Appendix D

Preliminary Section 106 and 4(f) Analysis for Tappan Zee Bridge

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Attachments

D1 Introduction

D1.1 Purpose of Document

This appendix has been prepared as part of the TZB/I-287 Environmental Review to analyze the potential impacts that the four bridge Rehabilitation Options, described in Chapter 3, would have on the National Register-eligible Tappan Zee Bridge (TZB) as an initial step toward compliance with two federal statutes:

- Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended (implementing regulations at 36 CFR Part 800)

  Section 4(f) of the Department of Transportation Act of 1966, as amended (implementing regulations at 23 CFR Part 774).

This preliminary analysis will be further addressed in the TZB/I-287 Environmental Review Draft Environmental Impact Statement (DEIS). In compliance with Section 106, archaeological and historic architectural resources within the 30-mile I-287 Corridor, in addition to the TZB, will be identified and analyzed. In compliance with Section 4(f), all possible planning to minimize harm to the TZB and other applicable resources will also be documented. The DEIS will also include a summary of public outreach efforts and mitigation schemes for the TZB and other applicable resources. Recommended mitigation will be mutually agreeable to the appropriate parties.

D1.2 Project Background

The I-287 Corridor extends 30 miles between the Village of Suffern in Rockland County and the Village of Port Chester in Westchester County. The counties are linked by the TZB over the Hudson River. The aim of the TZB/I-287 Environmental Review is to:

Resolve the structural needs of the TZB.
Identify a potential transit link for the region.
Determine the safest, most efficient, environmentally sound, and responsible way to address the transportation needs of the I-287 Corridor for the next century.

The scoping stage of this study included a comprehensive three-level screening process. The purpose of the screening process has been to reduce the initial 150 project elements identified during the Level 1 screening into a short list of alternatives and options to be carried forward into the DEIS. Six alternatives were selected in the DEIS study as a result of Level 1 and Level 2 screening. Three options were developed after the AA process. The six alternatives and three options currently under evaluation as part of Level 3 screening are:

- **Alternative 1** – No Build
- **Alternative 2** – Bridge Rehabilitation with Transportation Demand Management and Transportation System Management (TDM & TSM) Measures
- **Alternative 3** – Full Corridor Bus Rapid Transit (BRT)
  - **Option 3A** – Enhanced Full Corridor Bus Rapid Transit (BRT)
  - **Option 3B** – Full Corridor Bus Rapid Transit (BRT)-Dedicated Busway in Westchester
- **Alternative 4A** – Full Corridor Commuter Rail Transit (CRT)
- **Alternative 4B** – Manhattan Bound CRT with LRT in Westchester
- **Alternative 4C** – Manhattan Bound CRT with BRT in Westchester
  - **Option 4D** – Manhattan Bound CRT with Full Corridor BRT

The conclusion of the Level 3 screening may result in elimination, combination, or modification of one or more of the alternatives/options considered to date. Key questions of the Level 3 screening process that must be resolved include:

What TZB options should be progressed into the DEIS?
Which transit mode or modes should form part of the project?
What assessment methodologies should be used in the DEIS?

The purpose of this appendix is to assist in partially determining the answer to the first issue: could the TZB be rehabilitated in a historically sensitive manner given its status as a National Register-eligible bridge that is protected by Section 106 and Section 4(f).

D1.3 Purpose and Need

The Purpose and Need statement for the TZB/I-287 Environmental Review as detailed in the February 2008 Scoping Update Package, includes the following five broad goals and specific objectives:

1. Improve the mobility of people, goods and services for travel markets served by the I-287 Corridor:
   - Reduce traffic congestion levels
   - Improve travel times for local trips
   - Improve travel times for regional trips
   - Provide modal travel alternatives not subject to roadway congestion
   - Increase the share of travel demand accommodated by transit and ridesharing
   - Provide a non-motorized means of travel, such as a Pedestrian and Bicycle Path across the Hudson River
2. Maximize the flexibility and adaptability of new transportation infrastructure to accommodate changing long-term demand:
   - Maximize ability to accommodate increases in travel demand
   - Minimize constraints to serving future travel patterns and markets
3. Maintain and preserve vital elements of transportation infrastructure:
   - Assure that the I-287 Corridor's transportation infrastructure meets applicable standards for structural design and integrity
4. Improve safety and security of the transportation system:
   - Reduce motor vehicle accident severity and rates
   - Improve roadway geometrics to current standards
   - Improve the likelihood that the Bridge would withstand a severe natural or man-made event
5. Avoid, minimize and or mitigate any significant adverse environmental impacts caused by feasible and prudent I-287 Corridor improvements:
   - Minimize community disruption, displacements and relocations, as well as adverse impacts to public parks, visual resources and aesthetics resulting from mobility improvements in the I-287 Corridor
   - Implement mitigation measures that are feasible, constructible, innovative, sustainable, cost effective, and that address regulatory requirements

D2 Engineering Elements

This chapter addresses the engineering criteria, which consider technical performance and compliance with codes, standards, or agency requirements, that were used to assess the TZB Rehabilitation Options. In addition, any option that is developed for the TZB must meet the operating and maintenance requirements of the potential operating agencies, the NYS Thruway Authority (NYSTA) and Metro-North, or agencies that have a direct interest in the Bridge such as the US Coast Guard, in addition to complying with other state and federal requirements.

