CHARACTERISTICS OF DECOMMISSIONED BRIDGES

FINAL REPORT

Prepared for:

The National Cooperative Highway Research Program (NCHRP)
of
The National Academies of Sciences, Engineering, and Medicine

Prepared by:

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Institute for Transportation, Iowa State University
Ames, Iowa

June 30, 2018

The information contained in this report was prepared as part of NCHRP Project 20-07, Task 397, National Cooperative Highway Research Program.

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ABSTRACT

The main objective of this research was to identify the main reasons for bridge decommissioning in the United States. Relevant studies from the literature reported deficiency, poor NBI condition ratings, lower load carrying capacities, vulnerabilities, and road widening projects as most common causes of bridge decommissioning. A common finding in the earlier studies was that reasons for decommissioning could not be identified for a significant portion (15% to 30%) of the records. For the first analysis in this research, decommissioned structures were identified from historic NBI files and their characteristics were analyzed. Based on a national survey performed for the project, the literature review, and initial analysis, potential drivers of decommissioning were then identified. These potential drivers were then compared with agency reasons gathered from five States (Utah, Michigan, California, Pennsylvania, and Florida). The final task was a comparative analysis of the decommissioned structures with the new structures that replaced them. Overall, functional improvements are the major driver of bridge decommissioning and they also explain majority of unexplained cases. Structures replaced due to functional reasons are also replaced younger than the structures replaced due to poor condition on average. Although the potential drivers provide sufficient identifiers of decommissioning, drivers derived from the NBI data by themselves are not specific enough to explain decommissioning as comprehensively as agency-provided reasons.

SUMMARY

Bridge management and preservation efforts in the United States have advanced substantially in the last decade as bridge management practitioners and researchers have increasingly utilized decision-making processes based on objective data and improved data collection methods and tools. Extending the useful life of bridges through better design, construction, and management has been a shared effort of the bridge management community. The data in the National Bridge Inventory (NBI) and in element condition data offer valuable resources to understand the condition behavior of bridges throughout their service lives. However, once a bridge is decommissioned, it simply is no longer reported to the NBI, and the NBI does not record information on closures that may indicate why that structure was replaced. While the primary reason for replacement would intuitively be condition, recent research has indicated that bridge replacements may not necessarily be driven by the condition of the bridge, and the estimated median service life for bridges, 53 years, is much lower than the desired service life of 100 years.

The main objective of this research was to identify the main reasons for bridge decommissioning in the United States and to investigate the major factors behind bridge decommissioning (if bridge condition is not the primary factor). The research was conducted in four major tasks:

- Literature review and survey
- Analysis I, using historic NBI data files
- Analysis II, using select agency records
- Analysis III, using old and new structures at the same location

A literature review investigated and summarized relevant studies that discussed reasons or drivers of bridge decommissioning. Although agencies are in a transitional state of implementing the requirements of the Moving Ahead for Progress in the 21st Century Act (MAP-21) and Fixing America's Surface Transportation (FAST) Act, they reported that, traditionally, load rating/posting, NBI condition ratings, vulnerabilities (scour, seismic, fracture critical, fatigue-prone details), traffic capacity, and functional aspects have been the major factors considered in selecting candidates for bridge replacement. Relevant studies from the literature reported deficiency, poor NBI condition ratings, lower load carrying capacities, vulnerabilities, the need for additional lanes, and road widening projects as most common causes of bridge decommissioning. A common finding in all studies was that reasons for decommissioning could not be identified for a significant portion (15% to 30%) of the records.

For the first analysis in this research, unique bridge numbers were tracked through the NBI files to identify decommissioned structures. A comprehensive sample of 36,459 structures decommissioned between 1992 and 2016 were identified and gathered for the study sample. NBI data variables were analyzed for this data set to identify potential drivers of replacements. Based on the analysis results and the findings from the literature review and a survey of State agencies,

potential drivers of bridge decommissioning were selected. Poor condition, functional inadequacy, and vulnerabilities were selected as the primary drivers of decommissioning. Fair condition and fair appraisal ratings were selected as secondary drivers. Assignment of all primary and secondary drivers to the decommissioned structures showed that approximately 82% of the decommissioned structures had more than one primary or secondary driver associated with them. Functional inadequacy was the most frequent driver, with almost 57% of decommissioned structures listing functional inadequacy as a driver. Poor condition by itself was observed for only 9% of decommissioned structures, and 36% of decommissioned structures had poor condition as one of the drivers.

For the second analysis, agency records that cited the reasons for decommissioning structures were gathered from five States (Utah, Michigan, California, Pennsylvania, and Florida), each State representing one of the four AASHTO Transportation System Preservation Technical Services Program (TSP2) bridge preservation partnerships. The records for the 788 decommissioned structures covered by the agency records indicated that approximately 8% of the structures had actually changed ownership and that another 3.5% were either removed from the State inventory or the NBI. A total of 7% of the structures were decommissioned to address vulnerabilities, while 9.4% were decommissioned to address poor condition. Approximately 18% of the decommissioned structures were deficient, including both SD and FO structures. Decommissioning due to functional improvements was by far the most common reason cited. Almost 40% of the structures were removed or replaced for roadway projects, while 15% of the structures were not linked to a reason for replacement. A comparison of the potential drivers identified by the research team and reasons cited by the agencies showed that almost 40% of structures were decommissioned due to functional reasons. In comparison, poor condition and deficiency collectively accounted for 32% of the decommissioning decisions. Relevant drivers identified by the research team matched a majority of the agency-cited reasons for decommissioning. However, it was not possible to assign these drivers as reasons, particularly when structures had multiple drivers associated with them. Agency decisions are bridge- and location-specific and involve policy and funding constraints that are not captured within the NBI data. The findings show that analyzing only the NBI data for decommissioned structures can help identify a series of potential reasons for decommissioning but cannot pinpoint the real reason for decommissioning.

The third analysis was a comparative analysis of the characteristics of 9,810 decommissioned (old) structures that were matched with the new structures that replaced them. The findings indicated a significant number of functional improvement projects, based on the observed increases in bridge geometry. Replacements appeared to be most frequently driven by functional inadequacy and poor condition (35%), by only functional inadequacy (22%), or by only poor condition (12%). Functional inadequacy was the major driver of replacements. Approximately 14% of the old structures had no drivers associated with them, consistent with the studies in the literature and the other analyses within this study. Further analysis of the data for these old structures and the subsequent structures in the same location revealed that 71% of the old structures for which no drivers were identified were replaced with wider bridges on wider roads. Most likely, these structures were replaced due to functional improvement projects. This finding provides a potential explanation of the decommissioning and replacements that could not be linked to any driver in earlier studies. Also, structures potentially replaced due to functional

reasons were replaced younger than the structures replaced potentially due to poor condition, which may be leading to overall younger than expected ages for decommissioning.

Although the potential drivers identified in this project provide sufficient identifiers of decommissioning, drivers derived from the NBI data by themselves are not specific enough to explain decommissioning as comprehensively as agency-provided reasons can. Comparing replaced structures with new structures at the same location provides the ability to do comparative analyses. However, making this comparison is challenging due to the lack of relevant data fields and the lack of accurate and precise location information in historic archives.

The high portion of functional improvements in bridge decommissioning as reported by the agencies highlights the fact that bridge replacement decisions are often made for the transportation system rather than single assets. Tracking the reasons for decommissioning within the State and NBI databases and archiving the information such that it can be queried and integrated into relevant bridge management databases and tools would provide bridge managers and researchers with valuable information. Studying and understanding bridge performance using these improved data sets would improve bridge performance modeling and guide policy at the State and National levels.

In light of this study's findings, the research team suggests that adding data fields such as type of decommissioning (ownership change, removal from the inventory because the road is no longer maintained, replacement), previous and subsequent structure numbers, agency reason(s) for replacement, and source of funding for the replacement project into State and National bridge databases would be valuable for future research and bridge management.

CHAPTER 1 BACKGROUND

In the first section of this chapter, the general reasons of bridge collapses as reported in the literature are briefly discussed. The second section summarizes relevant studies in the United States that have examined the drivers of bridge decommissioning at the National and State levels. The third section gives an overview of forensic studies on decommissioned (structures whose records no longer appear in future NBI files) bridges. The fourth section presents a summary of major policies and practices that historically have impacted bridge replacements in the United States and the results of a survey on current agency policies.

1.1. General Reasons of Bridge Collapses

Bridge collapses may have devastating consequences for public safety and may lead to significant costs to bridge owners. Throughout history, many bridge collapses have led to fatalities, such as in the collapse of the Silver Bridge in Ohio in 1967. Bridge collapses, despite their costs to the public and to bridge owners, nevertheless provide information about the shortcomings in inspection and management practices and potential areas for improvement. The Federal Highway Administration (FHWA) and State departments of transportation (DOTs) have improved inspection and management practices to address lessons learned from past bridge collapses. In a study performed on 503 bridges in the United States, it was shown that nearly half of bridge collapses were due to either flood or scour, 32.8% and 15.5%, respectively (Wardhana and Hadipriono 2003). Floods usually contribute to the compromised structural integrity of bridges through a combination of soil erosion, scouring, softening of the bed rock, hydraulic jumping, sand mining, abrasion on bridge foundations, and debris impacts (Witzany et al. 2008, Hong et al. 2011, Wang et al. 2014). Scour can also cause lateral deflection of the foundation (Daniels et al. 2007, Lin et al. 2010).

Seismic vulnerability is another issue that may lead to bridge collapses. An earthquake may adversely affect the structural strength of a bridge as the vertical ground movement results in axial forces in piers and columns that can lead to major cracks, buckling, and a high bending moment in the mid-span of the bridge, along with induced shear cracks due to the horizontal ground movement (Kunnath et al. 2008, Kim et al. 2010, Veletzos et al. 2006, Priestley et al. 1994, Sun et al. 2011). Seismic events can also cause soil liquefaction, which alters the carrying capacity of the foundation and limits its ability to carry assigned loads (Hashimoto and Chouw 2003, Wang et al. 2013). Wind is another factor contributing to bridge collapses; wind causes torsional divergence, lateral torsional buckling and vibration, originating displacement, and stresses, especially in decks (Boonyapinyo et al. 1994, Cheng et al. 2002). Fire, overloading of vehicles, poor design, and lack of maintenance are some other factors that contribute to bridge instability and collapses (Deng et al. 2015).

Deng et al. (2015) conducted a study of the most common reasons of bridge collapses for different types of bridges. The study revealed that for beam bridges, flood, scour, earthquake, collision, and overloading are the primary reasons of bridge collapses. The same reasons, excluding overloading, also apply to masonry arch bridges. However, steel arch bridges commonly collapse due to wind and steel truss bridges commonly collapse due to fatigue, while

the most common reason of collapse for both is overloading. Wind was found to be the major reason of structural instability in flexible long-span bridges. The study further concluded that beam bridges fail due to misalignment of bridge deck sections, weak connection supports, shear and flexural failure in the deck, and dysfunction in the bearings. Failures in steel truss bridges are typically triggered by the failure of critical elements, such as connections and joints.

While bridge collapses naturally cause the removal of structures from bridge networks and the construction of new structures, they account for only a part of the structures that drop from bridge inventories. This study is focused on identifying the major triggers of bridge decommissioning and the reasons behind owners' decisions to remove or replace structures.

1.2. Major Reasons of Bridge Decommissioning in the United States

Although the number of studies overall has been limited, several studies in the literature have examined reasons for bridge replacement and decommissioning. Chase (2014) discussed different types of bridge decommissioning and analyzed the major factors for replacement based on National Bridge Inventory (NBI) data from 1992 to 2012. Analyses were performed in order to identify the service life of existing bridges and the factors limiting their service life. A sample of 11,753 bridges that were in service in 1992 and replaced (structures that were replaced with new structures at the same location) between 1993 and 2012 was studied; these bridges represented a partial sample of all replaced bridges.

The analysis showed that the median service life of the analyzed sample was 53 years. The analysis further showed that more than half of the replaced bridges were structurally deficient and 14% were functionally obsolete. However, 30% of the replaced bridges were not classified as deficient and were replaced for unidentified reasons.

Chase (2014) focused primarily on identifying the main reasons for deficiency within the selected sample. The main factors for structural deficiency were found to be load capacity and poor condition of the substructure. However, the main factor for functional obsolescence was a substandard roadway width.

The study revealed that some non-deficient bridges were replaced that had less than 20 years of service. An analysis of bridge length and width on the non-deficient bridges showed that the replacement bridges were longer and wider than the decommissioned ones. For 41% of the sample, the initial design capacities were lower than today's standards, and lower design capacity was a major contributor to deficiency in the sample. The study recommended detailed forensic autopsies on several decommissioned bridges each year to better understand the factors that limit bridge service life. The study further acknowledged that socio-political and economic reasons strongly affect bridge service lives.

In 2011, Hooks (2011) published a comprehensive study that included 20,645 bridges that fell out of service between 1992 and 2009. The study presented a variety of reasons for bridge failures, such as floods, earthquake, deck failure, vehicle impacts, and reconstruction of roads

(Hooks 2011). The surveyed sample showed that 85% of bridges were replaced due to structural deficiency or functional obsolescence, leaving 15% of the sample without well-identified reasons for their decommissioning. The findings of the study also showed that the most common reason for functional obsolescence was deck geometry, as also noted by Chase (2014). Hooks (2011) reported a normal distribution of median ages and significant variation in the median age of replacement with respect to the type and material of the bridge. Furthermore, it was found that 62% of the decommissioned bridges were carrying 500 vehicles per day, and another 25% carried between 500 and 1000 vehicles per day. The study further revealed that the primary reason for bridge decommissioning was for structural evaluation of the bridge.

In a recent study, Sobanjo and Thompson (2013) identified some reasons for the demolition or replacement of bridges in Florida. The authors reported that the most important factors were specific comments regarding the bridges in the agency database; the need to increase the number of lanes; an NBI condition rating of 4 for any structure, especially when combined with a reduced operating rating; and vulnerabilities such as severe channel deterioration, waterway inadequacy, and scour or fracture criticality. The authors noted that their assignment of a primary reason was not necessarily authoritative but based on presumptions regarding the differences between the new and old structures. Of 1,480 bridge retirements, the authors could assign a primary reason to approximately 70% but were unable to determine a reason for the remaining 30%.

These studies collectively report that deficiency, poor NBI condition ratings, lower load carrying capacities, vulnerabilities, the need for additional lanes, and road widening projects appear to be most common reasons of bridge decommissioning. The decommissioned structures are not necessarily old structures; the median age reported was 53 years. A common finding in all studies was that reasons for decommissioning could not be identified for a significant portion (15% to 30%) of the samples.

1.3. Forensic Studies on Decommissioned Bridges

Although, as discussed above, many reasons possibly contribute to the decommissioning of bridges, forensic autopsies on decommissioned bridges have indicated that load carrying capacity is not necessarily a factor in the decommissioning of bridges. Bridges that are classified as “structurally deficient” based on the current standards for rating bridges may still be able to safely carry the traffic loads on the highway system.

In a study analyzing a decommissioned skewed steel I-girder bridge, loads were applied while field testing that were representative of 17 HS-20 design vehicles, or 1,224 kips, until failure (McConnell et al. 2014). This study showed that the bridge could sustain 30% more loads than predicted by AASHTO (2013a), which uses a line-girder approach rather than a system approach.

In another study, done on a 38-year-old deteriorating two-lane concrete bridge with two shoulders, a destructive test revealed that the bridge was actually capable of bearing a total load of 720 Kips, the equivalent of 22 HS22-44 trucks, which was a load level that the bridge was

unlikely to ever bear. Therefore, decommissioning due to structural deficiency was not warranted, and it was concluded that the main reason for decommissioning was the deterioration of the bridge shoulder (Aktan et al. 1992, Miller et al. 1994).

Amleh and Mirza (2004), in their analysis of the Montreal Dickson Bridge, stated that the main reason of the bridge's deterioration and subsequent decommissioning was the effect of using deicing salts, which severely damaged the steel reinforcement through corrosion.

Another study was conducted by Zhang et al. (2013) that used destructive testing to understand the load carrying mechanism of a 43-year-old decommissioned bridge in China. The authors investigated the ultimate load carrying capacity of an existing reinforced concrete bridge and its structural response during the loading process. They reported that most of the load was carried by the middle beams due to the weakness of the transverse connection and that, accordingly, most of the cracks appeared at those transverse beams. Findings from several other studies have also confirmed the early decommissioning of reinforced concrete bridges (Jorgenson and Larson 1976, Burdette and Goodpasture 1973, Quinn 2005).

1.4. Policies on Bridge Replacement Eligibility and Selection

1.4.1. Introduction

The 1968 Federal-Aid Highway Act prompted state transportation authorities to collect and maintain an inventory of federal-aid highway system bridges. Congress later established two major federal bridge programs: the Special Bridge Replacement Program (SPRB) in 1970, which assists states in replacing and rehabilitating bridges, and the National Bridge Inspection Program (NBIP) in 1971, which ensures periodic national inspections (GAO 2008). The SBRP was enhanced and renamed by subsequent federal programs, first by the Highway Bridge Replacement and Rehabilitation Program (HBRRP) and later by the Highway Bridge Program (HBP). The HBP provided funding to enable states to improve the condition of bridges through replacement, rehabilitation, and systematic preventive maintenance and was the primary source of federal funding for bridges. HBP funds were available for deficient structures and based on thresholds of sufficiency rating (SR).

Until the Moving Ahead for Progress in the 21st Century Act (MAP-21) of 2012, the FHWA defined deficiency under two categories: structural deficiency (SD) or functional obsolescence (FO). Structural deficiency indicated poor condition and deterioration in structural elements or inadequacies in structural or hydraulic capacity, while functional obsolescence indicated a design or configuration that was no longer adequate for the traffic. Deficiency status affected both the allocation of federal funding and the eligibility to use federal bridge replacement funds.

For an NBI bridge to be designated as SD, it had to have either of the following:

- A bridge component (deck, superstructure, substructure, or culvert) having an NBI general condition rating of 4 or less (poor condition).

- A structural evaluation or waterway adequacy rating of 2 or less (a bridge with a very low load rating capacity or a bridge that is subject to overtopping and causing significant or severe traffic delays).

A bridge was designated FO when the deck geometry, load carrying capacity, underclearances, or approach roadway alignment no longer met the usual criteria for the current standards. In general, FO meant that the bridge was built according to older standards.

FO was numerically defined as follows:

- An appraisal rating of 3 or less for deck geometry, underclearances, or approach roadway alignment.

- An appraisal rating of 3 for structural evaluation or waterway adequacy.

In addition to SD and FO, the third criterion that determined the eligibility of bridges for rehabilitation or replacement was SR. Deficient structures with an SR between 50 and 80 were eligible for rehabilitation, whereas structures with an SR less than 50 were eligible for both rehabilitation and replacement.

Until MAP-21 eliminated the HBP, the criteria that determined the eligibility of highway bridges for federal funds, as described above, remained major performance measures for bridge management (Bektas 2011). MAP-21 established new performance requirements and penalties for the National Highway System (NHS), eliminated the HBP, and extended the scope of the NHS to include approximately 25,600 additional bridges nationally. With the Fixing America's Surface Transportation (FAST) Act, highway bridges continue to be eligible under the Surface Transportation Block Grant Program (STBGP) and the National Highway Performance Program (NHPP), with more federal-aid resources available for local highways and bridges. The changes under MAP-21 and the FAST Act collectively provide funding and resource allocation flexibility to state DOTs but also impose requirements for performance targets. For NHS bridges, two national performance measures took effect as of May 20, 2017: (1) percentage of NHS bridge deck area classified as being in good condition, and (2) percentage of NHS bridge deck area classified as being in poor condition. A bridge is in good condition if all NBI condition ratings are 7 or above. A bridge is considered to be in poor condition if the lowest of the NBI condition ratings is 4 or below. With the final rule, the FHWA also revised the definition and methodology used to classify a bridge as SD. As of 2018, an SD classification is given to a bridge that has any component in poor condition; therefore, SD is now equal to any bridge performance measure that receives a rating of “poor.”

23 U.S.C. 119(f) established a minimum standard for NHS bridge conditions. If more than 10 percent of the total deck area of NHS bridges in a State is on structurally deficient bridges for three consecutive years prior to the date of the determination, the State must devote NHPP funds equal to 50 percent of the State’s FY 2009 Highway Bridge Program apportionment under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

(SAFETEA-LU) to improve bridge conditions during the following fiscal year and each year thereafter in which the percentage of deck area on structurally deficient bridges remains at or above 10 percent of the total deck area on NHS bridges (FHWA 2016). All bridges on NHS must comply with Federal regulations. On October 1, 2012, Section 1104 of MAP-21 added to the NHS those roads that were at that time functionally classified as principal arterials but not yet part of the System. The NHS was expanded to about 230,000 total miles with these additions (FHWA 2013). Therefore, MAP-21 added bridges to the NHS that are owned by local agencies. While the construction, replacement, rehabilitation, preservation, and protection decisions for these structures are the responsibility of the structures' owners, the resulting condition of NHS bridges, including those structures, is ultimately the responsibility of State DOTs. Therefore, with all the legislative and operational changes noted above, State DOTs are currently in transition and are reassessing the eligibility of highway bridges for replacement and other bridge work and incorporating their revised bridge management frameworks into the State transportation asset management plans (TAMPs).

1.4.2. Policy Documents

Since State agencies are currently in transition in terms of meeting the requirements of MAP-21 and the FAST Act, the documents that could be found online to examine policy were primarily draft TAMPs. Older documents on bridge replacement eligibility were typically not available. Comprehensive information on agency practice and definition regarding the eligibility of bridges for replacement have been gathered from a survey that will be discussed in the next section. In this section, set criteria for agency policies on bridge replacement, as identified from the State TAMPs, are presented.

The Montana DOT (MDT) considers mainly superstructure and substructure conditions, deck condition, and structural deficiency when replacing a bridge in the network (MDT 2015). However, MDT bridge and performance targets include the possibility of bridge replacement when capacity expansion and mobility improvement are required, the safety of the traveling public is jeopardized, or the existing system must be preserved.

The MDT follows an established method when identifying bridges to be nominated for replacement and uses a decision tree for the selection of bridge preservation, rehabilitation, or replacement actions. Any structurally deficient structure is a candidate for repair or replacement. If a structure is not structurally deficient but its substructure rating is five, then it is a candidate for repair. Structures that are not structurally deficient but whose substructure ratings are greater than five are candidates for preservation.

The North Dakota DOT's (NDDOT's) TAMP specifies that the agency uses software tools such as AASHTOWare Bridge Management (BrM) software to nominate bridges for reconstruction or replacement after inputting required data from inspections (NDDOT 2015). By predicting the future conditions of bridges and by maximizing the benefits from a specific budget, the NDDOT nominates bridges for treatment or replacement. Nonetheless, the major contributor to the selection of bridges for replacement is still structural deficiency.

After MAP-21, the percentage of deficient deck area in the NHS system in Florida was reduced because more bridges were added to the NHS. The Florida DOT (FDOT) relies on preventative maintenance and repairs before advanced deterioration can develop, which results in less frequent replacements due to bridge condition. FDOT follows a strategy of replacing or repairing all structurally deficient and weight-restricted bridges within six years of the deficiency identification. Another strategy that FDOT uses to continue meeting the standards of MAP-21 is to replace all FDOT-owned bridges that are designated for replacement within nine years of identification (FDOT 2015).

FDOT uses life-cycle cost in the project prioritization process in addition to tools such as AASHTOWare BrM to evaluate various project options.

The Louisiana Department of Transportation and Development (LADOTD) has established a performance target in line with MAP-21 of having no more than 10% of state-maintained bridges in a structurally deficient condition (LADOTD 2015). LADOTD uses life-cycle cost analysis (LCCA) to identify bridges that need repairs and to reduce the number of deficient bridges in the long term by using a software tool (POINTS) as part of its bridge management system. POINTS forecasts future network conditions and budget allocation scenarios. Furthermore, LADOTD exports the NBI component condition ratings to the existing mainframe structures database (STRM) for basic prioritization based on deficiency, sufficiency rating calculations, and condition ratings of the deck, superstructure, and substructure.

When identifying candidate bridges, LADOTD queries STRM for certain criteria related to program goals. Projects and proposed actions, including replacements, are then generated and tracked by the PS Module of the LAGov management system to allow the generation of potential candidates and the removal of any structures that are currently programmed regardless of funding sources. Thus, the candidate bridges that qualify for replacement would be the ones identified under MAP-21 guidelines. The list of potential candidates is then distributed to the districts for their review, and the districts submit a prioritized list in return based on truck routes, average daily traffic (ADT) counts, the ages of structures, whether structures are timber, the conditions of structures, route continuity, and traffic crash data. After compiling a more refined list from the districts, the LADOTD Bridge Management Section runs a network analysis while considering whether the selected structures and actions are consistent with the department goals.

LADOTD intends to rely more on AASHTOWare BrM than POINTS to consider different variables such as LCCA, mobility safety risk, and other performance concerns.

The policy documents reviewed for this research indicate that some agencies have begun to expand or have expanded their use of decision-making tools, performance-based decision making, and performance measures beyond condition alone. However, although the deficiency criterion is now entirely based on condition ratings and SR no longer applies, the percentage of deficient deck area in the network remains a key measure in the selection of structures for replacement.

1.4.3. Survey Findings

In order to gather more information on current policies and criteria that State DOTs use to select bridges for replacement or define replacement eligibility, a survey was sent to State bridge engineers. The survey questions and response data are given in Appendix A. A total of 28 states responded to the survey.

The initial questions in the survey asked whether agencies use a set of criteria or a life-cycle cost or benefit-cost ratio (BCR) threshold to define the eligibility of highway bridges for replacement. Only seven states reported that they use a set of criteria. The respondents were also asked to share any documentation that they could for defining replacement eligibility or prioritizing bridge replacement versus major rehabilitation. Arizona, Illinois, Virginia, and Kansas shared documents that described these States' selection criteria.

Arizona's current State bridge preservation program documentation is dated November 2016 and presents information on the selection and prioritization of bridge preservation, rehabilitation, and replacement actions. Bridges are eligible for replacement based on HBP funding eligibility (i.e., a bridge is either SD or FO or both and has a SR $\leq$ 50, or the bridge has an NBI condition rating of 4 or less). In addition to meeting the HBP eligibility criteria, a bridge's deck and/or superstructure should be in poor condition but the substructure should be in fair to poor condition in order for that structure to be classified as eligible for replacement. The Arizona DOT (ADOT) uses two priority ranking formulae, one for bridges and one for culverts, for its prioritization process (ADOT 2016). Deficiency status, traffic volume, condition ratings, vulnerabilities (scour and fracture criticality), deck geometry, and clearances are the major factors that affect the ranking.

The Illinois DOT (IDOT) defines and considers four main criteria in identifying the scope of work for a bridge: structure condition and load capacity, geometric and hydraulic acceptability, economic evaluation, and exterior constraints (i.e., adverse effects on traffic control, unacceptable user delay, need for emergency repair, availability of funding) (IDOT 2011).The results are reviewed at the network level to select the most appropriate option for each structure. IDOT does not have defined eligibility criteria.

The Virginia DOT (VDOT) shared its current maintenance and repair manual (VDOT 2012). Replacement eligibility is again mostly based on HBP eligibility criteria. When choosing between rehabilitation and replacement for a structure, VDOT considers rehabilitation and replacement costs for the deck, superstructure, and substructure and the elimination of approach slabs or joints. If the cost of rehabilitation, with or without widening, is greater than 65% of the cost of a new bridge, then the bridge is eligible for replacement. Some of the limitations based on HBP requirements, such as the sufficiency rating thresholds, that are addressed in the VDOT manual no longer hold. Therefore, VDOT may revise this document in the near future to reflect these changes.

The Kansas DOT (KSDOT) shared information regarding its typical bridge actions and bridge condition measures (Figure 1-1). KSDOT only replaces bridges in poor condition and may re-deck some of these structures based on the overall condition of components.

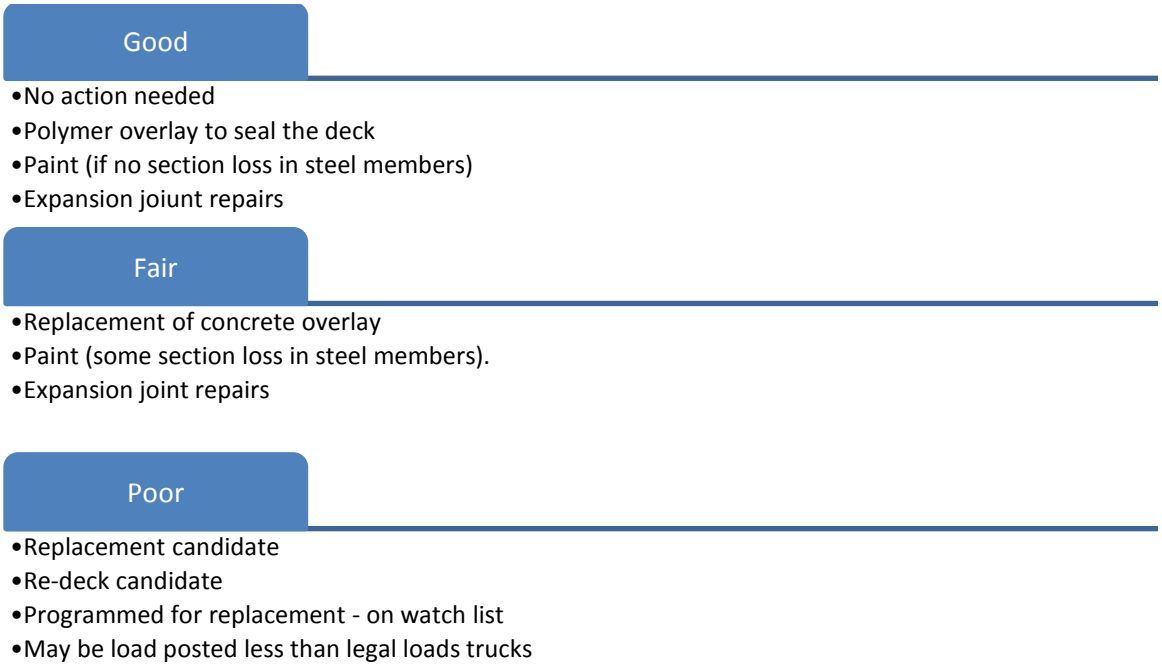


Figure 1-1. KSDOT Typical Bridge Actions by Bridge Condition Performance Measure

Using HBP funding eligibility criteria as part of an agency's bridge replacement eligibility policy remains a common practice. One thing to keep in mind regarding the current policy documents and information, however, is that the decision making and asset management frameworks used by many agencies are in transition. Agencies are trying to address the requirements of MAP-21 and the FAST Act by updating their decision making methodologies, and these efforts are a work in progress for many agencies.

Because the eligibility criteria for HBP funds for replacement under SAFETEA-LU, based on structurally deficient or functionally obsolete status and sufficiency rating, no longer apply under MAP-21 and the FAST Act, the respondents were also asked whether this change affected their State or local bridge replacement policy regarding eligibility. The majority (17 of 28 agencies) reported that it did not change their policy for State or local (15 agencies) bridge replacement eligibility (Table 1-1). Forty percent of the respondents reported that the change in eligibility criteria changed their agencies' replacement policies for State bridges, while 32% reported a change in their local bridge replacement policy. The follow-up question on this issue asked for specific comments and explanation. The respondents collectively reported that the removal of the sufficiency rating threshold requirement and the 10-year rule for federal funds allowed agencies more flexibility in State fund allocation for replacement candidates and the selection of rehabilitation versus replacement. Some agencies also reported that they could address their needs without having to place a structure on the selection list. Because bridges on local systems

will no longer have specific funds designated to them but will be eligible for overall State funding, few agencies reported that they are working with local agencies in revising their replacement eligibility criteria. Some agencies also reported that they are incorporating performance measures beyond condition, such as mobility, or considering improvements for alternative modes in their policies.

Table 1-1. Whether New Federal Guidelines Changed Replacement Eligibility

Answer	Count of Agencies	Percentage of Respondent Agencies
Yes (State)	**11**	**39%**
No (State)	**17**	**61%**
Yes (Local)	**9**	**32%**
No (Local)	**15**	**54%**

The three most common criteria considered by the responding agencies in selecting structures for replacement are load rating/posting, NBI condition ratings, and vulnerabilities, respectively (Table 1-2). These items are followed by traffic capacity and functional aspects. Within the vulnerability category, scour criticality was reported to be the most common criterion (reported by 22 agencies), followed by fracture criticality (19 agencies), and fatigue-prone details (17 agencies). Seismic vulnerability was reported by 9 agencies; however, this vulnerability is not a consideration for States that are not located in highly seismic zones. While element condition data are considered by 68% of the respondents, bridge management system (BMS) recommendations, proximity to other projects, detour length, and economic efficiency are considered by less than half of the respondents.

Table 1-2. Common Criteria for Selection of Bridge Replacements

Bridge Replacement Criteria	Percentage of Respondent Agencies	Count of Agencies
Load rating/posting	93%	26
NBI condition ratings	89%	25
Vulnerabilities (scour, seismic, fracture critical, fatigue-prone details)	86%	24
Traffic capacity	82%	23
Functional aspects	71%	20
Element condition data	68%	19
Bridge management system recommendations	43%	12
Proximity to other projects	39%	11
Detour length	39%	11
Life-cycle cost analysis, benefit-cost analysis or similar cost analysis	36%	10
Age	36%	10
Other	4%	1

Horizontal and vertical clearances were reported to be the major functional aspects considered in selecting bridge replacements (Table 1-3). Accident history near or on the bridge is the second most frequently considered functional aspect, reported by almost half of the responding agencies. Speed restrictions are considered by only two agencies.

Table 1-3. Functional Aspects Considered in Bridge Replacements

Functional Aspects Considered in Bridge Replacements	Percentage of Respondent Agencies	Count of Agencies
Horizontal and/or vertical clearances?	61%	17
Accident history near/on bridge	43%	12
Less than desirable sight distances (safety concern)	39%	11
Shoulder width	32%	9
Speed restrictions	7%	2

In order to identify agencies with historic project-level records of bridge replacements that were used in the second phase of the project, questions regarding the existence of such record and agencies' willingness to share them were included in the survey. Half of the respondents (14 agencies) reported that they have such records. Eight agencies also noted that they would be willing to share these records. These state agencies are California, Florida, Georgia, Illinois, Michigan, North Carolina, Pennsylvania, and Utah.

The survey findings show that load rating/posting, NBI condition ratings, vulnerabilities (scour, seismic, fracture critical, fatigue-prone details), traffic capacity, and functional aspects are the major factors considered by the agencies in identifying and selecting candidates for bridge replacements. Agencies reported that the legislative changes brought by MAP-21 and the FAST Act gave them more flexibility in selecting rehabilitation and replacement projects, and these changes have impacted agencies' decisions. As agencies continue to develop their TAMPs and implement the NHPP, the reported criteria will probably come to include performance measures beyond condition, vulnerabilities, and functional aspects. It would be valuable to repeat this survey in a couple of years to see the changes.

1.5. Project Objectives and Scope

The main objective of this research project was to determine the reasons of bridge decommissioning for State highway agency–owned bridges in the United States. The research team identified decommissioned bridges from the NBI data files and analyzed data from available DOT project records to classify the real drivers of bridge replacement. The research project aimed to identify candidate NBI data items that can improve the understanding of premature bridge replacements at the National level and help bridge managers better focus bridge management and preservation efforts to extend bridge service lives.

CHAPTER 2 RESEARCH APPROACH

This research consisted of five major tasks, as summarized in Figure 2-1. The initial task included the literature review, the agency survey, and the discussion of the findings from both, as presented in Chapter 1. The second task, Analysis I, was a major effort that involved tracking State-owned NBI structures through the NBI data files to identify decommissioned structures, analyzing the NBI data for these structures based on the insights from the initial task, and identifying potential drivers of bridge decommissioning. Analysis I also included a discussion of single versus multiple drivers. The third task, Analysis II, focused on relating the potential drivers identified in Analysis I to the reasons for decommissioning cited by an agency. Decommissioned structures and the agency-provided reasons for decommissioning for five State DOTs (Utah, Michigan, California, Pennsylvania, and Florida) were matched to the decommissioned structures and drivers identified in Analysis I. The drivers and agency-provided reasons were then compared to identify correlations. The fourth task, Analysis III, was an additional task that identified a subset of the decommissioned structures from Analysis I with the new structures that replaced them to perform comparison analyses and to further explore the findings from the earlier analyses. The final task involved gathering the findings from all analyses and suggesting future research directions.

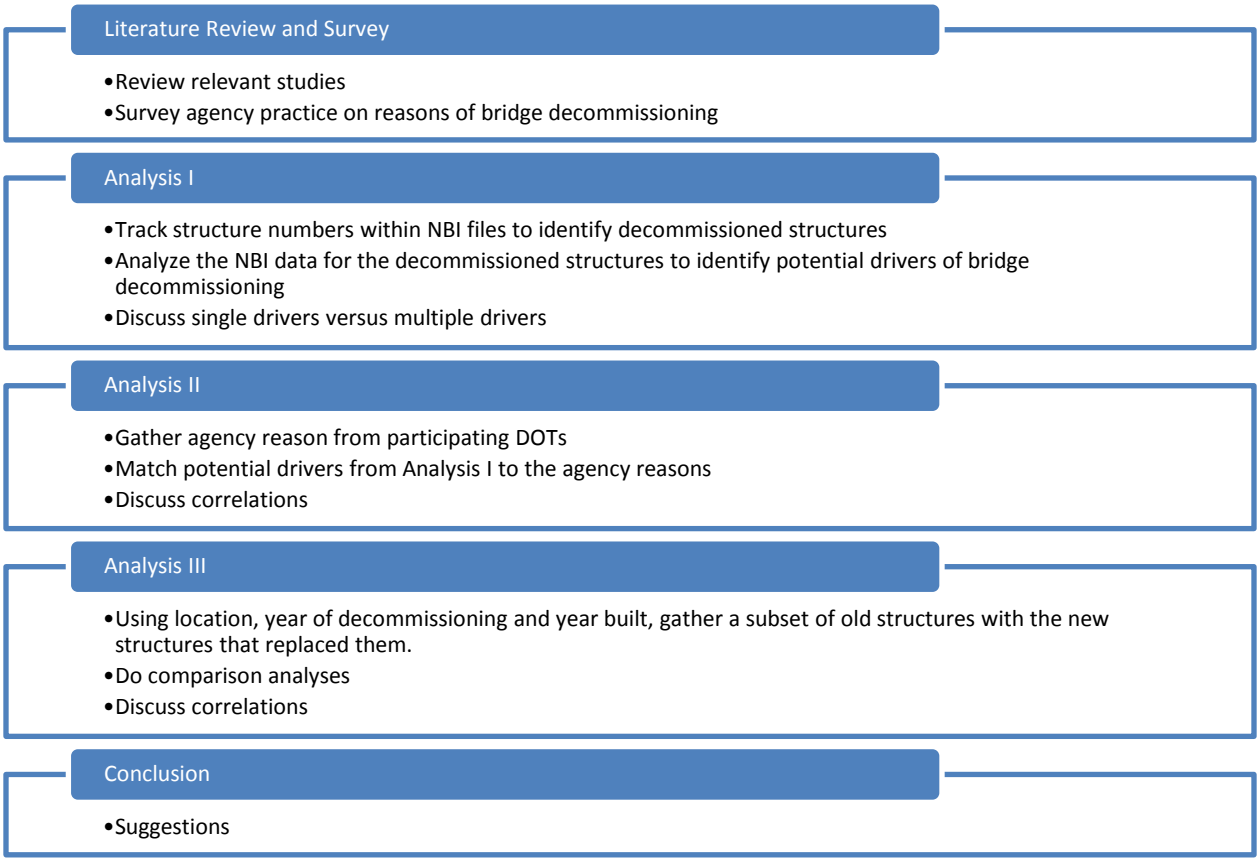


Figure 2-1. Research Approach

CHAPTER 3 RESEARCH FINDINGS

3.1. Identification of Possible Reasons

As a first step in finding the major drivers of bridge decommissioning, the research team selected apparent drivers of the replacement of highway bridges based on the literature review and the survey findings. These drivers include bridge condition, functionality, load carrying capacity, vulnerability, and traffic capacity, as specified in the request for proposals for this research project.

One fundamental concept to clarify for this study is that statistical trends and correlations may guide us to hypothesize causality yet by themselves do not indicate causality. The ideal process to identify the real reason behind a bridge replacement or decommissioning would be to find agency documents that indicate the main reason behind a project. By only looking at the NBI data for a structure, the real reason for decommissioning cannot be identified. For example, for a particular ND structure with overall good NBI ratings, fair deck condition could be the only match for a potential driver among all the reasons of decommissioning in the NBI data. However, the same structure might have been replaced during a corridor widening project and not replaced due to condition. Without project records and a specific documented reason, the real reason behind decommissioning cannot be identified with full confidence. With that caveat, the statistical analysis described in this section identifies notable trends and informs future phases of the analysis.

The potential drivers of bridge decommissioning in the United States, as identified from the literature and survey findings and as used in the analysis, are as follows:

- Deficiency status (SD, FO, non-deficient [ND])
- Bridge posting (NBI 70 and NBI 41)
- Structural evaluation (NBI 67)
- Deck geometry (NBI 68)
- Underclearances (NBI 69)
- Waterway adequacy (NBI 71)
- Approach roadway alignment (NBI 72)
- Type of work (NBI 75A)
- NBI condition ratings (NBI 58, 59, 60, and 62)
- Sufficiency rating
- Vulnerabilities
- Age
- Reconstruction age
- Material
- Design type
- Maximum span length
- Operating rating
- Traffic volume

- Functional classification of the inventory route (NBI 26)
- Proposed work (NBI 75A)

While some of these factors, such as deficiency status and deck geometry, may be potential reasons for decommissioning, some variables, such as maximum span length and functional classification, were used to assess and compare the characteristics of decommissioned bridges.

3.2. Identification of Decommissioned Bridges from NBI files

The research team used NBI data files from 1992 to 2016 from the FHWA website to identify decommissioned bridges. All available NBI files were gathered to form the study database. As noted in the project proposal, the data set was refined so that it was limited only to State highway agency–owned structures. For the purposes of this study, the research team identified a decommissioned structure as a structure whose unique ID (a combination of state code and structure number) in the NBI data set for a particular year does not reappear in future NBI data sets (Figure 3-1). Because some state DOTs changed the way they created structure numbers over the years, a preliminary step was to gather these changes from the FHWA and apply them to the data set. The research team also found that, especially in the earlier years of NBI submissions, some bridges in the inventory were not reported every year. For example, a structure could be reported in 1998, not reported in 1999, and reported in 2000. Therefore, for all unique IDs, NBI data sets for all analysis years were checked to account for such cases. The years in which bridges were not reported could potentially have been the years in which those structures were not inspected.

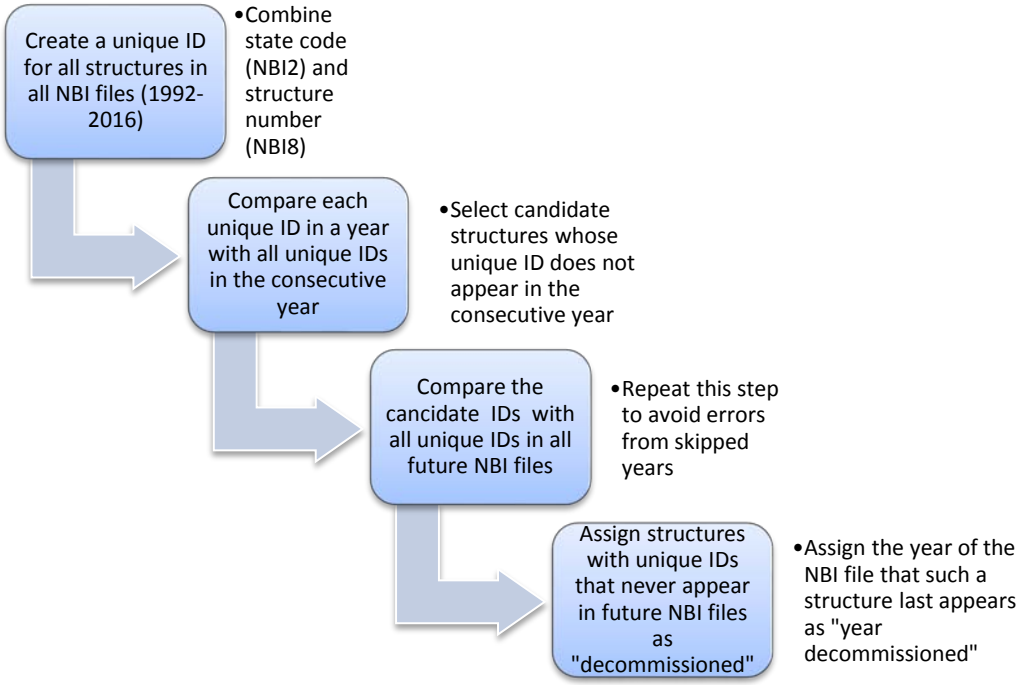


Figure 3-1. Process for Identifying Decommissioned Structures

Table 3-1 presents the summary of decommissioned structures per year identified using the process described above compared to the entire network of State-owned structures for that year. A total of 31,803 bridges and 4,656 culverts were identified as decommissioned. The focus of the analyses in this report is bridges. For the analyses done using the bridge data set, the data element is referred to as "bridge." Some analyses were done using the combined data set for both bridges and culverts, in which case the data element is described as "structure." The corresponding figures and tables are labeled accordingly. When only culvert data were analyzed, the data element is described as "culvert" and referred to as such in figures and tables. Because culverts have a single condition rating compared to the three condition ratings used for bridges, separate culvert-, and bridge-specific analyses were completed for analyses focused on condition.

