



# *Bridge Inspections*

Municipalities Could be Encouraged to  
Take More Action with Improved  
Communication of Deficiencies by the  
Agency of Transportation



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Dear Colleagues,

Bridges are essential to the nation's transportation system, supporting commerce, economic vitality, and personal mobility. In Vermont, the Agency of Transportation (VTrans) inspects all non-federally owned highway bridges located on public roads that are in excess of 20 feet, including those owned by municipalities, in accordance with the Federal Highway Administration's National Bridge Inspection Standards. The primary purpose of these standards is to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public. VTrans inspects and issues inspection reports at least biennially and may inspect bridges more often if deemed necessary due to deteriorating conditions.

We chose to audit how municipalities respond to bridge inspections and what support VTrans provides them. Our objectives were to (1) assess the extent to which 20 municipalities took action to address findings in VTrans bridge inspection reports issued in 2014 and 2015, and (2) characterize the processes VTrans uses to provide funding and other assistance to municipalities to repair, rehabilitate, or replace bridges.

Our analysis of the deficiencies identified in VTrans' 2014-2015 bridge inspections found that about a third of 53 bridges in the 20 municipalities in our review were addressed or in the course of being addressed, while about two thirds of these bridges had none or only some of the deficiencies addressed. These deficiencies were generally communicated in the narrative portion of the bridge inspection reports, which is used by the bridge inspectors to highlight significant issues, especially those that affect the safety or structural integrity of the bridge.

Officials from the municipalities in our review provided a variety of explanations as to why they did not act to address deficiencies raised in the bridge inspection reports. In some cases, the municipalities were not aware of the inspection reports; in others, the municipalities decided not to take action based upon concerns about funding or their assessment of the deficiency. For example, officials at four municipalities were not aware of the deficiencies raised by the VTrans inspectors because they were unaware that the bridge inspection reports had been issued. In 2014 VTrans stopped mailing bridge inspection reports to the municipalities, instead posting them online at VTransparency (<http://vtrans.vermont.gov/vtransparency>) along with accompanying photos. Although VTrans communicated the change to the municipalities, some were unaware that the reports were only available online. In addition, VTrans did not notify municipalities when reports of new inspections were available.

According to 19 V.S.A. §304, the selectboard of each municipality is responsible for maintaining the bridges that they own. Nevertheless, improvements in VTrans communication of bridge deficiencies could encourage municipalities to

be more proactive. Officials from 14 municipalities stated that additional information in the narratives, such as explanations of the severity of the deficiency and/or more detailed descriptions, could improve their responses to inspection reports. For example, officials from two of these municipalities commented that such explanations could help with making presentations to the selectboard when asking for resources to deal with the deficiencies. The type and level of detail provided in the narrative portion of the inspection report is left to the discretion of the individual inspector as VTrans does not have guidance on how the narratives should be written, thus resulting in inconsistent reporting.

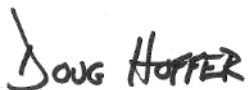
VTrans has several programs that provide millions of dollars in funding annually for the repair, rehabilitation, and replacement of bridges owned by municipalities. The largest was the town highway bridge program, for which VTrans spent an average of \$23 million a year between fiscal years 2015-2017. On most projects under this program, VTrans is responsible for all aspects of preliminary design, obtains agreement on a conceptual plan with the municipality, and contracts for and oversees construction work.

VTrans also provided ad hoc and other non-financial assistance when requested by a municipality. However, the VTrans local roads program, which provided workshops and seminars to municipalities on transportation-related topics, did not provide bridge-related training. Thirteen municipalities indicated that they would welcome such training. VTrans is working on developing a half-day bridge awareness training workshop.

We made two recommendations to VTrans intended to improve the communications of bridge inspection findings to the users of the reports, such as providing guidance to bridge inspectors on writing the narrative of the report.

I would like to thank the staff at VTrans and at the municipalities in our review for their cooperation and professionalism during this audit. This report is available on the state auditor's website, <http://auditor.vermont.gov/>.

Sincerely,



DOUGLAS R. HOFFER  
State Auditor

ADDRESSEES

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Speaker of the House of Representatives

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# Introduction

Bridges are essential to the nation's transportation system, supporting commerce, economic vitality, and personal mobility. In response to a bridge collapse in West Virginia that killed 46 people, the federal government established bridge inspection standards in 1971—the Federal Highway Administration's (FHWA) National Bridge Inspection Standards (NBIS). The primary purpose of these standards is to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public.

In accordance with the NBIS, Vermont's Agency of Transportation (VTrans) inspects all non-federally owned highway bridges located on public roads that are in excess of 20 feet, including those owned by municipalities.<sup>1</sup> VTrans inspects such bridges and issues inspection reports<sup>2</sup> at least biennially and may inspect bridges more often if deemed necessary due to deteriorating conditions. FHWA annually evaluates the VTrans inspection program against 23 metrics, such as those related to the qualification of personnel and inspection frequency and procedures. In 2017, FHWA assessed VTrans as compliant or substantially compliant with all the metrics.

There are 1,642 municipally-owned bridges subject to VTrans inspections. According to 19 V.S.A. §304, the selectboard of each municipality is responsible for maintaining the bridges that they own. If damage occurs to a person or property because of the insufficiency or want of repair of a bridge, the affected individual may seek compensation as a civil action (19 V.S.A. §985).

We undertook an audit to look at municipal bridges because bridge safety is important. Our objectives were to: (1) assess the extent to which 20 municipalities took action to address findings in VTrans bridge inspection reports issued in 2014 and 2015, and (2) characterize the processes VTrans uses to provide funding and other assistance to municipalities to repair, rehabilitate, or replace bridges. Regarding objective 1, we focused our work on 53 bridges owned by the 20 municipalities selected for the audit.<sup>3</sup> Appendix I details how we chose these bridges and municipalities and other information on our scope and methodology. Appendix II contains a list of abbreviations used in this report.

<sup>1</sup> VTrans also inspects state-owned (but not municipal-owned) bridges between 6 and 20 feet in length.

<sup>2</sup> These reports are labeled "Structure Inspection, Inventory, and Appraisal Sheet."

<sup>3</sup> Mount Tabor did not cooperate with this audit. Nonetheless, we were able to determine the status of its bridge in our scope using other sources.



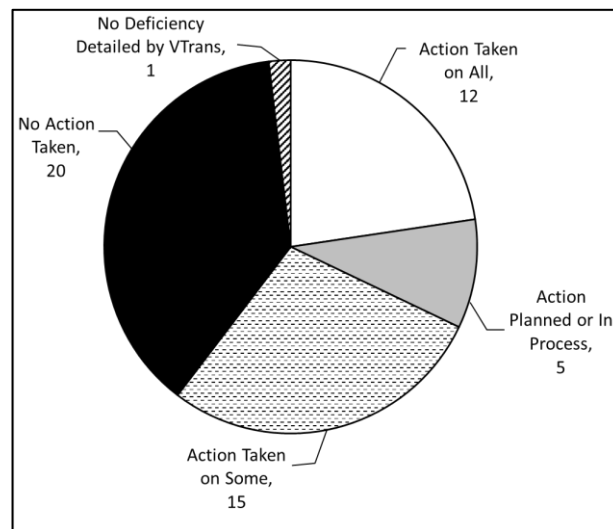
# Highlights

Municipalities are responsible for the safety of their bridges. Bridges that are greater than 20 feet in length are inspected by VTrans in accordance with federal standards. The primary purpose of these standards is to locate and evaluate existing bridge deficiencies to ensure public safety. Our objectives were to: (1) assess the extent to which 20 municipalities took action to address findings in VTrans bridge inspection reports issued in 2014 and 2015, and (2) characterize the processes VTrans uses to provide funding and other assistance to municipalities to repair, rehabilitate, or replace bridges.

## Objective 1 Finding

As shown in Figure 1, deficiencies identified in VTrans’ 2014-2015 bridge inspections were addressed or in the course of being addressed for about a third of the 53 municipal bridges in our review, while about two thirds of these bridges had none or only some of the deficiencies addressed. These deficiencies were generally communicated in the narrative portion of the bridge inspection reports, which is used by the bridge inspectors to highlight significant issues, especially those that affect the safety or structural integrity of the bridge.

**Figure 1: Summary of the Extent to Which Actions Were Taken to Address Deficiencies from 2014 and 2015 Bridge Inspection Reports for 53 Bridges**



The actions taken were wide ranging, including replacing part or all of a bridge and patching a hole. Examples of deficiencies not addressed by municipalities included concrete or steel deterioration and scour.<sup>4</sup>

Officials from the municipalities in our review provided a variety of explanations as to why they did not act to address deficiencies raised in the bridge inspection reports. The following are the most common reasons cited by the officials:

- *Funding.* Officials at five municipalities explained that funding was a direct cause for not addressing a deficiency.
- *Unaware of the Issue.* Officials at four municipalities were not aware of the deficiencies raised by the VTrans inspectors because they were unaware that the bridge inspection reports had been issued. In 2014 VTrans stopped mailing bridge inspection reports to the municipalities, instead posting them online at VTransparency along with accompanying photos.<sup>5</sup> Although VTrans communicated the change to the municipalities, some were unaware that the reports were only available online. In addition, VTrans did not notify municipalities when reports of new inspections were available.
- *Decided Not to Act.* Officials at nine municipalities explained that they decided not to take action on one or more deficiencies raised by VTrans—two citing higher priorities to address, five citing their determination that the deficiency raised by VTrans was not critical or did not require immediate attention, and two citing both reasons.

The decision as to whether to act on a deficiency rests with the municipalities. Nevertheless, improvements in VTrans communication of deficiencies could encourage municipalities to be more proactive. Officials from 14 municipalities stated that additional information in the narratives, such as explanations of the severity of the deficiency and/or more detailed descriptions, could improve their responses to inspection reports. For example, officials from two of these municipalities explained that such explanations could help with making presentations to the selectboard when asking for resources to deal with the deficiencies. The type and level of detail provided in the narrative portion of the inspection report is left to the discretion of the individual inspector as VTrans does not have guidance on how the narratives should be written, thus resulting in inconsistent reporting.

## Objective 2 Finding

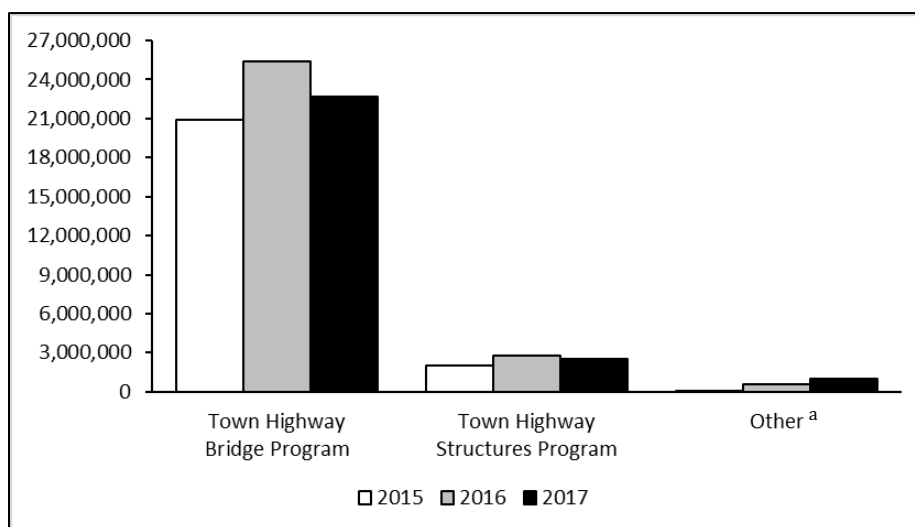
VTrans uses several programs to provide funding and assistance to municipalities for the repair, rehabilitation, or replacement of bridges. As shown in Figure 2, the town highway bridge program has been the main source of such funding. For most projects under this program, VTrans is responsible for

<sup>4</sup> Scour is the removal of a streambed or bank area by stream flow or erosion of streambed or bank material due to flowing water.

<sup>5</sup> <http://vtrans.vermont.gov/vtransparency>.

preliminary design, consults and reaches agreement with the municipality, and contracts for and oversees construction work. VTrans chooses the bridge projects to be included in this program, subject to the review and approval of the legislature. As part of the process of choosing the projects, and in accordance with 19 V.S.A. §10g(l), VTrans used a documented numerical grading system to assign a priority ranking to ongoing and possible bridge projects. VTrans’ fiscal year 2018 priority ranking of municipal bridges were consistent with this process. Town highway bridge program projects are paid for via a combination of funds from the Federal Highway Administration (FHWA), the State, and the municipality. The other VTrans programs that provide funding for municipal bridge projects were grant programs, the largest of which was the town highway structures program, which has a maximum award of \$175,000.

**Figure 2: VTrans Expenditures in Support of Town Highway Bridges, Fiscal Years 2015 – 2017**



<sup>a</sup> This category includes expenditures from the town highway state aid, non-federal disasters and transportation alternatives programs. It does not include expenditures from the town highway state aid, federal disasters program because VTrans does not track expenditures for bridge projects separately in this program.

VTrans also provided ad hoc and other non-financial assistance when requested by a municipality. However, the VTrans local roads program, which provided workshops and seminars to municipalities on transportation-related topics, did not provide bridge-related training. Thirteen municipalities indicated that they would welcome such training.

### Recommendations

We made two recommendations to VTrans intended to improve the communications of bridge inspection findings to the users of the reports, such as providing guidance to bridge inspectors on writing the narrative of the report.

## Background

Federal regulations (23 CFR §650.307) state that each state transportation department must inspect, or cause to be inspected, all highway bridges<sup>6</sup> located on public roads that are fully or partially within the state's boundaries, except for federally-owned bridges.<sup>7</sup>

In Vermont, VTTrans performs all inspections called for in the Federal regulations, even for bridges owned by municipalities. According to VTTrans, the purposes of its bridge inspections are to (1) ensure public safety and confidence in bridge structural capacity, (2) protect public investment and allow efficient allocation of resources, (3) effectively schedule maintenance and rehabilitation operations, (4) provide a basis for repair, replacement, or other improvements, and (5) ensure that federal funding will remain available for bridge rehabilitation and replacement.

The VTTrans bridge inspection group is part of its asset management and performance bureau and is composed of a manager, a quality assurance/quality control inspector, two load rating engineers, and four 2-person bridge inspection teams. Each inspection team is responsible for inspecting about 400 state and municipal-owned bridges annually.

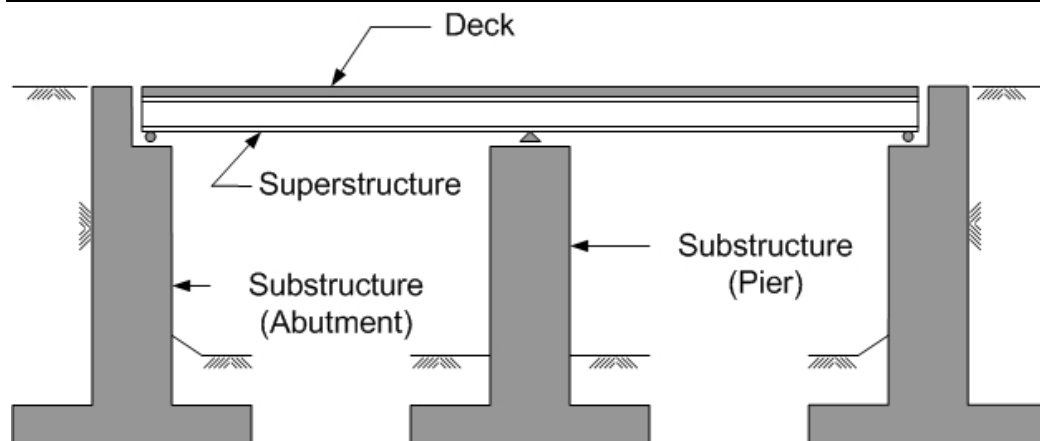
As part of a bridge inspection, the VTTrans inspectors evaluate the condition of major bridge components. Figure 3 is an illustration of three of the major components: deck, superstructure, and substructure.<sup>8</sup> Bridge inspectors also evaluate the condition of the waterway channel and its protection.<sup>9</sup>

<sup>6</sup> 23 CFR §650.305 defines a bridge as a structure, including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or over moving loads, and having an opening measured along the center of the roadway of more than 20 feet between the undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes.

