

EXHIBIT C

CONSULTING ENGINEER'S REPORT ON PHYSICAL CONDITION OF BRIDGES



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December 16, 2019

Ms. Tara Sullivan, Acting Executive Director
New York State Bridge Authority
P.O. 1010
Highland, NY 12528

ATTN: Jeffrey Wright, P.E., Chief Engineer

RE: PN 3672.19
CONSULTING ENGINEER'S REPORT ON
PHYSICAL CONDITION OF BRIDGES

Dear Ms. Sullivan:

Modjeski and Masters has prepared this letter report on the physical condition of the bridges operated by the New York State Bridge Authority (NYSBA) to serve as documentation related to the future financial needs for the Authority's Bridges.

DESCRIPTION OF SYSTEM BRIDGES

The Authority operates six vehicular major bridge structures at five sites along the Hudson River and is also responsible for the structural maintenance of the Walkway Over the Hudson Pedestrian Bridge.

The oldest of the vehicular crossings is the Bear Mountain Bridge, opened in 1924, a suspension bridge with a 38-foot wide roadway and a main span length of 1632 feet. The bridge was constructed by a private corporation and acquired by the Authority in 1940. The original roadway deck was replaced and the floor system modernized in 1976 and 1977.

The Mid-Hudson Bridge, a suspension bridge with a main span of 1,495 feet, was opened in 1930. The original roadway deck was replaced in 1987 and 1988 with a new 31-foot wide deck which is operated as a three lane roadway during peak traffic periods. The mile-long four-lane divided highway approach on the west side of the bridge was completed in 1967. The structure-supported approach roadway on the Poughkeepsie end of the bridge was widened to its present four lane configuration in several stages from the 1940s to the 1990s.

The Rip Van Winkle Bridge is a 4,978 foot cantilever through truss and deck truss bridge with an 800-foot main span. Opened in 1935, the bridge has benefitted from several projects to extend the useful life of its deck and improve roadway lighting. In 1992, a deck replacement project increased the roadway width to its present 34 feet with a 6-foot sidewalk on the south side of the bridge. Sidewalk widenings (lookouts) were constructed in 2019.

The Kingston-Rhinecliff Bridge, opened in 1957, is a continuous truss bridge with an overall length of 7,793 feet and two main channel spans of 800 feet each. In 2002, a deck





replacement project increased the roadway width from 36 feet to 40 feet. In 2019, a barrier was placed on the deck to provide a separated pedestrian path for the Empire State Trail, resulting in a 34-foot roadway and a 4-foot wide pedestrian path (with 5-foot wide passing zones every 200 feet).

The North Span of the Newburgh-Beacon Bridge complex was opened in 1963. It is 7,789 feet long overall with a 1,000-foot main channel cantilever truss span. Originally designed to accommodate two 15-foot traffic lanes, the bridge was the object of a major reconstruction beginning in 1980 and was reopened in 1984 with a 39-foot 5-inch wide roadway accommodating three lanes of westbound traffic.

The South Span at Newburgh-Beacon, opened in 1980, is 7,801 feet long overall, slightly longer than the North Span. The newer bridge has a 53-foot 5-inch wide roadway accommodating three lanes of eastbound traffic and a 12-foot wide shoulder, serving as a breakdown lane. The South Span also carries a separate 8-foot wide pedestrian walkway and bicycle path. The deck was replaced from 2013-2015.

In 2010 the Poughkeepsie Railway Bridges, now designated the Walkway over the Hudson, was placed under the ownership of the New York State Bridge Authority. This bridge was originally opened to rail traffic in 1888, was modified in 1923 to increase load capacity, closed to rail traffic in 1974 after being damaged by fire, and converted to a pedestrian walkway in 2009-2010. The bridge presently carries only pedestrians on a concrete deck 25 feet wide with a 21'-7" clear walkway.

ANNUAL INSPECTION PROCEDURE, ADDITIONAL PROCEDURES & IMPLEMENTATION

The Authority regularly contracts with independent firms of civil and structural engineers to provide various inspection, investigation, design and construction supervision services.