Table 3-1. Summary of State-Owned NBI Structures and Decommissioned Structures

Year	Total Number of State Structures in the NBI File	Number of Decommissioned Structures	Percentage of Decommissioned Structures in the NBI
1992	248,336	1,474	0.59%
1993	265,008	1,727	0.65%
1994	265,742	1,626	0.61%
1995	251,812	1,314	0.52%
1996	255,033	1,346	0.53%
1997	252,077	1,341	0.53%
1998	268,247	1,475	0.55%
1999	253,543	1,391	0.55%
2000	270,983	1,269	0.47%
2001	272,301	1,787	0.66%
2002	269,838	1,142	0.42%
2003	269,503	1,565	0.58%
2004	275,012	1,567	0.57%
2005	264,471	1,255	0.47%
2006	276,966	1,410	0.51%
2007	277,894	1,439	0.52%
2008	280,370	1,487	0.53%
2009	279,264	1,836	0.66%
2010	281,721	1,873	0.66%
2011	272,078	1,461	0.54%
2012	281,582	1,932	0.69%
2013	283,993	1,585	0.56%
2014	284,774	1,478	0.52%
2015	285,415	1,679	0.59%
Total		36,459	0.56%

For each analysis year, the research team also examined the number of decommissioned structures by State and the percentage of these structures in the entire State network. By looking at this information, the research team was able to identify unexpectedly high percentages of decommissioned structures for particular years. Some State agencies were contacted based on these findings. One reason behind high numbers was a change in structure numbering. Some agencies had documentation on the changes and were able to provide it. If documentation was provided, these changes were again applied to the data set. However, in some cases the reasons for decommissioning were unclear and current DOT staff did not have the necessary data or information from past years to comment on these findings. Reviewing the percentages of State inventories decommissioned by year, it was observed that a majority of the values are between 0% and 2% and that clear outliers are percentages above 2% (Figure 3-2). In order to avoid high percentages that may stem from reporting or numbering changes, the samples in which more than 2% of the network was decommissioned for a State and data year were excluded from the final data set reported in Table 3-1. A total of 5,092 structures were excluded. The distribution of decommissioned structures by State and data year is given in Appendix B.

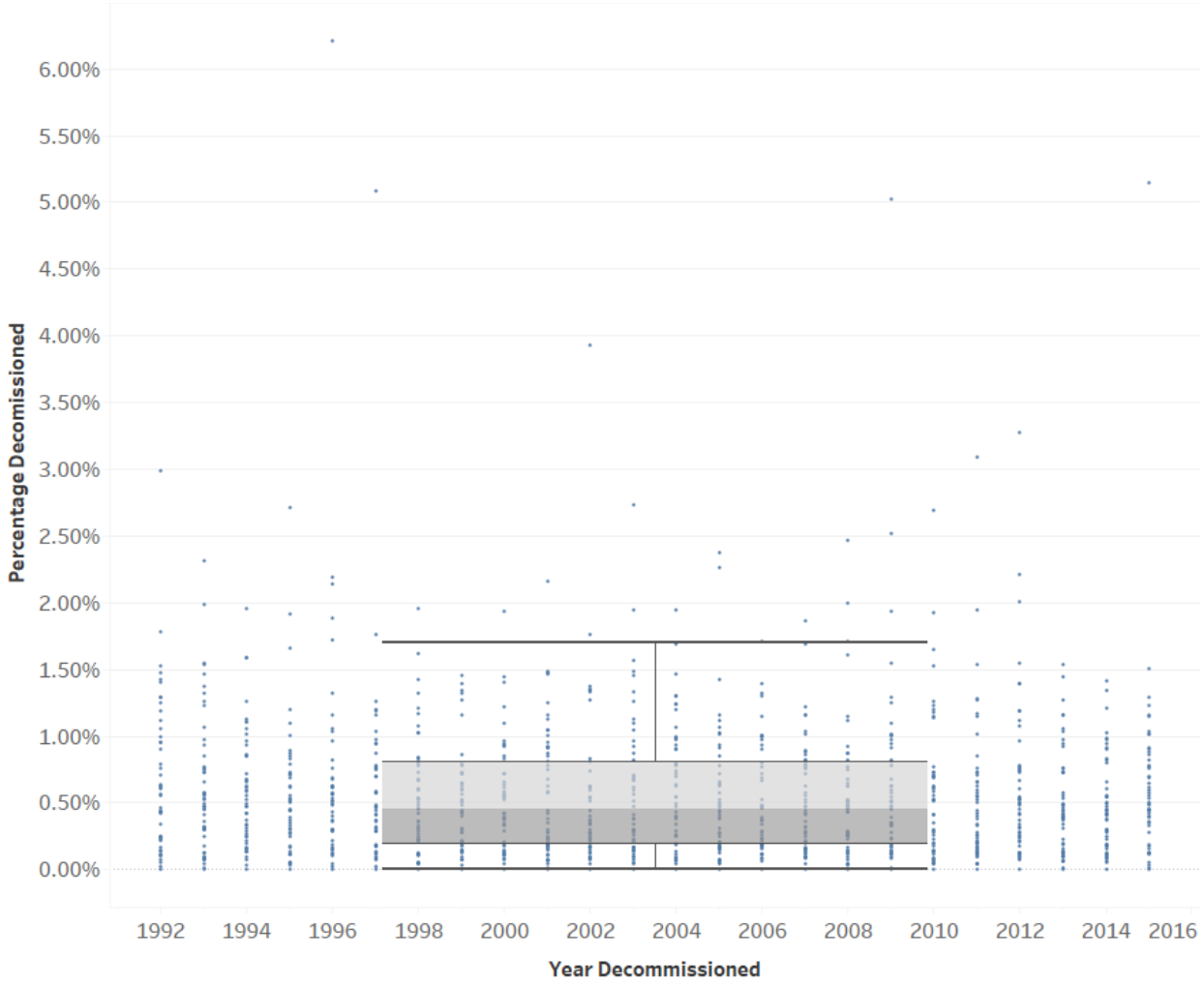


Figure 3-2. Percentage of Decommissioned Structures for Each State by Year

3.3. Analyses for Potential Drivers

This section describes a series of analyses for each potential driver that were designed to identify trends in the data set. Because a majority of the NBI variables are discrete variables with multiple levels, the frequencies of decommissioned structures are generally reported in terms of these levels. For most potential drivers, the frequencies are reported by deficiency status.

NBI data include missing or "Not Applicable" values for many variables. For consistency, such values are reported as "." within the report.

Deficiency Status

Deficiency status, due to the reasons explained above, is a major driver for bridge replacements. For all decommissioned structures in the data set, 45% were SD and 19% were FO, while the percentages were higher for bridges and lower for culverts (Figure 3-3, Figure 3-4, Figure 3-5). More than 70% of decommissioned structures were deficient structures. These findings are consistent with the percentages of deficient structures reported in previous studies by Chase (2014) and Hooks (2011).

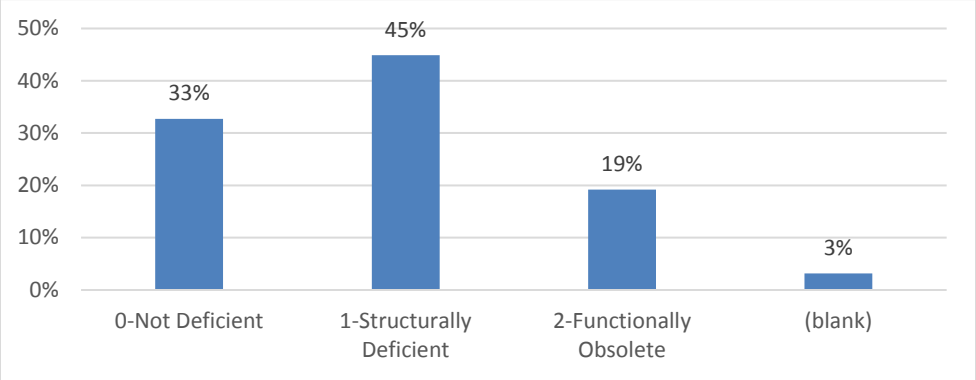


Figure 3-3. Percentage of Decommissioned Structures by Deficiency Status

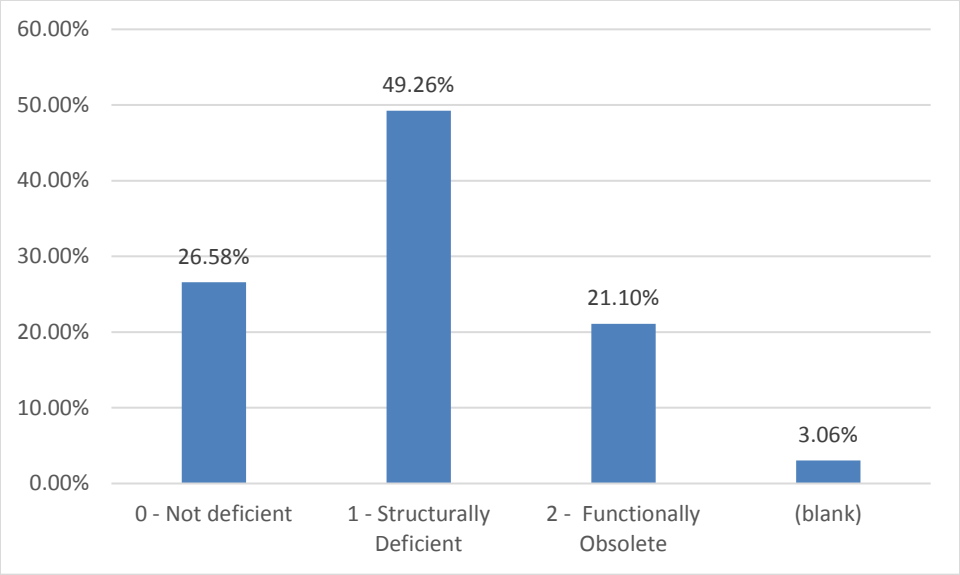


Figure 3-4. Percentage of Decommissioned Bridges by Deficiency Status

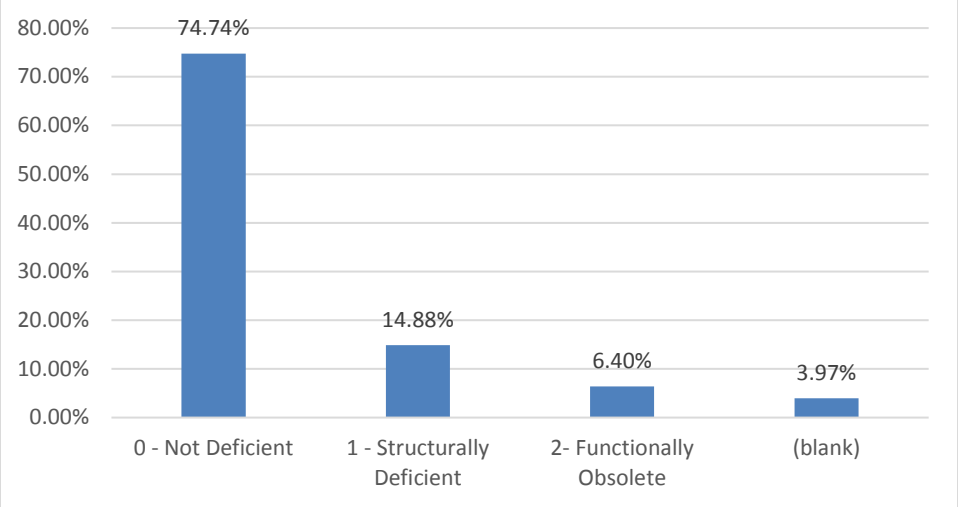


Figure 3-5. Percentage of Decommissioned Culverts by Deficiency Status

Also, other than few variables reported specifically for culverts, all percentages reported are the percentage of that particular group in the entire decommissioned structures sample. Any exceptions are noted in the text. It should also be noted that, the deficiency status reported with 10-year rule and as reported in the NBI files were used for the analysis.

Bridge Posting (NBI 70 and NBI 41)

NBI Item 70 (Bridge Posting) can be assigned a value from 0 to 5, with a rating of 5 designating that no posting is required for the structures. Regardless of other factors, 20.3% of the sample consists of posted structures, and 1.1% of ND structures are posted structures (Table 3-2). Therefore, most posted structures are included within the deficient structures. A total of 2.7% of decommissioned structures were FO and not designated as SD but nevertheless posted.

Temporary supports installed on a bridge or the use or presence of a temporary bridge affect the coding of items 70 and 41. For Item 70, the actual operating rating of the temporary bridge should be used to identify the proper code designation. For Item 41, open structures that would be posted or closed except for temporary shoring are coded as "D", and structures that are closed and awaiting for replacement or rehabilitation but have a temporary structure in place to carry legal loads are coded as "E". Structures with these codes (collectively 0.38% in Table 3-3) indicate a small portion of the network that is designated as open but would have been posted or closed without the temporary supports in place.

Table 3-2. Percentage of Decommissioned Bridges by Deficiency Status and Bridge Posting

Bridge Posting (Item 70)	ND	SD	FO	.	Grand Total
0	0.2%	6.9%	0.5%	0.3%	7.9%
1	0.1%	1.8%	0.3%	0.1%	2.3%
2	0.2%	1.6%	0.2%	0.1%	2.1%
3	0.2%	1.9%	0.7%	0.1%	2.9%
4	0.4%	3.4%	1.0%	0.2%	5.1%
5	25.2%	33.6%	18.3%	2.0%	79.1%
.	0.2%	0.2%	0.1%	0.2%	0.7%
Grand Total	26.6%	49.3%	21.1%	3.1%	100.0%

NBI Item 41 (Structure Open, Posted, or Closed to Traffic) reports the operational status of a structure (Table 3-3). Based on this item, 1.3% of ND structures are posted for load and another 1.3% of ND structures have some type of restriction.

Table 3-3. Percentage of Decommissioned Bridges by Deficiency Status and Operational Status

Operational Status - Structure Open, Posted, Or Closed to Traffic (Item 41)	ND	SD	FO	.	Grand Total
A- Open, no restriction	23.70%	25.94%	16.67%	1.98%	68.30%
B-Open, posting recommended but not legally implemented	**0.07%**	0.41%	0.14%	0.02%	0.63%
D- Open, would be posted or closed except for temporary shoring	**0.12%**	2.54%	0.09%	0.11%	2.86%
E-Open, temporary structure in place to carry legal loads	**0.26%**	1.40%	0.31%	0.00%	1.98%
G- New structure not yet open to traffic	**0.45%**	0.43%	0.23%	0.01%	1.11%
K-Bridge closed to all traffic	**0.29%**	3.85%	0.34%	0.08%	4.57%
P-Posted for load	**1.27%**	13.43%	2.88%	0.80%	18.38%
R- Posted for other load-capacity restriction	**0.08%**	0.73%	0.08%	0.01%	0.89%
.	0.33%	0.53%	0.36%	0.07%	1.28%
Grand Total	26.58%	49.26%	21.10%	3.06%	100.00%

Structural Evaluation (NBI 67)

When Item 67 is equal to or less than 2, a structure is designated as SD, and if this item is equal to or less than 3, a structure is designated as FO. A majority of the decommissioned structures have a rating of 4 in this category, which indicates a minimum tolerable condition to be left in place as is (Figure 3-6).

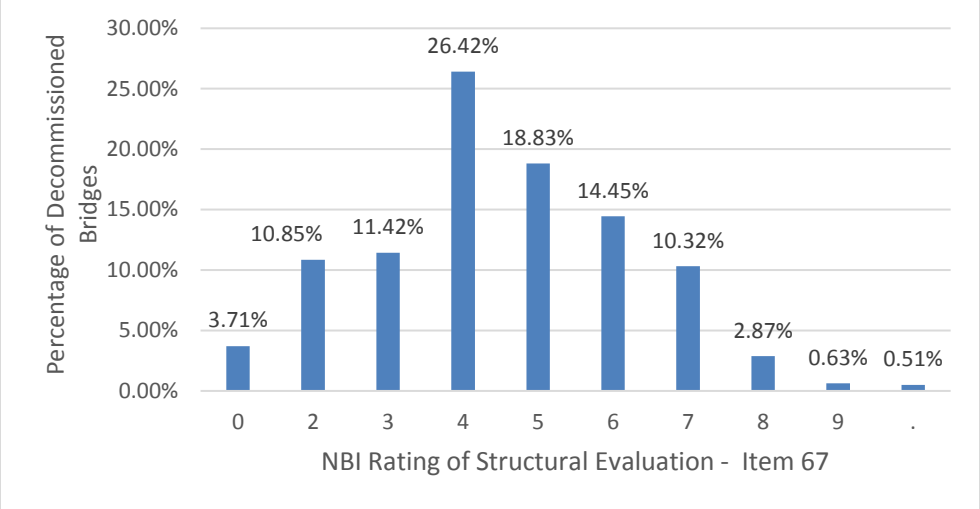


Figure 3-6. Structural Evaluation Rating

Aside from structures designated as deficient, 0.4% of ND structures can have a rating of 3 and below (Table 3-4).

Table 3-4. Percentage of Bridges by Deficiency Status and Structural Evaluation

Structural Evaluation (Item 67)	ND	SD	FO	.	Grand Total
0	0.1%	3.6%	0.0%	0.0%	3.7%
2	0.1%	10.4%	0.0%	0.3%	10.8%
3	*0.2%*	9.6%	1.4%	0.2%	11.4%
4	2.0%	21.2%	2.8%	0.4%	26.4%
5	7.5%	3.1%	7.7%	0.5%	18.8%
6	7.3%	0.9%	5.5%	0.7%	14.4%
7	6.5%	0.2%	3.2%	0.4%	10.3%
8	2.3%	0.0%	0.4%	0.2%	2.9%
9	0.5%	0.0%	0.0%	0.0%	0.6%
.	0.2%	0.0%	0.0%	0.2%	0.5%
Grand Total	26.6%	49.3%	21.1%	3.1%	100.0%

These would have been designated as deficient if it were not for the 10-year rule. More than 45% of the bridges in the data set have a rating of 4 or 5, which indicates the minimum tolerable condition or a condition slightly above tolerable. ND culverts had higher ratings in the lower range for Item 67 (Table 3-5).

Table 3-5. Percentage of Culverts by Deficiency Status and Structural Evaluation

Structural Evaluation (Item 67)	ND	SD	FO	.	Grand Total
0	0.0%	1.1%	0.0%	0.0%	1.1%
2	0.0%	1.3%	0.0%	0.0%	1.3%
3	0.2%	3.6%	0.9%	0.0%	4.7%
4	5.9%	8.2%	0.7%	0.1%	14.8%
5	13.1%	0.1%	1.2%	0.3%	14.7%
6	19.5%	0.2%	1.8%	1.2%	22.7%
7	22.0%	0.1%	1.1%	1.5%	24.7%
8	9.1%	0.0%	0.2%	0.6%	9.9%
9	0.8%	0.0%	0.0%	0.1%	1.0%
.	4.1%	0.3%	0.5%	0.1%	5.0%
Grand Total	74.7%	14.9%	6.4%	4.0%	100.0%

Deck Geometry (NBI 68)

A majority of the decommissioned bridges either have the minimum tolerable or intolerable deck geometry ratings (Figure 3-7, Table 3-6). A total of 0.6% of structures are ND with intolerable deck geometry, and 9.3% are ND with the minimum tolerable deck geometry. These bridges could have potentially been decommissioned as part of capacity improvements or widenings, despite their status as ND. Older bridges being considered for replacement are often narrow in comparison with today's standards, which could be a significant driver toward replacement rather than strengthening or rehabilitation. Fair appraisal ratings (4 and 5) will be discussed further in the next section.

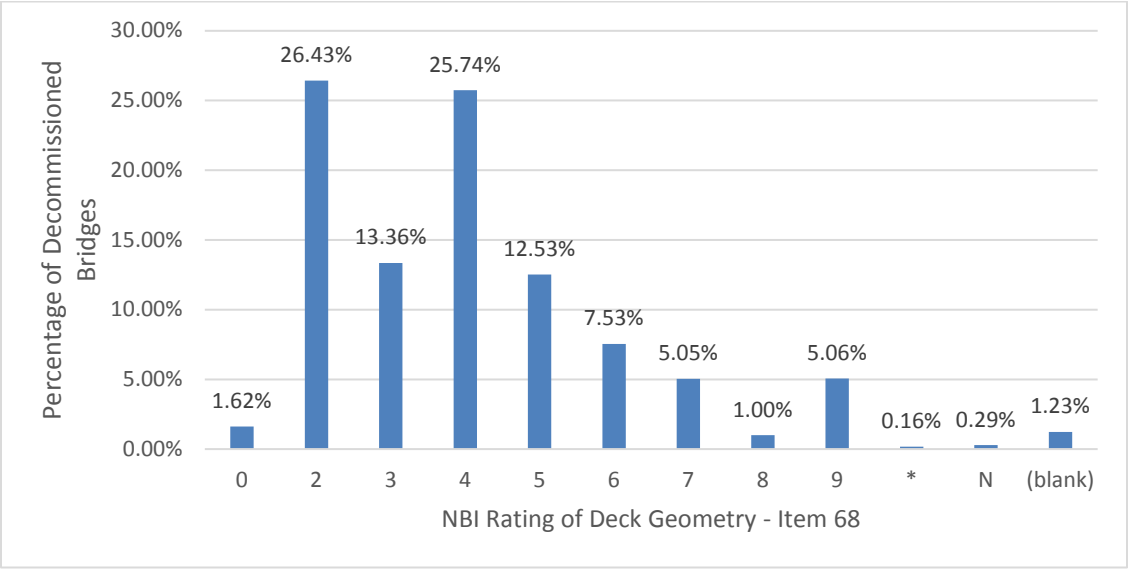


Figure 3-7. Deck Geometry Rating

Table 3-6. Percentage of Decommissioned Bridges by Deficiency Status and Deck Geometry

Deck Geometry (Item 68)	ND	SD	FO	.	Grand Total
0	0.0%	1.4%	0.2%	0.0%	1.6%
2	0.4%	14.7%	10.8%	0.5%	26.4%
3	0.2%	7.4%	5.2%	0.5%	13.4%
4	9.3%	13.9%	1.9%	0.7%	25.7%
5	5.3%	6.0%	0.9%	0.3%	12.5%
6	3.9%	2.9%	0.7%	0.1%	7.5%
7	3.1%	1.3%	0.6%	0.0%	5.0%
8	0.6%	0.3%	0.1%	0.0%	1.0%
9	3.2%	1.2%	0.6%	0.0%	5.1%
*	0.0%	0.0%	0.0%	0.1%	0.2%
N	0.1%	0.0%	0.0%	0.2%	0.3%
.	0.4%	0.2%	0.1%	0.5%	1.2%
Grand Total	26.6%	49.3%	21.1%	3.1%	100.0%

Underclearances (NBI 69)

Low ratings for underclearances (underclearances, vertical and horizontal) were not identified as a strong driver for decommissioning because only 0.3% of the sample is ND and has an underclearance appraisal rating of 3 and below (Table 3-7).

Table 3-7. Percentage of Decommissioned Bridges by Deficiency Status and Underclearance

Underclearances (Item 69)	ND	SD	FO	.	Grand Total
*	0.1%	0.0%	0.0%	0.0%	0.2%
0	0.0%	0.5%	0.1%	0.0%	0.6%
2	0.0%	1.4%	0.9%	0.0%	2.4%
3	0.3%	1.2%	4.2%	0.1%	5.8%
4	3.2%	2.3%	1.2%	0.2%	6.9%
5	2.1%	1.1%	0.7%	0.1%	4.0%
6	1.9%	0.8%	0.5%	0.1%	3.4%
7	0.9%	0.3%	0.2%	0.1%	1.5%
8	0.2%	0.1%	0.0%	0.0%	0.3%
9	0.9%	0.4%	0.1%	0.0%	1.4%
N	17.0%	41.1%	13.1%	2.4%	73.5%
.	0.0%	0.0%	0.0%	0.0%	0.0%
Grand Total	26.6%	49.3%	21.1%	3.1%	100.0%

Waterway Adequacy (NBI 71)

Similar to underclearances, waterway adequacy is not a strong driver for decommissioning (Table 3-8).

Table 3-8. Percentage of Decommissioned Bridges by Deficiency Status and Waterway Adequacy

Waterway Adequacy (Item 71)	ND	SD	FO	.	Grand Total
0	0.0%	0.4%	0.0%	0.0%	0.4%
2	0.0%	0.3%	0.0%	0.0%	0.4%
3	0.0%	0.7%	0.4%	0.0%	1.1%
4	0.3%	1.5%	0.4%	0.0%	2.2%
5	0.6%	2.6%	0.6%	0.1%	3.9%
6	3.6%	11.2%	3.5%	0.4%	18.7%
7	2.9%	7.8%	2.4%	0.6%	13.6%
8	6.8%	13.3%	4.6%	1.1%	25.9%
9	1.9%	3.0%	1.1%	0.1%	6.0%
N	0.8%	0.7%	0.7%	0.0%	2.2%
.	9.7%	7.6%	7.5%	0.7%	25.5%
Grand Total	26.6%	49.3%	21.1%	3.1%	100.0%

Approach Roadway Alignment (NBI 72)

Approach roadway alignment also does not appear to be a strong driver for decommissioning by itself. However, 1.5% of the sample has the minimum tolerable or a slightly better roadway alignment (Table 3-9).

Table 3-9. Percentage of Decommissioned Bridges by Deficiency Status and Approach Roadway Alignment

Approach Roadway Alignment (Item 72)	ND	SD	FO	.	Grand Total
0	0.01%	0.45%	0.02%	0.01%	0.48%
2	0.01%	0.52%	0.15%	0.02%	0.69%
3	0.07%	1.81%	0.50%	0.02%	2.40%
4	0.58%	2.75%	0.74%	0.03%	4.10%
5	0.89%	3.26%	0.96%	0.06%	5.16%
6	2.99%	8.85%	3.05%	0.35%	15.24%
7	3.39%	6.94%	2.66%	0.51%	13.51%
8	17.36%	24.36%	12.24%	1.48%	55.44%
9	0.96%	0.21%	0.70%	0.03%	1.90%
.	0.33%	0.11%	0.08%	0.56%	1.08%
Grand Total	26.58%	49.26%	21.10%	3.06%	100.00%

Among all appraisal ratings, structural evaluation and deck geometry, independent of deficiency status, are potentially the most influential in terms of decommissioning. Ratings of 3 and below were found for 26% of the sample for Item 67 (SE) and for 41.41% of the sample for Item 68 (DG). See Table 3-10.

Table 3-10. Percentage of Decommissioned Bridges by Deficiency Status and Appraisal Ratings

Appraisal Ratings	SE Item 67	DG Item 68	UE Item 69	WE Item 71	ARE Item 72
0	3.70%	1.60%	0.60%	0.40%	0.50%
2	10.80%	26.40%	2.40%	0.40%	0.70%
3	11.40%	13.40%	5.80%	1.10%	2.40%
4	26.40%	25.70%	6.90%	2.20%	4.10%
5	18.80%	12.50%	4.00%	3.90%	5.20%
6	14.40%	7.50%	3.40%	18.70%	15.20%
7	10.30%	5.00%	1.50%	13.60%	13.50%
8	2.90%	1.00%	0.30%	25.90%	55.40%
9	0.60%	5.10%	1.40%	6.00%	1.90%
*		0.20%	0.20%		
N		0.30%	73.50%	2.20%	
.	0.50%	1.20%		25.50%	1.10%

NBI Condition Ratings (NBI 58, 59, 60, and 62)

Bridge condition assessment is a fundamental part of bridge management and improvement decisions. Deck, superstructure, substructure, and culvert condition ratings, corresponding to NBI Items 58, 59, 60, and 62, have been the core bridge condition data used by Federal and State agencies since the early 1970s. Current condition performance measures are also based on NBI condition ratings. Most of the condition data lie between 7 and 4 (Figure 3-8).

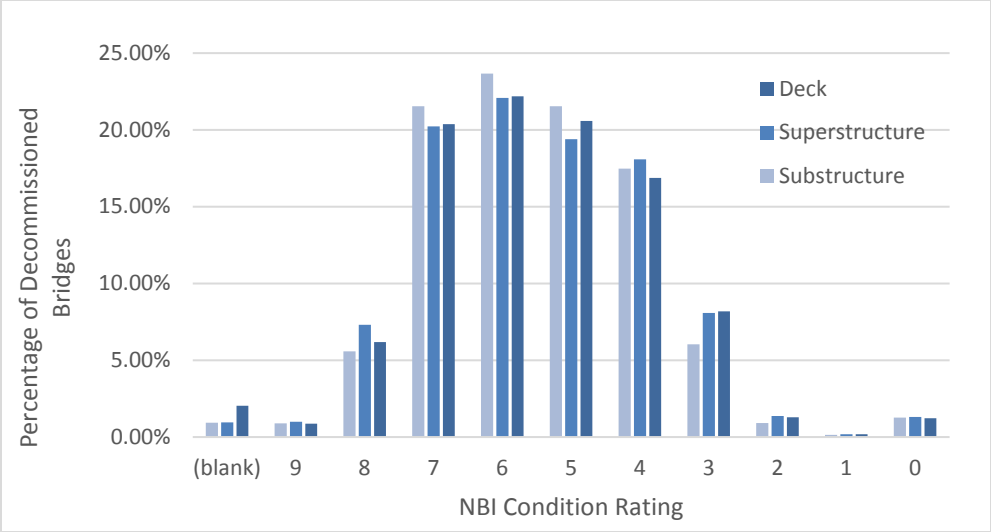


Figure 3-8. Percentages of Decommissioned Bridges Condition Ratings - Item 58, 59, 60

Class percentages in Table 3-11 indicate the percentage of the bridges in good, fair, or poor condition (referred to as the condition class) based on individual component ratings.

Table 3-11. Percentage of Decommissioned Bridges by Structure Condition Ratings

	Deck Condition Item 58		Superstructure Condition Item 59		Substructure Condition Item 60	
NBI Rating	Percentage	Class Percentage	Percentage	Class Percentage	Percentage	Class Percentage
0	1.2%	27.8%	1.3%	29.0%	1.3%	25.8%
1	0.2%		0.2%		0.1%	
2	1.3%		1.4%		0.9%	
3	8.2%		8.1%		6.1%	
4	16.9%		18.1%		17.5%	
5	20.6%	42.8%	19.4%	41.5%	21.6%	45.2%
6	22.2%		22.1%		23.7%	
7	20.4%	27.4%	20.2%	28.6%	21.6%	28.0%
8	6.2%		7.3%		5.6%	
9	0.9%		1.0%		0.9%	
.	2.0%		1.0%		0.9%	

However, when condition performance measures are assigned for the entire bridge in accordance with the current condition performance measures, 43% of the sample are in poor condition and 37% are in fair condition (Table 3-12). Aside from a poor condition rating, which also determines structurally deficiency, condition does not appear to be a driver of decommissioning for a majority of the sample. Fair condition combined with other issues appear to have driven 37% of bridge decommissioning decisions.

Table 3-12. Percentage of Decommissioned Bridges by NBI Condition Class

NBI Condition Class	Percentage of Decommissioned Bridges
Fair	37%
Good	19%
Poor	43%
.	1%

The culverts in the sample overall have better condition ratings than bridges (Table 3-13). Only 14% of culverts are in poor condition. Condition does not appear to be a major driver for culvert decommissioning.

Table 3-13. Percentage of Decommissioned Culverts by Structure Condition Ratings

Culvert Condition Rating Item 62	Percentage of Culverts	
	Percentage	NBI Condition Class
0	0.45%	13.63%
1	0.02%	
2	0.62%	
3	3.80%	
4	8.74%	
5	10.76%	33.81%
6	23.05%	
7	36.36%	51.83%
8	13.34%	
9	2.13%	
N	0.43%	
.	0.30%	

Sufficiency Rating

Condition is the major factor in the SR calculation, and therefore the lowest values for SR are observed for SD structures (Table 3-14).

Table 3-14. Summary Statistics of Decommissioned Structures by Sufficiency Rating

Sufficiency Rating Summary Statistics	ND	SD	FO
Minimum	2	0.2	1
Mean	81.8	33.9	63
Maximum	100	97	96
Standard Deviation	15.1	19.5	16.5

A total of 43% of the structures in the data set were eligible for Federal funds for replacement, and 33% were eligible for rehabilitation funds (Table 3-15). These structures, though, appear to have been replaced or removed (structures that were taken out of inventory and not replaced) from the inventory. Based on the literature, survey findings, and the data, SR does not appear to be more influential than deficiency status and NBI condition ratings. Also, these three variables are highly correlated because NBI condition ratings greatly impact the other values. Due to this correlation, SR will not be discussed further in this report.

Table 3-15. Eligibility for Federal Funds for Decommissioned Structures by Deficiency Status

Eligibility for Federal Funds	ND	SD	FO	Blank	Grand Total
Not Eligible	20.07%	0.67%	2.49%	0.78%	24.02%
Rehabilitation	11.38%	7.89%	12.28%	1.12%	32.66%
Replacement	1.28%	36.31%	4.45%	1.28%	43.32%
Grand Total	32.73%	44.87%	19.22%	3.18%	100.00%

Age

Consistent with the literature, age does not appear to be a major driver in bridge decommissioning. The mean and median age for the sample is 54 years (Figure 3-9).

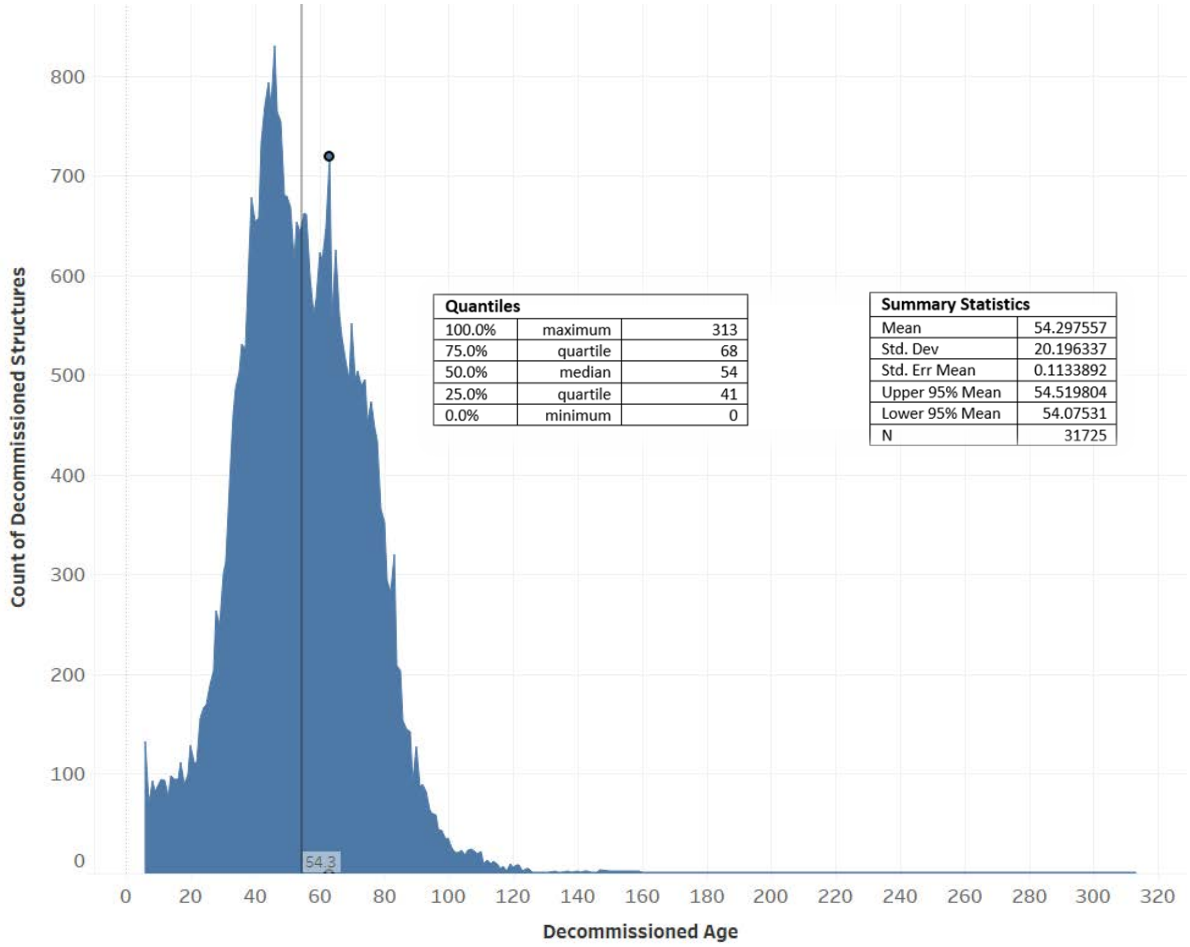


Figure 3-9. Summary Statistics and Distribution for Decommissioned Age

Only 25% of the structures are 68 years old and older. A majority of the ND structures in the sample are 55 years old or younger (Figure 3-9). Only 14% of the structures are 75 years old or older.

Table 3-16. Percentage of Decommissioned Structures by Deficiency Status and Age Class

Age Class	ND	SD	FO	Blank	Grand Total
Less than 55	23.6%	16.7%	10.9%	2.3%	53.5%
55 to 75	6.8%	17.8%	6.3%	0.6%	31.5%
Greater than 75	2.1%	9.6%	1.9%	0.2%	13.8%
.	0.2%	0.8%	0.2%	0.0%	1.2%
Grand Total	32.7%	44.9%	19.2%	3.2%	100.0%

Reconstruction Age

No particular trend is observed for the reconstruction year that would make this variable a strong driver of decommissioning (Figure 3-10). Only 17% of the structures had significant

reconstruction during their life-cycles, and on average this reconstruction was 34 years prior to decommissioning.

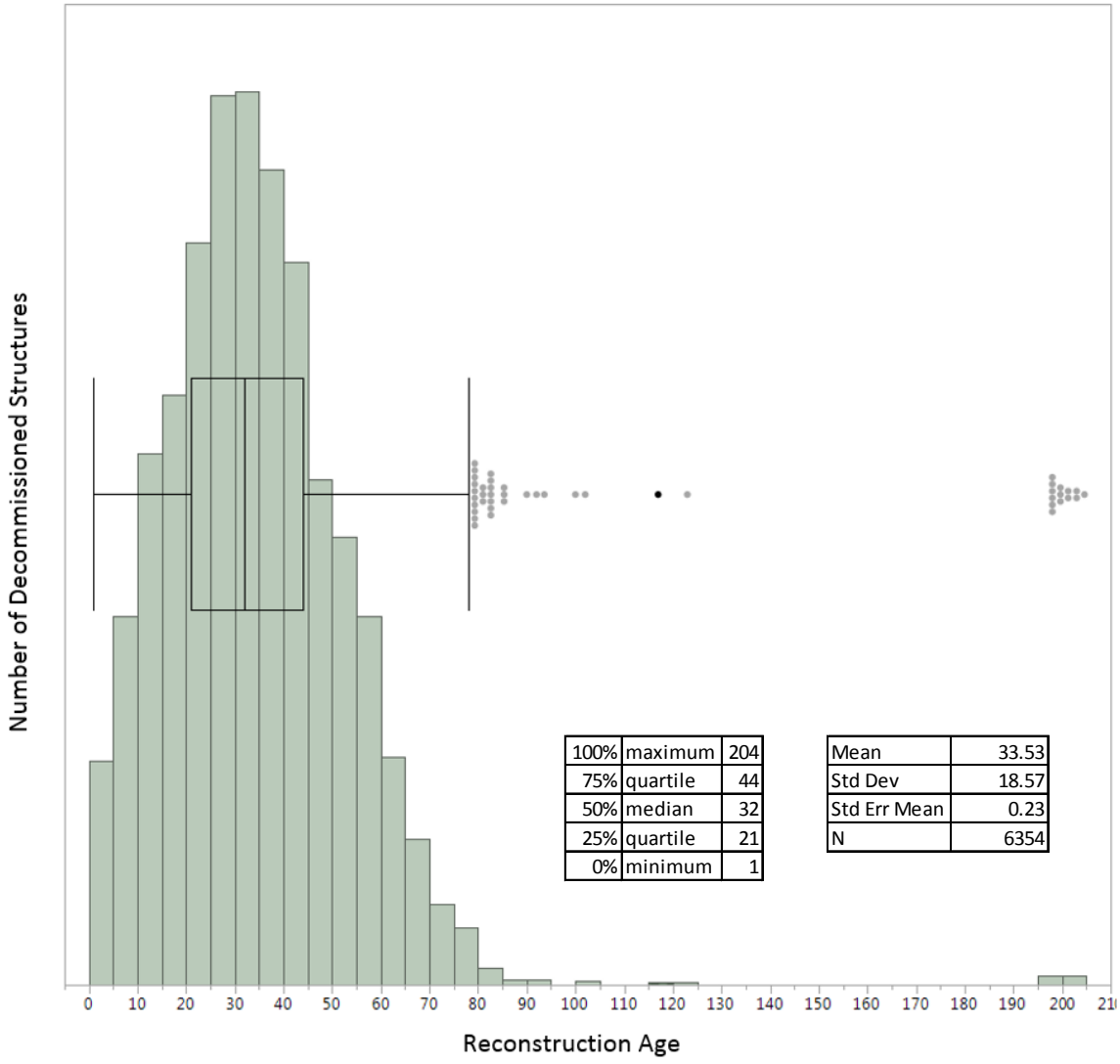


Figure 3-10: Statistical Distribution of Reconstruction Age

Vulnerabilities

The vulnerabilities assessed in this study were Item 61, Channel and Channel Protection (Table 3-17); Item 113, Scour Criticality (Table 3-18); and Item 92A, Fracture Criticality (Table 3-17). Vulnerabilities were the third most common criterion reported by the agencies in the survey. Only 1% of all decommissioned structures were ND but also scour critical, and another 0.5% were ND but also fracture critical. Later analyses also showed that these structures do not overlap; one structure typically does not have multiple vulnerabilities.

Table 3-17. Percentage of Decommissioned Structures by Deficiency Status and Channel Protection

Channel and Channel Protection (Item 61)	ND	SD	FO	Blank	Grand Total
0	0.0%	0.4%	0.0%	0.0%	0.5%
1	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.1%	0.0%	0.0%	0.1%
3	0.1%	0.6%	0.1%	0.0%	0.7%
4	0.6%	3.3%	0.3%	0.0%	4.2%
5	2.0%	6.7%	1.3%	0.2%	10.3%
6	5.6%	10.8%	3.4%	0.6%	20.4%
7	8.3%	10.3%	4.4%	0.7%	23.7%
8	6.2%	5.0%	2.5%	0.9%	14.6%
9	0.5%	0.1%	0.0%	0.0%	0.7%
N	0.6%	0.6%	0.6%	0.0%	1.8%
.	8.8%	6.9%	6.6%	0.7%	23.1%
Grand Total	32.7%	44.9%	19.2%	3.2%	100.0%

Table 3-18. Percentage of Decommissioned Structures by Deficiency Status and Scour Criticality

Scour Critical Bridges (Item 113)	ND	SD	FO	Blank	Grand Total
0	0.0%	0.1%	0.0%	0.0%	0.1%
1	0.0%	0.0%	0.0%	0.0%	0.0%
2	0.1%	0.4%	0.1%	0.0%	0.5%
3	0.9%	3.6%	0.7%	0.0%	5.3%
4	0.4%	1.5%	0.2%	0.0%	2.2%
5	2.6%	5.5%	1.6%	0.1%	9.8%
6	4.8%	9.8%	3.3%	0.3%	18.2%
7	0.8%	1.2%	0.4%	0.0%	2.3%
8	13.2%	13.2%	4.5%	0.8%	31.6%
9	0.1%	0.1%	0.0%	0.0%	0.2%
N	5.8%	4.9%	4.6%	0.3%	15.6%
T	0.0%	0.0%	0.0%	0.0%	0.1%
U	0.5%	1.5%	0.8%	1.0%	3.8%
.	3.6%	3.2%	3.0%	0.5%	10.3%
Grand Total	32.7%	44.9%	19.2%	3.2%	100.0%

Table 3-19. Percentage of Decommissioned Structures by Deficiency Status and Fracture Criticality

Fracture Critical (Item 92A)	ND	SD	FO	Blank	Grand Total
N	31.7%	39.7%	18.2%	3.0%	92.6%
Y06	0.0%	0.2%	0.0%	0.0%	0.2%
Y08	0.0%	0.0%	0.0%	0.0%	0.0%
Y12	0.1%	2.0%	0.2%	0.0%	2.3%
Y24	0.4%	2.1%	0.6%	0.1%	3.2%
Y48	0.0%	0.2%	0.1%	0.0%	0.3%
Y60	0.0%	0.2%	0.0%	0.0%	0.2%
.	0.4%	0.4%	0.2%	0.1%	1.1%
Grand Total	32.7%	44.9%	19.2%	3.2%	100.0%

Material

The material type is one of the variables that the research team perceives as a secondary driver of decommissioning. The primary drivers are the ones such as deficiency, load posting, or NBI condition that the team believes are often major criteria for replacement decisions. An agency may prefer a prestressed concrete structure to a steel structure in design, but this is a secondary decision. In other words, agencies would not change a structure just because they do not prefer the material. However, looking at the distribution of this variable in the decommissioned structures identified in the data set versus the distribution of this variable in current state-owned bridge network is informative. A majority of the decommissioned structures are concrete (31%) or steel (29%) structures (Table 3-20). The percentage of concrete structures in the 2016 network is similar, but steel structures constitute only 16% of the 2016 network. Continuous steel structures have similar percentages. While prestressed concrete structures are only 10% of the decommissioned structures, they constitute more than 27% of the current network.

