Emergency Inspection & Evaluation Summary

Templeton T-02-045 (69L)
Stone Bridge Road over Stone Bridge Pond
September 13, 2018

Town of Templeton

Gill Engineering Associates, Inc.
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Needham, MA 02494

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1. BACKGROUND AND SCOPE

1.1. Background

Bridge T-02-045 (69L) is a single lane bridge that carries two-way traffic of Stone Bridge Road over the Stone Bridge Pond in the Town of Templeton a short distance from the bordering Town of Phillipston, Massachusetts. The bridge is located within a lightly travelled single lane causeway used primarily by passenger cars and is categorized with a functional class of rural local level of service on the Structure Inventory and Appraisal (SI&A) report. The SI&A reports an ADT of only 100 vehicles per day for the year 1987, with 0% Truck ADT and a future ADT of 158 vehicles per day projected for the year 2021. The bypass detour route listed in the SI&A for the structure is only 3.5 miles.

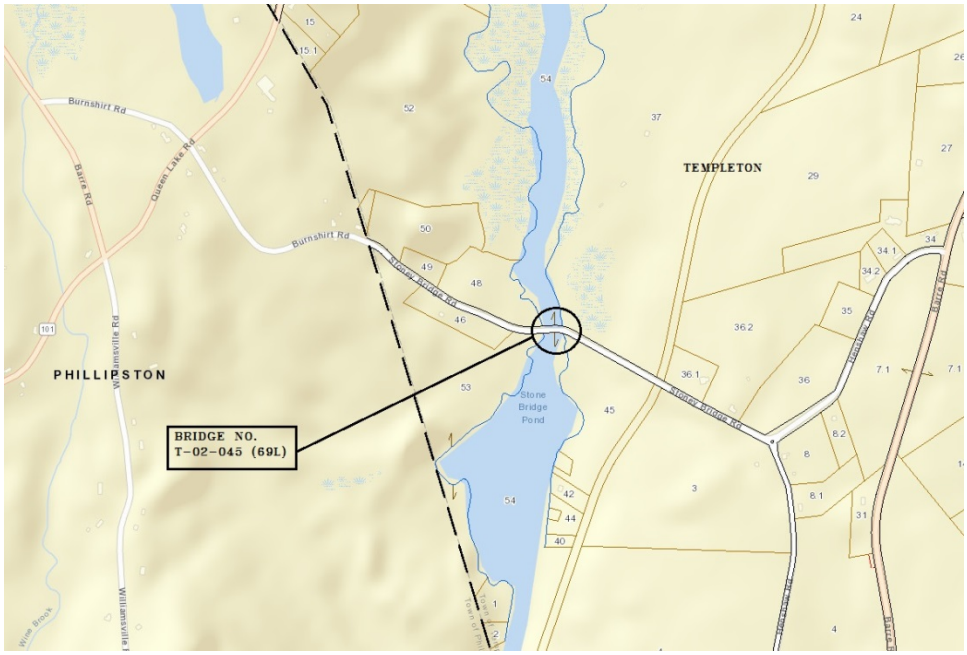

Figure 1 – Locus Map

The existing structure T-02-045 (69L) is a simple span masonry slab bridge comprised of butted granite slabs and granite headwalls supported by stone abutments. The bridge is overlaid with earth and gravel fill and HMA wearing surface of varying thickness. There are no traffic rails or other traffic safety features on the structure, aside from a number of large stones 2-3 feet in diameter along the southern edge of the roadway that serve as the traffic curbs. Similar stone curbs previously existed along the northerly edge of roadway, but have since collapsed into the waterway.

The Stone Bridge and the Stone Bridge Road Causeway were originally constructed in 1850 as a means to access businesses, a school house and a meeting house west of the pond. The Stone Bridge Pond is a heavily vegetated, slow moving waterway within the Burnshirt River and serves as the

habitat for beaver, birds and other wildlife. The pond is fed by the Burnshirt River to the north and discharging back into the Burnshirt River to the south. There is a weir and culvert located well upstream of the subject bridge to the north, and a railway trestle located well below the bridge to the south.

1.2. Purpose & Need

On August 8, 2018, Templeton Town Administrator Carter Terenzini contacted Gill Engineering to inquire about the possibility of assisting the Town in evaluating the condition of a Town owned culvert structure, T-02-045 (69L) Stone Bridge Road over Stone Bridge Pond. The hydraulic opening of the structure had become blocked by what was presumed to be a partial collapse of the structure's roof (roadway) resulting in an increase in the headwater elevation and the waterway overtopping the roadway.

The Town had already taken the precautionary action of closing the roadway to traffic using concrete jersey barriers and had begun operating two (2) portable 6" diameter pumps with a reported combined capacity of 6500 gph to drop the level of the headwater and the topping of the roadway to reduce the potential for washout of the causeway at the overtopping location. There are two residences located west of the waterway that are within the Town of Templeton however the Town officials indicated emergency services and plowing would not be impacted as a result of the road closure.

