Chester County Bridge #111 Structure Rehabilitation
Carrying Allerton Road over the East Branch of Brandywine Creek
East Bradford Township, Chester County

Public Meeting Presentation

January 30, 2020
Presented By: Douglas Stumpp, PE
              Jason Wehr, PE
Chester County Bridge #111 – Agenda

- Welcome & Introductions
- Purpose and Need
- Project Overview
- Existing Conditions
- Proposed Structure Rehabilitation
- Other Design Considerations
- Feedback / Questions & Answers
Bridge #111 – Project Purpose and Need

Purpose

• To rehabilitate the existing structure to increase its load carrying capacity, improve safety, and extend the life of the bridge, while maintaining the historic character and National Register eligibility of the structure and its surroundings.

Need

• Repair/replace deteriorated bridge elements.
• Increase load capacity for improved serviceability.
• Improve safety.
  – Sight distance.
  – Protect the structure and motorists on the bridge.
Bridge #111 – Project Overview
Bridge #111 – Existing Conditions – Roadway

Roadway
• 20’ wide asphalt pavement (two 10’ lanes)
• Posted 25 mph speed limit
• ADT = 1361 vehicles per day
• Kink in roadway at west abutment
• Steep upgrade to bridge at west abutment
Bridge #111 – Existing Conditions – Bridge

Bridge
- Single span Pratt through truss bridge
- Timber bridge deck with asphalt overlay
- Stringer / Floorbeam floor system
- 104’ length
- 14’-5½” curb-to-curb width (one lane, Functionally Obsolete)
- 12’-1” vertical clearance to truss portal
Bridge #111 – Existing Conditions – Bridge

Bridge
• Original covered bridge at site dating to 1883
• Truss originally constructed 1905
• Formerly County Bridge #80 at Palmer’s Paper Mill in West Marlborough Township
• Moved to present location in 1953 after fire destroyed the covered bridge
• Current structure condition: Poor (Structurally Deficient)
Bridge #111 – Existing Conditions – Bridge

Historic character defining and significant features:

- Pratt truss configuration
- Riveted end connections
- U-shaped floorbeam hangers and saddles
- Rolled floorbeams
- Lattice railing

Source: Preservation Assessment - Allerton Road over the East Branch of Brandywine Creek, BMS #15 7015 0438 0111, Chester County, PennDOT Engineering District 6-0. TranSystems, 2017
Bridge #111 – Existing Conditions – Bridge

Lattice Railing
Bridge #111 – Existing Conditions – Bridge

Floorbeams
Bridge #111 – Existing Conditions – Bridge

Truss Lower Chord Panel Points and Floorbeam Hangers
Bridge #111 – Existing Conditions – Bridge

Welded Truss Member

Lower Chord Gusset Plate
Floorbeam Hanger
Bridge #111 – Existing Conditions – Bridge

Upper Chord Connection Exterior

Upper Chord Connection Interior
Bridge #111 – Existing Conditions – Bridge

Gusset Plate Deformation

Typical Bearing
Bridge #111 – Existing Conditions – Bridge

West Abutment

East Abutment
Bridge #111 – Existing Conditions – Bridge

Northwest Wing Wall

Northwest Wing Wall Inside Face
Bridge #111 – Existing Conditions – Safety
Bridge #111 – Existing Conditions – Safety
Bridge #111 – Existing Conditions – Safety
Bridge #111 – Proposed Structure Rehabilitation

Engineering to Date

• In-depth Bridge Inspection
• Structural Analysis / Load Rating Analysis
• Rehabilitation Alternatives
  – Bridge Barrier
  – Bridge Deck
  – Floor System (Stringers and Floorbeams)
  – Substructure
• Target Posted Weight Limit: 20 tons
Bridge #111 – Proposed Structure Rehabilitation

**APPROMATE VEHICLE WEIGHTS**

- **AVERAGE STANDARD CAR** - 1.5 TONS
- **AVERAGE STANDARD TRUCK** - 3 TONS
- **AVERAGE AMBULANCE** - 5 TONS
- **AVERAGE DELIVERY TRUCK** - 6 TONS
- **AVERAGE LOADED SCHOOL BUS** - 17 TONS
- **AVERAGE LOADED CHARTER BUS** - 20 TONS

US Fuel Oil delivery truck wt. = 33,000 GVW (16.5 ton). Height is approximately 12.14'.