<sup>7</sup> 23 CFR §650.307 also allows a state to delegate these responsibilities, but such delegation does not relieve the State transportation department of its responsibilities. Vermont has not delegated its responsibilities under these regulations.

<sup>8</sup> A deck is the portion of the bridge that provides direct support for vehicular and pedestrian traffic and is supported by the superstructure. The superstructure is the entire portion of a bridge structure that primarily receives and supports traffic loads and transfers these loads to the substructure. The substructure consists of the abutments and piers built to support the span of a bridge superstructure.

<sup>9</sup> Channel and channel protection describe physical conditions associated with the flow of water through the bridge such as stream stability and the condition of the channel, riprap, slope protection, or stream control devices.

**Figure 3: Major Bridge Components**

Source: *Bridge Inspector's Reference Manual* (FHWA, publication no. FHWA NHI 12-049, December 2012).

As prescribed by FHWA,<sup>10</sup> inspectors rate the condition of the deck, superstructure, substructure, and waterway channel and protection on a scale of zero to nine—a nine rating means excellent condition and zero is failed condition. These ratings are included in a bridge inspection report along with a narrative description of the inspector's findings. See Appendix III for an example of a bridge inspection report.

## Objective 1: Municipal Responses to Bridge Inspections Could Be Improved with Better Communication

About two thirds of the 53 bridges in our review had none or only some of their deficiencies addressed. The reasons why the deficiencies were not addressed varied. In some cases, the municipalities were not aware of the inspection reports; in others, the municipalities decided not to take action based upon their funding concerns or assessment of the deficiency. Municipalities could be encouraged to take additional action on deficiencies found during inspections if more information were provided in the narrative portion of the inspection reports. For example, officials from 14 municipalities stated that additional information in the narratives, such as explanations of the severity of the deficiency and/or more detailed descriptions, could improve their responses to inspection reports. It is

<sup>10</sup> *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* (FHWA, Report No. FHWA-PD-96-001, December 1995).

important for municipalities to address deficiencies because action taken on repairs and preventative maintenance can extend the service life of a bridge.

## Extent of Municipal Actions to Address Bridge Deficiencies

After a bridge inspection is completed, VTrans posts the bridge inspection report and photos on its VTransparency website. The report contains ratings of each bridge component and a narrative section where the inspector describes the condition of the bridge, including its deficiencies and needs. The bridge inspectors told us that they generally include significant issues in this section, especially those that affect the safety or structural integrity of the bridge.

Bridge inspections may also result in VTrans communicating the bridge deficiency to a municipality's selectboard or other governing body. In particular, findings of a critical nature, which are defined as a structural or safety-related deficiency requiring an immediate follow-up inspection or action, are required to be separately reported to the municipality's selectboard or other governing body via a letter.<sup>11</sup> At the discretion of the bridge inspector, letters may also be sent to the municipality's selectboard or other governing body, even if the deficiency is not deemed to be a critical finding.

Table 1 summarizes the extent to which deficiencies identified in the narrative portion of the 2014 and 2015 bridge inspection reports or in letters sent to the municipalities were addressed. Deficiencies identified in VTrans' 2014-2015 bridge inspections were addressed or in the course of being addressed for about a third of the 53 municipal bridges in our review, while about two thirds of these bridges had none or only some of the deficiencies addressed. The municipalities that completed at least one action to address a deficiency used a variety of funding sources: their own municipal funds exclusively, VTrans programs,<sup>12</sup> or other funding mechanisms (e.g., one bridge was replaced by the U.S. Forest Service). Appendix IV provides summaries of the bridge inspection results, examples of deficiencies contained in the bridge report narrative, and pictures of each of the bridges in our review (organized alphabetically by municipality).

<sup>11</sup> VTrans sent few critical findings letters to municipalities (11 between January 1, 2014 and December 20, 2017). VTrans tracks municipal actions taken in response to these letters and reports the status of critical deficiencies to FHWA semi-annually.

<sup>12</sup> Depending on the program, municipalities are generally responsible for 2.5 percent to 20 percent of the project costs. FHWA and VTrans provide funding for the remainder.

**Table 1: Summary of the Extent Actions Were Taken to Address Deficiencies Found During 2014-2015 Bridge Inspections of Municipal-Owned Bridges<sup>a, b</sup>**

| Municipality    | # of Bridges in Scope | Deficiencies Not Detailed in Communication to Municipality | Action on Deficiencies Communicated by Bridge Inspections (for each bridge in scope) |                         |                              |                         |
|-----------------|-----------------------|--|--|-------------------------|------------------------------|-------------------------|
|                 |                       |  | Action Taken on All  | Action Taken on Some    | Action Planned or In Process | No Action Taken         |
| Barton Village  | 3                     | 0  | 2  | 1                       | 0                            | 0                       |
| Bennington      | 4                     | 0  | 1  | 1                       | 1                            | 1                       |
| Brattleboro     | 2                     | 0  | 0  | 1                       | 0                            | 1                       |
| Burke           | 3                     | 0  | 0  | 1                       | 0                            | 2                       |
| Dorset          | 1                     | 0  | 1  | 0                       | 0                            | 0                       |
| Hartford        | 1                     | 0  | 0  | 1                       | 0                            | 0                       |
| Highgate        | 1                     | 0  | 0  | 1                       | 0                            | 0                       |
| Montgomery      | 1                     | 0  | 0  | 0                       | 0                            | 1                       |
| Montpelier      | 6                     | 0  | 0  | 3                       | 2                            | 1                       |
| Mount Tabor     | 1                     | 0  | 1  | 0                       | 0                            | 0                       |
| New Haven       | 2                     | 0  | 1  | 0                       | 0                            | 1                       |
| Newfane         | 7                     | 0  | 2  | 2                       | 0                            | 3                       |
| Northfield      | 8                     | 0  | 1  | 2                       | 0                            | 5                       |
| Orleans Village | 1                     | 0  | 0  | 0                       | 1                            | 0                       |
| Randolph        | 3                     | 1  | 1  | 0                       | 0                            | 1                       |
| Rutland City    | 2                     | 0  | 1  | 1                       | 0                            | 0                       |
| Shrewsbury      | 1                     | 0  | 0  | 0                       | 0                            | 1                       |
| Townshend       | 2                     | 0  | 0  | 0                       | 1                            | 1                       |
| Weathersfield   | 2                     | 0  | 0  | 1                       | 0                            | 1                       |
| West Rutland    | 2                     | 0  | 1  | 0                       | 0                            | 1                       |
| <b>Total</b>    | <b>53</b>             | <b>1</b><br><b>2%</b>                                      | <b>12</b><br><b>23%</b>  | <b>15</b><br><b>28%</b> | <b>5</b><br><b>9%</b>        | <b>20</b><br><b>38%</b> |

<sup>a</sup> These deficiencies were contained in the narrative part of the bridge inspection reports and/or in letters sent to the municipality.

<sup>b</sup> Almost all the municipalities had additional bridges that were not in our scope.

The following are examples of actions taken to address such deficiencies.

- Northfield bridge #47. According to the inspection report, the bridge had a hole that went all the way through the deck. The hole was repaired by the town in 2016 using only municipal funds.
- Barton Village bridge #58. According to the inspection report, the bridge was in poor condition due to voids in the abutments and piers. A replacement bridge was completed in 2017 under the VTrans town highway bridge program.

- Bennington bridge #29. According to the inspection report, the deck underside was leaking. Bennington installed a new membrane<sup>13</sup> and repaved the bridge in 2016 using its own funds.

The types of deficiencies identified during inspections and reported to the municipality that were not addressed varied. The following are examples of types of deficiencies that were not addressed.

*Steel Deterioration.* Steel is a widely used construction material for bridges due to its strength and reliability. In its inspection reports, VTrans pointed out deterioration to steel bridge components and in some cases suggested cleaning, painting, and or greasing to deter further corrosion or pointed out work that could be done to replace or repair damaged steel beams. See Figure 4 for an example of ongoing steel deterioration.

**Figure 4: Example of Steel Deterioration on a Municipal-Owned Bridge**



Source: VTrans 2014 bridge inspection.

*Concrete Deterioration.* Concrete is commonly used in bridge applications due to its compressive strength properties. In its inspection reports, VTrans pointed out deterioration in concrete elements, at times suggesting repairs or patches to deter further damage to the structure. See Figure 5 for an example of ongoing concrete deterioration.

<sup>13</sup> A membrane is an impervious layer placed between the wearing surface and the concrete deck, used to protect the deck from water and corrosive chemicals that could damage it.



**Figure 5: Example of Concrete Deterioration on a Municipal-Owned Bridge**

Source: VTrans 2015 bridge inspection.

*Scour.*<sup>14</sup> The physical conditions associated with the flow of water through the bridge may cause undermining of the slope, erosion of the banks, or realignment of the stream. In its inspection reports, VTrans pointed out waterway issues and sometimes suggested taking erosion control measures, such as adding stones or removing impediments to water flow. See Figure 6 for an example of an ongoing scour problem.

**Figure 6: Example of Effect of Scour on a Municipal-Owned Bridge**

Source: VTrans 2014 bridge inspection.

<sup>14</sup> Scour is the removal of a streambed or bank area by stream flow or erosion of streambed or bank material due to flowing water.

Officials at the municipalities provided a variety of explanations as to why they did not act to address deficiencies raised in the bridge inspection reports. The following are the most common reasons cited by municipalities.

### Funding

Officials at five municipalities explained that funding was a direct cause for not addressing a deficiency. For example, in some cases municipal officials perceived that the corrective action would be prohibitively expensive, while in others the selectboard did not approve the expenditure of the funds. More generally, other municipal officials also expressed some level of concern about funding activities to address deficiencies raised during inspections.

### Municipality Unaware of the Issue

Officials at four municipalities were not aware of specific deficiencies raised by the VTrans inspectors in 2014 and 2015 because they were unaware that the bridge inspection reports had been issued. VTrans stopped mailing bridge inspection reports to the municipalities in 2014, instead posting them online at VTransparency along with the accompanying photos of the inspections (<http://vtrans.vermont.gov/vtransparency>).

According to the VTrans bridge inspection manager, it is the responsibility of the municipality to retrieve and review reports, which are generally issued biennially.<sup>15</sup> However, while VTrans sent several letters to the municipalities explaining its plan to post inspection reports online, some of the municipal officials stated that they were new to their positions and/or were not aware that VTrans was no longer mailing the reports.<sup>16</sup> VTrans does not notify the municipality when a new inspection report is posted. Officials at almost all of the municipalities in our review stated that notifications would help them improve the condition or maintenance of town bridges because without notification they may forget to check for new reports.

### Municipality Decided Not to Act

Officials at nine municipalities explained that they decided not to take action on one or more deficiencies raised by VTrans—two cited higher priorities to address, five cited their determination that the deficiency raised by VTrans was not critical or did not require immediate attention, and two cited both reasons.

<sup>15</sup> If conditions warrant, VTrans may inspect a bridge more frequently.

<sup>16</sup> In the case of three municipalities, the officials first heard of VTransparency when we brought it to their attention.

## VTrans Communication of Bridge Deficiencies Could Be Improved

According to the FHWA, the role of a bridge inspector includes (1) preparing reports documenting deficiencies and providing alerts of any findings that might impact the safety of the roadway user or the integrity of the structure, (2) recognizing bridge components that need repair in order to maintain bridge safety and avoid replacement costs, and (3) being on guard for minor problems that can be corrected before they lead to major repairs. This role is consistent with the needs expressed by the municipalities who generally relied on the bridge inspection reports to inform them of the condition of their bridges and what maintenance or repair was necessary. For some municipalities it was the sole source of technical information on their bridges. Moreover, officials from 17 municipalities in our review used or planned to use the bridge inspection reports for planning and budgeting purposes.

The VTrans bridge inspection manager agreed that the inspection reports are a tool for municipalities but stated that their primary purpose is to identify safety issues, as they do not provide an engineering assessment. The manager added that although she expects the reports to identify deficiencies that, once addressed, could extend the life of bridges, it is the responsibility of each municipality to come up with solutions. She noted that the municipalities are responsible for maintaining their bridges and, if needed, they could consult with outside engineers, contractors, or other experts to determine the appropriate solution.

We concur that municipalities are statutorily responsible for maintaining their bridges. Nevertheless, VTrans bridge inspections identify important information regarding bridge deficiencies that could help them fulfill this responsibility. Yet, VTrans does not provide guidance to the bridge inspectors on what information they should be providing to municipalities in the narrative portion of the inspection report. There is also no guidance as to whether and under what circumstances VTrans should send letters for non-critical items to municipalities.

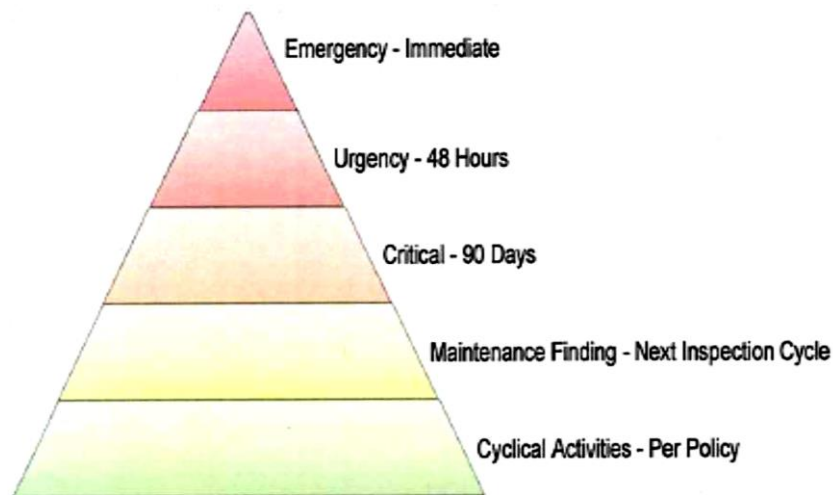
Officials from 14 municipalities stated that additional information in the narratives, such as explanations of the severity of the deficiency and/or more detailed descriptions of the finding, could improve their responses to inspection reports. For example, officials from two municipalities stated that such explanations could help with making presentations to the selectboard when asking for resources to deal with deficiencies. VTrans has additional information that it could provide to municipalities in the narrative portion of bridge inspection reports.

**Severity of the Deficiency**

The FHWA bridge inspector’s reference manual<sup>17</sup> states that a good inspection includes an indication of the type, severity, and extent of a deficiency. The narrative in the VTrans inspection reports did not always contain such information or the wording was ambiguous as to whether or how quickly actions should be taken. For example, the inspection report narrative for Shrewsbury bridge #32 recommended the town “consider” cleaning and painting the steel superstructure. Town officials stated this wording indicated to them that they did not need to take any action. The inspection report for Brattleboro bridge #4 stated that the town “should” remove a gravel bar and cut back brush. A city official stated this was confusing because it was not clear to him when that action should be completed. The ambiguity in some of the language in the reports undercut the inspectors’ intention to use the narrative portion of the report to highlight significant issues.

