

**STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
BRIDGE MAINTENANCE**

**PERFORMANCE AUDIT REPORT
SEPTEMBER 2016**



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To The Fiscal Committee Of The General Court:

We conducted a performance audit of Department of Transportation (DOT) bridge maintenance to address the recommendation made to you by the joint Legislative Performance Audit and Oversight Committee. We conducted this audit in accordance with generally accepted government auditing standards. Those standards require we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions. The evidence we obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

The purpose of the audit was to determine how efficient and effective DOT bridge maintenance and preservation practices were during State fiscal years 2014 and 2015.

Office of Legislative Budget Assistant
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September 2016

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**STATE OF NEW HAMPSHIRE
DOT BRIDGE MAINTENANCE**

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ABBREVIATIONS AND GLOSSARY OF TERMS

AASHTO	American Association Of State Highway And Transportation Officials
AMPS	Asset Management, Performance, And Strategies
BMS	Bridge Management System
BOBD	Bureau Of Bridge Design
BOBM	Bureau Of Bridge Maintenance
BPL	Bridge Priority List

ABBREVIATIONS AND GLOSSARY OF TERMS (CONTINUED)

Bridge	A structure, having a clear span of ten feet or more measured along the center line of the roadway at the elevation of the bridge seats, spanning a watercourse or other opening or obstruction, on a public highway to carry traffic across, including the substructure, superstructure and approaches, and including a combination of closely-placed culverts constructed to provide drainage for a public highway with an overall combined span of ten feet or more.
BrM	Bridge Management – software to automate support to bridge manager decision making and compliance with National Bridge Element inspection requirements, dating to 2013. Scheduled by the DOT to replace the current system, Pontis, in 2017.
BWG	Bridge Workgroup
CY	Calendar Year
DAS	Department Of Administrative Services
Design Life	A bridge’s estimated life and target life which entails a forecast and target for the bridge’s economic life and is established when the bridge is designed.
DOT	Department Of Transportation
EOR	Engineer Of Record
FHWA	Federal Highway Administration
HIB	High Investment Bridge
Improvement	Widening, raising, strengthening, and other work on a bridge altering its performance beyond its originally designed strength or capacity; also described as an upgrade.
LCCA	Lifecycle Cost Analysis
Maintenance	Work performed to keep a bridge in its current condition; can also be applied to strategies, tactics, and operations (e.g., an organization can have a maintenance strategy); and can be modified with preventive, routine, emergency, or other terms.
MATS	Managing Assets For Transportation Systems – software to track work, expenditures, equipment, materials, planning, and assets.
NBI	National Bridge Inventory
Pontis	Software to automate support to bridge manager decision making, dating to the late 1990s. Scheduled by the DOT to be replaced by BrM in 2017.
Preservation	Actions to prevent, delay, or correct deterioration of a bridge to extend its service life; does not entail structural or operational improvement of an existing bridge beyond its originally designed strength or capacity. The term can be applied to strategies, tactics, and operations: a preservation strategy can set goals, describe tactics to be used to achieve that goal, and in turn operations, or work and effort, can be expended to support a tactic, and the overarching strategy.
Rehabilitation	Major work required to restore structural integrity of a bridge, as well as work necessary to correct major safety defects.
Repair	Work performed to correct a damaged component to working order.

ABBREVIATIONS AND GLOSSARY OF TERMS (CONTINUED)

Replacement	Repair work substituting a functional component for a defective component; may be maintenance-, preservation-, or improvement-oriented. Bridge replacement is constructing an entire structure and is not a preservation activity.
Service Life	The period of time in which a bridge is providing the intended type of service, even if at a degraded level of service.
SFY	State Fiscal Year
TAM	Transportation Asset Management
TYP	Ten Year Transportation Improvement Plan
Typical Cycle	The typical maintenance and preservation, rehabilitation, and reconstruction cycle for recently constructed bridges.
WCC	Work Class Code
Worst-first	Applying a treatment to a bridge to return it to an acceptable condition only when it becomes deficient and cannot serve its intended function, while not undertaking warranted preservation actions inventory-wide.

STATE OF NEW HAMPSHIRE DOT BRIDGE MAINTENANCE

EXECUTIVE SUMMARY

The Department of Transportation (DOT) should improve its bridge maintenance and preservation management controls to ensure efficiency and effectiveness. The DOT's March 2015 *Bridge Strategy* was incomplete and evolving. The DOT did not have a comprehensive bridge program or bridge management system to help optimize its efforts. The DOT planned to implement asset management to improve decision-making by migrating towards holistic and objective planning and programming. Bridges were the highest priority identified in the DOT's June 2014 *Transportation Asset Management Implementation Plan*. However, the DOT delayed asset management implementation and did not realize potential improvements, reportedly due to ongoing delays in federal rulemaking, staffing shortages and turnover, and lack of dedicated resources. Federal rules were not projected to be finalized until December 1, 2016, delaying the DOT's draft transportation asset management plan until spring 2017, nearly two years after it was originally scheduled to be published. The DOT was in the position of having to further delay a process that, by 2016, had taken six years and cost more than \$287,000 in consulting fees alone.

Key underpinnings, such as clear delegations of authority and responsibilities, gap analyses, risk management, and planning efforts, were incomplete. Performance standards at the strategic, tactical, and operational levels were not fully developed; performance was not holistically tracked; investment and disinvestment decisions were unstructured; and we found \$429,264 expended on Bureau of Bridge Maintenance non-bridge work. This included \$338,926 the DOT reported was appropriated for bridge maintenance activities but was spent on non-bridge work. Concurrently, most bridge performance metrics trended negatively or missed targets. A preservation strategy was not fully implemented and prioritization of effort remained focused on a more costly worst-first approach. Also, the DOT undertook building construction, reconstruction, alteration, and maintenance without statutory authority; bridge management-related efficiency was not understood or objectively analyzed; and project management practices were informal and inconsistent. We found statutory noncompliance related to the Red List, delegating authority, records management, and expending appropriated funds.

Information governance was fractured. Calendar year 2014 Red List data were erroneous, with as many as 16 of the 153 red-listed structures (10.5 percent) not warranting inclusion on the Red List. The DOT continued to use the Red List as an inspection scheduling tool based on legacy practices, instead of a statutorily-required report prioritizing structurally deficient bridges for repair or replacement. Calendar year 2014 bridge inventory data were also affected, with at least 57 non-bridge structures (2.6 percent) included in the DOT-reported State bridge inventory total of 2,160. Other data quality issues manifested themselves, and we qualify our use of DOT data and our conclusions resting thereon as a result.

Nonetheless, the proper and full implementation of transportation asset management is likely to result in good management controls. The DOT reported it is committed to transportation asset management implementation in the future.

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**STATE OF NEW HAMPSHIRE
DOT BRIDGE MAINTENANCE**

RECOMMENDATION SUMMARY

Observation Number	Page	Legislative Action Required?	Recommendations	Agency Response
1	15	No	Department of Transportation (DOT) management formalize and implement a time-phased plan with milestones for a comprehensive bridge program with a unified bridge management system; develop a Bureau of Bridge Maintenance (BOBM) mission statement, goals, and objectives; evaluate the propriety of the Bureau of Bridge Design mission, goals, and objectives; expand the <i>Bridge Strategy</i> ; and consider simplifying and coordinating the tier system between highways and bridges.	Concur In Part
2	22	No	DOT management develop, formalize, and implement a time-phased asset management change strategy to migrate towards preservation-focused and data-driven decision-making; integrate key transportation asset management concepts into Department culture; and utilize its governance architecture to implement asset management.	Concur In Part
3	27	No	DOT management evaluate its organizational structure, assigned duties, responsibilities, and delegations; comply with statute and formally delegate authority; designate a bridge asset management lead; charter the bridge workgroup (BWG); formalize BWG, engineer of record, and responsible charge procedures and practices; update job descriptions and class specifications; monitor and assess effectiveness; and revise policy and procedure.	Concur In Part
4	34	No	DOT management revise the <i>Implementation Plan</i> and schedule; set milestones for developing and publishing plans and procedures; timely develop and publish plans and procedures; and develop and implement a review process to ensure annual repair task lists support maintenance and preservation strategies.	Concur In Part

Recommendation Summary

Observation Number	Page	Legislative Action Required?	Recommendations	Agency Response
4 (Continued)			BOBM management formalize maintenance and preservation planning processes and practices; incorporate asset management fundamentals to optimize resource utilization; collect and retain planning and scheduling data; and monitor and revise planning practices as needed.	
5	40	No	DOT management institutionalize and timely complete scheduled gap analyses; conduct gap analyses specific to bridge management, maintenance, and preservation activities; cyclically conduct gap analyses; and address identified issues.	Concur In Part
6	42	No	DOT management institutionalize and formalize risk management practices; cyclically identify risks; conduct and record assessments; develop and implement controls, policies, and procedures; and evaluate effectiveness.	Concur In Part
7	46	No	DOT management establish and timely implement an asset performance management system; define bridge performance measures; and formalize processes.	Concur In Part
8	49	No	<p>DOT management develop maintenance and preservation outputs, outcomes, and performance measures; establish bridge levels of service and bridge condition performance standards; integrate performance measurement and evaluation; formalize internal reporting processes; and routinely monitor, evaluate, and report on performance.</p> <p>BOBM management implement and track typical maintenance and preservation, rehabilitation, and reconstruction cycles for all bridges and routinely evaluate performance.</p>	Concur
9	54	No	DOT management collect comprehensive data; estimate and incorporate bridge user benefits; revise, standardize, validate, and assess cost estimation practices; establish, validate, publish, and periodically assess a	Concur

Observation Number	Page	Legislative Action Required?	Recommendations	Agency Response
9 (Continued)			formal backlog calculation methodology; and adopt lifecycle cost analysis for bridge maintenance and preservation decision-making.	
10	58	No	DOT management formalize disinvestment strategies, procedures, practices, and definitions; consistently make and maintain records detailing disinvestment-related decisions; implement a systemic, timely, consistent method for disinvestment and allocating resources; and discontinue entering into agreements obligating the State to future expenditures.	Concur In Part
11	64	No	DOT management improve the effectiveness of its bridge maintenance and preservation management controls, and discontinue and refer building construction, reconstruction, alteration, and maintenance to the Department of Administrative Services.	Concur In Part
12	71	Yes	DOT management improve bridge maintenance and preservation project management practices; develop formal policy, practice, and procedures; and include planning and scheduling, designs and specifications, quality, documentation, monitoring, change control, auditing, and evaluating performance. DOT management consider seeking legislative changes to differentiate between projects and tasks.	Concur In Part
13	77	No	DOT management establish goals and objectives for overhead, efficiency, and productivity, as well as develop a time-phased plan to optimize maintenance and preservation activities. BOBM management collect and analyze data; formalize overhead and productivity practice and procedures; and formalize and manage to goals.	Concur In Part

Recommendation Summary

Observation Number	Page	Legislative Action Required?	Recommendations	Agency Response
14	86	No	DOT management expand upon existing plans and implement a comprehensive information governance structure with a data business plan; incorporate data governance and knowledge management policy, procedure, and practices; and develop and adhere to an expedited schedule for implementation.	Concur
15	91	Yes	DOT management discontinue using legacy inspection criteria to add bridges to the Red List; adopt a quantitative, objective definition of structurally deficient, seeking rule-making authority if warranted; and comply with statute by including all structurally deficient bridges on, and removing non-structurally deficient bridges from, the Red List.	Do Not Concur
16	96	Yes	DOT management seek clarification of the statutory definition of a bridge should it be too narrow to encompass the current scope of the transportation network and include only bridges on, and remove all non-bridge structures from, the Red List.	Do Not Concur
17	100	Yes	DOT management comply with statutory Red List reporting requirements; number and prioritize the Red List; timely submit a complete Red List; and evaluate the need for changes to statutory inspection frequencies.	Concur In Part
18	103	No	DOT management simplify and document processes for categorizing bridges by condition and integrate all bridge subgroups into the <i>Bridge Strategy</i> .	Concur In Part
19	105	No	DOT management assign responsibility for developing, implementing, and training staff on data policies and procedures; validating data; and remediating errors, and review and monitor bridge-related data systems general and application controls.	Concur In Part
20	110	No	DOT management comply with statute and implement a records management program; make and maintain adequate and proper records; formalize a record retention schedule, practices, and procedures; retain and dispose of records according to schedule; centralize bridge records; define a complete bridge	Concur In Part

Observation Number	Page	Legislative Action Required?	Recommendations	Agency Response
20 (Continued)			record and ensure accessibility; record transaction lifecycles and significant events; and assess program effectiveness and efficiency.	

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**STATE OF NEW HAMPSHIRE
DOT BRIDGE MAINTENANCE**

BRIDGE MAINTENANCE AND PRESERVATION

Background

A critical component of the State’s transportation system, bridges constituted two-thirds (approximately \$8 billion) of the total replacement value of the State’s transportation system (approximately \$12 billion), according to unaudited Department of Transportation (DOT) data. The DOT’s 2015 *Bridge Summary* listed 3,847 State- and locally-owned bridges, and culverts meeting the State definition of a bridge, of which 2,160 (56.1 percent) were listed as State-owned. The State’s inventory encompassed nearly 10.5 million square feet of deck area as of December 31, 2014. Table 1 depicts growth in the number of bridges and deck area for calendar years (CY) 2009 through 2014.

Table 1

**DOT-reported State Bridge Count And Deck Area,
Calendar Years 2009 Through 2014**

	Calendar Year ¹					
	2009	2010	2011	2012	2013	2014 ²
Count	2,128	2,137	2,143	2,153	2,155	2,160 ³
Deck Area⁴	9,845,586	9,899,513	10,222,854	10,350,287	10,385,491	10,463,769

Notes:

¹ Calendar year data are as of December 31.

² See Observations No. 15 and No. 16 for limitations on CY 2014 inventory data.

³ Includes 23 non-bridge structures reported by the DOT.

⁴ Deck area in square feet.

Source: Unaudited DOT data.

Bridge service life means the period of time during which the bridge provides its intended service, while the design life means the *estimated* life established at design, entailing a forecast and target for economically keeping the structure in service. Generally, overall bridge service life spans can be 50 to 100 years, but bridges begin to deteriorate as soon as they are put into service, due to elements such as the original design, materials, protective systems, quality of the as-built construction, climate and environment, and use. The final critical factors are the type, timing, and effectiveness of maintenance, preservation, rehabilitation, and replacement. If the design life is to be achieved, design alternatives inherently commit a bridge steward to future maintenance and rehabilitation activities and expenditures during the structure’s lifecycle.

Utilizing a worst-first bridge management strategy focuses efforts and resources on deficient bridges, delaying or forgoing warranted, and generally more cost-effective, routine treatments inventory-wide. This results in worsening condition and increased costs. Preservation can be more cost-effective than a worst-first approach to maintenance, costing less than reconstruction or replacement. According to the DOT, the preservation benefit-cost ratio can be as high as 10:1.

Maintenance, as a component of a bridge preservation strategy, is generally minor, includes low-cost routine tasks or repair work, and can prevent or delay deterioration, extending a bridge’s service life beyond its design life. Effectively and efficiently managing deterioration requires timely maintenance, preservation, repair, and rehabilitation of bridges at the lowest cost. The end of a bridge’s service life hinges, in part, upon the cost-effectiveness of the maintenance, repair, or rehabilitation needed to extend a bridge’s service life when compared to its replacement.

As measured by individual bridge condition ratings and as depicted in Table 2, the State has not been effective in controlling bridge deterioration.

Table 2

**DOT-reported Bridge Conditions,
Calendar Years 2009 Through 2014**

Calendar Year	Rating						Total	
	Green ¹		Yellow ²		Red ³			
	Count	Percent	Count	Percent	Count	Percent	Count ⁴	Percent
2009	1,183	56.4	772	36.8	142	6.8	2,097	100.0
2010	1,190	56.4	771	36.6	148	7.0	2,109	100.0
2011	1,205	56.9	772	36.5	140	6.6	2,117	100.0
2012	1,214	57.1	768	36.1	145	6.8	2,127	100.0
2013	1,192	55.9	793	37.2	147	6.9	2,132	100.0
2014 ⁵	1,193	55.8	791	37.0	153	7.2	2,137	100.0

Notes:

¹ Green ratings are considered excellent to good.

² Yellow ratings are considered satisfactory to fair.

³ Red ratings are considered poor or worse.

⁴ Excludes DOT-reported non-bridge structures, including 23 listed in CY 2014.

⁵ See Observations No. 15 and No. 16 on limitations on CY 2014 inventory data.

Source: Unaudited DOT data.

The State has been more successful in controlling deterioration as measured by deck area ratings and as depicted in Table 3.

Table 3

**DOT-reported State Bridge Deck Area By Condition,
Calendar Years 2009 Through 2014**

Calendar Year	Rating						Total	
	Green ¹		Yellow		Red		Area ²	Percent ³
	Area	Percent	Area	Percent	Area	Percent		
2009	5,522,383	56.5	3,246,994	33.2	999,642	10.2	9,769,019	100.0
2010	5,484,655	55.8	3,339,085	34.0	1,006,288	10.2	9,830,028	100.0
2011	5,898,443	58.1	3,340,112	32.9	916,221	9.0	10,154,776	100.0
2012	6,065,147	59.0	3,360,737	32.7	856,323	8.3	10,282,207	100.0
2013	5,997,584	58.1	3,454,213	33.5	868,081	8.4	10,319,878	100.0
2014 ³	6,215,386	59.8	3,355,436	32.3	827,327	8.0	10,398,149	100.0

Notes:

¹ The increase in green-rated deck area was due in part to inventory expansion, which added new bridges and over 600,000 square feet of new (green-rated) deck area. This tended to skew the data when compared to bridge counts.

² Excludes deck area associated with DOT-reported non-bridge structures, including 23 listed in CY 2014.

³ Percents may not add due to rounding.

⁴ See Observations No. 15 and No. 16 on limitations on CY 2014 inventory data.

Source: Unaudited DOT data.

Transportation Asset Management (TAM)

Effective management control systems help managers achieve desired results. TAM is designed to achieve good management. It assists decision-makers in selecting effective strategies or actions to improve infrastructure efficiency and safety, and includes:

- collecting and analyzing data;
- determining needs;
- forecasting and evaluating actions;
- selecting appropriate strategies;
- measuring performance; and
- assessing effectiveness.

As with all management control systems, asset management is *not* a distinct or separate process. Properly implemented, it is *the* organization's business model. TAM has been formalized at the federal level since at least 1999, with guidance published starting in 2001. As a management control system, TAM is a holistic, strategic, systematic process of operating, maintaining, and improving transportation assets. To achieve or sustain a state of good repair over the asset's lifecycle at minimum practicable cost, it relies on engineering and economic analyses to sequence asset maintenance, preservation, repair, rehabilitation, and replacement. Asset

management relies upon structured, data-based decision-making to make tradeoffs between alternatives at the strategic, tactical, and operational levels. Optimizing design, methods, and material costs; life expectancy; and life extension potential are integral.

The State is federally-required to develop a risk-based asset management plan for National Highway System assets. While no single way to implement asset management was prescribed, and TAM can be implemented in stages, federal funding of State transportation projects could be reduced if State outcome measures are not timely met in the future.

Gap analyses should be an ongoing element of TAM implementation to identify areas needing improvement, assess process maturity, benchmark efforts, and enable continuous improvement. Performance gap identification is a federally-required element of State asset management. TAM gaps at the strategic, tactical, and operational levels are rated using a five-level maturity model, which are expanded to include six characteristics. This leads to a grid, depicted in Table 4, to facilitate measurement.

DOT TAM Implementation

As required, the DOT adopted TAM as its asset management approach and published several supporting documents, including an implementation plan and a governance guide. To improve existing DOT management practices and facilitate data-based, strategic decision-making, the DOT began work on asset management in 2010, and TAM implementation began in 2014. TAM was to cut across programs and functions, generate consistent decisions and performance measurement, ensure accountability, and guide preservation decisions and investments. Previously, DOT asset management was less structured, decisions were more judgment-based, and strategy secondarily focused on preservation. Given its inherent management control features, and the DOT's expressed commitment to implement it, we used TAM as the audit's methodological framework.

The DOT's June 2014 *Transportation Asset Management Implementation Plan (Implementation Plan)* provided a six-year schedule for implementation, starting in 2014 and concluding in 2019. Given the DOT's timeline, we did not expect our audit to find TAM implementation complete during the audit period. However, the DOT reported several factors inhibited achievement of intermediate goals which were scheduled to occur during the audit period, and its overall TAM implementation, including delayed federal rulemaking, staff turnover, resources, and higher priority tasks. With federal rulemaking not expected to conclude any earlier than December 2016, two years after the initial deadline, the timeline for DOT's implementation of TAM was expected to be further delayed, and there was no delivery date set for the State's asset management plan. The DOT reported the asset management plan would be completed one year after relevant federal rules are completed.

We applied maturity assessments based on the TAM maturity model construct and incorporated them into observations. Overall, we found the DOT's implementation and the integration of TAM principles into the management of bridge assets at the initial level of TAM maturity and nearing the awakening level. Given the DOT reported a commitment to TAM implementation in

the future, proper and full implementation is likely to result in improved management controls, and increased maturity.

Table 4

TAM Maturity Model Assessment Grid

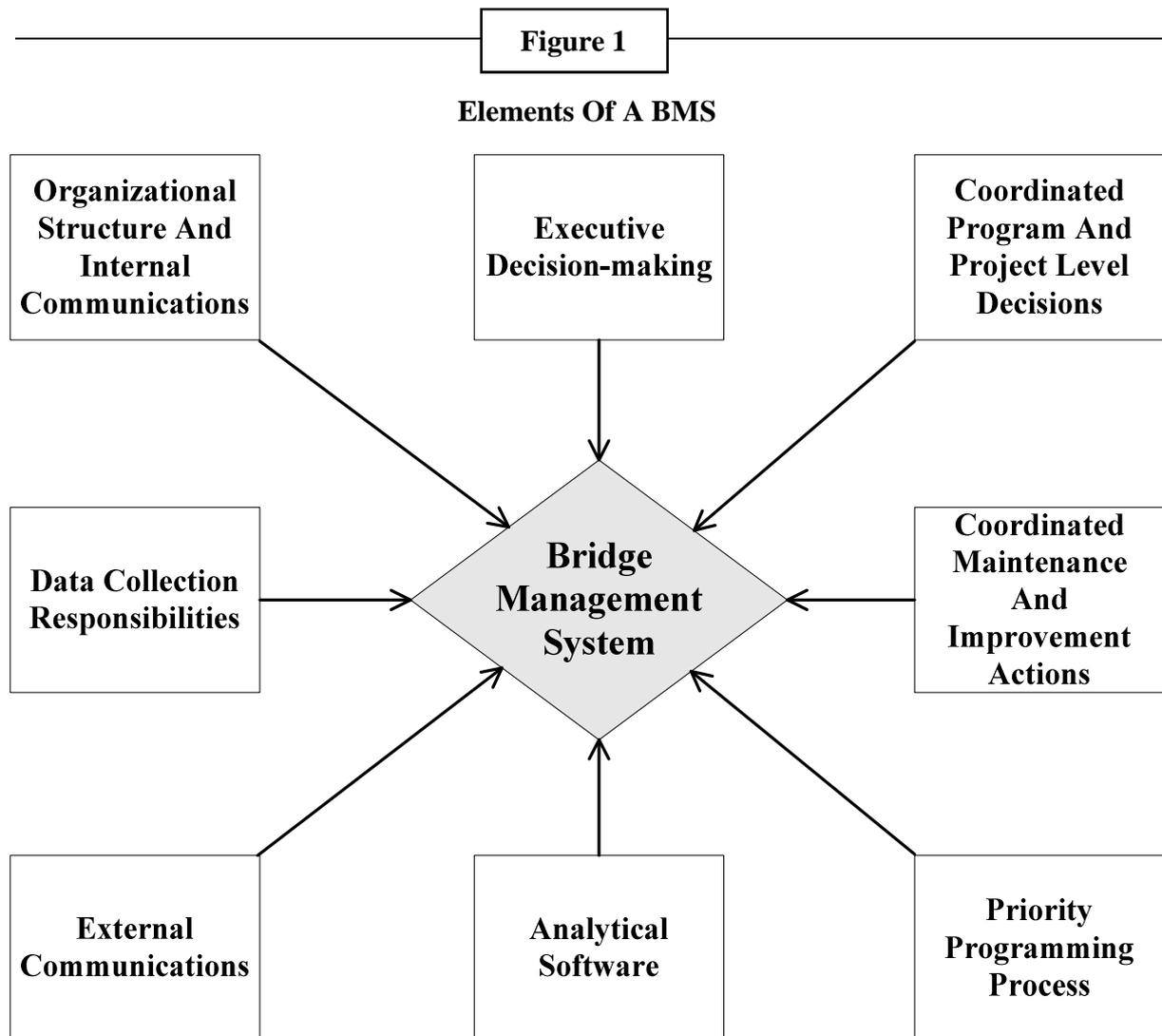
Maturity Scale	Processes	Frequency	Sub-element Emphasis	Process Formality	Data And Technology	Outputs And Results
Initial	Initial stages of inquiry; focus is on literature search and peer reviews/calls	Occasionally do this	Receives minimal emphasis; some efforts underway	Done informally only; ad hoc procedures; minimal documentation; no organizational integration	Manual system exists; plans for automated system in place	Minimal results; long way to go
Awakening	Identify nature/extent of capital assets; prompted by new financial reporting	Sometimes done on an as-needed basis for critical program activities	Moderately emphasized; try to adhere to this	Semiformal process; some routine procedures exist; limited organizational integration	Automated system exists; meets basic needs	Some results; still below expectations
Structured	Processes identify, assess, and value infrastructure assets; focus on preservation and replacement/rehabilitation	Often do this on many programs and activities	Generally emphasize; something that is done and checked	Formal process exists; modestly documented; good but still evolving; some organizational integration	Good system in place, widely available; meets all key user needs	Good results; getting there
Proficient	Processes extended to lifecycle development and preservation	Usually do this; omitted only in exceptional circumstances	Strongly emphasize; used to measure and reward by	Formal documented process; well-tested and well followed; considerable organizational integration	Strong system in place; fully integrated; meets nearly all user needs	Excellent results; still some room to improve
Best Practice	Fully integrated processes; across all functions; flexible to change	Always do this; standard operating procedure	Heavily emphasize; one of the principles by which business is done	Mastery of formal processes; well-documented; standardized; full organizational integration	State-of-the-art system in place; always seeking betterment	Unparalleled results; fully engaged organization; a total success

Source: American Association of State Highway and Transportation Officials (AASHTO), *Transportation Asset Management Guide – A Focus on Implementation*, January 2011.

State Bridge Asset Management

A component of DOT’s asset management was a bridge strategy focused on effective and efficient asset management, and encompassing three main tenets: 1) maintenance and preservation, 2) replacement with an equivalent structure and performance, and 3) upgrades to increase performance. The DOT’s strategic objective of asset condition improvement encompassed reducing the number of deficient bridges.

Bridge management systems (BMS) are designed to optimize available resources for inspecting, maintaining, preserving, rehabilitating, and replacing bridges. A BMS can consist of many analytical and decision-support tools, automated and otherwise. Figure 1 illustrates typical BMS elements.



Source: AASHTO, *Guidelines for Bridge Management Systems*, June 1993.

The Division of Operations, Bureau of Bridge Maintenance (BOBM) was responsible for in-house, force account bridge maintenance, preservation, repair, and rehabilitation; operating movable bridges; and limited design and minor bridge replacement work. The Division of Project Development, Bureau of Bridge Design (BOBD) planned, designed, and prepared plans for contracted bridge maintenance, rehabilitation, and replacement projects; inspected and rated State and municipal bridges; managed the federally-funded preservation program and other preservation work; and maintained the State's bridge management information systems. In-

house, force account BOBM work was generally smaller in scale than contracted-out BOBD work.

The effectiveness of DOT's bridge maintenance and preservation management controls required improvement in several areas, including:

- planning and organizing;
- stewardship of financial resources;
- stewardship of bridge assets;
- data-driven planning optimizing resource utilization;
- measuring performance and efficiency;
- managing change; and
- stewardship of information and data.

Observation No. 1

Develop And Implement A Comprehensive Bridge Management Program

While the DOT had elements of a bridge management program, it was not comprehensive and formalized. The bridge bureaus performed separate functions under separate bureau and division management; lacked a shared bridge-centric mission, relying on the umbrella DOT-level mission; lacked unified bridge-centric goals and objectives; and relied on ad hoc, unintegrated management systems. The DOT was at the initial stage of TAM maturity in establishing a bridge asset management program and mission with supporting goals and objectives.

Bridge Management System

The bridge bureaus lacked a formal, comprehensive BMS. A BMS helps managers apply the right activity to the right bridge, at the right time and cost. It is a systematic process designed to optimize resources by supplying analyses and data summaries, utilizing models to forecast and make recommendations, and providing the means to efficiently consider alternative policies and programs. An effective BMS minimally includes formal procedures for: 1) collecting, processing, and updating data; 2) predicting deterioration; 3) identifying alternative actions; 4) predicting costs; 5) determining optimal policies; 6) performing short- and long-term budget forecasting; and 7) recommending programs and schedules for implementation within policy and budget constraints. One of seven components, collecting, processing, and updating data, was formally assigned and supported by draft procedural guidance.

While the DOT formally assigned the BOBD responsibility to develop, manage, and utilize Pontis, an AASHTO bridge information management software application intended to serve as a unified, comprehensive bridge information management system, its full capabilities were never realized due to concerns regarding the reliability of several analytical features. Consequently, the application's use was limited to collecting, storing, and reporting inspection data. To establish a BMS, the DOT reported in 2011 its future transition to a new bridge information management system that captured element-level inspection data, was contingent on available resources. However, several issues remained, as the DOT did not address the shortfalls experienced with

the previous application, and, although the new application was advertised as meeting the minimum standards of a BMS, whether it would function as one in practice had yet to be determined. There was no formal migration plan, and the BOBD was still utilizing the old application as of June 2016. Further, supplemental programs, applications, and practices intended to address system shortcomings lacked formal policies and procedures. Nor were they sufficiently developed, integrated, complete, or reliable to serve as a surrogate BMS. Without a BMS providing analyses, the bridge bureaus relied on qualitative, judgment-based decision-making processes, and could not objectively demonstrate the balanced, rational, defensible, and cost-effective bases for their decisions.