Annual Inspection Procedures

From the late 1950s through 1989, the Authority retained Modjeski and Masters to conduct annual inspections of its bridges. In 1990, 1991, and 1992, the Authority bridges were inspected by three consulting engineering firms with each firm being assigned a different pair of bridges each year. Over the three-year period, each firm inspected the entire group of six bridges. The three consultants utilized were Ammann and Whitney (now WSP); Modjeski and Masters, Inc.; and Parsons Brinkerhoff Quade and Douglas, Inc (now WSP). Between 1993 and 2016, Modjeski and Masters, Inc. has performed the annual inspections for all six of the Authority's bridges. In 2017, 2018 and 2019 (with an extension through 2022), the bridge inspections were again divided among three consulting engineering firms. The three firms are HAKS Engineers (now Atane), Modjeski and Masters, and WSP. Since 2017, three maintenance inspections are performed by Modjeski and Masters each year and each of the three firms perform one biennial inspection each year.

The actual inspections are performed by a team of each firm's licensed professional engineers and, where appropriate, experienced engineers under the direction of licensed professional engineers. Presently, all bridges are inspected annually with three bridges receiving a biennial inspection and three bridges receiving a maintenance inspection. The biennial



inspection is performed to meet the state and federal requirements while the maintenance inspections are performed to ensure the continuation of the present high level of bridge maintenance. For the biennial inspections, the bridges receive hands-on close-up visual inspection of virtually every steel member of the bridges. Special attention is paid to all fracture critical members. Fracture critical members are those steel members whose failure would be expected to result in collapse of the structure. Where it is useful, "snooper" crane trucks and/or under-bridge inspection platforms are utilized to provide access for inspections to the bridge floor systems and below deck trusses. Elsewhere, Authority employees rig scaffolding as needed, or the inspectors climb the structural members themselves using "technical access methods" to complete their observations.

The products of these annual inspections include:

- (1) A photographically illustrated narrative report on the condition of each bridge;
- (2) A numerical rating of each component of each vehicular bridge structure consistent with the requirements of the New York State Department of Transportation inspection and reporting manuals and the Federal Highway Administration's National Bridge Inspection Standards. No such numerical rating system exists for pedestrian structures therefore no numerical assignment is made for the components of the Walkway Over the Hudson;
- (3) A checklist of maintenance tasks recommended for implementation by the Authority's in-house maintenance staff; and
- (4) A prioritized listing of extraordinary maintenance, rehabilitation and replacement projects recommended for implementation through the use of outside contractors.

In 1987, the adequacy and effectiveness of the Authority's annual inspection program was evaluated by a joint team of Federal Highway Administration and New York State Department of Transportation officials. They concluded in their evaluation report that the Authority was 100% in compliance with the national standards for frequency of inspection, that the inspections were being carried out by competent and qualified personnel and that "the New York State Bridge Authority should be commended for instituting special in-depth inspections, such as the cable inspection of their suspension bridges, as an indication of their foresight into areas of possible problems." Subsequent FHWA/NYS DOT evaluations have made similar findings.

Additional Procedures

In addition to developing its annual inspection reports, Modjeski and Masters also prepares additional investigation and inspection reports and reviews investigation and inspection reports of other consulting engineering firms retained by the Authority to undertake specific projects. In recent years such additional procedures have included, among others:

- Underwater inspections of each of the Authority's submerged bridge piers, which have been routinely done at five-year intervals;
- Unwrapping, interior inspection, chemical analysis and fatigue testing of suspension bridge main-cable wires, undertaken at not greater than five-year intervals;



- Removal, inspection and testing of suspender ropes;
- Review of sonar depth plotting and scour monitoring of the river bottom adjacent to the Authority's bridge piers;
- Ship collision studies and associated risk assessments at all bridge crossings with piers in the river;
- Vulnerability Assessment of all NYSBA facilities;
- Seismic analyses of the bridges to identify areas of the structures that do not meet current seismic standards; and
- Truss hanger stress and fatigue analysis.

