New York State Office of the State Comptroller
Thomas P. DiNapoli

Division of State Government Accountability

Infrastructure Inspection and Maintenance

New York State Canal Corporation

Report 2014-S-45 May 2015

Executive Summary

Purpose

To determine whether the New York State Canal Corporation's (Corporation) inspection scheduling procedures ensure that all high- and intermediate-importance structures are periodically inspected and whether inspection results are considered when maintenance activities are prioritized. The audit covers the period January 2012 through October 2014.

Background

The Corporation, a subsidiary of the New York State Thruway Authority (Thruway Authority), was created in 1992 to operate and maintain the New York State Canal System (Canal System). The Canal Law requires the Corporation to maintain the Canal System in good condition. The Corporation's Canal Structure Inspection Manual-95 has established inspection requirements and frequency standards, including in-depth inspections (Inspections) – both above and below water – of structural safety and integrity on a 2-year cycle. Of the 2,065 structures the Corporation is required to inspect, 747 are deemed "critical" (e.g., dams and locks).

Key Findings

- While the Corporation does perform routine operational and reliability checks of the Canal System's critical structures, it has not performed the two-year Inspections of a significant number of these structures. In fact, some structures that the Corporation's infrastructure management system identifies as critical have not had an Inspection in many years – and some not at all.
- The Corporation's process for determining Inspection and maintenance priorities is inconsistent, and the basis for decisions is sometimes unclear. In numerous instances, we found no evidence that the Inspection results were considered when determining maintenance priorities. Thus, there is a risk the structures most in need of repair were not given priority.
- Despite the low rating of many of its critical structures, funding shortages have greatly inhibited the Corporation's ability to address its priority maintenance needs, especially after the damage inflicted by major storms in recent years.

Key Recommendations

- Promptly conduct Inspections of any high- and intermediate-importance structures that have never had Inspections or where significant time has elapsed since the last Inspection.
- Improve the clarity and effectiveness of the Inspection scheduling process for high- and intermediate-importance structures.
- Work with the Thruway Authority to develop a realistic, long-term, detailed strategic and financing plan aimed at improving the overall condition of the Canal System's infrastructure while also dealing with emergency response.

Other Related Audits/Reports of Interest

Thruway Authority: Inspecting Highway Bridges and Repairing Defects (2012-S-33)
Port Authority of New York and New Jersey: Inspecting Highway Bridges and Repairing Defects (2012-S-34)

State of New York
Office of the New York State Comptroller

Division of State Government Accountability

May 26, 2015

Ms. Joanie Mahoney
Chair
New York State Thruway Authority
200 Southern Blvd.
Albany, NY 12201-0189

Dear Ms. Mahoney:

The Office of the State Comptroller is committed to helping State agencies, public authorities, and local government agencies manage their resources efficiently and effectively. By so doing, it provides accountability for tax dollars spent to support government operations. The Comptroller oversees the fiscal affairs of State agencies, public authorities, and local government agencies, as well as their compliance with relevant statutes and their observance of good business practices. This fiscal oversight is accomplished, in part, through our audits, which identify opportunities for improving operations. Audits can also identify strategies for reducing costs and strengthening controls that are intended to safeguard assets.

Following is a report of our audit entitled *Infrastructure Inspection and Maintenance* for the New York State Canal Corporation. This audit was performed pursuant to the State Comptroller's authority as set forth in Article X, Section 5 of the State Constitution and Section 2803 of Public Authorities Law.

This audit's results and recommendations are resources for you to use in effectively managing your operations and in meeting the expectations of taxpayers. If you have any questions about this report, please feel free to contact us.

Respectfully submitted,

Office of the State Comptroller
Division of State Government Accountability

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Background

The New York State Canal Corporation (Corporation), a subsidiary of the New York State Thruway Authority (Thruway Authority), was created in 1992 to operate and maintain the New York State Canal System (Canal System), previously the responsibility of the New York State Department of Transportation (DOT). Since its creation, the Canal System has played a key role in New York's history and social and economic development, and continues to be an important resource in terms of hydropower, agriculture, industry, and recreation.

The Canal System includes 524 miles of waterways for four canals (Erie, Oswego, Champlain, and Cayuga-Seneca) and consists of 2,387 structures, including 57 locks, 20 lift bridges, 56 permanent dams, and 11 movable dams. The Corporation also maintains approximately 300 miles of adjacent recreational trails and 22 reservoirs that are used to manage the Canal System's water levels. The Canal Law requires the Corporation to maintain the Canal System in good condition. To accomplish this, the Corporation has implemented an inspection program to identify structures with any critical weaknesses (e.g., deterioration, corrosion, material defects, and damage) that need repair. The Corporation is responsible for inspecting 2,065 of the Canal System's 2,387 structures (101 are inspected by other entities and 221 do not require inspection).

The Corporation's inspection program includes an annual operations inspection of the Canal System by boat, checking the general condition of mechanical and electrical systems of locks and lift bridges, appearance, and customer service elements; as well as other inspection options to monitor structures' safety and reliability (e.g., unannounced site visits, inspections of certain structures by consultants or other agency divisions). In addition, the Corporation performs in-depth biennial structural inspections (Inspections). As opposed to the annual operations inspection and visual site checks, these Inspections involve in-depth engineering evaluations of structural safety and integrity, as prescribed in the Corporation's Canal Structure Inspection Manual-95 (Manual). Based on Manual guidelines, excluding upland disposal sites, half of the Canal System structures (typically those partially and/or substantially under water such as locks, guard gates, and dams) require both an Above-Water and a Below-Water Inspection every two years. During the period January 1, 2012 through June 30, 2014, the Corporation provided oversight of 1,048 Inspections of Canal System structures: 429 by consultants and 619 done in-house.