Bridge Strategy

Bridges require a thorough maintenance and preservation strategy. In March 2015, the DOT formalized the State's first bridge strategy (*Bridge Strategy*) and focused on efficient and effective network management. The *Bridge Strategy* was based on three concepts: 1) prioritizing bridges in the form of tiers, 2) making sustainable investments, and 3) identifying redundant bridges for possible disinvestment. It also set a single goal - achieving a 120-year bridge service life for recently constructed bridges. However, the *Bridge Strategy* was not complete and continued to evolve. It:

- did not define or quantify “recently constructed bridges;”
- excluded several bridge subgroups, such as High Investment Bridges (HIB), and likely the majority of the State's bridge inventory;
- excluded culverts within the State's bridge inventory, with an expected service life generally less than that of a bridge;
- lacked clear maintenance and preservation definitions and strategies;
- was inconsistent with the bridge bureaus' practices, such as the BOBD's 2015 design manual citing a 75-year bridge service life goal; and
- lacked a schedule for review, revision, and updating in general, and delivery of the HIB sub-strategy specifically.

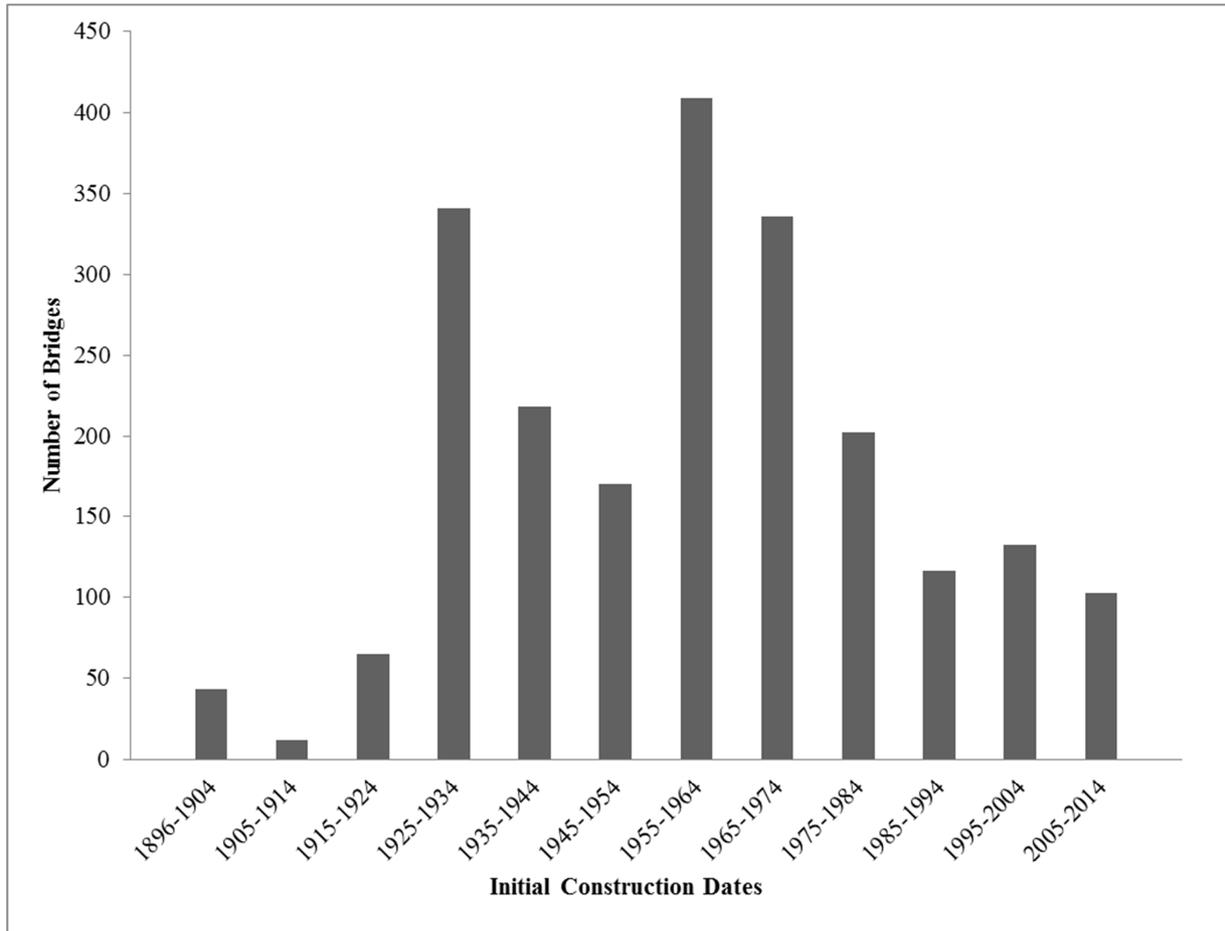
According to unaudited DOT data, the CY 2014 State bridge inventory consisted of 2,160 bridges with an average age of nearly 55 years. Of the total inventory, 2,057 bridges (95.2 percent) were constructed before 2005, with the remaining 103 bridges (4.8 percent) constructed between 2005 and 2014. Depending on the DOT's definition of “recently constructed,” a majority of the bridge inventory was potentially excluded from the single *Bridge Strategy* goal. In addition, 471 bridges (21.8 percent) were culverts meeting the State definition of a bridge and were not subject to a 120-year service life goal. Figure 2 depicts the distribution of bridges and culverts in the State bridge inventory by decade of initial construction, according to unaudited CY 2014 DOT data.

Within the bridge bureaus, the *Bridge Strategy* provided no clear connection to other subgroups of bridges such as functionally obsolete, load-rated or load-posted, keep-in-service, and color-coded bridge condition list categorizations, all of which required varying levels of monitoring and maintenance. The BOBM did not have bridge-specific maintenance schedules to supplement

the *Bridge Strategy*, and bridge managers recognized not all bridges received recommended maintenance, likely making the 120-year service life goal unattainable for those bridges.

Figure 2

Bridge Count By Date Of Initial Construction¹



Note:

¹ Twelve bridges (0.6 percent) were constructed prior to 1896.

Source: LBA analysis of unaudited DOT data.

Further, the DOT reported funding for the *Ten Year Transportation Improvement Plan, 2017-2026*, was linked to the DOT's tier system in the *Bridge Strategy*. Bridges were categorized as:

- HIB – largest and most costly bridges,
- Tier 1 – interstates and turnpikes,
- Tier 2 – major corridors,
- Tier 3 – collectors, and

- Tier 4 – secondary highways and unnumbered routes.

Highway categories were similar for tiers 1 through 4, but had two additional tiers for local roads, Tier 5, and off-network assets, Tier 6. Highway categories did not contain a classification comparable to HIB, potentially complicating a cross-asset funding strategy as resources were to be allocated according to tiers.

Bridge-related Missions, Goals, And Objectives

The DOT mission was “transportation excellence enhancing the quality of life in New Hampshire,” with the purpose of providing a safe, well-maintained, efficient, and reliable transportation system. However, there were no formal Department-level maintenance and preservation goals and objectives. While the BOBD created a mission statement in 2015, it lacked a component reflecting the BOBD’s role in bridge maintenance and preservation. The BOBM lacked a formal mission, goals, and objectives, and only tracked three outputs formally: the number of bridges 1) removed from the Red List, 2) washed, and 3) sealed. There were no benchmarks to gauge performance. Without a formal, comprehensive bridge management program or a mission related to maintenance and preservation, the bridge bureaus could not set goals and objectives, measure improvements, or establish accountability for asset management performance. TAM relies upon a clear mission, goals, and objectives to enable decision-making based on quality information, and achieve the best return on investments.

Recommendations:

We recommend DOT management:

- **formalize and implement a time-phased plan with milestones for implementing a comprehensive bridge program with a unified BMS;**
- **develop a BOBM mission statement, goals, and objectives focused on clearly defined maintenance and preservation terms;**
- **evaluate the propriety of the BOBD mission, goals, and objectives and practice, and revise them as warranted;**
- **expand on the *Bridge Strategy* to include the entire bridge inventory and its sub-groups; and**
- **consider simplifying and coordinating the tier system between highways and bridges.**

Agency Response:

We concur in part.

We concur that the BMS in place is not fully aligned with asset management best practices; however the Department does have a bridge management process in place. For this reason the Department does not concur with the conclusion that the DOT is in the initial stage of TAM maturity for bridge management. Instead the DOT considers bridge management to be in the awakening stage and moving towards achieving structured. The DOT does have systems that

meet the basic needs for bridge inspection, overall bridge inventory management and cost tracking. There are semiformal processes in place, some documented, with limited organizational integration, and some positive results in terms of the ability to model outcomes based on Capital Budget investment scenarios.

The DOT reaffirms that the agency is transitioning to a new BMS and does not concur with the implications to the contrary. The Department does not concur that it is unknown whether the new application would meet the minimum standards of a BMS.

The development of a comprehensive system takes time and continued investment. Investment in these initiatives will increase overall efficiency, however with current staffing levels, progress will be gradual as staff attempt to balance working on strategic improvement while ensuring the delivery of the bridge program. The Federal Highway Administration (FHWA) routinely considers the states of Utah and Washington as leaders in the industry. These states have dedicated resources to these efforts for more than 20 years and while the DOT can apply lessons learned, this is still considered a multi-year effort. Additionally, the states of Utah and Washington consider their BMS structured or proficient and no state has achieved the best practice level of maturity for bridge management.

Bridge Management System

A comprehensive asset management system requires data that can be grouped into the following 11 categories: asset identification/location, asset characteristics, asset valuation, composition, maintenance, condition, predictive, performance, risk, lifecycle and optimized lifecycle. The DOT concurs that comprehensive data is not available in all of these categories. The Department also agrees that fully integrated software is needed to support expanding these data sets. Robust inventory, characteristic and condition data sets do exist, which are used to prioritize Capital Budget investments. The type and cost of bridge maintenance activities are also being tracked to determine how much we are spending on repair and replacement, versus preservation and maintenance. The number of red-listed bridges is monitored to understand how the health of the overall inventory is being impacted by these activities.

The migration from the current bridge management system (Pontis) to AASHTOWare's new Bridge Management (BrM) software has encountered multiple issues. The Department is working with the new application's developer to resolve the data migration and platform stability issues. Expectations are the issues will be resolved in time to implement BrM by April 1, 2017. It will then take two years before all of the bridge inspections will be completed using the new AASHTO provisions for bridge elements. Migrated data will be used until that time which will impact data accuracy.

Bridge Strategy

The DOT does not concur with LBA's conclusion that the Bridge Strategy only relates to newly constructed bridges. The intent of the Bridge Strategy document as stated, is to establish how bridges are prioritized, to guide sustainable investments and to consider

redundancy. The Department's goal is to extend the service life of all bridges in the inventory. It is unreasonable to assume the service life of "older" structures (those constructed prior to 1995) will reach the 120 year expectancy if preservation strategies developed and implemented over the last few years were not in place when the bridge was placed into service. Furthermore, it should be noted that funding for preservation activities was previously not available from FHWA until the bridge reached a particular level of deficiency, by way of federal sufficiency rating, which likely occurred 30 to 40 years after it was placed into service. That being said, depending on age and how much work has been performed, preservation activities will certainly extend the service life, but the desired service life may not be achieved. As evidenced through the recent Ten Year Transportation Improvement Plan (TYP) process and allocation of additional funds for bridge preservation, the Bridge Strategy, although it continues to evolve, was an effective public communication tool.

Bridge-related Missions, Goals, and Objectives

The Department is developing and formalizing maintenance and preservation missions, goals and objectives to evaluate performance, however the mission and purpose of the DOT are well understood throughout the Department. As goals are developed for both the BOBM and BOBD, the Department's purpose, "to provide safe and secure mobility and travel options..., through a transportation system and services that are well maintained, efficient, reliable and provide seamless interstate and intrastate connectivity..., " cannot be forgotten.

While the Department strives to move away from a worst-first approach, keeping the travelling public safe and keeping bridge infrastructure open when it is essential to the movement of goods and people remains the focus. It should be recognized that a true balance between preservation and replacement may never be fully achieved, as the Department strives to balance customer needs and making the most prudent financial investments. Project prioritization today is determined by evaluating not just the condition of the structure, but the overall use. Repairs that keep a bridge open and safe may be required even if they don't increase the service life of a structure, as the impacts of closure or posting may severely impact mobility. While the DOT aspires to make data-driven decisions, it is recognized that professional engineering judgment and local issues may still lead to alternate investment strategies.

Recommendations

- A. The Department will develop a time-phased plan with milestones for a comprehensive bridge management program. The development of an implementation plan for the bridge management program will be completed by June 30, 2017. While a comprehensive management program will create efficiencies in the long-term, the development of the program will require resources in the short-term. The DOT will work to identify those resource needs and to include them in the SFY 2018 and SFY 2019 budget. Full implementation of a comprehensive program is contingent on the availability of resources in future years.*

- B. *The Department will develop goals and a mission for the BOBM by June 30, 2017.*
- C. *The Department will continuously update the BOBM mission and goals as part of the budget process in future years.*
- D. *The Department will continue to enhance the Bridge Strategy to include the entirety of the bridge inventory concurrently with the development of a comprehensive bridge management program. A certain level of information is necessary to develop a well-rounded strategy. As more information about the bridge subgroups is captured and understood the Bridge Strategy will expand and will include five recently developed recommended maintenance schedules.*
- E. *A unified tier definition between bridges and pavements has already been created by the Department. The DOT will integrate the unified definitions into the bridge data by June 30, 2017. HIBs remain a special case for bridges. The tier system was designed to convey the significance of a corridor from a network perspective. The HIB designation was created explicitly because some bridges are more valuable from an investment perspective than would be expected from a network perspective, and warrant a targeted maintenance and preservation prioritization. The Department will continue to evaluate the tier definitions and the application of those definitions as asset management evolves at the DOT.*

LBA Rejoinder:

The DOT appears to concur with our recommendations.

We disagree with the DOT assessment that its bridge management program was beyond the initial stage of TAM maturity; the DOT lacked credible evidence to support its assessment. We noted it would likely improve if the DOT fully and properly implemented TAM. We also noted the old bridge information management system, Pontis, was to be replaced, and the DOT rested its maturity upon that system and the practices developed to support it. With its scheduled replacement by BrM, even those legacy components of a BMS will be under renovation. Maturity may be negatively affected as a result, which was emphasized by the DOT's response indicating two years will elapse between BrM implementation and full data reliability using the new system.

We did not imply the DOT was not transitioning to BrM. We reported the transition was delayed and without a documented plan or timeline. While BrM was purported to be comprehensive, the DOT had yet to determine whether it would meet its operational needs because it was not implemented.

The *Bridge Strategy* was incomplete and was inapplicable to the majority of the bridge inventory. The *Bridge Strategy* provided, “[t]o maximize the return on [the State’s initial] investment, bridges require a thorough preservation and maintenance strategy. For recently constructed bridges, our goal is to extend the expected service life up to and beyond 120 years,” which was not achievable for many existing bridges due to a lack of recommended maintenance. The *Bridge Strategy* did not define recently constructed, provide alternative goals for bridges other than those recently constructed, or include all

the recommended maintenance schedules, and a HIB sub-strategy and detailed maintenance plans were unpublished.

We note no professional engineering judgment was codified in this area – no signed, dated, and stamped products related to these aspects of bridge management were produced.

Change Management

Successful bridge programs balance preservation against replacement needs. Focus on replacing deteriorated bridges, or adopting a worst-first approach, may lead to higher costs and inefficiencies. A comprehensive asset management system includes long-term preservation considerations, as preservation is considered effective for extending bridge service life and minimizing cost. Effective plans for change must provide guidance for incorporating and integrating changes into daily practices and for long-term sustainability.

Observation No. 2

Improve Asset Management Integration Into Management And Culture

The DOT did not develop a formal change strategy and fully integrate TAM into bridge management practices and Department culture. The DOT reported continuous quality improvement and evolving processes. However, a TAM change strategy and integrating asset management fundamentals into Department culture was at the initial stage of TAM maturity.

Change Strategy

TAM requires a cultural change. All levels of an organization should be involved in its implementation. Developing a change strategy and integrating asset management into an organization's culture are early steps in the implementation process and are required to align the organization with TAM objectives. Strategic plans help management define objectives, identify risks, and continuously improve performance.

In its *Implementation Plan*, the DOT identified strategic direction, training, and communications were needed to bridge a gap in asset management knowledge. Initiatives included developing a TAM strategy along with strategic, training, and communications plans to help TAM implementation. The DOT issued a *Transportation Asset Management Governance* structure document in February 2015, but as we discuss in Observation No. 4, did not timely produce a TAM plan or a strategy for several reasons. The DOT reported their contractor was to generate drafts and the TAM plan would necessarily follow finalized federal rules.

Preservation Strategy

In the *Implementation Plan*, the DOT recognized internal inconsistencies in applying a preservation-first policy. Also, an objective, data-driven balance between preservation and replacement had not yet been achieved. There was no system or formal, reproducible,

documented process to manage assets to their lowest lifecycle costs. DOT personnel reported efforts to move away from a worst-first approach and towards a preservation strategy, but TAM was still considered a new concept and worst-first remained the primary approach to prioritizing bridge work because:

- The State lacked a formal bridge strategy until the DOT published one in March 2015.
- The reported backlog of bridge repair and replacement work, paired with funding constraints, required the DOT to expend resources replacing deteriorated bridges rather than focus on preserving other bridges.
- Bridge priority lists (BPL), with minor exceptions, prioritized Red List bridge repair and replacement using a worst-first approach.
- Inadequate and unintegrated data and deterioration modeling for preservation-oriented analysis and activity effectiveness limited objective identification of cost-effective practice.
- The Bridge Workgroup (BWG), founded as part of the *Transportation Asset Management Governance* structure, remained unchartered and had only informal direction through early 2016. While it produced BPLs, it did not produce bridge asset management procedures, such as forecasting bridge conditions and performance target criteria.
- Although the DOT established the Asset Management, Performance, and Strategies (AMPS) section to coordinate and support the Department's TAM efforts, incomplete implementation of the TAM implementation and governance plans had not led to the creation of a strategic plan or preservation-related and non-Red List bridge performance metrics as of June 2016.

BOBM field personnel understood preservation to be a priority, but it was not clearly defined and some non-preservation projects were reported as receiving more emphasis. In early 2016, the DOT sought to adopt a preservation priority list to be paired with the BPL, but key decisions regarding the nature of the list had not been made as of May 2016.

Data-driven Decision-making

Goals, performance indicators, and objective measurements drive TAM decision-making, and establish investment levels reflecting service needs. Management at all levels must lead by example to demonstrate new organizational values, philosophy, and operating style.

Since February 2011, the DOT identified moving toward more data-driven decision-making as a goal, but continued to rely on judgment-based decision-making for bridge prioritization, bridge maintenance and preservation task prioritization, cost estimates, and performance. As we discuss in Observation No. 8, the DOT lacked bridge maintenance outcome tracking, and relied on interpreting element ratings and photos, as well as staff experience, to track bridge conditions. DOT staff reported judgment was used to make key bridge maintenance and preservation decisions, particularly at the project level, and for bridge lifecycle decisions such as disinvestment. These judgment-based decisions were also made at the tactical and operational levels.

As we discuss in Observation No. 20, BOBM activities were not recorded consistently, records of key decisions were not systematically made or retained, and key data were not collected and retained. The BOBM maintenance database did not include project completion information despite being set up to do so, and certain scheduling documents were not retained. Although BOBM work crews had three targets for work outputs, the number of bridges 1) removed from the Red List, 2) washed, and 3) sealed, they did not have defined performance metrics for the outcomes of their bridge work. Objective, data-driven bridge asset management decisions were compromised as a result.

Recommendations:

We recommend DOT management:

- **develop, formalize, and implement a time-phased asset management change strategy to migrate towards data-based, preservation-focused decision-making;**
- **timely adopt preservation and data-driven decision-making practices;**
- **ensure key TAM concepts are integrated into Department culture, including collection and use of key data; and**
- **utilize its TAM governance architecture to fully implement asset management.**

Agency Response:

We concur in part.

We offer the following for clarification.

We do not concur with the recommendation that asset management for all assets can be implemented in a timely fashion.

The Department agrees that the integration of asset management with management and culture is essential to success. To that end, the DOT has dedicated resources toward the development of a strategic plan, a governance plan, a training plan, a communication plan, and an overall asset management plan. Drafts have existed, governance structures were created, and all occurring through an inclusive process, that has contributed to cultural change.

Change Strategy

The Department has already implemented a governance structure to assist with cultural change and meeting to socialize asset management principles has had value. The time needed to socialize the best practices, as well as the time needed to identify the tools and processes required to support those best practice was underestimated. Moving forward the Department will continue to advocate for the resources to implement the asset management strategy, as well as a comprehensive bridge management system. Once again, investment in these initiatives will increase overall efficiency, however with

current staffing levels, progress will be gradual as staff attempt to balance working on strategic improvement while ensuring the delivery of the bridge program.

Preservation Strategy

The Department does believe that a preservation-first policy provides for the lowest lifecycle cost for bridges. However maintenance, preservation, rehabilitation, and replacement approaches will always be part of TAM, and while the Department will advocate for preservation and maintenance funding, it is recognized that ultimately factors such as the type and level of funding, as well as mobility and customer needs, may still impact investment choices. Preservation strategies have been implemented over the last few years as federal funding for preservation efforts became available and the Department is developing systems to manage assets to the lowest lifecycle costs. Given prior investment levels, balancing the need to address the backlog of deficient structures with the desire to adopt this new approach will continue to prove challenging.

Data-driven Decision-making

- Data-driven models for establishing preservation/maintenance and rehabilitation/replacement priorities for bridges are under development and will be fully implemented as the models mature. Presently, deterioration models are not readily available. These models will provide more objective results that are reproducible and transparent.*
- It was stated that the DOT is lacking bridge maintenance outcome tracking. The timespans and environmental conditions associated with bridge management complicate the availability of good data regarding maintenance and preservation in New Hampshire and across the nation. In many cases it will take 20, 30, or more years before the true effects, or outcomes are realized in bridge condition data and element lifespans. For example, the Department sets targets with respect to tasks such as bridge washing. If we fail to meet those targets for a single year the outcome may not be noticeable, however failing to wash bridges and remove salt over an extended period of time will have negative consequences. Rather than tie a single performance goal to an outcome, the Department monitors the overall health of the inventory and adjusts the maintenance program as necessary.*
- Today bridge inspectors, bridge maintainers, engineers, and management utilize photographs, condition ratings, inspection reports, system tiers, traffic volumes and other data as part of the decision making process. The process could be improved, become more repeatable, and be more transparent as data integration increases through the deployment of enhanced BMS. This however requires dedicated DOT and Department of Information Technology resources as well as the completion of the BrM implementation.*
- While time is needed to implement the tools and data integration, since April 2016, the Department has embarked on documenting and enhancing the approach used to prioritize both maintenance/preservation activities and rehabilitation/reconstruction needs. While still in draft form this systematic approach will provide greater*

consistency to the process as an interim step toward a comprehensive bridge management program.

Recommendations

- A. The Department revisited the original Implementation Plan and determined that completing a strategic plan for all assets was necessary to understand priorities for the agency. Once the strategy is understood, the Implementation Plan will be revised to include prioritized tasks and a schedule that reflects available resources. While this audit is focused on bridge management, the Department needs to develop strategies for managing all assets. The Department will develop a time-phased plan with milestones for an asset management strategic plan. The development of the strategic plan will be completed by June 30, 2017.*
- B. Implementing asset management best practices for all assets and collecting adequate information to make data-driven decision making across all preservation programs will take many years. Both the overall asset management strategy, as well as enhancing the BMS, will require near term additional resources. The DOT will work to estimate those resource needs and include them in the SFY 2018 and SFY 2019 budget. Full implementation of the asset management strategy is contingent on the availability of resources in future years.*
- C. The Department is committed to a bridge management system based on asset management principles and sound data. The Implementation Plan outlined above will include those principles and data-driven decision making processes.*
- D. The Department has already contracted with consultants and is working toward the completion of a strategic plan, communication plan, training plan, and portions of the overall asset management plan. Each of the plans mentioned will be completed by June 30, 2017.*
- E. The Department has utilized the governance structure for more than a year to implement aspects of asset management. As plans are finalized, the Department will continue to utilize and refine the governance structure.*

LBA Rejoinder:

The DOT appears to fully concur with our recommendations.

We made no recommendation to implement asset management for all assets in a timely fashion. We recommended a time-phased strategy and did not recommend a timeline for implementing asset management, or any element thereof.

We question an all-assets-at-once approach. The *Implementation Plan* was prioritized to focus first on bridges due to their disproportionate value when compared to other assets, but the DOT deviated from this approach until implementation of the new BrM software. The BrM software had multiple implementation delays and was without a documented migration timeline or plan.

Draft documents were inherently unimplemented. While the DOT previously reported the strategic plan and other draft plans were being worked on by a contractor, we were not provided any drafts, although they were requested. Delivery of key documents was planned for June 30, 2017, more than two years after the originally scheduled delivery date.

Roles And Responsibilities

Asset management is a team effort, often requiring new skills and specialized capabilities. Establishing asset management roles is integral to aligning the organization for TAM implementation. Clearly defined and delegated roles, authority, and responsibility facilitate consistency, accountability, compliance, efficiency, and effectiveness, and are fundamental elements of good management control. Clear descriptions of tasks and requirements should be developed and can encourage more strategic and integrated approaches. While vertically-aligned organizational units may exist to maintain core expertise, horizontally-aligned business processes and decisions involve wider participation. Establishing new roles and managing the transition is an important task for an organization to mature. Properly implemented, TAM integrates its principles and practices horizontally and vertically throughout an organization's business process. DOT bridge asset management roles and responsibilities were assigned to two bureaus within two different divisions, an ad hoc work group, and the AMPS section.

Observation No. 3

Improve Assignment Of Bridge Asset Management Roles And Responsibilities

While the DOT operated several processes and had practices related to bridge management, there was no formal, comprehensive bridge program, no lead bridge bureau or bridge-specific asset steward was designated, and some roles and responsibilities were unassigned. The DOT was at the awakening stage of TAM maturity in integrating and institutionalizing bridge asset management roles and responsibilities.

The DOT's asset management structure was designed to promote decision-making reliant on bottom-up information generated by subject matter experts. Statute required the Commissioner delegate necessary and appropriate authority to subordinates. Delegations must: 1) be written, 2) clearly delineate the authority delegated, 3) clearly delineate limitations on the authority delegated, and 4) be kept on file. While several DOT commissioners codified delegations, they were ministerial in nature. Operational authority was delegated by class specifications and supplemental job descriptions, and was not comprehensive. Management should also periodically evaluate its organizational structure and make modifications in response to changing laws and management approaches, such as TAM implementation. There were no relevant evaluations of bridge management roles and responsibilities.

Statutory Duties

Core bridge-related statutory duties were inconsistently assigned to bridge asset managers. Key duties not clearly and specifically delegated included:

- Red List bridge reporting by February 1 annually, numbering and prioritizing for repair, and related requirements;
- bridge closure and restriction authority;
- permanent bridge closures or certifying bridge repair and replacement;
- bi-annual Red List bridge inspection;
- biennial inspection of non-red-listed bridges; and
- destroying records.

We detail elsewhere significant noncompliance with several of these statutory provisions.

Asset Management

Asset management responsibility was not explicitly assigned to bridge bureau managers. The bureaus were jointly responsible for State bridges and developed a surrogate for a formal, comprehensive BMS. Bureau managers constituted part of the BWG, a recognized component of the DOT's TAM governance structure and responsible for statewide bridge asset management. However, the unchartered BWG's composition, practices, and procedures, were not formalized. BWG responsibilities were not specified in job descriptions for any of the bridge bureaus' management, although related duties pre-existed.

The BWG was intended to direct policy and effort. Annually, the DOT created a BPL, establishing the relative priority of effort for a particular bridge in need of work. Generating the BPL was not a specified responsibility of the BWG or a bridge bureau manager. Although not contained within its design-centric mission, the BOBD functionally led tactical bridge asset planning efforts driving operational maintenance and preservation planning, including the BOBM annual repair task list.

Responsibility for the BWG's focus on the current inventory and condition was distributed, but rested primarily with the BOBD. There were known data integration gaps between bridge bureaus and informal efforts to improve integration, but there was no plan to address them or to rationalize responsibilities.

The BWG was to develop preservation and management strategies. While not part of the BOBD design-centric mission, preservation priorities, policy-setting, and contract project work, including preservation, were BOBD responsibilities. The BOBM also took part in preservation work and was primarily responsible for maintenance programming and prioritization. Responsibility for repairs was also distributed. The BOBM was responsible for repair standards, advising on repair priorities, and conducting force account repairs, while BOBD recommended timely repair action and handled larger repair project contracts. Bridge rehabilitation and reconstruction were primarily BOBD responsibilities, as were policy development, evaluating construction practices, recommending timely action, and handling contracted projects. The BOBM advised on construction priorities and undertook some rehabilitation and reconstruction force account work.

BWG foci not embedded within bridge bureau responsibilities included forecasting conditions, setting condition targets, and risk management. The BWG was to support achieving strategic outcomes, but assessing efficiency and effectiveness was not assigned to either bureau. No individual had explicit responsibility to approve BPLs, or changes thereto. The CY 2014 and CY 2015 BPLs were issued without signature and changed in BWG sessions, triggered by the annual Red List publication, and, in effect, during review and generation of repair task lists. Non-bridge projects, such as building construction, were approved without any delegated authority and were included on BOBM's annual repair task lists, detracting from the completion of actual bridge maintenance tasks as we detail in Observation No. 11.

Drafts intended to document the BPL process were generated and continued to be modified after the audit period, indicating the DOT was working on identifying and formalizing related procedures and practices. However, there was no associated plan or timeline detailing milestones or specifying when this effort was to conclude, and documenting practice only memorialized past practice, as no objective end state was defined. According to the *Implementation Plan*, other bridge asset management procedures and plans were to be completed by June 2015, but had not been by June 2016.

Engineer Of Record And Responsible Charge

While BOBM engineers were to oversee projects under the supervision of the BOBM Administrator, the DOT did not formally assign engineers of record (EOR) or designate engineers to be in responsible charge of BOBM projects. BOBM professional engineers practiced engineering when they planned, designed, and provided responsible construction or operations oversight in connection with State projects. Professional engineers were required to date, sign, and seal the professional work they either prepared or for which they were responsible and approved. When sealing drawings, reports, or documents for a project, or modifying certain details of standard designs, professional engineers became an EOR. Also, federal requirements for responsible charge applied to federal aid projects. The responsible charge must be a fulltime State engineer accountable for each project in terms of time, cost, quality, changes, documentation, and project operations.