D2.1 Engineering Criteria

The engineering criteria consider technical performance and compliance with codes, standards, or agency requirements. The following discussion examines each of the major engineering criteria that are detailed in the report.

1. Structural Integrity

As defined in the Level 2 Screening, structural integrity is the degree to which the TZB is in compliance with current structural standards and specifications. For the purpose of the report, the definition has been expanded to include the degree to which the TZB is to be modified to extend its service life for a further 150 years.

The NYS Department of Transportation (NYSDOT) standards include the design specifications from the American Association of State Highway and Transportation Officials (AASHTO). The following quote outlines the design philosophy that establishes the requirements for structural integrity:

> *"Bridges shall be designed for specified limit states to achieve the objectives of constructability, safety, and serviceability with due regard for economy and aesthetics."*
> (AASHTO. LRFD Bridge Design Specifications, 4th Edition)

Limit states are conditions beyond which a bridge or components of a bridge cease to satisfy the provisions for which it was designed. Four limit states are identified for this project, including:

- Service Limit State (restrictions on stress, deformation and crack widths)
- Fatigue/Fracture Limit State (restrictions on stress ranges due to repetitive truck loading)
- Strength Limit State (live load; wind; overload vehicles)
- Extreme Events Limit State (seismic; collision/impact/explosion; redundancy)

2. Vulnerability

Measures to assess the overall risk framework include the following:

- Vulnerability Assessment – based on standardized procedures in six NYSDOT vulnerability manuals to establish inspection, capital, and safety priority
- Threat and Risk Assessment (TARA) – This process identifies hazards and specific event scenarios, establishes the consequence of these events based on known capacity and condition, and assigns rankings to both probability and criticality

3. Seismic

The TZB is a designated a 'critical' piece of infrastructure and is required to meet certain performance levels established by NYSDOT for downstate New York such as:

- Functional Event – or a 500-year return period earthquake, with no damage to primary members and the Bridge should be open to traffic within hours
- Safety Event – or a 2,500-year return period earthquake, which could have repairable damage, be open to emergency services within 48 hours, and be open to traffic within months

4. Redundancy

The measure of the ability of a service element to fulfill its function by secondary means after its primary functional mechanism is incapacitated. For the TZB, two aspects of its redundancy are important:

- The capacity of the crossing after an event
- The time required to restore previous capacity after an event

5. Emergency Response

This criterion focuses on the ability of emergency services to access emergency events. In order for emergency responders to access the TZB in the case of an event, certain design features of the crossing need to be in place, such as:

- Shoulder access
- Highway crossovers
- CRT access

6. Navigation Clearance

The measure for this criterion is the level of conformance to navigational requirements of the US Coast Guard, under whose jurisdiction lays the 600-foot wide shipping channel under the TZB. The existing TZB and therefore, all the Rehabilitation Options, meet the minimum standard of 139-feet vertical clearance to the river for shipping.

7. Construction Impacts

Construction impacts include the type, scale, and duration of construction and its potential effects on local residents and businesses. Construction activities that would differ between options include:

- Foundation construction in reference to the number of new piles and cofferdams
- Superstructure erection or modification
- Construction at the landings in Rockland and Westchester Counties
- Construction duration

8. Life Span

The life span of a bridge is a function of the life span of its components including steelwork, joints, and bearings. The life span of components can range from as low as five to ten-years for some types of deck joints up to 100 to 200 years for steelwork and concrete that has been adequately protected. To ensure a long life span for a bridge, a full program of maintenance, repair, and replacement is necessary based on component inspections and expectations.

Among the criteria established by the NYSTA, is the requirement for no major replacement for the first 100-years in any of the Rehabilitation Options. Overall, an economic life span in excess of 150 years is anticipated.

D2.2 Operating Criteria, Design Requirements

With the Purpose and Need of the TZB/I-287 Environmental Review established and its goals stated, which includes the introduction of a transit mode to the TZB, the next step in the process of developing options/alternatives for changing the TZB was to define the operating criteria and design requirements for the transportation systems. CRT and BRT are the two transportation modes that will be evaluated.

NYSDOT has the responsibility to provide policies, guidance and procedures for the design of projects that carry public highways in the State of New York. These policies and procedures are identified in this appendix as design requirements or standards. The primary goal of these standards is to provide assistance to designers to ensure that "quality" bridges are constructed. "Quality" bridges are durable, economical, aesthetically pleasing, and environmentally sound.

Operating Criteria is a tool used by individual facility operators to identify key elements required to operate their facility. These project-specific requirements were provided by NYSTA for the TZB approaches, BRT and CRT. Metro-North provided requirements for CRT. The US Coast Guard provided navigation requirements. Specific functional design elements for the TZB approach and bridge were developed according to NYSDOT design manuals.