The VTrans bridge inspection group uses a framework to communicate the severity of bridge deficiency findings for state-owned bridges. As shown in Figure 7, this framework indicates both the severity of the finding and the recommended timeline for addressing it.

**Figure 7: Framework for Bridge Deficiency Severity**



Source: VTrans Bridge Inspection Finding Report.

Officials from 12 municipalities stated that an explanation of the severity of the finding could improve their responses to inspection reports. Since VTrans already has a framework to identify the severity of a deficiency, it would be

<sup>17</sup> This is a comprehensive FHWA manual on programs, procedures, and techniques for inspecting and evaluating a variety of in-service highway bridges.

beneficial to share this kind of expertise with those responsible for maintaining municipal bridges.

### Narrative Descriptions of Deficiencies

The inspectors differed on when to include a description of a deficiency in the narrative portion of the inspection reports. Two inspectors stated that they generally write explanations of deficiencies if a bridge component is rated as a 5 (fair condition)<sup>18</sup> or less, while the other two inspectors' criterion for writing explanations is a rating of a 4 (poor condition)<sup>19</sup> or less. This distinction is important because bringing deficiencies to the attention of a municipality earlier (e.g., before the condition becomes poor) may provide the municipality with the opportunity to take corrective action before a more major repair (or replacement) is needed.

Furthermore, inspection reports are not always consistent in the deficiencies that they report from inspection to inspection even if the same deficiency remains. For example, as shown in Figure 8, Randolph bridge #36 has a crack in one of its abutments, which was identified in both 2015 and 2017 inspections. The inspector in 2015 did not include any language in the report's narrative about the crack, even though he noted it in internal VTrans documents. A different inspector added a detailed description of the crack, including measurements, in the 2017 report's narrative.

<sup>18</sup> A rating of 5 indicates that all primary structural elements are sound but may have minor section loss, cracking, spalling, or scour (for deck, superstructure, and substructure); bank protection is being eroded, river control devices and/or embankment have major damage, trees and brush restrict channel (for channel).

<sup>19</sup> A rating of 4 is defined as advanced section loss, deterioration, spalling or scour (for deck, superstructure, and substructure); bank and embankment protection is severely undermined, river control devices have severe damage, or large deposits of debris are in the channel (for channel).

**Figure 8: Crack in Randolph Bridge #36 Abutment**



Source: VTrans.

Officials from ten municipalities stated that more detailed descriptions and locations of findings could improve their response to inspection reports. Aside from letters sent due to critical findings, each inspector uses his own judgment to determine what to communicate and how to communicate deficiencies in the inspection report narrative or letter. Moreover, the bridge inspectors had varying views as to what should be in the narrative and how it should be written. For example, some inspectors believed that the narratives should include recommendations while others did not. In addition, inspectors noted that there are times when they do not repeat previous unaddressed deficiencies.

**Providing Municipalities with More Information**

VTrans has internal documents in which it collects and reports more information on deficiencies found. The VTrans bridge inspection manager stated this documentation is available to municipalities if requested. However, almost all the municipalities in our review were unaware of these internal VTrans documents. In addition, when asked about including additional information in the externally available bridge inspection reports, the VTrans bridge inspection manager and some inspectors stated that municipalities can call or email them or the district offices if they need more information or clarification. We do not believe this strategy serves to promote some of the purposes of VTrans bridge inspections, which include to (1) protect public investment and allow efficient allocation of resources, (2) effectively schedule maintenance and rehabilitation operations, and (3) provide a basis for repair, replacement, or other improvements. This is

particularly important since VTrans believes that if preventative maintenance is done on a routine schedule it will extend the service life of bridges.

To illustrate the potential benefits of improved communication of bridge deficiencies, note that as of April 2017, 688 of the 1,642 bridges (42 percent) owned by Vermont municipalities had at least one condition rating of 6 or less for the deck, superstructure, or substructure. A rating of 6 or less indicates that some level of deterioration of structural elements has occurred. Table 2 includes a description of the NBIS condition ratings and commonly employed actions based on the conditions, per FHWA.

**Table 2: National Bridge Inventory General Condition Rating Guidance**

| Rating | Description  | Commonly Employed Feasible Actions    |
|--------|--|---------------------------------------|
| 9      | Excellent condition.   | Preventive maintenance                |
| 8      | Very good condition. No problems noted.  |                                       |
| 7      | Good condition. Some minor problems.   |                                       |
| 6      | Satisfactory condition. Structural elements show some minor deterioration.   | Preventive maintenance and/or repairs |
| 5      | Fair condition. All primary structural elements are sound, but may have some minor section loss, cracking, spalling, <sup>a</sup> or scour. <sup>b</sup>   |                                       |
| 4      | Poor condition. Advanced section loss, deterioration, spalling, or scour.  | Rehabilitation or replacement         |
| 3      | Serious condition. Loss of section, deterioration, spalling or scour, have seriously affected primary structural components. Local failures are possible. Fatigue cracks or sheer cracks in concrete may be present.   |                                       |
| 2      | Critical condition. Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, the bridge may have to be closed until corrective action is taken. |                                       |
| 1      | Imminent failure condition. Major deterioration or section loss present in critical structural elements or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put back in light service.                        |                                       |
| 0      | Failed condition. Out-of-service, beyond corrective action.  |                                       |

<sup>a</sup> A spall is a depression in concrete caused by separation of a portion of the surface concrete, revealing a fracture parallel with or slightly inclined to the surface.

<sup>b</sup> Scour is the removal of a streambed or bank area by stream flow or erosion of streambed or bank material due to flowing water.

Source: *Bridge Preservation Guide: Maintaining a State of Good Repair Using Cost Effective Investment Strategies* (FHWA, publication no. FHWA-HIF-11042, August 2011).

By clearly communicating the deterioration found during the inspection and indicating its known and potential severity level, VTrans may encourage municipalities to more proactively address deficiencies and delay the need for more expensive rehabilitation or replacement work.

## Objective 2: VTrans Spends Millions of Dollars on Municipal Bridge Projects Annually

VTrans has several programs that provide millions of dollars in funding annually for the repair, rehabilitation, and replacement of bridges owned by municipalities. Its largest program was the town highway bridge program. Between fiscal years 2015-2017, VTrans spent an average of \$23 million a year for this program. On most projects under this program, VTrans is responsible for all aspects of preliminary design, obtains agreement on a conceptual plan with the municipality, and contracts for and oversees construction work. VTrans also provides other assistance to municipalities pertaining to bridges, such as consultation by district officials or the bridge inspection manager. However, VTrans did not utilize one of its statutorily allowed avenues to provide additional assistance, namely training. The VTrans local roads program provides information, training, and technical assistance to cities, towns and villages in Vermont. However, this program did not offer training on bridges, such as maintenance. Most of the officials at the municipalities interviewed expressed interest in such training.

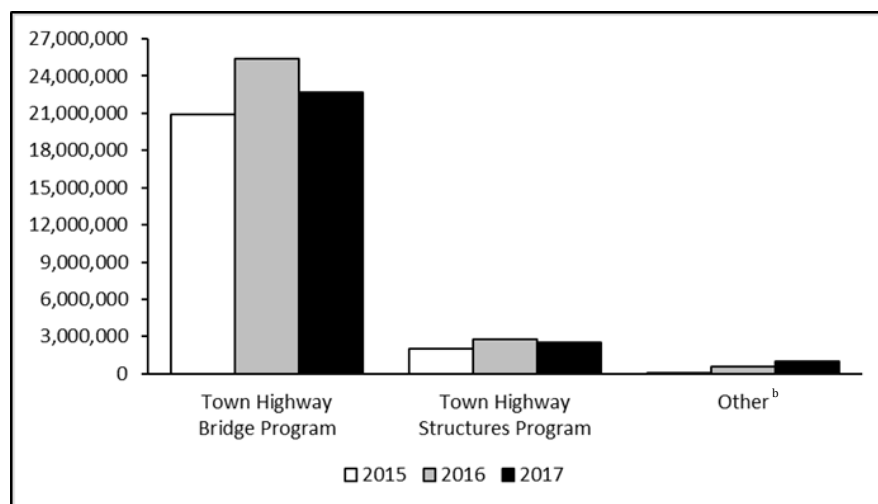
### VTrans Programs that Provide Funding for Municipal Bridge Projects

VTrans annually presents the legislature with a multiyear transportation program that contains expenditures for the most recently completed fiscal year along with a recommended budget for all its activities, including programs that fund projects for municipal-owned bridges. These recommendations are subject to the approval and/or changes by the legislature as part of the annual transportation bill.

As shown in Figure 9, by far the most significant source of VTrans funding in support of municipal-owned bridges is the town highway bridge program. This is the only program dedicated to municipal-owned bridges. The other sources of funding are grant programs that also fund other types of structures (Figure 9 only includes the expenditures for bridge projects in these programs). In fiscal years 2015-2017 VTrans expended an average of \$23 million a year in the town highway bridge program. Other VTrans programs that funded municipal bridge projects were much smaller, with the town highway structures program being the largest among them, with average expenditures of \$2.4 million a year during the same period.



**Figure 9: VTrans Expenditures in Support of Municipal Bridges, Fiscal Years 2015 – 2017<sup>a</sup>**



- <sup>a</sup> Some of these programs fund non-bridge projects, but only expenditures for municipal bridge projects are included in this figure.
- <sup>b</sup> This category includes expenditures from the town highway state aid, non-federal disasters and transportation alternatives programs. It does not include expenditures from the town highway state aid, federal disasters program because VTrans does not track expenditures for bridge projects separately in this program.

### Town Highway Bridge Program

The town highway bridge program is authorized by 19 V.S.A. §306(c), which provides for an annual appropriation to VTrans to supply towns with bridge engineering services and aid in maintaining and constructing bridges of six feet or more on class 1, 2, and 3 town highways. Projects may (1) extend the life of an existing bridge or major component, (2) provide for the reconstruction or replacement of a bridge, or (3) eliminate a bridge by construction of alternative access.

19 V.S.A. §10g(l) requires VTrans to develop a numerical grading system to assign a priority rating to all town highway bridge projects, to consist of two components: (1) asset management- and performance-based factors that are objective and quantifiable and include consideration of, for example, safety and the relative priority assigned to the project by the relevant regional planning commission<sup>20</sup> and (2) the importance of the transportation infrastructure as a factor in the local, regional, or state economy and the health, social, and cultural life of the surrounding communities.

In accordance with this statute, VTrans utilized a documented bridge prioritization process, last modified in 2009, to numerically rank municipal

<sup>20</sup> Vermont has 11 regional planning commissions.

bridges with a span of greater than 20 feet.<sup>21</sup> The bridge inspection manager annually performs this process, which is based on calculations involving nine factors. These factors take into account various information on each bridge, such as its condition, load restrictions, average daily traffic, and the priority assigned by the applicable regional planning commission (Appendix V provides additional information on the factors and the calculations used by VTrans).<sup>22</sup> For the fiscal year 2018 municipal bridges priority rankings, VTrans adhered to this process in that its calculations were reliably performed.

Once the rankings of municipal bridges are established, the VTrans structures manager and bridge inspection manager work together to determine which projects will be recommended for funding during the upcoming fiscal year. According to these managers, their recommendations were not only based on the town highway bridge priority rankings, but also considered available funding, internal resources, the complexity of the portfolio of projects, and the readiness of projects (e.g., whether they were still being scoped or were ready for construction). In addition, in making their recommendations, these managers took into consideration all publicly owned bridges: interstate, state, and town highway. Lastly, even if a bridge was ranked high on VTrans' priority list, it may not become a town highway bridge project because the municipality could decline to participate.

VTrans submits its recommended town highway bridge projects to the legislature each year as part of its proposed transportation program. There are three categories of municipal bridge projects:

- *Front of the Book Project.* These are projects approved by the legislature that are anticipated to have construction expenditures during the budget year and/or the following three years. In fiscal year 2018, there were 25 municipal projects in this category.<sup>23</sup>
- *Development and Evaluation Project.* These are projects approved by the legislature that are anticipated to have preliminary engineering and/or right-of-way expenditures during the budget year. VTrans is committed to delivering these projects to construction on a timeline driven by

<sup>21</sup> Municipal bridges with a span length greater than 6 feet and up to or equal to 20 feet (also called short structures) are neither inspected nor ranked by VTrans. In addition, bridges owned by an adjacent state (e.g., New Hampshire) for which VTrans is responsible for part of the bridge project funding are not ranked.

<sup>22</sup> VTrans is in the process of revising the prioritization process of the town highway bridge program and expects to pilot the new process for the fiscal year 2020 budget.

<sup>23</sup> In fiscal year 2018, the "front of the book" category also included funding for four statewide projects: (1) rehabilitation of covered bridges, (2) projects that were under development, evaluation, and scoping, (3) truss painting, and (4) the inventory, inspection, and classification of bridges that are not part of the federal-aid system.

priority and available funding. In fiscal year 2018 there were nine projects in this category.

- *Candidate Project.* Projects approved by the legislature that are not anticipated to have significant preliminary engineering or right-of-way expenditures during the budget year and funding for construction is not anticipated within a predictable timeframe. In fiscal year 2018 there were 41 projects in this category.

On most town highway bridge projects, VTrans is responsible for all aspects of preliminary design, including all permits and clearances.<sup>24</sup> Plans are presented to, and discussed with, the municipality at the end of the design phase. The municipality then holds informational meetings or public hearings. Once the municipality agrees with the conceptual plan, it is required to sign a finance and maintenance agreement. This agreement contains the percentage of project funding that is the responsibility of the municipality as well as the municipality's agreement to maintain the bridge once the project is completed. At this point, the project may be moved to a construction phase, based on available funding. In the construction phase, VTrans contracts for and oversees the work. The project is completed when the work is accepted after a final inspection by VTrans and others, including the municipality.

A municipal bridge project may take years to move from being a candidate to completion. For example, a project to replace bridge #20 in Barton Village was first listed as a candidate in the fiscal year 2011 transportation program. VTrans and Barton Village signed a finance and maintenance agreement for this project in 2013 and the bridge was constructed in 2017.

Projects under the town highway bridge program are funded via a combination of federal, state, and municipal funds, as follows:

- *Federal:* FHWA generally pays for 80 percent of eligible project costs.<sup>25</sup>
- *State and Municipality:* The State generally pays 10 percent to 20 percent of eligible project costs and the municipality would pay the (non-federal) remainder. Vermont statute calls for municipalities to provide a 10 percent match for eligible project costs.<sup>26</sup> However, the statute provides for exceptions. For example: (1) if the municipality closes the bridge during construction and does not construct a temporary bridge, the local

<sup>24</sup> In fiscal years 2015-2017, there were three projects in which grants were provided to the municipality for a town highway bridge project and the grant was overseen by the VTrans municipal assistance bureau.

<sup>25</sup> The federal share for some programs, such as FHWA's public lands highways program, may be different.

<sup>26</sup> 19 V.S.A. §309a.

match is 5 percent; (2) if the municipality and the State agree that the rehabilitation of an existing bridge is the preferred alternative and the municipality closes the bridge during construction and does not construct a temporary bridge, the local match is 2.5 percent. In addition, there are circumstances in which a municipality may not be required to pay a local share, such as when a bridge located on a town highway extends between Vermont and an adjacent state. Moreover, 19 V.S.A. §309a(c) caps the municipalities' share of any single project to an amount equivalent to the amount which could be raised in one year by increasing the municipality's tax rate by \$0.50.