BOBM engineers were responsible for many of the relevant EOR and responsible charge functions. However, our file review of 66 projects on the BOBM's CY 2014 and CY 2015 annual repair task lists, encompassing projects completed, underway, and not yet started, demonstrated none contained a documented plan or estimated work required, project duration, or start or completion dates. Fifty-four (81.8 percent) were bridge projects and 28 of these were completed or underway; none contained dated, signed, and stamped drawings and specifications, even though the scope of work for 31 projects (57.4 percent) appeared to involve structural alterations. Lastly, at least seven bridge projects (13.0 percent) were federally-aided. None had an EOR or a responsible charge assigned.

Recommendations:

We recommend DOT management:

- **evaluate its organizational structure, assigned duties and responsibilities, and delegations;**
- **comply with statute and formally delegate authority and responsibility;**
- **designate a bridge asset management lead and obligate other organizational units to provide necessary support to achieve bridge management goals and objectives;**
- **charter the BWG, formalizing membership, procedures, and practices;**
- **formalize EOR procedures and practices, assign one or more EORs to bridge projects, and ensure professional obligations of EORs are consistently met and relevant documentation is dated, signed, stamped, and permanently retained;**
- **formalize responsible charge procedures and practices, assign one or more engineers to be in responsible charge of federal-aid bridge projects, and ensure adherence with relevant federal requirements;**
- **formalize roles in governing documents, and update job descriptions and class specifications to reflect the current operating environment; and**
- **develop management controls to ensure effective delegations of roles and responsibilities, monitor and assess effectiveness, and revise policy, procedure, and practices as necessary.**

Agency Response:

We concur in part.

We do not concur that:

- *there was no formal bridge program;*
- *some roles and responsibilities were unassigned; and*
- *subject matter experts are making decisions without first seeking the commissioners' approval or that the Commissioner should be delegating authority.*

Statutory Duties

We do not concur that bridge related duties were inconsistently assigned or not specifically delegated.

- *The bridge inspection program and associated reporting are duties assigned to the BOBD and to staff within that bureau through supplemental job descriptions. The Red List and other bridge reports prepared by the BOBD are reviewed by the executive office and circulated after the commissioners review.*
- *Similarly, a bridge closure or posting is recommended after an inspection or rating is performed, but not implemented until the commissioners review and concur with the recommendation.*

- *The BOBD and the BOBM coordinate and collaborate on a routine basis to both prioritize work and to determine which of the two bureaus should be the lead given the scope of the required work. The organizational structure and the duties of the individuals within the bureaus are well defined and well understood by the staff in both bureaus. We agree that the documentation of duties and how coordination/collaboration occurs can be improved.*

Asset Management

- *The bridge asset management roles and responsibilities are actually assigned to three units within two different divisions with very clear roles and responsibilities for each of those bureaus. The Bridge Strategy and direction is from the executive office under the advisement of the BWG and the AMPS section.*
- *The responsibility to produce plans for bridge work being bid and contracted out is the responsibility of the Division of Project Development and undertaken by the BOBD and Construction. The BOBD is responsible for completing inspections, maintaining data, and producing Red List reporting.*
- *Bridge maintenance, repairs and emergency response are the responsibility of the Division of Operations and performed by the BOBM.*
- *The collation of this effort is the responsibility of the AMPS section which is also the liaison between the executive office, bridge bureaus and the BWG.*
- *Although the BWG did not have a formal charter, the following items were completed over the past year: recommended maintenance schedules, refined bridge backlog estimation, the Bridge Strategy, and improvements in other areas.*
- *We disagree that the BPLs are changed informally as the BPLs are issued once a year. BPLs are updated and issued once a year, the two-week task list is a separate document that is updated frequently as the name infers. The BPL represents funding priority, not the order in which bridges will be rehabilitated or replaced. The funding priority considers items in addition to condition such as, importance, risk, time when action is needed etc.. Since conditions change from year-to-year, and other bridges are added, the priorities of some bridges change from year-to-year.*
- *The two-week task lists are an internal coordination tool that supplements the BPL for projects worked on by the BOBM.*
- *Description of non-bridge support work is discussed in Observation No. 11.*

Engineer of Record and Responsible Charge

- *Although there was no EOR listed on the BOBM plans, the Chief of the Existing Bridge Section stamped and signed the load rating form for those projects that were completed and that modified the structure to the degree that the structure's load carrying capacity was modified. In consultation with the Attorney General's Office, the DOT agrees that final plans and final documents for projects that require the "application of advanced knowledge of mathematics and physical sciences," such as structural modifications to bridges, should be and will be stamped by an EOR. Draft documents and other working documents that do not require the aforementioned applications of engineering are not required to be and will not be stamped.*

- *BOBM developed plans for work that involved structural modifications to bridges. Of the 66 projects in the sample, 14 involved structural modifications, of which 12 had unstamped plans filed and two were actively being worked. The remaining 52 involved work identified as replacement in-kind or had non-structural modifications or not worked on and did not require plans be developed.*
 - *Of those projects sampled, 26 were designated “when time permits” which is our designation for a non-scheduled project. This designation indicates that they were not a high priority and would only be done if time permitted. Documents would only be prepared for these projects when it was known that they would fit into the schedule and if they had work that affected public safety or involved work other than replacement in-kind. Of these 26, only three had any work during the audit period and none had structural modifications.*
 - *Two of the sampled projects were slated for scheduled work outside the sample period (one for 2018) and documents had not been prepared yet.*
 - *In addition, five projects were designated as keep-in-service. This designation is for those bridges which are in poor condition that are scheduled for a Capital Budget project. The intent is to perform minimal work on these structures as-needed to keep them in service until future scheduled work is performed. Of these structures, only one had work performed, the Sarah Mildred Long Bridge, and the majority of the work included the regular maintenance associated with a lift bridge.*
 - *The remaining projects were not worked on or did not involve structural modifications to a bridge.*

Recommendations

- A. *The organizational structure was evaluated as part of the TAM governance plan and will continue to be with each budget cycle and as bridge management needs evolve at the DOT.*
- B. *The DOT will review supplemental job descriptions, bureau missions and goals, and other material by June 30, 2017 to ensure that delegation of authority is consistently defined.*
- C. *The DOT has located bridge asset management within three organizational units: 1) BOBD, 2) BOBM, and 3) AMPS section. The assignment of those responsibilities will continue to be evaluated as bridge asset management evolves at the DOT.*
- D. *Within the DOT many other organizational units provide support to achieve bridge management goals and objectives. Investing more resources across the agency in the improvement of the bridge management program will reduce services elsewhere and will be considered through the budget process. The Commissioner and directors are responsible for ensuring coordination and support for bridge management goals within the entire Department.*
- E. *A charter for the BWG will be created by June 30, 2017.*
- F. *EOR procedures and practices will be documented by December 31, 2017.*
- G. *Responsible charge procedures and practices will be documented by December 31, 2017.*

- H. *Job descriptions and class specifications will be updated by June 30, 2017.*
- I. *As part of asset management implementation, we will continue to review the current roles and responsibilities and make changes as appropriate. The DOT is a pioneer in the development and use of the balanced scorecard within State government in New Hampshire. We will continue to utilize tools like the balanced scorecard to monitor and assess effectiveness, making improvements over time.*

LBA Rejoinder:

While the DOT operated several processes and had practices related to bridge management, as we noted throughout the report, it lacked a formal, comprehensive program as demonstrated by the number of missing components we identified in this and other observations. We found:

- **Commissioner-level review and approval of BPLs, annual maintenance task lists, published complete Red Lists, bridge closure notices, and agreements on historic structures were not documented.**
- **Statutory Red List responsibilities were not contained in bridge management-related supplemental job descriptions, and only a generalized reporting obligation existed. No policy indicated management had designed a control structure around meeting the related statutory requirements.**
- **There was a lack of delegations of authority as required by statute.**
- **The DOT also lacked effective, procedurally-defined management monitoring of results, which should follow the delegation of decision-making authority.**
- **The DOT relied upon generalized assignment of duties, and, inferentially, certain personnel were responsible for accomplishing certain statutory duties. We found significant statutory noncompliance with some of these duties.**

We did not recommend draft and working documents contributing to a final exercise of engineering judgment, captured in a final document, needed to be signed, dated, and sealed by a professional engineer. However, we expected plans, analyses, decisions, and relevant reports to be supported and documented as either a management decision or signed, dated, and sealed by a professional engineer when they are the culmination of professional engineering judgment. While BOBD-generated load ratings may have a nexus with public safety, statute provided numerous acts were professional engineering. There was no EOR indicated for any activity the BOBM undertook in our review, including designs for construction and rehabilitation work.

Planning

Planning is integral to good management control, efficient and effective operation, and asset management implementation. Planning occurs at the strategic, tactical, and operational levels and constitutes management's approach to achieve its objectives. Planning should be integrated, iterative, goal-oriented, and risk-based.

Observation No. 4

Improve Planning

While the DOT reported developing certain draft plans and began TAM implementation, the DOT did not publish an asset management strategic plan, a TAM plan, or a supporting bridge asset management plan and procedures. Bridge maintenance and preservation planning lacked formal structure and connection to strategies and goals. DOT bridge asset-related planning was at the awakening stage of TAM maturity.

Asset Management Plans

The 2014 *Implementation Plan* provided a framework for implementing TAM DOT-wide and established a six-year schedule with milestones for completing major features of implementation. The *Implementation Plan* provided:

- A TAM strategic plan would be completed by January 2015. The strategic plan was to establish a clear set of policies, goals, and objectives, enabling performance measurement, and was to precede other plans.
- The federally-required TAM plan would be completed by August 2015. The TAM plan was to be risk-based, establish objectives and measures, identify performance gaps, and include lifecycle costs and investment strategies. It would facilitate realignment of then-existing processes and practices with those needed for proper asset management implementation.
- Bridge asset management procedures were to be completed by July 2015. The procedures were intended to ensure asset-related decisions were data-based and an optimal program developed. Processes were to be documented and a detailed plan with manuals documenting all aspects of related processes were to be generated. Bridges were the number one priority for plan and procedure development.

As of June 2016, none of the specified plans had been issued, but:

- the *Transportation Asset Management Governance* structure, planned for completion in July 2014 according to the *Implementation Plan*, was published in February 2015;
- the *Bridge Strategy* was issued in March 2015; and
- a preliminary draft of the process used to develop a BPL was created in early 2016.

Further, while the *Implementation Plan* was to be aligned with the strategic plan when published, revisited annually, and revised as needed, no revisions were issued through June 2016. The DOT reported a draft strategic plan was expected in the fall of 2016, with a draft TAM plan to follow in the spring of 2017, contingent upon federal rulemaking.

Maintenance And Preservation Plans

Bridges require a thorough maintenance and preservation strategy, integrating asset management practices and principles at all levels of the organization, and systematically identifying a

structured sequence of bridge maintenance, preservation, repair, rehabilitation, and replacement. However, maintenance and preservation project selection, while data-informed, was a manual process. The DOT reported its staff combined judgment with photographs, condition ratings, inspection reports, and other information when selecting projects. No detailed records were retained, nor were embedded engineer judgments codified.

Major DOT computer applications contained work planning and scheduling modules, but they were not utilized due to DOT-reported methodological concerns. BOBM planning was instead accomplished with an annual repair task list based in part on preceding years' evolving and qualitatively-developed BPL that focused on Red List bridge rehabilitation and reconstruction. A lack of formal goals, objectives, performance standards and levels of service, and expectations in terms of maintenance efficiency or other maintenance- or preservation-specific metric, left BOBM project planning for major repair or rehabilitation projects focused on red-listed bridges and inherently reactive. The DOT expected the BOBM to remain reactive at least through 2018. It intentionally kept the Red List bridge workload light, providing flexibility to address future Red List bridge needs. When we reviewed the CY 2013 BPL and the CY 2014 annual repair task list for commonality, we found 69 of the 326 maintenance tasks were numerically prioritized and 45 of the 69 numerically-prioritized tasks (65.2 percent) were not on the BPL, indicating the BPL played a relatively minor role in development of the annual repair task list.

Planning practices for other tasks were routinized, but not formalized; changed during the audit period; and were judgment-based. Until the development of the *Bridge Strategy* in March 2015, the DOT did not formalize: 1) bridge tiers, which were intended to prioritize resource allocation, and 2) the typical maintenance and preservation, rehabilitation, and reconstruction cycle for recently constructed bridges (Typical Cycle). The DOT reported planning practices were evolving as personnel sought better and more efficient ways to prioritize and schedule work. However, in practice, the overall strategy remained focused on which red-listed bridges to fix and did not fully incorporate preservation elements that may have provided additional structure for maintenance planning. A clear connection between the DOT's Typical Cycle and any specific structure had yet to be made, and a preservation priorities list remained a concept as of June 2016. BOBM repair tasks not derived from the BPL were: self-identified; driven by pavement programs; based on the seasons; based on permit availability or pending permit expiration, rather than priority; added by the front office or other units within the DOT; and emergencies.

While many projects selected appeared to have a potential preservation outcome, without a preservation priority, there was no way to determine whether project selection conformed to a preservation strategy.

Further, while the DOT asserted using the BOBM to address red-listed bridges was reasonable and cost-effective, we found no objective way to assess whether project selection decisions made economic sense and were cost-effective, nor were trade-off analyses evident. As we discuss in Observation No. 9, the DOT lacked formal and reliable lifecycle cost, benefit-cost, and estimating practices.

Finally, while annual repair task lists were called "Repair Schedules," there was no schedule feature to them. Projects were assigned a numerical priority, calendar year for completion

priority, or designated “when time permits.” BOBM management reported estimates of task or project duration were used to build annual repair task lists, but BOBM management did not retain them. In practice, annual repair task lists were translated into two-week lists, which were reviewed, revised, and recreated every two weeks. The new two-week repair task list drove most field crew efforts. Scheduling was managed based on judgment, and other tasks informally identified by field crews and outside BOBM schedules might also be inserted at crew discretion. Since records were not retained, we reviewed post-audit period two-week repair task lists and found they did not contain start or end dates, estimated effort or duration, budgets, percent complete or executed, or other progress metrics. Two-week repair task list approvals remained within the BOBM. Annual repair task lists were transmitted via memorandum to the Operations Division Director. No review to confirm the tasks listed supported broader goals and objectives occurred, and no approval of task lists occurred. The annual repair task list was the budget execution document for more than \$7 million annually in bridge maintenance appropriations.

To improve the process, the DOT reported starting to apply formal start and end dates to projects during two-week schedule development. Other initiatives to structure schedule management were also reportedly underway. There was no plan structuring the reported changes, defining a desired end state, or establishing milestones for initiatives.

Recommendations:

We recommend DOT management:

- **revise the *Implementation Plan* and schedule;**
- **set milestones for developing and publishing a strategic plan, a TAM plan, and bridge asset management plans and procedures;**
- **timely develop and publish plans and bridge asset management procedures; and**
- **institutionalize annual *Implementation Plan* reviews, revising it when necessary.**

We recommend BOBM management:

- **formalize maintenance and preservation planning processes and practices;**
- **incorporate asset management fundamentals, such as benefit-cost, lifecycle cost, and tradeoff analyses, into planning processes to help optimize resource utilization;**
- **collect and retain planning and scheduling data and information to enable data-based decision-making and facilitate longitudinal evaluation of productivity; and**
- **monitor planning practices, revising them as needed to ensure continuous process quality improvement.**

We also recommend DOT management develop and implement a review process to ensure annual and two-week repair task lists fully support maintenance and preservation strategies.

Agency Response:

We concur in part.

Asset Management Plans

- *The Department did revisit the Implementation Plan and determined that completing the strategic plan and asset management plan were priorities over updating the Implementation Plan.*
- *It is incomplete to suggest that federal law requires asset management plans because the law also outlines phase-in requirements. The phase-in requirements of the law concerning asset management plans begin with the FHWA publishing a final rule which is not anticipated until December 2016. After the rule is published, the DOT has at least one year to prepare an asset management plan; the DOT will meet that requirement.*

Maintenance and Preservation Plans

- *The DOT disagrees with the implication of the statement that “Major DOT computer applications contained work planning and scheduling modules” because the quality of and resources required to utilize those tools is not mentioned. There are major systems, like Pontis, with such capabilities. However few states utilize the expanded modules of Pontis because they are difficult to implement. States that did use such modules often developed other applications to integrate with Pontis to provide the necessary data. The DOT expects that these tools will be improved in BrM and that we can more readily integrate such systems in the future.*
- *The Department has made strides and will continue to work towards attaining best practices in both asset management and planning for bridges. The DOT is in the process of developing a strategic plan for asset management and a TAM plan. The Department-wide Implementation Plan will be revised after the completion of the strategic plan along with the development of an implementation plan specific to the management of bridges. These plans together will form the basis for tactical decisions regarding the maintenance, preservation, rehabilitation, and replacement of specific bridges.*
- *The report suggests that establishment of formal goals, objectives, performance standards, levels of service, etc. alone should have immediately changed the worst-first “reactionary” approach that focused on Red List bridges. BOBM forces are utilized to complete rehabilitations on red-listed bridges when the work is within their capabilities and the size and scope will be cost-effective. They can respond and complete the necessary work in a more expeditious manner when compared to the conventional design/bid/build delivery method used by the BOBD.*
- *Of the 30 projects listed in the CY 2013 BPL for the BOBM, all were on the CY 2014 schedule or were already completed with the exception of three that were listed as “monitor”. The BPL represents funding priority, not the order in which bridges will be rehabilitated or replaced as evidenced by the dates listed for construction. Bridges*

listed for construction in future years were not always prioritized on the schedule for that year.

- *Planning practices are always evolving as we look for better and more efficient ways to prioritize and schedule work; therefore, changes can occur from year to year. The scheduling process was documented in a letter each year. Including considerations when undertaking projects, such as pavement programs, seasons, and permit availability, minimize disruptions to communities and offer efficiencies. These are considered in every construction project whether it is contracted or completed using in-house forces.*
- *The BPL originally started with red-listed bridges only. The Department had begun the transition to include some large preservation projects on the BPL to account for their impact in the TYP. Therefore, smaller BOBM maintenance and preservation activities were not listed on the BPL. The Department recognizes the need for a preservation priority list and is in the process of developing this list.*
- *The BOBM does routinely review its project costs in comparison to contracted projects, but there is no formal process with the exception of the Bridge Rehabilitation, Painting, Preservation, and Improvement program justification submitted to the FHWA which includes direct comparisons.*
- *Bi-weekly meetings in the BOBM are for internal coordination and include the field engineers, administration, and design engineer. The purpose of this meeting is to discuss the status of projects, other items that have emerged, discussions of sharing personnel between crews, and coordinating use of BOBM equipment. If an opportunity arises to more efficiently do a task or project (such as low water) or something delays an existing project that would affect the sequence of the next project, changes are made and the information is conveyed via what is called two-week schedule. One of the missions of the BOBM is to deal with maintenance items (potholes on the bridge deck, joint armor that could puncture tires, etc.) and to quickly deal with emergencies. These items do impact schedules on a regular basis.*

Recommendations

- A. The DOT will complete a revised implementation plan by June 30, 2017.*
- B. The DOT will develop an internal interim roadmap with milestones for completing the strategic plan, asset management plan, and implementation plan by December 30, 2016.*
- C. The DOT will publish a strategic plan, portions of the overall asset management plan, and implementation plan by June 30, 2017. The implementation plan will include updated timelines for other plans associated with bridge asset management.*
- D. The revised implementation plan, completed by June 30, 2017, will specify an update cycle.*
- E. The revised implementation plan will include expectations for maintenance and preservation processes/practices for all bridges.*
- F. The revised implementation plan, completed by June 30, 2017, will outline the process to develop a comprehensive bridge management system to include resource optimization, tradeoff analyses, and lifecycle cost analyses.*

- G. The revised implementation plan, completed by June 30, 2017, will include a discussion of systems to facilitate enhanced data-driven decision making.*
- H. Once plans are finalized, the DOT will monitor progress toward the implementation plan while meeting the goals of the asset management plan and strategic plan.*
- I. The DOT will establish performance metrics to routinely monitor maintenance and preservation activities. Until systems are developed/revised to capture and report, information monitoring will continue through annual work plans and quarterly updates.*

LBA Rejoinder:

The DOT appears to concur with our recommendations.

We did not suggest the establishment of formal goals, objectives, performance standards, levels of service, etc. alone would immediately change the worst-first “reactionary” approach that focused on Red List bridges. Nor did we suggest any one act would have altered the DOT’s approach. These steps are necessary for a comprehensive and orderly change of approach and are integral to adequate management control.

While the DOT asserts project cost comparisons to contracted project costs occur, the process for the Bridge Rehabilitation, Painting, Preservation, and Improvement program justification submitted to the FHWA was problematic. The State-submitted justification was heavily qualified and made few to no direct comparisons. As we noted in Observation No. 13, overhead was not well incorporated into BOBM costs which would affect any comparisons. Further, most of the management controls imposed on other DOT projects were not applied to BOBM projects, reducing the costs of BOBM projects and further reducing the comparability of BOBM and contracted project costs. Until BOBM complies with DOT requirements related to project management, quality, audit, and other areas, comparisons will remain problematic.

DOT personnel indicated concerns with the Pontis methodology and available data for analysis; however, Pontis contained scheduling and planning modules and functions, as did other DOT applications and databases.

Gap Analysis

A gap analysis is a formal process identifying the difference, or gap, between a performance target and the current level of performance. This includes assessing strategy against best practice. Gaps are TAM elements which are not well-understood, supported, or integrated into asset decision-making. Gap analyses function as both a starting point and a recurring, periodic assessment of asset management implementation, cyclically adding more detail as warranted.

Ongoing gap analyses are relevant at any stage of TAM implementation, benchmark progress, demonstrate gaps and successes, and identify progress on the TAM maturity scale. Asset management relies upon structured decision-making to make tradeoffs between alternatives at

the strategic, tactical, and operational levels. Asset management practices and principles should be integrated at all levels of the organization. Federal law required state TAM plans for National Highway System infrastructure include performance gap identification. Assessments and strategic planning facilitate risk identification and inform performance measurement.

Observation No. 5

Improve Bridge Asset Management Gap Analysis Practices

The DOT did not fully implement bridge asset management gap analysis practices, lacked policy and procedure, and utilized contractors to assist with gap analyses. DOT gap analysis efforts were at the awakening stage of TAM maturity.

No bridge-specific gap analysis existed. Since at least 2010, the DOT had been working to implement asset management. Based on the DOT's internal February 2011 assessment of TAM goals, a contractor delivered a draft February 2012 comparative assessment of asset management systems in other jurisdictions for planning purposes. Subsequently, BOBD and BOBM staff participated in a Department-wide 2014 gap analysis workshop following a 2013 survey and interviews facilitated by a second contractor. The workshop, survey, and reports were not published. The 2011-2012 and 2013-2014 efforts identified gaps related to:

- information management and integration;
- maintenance cost tracking;
- forecasting future preservation costs;
- deterioration and performance modeling;
- data-driven, reproducible, and transparent decision-making;
- decision-support tools, including weighted decision criteria, and trade-off analyses;
- strategic planning;
- policies and procedures;
- risk assessment;
- movement from worst-first to preservation-focused business approaches; and
- alignment between the balanced scorecard and budgets, programs, projects, and asset value.

The same contractor employed for the 2013-2014 gap analysis effort was under contract to complete the TAM plan, which was to be built upon prior gap analyses. The \$389,634 contract started in October 2014, was extended to March 2017, and was to include another gap analysis. The DOT reported more than \$244,000 of the total current contract's value (62.6 percent) was expended through February 3, 2016. The extended contract was funded with 80 percent federal funds and 20 percent Turnpike toll credit funds. The DOT also reported the 2011-2012 gap analysis cost was approximately \$43,596, making the total direct, preparatory costs of implementing asset management over \$287,000.

No TAM plan had been produced as of June 2016, in part due to delays in federal rulemaking regulating the planning process. The DOT did not produce any interim gap analyses. The gap analysis associated with the TAM plan was expected to be completed in either September 2015

or September 2016, depending upon federal rulemaking. While bridges or culverts were six of the highest eight asset risk categories identified in the DOT's January 2016 draft risk assessment, and bridge asset management procedures were to be in place by June 2015, as we discuss in Observation No. 4, none of this was accomplished as of June 2016.

Recommendations:

We recommend DOT management:

- **institutionalize gap analysis at the strategic, tactical, and operational levels;**
- **timely complete scheduled gap analyses;**
- **conduct gap analyses specific to bridge management, and maintenance and preservation activities;**
- **cyclically conduct gap analyses; and**
- **timely address issues identified in gap analyses and similar assessments.**

Agency Response:

We concur in part.

We do not concur with the following:

- *It is stated that gap analysis efforts were at an awakening stage at DOT, however gap analysis practices are typically used to assess the level of asset management maturity within an organization.*
- *The observation infers that using contractors for gap analysis efforts reflects a low level of maturity. It is actually recommended that contractors are used for gap analysis, with staff participation. This ensures an independent assessment of how an asset management process differs from the best practice.*
- *The DOT is working to implement asset management which is a process that takes many years and is continually evolving nationwide. Conducting a gap analysis lays the groundwork for making progress toward asset management best practices, but does not constitute asset management itself. The DOT began allocating resources toward asset management in 2013.*
- *Risks associated with bridges will be included in the asset management plan along with mitigation strategies.*

The Department is in the process of developing a strategic plan, asset management plan, and implementation plan. The new implementation plan will follow and include specific information for bridge management. The implementation plan will include goals, timelines, and performance measures. From that point forward progress toward meeting the implementation plan along with any shortcomings (gaps) will be identified on a routine basis. The Department will work towards addressing gaps as they are identified.

Recommendations

- A. *As noted in the observation, the DOT has identified gaps through study and internal efforts. This work will continue after the strategic plan, asset management plan, and implementation plans are complete.*
- B. *The implementation plan will include a review and update cycle. As part of that process gaps will be analyzed.*
- C. *The implementation plan will include specific information for bridges to close already identified gaps. After the implementation plan is completed, gaps will continue to be analyzed.*
- D. *Gaps will be analyzed routinely as part of implementation plan reviews and revisions.*
- E. *Gaps will be addressed through revisions to the implementation plan. While some gaps can be readily addressed others may require substantial time or resource investments to close.*

LBA Rejoinder:

The DOT appears to concur with our recommendations.

We did not connect maturity to reliance on contractors as the DOT suggested. TAM gap analyses should be objective, but available literature did not recommend gap analysis be contracted. Rather, it indicated they are internal to an agency. Unless the DOT will contract for these services for the foreseeable future, internal gap analysis capacity will be necessary for its cyclical analyses.

Bridge Risk Management

Risk management is a core business driver. Organizations should systematically identify, analyze, assess, plan for, and respond to risks related to achieving objectives through routinized mitigation strategies. Routine risk assessments are a key component of risk management and provide additional, longitudinal metrics for prioritizing resources. Risks from individual assets translate directly into risks to the organization and can stem from natural hazards and other external impacts, physical asset failures, and operational risks. TAM requires identifying critical assets, considering transportation network resiliency related to risk events, developing risk management plans, and prioritizing funding for identified improvements. Risk management analysis is a required component of a National Highway System TAM plan.

Observation No. 6

Improve Bridge Asset Risk Management Practices

While risks were informally considered or inherent in various operational-level practices, the DOT lacked a formal, comprehensive risk management process and strategy for bridge assets

and maintenance, preservation, rehabilitation, and replacement efforts. DOT risk assessment efforts were at the awakening stage of TAM maturity.

DOT officials conducted several bridge-related risk assessment and mitigation activities, primarily for bridge work prioritization, without formally identifying these activities as components of a holistic risk management strategy. The DOT:

- inspected bridges and assessed erosion, or scour, vulnerability routinely under a federally-required program to track and categorize bridge conditions;
- operated the statutorily-required overweight and oversize permitting program;
- informally considered network risks in the BPL process through reviewing detour lengths and traffic volume;
- identified tiers and HIBs to prioritize resource allocation, and established the Typical Cycle for certain bridges; and
- created annual and two-week repair task lists to structure BOBM maintenance work and based in part on bridge ratings, safety, and capacity.

To manage risks, bridges require a thorough maintenance and preservation strategy which systematically identifies a structured sequence of bridge maintenance, preservation, repair, rehabilitation, and replacement. However, the DOT did not have formal, comprehensive risk assessments of bridge maintenance and preservation efforts. The January 2016 risk assessment draft began a strategic-level process to identify, understand, and assess risk, and identified bridges as a primary concern and scored risks based on probability and severity. The DOT did not finalize this assessment through May 2016. Existing bridge risk management practices were focused on operational-level risk and were not integrated by strategic risk planning or comprehensive asset-specific tactical plans. While bridge condition was evaluated through inspections, risk probabilities and associated costs were not estimated. The DOT did not have formal strategies or procedures for bridge risk management, although two asset management workgroups were responsible for developing them and the 2016 risk assessment draft created a methodology for quantifying risk Department-wide. Bridge project prioritization decisions were not informed by quantitative risk assessments, and some bridges were permitted to deteriorate pending replacement, rather than be preserved or rehabilitated, without formal analysis. Non-bridge work, such as building construction and reconstruction, was undertaken by the BOBM, but non-bridge structures had no associated risk in the 2016 draft assessment. The DOT made no clear connections between the Typical Cycle for recently constructed bridges and specific structures, and lacked tailored maintenance schedules for other bridge subgroups. While the BOBD administrator was responsible for the bridge inspection program, no single official was responsible for managing specific bridge-related risk decisions or risk assessments of BOBD and BOBM activities.

Recommendations:

We recommend DOT management:

- **institutionalize and formalize risk management practices at the strategic, tactical, and operational levels;**

- **cyclically identify risks, conduct and record risk assessments, develop and implement controls, and evaluate effectiveness; and**
- **develop policies and procedures for risk management activities.**

Agency Response:

We concur in part.

Risk management needs to be expanded at the Department, however we do not concur that bridge related risk assessment efforts were not formally identified as risk management strategies.