NYSTA Key Operating Requirements

The key operating requirements of the NYSTA are:

- Maintain or improve existing levels of service
- Locate all highway (vehicular) lanes on one level
- Locate access roads/ramps to and from the Thruway on the right side
- Design the TZB to accommodate pedestrians, cyclists, public transportation modes and private road vehicles as well as maintenance and operation vehicles
- Provide effective separation between pedestrians and CRT
- Include staging areas on both ends of the TZB for quick and safe stopping of commercial traffic for inspection before entering the TZB
- Any NYSTA building or facility eliminated or significantly impacted should be replaced in function
- Locate facilities such that State Police and NYSTA emergency vehicles are in close proximity to the TZB, while providing a one-minute access time to the northbound and southbound lanes on the TZB
- Provide independent and dedicated access (northbound and southbound) from Thruway maintenance and administrative facilities (including State Police) to the mainline at all times
- Provide access roads at both ends of the TZB for turn-around at Thruway maintenance and State Police vehicles carrying out emergency response and maintenance activities
- Provide unrestricted maintenance access at all times to the bridge structure, including the area over commuter rail tracks
- Provide four U-turns (with electronic gates) on the main roadway to accommodate emergency response and maintenance vehicles
- Provide one U-turn on each end of the TZB and two in between
- No major replacement for the first 100 years in any option; an anticipated economic life span in excess of 150 years

Metro-North Key Operating Requirements

The key Metro-North operating requirements relative to the provision of CRT on the Bridge are:

- Railroad capable of 24 hours a day, seven days a week operation, albeit with reduced capacity during maintenance operations
- Have the capacity to support train services at a three minute frequency
- The ability to electrify the line using the standard Metro-North third rail system
- Provide a ten-foot wide vehicular maintenance way adjacent to the railroad tracks, or equivalent access, for scheduled and unscheduled maintenance activities in support of Metro-North's maintenance/inspection procedures that follow the federally mandated code for high speed class V track, ensuring minimum impact on operations
- Base criteria for fire/life safety on National Fire Prevention Association (NFPA) 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems* (2003 Edition) and NFPA 502, *Standard for Road Tunnels, Bridges and Other Limited Access Highways* (2004 edition)
- Provide regular, unrestricted access to the railroad tracks for emergency services personnel from the highway shoulder
- Accommodate both diesel and electrically powered, third rail operations
- Railroad shall accommodate standard freight vehicles with maximum axle loads of 65,000 pounds and trailer on flat car (TOFC) vehicle clearance envelope
- Provide crossovers at each end of the river crossing to maximize operational flexibility and to ensure that any section of the system can be made available for one-track operation
- The maximum grade for track is 2.0 percent for sustained lengths with short sections up to an absolute maximum of 2.5 percent where necessary due to geometric constraint

US Coast Guard

The requirements from the US Coast Guard are as follows:

- Minimum navigation clearance of 139 feet
- Initial indication of a preferred navigation clearance for new construction of 155 feet

NYS Department of Transportation

There are general design criteria that are adopted from the *NYSDOT Highway Design Manual and Bridge Design Manual*, as amended by NYSTA, and would be applicable to the TZB and its approaches. A list of these standard criteria compared to the existing conditions on the TZB and its approaches, and to proposed conditions on the TZB and its approaches, appears in Chapter 2, Table 2-1 on Page 3. Table D-1 is based on Table 2-1 and provides a list of design criteria for bridge elements that are most relevant to this appendix.

Element	Standard Criteria	Existing Conditions on TZB and Approaches	Proposed Conditions On Four Rehabilitation Options
Lane Width	12 feet	10 feet	Option 1: No change Options 2-4: 12 feet
Shoulder Width	Right: 10 feet minimum, 12 feet desirable Climbing: 4 feet minimum, 12 feet desirable Left: 4 feet minimum. 12 feet desirable	There are no shoulders	Option 1: No change Options 2-4: 12 feet on both sides of travel way
TZB Roadway Width	Full approach roadway width	Reduced by one lane from approach	Option 1: No change Options 2-4: 8 travel lanes, the approach roadway width
Median Width	10 feet minimum	4 feet typical	Option 1: No change Options 2-4: Not applicable

Table D-1

NYSDOT Standard Design Criteria vs. Existing Conditions and Proposed Conditions for Rehabilitation Options

D3 National Register-Eligible TZB

D3.1 Description of the Bridge

The TZB is a 3.1-mile long bridge that carries the New York State Thruway Authority (NYSTA) (I-87/I-287) over the Hudson River between Rockland and Westchester counties. The TZB consists of five visually and structurally distinct segments (Figure D-1). From west to east, these include the following:

- Causeway
- West Deck-Truss Spans
- Mains Spans
- East Deck-Truss Spans
- East Trestle Spans