On the morning of August 9, 2018, the Town confirmed they would like to engage Gill Engineering to provide the inspection and engineering services on an emergency basis. Gill Engineering responded immediately to the request, meeting the Town Administrator at the Town Offices at approximately 9:30 AM and then traveling to the bridge site to view the problem first hand.

2. EXISTING BRIDGE PLANS AND BRIDGE GEOMETRY

2.1. Existing Bridge Plans

There are no record plans available for the existing structure. The Structures Inventory and Appraisal Report (SI&A) indicate the structure was built in 1850 and no record of any reconstruction. There were no inspection reports available at the time of the emergency inspection. The SI&A indicate the most recent inspection was performed on December 14, 2017 and the condition evaluations for the deck, superstructure and substructure, Item Numbers 58, 59 and 60 respectively all received condition ratings of five (5) fair. The channel and channel protection ratings were reports as six (6) satisfactory.

2.2. Existing Bridge Geometry

The structure is an eight and one-half foot (8.5') long granite masonry slab bridge comprised of dry-fit irregular granite stone abutments supporting tightly butted dry-fit granite slabs. The slabs are

roughly dressed and non-uniform in dimension, but measure approximately eighteen inches (18") in depth and twelve inches in thickness at their cross section. Each of the deck slab are approximately eight and one-half (8.5') to ten (9') feet in length.

The limited access and the irregular abutments prevented accurate measurements of the structure and hydraulic opening, but the approximate dimensions listed on the Structure Inventory & Appraisal (SI&A) were confirmed at the headwall of the downstream opening.

3. FIELD INSPECTION AND OBSERVATION OF EXISTING CONDITIONS

3.1. Initial Site Assessment & Structure Evaluation

Upon arrival to the site, it was apparent there was a significant obstruction of the hydraulic opening that prevented the flow through the culvert as intended, raising the headwater elevation significantly to the point where topping of the roadway occurred.

The two six inch (6") portable pumps were actively pumping and it was reported that, after twelve (12) hours of continuous operation, they had managed to slightly reduce the level of the headwater. However there continued to be some flow over the top of the roadway.

A steel roadway plate was in place with HMA patch securing the plate at the southeast corner of the deck where a prior collapse had occurred.

Town personnel indicated that they had secured several truck-loads of rip-rap and were prepared to use an excavator to create a bypass to the culvert. After discussing the action alternatives and possible drawbacks to bypassing the culvert with the Town Administrator and Public Works Director, it was decided the best alternative would be to make an attempt to visually locate the obstruction and clear it since the culvert had been functioning adequately for more than 150 years. If the obstruction could not be cleared, the bypass option could always be undertake as a secondary alternative.

3.2. Investigation and Observations of Existing Conditions

Some preliminary measurements were made confirming the approximate structure span length of eight and one-half feet (8.5') at the southerly headwall. The Northerly (upstream) end of the structure was submerged and the dimensions could not be verified. A large beaver lodge was also noted to be located approximately 75 yards south (downstream) of the structure.

The depth of water at the downstream opening varied, but measured as an average to be approximately 5'-0". Probing the streambed at the downstream opening indicated a layer of soft organic matter. The depth of the water to the streambed at the upstream side could not be obtained, but some obstructions, believed to be stones collapsed from the upstream curbs and headwall were met at a depth of approximately 3'-6" at the upstream opening of the culvert. The lack of visibility prevented a confirmation of this visually.

The difference in the observed water elevation between the upstream and downstream sides of the structure was measured to be approximately 4'-6". The static head due to the high water elevation at the upstream (North) end of the structure should have resulted in rapid flow in the channel, however there was only a relatively low velocity of stream flow in the channel at the downstream side.

A waterproof video camera secured to a wand was used to view the condition of the structure opening at the southerly (downstream) end of the structure. The images confirmed there was approximately eighteen inches (18") of freeboard between the surface of the water and bottom of the culvert roof (bridge deck) through the length of the structure and that the blockage was actually located at the entrance on the upstream end of the structure. The images from the downstream end showed that only a small amount of flow was entering through what appeared to be a large amount of vegetation and branches.

On the northerly (upstream) end of the structure, the edging boulders and edge of the HMA pavement were missing, presumably having collapsed into the waterway.

Several attempts were made using the submersible camera to assess the blockage from the upstream end of the structure, but poor visibility prevented the capture of any definitive images. The Town was able to secure the assistance of a dive team from a neighboring community. The lack of visibility prevented the divers from a visual confirmation of the blockage as well, but they were able to feel around and confirm that several large boulders as well as the vegetation and sediment were in fact blocking the upstream entrance of the culvert.