- *The Bridge Inspection Program is risk based, has been in place for decades and is certified by FHWA.*
- *Bridge scour critical points of actions were identified and addressed through a plan.*
- *The Transportation Security Administration and incident management task force of the New Hampshire Division of Homeland Security and Emergency Management have conducted risk assessments and prepared mitigation strategies for sensitive bridge assets.*
- *The Red List inspection frequency (two times per year instead of once every two years) is a mitigation strategy to monitor bridge condition driven by level of risk.*
- *The oversize and overweight permitting process is also a strategy to reduce the likelihood of damage to bridges from vehicles while balancing the needs of commerce.*

Everyday DOT personnel conduct risk management relating to maintenance and construction activities, design alternatives, and project prioritization. Without tools to model outcomes based on different levels of investment, attaining the best practice with respect to risk and lifecycle cost analysis is not possible. The financial risk of deferred investment and the degree to which lifecycle costs and service life are impacted by maintenance and preservation actions will be the areas of focus in the future. Without the needed tools it is challenging and costly to perform this type of analysis for every individual structure. Once BrM is deployed additional progress will be made, but in the interim the Department will continue to use inspection and inventory data to group bridges into categories (i.e., type, age, general condition, traffic volume, etc.) and advocate for funding to address each category. To complete a cost-benefit analysis for every structure and every repair strategy would be inefficient and costly. Instead professional engineering judgment and experience are used to review the available data which we feel is a prudent use of resources.

The Department does concur that risk management is an integral component to a comprehensive bridge management program and has worked to formalize the risk management process. Risk management is one of the newer components of asset management nationwide and will be included in the asset management plan. The Department concurs that a comprehensive asset management approach would improve documentation, repeatability, transparency and would consider network-wide risks, but analytical tools are needed to ensure that this activity is completed efficiently.

Recommendations

- A. *The DOT will formalize risk management practices through the asset management and implementation plans at the strategic level by June 30, 2017. The implementation plan will provide guidance for formalizing risk management at the tactical and operational levels.*
- B. *The asset management plan will include an update frequency and risks will be reviewed as part of that process. Performance metrics relating to the asset management plan and the implementation plan will provide insight into how the Department is performing regarding risk management.*
- C. *The asset management plan and the implementation plan will provide guidance for developing policies and procedures relating to risk management.*

LBA Rejoinder:

The DOT appears to fully concur with our recommendations.

Risk assessment and management is a long-standing element of adequate management control, and related practices should have pre-dated TAM implementation at the DOT. We found no formal, comprehensive bridge risk assessment or strategy. However, we acknowledged some DOT practices, primarily at the operational level, help mitigate risk. While these operational level activities likely contribute to tactical and strategic outcomes, they did not constitute a formal, comprehensive bridge risk management strategy. Notably, several key activities were externally imposed upon the DOT or were conducted by other agencies. Further, the DOT reported being unable to access federal Transportation Security Administration risk assessments because DOT personnel lacked necessary security clearances.

At no time was the risk of a maintenance and preservation activity articulated, formalized, quantified, and analyzed; nor were professional engineering judgments codified.

Bridge Performance Management

Performance-based decision-making is a core TAM principle. Performance management allows an organization to compare actual performance against stated goals and objectives, and analyze significant differences identifying where improvement may be necessary. Performance management can help an organization demonstrate responsiveness to customer needs, provide accountability, and ensure satisfactory levels of service. A mature performance management framework includes performance targets, monitors progress toward a result or goal, and provides quality data to aid decision-making. Binding performance measures to types of impacts promotes a direct connection between policy objectives and the results of investments intended to achieve those objectives. Output measures provide an immediate indication of an accomplishment for those activities, whereas outcomes are not immediately apparent and should be monitored over the long term. Measuring outcomes is preferable to measuring outputs to achieve results-oriented performance monitoring.

A balanced scorecard is a strategic planning and management system used to align business activities to an organization's vision, improve communications, and monitor performance. The DOT focused on its mission and strategic vision by categorizing the corresponding components into: 1) effective resource management, 2) performance, 3) employee development, and 4) customer satisfaction. The balanced scorecard process was incorporated into the DOT's TAM implementation efforts, but was minimally connected to bridge asset management. Without outcome-based performance measures to evaluate BOBM performance through reliable and repeatable processes, management had to rely substantially on judgment and experience to inform decision-making, risking ineffective and inefficient allocation and use of resources.

Observation No. 7

Establish Bridge Performance Management Standards

While the DOT reported bridge-related outputs using several reporting systems, it lacked uniform and comprehensive bridge performance management standards. Efficient and effective retrieval data to measure bridge performance was hindered by documentation practices and processes, and unintegrated information systems. DOT bridge performance management practices were at the initial stage of TAM maturity.

Performance Reporting

The DOT intermittently reported asset performance measures using the balanced scorecard, annually contributed to Tri-State Performance Measure reporting, and produced one federal Stewardship and Oversight Agreement performance indicators report. None contained direct maintenance- or preservation-related measurements which were essential to performance and cost analyses, decision-making processes, policy development, and resource allocation and optimization.

Balanced Scorecard

DOT balanced scorecards contained bridge-related asset performance metrics. However, bridge-specific asset performance reporting was limited to the number of bridges removed from and added to the Red List annually, as well as predicting changes in upcoming years with a consistent goal of decreasing the number to 140. The scorecard goal was met in CY 2012, but the number of red-listed bridges increased in each of the following years, and was predicted to continue increasing at least through CY 2026. The DOT also annually published a Red List progress chart, which depicted the same output. No other bridge-specific metrics related to efficiency or effectiveness were available to be incorporated into the balanced scorecard. Also, limiting tracking to red-listed bridges inherently focused on the legacy worst-first strategy, and was not preservation-focused as red-listed bridges reflected a failure to preserve.

Although the BOBD maintained the Red List and contracted most red-listed bridge rehabilitation and replacement projects, the BOBM contributed to the measure by removing some bridges from the Red List and preserving others. The first DOT balanced scorecard was created in 2011 and

was drafted annually until 2015. However, the 2013 version was never finalized nor issued, and as of June 2016, the 2015 version remained in draft form.

Tri-State Performance Measures Annual Report

Tri-State Performance Measures reports provided for quarterly and annual reporting on standard performance measures of asset condition, business processes, and safety by the three signatory states under a memorandum of understanding. Reported bridge performance outputs did not include the number of red-listed bridges, but instead included average bridge condition ratings and percent of structurally deficient bridge deck area within the national, state, and local highway systems. In the 2014 report, the states added the number of roadway bridges by bridge condition rating categorized using an AASHTO color scale and characterized by National Bridge Inventory (NBI) condition ratings as follows:

- green (NBI rating of 9 through 7),
- yellow (NBI rating of 6 and 5), and
- red (NBI rating of 4 through 0).

The annual Tri-State Performance Measures report was established in 2010 in recognition of increased national emphasis on transportation performance standards. CY 2015 performance measures were published in May 2016.

Federal Stewardship And Oversight Agreement

The federal Stewardship and Oversight Agreement documented DOT accountabilities and responsibilities for federal-aid projects, and required the DOT to annually provide information identifying whether action was needed when State performance data was moving away from desired targets or trends. Similar to the other performance reporting systems, the federal Stewardship and Oversight Agreement did not require, and the resulting report did not include, bridge-specific maintenance and preservation performance metrics. Instead, bridge performance measures were limited to BOBD outputs, including the percent the State's bridge inspection program complied with federal requirements and element-level inspections. BOBM efforts indirectly contributed to the targeted percent of structurally deficient State bridge deck area on the National Highway System, and the percent of structurally deficient State-owned bridges. The annual stewardship and oversight agreement performance indicators report was first published in December 2015.

Measurement System Gaps

While the DOT developed a Department-wide asset performance management framework focused on the DOT's mission, goals, and objectives using a balanced scorecard, the BOBM lacked a formal mission, goals, and objectives. Consequently, outcome-related measures vital to determining the efficiency and effectiveness of maintenance and preservation efforts, could not be developed and the DOT continued to report Red List-focused outputs to represent bridge performance. For example, the DOT's 2015 *State Bridge Red List Summary* incorporated

condition ratings similar to the AASHTO color scale, the number of red-listed bridges, and the percent of structurally deficient bridges on the National Highway System.

Since at least February 2011, the DOT identified deficiencies in its asset management performance and measurement. The *Implementation Plan* specified data analytics capabilities were to be established from October 2014 to September 2016, followed by enhanced performance-based planning and programming beginning in March 2015 and completed in February 2018. In April 2015, a Performance Measurement Workgroup charter was formalized to address asset performance management with membership including a representative from the BOBD, but not the BOBM. The Performance Measurement Workgroup's responsibilities included: collecting comprehensive performance measures, documenting and simplifying processes, establishing measurement frequencies, assigning responsibilities for collection and reporting, and adding, combining, or eliminating measures.

Performance Measurement Workgroup meetings and initiatives, including issuing a balanced scorecard for 2015, were postponed by senior DOT management shortly after the October 2015 meeting, while the DOT's asset management vision and strategies were realigned. Realignment was still underway as of June 2016. Further, improvements to the DOT's data analytics capabilities were reported to be limited to planning discussions, and the DOT had not made significant changes to data systems. The DOT continued to rely on an undocumented, manual process for retrieving reported bridge-related performance measures by knowledgeable personnel. Consequently, inconsistency and errors were more likely to occur. For example, the number of red-listed bridges reported in the 2011 and 2012 versions of the balanced scorecard, and published in January 2012 and February 2014 respectively, were not reflected by other DOT data and publicly-posted Red List progress charts for those years. Postponing asset management initiatives resulted in further deviation from the *Implementation Plan's* schedule and delayed establishing and implementing performance management standards and processes.

Without an asset performance management system standardizing and defining processes aligned with the DOT vision and strategies, it was more difficult for the DOT and its bridge bureaus to achieve greater effectiveness and accountability, increase organizational efficiency, or improve communication and business processes.

Recommendations:

We recommend DOT management:

- **establish an asset performance management system with standards and defined processes aligned with the DOT's vision and strategies;**
- **implement the system within the timeframe specified in the formal implementation schedule;**
- **define bridge performance measures, including maintenance and preservation;**
and
- **formalize processes to facilitate efficient and effective data retrieval and reporting.**

Agency Response:

We concur in part.

We offer the following clarifications.

The Department agrees that performance management is a critical component of asset management and the development of a comprehensive bridge management program. In recognition of the importance of performance metrics, the DOT was one of the first State agencies to implement a balanced scorecard. The scorecard, along with the other performance metrics identified in the findings, demonstrates that the agency understands the importance of performance management. We agree that improvements can be made and will establish guidance as part of the Implementation Plan.

It also should be noted that Red List focused performance measures are important to the agency and many stakeholders, including the Legislature. More sophisticated performance management will not eliminate such measures, but will instead refine the measure process and add measures that relate more specifically to Department performance and overall bridge health.

Recommendations

- A. The DOT will publish a strategic plan, portions of the TAM plan, and an implementation plan by June 30, 2017. The implementation plan will include milestones for performance management and reporting.*
- B. The implementation plan will include milestones and schedules which the DOT will strive to meet.*
- C. The implementation plan will include milestones for performance metric development and reporting.*
- D. The implementation plan will include timelines for implementation of new systems and data governance. Any changes to those systems that are required will take time and resources to complete.*

LBA Rejoinder:

The DOT appears to fully concur with our recommendations.

Observation No. 8

Evaluate Performance And Outcomes

While the DOT formally tracked three outputs related to bridge performance, and output tracking was relevant to evaluating outcomes and performance, it did not establish bridge-related levels of service and did not evaluate maintenance and preservation performance and outcomes. Performance and outcome evaluation was at the initial stage of TAM maturity.

While the March 2015 *Bridge Strategy* was created during the audit period, its influence was limited, as was its scope. The *Bridge Strategy* cited a maintenance and preservation objective of extending the life of *recently constructed bridges* to 120 years and beyond. Table 5 outlines the DOT-developed Typical Cycle needed to achieve a 120-year service life for recently constructed bridges.

Table 5

Typical Maintenance And Preservation, Rehabilitation, And Reconstruction Cycle For Recently Constructed Bridges, March 2015

Category	Effort	Schedule
Maintenance And Preservation	Wash and oil ¹	Annual ²
	Crack seal pavement	Once in ten years, starting at year five
	Replace pavement	Once in ten years, starting at year ten
	Replace membrane and expansion joints	Once in 20 years
	Paint exposed steel	Once in 20 years
Rehabilitation	Replace worn components ³	Once in 60 years
Reconstruction	Complete replacement	Once in 120 years

Notes:

¹ Oiling bridges is a legacy term; bridge concrete is now sealed.

² The target frequency for concrete sealing is once in five years, and washing remains annual.

³ Replacing components may occur earlier, on an as-needed basis.

Source: The *Bridge Strategy*.

While the *Bridge Strategy* conveyed a generalized intent to keep good bridges good, restore poor bridges, and replace others, no specific goals were set for other bridge subgroups in the inventory, nor were subgroup tailored typical cycles specified. No definite dates, framing which bridges were considered *recently constructed*, were included. Prior to the *Bridge Strategy*, maintenance and preservation was not a formal DOT goal, and the BOBM focused on removing bridges from the Red List and other tasks without clear connection to strategic outcomes. Additionally, the BOBM lacked a formal mission, goals, or objectives, as well as outcome-based performance measures, hindering measurement and monitoring of efficiency, effectiveness, and attainment of desired service levels.

While BOBM resource use was to be optimized, general BOBM practice was to track several outputs without corresponding goals, or further analysis. The BOBM was also to generate reports on repair activities and performance measures, and integrate its activities into management systems. However, with the exception of the statutorily-required Red List reported by the BOBD, there were no established BOBM reporting requirements or policies for maintenance and preservation performance.

Internally, the BOBM tracked three outputs formally, the number of bridges washed, sealed, and removed from the Red List, as well as informally tracked the number of bridge pavements crack-sealed and the number of joints and guardrails repaired and replaced. The Typical Cycle provided the BOBM a guide to begin implementing performance measures to meet targets for at least one subgroup of bridges. However, management acknowledged bridges had not received all recommended maintenance, and a clear connection between the Typical Cycle and any specific structure had yet to be made. Consequently, relying on outputs without connection to outcomes limited the ability to analyze performance. For example, some attempts were made to determine bridge condition deterioration rates through manual analysis. An accurate representation of the rates could not be validated due to the lack of performance measures, tracking, and documenting bridges not receiving recommended maintenance and preservation work, however.

Levels of service support both the customer levels of service and an organization's strategic objectives. They are classifications or standards describing the quality of service provided to users compared against measurable performance, such as number of complaints received, ride comfort over bridge joints, response time to incidents, and time to complete minor emergency repairs. The BOBM recorded complaints about bridges and follow-up actions taken, but it did not track related performance. The BOBM could not quantify or track metrics to evaluate the level of service it provided to its users without the appropriate performance measures established.

Recommendations:

We recommend DOT management:

- **develop maintenance and preservation outputs, outcomes, and performance measures;**
- **establish bridge levels of service and bridge condition performance standards;**
- **integrate performance measurement and evaluation throughout the organization;**
- **formalize internal reporting formats and processes; and**
- **routinely monitor, evaluate, and report on performance.**

We recommend BOBM management implement and regularly track typical maintenance and preservation, rehabilitation, and reconstruction cycles for all bridges, regardless of construction date, to maximize the State's investment and facilitate performance evaluation and monitoring.

Agency Response:

We concur.

We offer the following clarifications.

The Department concurs that the evaluation of performance and outcomes is essential to a comprehensive bridge management program. Recognizing the importance has led to the

development of various reports (see Observation No. 7) and systems like Managing Assets for Transportation Systems (MATS). The development of these systems shows the Department's dedication to overall performance management. As asset and performance management continue to evolve at the DOT so will the ability to monitor performance.

- As stated in the response to Observations No. 1 and No. 2, due to environmental factors and the life expectancy of bridges, it may not be possible to fully evaluate a strategy in the near term that is intended to extend the service life of bridges, as it takes many years to see the results or outcome. For this reason, the Department will continue to look for ways to extend bridge service life by monitoring levels of investment, type of preservation and/or repair, and overall health of the inventory. By expanding data collection and implementing BrM, the Department will be able to perform trending analysis and model outcomes by bridge categories.
- As previously stated, the intent of the Bridge Strategy is to emphasize the need to preserve all bridges, however it is unreasonable to assume the service life of "older" structures (constructed prior to 1995) will reach the 120 year expectancy if preservation strategies developed and implemented over the last few years were not in place when the bridge was placed into service.
- Bridge preservation was not a formalized goal prior to the Bridge Strategy being developed. TAM development across the country was in its infancy, and the final federal rule for TAM still has not been issued as of the issue date of this report. We have also shared that bridge preservation activities until recently were not a federally eligible expense until the bridge reached a particular level of deficiency. Going forward, through the Bridge Strategy we hope to identify investment opportunities that will maximize the life expectancy of structures and lead to future cost avoidance. However, the Department will use preservation strategies as a tool, but will not needlessly expend resources to meet the typical schedule if the work is not warranted.
- A subset of the BWG has been working toward integrating maintenance, preservation, and rehabilitation data for specific assets. The work was delayed until it could be determined how BrM could effectively accommodate this integration. The first module for this system is under development.
- The level of service provided by a bridge is determined by the level of mobility it provides to the user. Level of mobility is set by whether it can safely carry legal loads or not. Bridges that are load-posted or that have lane restrictions limit mobility and therefore have a reduced level of service for some of the users (e.g., heavy trucks). In many cases the majority of the users still enjoy a bridge at the highest level of service even if the bridge condition is identified as poor.

Recommendations

- A. The DOT will publish a strategic plan, portions of the overall asset management plan, and implementation plan by June 30, 2017. The implementation plan will include guidance for performance management.
- B. See above (A)
- C. See above (A)

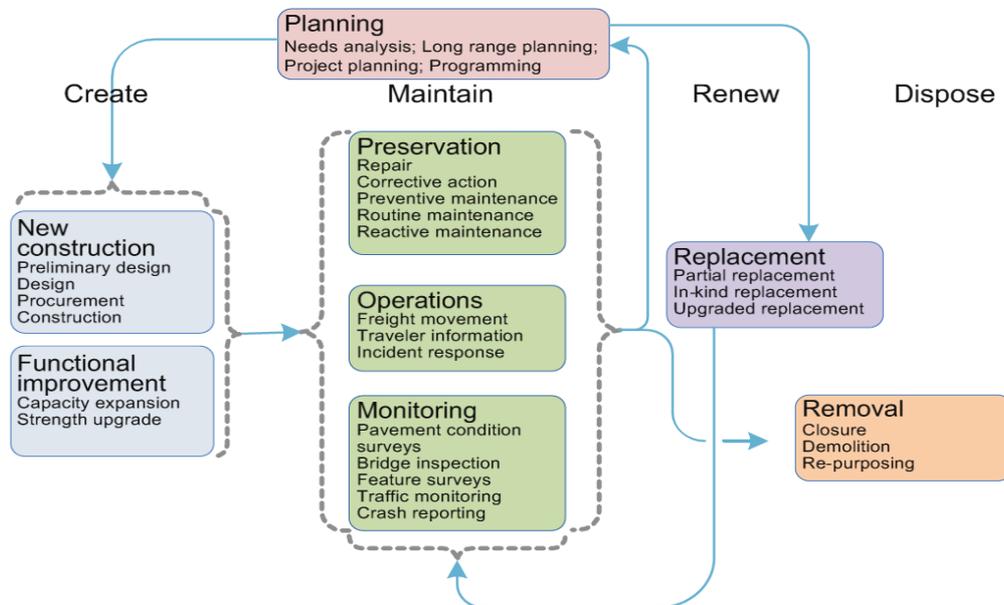
- D. After the implementation plan is finalized and performance metrics identified then the DOT will work to formalize and standardize reporting of the new measures.
- E. The DOT already routinely reports on performance through the various reports identified in the findings. The agency will continue to do so as new and enhanced performance metrics are identified.
- F. The DOT has been collecting maintenance data through MATS since 2007. The implementation plan will include recommendations and milestones relating to improved tracking of bridge work across the Department.

Lifecycle Management

Lifecycle management, including lifecycle strategies for all activities relating to an asset, should be part of a TAM plan and be the result of lifecycle analyses. Lifecycle cost analysis (LCCA) is an engineering economic analysis technique. Investment decisions should not only consider the initial cost of an asset, but also the costs of future activities, including maintenance and preservation, required to maintain functionality. Agencies should understand the economic viability of bridges and consider disinvestment of certain assets to obtain an effective mix of inventory investments. Lifecycle analyses can be used to inform decisions, making the most efficient use of remaining assets by reallocating limited resources to more cost-effective assets. Figure 3 illustrates a typical asset lifecycle model.

Figure 3

Typical Asset Lifecycle Model



Source: AASHTO, *Transportation Asset Management Guide: A Focus On Implementation, Executive Summary*, June 2013.

Observation No. 9

Improve Cost Projections And Conduct Lifecycle Cost Analyses

Although the DOT reported at times using informal methodologies to estimate costs, it did not regularly conduct bridge LCCAs; had limited cost estimating procedures, which were selectively applied; and did not appear to have a set methodology for calculating the backlogged cost of incomplete or deferred bridge repairs, replacements, and maintenance. The DOT's cost projection practices were at the initial stage of TAM maturity.

Lifecycle Cost Analysis

LCCA provides critical information to decision-makers. LCCA considers all costs incurred during the service life of an asset, from initial construction through salvage, and compares the relative merit of project design, construction, maintenance, repair, and rehabilitation or replacement alternatives. LCCA includes costs to the organization managing an asset, such as construction, regular maintenance, and rehabilitation costs, as well as the asset's users, such as costs of using detours, load or clearance restrictions, accidents, and construction delays.

Lifecycle costs are important mission performance indicators for planning preventative maintenance programs. LCCA models and deterioration data should be used routinely to plan future maintenance and preservation work, and refine deterioration models. Effective management of bridge assets requires understanding individual asset life expectancy. LCCA requires life expectancy estimates for design decision-making. Documenting LCCAs also demonstrates: 1) stewardship of assets and 2) transparent, efficient decision-making processes.

DOT personnel and management reported few quantitative LCCAs were completed, and those completed were components of large contracted projects. Other bridge project cost estimation analyses were limited. DOT personnel reported data uncertainties related to the long lifecycles of bridges, which limited accurate life expectancy projections for new bridges and measuring the lifecycle benefits of preservation work. User cost and benefit calculations for projects were limited to considerations of detour length and roadway traffic, were not synthesized quantitatively, and were inconsistently included in task prioritization efforts. Key maintenance, preservation, rehabilitation, and replacement decisions, including designating bridges as keep-in-service or wait-for-red-list as we discuss in Observation No. 10, were based on judgment and without quantitative LCCAs.

DOT personnel reported awareness of LCCA and expressed an interest in obtaining more accurate cost analyses. DOT personnel also reported researching LCCAs for maintenance, preservation, and various bridge construction methods, and applied that research in at least one instance. The BOBD projected the date a bridge would be red-listed by aggregating the deterioration rate of all State bridge inspection results, but this method was not considered definitive and did not appear to be relied upon for bridge maintenance prioritization.

Cost Estimates

A good cost accounting system is essential for estimating activity costs, and good cost estimates for construction, maintenance, preservation, and rehabilitation activities underpin LCCA. The cost incurred for each type of action performed on bridge elements, and the change in bridge element condition, should be recorded and used for future cost estimates.

Cost estimates for bridge projects were not produced regularly by the BOBM. When produced for a BPL project, BOBM cost estimates were based on prior experience, typical weekly costs per work crew and similar projects, and judgment. Not all BOBM costs were tracked in a manner attributable to an asset or task. We reviewed 54 bridge projects, and five (9.3 percent) completed projects had cost estimates. Based on unaudited DOT data, the actual cost for one project was within five percent of the estimated cost, while the other four ranged from 68 percent under to 119 percent over the estimated cost. In comparison, DOT balanced scorecards used a five percent margin of error to measure whether *contracted* construction projects were within expected costs and to evaluate DOT efficiency.

As we discuss in Observation No. 4, while using the BOBM to address red-listed bridges was purported to be “reasonable” and “cost-effective,” we found no objective measures to determine either for bridge projects and other tasks. No method existed to assess whether project selection decisions made economic sense and were cost-effective, nor were trade-off analyses evident.

Cost estimates were produced by the BOBD for BPL projects near project start dates, but the methodology likely limited the accuracy of these cost estimates. BOBD cost estimates were developed using selections of data from 42 sampled projects, with dates ranging from 2010 to 2015. These sampled projects were used to develop estimates for 14 different construction-type and tier combinations of projects, including four which were not included in the sample and five additional estimates based on the costs of one project each. From those estimates and other unidentified sources, rounded multipliers were created and then applied to BOBD cost and backlog estimates. Estimation methods did not appear to account for price changes in construction costs over time, and DOT personnel relied in part on draft recommended maintenance schedules to produce cost estimates.

Backlogged and expected ongoing costs were not estimated using a set procedure. At least two different sets of backlog estimate calculations existed. The DOT-reported backlog estimates using the differing methodologies ranged from \$256 million for all needed bridge maintenance work in 2012 to \$500 million for only repair work on bridges in poor condition in 2014. The annual projected cost to maintain State bridges were reported to increase from \$59 million to \$115 million during the same period. The DOT had Pontis bridge management software with the ability to produce backlog summary reports, but did not use Pontis for projections due to methodological concerns.

Recommendations:

We recommend DOT management:

- **collect comprehensive cost and condition data, including life expectancy, deterioration, and the effects of maintenance and preservation activities on bridge performance;**
- **estimate and incorporate bridge user benefits;**
- **revise, standardize, validate, and assess cost estimation practices for bridge maintenance and preservation projects;**
- **establish, validate, publish, and periodically assess a formal backlog calculation methodology, amending it as needed to ensure continued validity; and**
- **adopt LCCA for bridge maintenance and preservation project and treatment decision-making.**

Agency Response:

We concur.

We offer the following clarifications.

The Department is committed to asset management and the development of a comprehensive bridge management program of which project cost and lifecycle costs are essential. Estimating project costs for contracted projects is a routine procedure at the DOT though it would benefit from a higher level of consistency and more historic data. A similar yet simplified process will be adapted for the smaller-scale projects undertaken by BOBM as part of the broader TAM implementation.

Lifecycle Cost Analysis

As outlined in the response to Observation No. 6, without tools to model outcomes based on different levels of investment, attaining the best practice with respect to LCCA is not possible. The financial risk of deferred investment and the degree to which lifecycle costs and service life are impacted by maintenance and preservation actions will be the areas of focus in the future. Without additional tools it is challenging and costly to perform this type of analysis for every individual structure. Once BrM is deployed additional progress will be made, but in the interim the Department will continue to use inspection and inventory data to group bridges into categories (e.g., type, age, general condition, traffic volume) and advocate for funding to address each category. To complete a cost-benefit analysis for every structure and every repair strategy would be inefficient and costly. Instead, professional engineering judgment and experience are used to identify what level of preservation or repair is needed for bridges in each category.

Cost Estimates

- *There are multiple points during a project where costs may be estimated and later used to determine estimate accuracy. The balanced scorecard measure for contracted projects does not relate to the BOBM estimate performance because they are each from different points in the project development lifecycle. The contracted project measure is only from the contracted estimate amount (based on bids) to the completed amount. The BOBM estimate is from project inception.*
- *Any methodology for estimating cost will be imperfect. The approach vetted through the bridge working group utilized information from 42 projects, which is a substantial number as we are a small state. Estimating will be improved over time.*
- *Regarding the backlog estimating procedure, in 2012, the backlog was based on generalized assumptions concerning bridge age and reflecting a higher percentage of bridge rehabilitation versus bridge replacements. The methodology used in 2012 estimated solely bridge costs. In 2014, the backlog estimate was refined to include a more accurate estimation of bridge replacement versus bridge rehabilitation after a review of element level condition. The work performed to review the costs associated with 42 completed projects was used to estimate total project cost rather than the value of bridge work required. These two changes in methodology account for the significant increase in the value of the backlog. The higher more comprehensive value more accurately reflects the funding necessary to address condition and meet system needs.*
- *In 2012 the estimated value of maintenance investment needs was calculated based on the assumption that the BOBM would continue to maintain the same level of service. The higher projected need calculated in 2014 reflects the Department's desire to increase preventative maintenance and preservation work in accordance with the Bridge Strategy. Similar to the increase in backlog value, this estimate was also based on total project cost and not just estimated bridge work.*

Recommendations

- A. The DOT already collects extensive cost and condition data and will prepare a scope to improve alignment between cost and work completed by June 30, 2017. Deterioration of bridge elements and the effects of maintenance/preservation is an issue at the national level simply because of the timespans and number of variables involved. The DOT will continue to stay apprised of the national discussion and identify practices that can be implemented in New Hampshire. The Implementation Plan, completed by June 30, 2017, will also provide a roadmap for incorporating these activities.*
- B. The Implementation Plan and TAM plan, as part of the LCCA discussion, will include recommendations for estimating and incorporating user costs/benefits.*
- C. The DOT will develop and document a process to estimate costs for all BOBM and BOBD projects that takes into account the scale of the project by June 30, 2017. The process will include performance measures for BOBM estimating.*

- D. The DOT will review and formalize the process used to develop an estimated backlog of Red List bridges as part of the Ten Year Transportation Improvement Plan, 2017-2026 by June 30, 2017.
- E. The DOT will publish a strategic plan, portions of the overall asset management plan, and implementation plan by June 30, 2017. The asset management and implementation plans will include guidance and roadmaps for integrating LCCA into decision-making.

LBA Comment:

Estimates for needed or known, pending work efforts should include all maintenance and preservation backlog and not just Red List bridge backlog. A Red List bridge backlog is inherently not a maintenance backlog, but rather a future reconstruction demand which reflects a worst-first approach.

Disinvestment Decisions

Maintenance demand exceeding available resources requires critical examination and efficient use of assets, and includes investment and disinvestment decisions. Disinvestment is a conscious choice to accept lower asset performance or focus limited resources on alternate assets instead of underinvesting inventory-wide. Bridges may be decommissioned when functionally redundant and no longer cost-effective to retain. Increasing influences of user demand, aging transportation infrastructure, fiscal constraints, and environmental factors emphasize the need for organizations to consider disinvestment of no longer cost-effective assets to facilitate better investment decisions. Decommissioning redundant bridges was an unimplemented element of the *Bridge Strategy*, while the DOT engaged in other informal disinvestment practices.

Observation No. 10

Formalize Disinvestment Decision Processes

Although the DOT reported at times using informal methodologies to quantify disinvestment decisions, the DOT lacked formal policies and procedures for deciding whether a State-owned bridge should be maintained and preserved, or allowed to deteriorate prior to major rehabilitation or replacement. DOT decision-making procedures, processes, and practices for bridge disinvestment were at the initial stage of TAM maturity.