The Manual also requires that Inspections be done by professional engineers. During Inspections, inspectors assess all the individual parts of structures and assign an overall General Condition Rating (Rating), as described in Table 1.

Table 1

Rating	Description
5 – 7	Good to excellent (i.e., new) condition
4	Moderate to significant deterioration, but capable of performing its designed function until the next scheduled inspection
3 – 1	Poor condition, with a rating of 1 being the most serious and indicating a clear and present safety hazard

When deficiencies are found – either upon inspection or during routine duties – inspectors prepare flag ("Red," "Yellow," and "Safety") reports to identify the degree of criticality. Additionally, according to the Manual, inspectors should use the Work Urgency Index (Index) to document repair urgency.

In 2008, the Corporation began to phase in its comprehensive asset management system, the Canal Infrastructure Management System (CIMS), which would allow managers to prioritize inspections and repairs and monitor capital and maintenance work for funding allocation purposes. Within CIMS, Canal System structures are classified as either "high," "intermediate," or "low" based on importance and impact in the event of failure. See Table 2.

Table 2

Structure Classification	Impact	Number of Structures	Examples
High	Possible loss of life; serious property, environmental, infrastructure damage; substantial economic loss; or closing of Canal System for longer than one week.	408	Dams, locks (typically considered critical)
Intermediate	Failure will have similar outcomes as "high" but on lesser scale; no loss of life.	339	
Low	Only isolated damage; no system closure or personal injury.	1,318	Ditches, parking lots, access roads

Upon identification of deficiencies, responsible division staff make repairs when possible to keep structures safe and operating effectively. More extensive repairs that require significant resource allocations are done as part of capital projects. Because the Canal System is not self-supporting, the Corporation relies on State appropriations and the Thruway Authority for operating and maintenance support, including funding for capital projects. During its annual budgeting process, the Corporation submits its maintenance priority projects to the Thruway Authority's Capital Program Executive Committee, executive management, and the Thruway and Canal Boards for funding approval.

The Thruway Authority's 2012-15 capital plan allocated $215.5 million for the Canal System, including $188.2 million for infrastructure, $3.5 million for equipment, and $23.8 million for trail projects. During the three years ended December 31, 2014, the Corporation started 65 new capital projects valued at $279.6 million. In addition, during the period January 1, 2012 through June 30, 2014, the Corporation's maintenance staff undertook 40 maintenance projects.

Audit Findings and Recommendations

We found that the Corporation performs routine operational and reliability checks of the Canal System's critical structures, but has not conducted regular Inspections of a significant number of these structures. In fact, the Corporation's CIMS data indicates some critical structures' last Inspection occurred many years ago. Because the Canal System includes various aging hydraulic steel structures and many of its other structures are constructed of materials that are subject to erosion, movement, corrosion, and deterioration as a result of exposure to wind, water, ice, and temperature extremes, regular inspections are essential to ensure safety. According to the minutes from the June 6, 2014 meeting between the Thruway Authority and Corporation Boards, only about 55 percent of the Canal System's critical structures were in good condition in recent years due to resource constraints. The minutes further reveal the 2014-15 goal was to maintain this percentage. Board members agreed it was imperative that the structures remain in good condition to maintain the Canal System's reliability and continued safe operation. Given this goal, it is important that structures have regular Inspections to identify and prioritize the Canal System's greatest repair needs.

According to Corporation management, funding shortages have greatly inhibited their ability to address Inspection backlogs and priority maintenance needs. Furthermore, during our scope period, Hurricane Irene, Tropical Storm Lee, and other emergencies tied up a significant portion of the funding ($120 million of $279.6 million) earmarked for repairs and improvements. During this time, numerous capital repair projects involving critical structures were deferred for extended periods or were postponed indefinitely due to funding limitations.

Given the magnitude of the repairs needed to keep the Canal System operational after the storms, inspection results were not the primary driver of maintenance activities. However, it doesn't appear that the Corporation considered all Inspection findings involving critical structures when determining other non-emergency maintenance priorities. Although the Corporation has worked toward implementing a risk-based system for prioritizing Inspections and repairs since 2011, we found its methodologies were flawed and thus could not be relied on to accurately prioritize repair projects. Furthermore, in numerous instances, we found the Corporation's process for determining Inspection and maintenance priorities lacked clarity.

While factors such as the level of available resources and severe storm damage have greatly influenced the Canal System's inspection and maintenance programs in recent years, we believe the Corporation could have used its inspection and maintenance resources more effectively. Before deciding on its Inspection priorities, the Corporation should re-examine its inspection requirements and procedures while considering available resources, legal and safety requirements, and industry best practices. In conjunction with these considerations, the Corporation should also identify its exact resource needs and inspection responsibilities. In addition, it should ensure its inspection tracking system accurately accounts for structures that need Inspections.

In response to our preliminary findings, Corporation management concurred with many of our conclusions, and acknowledged that the prioritization tools the Corporation has developed in

CIMS are not being used to their fullest extent. Further, they added that the Corporation plans on implementing new procedures and organizational enhancements to better manage the relationship between its inspection program and its capital and maintenance work. Given the present overall state of the Canal System and resource limitations, we recommend that the Corporation prioritize completing these tasks.