**AVERAGE FIRE TRUCK**

19 TONS - 30 TONS

- **AVERAGE LOADED GARBAGE TRUCK** - 25 TONS
- **AVERAGE LOADED PLOW TRUCK** - 28 TONS
- **AVERAGE LOADED CEMENT TRUCK** - 33 TONS
- **AVERAGE LOADED DUMP TRUCK** - 36 TONS
- **AVERAGE LOADED TRACTOR TRAILER** - 40 TONS

Fedex & UPS truck wt = 5 ton, moving truck = 7 ton.

Moving trucks, Fedex & UPS truck height = 10'-0".

13'-6" to 14'-0" high.
# Bridge #111 – Proposed Structure Rehabilitation

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Weight</th>
<th>Vehicle</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Standard Car</td>
<td>1.5 Tons</td>
<td>West Chester Fire Engine 51-1</td>
<td>23.0 Tons</td>
</tr>
<tr>
<td>Average Standard Pickup Truck</td>
<td>3.0 Tons</td>
<td>West Chester Fire Engine 51-2</td>
<td>20.0 Tons</td>
</tr>
<tr>
<td>Average Standard Ambulance</td>
<td>5.0 Tons</td>
<td>West Bradford Fire Engine 39-1</td>
<td>24.3 Tons</td>
</tr>
<tr>
<td>Delivery Trucks (Fedex, UPS, etc.)</td>
<td>5.0 Tons</td>
<td>West Bradford Fire Engine 39-2</td>
<td>19.2 Tons</td>
</tr>
<tr>
<td>Moving Trucks (U-Haul, etc.)</td>
<td>7.0 Tons</td>
<td>West Bradford Fire Engine 39-3</td>
<td>24.3 Tons</td>
</tr>
<tr>
<td>Fuel Delivery Trucks</td>
<td>16.5 Tons</td>
<td>West Bradford Fire Tanker 39</td>
<td>32.3 Tons</td>
</tr>
<tr>
<td>Average Loaded School Bus</td>
<td>17.0 Tons</td>
<td>West Bradford Fire Rescue 39</td>
<td>24.5 Tons</td>
</tr>
<tr>
<td>AASHTO H20 Vehicle</td>
<td>20.0 Tons</td>
<td>AASHTO HS20 Vehicle</td>
<td>36.0 Tons</td>
</tr>
</tbody>
</table>
Bridge #111 – Proposed Structure Rehabilitation

Bridge Deck Alternatives

• Five different deck types investigated.
  – Concrete Filled Steel Grid Deck
  – Fiber Reinforced Polymer (FRP) Deck
  – Lightweight Concrete Deck
  – Glue Laminated Timber Deck with Asphalt Overlay
  – Aluminum Bridge Deck

• Decision Matrix Selection Criteria
  – Structure Safe Load Capacity (Deck Weight)
  – Initial Cost
  – Life cycle costs (expected maintenance)
  – Truss member upgrades
  – Vertical clearance
  – Historic context
  – Ride surface
  – Waterproofness
  – Constructability
Bridge #111 – Proposed Structure Rehabilitation

Deck Alternative 1 – Steel Grid Deck
(NOT TO SCALE)

Deck Alternative 2 – FRP Deck
(NOT TO SCALE)

Deck Alternative 3 – Lightweight Concrete Deck
(NOT TO SCALE)

Deck Alternative 4 – Gluelam Deck
(NOT TO SCALE)

Deck Alternative 5 – Aluminum Deck
(NOT TO SCALE)

Legend:
- Red: Member requiring replacement due to reasons other than failing to meet the required safe load capacity
- Black: Member with a safe load capacity less than 20 ton
- Double Black: Member requiring replacement because it is continuous with a member not achieving a 20 ton rating
Bridge #111 – Proposed Structure Rehabilitation

Recommended Bridge Deck

• Aluminum Bridge Deck
  – Lightest weight
  – Strong
  – Fewest modifications or strengthening to existing truss members
  – Highest load posting
  – Most resistant to deterioration – 100+ year life
  – Example project: Corbin Bridge, Huntingdon County Bridge #20
    • Suspension bridge rehabilitated in 1996 with a current deck condition rating of 7 (Good)

• Manufacturer
  – Alumabridge by L.B. Foster
  – Pittsburgh firm
Bridge #111 – Proposed Structure Rehabilitation