The DOT employed disinvestment-related practices and designated bridges as wait-for-red-list and keep-in-service to prevent wasting maintenance and preservation efforts on bridges that could not be preserved and needed replacement or reconstruction. These designations may have aided DOT efficiency; however, no supporting quantitative analysis was conducted, nor were the designations identified within the March 2015 *Bridge Strategy*. Conversely, redundant bridge identification was an element of the *Bridge Strategy*, intending to increase efficiency and effectiveness, but the DOT did not formally implement identification of redundant bridges

during the audit period. No formal procedures and practices existed for any of these designations, and they were not guided by quantitative lifecycle or economic analyses.

Wait-For-Red-List

The CY 2016 annual repair task list contained 13 bridges (0.6 percent of all bridges) designated wait-for-red-list, including a culvert with NBI rating of 6, or satisfactory. The other 12 bridges had minimum NBI ratings of 5, or fair, and accounted for 4.0 percent of the 298 bridges with similar minimum ratings in CY 2015. No wait-for-red-list bridges were on the CY 2015 BPL. DOT personnel reported this designation was assigned when the BOBM Administrator, with input from other BOBM personnel, determined a bridge had deteriorated past the point of effective preservation. The DOT reported this designation was intended to alert BOBD personnel, who might then be more likely to consider a wait-for-red-list designated bridge for contract rehabilitation or replacement. This designation also informed BOBM crews that repairs to a wait-for-red-list bridge might not be critical and their efforts may be more effectively expended on other bridges, and allowed the DOT to start the permitting process in anticipation of a future project. Once a bridge was red-listed, DOT personnel reported it was more likely to receive maintenance attention. The CY 2016 annual repair task list identified various tasks for the wait-for-red-list bridges, including needing no pressing work, requiring minor repairs, or requiring major replacement projects.

Keep-In-Service

DOT personnel reported designating a bridge as keep-in-service indicated the BOBM should maintain the bridge in a safe and operable condition, without any major rehabilitation or repair work being undertaken until upcoming, planned contract or BOBM replacement or major rehabilitation work occurred years into the future. BOBM annual repair task lists included 26 keep-in-service bridges in CY 2014 (1.2 percent of all bridges), 30 in CY 2015 (1.4 percent of all bridges), and 36 in CY 2016 (1.7 percent of all bridges). Keep-in-service bridge conditions ranged from bridges with two elements with NBI ratings of 3, or serious, to bridges with minimum NBI ratings of 7, or good. At least four keep-in-service bridges on the CY 2015 annual repair task list did not appear scheduled for upcoming contract or BOBM work on the *Ten Year Transportation Improvement Plan, 2015-2024*, compromising the reported purpose of the designation. Designating a bridge as keep-in-service before replacement or major rehabilitation work was definitively scheduled, and discontinuing normal maintenance and preservation as a result of the designation, could result in work needed to maximize the service life of the bridge not being completed.

Redundant And Former Bridges

The *Bridge Strategy* indicated continued investment in certain bridges should be evaluated, as newly constructed roads and bridges may render older structures unnecessary, or redundant. Resources expended on potentially redundant bridges reduced available hours and funding for more critical bridge work. However, bypassed historic structures and other potentially redundant bridges were treated inconsistently, and while the DOT reported one contracted assessment of three specific bridges examined potential redundancy, no additional quantitative redundancy

analyses were apparent or reported. Informal DOT practices identified, and disinvested in, certain redundant bridges without formal designation, as DOT personnel reported the Department hesitated to publically declare bridges redundant. Redundant bridges did not appear to be identified or evaluated in a systematic or timely manner.

Under DOT practice, closed former bridge structures remained in the inventory and received ongoing inspections. The September 2015 draft *Bridge Inspection Manual* indicated a bridge could be removed from the Red List and be black-listed after being closed for two years. The FHWA reported closed bridges were generally removed from the federal bridge inventory five years after closure, unless there were special circumstances, such as active work to return the structure to highway service. However, in practice, former bridge structures could remain in the DOT bridge inventory indefinitely. We found at least 57 non-bridge structures in CY 2014 bridge inventory data, including the 23 DOT black-listed structures. Several structures had been closed for decades. Some continued to consume inspection and maintenance resources.

The DOT reported 15 structures were under agreements to keep them in place. Of the 15 structures, 11 were no longer bridges, had been closed to public highway traffic for more than five years, were still in the bridge inventory, and received routine inspections, including one structure which was disassembled and placed on the ground adjacent to the road it formerly carried. Another had an average daily traffic count of one vehicle. Four structures were listed on BPLs and had project estimates totaling nearly \$42 million. The DOT provided documentation on 12 structures, five of which were formal agreements, covering three structures and two bridges. They provided for ongoing maintenance and inspections, three indefinitely. None of the agreements were signed by DOT commissioners, approved through legislative processes or Governor and Council, or supported by LCCAs or benefit-cost analyses. DOT management recognized retaining ownership of redundant or closed bridges was not always the optimal allocation of resources, but they were bound by external factors, such as permitting authorities, to retain them and expend resources. The 11 former bridge structures were likely suited for disinvestment and removal from the bridge inventory.

Recommendations:

We recommend DOT management:

- **formalize disinvestment strategies;**
- **formalize procedures, practices, and definitions regulating disinvestment decisions, including wait-for-red-list and keep-in-service designations;**
- **consistently make and maintain records detailing disinvestment-related decisions; and**
- **implement a systemic, timely, consistent method for evaluating bridges for disinvestment and allocate resources accordingly.**

We also recommend the DOT discontinue entering into agreements obligating the State to future expenditures without LCCAs to inform all decision-makers of projects' full costs.

Agency Response:

We concur in part.

The Department agrees that formal documentation of processes regarding investment decisions will improve transparency. A comprehensive bridge management program will include criteria that will identify which bridges should be rehabilitated, kept in service, preserved, or none of the above. Such decisions though are not strictly data-driven and also need to weigh feedback from the public, elected officials, and our partners charged with the preservation of historic structures. An overall framework that includes the data and feedback from stakeholders will be formalized.

The Department does not concur that decisions about internal planning designations were made without supporting economic consideration. We further do not concur with the insinuation that such designations compromised the reporting purpose.

Keep-In-Service

- *The term “keep-in-service” is an internal planning designation to designate bridges in the BOBM schedule that were currently planned or should be included in a future Capital Budget program, as well as designated in the BPL to identify bridges that should be monitored to ensure public safety is not compromised.*
- *Of the four projects listed as not included in the Ten Year Transportation Improvement Plan, 2015-2024:*
 - *Two indicated that BOBM had requested they be included in the Bridge Rehabilitation, Painting, Preservation, and Improvement program which is in the TYP (but does not have specific assets listed).*
 - *One was a bridge red-listed due to weight posting. There was no work planned for this bridge; however, a bridge with a reduced load posting, even in good condition, is more susceptible to damage and this designation highlights the need to pay closer attention to the bridge. This is a risk management strategy.*
 - *One requested that the work be added to a Capital Budget paving program. The paving program was not able to incorporate the work, so BOBM made repairs prior to the paving project.*
- *We strongly disagree that the four instances outlined above “compromised” the reported purpose of the designation.*

Redundant and Former Bridges

- *The Department believes that there are bridges owned by the State that are no longer needed for the State transportation network and a reasonable alternative crossing is available. These bridges should be considered redundant and given funding limitations leading to future closure, removal, or assumption of responsibilities by another entity such as a municipality.*

- *The Department has experienced substantial pressure from the public and Legislators whenever this has been discussed. Given the lack of support, the Department has not conducted a thorough analysis of the transportation network to identify all bridges that could be considered redundant. If supported by the Legislature, the Department would complete this analysis and prepare a more formal plan for these bridges.*
- *Closed bridges that are owned by the State still pose a risk until such time as they are physically removed. As such, inspections are required, as is maintenance, to prevent collapse or danger to the public. Bridges that are closed to vehicular traffic, but still carry utilities, span public rights-of-way or are used for bicycle and pedestrian use, still need to be kept safe.*
- *We also believe FHWA, the State Historic Preservation Office and other stakeholders will strongly oppose a policy that would discontinue entering into agreements obligating the State to future expenditures relating to historic structures. The DOT would be willing to consider that approach in many circumstances, however if a bridge is considered historically significant then FHWA and State Historic Preservation Office oversight is anticipated.*
- *Bridge commitments made as part of the federal review process are signed by the Director of Project Development, who is responsible for project delivery. These were typically commitments made relative to mitigation measures required under the federal design process and integral to the permitting and approvals necessary to the delivery of the bridge project.*

Recommendations

- A. The DOT will formalize disinvestment strategies. The implementation plan will provide guidance on timeframes.*
- B. The DOT will formalize procedures and practices for determining designation as “wait-for-red-list” or designation as “keep-in-service” by March 31, 2017.*
- C. The DOT will document any decisions regarding investment or disinvestment in bridges as supplemental documents with enhanced commentary to document the changes to the TYP, BPL, and work plan.*
- D. Many of the investment decisions are already part of the processes outlined in C above. The DOT will enhance the evaluation of bridge investment with the development of a comprehensive bridge management program that will be guided through the implementation plan.*
- E. Most projects constructed by the Department require permits from State and federal permitting agencies. A majority of the permits require some additional expense in the form of mitigation measures during construction and/or a commitment to future maintenance. The Department recognizes the risk and liability of long term commitments and will perform LCCAs to better understand and communicate the true cost of the mitigation measure.*

LBA Rejoinder:

The DOT-reported purpose of wait-for-red-list and keep-in-service designations was to prevent expending routine maintenance and preservation resources on bridges scheduled

for future rehabilitation or replacement. The DOT's response, however, did not clearly justify using such designations when structures were *not* scheduled for rehabilitation or replacement. Funding for work on three of the bridges the DOT discussed was apparently not obtained as planned, and the keep-in-service designation may have resulted in missed opportunities to preserve or extend the life of these structures. The fourth bridge was emblematic of the DOT using the keep-in-service designation to guide inspection practices, rather than maintenance work, and its use as a guide for inspections was not formalized.

Additionally, the DOT lacked documented processes and economic analyses for disinvestment, and professional engineering judgment was not codified in this area – no signed, dated, and stamped products related to these aspects of bridge management were produced. TAM requires a formal, fact-based, documented, reproducible, and systematic approach to managing assets.

Maintenance, Preservation, Rehabilitation, And Reconstruction

Bridges require a thorough maintenance and preservation strategy. Each bridge should have a recommended maintenance and preservation schedule that, when followed, maximizes the structure's performance. To maximize return on State infrastructure investments, the *Bridge Strategy* sought to extend recently constructed bridge service life up to 120 years. The strategy relied upon maintenance and preservation to reduce the frequency of higher-cost reconstruction and replacement. Preservation included routine maintenance tasks, repair, and limited replacement of bridge components to preserve, rather than improve, structural integrity or expand facility capacity.

Rehabilitation is restoring a structure or element to designed functionality, improving condition and extending service life, without replacing the whole structure. Rehabilitation is moderate in cost, and time consuming. Rehabilitation can be part of a preservation strategy. Replacing elements also occurs as a maintenance function and is expected, as some elements have shorter life expectancies than the overall bridge structure. Bridge replacement, or reconstruction, is an economic function: the structure may no longer be economically repairable or may no longer serve the current demand and requires replacement, perhaps even though service life remains. Bridge replacement results in a new structure of similar function to the original. It is also high-cost and time-consuming. Bridge element replacement can be part of a preservation strategy, but replacing an entire structure is not, although both are inevitable for most bridges.

On a force account basis, the BOBM undertook routine preservation activities, including washing, sealing, painting, deck maintenance, joint maintenance and replacement, scour protection, and bearing maintenance and replacement. Other preservation work was conducted by contract after design and specification work was completed by the BOBD or contracted consultants. The DOT reported many existing bridges did not receive recommended maintenance through 2014, and may require rehabilitation and reconstruction earlier than projected.

Observation No. 11

Improve Resource Allocation Effectiveness

While having the BOBM undertake some amount of non-bridge work was likely necessary, the DOT used funds appropriated for bridge maintenance for non-bridge purposes and undertook construction activities which specifically were the responsibility of another department. DOT bridge maintenance and preservation management controls did not ensure allocated resources optimized the condition of the 2,160 bridges reported in the DOT inventory. Effective bridge maintenance and preservation resource allocation was at the initial stage of TAM maturity.

Statute required appropriations be used only for the appropriated purpose. Department compliance with law is a fundamental expectation and aids agencies in achieving their objectives. The BOBM was appropriated nearly \$14.9 million for bridge maintenance during the audit period. Unaudited DOT data demonstrated the total amount expended on BOBM non-bridge work projects was \$429,264 during the same period. Of these non-bridge project expenditures, \$338,926 (79.0 percent) were reported by the DOT to be bridge maintenance appropriations, or 2.2 percent of all bridge maintenance appropriations.

DOT officials reported the BOBM performed non-bridge work when their skill sets were suitable for other DOT projects. Bridge maintenance crews reported conducting non-bridge work between other projects, when weather conditions limited bridge work, or when directed. Non-bridge tasks were requested by other components of the DOT, directed by DOT management, or self-assigned. Each non-bridge maintenance task consumed some of the finite personnel hours and appropriated funds provided for bridge maintenance.

Some non-bridge projects, including work on buildings, trailers, and small, non-bridge, culverts, were assigned higher priority than bridge maintenance projects on annual repair task lists. Non-bridge projects were ranked as the first priority in two instances, second priority in one instance, third priority in one instance, and fifth priority in one instance on annual repair task lists. On average, crews had 34 prioritized tasks per year during CY 2014 and CY 2015. Of the numerically-ranked priority tasks, 13 of 113 (11.5 percent) were categorized by the BOBM as non-bridge work in CY 2014 and two of 104 (1.9 percent) as non-bridge work in CY 2015. Of those scheduled for completion within the calendar year, but not assigned a numerically-ranked priority, one of 21 (4.8 percent) was identified as non-bridge work in CY 2014 and 26 of 58 (44.8 percent) were identified as non-bridge work in CY 2015. In some instances, categorization in these unaudited BOBM data was inconsistent, but the data were sufficient to indicate a routine practice.

Building Construction

The DOT lacked statutory authority to undertake building construction, reconstruction, alteration, and maintenance. Statutory authority related to buildings belonged to the Department of Administrative Services (DAS). Agencies cannot exercise authority delegated to another department.

We selected 12 non-bridge projects for file review. Unaudited DOT data related to these projects demonstrated at least \$208,627 in bridge maintenance appropriations were expended, including the costs of 4,937.5 hours of work logged, for building projects in SFYs 2014 and 2015. Bridge maintenance funds constituted 92.8 percent of the \$224,922 in charges to non-bridge work projects during SFYs 2014 and 2015 that we reviewed, and were \$489,258 of \$546,238 (89.6 percent) in total costs of these non-bridge projects. The non-bridge projects we reviewed included:

- Constructing a building addition with \$129,822 in bridge maintenance appropriations expended, including the costs of 2,997.0 hours of BOBM labor logged, by two different crews during SFYs 2014 and 2015. All charges during this timeframe were against bridge maintenance funds. The total project cost was \$171,423, with \$155,337 (90.6 percent) charged to bridge maintenance appropriations. A total of 3,816.5 hours of BOBM labor were logged.
- Building construction and septic system installation with \$26,728 in bridge maintenance appropriations expended, including the costs of 774 hours of BOBM labor logged, during SFYs 2014 and 2015. The total project cost was \$191,251, with \$180,170 (94.2 percent) charged to bridge maintenance appropriations. A total of 4,360.5 hours of BOBM labor were logged.
- Altering a crew shed at a cost of \$41,328 charged to bridge maintenance appropriations, including the costs of 1,036.5 hours of BOBM labor logged, during SFYs 2014 and 2015. The total cost of these improvements was \$55,503, with \$43,703 (78.7 percent) charged to bridge maintenance appropriations. A total of 1,076.5 hours of BOBM crew labor time were logged.
- Constructing a storage building with \$5,684 charged to bridge maintenance appropriations, including the costs of 130 hours of BOBM labor logged, during SFYs 2014 and 2015. The recorded costs of this project totaled \$116,425, with \$105,577 (90.7 percent) charged to bridge maintenance appropriations. A total of 2,923.5 hours of BOBM crew labor were logged.
- Repairing a building, with \$5,065 charged to bridge maintenance appropriations during SFYs 2014 and 2015. The total project cost was \$11,636, with \$5,101 (43.8 percent) charged to bridge maintenance appropriations. A total of 117 hours of BOBM labor were logged.

In addition to building projects included in our file review, unaudited DOT records included additional building projects, such as constructing a warehouse, installing a crew shed electrical system, installing yard fencing, and building a septic system. These projects cost \$86,351 during the audit period. We did not determine the labor committed or costs to bridge maintenance appropriations of the projects outside of our file review sample.

Bureau Of Highway Maintenance Tasks

The BOBM completed various tasks for the Bureau of Highway Maintenance, with costs partially charged to BOBM bridge maintenance funds. According to unaudited DOT data and BOBM personnel, non-bridge work included small culvert maintenance and repair, curb construction, flagging at worksites, and other tasks.

Additionally, \$48,964 was charged to bridge maintenance appropriations, and 1,621 hours of BOBM labor were logged, for modifying fueling stations to comply with environmental regulations during SFYs 2014 and 2015. The total cost of this project was \$350,843 during these two years and \$817,910 in total, of which \$145,557 (17.8 percent) was charged to bridge maintenance appropriations. The DOT reported requesting funds for a contract project, but had to complete the project with in-house resources.

Bureau Of Turnpikes Tasks

One BOBM crew was primarily responsible for bridge maintenance on the Turnpike System. The DOT reported certain costs for this crew were charged to the Bureau of Turnpikes. Projects were generated by both the Bureau of Turnpikes and the BOBM, resulting in additional types of non-bridge projects being added to the annual repair task list, including:

- toll booth modifications;
- concrete pads, foundations, and floors;
- hazmat storage buildings; and
- a brick barbeque pit in a park.

Concurrent with work on non-bridge projects funded, in part, by bridge maintenance appropriations and conducted with personnel hours allocated to bridge maintenance:

- the DOT reported in SFY 2014 bridge maintenance, preservation, rehabilitation, and replacement efforts were funded at \$53.6 million annually, but required approximately \$115 million annually and had a backlog of deferred effort valued over \$500 million;
- the number of red-listed bridges increased from 147 (6.8 percent) as of CY 2013 to 154 (7.1 percent) as of CY 2015, and was expected to continue to increase;
- the BOBM increased its use of keep-in-service designations, and began designating bridges as wait-for-red-list, both designations resulting in the discontinuance of routine maintenance and preservation treatments;
- the number of bridges rated yellow increased from 793 (36.8 percent) as of CY 2013 to 820 (38.0 percent) as of CY 2015; and
- the number of bridges rated green decreased from 1,206 (56.0 percent) as of CY 2013 to 1,174 (54.4 percent) as of CY 2015.

Additionally, targets for routine preservation work, which can extend bridge service life, were not met, including:

- 707 (32.7 percent) bridges were washed in CY 2014 and 1,454 (67.3 percent) in CY 2015, demonstrating the BOBM missed its target of washing each bridge annually;
- a sample of 25 bridges showed nine bridges (36.0 percent) had been washed twice, two bridges (8.0 percent) had been washed once, and four bridges (16.0 percent) had been washed annually since the start of CY 2011, although several non-bridge culverts were washed during this time; and

- one crew reported it was busy with fuel station upgrades, and did not complete scheduled bridge joint repair work before ongoing paving projects went forward and sealed in the defective joint.

Finally, bridge projects remained pending from one year to another. Of the bridges numerically-ranked as a priority or identified with a year-based priority on the CY 2014 annual repair task list, 69.9 percent appeared again on the CY 2015 annual repair task list. Of bridges numerically-ranked as the fifth or higher priority on the CY 2014 annual repair task list, six bridges, including one red-listed bridge, were assigned a lower priority on the CY 2015 annual repair task list, and non-bridge projects were given higher priority.

Recommendations:

We recommend DOT management improve the effectiveness of its bridge maintenance and preservation management controls. The DOT should conform to statute by:

- **discontinuing non-bridge work using BOBM assets and funds appropriated for bridge maintenance; and**
- **referring building construction, reconstruction, alteration, and maintenance to the DAS.**

Agency Response:

We concur in part.

We agree controls can be improved to optimize resources and the Department shall continue to improve the effectiveness of its bridge maintenance and preservation management controls. The following goals will help us achieve these results:

- 1. Improve the reporting of project work for BOBM employees to better capture work that is related to a specific bridge or project.*
- 2. Improve efficiency of building and equipment operations, maintenance and clean-up.*
- 3. Reduce the amount of yard work to maximize the amount of production without sacrificing our buildings, equipment and materials.*

The Department does not concur that the DOT lacked authority to undertake maintenance activities on BOBM support facilities, or that non-bridge work undermined the BOBM's or Department's effectiveness.

The Department believes that to be most effective our bureaus need to focus on their individual missions, but that they also need to contribute to the overall Department mission of transportation excellence. This is precisely why it may be most effective and efficient for bridge maintenance to do some non-bridge work, such as responding to concrete and steel damage when a toll booth is hit by a tractor trailer truck. The Department strives to use the resources and skills available to most effectively address necessary work.

The Department owns over 500 buildings and sheds with a 2015 value estimated to exceed \$96,000,000. Per RSA 228:1 the definition of a “Project” does not include the, “facilities formerly administered through the department of transportation, division of public works, or matters managed by the department of administrative services, division of public works design and construction.” The DAS Bureau of General Services is assigned three DOT buildings: the Morton Building, the Materials and Research building, and the highway garage located on Smokey Bear Drive. The remaining buildings have always been maintained by highway employees, not public works employees and continue to be assigned to DOT for their maintenance responsibilities. We concur with LBA’s determination that construction of new buildings and rehabilitation of facilities should be completed by the DAS, but do not concur that routine repair and maintenance is statutorily restricted.

The BOBM is assigned 37 of these buildings with an estimated value exceeding \$2,400,000. The BOBM budget includes work classes which directly support building maintenance including class 47 “own forces- maintenance buildings and grounds”.

General Comments

- The Department does not agree that all BOBM expenditures for non-bridge work are in non-compliance of the law. During the budget process, the Department identifies funding required in various class lines to pay for various expenditures and communicates with and receives approval from the Legislature. For example, since class 47 (own forces – maintenance buildings and grounds) is budgeted to be used to acquire materials for use on BOBM buildings and grounds, it is assumed that payroll costs would be incurred with the associated work. The \$429,264 non-bridge work includes approximately \$338,926 from BOBM accounting unit 3008 (BOBM) expenditures, it also included expenditures from the following accounting units: 2073 Land and Buildings, 2931 Railroad, 2991 Reimbursable Maintenance and Repair, 3039 Betterment, 3048 Asset maintenance and Critical Repair, 5034 Lift bridge operations, 7025 Turnpike Renewal-Replacement and 7027 Turnpike Central maintenance. The Department strives to charge expenditures to the appropriate classes, but the payroll expenditures are restricted to the individual bureaus and are not cross billed with the exception of billing for Turnpike work, which is paid under a separate fund.*
- The Department agrees that running an efficient BOBM includes maximizing the amount of bridge production work; however, we also know that we must proactively maintain our buildings and equipment. We plan and complete equipment and building work only when necessary and only when it has the minimum impact on bridge production work. For example, in the winter bridge work, which requires lane or traffic restriction or specialized heating procedures, is discontinued, and BOBM forces may be assigned to other non-bridge tasks.*
- The Department disagrees when the audit states “Non-bridge projects were ranked as the first priority in two instances, second priority in one instance, third priority in one instance, and fifth priority in one instance on annual repair task lists.” The schedule is developed at the start of the calendar year with the numbered items being work we plan to accomplish in the year, work anticipated to be completed in*

subsequent years so design and permitting can be anticipated and begun, and work titled “when time permits” which is needed work but of lower priority. Some non-bridge tasks were scheduled in January because they were best suited for winter, when some bridge work is less efficient to complete, not because they were higher priority.

Building Construction

The audit asserts that during the audit period the BOBM spent 2.2 percent of their resources on non-bridge work. A portion of this 2.2 percent non-bridge work was spent on building construction, reconstruction, alteration, and maintenance. The Department agrees that unlike the Department of Resources and Economic Development, Fish and Game Department and the Adjutant General, the DOT does not currently have a specific exemption to complete building projects clearly identified in RSA 21-I. The Department will seek a similar exemption in the future. This will ensure that there is alignment between the authority granted in RSA 228:1 and RSA 21-I:78 through 21-I:80 to ensure consistency and clarity between the statutes.

Bureau of Turnpikes Tasks

The BOBM does work on toll booths as an emergency response when accidents occur and when minor concrete and steel repairs need to be made. The BOBM has not constructed any brick barbecue pits in a park. The Bureau of Turnpikes is responsible for Hilton Park in Dover. While a barbecue pit was on the BOBM work plan, the work was never performed.

In summary the average small bridge replacement project cost is approximately \$500,000 to \$900,000; therefore the expenditure of funds for non-bridge work such as fuel tank upgrades and BOBM building maintenance at approximately \$339,000 did not have a significant impact on the overall condition of the bridge inventory.

Recommendations

- A. The Department does not concur that “discontinuing non-bridge work using BOBM assets and funds appropriated for bridge maintenance” in the context presented in this observation will improve the effectiveness of the BOBM, the DOT, or the State of New Hampshire. The Department does concur that these activities should continue to be tracked and that we need to be sure that they support the Bureau, the Department and the State.*
- B. The Department agrees that to be compliant with statute when constructing a new building or undertaking a significant reconstruction, the DOT must defer to the DAS for competitive bid. The Department agrees that unlike Department of Resources and Economic Development, Fish and Game Department and the Adjutant General, the DOT does not currently have a specific exemption to complete building projects clearly identified in RSA 21-I. The Department will seek a similar exemption in the future. This will ensure that there is alignment between the authority granted in RSA*

228:1 and RSA 21-I:78 through 21-I:80 to ensure consistency and clarity between the statutes.

The Department will seek legislative authority similar to that enjoyed by the Fish and Game Department, the Adjutant General's Department, and the Department of Resources and Economic Development. The DAS has indicated they would support this type of amendment.

LBA Rejoinder:

We question the DOT's continued use of bridge maintenance funds for non-bridge work. This issue may be of particular interest to the Legislature and its oversight of bridge maintenance fund expenditures. In 2005, the Legislature transferred from the DOT, to the DAS, responsibility for the construction, reconstruction, alteration, or maintenance of any building, plant, fixture, or facility. The DAS was also assigned specific authority for developing and maintaining State-owned and State-supported land and buildings, including force account public works, design, and construction. The DOT was explicitly left with authority to construct, reconstruct, alter, and maintain highways, bridges, and other items directly related to transportation. The definition of a DOT project was also statutorily established to specifically exclude the construction, reconstruction, alteration, or maintenance of buildings, plants, fixtures, or facilities or other matters managed by the DAS.

The purpose of Class 47 own forces maintenance appropriations was not defined in detail for the budget in effect during the audit period. During the audit period, for the subsequent biennium, Class 47 was defined as grounds and building maintenance, including the cost of supplies for completing DAS-recommended repairs to buildings and grounds, and the cost of contracted maintenance projects procured by the DAS. During the audit period, BOBM Class 47 was appropriated \$10,000, of which \$8,781 (87.8 percent) was reported expended. However, DOT data from our sampled projects indicated at least \$208,627 was actually spent during the audit period on non-bridge work, including new construction and major reconstruction projects. Further, the DOT reported a total non-bridge work expenditure of \$338,926 in bridge maintenance funds, while also reporting a growing backlog of bridge work.

The value of the DOT's real property is immaterial to its statutory authority. We do not suggest the State abdicate responsibility for any structure. We recommend the appropriate agency carry out its statutorily-assigned duties. BOBM activities appeared to be well outside the scope of own forces maintenance and was not the critical work on the State's bridge infrastructure the BOBM was created to undertake. Further, new construction projects were outside the Capital Budget program and created an indeterminate future liability for maintenance, repair, and reconstruction. As we discuss elsewhere, LCCAs were not completed and the DOT lacked a cross-asset prioritization process. Other mechanisms existed for conducting non-bridge work, mechanisms which could have allowed BOBM bridge maintenance crews to focus on their primary purpose. Each hour of BOBM crew time diverted to non-bridge tasks compromised bridge maintenance efforts. Reimbursement from non-bridge funds may achieve compliance with statutes governing

appropriations, but effectiveness was compromised by the diversion of skilled bridge maintainer time to non-bridge tasks.

The rationale for doing non-bridge work in January rather than September may be sound, but it does not justify conducting non-bridge work with bridge maintenance assets and funds. Bridge work also occurred during winter months, indicating not all winter bridge work was impractical, and the DOT reported it had more bridge work projects than could be completed in a given year. Additionally, the annual repair task list was not a schedule. Dates for conducting work on projects were not included or specified beyond a recommended calendar year.

The DOT cannot definitively state the audit period expenditure of \$338,926 in BOBM bridge maintenance funds on non-bridge work did not have a significant impact on the overall condition of the bridge inventory. As we discuss in Observation No. 9, the DOT lacked adequate cost estimation data and analysis to accurately estimate the cost of preservation activities. Time and resources spent on non-bridge work, including new construction and upgrades to buildings, could have instead been used to complete bridge preservation and maintenance work statewide and reduce the growth in backlog. The amount mis-spent could have translated into over 940 additional bridges washed.

Project Management

Project management applies knowledge, skills, tools, and techniques to project activities to meet requirements. Project management is vital to achieving quality results on time and within budget, in reducing risk, and for continuous improvement in efficiency and effectiveness. Statute defined a DOT project as any construction, reconstruction, alteration, or maintenance of any highway, bridge, or other item directly related to transportation. Statute, federal rules, and DOT design standards, specifications, process, and procedures established requirements encompassing plans, designs, specifications, supervision, quality, inspections, monitoring, and audits. Most of these requirements were reflected in BOBM engineering staff responsibilities.

Observation No. 12

Improve Maintenance Project Management

While engineers oversaw BOBM projects, the same level of effort was not invested in planning and controlling its projects as other, contracted DOT projects received. There was no repair procedure and practice manual. Project management in practice was informal and unstructured, and not subject to relevant requirements imposed on managers of other projects. There was no formal policy, State or federal, exempting BOBM projects from these requirements. BOBM project management practices were at the awakening stage of TAM maturity.

Planning And Scheduling

Bureau-level project programming started with an annual repair task list. The DOT reported judgment-based estimates of project duration were used to build an annual repair task list, but estimated start dates, estimated completion dates, estimated effort, and other planning factors were not included in the underlying database or annual repair task lists. The scheduling process also changed during the years encompassing the audit period, and the estimates were not retained by BOBM management, limiting reviews of performance.