Finally, Bridge Authority maintenance and engineering personnel are interviewed in connection with both the annual inspections and any additional procedures to collect information on conditions and events observed by them during the course of their work on the bridges.

Implementation

Implementation of the recommended maintenance and rehabilitation and replacement programs is the responsibility of the Authority. After review of the annual inspection reports, the reports of the additional studies and investigations, and the prioritized list of major projects developed by the Authority and reviewed by Modjeski and Masters, the Authority develops both an annual maintenance work plan for its in-house forces and an annual revision of its Five Year Capital Construction and Rehabilitation Program. The current Five Year Program includes work scheduled for the years 2019 through 2024. In addition to the Five-Year Program, a long range Capital Construction and Rehabilitation Program extending through the year 2040 has been developed.

Since its inception in 1986, the Authority's Department of Engineering and Maintenance has been responsible for the condition and proper repair of the bridges. The Chief Engineer is a licensed professional engineer with experience in the inspection, construction and maintenance of large over-water bridges. He oversees a Director of Bridge Maintenance who is responsible for the activities of all Authority maintenance employees and a Director of Contract Maintenance who coordinates the activities of all outside contractors. The Authority employs one bridge maintenance foreman at each bridge and a staff of approximately 50 full-time maintenance workers throughout the bridge system.

These forces are responsible for many maintenance activities which prevent or delay deterioration of the bridges, such as annual washing of the metalwork effected by road salt and debris, lubrication of moving portions of the bridges, spot painting and repainting of portions of the bridges, repairing of roadway deck concrete spalls and deck joints, and minor structural steel repairs and modifications.



The NYSBA has always pursued the policy of maintaining an adequate paint coating on steel bridge members. For many years NYSBA maintenance personnel repainted the bridges. However, with the environmental constraints and associated specialized equipment and expertise required for lead paint removal as well as an increase in general repainting needs, a larger portion of the work has been performed in recent years under contract. Until recently, the practice of the NYSBA was to repaint, under contract, each bridge on a five-year cycle. As evidence of the effectiveness of that painting program, as well as other maintenance functions, the calculations made in 1988 and 1992 to set vehicle posting and loading limits did not have any loss of material deducted from steel members due to corrosive deterioration at critical points. However, in order to efficiently manage the current cost and regulatory requests of lead abatement and repainting, the Authority has revised its approach and is now assembling larger paint contracts at less frequent intervals. If this program is continued as planned, the bridges will display more cosmetic deficiencies from time to time, but should not suffer structurally in any significant way.

In addition to the inspection information described herein, the NYSBA has received from Modjeski and Masters load rating reports in 1988 and 1992. Rating analysis calculations were made for the floor system members of all NYSBA structures. This vehicle load capacity information is used by the NYSBA to control weights of vehicles crossing the bridges. The goal of preventing vehicle overloading on the bridges results in reducing maintenance and contract work and may extend the service life of the bridges. A recent assignment to meet federal requirements for the rating of Emergency Vehicles (EVs) involved updating the 1988 and 1992 load ratings for changes in dead loads.

CONDITION OF BRIDGE FACILITIES

Annual inspections were made and reports filed in 2019 on the following NYSBA facilities:

- Bear Mountain Bridge and Approaches
- Newburgh-Beacon North Span and Approaches
- Newburgh-Beacon South Span and Approaches, including the Balmville Road Bridge over Route I-84 and the Route I-84 Bridge over Route 9W
- Mid-Hudson Bridge and Approaches, including the Route 44/55 Bridge over Route 9W
- Kingston-Rhinecliff Bridge and Approaches
- Rip Van Winkle Bridge and Approaches
- Walkway Over the Hudson

In the case of the Walkway over the Hudson, an inspection was completed in 2015. At the present time, it is anticipated that condition inspections will be completed on a 5-year cycle for this particular bridge with the next inspection to take place in 2020.