Advanced Design
in Aluminum Bridge Decking
Features and Benefits

AlumaBridge, LLC is North America’s premier supplier of aluminum bridge decking with time-proven technology. The company is backed by 20 years of innovation and experience, and has a history of highly successful installations in both the United States and Europe. AlumaBridge’s advanced design solutions are a rehabilitation alternative to reconstruction and offer unmatched benefits compared to traditional concrete and steel construction:

- **Rapid Deployment** – “Deployment Ready” technology can be pre-assembled for rapid bridge deck or whole bridge replacement. Panels can be shipped over-the-road for quick on-site installation.
- **Significant Savings in Time and Money** – Accelerated construction reduces costs in both A+B and A+B+C bid evaluations. Perfect for many bridge rehabilitation projects, AlumaBridge decking assures savings for affected transportation authorities and communities. The immediate benefits of limited traffic interruption lower traffic control expenses and reduce costs for car and truck users.
- **Reduced Lifecycle Costs** – From initial installation throughout the life of the bridge, the skid resistant and aggregate bonded wearing surface lowers maintenance costs compared to concrete deck repairs or replacement. AlumaBridge materials never need painting even in the presence of deicing salts. (Composite or non-composite applications are available.)
- **Reduced Weight Reduces Dead Load** – The lightweight aluminum deck (18 to 25 pounds per square foot depending upon deck depth and wearing surface) mirrors the strength of monolithic concrete, but is up to 80% lighter than steel with concrete. That allows for widening of functionally obsolete bridges using the existing substructure. Bridges can then be immediately reopened and improve traffic flow.
- **Environmentally Friendly** – AlumaBridge aluminum decking is the “green metal”, contains significant recycled content and is easily and profitably recycled. Of all aluminum extrusions produced since 1890, 76 percent are still in use.
- **Infinite Fatigue Life** – Using AASHTO Specifications / Bridge Code Compliant in U.S. and Canada

Applications
AlumaBridge aluminum bridge decking systems all deliver the advantages of rapid deployment and lightweight plus reduced installation, lifecycle and maintenance costs. In both standard and custom configurations, they are available for a variety of solid surface lightweight deck solutions including:

- Roadway / Highway Bridges
- Moveable Bridges and Structures
- Emergency Deployment Bridges
- Temporary Bridges
- Military Bridges
- Marine Decking
- Construction Platforms

Products
As a bridge-market focused organization, AlumaBridge’s patented systems are available for a variety of solid surface lightweight deck solution applications.

Our experience and technical support is unmatched. We use the latest advancements in Friction Stir Welding (FSW) for strength and precision in superior deck fabrication. AlumaBridge engineers custom designs and manufactures time-proven aluminum isotropic as well as orthotropic deck construction.

8’ Deep Bridge Deck – Replaces concrete bridges

5’ Deep Bridge Deck – Replaces steel grid bridge decks and decks on moveable bridges
Bridge #111 – Proposed Structure Rehabilitation

Bridge Barrier Alternatives

• Required for motorist protection and to protect the fracture critical truss members.

• Eight different barriers investigated – various configurations
  – Steel Post & Tube Railings
  – Concrete Walls
  – Timber

• Decision Matrix Criteria
  – Width
  – Height
  – Weight
  – Cost
  – Historic Context
  – Aesthetics
  – Availability
  – Safety (crash test level)
  – Truss protection
  – Design life
  – Constructability
  – Adaptability to deck types
Bridge #111 – Proposed Structure Rehabilitation

Bridge Barrier Alternatives
• Barrier Types

- Timber Post Bridge Barrier
- Concrete Vertical Wall Barrier
- Structure Mounted Guide Rail Barrier
- PennDOT Type 10M Bridge Barrier
Bridge #111 – Proposed Structure Rehabilitation

Bridge Barrier Alternatives

- Selected NYSDOT steel tube barrier railing, TL-4

Photo of Railing on PA 926 over the Brandywine Creek similar to Proposed NYSDOT 3-Rail Steel Bridge Barrier

*(source: Google Maps)*
Bridge #111 – Proposed Structure Rehabilitation

Other Structural Elements

- **Stringers**
  - Replace with I-shape aluminum beams

- **Floorbeams**
  - Replace with similar I-shaped rolled steel beams

- **Floorbeam Supports**
  - Replace existing U-shaped hangers and saddle in kind