Table 3-20. Comparison between 2016 Structures and Decommissioned Structures by Deficiency Status and Structure Kind/ Material

Structure Kind/ Material	2016 Structures				Decommissioned Structures				
(Item 43A)	0- ND	1-SD	2-FO	Total	0- ND	1-SD	2-FO	blank	Total
0-Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%
1-Concrete	24.0%	1.4%	3.3%	28.6%	11.6%	12.8%	6.2%	0.8%	31.4%
2-Concrete continuous	12.1%	0.4%	1.7%	14.2%	5.2%	3.5%	2.5%	0.2%	11.4%
3-Steel	10.3%	2.2%	3.5%	15.9%	5.4%	17.5%	4.9%	1.1%	28.8%
4-Steel continuous	10.0%	0.7%	2.2%	13.0%	3.7%	5.3%	3.0%	0.1%	12.0%
5-Prestressed concrete	17.6%	0.6%	2.2%	20.4%	4.4%	2.6%	1.9%	0.1%	9.1%
6-Prestressed concrete continuous	6.2%	0.1%	0.6%	6.8%	1.0%	0.1%	0.2%	0.1%	1.4%
7-Wood or timber	0.4%	0.2%	0.1%	0.7%	1.1%	2.8%	0.5%	0.7%	5.1%
8-Masonry	0.1%	0.0%	0.0%	0.2%	0.1%	0.1%	0.1%	0.0%	0.3%
9-Aluminum, Wrought Iron or Cast Iron	0.1%	0.0%	0.0%	0.2%	0.1%	0.1%	0.0%	0.0%	0.2%

Design Type

Design type is another secondary driver. The distribution is quite similar between the decommissioned bridges and the current inventory, aside from fewer multiple box beam/girder structures and more culverts in the current inventory (Table 3-21). The changes in design, presumably, reflect agencies' preferences based on the type of structures they prefer to preserve and manage and represent a secondary decision made.

Table 3-21. Comparison between 2016 Structures and Decommissioned Structures by Deficiency Status and Structure Type

Structure Type Item 43B	2016 Structures				Decommissioned Structures				
	0- ND	1-SD	2-FO	Total	0- ND	1-SD	2-FO	.	Total
01 Slab	0.1%	0%	0%	0.1%	0.20%	0.20%	0.10%	0%	0.5%
02 Stringer/Multi-beam or girder	10%	0.6%	1.5%	12.2%	4.8%	5.8%	3.3%	0.5%	14.3%
03 Girder and floor beam system	35%	2.9%	7%	44.8%	12.2%	21.8%	9.7%	1.6%	45.4%
04 Tee beam	0.4%	0.2%	0.2%	0.8%	0.3%	1.7%	0.3%	0.1%	2.5%
05 Box beam or girders - Multiple	4.3%	0.6%	1.6%	6.6%	2.4%	6%	2.9%	0.1%	11.3%
06 Box Beam or girders - Single or Spread	5.5%	0.3%	1.1%	6.9%	1.6%	1.7%	0.7%	0.1%	4.1%
07 Frame	2%	0.1%	0.3%	2.4%	0.5%	0.2%	0.2%	0.1%	0.9%
08 Orthotropic	0.5%	0%	0.3%	0.8%	0.3%	0.2%	0.3%	0%	0.8%
09 Truss - Deck	0%	0%	0%	0.10%	0%	0.3%	0%	0%	0.3%
10 Truss - Thru	0.2%	0.2%	0.2%	0.6%	0.3%	3.4%	0.4%	0.1%	4.1%
11 Arch - Deck	0.4%	0.2%	0.3%	0.9%	0.2%	0.9%	0.3%	0%	1.5%
12 Arch - Thru	0%	0%	0%	0.10%	0%	0.1%	0%	0%	0.1%
19 Culvert	21.8%	0.3%	0.8%	22.9%	9.5%	1.9%	0.8%	0.5%	12.8%
22 Channel beam	0.4%	0.1%	0.1%	0.6%	0.2%	0.6%	0.1%	0%	0.9%
Grand Total	80.9%	5.6%	14%		32.7%	44.9%	19.2%	3.2%	

Operating Rating

Regardless of deficiency status, 5.4% of all decommissioned structures were coded with an operating rating of zero, which indicates that the structure would not carry a minimum of 2.7 metric tons of live load (Table 3-22). For the operating rating, a bridge shored up or repaired on a temporary basis is considered a temporary bridge and the operating rating is to be coded as if the temporary shoring were not in place.

Table 3-22. Number of Structures with Zero Operating Rating

Deficiency Status	Structure Count	Percentage of Decommissioned Structures
Blank	200	0.5%
ND	51	0.1%
SD	1629	4.5%
FO	94	0.3%
Total	1974	5.4%

However, a majority of these structures are also deficient; therefore, deficiency as a primary variable covers these structures. Only 0.1% of the decommissioned structures are both ND and coded with an operating rating of zero. The average operating rating is 36.1 metric tons for all decommissioned structures and 48.6 metric tons for ND structures (Figure 3-11 and Figure 3-12). Overall, the operating ratings for ND structures are higher, and operating rating is therefore not a strong variable to explain the decommissioning of ND structures.

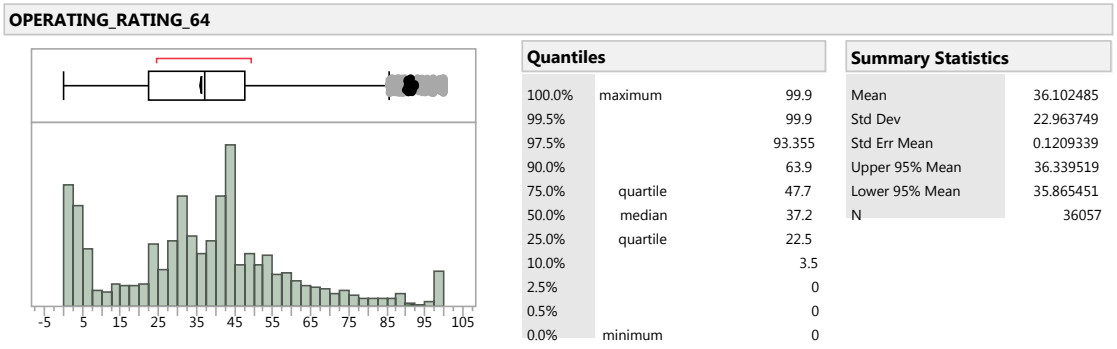


Figure 3-11. Statistical Distribution of Operating Rating for All Decommissioned Structures

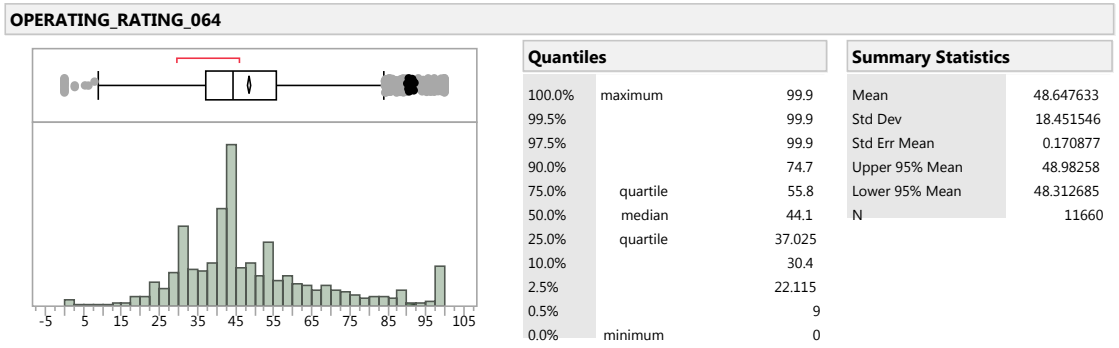


Figure 3-12. Statistical Distribution of Operating Rating for ND Decommissioned Structures

Traffic Volume

Traffic volume, or Item 29, Average Daily Traffic (ADT), is a variable that may provide insight into the replacement of structures due to capacity improvement projects and not necessarily

condition. However, rather than the variable itself, the change in traffic volume between the decommissioned bridges and the new/replacement structures would provide the ideal variable. The research team explored this variable using a subset of decommissioned structures in an additional task. For this initial analysis, the traffic volumes for the traffic volume ranges reported in the FHWA Condition and Performance reports were compared for the structures in the 2016 network and the decommissioned structures (Table 3-23). Grand total percentages are comparable for both groups, and a similar percentage of structures is observed for each volume group. Comparing deficiency status percentages is not insightful because the sample of decommissioned bridges has a much higher ratio of deficient structures. If we look at the percentages of only ND structures in each traffic volume class (values in parentheses in Table 3-23), it can be observed that the percentages in each volume class are quite close. Therefore, this variable is not identified as a strong variable to explain the decommissioning of ND structures.

Table 3-23. Comparison between 2016 Structures and Decommissioned Structures by Deficiency Status and Traffic Volume

Traffic Volume (Item 29 ADT)	2016 Structures				Decommissioned Structures				
	ND	SD	FO	Total	ND	SD	FO	.	Total
< 1,000	19.9% (25% ND)	2.1%	2.3%	24.3%	7.8% (24% ND)	15.3%	3.1%	2.1%	28.3%
1,001 to 10,000	37.0% 46% ND)	2.3%	5.9%	45.2%	13.0% (40% ND)	22.3%	9.0%	0.8%	45.1%
10,001 to 50,000	19.3% (24% ND)	1.0%	4.2%	24.5%	9.3% (28% ND)	6.2%	5.7%	0.2%	21.5%
> 50,000	4.7% (6% ND)	0.2%	1.1%	6.0%	2.7% (8% ND)	1.0%	1.3%	0.1%	5.1%
Grand Total	80.9%	5.6%	13.5%	100.0%	32.7%	44.9%	19.2%	3.2%	100.0%

Number of Lanes

Number of lanes is another potential variable that could help explain decommissioning decisions resulting from corridor widening projects. As with traffic volume, the best way to look at this variable is to compare the new structures with the decommissioned/replaced ones. This variable was added to the additional task undertaken for comparing replaced structures with new structures and is further discussed in Section 3.6. Comparison of the number of lanes on the decommissioned structures versus the number of lanes on the structures in the 2016 network did not provide significant findings, aside from a general decrease in one- and two-lane roads and an increase in three-lane roads (Table 3-24). When we examine ND structures only, though, the percentages of structures (in parentheses in Table 3-24) are quite similar with respect to number of lanes. This result does not support the possibility that this variable influenced the decommissioning of ND structures.

Table 3-24. Comparison between 2016 Structures and Decommissioned Structures by Deficiency Status and Number of Lanes

Number of Lanes (Item 28)	2016 Structures				Decommissioned Structures				
	0- ND	1-SD	2-FO	Total	0- ND	1-SD	2-FO	.	Total
1	2.4% (3% ND)	0.5%	1.0%	3.9%	1.3% (4%)	5.1%	1.4%	0.2%	8.1%
2	60.4% (74.7% ND)	4.3%	8.9%	73.7%	24.8% (75.8% ND)	36.4%	14.6%	2.1%	77.9%
≥ 3	18.1% (22.4% ND)	0.7%	3.6%	22.4%	6.6% (20.2%)	3.3%	3.2%	0.2%	13.3%
.								0.6%	0.7%
Grand Total	80.9%	5.6%	13.5%	100%	32.7%	44.9%	19.2%	3.2%	100%

Functional Classification of Inventory Route (NBI 26)

The percentages of structures in the 2016 network and the percentages of decommissioned structures for each road functional classification were examined (Table 3-25). Like traffic volume and number of lanes, this variable has the potential to provide information about decommissioning decisions when old and new structures are compared. However, no significant trend was observed in the preliminary analysis.

Table 3-25. Comparison between 2016 Bridges and Decommissioned Structures by Deficiency Status and Functional Class

Functional Classification	2016				Decommissioned				
	0- ND	1-SD	2-FO	Grand Total	0- ND	1-SD	2-FO	Blank	Grand Total
1	7.3%	0.2%	0.9%	8.4%	2.3%	1.5%	0.8%	0.1%	4.7%
2	11.5%	0.3%	0.8%	12.7%	5.3%	4.8%	2.8%	0.2%	13.1%
6	10.6%	0.6%	1.0%	12.2%	4.1%	8.5%	2.3%	0.4%	15.3%
7	14.6%	1.2%	1.6%	17.4%	4.4%	12.6%	3.0%	0.3%	20.3%
8	4.1%	0.5%	0.6%	5.2%	1.3%	3.2%	0.8%	0.1%	5.4%
9	6.6%	1.0%	1.2%	8.8%	3.2%	4.8%	1.3%	1.2%	10.4%
11	8.1%	0.4%	2.0%	10.4%	3.9%	2.1%	2.5%	0.1%	8.7%
12	4.8%	0.2%	1.2%	6.1%	2.3%	1.0%	1.4%	0.1%	4.7%
14	6.2%	0.4%	1.5%	8.1%	3.1%	2.7%	2.0%	0.2%	8.0%
16	3.7%	0.4%	1.4%	5.5%	1.6%	2.0%	1.3%	0.1%	5.0%
17	2.1%	0.2%	0.9%	3.2%	0.7%	1.0%	0.6%	0.0%	2.3%
19	1.3%	0.2%	0.6%	2.1%	0.6%	0.7%	0.4%	0.1%	1.8%
Blank	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%
Grand Total	**80.9%**	**5.6%**	**13.5%**	**100.0%**	**32.7%**	**44.9%**	**19.2%**	**3.2%**	**100.0%**

Proposed Work (NBI 75A)

The proposed work item fields for each structure were analyzed to detect any trends that could not be detected from the previous analyses. A total of 64.8% of decommissioned structures have some entry in this field (Table 3-26).

Table 3-26. Percentages of Structures by Proposed Work and Deficiency Status

Row Labels	ND	SD	FO	.	Total
31	**4.3%**	31.0%	6.4%	1.1%	42.8%
32	0.1%	0.1%	0.1%	0.0%	0.2%
33	**0.6%**	0.2%	0.9%	0.0%	1.7%
34	**0.8%**	1.8%	1.9%	0.0%	4.5%
35	**1.6%**	3.0%	1.8%	0.1%	6.5%
36	0.1%	0.2%	0.1%	0.0%	0.4%
37	**0.6%**	0.4%	0.3%	0.0%	1.4%
38	**1.5%**	2.2%	3.3%	0.1%	7.1%
Grand Total	9.6%	39.0%	14.8%	1.4%	64.8%

A total of 9.6% of decommissioned structures are ND and have an entry in this field, 23.4% of structures are ND with no explanation of the proposed work, and 4.3% of structures are ND but were scheduled to be replaced due to substandard load carrying capacity and issues related to roadway geometry. Collectively, the codes related to widening (33, 34, 36, and 37, as shown in Table 3-26) represent 2.1% of all decommissioned structures that are also ND. Although not all decommissioned structures with these codes were originally proposed to be replaced, eventually these structures seem to have been replaced for widening. Overall, 8.1% of the decommissioned structures had some widening project proposed. Only 1.6% of all structures are ND with a rehabilitation project proposed due to inadequate strength or advanced deterioration. These structures are primarily in good or fair condition; therefore, we believe these structures had a strength problem. A total of 7.1% of all structures were potentially replaced due to hydraulic issues, and 1.5% were also ND. These variables are included in the next section where all potential drivers are discussed.

Table 3-27. Code Values for Proposed Work

Proposed Work Code	Type of Work
31	Replacement of bridge or other structure because of substandard load carrying capacity or substantial bridge roadway geometry.
32	Replacement of bridge or other structure because of relocation of road.
33	Widening of existing bridge or other major structure without deck rehabilitation or replacement; includes culvert lengthening.
34	Widening of existing bridge with deck rehabilitation or replacement.
35	Bridge rehabilitation because of general structure deterioration or inadequate strength.
36	Bridge deck rehabilitation with only incidental widening.
37	Bridge deck replacement with only incidental widening.
38	Other structural work, including hydraulic replacements.

3.4. Reported Reasons of Bridge Replacements

Among the variety of NBI items investigated, six major categories were found to be more influential than others based on their frequencies in the data set. Section 3.3 summarized the basic analyses for each potential driver and noted whether each had the potential to be considered as a driver. Since deficiency status determined the eligibility of bridge work for HBP federal funding, was a known driver for bridge replacements, was a major performance criterion consistently used by State DOTs, and was the status for 64% of the decommissioned structures, this variable was initially designated as a major driver. Also, isolating deficiency status from other potential drivers was useful for identifying these other drivers because this study was particularly interested in additional drivers of bridge replacement besides condition. The research team was particularly interested in identifying the factors that led to the decommissioning of ND structures and kept that perspective for the remainder of the analyses.

A summary of the reasons for including each variable in the list of potential drivers is given below.

Deficiency Status with 10-Year Rule

A total of 45% of decommissioned structures are SD, 19% are FO, and 33% are ND.

Bridge Posting (NBI 70 & NBI 41)

Regardless of other factors, 19.3% of decommissioned bridges are posted. Only 1.1% of decommissioned bridges are posted and ND at the same time. Therefore, the majority of the posted bridges are included within the set of deficient structures.

Structural Evaluation (NBI 67)

Among all appraisal ratings, Structural Evaluation (SE) and Deck Geometry (DG), independent of deficiency status, are potentially the most influential ones for bridge replacement. A total of 26% of structures have ratings of three or below for Item 67 (SE), and 41.4% of structures have ratings of three or below for Item 68 (DG).

When Item 67 is rated three or below, a structure is designated as deficient. Therefore, a poor SE rating is covered within deficiency. A majority of the decommissioned structures have a rating of 4 in this category, which indicates the minimum tolerable condition for the structure to be left in place as is. Therefore, a fair rating for SE, including ratings of 4 or 5, was selected as a secondary driver. More than 45% of the bridges have a rating of 4 or 5, indicating the minimum tolerable conditions or slightly better than tolerable conditions.

Deck Geometry (NBI 68)

A majority of the decommissioned structures have either the minimum tolerable or intolerable deck geometry ratings. A total of 0.6% of structures are ND with intolerable deck geometry, and 9.3% are ND with the minimum tolerable deck geometry. These structures could have potentially been decommissioned as part of capacity improvements or widenings, even though they could have been ND. Therefore, a fair rating for DG, including ratings of 4 or 5, was selected as a secondary driver.

Vulnerabilities

A total of 1.6% of all decommissioned structures were both ND and vulnerable (considering ratings of 3 or less for all items). A total of 1% of all decommissioned structures were ND but scour critical, and another 0.5% were fracture critical. Subsequent analyses also showed that these structures do not overlap; one structure typically does not have multiple vulnerabilities.

Fair Condition

Poor condition is covered under deficiency status. However, combined with other issues, fair condition appears to be influential in bridge decommissioning. Fair deck, superstructure, substructure, and culvert conditions were identified as secondary drivers. Poor condition was considered as a primary driver to account for structures that were not designated as deficient due to the 10-year rule.

Type of Work (NBI 75A)

This NBI item is, in fact, not a driver but a variable that indicates an agency's decision. It is, rather, an outcome of the drivers. The reason to keep this variable in the analyses was to see

whether the variables described above identified all of the proposed work. Code 31 was defined as “Work for Deficient Structures,” 35 was defined as “Work for Strength,” and 33 through 37, except 35, were defines as “Work for Widening.”

Redefined Deficiency Status

After the Phase I report was reviewed by the project panel, the research team received a recommendation to redefine deficiency. This redefinition is further explained in this section. Based on this redefinition, 41.4% of the decommissioned structures are in poor condition, 32.7% are not in poor condition but have inadequate function, and 25.9% are neither in poor condition nor functionally inadequate.

After the potential drivers were identified, a two-level hierarchy (Figure 3-13) and priority order was used to prioritize the potential drivers (Table 3-28). The hierarchy indicates whether a driver is primary or secondary in our assessment. The basic assumption in this classification is that if a decommissioned structure has a list of potential drivers based on its NBI records, the drivers listed as primary would have precedence in a replacement decision over the secondary ones. For example, if a structure is both SD and has a fair rating for waterway adequacy, SD status would have mostly driven the replacement decision. Secondary drivers were considered in this classification to account for cases in which a structure is decommissioned without an obvious or primary driver but the structure has some less-than-desired values for the listed NBI fields.

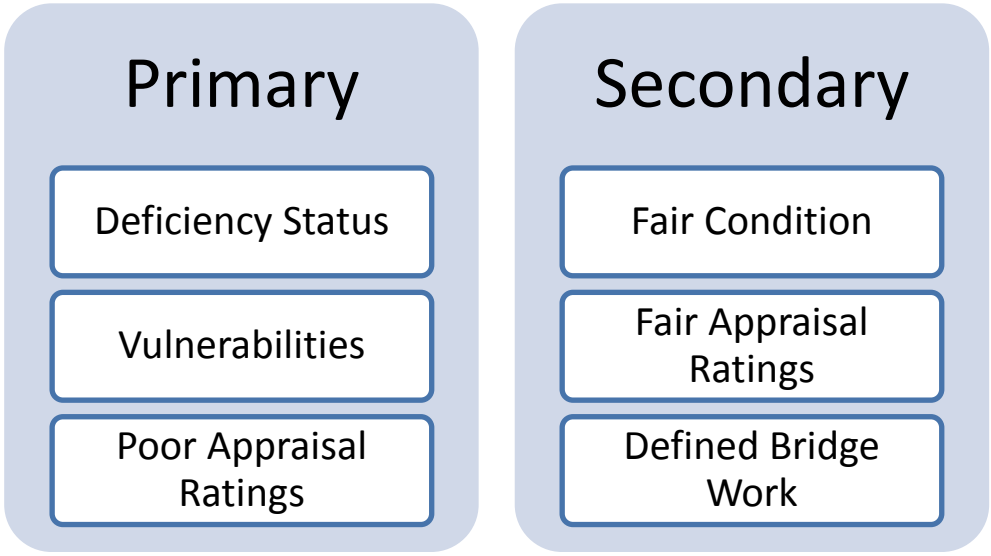


Figure 3-13. Initial Hierarchy of Potential Drivers

The priority order in Table 3-28 was assigned by the research team based on the assumption that any driver with a lower order (higher priority) would have precedence over any other driver with a higher order (lower priority) in a replacement decision. A critical point to note here that this conjectured priority order is an attempt to guess the most important driver, in light of a lack of agency documentation, when a decommissioned structure has multiple drivers. The order is subjective but is based on the assessment of the research team given the analyses so far and the

survey findings. Depending on the particular structure, agency policy, or bridge manager, alternative rankings are possible. For any decommissioned structure in the data set, all assigned drivers were checked, and the driver with the lowest order (highest priority) was assigned as the major potential driver.

Table 3-28. Initial Potential Drivers of Bridge Decommissioning

Priority Order	Hierarchy	Major Potential Driver	Count	Percentage	
1	Primary	Structural Deficiency	16359	44.87%	69.00%
2		Functional Obsolescence	7008	19.22%	
3		Posted for Load	682	1.87%	
4		Scour Critical	373	1.02%	
5		Fracture Critical	202	0.55%	
6		Failed Channel	23	0.06%	
7		Poor Structural Evaluation	154	0.42%	
8		Poor Substructure Condition	39	0.11%	
9		Poor Superstructure Condition	21	0.06%	
10		Poor Deck Condition	23	0.06%	
11		Poor Culvert Condition	5	0.01%	
12		Poor Deck Geometry	268	0.74%	
13	Secondary	Fair Structural Evaluation	3296	9.04%	24.27%
14		Fair Deck Geometry	2727	7.48%	
15		Fair Underclearance	721	1.98%	
16		Fair Waterway Evaluation	134	0.37%	
17		Fair Approach Roadway Alignment	94	0.26%	
18		Fair Substructure Condition	399	1.09%	
19		Fair Superstructure Condition	177	0.49%	
20		Fair Deck Condition	167	0.46%	
21		Fair Channel Condition	177	0.49%	
22		Fair Culvert Condition	589	1.62%	
23		Fair Scour Criticality	111	0.30%	
24		Widening Work	92	0.25%	
25		Work for Deficient Structures	123	0.34%	
26		Work for Strengthening	43	0.12%	
		Unidentified	2452	6.73%	6.73%
		Total	36,459	100.00%	100%

The potential drivers with priority orders of 7 through 12 include drivers for structures that should have been deficient but could not be identified as such due to the 10-year rule. Structural

Deficiency, Functional Obsolescence, Fair Structural Evaluation, and Fair Deck Geometry were the top four drivers of bridge decommissioning in terms of frequency and accounted for more than 80% of the decommissioned structures. Almost 7% of the decommissioned structures were not associated with any identified driver.

After the Phase I report was reviewed by the panel members, the research team received a suggestion to redefine deficiency so that it describes any structure having a poor condition and functional adequacy, independent of the 10-year rule. Poor condition was suggested to be based on condition only (consistent with the current SD definition), while adequate function was suggested to be based on appraisal ratings (consistent with previous FO classification) plus posting status. See Table 3-29. The percentage of decommissioned structures in poor condition (41%) is close to the percentage of decommissioned structures that are SD (45%, Table 3-28). According to this new classification, 33% of the decommissioned structures are not in poor condition and are also functionally adequate. Based on the previous definition of deficiency, 26% of the decommissioned structures were neither structurally deficient nor functionally obsolete (Figure 3-3). The difference between these two comparable percentages is due to the inclusion of posted structures and structures that could not be classified as deficient previously due to the 10-year rule. This new definition is a better indicator of the percentage of decommissioned structures without condition or functional limitations.

Table 3-29. Percentage of Decommissioned Structures by Poor Condition and Functional Adequacy

Functional Adequacy	Poor Condition	Not Poor Condition	Total
Inadequate Function	31.2%	25.9%	57.1%
Adequate Function	10.2%	32.7%	42.9%
Total	41.4%	58.6%	100.0%

Based on the new definition of deficiency (Figure 3-14), the list of potential drivers of bridge decommissioning was updated as shown in Table 3-30. This updated list was preferred for future analyses because it does not have the ambiguity that comes from the 10-year rule and because the poor condition classification matches the current definition of SD. Poor condition, functional inadequacy, and vulnerabilities (scour critical and fracture critical structures and structures with failed channels) collectively account for approximately 70% of decommissioned structures. Secondary potential drivers were assigned to almost 24% of the decommissioned structures, yet these drivers by themselves are not strong enough to warrant a replacement. A total of 6.5% of the decommissioned structures have no primary or secondary potential driver assigned to them.

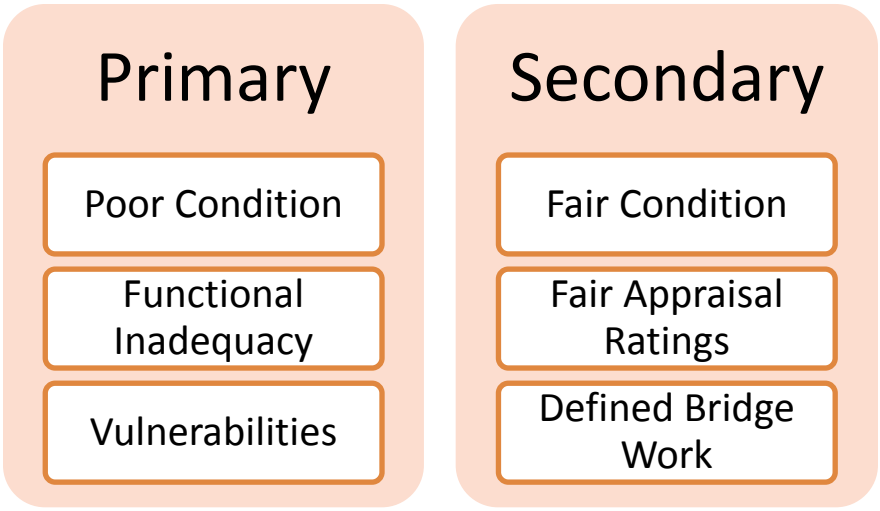


Figure 3-14. Final Hierarchy of Potential Drivers

Table 3-30. Updated Potential Drivers of Bridge Decommissioning

Order	Hierarchy	Potential Driver	Count	Percentage	
1	Primary	Poor Condition	15093	41.40%	69.65%
2		Functional Inadequacy	9443	25.90%	
3		Scour Critical	344	0.94%	
4		Fracture Critical	162	0.44%	
5		Failed Channel	26	0.07%	
10		Poor Culvert Condition	326	0.89%	
12	Secondary	Fair Structural Evaluation	3245	8.90%	23.87%
13		Fair Deck Geometry	2679	7.35%	
14		Fair Underclearance	709	1.94%	
15		Fair Waterway Evaluation	133	0.36%	
16		Fair Approach Roadway Alignment	93	0.26%	
17		Fair Substructure Condition	384	1.05%	
18		Fair Superstructure Condition	173	0.47%	
19		Fair Deck Condition	167	0.46%	
20		Fair Channel Condition	176	0.48%	
21		Fair Culvert Condition	585	1.60%	
22		Fair Scour Criticality	110	0.30%	
23		Widening Work	93	0.26%	
24		Work for Deficient Structures	116	0.32%	
25		Work for Strengthening	41	0.11%	
		Unidentified	2361	6.48%	6.48%
		Total	36459	100.00%	100.00%

3.5. Replacements with Multiple Reasons

Based on the new potential drivers in Table 3-30, all potential drivers were assigned to each decommissioned structure, without considering the hierarchy, to determine the occurrences of multiple drivers (Table 3-31). Approximately 82% of the decommissioned structures had more than one primary or secondary driver associated with them. Then, the combinations of all primary drivers for each structure were listed to check for the most frequent combinations (Table 3-32).

Table 3-31. Percentages of Decommissioned Structures by the Sum of Primary and Secondary Drivers

	Sum of Secondary Drivers									
Sum of Primary Drivers	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Grand Total**
0	6.5%	6.7%	5.1%	4.1%	3.1%	2.5%	1.5%	0.6%	0.1%	30.3%
1	1.9%	3.4%	4.8%	6.0%	7.3%	6.7%	3.1%	0.8%	0.1%	34.1%
2	0.4%	2.5%	5.5%	7.4%	7.1%	3.8%	1.3%	0.3%		28.4%
3	0.1%	0.7%	1.5%	1.8%	1.5%	0.8%	0.2%	0.1%		6.6%
4		0.1%	0.2%	0.1%	0.1%					0.6%
Grand Total	8.8%	13.5%	17.1%	19.4%	19.1%	13.9%	6.1%	1.8%	0.3%	100.0%

Table 3-32. Percentages of Decommissioned Structures by Combined Primary Drivers

Order	Combined Primary Drivers	Percentage of Decommissioned Structures
1	No Driver	30.3%
2	Functionally Inadequate-Poor Condition	24.4%
3	Functionally Inadequate	23.1%
4	Poor Condition	8.8%
5	Functionally Inadequate-Fracture Critical	4.4%
6	Functionally Inadequate-Scour Critical	2.6%
7	Poor Culvert Condition	0.9%
8	Scour Critical	0.9%
9	Poor Condition-Scour Critical	0.8%
10	Functionally Inadequate- Scour Critical	0.8%
11	Functionally Inadequate-Failed Channel	0.6%
12	Functionally Inadequate-Poor Culvert Condition	0.6%
13	Fracture Critical	0.4%
14	Poor Condition- Fracture Critical	0.4%
15	Functionally Inadequate-Poor Condition- Scour Critical -Failed Channel	0.5%
16	Functionally Inadequate- Failed Channel-Poor Culvert Condition	0.1%
17	Poor Condition- Failed Channel	0.1%
18	Poor Condition-Scour Critical -Fracture Critical	0.1%
		99.6%

Figure 3-15 shows the relative frequency of decommissioned structures by the most common combinations of primary drivers. Figure 3-15 highlights the dominance of functional inadequacy over poor condition as a potential driver of decommissioning in the most frequent drivers. Each circle in this graph is sized according to the frequency of that driver combination for all decommissioned structures. When the top 18 most frequent combinations for primary drivers are examined, almost 57% of decommissioned structures list functional inadequacy as a driver. Poor condition by itself is observed for only 9% of decommissioned structures, and 36% of decommissioned structures list poor condition as one of the drivers.

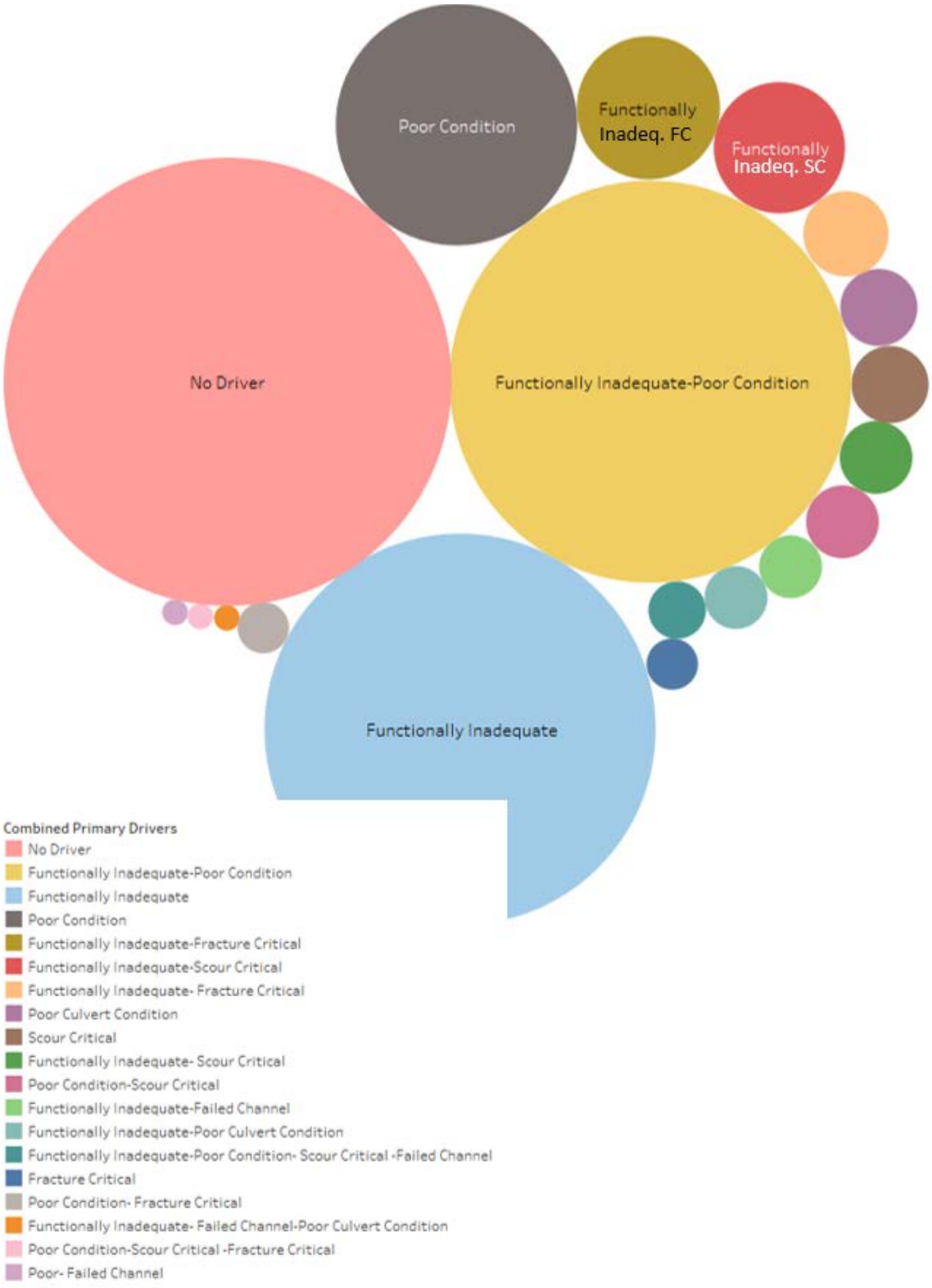


Figure 3-15. Relative Frequency of Combined Primary Drivers

The top 20 most frequent combinations of secondary drivers for all decommissioned structures without a primary driver are given in Table 3-33. These secondary drivers collectively match 10% of the decommissioned structures. When Table 3-33 is examined, it is observed that 5.4% of decommissioned structures have a form of fair functional adequacy (such as for underclearances or deck geometry) and 4.8% have fair condition as one of their NBI components.

Table 3-33. Percentages of Decommissioned Structures without Primary Drivers by Combined Secondary Drivers

Order	Combined Secondary Drivers for Structures with no Primary Driver	Percentage of Decommissioned Structures
1	Fair Deck Geo.	2.0%
2	Fair Culvert Condition	1.3%
3	Fair Underclearance	0.8%
4	Fair Structural Evaluation-Fair Culvert Condition	0.7%
5	Fair Structural Evaluation-Fair Deck Geo.-Fair Condition (Deck, Super, Sub)	0.6%
6	Fair Structural Evaluation	0.5%
7	Fair Deck Geo.-Fair Underclearance	0.4%
8	Fair Structural Evaluation- Fair Condition (Deck, Super, Sub)	0.4%
9	Fair Deck Condition	0.4%
10	Fair Deck Geo.- Fair Condition (Deck, Super, Sub)	0.3%
11	Fair Structural Evaluation-Fair Deck Geo.- Fair Condition (Deck, Super, Sub)-Defined Work	0.3%
12	Defined Work	0.3%
13	Fair Condition (Deck, Super, Sub)	0.3%
14	Fair Scour Critical	0.3%
15	Fair Deck Geo.-Fair Deck Condition	0.3%
16	Fair Deck Geo.-Fair Sub. Condition	0.3%
17	Widening Work	0.3%
18	Fair Sub. Condition	0.2%
19	Fair Channel	0.2%
20	Fair Deck Geo.- Fair Scour Critical	0.2%
Order		10.2%

3.6. Comparison of Potential Drivers with Agency Reasons

The objective for the second phase of the project was to compare the potential drivers of bridge decommissioning with project-level records from State DOTs. The intention was to analyze records from at least four state DOTs, with at least one DOT representing each of the four AASHTO Transportation System Preservation Technical Services Program (TSP2) bridge preservation partnerships. One of the questions in the survey performed earlier in the project asked respondents whether they had such project-level records and whether they would be willing to share them for this research project. Eight states reported they had such records and would share them with the project team. During the second phase of the project, some of the agencies did not have either time or resources to do the internal work needed to gather these records. The five States listed in Table 3-34 shared their documentation on bridge replacements or shared data that could help the project team identify the agency's reasoning. The processes, documents, and data kept by agencies varied, as did the classification of their reasons. Information regarding each agency's data and a comparison between potential drivers and agency reasoning are discussed in following sections.

Table 3-34. Agencies that Provided Records

Bridge Preservation Partnership	Representative States
Midwest (MWBPP)	Michigan
Northeast (NEBPP)	Pennsylvania
Southeast (SEBPP)	Florida
Western (WBPP)	Utah and California

Utah

The Utah DOT (UDOT) maintains a detailed document on the State's bridge replacements entitled "Structure Type Selection Report." This document contains an overview of each project, the basis of evaluation, a summary of existing conditions, design issues, a discussion on the proposed work, estimated closures and project costs, and a conclusion on the selection decision. For most bridge replacements, this document provides enough details to assign a reason for or driver of decommissioning. While the agency has the data and documentation to determine the reasons for and dates of decommissioning, an internal review process was needed to identify the reason because bridge-level records describing the reasons for decommissioning are not collected in a database. The project team worked with UDOT engineers as they reviewed their documents and databases to determine the agency's reasons (Figure 3-16) for 40 decommissioned structures identified in the first phase of this project. A high percentage (32.5%) of structures in this sample were identified as decommissioned due to a change in ownership. The tracking algorithm used by the research team was applied only to State-owned structures as per the scope of the project and could not detect the transfers of State structures to local systems. The most common reason for decommissioning was widening and improvement projects (35% of decommissioned structures), while poor condition was the second most common reason (17.5%). Few structures that were not deficient were noted to have been replaced due to aging or

fair condition. Another 5% of structures were replaced due to widening projects and were also structurally deficient.

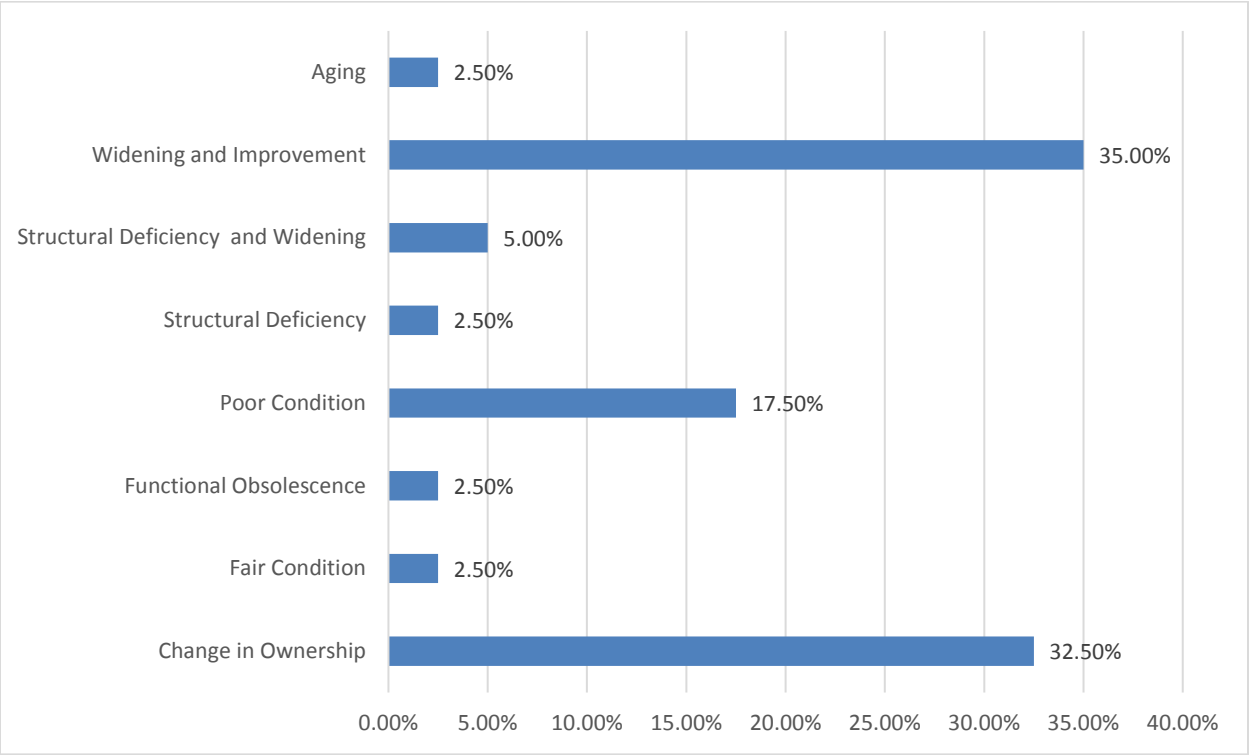


Figure 3-16. Percentage of Decommissioned Structures by UDOT Reasons

Figure 3-17 compares the reasons cited by UDOT with the potential drivers identified by the Iowa State University (ISU) research team. The columns list the reasons for decommissioning provided by UDOT, and the bars in each column show the percentages of ISU-identified drivers that match the decommissioned structures for each reason provided by UDOT. For example, 50% of the structures that UDOT selected for replacement due to structural deficiency and widening had poor condition as the ISU-identified driver, and the remaining structures had inadequacy and poor condition as the ISU-identified driver. The bar sizes are also directly proportional to the number of decommissioned structures by that reason and driver within the overall agency sample. For this part of the analysis, the combinations of drivers were highly condensed. For example, if a structure had poor deck condition and poor substructure condition and was scour critical and fracture critical, the ISU-identified driver was noted as poor condition-vulnerability. In addition, for all structures, when a primary driver was identified, secondary drivers were ignored. Secondary drivers included in figures and tables indicate that no primary drivers were found for those structures.

One structure that was replaced due to aging by UDOT was captured by the ISU-identified driver of fair condition rating. Although fair condition is a secondary driver and not a common reason for replacement, it seems to be a factor considered by agencies on occasion. Although the details for this particular project are not known, the structure may have been in close proximity to another replacement project and therefore chosen due to the cost savings that would result from a

bundle project. Such factors play into project costs and ultimately affect decision-making but are not always documented. Agencies may have internal documentation that notes whether proximity to other projects is a factor in decommissioning, but in the case of UDOT, neither the reasons shared with the project team nor the agency data included this detail.

Figure 3-17. Comparison of Potential Drivers with Utah Reasons

Michigan

The Michigan DOT (MDOT) keeps bridge-level records of its projects, including replacements. Soon after they were contacted, MDOT engineers were able to provide agency reasoning and data for the 173 structures identified as decommissioned by the research team (Figure 3-18). Similar to the Utah findings, a high percentage (29.5%) of structures in the sample were identified as decommissioned due to a change in ownership; these structures had been returned to local agencies. Approximately 7.5% of the structures were decommissioned because they were removed from the inventory, mostly due to filled roadways that would no longer be maintained. Approximately 8% of the decommissioned structures were removed from the NBI data since they were too short. Similar to Utah, road projects were the main reason for decommissioning; 41% of the structures were removed or replaced due to road upgrades, including interchange

reconfiguration, freeway reconstruction, and widening or corridor reconstruction. Approximately 13% of the structures were reported as replaced, apparently due to poor condition, vulnerabilities, or functional inadequacy in terms of project specifications. Two structures were replaced for hydraulic improvements; one was for scour-related and the other for channel-related improvements.