4. RECOMMENDATIONS – IMMEDIATE ACTION

Since it was determined through the camera images from the downstream side and then confirmed by the divers the blockage was located at the upstream opening to the culvert, and was due to the collapse of the northerly headwall and possibly some deck slabs and curb stones, it was recommended that the Town owned wheeled excavator be mobilized with a grapple attachment and an attempt be made to clear the boulders at the upstream opening. If the excavator was unable to clear the obstruction, it would be readily available for use in the construction of the bypass.

The narrow causeway hampered the excavator from reaching into the opening with the machine, however the operator was able push clear from the opening enough vegetation, debris and to remove one large granite deck slab that had collapsed into the channel. The remaining boulders were sufficiently shifted to restore a portion of the flow through the culvert.

5. ALTERNATIVES AND RECOMMENDATIONS FOR REPAIR OR REPLACEMENT

A complete inspection and assessment of the structure has not been performed, however a general assessment can be made from the observations and the record images obtained during the emergency response to sufficiently evaluate the current alternatives.

Reconstructing the bridge in its present form can be discounted as an unrealistic alternative. Current design standards for load capacity and traffic safety features could not be met leaving two viable alternatives. Those two primary alternatives are that the bridge is permanently closed to all traffic and the second alternative is for a complete bridge replacement. Each has advantages or disadvantages relating to initial and long-term costs. Regardless of which alternative is pursued, some measure of maintenance and restoration should be performed to restore the full capacity of the waterway and reduce the likelihood of a similar flooding event reoccurring.

Alternative No. 1 – Permanently Close the Bridge to Traffic

The first alternative is to permanently close the bridge to traffic through the construction of permanent barriers, or by keeping the temporary concrete barriers in place. It was previously indicated that the bridge is not critical for emergency response services and snow removal for the two Templeton residences located on the roadway west of the waterway. Both can be provided from the westerly access, or through cooperation and coordination with the neighboring Town of Phillipston.

The waterway should be cleared of all collapsed stones and any remaining vegetation to restore the full capacity of the channel. An assessment should be made of the stone abutments and repairs should be made as necessary to reduce the likelihood of future collapses that may block the channel. Complete removal of the remainder of the bridge deck may also be considered to provide greater access for any immediate repairs and for any future channel or wall maintenance that may be required. While this alternative will have the lower initial cost, future maintenance is likely higher under this alternative than for a complete bridge replacement project.

Alternative No. 2 – Complete Bridge Replacement

The second alternative is to design and construct a complete bridge replacement that would likely include removal of the existing bridge deck and stone abutments in their entirety and installing a precast concrete box culvert to meet current loadings and traffic safety features.

The design would require soil borings to establish the subsurface strata, perform a hydraulic analysis to assess the impact of the structure upstream and downstream, and develop contract plans and specifications to define the work to be performed. The complete bridge replacement alternative will obviously be met with higher initial costs, however, there are the benefits of restoring the existing roadway access, reduced future maintenance costs and likely an improved hydraulic capacity.

APPENDIX

6.1. Photographs

Photo 1 - S. Headwall & Stone Guard Condition East Approach

Photo 2 - N. Headwall & Stone Guard Condition East Approach

Photo 3 – Upstream Conditions (Looking North)

Photo 4 – Downstream Conditions (Looking South)

Photo 5 – Roadway Plate & Stream Overtopping Roadway

Photo 6 – One of Two 6" Diameter Pumps Discharging Downstream

Photo 7 – South (Downstream) End of Structure and Headwall Stone

Photo 8 - South (Downstream) Headwall Stone and Support

Photo 9 – Roof (Deck) Stones, Stone Abutments & Vegetation at Upstream (North) Opening

Photo 10 - Roof (Deck) Stones, East Abutment & Vegetation Blocking Upstream (North) Opening

Photo 11 – Irregular Roof (Deck) Stones & West Abutment

Photo 12 – Roof (Deck) Stones and East Abutment

Photo 13 - East Abutment below Roadway Plate

Photo 14 - Roof (Deck) Stones below Roadway Plate and West Abutment

APPENDIX

6.2. Structure Inventory and Appraisal

Report Date: September 7, 2018

State Information

BDEPT#= T02045 Agency Br.No.

Town= Templeton L.O.