Inspections of Critical Structures

The Manual describes the Corporation's detailed procedures for conducting Above-Water and Below-Water Inspections, rating structure conditions, prioritizing repairs, and reporting inspection results. According to the Manual, inspections are needed, among other reasons, to:

- Ensure the discovery of any critical weakness due to deterioration, corrosion, material defects, and damage.
- Appraise the severity of these defects so that appropriate action can be taken to safeguard users, preserve structure integrity, and prevent additional deterioration.
- Provide a basis for deciding upon contract and maintenance repair work and for estimating the time and materials needed for repairs.
- Provide an inspection record enabling the detection of progressive changes.

To determine whether critical structures have regular inspections and whether the Corporation prioritizes inspections of critical structures over other structures, we conducted an analysis of the Corporation's latest inspections data (Above-Water and Below-Water), using the structure classifications outlined earlier in this report, for the 2,065 structures it is responsible for inspecting as of September 30, 2014 (see Table 3).

Table 3

Date of Last Inspection	High	% of Total	Inter-mediate	% of Total	Low	% of Total	Grand Total	% of Total
Above-Water Inspections								
Within Last 2 Years	180	44%	137	41%	423	32%	740	36%
Within 2 to 5 Years	170	42	150	44	213	16	533	26
Within 5 to 10 Years	11	3	17	5	84	7	112	5
Over 10 Years	37	9	18	5	462	35	517	25
Never Inspected	10	2	17	5	136	10	163	8
Total Above-Water	**408**	**100%**	**339**	**100%**	**1,318**	**100%**	**2,065**	**100%**
Below-Water Inspections								
Within Last 2 Years	98	25%	15	6%	1	0%	114	11%
Within 2 to 5 Years	27	7	55	23	40	9	122	11
Within 5 to 10 Years	10	3	67	28	24	6	101	9
Over 10 Years	27	7	6	3	6	1	39	4
Never Inspected	223	58	94	40	375	84	692	65
Total Below-Water	**385**	**100%**	**237**	**100%**	**446**	**100%**	**1,068**	**100%**

As this analysis shows, the Corporation has not been conducting Above-Water Inspections in a timely manner. Among our observations:

- In total, 792 (38 percent) structures did not have an Above-Water Inspection within the last five years, and 163 of these (8 percent) have never had one. (*shaded red*)
- 430 high- and intermediate-importance structures (58 percent) have not had an inspection within the last two years, as required, including 55 (7 percent) that have not had an inspection in 10 years and 27 (4 percent) that have never had one. (*shaded yellow*)

While our analysis shows a significant difference exists between the percentages of timely Above-Water Inspections for low-importance versus high- and intermediate-importance structures, this was not the case for Below-Water Inspections. As Table 3 illustrates, of the 1,068 structures requiring Below-Water Inspections,

- As of August 2014, only 114 (11 percent) had received them within the last 2 years. *(shaded green)*
- 832 (78 percent) had not received a required Below-Water Inspection within five years, including 692 structures (65 percent) that have never had one, 223 of which are deemed high importance by the Corporation. *(shaded red)*

When discussing our inspection data, management acknowledged the backlog for high- and intermediate-importance structures. Yet they disagreed with our numbers, stating that CIMS data on which our analysis was based – and which management uses to prioritize inspections and repairs – is not reliable for a number of reasons. According to officials, CIMS data still had not been verified from when it was originally entered in 2008 and, as a result, misclassifies some critical structures that are no longer in use. In addition, management indicated that numerous structures have been added to CIMS in the last two years, or are still under construction, and CIMS reports them as due for inspection. Furthermore, management told us CIMS may significantly overstate the number of structures that require a Below-Water Inspection, explaining that CIMS, by default, lists certain structure types as requiring Below-Water Inspections without considering individual structures' actual function.

We believe, and the Thruway Authority and Corporation Boards indicate concurrence, that it is imperative that the Corporation knows the condition of all Canal System critical infrastructure. According to management, for CIMS to accurately reflect the true backlog of inspections, knowledgeable staff would need to go through each structure listing, and then update the inspection due dates based on actual circumstances. Once this occurs, and CIMS data is tested, management indicated the Corporation can reasonably quantify the real backlog of inspections. However, they did not provide a time table for when this could occur.

Identification of Inspection Priorities

The Manual identifies specific inspection cycles and procedures for prioritizing repairs that, if followed, would ensure all critical structures are regularly inspected and priority repairs promptly made. However, management indicated the Corporation does not have the resources to meet all of

the Manual's requirements, especially its two-year inspection requirements. As evidenced by the previous inspection frequency table, the Corporation has great difficulty conducting Below-Water Inspections within a two-year cycle or even conducting such inspections at all for many high- and intermediate-priority structures. Management indicated that the Manual's requirements are far more stringent than necessary, and as a result, the Corporation has adopted informal practices that deviate from the Manual.

Our research identified certain information that tends to support the Corporation's position regarding inspection frequency. For example, we found other relevant State requirements covering Below-Water Inspections (i.e., diving inspections) that called for less frequent inspections. DOT guidelines, for instance, require that State bridges only have diving inspections every five years. Furthermore, industry experts (including the U.S. Army Corps of Engineers, the American Society of Civil Engineers, the U.S. Navy, and other State authorities) generally concur that it is not economical to conduct routine inspections of all structures, but go further in suggesting that inspection type and frequency be tied to each structure's potential risk of failure and corresponding overall system impact. In particular, they recommend an integrated inspection approach, consisting of visual site inspections and limited assessments to ensure structures are safe and reliable, with in-depth inspections of flawed or damaged critical structures to analyze their potential for failure.