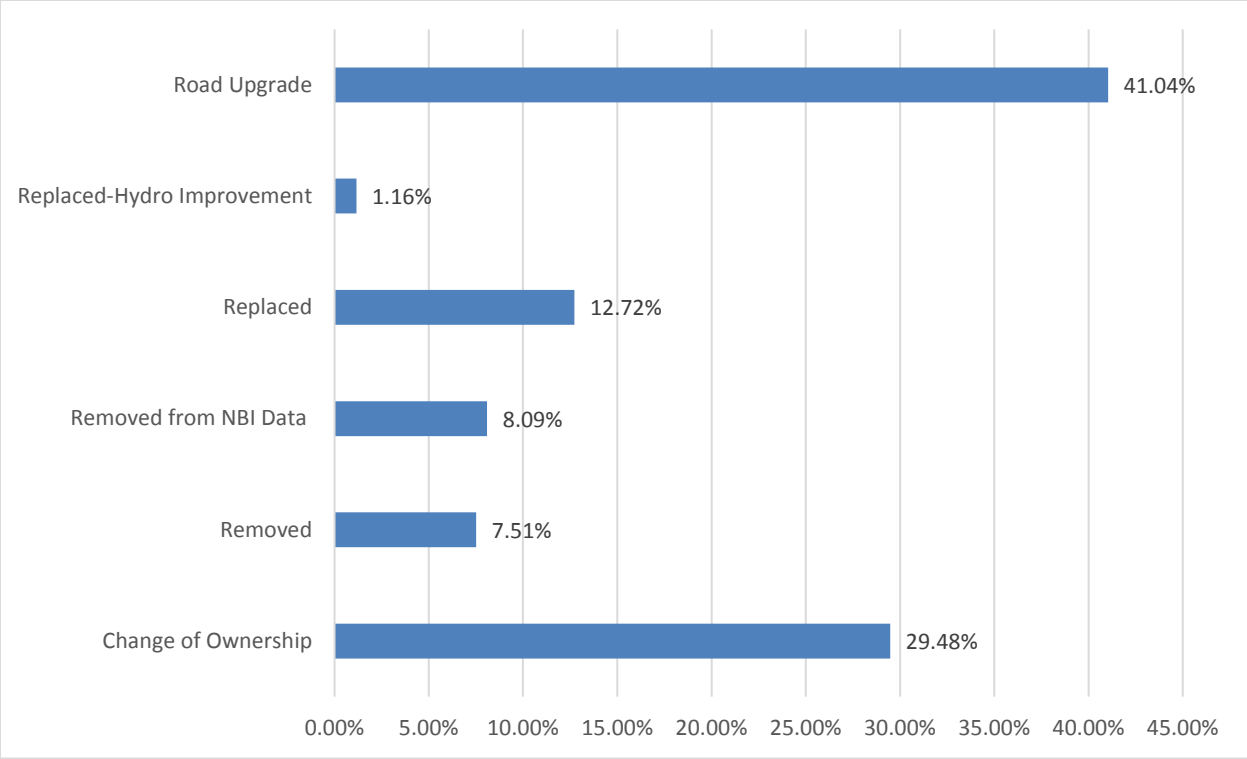


Figure 3-18. Percentage of Decommissioned Structures by Michigan Agency Reasons

Figure 3-19 compares the reasons cited by MDOT with the potential drivers identified by the ISU research team. The columns that show changed ownership and structures removed from the NBI do not provide relevant information because these structures were not technically decommissioned. Removed structures match a variety of ISU-identified drivers, primary drivers in most cases, and generally were in poor condition and had functional issues. However, the removal of these structures from the inventory is typically explained by filled roadways, and neither ISU-identified drivers nor NBI data fields account for this reason. Replaced structures mostly were in poor condition or had a combination of poor condition and functional inadequacy. The two structures replaced by MDOT for hydraulic improvements had fair channel ratings, and one had fair condition and structural evaluation ratings. Knowing the reasons behind these replacements, fair channel ratings make sense as drivers of decommissioning. However, fair ratings by themselves are not strong enough drivers to identify channel problems as the main reasons for these replacements. The majority of replacements by MDOT were due to road upgrades, and half of them were covered by the driver of functional inadequacy. The matching ISU-identified driver for 20% of the structures decommissioned due to road upgrades was poor condition, because these structures were not functionally inadequate. However, the actual reason for their replacement was road upgrade, including road realignment, freeway reconstruction, or

widening projects. The remaining structures decommissioned due to road upgrades matched a variety of ISU-identified drivers, such as vulnerability, fair condition, and fair functional adequacy. Overall, only half of the structures decommissioned due to road upgrades were originally matched with the ISU-identified driver of functional inadequacy.

Figure 3-19. Comparison of Potential Drivers with Michigan Reasons

California

The California Department of Transportation (Caltrans) had performed a similar study internally to investigate the reasons for its bridge replacements, and Caltrans shared its findings with the research team. By combining the Caltrans sample with the ISU sample, 178 structures common to both samples were identified. Unlike Utah and Michigan, Caltrans replaced more than 20% of its bridges to address scour and seismic problems. For a majority of the replacements (61%), the reason for replacement was listed as functional improvements such as realignment, widening, or interchange projects. One structure was replaced due to damage from a rock slide, and only 17% of structures were replaced due to poor condition. The structure replaced due to damage from a rock slide was actually fracture critical and functionally inadequate.

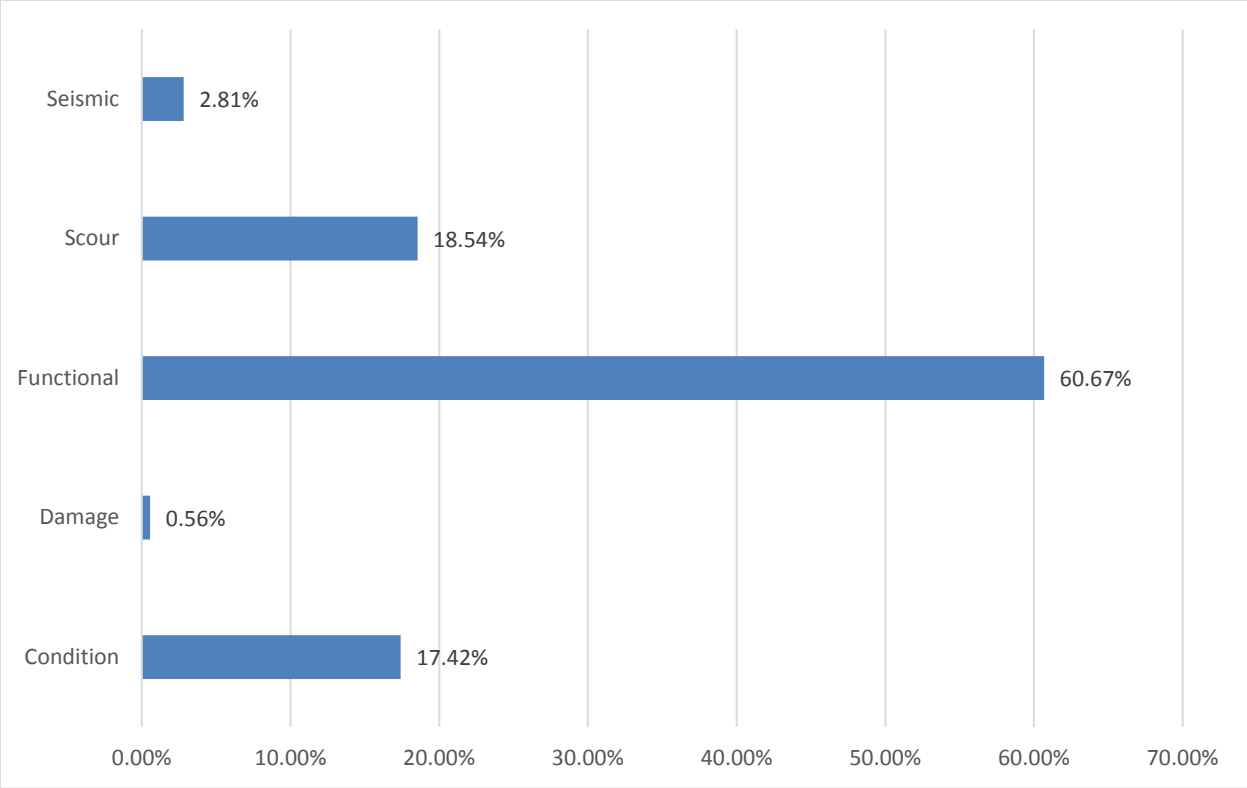


Figure 3-20. Percentage of Decommissioned Structures by California Agency Reasons

Only 19% of the sample structures that were replaced by Caltrans due to poor condition had poor condition as their only ISU-identified driver (Figure 3-21). Almost 25% of these structures matched ISU-identified drivers that included poor condition, but the rest of the structures had a combination of functional inadequacy, vulnerability, or fair condition among their ISU-identified drivers. Almost half of the structures that were replaced for functional improvements had functional inadequacy as a driver, and another 19% had fair functional adequacy, but the rest had various drivers that did not suggest a replacement due to functional issues. A total of 21% of the structures replaced due to scour only had scour criticality or failed channel as an ISU-identified driver. Almost 70% of the structures replaced due to scour included scour criticality or failed channel among their ISU-identified drivers, but only looking at the NBI data, one would not be able to conclude that these were replaced due to scour issues. Five replacements were due to seismic issues: one was functionally inadequate, two were SD, and two were both SD and fracture critical. Again, the reasons for decommissioning that could be identified by ISU-identified drivers did not match the agency's reasons. Overall, while the ISU-identified drivers were sufficient in explaining some of these replacements, some ISU-identified drivers were not related to the agency's reasons.

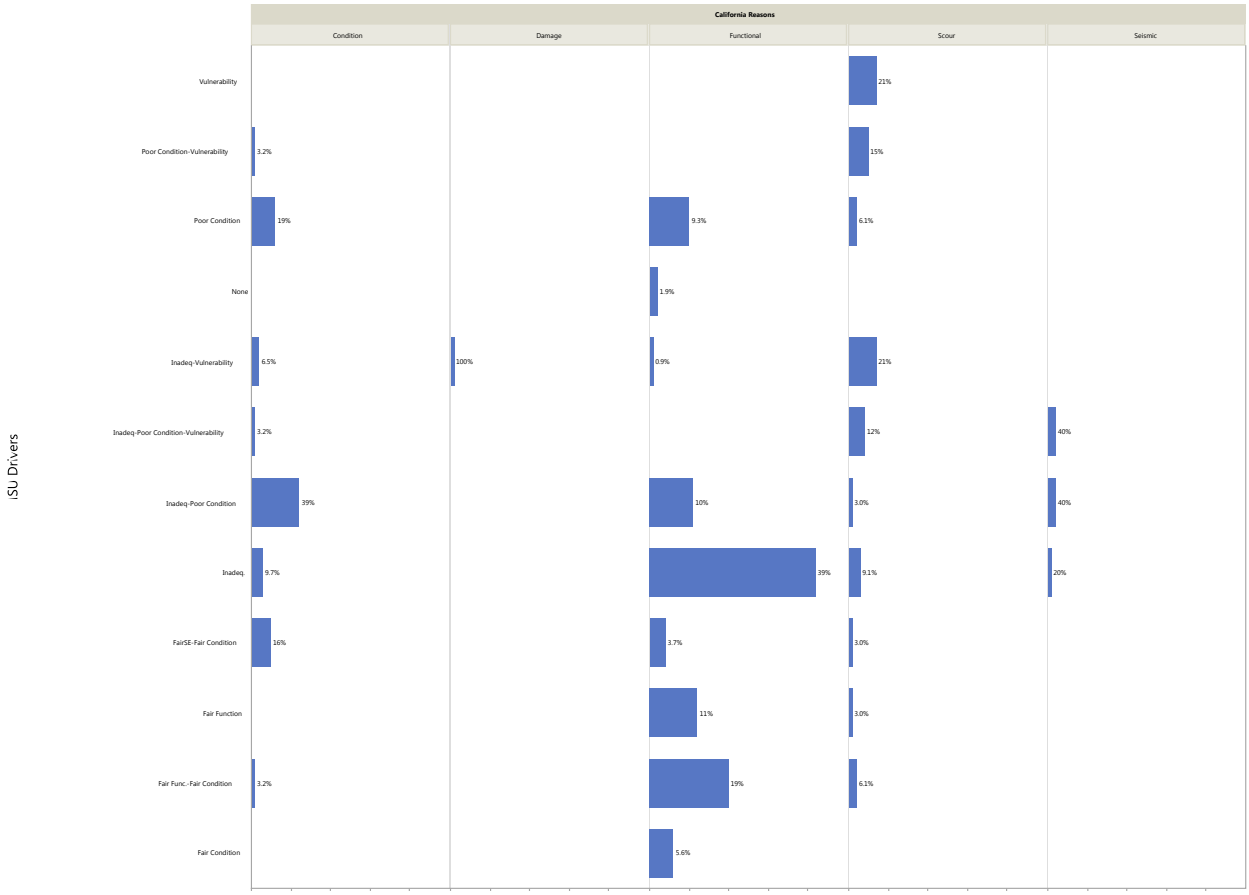


Figure 3-21. Comparison of Potential Drivers with California Reasons

Pennsylvania

The Pennsylvania Department of Transportation (PennDOT) keeps a rich database of bridge actions that generally contains bridge actions for NBI components. The database also includes replacement reasons for some of the structures. The research team was able to match PennDOT records to ISU-identified drivers for 107 structures. The research team and representatives of the PennDOT Bridge Office had several online calls to discuss the agency's approach to replacements and the details of the agency's records. Because the agency did not specify reasons for all of the replacements, the reasons were assigned by the ISU team based on NBI data and the discussions with the agency. A majority of the replacements were driven by condition, as reported by PennDOT (Figure 3-22). Only 6% of the replacements in the sample were due to functional reasons, and another 6% did not have an assigned reason. Because reasons were not assigned solely based on the agency's archives but rather through a process led by the research team, the variability in the agency's reasons observed for Utah, Michigan, and California was not observed here (Figure 3-23). All structures that were replaced due to deficiency had poor condition as one of their ISU-identified drivers. Only 67% of the replacements due to functional issues had functional inadequacy as an ISU-identified driver. The replacements that did not have an assigned reason appear to have been replaced mostly due to vulnerabilities and functional inadequacy.

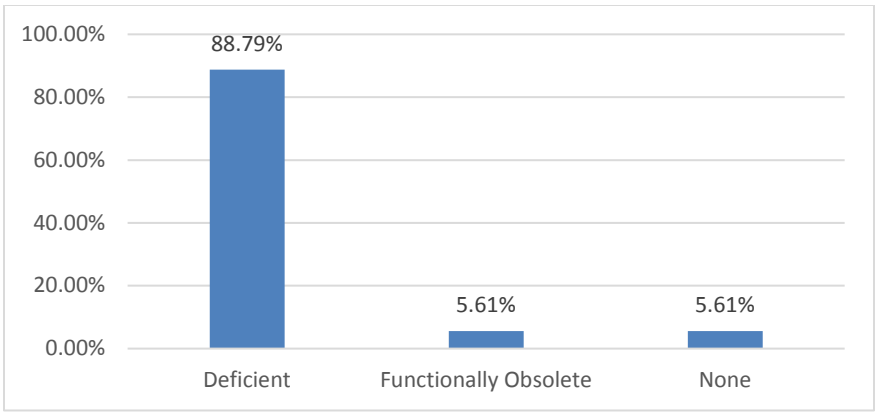


Figure 3-22. Percentage of Decommissioned Structures by Pennsylvania Agency Reasons

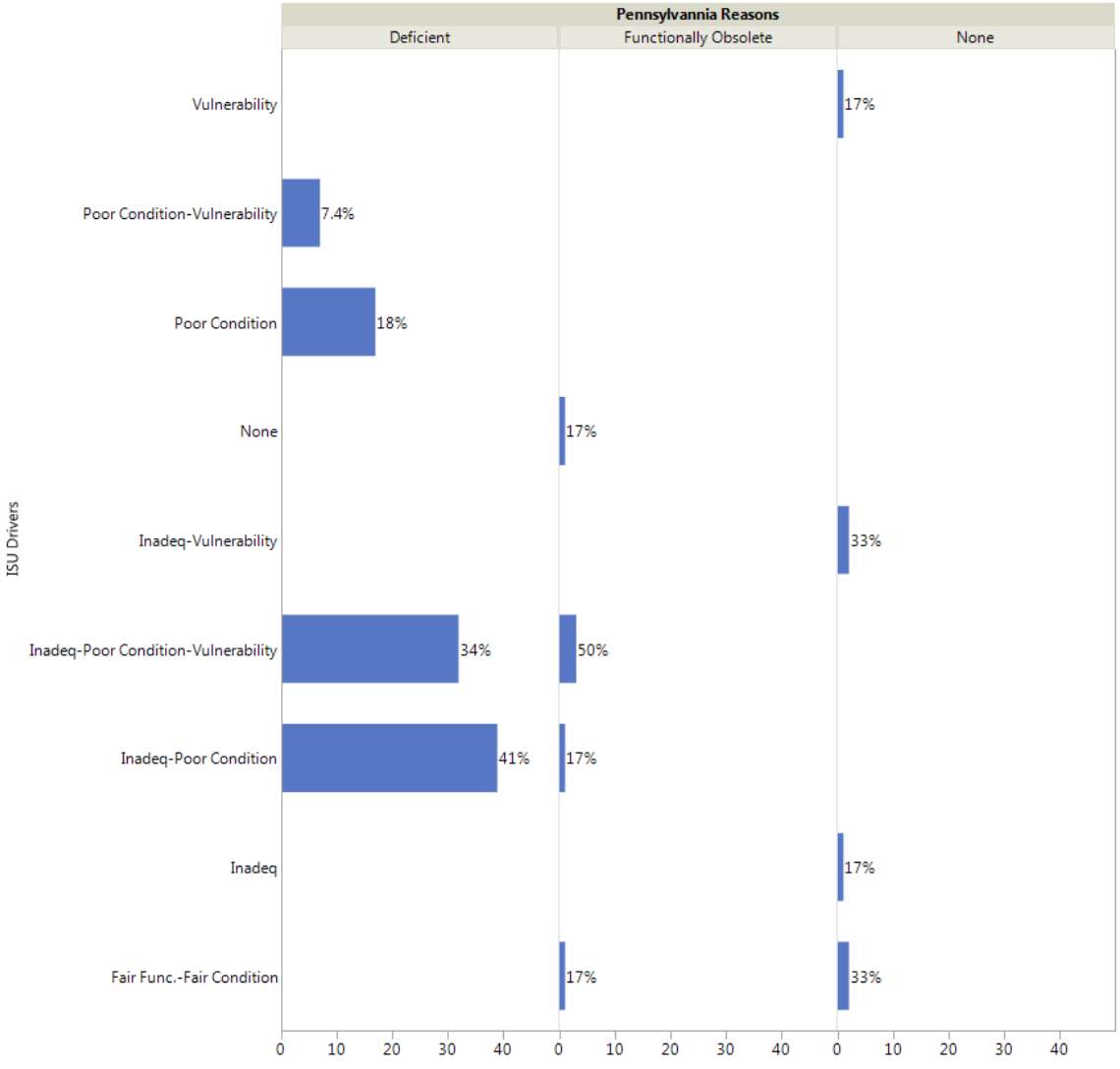


Figure 3-23. Comparison of Potential Drivers with Pennsylvania Reasons

Florida

FDOT has the most comprehensive process for tracking its structures. FDOT keeps a bridge table within its Bridge Management System database that has fields to note previous and subsequent bridge numbers for the agency's structures. While the agency does not systematically keep reasons for replacements, one can investigate the before and after conditions of a replaced structure, and the notes field in the bridge table can provide additional insight into the reasons behind a replacement. For 290 structures common to the ISU team's list of decommissioned structures and FDOT's records, the reasons for replacement by percentages are reported in Figure 3-24. For 37% of the structures, a reason could not be identified, while the majority of replacements (39%) for which a reason was identified were replaced due to functional improvements. The structures that were replaced due to deficiency had functional inadequacy and poor condition as their ISU-identified drivers, but a few were not deficient according to the ISU team's records (Figure 3-25). A total of 89% of the structures replaced due to functional reasons, such as widening or roadway improvement projects, had functional inadequacy as an ISU-identified driver. The replacements for which no reason was identified had mostly secondary ISU-identified drivers, and the research team believes that these could, again, be functional improvements that were not captured in the notes or within FDOT's bridge table. Most structures that were replaced due to poor condition or vulnerabilities were matched with relevant ISU-identified drivers.

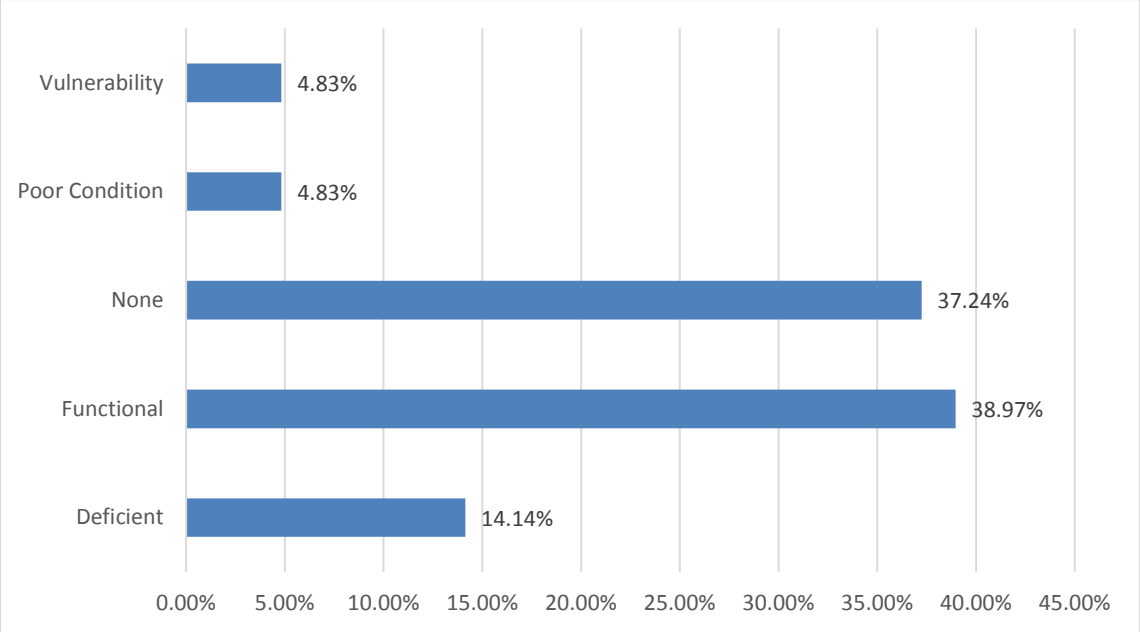


Figure 3-24. Percentage of Decommissioned Structures by Florida Agency Reasons

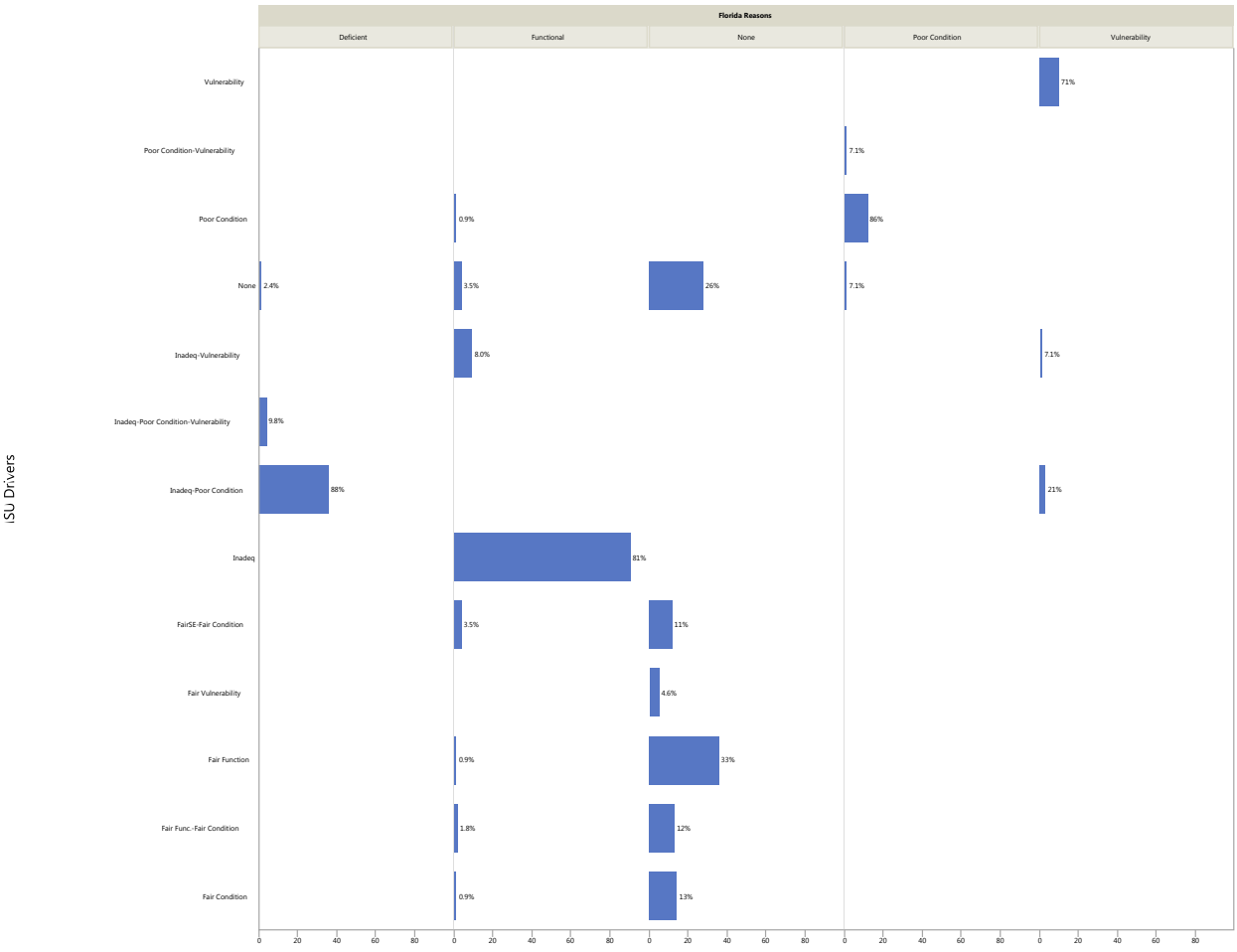


Figure 3-25. Comparison of Potential Drivers with Florida Reasons

Overall, 788 decommissioned structures were included in the comparison between the ISU-identified drivers and the reasons provided by the agencies. Figure 3-26 shows the percentages of decommissioned structures by generalized agency reasons. Although there were slight changes in wording, some agency reason categories addressed common issues and were therefore simplified for overall comparison. Approximately 8% of the structures had actually changed ownership, as reported by agencies. As previously noted, the scope of this project was State structures only; therefore, the tracking algorithm developed by the research team was not able to detect these changes. Some structures were removed from the inventory (1.7%), while some were removed from the NBI (1.8%). These changes also cannot be detected by looking only at the NBI data. The reasons for decommissioning for almost 15% of the structures were unknown, because while some agencies had complete archives, some had partial archives. Approximately 7% of the structures were decommissioned to address vulnerabilities, while 9.4% were decommissioned to address poor condition. Approximately 18% of the decommissioned structures were deficient, including both SD and FO structures. Decommissioning due to functional improvements was by far the most common reason. Almost 40% of the structures were removed or replaced for roadway projects.

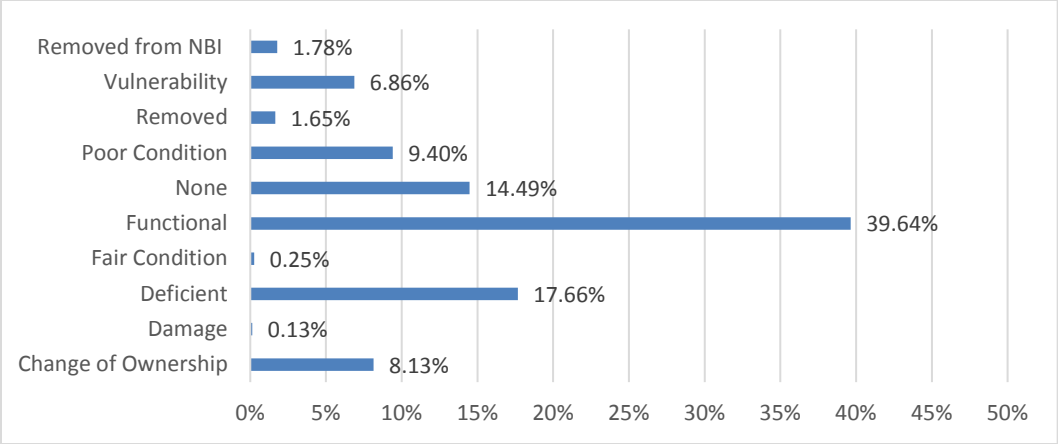


Figure 3-26. Overall Percentage of Decommissioned Structures by Agency Reasons

In Figure 3-27, the data from Figure 3-26 were broken down between the high-growth states (presumed Florida, Utah and California) and the low-growth states (presumed Michigan and Pennsylvania) in order to compare the difference. Decommissioning due to functional reasons are almost half (46.5%) of all decommissioning in high-growth states while only 27.5% of the decommissioning was reported to be due to functional reasons in low-growth states. The percentage of decommissioned structures due to deficiency and poor condition is also quite different between high- and low-growth states. For low-growth states, the percentage of decommissioned structures due to deficiency and poor condition was approximately 42%, higher than the percentage of decommissioned structures due to functional reasons (27.5%). However, only 19% of the decommissioning in high-growth states were due to deficiency and poor condition. Based on the data provided by the agencies in this study, functional reasons were the most common reason of bridge decommissioning in high-growth states while deficiency was the most common reason in low-growth states.

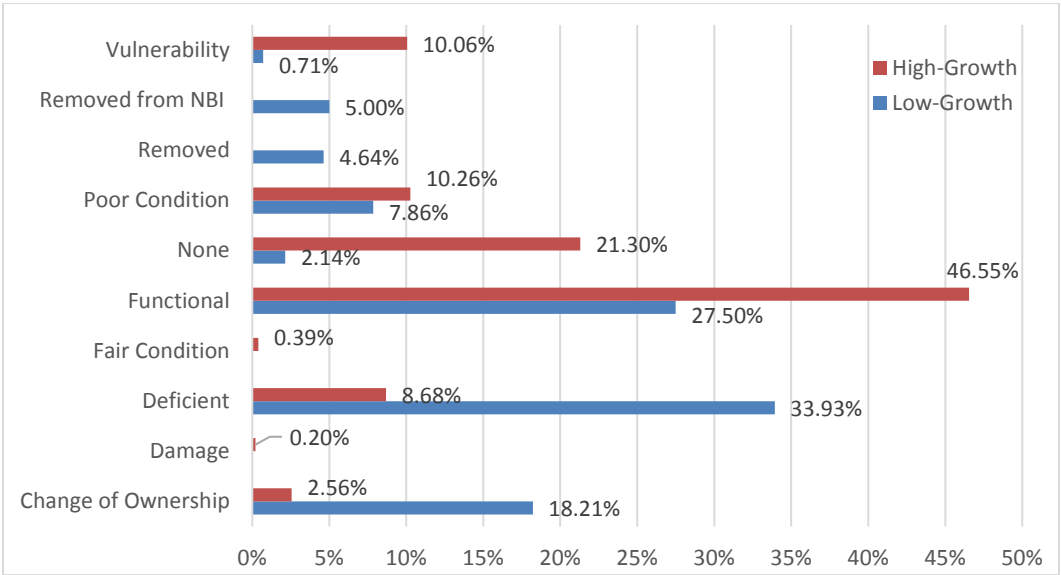


Figure 3-27. Percentage of Decommissioned Structures by High- and Low-Growth States

A total of 139 structures in the sample were replaced due to deficiency, while 313 structures were replaced due to functional reasons (Figure 3-28). The numbers at the top of each column in Figure 3-28 show the number of structures decommissioned due to the specified agency reason in that column.

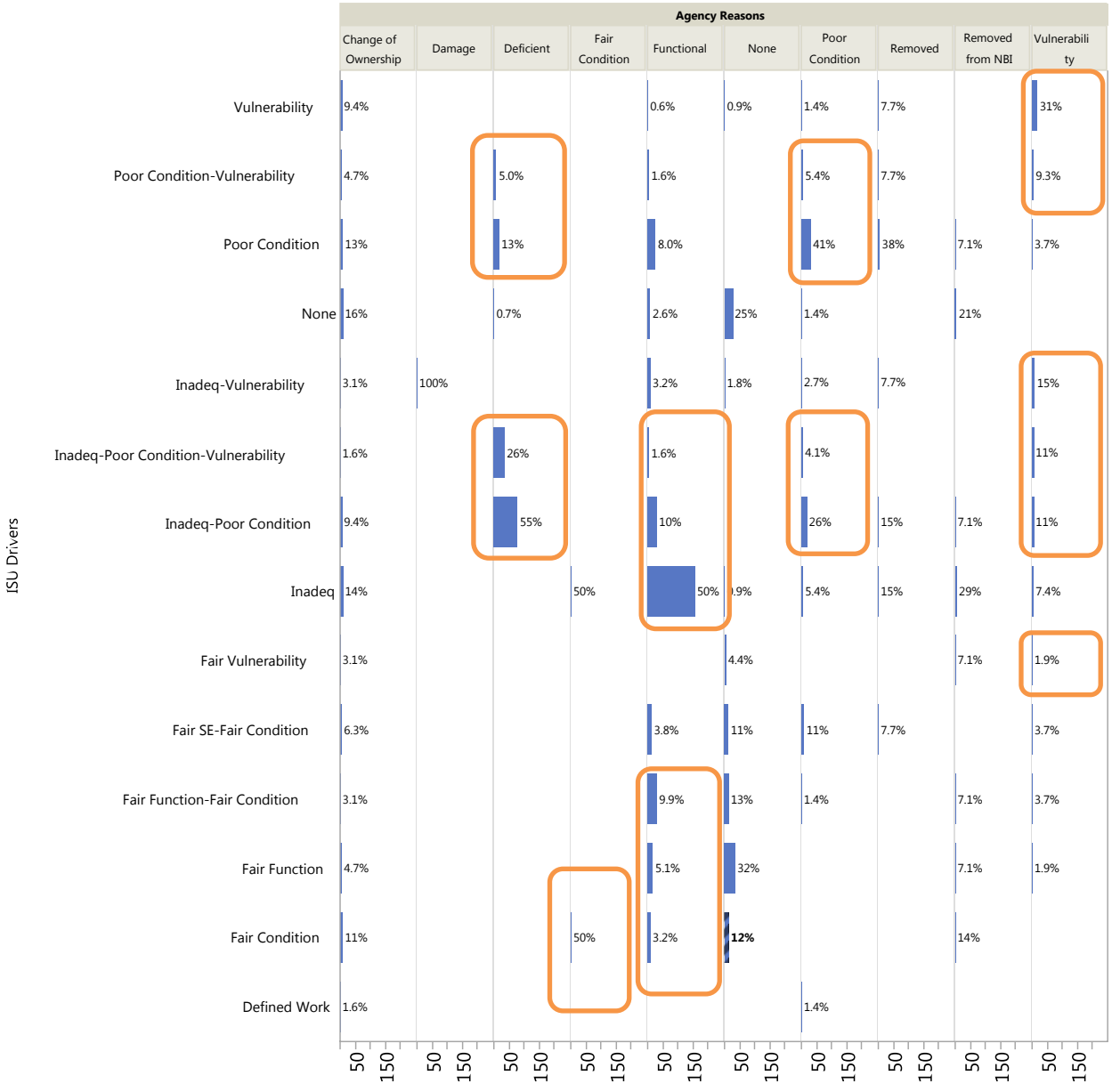


Figure 3-28. Comparison of ISU-identified drivers with Overall Agency Reasons

The boxes highlight the portion of the decommissioned structures that had ISU-identified drivers relevant to the agency reasons. Structures that were decommissioned due to deficiency were

mostly identified by functional inadequacy and poor condition or by poor condition alone. However, when multiple ISU-identified drivers were present, such as the drivers that included vulnerabilities, it was difficult to tell based on the ISU-identified drivers whether a structure was replaced to address the deficiency or the vulnerability. Half of the structures decommissioned for functional reasons were covered by the ISU-identified driver of functional inadequacy. Another 15% of these structures were covered by multiple drivers that included functional inadequacy. The remaining 35% of these structures were distributed among other drivers. Fair functional adequacy was a matched driver for another 5%, while the combination of fair condition and fair functional adequacy matched an additional 10%. For 25% of the decommissioned structures for which no reason was identified, an ISU-identified driver could also not be identified. Secondary drivers, such as fair functional adequacy and condition, indicate potential reasons for decommissioning these structures. Almost 76% of the structures decommissioned due to poor condition had an ISU-identified driver that included poor condition, but only 41% of these structures had poor condition as their only driver, which could be interpreted as the reason for decommissioning prior to this analysis. However, 8% of the structures that were replaced due to functional reasons also had poor condition as their only driver. Therefore, although functional inadequacy or poor condition by themselves may appear to be strong drivers, they still cannot be declared as the reasons for decommissioning in complete confidence.

In summary, the comparison of potential ISU-identified drivers with agency reasons indicates that almost 40% of the structures in the sample were decommissioned due to functional reasons. Poor condition and deficiency remain strong reasons for decommissioning but collectively account for 32% of the decommissioning in comparison. Relevant ISU-identified drivers matched a majority of the structures decommissioned due to each reason provided by the agency. However, it was not possible to assign these drivers as reasons, particularly when combinations of drivers were identified. Agency decisions are bridge- and location-specific and involve policy and funding constraints that are not captured within the NBI data. The findings show that analyzing only the NBI data for decommissioned structures can help identify a series of potential reasons for decommissioning but cannot pinpoint the real reason for decommissioning.

3.7. Pairwise Comparison

The ideal way to identify the real drivers or reasons of bridge decommissioning is to see agency reasoning from project documents. When a sample of bridges is examined based on various characteristics, it is only possible to identify potential drivers without declaring a causal relationship.

However, if a replaced structure is compared with the new bridge constructed in its place, the potential reasons can be identified, especially the reasons related to geometric drivers. This technique is a pairwise comparison of two groups, which offers a way to compare replaced and new structures. While such a comparison was not within the scope of the research proposal, the research team decided that it would provide essential information for the project. Because this sample would contain only replaced structures, it would also certainly contain decommissioned structures and would be free of errors due to changes in ownership or structure numbering. A small sample of 3,365 structures was initially gathered and analyzed for Phase I. This additional task was well received by the panel members and expanded for the final report.

Initially, a simple approach to gather a sample of structures that were certainly replaced with new structures at the same locations was followed to gather the sample in a short timeframe. A unique ID that includes the latitudes and longitudes of structures was created, and NBI files were queried to identify structures with different built years at the same location. Then, NBI items such as County, Inventory Route, Features Intersected, and Facility Carried by Structure were checked to ensure that the structures were indeed at the same location. Also, the year in which the new structure was built was required to be at most within two years of the decommissioning of the replaced structure. As a result, 3,365 locations that included a pair of old and new structures were identified. This sample represented 9.2% of the main sample of decommissioned structures. The search of similar structures was then expanded in Phase II using ArcGIS. The final data set included 9,810 decommissioned structures paired with new structures that replaced them. This final sample of paired structures represents 27% of the overall sample.

The pairwise comparisons based on the sample are presented in Appendix C. Primary findings from the analysis are summarized here:

- On average, 5% of the old structures were disjoined and replaced with two new structures, and 5% of the old structures were joined and replaced with one new structure. This change affects the total number of replaced and new structures when group averages for a variable are compared.
- A total of 62.5% of the replaced bridges are SD, 19.6% are FO, and 17.7% are ND. In the overall sample, 45% of the decommissioned structures are SD, 19% are FO, and 33% are ND. Based on the updated definition of deficiency, only 16% of the old structures were not in poor condition and were functionally adequate (Table 3-35). A total of 71% of the old structures were functionally inadequate, and 60% were in poor condition. Compared to the main sample of decommissioned bridges, this subset of old bridges includes structures that are more deficient, in poorer condition, and more functionally inadequate.

Table 3-35. Percentage of Old Structures by Poor Condition and Functional Adequacy

Functional Adequacy	Poor Condition	Not Poor Condition	Total
Adequate Function	13.59%	15.72%	29.32%
Inadequate Function	46.03%	24.65%	70.68%
Total	59.63%	40.37%	100.00%

- The average age of the replaced bridges is 58 years, with a median of 58 years. This is slightly older than the overall sample, which has a median of 54 years.
- A significant decrease in the construction of steel structures and a significant increase in the construction of prestressed concrete structures is observed, consistent with the overall analysis.
- An increase in the number of lanes on the rebuilt bridges was observed (Figure 3-29). The average number of lanes increased from 2.1 to 2.5. A total of 21.4% of old structures were replaced with structures that carried a higher number of lanes.

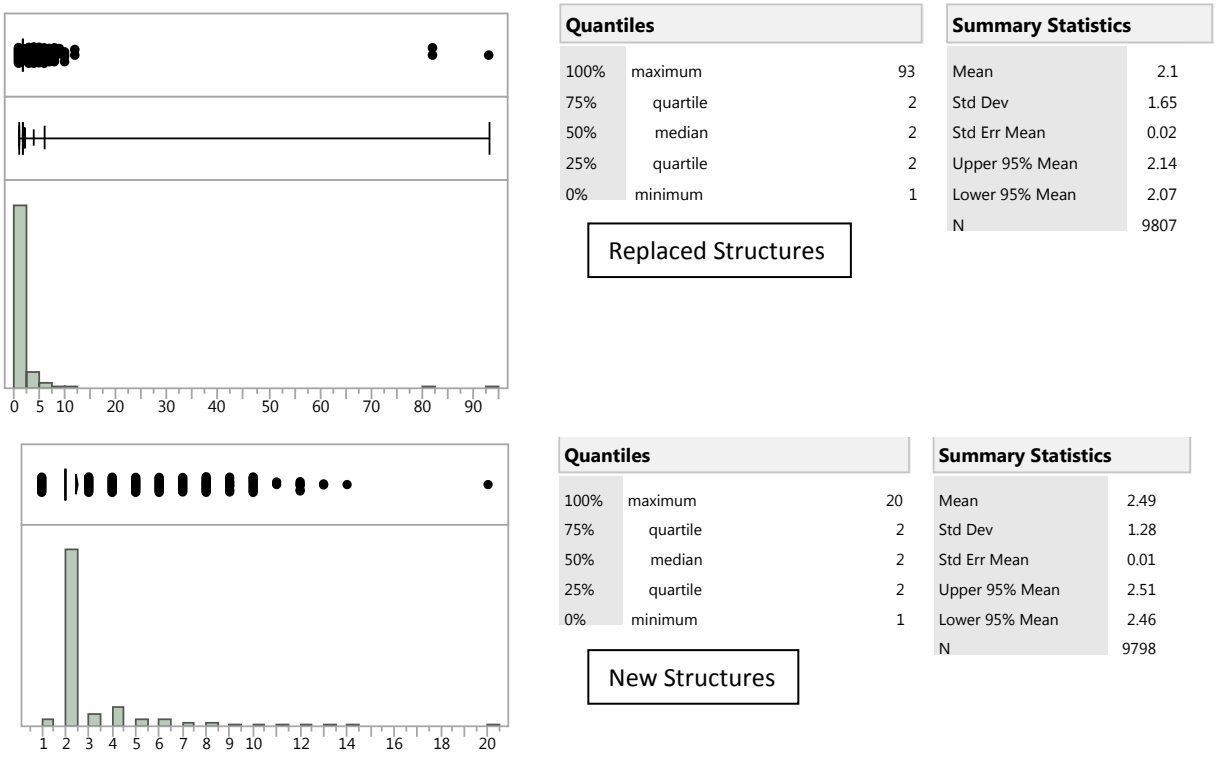
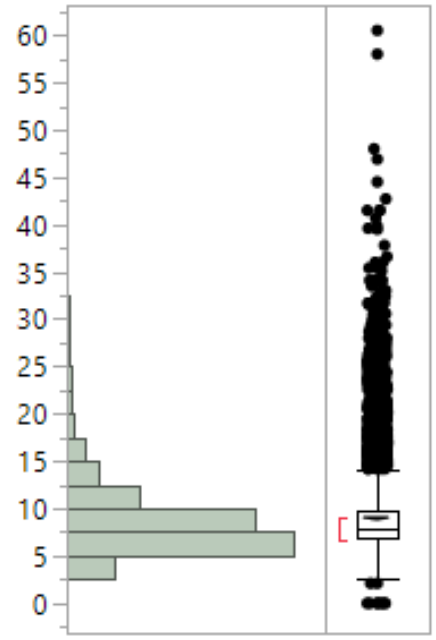


Figure 3-29. Distribution of Number of Lanes on Replaced and New Structures

- An increase was observed in the maximum span length and the structure length (i.e., more rebuilt bridges with span lengths greater than 20 meters) among the rebuilt bridges. An overall trend toward larger dimensions in bridge geometry is observed and is potentially due to functional improvement projects and changes in design.

- The newer bridges, on average, have greater roadway and deck widths (Figure 3-30 and Figure 3-31). The average road with increased to 12.8 meters from 8.9 meters, and the average deck width increased from 10 meters to 14.3 meters.