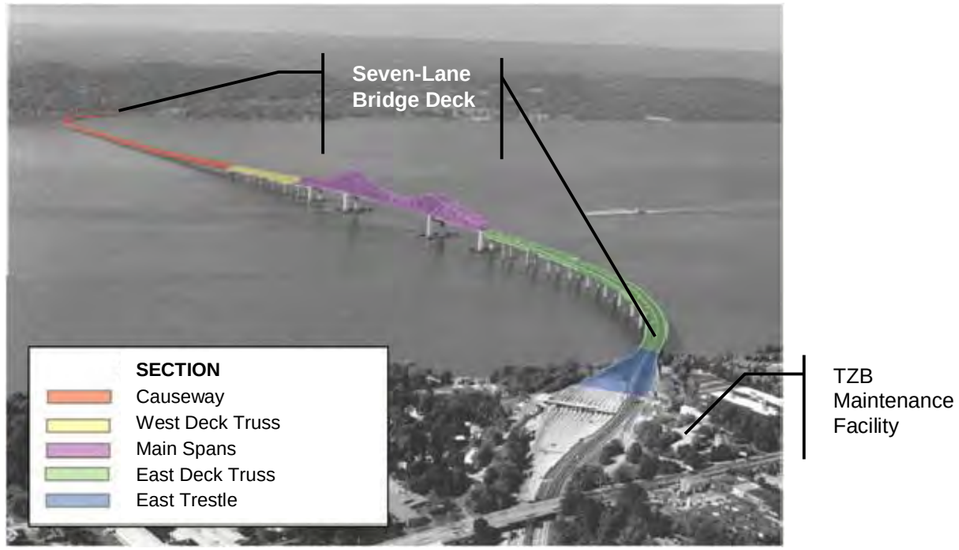


Figure D-1
Existing Tappan Zee Bridge

Each segment is comprised of a substructure and superstructure. The substructure includes foundation elements and piers that support the superstructure. The superstructure provides the means to span between the piers and carries the concrete deck.

Several types of substructure and superstructure are used in the five segments. The Causeway and the East Trestle Spans use simple steel I-beam stringers to carry an integrated concrete deck. Both segments are supported by concrete piers. The Causeway piers, which are in the river, are supported in turn by untreated timber piles. The East Trestle piers are founded in the rock escarpment in the Village of Tarrytown. At the west and east ends of the respective Causeway and East Trestle Spans, the TZB connects with the land at reinforced concrete abutments.

The Main Spans are comprised of two cantilever through trusses that carry a central suspended truss. These large trusses are supported by four steel piers. The piers are supported by four large Buoyant Caissons which, by virtue of the uplift they provide, reduce the loads on the steel piles below, which extend over 200 feet down to rock. The west and east Deck Truss Spans are of similar form, comprised of long trusses supported on tall concrete piers. Most of these piers are supported by circular cofferdam foundations; however, four of the West Deck Truss piers are supported on Buoyant Foundations.

The superstructure includes the bridge deck which was reconfigured to accommodate seven lanes in 1987. The bridge deck is equipped with a movable barrier that was installed in 1992.

Other features are also associated with the TZB. In the Village of Tarrytown, these include the Toll Plaza reconstructed in the 1970s and 1980s; the 1990s-era movable barrier garage; and the 1950s-era single-story, brick NYSTA Police Barracks & Office Building, presently referred to as the TZB Maintenance Facility. In the Village of Grand View-on-Hudson/Village of South Nyack, these include a modern maintenance dock below the TZB, modern Dockside Maintenance Facility and another 1990s-era movable barrier garage.

D3.2 History of the TZB

The TZB was constructed between 1952 and 1955 to carry the newly constructed Thruway over the Hudson River at its second widest point, which is between Rockland County to the west and Westchester County to the east. During the 1950s, Governor Thomas E. Dewey envisioned and supported the construction of a cross-state highway that would link to major expressways in Connecticut, Massachusetts, and New Jersey, and form part of the burgeoning US interstate highway system made possible, in part, by the Federal Aid Highway Act, which was passed in 1956, one year after completion of the TZB. The New York State Thruway Authority, an independent public corporation, was created in 1950 by the New York State Assembly to build, operate and maintain the Thruway, including the TZB, through user fees rather than state tax dollars (NYSTA-A, n.d.). The Thruway mainline, including the TZB, provides a 426-mile connection between New York's two largest cities, New York City and Buffalo, before continuing westward to the Pennsylvania state line at Ripley.

The TZB was designed for the NYSTA by the New York City-based engineering firm Madigan-Hyland. Major contractors included New York City-based Merritt-Chapman & Scott; American Bridge Company, renowned erectors of steel bridges throughout the United States; and others. The NYSTA and its contractors ultimately opted to employ the cantilever truss bridge form for the Main Spans of the superstructure instead of a more costly arch bridge. This form was chosen because of its standard design, associated cost savings, and the familiarity of American Bridge Company with construction of cantilever-truss bridges gained on other projects (*New York Times*, August 20, 1953).

The TZB substructure designs were far more innovative than the superstructure designs (Lowe, n.d.). Captain Emil H. Praeger, US Navy Retired (1882-1973), served as chief engineer of the TZB for Madigan-Hyland. During World War II, Praeger designed rectangular buoyant concrete breakwaters, code named "Phoenix," which were constructed in England and floated across the English Channel to form a protected harbor for the invasion of Normandy (Rensselaer Polytechnic Institute, Alumni Hall of Fame, April 8, 2008). A decade later, Praeger would apply this innovative technology to the design of the TZB.