The annual repair task list was reviewed and a two-week task repair task list generated. This task list was reviewed every two weeks and a new two-week repair task list subsequently developed. The two-week repair task list drove crew efforts, but did not contain start or end dates, estimated effort or duration, budget, percent complete or executed, or any other progress or performance metric. Two-week task lists were not retained, again limiting opportunity to review performance.

Our file review of 66 projects on the BOBM's CY 2014 and CY 2015 annual repair task lists, which included projects and tasks completed, underway, and not yet started, illustrated the lack of formal planning – none had a documented plan or estimated or actual work required, project duration, or start or completion dates. The DOT asserted BOBM bridge files were to contain pertinent information related to the specific bridge.

Designs And Specifications

Not every project had designs, even those with structural alterations. The DOT reported when a design was applied, standard DOT plans and specifications might be used, an existing similar design or prior design might be adapted and used, or new elements might be designed, reviewed, and used. There was no formal threshold for determining the need for a design, but if any design work was done, DOT personnel and management reported it included a drawing. As-built drawings, completed to ensure archived plans contained accurate information following completion of work, were inconsistently required.

The lack of formal design and specification requirements was evident in our file review. None had final, approved designs and specifications filed. This included 31 bridge projects with apparent structural alterations within the scope of work, 18 (58.1 percent) of which were actually worked on during the audit period.

Quality

Statute required DOT policies, practices, and procedures to ensure compliance with laws and high standards of continuous quality improvement. The DOT's federally-required quality assurance program was to provide assurance the materials and workmanship used on projects conformed to specified requirements. Controls included inspecting, sampling, testing, measuring, reporting results, and follow-up. A plan had to be developed before construction began and include materials sampling and testing requirements and schedules. However, the DOT quality assurance program was not formally, or fully, applied to BOBM projects. There was no formal delineation of quality control and assurance responsibilities identifiable in BOBM practice.

BOBM staff reported conducting inspections and certain types of testing and sampling. The DOT reported some records were held by other components of the DOT even though BOBM bridge files were to contain pertinent information related to the specific bridge.

Our file review illustrated the lack of quality-related planning – none had a documented quality control and assurance plan. Only four of 18 (22.2 percent) bridge projects with structural alterations within the scope of work and worked on during the audit period, contained documentation of some form of quality test, inspection, or certification. None of the documentation could be described as complete.

Documentation

Statute required the DOT to operate a records management program, preserve and retain records, and document its organization, policies, and procedures. Records had to document decisions, procedures, and transaction lifecycles promptly, completely, and accurately. DOT guidelines provided: 1) a project folder, constituting the permanent, legal, design record of the project, should contain all necessary design materials, and 2) archives include drawings, plans, inspection reports, delivery slips, quality-related reports, and correspondences. The BOBM lacked a records retention schedule and complete records of work despite being responsible for the DOT's bridge maintenance files which were to contain pertinent information related to each bridge. Our file review contained 54 bridge project files and unaudited DOT data indicated the repair tasks were worked upon in 29 cases (53.7 percent). Eight of the 29 files (27.6 percent) had documentation reflecting task-specific work: two had only quality-related documentation, five had only photographs, and one had both.

Monitoring And Audits

The DOT was required to monitor and audit projects to ensure compliance with laws, contract provisions, and program objectives. The BOBM did not have a formal process for project monitoring, reporting completion, or auditing. Progress on field activities was tracked through intermittent site visits by supervisory engineers and via telephone. Bureau-wide progress was evaluated every two weeks, but task lists were not retained, limiting effective program evaluation. Project deadlines were characterized by BOBM management as “reasonable,” but there was no good way to assess ongoing activities at a given point-in-time. There were no efficiency or effectiveness measures, and performance was qualified as “good” or with similar terms.

The DOT reported schedule and design changes occurred frequently. Review and approval was not formalized, and the DOT reported review and approval could occur at one of five levels within the BOBM's organizational structure, from the field through the Administrator. There was no formal threshold regulating the echelon required for decision-making. We found no documented change approvals during our file review.

The quality of project selection, trade-off analyses, and resource allocation decisions are directly related to the quality of the information upon which they are based. The DOT historically based decisions on judgment-based qualitative analysis and identified a need for data governance to

migrate towards quantitative, data-based decision-making, including project-level decisions. This entailed detailed performance measures to determine efficiency and effectiveness at lower echelons. DOT goals included improved performance and effective resource management. Reducing project delivery delays was a federal performance metric and the DOT's balanced scorecard contained project timeliness measures. However, informal project management practices did not generate data to measure project delivery timeliness or other aspects of performance such as quality and efficiency, inform objective analysis and decision-making, or generate feedback and provide accountability. BOBM management was cognizant of some recordkeeping and data integration inadequacies, and reported working to improve recordkeeping and project close-out procedures. No formal plan detailing deliverables and milestones existed.

Recommendations:

We recommend DOT management improve bridge maintenance and preservation project management practices. This should include formal policy, practice, and procedures based on existing DOT standards and encompassing:

- **planning and scheduling,**
- **designs and specifications,**
- **quality,**
- **documentation,**
- **monitoring,**
- **change control, and**
- **auditing and evaluating performance.**

The DOT may benefit from defining the difference between:

- **a “project,” warranting higher-order practices and documentation such as pre-execution planning (e.g., drawings, estimates, quality assurance plans), progress tracking, and close-out documentation (e.g., quality test results, as-built drawings); and**
- **“tasks,” requiring less extensive documentation and tracking of effort.**

This would require the DOT to seek legislative changes to redefine “project.”

Agency Response:

We concur in part.

The Department agrees that the BOBM could improve the documentation of construction management by in-house forces. The Department believes this would best be accomplished in the form of a maintenance manual outlining items such as when plans are required, where they should reside upon completion of the work, and what level of quality assurance testing is appropriate.

The Department does not concur with the interpretation of what is required for maintenance projects done by in-house forces. The Department does not believe that such projects must meet the same criteria as those that are competitively bid and contracted. Per RSA 228:4 “State Transportation Projects”, all transportation projects are to be built under contracts awarded to the lowest bidder. Excluded from this competitive bidding requirement is “(a) Normal highway and bridge maintenance and improvements.” This exclusion also exempts the BOBM from meeting the requirements of RSA 228:5-a “Compliance With Contracts”. Furthermore, the Commissioner is authorized under 228:21 to determine the method and type of construction, kind, quality of materials used and manner to maintain the highway.

The Department disagrees that the same level of plans are needed for work performed by in-house forces as a contracted project. The BOBM does produce plans, project oversight and quality assurance testing for major rehabilitation projects undertaken by the Bureau. The Bureau does not produce pre-executed planning, drawings, estimates and quality assurance plans for minor maintenance or in-kind repair work. See also response to Observation No. 3 with respect to EOR and responsible charge.

Planning and Scheduling

The two week task lists are an internal coordination tool for the bi-weekly review meetings that take into account not only the yearly schedule and BPL, but the current status of projects, weather, unanticipated events that occur, and the additional emergencies that arise. Bi-weekly meetings in the BOBM include coordination with the field engineers, administration, and design engineer. The purpose of this meeting is to discuss the status of projects, other items that have emerged, discussions of sharing personnel between crews, and coordinating use of BOBM equipment. This is the primary means of project management controls that has proven to be effective and efficient. If an opportunity arises to more efficiently do a task or project (such as low water) or something delays an existing project that would affect the sequence of the next project, changes are made and the information is conveyed via what is called the “two-week schedule”. One of the missions of bridge maintenance is to deal with maintenance items (potholes on the bridge deck, joint armor that could puncture tires, etc.) and to quickly react to and deal with emergencies. These items do impact schedules on a regular basis.

Designs and Specifications

- The Department disagrees that the same level of plans are needed for work performed by in-house forces as a contracted project. A considerable amount of the plan detail and specification language is needed to support the competitive bid process and therefore is not necessary when accomplishing in-house work with our own forces. The BOBM does produce plans, but the Bureau does not produce pre-executed planning, drawings, estimates and quality assurance plans for minor maintenance or in-kind repair work. The Bureau uses the appropriate sections of the State specifications for the work performed.*
- The findings indicate that 66 projects were sampled from the bridge maintenance schedules for CY 2014 and CY 2015 and that plans were not prepared for those*

projects. As noted in Observation No. 3, plans were produced for those projects that required plans.

Quality

- *The Department does perform quality control testing on projects. The Department disagrees with the implication that all maintenance and repair work requires the same level of quality testing as large projects or competitively bid construction contracts where private contractor compliance with specifications is the aim. The Department agrees that documentation concerning what is the appropriate level of quality control can be improved for BOBM projects.*
- *Individual project quality control plans are only prepared for large scale projects bid by the Department.*

Documentation

The Department does retain a substantial amount of documentation for projects, although they are stored in multiple locations. As one example, all photos are now stored digitally by asset and are available to anyone in the Department. The Department does agree that formalizing procedures would be beneficial.

Monitoring and Audits

- *The BOBM is formalizing project close out procedures. This effort had been delayed in order to coordinate the database information format with the BOBD. Federal and balanced scorecard performance metrics are for contracted project development projects with more determinate fixed schedules and not maintenance activities.*
- *Schedule changes do occur frequently as the BOBM must respond immediately to discovered deficiencies, repairs, or emergencies. These cannot be planned and they can substantially impact schedules.*
- *Design changes occur on many rehabilitation projects since many older structures have no original plans and, in many cases, the degree of deterioration on a structure cannot be fully realized until a portion of the structure is removed. This is true whether the project is contracted or undertaken by in-house forces. For contracted projects, this is often contained in the contract as a dollar amount for “Repairs and Replacements as needed” and is paid on a time and materials basis to the contractor.*
- *The primary source of data used by the Department for planning bridge projects comes from the bridge inspection process. Although there are documented procedures for obtaining this data, a substantial amount of professional judgment by the trained inspector is utilized to arrive at a condition state.*

Recommendations

- A. *The Bureau will continue to improve its scheduling procedures. A BOBM maintenance manual will be prepared by December 31, 2017 that formalizes these procedures.*

- B. *The Bureau does provide designs for projects that affect the load carrying capacity of a structure and utilizes the DOT Standard Specifications for Road and Bridge Construction.*
- C. *See above (A)*
- D. *See above (A)*
- E. *See above (A)*
- F. *See above (A)*
- G. *See above (A)*
- H. *The Department does not feel legislative action is required to redefine “project” given the exemption from competitive bidding and compliance with contract provisions. Through the maintenance manual the difference between “project” and normal bridge maintenance will be clarified.*

LBA Rejoinder:

We made no recommendation DOT provide the same level of control for work performed with in-house forces as they require for contracted projects. We noted *no standard* was applied, and BOBM projects ranged in scope from minor maintenance to significant reconstruction. We recommended the DOT apply *some form of standard* to BOBM project management, and that the standards applied might be graduated based on project scope. As we discuss in Observations No. 11 and No. 13, the DOT lacked as basis to claim its “project management controls [have] proven to be effective and efficient.”

Additionally, the DOT asserted bridge files “on every state owned bridge.... These files include *pertinent information* from past projects. Past data has not been as complete as desired.” [emphasis added] The files we reviewed were inadequate, rendering the relevant practices unauditabile. This condition prevailed in several areas.

Efficiency Management

Managing efficiency helps minimize waste, is integral to TAM implementation and asset preservation, and is good management practice. Mature asset management supports efficient resource allocation decisions. The DOT committed to using resources efficiently to meet strategic objectives, and to measuring and reporting on program efficiency by adopting TAM; was statutorily obligated to continuously improve quality; and assigned related requirements to some BOBM staff.

Observation No. 13

Improve Management Of Maintenance Efficiency

The BOBM lacked performance goals and measures, did not evaluate performance or efficiency, and utilized inefficient data management practices. Efficiency management was at the initial stage of TAM maturity.

Outputs And Productivity

Outputs

Bridge bureau managers reported an informal objective was to expend appropriated funds toward removing bridges from the Red List and federally-approved maintenance and preservation activities. While the DOT reported the number of bridges added and removed from the Red List through the balanced scorecard, there was no cost element or measure to determine if work efforts were accomplished efficiently. While the BOBM tracked select outputs, as detailed in Table 6, with the exception of washing, sealing, and repairing Red List bridges, there were no corresponding targets. None of the outputs had goals or received further analysis for the BOBM to understand productivity.

Table 6

BOBM-reported Outputs, Calendar Years 2014 And 2015

Output	Calendar Year	
	2014 ¹	2015 ²
Red List Bridge Repair	8	10
Wash	707	1454
Seal	272	582
Crack Seal	81	13
Joint Repair	39	118
Joint Replacement	2	6
Rail Repair	14	13
Rail Replacement	3	5

Notes:

¹ DOT reported CY 2014 outputs were low due to several emergency tasks which required crew time and effort, limiting routine washing and sealing activities.

² DOT reported CY 2015 outputs included an additional, temporary wash and seal crew.

Source: Unaudited BOBM data.

Productivity

Measuring productivity is essential to understanding efficiency. Productivity measures of processes and work crews are needed to forecast outcomes in terms of performance, which can then facilitate determining which resource allocation option will yield the best performance for a given budget. As described in Observation No. 12, the BOBM lacked a formal process for project monitoring or reporting on completion, task lists were not retained, and timeliness was not measured.

Additionally, the BOBM lacked formal procedures to ensure resources were efficiently deployed to priorities on a statewide basis and did not measure crew-level productivity. Crew superintendents, field engineers, and BOBM management gauged efficiency through field

observations, informal meetings, and personnel evaluations, but lacked objective metrics to support their judgment. While the BOBM typically prioritized bridge maintenance tasks within fixed, geographic crew regions, crews occasionally assisted one another with specific tasks across regional lines. However, task completion efficiency analysis was hindered by inconsistent project completion recordkeeping. Unaudited BOBM data indicated 69.9 percent of bridges on the CY 2014 annual repair task list remained on the CY 2015 annual repair task list, and 40.0 to 88.9 percent of bridges assigned to individual crews for work within CY 2014 remained on the annual repair task list in CY 2015, indicating substantial variation between crews in priority task completion.

Overhead

The DOT defined “overhead” in a draft 2010 project development guide for contract management. However, the guide was not finalized and the definition did not apply to the BOBM. Limiting overhead helps control costs and contributes to efficiency. We found the BOBM lacked a formal definition of, and guidance on, overhead; utilized overhead inconsistently; and lacked controlling policies and procedures. The BOBM assigned overhead project numbers to Bureau-wide overhead activities, and work class codes (WCC) to task-level overhead, which could then be attributed to any project type such as repair, maintenance, and construction, and even overhead projects.

Bureau-wide Overhead

In SFYs 2014 and 2015, the BOBM reported 244 total projects consisting of 59 (24.2 percent) overhead projects, including 20 non-bridge construction projects and 39 other activities such as training, leave, and equipment purchases. According to unaudited DOT data, over \$19.3 million was expended on the 244 projects during the audit period. Overhead projects accounted for 31.1 percent of the BOBM’s total amount expended, second only to bridge work, which accounted for 53.0 percent of total reported expenditures. Table 7 outlines the BOBM-reported project expenditures.

However, reported overhead amounts expended could only be attributed to overhead projects. Unaudited BOBM data did not provide task-level overhead expenditures within other, non-overhead projects, which would have increased the amount expended on overhead during SFYs 2014-2015. Neither the DOT nor the BOBM had an accepted overhead rate for BOBM costs.

Table 7

BOBM-reported Project Amounts Expended, State Fiscal Years 2014 And 2015

Project Categories	Expenditures¹	Percent of Total Expenditures
Bridge Work	\$ 10,254,351	53.0
Overhead ²	6,017,950	31.1
Operate Moveable Bridges	2,143,197	11.1
Five-day Tasks	472,611	2.4
Non-bridge Work	429,264	2.2
Other ³	33,283	0.2
Total	\$ 19,350,656⁴	100.0

Notes:

¹ Project expenditures also included on-project overhead.

² Overhead projects only – overhead amounts expended within other DOT projects at the task-level were excluded.

³ Consisted of one project lacking details to permit categorization.

⁴ The total of \$19,350,656 was \$1,746,774 more than the amount reported the BOBM expended as detailed in SFY 2014-2015 Statements of Appropriations and in the DOT’s SFY 2014 and 2015 annual reports. Additional DOT funding sources were included in the total. We did not reconcile the difference.

Source: LBA analysis of unaudited BOBM data.

On-project Overhead

The BOBM could not measure Bureau- or crew-level efficiency without accurate data and consistent reporting. Without formal policies, overhead task-level WCCs were inconsistently applied to project numbers during the audit period, limiting the BOBM’s ability to retrieve accurate project costs and outputs by work class, or accomplishments, to establish productivity. For projects, BOBM crews could use up to seven overhead WCCs, including construction clean up, roadway reconstruction, traffic maintenance, field supervision, training, building maintenance and construction, and equipment maintenance. BOBM management reported running reports at least annually for project costs, which included overhead projects, but did not run reports for specific WCCs or tasks to quantify on-project overhead costs. As we discuss in Observation No. 14, data collection silos prevented integration of project data and WCC data covering the same activity, limiting analysis of the full cost of overhead. For example, although the WCC for training was to be used for all training, the BOBM would also assign project numbers for some training activities in order to determine specific costs and would not account for training costs associated with non-training projects. Management reported working to improve the consistency of crews’ application of overhead WCCs to project numbers.

Optimization

While the DOT reported being underfunded, it should have nonetheless optimized resources by reaching a balance between planned and unplanned maintenance, potentially reducing the amount of unplanned maintenance, lowering costs and potentially delaying rehabilitation and replacement. Of the 244 SFY 2014 and SFY 2015 BOBM projects reported, we found:

- 80 (32.8 percent) were likely preservation;
- 62 (25.4 percent) were likely repairs in response to damage, or rehabilitation or repair efforts beyond preservation such as asset capacity expansions;
- 28 (11.5 percent) were likely minor and routine maintenance; and
- 15 (6.1 percent) could not be categorized due to lack of project description details.

Although the DOT recognized the value of such undertakings and planned to integrate efficiency measures as part of TAM implementation, the BOBM had no formal, relevant plans and could not demonstrate if this project amalgam was optimal. Optimizing BOBM activities was further limited by:

- lack of LCCA, policies and procedures, and a governing bridge asset management plan;
- an informal and ad hoc information governance structure;
- unintegrated and inconsistently recorded data; and
- postponed asset management working group efforts and initiatives.

Recommendations:

We recommend DOT management establish goals and objectives for overhead, efficiency, and productivity, as well as develop a time-phased plan to optimize maintenance and preservation activities.

We recommend BOBM management:

- **collect quality data and conduct analyses to facilitate decisions;**
- **continuously evaluate performance and make improvements;**
- **formalize procedures on task and project overhead and productivity;**
- **formalize procedures and goals for crews to efficiently and effectively allocate assets and resources statewide, including efficiently using crews across regions to ensure the highest priorities are completed; and**
- **manage to goals, increasing productivity and reducing overhead.**

Agency Response:

We concur in part.

The Department will develop goals for overhead, efficiency, and preservation activities. DOT is developing a time phased plan to optimize maintenance and preservation activities for five

different structure types as evidenced by development of the “Recommended Maintenance Schedule” for each. These schedules will be included in the Bridge Strategy document as appendices. There is also a recognition that approximately 50 percent of the bridges in the inventory are in the later stages or near the end of their design life and maintenance and preservation alone will not substantially extend the useful life of those bridges.

Although the BOBM did not measure the degree of efficiency, the BOBM did informally evaluate work performance through bi-weekly review meetings to review status of projects and BOBM activities and ensure resources were efficiently deployed and statewide priorities or emergencies were being addressed.

We do not concur that the overhead was likely higher than reported.

Outputs

- *Annual work plans are developed based on goals and contain targets and performance metrics.*
- *Costs are tracked and measured to ensure efficient use of resources, but only certain activities lend themselves to comparing costs on a yearly basis (e.g., washing and sealing). Although there is a wide range of bridge sizes for washing and sealing, there are enough bridges within the population each year to offset larger and smaller efforts. However, every Red List bridge is different and costs vary widely depending upon the work required. In addition, items with only a few bridges in the statistical population vary widely from bridge to bridge.*

Productivity

The implication that productivity was lacking due to the number of bridges on the CY 2014 list occurring on the repair list for CY 2015 is not accurate. The bridge maintenance repair lists that are prioritized with numbers are prepared for the calendar year plus an additional four to six months into the next year. This ensures that permits and needed materials are available at the start of the work. Therefore, a large number of the projects are expected to be on the next year’s list. In addition, there are a number of activities that occur on a yearly basis and bridges that are to be kept in service will stay on the list until repaired under a Capital Budget project. Emergency and unanticipated work often disrupts a crew’s schedule and that can push a number of projects into the next year due to seasonal constraints.

Overhead

Table 7 breaks down bridge work, operation of bridges, and projects/activities with less than a five day duration, but then aggregates expenses for all overhead activities into a single line. Overhead should also be broken out accordingly. The overhead amounts contain the following breakdown.

Overhead Category	Expense	% Overall Expenditures	Comment
Leave and Holiday	\$1,972,275	10.1%	This is typical of all State Bureaus
Administration, Design, Permitting, Field Inspection, and Safety	\$1,235,382	6.3%	This includes Bureau administration, accounts payable, preparing designs for projects, preparing permits, field inspection, and our safety officer. For most small construction projects, design and inspection costs alone are 10 to 20 percent of the construction costs
Field Administration and otherwise uncategorized	\$866,133	4.4%	This includes administration and otherwise uncategorized charges for our 11 field construction crews. This also includes re-storing materials at crew yards after a project, preparing for future projects, building maintenance, plowing yards during the winter, ect.
Warehouse Operation	\$525,629	2.7%	The Bureau operates a central warehouse to store and supply materials for projects.
Maintenance of Equipment	\$364,041	1.9%	This includes maintenance of the equipment owned by the Bureau
Equipment Purchase/Replacement	\$310,438	1.6%	Purchase of new replacement equipment used for construction
Lift Bridge Administration	\$255,663	1.3%	This includes administration, accounts payable, and scheduling for lift bridges.
Training, Testing, Hazardous Materials	\$213,900	1.1%	This includes state mandated training as well as hazardous material and equipment training.
Utilities & Telecommunications	\$189,495	1.0%	This includes utilities for all Bureau facilities except the Morton Building and telecommunications for all facilities
Fuel	\$84,994	0.4%	Fuel for Bureau owned equipment used on projects.

Total *\$6,017,950*

For clarity, we offer the above table for overhead breakout. This table includes both direct and indirect (overhead) costs, therefore we do not concur that the overhead was likely higher than reported. Taking into account the inclusion of on-project overhead and the exclusion of the direct unallocated costs included in overhead projects, it is inconclusive whether overhead is over or under reported.

On-project Overhead

- *Although all information is collected in MATS, there were no standard reports that allowed easy viewing to determine whether information was accurately input. The LBA had access to a reporting tool developed by the BOBM in SFY 2016 that showed this discrepancy and is now being utilized to improve data accuracy.*
- *To clarify footnote 4 in table 7, the total BOBM project expense includes additional funding from other sources, such as Betterment Funds, to complete BOBM projects. The BOBM and Lift Bridge accounting units actually spent less than appropriated over SFY 2014 – SFY 2015. Per the Statement of Appropriations, combined budgets totaled \$18,817,861 with expenditures of \$17,608,139.38.*

Optimization

The Department has included a balanced mix of preservation, maintenance and rehabilitation in its yearly output. The increase in maintenance and preservation funding

approved in the Ten Year Transportation Improvement Plan, 2017-2026 should enable the Department to reduce its rehabilitation and repair efforts over time. However, until the DOT can fully address the backlog of deficient structures, dedicating sufficient resources towards preservation efforts will be challenging.

Recommendations

- A. The Department will develop a time-phased plan with milestones to optimize maintenance and preservation activities as part of a comprehensive bridge management program. As indicated in Observation No. 1, the development of an implementation plan for the bridge management program will be completed by June 30, 2017. While a comprehensive management program will create efficiencies in the long-term the development of the program will require resources in the short-term. The DOT will work to identify those resource needs and to include them in the SFY 2018 and SFY 2019 budget. Full implementation of a comprehensive program is contingent on the availability of resources in future years.*
- B. The BOBM has and will continue to enhance data quality and will formalize procedures for data analysis. A BOBM maintenance manual will be prepared by December 31, 2017 and will include analyses requirements to facilitate decision-making, performance evaluation criteria, formalized procedures for the calculation and inclusion of overhead for projects, formalized procedures and goals to efficiently and effectively allocate and utilize resources statewide, and guidance to manage productivity.*
- C. See above (A)*
- D. See above (A)*
- E. Once complete, the asset management strategic and implementation plans will provide guidance at the tactical and operational levels for bridges. That guidance will be incorporated into the BPL, work plans, and procedures. At the operational level, the allocation of crews/resources to meet those goals most efficiently within the available resource constraints will be monitored.*
- F. See above (A)*

LBA Rejoinder:

We noted beyond the five generalized recommended maintenance schedules, the DOT lacked bridge-specific schedules and lacked a plan and timeline for development and implementation of bridge-specific schedules.

The DOT asserted performance and efficiency were evaluated in bi-weekly review meetings. We requested evaluations and analyses; none were provided. This process, its outcomes, and changes or adjustments made were undocumented and unauditable. Without measuring outcomes, demonstrating long-term performance and efficiency was problematic.

Goals are clearly defined and formalized, and supported by data collection and evaluation, as well as corresponding objectives, targets, and measures. As we noted elsewhere, there

were no formal goals within the BOBM. The DOT had no maintenance and preservation goals. We discussed the number of bridges on the CY 2014 list re-occurring on the repair list for CY 2015 only as potential indicators.

The DOT disagrees total overhead was likely higher than the \$6 million reported using overhead project values alone, because the DOT redefines costs and speculates about the redistribution of these redefined costs. If the DOT had adequate controls over BOBM projects, such as policy and procedure, and auditing requirements like those required for other DOT projects, there might be no need for speculation. Based on actual practice during the audit period, aggregating only overhead project values excluded task-level overhead on all other projects, such as bridge work projects. Seven bridge work projects we examined during file review contained task-level overhead, demonstrating the total value of overhead was likely higher than the \$6 million of overhead projects alone. Further, task-level overhead was reportedly inconsistently applied to projects, indicating more projects should have had overhead charges, but they were not accounted for by DOT.

The DOT-provided table demonstrates the Department has, and can produce, volumes of data, which *could* be used to help optimize operations. However, in isolation these data have no inherent value. Established acceptable overhead rates, analysis to understand what the data indicate near- and long-term, and process changes to improve efficiency are also required. The DOT should use its output data, develop a system to establish performance and outcomes, set targets and goals for performance and outcomes, and measure performance and outcomes over time, changing practices as needed.

Information Governance

Management is accountable for creating a well-defined information governance structure with assigned responsibilities and established reporting lines to enable the organization to operate efficiently and effectively, comply with regulations, and communicate quality information. Asset management is data-intensive and relies upon integrated systems with embedded feedback loops to operate properly. The DOT reported multiple information systems underpinning bridge maintenance and preservation. The DOT also noted data weaknesses and inadequate interfacing of separate systems.

A core function for TAM information systems is to provide access to quality information for needs assessment, prioritization, work planning, and analysis. A mature asset management program is driven by consistent, quality, integrated data and processes for efficiently transforming the right data into needed information, influencing decision-making at the strategic, tactical, and operational levels. Although unintegrated and at times ad hoc, DOT had the data resources and capabilities to inform TAM. However, lack of coordinated, Department-wide planning and orchestration of data collection, management, and presentation led to both inefficiencies and data quality concerns.

Observation No. 14

Improve Information Governance

DOT bridge asset information governance relied on ad hoc and unintegrated data systems, and lacked a comprehensive information governance structure, as well as data business and knowledge management plans to help inform asset management. Information governance was at the awakening stage of TAM maturity.

In 2010, the DOT awarded a contract to assess its asset management needs. DOT management desired capabilities to develop structured and weighted decision-making, provide easily understood reporting, and analyze scenarios and project selection. The then-current environment was considered insufficient to communicate the rationale behind predictive deterioration models, as well as decisions regarding policies and programs. Additionally, the DOT relied on:

- separate proprietary systems to manage bridge inventory data, record work accomplishments, and maintain project costs in vertical silos of like-type data;
- common database management formats to manually manipulate inventory, accomplishment, and cost data, and merge them horizontally for programmatic use; and
- paper files to manage bridge maintenance and preservation efforts.

The DOT reiterated the needs identified in 2010 through another contracted assessment in 2013, and scheduled the development of a framework for a centralized TAM data warehouse and analytics from October 2014 to September 2016. While DOT personnel reported processes were likely inefficient, the centralization schedule was unrealized and bridge management systems, and practices and databases remained largely unchanged as of June 2016.

Data Business Plan

A data business plan aids efficient data management by aligning data investments with business needs. It can include: the business framework; documentation and assessment of existing data programs; a data program performance framework; strategies and actions, with sub-components of data governance, stewardship, collection, documentation, standards, integration, access, and quality improvement; and an implementation plan. The DOT made efforts toward framing a data business plan by assigning some data governance responsibility to the Statewide Asset Data Exchange System Workgroup, which developed a draft data governance guide in January 2016. However, neither the BOBM nor the BOBD were standing members.

Data Governance

Data governance establishes decision-making structures and processes to:

- determine which data sets will be managed at the enterprise level;
- designate single authoritative sources for shared data;
- formalize and support data stewardship roles and responsibilities;

- standardize data definitions, data structures, lists of values, and naming conventions;
- create and manage metadata;
- review proposed new data sets and applications to minimize redundant data collection and storage; and
- set data quality expectations and associated methods for quality assessment and improvements.

The 2016 draft data governance guide outlined the DOT's need to make quantitative decisions, provided a framework for data governance, and conceptualized a sequence of events to implement data governance. The guide also verified inadequacies in DOT data governance, but there was no clear connection to the *Bridge Strategy* or related data, the guide was not finalized as of June 2016, and there was no implementation schedule. Further, efforts to finalize the plan were delayed until senior management realigned the DOT's asset management vision and strategies. Bridge data collection and retrieval remained a vertically segregated process, relying on unintegrated databases; decision-making and data processes were undocumented; staff received informal training on data programs; and responsibility for data management platforms within the BOBM was absent. Therefore, the DOT depended on a limited number of personnel knowledgeable in specific databases within the bridge bureaus to facilitate data management. The DOT also relied on inefficient manual data retrieval and assembly, which was perceived as interrupting primary job functions.