Replaced Structures



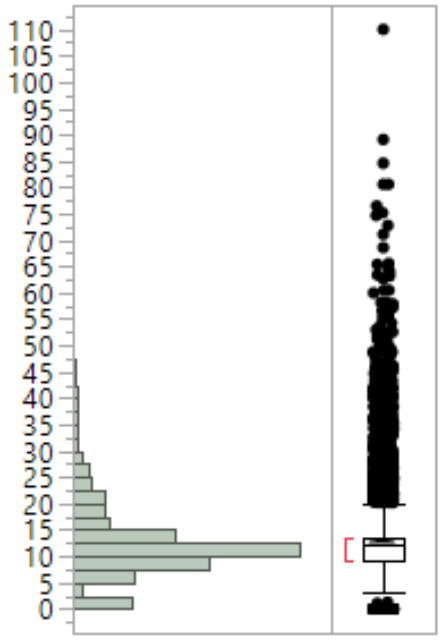
Quantiles

100.0%	maximum	60.5
75.0%	quartile	9.8
50.0%	median	7.9
25.0%	quartile	6.9
0.0%	minimum	0

Summary Statistics

Mean	8.93
Std Dev	4.11
Std Err Mean	0.04
Upper 95% Mean	9.01
Lower 95% Mean	8.86
N	9810

New Structures



Quantiles

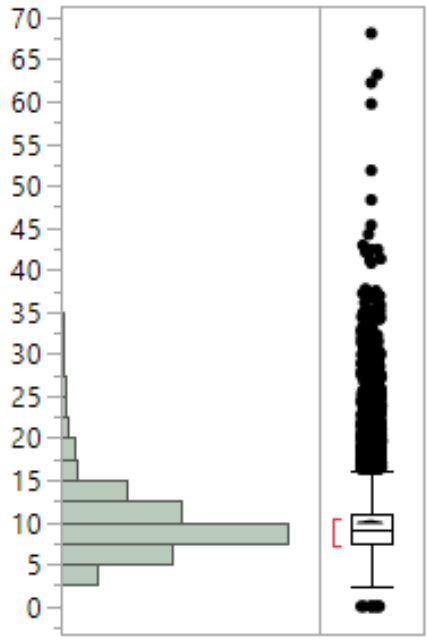
100.0%	maximum	110
75.0%	quartile	13.5
50.0%	median	12
25.0%	quartile	9.1
0.0%	minimum	0

Summary Statistics

Mean	12.83
Std Dev	8.16
Std Err Mean	0.079
Upper 95% Mean	12.99
Lower 95% Mean	12.68
N	9810

Figure 3-30. Distribution of Roadway Width (Meters) for Old and New Structures

Replaced Structures



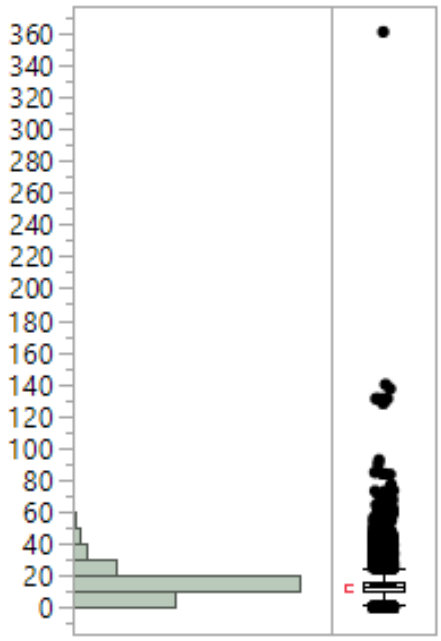
Quantiles

100.0%	maximum	68.1
75.0%	quartile	11
50.0%	median	9
25.0%	quartile	7.5
0.0%	minimum	0

Summary Statistics

Mean	9.97
Std Dev	4.60
Std Err Mean	0.04
Upper 95% Mean	10.06
Lower 95% Mean	9.88
N	9810

New Structures



Quantiles

100.0%	maximum	360.8
75.0%	quartile	15.6
50.0%	median	12.8
25.0%	quartile	9.8
0.0%	minimum	0

Summary Statistics

Mean	14.28
Std Dev	10.38
Std Err Mean	0.10
Upper 95% Mean	14.48
Lower 95% Mean	14.07
N	9810

Figure 3-31. Distribution of Deck Width (Meters) for Old and New Structures

- Approximately 14% of rebuilt bridges that had underclearances between 1 and 4 meters now have underclearances between 4.1 and 6 meters.
- Channel protection condition ratings have significantly improved for the new bridges.
- Approximately 47% of the old structures had basically intolerable or less tolerable deck geometry ratings, while only 6% of the new structures had such ratings.
- The number of posted structures decreased by 20.5%.
- The number of scour critical structures decreased by 8.3%, and the number of structures with fair scour ratings (rating of 4 or 5) decreased by 7%.

- The newer bridges have significantly safer designs; most of the rebuilt bridges have come to meet the current acceptable standards, in contrast to the replaced bridges. The number of bridges following current traffic safety feature guidelines for bridge railings, transitions, approach guardrails, and approach guardrail ends increased by 68%, 54.3%, 42.2%, and 44.7%, respectively.

ISU-identified drivers of decommissioning, as assigned during the comparison of potential drivers with agency reasons, were also assigned for the old structures in the subset (Figure 3-32). When the percentages of old structures to which ISU-identified drivers were assigned were compared with the comparable percentages for the overall sample gathered from the agencies (Figure 3-26), the research team observed that the percentages of structures whose only driver was poor condition (12% to 9.4%) were quite similar to the percentages of structures for which no driver was identified (14.5% to 14.2%).

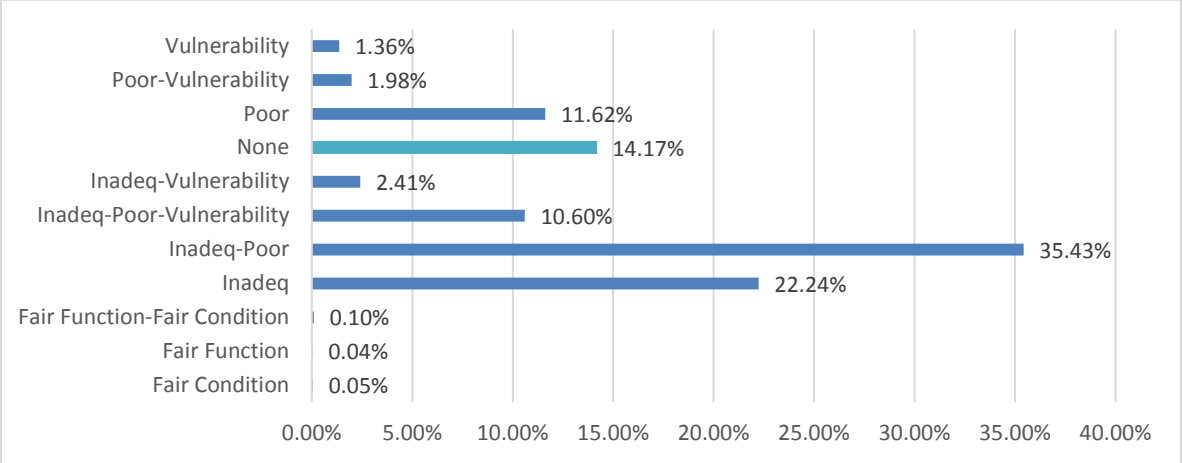


Figure 3-32. Percentage of Old Structures by ISU-Identified drivers

The analyses described above revealed increased road and deck widths in the new structures and indicated a significant number of roadway improvement projects. The research team then examined the percentage of old structures with no assigned drivers that were replaced with bridges with wider decks. A visual comparison of the number of old structures by ISU-identified drivers and by the presence of wider roads and decks in the replacement structures shows that a significant number of old structures without an assigned driver were replaced with wider bridges (Figure 3-33). These replacements were likely due to functional improvement projects. Approximately 10% of the old structures were replaced with wider bridges (Figure 3-34). Although it cannot be proven without agency records, these structures were potentially replaced as part of roadway widening or corridor improvement projects. Also, the average age of replacement for these structures is 48, ten years younger than the overall age of replacement at 59.3 years (Figure 3-34). The average age of old structures with inadequacy as a driver for replacement is 54 years old while the average ages of groups of old structures with poor condition as a driver range 54 to 74. These observations indicate that the old structures replaced due to functional reasons were potentially younger when replaced in comparison to old structures replaced due to poor condition.

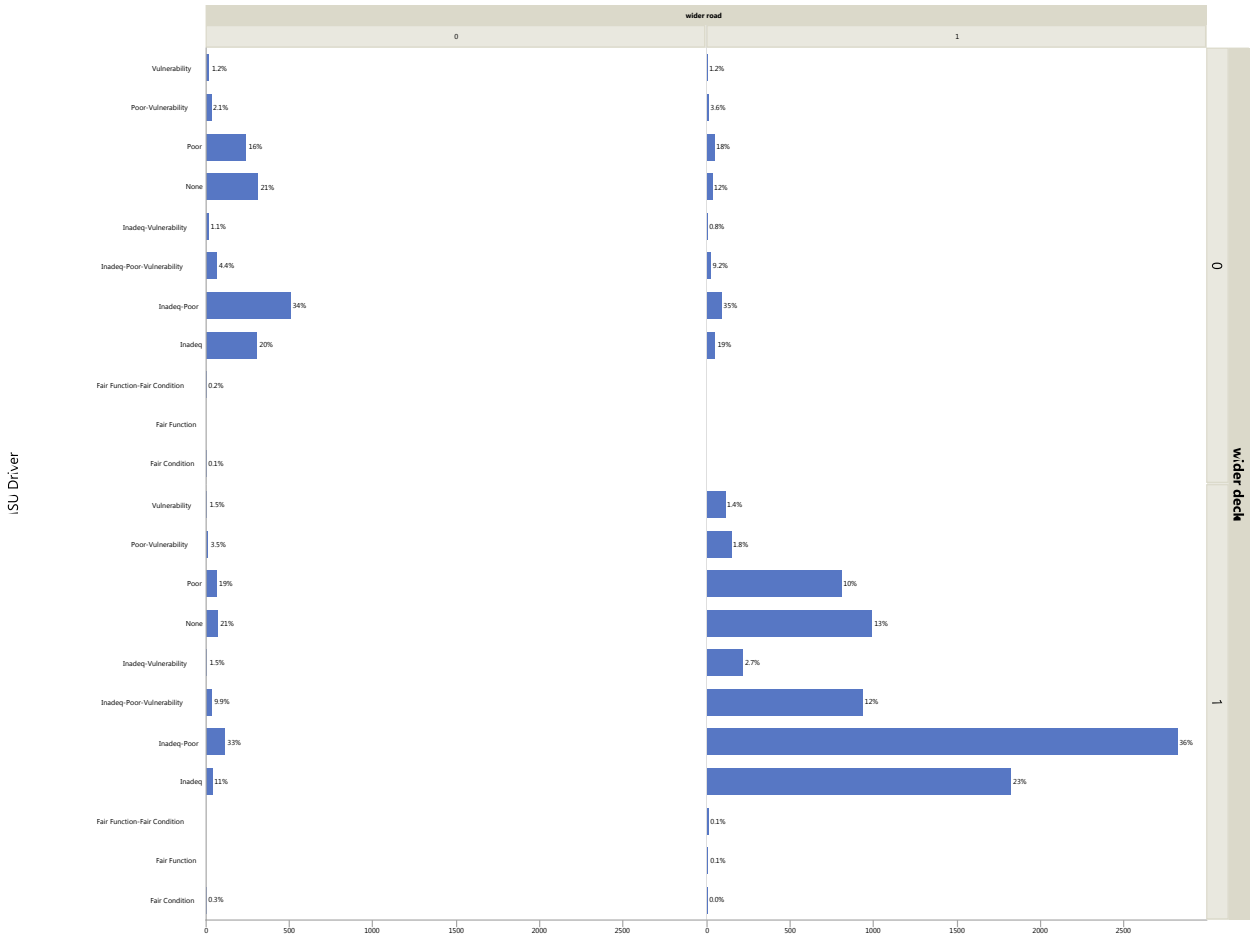


Figure 3-33.Percentage of Old Structures by ISU Drivers and Road/Deck Width

ISU Driver	Wider Deck				Wider Road				Grand Total	Average of Age
	Percentage		Average of Age		Percentage		Average of Age			
	0	1	0	1	0	1	0	1		
Fair Condition	0.0%	0.0%	78.0	39.3	0.0%	0.0%	60.0	38.3	0.1%	47.0
Fair Function		0.0%		34.3	0.0%	0.0%		34.3	0.0%	34.3
Fair Function-Fair Condition	0.0%	0.1%	43.7	45.0	0.0%	0.1%	43.7	45.0	0.1%	44.6
Inadeq	3.6%	18.7%	52.9	54.2	3.4%	18.8%	53.4	54.1	22.2%	54.0
Inadeq-Poor	6.0%	29.4%	60.2	61.9	6.2%	29.2%	60.4	61.9	35.4%	61.6
Inadeq-Poor-Vulnerability	0.9%	9.7%	68.2	74.1	1.0%	9.6%	70.1	73.9	10.6%	73.6
Inadeq-Vulnerability	0.2%	2.2%	55.4	73.8	0.2%	2.2%	55.9	74.0	2.4%	72.4
None	3.5%	10.7%	45.2	48.4	3.8%	10.3%	45.7	48.3	14.2%	49.0
Poor	2.9%	8.7%	61.3	58.0	3.1%	8.6%	61.6	57.9	11.6%	58.9
Poor-Vulnerability	0.4%	1.6%	65.4	62.0	0.4%	1.5%	64.3	62.3	2.0%	62.7
Vulnerability	0.2%	1.2%	57.5	56.5	0.2%	1.1%	55.7	56.8	1.4%	56.7
Grand Total	17.6%	82.3%	56.4	59.6	18.5%	81.4%	56.7	59.6	100.0%	59.3

Figure 3-34 Percentages of Old Structures by ISU Drivers and Increased Road/Deck Width

CHAPTER 4 CONCLUSIONS AND RECOMMENDATIONS

This project focused on identifying the reasons of bridge decommissioning in the United States based on a literature review, survey findings, a comprehensive analysis of the NBI data items and archives, and a comparison between identified drivers and agencies' reasons for bridge replacements. In light of relevant research studies that indicated that condition may not be the major driver of bridge decommissioning, a large-scale national study was performed to understand the reasons of premature bridge replacements and to provide feedback for bridge management and preservation efforts.

The following information highlights the key findings from the analyses:

- Relevant studies in the literature collectively report that deficiency, poor NBI condition ratings, lower load carrying capacities, vulnerabilities, the need for additional lanes, and road widening projects appear to be most common reasons of bridge decommissioning. The decommissioned structures are not necessarily old structures; the median age reported was 53 years. A common finding in all studies was that reasons for decommissioning could not be identified for a significant portion (15% to 30%) of the samples.
- The survey findings show that load rating/posting, NBI condition ratings, vulnerabilities (scour, seismic, fracture critical, fatigue-prone details), traffic capacity, and functional aspects are the major factors considered by agencies in identifying and selecting candidates for bridge replacement.
- Analysis of the NBI data files from 1992 to 2016 identified a total of 36,459 decommissioned structures. Of these structures, 33% were not deficient while 45% were structurally deficient and another 19% were functionally obsolete. Based on a recommendation from this project's advisory panel, deficiency was redefined to exclude the 10-year rule and to ensure that such a classification was more aligned with the current condition performance measure. Based on this redefinition, 41.4% of the decommissioned structures were in poor condition, 32.7% were not in poor condition but had inadequate function, and 25.9% were neither in poor condition nor functionally inadequate. Consistent with the findings from the literature, 26% to 33% of the decommissioned structures did not have an obvious reason for replacement based on these numbers.
- Based on the analysis of the national NBI data set, poor condition, functional inadequacy, and vulnerabilities were selected as the primary drivers of decommissioning. Fair condition and fair appraisal ratings were selected as secondary drivers. Assignment of all primary and secondary drivers to the decommissioned structures showed that approximately 82% of the decommissioned structures had more than one primary or secondary driver associated with them. Within the subset of decommissioned structures with the most frequent combinations for primary drivers, functional inadequacy was the most frequent driver, with almost 57% of decommissioned structures listing functional inadequacy as a driver. Poor condition by itself was observed for only 9% of decommissioned structures, and 36% of decommissioned structures had poor condition as one of the drivers.
- Analysis of the data on agencies' reasons for decommissioning from five States (Utah, Michigan, California, Pennsylvania, and Florida) and for 788 decommissioned structures indicated that approximately 8% of the structures had actually changed ownership and that

another 3.5% were either removed from the inventory or the NBI. A total of 7% of the structures were decommissioned to address vulnerabilities, while 9.4% were decommissioned to address poor condition. Approximately 18% of the decommissioned structures were deficient, including both SD and FO structures. Decommissioning due to functional improvements was by far the most common reason. Almost 40% of the structures were removed or replaced for roadway projects, while 15% of the structures were not linked to a reason for replacement. Based on the data provided by the agencies in this study, functional reasons were the most common reason of bridge decommissioning in high-growth states (presumed Florida, Utah and California) while deficiency was the most common reason in low-growth states (presumed Michigan and Pennsylvania).

- A comparison between the potential drivers identified by the research team and the reasons cited by the agencies showed that almost 40% of structures were decommissioned due to functional reasons. Poor condition and deficiency remained strong reasons for decommissioning but collectively accounted for only 32% of the decommissioning decisions. Relevant ISU-identified drivers matched a majority of the decommissioned structures for each reason provided by the agency. However, it was not possible to assign these drivers as reasons, particularly when structures had multiple drivers associated with them. Agency decisions are bridge- and location-specific and involve policy and funding constraints that are not captured within the NBI data. The findings show that analyzing only the NBI data for decommissioned structures can help identify a series of potential reasons for decommissioning but cannot pinpoint the real reason for decommissioning.
- In an additional effort, a comparative analysis of the characteristics of 9,810 decommissioned (old) structures that were matched with the new structures that replaced them indicated a significant number of functional improvement projects, based on the observed increases in bridge geometry. The potential drivers for the old structures suggested that replacements were most frequently driven by functional inadequacy and poor condition (35%), by only functional inadequacy (22%), or by only poor condition (12%). Functional inadequacy again appeared to be the major driver of replacements. Approximately 14% of the old structures had no drivers associated with them, consistent with the studies in the literature and the other analyses within this study. Further analysis of the data for these old structures and the subsequent structures in the same location revealed that 10% of all of the old structures (71% of the old structures with no drivers) in this sample had no drivers associated with them but were replaced with wider bridges on wider roads. Most likely, these structures were replaced due to functional improvement projects. This finding provides a potential explanation of the decommissioning and replacements that could not be linked to any driver because this subset includes 27% of all the decommissioned structures identified from the historic NBI data files. Also, structures replaced without an identified driver or potentially due to functional reasons were replaced younger than the structures that may have been replaced due to poor condition.

A summary of major findings by each analysis type is provided in Table 4-1.

Table 4-1: Summary of Major Findings by Analysis Type

Analysis Type	Major Findings
Analysis I: Drivers gathered by tracking structure numbers within historic NBI files	• 41.4% in poor condition, 32.7% not in poor condition but had inadequate function, and 25.9% neither in poor condition nor functionally inadequate. • 26% to 33% of the decommissioned structures did not have an obvious reason for replacement based on these numbers. • Poor condition, functional inadequacy, and vulnerabilities were the primary drivers. • Among the most frequent combinations for primary drivers, functional inadequacy was the most frequent with almost 57% of decommissioned structures being functionally inadequate. • For the same data set, 36% of decommissioned structures had poor condition as one of the drivers.
Analysis II: Comparison of the drivers from Analysis I with reasons provided by study agencies	• 27.4% of the decommissioning in this subset was due to deficiency and poor condition, 40% due to functional reasons, and 15% did not have an identified reason. • Functional reasons were the most common reasons for decommissioning in high-growth states while poor condition and deficiency were the most common reasons for low-growth states.
Analysis III: Comparison of new structures with the structures they replaced	• Replaced structures were mostly functionally inadequate and in poor condition (35%), only functionally inadequate (22%), or only in poor condition (12%). • Approximately 14% of the old structures had no drivers associated with them. • Further analysis of the 14% of the decommissioned structures with no drivers revealed that 71% of these structures were replaced with wider bridges on wider roads, alluding to functional improvement projects. • Structures replaced potentially due to functional reasons are replaced younger on average than those replaced due to poor condition.

Although the potential drivers identified in this project provide sufficient identifiers of decommissioning and match a majority of the reasons cited by agencies, drivers derived from the NBI data by themselves cannot explain decommissioning as comprehensively as agency-provided reasons can. Comparing replaced structures with new structures at the same location provides the ability to do comparative analyses that can help identify replacements due to functional improvements or that can help select the most relevant drivers.

The high portion of functional improvements in bridge decommissioning as reported by the agencies highlights the fact that bridge replacement decisions are often made for the transportation system rather than single assets. Tracking the reasons for decommissioning within the State and NBI databases and archiving the information such that it can be queried and integrated into relevant bridge management databases and tools would provide bridge managers and researchers with valuable information. Studying and understanding bridge performance using these improved data sets would improve bridge performance modeling and guide policy at the State and National levels.

The addition of fields such as type of decommissioning (ownership change, removal from the inventory because the roadway is no longer maintained, replacement), previous and subsequent structure numbers, agency reason(s) for replacement, and source of funding to State and National bridge databases would be valuable for future research and bridge management.

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GLOSSARY

Decommissioned	Structures whose records no longer appear in future NBI files.
Driver	Potential reason identified from the data analysis.
Factor	Potential contributors of decommissioning.
Reason	Real reason for decommissioning as defined by the agency.
Removed	Structures that were taken out of inventory and not replaced.
Replaced	Structures that were replaced with new structures at the same location.

AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
ADT	Average Daily Traffic
BCR, B/C	Benefit-Cost Ratio
BMS	Bridge Management System
BrM	The AASHTOWare™ Bridge Management software
Caltrans	California Department of Transportation
DG	Deck Geometry
DOTs	State Departments of Transportation
FAST	Fixing America's Surface Transportation
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FO	Functional Obsolescence
GAO	Government Accountability Office
HBP	Highway Bridge Program
HBRRP	Highway Bridge Replacement and Rehabilitation Program
IDOT	Illinois Department of Transportation
InTrans	Institute for Transportation at Iowa State University
ISU	Iowa State University
KSDOT	Kansas Department of Transportation
LADOTD	Louisiana Department of Transportation and Development
LAGov	Louisiana Government
LCCA	Life-Cycle Cost Analysis
MAP-21	Moving Ahead for Progress in the 21st Century Act
MDOT	Michigan Department of Transportation
MDT	Montana Department of Transportation
MWBPP	Midwest Bridge Preservation Partnership
NBI	National Bridge Inventory
NBIP	National Bridge Inspection Program

NCHRP	National Cooperative Highway Research Program
ND	Non-Deficient
NDDOT	North Dakota Department of Transportation
NEBPP	Northeast Bridge Preservation Partnership
NHPP	National Highway Performance Program
NHS	National Highway System
PennDOT	Pennsylvania Department of Transportation
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SD	Structural Deficiency
SE	Structural Evaluation
SEBPP	Southeast Bridge Preservation Partnership
SPRB	Special Bridge Replacement Program
SR	Sufficiency Rating
STBGP	Surface Transportation Block Grant Program
TAMPs	Transportation Asset Management Plans
TSP2	Transportation System Preservation Technical Services Program
UDOT	Utah Department of Transportation
VDOT	Virginia Department of Transportation
WBPP	Western Bridge Preservation Partnership

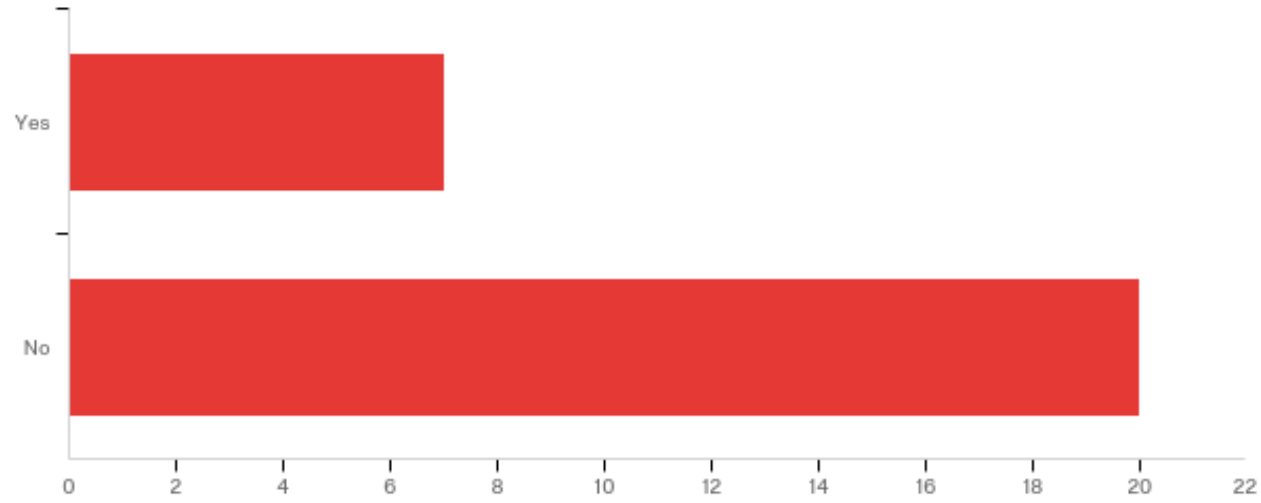
APPENDIX A. SURVEY RESULTS

NCHRP 20-07 Task 397, CHARACTERISTICS OF DECOMMISSIONED BRIDGES
June 29, 2017, 1:17 pm CDT

Agency - Which state transportation agency do you represent?

#	Answer	Count
7	AZ	1
9	CA	1
19	FL	1
21	GA	1
29	IL	1
31	IN	1
33	KS	1
37	LA	1
41	MD	1
45	MI	1
49	MO	1
53	MT	1
55	NC	1
57	ND	1
61	NH	1
65	NM	1
67	NV	1
69	NY	1
71	OH	1
73	OK	1
75	OR	1
77	PA	1
79	RI	1
83	SD	1
87	TX	1
89	UT	1
91	VA	1
101	WY	1
	Total	28

Q1 - Do you have a set criteria or LCCA (B/C) threshold in comparison to major rehabilitation that defines eligibility of highway bridges for replacement?

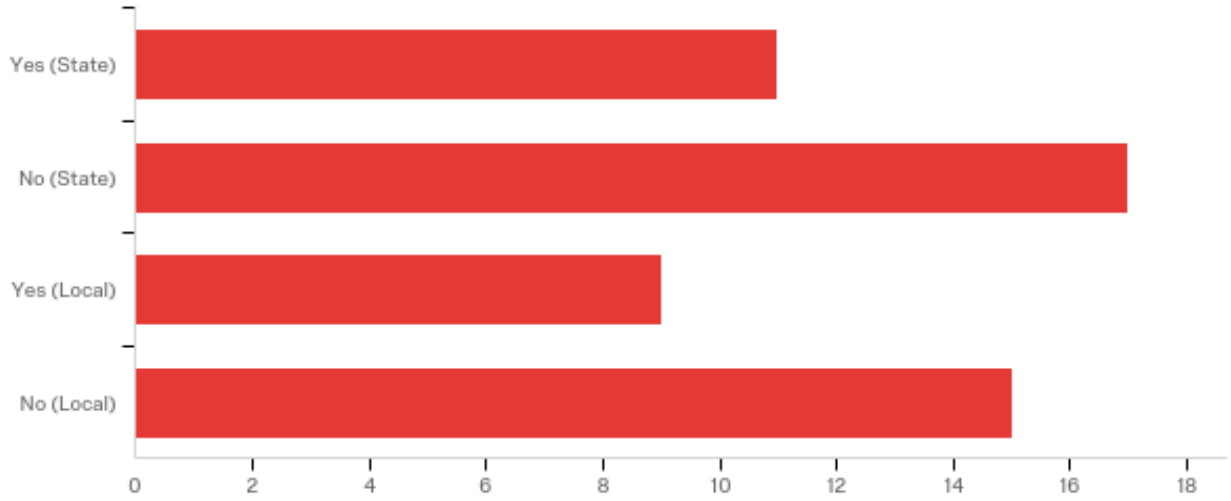


#	Answer	%	Count
1	Yes	25.93%	7
2	No	74.07%	20
	Total	100%	27

Q2 - If you have any documentation that you could share on your policies for defining replacement eligibility or prioritizing bridge replacements versus major rehabilitation, could you please upload here? You can also email them documents to basak@iastate.edu

ADOTBPP 4-24-17.doc
BCR Procedures and Practices .pdf
Chapter32.pdf
Chart - Typical Actions based on Structure Condition.JPG

Q3 - The eligibility criteria for Highway Bridge Program funds for replacement under SAFETEA-LU were based on structurally deficient or functionally obsolete status and sufficiency rating. Under MAP-21 and FAST-ACT, these criteria no longer apply. Did this change affect your state or local bridge replacement policy/eligibility?

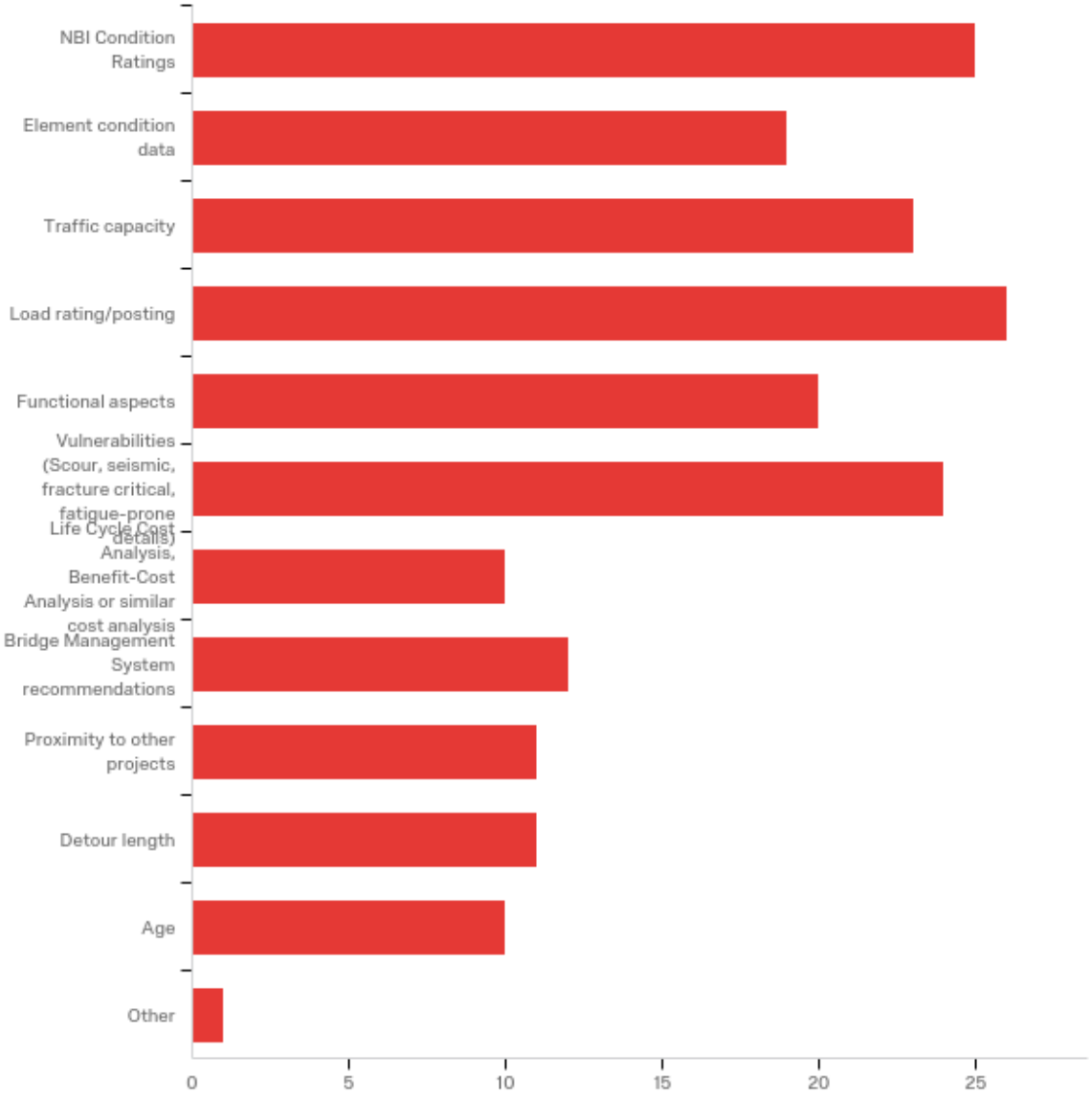


#	Answer	%	Count
1	Yes (State)	21.15%	11
2	No (State)	32.69%	17
3	Yes (Local)	17.31%	9
4	No (Local)	28.85%	15
	Total	100%	52

Q3.1. - Please briefly explain how MAP-21 and FAST-ACT affected your bridge replacement policy/eligibility?

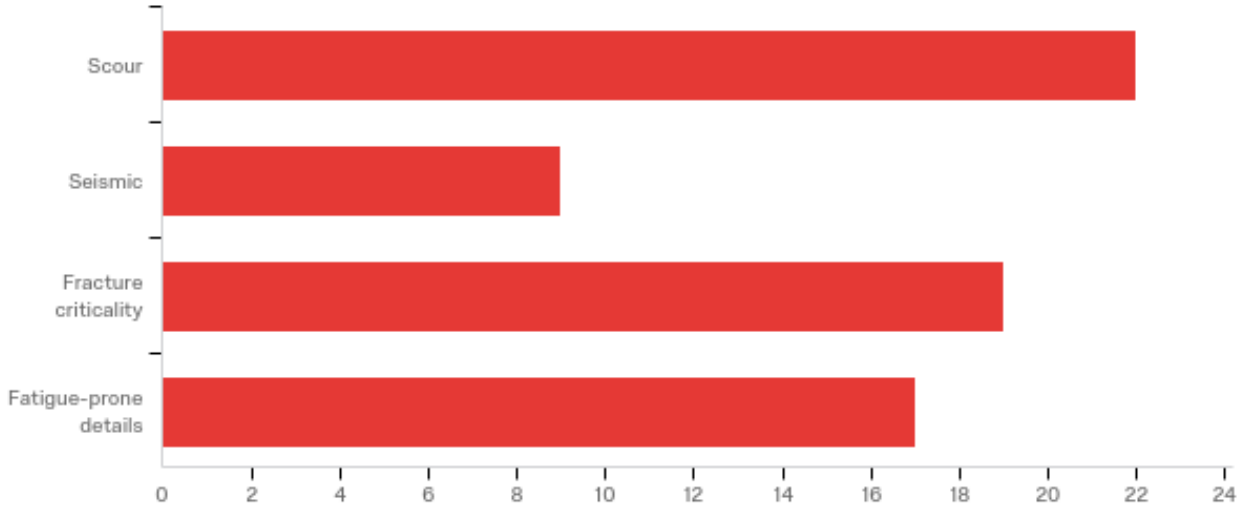
Please briefly explain how MAP-21 and FAST-ACT affected your bridge replace...
Local will no longer to have specific fund designated to local on system bridges but under the funding available from state. It also expanded the list of bridges suitable for rehab.
Gave the state more flexibility in making decisions to replace or rehabilitate bridges.
Could base more bridge work on based on actual conditions and needs without having to be on selection list.
It resulted in posting a lot of bridges and the Fast-Act may affect more NBI bridges on the NHS to be posted. Most of the bridges were designed by the old codes too. To increase the capacities of these structures, replacement may be the prudent option for the long run.
Sufficiency rating no longer applies. This helped us replace bridges we thought were not good preservation candidates.
We removed the criteria pertaining for sufficiency rating
Sufficiency rating is no longer a consideration. Additionally the 10 year rule is no longer in effect.
It gives us the flexibility to do use asset management to best determine our mix of fixes.
Our Highway Bridge Program for local bridges is currently working on new criteria to determine eligibility for bridge replacements. They utilize a committee of representatives of the over 640 Cities, Counties and regional local agencies in California to advise and recommend criteria for approval of federal funding. FHWA is represented on this committee as well. Prior to Map-21 and FASTact, the Local Program utilized the Sufficiency Rating from routine bridge inspection evaluations. New criteria being discussed may add other acceptable objectives beyond bridge health evaluation such as ADD improvements and even accommodation of other modes of transportation such as bikes and pedestrians if the approach roadway has been improved.
Allowed us to fund repair and rehabilitation rather than full replacement. In many cases.
The removal of the sufficiency rating threshold requirement for Federal funds allowed for more flexibility in state fund allocation for replacement candidates. In the past, if a bridge had a sufficiency rating less than 50 and it was not structurally deficient or functionally obsolete, a letter was written to justify use of Federal funds. The new Federal laws/guidelines allow each state to use internal performance measures or other policy guidelines to prioritize fund allocation.

Q4 - Please check any of the items below that are included in your criteria to select bridges for replacement.



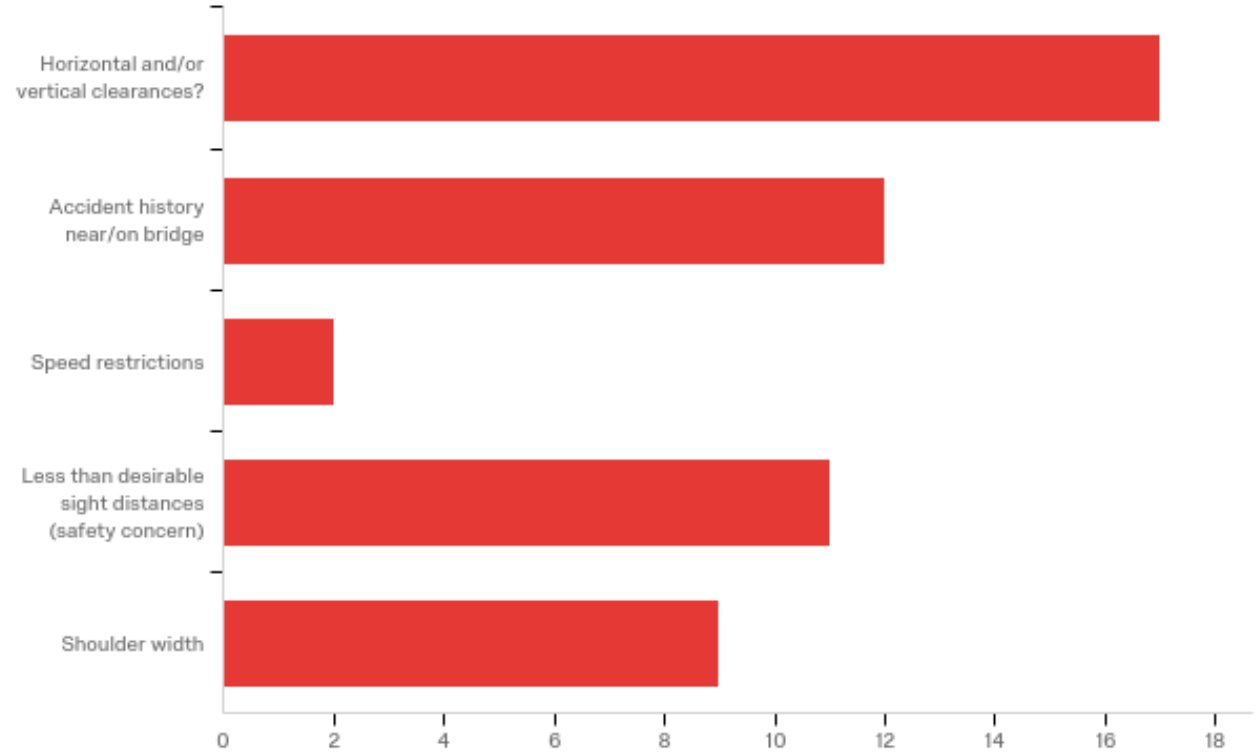
#	Answer	%	Count
299	Load rating/posting	13.54%	26
296	NBI Condition Ratings	13.02%	25
301	Vulnerabilities (Scour, seismic, fracture critical, fatigue-prone details)	12.50%	24
298	Traffic capacity	11.98%	23
300	Functional aspects	10.42%	20
297	Element condition data	9.90%	19
303	Bridge Management System recommendations	6.25%	12
304	Proximity to other projects	5.73%	11
305	Detour length	5.73%	11
302	Life-Cycle Cost Analysis, Benefit-Cost Analysis or similar cost analysis	5.21%	10
306	Age	5.21%	10
307	Other	0.52%	1
	Total	100%	192

Q4.1 - Please note which of the below are included in the vulnerability criterion you consider for selecting bridges for replacement



#	Answer	%	Count
1	Scour	32.84%	22
2	Seismic	13.43%	9
3	Fracture criticality	28.36%	19
4	Fatigue-prone details	25.37%	17
	Total	100%	67

Q4.2 - Please note which of the below are included in the functional aspects criterion you consider for selecting bridges for replacement

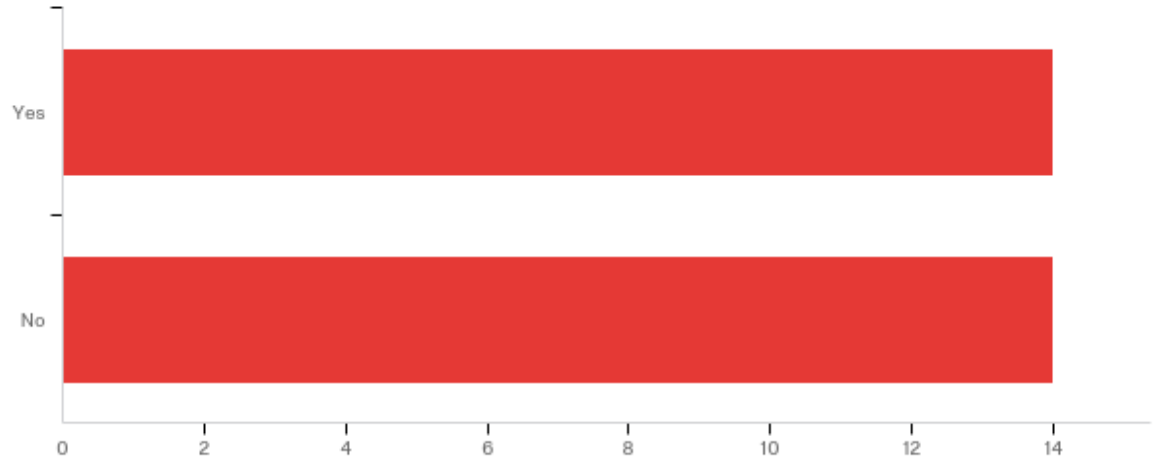


#	Answer	%	Count
1	Horizontal and/or vertical clearances?	33.33%	17
2	Accident history near/on bridge	23.53%	12
3	Speed restrictions	3.92%	2
4	Less than desirable sight distances (safety concern)	21.57%	11
5	Shoulder width	17.65%	9
	Total	100%	51

Q4.3 - Please note which other factors you include in your criteria to select bridges for replacement.

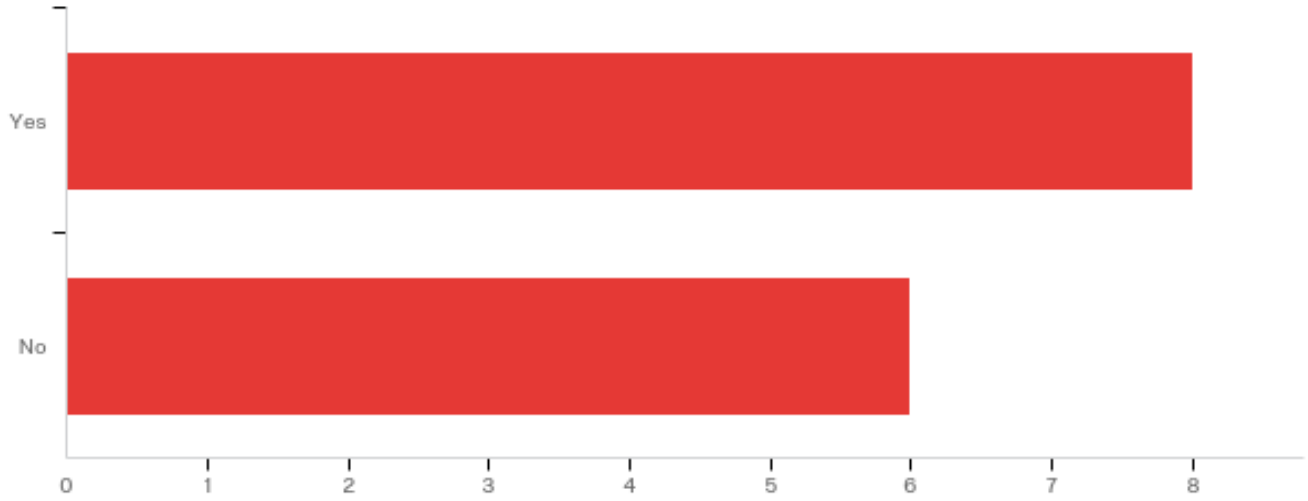
Vertical clearance

Q5 - Do you have historic project level records of bridge replacements, or can you identify the primary reason a bridge was replaced?



#	Answer	%	Count
1	Yes	50.00%	14
2	No	50.00%	14
	Total	100%	28

Q5.1 - Would you be interested in sharing historic project records for our future work, or providing a primary reason a bridge was replaced? The data will be used to identify reasons for bridge replacement.