The TZB was officially opened to traffic on December 15, 1955 as part of a 28-mile section of the Thruway that extended from Suffern in Rockland County to Yonkers in Westchester County (NYSTA, n.d.). Upon completion, the TZB was characterized as 3.1-mile structure supported by a substructure consisting of abutments and 197 piers. The abutments were located in the Village of Grand View-on-Hudson/Village of South Nyack vicinity in Rockland County, and in the Village of Tarrytown in Westchester County. The piers were erected upon four types of foundations including timber piles in the river, eight innovative Buoyant Caissons in the river, cofferdams in the river, and piers on land in the Village of Tarrytown. Piers in the river were protected by upstream and downstream ice breakers. The eight Buoyant Caissons were also protected by a fender system which was partially upgraded and replaced in the 1980s and 1990s (NYSTA-B, n.d.).

The bridge superstructure consisted of multiple types of commonplace structures that originally supported a six-lane bridge deck with a central curb-height median strip. The deck accommodated three eastbound and three westbound lanes. Moving west to east, the structures, which were representative of 1950s-era bridge design, included a causeway, two sets of deck-truss spans that flanked the thru-truss main spans to the east and west, and

trestle spans. In 1992, the bridge deck was reconfigured to accommodate a seventh lane, which is shifted during the morning and evening rush hours to provide an extra lane for eastbound or westbound traffic, respectively. Other features constructed at the east end of the TZB in the Village of Tarrytown included a 12-lane toll plaza, which was reconstructed in the 1970s and 1980s.

On February 28, 1956, Governor Averell Harriman approved an act of the New York State Assembly that named the structure the Tappan Zee Bridge. The name reflects the area's Native American and Dutch histories. In pre-Colonial times, the Tappan tribe lived along the Hudson River where the TZB is located. In the 1600s, when the Dutch were predominant in New York, the Hudson River was referred to as "zee," the Dutch term for "open sea." The Dutch referred to the stretch between what are now Piermont and Ossining as the "Tappan Zee" (NYSTA, n.d.). In 1994, the TZB was officially renamed the Governor Malcolm Wilson Tappan Zee Bridge after Governor Wilson, who completed Governor Nelson Rockefeller's term after he resigned in 1973 (Waymarking, April 21, 2008).

D3.3 National Register Eligibility Determination

In 2003, NYSHPO determined the 3.1-mile TZB to be eligible for listing on the National Register under Criteria A and C for its association with events that have made a significant contribution to the broad patterns of our history, and its distinctive design (Shaver, October 30, 2003). The determination was made at the request of NYSTA in compliance with 36 CFR 800.4 for the TZB/I-287 Environmental Review. The evaluation resulted in the following Statement of Significance:

> *Based on the information provided, it is the opinion of the State Historic Preservation Office that the Tappan Zee Bridge is significant in the areas of transportation and engineering as one of the state's most important bridges. Built between 1952 and 1955, the 3.2 mile long highway bridge has a unique caisson system supporting the piers and deck. It is the longest bridge in the state and one of the longest in the country, as well as having the world's ninth longest cantilever span, at 1,212 feet. The bridge is an essential component of the NYS Thruway system, with 135, 000 vehicles crossing the bridge daily to and from the New York Metropolitan area. The bridge has received minor modification since 1955, including the replacement of the concrete deck.*

A copy of NYSHPO's letter to NYSTA is included in Attachment A. [Subsequent to this statement, measurements have revealed that the TZB is 3.1 miles long.]

In its eligibility determination request to NYSHPO, NYSTA indicated that the 3.1-mile-long bridge, the longest in the state, connects Rockland and Westchester Counties. This connection is one of the TZB's contributions to broad patterns of history, as it has changed the patterns of habitation, travel, employment, and commercial/industrial development in both counties. The TZB is also a crucial part of the Thruway, the longest toll road in the United States.

NYSTA also indicated that the TZB has the world's ninth largest cantilever span, which measures 1,212 feet and forms part of the thru-truss Main Spans. It was also the first permanent bridge in the United States to be constructed on buoyant foundations, so that the TZBe "float[s] on air." The foundations are partially comprised of eight Buoyant Caissons, four of which support the three thru-truss Main Spans, while the balance support the easternmost spans of the West Deck Trusses. Their buoyancy provides lift, reducing the load on the piles below which must pass through 250 feet of mud and silt before reaching bedrock in this area. The 40-foot-high Buoyant Caissons vary in size from 120 feet by 60 feet (for the West Deck-Trusses) to 180 feet by 100 feet in plan for the Main Spans, with the largest weighing 25,000 tons. They were constructed upriver from the TZB in a natural clay pit, and are also the result of innovative engineering. Once they were completed, the clay pit, which was 32 feet below the river surface and was the world's largest natural dry dock, was flooded and they were floated downriver into place.

With the exception of the Buoyant Caissons, the TZB is primarily comprised of ordinary bridge components that were widely used by bridge designers during the mid-20th century. However, the inter-relationship of its components, including the Causeway, East and West Deck-Truss Span, thru-truss Main Span, and East Trestle Span, form a unified entity that convey the TZB's significance as critical piece of infrastructure in the New York Metropolitan Region. Upon its completion as part of the newly constructed Thruway in the 1950s, the TZB spurred development in the suburbs north of New York City, and continues to support the economic vitality of this region today.

The TZB retains a high degree of historic integrity. Its five contributing structural elements, including the Causeway, West Deck Truss Spans, Main Spans, East Deck Truss Spans, and East Trestle Spans, are described in Table D-2. In addition to its National Register eligibility, the TZB holds other designations. In 2006, the Federal Highway Administration (FHWA) included the TZB on the list of 22 features in New York State considered to be nationally and exceptionally significant features of the federal interstate highway system.