In the case of the vehicular bridges, the annual inspections were conducted in accordance with New York State Department of Transportation requirements and Federal Highway Administration guidelines. The New York State Department of Transportation Bridge Data Information System (BDIS) is updated each year for each bridge.



All of the elements of each vehicular bridge are rated. The entire bridge also receives an overall "General Recommendation", which is the Inspector's opinion of what he/she feels is the condition of the bridge as a whole. Important bridge elements such as primary structural members, abutment stems, pier columns, roadway deck, etc., heavily influence the general recommendation. The general recommendation is numerically rated from one to seven. This numerical rating system is described in general terms as follows: 1 signifies "very poor condition"; 2 signifies "poor condition"; 3 signifies "major structural repairs required"; 4 signifies "structural repairs required"; 5 signifies "repairs required"; 6 signifies "minor repairs required"; and 7 signifies "good condition".

The following is a summary of General Recommendations of Bridge Authority facilities from the latest Biennial Inspections:

<u>STRUCTURE</u>	<u>GENERAL RECOMMENDATION</u>
• Bear Mountain Bridge	5
• Newburgh-Beacon Bridge (South Span)	5
• Newburgh-Beacon Bridge (North Span)	5
• Balmville Road Overpass	5
• Interstate 84 over Route 9W Overpass	7
• Mid-Hudson Bridge	6
• Route 9W overpass at Mid-Hudson	6
• Kingston-Rhinecliff Bridge	5
• Rip Van Winkle Bridge	5

An inspection report for each bridge was submitted to the Authority. Maintenance recommendations were abstracted from the reports to serve as checklists for bridge maintenance crews. The Federal Structure Inventory and Appraisal Forms are to be updated for each bridge.

Modjeski and Masters reviews the findings of depth sounding surveys performed each year for all river piers. Findings from underwater diver inspections made in 2017 were reviewed as available. The next Underwater diver inspections are currently scheduled for the summer of 2022.

The findings on the bridge conditions are summarized below, based on the 2019 annual inspection reports. Reference is also made to the recommended 2019-2024 Capital Construction and Rehabilitation Program and the Long-range plan through 2040.

Bear Mountain Bridge

The current overall condition of this bridge is good and it requires only minor repair efforts, in addition to the contract repair work detailed below.

The main cable southwest backstay was strengthened in 2003. A periodic cable evaluation was performed in 2007 by Amman and Whitney (now WSP). Another main cable evaluation is underway by Modjeski and Masters, with wire testing results and delivery of a report expected in early 2020. The next main cable evaluation is scheduled for 2028.



The toll plaza of the bridge was completely rebuilt in 1992 with operational improvements made to the west approach. These improvements resulted in safety improvements to the plaza area operations.

The overlay was replaced in 2007. Interim deck shoring has recently been performed and a deck slab rehabilitation and overlay replacement contract is scheduled for 2020. A complete deck replacement is scheduled to start in 2026.

The upper and lower chords of the stiffening truss were repainted in 1992 and the towers were repainted in 1998. A maintenance painting contract was conducted in 2002. Maintenance painting of the towers above the roadway is scheduled for 2023.

As part of an enhanced security program, security fencing and cameras are in place and cameras are periodically added to the system.

Newburgh-Beacon South Span

The current overall condition of this bridge is good and it should require only minor repair efforts, except for the contract repair work described herein.

The deck was completely replaced from 2013 through 2015, including new barrier, railings, overhead sign gantries and other appurtenances. Steel repairs for the pedestrian walkway are scheduled for 2020.

A major maintenance painting contract is scheduled for 2029-2031.

Underwater pier repairs and substructure repairs were performed in 2003 and are scheduled again in 2020.

To enhance the security of the facility, new security fencing and cameras were installed in 2003 and cameras are periodically added to the system.

Newburgh-Beacon North Span

The current overall condition of this bridge is fair to good and it requires only minor repair effort by Authority maintenance forces, except for the contract repair work described herein.