The VTrans finance and administration division periodically bills the municipality for its portion of the bridge project. This division also tracks municipality payments against these bills.

#### VTrans Grant Programs That Fund Municipal Bridge Projects

Grant programs accounted for between 9 and 13 percent of VTrans funding for municipal-owned bridges in fiscal years 2015-2017. Table 3 describes each of the VTrans grant programs that funded bridge projects at the municipal level. These programs were also used for other types of structures, such as retaining walls. Once projects are complete, the municipality seeks reimbursement from VTrans for the non-municipal portion of the project up to the amount authorized.

**Table 3: VTrans Grant Programs that Funded Municipal Bridge Projects in Fiscal Years 2015 - 2017<sup>a</sup>**

| Program                                       | Overview of Program (as it pertains to bridges only)   | Funding Sources   |
|---|--|---|
| Town Highway Structures Program               | <p>19 V.S.A. §306(e) provides for an annual appropriation for grants to municipalities for maintenance and construction of bridges on class 1, 2, and 3 town highways.</p> <p>Annually, municipalities submit applications to the applicable VTrans district transportation administrator. The administrator chooses the projects to be funded, attempting to provide equitable distribution of funds allotted to the district.</p>  | <p><i>State:</i> Grants for up to \$175,000.</p> <p><i>Municipality:</i> Pays at least (1) 20% of project costs or (2) 10% of project costs if it adopted VTrans' town highway codes and standards and has a complete and up-to-date highway infrastructure study.</p>  |
| Town Highway State Aid, Federal Disasters     | <p>19 V.S.A. §306(f) allows towns receiving assistance under FHWA's emergency relief program for federal-aid highways to be eligible for state aid when a nonfederal match is required.</p> <p>Municipalities submit applications to the applicable VTrans district transportation administrator, who approves the grant subject to review by VTrans maintenance and operations bureau.</p>  | <p><i>FHWA:</i> Pays for 100% of costs for eligible emergency work and about 81% for permanent work.</p> <p><i>State:</i> Pays about 9% of eligible project costs for permanent work.</p> <p><i>Municipality:</i> Pays up to 10% of eligible project costs for permanent work.</p>  |
| Town Highway State Aid, Non-Federal Disasters | <p>19 V.S.A. §306(d) provides for an annual appropriation for emergency aid in repairing or replacing bridges on class 1, 2, 3, and 4 town highways damaged by natural or man-made disasters that do not qualify for major disaster assistance from the Federal Emergency Management Agency.</p> <p>Municipalities submit applications to the applicable VTrans district transportation administrator, who approves the grant subject to review by VTrans maintenance and operations bureau.</p> | <p><i>State:</i> Grants for the greater of (1) up to 90% of eligible repair or replacement costs or (2) the eligible repair or replacement cost minus an amount equal to 10% of the municipality's total highway budget minus its winter maintenance budget.</p> <p><i>Municipality:</i> Pays up to 10% of eligible costs subject to the above calculation.</p> |
| Transportation Alternatives Program           | <p>19 V.S.A. §38 created this program that funds activities authorized by federal law (section 213 of Title 23, United States Code). Grants can be used to fund a variety of activities, including environmental mitigation and preservation and rehabilitation of historic transportation facilities, including bridges.<sup>b</sup></p> <p>Municipalities submit applications to VTrans, which are reviewed, scored, and approved by the Transportation Alternatives Selection Committee.</p>  | <p><i>FHWA:</i> Pays for 80% of allowable project costs up to \$300,000.</p> <p><i>Municipalities:</i> Pays at least 20% of eligible projects costs.</p>  |

<sup>a</sup> The VTrans better roads program, which provides funding for planning and erosion control projects that improve water quality and reduce maintenance costs, can also fund bridge projects. However, according to the VTrans director of the municipal assistance bureau, no grants for bridge projects were issued in this program during fiscal years 2015-2017.

<sup>b</sup> Act 38 (2017) restricts funding in this program in fiscal years 2018-2019 to environmental mitigation projects relating to stormwater and highways, so grants in these years will not include historic bridge projects.

## Other Assistance Provided by VTrans

VTrans provided ad hoc and other non-financial bridge assistance when requested by a municipality.<sup>27</sup> For example, officials from many municipalities told us that if they have questions regarding a bridge, they may contact the VTrans district office or the bridge inspection group. In addition, 19 V.S.A. §7(f)(6) allows the Secretary of Transportation to provide training and instruction for municipal employees at the expense of the agency.

VTrans and FHWA sponsor the Vermont local roads program,<sup>28</sup> which provides information, training, and technical assistance on transportation-related topics to cities, towns, and villages in Vermont. This is done through seminars and workshops, regional road foreman meetings, distribution of materials, and technical assistance to fulfill service requests.

Currently the local roads program does not offer bridge-related training to municipalities. Officials at 13 municipalities we interviewed expressed interest in bridge-related training. For example, among the topics the officials cited that would be of interest were understanding the condition of bridges, common problems, and bridge maintenance.

The manager of the local roads program stated that he researched vendors that could provide such bridge-related training, but they were too costly. The manager is currently working on developing a half-day bridge awareness training workshop internally. As part of this initiative, in February 2018 the manager sent out a query to its listserv subscribers requesting suggestions for topics. At this time, the local roads program is planning on sponsoring two half-day classes, one in Mendon and one at the VTrans training center in Berlin.

## Conclusions

Maintaining the safety and structural integrity of bridges is vital to the nation's transportation system, supporting commerce, economic vitality, and personal mobility. The municipalities rely on the inspection reports to plan and budget maintenance and repairs. However, only about a third of the deficiencies identified in 2014 and 2015 inspections were addressed or were planned or in the process of being addressed. Although the municipalities are statutorily responsible for maintaining the bridges that they own, improvements in how VTrans communicate bridge deficiencies could more effectively encourage municipalities to address identified deficiencies. For

<sup>27</sup> 19 V.S.A. §10(5) states that VTrans shall furnish technical and engineering assistance when requested and be available to municipalities at cost. According to VTrans, for other than very modest work, municipalities must reimburse it for its costs.

<sup>28</sup> VTrans used to contract with St. Michael's College for this program; it transitioned to VTrans on September 1, 2014.

example, currently VTrans does not notify municipalities when inspection reports are available online. Moreover, VTrans could improve how it communicates deficiencies in these reports by providing bridge inspectors with guidance on writing the narrative part of the inspection report.

In addition to the bridge inspections themselves, VTrans provided significant funding and other assistance to municipalities. However, this assistance does not currently include training on bridge-related topics. VTrans is working on developing a bridge awareness workshop.

## Recommendations

We make the recommendations in Table 4 to the Secretary of the Agency of Transportation.

**Table 4: Recommendations and Related Issues**

| Recommendation  | Report Pages | Issue  |
|---|--------------|--|
| 1. Develop a process to notify municipalities when a new inspection report is available.  | 16           | Officials at four municipalities were not aware of specific deficiencies raised by the VTrans inspectors in 2014 and 2015 because they were unaware that the bridge inspection reports had been issued. VTrans does not notify the municipality when a new inspection report is posted. Officials at almost all of the municipalities in our review stated that notifications would help them improve the condition or maintenance of town bridges because without notification they may forget to check for new reports.  |
| 2. Develop guidance on the severity, type, and level of detail to be included in the narrative part of the bridge inspection reports and under what circumstances deficiencies should be communicated to municipalities by letters to the selectboard or governing body, including non-critical deficiencies. | 17-21        | VTrans does not provide guidance to the bridge inspectors on what information should be provided to municipalities in the narrative portion of the inspection report. There is also no guidance as to whether and under what circumstances VTrans should send letters for non-critical items to municipalities. Officials from 14 municipalities stated that additional information in the narratives, such as explanations of the severity of the deficiency and/or more detailed descriptions of the finding, could improve their responses to inspection reports. |

## Management’s Comments and Our Evaluation

On April 3, 2018, the Secretary of the Agency of Transportation provided comments on a draft of this report, which are reprinted in Appendix VI. The

Secretary agreed that more can be done to assist and encourage towns to direct resources toward repair and preventive maintenance of bridges and provided descriptions of actions VTrans intends to take in response to our recommendations. We clarified the wording of our second recommendation as a result of the Secretary's comments.



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## Appendix I

### Scope and Methodology

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To address both objectives, we reviewed a variety of criteria, including:

- The Code of Federal Regulations
- State statutes
- VTrans 2017 and 2018 factbooks and annual reports
- FHWA's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges
- FHWA's NBIS Metrics for the Oversight of the National Bridge Inspection Program
- VTrans metric procedures
- FHWA Bridge Inspector's Reference Manual
- FHWA Bridge Preservation Guide

We also discussed the bridge inspection process and the funding mechanisms with various VTrans officials, including the bridge inspection manager, the technical services manager, the structures manager, and the budget and programming manager.

With respect to Objective 1, to obtain the information on the bridge inspections performed during 2014 and 2015, VTrans provided a snapshot of the bridge inspection database for performance years 2014, 2015, 2016, and 2017. We performed procedures to confirm the validity of the snapshots and assess the reliability of the data.

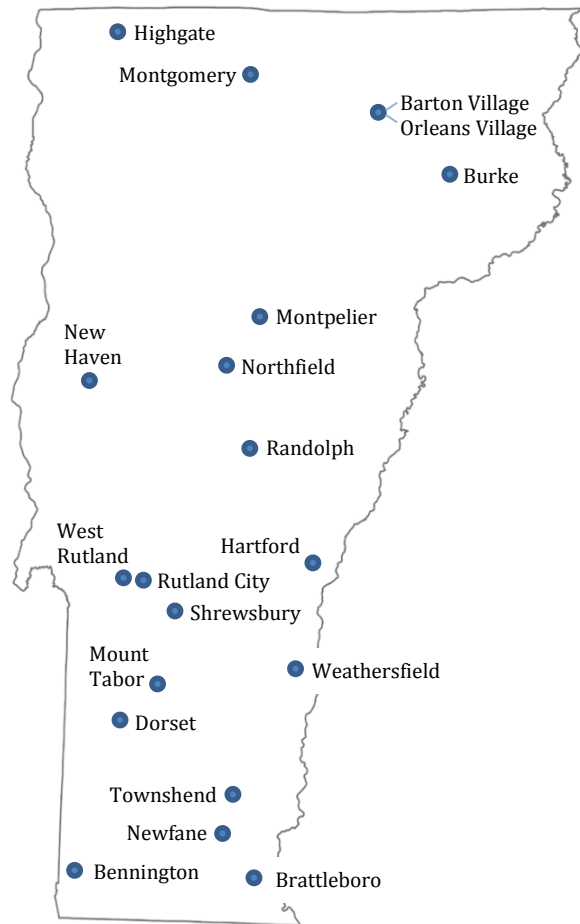
We then filtered the data to obtain the data for the 2014/2015 bridge inspections cycles for municipally-owned bridges and selected 20 municipalities for testing. Ten municipalities were chosen because they had average daily traffic above the average of 849 and at least one bridge that had a rating of 4 or below in at least one of the four condition ratings (deck, superstructure, substructure, channel) in their 2014 or 2015 inspection. The remaining ten were selected randomly from municipalities that had at least one bridge with a condition rating of 5 or below in at least one of the four condition ratings during the same period.

Once the municipalities were selected, only bridges within those municipalities that had at least one condition rating of a 5 or below in their 2014 or 2015 inspection were chosen to be analyzed, for a total of 53

## Appendix I Scope and Methodology

bridges.<sup>29</sup> Figure 10 is a map showing each of the 20 municipalities in our scope.

**Figure 10: Map of Vermont with Municipalities in Scope**



For each of the bridges in our scope, we obtained the VTrans bridge file, which included a record of current and previous bridge inspection reports, field reports, photos, correspondence, and other related information. As needed, we inquired of the VTrans bridge inspectors to clarify our understanding of the deficiencies found during the inspection. We conducted structured interviews with the relevant municipal officials, including road commissions, selectboard members, town managers and public works officials.<sup>30</sup> We obtained documentation from municipalities of any actions or in process actions to address a deficiency, such as a contractor invoice, grant

<sup>29</sup> We did not include in our scope culverts that VTrans also inspects and reports to FHWA as part of the NBIS because the evaluation of their condition is on a different basis than that of bridges.

<sup>30</sup> Mount Tabor did not cooperate with this audit, nonetheless we were able to determine the status of its bridge in our scope using other sources.

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## Appendix I

### Scope and Methodology

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award document, or other supporting information. We also inquired as to reasons if no action was taken to address a deficiency.

Regarding Objective 2, we reviewed the transportation acts and VTrans transportation programs for fiscal years 2015–2018 and identified the various programs that provide funding for municipal bridge projects. We obtained expenditure data for fiscal years 2015–2017 from the VTrans finance and administration division for each of the programs that funded municipal bridges and identified and summarized the amounts that were expended for bridge projects. We did not validate the expenditure data.

With respect to the town highway bridge program, we reviewed the procedures for establishing bridge project priorities, obtained the spreadsheet VTrans used to rank municipal bridges for fiscal year 2018, recalculated and confirmed the ranking of 20 bridges, and found only non-material differences. We also interviewed the VTrans managers that recommend specific projects for funding to obtain an explanation of this process.

With respect to the VTrans grant programs that fund municipal bridge projects, we interviewed officials in charge of these programs in the VTrans maintenance and operations bureau and municipal assistance bureau. We also reviewed the VTrans granting plan for fiscal year 2018 and various publications developed for municipalities.<sup>31</sup>

We performed our audit work between August 2017 and March 2018 at VTrans in the Montpelier area, and the municipalities selected for testing. We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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<sup>31</sup> *The Orange Book 2017-2019: A Handbook for Local Officials* (VTrans, revised September 18, 2017), *Municipal Assistance Bureau Local Projects Guidebook for Locally Managed Projects* (VTrans, revised September 2017), and *Show Me the Money!: A Guide for Municipalities to Vermont Agency of Transportation Grants* (VTrans, February 2017).