Knowledge Management

Good knowledge management is integral to a data governance framework, and can enhance organizational effectiveness and efficiency by facilitating documentation of processes, procedures, training materials, and experiences pertinent to business operations. Institutional knowledge loss posed a substantial risk to bridge asset management, due to a targeted service life up to 120 years, making good knowledge management practices all-the-more important. However:

- Management stated efforts to document BPL project selection decision-making and data-retrieval processes were underway, albeit in early stages during the audit period. Consequently, the bridge bureaus relied substantially on judgment and experience to make key decisions, affecting bridge lifecycles, project selection and prioritization, scope of work, and scheduling estimations. There was no implementation plan or schedule to complete process documentation or improve practices.
- Historically, bridge maintenance activities and decisions were not fully or consistently recorded, and management acknowledged documentation was a program weakness that allowed the specifics of bridge work to be forgotten over time. This created inefficiencies and added costs. Bridge information management software training for Pontis was informal and on-the-job. Pontis was underutilized as a bridge asset management program, and cost and deterioration modeling features were abandoned due to DOT-reported methodological concerns. The new bridge inventory application, BrM, was to be implemented by spring 2016, but was reported as delayed until winter 2016-2017. There were no formal implementation or training plans, and how useful BrM would be when implemented by the DOT was not yet known.

Asset management relies upon quality data to achieve the best return on investments. Under the *Implementation Plan*, the DOT was to have developed a data governance framework, defining data and analytical capabilities required organization-wide to support asset management, by September 2016. Better information was to lead to better decision-making and improve processes. While management stated discussions occurred regarding integrating data, it also reported resource constraints. TAM implementation was delayed to at least 2017 and the lack of data governance, integrated systems, and planning, with duplicate and inaccurate data risks, time-consuming manual processes, and the loss of potentially valuable decision-support capabilities, continued.

Recommendations:

We recommend DOT management:

- **expand upon existing plans and implement a comprehensive information governance structure with a data business plan;**
- **incorporate data governance and knowledge management policy, procedure, and practices; and**
- **develop and adhere to an expedited schedule with timelines and milestones for its implementation.**

Agency Response:

We concur.

The Department agrees that information governance and knowledge management is critical. The Department is taking steps toward enhancing those areas through the development of a strategic plan and implementation plan that will include guidance for asset data governance. In addition the Department is also committing resources to implement BrM being developed by AASHTO.

- *The Department is working on implementing the new BrM software to have all bridge inventory data.*
- *The new BrM software will have improved functionality to aid in the integration of data and be the basis for our bridge management system. While the new software is intended to meet the minimum standards of a BMS, the Department is evaluating the implementation to determine how to most efficiently utilize the software in our BMS process. The Department will continue to implement the new software for uses beyond just bridge inspections and inventory as part of establishing a comprehensive bridge management program. Through the implementation phase we will determine how best to utilize the software to aid in modeling outcomes, projecting investment levels, and decision making. Where the software is unable to meet the needs, the DOT will look to other solutions to augment and work to integrate systems to provide a complete bridge management system.*
- *The current program, Pontis, had promised to be the single point bridge data management system program when it was rolled out in the 1990s and made available*

to all the states' DOT bridge divisions. Based on input from all of the national users and experiences in New Hampshire, the Department realized that Pontis did not produce the promised results. The Department will continue to review other products and solicit feedback from other states to ensure we are using systems that most closely meet our needs.

Recommendations

- A. The Department will provide guidance through the strategic plan and implementation plan being developed by June 30, 2017. Following those plans the Department will develop and implement a more comprehensive data governance framework.*
- B. See above (A).*
- C. See above (A). In addition, the roadmap described in the response to Observation No. 4 (C) will include milestones for data/information governance.*

Inventory, Inspection, And Condition Assessment Data

Understanding asset inventory is a key precursor for proper asset management implementation. The State's reported CY 2014 inventory of 2,160 structures consisted of 1,635 bridges (75.7 percent), 468 culverts (21.7 percent) meeting the State definition of a bridge, and 57 other, non-bridge structures (2.6 percent). The DOT reported including, in addition to public highway bridges:

- State-owned, non-bridge structures, such as bypassed historic and pedestrian structures, and railroad trestles;
- structures crossing State highways; and
- other structures of interest to the State.

Inspections are a key function in establishing the condition and maintenance needs of bridges. The DOT established an inspection program to meet federal requirements, and in 2015, the BOBD produced a draft *Bridge Inspection Manual* to collect and formalize bridge inspection, inventory, and evaluation policy and procedures. This was derived from practices and procedures contained in a 1991 predecessor manual, written and unwritten policy, and historic practice. Condition ratings were federally-standardized, as depicted in Table 8.

The federal government reviewed the State's inspection practices annually, with deficiencies found in at least CY 2011 and CY 2014. The CY 2015 report indicated most prior deficiencies were corrected and it was compliant with 20 of 23 metrics (87.0 percent) and conditionally compliant with three (13.0 percent). The CY 2015 federal report also indicated data quality issues may exist in inspection data and noted other inconsistencies that were corrected during the review.

Inspectors routinely inspected and assessed bridges at varying intervals. Generally, structures in fair or better condition, NBI ratings of 5 and above, were biennially inspected. Red-listed bridges, usually structurally deficient and generally in poor or worse condition, NBI rating of 4

and under, were inspected biannually. Structurally deficient bridges were not inherently unsafe, but may have significant load-carrying elements in poor or worse condition due to deterioration and damage, or may be an impediment to traffic. Structurally deficient bridges left open typically required significant maintenance to remain in service, and eventual rehabilitation or replacement.

Table 8

NBI Inspection Ratings For Bridge Elements

Rating	Condition Category	Description
9	Excellent	
8	Very Good	No problems noted.
7	Good	Some minor problems.
6	Satisfactory	Structural elements show some minor deterioration.
5	Fair	All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour.
4	Poor	Advanced section loss, deterioration, spalling, or scour.
3	Serious	Loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
1	Imminent Failure	Major deterioration or section loss present in critical structural components, or obvious loss present in critical structural components, or obvious vertical or horizontal movement affecting structural stability. Bridge is closed to traffic, but corrective action may be sufficient to put the bridge back in light service.
0	Failed	Bridge is out of service and is beyond corrective action.

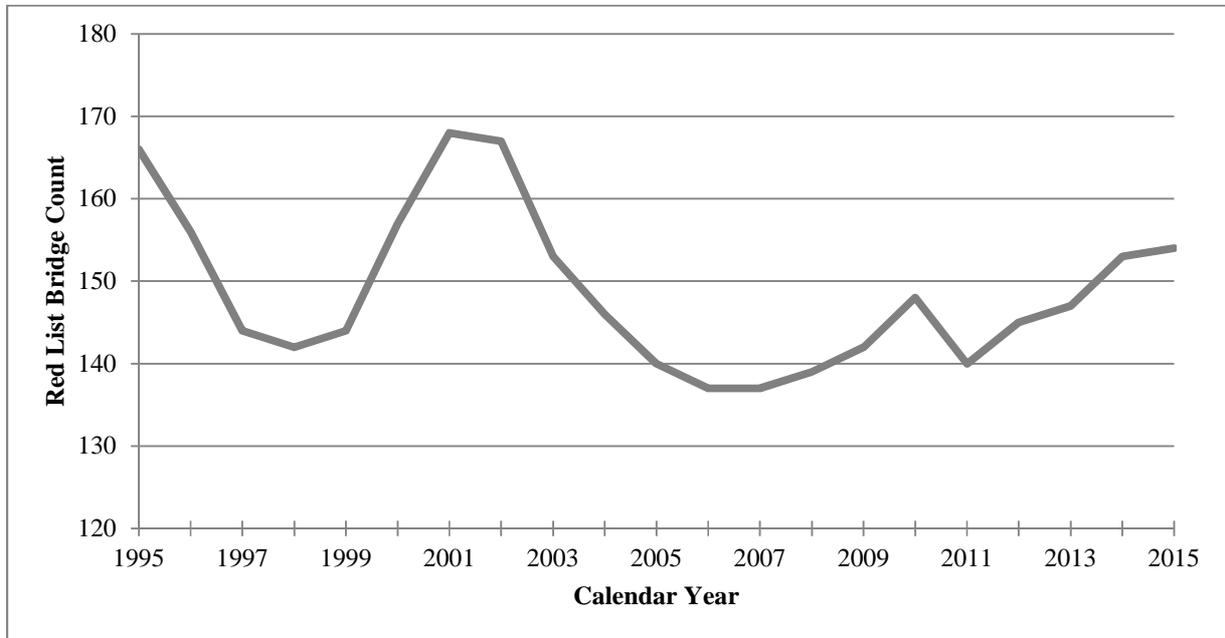
Source: FHWA, *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*, December 1995.

The Red List

Since August 2014, statute required the DOT maintain and publish annually the Red List, a list of State-owned bridges found by inspection to be structurally deficient. The *State Owned Red List Bridges*, April 1, 2015, (2015 Red List) included 153 structures, representing 7.1 percent of the 2,160 State-owned structures in the DOT-reported inventory. According to the DOT, every bridge will deteriorate over time, so at some point, each bridge will be on the Red List. The DOT expected the recent upward trend of the red-listed bridge count depicted in Figure 4, to continue, because increasing age, deterioration, and inventory growth outpaced funding. The DOT reported it was unable to follow recommended maintenance and preservation schedules due to a backlog in red-listed bridge work. In CY 2015, the DOT reported maintaining the condition of the State red-listed bridges alone required approximately \$15 million annually, and another \$15 million to improve their condition.

Figure 4

State-owned Red List Bridges At Year End, Calendar Years 1995 Through 2015



Source: Unaudited DOT data.

In addition to the 153 State red-listed structures with significant deficiencies, 791 State structures (36.6 percent) were on the yellow list, indicating deterioration of one or two condition ratings would make them eligible for the Red List. Without timely and effective intervention, these structures represented the next generation of red-listed structures and should be a preservation focus.

Observation No. 15

Comply With Statutory Red List Requirements To List Structurally Deficient Bridges

In addition to listing structurally deficient bridges on the Red List as required by statute, the DOT also included certain functionally obsolete bridges, non-bridge structures, and other bridges based on legacy criteria. Some were not structurally deficient. Of the 153 structures on the 2015 Red List, as few as six, or as many as 16, were over counted. The DOT’s management of the Red List was at the awakening stage of TAM maturity.

The Red List was to contain structurally deficient bridges to illustrate to the Legislature funding needs. Statute required red-listed State bridges be inspected bi-annually, while other State bridges were to be inspected biennially. “Structurally deficient” was not defined in statute or State rule, but at least two potentially applicable definitions existed:

- the DOT defined structurally deficient in the *Bridge Strategy* and the balanced scorecard as at least one of the three major bridge elements being identified by inspection to be in poor condition, NBI rating of 4 or less; and
- federal guidance added structural condition and waterway adequacy to the three *Bridge Strategy* and balanced scorecard criteria, with a low rating in any one of the five categories triggering a rating of structurally deficient.

However, the DOT did not use either of the definitions of structurally deficient to build the Red List. Instead, the DOT used the decision criteria it relied upon to determine whether a structure required inspections bi-annually or biennially as had been their past practice. Before the statute established legal requirements for the Red List, and dating to the 1970s, the DOT used the Red List to identify structures warranting bi-annual inspection for many reasons, not to list just structurally deficient bridges. The criteria used to place bridges on the Red List were qualitative and included “bridges requiring interim inspections due to known deficiencies, poor conditions, weight restrictions, or type of construction” as reasons structures required more frequent inspection.

We applied the DOT-developed *Bridge Strategy* and federal definitions of structurally deficient condition ratings to the DOT’s CY 2014 bridge condition data to produce counts of structurally deficient bridges, and compared the results to the DOT’s 153 structure-count published on the *2015 Red List*.

- We found 147 bridges (96.1 percent) had condition ratings meeting the federal thresholds of structurally deficient, a net difference from the *2015 Red List* of six (3.9 percent). Further, the total, or gross, number of individual structures mis-listed, either because they were included or excluded, was 12 (7.8 percent).
- We found 137 bridges (89.5 percent) had condition ratings meeting the DOT-established *Bridge Strategy* definition of structurally deficient, a net difference from the *2015 Red List* of 16 (10.5 percent). The total, or gross, number of individual structures mis-listed was also 16 (10.5 percent).

Some structures which were not structurally deficient, or State-definition bridges, were red-listed, while others that were structurally deficient were not red-listed. Red-listed structures included six structures which were non-bridge structures, as discussed in Observation No. 16. Also red-listed were three load-posted and functionally obsolete bridges which were not structurally deficient by either the federal or *Bridge Strategy* definitions and all were in satisfactory condition, with NBI ratings of 6 or better. While seven bridges with ratings meeting the federal definition of structurally deficient were also included on the Red List, three also with ratings meeting the federal structurally deficient definition were excluded, with the DOT identifying load-postings, or the lack thereof, as the rationale for inclusion or exclusion.

The Legislature appeared to narrow the Red List to only structurally deficient bridges with an intent to clarify red-listing practices and focus resources on the most deficient bridges. Including functionally obsolete bridges on the Red List, which was specifically deleted from the proposed legislation creating statutory Red List requirements, inflated the Red List. However, the DOT reported interpreting the lack of a definition for structurally deficient in statute to indicate

structurally deficient bridges would be defined through being placed on the Red List using its legacy criteria for determining whether a structure warranted increased inspection frequency.

Rather than using one of the available quantitative definitions, the DOT continued to include some functionally obsolete and load-posted bridges on the Red List. Some functionally obsolete bridges and load-posted bridges were historic covered bridges, preserved in or near as-built conditions due to historic significance, and which, without reconstruction and alteration of their historic nature, will *always* be functionally obsolete or load-posted even though they were in good condition otherwise and not in immediate need of repair. Further, not all functionally obsolete bridges were red-listed. Of the federal-definition bridges in unaudited DOT data, 191 of the 194 (98.5 percent) bridges identified as functionally obsolete were not red-listed.

Finally, data processing and federal submission errors limited our ability to verify DOT data, as separate DOT databases were updated on different schedules with varying frequencies, included known errors, and had the potential to affect the number of bridges eligible for the Red List. Our review indicated 12 additional bridges appeared to be structurally deficient in DOT data, but were reported by the DOT to be in better condition than the data indicated due to data errors and a lack of database updates.

DOT Red List development practice remained unchanged during SFY 2016.

Recommendations:

We recommend DOT management:

- **discontinue using legacy inspection criteria to add bridges to the Red List;**
- **formally adopt a quantitative, objective definition of structurally deficient in administrative rule, seeking rule-making authority if warranted; and**
- **comply with statute by including all structurally deficient bridges on, and removing non-structurally deficient bridges from, the Red List.**

Agency Response:

We do not concur.

We do not concur with the interpretation of the statutes relating to the Red List as described in the audit observation and the definition of what is considered structurally deficient.

The referenced legislation directed the Department to establish a list of bridges found to be structurally deficient. The legislation does not define structurally deficient, and the Department has never formally defined structurally deficient. However, the Department has maintained a Red List since the 1970s, and has consistently defined the content of that list as “State owned bridges requiring interim inspections due to known deficiencies, poor conditions, weight restrictions, or type of construction.” Further, RSA 234:25-a, III requires that the DOT specify whether a bridge is structurally deficient within the Red List, implying other non-structurally deficient bridges exist on the Red List.

- *The DOT strongly believes that the Red List was created first and foremost as a tool for the benefit of public safety relating to bridges. As such, any State-owned bridge, regardless of the type of facility carried, that is deemed by bridge experts to be of concern and warrants closer scrutiny, should be included in the Red List. Areas of concern that have long been used by the Department to include bridges in the Red List are known deficiencies, poor conditions, weight restrictions, or type of construction.*
- *The Department is compliant or conditionally compliant with all federal bridge inspection requirements according to the 2015, 23-metric federal review of the bridge inspection program. The three FHWA metrics conditionally compliant are:*
 - *Inspection procedures – Fracture Critical Members #16 –we need to revise current standard forms to allow recording inspection type.*
 - *Inspection procedures – Complex Bridges #19 –we need to add general inspection procedures.*
 - *We have removed the third item as of December 16, 2015.*
- *Although there were some data errors, these were captured in the snapshots of data from different dates given to the audit team. The DOT pointed out the corrected data to the audit team. These errors have been corrected in the database through our ongoing quality assurance and quality control process, which is being documented as we complete our Bridge Inspection Manual. This correction eliminated the reported errors.*

Recommendations

- A. *The Department does not only use inspection criteria to add bridges to the Red List. The Red List is the result of inspections (poor conditions), known deficiencies, weight restrictions, and type of construction. To mitigate the risk to public safety structures that meet the criteria above are inspected more frequently. The DOT will review the Red List report for potential changes to make clearer why each bridge is included. In addition, the DOT will amend the Red List in the future to remove any down-posted bridges (bridges that cannot carry legal loads and are posted with a weight limit) that are in good or fair condition (NBI rating of 5 and above) to more accurately conform to the statute. These down-posted bridges will continue to be inspected on a more frequent basis than once every two years to ensure safety for the travelling public.*
- B. *The Department will pursue a modification to the statute to clearly define “structurally deficient” and further define the content of the Red List. The Department will also continue to monitor the federal Notice of Proposed Rulemaking for revised federal definition of structurally deficient to ensure consistency between the federal and State definitions.*
- C. *See A and B above.*

LBA Rejoinder:

The DOT appears to concur in part with our recommendations.

The DOT concurs with the removal from the Red List of weight-posted bridges that are otherwise in good condition.

We read statute based on plain meaning and interpretations the DOT formalized. Statute did not define structurally deficient, nor did the DOT define structurally deficient in administrative rule, which we would have viewed as authoritative. The DOT did define structurally deficient in the *Bridge Strategy* and published balanced scorecards. However, to produce the Red List, the DOT reported in practice it relied instead on the criteria historically used to identify bridges requiring increased inspection frequencies. These criteria were never defined by the DOT as “structurally deficient.” DOT personnel also reported these criteria changed over time. This lack of clarity created two possible sets of standards for determining Red List eligibility, only one of which was actually presented as a definition of structurally deficient, the statutorily-established threshold for Red List inclusion. The definition reflecting statute was the one which we viewed to be authoritative.

Further, the *Bridge Strategy* described the Red List and noted “[s]tructurally deficient bridges comprise *most* of the Red List,” [emphasis added] indicating the DOT knowingly placed bridges on the Red List that were not structurally deficient. This was reflected in the draft *Bridge Inspection Manual*, which stated, in part “[t]he Department chooses to inspect bridges of concern on a reduced inspection interval (more restrictive than required by the NBIS). The Department’s ‘Red List’ bridges require interim inspections due to known deficiencies, poor condition, weight restrictions, or type of construction.” The draft *Bridge Inspection Manual* further provided “[t]he Department maintains a ‘Red List’ of bridges requiring a reduced inspection interval due to known deficiencies, poor condition, weight restrictions, or type of construction” [emphasis added] and not due to structural deficiency. The draft manual did not define structurally deficient. The *2015 Red List* contained 42 structures (27.5 percent of the list) that the DOT identified were something other than structurally deficient, including some non-federal definition bridges.

Additionally, statute required the DOT to “number and prioritize all state-owned red list bridges relative to the need for repair or replacement,” specifying the intended outcome for the Red List - a complete list of numbered and prioritized for repair or replacement structurally deficient State-owned bridges timely delivered to key public officials.

We note non-bridge structures likely warrant inspection and management. We made no recommendations here related to other structures beyond deleting them from the Red List.

As we discussed in Observation No. 19, DOT-identified element-rating inspection data errors were corrected in State inventory data after one year, and corrections were submitted to federal authorities after nearly two years. DOT personnel reported identifying and correcting three of the remaining ten bridges with data errors potentially affecting structural deficiency categorization prior to our identification of them.

Red-listed Non-bridge Structures

The statute defining a bridge, originating in 1921, initially detailed State and local funding of bridge construction and maintenance, but was amended iteratively and broadened to include subdivisions on covered bridge rehabilitation, bridge inspections, military defense of interstate bridges, an interstate compact, and Red List bridges. The statute defined bridges, in part, as structures on a public highway carrying traffic across a clear span of at least ten feet. The definition was largely unchanged despite the law's expanded application and the shifting expectations for transportation infrastructure. Based on this definition, the DOT maintained non-bridge structures in its bridge inventory, including previously closed, pedestrian, and other structures, for inspection purposes. These non-bridge structures in fair or better condition, NBI rating of 5 or higher, were reported to be inspected biennially and placed on the "black list." Non-bridge structures were also included on BPLs and in TYPs as bridge projects.

Observation No. 16

Include Only Bridges On The Red List

In addition to listing structurally deficient bridges, DOT-published Red List bridge reports included non-bridge structures based on its current operating definition of bridge, which was broader than we recognized in statute. DOT compliance with statutes and management practices related to the Red List were at the initial stage of TAM maturity.

The DOT maintained a black list for structures not carrying public highway traffic, no longer meeting the statutory definition of a bridge, listing 23 such structures (1.1 percent) in CY 2014 inventory data. We found at least 57 structures (2.6 percent) in the same data, including the 23 black-listed structures, were not bridges.

Eleven structures not carrying public highway traffic had condition ratings poor enough to warrant structural deficiency classification using the federal definition and were black-listed. However, six of the 153 structures (3.9 percent) on the *2015 Red List* were closed to public highway traffic, and:

- one was not structurally deficient;
- one was closed in 1984 and not expected to carry public highway traffic again;
- one was closed in 2009 and no rehabilitation or replacement was scheduled; and
- three structures carried railroad rights-of-way.

At least three additional bridges were red-listed and closed to traffic, but were under construction. Statute required State bridges closed by the DOT remain red-listed until permanently closed or the DOT certified they were satisfactorily repaired or replaced. In the *Bridge Strategy*, the DOT articulated an intent to increase DOT efficiency and effectiveness, in part, by evaluating whether redundant bridges should remain open and maintained. Including non-bridge structures on the Red List inflated the number of structurally deficient bridges reported and focused attention and resources on bridges which did not, and were not likely to again, carry public highway traffic.

Recommendations:

We recommend DOT management seek clarification of the statutory definition of a bridge should it be too narrow to encompass the current scope of the transportation network.

We also recommend DOT management include only bridges on, and remove all non-bridge structures from, the Red List.

Agency Response:

We do not concur.

The Department does not concur with the report's interpretation of the statutes relating to the Red List as described in the observations. The report claims that when a bridge does not carry motorized traffic, it should not be included on the Red List. The Department believes that the Red List was created first and foremost as a tool for the benefit of public safety relating to all bridges. Regardless of whether a bridge is temporarily closed (and may be re-opened once repaired), a bridge is over a highway and carries motorized or non-motorized traffic, or a bridge is a recreational structure conveying pedestrians and bicyclists, if it is in poor condition, it requires more frequent inspection to maintain public safety. As such, any State-owned bridge, regardless of the type of facility carried, that is deemed by bridge experts to have structural deficiencies, should be included in the Red List.

*Further, the statutory definition of a bridge in RSA 234:2 is defined as on a "public highway to carry the traffic across". Traffic is defined in RSA 259:110 to "mean pedestrians, ridden or herded animals, vehicles, streetcars, and other conveyances either singly or together while using any way for purposes of travel". In consultation with the Attorney General's Office, the doctrine of administrative gloss allows the Department latitude to interpret ambiguity in a statute. Specifically, the Attorney General's Office notes "The doctrine of administrative gloss, which is a rule of statutory construction, is typically applied to resolve the ambiguity within a statute. Bovaird v. N.H. Dep't of Admin. Servs., 166 N.H. 755, 761 (2014). Administrative gloss is placed upon an ambiguous clause when those responsible for its implementation interpret the clause in a consistent manner over a period of years without legislative interference. *Id.* at 762. "If an 'administrative gloss' is found to have been placed upon a clause, the agency may not change its de facto policy, in the absence of legislative action, because to do so would, presumably, violate legislative intent." Under the several pertinent statutes (specifically RSA 12-B:4, 21-L:2 II (a) 229:5 III(a), 230:74, 230:75, 230:77, 240:3, and 259:110), the Department has viewed traffic to include pedestrians, bicyclists, and recreational vehicle, and considers structures that carry this public traffic as bridges.*

Additionally, the Department offers the following in response to the report's claim that six of the 153 structures on the Red List were closed to public highway traffic:

- *Per RSA 234:25-a, IV, a closed structure can remain on the list until the bridge is satisfactorily repaired, replaced or permanently closed by the Department.*

- *One bridge noted as not structurally deficient is a State-owned bridge (owned by the Department of Resources and Economic Development) in Lincoln. This bridge (br. no. 149/110) is a 15-ton design covered bridge and was designed by the DOT for use at Franconia Notch State Park to carry pedestrians, buses, and maintenance vehicles. Because the bridge is a State-owned structure and is down-posted, the Department inspects the bridge twice a year to ensure it is safe for the visitors to the State park.*
- *One bridge noted as closed in 1984 is the General Sullivan Bridge, which is used as a critical public connection across Little Bay for pedestrians and bicyclist. The only other crossing for this mode of transportation would result in a 22-mile detour. The Department's mission and purpose is transportation excellence enhancing the quality of life – and to provide safe and secure mobility and travel options for all of the state's residents and visitors. This bridge is scheduled to be rehabilitated and is included in the recently approved Ten Year Transportation Improvement Plan, 2017-2026.*
- *One bridge noted as closed in 2009 is the Walpole, NH – Rockingham, VT (Vilas) bridge that the Department had included in previous TYPs for rehabilitation and ultimate removal from the Red List. Although this bridge rehabilitation project was not included in the recently approved Ten Year Transportation Improvement Plan, 2017-2026, the Department has received many recent inquiries from the local communities, general public, and FHWA relative to the status of the bridge and need for rehabilitation and re-opening for travel.*
- *Three structures carrying railroads over highways. Federal law requires the Department to inventory and inspect bridges in addition to those required by state law. These include bridges over highways where the bridges are not carrying highway traffic.*

Recommendations

The Department will seek clarification of the statutory definition of a “bridge” and will seek to amend the legislation if deemed appropriate.

The Department will amend the Red List in the future to remove any down-posted bridges (bridges that cannot carry legal loads and are posted with a weight limit) that are in good or fair condition (NBI rating of 5 and above) to more accurately conform to the statute. These down-posted bridges may continue to be inspected on a more frequent basis than once every two years to ensure safety for the travelling public.

The Department believes structures, which are in poor condition (NBI rating of 4 or lower) should be included in the Red List, as these structures do or may in the future carry traffic, whether motorized or non-motorized. It is imperative for the safety of the travelling public that the Department is diligent in inspecting and including all structures under State ownership that have structural deficiencies whether over traffic, carrying pedestrians or bicycles, or are temporarily closed in a comprehensive inspection program and by statute on the Red List.

LBA Rejoinder:

The DOT appears to concur with our recommendations.

We did not recommend the State abdicate responsibility for non-bridge structures. We recommended removing non-bridge structures from the Red List.

We did not claim “when a bridge does not carry motorized traffic, it should not be included on the Red List.” We asserted structurally deficient bridges should have been included on the Red List as statute required. We found the DOT lacked a formally codified definition of a bridge and of highway traffic. State law, federal guidance, and internal and published DOT information did not establish structures that carried only railways, or pedestrian or bicycle traffic as bridges carrying public highway traffic. DOT bridge inventory data specified whether a structure carried a highway or not, and five red-listed structures did not, including two railroads, two pedestrian and bicycle paths, and one unmaintained way. The DOT reported one additional red-listed structure was closed to all modes, and one additional structure did not appear to carry a public highway. The DOT’s current operating definition of bridge encompassed all these structures, including railroads, even though rail- and track-bound machines were specifically excluded from the statutory definition of traffic, and even included one black-listed structure which was disassembled and placed on the ground adjacent to the highway it formerly carried. We also note while federal requirements may compel the DOT to *inspect* structures over highways, such as railroads, even when they do not carry public highway traffic, there is no federal requirement they be included on the State’s Red List. State law does not require a structure be red-listed when it is not a structurally deficient bridge.

As we discuss in our Other Issue and Concern section, administrative gloss is a legal doctrine based in case law with origins in local zoning ordinance disputes before a court. Regardless of DOT speculation about how its actions may be defended in court, we have a responsibility to inform the Legislature of actions affecting DOT efficiency and effectiveness. We also note the DOT, by suggesting administrative gloss might apply to its past practices, acknowledges ambiguity in law.

Red List Reporting And Inspection Requirements

Since August 2014, statute required:

- red-listed State bridges be inspected bi-annually;
- non-red-listed bridges be inspected biennially, unless a more frequent inspection was requested by a municipality;
- red-listed bridges be numbered and prioritized relative to the need for repair or replacement; and
- the DOT annually provide complete State and municipal Red Lists to key members of the Legislature, the Governor, and the Executive Council by February 1.

Observation No. 17

Improve Compliance With Red List Reporting And Inspection Requirements

DOT-published Red List bridge reports did not conform to statutory requirements to prioritize bridges on the Red List for repair and to publish complete reports timely. Inspection cycles may have also been unnecessarily limited by, or non-compliant with, statute. Department compliance with law is a fundamental expectation and aids agencies in achieving their objectives. DOT compliance with statutory Red List reporting requirements and management practices related to the Red List were at the initial stage of TAM maturity.

Prioritization

The *2015 Red List* was not numerically prioritized as required. The DOT maintained a separate BPL which included numerically prioritized red-listed bridges, non-bridges, and non-red-listed bridges. Some red-listed bridges were not given numeric priorities and the *2015 Red List* did not include any BPL priority information.

Annual Reporting

The listing of State bridges provided to designated recipients on January 30, 2015 by the DOT was marked as draft and was being reviewed for completeness. The February 5, 2016 document was late, included the *2015 Red List* with preliminary draft information on anticipated CY 2016 Red List changes, and excluded relevant, vetted inspection data for CY 2015. DOT practice was to produce a final and complete version of the annual Red List by April 1, when the federal government required bridge information be submitted. DOT personnel reported needing more time than statute permitted to vet inspection results and load ratings, and that they sought to comply with federal requirements.

Inspection Frequency

Statute provided two inspection frequencies: bi-annual for red-listed State bridges or biennial for all other State bridges. Statute did not provide for DOT increasing inspection frequencies for non-red-listed bridges. However, the DOT used the Red List as the tool to identify structures, including non-structurally deficient bridges and non-bridge structures, it found warranted bi-annual inspections due to perceived risk. The DOT also reported inspecting special structures, such as those requiring underwater inspections or specialized equipment, on a cycle more frequent than biennial regardless of their Red List status.