B.I.N= 69L AASHTO= 020.6

RANK= 0 H.I.= NA FHWA Select List= N (6/21/2017)

Identification

(8) Structure Number T0204569LMUNCUL

(5) Inventory Route 151000000

(2) State Highway Department District 02

(3) County Code 027 (4) Place code 69275

(6) Features Intersected **WATER STONE BRIDGE POND**

(7) Facility Carried **HWY STONE BRG RD**

(9) Location

(11) Kilometerpoint 0000.000

(12) Base Highway Network N

(13) LRS Inventory Route & Subroute 000000000000

(16) Latitude 42 DEG 31 MIN 52.10 SEC

(17) Longitude 72 DEG 05 MIN 22.10 SEC

(98) Border Bridge State Code Share %

(99) Border Bridge Structure No. #

Structure Type and Material

(43) Structure Type Main: Masonry Code 801

Slab Jointless bridge type: Not applicable

(44) Structure Type Appr:

Other Code 000

(45) Number of spans in main unit 001

(46) Number of approach spans 0000

(107) Deck Structure Type - Other Code 9

(108) Wearing Surface / Protective System:

A) Type of wearing surface - Bituminous Code 6

B) Type of membrane - None Code 0

C) Type of deck protection - None Code 0

Age and Service

(27) Year Built 1850

(106) Year Reconstructed 0000

(42) Type of Service: On - Highway

Under - Waterway Code 15

(28) Lanes: On Structure 01 Under structure 00

(29) Average Daily Traffic 000100

(30) Year of ADT 1987 (109) Truck ADT 00 %

(19) Bypass, detour length 006 KM

Geometric Data

(48) Length of maximum span 0002.6M

(49) Structure Length 00002.6M

(50) Curb or sidewalk: Left 00.0M Right 00.0M

(51) Bridge Roadway Width Curb to Curb 003.6M

(52) Deck Width Out to Out 006.7M

(32) Approach Roadway Width (w/shoulders) 004.6M

(33) Bridge Median - No median Code 0

(34) Skew 00 DEG (35) Structure Flared N

(10) Inventory Route MIN Vert Clear 99.99M

(47) Inventory Route Total Horiz Clear 03.6M

(53) Min Vert Clear Over Bridge Rdwy 99.99M

(54) Min Vert Underclear ref N 00.00M

(55) Min Lat Underclear RT ref N 00.0M

(56) Min Lat Underclear LT 00.0M

Navigation Data

(38) Navigation Control - No navigation control on waterway Code 0

(111) Pier Protection Code

(39) Navigation Vertical Clearance 000.0M

(116) Vert-lift Bridge Nav Min Vert Clear M

(40) Navigation Horizontal Clearance 0000.0M

Classification — Code

(112) NBIS Bridge Length N

(104) Highway System N

(26) Functional Class - Rural Local 09

(100) Defense Highway 0

(101) Parallel Structure N

(102) Direction of Traffic - One lane for 2-way traffic 3

(103) Temporary Structure N

(105) Federal Lands Highways 0

(110) Designated National Network N

(20) Toll - On free road 3

(21) Maintain - Town Agency 03

(22) Owner - Town Agency 03

(37) Historical Significance undetermined

Condition — Code

(58) Deck 5

(59) Superstructure 5

(60) Substructure 5

(61) Channel & Channel Protection 6

(62) Culverts N

Load Rating and Posting — Code

(31) Design Load - Unknown 0

(63) Operating Rating Method - Allowable Stress (AS) 2

(64) Operating Rating 00.0

(65) Inventory Rating Method - Allowable Stress (AS) 2

(66) Inventory Rating 00.0

(70) Bridge Posting 0

(41) Structure - Open A

Appraisal — Code

(67) Structural Evaluation 3

(68) Deck Geometry 3

(69) Underclearances, vert. and horiz. N

(71) Waterway adequacy 6

(72) Approach Roadway Alignment 6

(36) Traffic Safety Features 0 0 0 0

(113) Scour Critical Bridges 6

Proposed Improvements

(75) Type of Work Code 38 1

(76) Length of Structure Improvement 00005.0M

(94) Bridge Improvement Cost (K) $3

(95) Road Improvement Cost (K) $1

(96) Total Project Cost (K) $5

(97) Year of Improvement Cost Estimate 2008

(114)Future ADT 000158

(115)Year of Future ADT 0021

Inspections

(90) Inspection Date 12/14/17 (91) Frequency 24 MO

(92) Critical Feature Inspection: (93) CFI DATE

(A) Fracture Critical Detail	N	00	MO A)	00/00/00
(B) Underwater Inspection	N	00	MO B)	00/00/00
(C) Other Special Inspection	N	00	MO C)	00/00/00
(*) Other Inspection ()	N	00	MO *)	00/00/00
(*) Closed Bridge	N	00	MO *)	00/00/00
(*) UW Special Inspection	N	00	MO *)	00/00/00
(*) Damage Inspection			MO *)	00/00/00

Rating Loads

Report Date 00/00/00	H20	Type 3	Type 3S2	Type HS
Operating	0.0	0.0	0.0	0.0
Inventory	0.0	0.0	0.0	0.0

Field Posting

Status Posting Date 00/00/00

	2 Axle	3 Axle	5 Axle
Actual			
Recommended			

Missing Signs N