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## Appendix II Abbreviations

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|        |                                      |
|--------|--------------------------------------|
| FHWA   | Federal Highway Administration       |
| NBIS   | National Bridge Inspection Standards |
| V.S.A. | Vermont Statutes Annotated           |
| VTrans | Vermont Agency of Transportation     |



# Appendix III

## Example of Bridge Inspection Report

*Glossary of Terms for the  
STRUCTURE INSPECTION, INVENTORY AND APPRAISAL SHEET*

*Vermont Agency of Transportation—Structures Section—Bridge Management and Inspection  
Unit*

|   |   |
|---|---|
| <p><b>CONDITION</b><br/>A judgment of a bridge component condition in comparison to its original as-built condition</p> <p><b>Deck Rating:</b><br/>Condition rating for that portion of a bridge which provides direct support for vehicular and pedestrian traffic, supported by a superstructure</p> <p><b>Superstructure Rating:</b><br/>Condition rating for the portion of a bridge which carries the traffic load and passes that load to the substructure</p> <p><b>Substructure Rating:</b><br/>Condition rating for the abutments and piers built to support the span of a bridge superstructure</p> <p><b>Channel Rating:</b><br/>Condition rating for a waterway connecting two bodies of water or containing moving water; a rolled steel member having a C-shaped cross section</p> <p><b>Culvert Rating:</b><br/>Condition rating for a drainage structure beneath an embankment (e.g., corrugated metal pipe, concrete box culvert) curb - a low barrier at the side limit of the roadway used to guide the movement of vehicles</p> <p><b>Federal Str. Number:</b><br/>This is a unique identifier for every bridge and culvert in the State</p> <p><b>Federal Sufficiency Rating:</b><br/>The sufficiency rating of a bridge is a single aggregate number from 0 (low) to 100 (high) taking into account many items including, the condition of the bridge, the geometry of the roadway the bridge carries and crosses over, the amount of traffic the bridge carries and how well a river, or other waterway, passes underneath the bridge. A low sufficiency rating does not necessarily mean the bridge is unsafe or in need of immediate repair</p> <p><b>Deficiency Status of Structure:</b><br/>Bridge Deficiency - a defect in a bridge component or member that makes the bridge less capable or less desirable for use</p> <p><b>AGE and SERVICE</b></p> <p><b>Year Built, Year Reconstructed:</b><br/>The year Structure was built and/or reconstructed</p> <p><b>Service On:</b><br/>This represents the type of service "on" the bridge; highway, railroad, pedestrian, etc.</p> <p><b>Service Under:</b><br/>This represents the type of service "under" the bridge; highway, railroad, pedestrian, waterway, etc.</p> <p><b>Lanes On the Structure:</b><br/>The number of lanes on the structure</p> <p><b>Lanes Under the Structure:</b><br/>The number of lanes under the structure</p> <p><b>Bypass, Detour Length (miles):</b><br/>The length of the Bypass or Detour in miles</p> <p><b>ADT, % Truck ADT:</b><br/>Average Daily Traffic, % of Average Daily Truck Traffic</p> <p><b>Year of ADT:</b><br/>The year the Average Daily Traffic was collected</p> <p><b>GEOMETRIC DATA</b></p> <p><b>Length of Maximum Span (ft):</b><br/>The length in feet of the max distance between the supports of a beam</p> <p><b>Structure Length (ft):</b><br/>The length of the Structure in feet</p> <p><b>Lt Curb/Sidewalk Width (ft):</b><br/>The width of the Left Curb/Sidewalk in feet</p> <p><b>Rt Curb/Sidewalk Width (ft):</b><br/>The width of the Right Curb/Sidewalk in feet</p> <p><b>Bridge Rdwy Width Curb-to-Curb (ft):</b><br/>The most restrictive width between curbs or rails on the structure roadway</p> <p><b>Deck Width Out-to-Out:</b><br/>Represents the out to out (fascia to fascia) width of the bridge</p> <p><b>Appr. Roadway Width (ft):</b><br/>Represents the normal width of usable roadway approaching the structure</p> <p><b>Skew:</b><br/>The angle between the centerline of an abutment or pier and a line normal to the roadway centerline</p> <p><b>Bridge Median:</b><br/>Type of separation between opposing lanes of highway traffic; also known as median strip</p> <p><b>Min Vertical Clr Over (ft):</b><br/>The minimum vertical clearance over the bridge roadway, including shoulders, to any superstructure restriction</p> <p><b>Feature Under:</b><br/>Reference feature from which the clearance measurement is taken</p> <p><b>Min Vertical Underclr (ft):</b><br/>The minimum vertical clearance from the roadway or railroad track beneath the structure to the underside of the superstructure</p> <p><b>INSPECTION SUMMARY and NEEDS</b><br/>Comment Section, includes the Inspection Summary and any of the structure's needs</p> | <p><b>STRUCTURE TYPE and MATERIALS</b></p> <p><b>Bridge Type:</b><br/>Type of raised structure built to carry vehicles or pedestrians over an obstacle</p> <p><b>Number of Approach Spans:</b><br/>Approach - the part of the roadway immediately before and after the bridge structure</p> <p><b>Number of Main Spans:</b><br/>Span - the distance between the supports of a beam; the distance between the faces of the substructure elements</p> <p><b>Kind of Material and/or Design:</b><br/>Main Structure Material</p> <p><b>Deck Structure Type:</b><br/>Type of deck system on the bridge</p> <p><b>Type of Wearing Surface:</b><br/>The topmost layer of material applied upon a roadway to receive the traffic loads and to resist the resulting disintegrating action</p> <p><b>Type of Membrane:</b><br/>An impervious layer placed between the wearing surface and the concrete deck, used to protect the deck from water and corrosive chemicals that could damage it</p> <p><b>Deck Protection:</b><br/>Protective system of the bridge deck</p> <p><b>APPRAISAL *AS COMPARED TO FEDERAL STANDARDS</b><br/>A judgment of a bridge component's adequacy in comparison to current standards</p> <p><b>Bridge Railings:</b><br/>Railing "on" the bridge</p> <p><b>Transitions:</b><br/>Section of rail transitioning from the approach to bridge rail</p> <p><b>Approach Guardrail:</b><br/>A safety feature element intended to redirect an errant vehicle guide rail</p> <p><b>Approach Guardrail Ends:</b><br/>A safety feature element intended to redirect an errant vehicle guide rail</p> <p><b>Structural Evaluation:</b><br/>This item, comparing existing overall condition and load rating to current design standards, is calculated and not coded by the inspector</p> <p><b>Deck Geometry:</b><br/>This item, comparing existing conditions (curb to curb width and vertical clearance over roadway) to current design standards, is calculated and not coded by the inspector</p> <p><b>Underclearances Vertical and Horizontal:</b><br/>This item, comparing existing conditions (vertical and horizontal underclearances) to current design standards, is calculated and not coded by the inspector</p> <p><b>Waterway Adequacy:</b><br/>The available width for the passage of water beneath a bridge</p> <p><b>Approach Roadway Alignment:</b><br/>The available width for the passage of water beneath a bridge</p> <p><b>Scour Critical Bridges:</b><br/>Current status of the bridge regarding its vulnerability to scour</p> <p><b>DESIGN VEHICLE, RATING AND POSTING</b></p> <p><b>Load Rating Method (Inv):</b><br/>Method used for load rating analysis</p> <p><b>Posting Status:</b><br/>Provides information about the actual operational status of a structure</p> <p><b>Bridge Posting:</b><br/>Evaluated the load capacity of a bridge in comparison to state or town legal load</p> <p><b>Load Posting:</b><br/>Need, existence and type of load posting signage</p> <p><b>Posted Vehicle:</b><br/>Type of vehicle used for posting</p> <p><b>Posted Weight (tons):</b><br/>Actual posted weight</p> <p><b>Design Load:</b><br/>Live load for which the structure was designed</p> <p><b>INSPECTION</b></p> <p><b>Insp. Date:</b><br/>Date of Inspection</p> <p><b>Insp. Freq. (months):</b><br/>The frequency with which the bridge is inspected -- normally every two years</p> <p><b>X-Ref. Route:</b><br/>Cross reference route number. This item is used when a duplicate record is required</p> <p><b>X-Ref. BrNum:</b><br/>Cross reference bridge number. This item is used when a duplicate record is required</p> |
|---|---|

# Appendix IV

## Profile of Bridges in Audit Scope

### BARTON VILLAGE

**Structure Number:** 200037002010022

**Year Built:** 1919 (replaced in 2017)

**Bridge Number:** 20

**Average Daily Traffic:** 3,280 (1998)

**Location:** VT-16, 0.2 miles south of junction with US-5 (over Crystal Lake Outlet)

#### Bridge Inspection Condition Ratings

|                | 7/2/2015         | 8/25/2017 (new bridge) |
|----------------|------------------|------------------------|
| Deck           | 5 (fair)         | 8 (very good)          |
| Superstructure | 5 (fair)         | 8 (very good)          |
| Substructure   | 5 (fair)         | 8 (very good)          |
| Channel        | 6 (satisfactory) | 8 (very good)          |

**Figure 11: Illustrative Pictures of Barton Village Bridge 20**

**Photo and Finding from 2015 VTrans Inspection**

Voids in the abutments and the pier should be chinked with smaller stone.



**Photo from Latest VTrans Inspection**

VTrans replaced bridge as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### BARTON VILLAGE

**Structure Number:** 101002005510021      **Year Built:** 1919 (reconstructed in 1971)  
**Bridge Number:** 55      **Average Daily Traffic:** 1,500 (2008)  
**Location:** Town Hwy. 5, 0.03 miles west of junction with Town Hwy. 2 (over Barton River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 10/13/2014                          | 8/1/2017         |
| Deck           | 6 (satisfactory)                    | 5 (fair)         |
| Superstructure | 6 (satisfactory)                    | 5 (fair)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 5 (fair)                            | 6 (satisfactory) |

**Figure 12: Illustrative Pictures of Barton Village Bridge 55**

**Photo and Finding from 2014 VTrans Inspection**

Timber debris in spans 3 and 4 should be removed.



**Photo from 2016 VTrans Inspection**

Barton Village removed the debris.





# Appendix IV

## Profile of Bridges in Audit Scope

### BARTON VILLAGE

**Structure Number:** 101002005810021

**Year Built:** 1956 (replaced in 2017)

**Bridge Number:** 58

**Average Daily Traffic:** 1,500 (2008)

**Location:** At junction of VT-16 and Town Hwy. 4 (over Barton River)

#### Bridge Inspection Condition Ratings

|                | 5/28/2014        | 8/25/2017 (new bridge) |
|----------------|------------------|------------------------|
| Deck           | 4 (poor)         | 8 (very good)          |
| Superstructure | 4 (poor)         | 8 (very good)          |
| Substructure   | 6 (satisfactory) | 8 (very good)          |
| Channel        | 6 (satisfactory) | 8 (very good)          |

**Figure 13: Illustrative Pictures of Barton Village Bridge 58**

#### Photo and Finding from 2014 VTrans Inspection

Structure in poor condition, including voids in the stone blocks of the abutments and piers.



#### Photo from Latest VTrans Inspection

VTrans replaced bridge as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### BENNINGTON

**Structure Number:** 200010000602022      **Year Built:** 1923  
**Bridge Number:** 6      **Average Daily Traffic:** 12,300 (1998)  
**Location:** VT-9, 0.6 miles east of junction with US-7 (over Walloomsac River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 6/9/2015                            | 5/30/2017        |
| Deck           | 7 (good)                            | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 5 (fair)                            | 5 (fair)         |
| Channel        | 6 (satisfactory)                    | 6 (satisfactory) |

**Figure 14: Illustrative Pictures of Bennington Bridge 6**

**Photo and Finding from 2015 VTrans Inspection**

Extensive concrete repairs are needed.



**Photo from Latest VTrans Inspection**

VTrans is evaluating alternatives as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### BENNINGTON

**Structure Number:** 100202002902021

**Year Built:** 1956

**Bridge Number:** 29

**Average Daily Traffic:** 1,200 (2007)

**Location:** Town Hwy. 17, 0.08 miles west of junction with US-7 (over Furnace Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 4/21/2015                           | 10/23/2017       |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 7 (good)                            | 7 (good)         |
| Channel        | 7 (good)                            | 7 (good)         |

**Figure 15: Illustrative Pictures of Bennington Bridge 29**

**Photo and Finding from 2015 VTrans Inspection**

Repairs needed to supplement section loss in three beams. All beams need cleaning and painting.



**Photo from Latest VTrans Inspection**

Bennington has not acted to address issue as of December 2017.



## Appendix IV Profile of Bridges in Audit Scope

### BENNINGTON

**Structure Number:** 201018004302022

**Year Built:** 1926

**Bridge Number:** 43

**Average Daily Traffic:** 8,100 (1997)

**Location:** Depot St. (over Walloomsac River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 6/2/2014                            | 6/23/2016        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 7 (good)                            | 6 (satisfactory) |

**Figure 16: Illustrative Pictures of Bennington Bridge 43**

**Photo and Finding from 2014 VTrans Inspection**

Deterioration of arches.



**Photo from Latest VTrans Inspection**

Bennington has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### BENNINGTON

**Structure Number:** 201030005702022      **Year Built:** 1938 (reconstructed in 2016)  
**Bridge Number:** 57      **Average Daily Traffic:** 10,500 (2013)  
**Location:** Hunt St. (over Roaring Branch of Walloomsac Brook)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 4/21/2014                           | 10/18/2016    |
| Deck           | 4 (poor)                            | 8 (very good) |
| Superstructure | 6 (satisfactory)                    | 8 (very good) |
| Substructure   | 6 (satisfactory)                    | 7 (good)      |
| Channel        | 8 (very good)                       | 7 (good)      |

**Figure 17: Illustrative Pictures of Bennington Bridge 57**

**Photo and Finding from 2014 VTrans Inspection**

Structure needs to have a rehabilitation project and full deck replacement.



**Photo from Latest VTrans Inspection**

VTrans rehabilitated structure, including replacing the deck, as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### BRATTLEBORO

**Structure Number:** 101302000413021      **Year Built:** 1952  
**Bridge Number:** 4      **Average Daily Traffic:** 1,650 (2008)  
**Location:** Town Hwy 6, 0.3 miles west of junction with Town Hwy. 8 (over Ames Hill Brook)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 9/2/2014                            | 9/8/2016      |
| Deck           | 7 (good)                            | 7 (good)      |
| Superstructure | 7 (good)                            | 7 (good)      |
| Substructure   | 8 (very good)                       | 8 (very good) |
| Channel        | 5 (fair)                            | 5 (fair)      |

**Figure 18: Illustrative Pictures of Brattleboro Bridge 4**

**Photo and Finding from 2014 VTrans Inspection**

Gravel bar should be removed.



**Photo from Latest VTrans Inspection**

Brattleboro has not acted to address issue as of January 2018.



## Appendix IV Profile of Bridges in Audit Scope

### BRATTLEBORO

**Structure Number:** 202012003113022

**Year Built:** 1946 (reconstructed in 2016)

**Bridge Number:** 31

**Average Daily Traffic:** 4,800 (2015)

**Location:** Elliott St. (over Whetstone Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 6/19/2014                           | 9/27/2016        |
| Deck           | 4 (poor)                            | 8 (very good)    |
| Superstructure | 7 (good)                            | 7 (good)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 19: Illustrative Pictures of Brattleboro Bridge 31**

#### Photo and Finding from 2014 VTrans Inspection

Deck will need rehabilitation in the near future.



#### Photo from Latest VTrans Inspection

VTrans replaced deck as part of town highway bridge program.



# Appendix IV Profile of Bridges in Audit Scope

## BURKE

**Structure Number:** 200261001403022

**Year Built:** 1928

**Bridge Number:** 14

**Average Daily Traffic:** 740 (1995)

**Location:** Town Rd. 3, 0.8 miles west of junction with US-5 (over Calendar Brook)

### Bridge Inspection Condition Ratings

|                | 7/9/2014         | 7/19/2016        |
|----------------|------------------|------------------|
| Deck           | 6 (satisfactory) | 6 (satisfactory) |
| Superstructure | 5 (fair)         | 6 (satisfactory) |
| Substructure   | 5 (fair)         | 5 (fair)         |
| Channel        | 5 (fair)         | 7 (good)         |

**Figure 20: Illustrative Pictures of Burke Bridge 14**

**Photo and Finding from 2014 VTrans Inspection**

Concrete deterioration due to roadway runoff.



**Photo from Latest VTrans Inspection**

Burke has not acted to address issue as of November 2017.