In June 2012, the Corporation developed an Inspection Schedule Matrix (Matrix) for identifying priority structures for its inspection consultants to inspect. Similar to what industry experts suggest, the Matrix incorporated a risk-based methodology that uses less stringent requirements for determining inspection frequency. Management indicated these are the frequency requirements the Corporation strives to attain for all of its inspections. The Matrix derives a priority score tied to five weighted factors: structure type, Rating (based on most recent inspection), last inspection date, flag reports, the structure's overall importance to the Canal System, and need. The lower the Matrix score, the greater the need for an inspection.

Management indicated that, under the Matrix's inspection schedule, higher priority is given to certain more critical structures: locks, flood gates, bridges, and dams. If these critical structures obtain an acceptable overall Matrix score, the structures are on a two-year inspection cycle. If not, an annual inspection should be done. All other types of structures (e.g., spillways, approach walls, culverts, and parking lots) have a one- to five-year cycle depending on their Matrix score. The Manual and Matrix use similar inspection cycles for both Above-Water and Below-Water Inspections.

We found that the Matrix's approach for prioritizing inspections is still largely a work-in-progress and underutilized in prioritizing inspections. The Corporation has never evaluated the appropriateness of the importance weights the Matrix uses when calculating an overall priority score. Also, the Manual, which was last updated in 1995, has not been revised to reflect the Matrix requirements, including those related to documenting decision making. In addition, during our scope period, the Matrix omitted 751 of the 2,065 structures, including 38 high- and 54 intermediate-importance structures, that the Corporation is responsible for inspecting. Management told us these structures were excluded because the Corporation did not know their

previous inspection dates. After we brought this to management's attention, they corrected the way the Matrix worked so these structures would receive a score in the future.

Management informed us that, unlike inspection scheduling for consultants, divisions do not consider the Matrix rating when they decide which structures to inspect. Therefore, the Matrix was only used to schedule 425 of the 1,048 inspections (i.e., 41 percent) conducted during our audit period. Furthermore, even when the Matrix was used, its results were often altered by Corporation headquarters and the divisions for no apparent reason. Specifically, of the 590 structures on the Matrix's original Above-Water Inspection priority list, 260 had been removed and 118 replaced. Management could not explain why these changes were made but stated they were not done as part of a formalized process; the list was passed back and forth by e-mail and no records were kept documenting the changes.

Because the Corporation does not document its decisions about inspection scheduling priorities, it is not apparent why certain critical structures did not have inspections while other non-critical structures did. For example:

- Of the 260 structures that had been removed from the Matrix's original Above-Water Inspection priority list, 78 were high-importance structures, including one retaining wall that did not have an inspection since September 1980. Of those added as replacements, 70 were deemed low-importance structures. Within the last two years, 54 of the 70 low-importance structures had inspections.
- Of the 48 high-importance structures that have not had inspections in over 5 years, 18 had a Rating of 4 or below, indicating a condition of moderate to significant deterioration or worse.

While the Corporation's current goal is to follow the Matrix's inspection schedule, it does not currently track how successful it is in doing so. Nor does it account for deviations from the schedule, which would be useful for evaluating the appropriateness of the Matrix rating factors. Management informed us that the Corporation currently relies on priority inspection lists that the divisions maintain, and the divisions consider various risk factors and overall system importance when creating inspection schedules. Management emphasized the Matrix is an evolving tool that, while helpful for identifying inspection scheduling priorities, is augmented by staff professional judgment gained from years of experience.

In their response to our preliminary findings, management generally agreed that the Corporation could make major improvements in its scheduling, execution, and frequency of inspections. While they agreed their ability to prioritize repair needs would be enhanced if CIMS structure information was more accurate and effectively used, they do not believe their ability to prioritize repair needs has been significantly impaired, citing the continued safe operation of the Canal System, even in the wake of catastrophic weather events, as evidence of the Corporation's ability to make sound decisions despite resource limitations.

We acknowledge the prompt steps the Corporation took to identify repair needs after recent storms. However, in their preliminary response to our findings, management did not address specifically

how they will maintain and/or improve the overall condition of the Canal System, merely that the Corporation would implement a "robust" inspection prioritization and management process. To maximize the future benefit of these changes, the Corporation should re-examine its inspection frequency requirements and procedures, taking into account available resources, legal and safety requirements, and industry best practices.

Inspection Resources

Throughout our audit, management repeatedly mentioned that funding limitations had inhibited the Corporation's ability to conduct inspections. Based upon our review of recent resource allocation trends, we did not see any significant changes in dedicated inspection resources (e.g., staffing, inspection expenditures) that would account for the trends previously noted in Table 3.

In an attempt to quantify the impact of funding limitations, we asked management to provide breakdowns of the in-house and consultant resources needed to address inspection backlogs. However, they were unable to do so. Because management could not determine the average length of time that in-house inspections take, they could not estimate the internal resources needed. Furthermore, without knowing which structures require Below-Water Inspections, along with all the structures that involve more complex above-ground water inspections, management said they could not precisely estimate the amount of consultant resources needed.

Unless management gets a better handle on the Corporation's inspection program resource needs, they will have a difficult time accurately budgeting for those needs. Without accurate budgets, executive management may have difficulty planning for long-term inspection program needs and deciding on funding priorities. Since many structures have not had timely inspections – some for more than 30 years – there is limited assurance that monies spent on non-emergency maintenance went to the critical structures most in need of repair.