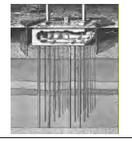
Number	Photo	Contributing Structural Elements
1		Causeway 167 spans, supported by the west abutment in Grand View-on Hudson /South Nyack and piers on timber piles.
2	 	7 West Deck Truss Spans west of the main spans supported by piers on circular cofferdams, and piers on 4 Buoyant Caissons.
3	 	3 Main Spans supported by piers on 4 Buoyant Caissons, including: • 2 cantilever anchor spans • 1 suspended span.
4		13 East Deck Truss Spans supported by piers on circular cofferdams.
5		7 East Trestle Spans east of the Main Spans supported by the east abutment and land-based piers in Tarrytown.

Table D-2

TZB Contributing Structural Elements

Since construction of the TZB in the 1950s, major alterations have included: replacement of the decking in the East Deck Truss Spans; reconfiguration of the six-lane deck to accommodate a seventh lane; installation of an automatic lane changer (the movable barrier); reconfiguration of the Tarrytown Toll Plaza; and replacement of the pier bent-protection system. In 2008-09, the concrete deck; supporting steel stringers; bearings; hold-down bolts; fascia beams; safety fence; and outer walkway of the outer two lanes of the Causeway and West Deck-Truss Spans were replaced. Drainage improvements were also undertaken. In 2004, prior to commencement of this work, NYSHPO concurred with NYSTA that the deck replacement project would have no adverse effect on the TZB. It is anticipated that the same work will occur along the Main Spans and remaining lanes of the Causeway and West Deck Truss Spans soon.

D4 Potential Impacts of the Rehabilitation Options – Section 106

The four bridge Rehabilitation Options were developed for analysis as described in Chapter 3 of this report (Figure D-2). Here, in Chapter D4 the impacts of the four options on the TZB are analyzed in accordance with Section 106 of NHPA.

Requirements

Section 106 requires that federal agencies take into account the effects of their actions on any district, site, building, structure, or object included in, or eligible for listing in, the National Register. Implementing regulations for Section 106 established by the Advisory Council on Historic Preservation (ACHP) are contained in 36 CFR Part 800 – Protection of Historic Properties. These regulations provide specific criteria for assessing the effects, in particular adverse effects, of federal undertakings on historic properties. The anticipated consequences on a cultural resource that result from proposed actions under an alternative are examined, as well as important characteristics of the impacted resource itself. Effects on cultural resources that are listed in, or eligible for listing in, the National Register are evaluated based on the Criteria of Adverse Effect set forth in 36 CFR 800.5 (Table D-3).

Secretary of the Interior's Standards for Treatment of Historic Properties

As indicated in Table D-3 (Item 2), a National Register-eligible resource may be adversely affected by an undertaking if it is not performed in accordance with the *Secretary of the Interior's Standards for Treatment of Historic Properties* (US Department of the Interior, 1991). Four treatment approaches have been developed by the Secretary, including preservation, rehabilitation, restoration, and reconstruction. The standards are primarily geared toward buildings. For this project, it is most relevant to determine whether the four Rehabilitation Options meet the Standards for Rehabilitation (Table D-4).

The NYSDOT has also prepared documents concerning the *Secretary of the Interior's Standards for Rehabilitation* and how it relates to bridges. The *New York State Department of Transportation Historic Bridge Management Plan*, prepared for NYSDOT and FHWA (Mead & Hunt, 2002), indicates that the Virginia Transportation Research Council adapted the rehabilitation standards for bridges. These standards provide useful guidance concerning their application to bridges (Table D-5).

Criteria of Adverse Effect

"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative"
(36 CFR 800.5[a][1]).

Examples of Adverse Effects

Adverse effects on historic properties include, but are not limited to:

1. Physical destruction of or damage to all or part of the property;
2. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's *Standards for the Treatment of Historic Properties* (36 CFR Part 68) and applicable guidelines;
3. Removal of the property from its historic location;
4. Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
5. Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features;
6. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization;
7. Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance" (36 CFR 800.5[a][2]).

Table D-3

Assessment of Adverse Effects

Standards
1. A property will be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces, and spatial relationships that characterize a property will be avoided.
3. Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, will not be undertaken.
4. Changes to a property that have acquired historic significance in their own right will be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property will be preserved.
6. Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature will match the old in design, color, texture, and, where possible, materials. Replacement of missing features will be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, will be undertaken using the gentlest means possible. Treatments that cause damage to historic materials will not be used.
8. Archeological resources will be protected and preserved in place. If such resources must be disturbed, mitigation measures will be undertaken.
9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportion, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction will be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.
Source: *Secretary of the Interior's Standards for Treatment of Historic Properties*. US Department of the Interior. 1991.