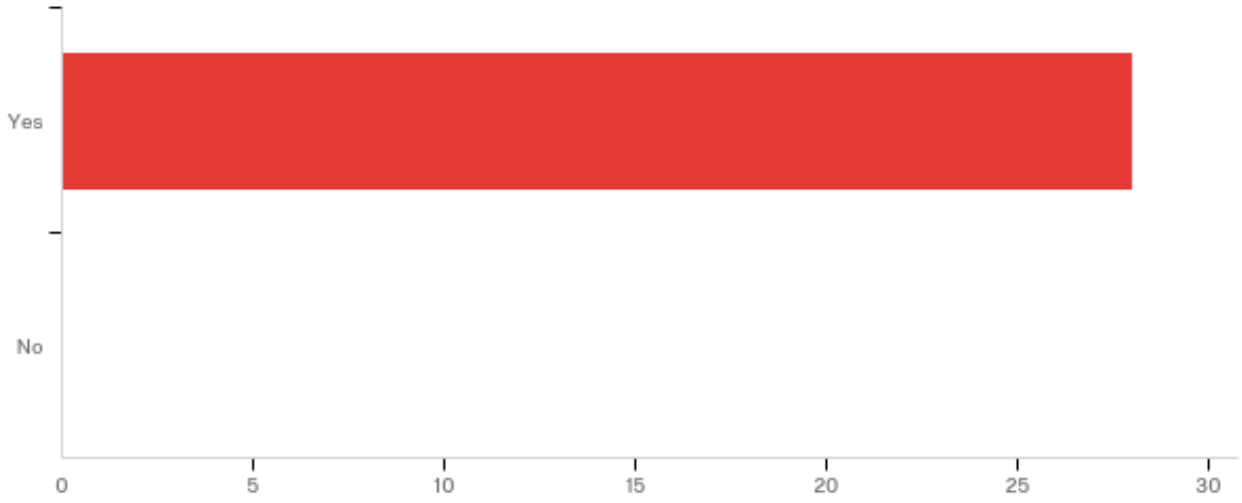


#	Answer	%	Count
1	Yes	57.14%	8
2	No	42.86%	6
	Total	100%	14

These 8 States are:

- CA
- FL
- GA
- IL
- MI
- NC
- PA
- UT

Q6 - Can we follow up with you by phone or email regarding this survey?



#	Answer	%	Count
1	Yes	100.00%	28
2	No	0.00%	0
	Total	100%	28

APPENDIX B. DECOMMISSIONED BRIDGES BY STATE

Name	1992			1993		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5386	96	1.782%	5404	71	1.314%
Alaska	689	0	0.000%	689	0	0.000%
Arizona	3967	28	0.706%	4013	23	0.573%
Arkansas	6764	64	0.946%	6757	49	0.725%
California	11141	11	0.099%	11158	10	0.090%
Colorado	3443	31	0.900%	3438	40	1.163%
Connecticut	2660	20	0.752%	2695	11	0.408%
Delaware	731	0	0.000%	735	17	2.313%
District of Columbia	212	0	0.000%	212	1	0.472%
Florida	5033	28	0.556%	5145	39	0.758%
Georgia	6277	81	1.290%	6281	79	1.258%
Hawaii	658	0	0.000%	670	0	0.000%
Idaho	1331	8	0.601%	1337	10	0.748%
Illinois	7446	88	1.182%	7423	114	1.536%
Indiana	4954	1	0.020%	5033	15	0.298%
Iowa	3872	50	1.291%	3856	12	0.311%
Kansas	4630	46	0.994%	4640	92	1.983%
Kentucky	8600	68	0.791%	8618	84	0.975%
Louisiana	7622	32	0.420%	7693	36	0.468%
Maine	1497	5	0.334%	1496	1	0.067%
Maryland	2317	22	0.950%	2332	7	0.300%
Massachusetts	2924	7	0.239%	2930	2	0.068%
Michigan	4162	2	0.048%	4159	5	0.120%
Minnesota	3433	48	1.398%	3417	10	0.293%
Mississippi	5003	11	0.220%	5061	25	0.494%
Missouri	9446	99	1.048%	9430	88	0.933%
Montana	2318	34	1.467%	2279	8	0.351%
Nebraska	3290	15	0.456%	3308	19	0.574%
Nevada	868	1	0.115%	872	0	0.000%
New Hampshire	1246	2	0.161%	1248	1	0.080%
New Jersey	2268	14	0.617%	2275	1	0.044%
New Mexico	2887	36	1.247%	2883	22	0.763%
New York	7361	10	0.136%	7372	9	0.122%
North Carolina	15780	22	0.139%	15872	28	0.176%
North Dakota	1080	6	0.556%	1075	7	0.651%
Ohio	8689	123	1.416%	8745	135	1.544%
Oklahoma	6636	42	0.633%	6666	37	0.555%
Oregon	2527	28	1.108%	2625	28	1.067%
Pennsylvania	15241 *	455 *	2.99%*	15255	222	1.455%
Rhode Island	562	0	0.000%	577	3	0.520%
South Carolina	8061	6	0.074%	8095	7	0.086%
South Dakota	1796	11	0.612%	1789	10	0.559%
Tennessee	7397	18	0.243%	7495	1	0.013%
Texas	30326	133	0.439%	30600	96	0.314%
Utah	1650	7	0.424%	1652	12	0.726%
Vermont	1053	0	0.000%	1051	0	0.000%
Virginia	11344	11	0.097%	11437	156	1.364%
Washington	2776	6	0.216%	2874	13	0.452%
West Virginia	6109	14	0.229%	6171	15	0.243%
Wisconsin	4473	68	1.520%	4499	38	0.845%
Wyoming	1867	8	0.428%	1876	10	0.533%
Puerto Rico	1774	13	0.733%	1795	8	0.446%
Total	**248336**	**1474**	**0.59%**	**265008**	**1727**	**0.65%**

*Values excluded from analysis.

Name	1994			1995		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5421	68	1.254%	5442	27	0.496%
Alaska	690	4	0.580%	700	5	0.714%
Arizona	4080	19	0.466%	4108	16	0.389%
Arkansas	6775	32	0.472%	6816	35	0.513%
California	11242	62	0.552%	11369	30	0.264%
Colorado	3470	18	0.519%	3467	38	1.096%
Connecticut	2705	23	0.850%	2740	0	0.000%
Delaware	768	5	0.651%	767	0	0.000%
District of Columbia	211	0	0.000%	211	0	0.000%
Florida	5179	44	0.850%	5075	45	0.887%
Georgia	6309	39	0.618%	6326	52	0.822%
Hawaii	678	1	0.147%	685	0	0.000%
Idaho	1268	9	0.710%	1338	7	0.523%
Illinois	7424	145	1.953%	7418	89	1.200%
Indiana	5057	11	0.218%	5077	22	0.433%
Iowa	3872	36	0.930%	3892	24	0.617%
Kansas	4609	73	1.584%	4673	32	0.685%
Kentucky	8629	57	0.661%	8661	87	1.005%
Louisiana	7698	10	0.130%	7693	21	0.273%
Maine	1488	2	0.134%	1729	2	0.116%
Maryland	2363	14	0.592%	2441	13	0.533%
Massachusetts	2934	7	0.239%	2929	5	0.171%
Michigan	4241	3	0.071%	4247	2	0.047%
Minnesota	3422	33	0.964%	3440	27	0.785%
Mississippi	5053	51	1.009%	5114	23	0.450%
Missouri	9407	63	0.670%	9515	42	0.441%
Montana	2272	24	1.056%	2245	3	0.134%
Nebraska	3366	11	0.327%	3390	24	0.708%
Nevada	870	0	0.000%	904	1	0.111%
New Hampshire	1247	3	0.241%	1254	2	0.159%
New Jersey	2303	3	0.130%	2316	0	0.000%
New Mexico	2898	12	0.414%	2900	21	0.724%
New York	7358	7	0.095%	7398	3	0.041%
North Carolina	15950	24	0.150%	16021	47	0.293%
North Dakota	1066	2	0.188%	1081	6	0.555%
Ohio	8787	97	1.104%	8790	76	0.865%
Oklahoma	6655	28	0.421%	6661	23	0.345%
Oregon	2629	16	0.609%	2627	0	0.000%
Pennsylvania	15257	237	1.553%	15276 *	413 *	2.7% *
Rhode Island	583	5	0.858%	581	0	0.000%
South Carolina	8099	13	0.161%	8111	2	0.025%
South Dakota	1781	6	0.337%	1783	2	0.112%
Tennessee	7558	2	0.026%	7592	4	0.053%
Texas	30712	95	0.309%	30876	112	0.363%
Utah	1651	8	0.485%	1654	5	0.302%
Vermont	1057	0	0.000%	1069	0	0.000%
Virginia	11383	125	1.098%	11411	218	1.910%
Washington	2910	0	0.000%	2967	49	1.651%
West Virginia	6175	16	0.259%	6200	20	0.323%
Wisconsin	4544	51	1.122%	4568	36	0.788%
Wyoming	1899	7	0.369%	1931	12	0.621%
Puerto Rico	1739	5	0.288%	1609	4	0.249%
Total	**265742**	**1626**	**0.61%**	**251812**	**1314**	**0.52%**

*Values excluded from analysis.

Name	1996			1997		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5453	29	0.532%	5474	25	0.457%
Alaska	706	4	0.567%	711	2	0.281%
Arizona	4116	12	0.292%	4145	13	0.314%
Arkansas	6826	38	0.557%	6855	81	1.182%
California	11421	12	0.105%	11424	20	0.175%
Colorado	3461	26	0.751%	3470	26	0.749%
Connecticut	2749	8	0.291%	2755	0	0.000%
Delaware	791	0	0.000%	813 *	61 *	7.503% *
District of Columbia	211	0	0.000%	211	0	0.000%
Florida	5095	49	0.962%	5096	39	0.765%
Georgia	6338	18	0.284%	6330	36	0.569%
Hawaii	685	0	0.000%	720	0	0.000%
Idaho	1337 *	83 *	6.21% *	1245	6	0.482%
Illinois	7450	86	1.154%	7471	52	0.696%
Indiana	5072	8	0.158%	5079	18	0.354%
Iowa	3921	24	0.612%	3951	12	0.304%
Kansas	4708	103	2.188%	4707	41	0.871%
Kentucky	8683	49	0.564%	8698	82	0.943%
Louisiana	7743	52	0.672%	7790	22	0.282%
Maine	1739	2	0.115%	1730	5	0.289%
Maryland	2452	20	0.816%	2450	17	0.694%
Massachusetts	2933	15	0.511%	2928	22	0.751%
Michigan	4257	1	0.023%	4206	1	0.024%
Minnesota	3443	21	0.610%	3436	4	0.116%
Mississippi	5125	88	1.717%	5230	30	0.574%
Missouri	9523	59	0.620%	9515	89	0.935%
Montana	2241	11	0.491%	2229	13	0.583%
Nebraska	3400	10	0.294%	3405	15	0.441%
Nevada	915	0	0.000%	928	1	0.108%
New Hampshire	1256	0	0.000%	1354	0	0.000%
New Jersey	2318	1	0.043%	2335	0	0.000%
New Mexico	2901	18	0.620%	2892	5	0.173%
New York	7432	11	0.148%	7436	6	0.081%
North Carolina	16064	20	0.125%	16129	27	0.167%
North Dakota	1082	2	0.185%	1084	4	0.369%
Ohio	8782	92	1.048%	8780	101	1.150%
Oklahoma	6656	32	0.481%	6672	27	0.405%
Oregon	2654	50	1.884%	2629	33	1.255%
Pennsylvania	15274	60	0.393%	15324 *	778 *	5.077% *
Rhode Island	588	0	0.000%	589	0	0.000%
South Carolina	8142	17	0.209%	8141	6	0.074%
South Dakota	1778	5	0.281%	1783	3	0.168%
Tennessee	7657	11	0.144%	7790	7	0.090%
Texas	30922	110	0.356%	30837	126	0.409%
Utah	1649	7	0.424%	1650	16	0.970%
Vermont	1070	0	0.000%	1071	0	0.000%
Virginia	11311 *	241 *	2.13 % *	11206	116	1.035%
Washington	2943	20	0.680%	2994	4	0.134%
West Virginia	6236	82	1.315%	6257	110	1.758%
Wisconsin	4581	47	1.026%	4613	55	1.192%
Wyoming	1947	10	0.514%	1945	15	0.771%
Puerto Rico	1644	6	0.365%	1701	8	0.470%
Total	**255033**	**1346**	**0.53%**	**252077**	**1341**	**0.53%**

*Values excluded from analysis.

Name	1998			1999		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5493	29	0.528%	5497	24	0.437%
Alaska	713	2	0.281%	717	2	0.279%
Arizona	4144	4	0.097%	4151	6	0.145%
Arkansas	6910	58	0.839%	6927	43	0.621%
California	11460	30	0.262%	11627	15	0.129%
Colorado	3470	25	0.720%	3477	40	1.150%
Connecticut	2758	3	0.109%	2765	0	0.000%
Delaware	761	4	0.526%	774	5	0.646%
District of Columbia	211	3	1.422%	210	0	0.000%
Florida	5096	82	1.609%	5108	71	1.390%
Georgia	6338	38	0.600%	6358	38	0.598%
Hawaii	720	0	0.000%	718	0	0.000%
Idaho	1249	6	0.480%	1248	5	0.401%
Illinois	7483	50	0.668%	7521	109	1.449%
Indiana	5075	11	0.217%	5078	30	0.591%
Iowa	3988	12	0.301%	3994	17	0.426%
Kansas	4714	62	1.315%	4803	41	0.854%
Kentucky	8733	68	0.779%	8737	62	0.710%
Louisiana	7786	28	0.360%	7785	23	0.295%
Maine	1740	2	0.115%	1732	3	0.173%
Maryland	2434	20	0.822%	2458	3	0.122%
Massachusetts	2912	9	0.309%	2913	14	0.481%
Michigan	4262	2	0.047%	4282	3	0.070%
Minnesota	3434	35	1.019%	3482	27	0.775%
Mississippi	5266	13	0.247%	5309	11	0.207%
Missouri	9511	21	0.221%	9836	49	0.498%
Montana	2217	10	0.451%	2209	0	0.000%
Nebraska	3409	12	0.352%	3416	7	0.205%
Nevada	927	2	0.216%	937	2	0.213%
New Hampshire	1358	8	0.589%	1367	1	0.073%
New Jersey	2342	1	0.043%	2343	0	0.000%
New Mexico	2895	23	0.794%	2894	12	0.415%
New York	7381	3	0.041%	7390	2	0.027%
North Carolina	16189	35	0.216%	16318 *	2005 *	12.287% *
North Dakota	1096	0	0.000%	1096	0	0.000%
Ohio	8782	94	1.070%	8748	115	1.315%
Oklahoma	6653	28	0.421%	6691	35	0.523%
Oregon	2616	21	0.803%	2632	17	0.646%
Pennsylvania	14562	176	1.209%	14615	44	0.301%
Rhode Island	595	3	0.504%	591	0	0.000%
South Carolina	8151	10	0.123%	8207	7	0.085%
South Dakota	1786	4	0.224%	1792	5	0.279%
Tennessee	7820	4	0.051%	7894	11	0.139%
Texas	31102	102	0.328%	31323	224	0.715%
Utah	1648	11	0.667%	1660	12	0.723%
Vermont	1072	0	0.000%	1073	2	0.186%
Virginia	11266	115	1.021%	11302	89	0.787%
Washington	3007	0	0.000%	3045	0	0.000%
West Virginia	6307	123	1.950%	6354	85	1.338%
Wisconsin	4728	55	1.163%	4734	60	1.267%
Wyoming	1946	9	0.462%	1949	10	0.513%
Puerto Rico	1731	9	0.520%	1774	10	0.564%
Total	**268247**	**1475**	**0.55%**	**253543**	**1391**	**0.55%**

*Values excluded from analysis.

Name	2000			2001		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5482	36	0.657%	5488	32	0.583%
Alaska	717	0	0.000%	725	2	0.276%
Arizona	4172	16	0.384%	4277	16	0.374%
Arkansas	6979	43	0.616%	6985	59	0.845%
California	11719	44	0.375%	11769	65	0.552%
Colorado	3476	38	1.093%	3486	32	0.918%
Connecticut	2771	3	0.108%	2775	3	0.108%
Delaware	782	0	0.000%	802	5	0.623%
District of Columbia	210	0	0.000%	210	0	0.000%
Florida	5198	75	1.443%	5225	65	1.244%
Georgia	6396	25	0.391%	6409	28	0.437%
Hawaii	725	14	1.931%	709	1	0.141%
Idaho	1254	7	0.558%	1254	27	2.153%
Illinois	7515	72	0.958%	7514	68	0.905%
Indiana	5087	17	0.334%	5104	14	0.274%
Iowa	4005	37	0.924%	4098	14	0.342%
Kansas	4802	27	0.562%	4788	55	1.149%
Kentucky	8753	55	0.628%	8781	59	0.672%
Louisiana	7791	25	0.321%	7787	18	0.231%
Maine	1735	5	0.288%	1735	3	0.173%
Maryland	2478	5	0.202%	2477	6	0.242%
Massachusetts	2888	12	0.416%	2883	12	0.416%
Michigan	4282	40	0.934%	4275	3	0.070%
Minnesota	3502	25	0.714%	3504	32	0.913%
Mississippi	5333	38	0.713%	5394	16	0.297%
Missouri	9859	36	0.365%	10022	95	0.948%
Montana	2218	13	0.586%	2403	18	0.749%
Nebraska	3424	4	0.117%	3429	7	0.204%
Nevada	957	5	0.522%	959	1	0.104%
New Hampshire	1370	2	0.146%	1371	3	0.219%
New Jersey	2345	1	0.043%	2345	1	0.043%
New Mexico	2898	5	0.173%	2903	29	0.999%
New York	7460	5	0.067%	7463	1	0.013%
North Carolina	16471	14	0.085%	16605	12	0.072%
North Dakota	1101	0	0.000%	1101	2	0.182%
Ohio	8777	74	0.843%	8783	128	1.457%
Oklahoma	6705	7	0.104%	6703	70	1.044%
Oregon	2636	32	1.214%	2646	23	0.869%
Pennsylvania	14640	27	0.184%	14674	26	0.177%
Rhode Island	591	0	0.000%	590	0	0.000%
South Carolina	8216	11	0.134%	8209	13	0.158%
South Dakota	1799	2	0.111%	1791	4	0.223%
Tennessee	7959	66	0.829%	7967	12	0.151%
Texas	31387	104	0.331%	31577	256	0.811%
Utah	1659	7	0.422%	1657	124	7.483%
Vermont	1073	0	0.000%	1073	2	0.186%
Virginia	11360	61	0.537%	11414	119	1.043%
Washington	3084	0	0.000%	3100	46	1.484%
West Virginia	6416	90	1.403%	6472	73	1.128%
Wisconsin	4785	26	0.543%	4838	71	1.468%
Wyoming	1954	18	0.921%	1944	15	0.772%
Puerto Rico	1787	0	0.000%	1808	1	0.055%
Total	**270983**	**1269**	**0.47%**	**272301**	**1787**	**0.66%**

Name	2002			2003		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5549	30	0.541%	5559	39	0.702%
Alaska	729	2	0.274%	739	2	0.271%
Arizona	4323	23	0.532%	4399	13	0.296%
Arkansas	6989	51	0.730%	7017	102	1.454%
California	11805	43	0.364%	11909	35	0.294%
Colorado	3488 *	137 *	3.928% *	3476	32	0.921%
Connecticut	2776	1	0.036%	2776	2	0.072%
Delaware	800	0	0.000%	808	12	1.485%
District of Columbia	211	0	0.000%	213	0	0.000%
Florida	5232	42	0.803%	5268	43	0.816%
Georgia	6428	39	0.607%	6440	38	0.590%
Hawaii	712	9	1.264%	711	2	0.281%
Idaho	1257	0	0.000%	1257	2	0.159%
Illinois	7509	101	1.345%	7507	82	1.092%
Indiana	5103	6	0.118%	5104	7	0.137%
Iowa	4116	12	0.292%	4139	28	0.676%
Kansas	4779	84	1.758%	4799	16	0.333%
Kentucky	8817	0	0.000%	8817	117	1.327%
Louisiana	7784	6	0.077%	7791	17	0.218%
Maine	1920	5	0.260%	1932	1	0.052%
Maryland	2480	6	0.242%	2503	5	0.200%
Massachusetts	2894	24	0.829%	2886	56	1.940%
Michigan	4390	4	0.091%	4294	11	0.256%
Minnesota	3575	49	1.371%	3569	31	0.869%
Mississippi	5426	18	0.332%	5446	22	0.404%
Missouri	9988	27	0.270%	10193	159	1.560%
Montana	2411	3	0.124%	2425	7	0.289%
Nebraska	3438	5	0.145%	3449	13	0.377%
Nevada	941	2	0.213%	944	2	0.212%
New Hampshire	1385	0	0.000%	1401	2	0.143%
New Jersey	2373	0	0.000%	2356	0	0.000%
New Mexico	2895	18	0.622%	2926	15	0.513%
New York	7469	12	0.161%	7459	12	0.161%
North Carolina	16698	27	0.162%	16775	15	0.089%
North Dakota	1106	4	0.362%	1106	0	0.000%
Ohio	8765	20	0.228%	8737	60	0.687%
Oklahoma	6683	29	0.434%	6703	70	1.044%
Oregon	2654	7	0.264%	2659	10	0.376%
Pennsylvania	14729	28	0.190%	14757	19	0.129%
Rhode Island	588	1	0.170%	587	0	0.000%
South Carolina	8215	7	0.085%	8266	3	0.036%
South Dakota	1800	6	0.333%	1806	2	0.111%
Tennessee	8025	6	0.075%	8025	45	0.561%
Texas	31640	187	0.591%	31838	221	0.694%
Utah	1713	21	1.226%	1695	19	1.121%
Vermont	1072	0	0.000%	1072	1	0.093%
Virginia	11439	45	0.393%	11515	71	0.617%
Washington	3065	7	0.228%	3101	5	0.161%
West Virginia	6535	87	1.331%	6578	63	0.958%
Wisconsin	4850	17	0.351%	4916 *	134 *	2.726% *
Wyoming	1947	10	0.514%	1946	13	0.668%
Puerto Rico	1810	11	0.608%	1825	23	1.260%
Total	**269838**	**1142**	**0.42%**	**269503**	**1565**	**0.58%**

*Values excluded from analysis.

Name	2004			2005		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5560	16	0.288%	5605	29	0.517%
Alaska	743	1	0.135%	756	2	0.265%
Arizona	4452	19	0.427%	4474	18	0.402%
Arkansas	7052	87	1.234%	7091	44	0.621%
California	11939	65	0.544%	11935	36	0.302%
Colorado	3507	42	1.198%	3509	38	1.083%
Connecticut	2774	1	0.036%	2775	1	0.036%
Delaware	810	10	1.235%	809	2	0.247%
District of Columbia	212	0	0.000%	212	0	0.000%
Florida	5258	68	1.293%	5300	41	0.774%
Georgia	6443	50	0.776%	6483	32	0.494%
Hawaii	712	7	0.983%	711	0	0.000%
Idaho	1266	8	0.632%	1269	6	0.473%
Illinois	7510	73	0.972%	7512	70	0.932%
Indiana	5114	20	0.391%	5132	3	0.058%
Iowa	3964	42	1.060%	3972	42	1.057%
Kansas	4799	93	1.938%	4831	44	0.911%
Kentucky	8796	0	0.000%	8796 *	199 *	2.262% *
Louisiana	7801	15	0.192%	7817	12	0.154%
Maine	1936	0	0.000%	1937	4	0.207%
Maryland	2504	6	0.240%	2503	0	0.000%
Massachusetts	2847	42	1.475%	2819	12	0.426%
Michigan	4395	11	0.250%	4406	3	0.068%
Minnesota	3613	25	0.692%	3628	37	1.020%
Mississippi	5478	22	0.402%	5539	9	0.162%
Missouri	10122	72	0.711%	10134	66	0.651%
Montana	2410	9	0.373%	2459	5	0.203%
Nebraska	3451	3	0.087%	3471	6	0.173%
Nevada	944	0	0.000%	956	0	0.000%
New Hampshire	1405	1	0.071%	1405	1	0.071%
New Jersey	2391	13	0.544%	2370	9	0.380%
New Mexico	2933	23	0.784%	2945	25	0.849%
New York	7419	6	0.081%	7424	12	0.162%
North Carolina	16906	10	0.059%	17020	8	0.047%
North Dakota	1110	2	0.180%	1111	2	0.180%
Ohio	8755	69	0.788%	8855	63	0.711%
Oklahoma	6720	33	0.491%	6759	32	0.473%
Oregon	2665	21	0.788%	2661 *	63 *	2.368% *
Pennsylvania	14787	38	0.257%	14813	65	0.439%
Rhode Island	588	0	0.000%	588	0	0.000%
South Carolina	8323	9	0.108%	8325	10	0.120%
South Dakota	1809	6	0.332%	1811	9	0.497%
Tennessee	8033	59	0.734%	8054	11	0.137%
Texas	31984	199	0.622%	32088	202	0.630%
Utah	1695	22	1.298%	1706	11	0.645%
Vermont	1072	0	0.000%	1077	0	0.000%
Virginia	11600	54	0.466%	11709	45	0.384%
Washington	3120	28	0.897%	3111	36	1.157%
West Virginia	6598	59	0.894%	6628	67	1.011%
Wisconsin	4927	72	1.461%	4875	69	1.415%
Wyoming	1944	18	0.926%	1940	11	0.567%
Puerto Rico	1816	18	0.991%	1812	5	0.276%
Total	**275012**	**1567**	**0.57%**	**264471**	**1255**	**0.47%**

*Values excluded from analysis.

Name	2006			2007		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5680	21	0.370%	5693	18	0.316%
Alaska	761	0	0.000%	776	6	0.773%
Arizona	4523	7	0.155%	4601	9	0.196%
Arkansas	7117	33	0.464%	7134	39	0.547%
California	11985	23	0.192%	12005	42	0.350%
Colorado	3503	28	0.799%	3509	30	0.855%
Connecticut	2777	3	0.108%	2782	1	0.036%
Delaware	816	3	0.368%	823	10	1.215%
District of Columbia	212	0	0.000%	215	2	0.930%
Florida	5323	70	1.315%	5354	55	1.027%
Georgia	6509	65	0.999%	6532	66	1.010%
Hawaii	719	2	0.278%	715	2	0.280%
Idaho	1271	6	0.472%	1282	8	0.624%
Illinois	7572	98	1.294%	7570	62	0.819%
Indiana	5164	0	0.000%	5188	8	0.154%
Iowa	3996	36	0.901%	4025	33	0.820%
Kansas	4847	48	0.990%	4861	56	1.152%
Kentucky	8834	0	0.000%	8835	149	1.686%
Louisiana	7816	14	0.179%	7840	12	0.153%
Maine	1944	0	0.000%	1952	4	0.205%
Maryland	2533	6	0.237%	2535	4	0.158%
Massachusetts	2840	13	0.458%	2852	12	0.421%
Michigan	4406	10	0.227%	4406	5	0.113%
Minnesota	3613	35	0.969%	3624	29	0.800%
Mississippi	5562	12	0.216%	5631	12	0.213%
Missouri	10167	67	0.659%	10189	77	0.756%
Montana	2442	9	0.369%	2437	6	0.246%
Nebraska	3469	2	0.058%	3497	5	0.143%
Nevada	956	5	0.523%	1007	2	0.199%
New Hampshire	1405	4	0.285%	1408	7	0.497%
New Jersey	2370	4	0.169%	2374	3	0.126%
New Mexico	2959	10	0.338%	2963	12	0.405%
New York	7429	8	0.108%	7420	7	0.094%
North Carolina	17146	13	0.076%	17202	15	0.087%
North Dakota	1119	2	0.179%	1124	3	0.267%
Ohio	8795	88	1.001%	8830	78	0.883%
Oklahoma	6769	46	0.680%	6793	30	0.442%
Oregon	2641	45	1.704%	2661	20	0.752%
Pennsylvania	14868	71	0.478%	14863	69	0.464%
Rhode Island	611	7	1.146%	606	7	1.155%
South Carolina	8352	7	0.084%	8343	7	0.084%
South Dakota	1811	7	0.387%	1799	0	0.000%
Tennessee	8092	13	0.161%	8099	10	0.123%
Texas	32290	246	0.762%	32555	231	0.710%
Utah	1710	8	0.468%	1711	15	0.877%
Vermont	1077	2	0.186%	1077	1	0.093%
Virginia	11781	54	0.458%	11722	55	0.469%
Washington	3083	22	0.714%	3130	10	0.319%
West Virginia	6656	62	0.931%	6697	52	0.776%
Wisconsin	4900	68	1.388%	4893	28	0.572%
Wyoming	1939	5	0.258%	1940	10	0.515%
Puerto Rico	1806	2	0.111%	1814	5	0.276%
Total	**276966**	**1410**	**0.51%**	**277894**	**1439**	**0.52%**

Name	2008			2009		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5710	29	0.508%	5718	13	0.227%
Alaska	773	2	0.259%	789	1	0.127%
Arizona	4607	21	0.456%	4606	23	0.499%
Arkansas	7149	19	0.266%	7164	13	0.181%
California	12090	16	0.132%	12166	41	0.337%
Colorado	3471	32	0.922%	3477	67	1.927%
Connecticut	2784	1	0.036%	2788	0	0.000%
Delaware	825	2	0.242%	828	8	0.966%
District of Columbia	212	0	0.000%	212	2	0.943%
Florida	5352	41	0.766%	5384	54	1.003%
Georgia	6543	73	1.116%	6587	51	0.774%
Hawaii	724	1	0.138%	723	1	0.138%
Idaho	1291	6	0.465%	1295	8	0.618%
Illinois	7606	66	0.868%	7691	96	1.248%
Indiana	5208	2	0.038%	5204	12	0.231%
Iowa	4071	21	0.516%	4092	41	1.002%
Kansas	4863	21	0.432%	4910	16	0.326%
Kentucky	8836	42	0.475%	8871	45	0.507%
Louisiana	7885	9	0.114%	7891	72	0.912%
Maine	1955	0	0.000%	1961	0	0.000%
Maryland	2557	7	0.274%	2560	3	0.117%
Massachusetts	2871	25	0.871%	2865	16	0.558%
Michigan	4415	22	0.498%	4390	5	0.114%
Minnesota	3684	63	1.710%	3642	56	1.538%
Mississippi	5641	36	0.638%	5651	19	0.336%
Missouri	10224	49	0.479%	10197	39	0.382%
Montana	2445	3	0.123%	2441	8	0.328%
Nebraska	3512	15	0.427%	3499	6	0.171%
Nevada	1010	0	0.000%	1012	13	1.285%
New Hampshire	1407	7	0.498%	1410 *	115 *	8.156% *
New Jersey	2379	6	0.252%	2380	2	0.084%
New Mexico	2965	15	0.506%	2968	15	0.505%
New York	7447	12	0.161%	7447	8	0.107%
North Carolina	17305	12	0.069%	17413	438	2.515%
North Dakota	1123	1	0.089%	1126	1	0.089%
Ohio	10348	64	0.618%	10365	64	0.617%
Oklahoma	6797	109	1.604%	6790	46	0.677%
Oregon	2666	53	1.988%	2681	22	0.821%
Pennsylvania	14933	93	0.623%	14930	81	0.543%
Rhode Island	598	4	0.669%	598 *	30 *	5.017% *
South Carolina	8351	2	0.024%	8356	1	0.012%
South Dakota	1804	4	0.222%	1808	3	0.166%
Tennessee	8137	21	0.258%	8124	28	0.345%
Texas	32609	242	0.742%	32886	187	0.569%
Utah	1706	42	2.462%	1740	19	1.092%
Vermont	1077	0	0.000%	1077	0	0.000%
Virginia	11754	34	0.289%	11813	55	0.466%
Washington	3140	14	0.446%	3159	14	0.443%
West Virginia	6736	77	1.143%	6740	68	1.009%
Wisconsin	4996	41	0.821%	5070	41	0.809%
Wyoming	1942	5	0.257%	1940	9	0.464%
Puerto Rico	1836	5	0.272%	1837	5	0.272%
Total	**280370**	**1487**	**0.53%**	**279264**	**1836**	**0.66%**

*Values excluded from analysis.

Name	2010			2011		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5734	13	0.227%	5736	9	0.157%
Alaska	788	1	0.127%	800	1	0.125%
Arizona	4637	16	0.345%	4660	12	0.258%
Arkansas	7182	37	0.515%	7201	39	0.542%
California	12190	75	0.615%	12171	80	0.657%
Colorado	3444	19	0.552%	3447	25	0.725%
Connecticut	2794	0	0.000%	2801	1	0.036%
Delaware	826	6	0.726%	826	1	0.121%
District of Columbia	206	0	0.000%	206	4	1.942%
Florida	5423	37	0.682%	5441	24	0.441%
Georgia	6592	18	0.273%	6616	13	0.196%
Hawaii	723	1	0.138%	719	1	0.139%
Idaho	1295	8	0.618%	1307	15	1.148%
Illinois	7706	94	1.220%	7724	90	1.165%
Indiana	5201	140	2.692%	5267	17	0.323%
Iowa	4106	21	0.511%	4092	52	1.271%
Kansas	4913	34	0.692%	4952	42	0.848%
Kentucky	8928	52	0.582%	8960	49	0.547%
Louisiana	7904	130	1.645%	7853	42	0.535%
Maine	1964	1	0.051%	1965	2	0.102%
Maryland	2559	5	0.195%	2555	6	0.235%
Massachusetts	3447	25	0.725%	3441	18	0.523%
Michigan	4400	13	0.295%	4397	0	0.000%
Minnesota	3627	25	0.689%	3618	10	0.276%
Mississippi	5676	23	0.405%	5692	43	0.755%
Missouri	10302	198	1.922%	10371 *	320 *	3.086% *
Montana	2497	13	0.521%	2487	5	0.201%
Nebraska	3496	4	0.114%	3502	4	0.114%
Nevada	1017	2	0.197%	1029	0	0.000%
New Hampshire	1290	1	0.078%	1294	2	0.155%
New Jersey	2381	1	0.042%	2374	5	0.211%
New Mexico	2968	5	0.168%	2977	15	0.504%
New York	7437	3	0.040%	7445	10	0.134%
North Carolina	17000	11	0.065%	17046	120	0.704%
North Dakota	1127	0	0.000%	1127	0	0.000%
Ohio	10386	73	0.703%	10372	75	0.723%
Oklahoma	6787	81	1.193%	6774	42	0.620%
Oregon	2692	33	1.226%	2700	16	0.593%
Pennsylvania	14960	228	1.524%	14923	190	1.273%
Rhode Island	595	7	1.176%	590	1	0.169%
South Carolina	8355	7	0.084%	8373	3	0.036%
South Dakota	1803	1	0.055%	1803	6	0.333%
Tennessee	8128	11	0.135%	8157	3	0.037%
Texas	33036	200	0.605%	33334	126	0.378%
Utah	1748	20	1.144%	1767	7	0.396%
Vermont	1078	0	0.000%	1081	1	0.093%
Virginia	11816	48	0.406%	11822	49	0.414%
Washington	3194	9	0.282%	3205	21	0.655%
West Virginia	6779	77	1.136%	6806	104	1.528%
Wisconsin	5096	39	0.765%	5134	52	1.013%
Wyoming	1944	5	0.257%	1948	5	0.257%
Puerto Rico	1544	2	0.130%	1561	3	0.192%
Total	**281721**	**1873**	**0.66%**	**272078**	**1461**	**0.54%**

*Values excluded from analysis.

Name	2012			2013		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5738	31	0.540%	5739	23	0.401%
Alaska	807	2	0.248%	810	3	0.370%
Arizona	4700	25	0.532%	4702	6	0.128%
Arkansas	7236	30	0.415%	7253	40	0.551%
California	12180	55	0.452%	12232	59	0.482%
Colorado	3449	41	1.189%	3437	25	0.727%
Connecticut	2804	2	0.071%	2812	0	0.000%
Delaware	829	1	0.121%	830	1	0.120%
District of Columbia	200	4	2.000%	212	2	0.943%
Florida	5414	14	0.259%	5441	31	0.570%
Georgia	6632	14	0.211%	6647	15	0.226%
Hawaii	719	0	0.000%	716	11	1.536%
Idaho	1311	10	0.763%	1321	10	0.757%
Illinois	7740	86	1.111%	7767	82	1.056%
Indiana	5315	74	1.392%	5434	29	0.534%
Iowa	4071	19	0.467%	4097	18	0.439%
Kansas	4976	26	0.523%	5018	38	0.757%
Kentucky	8975	54	0.602%	8977	27	0.301%
Louisiana	7876	174	2.209%	7781	90	1.157%
Maine	1965	4	0.204%	1963	0	0.000%
Maryland	2560	6	0.234%	2555	4	0.157%
Massachusetts	3459	18	0.520%	3462	25	0.722%
Michigan	4410	12	0.272%	4419	8	0.181%
Minnesota	3615	18	0.498%	3614	52	1.439%
Mississippi	5716	43	0.752%	5722	24	0.419%
Missouri	10372	160	1.543%	10328	39	0.378%
Montana	2488	12	0.482%	2482	10	0.403%
Nebraska	3503	3	0.086%	3509	2	0.057%
Nevada	1041	1	0.096%	1060	2	0.189%
New Hampshire	1298	4	0.308%	1301	5	0.384%
New Jersey	2371	8	0.337%	2367	3	0.127%
New Mexico	2967	23	0.775%	2975	13	0.437%
New York	7460	9	0.121%	7475	7	0.094%
North Carolina	16976	69	0.406%	16946	174	1.027%
North Dakota	1131	0	0.000%	1130	1	0.088%
Ohio	10345	75	0.725%	10355	75	0.724%
Oklahoma	6799	65	0.956%	6792	66	0.972%
Oregon	2706	18	0.665%	2715	3	0.110%
Pennsylvania	15202	211	1.388%	15207	192	1.263%
Rhode Island	593	1	0.169%	597	2	0.335%
South Carolina	8395	7	0.083%	8404	1	0.012%
South Dakota	1798	2	0.111%	1796	0	0.000%
Tennessee	8196	10	0.122%	8247	5	0.061%
Texas	33513	246	0.734%	33719	156	0.463%
Utah	1773 *	58 *	3.271% *	1804	7	0.388%
Vermont	1084	0	0.000%	1087	0	0.000%
Virginia	11892	89	0.748%	11886	57	0.480%
Washington	3262	12	0.368%	3274	16	0.489%
West Virginia	6802	73	1.073%	6837	63	0.921%
Wisconsin	5165	61	1.181%	5185	60	1.157%
Wyoming	1954	5	0.256%	1955	2	0.102%
Puerto Rico	1572	5	0.318%	1599	1	0.063%
Total	**281582**	**1932**	**0.69%**	**283993**	**1585**	**0.56%**

*Values excluded from analysis.

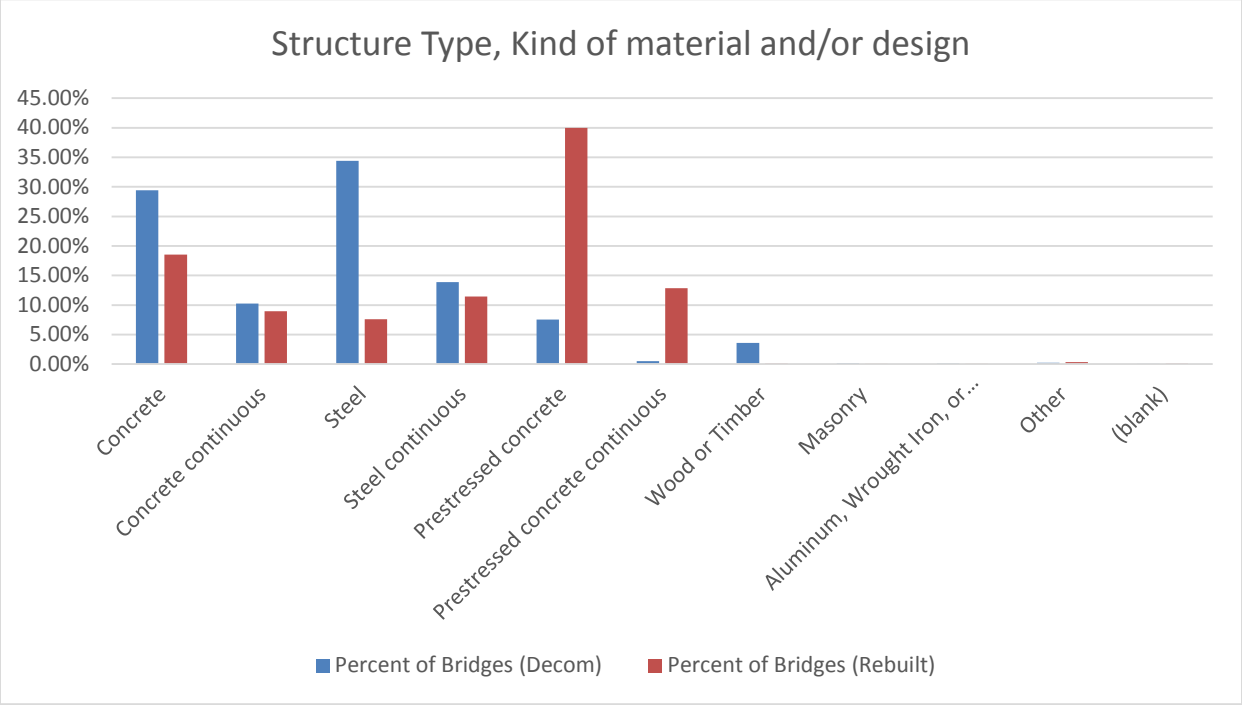
Name	2014			2015		
	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent	Total Number of State Owned Br.	Total Number of State Owned Decom. Br.	State Percent
Alabama	5734	17	0.296%	5741	34	0.592%
Alaska	809	2	0.247%	812	0	0.000%
Arizona	4741	20	0.422%	4748	61	1.285%
Arkansas	7271	32	0.440%	7300	33	0.452%
California	12347	98	0.794%	12347	71	0.575%
Colorado	3444	35	1.016%	3407	22	0.646%
Connecticut	2814	5	0.178%	2820	14	0.496%
Delaware	831	0	0.000%	841	4	0.476%
District of Columbia	213	1	0.469%	214	2	0.935%
Florida	5480	36	0.657%	5481	50	0.912%
Georgia	6651	33	0.496%	6632	30	0.452%
Hawaii	729	0	0.000%	733	0	0.000%
Idaho	1325	13	0.981%	1327	7	0.528%
Illinois	7766	23	0.296%	7805	70	0.897%
Indiana	5484	27	0.492%	5599	31	0.554%
Iowa	4103	34	0.829%	4101	31	0.756%
Kansas	5031	45	0.894%	5042	39	0.774%
Kentucky	9004	40	0.444%	9031	77	0.853%
Louisiana	7769	34	0.438%	7828	64	0.818%
Maine	1971	2	0.101%	1973	3	0.152%
Maryland	2553	4	0.157%	2546	3	0.118%
Massachusetts	3460	17	0.491%	3464	17	0.491%
Michigan	4441	2	0.045%	4451	5	0.112%
Minnesota	3616	33	0.913%	3672	37	1.008%
Mississippi	5775	35	0.606%	5760	40	0.694%
Missouri	10344	38	0.367%	10348	45	0.435%
Montana	2478	10	0.404%	2493	3	0.120%
Nebraska	3512	6	0.171%	3520	1	0.028%
Nevada	1069	3	0.281%	1076	0	0.000%
New Hampshire	1300	7	0.538%	1302	5	0.384%
New Jersey	2370	2	0.084%	2389	4	0.167%
New Mexico	2975	16	0.538%	2969	30	1.010%
New York	7487	14	0.187%	7488	9	0.120%
North Carolina	16861	64	0.380%	16852	67	0.398%
North Dakota	1129	1	0.089%	1129	4	0.354%
Ohio	10361	100	0.965%	10292	79	0.768%
Oklahoma	6791	91	1.340%	6768	78	1.152%
Oregon	2718	6	0.221%	2727	9	0.330%
Pennsylvania	15153	183	1.208%	15188	174	1.146%
Rhode Island	586	1	0.171%	585	2	0.342%
South Carolina	8467	5	0.059%	8429	4	0.047%
South Dakota	1797	2	0.111%	1800	5	0.278%
Tennessee	8265	7	0.085%	8276	1	0.012%
Texas	34002	161	0.474%	34176	142	0.415%
Utah	1808	2	0.111%	1812	8	0.442%
Vermont	1087	3	0.276%	1089	0	0.000%
Virginia	11911	48	0.403%	12016	105	0.874%
Washington	3277	4	0.122%	3297	33	1.001%
West Virginia	6890	56	0.813%	6921	47	0.679%
Wisconsin	5200	49	0.942%	5219	64	1.226%
Wyoming	1955	8	0.409%	1960	12	0.612%
Puerto Rico	1619	3	0.185%	1619	3	0.185%
Total	**284774**	**1478**	**0.52%**	**285415**	**1679**	**0.59%**

*Values excluded from analysis.