# Appendix IV

## Profile of Bridges in Audit Scope

### BURKE

**Structure Number:** 100302001503021

**Year Built:** 1922

**Bridge Number:** 15

**Average Daily Traffic:** 350 (2008)

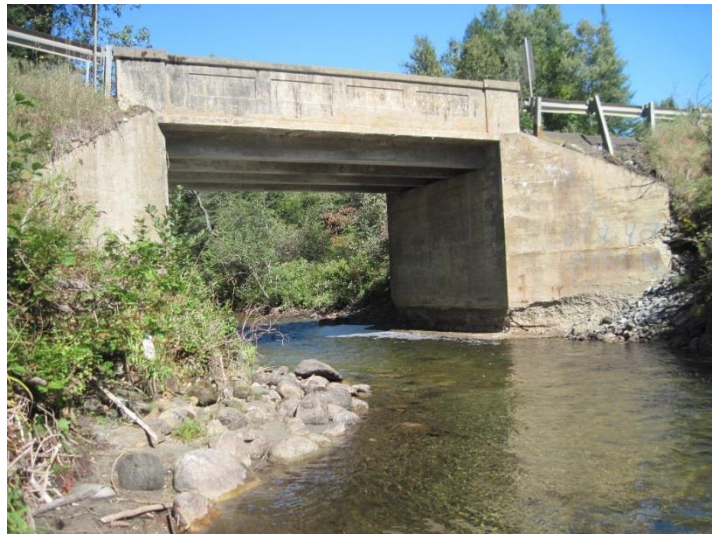
**Location:** Town Hwy. 44, 0.1 miles from junction of Town Hwy. 58 and US- 5 (over west branch of Passumpsic river)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/17/2014                           | 9/27/2016        |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 7 (good)                            | 6 (satisfactory) |
| Substructure   | 6 (satisfactory)                    | 5 (fair)         |
| Channel        | 5 (fair)                            | 5 (fair)         |

**Figure 21: Illustrative Pictures of Burke Bridge 15**

**Photo and Finding from 2014 VTrans Inspection**

Approaches behind rail in corners need to be filled in with stone to prevent further deterioration.



**Photo Provided by Burke**

Burke filled in area behind approach rails with stone.



# Appendix IV Profile of Bridges in Audit Scope

## BURKE

**Structure Number:** 200267001903022

**Year Built:** 1939

**Bridge Number:** 19

**Average Daily Traffic:** 860 (1995)

**Location:** Town Hwy. 6, 0.1 mile west to junction with VT-114 (over east branch of Passumpsic river)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 7/9/2014                            | 7/19/2016        |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 6 (satisfactory) |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 7 (good)         |

**Figure 22: Illustrative Pictures of Burke Bridge 19**

**Photo and Finding from 2014 VTrans Inspection**

Steel should be cleaned and painted.



**Photo from Latest VTrans Inspection**

Burke has not acted to address issue as of November 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### DORSET

**Structure Number:** 100203003002031

**Year Built:** 1919 (reconstructed in 2016)

**Bridge Number:** 30

**Average Daily Traffic:** 150 (2016)

**Location:** Town Hwy. 10, 1.3 miles west of junction with Town Hwy. 7 (over Mettawee River)

#### Bridge Inspection Condition Ratings

|                | 9/24/2014        | 9/9/2016 (reconstructed bridge) |
|----------------|------------------|---------------------------------|
| Deck           | 5 (fair)         | 8 (very good)                   |
| Superstructure | 5 (fair)         | 8 (very good)                   |
| Substructure   | 7 (good)         | 7 (good)                        |
| Channel        | 6 (satisfactory) | 6 (satisfactory)                |

**Figure 23: Illustrative Pictures of Dorset Bridge 30**

#### Photo and Finding from 2014 VTrans Inspection

Deck and steel beam superstructure are reaching point for full replacement.



#### Photo from Latest VTrans Inspection

Dorset obtained a town structures grant from VTrans and replaced the deck and superstructure with pre-stressed concrete slabs.



# Appendix IV

## Profile of Bridges in Audit Scope

### HARTFORD

**Structure Number:** 101408000714081

**Year Built:** 1929 (reconstructed in 1973)

**Bridge Number:** 7

**Average Daily Traffic:** 2,000 (2008)

**Location:** At junction with Town Hwy. 6 (over White River and Town Hwy. 98)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/22/2014                           | 9/19/2017        |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 4 (poor)                            | 4 (poor)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 24: Illustrative Pictures of Hartford Bridge 7**

**Photo and Finding from 2014 VTrans Inspection**

Deterioration along the lower node and bottom cord. Steel repairs and replacement of members is needed around these areas. The superstructure needs cleaning and painting.



**Photo from Latest VTrans Inspection**

Hartford partially addressed issue by greasing lower node in some areas, which temporarily protects the steel elements. VTrans is evaluating alternatives as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### HIGHGATE

**Structure Number:** 100609002506091

**Year Built:** 1928

**Bridge Number:** 25

**Average Daily Traffic:** 1,200 (2007)

**Location:** Town Hwy 4, 0.02 miles west to junction with VT-78 (over Missisquoi river)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 9/23/2014                           | 9/13/2017     |
| Deck           | 5 (fair)                            | 4 (poor)      |
| Superstructure | 4 (poor)                            | 3 (serious)   |
| Substructure   | 4 (poor)                            | 4 (poor)      |
| Channel        | 8 (very good)                       | 8 (very good) |

**Figure 25: Illustrative Pictures of Highgate Bridge 25**

**Photo and Finding from 2014 VTrans Inspection**

Deck needs full replacement



**Photo from Latest VTrans Inspection**

Highgate partially addressed issue by patching holes in surface of the deck, VTrans scheduled to replace bridge in 2018-2019 as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTGOMERY

**Structure Number:** 200308000406102

**Year Built:** 1927

**Bridge Number:** 4

**Average Daily Traffic:** 180 (1995)

**Location:** Town Rd. 2, 3.8 miles east of junction with VT-118 (over Wade brook)

#### Bridge Inspection Condition Ratings

|                | 9/3/2014 | 9/19/2016 |
|----------------|----------|-----------|
| Deck           | 7 (good) | 7 (good)  |
| Superstructure | 7 (good) | 7 (good)  |
| Substructure   | 5 (fair) | 5 (fair)  |
| Channel        | 5 (fair) | 5 (fair)  |

**Figure 26: Illustrative Pictures of Montgomery Bridge 4**

**Photo and Finding from 2014 VTrans Inspection**

Past settlement damage along east abutment (no change in several years).



**Photo from Latest VTrans Inspection**

Montgomery has not acted to address issue as of November 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 206426000512112  
**Bridge Number:** 5  
**Location:** Taylor St. (over Winooski River)

**Year Built:** 1929 (reconstructed in 2010)  
**Average Daily Traffic:** 4,100 (1997)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 7/16/2014                           | 7/20/2016     |
| Deck           | 8 (very good)                       | 8 (very good) |
| Superstructure | 5 (fair)                            | 5 (fair)      |
| Substructure   | 8 (very good)                       | 8 (very good) |
| Channel        | 8 (very good)                       | 8 (very good) |

**Figure 27: Illustrative Pictures of Montpelier Bridge 5**

**Photo and Finding from 2014 VTrans Inspection**

Fabric trough for the Vermont joint needs flushing out to keep corrosion at bay.



**Photo from Latest VTrans Inspection**

Montpelier has not acted to address issue as of December 2017; bridge cleaning and greasing planned for 2018.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 101211001312111

**Year Built:** 1929

**Bridge Number:** 13

**Average Daily Traffic:** 300 (2007)

**Location:** Cummings Street, 0.1 miles west of junction with Town Hwy. 5 (over North Branch of Winooski River)

|                | Bridge Inspection Condition Ratings |          |
|----------------|-------------------------------------|----------|
|                | 8/20/2014                           | 4/5/2017 |
| Deck           | 4 (poor)                            | 4 (poor) |
| Superstructure | 4 (poor)                            | 4 (poor) |
| Substructure   | 5 (fair)                            | 5 (fair) |
| Channel        | 5 (fair)                            | 5 (fair) |

**Figure 28: Illustrative Pictures of Montpelier Bridge 13**

**Photo and Finding from 2014 VTrans Inspection**

Beams have very heavy rusting and minor crushing at abutment 2 end. Bridge needs replacement or extensive reconstruction.



**Photo from 2016 VTrans Inspection**

VTrans plans to replace bridge in 2019 as part of town highway bridge program.





# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 101211001512111

**Year Built:** 1927 (reconstructed in 1977)

**Bridge Number:** 15

**Average Daily Traffic:** 50 (2007)

**Location:** Grout Rd., 0.03 miles west of junction with Town Hwy. 5 (over North Branch of Winooski River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/13/2015                           | 8/17/2017        |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 5 (fair)                            | 5 (fair)         |
| Channel        | 6 (satisfactory)                    | 6 (satisfactory) |

**Figure 29: Illustrative Pictures of Montpelier Bridge 15**

**Photo and Finding from 2015 VTrans Inspection**

Runner planks damaged.



**Photo from Latest VTrans Inspection**

Montpelier replaced the runners.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 206416001712112  
**Bridge Number:** 17  
**Location:** Granite St. (over Winooski River)

**Year Built:** 1902 (reconstructed 1992)  
**Average Daily Traffic:** 2,900 (1997)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 7/17/2014                           | 7/20/2016        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 30: Illustrative Pictures of Montpelier Bridge 17**

**Photo and Finding from 2014 VTrans Inspection**

Steel superstructure needs extensive cleaning and painting.



**Photo from Latest VTrans Inspection**

VTrans cleaned and painted the superstructure as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 200028006412112

**Year Built:** 1961

**Bridge Number:** 64

**Average Daily Traffic:** 8,600 (1998)

**Location:** US-2, 0.5 miles east of junction with US-302 (over Winooski River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 6/24/2015                           | 6/27/2017        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 7 (good)                            | 7 (good)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 7 (good)                            | 7 (good)         |

**Figure 31: Illustrative Pictures of Montpelier Bridge 64**

**Photo and Finding from 2015 VTrans Inspection**

Abutments need cleaning and patch repair work



**Photo from Latest VTrans Inspection**

Montpelier has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### MONTPELIER

**Structure Number:** 206400B2-112112

**Year Built:** 1916

**Bridge Number:** OB2-1

**Average Daily Traffic:** 6,000 (1998)

**Location:** State St., 0.1 miles west of junction with VT-12 (over North Branch)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 7/30/2015                           | 7/26/2017     |
| Deck           | 5 (fair)                            | 5 (fair)      |
| Superstructure | 5 (fair)                            | 5 (fair)      |
| Substructure   | 4 (poor)                            | 5 (fair)      |
| Channel        | 8 (very good)                       | 8 (very good) |

**Figure 32: Illustrative Pictures of Montpelier Bridge OB2-1**

**Photo and Finding from 2015 VTrans Inspection**

Heavy concrete damage along the western abutment stem and seats



**Photo from Latest VTrans Inspection**

Montpelier patched the concrete.



# Appendix IV

## Profile of Bridges in Audit Scope

### MOUNT TABOR

**Structure Number:** 101113000211131      **Year Built:** 1947 (replaced in 2015)  
**Bridge Number:** 2      **Average Daily Traffic:** 200 (2016)  
**Location:** Town Hwy. 1, 0.2 miles west of junction with US-7 (over Otter Creek)

|                | Bridge Inspection Condition Ratings |                       |
|----------------|-------------------------------------|-----------------------|
|                | 9/18/2014                           | 9/8/2016 (new bridge) |
| Deck           | 5 (fair)                            | 8 (very good)         |
| Superstructure | 7 (good)                            | 8 (very good)         |
| Substructure   | 7 (good)                            | 8 (very good)         |
| Channel        | 8 (very good)                       | 8 (very good)         |

**Figure 33: Illustrative Pictures of Mount Tabor Bridge 2**

**Photo and Finding from 2014 VTrans Inspection**

Bridge would benefit greatly from a deck replacement and cleaning and painting of steel superstructure.



**Photo from Latest VTrans Inspection**

U.S. Forest Service replaced bridge.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEW HAVEN

**Structure Number:** 200183001001132

**Year Built:** 1934 (replaced in 2016)

**Bridge Number:** 10

**Average Daily Traffic:** 1,600 (2014)

**Location:** Town Rd. 2, 1.1 miles east of junction with US-7 (over New Haven River)

#### Bridge Inspection Condition Ratings

|                | 8/20/2014 | 9/2/2016 (new bridge) |
|----------------|-----------|-----------------------|
| Deck           | 4 (poor)  | 8 (very good)         |
| Superstructure | 5 (fair)  | 8 (very good)         |
| Substructure   | 5 (fair)  | 8 (very good)         |
| Channel        | 5 (fair)  | 7 (good)              |

**Figure 34: Illustrative Pictures of New Haven Bridge 10**

#### Photo and Finding from 2014 VTrans Inspection

Deck is poor and bridge in need of extensive reconstruction.



#### Photo from Latest VTrans Inspection

VTrans replaced bridge as part of town highway bridge program.



# Appendix IV Profile of Bridges in Audit Scope

## NEW HAVEN

**Structure Number:** 100113003001131

**Year Built:** 1927

**Bridge Number:** 30

**Average Daily Traffic:** 200 (2008)

**Location:** Town Hwy. 5, 0.25 miles west of junction with of US-7 (over New Haven River)

|                | Bridge Inspection Condition Ratings |           |
|----------------|-------------------------------------|-----------|
|                | 8/21/2014                           | 8/10/2016 |
| Deck           | 5 (fair)                            | 5 (fair)  |
| Superstructure | 5 (fair)                            | 5 (fair)  |
| Substructure   | 5 (fair)                            | 5 (fair)  |
| Channel        | 7 (good)                            | 7 (good)  |

**Figure 35: Illustrative Pictures of New Haven Bridge 30**

**Photo and Finding from 2014 VTrans Inspection**

This structure should have concrete repairs to the piers and superstructure.



**Photo from Latest VTrans Inspection**

New Haven has not acted to address issue as of November 2017.



## Appendix IV Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312000813121

**Year Built:** 1926

**Bridge Number:** 8

**Average Daily Traffic:** 540 (2008)

**Location:** Town Hwy. 1, 0.15 miles west of junction with Town Hwy. 12 (over Wardsboro Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/4/2014                            | 9/16/2016        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 6 (satisfactory)                    | 6 (satisfactory) |
| Substructure   | 7 (good)                            | 7 (good)         |
| Channel        | 6 (satisfactory)                    | 6 (satisfactory) |

**Figure 36: Illustrative Pictures of Newfane Bridge 8**

**Photo and Finding from 2014 VTrans Inspection**

Approach rail should be raised to meet standards.



**2018 Photo Provided by Newfane.**

Newfane replaced railings.





# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312000913121

**Year Built:** 1939

**Bridge Number:** 9

**Average Daily Traffic:** 160 (2008)

**Location:** Town Hwy. 1, 0.04 miles west of junction with Town Hwy. 6 (over Wardsboro Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/4/2014                            | 9/16/2016        |
| Deck           | 7 (good)                            | 7 (good)         |
| Superstructure | 7 (good)                            | 7 (good)         |
| Substructure   | 7 (good)                            | 7 (good)         |
| Channel        | 5 (fair)                            | 6 (satisfactory) |

**Figure 37: Illustrative Pictures of Newfane Bridge 9**

**Photo and Finding from 2014 VTrans Inspection**

Trees and brush on the upstream side should be removed from the channel.



**Photo from Latest VTrans Inspection**

After consultation with the Vermont Department of Environmental Conservation, which did not approve removal of the trees and brush, Newfane did not take action.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312004113121

**Year Built:** 1939 (reconstructed in 1971)

**Bridge Number:** 41

**Average Daily Traffic:** 100 (2008)

**Location:** Town Hwy. 26, at junction with Town Hwy. 19 (over Baker Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/10/2014                           | 9/21/2016        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 7 (good)                            | 6 (satisfactory) |
| Channel        | 7 (good)                            | 8 (very good)    |

**Figure 38: Illustrative Pictures of Newfane Bridge 41**

**Photo and Finding from 2014 VTrans Inspection**

Beams are in poor condition.