Table D-4

Secretary of the Interior's Standards for Rehabilitation

Virginia Guidelines
1. The original character-defining qualities or elements of a bridge, its site, and its environment should be respected. The removal, concealment, or alteration of any historic material or distinctive engineering or architectural features should be avoided.
2. All bridges shall be recognized as products of their own time. Alterations that have no historical basis that seek to create a false historical appearance shall not be undertaken.
3. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.
4. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.
5. Deteriorated structural members shall be retained and repaired, rather than replaced. Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
6. Chemical and physical treatments that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the most environmentally sensitive means possible.
7. Significant archaeological and cultural resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.
8. New additions, exterior alterations, structural reinforcements, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to the historic integrity of the property and its environment.
9. New additions and adjacent or related new construction shall be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.
Source: *Management Plan for Historic Bridges in Virginia.* Virginia Transportation Research Council. Excerpted from *New York State Department of Transportation Management Plan*. Mead & Hunt. September 2002.

Table D-5

Virginia Guidelines for Bridge Maintenance and Rehabilitation

D4.1 Impacts Assessment

As indicated in Sub-Chapter D3, the TZB consists of five contributing structural elements. Table D-6 provides a summary of the four Rehabilitation Options, the structural deficiencies that they address, and their impacts on the five contributing structural elements. An analysis of the impacts of each option on the five contributing structural elements is provided in Table D-6 and below in accordance with 36 CFR 800.5, assessment of adverse effects (See Table D-3 on Page D-7).

Causeway

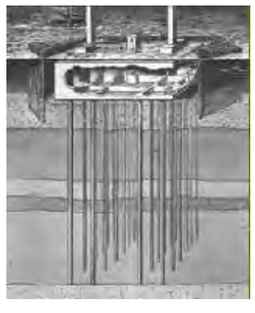
All Rehabilitation Options construct a new supplemental Causeway north of the existing Causeway and then remove the Causeway and its timber pile foundations. Options 2, 3 & 4 replace the existing Causeway. This action physically destroys part of the TZB. It also results in a change to the physical features of the TZB that contribute to its significance. Furthermore, the action introduces a replacement Causeway that would diminish the integrity of the TZB. Removal and replacement of the Causeway is not consistent with the *Secretary of Interior's Standards for Rehabilitation* because it permanently alters the historic form of the Causeway, a contributing structural element of the TZB. Therefore, removal and replacement of the Causeway and foundation system under all Rehabilitation Options would result in an adverse effect to the TZB.

West Deck-Truss Spans

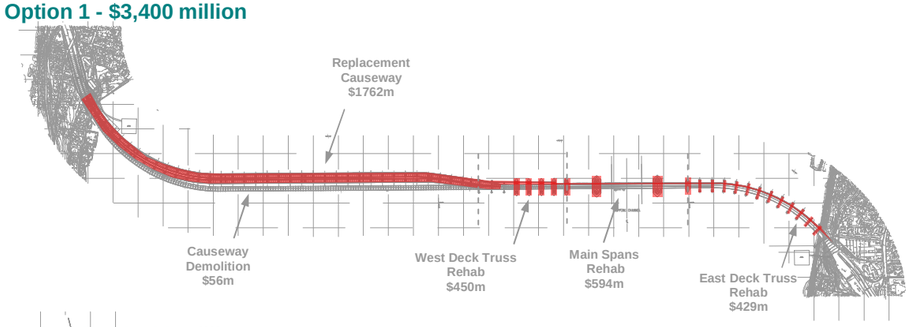
For the seven West Deck Truss Spans, Rehabilitation Options 1 and 2 require strengthening of the circular cofferdams, removal of the Buoyant Caissons with their replacement by seismically upgraded foundations, and significant reconstruction of the superstructure to accommodate the tie-in of the supplemental Causeway and to bring the TZB into compliance with the requirements of applicable bridge design standards. Rehabilitation Option 2 also requires widening of the West Deck Truss Span to accommodate eight highway lanes, two BRT/HOT lanes, and two cantilevered Pedestrian and Bicycle Paths. This action physically destroys part of the TZB. It also results in a change to the physical features of the TZB that contribute to its significance. Furthermore, this action alters the West Deck Truss Spans in a manner that would diminish the integrity of the TZB.

This action is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the West Deck Truss Spans, a contributing structural element of the TZB. Therefore, its alteration under Rehabilitation Options 1 and 2 would result in an adverse effect to the TZB.

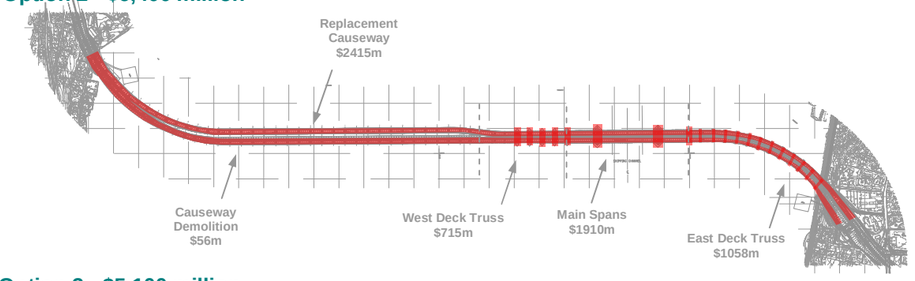
Rehabilitation Options 3 and 4 also require significant alterations to the West Deck Truss Spans. Like Options 1 and 2, the circular cofferdams would be strengthened and the piers with Buoyant Caissons would be re-supported on new foundations with removal of the caissons. The superstructure would be strengthened and modified to accommodate four eastbound highway lanes, one BRT/HOT lane, two shoulders, and one cantilevered Pedestrian and Bicycle Path. Furthermore, a Supplemental Bridge would be erected north of the West Deck Truss Spans carrying a similar transportation arrangement westbound. Under Rehabilitation Option 4, this Supplemental Bridge would carry two CRT tracks beneath the bridge deck. This action physically destroys part of the TZB. Furthermore, this action alters the West Deck-Truss Spans in a manner that would diminish the integrity of the TZB.