APPENDIX C. DECOMMISSIONED VERSUS REBUILT BRIDGES

STRUCTURE_KIND_043A

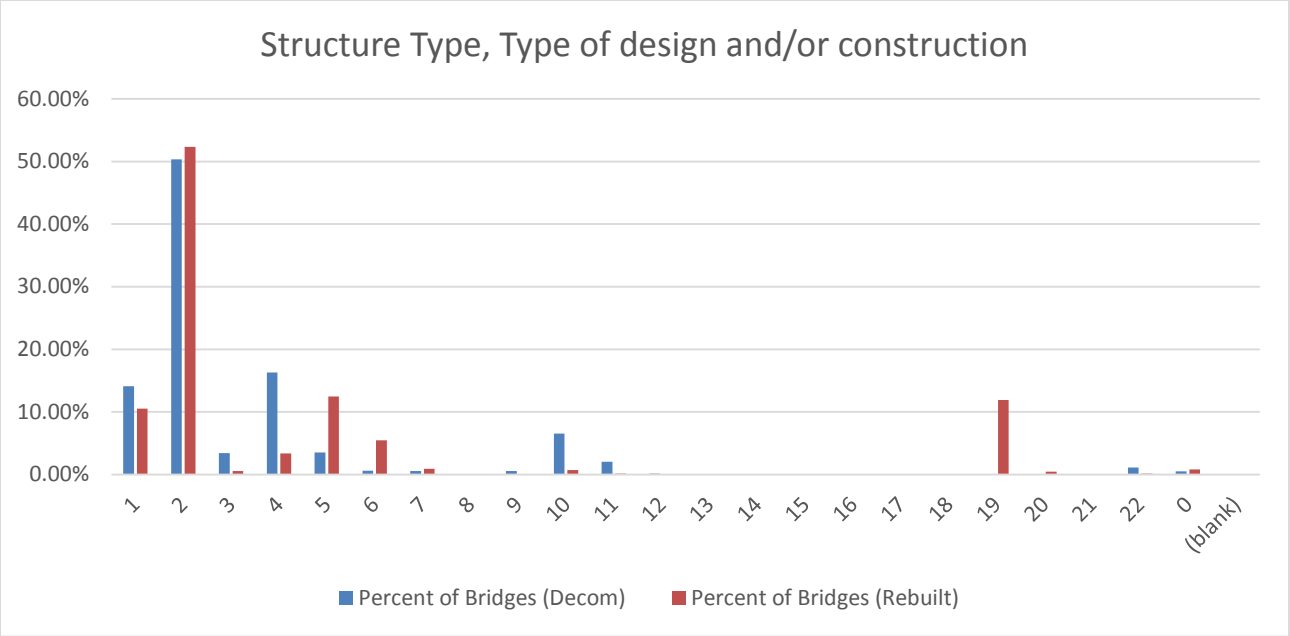
Structure Type, Kind of material and/or design			
Code	**STRUCTURE_KIND_043A**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1	Concrete	2887	1819
2	Concrete continuous	1005	876
3	Steel	3372	743
4	Steel continuous	1360	1122
5	Prestressed concrete	737	3920
6	Prestressed concrete continuous	48	1262
7	Wood or Timber	352	14
8	Masonry	15	2
9	Aluminum, Wrought Iron, or Cast Iron	13	8
0	Other	20	32
	(blank)	1	12
	Total	9810	9810



Structure Type, Kind of material and/or design			
Code	STRUCTURE_KIND_043A	Percent of Bridges (Decom)	Percent of Bridges (Rebuilt)
1	Concrete	29.43%	18.54%
2	Concrete continuous	10.24%	8.93%
3	Steel	34.37%	7.57%
4	Steel continuous	13.86%	11.44%
5	Prestressed concrete	7.51%	39.96%
6	Prestressed concrete continuous	0.49%	12.86%
7	Wood or Timber	3.59%	0.14%
8	Masonry	0.15%	0.02%
9	Aluminum, Wrought Iron, or Cast Iron	0.13%	0.08%
0	Other	0.20%	0.33%
	(blank)	0.01%	0.12%
	Total	100.00%	100.00%

STRUCTURE_TYPE_043B

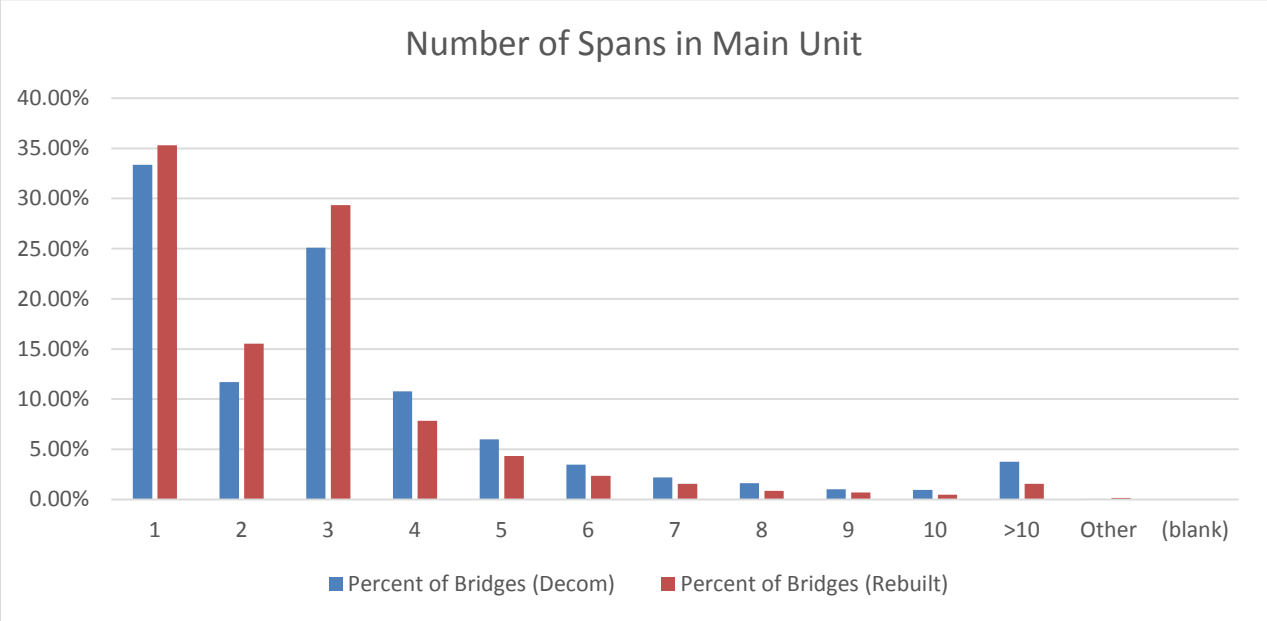
Structure Type, Type of design and/or construction			
Code	STRUCTURE_TYPE_043B	Number of Bridges (Decom)	Number of Bridges (Rebuilt)
1	Slab	1381	1032
2	Stringer/Multi-beam or Girder	4941	5133
3	Girder and Floorbeam System	334	55
4	Tee Beam	1599	328
5	Box Beam or Girders - Multiple	345	1222
6	Box Beam or Girders - Single or Spread	62	538
7	Frame (except frame culverts)	54	89
8	Orthotropic	0	0
9	Truss - Deck	56	2
10	Truss - Thru	639	69
11	Arch - Deck	202	14
12	Arch - Thru	15	2
13	Suspension	3	0
14	Stayed Girder	0	6
15	Movable - Lift	3	1
16	Movable - Bascule	5	1
17	Movable - Swing	6	1
18	Tunnel	0	1
19	Culvert (includes frame culverts)	0	1167
20	Mixed types	4	44
21	Segmental Box Girder	0	6
22	Channel Beam	109	15
0	Other	49	78
	(blank)	3	6
	Total	9810	9810



Structure Type, Type of design and/or construction			
Code	**STRUCTURE_TYPE_043B**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1	Slab	14.08%	10.52%
2	Stringer/Multi-beam or Girder	50.37%	52.32%
3	Girder and Floorbeam System	3.40%	0.56%
4	Tee Beam	16.30%	3.34%
5	Box Beam or Girders - Multiple	3.52%	12.46%
6	Box Beam or Girders - Single or Spread	0.63%	5.48%
7	Frame (except frame culverts)	0.55%	0.91%
8	Orthotropic	0.00%	0.00%
9	Truss - Deck	0.57%	0.02%
10	Truss - Thru	6.51%	0.70%
11	Arch - Deck	2.06%	0.14%
12	Arch - Thru	0.15%	0.02%
13	Suspension	0.03%	0.00%
14	Stayed Girder	0.00%	0.06%
15	Movable - Lift	0.03%	0.01%
16	Movable - Bascule	0.05%	0.01%
17	Movable - Swing	0.06%	0.01%
18	Tunnel	0.00%	0.01%
19	Culvert (includes frame culverts)	0.00%	11.90%
20	Mixed types	0.04%	0.45%
21	Segmental Box Girder	0.00%	0.06%
22	Channel Beam	1.11%	0.15%
0	Other	0.50%	0.80%
(blank)	(blank)	0.03%	0.06%
	Total	100.00%	100.00%

MAIN_UNIT_SPANS_045

Number of Spans in Main Unit		
MAIN_UNIT_SPANS_045	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1	3273	3464
2	1148	1522
3	2463	2879
4	1058	768
5	589	426
6	340	230
7	214	154
8	159	83
9	100	68
10	92	46
>10	369	152
Other	4	16
(blank)	1	2
Total	9810	9810

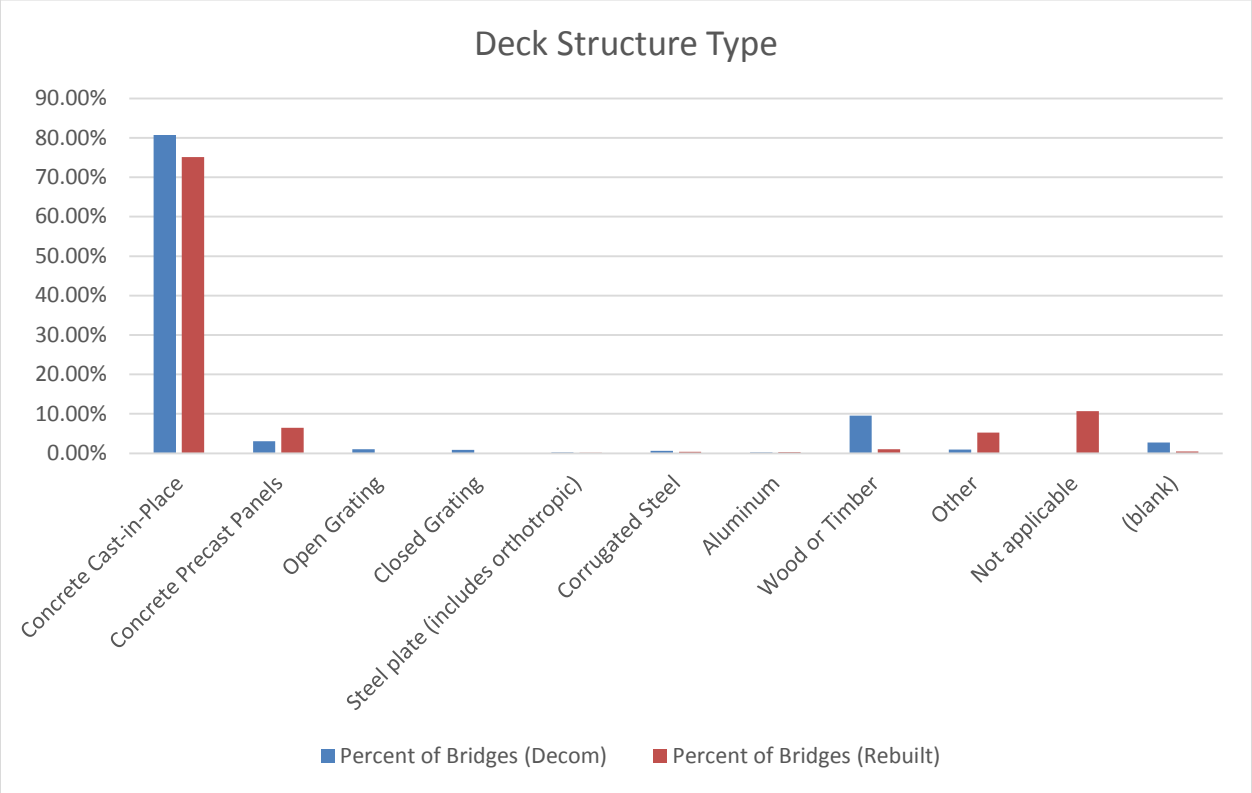


Number of Spans in Main Unit		
MAIN_UNIT_SPANS_045	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1	33.36%	35.31%
2	11.70%	15.51%
3	25.11%	29.35%
4	10.78%	7.83%
5	6.00%	4.34%
6	3.47%	2.34%
7	2.18%	1.57%
8	1.62%	0.85%
9	1.02%	0.69%
10	0.94%	0.47%
>10	3.76%	1.55%
Other	0.04%	0.16%
(blank)	0.01%	0.02%
Total	100.00%	100.00%

DECK_STRUCTURE_TYPE_107

Deck Structure Type			
Code	**STRUCTURE_TYPE_043B**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1	Concrete Cast-in-Place	7916	7372
2	Concrete Precast Panels	296	636
3	Open Grating	103	5
4	Closed Grating	87	4
5	Steel plate (includes orthotropic)	24	16
6	Corrugated Steel	63	40
7	Aluminum	24	25
8	Wood or Timber	937	103
9	Other	94	511
N	Not applicable	0	1050
	(blank)	266	48
	Total	9810	9810

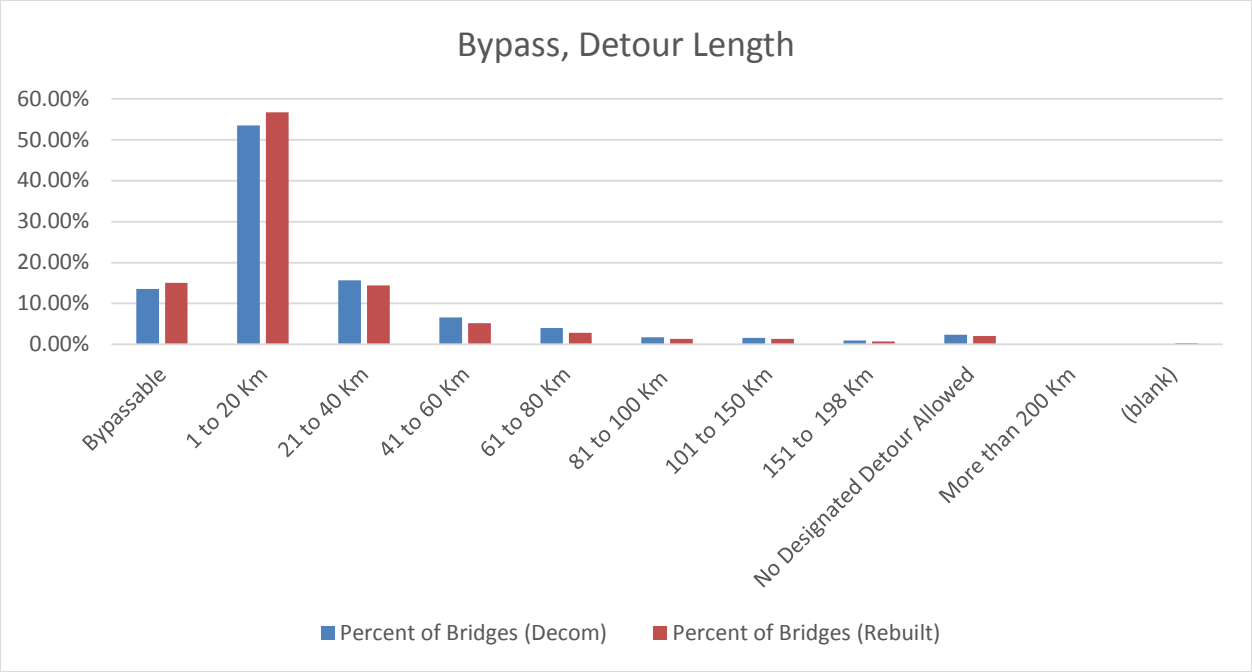
Deck Structure Type			
Code	**STRUCTURE_TYPE_043B**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1	Concrete Cast-in-Place	80.69%	75.15%
2	Concrete Precast Panels	3.02%	6.48%
3	Open Grating	1.05%	0.05%
4	Closed Grating	0.89%	0.04%
5	Steel plate (includes orthotropic)	0.24%	0.16%
6	Corrugated Steel	0.64%	0.41%
7	Aluminum	0.24%	0.25%
8	Wood or Timber	9.55%	1.05%
9	Other	0.96%	5.21%
N	Not applicable	0.00%	10.70%
	(blank)	2.71%	0.49%
	Total	100.00%	100.00%



DETOUR_KILOS_019

Bypass, Detour Length		
DETOUR_KILOS_019	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Bypassable	1327	1474
1 to 20 Km	5252	5564
21 to 40 Km	1540	1417
41 to 60 Km	646	507
61 to 80 Km	391	278
81 to 100 Km	174	131
101 to 150 Km	158	129
151 to 198 Km	91	74
No Designated Detour Allowed	228	200
More than 200 Km	1	5
(blank)	2	31
Total	9810	9810

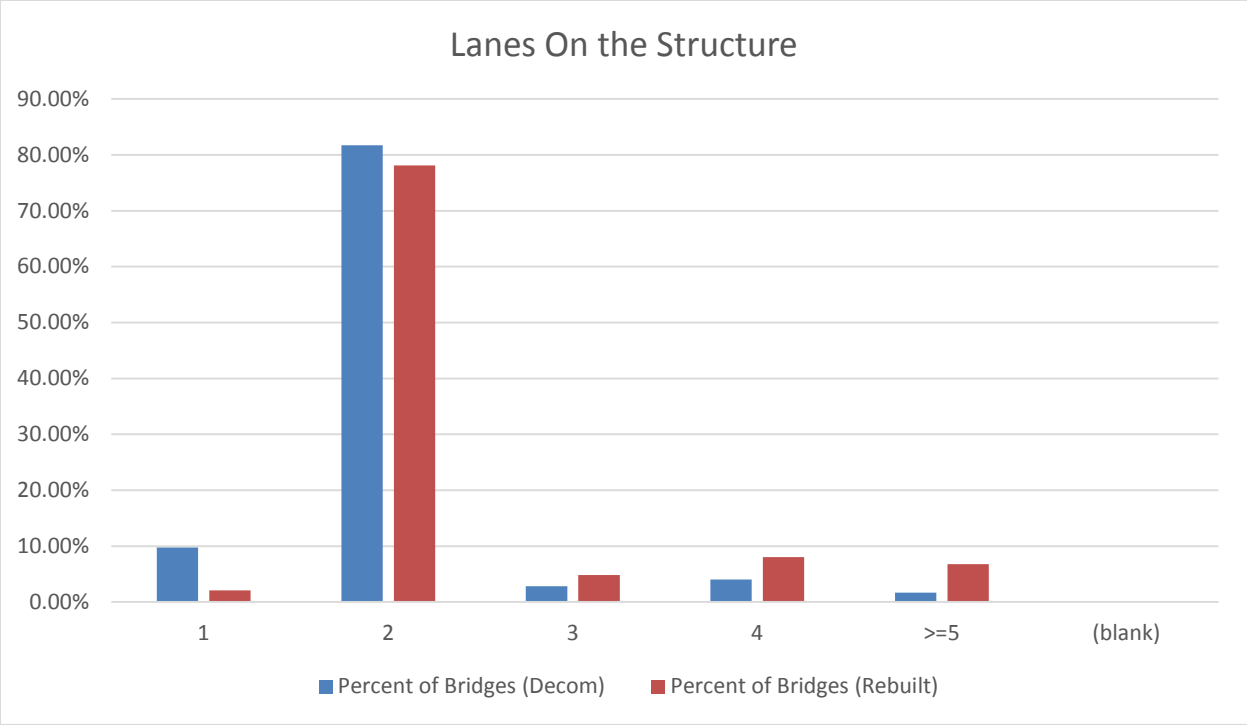
Bypass, Detour Length		
DETOUR_KILOS_019	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
Bypassable	13.53%	15.03%
1 to 20 Km	53.54%	56.72%
21 to 40 Km	15.70%	14.44%
41 to 60 Km	6.59%	5.17%
61 to 80 Km	3.99%	2.83%
81 to 100 Km	1.77%	1.34%
101 to 150 Km	1.61%	1.31%
151 to 198 Km	0.93%	0.75%
No Designated Detour Allowed	2.32%	2.04%
More than 200 Km	0.01%	0.05%
(blank)	0.02%	0.32%
Total	100.00%	100.00%



TRAFFIC_LANES_ON_028A

Lanes On the Structure		
TRAFFIC_LANES_ON_028A	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1	956	206
2	8014	7663
3	277	472
4	396	791
>=5	164	666
(blank)	3	12
Total	9810	9810

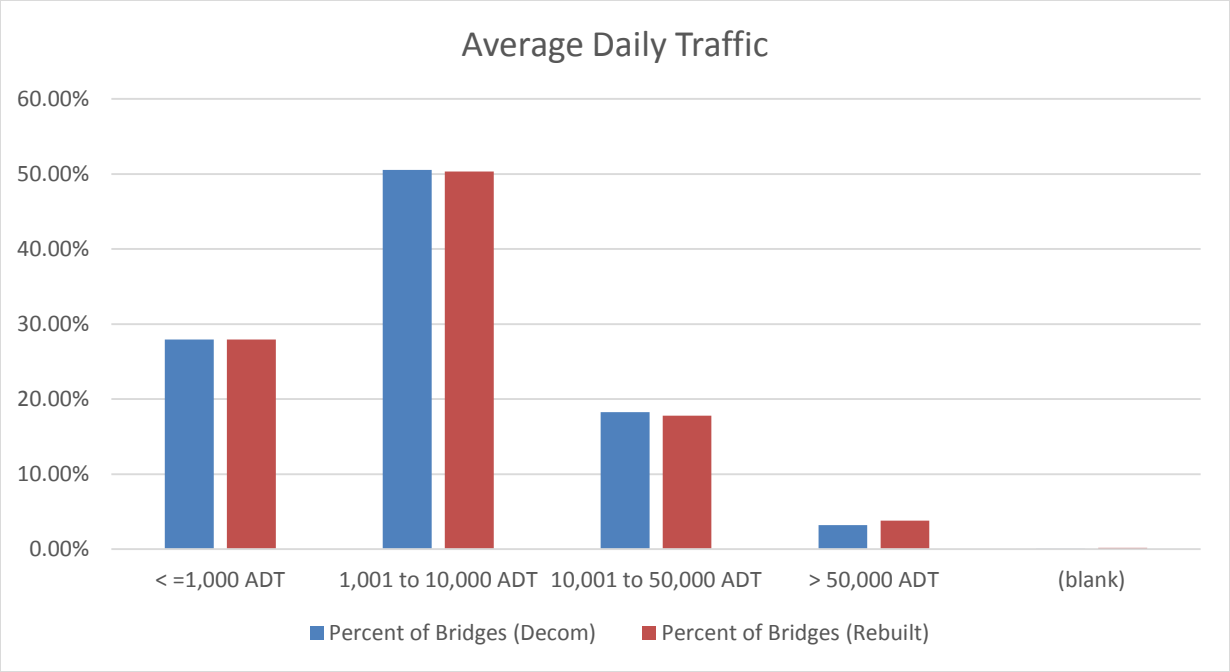
Lanes On the Structure		
TRAFFIC_LANES_ON_028A	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1	9.75%	2.10%
2	81.69%	78.11%
3	2.82%	4.81%
4	4.04%	8.06%
>=5	1.67%	6.79%
(blank)	0.03%	0.12%
Total	100.0%	100.0%



ADT_029

Average Daily Traffic		
ADT_029	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
< =1,000 ADT	2739	2740
1,001 to 10,000 ADT	4959	4937
10,001 to 50,000 ADT	1792	1745
> 50,000 ADT	314	373
(blank)	6	15
Total	9810	9810

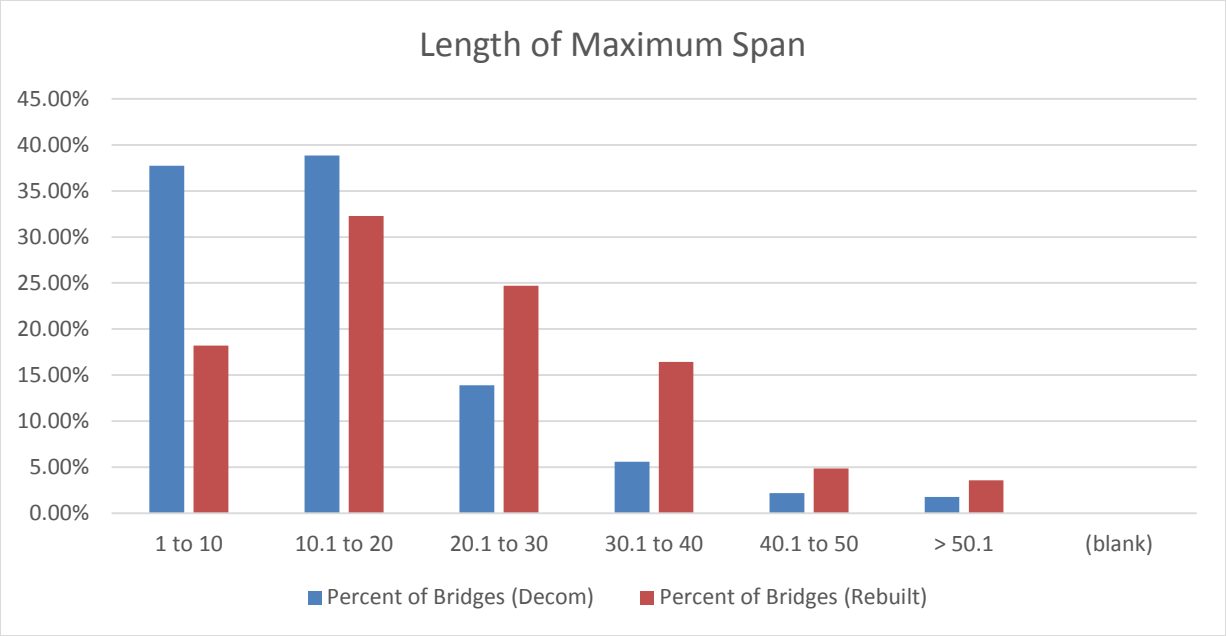
Average Daily Traffic		
ADT_029	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
< =1,000 ADT	27.92%	27.93%
1,001 to 10,000 ADT	50.55%	50.33%
10,001 to 50,000 ADT	18.27%	17.79%
> 50,000 ADT	3.20%	3.80%
(blank)	0.06%	0.15%
Total	100.00%	100.00%



MAX_SPAN_LEN_MT_048

Length of Maximum Span		
MAX_SPAN_LEN_MT_048	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1 to 10	3702	1784
10.1 to 20	3811	3166
20.1 to 30	1363	2424
30.1 to 40	547	1610
40.1 to 50	213	475
> 50.1	172	349
(blank)	2	2
Total	9810	9810

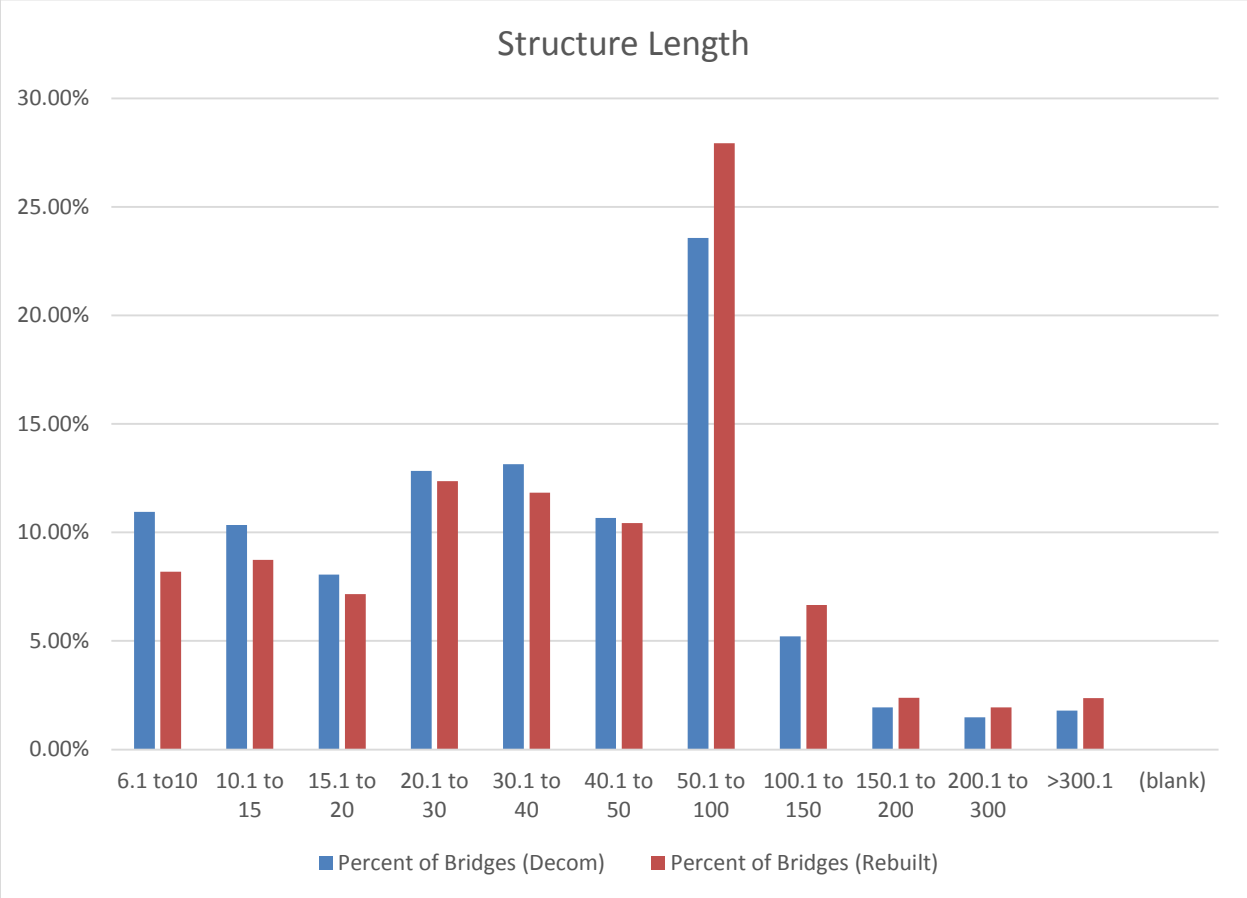
Length of Maximum Span		
MAX_SPAN_LEN_MT_048	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1 to 10	37.74%	18.19%
10.1 to 20	38.85%	32.27%
20.1 to 30	13.89%	24.71%
30.1 to 40	5.58%	16.41%
40.1 to 50	2.17%	4.84%
> 50.1	1.75%	3.56%
(blank)	0.02%	0.02%
Total	100.00%	100.00%



STRUCTURE_LEN_MT_049

Structure Length		
STRUCTURE_LEN_MT_049	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
6.1 to10	1074	804
10.1 to 15	1015	857
15.1 to 20	790	702
20.1 to 30	1259	1213
30.1 to 40	1289	1161
40.1 to 50	1046	1023
50.1 to 100	2312	2741
100.1 to 150	512	653
150.1 to 200	190	234
200.1 to 300	145	190
>300.1	176	232
(blank)	2	2
Total	9810	9812

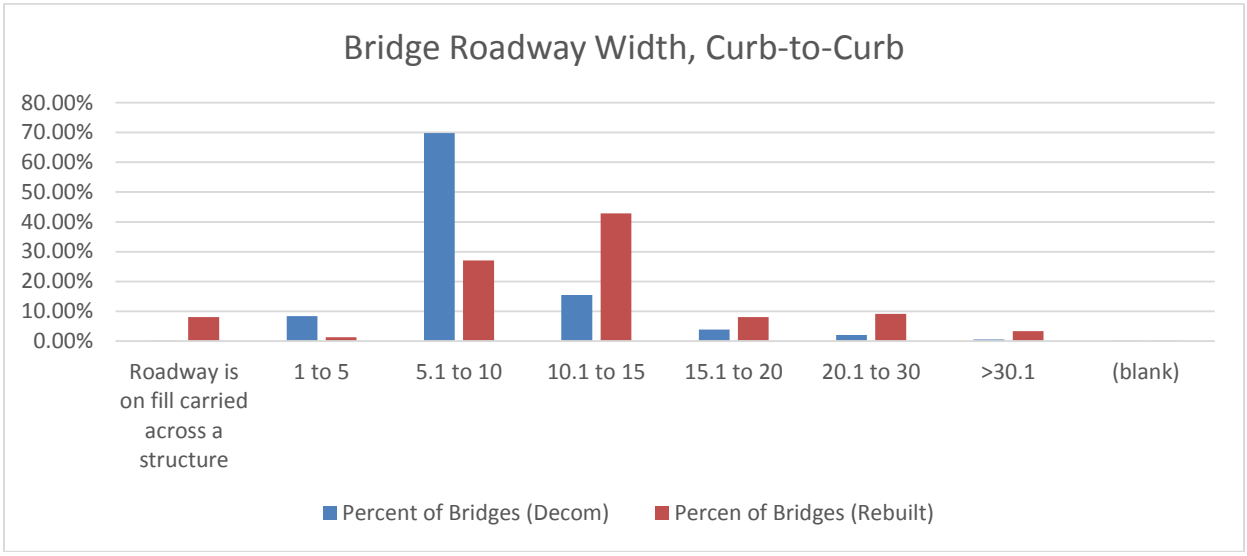
Structure Length		
STRUCTURE_LEN_MT_049	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
6.1 to10	10.95%	8.19%
10.1 to 15	10.35%	8.73%
15.1 to 20	8.05%	7.15%
20.1 to 30	12.83%	12.36%
30.1 to 40	13.14%	11.83%
40.1 to 50	10.66%	10.43%
50.1 to 100	23.57%	27.94%
100.1 to 150	5.22%	6.66%
150.1 to 200	1.94%	2.38%
200.1 to 300	1.48%	1.94%
>300.1	1.79%	2.36%
(blank)	0.02%	0.02%
Total	100.00%	100.00%



ROADWAY_WIDTH_MT_051

Bridge Roadway Width, Curb-to-Curb		
ROADWAY_WIDTH_MT_051	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Roadway is on fill carried across a structure	7	791
1 to 5	817	123
5.1 to 10	6844	2658
10.1 to 15	1520	4207
15.1 to 20	374	792
20.1 to 30	198	900
>30.1	48	328
(blank)	2	11
Total	9810	9810

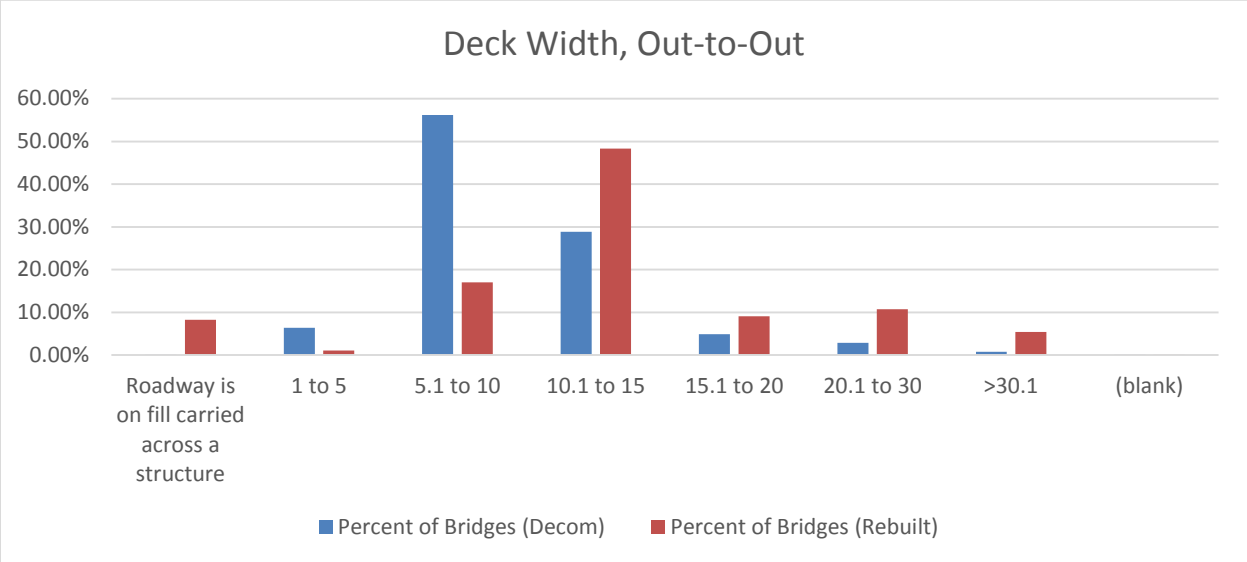
Bridge Roadway Width, Curb-to-Curb		
ROADWAY_WIDTH_MT_051	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
Roadway is on fill carried across a structure	0.07%	8.06%
1 to 5	8.33%	1.25%
5.1 to 10	69.77%	27.09%
10.1 to 15	15.49%	42.88%
15.1 to 20	3.81%	8.07%
20.1 to 30	2.02%	9.17%
>30.1	0.49%	3.34%
(blank)	0.02%	0.11%
Total	100.00%	100.00%



DECK_WIDTH_MT_052

Deck Width, Out-to-Out		
DECK_WIDTH_MT_052	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Roadway is on fill carried across a structure	7	812
1 to 5	626	104
5.1 to 10	5512	1671
10.1 to 15	2829	4740
15.1 to 20	479	890
20.1 to 30	281	1054
>30.1	74	532
(blank)	2	7
Total	9810	9810

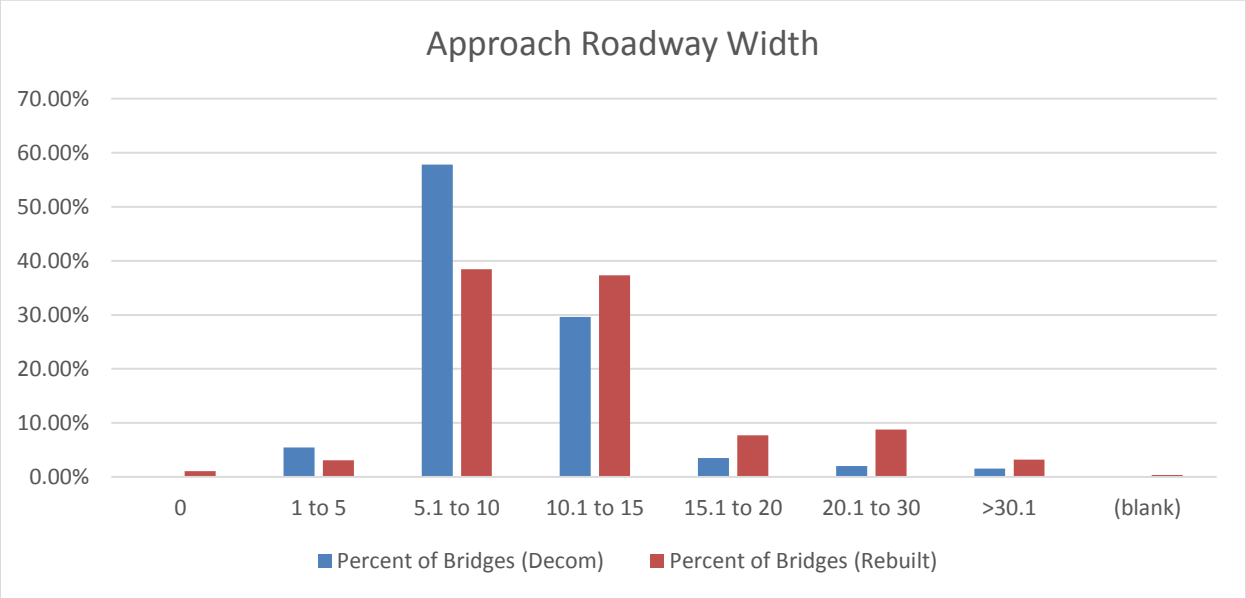
Deck Width, Out-to-Out		
DECK_WIDTH_MT_052	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
Roadway is on fill carried across a structure	0.07%	8.28%
1 to 5	6.38%	1.06%
5.1 to 10	56.19%	17.03%
10.1 to 15	28.84%	48.32%
15.1 to 20	4.88%	9.07%
20.1 to 30	2.86%	10.74%
>30.1	0.75%	5.42%
(blank)	0.02%	0.07%
Total	100.00%	100.00%



APPR_WIDTH_MT_032

Approach Roadway Width		
APPR_WIDTH_MT_032	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	1	107
1 to 5	537	301
5.1 to 10	5668	3770
10.1 to 15	2905	3662
15.1 to 20	346	757
20.1 to 30	197	860
>30.1	153	315
(blank)	3	38
Total	9810	9810

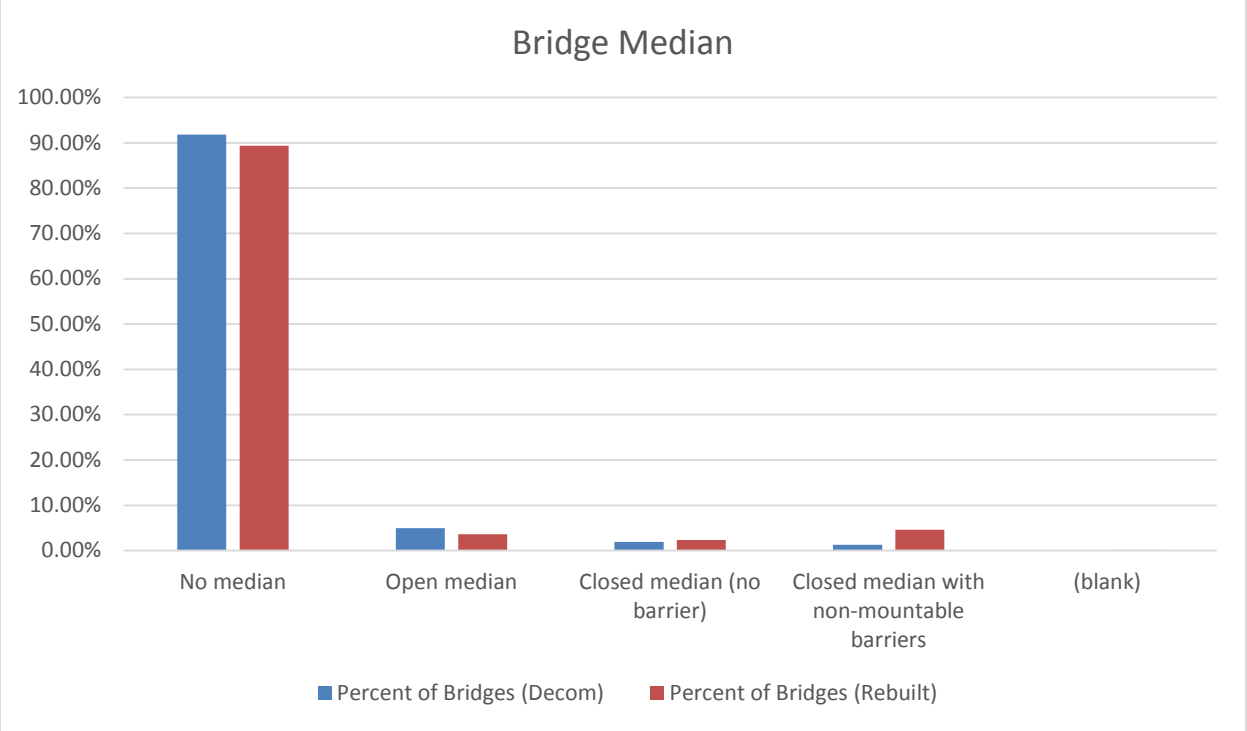
Approach Roadway Width		
APPR_WIDTH_MT_032	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
0	0.01%	1.09%
1 to 5	5.47%	3.07%
5.1 to 10	57.78%	38.43%
10.1 to 15	29.61%	37.33%
15.1 to 20	3.53%	7.72%
20.1 to 30	2.01%	8.77%
>30.1	1.56%	3.21%
(blank)	0.03%	0.39%
Total	100.00%	100.00%



MEDIAN_CODE_033

Bridge Median			
Code	MEDIAN_CODE_033	Number of Bridges (Decom)	Number of Bridges (Rebuilt)
0	No median	9006	8766
1	Open median	488	352
2	Closed median (no barrier)	188	231
3	Closed median with non-mountable barriers	127	449
	(blank)	1	12
	Total	9810	9810

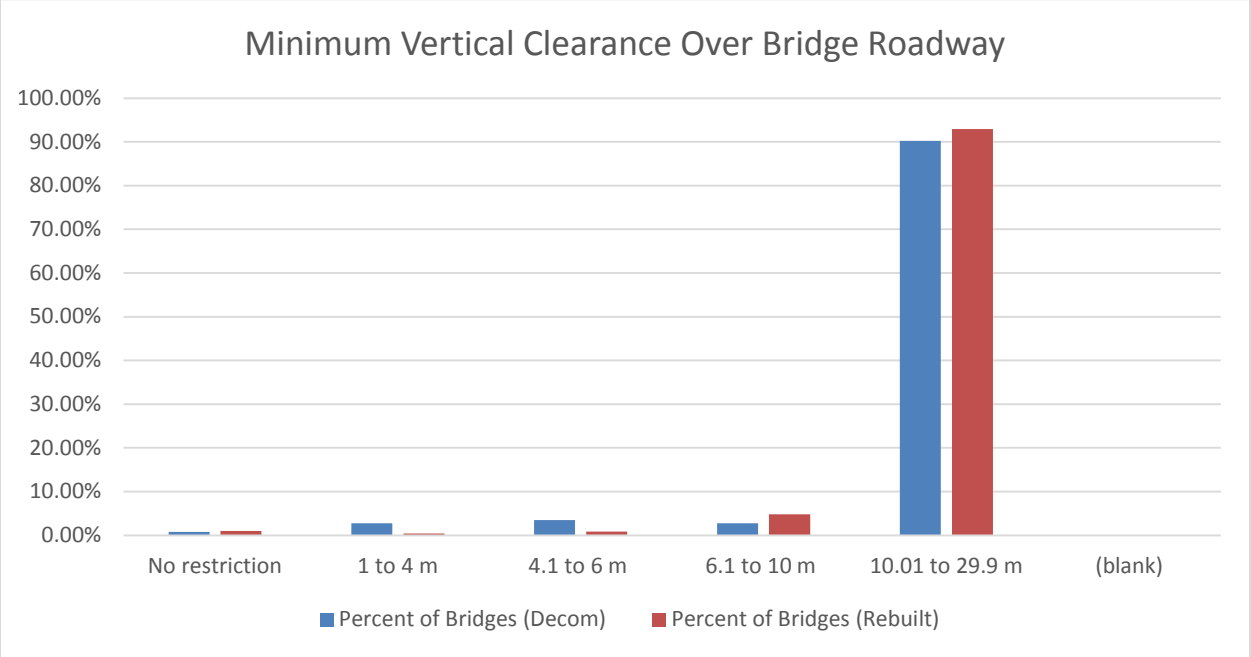
Bridge Median			
Code	MEDIAN_CODE_033	Percent of Bridges (Decom)	Percent of Bridges (Rebuilt)
0	No median	91.80%	89.36%
1	Open median	4.97%	3.59%
2	Closed median (no barrier)	1.92%	2.35%
3	Closed median with non-mountable barriers	1.29%	4.58%
	(blank)	0.01%	0.12%
	Total	100.00%	100.00%