The overall condition is influenced by the fair condition of the roadway deck that dates back to the early 1980s. Planning and design for a deck replacement are underway, with construction anticipated to start in mid to late 2020 and run through Spring 2023.

The last major painting and lead abatement project was completed in 2012.

The I-84 over Rte 9W approach structure is in good condition having received an extensive rehabilitation in 2018-2019. This rehabilitation included raising the superstructure two feet, a complete deck replacement, elimination of deck joints, full cleaning and painting of superstructure metalwork, seismic retrofits and reconstruction of the approach highway and barrier system.



Mid-Hudson Bridge

The current overall condition of the Mid-Hudson Bridge is good and it requires only minor repair work, except for the contract repair work described herein.

A main cable restoration project was completed in 1993, during which an extensive cable condition investigation was conducted. This contract provided for unwrapping and rewrapping the main cables, coating the cable wires with lubricant, and painting the cable wrapping. The objective was to prolong the service life of the cables as much as possible. The most recent main cable evaluation is currently underway, with wire test results and delivery of a report expected in early 2020. The next evaluation is scheduled in 2024, where suspender ropes are also scheduled to be replaced.

The bridge deck wearing surface was replaced in 1993. Because of the traffic volume carried by this bridge, the wearing surface was also replaced in 2003 and 2007. The next wearing surface replacement is scheduled in 2021.

The steel curb, railing bases and concrete-filled grid deck along the curb lines exhibit deterioration and design is currently underway for these areas of the bridge to be rehabilitated along the entire length of the suspension spans. As part of this contract, the finger joint system at each tower will also be rehabilitated. This railing/curb and finger joint rehabilitation is scheduled for construction in 2020.

The east approach was extensively rehabilitated by contract work in 1989-91. The overlay on the east approach has been replaced several times since and is scheduled for its next replacement in 2021. The west approach received a major rehabilitation from two contracts in 1990 and 1991. The toll plaza was enlarged and rehabilitated in 1998 providing additional capacity and facilitating the installation of EZ Pass.

Contracts for performing lead abatement painting of the superstructure occurs periodically with the next contract scheduled for 2022.

An emergency command center was added at the Mid-Hudson Bridge in 2010 to handle systemwide emergency coordination. In addition, security fencing and cameras were added in 2003 and cameras have been added periodically.

Kingston-Rhinecliff Bridge

The current overall condition of this bridge is good. The bridge requires only minor repair effort, except for the contract repair work described below.

The deck was replaced in 2002. A micro-surface overlay was placed in 2007. The overlay is showing signs of age and is scheduled for replacement in 2020. Another deck overlay and approach paving contract is scheduled for 2028.

Electrical upgrades and substructure repairs are scheduled for 2020.



In 2019, a barrier was placed on the bridge to separate pedestrians from vehicular traffic as part of the Empire State Trail. The barrier placed was precast "temporary" barrier. A more permanent solution with a cantilevered sidewalk is being considered by the Authority.

A major lead abatement painting project was completed in 2003. A major maintenance painting contract for the approach girder spans is scheduled for 2022. A maintenance painting and seismic retrofit project for the deck truss spans is scheduled for 2025.

To enhance security at the facility, security fencing was added in 2003 with video cameras installed in 2010. Other cameras have been added periodically since.

Rip Van Winkle Bridge

The current overall condition of this bridge is good and it requires only minor repair efforts, except for the contract repair work described herein.

The complete replacement of the reinforced concrete roadway deck was completed in 1992. The roadway deck and sidewalks received a micro-surface overlay in 2007. The sidewalks were replaced in 2019 and included intermittent lookouts in the deck truss spans. The roadway overlay is scheduled to be replaced in 2020.

The river towers and lower chords of the bridge were repainted using full lead abatement procedures from 1993 to 1995. Lead abatement continued in 2006. The next major lead abatement painting contract is scheduled for the pier towers and deck truss spans in 2022.