Inspection Responsibility

Some Canal System structures are inspected by other agencies, including DOT and the Federal Energy Regulatory Commission (FERC). Various different rules, regulations, and laws define inspection responsibilities relating to Canal System structures. For example, Corporation-owned dams, which are under FERC license for purposes of hydropower projects, are subject to FERC regulations for dam safety. The FERC licensee, not the Corporation, is responsible for complying with the FERC regulations. FERC sometimes performs its own inspections to test that licensees meet compliance requirements.

Highway bridges, including those that cross the Canal System, generally have to be inspected at least once every 24 months under federal and State law. Article 1-A, Section 5 of the Canal Law authorizes the Corporation and the DOT to enter into an agreement relating to any or all bridges and highways over the Canal System. However, according to management, the Corporation has not entered into any agreements with DOT that cover bridge inspection responsibilities. As such, there appears to be confusion concerning who is responsible for inspecting certain bridges.

Of the Corporation's 1,048 inspections that were performed between January 1, 2012 and June 30, 2014, 26 involved structures for which either DOT or FERC had inspection responsibility. Thus, the Corporation unnecessarily expended resources that could have been used to inspect other structures. In response, management stated that, in these instances, Corporation employees were unsure who had inspection responsibility. As a result of our audit, the Corporation embedded a field within CIMS for inspection responsibility to prevent similar situations in the future.

Recommendations

1. Improve the clarity and effectiveness of the inspection scheduling process for high- and intermediate-importance structures. This should include, but not be limited to, taking the necessary steps to:

    - Ensure CIMS properly accounts for all structures that require inspections and contains accurate inspection data.
    - Determine the optimal inspection frequency requirements, taking into account available resources, legal and safety requirements, and industry best practices.
    - Establish a sound and supportable risk-based method for determining inspection priorities.
    - Develop and abide by written guidelines that reflect the current overall inspection program and promote clarity in decision making.

2. Promptly conduct inspections of any high- and intermediate-importance structures that have never had inspections or where significant time has elapsed since the last inspection.

3. Account for the Corporation's true inspection program resource needs and incorporate them into budget requests.

4. Enter into a formal agreement with the DOT that covers inspection responsibilities for all State-owned Canal System bridges and adhere by its provisions.

Maintenance Activities

The Corporation has developed several tools to prioritize its capital and maintenance repair needs. However, we determined that, in many cases, these tools do not use data that is accurate or current and are thus unreliable (e.g., tools that are based on outdated inspection results). In addition, the tools are not the primary basis for maintenance priority decisions, with the Corporation giving greater weight instead to worker knowledge and professional judgment. Furthermore, since the reasons for decisions aren't generally documented, a lack of clarity exists regarding the basis for these decisions.

Our review of Corporation inspection and repair data reveals that numerous deficiencies have not been addressed. Furthermore, many of the critical structures that have a General Condition Rating less than 5 (indicating at the very least moderate to significant deterioration) do not appear on current capital plans. Therefore, these factors may hinder the Corporation's ability to improve the

overall condition of the Canal System. Considering the age of many Canal structures, deferring or postponing capital projects could increase the future cost of necessary repairs.

Prioritizing Repair and Maintenance

To help prioritize capital and maintenance repair work, the Corporation has been developing the CAP (capital planning) and MAP (maintenance planning) rating systems since 2008. As of April 2011, the CPMS began calculating CAP scores for structures based on prior inspection results, with scores tied to structural importance and condition ratings (e.g., giving greater priority to a failing dam than a failing parking lot). A CAP score of 32.5 or lower indicates that a structure needs work. At the time of our audit, 1,743 of the 2,065 structures had a CAP score and 322 did not for a variety of different reasons.

Despite the consultant's 2012 recommendation that a sound capital planning and project prioritization process be implemented, we found the CAP system does not seem reliable. For example:

- For one lock with a CAP score of 25.18, officials stated that the CAP score is not necessarily representative of the greatest need. For instance, they explained that another lock is next on their priority list, due to some continued movement of the chamber wall and significant structural concerns. However, we found this structure has a current CAP score of 40.26.
- Another lock has a CAP score of 26.11, primarily due to poor concrete conditions and the severely deteriorated condition of the "swing" buffer beams. However, the buffer beams are no longer used and will eventually be removed. As a result, although they do not adversely impact the operation of the lock or safety of Canal patrons, they unnecessarily reduce the structure's CAP score.

Further, we identified 12 other instances, as shared with Corporation management, where CAPS scores did not appear reliable in comparison with contradictory CIMS data.

During our testing, we compared the list of 65 projects that were included on the 2012, 2013, and 2014 budgets, or were added after the budgets were approved, with the CAP scores for the structures impacted by the projects. We found that 25 of the 65 projects do not relate to specific structures that are assigned a CAP score (e.g., trail projects, on-demand repair contracts). The remaining 40 projects include 88 different structures. Based on CAP scores, 18 are in the "Needs Work" range, 14 are in the "Candidate for Future Work" range, and 38 are in the "Does Not Need Work" range; the remaining 18 had a CAP score of zero (i.e., project was not rated).

In response to our findings, management agreed the examples illustrate an inherent flaw in how CAP scores are calculated, which must be addressed. They indicated that the flaws further reinforce the fact that the CAP system should not be the sole determining factor in scheduling capital projects. They emphasized that while CAP scores are an important tool, the professional judgment and experience of the Corporation's engineering staff remain the most critical factor in deciding maintenance priorities. They believe it would be irresponsible to simply give greatest priority to structures most in need of repair without considering the role a specific structure

plays in the operational readiness and safety of the Canal System. Further, they indicated that failure to consider these additional factors, as well as the latest relevant observations from Canal Corporation staff, in programming capital work would be inconsistent with the Corporation's statutory obligations.