VERT_CLR_OVER_MT_053

Minimum Vertical Clearance Over Bridge Roadway		
VERT_CLR_OVER_MT_053	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
No restriction	73	96
1 to 4 m	274	38
4.1 to 6 m	343	81
6.1 to 10 m	272	475
10.01 to 29.9 m	8848	9116
(blank)	0	4
Total	9810	9810

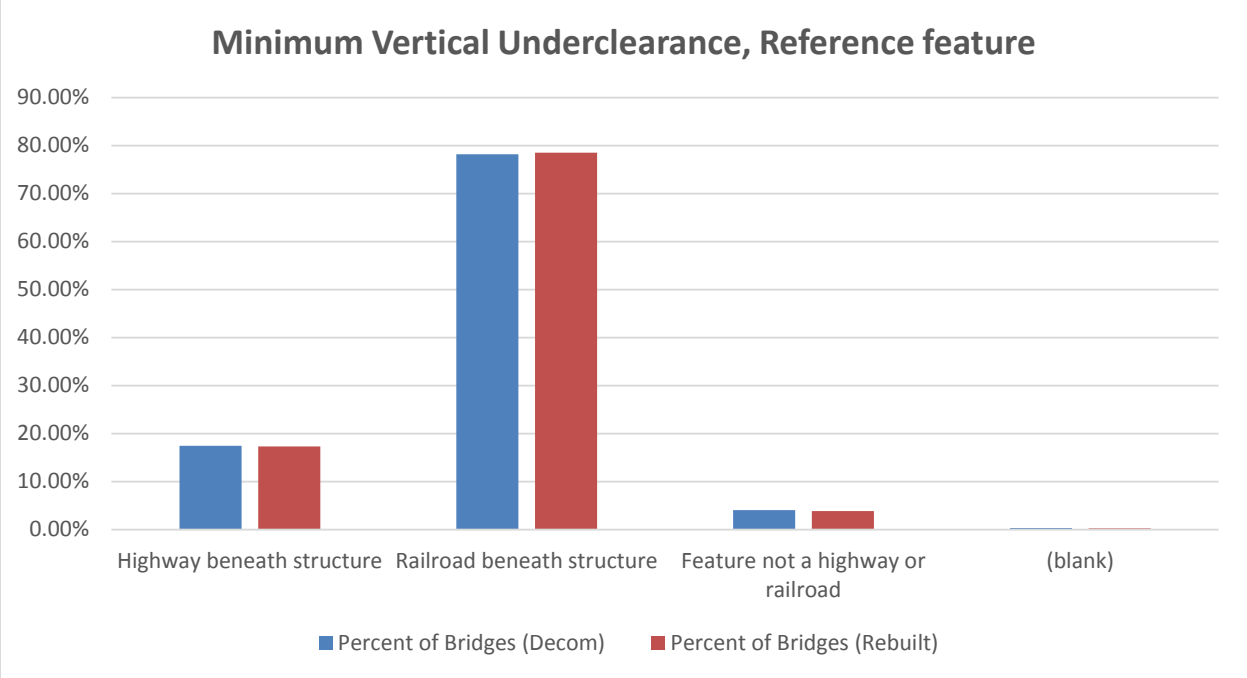
Minimum Vertical Clearance Over Bridge Roadway		
VERT_CLR_OVER_MT_053	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
No restriction	0.74%	0.98%
1 to 4 m	2.79%	0.39%
4.1 to 6 m	3.50%	0.83%
6.1 to 10 m	2.77%	4.84%
10.01 to 29.9 m	90.19%	92.93%
(blank)	0.00%	0.04%
Total	100.00%	100.00%



VERT_CLR_UND_REF_054A

Minimum Vertical Underclearance, Reference feature			
Code	**MEDIAN_CODE_033**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
H	Highway beneath structure	1713	1703
R	Railroad beneath structure	7668	7702
N	Feature not a highway or railroad	397	379
	(blank)	32	26
	Total	9810	9810

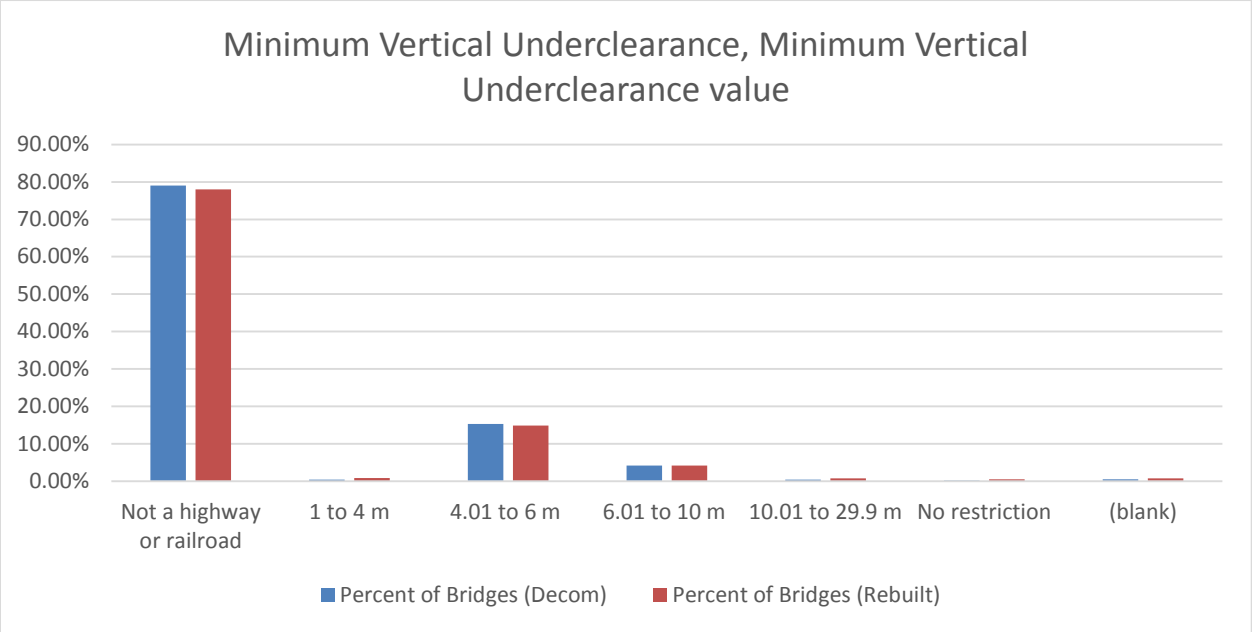
Minimum Vertical Underclearance, Reference feature			
Code	**MEDIAN_CODE_033**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
H	Highway beneath structure	17.46%	17.36%
R	Railroad beneath structure	78.17%	78.51%
N	Feature not a highway or railroad	4.05%	3.86%
	(blank)	0.33%	0.27%
	Total	100.00%	100.00%



VERT_CLR_UND_054B

Minimum Vertical Underclearance, Minimum Vertical Underclearance value		
VERT_CLR_UND_054B	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Not a highway or railroad	7754	7651
1 to 4 m	41	84
4.01 to 6 m	1501	1459
6.01 to 10 m	409	414
10.01 to 29.9 m	41	77
No restriction	12	52
(blank)	52	73
Total	9810	9810

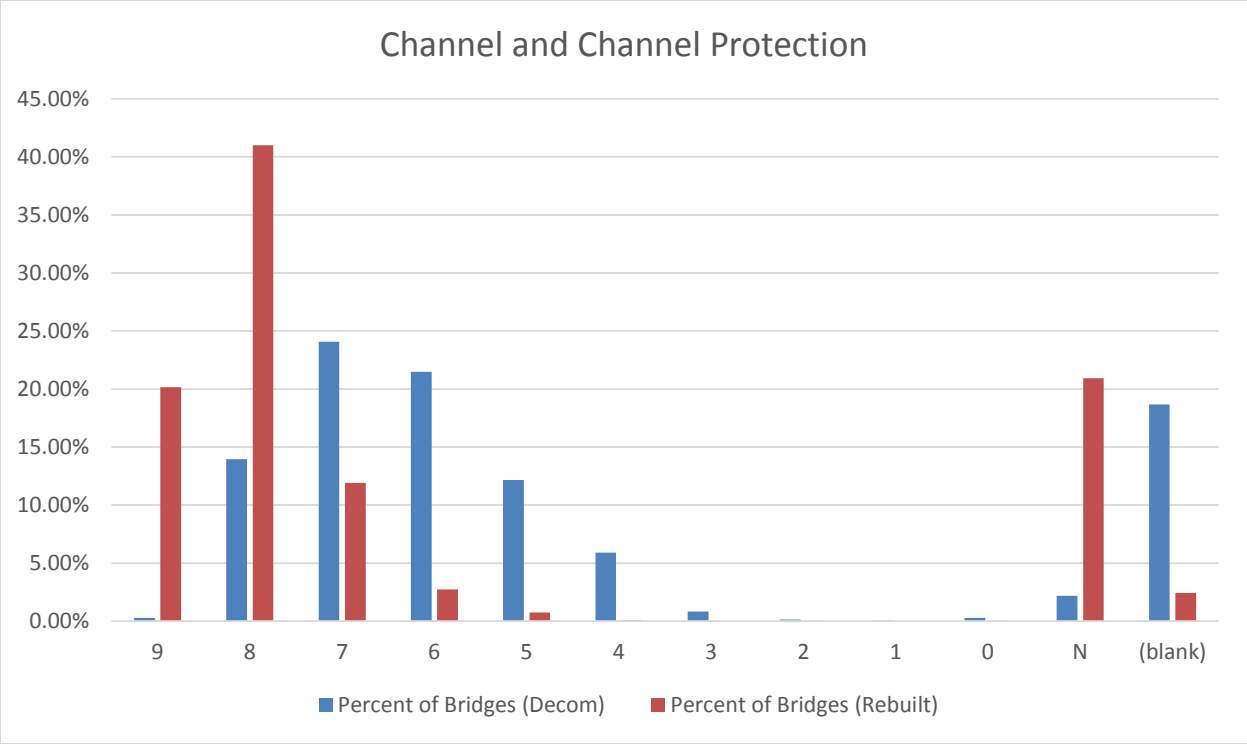
Minimum Vertical Underclearance, Minimum Vertical Underclearance value		
VERT_CLR_UND_054B	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
Not a highway or railroad	79.04%	77.99%
1 to 4 m	0.42%	0.86%
4.01 to 6 m	15.30%	14.87%
6.01 to 10 m	4.17%	4.22%
10.01 to 29.9 m	0.42%	0.78%
No restriction	0.12%	0.53%
(blank)	0.53%	0.74%
Total	100.00%	100.00%



CHANNEL_COND_061

Channel and Channel Protection			
Code	**CHANNEL_COND_061**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
9	There are no noticeable or noteworthy deficiencies which affect the condition of the channel.	27	1978
8	Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.	1368	4022
7	Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift.	2362	1170
6	Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor stream bed movement evident. Debris is restricting the channel slightly.	2108	267
5	Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.	1194	73
4	Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.	580	8
3	Bank protection has failed. River control devices have been destroyed. Stream bed aggradation, degradation or lateral movement has changed the channel to now threaten the bridge and/or approach roadway.	81	0
2	The channel has changed to the extent the bridge is near a state of collapse.	13	1
1	Bridge closed because of channel failure. Corrective action may put back in light service.	6	0
0	Bridge closed because of channel failure. Replacement necessary.	26	2
N	Not applicable. Use when bridge is not over a waterway (channel).	213	2052
	(blank)	1832	237
	Total	9810	9810

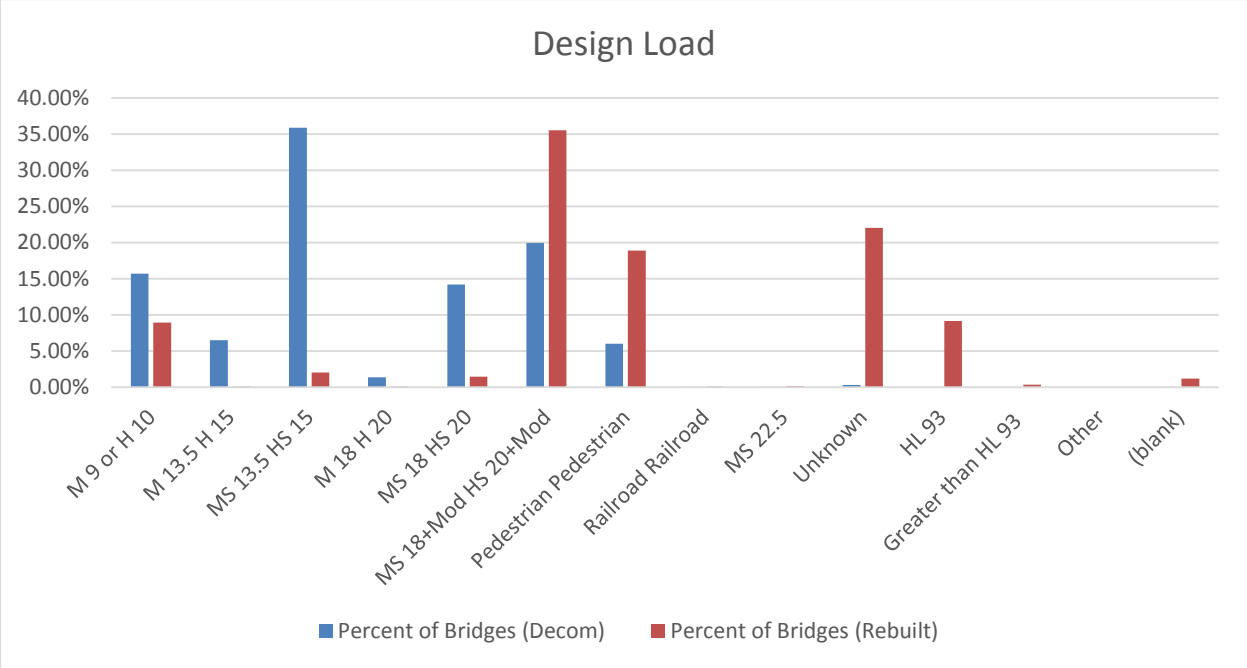
Channel and Channel Protection			
Code	**CHANNEL_COND_061**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
9	There are no noticeable or noteworthy deficiencies which affect the condition of the channel.	0.28%	20.16%
8	Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.	13.94%	41.00%
7	Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift.	24.08%	11.93%
6	Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor stream bed movement evident. Debris is restricting the channel slightly.	21.49%	2.72%
5	Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.	12.17%	0.74%
4	Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.	5.91%	0.08%
3	Bank protection has failed. River control devices have been destroyed. Stream bed aggradation, degradation or lateral movement has changed the channel to now threaten the bridge and/or approach roadway.	0.83%	0.00%
2	The channel has changed to the extent the bridge is near a state of collapse.	0.13%	0.01%
1	Bridge closed because of channel failure. Corrective action may put back in light service.	0.06%	0.00%
0	Bridge closed because of channel failure. Replacement necessary.	0.27%	0.02%
N	Not applicable. Use when bridge is not over a waterway (channel).	2.17%	20.92%
	(blank)	18.67%	2.42%
	Total	100.00%	100.00%



DESIGN_LOAD_031

Design Load			
Code	**DESIGN_LOAD_031**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
1	M 9 or H 10	1540	876
2	M 13.5 H 15	637	10
3	MS 13.5 HS 15	3521	200
4	M 18 H 20	135	7
5	MS 18 HS 20	1392	142
6	MS 18+Mod HS 20+Mod	1957	3486
7	Pedestrian Pedestrian	590	1852
8	Railroad Railroad	2	9
9	MS 22.5	4	14
0	Unknown	28	2162
A	HL 93	N/A	899
B	Greater than HL 93	N/A	36
C	Other	N/A	0
	(blank)	4	117
	Total	9810	9810

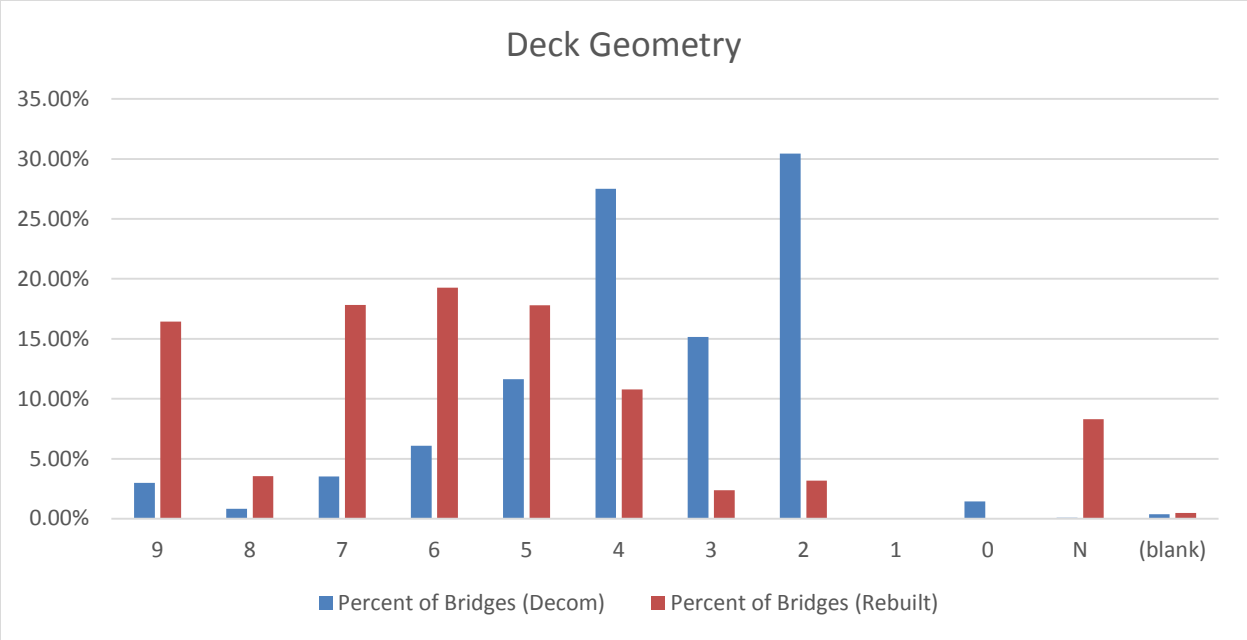
Design Load			
Code	**DESIGN_LOAD_031**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
1	M 9 or H 10	15.70%	8.93%
2	M 13.5 H 15	6.49%	0.10%
3	MS 13.5 HS 15	35.89%	2.04%
4	M 18 H 20	1.38%	0.07%
5	MS 18 HS 20	14.19%	1.45%
6	MS 18+Mod HS 20+Mod	19.95%	35.54%
7	Pedestrian Pedestrian	6.01%	18.88%
8	Railroad Railroad	0.02%	0.09%
9	MS 22.5	0.04%	0.14%
0	Unknown	0.29%	22.04%
A	HL 93	N/A	9.16%
B	Greater than HL 93	N/A	0.37%
C	Other	N/A	0.00%
	(blank)	0.04%	1.19%
	Total	100.00%	100.00%



DECK_GEOMETRY_EVAL_068

Deck Geometry			
Code	DECK_GEOMETRY_EVAL_068	Number of Bridges (Decom)	Number of Bridges (Rebuilt)
9	Superior to present desirable criteria	292	1612
8	Equal to present desirable criteria	80	348
7	Better than present minimum criteria	345	1749
6	Equal to present minimum criteria	596	1889
5	Somewhat better than minimum adequacy to tolerate being left in place as is	1141	1747
4	Meets minimum tolerable limits to be left in place as is	2699	1057
3	Basically intolerable requiring high priority of corrective action	1487	234
2	Basically intolerable requiring high priority of replacement	2986	312
1	This value of rating code not used	0	0
0	Bridge closed	141	1
N	Not applicable	7	815
	(blank)	36	46
	Total	9810	9810

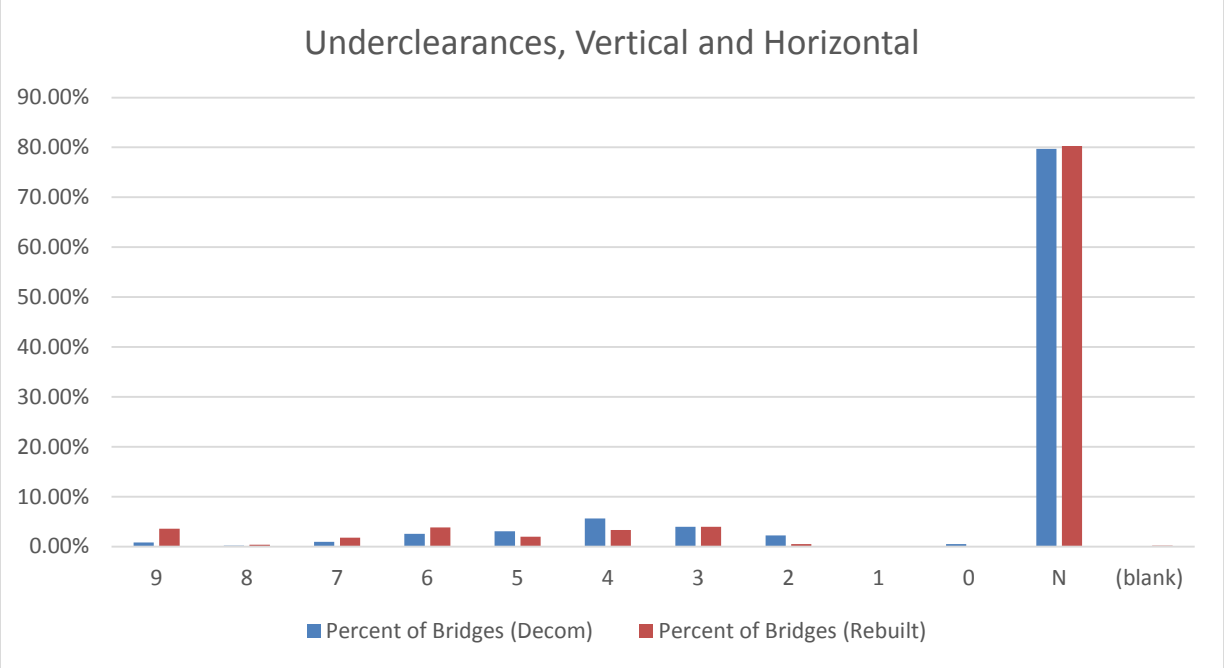
Deck Geometry			
Code	DECK_GEOMETRY_EVAL_068	Percent of Bridges (Decom)	Percent of Bridges (Rebuilt)
9	Superior to present desirable criteria	2.98%	16.43%
8	Equal to present desirable criteria	0.82%	3.55%
7	Better than present minimum criteria	3.52%	17.83%
6	Equal to present minimum criteria	6.08%	19.26%
5	Somewhat better than minimum adequacy to tolerate being left in place as is	11.63%	17.81%
4	Meets minimum tolerable limits to be left in place as is	27.51%	10.77%
3	Basically intolerable requiring high priority of corrective action	15.16%	2.39%
2	Basically intolerable requiring high priority of replacement	30.44%	3.18%
1	This value of rating code not used	0.00%	0.00%
0	Bridge closed	1.44%	0.01%
N	Not applicable	0.07%	8.31%
	(blank)	0.37%	0.47%
	Total	100.00%	100.00%



UNDCLRENCE_EVAL_069

Underclearances, Vertical and Horizontal			
Code	**UNDCLRENCE_EVAL_069**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
9	Superior to present desirable criteria	83	355
8	Equal to present desirable criteria	19	41
7	Better than present minimum criteria	98	174
6	Equal to present minimum criteria	254	377
5	Somewhat better than minimum adequacy to tolerate being left in place as is	302	193
4	Meets minimum tolerable limits to be left in place as is	554	325
3	Basically intolerable requiring high priority of corrective action	394	393
2	Basically intolerable requiring high priority of replacement	219	52
1	This value of rating code not used	0	0
0	Bridge closed	53	0
N	Not applicable	7821	7879
	(blank)	13	21
	Total	9810	9810

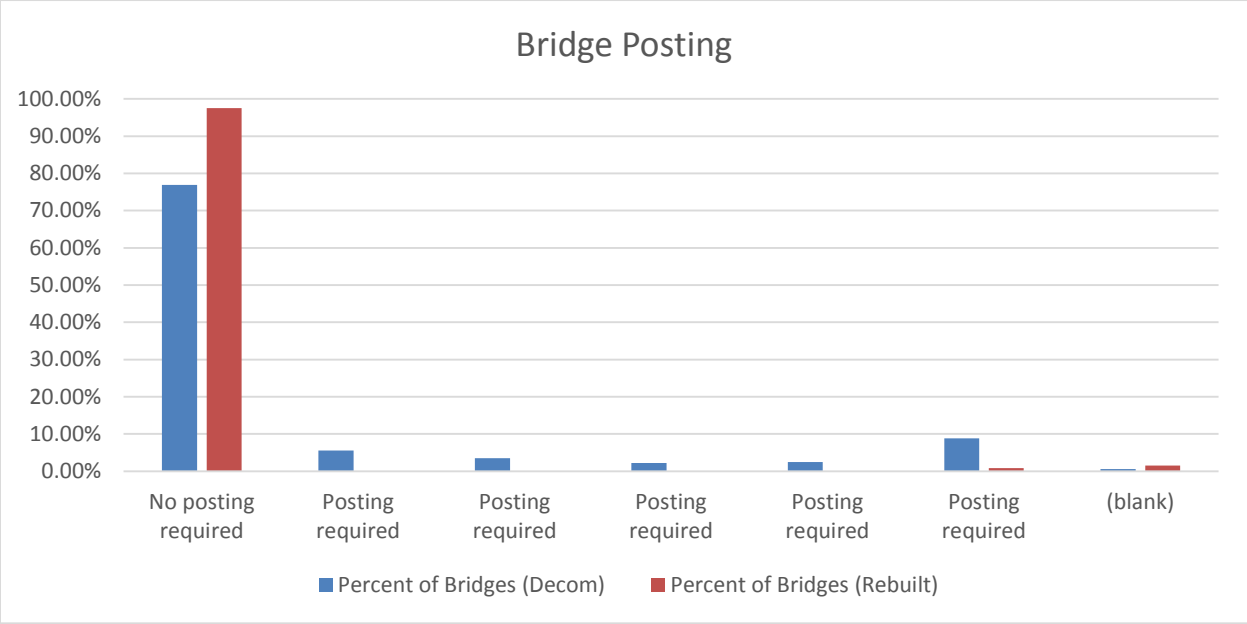
Underclearances, Vertical and Horizontal			
Code	**UNDCLRENCE_EVAL_069**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
9	Superior to present desirable criteria	0.85%	3.62%
8	Equal to present desirable criteria	0.19%	0.42%
7	Better than present minimum criteria	1.00%	1.77%
6	Equal to present minimum criteria	2.59%	3.84%
5	Somewhat better than minimum adequacy to tolerate being left in place as is	3.08%	1.97%
4	Meets minimum tolerable limits to be left in place as is	5.65%	3.31%
3	Basically intolerable requiring high priority of corrective action	4.02%	4.01%
2	Basically intolerable requiring high priority of replacement	2.23%	0.53%
1	This value of rating code not used	0.00%	0.00%
0	Bridge closed	0.54%	0.00%
N	Not applicable	79.72%	80.32%
	(blank)	0.13%	0.21%
	Total	100.00%	100.00%



POSTING_EVAL_070

Bridge Posting			
Code	**POSTING_EVAL_070**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
5	No posting required	7546	9565
4	Posting required	542	7
3	Posting required	342	3
2	Posting required	215	0
1	Posting required	241	4
0	Posting required	867	85
	(blank)	57	146
	Total	9810	9810

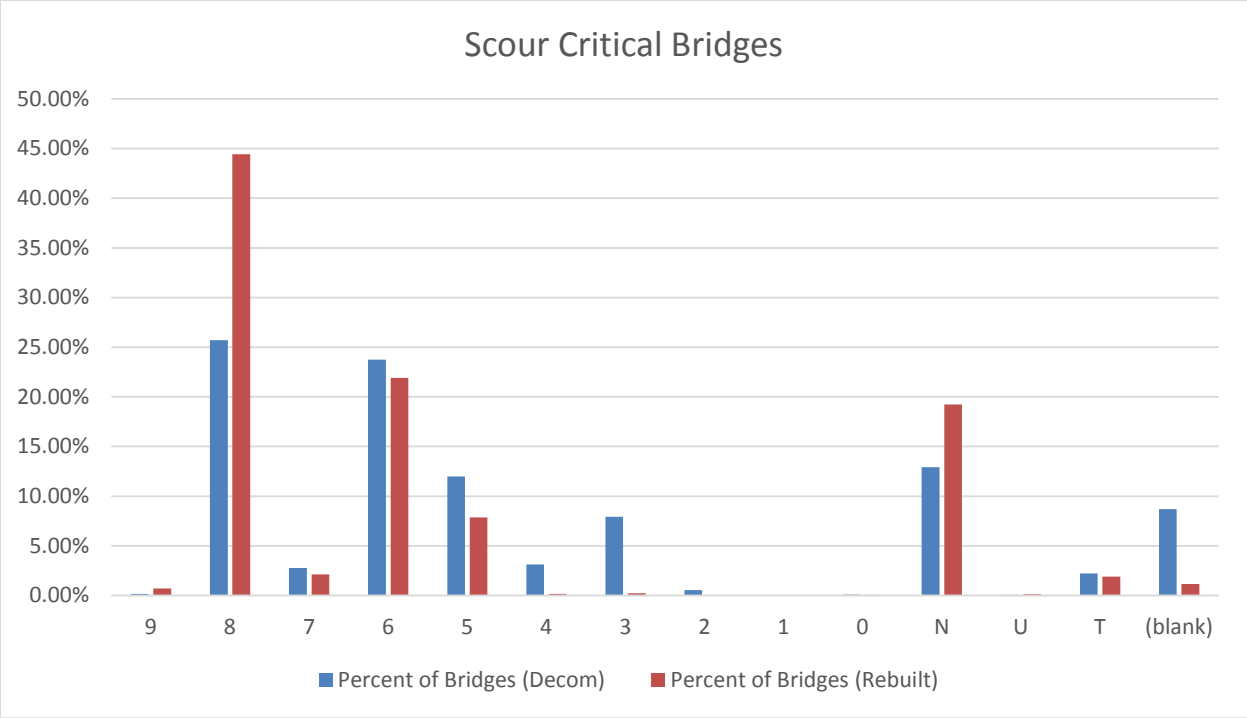
Bridge Posting			
Code	**POSTING_EVAL_070**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
5	No posting required	76.92%	97.50%
4	Posting required	5.52%	0.07%
3	Posting required	3.49%	0.03%
2	Posting required	2.19%	0.00%
1	Posting required	2.46%	0.04%
0	Posting required	8.84%	0.87%
	(blank)	0.58%	1.49%
	Total	100.00%	100.00%



SCOUR_CRITICAL_113

Scour Critical Bridges			
Code	**SCOUR_CRITICAL_113**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
9	Bridge foundations (including piles) on dry land well above flood water elevations.	16	70
8	Bridge foundations determined to be stable for assessed or calculated scour conditions; calculated scour is above top of footing.	2522	4357
7	Countermeasures have been installed to correct a previously existing problem with scour. Bridge is no longer scour critical.	271	209
6	Scour calculation/evaluation has not been made.	2331	2150
5	Bridge foundations determined to be stable for calculated scour conditions; scour within limits of footing or piles.	1176	772
4	Bridge foundations determined to be stable for calculated scour conditions; field review indicates action is required to protect exposed foundations from effects of additional erosion and corrosion.	306	16
3	Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions	777	22
2	Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations. Immediate action is required to provide scour countermeasures.	53	1
1	Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.	3	2
0	Bridge is scour critical. Bridge has failed and is closed to traffic	10	8
N	Bridge not over waterway	1267	1888
U	Bridge with "unknown" foundation that has not been evaluated for scour. Since risk cannot be determined, flag for monitoring during flood events and, if appropriate, closure.	7	13
T	Bridge over "tidal" waters that has not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections.	219	188
	(blank)	852	114
	Total	9810	9810

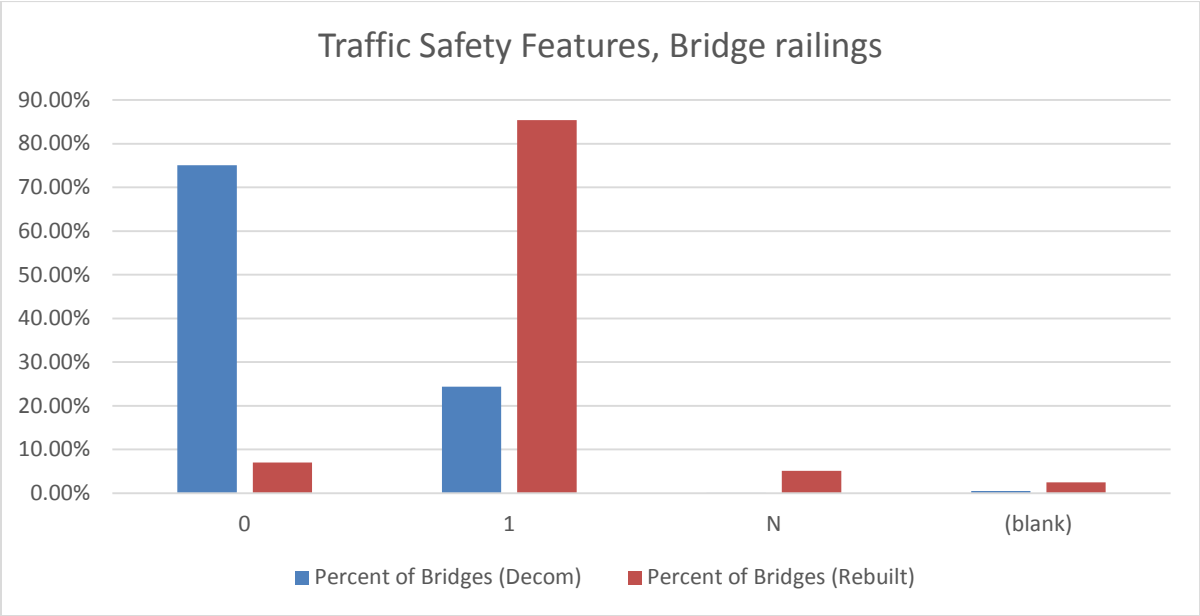
Scour Critical Bridges			
Code	**SCOUR_CRITICAL_113**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
9	Bridge foundations (including piles) on dry land well above flood water elevations.	0.16%	0.71%
8	Bridge foundations determined to be stable for assessed or calculated scour conditions; calculated scour is above top of footing.	25.71%	44.41%
7	Countermeasures have been installed to correct a previously existing problem with scour. Bridge is no longer scour critical.	2.76%	2.13%
6	Scour calculation/evaluation has not been made.	23.76%	21.92%
5	Bridge foundations determined to be stable for calculated scour conditions; scour within limits of footing or piles.	11.99%	7.87%
4	Bridge foundations determined to be stable for calculated scour conditions; field review indicates action is required to protect exposed foundations from effects of additional erosion and corrosion.	3.12%	0.16%
3	Bridge is scour critical; bridge foundations determined to be unstable for calculated scour conditions	7.92%	0.22%
2	Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations. Immediate action is required to provide scour countermeasures.	0.54%	0.01%
1	Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic.	0.03%	0.02%
0	Bridge is scour critical. Bridge has failed and is closed to traffic	0.10%	0.08%
N	Bridge not over waterway	12.92%	19.25%
U	Bridge with "unknown" foundation that has not been evaluated for scour. Since risk cannot be determined, flag for monitoring during flood events and, if appropriate, closure.	0.07%	0.13%
T	Bridge over "tidal" waters that has not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections.	2.23%	1.92%
	(blank)	8.69%	1.16%
	Total	100.00%	100.00%



RAILINGS_036A

Traffic Safety Features, Bridge railings			
Code	**RAILINGS_036A**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	7365	689
1	Inspected feature meets currently acceptable standards.	2392	8376
N	Not applicable or a safety feature is not required.	4	499
	(blank)	49	246
	Total	9810	9810

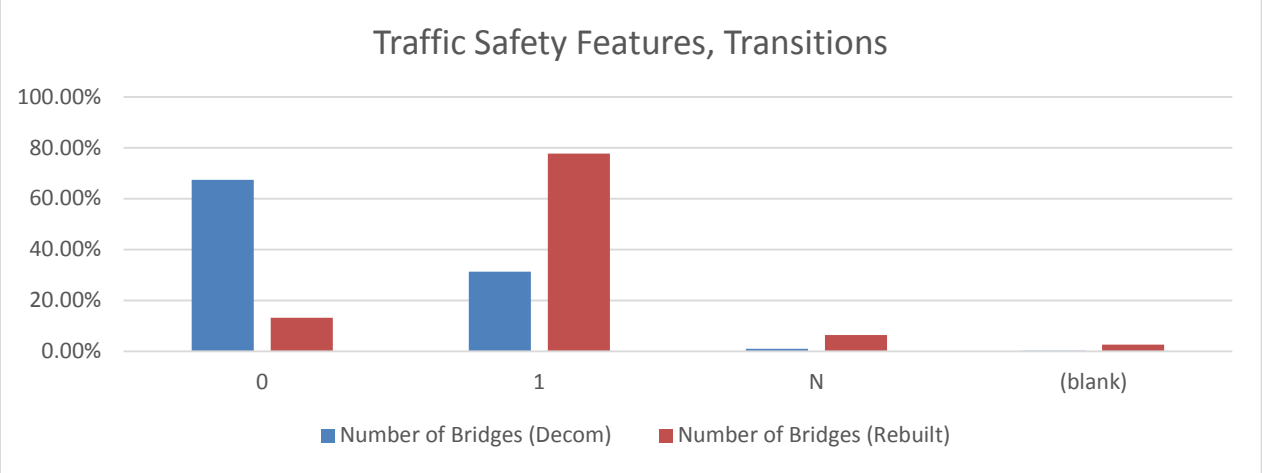
Traffic Safety Features, Bridge railings			
Code	**RAILINGS_036A**	**Percent of Bridges (Decom)**	**Percent of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	75.08%	7.02%
1	Inspected feature meets currently acceptable standards.	24.38%	85.38%
N	Not applicable or a safety feature is not required.	0.04%	5.09%
	(blank)	0.50%	2.51%
	Total	100.00%	100.00%



TRANSITIONS_036B

Traffic Safety Features, Transitions			
Code	**TRANSITIONS_036B**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	6617	1290
1	Inspected feature meets currently acceptable standards.	3072	7624
N	Not applicable or a safety feature is not required.	99	631
	(blank)	22	265
	Total	9810	9810

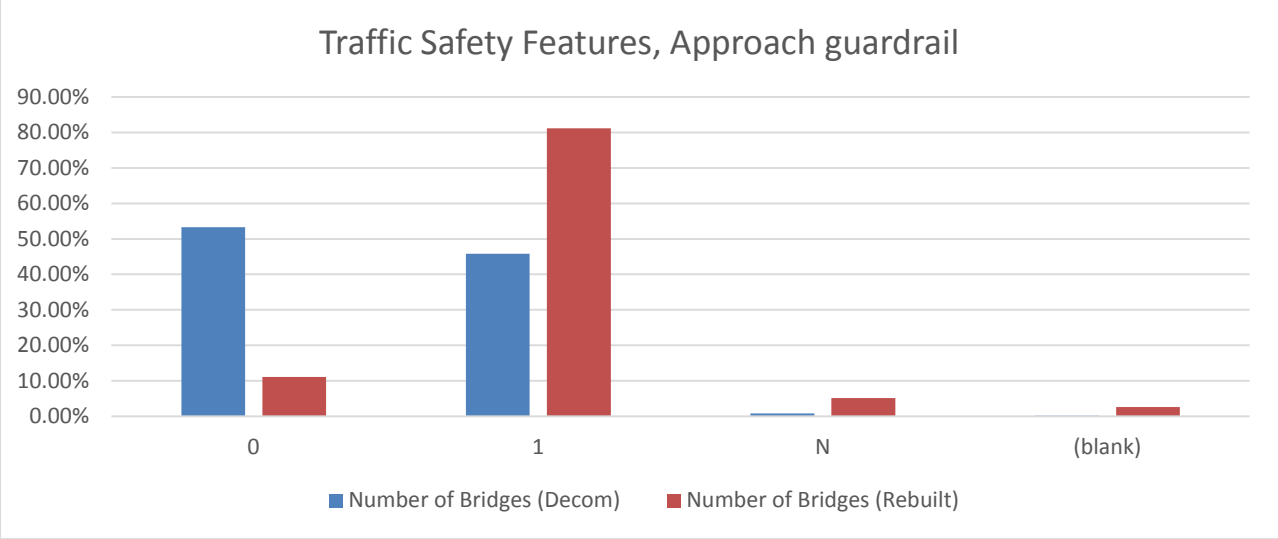
Traffic Safety Features, Transitions			
Code	**TRANSITIONS_036B**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	67.45%	13.15%
1	Inspected feature meets currently acceptable standards.	31.31%	77.72%
N	Not applicable or a safety feature is not required.	1.01%	6.43%
	(blank)	0.22%	2.70%
	Total	100.00%	100.00%



APPR_RAIL_036C

Traffic Safety Features, Approach guardrail			
Code	**APPR_RAIL_036C**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	5229	1089
1	Inspected feature meets currently acceptable standards.	4490	7963
N	Not applicable or a safety feature is not required.	75	503
	(blank)	16	255
	Total	9810	9810

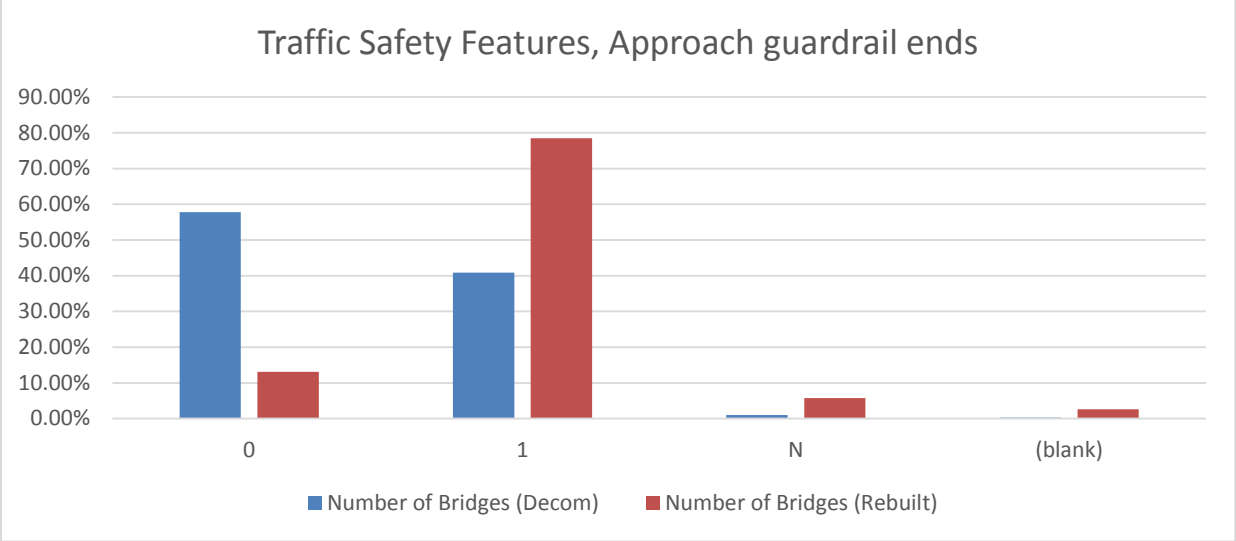
Traffic Safety Features, Approach guardrail			
Code	**APPR_RAIL_036C**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	53.30%	11.10%
1	Inspected feature meets currently acceptable standards.	45.77%	81.17%
N	Not applicable or a safety feature is not required.	0.76%	5.13%
	(blank)	0.16%	2.60%
	Total	100.00%	100.00%



APPR_RAIL_END_036D

Traffic Safety Features, Approach guardrail ends			
Code	**APPR_RAIL_END_036D**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	5670	1285
1	Inspected feature meets currently acceptable standards.	4010	7701
N	Not applicable or a safety feature is not required.	100	567
	(blank)	30	257
	Total	9810	9810

Traffic Safety Features, Approach guardrail ends			
Code	**APPR_RAIL_END_036D**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
0	Inspected feature does not meet currently acceptable standards or a safety feature is required and none is provided	57.80%	13.10%
1	Inspected feature meets currently acceptable standards.	40.88%	78.50%
N	Not applicable or a safety feature is not required.	1.02%	5.78%
	(blank)	0.31%	2.62%
	Total	100.00%	100.00%



FRACTURE_092A

Critical Feature Inspection, Fracture Critical Details			
Code	**FRACTURE_092A**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Y	Special inspection or emphasis needed	867	85
N	Special inspection or emphasis NOT needed	8834	9456
	(blank)	109	269
	Total	9810	9810

Critical Feature Inspection, Fracture Critical Details			
Code	**FRACTURE_092A**	**Number of Bridges (Decom)**	**Number of Bridges (Rebuilt)**
Y	Special inspection or emphasis needed	8.84%	0.87%
N	Special inspection or emphasis NOT needed	90.05%	96.39%
	(blank)	1.11%	2.74%
	Total	100.00%	100.00%