Recommendations:

We recommend DOT management comply with statutory Red List reporting requirements and:

- **number and prioritize the Red List relative to the need for repair or replacement of red-listed State bridges;**

- **submit a complete Red List report to statutorily-designated recipients by February 1 annually, or request a statutory amendment requiring an April 1 submission date; and**
- **evaluate the need for statutory authority to inspect non-red-listed bridges more frequently than once every two years.**

Agency Response:

We concur in part.

The Department concurs that the report was not finalized by February 1, 2016 as required by statute, though it was complete on February 4, 2016. The Department will strive to meet the February 1 date in the future, but will seek to amend the statute to revise the February 1 date to April 1 to align with federal reporting requirements and make the process more efficient.

The Department does not concur with the report's interpretation that the statute stipulates the maximum number of inspections of State-owned and municipally-owned bridges. The Department believes the intent of the statute is to ensure the safety of the travelling public and the Department believes under the doctrine of administrative gloss that latitude exists for the Department to interpret RSA 234:22 and 234:25-b as a minimum requirement of inspections.

Recommendations

- A. The Department will number and prioritize the bridges on the Red List relative to need for repair and replacement.*
- B. In order to efficiently prepare and disseminate the Red List report with a prioritized listing of bridges, the Department will request a revised date to allow time to number and prioritize the Red List bridges for replacement or repair, as the prioritization process must occur after bridge inspections are complete. The current February 1 deadline does not provide enough time for the prioritization process to be fully completed and reviewed by the Commissioner. The Department will seek amending the statute to revise the February 1 date to April 1, which will align with federal reporting requirements and make the process more efficient.*
- C. The Department does not believe that any clarification or additional authority is required to inspect deficient or critical bridges on a more frequent basis. Compliance with federal law requires the DOT to inspect bridges on a three hour frequency in certain circumstances (i.e., scour events).*

LBA Rejoinder:

The document provided on February 4, 2016 was incomplete, as we detail in the observation.

We did not question the DOT rationale for inspecting bridges with greater frequency than provided in statute. Statute explicitly prescribed two inspection frequencies, and agencies have the authority they are provided in statute. As we discussed in our Other Issue and

Concern section, administrative gloss is a legal doctrine based in case law with origins in local zoning ordinance disputes before a court. Regardless of DOT speculation about how its actions may be defended in court, we have a responsibility to inform the Legislature of questionable DOT compliance with statute. We also note, if the DOT uses administrative gloss as a rationale for what it has been doing, it is also acknowledging there is ambiguity in law.

Other Bridge Conditions

The DOT identified bridges not meeting the needs of the public highway it carried, or current design standards, but were not structurally deficient. These bridges were functionally obsolete. Unaudited DOT data identified 194 functionally obsolete, federal-definition bridges (9.0 percent), those with clear spans of 20 or more feet, as of December 31, 2014. Functional obsolescence analyses were not conducted for non-federal definition bridges, those with clear spans of at least 10 but less than 20 feet, so 194 likely understated the number of functionally obsolete bridges in the State inventory.

To remain in service, bridges might have posted weight limits, restricting the weight of crossing vehicles to less than the maximum weight typically allowed. Also included in the inventory were excluded-crossing (E-posted) and caution-crossing (C-posted) bridges. The DOT was also required to regularly publish a list of these bridges. The DOT maintained six different categories of load-restricted bridges on its list, which encompassed 295 bridges, or 13.7 percent of the total CY 2014 bridge inventory, including:

- 24 bridges (1.1 percent), which were load-posted, with numeric gross weight restrictions identified;
- 193 bridges (8.9 percent) categorized as E-2, which excluded all certified vehicles;
- 49 bridges (2.3 percent) categorized as E-1, which excluded only single-unit certified vehicles;
- five bridges (0.2 percent) categorized as C-3, which excluded single-unit certified vehicles and required other certified vehicles to cross alone;
- 20 bridges (0.9 percent) categorized as C-2, which required all certified vehicles to cross alone; and
- four bridges (0.2 percent) categorized as C-1, which required only single-unit certified vehicles to cross alone.

Additionally, the DOT created formal and informal categories of non-red-listed bridges. Bridges with conditions generally better than red-listed bridges were also assigned color or other ratings by condition, including pink, yellow, and green. Former bridges closed to traffic but still standing were black-listed. Black-listed structures remained in the inventory and received routine inspections until de-listed.

Observation No. 18

Improve Bridge Condition Categorization And Reporting

DOT bridge condition categorization did not follow a single defined practice and was unnecessarily complex. DOT bridge condition categorization efforts were at the awakening stage of TAM maturity.

Common terminology and standardized information help remove communication barriers and facilitate cooperative decision-making. Policies and procedures should facilitate achieving organizational objectives and be documented. Some of DOT's formal and informal lists were publicly shared, while others were primarily internal but used for various reporting, prioritization, and analytical purposes.

Inspection ratings of major bridge elements permitted further bridge categorization beyond the structurally deficient bridge Red List. Additional categorization aided summary analyses of bridge inventory conditions and guided DOT decision-making regarding preservation and rehabilitation efforts. As many as five distinct systems listing bridge conditions existed. However, these bridge categorization lists were not identified in the *Bridge Strategy* as tools for guiding work priorities, and no manual existed to define each list or prescribe their uses. The DOT bridge inventory used four colors to code bridges, but other public reporting and internal analyses assigned different colors and other terms to bridges with the same conditions. Based on NBI condition ratings, and depending on the listing system used, the DOT identified structures with minimum:

- NBI ratings of 9 through 7 as “green” or “green list” bridges;
- NBI ratings of 6 as “yellow,” “yellow list,” or “mediocre list” bridges;
- NBI ratings of 5 as “yellow,” “yellow list,” “mediocre list,” “pink list,” or “near Red List,” with the latter two indicating the bridges were expected to deteriorate onto the Red List;
- NBI ratings of 4 through 2 as “red,” or “Red List” bridges or structures, with differing definitions of structurally deficient affecting Red List inclusion or exclusion as described in Observation No. 15; and
- NBI ratings of 1 and 0 as “black,” “black list,” or “Red List” structures, with one published report identifying both NBI ratings as warranting red-listing.

Certain bridges appeared incorrectly categorized as one color when their condition ratings appeared to warrant different categorizations. Based on unaudited DOT data, one green-listed structure had NBI ratings warranting yellow list status, three red-listed bridges should have been yellow-listed, and black-listing appeared more inconsistent.

The DOT lacked a policy for including or excluding bridges from the black list. In practice, the black list did not include structures carrying public highway traffic, although these structures were inconsistently marked as closed in inventory data. The black list included railroad-carrying structures, both in- and out-of-service, with NBI ratings of 9 through 7, but railroad structures with NBI ratings of 6 and 5 were yellow-listed, while those rated 4 and below were red-listed.

Bypassed historic structures were generally black-listed, but one was red-listed and another was green-listed. Non-bridge structures, such as those carrying bike and pedestrian paths and snowmobile trails, appeared to be black-listed if: 1) NBI-rated 9 through 7, or 2) NBI-rated 4 through 0, but were yellow-listed if NBI-rated 6 or 5. DOT personnel reported deciding whether a structure should be black-listed or red-listed was a judgment-based decision in certain situations. We identified at least 57 non-bridge structures in the DOT-reported CY 2014 inventory, 23 of which were included by the DOT on the black list.

Additionally, smaller, non-federal definition bridges were not categorized as functionally obsolete in DOT data, and functionally obsolete bridges were not tracked comprehensively in a separate list. The DOT did not consider C- and E-postings to be the same as load postings, or to trigger functional obsolescence designations, despite their limitations on the transportation network.

The *Bridge Strategy* did not specifically address any of these bridge subgroups.

Recommendation:

We recommend DOT management simplify and document processes for categorizing bridges by condition, and integrate all bridge subgroups into the *Bridge Strategy*.

Agency Response:

We concur in part.

The Department does not concur with the report's observation that certified load-posted bridges should be identified as functionally obsolete. The Department and FHWA do not consider an E-posted or C-posted bridge as a weight restricted bridge as only a bridge with a numerical gross weight is considered load-posted. These bridges are not functionally obsolete by the federal definition. The Department will document this along with other common terminology and standardized information.

The Department agrees that clarity in the categorization of bridges is important and will continue to make improvements to simplify and document the processes. Currently the Department has only one formal system of categorizing bridges (red, yellow, and green). The categorization process will be refined as the Department works toward a comprehensive bridge management program and as federal rules are finalized.

The Department will document the current process for categorizing bridges by condition state and follow the latest federal guidelines.

LBA Rejoinder:

The DOT did not address our recommendation to integrate all bridge subgroups. However, DOT management asserted elsewhere the *Bridge Strategy* specifically addressed maintenance and preservation of bridges, while the load-posted bridges may or may not be

driven by bridge condition ratings. The DOT agreed to document categorization processes, but determined the *Bridge Strategy* was not the appropriate method for documentation.

We did not recommend load-posted bridges be identified as functionally obsolete. We noted E-posted and C-posted bridges were based, in part, on vehicle weights and limit certain vehicles from crossing posted bridges.

The DOT noted having one formal system of categorizing bridges consisting of red, yellow, and green. However, as we noted in Observation No. 10, the September 2015 draft *Bridge Inspection Manual* provided guidelines for placing bridges on the black list and we found bridge condition inventory data explicitly listed bridges on the black list, albeit inconsistently. Further, DOT personnel reported practices for placing bridges on the black list.

Data Quality

Quality data underpin performance and cost analyses which support decision-making processes, and are integral to good management and successful TAM implementation. Management-assigned key roles and responsibilities, as well as formal, written policies and procedures help ensure data completeness, accuracy, and validity. The DOT could not demonstrate efficient and effective bridge management without quality data.

Observation No. 19

Improve Data Quality And Controls

The quality of select DOT bridge data and management controls needed improvement, and were at the awakening stage of TAM maturity.

Bridge-related data issues were commonly understood to exist. While the BOBD had more controls over bridge inventory data, the BOBM lacked adequate controls over bridge maintenance data, and both needed to remediate deficiencies and ensure quality. As outlined in Observations No. 14 and No. 20, the DOT operated unintegrated manual and automated information systems developed and maintained to meet specific needs, and a formal bridge records management program was needed. These factors, in conjunction with existing data management controls, in some cases affected the DOT's ability to collect and retain quality bridge data. Data errors, while affecting bridge condition and inventory records, had no apparent effect on bridge safety, capacity, or the number of structures on the *2015 Red List*.

BOBD Data And Controls

To fulfill federal requirements for the bridge inspection program, the DOT assigned the BOBD formal responsibility for maintaining and validating the bridge inventory and condition data for the annual NBI submissions. Federal program reviews identified data quality issues. While we did not deliberately review, and the DOT has never formally reviewed, bridge-related data

system general and application controls, we found discrepancies between the April 2015 NBI submission, encompassing CY 2014 inspection results, and CY 2014 bridge inventory and condition data, in addition to several condition and inventory data inaccuracies independent of these datasets.

- Eight bridges had conflicting inspection ratings between the bridge condition and inventory data and the NBI submission. The DOT identified the errors, corrected them in the State inventory data after one year, and submitted corrections to federal authorities after nearly two years.
- At least ten bridges had incorrect structural evaluation ratings in the NBI submission, which may have affected their structural deficiency categorization. The DOT reported three of these errors were corrected before we identified them, and accurate information was contained in a separate database. At least two bridges were inaccurately coded as structurally deficient or functionally obsolete in the NBI submission due to system calculation errors.
- One structure with NBI rating of 6 in the bridge condition and inventory data and eligible for yellow-listing was erroneously assigned to the green list.
- At least eight railroad structures, including three on the *2015 Red List*, were inaccurately labeled as railroads under highway bridges in the NBI submission, when the railroad structures were actually over a highway.
- A structure large enough to be defined as a bridge was located during a culvert inspection, but was not in the bridge condition and inventory data.
- Two separate bridges in the bridge condition and inventory data were inconsistently listed as one bridge in the NBI submission, resulting in the NBI submission reporting 2,159 bridges in the State bridge inventory, when 2,160 were listed in bridge condition and inventory data.
- At least 22 invalid bridge key numbers were used in the bridge condition and inventory data.

Another database held definitive data on bridge load carrying capacities which were not timely or consistently integrated and affected the quality of these datasets. The bridge file number database was incomplete and being developed, and did not include all corresponding bridge designs. Further, BOBD archive drawings were missing for 11 of 54 structures (20.4 percent).

BOBM Data And Controls

Although BOBM personnel held formal responsibility to maintain documents and accurate records, the DOT did not formally designate stewards for BOBM maintenance task data. There were no policies or procedures on BOBM data management. BOBM management reported working to alleviate data control inadequacies and was aware of:

- data entry errors in MATS;
- the inability to automate corrections from one database to another, or easily access data;
- a lack of data validation;

- data collection deficiencies, such as not being able to tie bridge maintenance activities to a specific asset across databases without manual data manipulation; and
- bridge maintenance activities not being fully or consistently recorded, creating an incomplete database.

We reviewed 66 bridge maintenance files and found:

- One bridge was removed from BOBD condition and inventory data following replacement and reconstruction, and assigned a new identifying number. However, the BOBM maintenance database was not updated, and the former bridge identification number continued to be identified as receiving maintenance activities.
- Two culvert repair tasks were categorized as bridge work in the maintenance database, but the structures did not meet the State definition of a bridge, and were not listed in bridge condition and inventory data.
- Systematic bridge maintenance and preservation work was categorized as both “non-bridge” and “unnumbered bridge” work throughout the maintenance database.

We also reviewed BOBM accomplishments in a separate DOT application and found:

- Evidence of invalid data entry such as recorded work hours with zero physical output and work hours with negative physical output, as well as WCCs and project numbers which management specified crews not to use, yet were prominent in the work accomplishments.
- All BOBM projects should have included some overhead, but it was inconsistently recorded for projects. For example, some projects lacked any recorded overhead, while others were charged entirely to overhead WCCs.

Recommendations:

We recommend DOT management assign responsibility for:

- **developing, implementing, and training staff on data policies and procedures;**
- **validating data to ensure accuracy; and**
- **remediating errors.**

We also recommend DOT management consider a formal review of general and application controls over bridge-related data systems and monitor controls to facilitate continuous improvement.

Agency Response:

We concur in part.

We offer the following for clarification.

The Department agrees that data quality is of critical importance to a comprehensive bridge management program and that improvements can be made to current practices and systems. Quality data does not equate to perfect data. Bridge inspection data, which is collected through a certified and structured program, is a well-established process and all inspectors are trained and certified. This inspection data is checked at a number of different levels to ensure its accuracy prior to formal submission.

The Department does not concur with various statements of inaccurate or incomplete data and offers the following to the contrary.

- The Department felt it was sufficient to include the corrected information in the subsequent submission to FHWA as the errors did not have an effect on the bridge capacity or safety and the correction did not affect the Red List.*
- The report stated that at least ten bridges had incorrect structural evaluations in the NBI submission. The Department identified the inaccuracies and corrected the ratings in the bridge database. This error resulted from a glitch in the system, which was due to a failed highway program termed the “translator” that was built into the Pontis system. The DOT bridge inspection team is aware of this glitch, and have taken steps to preclude the error from re-occurring in the future. The NBI submission did not affect the Red List.*
- The report stated that at least two bridges were incorrectly coded as structurally deficient or functionally obsolete in the NBI submission. The determination of structurally deficient (FHWA term) or functionally obsolete (FHWA term) is calculated by a FHWA approved program. FHWA makes the final determination whether a bridge is structurally deficient or functionally obsolete.*
- The report stated the NBI submission inconsistently reported 2,159 bridges in the state inventory when 2,160 bridges were listed in the bridge database. The NBI provides flexibility when coding northbound and southbound bridges as one or two structures. The NBI also provides flexibility for states to change the coding of bridges. In this circumstance, a northbound and southbound Turnpike bridge was initially coded as one bridge, and later coded as two bridges consistent with other northbound and southbound bridge situations.*

The Department does recognize the need for an integrated system to track bridge maintenance activities at a more comprehensive level. As outlined in previous responses the expectation is that BrM will help meet those needs.

The Department uses the MATS program to track all labor and equipment costs by BOBM staff for each bridge asset. The program also has the capability to track the quantity of work completed. However due to past limitation with the software, that was not corrected until the completion of a new report this fiscal year, it was difficult to determine if the quantity of work was accurately reported. With this reporting capability, the Department now has the capability and has instituted a verification of work accomplishment at project close out to eliminate zero output reporting errors.

The Department concurs that improvements are necessary to integrate data across multiple databases, as well as to tie bridge maintenance activities seamlessly to the specific assets. As stated earlier, the development of a comprehensive system takes time and continued investment of resources. Investment in these initiatives will increase overall efficiency, however with current staffing levels, progress will be gradual as staff attempt to balance working on strategic improvements while ensuring the delivery of the bridge program or bridge maintenance efforts.

Recommendations

The Department notes that training, quality assurance, quality control, and certification are already utilized for bridge inspection data. The Department will work to ensure that the program remains certified and efficient. As asset management and data governance continue to evolve and mature at the DOT, those principles, practices, and procedures will be incorporated into bridge management systems to ensure data accuracy and remediation of errors. The Department senior leadership and Commissioner's Office will continue to be engaged to guide the development of the asset management program, and as a subset the bridge program, to ensure appropriate levels of controls and continuous improvement are implemented.

LBA Rejoinder:

The DOT's response did not address our recommendation to consider a formal review of general and application controls over bridge-related data systems and monitor controls to facilitate continuous improvement.

We did not state the DOT was expected to have perfect data, just adequate management controls over its data. We found no data accuracy standard set by the DOT, and inadequate management controls.

While the DOT described the bridge inspection program as "structured," this did not correspond to a maturity level. We found the maturity level based on BOBD and BOBM controls to be at the awakening level. To move to the structured or proficient maturity levels, a broader perspective completely removed from data silos, such as a bridge information management system or MATS, is necessary. Further, the DOT was unsure if the new system, BrM, would meet DOT's bridge management data needs, and the DOT lacked a BrM implementation timeline or plan. Maturity may degrade during the implementation of BrM as new processes and practices are developed. Finally, the DOT's response stated bridge inspections under BOBD were more controlled under regular federal oversight, which we noted in the observation, but the DOT did not address the lack of BOBM controls under the Department's supervision.

Recordkeeping

Records contain information, and for an organization to run and control its operations, it must have relevant, reliable information. Information is integral to asset management implementation and its role as a decision-support system. The lifecycle of transactions and significant events

should be promptly, completely, and accurately recorded. Records include any information created, accepted, or obtained by, or on behalf of, the DOT in furtherance of its official function. Information includes knowledge, opinions, facts, or data of any kind. In addition to statutory recordkeeping obligations, the DOT had extensive project-related recordkeeping and archiving requirements in policy and maintained numerous manuals focused on construction projects, including manuals addressing quality, design, recordkeeping, and auditing.

Observation No. 20

Improve Records Management

While certain records were created and some decisions documented, the DOT lacked a formal, comprehensive records management program meeting statutory requirements. Statute required the DOT to establish and maintain a records management program, with records containing adequate and proper documentation of decisions, procedures, and transactions. The DOT operated unintegrated manual and automated information systems developed to meet specific needs. Management responsibility was distributed. DOT project-related recordkeeping and archiving policies were not applied to the BOBM. DOT bridge records management was at the initial stage of TAM maturity.

Key Decisions And Procedures

Key bridge management decisions might have been formally or informally documented only as an output – that the decision was made. The underlying bases and processes leading to these decisions were not documented. Other decisions were never memorialized. This included prioritizing bridges for inclusion and ranking on the BPL, creating and changing the BOBM’s annual and two-week repair task lists, relegating certain bridges to a wait-for-red-list or keep-in-service status, including non-bridge work on annual repair task lists; the use of bridge maintenance funds for non-bridge work; growing the State’s bridge inventory through completion of maintenance tasks expanding non-bridge culverts into bridges; adding non-structurally deficient bridges, and non-bridge structures, to the Red List; and generating backlog estimates.

There was no written BOBM manual, nor did BOBM have a records retention schedule.

Operational Records

Operational records memorialize transactions throughout their lifecycle. We found gaps in recordkeeping, including BOBD archive drawings for State bridges, BOBM bridge maintenance files, development and execution of long- and short-term repair task lists, and bridges not receiving recommended maintenance.

The quality of project selection, trade-off analyses, and resource allocation decisions are directly related to the quality of the information upon which they are based. Current crews might find unrecorded repairs to, or materials used on, bridges. The bridge maintenance files we reviewed often contained running indices of activities undertaken by the BOBM for each bridge. Utilizing

these records appears to have generally ceased in the 1990s. This nonetheless indicates that, at some point, the BOBM strove to record its efforts by asset, and memorialize them for subsequent generations of bridge maintainers. The repair task list database was also set up to accommodate similar data, but was unused.

BOBM management was cognizant of some recordkeeping and data integration inadequacies, and reported working to improve recordkeeping and project close-out procedures. However, no formal plan detailed deliverables and milestones.

Recommendations:

We recommend DOT management comply with statute and:

- **implement and operate an economical, efficient, and effective records management program;**
- **make and maintain records containing adequate and proper documentation of its organization, functions, policies, decisions, procedures, and transactions;**
- **retain all records made or received; and**
- **dispose of records not having a permanent or historical value according to the relevant retention schedule.**

We further recommend DOT management:

- **formalize a record retention schedule, and related practices and procedures;**
- **centralize and consolidate bridge records, unifying stewardship within a single organizational unit;**
- **define what a complete bridge record constitutes;**
- **ensure transaction lifecycles and significant events are promptly, completely, and accurately recorded;**
- **ensure complete records are available to support decision-making, benchmarking, and performance measurement; and**
- **assess effectiveness and efficiency of the program, improving upon it as necessary.**

Agency Response:

We concur in part.

The Department agrees that record management is important to the administration of a comprehensive bridge management program and needs to be improved. In recognition of this importance, the Department is committing resources to the development and implementation of BrM. We agree that the documentation, integration and retrieval of records need to be improved.

Prior to the 1990s paper records were kept for individual bridge, and with the implementation of tools such as MATS, BOBM stopped this practice. While we recognize it is important to have documentation on decision making, keeping paper files for over 2,000 bridges did not support

analytical and trending evaluations. Moving forward the Department will pursue asset management tools for data collection, as well as tools for document control and data management.

Recommendations

- A. The Department will continue to make efforts to manage records efficiently and effectively. A comprehensive program for the entire Department will require significant resources to implement and may be best developed at a statewide level.*
- B. The Department will review its current policies, procedures, and relevant documentation concerning decision-making to ensure they are up-to-date and reflect current practices.*
- C. thru E. The Department will develop a record policy in compliance with state and federal guidelines and laws to include what constitutes a record, how records are handled and stored and formulize a record retention schedule. This effort will be undertaken as part of the data governance aspect of asset management.*
- F. thru J. The Department will review records management practices relating to the bridge program and prepare a report by December 31, 2017. The Department will look to ensure the records management program includes the ability to link transactions and track significant events to the asset with an ability to promptly and accurately record the information. Additionally, the Department agrees that complete and accurate records are important to support decision-making, benchmarking, and tracking performance. This is the core of asset management and will be an element the Department builds the program on. Lastly, the program will include metrics and targets to help assess efficiency and effectiveness of the individual elements.*

LBA Rejoinder:

The DOT appears to fully concur with our recommendations.

Paper files for over 2,000 bridges may not efficiently support analysis. We did not suggest the DOT utilize paper, or any particular media, for recordkeeping. However, the DOT asserted the BOBM “maintains files on every state owned bridge.... These files include *pertinent information* from past projects. Past data has not been as complete as desired.” [emphasis added] We expected pertinent information within the BOBM bridge files. The records we found were inadequate, rendering the purpose for which they were created unauditible. This condition prevailed in several areas.

As we noted in the observation, BOBM had a repair task list database set up to accommodate similar data to bridge files, but was unused. Had it been used, it could have provided the DOT with the data it needed for analysis and evaluation.

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OTHER ISSUE AND CONCERN

In this section, we present an issue we consider noteworthy, but did not develop into a formal observation. The Department of Transportation (DOT) and the Legislature may wish to consider whether this issue and concern deserves further study or action.

Review Application Of Administrative Gloss

As we discussed in our April 2008 Board of Medicine Performance Audit report, administrative gloss is a legal doctrine based in case law with origins in local zoning ordinance disputes. Since its creation, courts have applied this doctrine to State law and State agency operations to clarify regulatory language and interpret legislative intent. Administrative gloss applies when: 1) a law or ordinance is ambiguous, 2) an implementing agency has consistently applied one interpretation across similar cases, 3) the same interpretation has been applied over a period of years, and 4) the governing legislative body has not interfered to change the implementing agency's interpretation. When these four criteria are met, a court may find the agency's implementation is, under the doctrine of administrative gloss, considered to be an implied fulfillment of legislative intent, and thus sets de facto policy that can only be changed through legislative action.

Administrative gloss erodes legislative authority. Where statutes require further clarity or interpretation for implementation, the Legislature provided Executive Branch agencies formal rulemaking and adjudication processes in statute, which include procedural, hearing, documentation, and legislative oversight requirements. Applying administrative gloss bypasses established processes and permits agencies to adopt past practice as de facto rules without public input, legislative review, or documentation. Lawmaking power resides with the people's representatives in the Legislature, and it may only delegate authority or discretion as to a law's execution. Separation of powers between the branches of government is a constitutional imperative, and administrative gloss may represent Executive Branch encroachment on the Legislature's authority.

The DOT speculated administrative gloss might apply to its practices regarding the definition of traffic, inspection frequency, and using bridge maintenance crews and appropriations for non-bridge structure maintenance and improvement. Determining whether administrative gloss applies is the role of the courts and occurs during a contested case. The doctrine did not appear to contemplate use by State agencies to circumvent seeking clarification or additional authority. Neither did it appear to contemplate application by a State agency seeking to justify past practices identified in a performance audit as contributing to inefficiency or ineffectiveness.

Nonetheless, we reviewed DOT's assertions and question their application of this doctrine, as each appeared to not meet at least one of the four relevant criteria:

- Bridge Maintenance Resources for Non-bridge Work. As discussed in Observation No. 11, the Legislature explicitly and specifically intervened in 2005 to transfer

authority for building construction, reconstruction, maintenance, and repair away from the DOT, and statute did not appear ambiguous.

- **Definition of Traffic to Define Bridges.** As discussed in Observation No. 16, statute and supporting information appeared to clarify the type of traffic bridges must carry, public highway traffic, and specifically excluded rail-bound modes from traffic altogether. Further, the DOT inconsistently implemented its interpretation across similar cases of closed structures. One red-listed structure was closed, and funding for its removal was allocated, but the structure remained red-listed. Similar structures were not red-listed. At least one structure in the bridge inventory did not even span a gap.
- **Inspection Frequency.** As discussed in Observation No. 17, the Legislature intervened in 2014 to address inspection frequency establishing an inspection frequency for red-listed bridges, codifying only one component of past DOT practice, and did not include the frequency as a minimum threshold, contrary to the interpretation proffered by the DOT.

We suggest the DOT discontinue speculating about what a court might conclude about its past interpretations were such a case to come before a court, and instead seek clarification from the Legislature or promulgate rules to clarify perceived statutory ambiguity, seeking relevant authority when necessary.

The Legislature may wish to examine the application of administrative gloss by the Executive Branch.

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APPENDIX A

OBJECTIVES, SCOPE, AND METHODOLOGY

Objectives And Scope

In December 2015, the Fiscal Committee of the General Court adopted a joint Legislative Performance Audit and Oversight Committee recommendation to conduct a performance audit of Department of Transportation (DOT) bridge maintenance practices. We held an entrance conference with DOT management in January 2016.

Our audit was designed to answer the following question:

How efficient and effective were Department of Transportation bridge maintenance and preservation practices during State fiscal years 2014 and 2015?

We sought to understand:

- the statutory and regulatory framework within which bridge maintenance and preservation activities occurred,
- the role of maintenance and preservation within the DOT's transportation asset management environment, and
- the implementation of management controls intended to achieve maintenance and preservation goals and objectives.

Methodology

To understand the statutory and regulatory framework within which bridge maintenance and preservation activities occurred, we:

- reviewed State and federal laws, rules, policy, and guidelines;
- interviewed knowledgeable DOT personnel and management;
- reviewed federal, interest group, academic, and other states' materials related to asset management;
- conducted four site visits to ongoing maintenance projects; and
- reviewed relevant DOT budgets, policies, procedures, plans, guidelines, and contracts.

To understand the role of maintenance and preservation within the transportation asset management environment, we interviewed knowledgeable DOT employees and reviewed:

- State and federal laws, rules, policy, and guidelines;
- federal, interest group, academic, and other states' materials related to asset management, including preservation, maintenance, lifecycle analysis, gap analysis,

performance management, disinvestment, construction and project management, information governance, and risk management;

- relevant audits, reviews, evaluations, and guidance from other states, academia, professional associations, and the federal government including the Federal Highway Administration and the American Association of State Highway and Transportation Officials;
- relevant DOT strategies, plans, goals, objectives, policies, and data;
- ongoing DOT initiatives, contracts, and deliverables; and
- DOT practices, and compared them to relevant guidelines and accepted practices.

To understand implementation of management controls intended to achieve maintenance and preservation goals and objectives, we:

- interviewed key DOT personnel and management;
- reviewed relevant audits, reviews, evaluations, and guidance from other states, academia, professional associations, and the federal government;
- reviewed bridge bureau organization charts, supplemental job descriptions, data applications, and the DOT website;
- observed relevant DOT field operations and office practices;
- attended management meetings prioritizing bridge projects;
- reviewed and analyzed relevant DOT performance data, records, and reports; and
- compared DOT practices to relevant guidelines and accepted practices.

We also reviewed a judgmental sample, randomized within specified categories, of 66 Bureau of Bridge Maintenance (BOBM) tasks in paper files, three software applications, and one MS Access database, to determine whether: 1) records were complete, accurate, and contained required project documentation; and 2) efficiency and effectiveness could be determined of recorded BOBM maintenance and preservation activities. Our sample of BOBM tasks included:

- 54 bridges, drawn from ten strata and randomly selected within each strata, including large and small projects of different prioritization, size, and condition rating; and
- 12 non-bridge work tasks, designed to be a complete review of non-bridge work project files based on available information.

Because we used a non-statistical sample, results cannot be projected to the entire population of bridge files. Other data quality issues manifested themselves, and we qualify our use of DOT data and our conclusions resting thereon as a result.

We did not examine engineering decisions, railroad bridges, non-State bridges, lift-bridge operations, or other management controls not directly related to bridge maintenance and preservation, such as information technology system general and application controls.