**Photo from Latest VTrans Inspection**

Newfane has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312004313121

**Year Built:** 1950 (reconstructed in 1980)

**Bridge Number:** 43

**Average Daily Traffic:** 150 (2008)

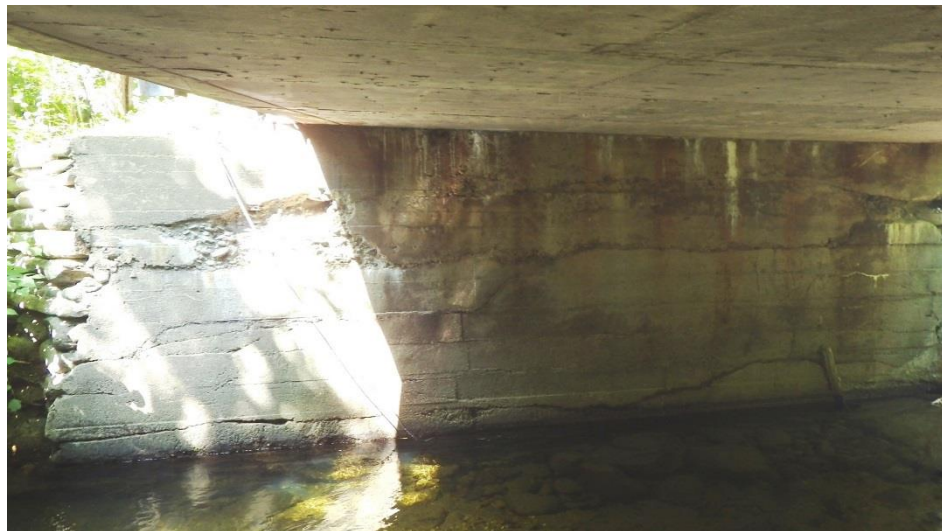
**Location:** Town Hwy. 11, 0.1 miles west of junction with Town Hwy. 1 (over Wardsboro Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/4/2014                            | 9/20/2016        |
| Deck           | 8 (very good)                       | 7 (good)         |
| Superstructure | 8 (very good)                       | 7 (good)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 5 (fair)                            | 5 (fair)         |

**Figure 39: Illustrative Pictures of Newfane Bridge 43**

**Photo and Finding from 2014 VTrans Inspection**

Abutment 2 should be refaced.



**Photo from Latest VTrans Inspection**

Newfane has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312004513121

**Year Built:** 1987 (reconstructed in 2014)

**Bridge Number:** 45

**Average Daily Traffic:** 25 (2015)

**Location:** Town Hwy. 32, 0.1 miles west of junction with Town Hwy. 2 (over Hunter Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 9/10/2014                           | 9/22/2016        |
| Deck           | 4 (poor)                            | 8 (very good)    |
| Superstructure | 6 (satisfactory)                    | 7 (good)         |
| Substructure   | 8 (very good)                       | 8 (very good)    |
| Channel        | 5 (fair)                            | 6 (satisfactory) |

**Figure 40: Illustrative Pictures of Newfane Bridge 45**

**Photo and Finding from 2014 VTrans Inspection**

The deck is in poor condition and should be replaced soon.



**Photo from Latest VTrans Inspection**

Newfane replaced the deck.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312004813121

**Year Built:** 1939 (reconstructed in 2017)

**Bridge Number:** 48

**Average Daily Traffic:** 400 (2017)

**Location:** Town Hwy. 15, 0.03 miles west of junction with VT-30 (over Smith Brook)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 9/10/2014                           | 12/6/2017     |
| Deck           | 7 (good)                            | 8 (very good) |
| Superstructure | 5 (fair)                            | 8 (very good) |
| Substructure   | 7 (good)                            | 8 (very good) |
| Channel        | 6 (satisfactory)                    | 7 (good)      |

**Figure 41: Illustrative Pictures of Newfane Bridge 48**

**Photo and Finding from 2014 VTrans Inspection**

Riprap on abutment 2 side should be repaired.



**Photo from Latest VTrans Inspection**

Newfane repaired rip rap during bridge reconstruction that utilized a VTrans town highway structures grant.



# Appendix IV

## Profile of Bridges in Audit Scope

### NEWFANE

**Structure Number:** 101312004913121

**Year Built:** 1939 (reconstructed in 1997)

**Bridge Number:** 49

**Average Daily Traffic:** 180 (2008)

**Location:** Town Hwy. 26, at junction west of Town Hwy. 2 (over Rock River)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 9/10/2014                           | 8/7/2017      |
| Deck           | 7 (good)                            | 8 (very good) |
| Superstructure | 5 (fair)                            | 5 (fair)      |
| Substructure   | 7 (good)                            | 7 (good)      |
| Channel        | 7 (good)                            | 8 (very good) |

**Figure 42: Illustrative Pictures of Newfane Bridge 49**

**Photo and Finding from 2014 VTrans Inspection**

Diagonal bracing on the downstream side should be replaced.



**Photo from VTrans Inspection 4/6/2017**

Newfane has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213001012131      **Year Built:** 1900 (reconstructed in 1967)  
**Bridge Number:** 10      **Average Daily Traffic:** 1,200 (2008)  
**Location:** Town Hwy. 3, 0.4 miles west of junction with VT-12 (over Cox Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/13/2014                           | 8/5/2016         |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 7 (good)                            | 7 (good)         |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 43: Illustrative Pictures of Northfield Bridge 10**

**Photo and Finding from 2014 VTrans Inspection**

Covered bridge portion needs reconstruction.



**Photo from Latest VTrans Inspection**

Northfield has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213004512131

**Year Built:** 1949 (reconstructed in 1994)

**Bridge Number:** 45

**Average Daily Traffic:** 200 (2008)

**Location:** Town Hwy. 25, 0.15 miles west of junction with Town Hwy. 8 (over Union Brook)

#### Bridge Inspection Condition Ratings

|                | 8/5/2014 | 8/2/2016 |
|----------------|----------|----------|
| Deck           | 7 (good) | 7 (good) |
| Superstructure | 7 (good) | 7 (good) |
| Substructure   | 7 (good) | 7 (good) |
| Channel        | 5 (fair) | 7 (good) |

**Figure 44: Illustrative Pictures of Northfield Bridge 45**

**Photo and Finding from 2014 VTrans Inspection**

Channel needs to be realigned.



**Photo from Latest VTrans Inspection**

High-water event redirected the channel.





# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213004712131

**Year Built:** 1933

**Bridge Number:** 47

**Average Daily Traffic:** 400 (2008)

**Location:** Town Hwy. 8, at junction with VT-12A (over Dog River)

|                | Bridge Inspection Condition Ratings |          |
|----------------|-------------------------------------|----------|
|                | 8/7/2014                            | 8/3/2016 |
| Deck           | 5 (fair)                            | 5 (fair) |
| Superstructure | 5 (fair)                            | 5 (fair) |
| Substructure   | 5 (fair)                            | 5 (fair) |
| Channel        | 6 (satisfactory)                    | 7 (good) |

**Figure 45: Illustrative Pictures of Northfield Bridge 47**

**Photo and Finding from 2014 VTrans Inspection**

Full-depth hole has occurred along backwall (the topmost portion) of abutment 1.



**Photo from Latest VTrans Inspection**

Northfield repaired the full depth hole.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213005612131

**Year Built:** 1919 (reconstructed in 1994)

**Bridge Number:** 56

**Average Daily Traffic:** 10 (2008)

**Location:** Town Hwy 54, at junction with VT-12 (over Sunny Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/11/2014                           | 4/11/2017        |
| Deck           | 7 (good)                            | 7 (good)         |
| Superstructure | 4 (poor)                            | 5 (fair)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 46: Illustrative Pictures of Northfield Bridge 56**

**Photo and Finding from 2014 VTrans Inspection**

Laid-up stone at abutment needs chinking and mortar repairs.



**Photo from Latest VTrans Inspection**

Northfield has not acted to address issue as of January 2018.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 200241006012132      **Year Built:** 1926 (Reconstructed in 1958)  
**Bridge Number:** 60      **Average Daily Traffic:** 5,200 (1998)  
**Location:** VT-12, 1.1 miles north of junction with VT-12A (over Dog River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 6/17/2015                           | 4/11/2017        |
| Deck           | 5 (fair)                            | 5 (fair)         |
| Superstructure | 4 (poor)                            | 4 (poor)         |
| Substructure   | 5 (fair)                            | 5 (fair)         |
| Channel        | 6 (satisfactory)                    | 6 (satisfactory) |

**Figure 47: Illustrative Pictures of Northfield Bridge 60**

**Photo and Finding from 2015 VTrans Inspection**

Concrete loss and substructure deterioration.



**Photo from Latest VTrans Inspection**

Northfield has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213006712131

**Year Built:** 1919 (reconstructed in 1968)

**Bridge Number:** 67

**Average Daily Traffic:** 10 (2008)

**Location:** Town Hwy. 93, 0.02 miles west of junction with VT-12 (over Sunny Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/11/2014                           | 8/2/2016         |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 48: Illustrative Pictures of Northfield Bridge 67**

**Photo and Finding from 2014 VTrans Inspection**

Structure deterioration is progressing. Steel superstructure is going to need replacement in five years or less.



**December 2017 SAO Photo**

Northfield has not acted to address issue as of December 2017.



## Appendix IV Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213008112131

**Year Built:** 1970 (reconstructed in 1999)

**Bridge Number:** 81

**Average Daily Traffic:** 150 (2008)

**Location:** Town Hwy. 431, 0.02 miles west of junction with Union St. (over Union Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/12/2014                           | 8/3/2016         |
| Deck           | 6 (satisfactory)                    | 7 (good)         |
| Superstructure | 5 (fair)                            | 5 (fair)         |
| Substructure   | 5 (fair)                            | 6 (satisfactory) |
| Channel        | 6 (satisfactory)                    | 7 (good)         |

**Figure 49: Illustrative Pictures of Northfield Bridge 81**

**Photo and Finding from 2014 VTrans Inspection**

Beams need to be cleaned and painted due to heavy rusting,



**Photo from Latest VTrans Inspection**

Northfield has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### NORTHFIELD

**Structure Number:** 101213008212131

**Year Built:** 1973 (reconstructed in 2001)

**Bridge Number:** 82

**Average Daily Traffic:** 750 (2008)

**Location:** Town Hwy. 450, 0.02 miles west of junction with Wall St. (over Union Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 8/12/2014                           | 8/3/2016         |
| Deck           | 8 (very good)                       | 8 (very good)    |
| Superstructure | 8 (very good)                       | 8 (very good)    |
| Substructure   | 7 (good)                            | 7 (good)         |
| Channel        | 5 (fair)                            | 6 (satisfactory) |

**Figure 50: Illustrative Pictures of Northfield Bridge 82**

**Photo and Finding from 2014 VTrans Inspection**

Sediment build-up should be removed,



**December 2017 SAO Photo**

Northfield removed the sediment build-up.



# Appendix IV

## Profile of Bridges in Audit Scope

### ORLEANS VILLAGE

**Structure Number:** 200310001010022      **Year Built:** 1933 (reconstructed in 1948)  
**Bridge Number:** 10      **Average Daily Traffic:** 3,700 (1998)  
**Location:** VT-58, 0.3 miles east of junction with US-5 (over Barton River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 5/27/2014                           | 4/5/2017         |
| Deck           | 4 (poor)                            | 4 (poor)         |
| Superstructure | 4 (poor)                            | 6 (satisfactory) |
| Substructure   | 6 (satisfactory)                    | 7 (good)         |
| Channel        | 8 (very good)                       | 8 (very good)    |

**Figure 51: Illustrative Pictures of Orleans Village Bridge 10**

**Photo and Finding from 2014 VTrans Inspection**

Deck deteriorating.



**Photo from Latest VTrans Inspection**

VTrans plans to replace bridge in 2019-2020 as part of the town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### RANDOLPH

**Structure Number:** 100909003609091

**Year Built:** 1923

**Bridge Number:** 36

**Average Daily Traffic:** 100 (2007)

**Location:** Town Hwy. 48, 0.3 miles to junction with Town Hwy. 48 and VT-14 (over Snows Brook)

|                | Bridge Inspection Condition Ratings |            |
|----------------|-------------------------------------|------------|
|                | 10/13/2015                          | 10/30/2017 |
| Deck           | 7 (good)                            | 7 (good)   |
| Superstructure | 7 (good)                            | 7 (good)   |
| Substructure   | 6 (satisfactory)                    | 5 (fair)   |
| Channel        | 5 (fair)                            | 5 (fair)   |

**Figure 52: Illustrative Pictures of Randolph Bridge 36**

**Photo and Finding from 2015 VTrans Inspection**

VTrans found abutment wall and footing damage but did not include this information in the report available to Randolph on VTransparency.



**Photo from Latest VTrans Inspection**

VTrans reported the abutment and footing damage in the report available to Randolph on VTransparency in 2017.





# Appendix IV

## Profile of Bridges in Audit Scope

### RANDOLPH

**Structure Number:** 100909003909091

**Year Built:** 1929

**Bridge Number:** 39

**Average Daily Traffic:** 50 (2007)

**Location:** At junction of Town Hwy. 73 and VT-14 (over Second Branch, White River)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 10/13/2015                          | 10/27/2017       |
| Deck           | 6 (satisfactory)                    | 6 (satisfactory) |
| Superstructure | 5 (fair)                            | 6 (satisfactory) |
| Substructure   | 6 (satisfactory)                    | 6 (satisfactory) |
| Channel        | 5 (fair)                            | 5 (fair)         |

**Figure 53: Illustrative Pictures of Randolph Bridge 39**

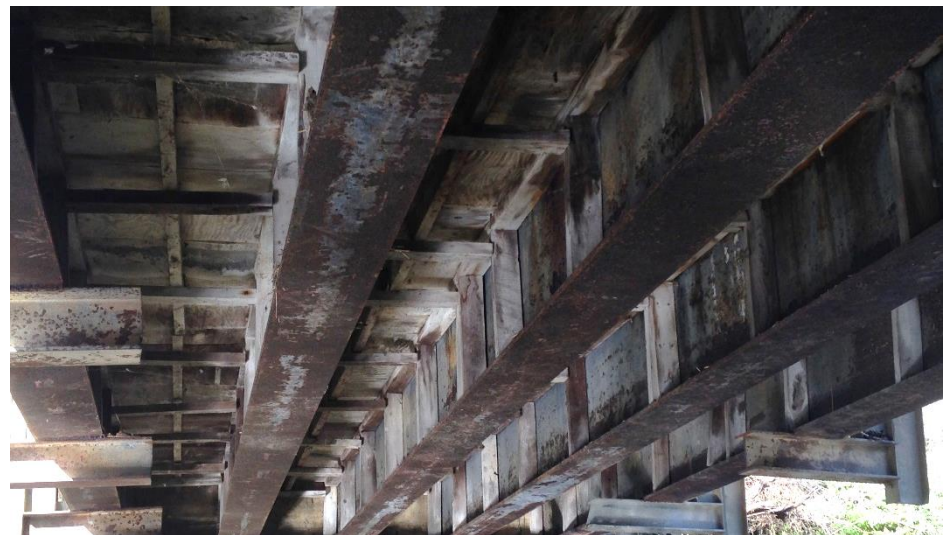
**Photo and Finding from 2015 VTrans Inspection**

Upgrade to superstructure and deck (within the next 10 years) should be considered.