At the conclusion of our audit, management informed us that the Corporation had developed a new Capital Project Planning Predictive Tool (CPPPT) in CIMS that will consider a variety of factors, including structural flag ratings, in producing a long-term plan for scheduled rehabilitation of different structures. Further, they indicated that, when applied to the Corporation's 2014 annual capital plan, the CPPPT matched up very well with the engineers' decisions. They stated the Corporation will continue to test the CPPPT, and it will play a larger role in programming capital work in the future.

Ultimately, the Corporation is responsible for creating capital plans for the Thruway Authority's final approval. While the Thruway Authority has its own system for prioritizing projects on the combined Authority–Corporation annual capital plan, it relies on the Corporation to identify which Canal System structures are the best candidates for capital project consideration. However, as explained, the Corporation's existing asset management and capital program management systems cannot yet be relied upon to target project selection. Because many decisions related to maintenance and capital priorities are not documented, it is not apparent that the Corporation gives greatest priority to structures most in need of repair. Given that only half of the Canal structures are in good condition based on the Corporation's own assessment, and considering its limited resources, the Corporation must prioritize improving its asset management and capital program management systems.

Consideration of Inspection Results

During our testing, we evaluated the extent to which the Corporation considers inspection results when prioritizing its maintenance activities. As previously noted, significant weather-related emergencies occurred in recent years that dictated a large share of the Corporation's maintenance priorities during our scope period. Regardless, the Corporation still spent over $90 million on Canal System capital projects that were neither emergency related nor tied to restricted funding sources. For those critical structures (i.e., high and intermediate importance) that had recent inspections, it does not seem that the Corporation considered the inspection results when determining non-emergency maintenance priorities.

As mentioned, when deficiencies are identified, inspectors use the flag system to identify criticality and the Index to rate repair urgency. The Index, like the Rating, uses a 1–7 scale to rate urgency:

- 5 or above = Lesser priority
- 4 = Priority; should be addressed soon
- 3 or below = Greater priority; should be repaired immediately
  - 3: High priority
  - 2: Highest priority; all other ongoing work should be discontinued if necessary
  - 1: Emergency; the Canal System should be closed and locks possibly drained

As of December 2014, of the 1,743 structures that had an Index score, 67 were higher priority structures with an Index score of 3 or less, including 13 classified as high importance and 22 as intermediate importance. Notably, an additional 367 structures appear to have not been assigned an Index rating, showing either a blank or a "0" for the Index score. We found that only three of the intermediate-importance structures with an Index rating of 3 were included in the budgeted capital projects. Due to funding availability, these projects have been delayed to 2015, 2016, and 2019.

From January 1, 2012 through June 30, 2014, 26 structure flags (7 Red, 8 Yellow, and 11 Safety) were issued on critical structures. As shown in the Table 4, as of October 30, 2014, 34 flags were still open.

Table 4

Flag Open	Red Flag	Yellow Flag	Safety Flag	Total
≤ 1 year	0	0	0	**0**
>1 to <2 years	3	0	0	**3**
>2 to <5 years	0	0	12	**12**
>5 to <10 years	2	1	12	**15**
>10 to < 15 years	0	0	1	**1**
>15 to <20 years	0	0	1	**1**
> 20 years	0	0	2	**2**
Total	**5**	**1**	**28**	**34**

Red structural flags are reserved for serious conditions that could result in the collapse of a major structural component or that is clearly hazardous to life and/or property along the canal. Examples include severe corrosion or damage to a major structural component and scour that undermines a spillway adjacent to a support structure. We noted that four of the five active Red flags originated prior to 2013, with one dating back to 1999, two to 2008, and one to 2012. When questioned about the overdue flags, management responded that, excluding one of the 2008 flagged structures, there were no plans to repair/replace the affected structures. Management is evaluating what, if any, repairs will be made to address the remaining 2008 flag. When discussing our findings related to Index scores, management informed us the Index is no longer used to any extent. Because inspectors assess individual structures, management believes they are not in the position to judge the overall system priority of individual repairs relative to all other structures' repair needs. However, we note that, by definition, Index scores of 3 or lower are of such urgency that the relative priority of other structures should not matter. In such cases, a licensed engineer has concluded that the condition requires immediate attention for safety/structural reasons.

In the Corporation's preliminary response, management indicated inspections themselves may not reflect a structure's current actual condition. Therefore, Corporation engineers and other division staff make decisions about repair priorities based on experience, professional judgment, and available resources. However, unlike the reporting forms used for the Index, there is no consistent approach to document the basis for these decisions. While CIMS tracks significant events related to flags (i.e., flag notification, prompt interim corrective action, flag closure reports), the Corporation does not have a centralized system that tracks the status of all maintenance

activity, except for pump-outs. Therefore, management cannot systematically assess the overall condition of critical structures at any given point in time considering current condition Ratings, known structural deficiencies, and repair activity status.

Maintenance Funding

The Thruway Authority's annual capital budgets for 2012, 2013, and 2014 included 58 Canal System projects. Of these, 48 projects had planned construction contract letting dates during the period, and the remaining 10 were scheduled for letting after 2014. However, as of September 16, 2014, only 22 of these 58 projects were actually let. Seven additional projects, with a construction value of $9.7 million, were also let during this time period but did not appear on the annual budgets. Specific to critical structures, 14 projects totaling $79.2 million have been delayed one to six years.