- **Truss Members**
  - Retain existing members in good condition
  - Replace deteriorated or weak members in kind

- **Gusset Plates**
  - Replace all gusset plates in kind

- **Top Lateral Bracing**
  - Retain

- **Bottom Lateral Bracing**
  - Replace in kind

- **Sway Bracing**
  - Retain

- **Portal Bracing**
  - Replace damaged members in kind

- **Bearings**
  - Replace with elastomeric bearings

- **Substructure**
  - Replace with concrete abutments with stone facing
Bridge #111 – Proposed Structure Rehabilitation

Other Structural Elements

• Connections
  – Rivets when both sides are exposed
  – Button head tension control (TC) bolts when one side exposed; e.g. truss member end connections
  – All truss member end fasteners replaced
  – Consistent appearance throughout
  – Approximately 700 TC bolts and 380 rivets
  – Relative costs:
    • $15 per TC Bolt
    • $85 per Rivet
Bridge #111 – Hydraulics

100 YEAR FLOOD EL. 190.62
EXISTING STREAMBED EL. 179.6
FRONT FACE OF EXISTING ABUTMENT
94.33'

100 YEAR FLOOD EL. 190.57
EXISTING STREAMBED EL. 179.6
FRONT FACE OF PROPOSED ABUTMENT
99.93'

TRAFFIC PLANNING AND DESIGN, INC.
Bridge #111 – Proposed Structure Plan

LEGEND

PROPOSED EDGE OF ROAD

PROPOSED BASELINE

APPROXIMATELY 1.5’ TO 2.0’ BETWEEN EXISTING AND PROPOSED BASELINES

LEGAL RIGHT OF WAY

TRUSS

BRIDGE BARRIER RAILING

EXISTING BASELINE

99.93’

LEGAL RIGHT OF WAY

EAST BRANCH BRIDY WINE CREEK

EAST BRANCH BRIDGE

PROPOSED

0 10 20 FEET

TRAFFIC PLANNING AND DESIGN, INC.
Bridge #111 – Proposed Plan Overlaying Existing

Legend:
- Proposed edge of road
- Proposed baseline
- Approximately 1.5' to 2.0' between existing and proposed baselines
- Legal right of way
- Existing baseline
- Bridge barrier railing
- Truss

Scale: 0 10 20 feet

Combined
Bridge #111 – Proposed Structure Rehabilitation
Bridge #111 – Proposed Structure Rehabilitation
Bridge #111 – Proposed Structure Rehabilitation
Bridge #111 – Proposed Structure Rehabilitation

Summary of Proposed Rehabilitated Structure to Address Purpose and Need

Increase Load Capacity and Extend Bridge Life
- Replace deck with lightweight aluminum deck
- Replace stringers with lightweight aluminum stringers
- Replace floorbeams with new rolled floorbeams
- Repair or replace deteriorated floorbeam hangers, truss members, and gusset plates in kind
- Replace bearings
- Replace substructure with stone faced concrete abutments

Improve Safety
- Lower bridge about 1’ to improve sight distance
- Adjust west abutment slightly to improve sight distance
- Flatten west approach roadway profile to improve sight distance
- Bridge barrier and guide rail added to protect motorists and truss

Maintain Historic Character
- Pratt truss configuration retained
- Riveted truss connections replicated
- Rolled floorbeams provided
- U-hanger floorbeam supports replicated
- Lattice railing retained
- Previous non-original modifications removed
Bridge #111 – Other Design Considerations

Environmental

• Bog Turtle
  – In-stream restrictions 4/1 to 10/31
  – Protective / Avoidance measures – perimeter barrier

• Erosion and Sediment Pollution Control
  – Perimeter controls
  – Cofferdams around abutments for dewatering
  – Other BMPs – filter bags, etc.
  – < 1 acre disturbance → no NPDES permit nor stormwater management facilities
Bridge #111 – Other Design Considerations

- Traffic Control
  - Detour, 1.8 miles
  - South Creek Road & South Bridge Road (PA 0842)

- Utilities
  - Aerial Relocations

- Right-of-Way
  - Minimal R/W at abutments
  - Temporary Construction Easements
Bridge #111 – Other Design Considerations
Bridge #111

Feedback / Questions & Answers