**Photo from Latest VTrans Inspection**

Randolph has not acted to address this issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### RANDOLPH

**Structure Number:** 100909005409091

**Year Built:** 1928

**Bridge Number:** 54

**Average Daily Traffic:** 150 (2007)

**Location:** Brook St., 0.1 miles to junction with School St. (over Thayer Brook)

|                | Bridge Inspection Condition Ratings |                  |
|----------------|-------------------------------------|------------------|
|                | 10/6/2015                           | 10/26/2017       |
| Deck           | 7 (good)                            | 6 (satisfactory) |
| Superstructure | 7 (good)                            | 7 (good)         |
| Substructure   | 5 (fair)                            | 5 (fair)         |
| Channel        | 5 (fair)                            | 5 (fair)         |

**Figure 54: Illustrative Pictures of Randolph Bridge 54**

**Photo and Finding from 2015 VTrans Inspection**

The northern abutment experienced some additional forward movement in 2011.



**Photo from Latest VTrans Inspection**

Randolph reported that it monitors and performs visual inspections of this bridge.



# Appendix IV

## Profile of Bridges in Audit Scope

### RUTLAND CITY

**Structure Number:** 203050001711192  
**Bridge Number:** 17  
**Location:** Ripley Rd. (over Otter Creek)

**Year Built:** 1928 (replaced in 2016)  
**Average Daily Traffic:** 2,100 (2012)

|                | Bridge Inspection Condition Ratings |                         |
|----------------|-------------------------------------|-------------------------|
|                | 7/7/2014                            | 10/18/2016 (new bridge) |
| Deck           | 7 (good)                            | 8 (very good)           |
| Superstructure | 3 (serious)                         | 8 (very good)           |
| Substructure   | 6 (satisfactory)                    | 7 (good)                |
| Channel        | 5 (fair)                            | 8 (very good)           |

**Figure 55: Illustrative Pictures of Rutland City Bridge 17**

**Photo and Finding from 2014 VTrans Inspection**

Pony truss in poor condition along steel superstructure.



**Photo from Latest VTrans Inspection**

VTrans replaced bridge as part of town highway bridge program.



# Appendix IV

## Profile of Bridges in Audit Scope

### RUTLAND CITY

**Structure Number:** 203022002511192

**Year Built:** 1947 (Reconstructed in 1978)

**Bridge Number:** 25

**Average Daily Traffic:** 2,300 (1997)

**Location:** Grove St. (over East Creek)

|                | Bridge Inspection Condition Ratings |           |
|----------------|-------------------------------------|-----------|
|                | 7/7/2014                            | 7/19/2016 |
| Deck           | 7 (good)                            | 7 (good)  |
| Superstructure | 7 (good)                            | 7 (good)  |
| Substructure   | 5 (fair)                            | 5 (fair)  |
| Channel        | 7 (good)                            | 7 (good)  |

**Figure 56: Illustrative Pictures of Rutland City Bridge 25**

**Photo and Finding from 2014 VTrans Inspection**

Pier columns need to be repaired as there is heavy cracking and concrete deterioration.



**Photo from Latest VTrans Inspection**

Rutland City has not acted to address finding as of January 2018.



# Appendix IV

## Profile of Bridges in Audit Scope

### SHREWSBURY

**Structure Number:** 101122003211221

**Year Built:** 1974

**Bridge Number:** 32

**Average Daily Traffic:** 150 (2008)

**Location:** Town Hwy 6, 0.3 miles to junction with Town Hwy. 12 (over Sargent Brook)

#### Bridge Inspection Condition Ratings

|                | 10/30/2014 | 10/20/2016 |
|----------------|------------|------------|
| Deck           | 7 (good)   | 7 (good)   |
| Superstructure | 7 (good)   | 7 (good)   |
| Substructure   | 7 (good)   | 7 (good)   |
| Channel        | 5 (fair)   | 5 (fair)   |

**Figure 57: Illustrative Pictures of Shrewsbury Bridge 32**

**Photo and Finding from 2014 VTrans Inspection**

Guard rail system needs upgrading.



**Photo from Latest VTrans Inspection**

Shrewsbury has not acted to address issue as of November 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### TOWNSHEND

**Structure Number:** 101317004213171

**Year Built:** 1939 (reconstructed in 1963)

**Bridge Number:** 42

**Average Daily Traffic:** 50 (2008)

**Location:** Town Hwy. 4, 0.1 miles to junction with Town Hwy. 4 and Town Hwy. 41 (over Brook)

|                | Bridge Inspection Condition Ratings |          |
|----------------|-------------------------------------|----------|
|                | 9/15/2014                           | 4/6/2017 |
| Deck           | 4 (poor)                            | 4 (poor) |
| Superstructure | 4 (poor)                            | 4 (poor) |
| Substructure   | 7 (good)                            | 7 (good) |
| Channel        | 7 (good)                            | 7 (good) |

**Figure 58: Illustrative Pictures of Townshend Bridge 42**

**Photo and Finding from 2014 VTrans Inspection**

Deck and superstructure will need replacement in the very near future.



**Photo from Latest Inspection**

Utilizing a VTrans town highways structures grant, Townshend is in the process of replacing bridge; expected completion in 2018.



# Appendix IV

## Profile of Bridges in Audit Scope

### TOWNSHEND

**Structure Number:** 101317004313171

**Year Built:** 1939 (reconstructed in 1963)

**Bridge Number:** 43

**Average Daily Traffic:** 50 (2008)

**Location:** Town Hwy. 4, 0.4 miles to junction with Town Hwy. 4 and Town Hwy. 41 (over Fair Brook)

#### Bridge Inspection Condition Ratings

|                | 9/15/2014 | 4/6/2017         |
|----------------|-----------|------------------|
| Deck           | 7 (good)  | 7 (good)         |
| Superstructure | 5 (fair)  | 4 (poor)         |
| Substructure   | 7 (good)  | 7 (good)         |
| Channel        | 5 (fair)  | 6 (satisfactory) |

**Figure 59: Illustrative Pictures of Townshend Bridge 43**

**Photo and Finding from 2014 VTrans Inspection**

Bridge and approach rail should be replaced.



**Photo from Latest VTrans Inspection**

Townshend has not acted to address issue as of December 2017.



# Appendix IV

## Profile of Bridges in Audit Scope

### WEATHERSFIELD

**Structure Number:** 101420006314201      **Year Built:** 1968  
**Bridge Number:** 63      **Average Daily Traffic:** 100 (2007)  
**Location:** Town Hwy. 6. 0.02 mile west of junction with VT-106 (over North Branch of Black River)

|                | Bridge Inspection Condition Ratings |           |
|----------------|-------------------------------------|-----------|
|                | 5/22/2014                           | 10/5/2017 |
| Deck           | 7 (good)                            | 7 (good)  |
| Superstructure | 5 (fair)                            | 5 (fair)  |
| Substructure   | 7 (good)                            | 7 (good)  |
| Channel        | 7 (good)                            | 7 (good)  |

**Figure 60: Illustrative Pictures of Weathersfield Bridge 63**

**Photo and Finding from 2014 VTrans Inspection**

Tension cable is in good condition. Beam/cable unit should be replaced before tension cable rusts beyond repair.



**Photo from Latest VTrans Inspection**

Weathersfield has not acted to address issue as of November 2017.





# Appendix IV

## Profile of Bridges in Audit Scope

### WEATHERSFIELD

**Structure Number:** 101420008314201      **Year Built:** 1870 (reconstructed in 1986)  
**Bridge Number:** 83      **Average Daily Traffic:** 10 (2007)  
**Location:** Town Hwy. 65, 0.15 mile west of junction with VT-131 (over Brook)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 10/21/2015                          | 10/5/2017     |
| Deck           | 7 (good)                            | 7 (good)      |
| Superstructure | 5 (fair)                            | 5 (fair)      |
| Substructure   | 8 (very good)                       | 8 (very good) |
| Channel        | 7 (good)                            | 7 (good)      |

**Figure 61: Illustrative Pictures of Weathersfield Bridge 83**

**Photo and Finding from 2015 VTrans Inspection**

Structure should be sprayed with animal repellent to prevent chewing.



**Photo from Latest VTrans Inspection**

Weathersfield sprayed structure with ammonia and multi-purpose cleaner, but damage from animals continues.



# Appendix IV Profile of Bridges in Audit Scope

## WEST RUTLAND

**Structure Number:** 103408001311282

**Year Built:** 1992

**Bridge Number:** 13

**Average Daily Traffic:** 200 (2008)

**Location:** Water Street, 0.2 miles west of junction with Town Hwy. 6 (over Castleton River)

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 10/10/2014                          | 10/17/2016    |
| Deck           | 7 (good)                            | 7 (good)      |
| Superstructure | 7 (good)                            | 7 (good)      |
| Substructure   | 5 (fair)                            | 5 (fair)      |
| Channel        | 8 (very good)                       | 8 (very good) |

**Figure 62: Illustrative Pictures of West Rutland Bridge 13**

**Photo and Finding from 2014 VTrans Inspection**

Load posting sign vandalized with spray paint.



**Photo from Latest VTrans Inspection**

West Rutland replaced the sign.



# Appendix IV Profile of Bridges in Audit Scope

## WEST RUTLAND

**Structure Number:** 101128001411281

**Year Built:** 1977

**Bridge Number:** 14

**Average Daily Traffic:** 30 (2008)

**Location:** Town Hwy. 17, 0.1 miles west of junction with VT133 (over Clarendon River).

|                | Bridge Inspection Condition Ratings |               |
|----------------|-------------------------------------|---------------|
|                | 10/22/2014                          | 10/17/2016    |
| Deck           | 7 (good)                            | 7 (good)      |
| Superstructure | 7 (good)                            | 8 (very good) |
| Substructure   | 7 (good)                            | 7 (good)      |
| Channel        | 5 (fair)                            | 5 (fair)      |

**Figure 63: Illustrative Pictures of West Rutland Bridge 14**

**Photo and Finding from 2014 VTrans Inspection**

Consider cleaning and painting and greasing the last few feet of the beam ends to deter further corrosion.



**Photo from Latest VTrans Inspection**

West Rutland has not acted to address issue as of January 2018.



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## Appendix V

### Summary of Bridge Prioritization Process

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Every year the VTrans bridge inspection manager applies formulas that are used to prioritize and rank municipality-owned bridges over 20 feet in length for possible inclusion in the town highway bridge program. There are two formulas: (1) bridges that are currently part of the town highway bridge program, including candidates and (2) bridges that are not part of the town highway bridge program (called pre-candidates). Both formulas use the same factors, but the final calculation differs.

#### Factors

*Bridge Condition (BC)*. This factor is based on the weighted condition of major, inspected components (e.g., deck, superstructure) as of the most recent inspection. More points are awarded for higher levels of deterioration. (30 points maximum)

*Remaining Life (RL)*. This factor correlates to the accelerated decline in remaining life due to the condition of the same inspected components utilized in the bridge condition factor. (10 points maximum)

*Functionality (FNC)*. This factor compares the roadway alignment and existing structure width based on roadway classification to state standards. Higher points are awarded to bridges that are too narrow or have a poor alignment because they are safety hazards and can impede traffic flow. (5 points maximum)

*Load Capacity and Use (LC)*. This factor relates to whether the bridge is posted (e.g., travel restrictions) as well as the extent to which closure would inconvenience the traveling public (e.g., taking into account average daily traffic and the length of a detour). (15 points maximum)

*Waterway Adequacy and Scour Susceptibility (WS)*. This factor relates to whether the bridge is susceptible to (1) being overtopped by water, (2) bank erosion or failure, or (3) scour (the removal or erosion of a streambed or bank area by flowing water, often around an abutment or pier). (10 points maximum)

*Asset-Benefit Cost (BCF)*. This factor compares the benefit of keeping a bridge in service to the cost of construction. The benefit is derived by using the average daily traffic and detour length to calculate the traveling public's time and gas cost if a bridge were posted. (10 points maximum)

*Project Momentum (PROJ)*. This factor takes into account the extent to which a bridge project has completed right-of-way work, environmental permits, and design work (5 points maximum).

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## Appendix V

### Summary of Bridge Prioritization Process

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*Regional Priority (REG).* This factor takes into account the highest priority bridges submitted by the regional planning commissions. Each planning commission can submit two lists of priority bridges (for projects already in the town highway bridge program and those that are not, also called pre-candidates) and points are awarded for up to 10 of the highest priority bridges in each list (15 points maximum).

*Importance (IMP).* This is a multiplying factor that considers the type of roadway the bridge is located on as well as the detour length. For municipal bridges, the multiplying factor can range from 0.56 to 0.9.

#### Calculations

If there is already a project for the bridge in the town highway bridge program the calculation is:

$$IMP \times (BC + RL + FNC + LC + WS + BCF + PROJ + REG)$$

If the bridge is in pre-candidate status the calculation is:

$$(IMP \times (BC + RL + FNC + LC + WS + BCF + PROJ)) + REG$$

# Appendix VI

## Reprint of Management's Comments and SAO's Evaluation



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*Agency of Transportation*

April 3, 2018

Mr. Douglas R. Hoffer  
State Auditor  
132 State Street  
Montpelier, VT 05633-5101

Dear Mr. Hoffer:

Thank you for the opportunity for your staff and mine to discuss the draft report of your audit entitled *Bridge Inspections: Municipalities Could Be Encouraged to Take More Action with Improved Communication of Deficiencies by the Agency of Transportation*.

As requested in your letter dated March 22, 2018, this letter conveys VTrans' official management comments related to the findings and recommendations conveyed in the draft, for insertion into the final report.

### **VTrans Response**

VTrans management has carefully considered the comments and recommendations in the report, and we are pleased but not surprised that no findings were identified. We are proud of our bridge inspection program and of our work with Vermont municipalities.

We agree that more can be done to assist and encourage towns to direct resources toward repair and preventive maintenance of bridges. In addition to our ongoing outreach and funding support for municipalities, we will take the following actions:

1. Annually, on or before February 1<sup>st</sup>, VTrans will send a notification to every municipality reminding them that all bridge safety inspections may be viewed or saved from our VTransparency website. VTrans will also use this notification as an opportunity to provide information on best maintenance practices, bridge owner responsibilities, the purpose of safety inspections, etc.
2. Guidance will be provided to inspection teams such that letters will be sent to municipalities when conditions are identified as a critical finding. A critical finding is defined as a structural or safety related deficiency that requires immediate or timely, before the next inspection, action.

To enhance inspection summaries, a correlative way to describe conditions will be suggested to inspectors. The lower the condition rating, the higher amount of descriptive detail and documentation required. Each team will also be asked to review previous inspections to ensure consistency in the reporting of findings. Added quality assurance and quality control reviews will be done on the reports during the inspection season, looking for notable inconsistencies and to suggest ways to improve or correct these, thereby limiting any confusion a bridge owner may have.

Our thanks to your team.

Sincerely,

  
Joe Flynn  
Secretary of Transportation



See SAO comment 1 on page 93.

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## Appendix VI

### Reprint of Management's Comments and SAO's Evaluation

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#### SAO Evaluation of Management's Comments

|            |   |
|------------|---|
| Comment 1. | The issue raised in the report concerned VTrans' lack of guidance for when letters should be sent to municipal governing bodies for non-critical deficiencies. We clarified our recommendation to specifically address these types of deficiencies. |
|------------|---|