One factor that may influence funding levels is delay in federal reimbursement for storms. Specifically, the Canal System was approved for $86.3 million for Federal Emergency Management Agency (FEMA) funding. Based on the percentage of work completed to date, FEMA only has paid $6.6 million, even though the Thruway Authority has been funding storm repairs since fall 2011. Under FEMA requirements, the remaining monies owed will not be received until all the work is complete; the contractors are paid by the Thruway Authority; the Thruway Authority submits the required paperwork to close out each project; and FEMA reviews it and verifies the costs are what was agreed upon. The process will continue in 2015 as projects are completed.

Because the Thruway Authority has faced financial constraints, it has coordinated with the Corporation to secure funding from other sources (e.g., FEMA, federal funding for historic sites) to meet the Canal System's maintenance needs. Absent significant new funding streams, Corporation management should take additional steps to ensure that all Canal System structures' repair needs, particularly those that are critical, are considered when developing projects for consideration for capital funding. To the extent that specific structures have more pressing needs, this should be communicated to the Thruway Authority Board of Directors, which is responsible for ensuring that the Authority, including the Canal Corporation, fulfills its mission. Without effective accountability and communication of its repair needs, funding for some Canal System structures may not be commensurate with the level of repair needs system-wide.

Recommendations

5. Improve the process for prioritizing infrastructure maintenance by taking the following steps, including but not limited to:

    - Ensuring all high- and intermediate-importance structures, and all inspection results, are considered when deciding on maintenance priorities and capital plans.
    - Implementing reliable maintenance prioritization tools to identify the highest repair priorities for improving the overall condition of the Canal System and maximizing the impact of capital investments while balancing safety, operational, and legal considerations.

- Using CIMS and other available maintenance prioritization tools to develop maintenance schedules and capital plans, and documenting the basis for decisions.

6. Routinely re-evaluate whether the Canal System's current maintenance and capital plans target funding toward its most pressing needs, and redirect funding when necessary.

7. Work with the Thruway Authority to develop a realistic, long-term, detailed strategic and financing plan aimed at improving the overall condition of the Canal System's infrastructure while also dealing with emergency response. As part of this process, take the necessary steps to:

   - Seek all available funding for infrastructure repair and promptly meet funding reimbursement requirements.
   - Ensure the Thruway Authority Board of Directors and other State decision makers are aware of the Canal System's most critical maintenance needs when making funding decisions.

Audit Scope and Methodology

Our audit determined whether the Corporation's inspection scheduling procedures ensure that all high- and intermediate-category structures are periodically inspected and whether they consider inspection results when prioritizing the maintenance activities. During the course of our audit, we excluded DOT embankment inspections from our review. The audit covers from January 2012 through October 2014.

To accomplish our audit objectives, we interviewed Corporation and Thruway Authority officials, and reviewed Corporation policies and procedures and relevant laws. We also reviewed Corporation structural inspection and operations inspection reports, analyzed infrastructure inspection data and project letting reports, and audited financial statements and budget reports. We made observations during one day of the operations inspection, a lock structural inspection, and a movable dam rehabilitation. We also conducted research on other navigational structure inspection programs and best practices. In addition, we assessed the Corporation's internal controls related to inspection scheduling and prioritizing maintenance activities.

We conducted our audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform our audits to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In addition to being the State Auditor, the Comptroller performs certain other constitutionally and statutorily mandated duties as the chief fiscal officer of New York State. These include operating the State's accounting system; preparing the State's financial statements; and approving State contracts, refunds, and other payments. In addition, the Comptroller appoints members to

certain boards, commissions, and public authorities, some of whom have minority voting rights. These duties may be considered management functions for purposes of evaluating organizational independence under generally accepted government auditing standards. In our opinion, these functions do not affect our ability to conduct independent audits of program performance.

Authority

Our audit was performed pursuant to the State Comptroller's authority as set forth in Article X, Section 5 of the State Constitution and Section 2803 of Public Authorities Law.

Reporting Requirements

A draft copy of this report was provided to Canal Corporation officials for their review and comment. Their comments were considered in preparing this final report. Officials agreed with each of our recommendations and reported several actions already underway to implement them. Their response is attached in its entirety at the end of this report.

Within 90 days after the final release of this report, as required by Section 170 of the Executive Law, the Chair of the New York State Thruway Authority shall report to the Governor, the State Comptroller, and the leaders of the Legislature and fiscal committees advising what steps were taken to implement the recommendations contained herein, and where the recommendations were not implemented, the reasons why.

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Vision

A team of accountability experts respected for providing information that decision makers value.

Mission

To improve government operations by conducting independent audits, reviews and evaluations of New York State and New York City taxpayer financed programs.

Authority Comments

NEW YORK STATE OF OPPORTUNITY. | Canal Corporation

ANDREW M. CUOMO
Governor

JOANNE M. MAHONEY
Chair

BRIAN U. STRATTON
Director

April 30, 2015

Mr. John Buyce, Audit Director
Office of the State Comptroller
110 State Street
Albany, NY 12236

Re: 2014-S-45 Draft Audit Report

Dear Mr. Buyce,

We have reviewed the draft report on the Canal Corporation's Infrastructure Inspection and Maintenance programs, and appreciate the opportunity to address its findings and recommendations.

The Erie Canal and the other canals that comprise the Canal system are an enduring symbol and artifact of New York State's history. We believe that any discussion of the Canal system should acknowledge that most of the system's structures date from nearly 100 years ago, and some structures from the enlarged Canal era (1836-1862) such as feeders and dams are still in use today.

Indeed, the Canal's continued operation through almost two centuries is a testament to the skill and professionalism of the men and women charged with its care and maintenance as well as the sound judgment of the engineering and other professionals faced with managing this historic artifact while tackling the difficult task of prioritizing projects with finite resources.