An investigation and inspection of truss hanger pins was completed in 1996 with all pins found to be in satisfactory condition. The truss span hold-down links at the west abutment exhibited wear and associated vertical settlement of the superstructure. These link assemblies, including the upper and lower pins, were completely replaced in 2019 as was the roadway joint at the west abutment.

To enhance security at the facility, security fencing was added in 2003 with video cameras installed in 2010. Cameras have been added periodically.

Long-Term Outlook for NYSBA Facilities

The NYSBA highway bridges will remain serviceable until they become either geometrically and functionally obsolete, or structurally unsafe. Bridges can potentially become geometrically and functionally obsolete because horizontal and vertical clearances become deficient or because traffic capacity reaches intolerable levels. Bridges can potentially become structurally unsafe because of deterioration, insufficient load-carrying capacity, increases in legal loads, or fatigue in structural steel.

Based on our knowledge of the information available from inspections, investigations and load ratings, our opinion is that NYSBA bridges are all geometrically and functionally serviceable, structurally safe, and maintained to high standards. It is our opinion that the current NYSBA policies of regular inspections, and timely maintenance and rehabilitation work must be continued so that the bridges will remain serviceable. Given the age of the structures, any substantial delays in preventative maintenance may result in rapid deterioration of the facility.



**EVALUATION OF INSPECTION AND MAINTENANCE PROCEDURES
AND THE FIVE YEAR PROGRAM**

Vehicular Bridges

Modjeski and Masters believes that the annual vehicular bridge inspection program conducted by the NYSBA is successful in achieving its goal of obtaining information on bridge conditions. As stated in the Federal report which reviewed NYSBA inspection procedures, the Authority is to be commended for its inspection program with its emphasis on special investigations such as the suspension bridge cable condition. The firm believes that the Authority is benefiting from the application of the latest techniques and state of the art knowledge to its inspections and investigations.

Modjeski and Masters believes that the Authority has an excellent record of response to the annual inspection findings. The maintenance program continually incorporates the inspection findings to the extent that Authority capabilities permit. Whenever maintenance forces cannot perform needed work as defined by the inspection results, this work is scheduled for maintenance or rehabilitation contract work. The Authority has appropriately determined the priority of the contract work in the Five-Year Program.

The Authority's in-house maintenance efforts are, in our judgment, well-directed toward the goal of minimizing the need for contract maintenance. These efforts are cost-effective, based on the condition of the bridges that have resulted. The Authority's maintenance and rehabilitation program keeps the Authority's facilities in very good condition and is, in our opinion, among the best in the nation.

The effects of aging, traffic and changing public needs can be expected to result in continued need for repair and rehabilitation. The firm believes that the planning which has produced the Five-Year Program is well-conceived. Adherence to the scheduled program will enable the Authority to cope with deterioration and will keep the facilities serviceable.

Walkway Over the Hudson

Though rehabilitated just prior to the Authority's assuming ownership, there have been a number of repairs performed since and repairs yet to be performed on the Walkway over the Hudson. Based on the findings of the last inspection performed in 2015, the Authority contracted to repair deteriorated railing post bases along the walkway deck. To facilitate inspection, the Authority also implemented an inspection access contract that added ladders and hand ropes at various locations on the structure. The next inspection is scheduled for 2020, so it is anticipated that many findings of that inspection will be addressed by Authority maintenance forces. However, \$2.6 million is programmed for steel repairs in 2024 and a major \$25 million lead abatement painting contract is scheduled for 2025 through 2027.



Ms. Tara Sullivan

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Conclusions

Modjeski and Masters believes that the Authority's current operating procedures, with their associated costs for maintenance operations, and the Five Year and Long Range Capital Construction and Rehabilitation Program expenditures, will sustain operations at a high standard. The high capital asset value of the Authority's facilities can be expected to be maintained as the service life is extended by Authority policies and operations.

Very truly yours,

A handwritten signature in blue ink, appearing to read "Quentin P. Johnson", is written over a horizontal line.

Quentin P. Johnson, P.E.
Vice President
Modjeski and Masters, Inc.

QPJ:qpj