periods ending June 30, 2015 (a.k.a. the Experience Study)
- A review of the data gathering and maintenance practices of the Office of the Actuary (OA) and FIRE (a.k.a. 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, 2014 (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, 2014, the FIRE plan had approximately \$19 billion in liabilities and \$11 billion in assets. The FY16 contribution was approximately \$1 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, 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 2016 (2014 Actuarial Valuation)

Bolton Partners has performed an actuarial audit of the June 30, 2014 (Lag) Actuarial Valuation which develops the employer contributions for Fiscal Year 2016. 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. Some general observations applicable to FIRE and the other plans included:

- (1) Consider revising the Lag Method
- (2) Expand current FIRE Actuarial Valuation Reports and cover all ASOP disclosure requirements in a single report.

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	\$ 22,764	\$ 22,679	-0.37%	4.00%	Pass
	Employer Contribution	\$ 1,054	\$ 1,044	-0.98%	5.00%	Pass

Experience Study

Bolton Partners has completed the Experience Study for the 4-year and 10-year periods ending June 30, 2015. Our observations include:

- (1) The 7.0% discount rate is reasonable as would be rates between 6.5% and 7.0% and the 2.5% inflation rate is also reasonable as would be rates between 2.0% and 2.5%.
- (2) The employee turnover assumption has been lower than assumed, which may be related to the hiring freeze (along with the overtime experience). This should be reviewed with the next study as more post-freeze information will be available.
- (3) The overtime assumption is high and increasing over time, and should be reviewed closely in the next study to determine whether this is a temporary variance from assumptions due to the hiring freeze or a more permanent change in the operation of the Fire Department.
- (4) Retiree mortality experience is close to the morality assumption, although as with all groups other than POLICE employee mortality (not a significant assumption) has been lower than expected.

- (5) Disability experience, while not a significant assumption, has been nearly all accidental disabilities with virtually no ordinary disabilities. The rate of World Trade Center disability has been decreasing over time (in addition to the decrease in the number of employees eligible for it).

Administrative Review

Bolton Partners has performed its initial 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 has recently been approved for corpus funding, and has plans to hire more staff and improve data security infrastructure. 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.

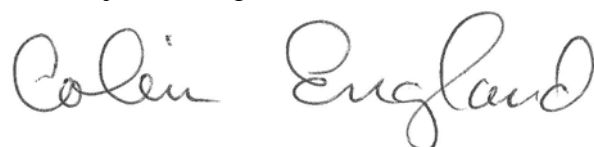
We are available to answer any questions on the material in this report or to provide explanations or further details as appropriate. The undersigned credentialed actuaries meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained in this report. 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,

BOLTON PARTNERS, INC.



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



Colin England, FSA, EA, MAAA
Experience Study Project Manager and
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Erika Bode, CEBS
Administrative Review Project Manager



Kevin Binder, FSA, EA
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Kari Szabo
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Manager