It is also important to note that while extreme weather has forced prolonged closures of the Canal system on several occasions in recent years, there have been no extended closures due to operational or structural issues over this period.

In addition to its traditional role of moving commercial and recreational vessels throughout the waterways of upstate New York, today's Canal system supports agricultural irrigation, hydroelectric power production, and drinking and industrial water supply for millions of New Yorkers. The complex system we manage today is closely linked to commerce, quality of life and economic development throughout upstate New York.

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There is no responsibility we take more seriously than being faithful stewards of the extensive infrastructure that comprises today's New York State Canal system. The extraordinary challenges of the last few years have necessitated new approaches to almost every aspect of the way we maintain and operate the Canal system, even while we rebuild from the unprecedented damage wrought by Hurricane Irene and Tropical Storm Lee.

Governor Cuomo has directed the Canal Corporation not just to rebuild, but to build back better, smarter, and stronger. Improvements to the movable dams in the Mohawk Valley, coupled with development of a new flood warning and optimization system, will enhance the way the Canal Corporation responds to events like these in the future, and afford additional protection to critical Canal infrastructure. Although we are certainly proud of our record on inspection and maintenance of the Canal infrastructure in recent years, we have also committed to making the Canal system more safe and resilient for tomorrow, so it is as reliable over its third century of operation as it has been during its first two.

The critical structures along the Canal System which are integral to its continued safe operation and to the safety of residents along its banks have been regularly and professionally inspected and diligently maintained. Still, the Canal Corporation acknowledges that additional steps can, and should, be taken to further enhance the way we manage and conduct inspections of canal structures, and we will be taking those steps in the coming weeks and months.

Our comments on specific recommendations of the draft report appear below:

Recommendation:

Improve the clarity and effectiveness of the inspection scheduling process for high- and intermediate-importance structures. This should include, but not be limited to, taking the necessary steps to:

- ***Ensure CIMS properly accounts for all structures that require inspections and contains accurate inspection data.***
- ***Determine the optimal inspection frequency requirements, taking into account available resources, legal and safety requirements, and industry best practices.***
- ***Establish a sound and supportable risk-based method for determining inspection priorities.***
- ***Develop and abide by written guidelines that reflect the current overall inspection program and promote clarity in decision making.***

Response:

The Canal Corporation concurs with this recommendation, and notes that the Canal Infrastructure Management System (CIMS) is still being fully implemented and refined, including implementation of quality control measures.

Prior to the Audit, Canal Corporation staff had already begun a risk-based comprehensive assessment of inspection frequency, and will soon deliver recommendations to the Chief Engineer for implementation.

The result will be improvements to the Canal Corporation's method for determining inspection priorities, and an alignment of guidelines and practices relative to an effective, robust Canal infrastructure inspection program.

Recommendation:

Promptly conduct inspections of any high- and intermediate-importance structures that have never had inspections or where significant time has elapsed since the last inspection.

Response:

The Canal Corporation concurs with this recommendation, and will ensure that all applicable high and intermediate importance structures are inspected as soon as possible.

Recommendation:

Account for the Corporation's true inspection program resource needs and incorporate them into budget requests.

Response:

The Canal Corporation concurs with this recommendation and will address it through the ongoing Thruway Authority and Canal Corporation budget process.

Recommendation:

Enter into a formal agreement with DOT that covers inspection responsibilities for all State-owned Canal System bridges and adhere by its provisions.

Response:

The Canal Corporation concurs with this recommendation, and will advance this goal with NYSDOT executive leadership.

Recommendation:

Improve the process for prioritizing infrastructure maintenance by taking the following steps, including but not limited to:

- ***Ensuring all high- and intermediate-importance structures, and all inspection results, are considered when deciding on maintenance priorities and capital plans.***
- ***Implementing reliable maintenance prioritization tools to identify the highest repair priorities for improving the overall condition of the Canal System and maximizing the impact of capital investments while balancing safety, operational, and legal considerations.***
- ***Using CIMS and other available maintenance prioritization tools to develop maintenance schedules and capital plans, and documenting the basis for decisions.***

Response:

The Canal Corporation concurs with this recommendation, and will continue to address these matters as we further implement and refine CIMS.

Recommendation:

Routinely re-evaluate whether the Canal System's current maintenance and capital plans target funding toward its most pressing needs, and redirect funding when necessary.

Response:

The Canal Corporation concurs with this recommendation, and will address it through the ongoing Thruway Authority and Canal Corporation budget and fiscal management processes.

Recommendation:

Work with the Thruway Authority to develop a realistic, long-term, detailed strategic and financing plan aimed at improving the overall condition of the Canal System's infrastructure while also dealing with emergency response. As part of this process, take the necessary steps to:

- ***Seek all available funding for infrastructure repair and promptly meet funding reimbursement requirements.***
- ***Ensure the Thruway Authority Board of Directors and other State decision makers are aware of the Canal System's most critical maintenance needs when making funding decisions.***

Response:

The Canal Corporation will continue to seek all available funding for infrastructure repair, and promptly meet funding reimbursement requirements. All decisions made relative to funding the Canal Corporation's maintenance and capital programs will be fully informed by an accurate assessment of the Canal's most pressing needs.

SUMMARY

The Canal Corporation is appreciative of the insight shared by the auditors during this process. The professionals at the Canal Corporation value any opportunity to enhance the way we preserve, maintain, and operate one of New York State's most iconic and enduring treasures.

Sincerely,

Brian U. Stratton
Director