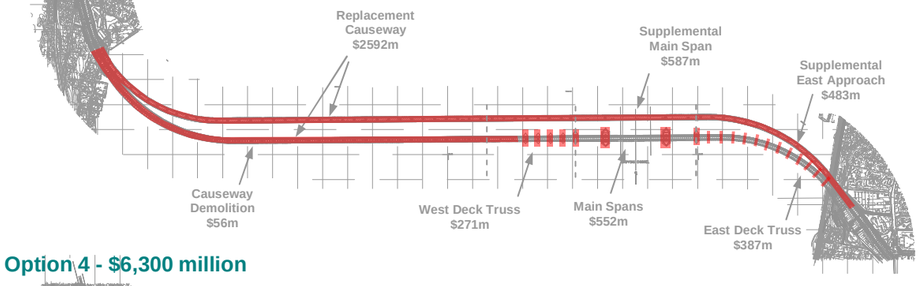
Option 1 - $3,400 million



Option 2 - $6,400 million



Option 3 - $5,100 million



Option 4 - $6,300 million

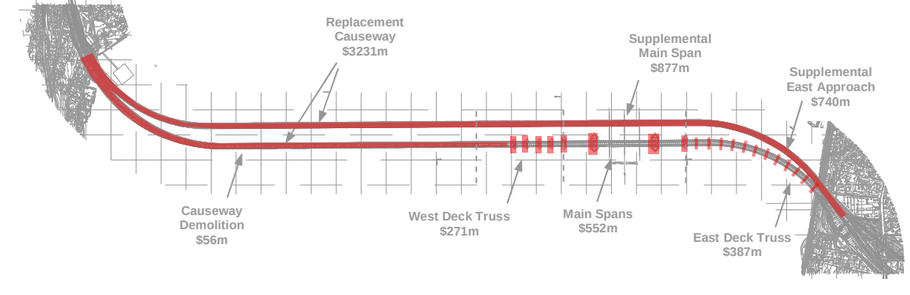
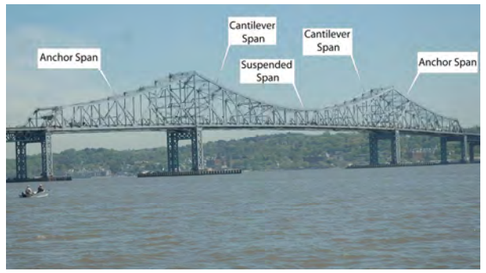


Figure D-2 Rehabilitation Options

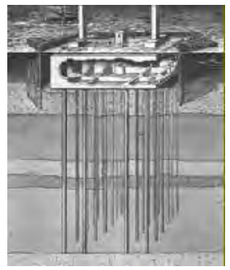
This action is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the West Deck Truss, a contributing structural element of the TZB. Therefore, alteration of the West Deck Truss Spans under Rehabilitation Options 3 and 4 would result in an adverse effect to the TZB.

Main Spans



For the three Main Spans, all Rehabilitation Options require construction of new outrigger foundations and removal of the Buoyant Caissons. Furthermore, the superstructure would be strengthened and modified for seismic purposes. In addition, a Pedestrian and Bicycle Path would be cantilevered from the main spans. In addition, under Options 3 and 4, a Supplemental Bridge would be erected north of the Main Spans carrying a similar transportation arrangement westbound. This Supplemental Bridge would carry two CRT tracks beneath the bridge deck under Option 4. This action physically destroys part of the TZB. Furthermore, this action alters the Main Spans in a manner that would diminish the integrity of the TZB.

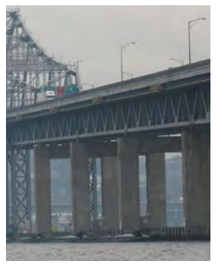
This action is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the Main Spans a contributing structural element of the TZB. Therefore, alteration of the Main Spans under Rehabilitation Options 1, 3 and 4 would result in an adverse effect to the TZB.



Rehabilitation Option 2 would result in additional alterations to the Main Spans. Like Options 1, 3 and 4, the Buoyant Caissons would be removed and replaced with new outrigger foundations. Furthermore, the superstructure would be strengthened, modified and significantly widened to accommodate eight highway lanes, two BRT/HOT lanes, four shoulders, and two cantilevered Pedestrian and Bicycle Paths. This action physically destroys part of the TZB. It also results in a change to the physical features of the TZB which contribute to its significance. Furthermore, this action alters the Main Spans in a manner that would diminish the integrity of the TZB.

It is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the Main Spans, a contributing structural element of the TZB. Therefore, alteration of the Main Spans under Rehabilitation Option 2 would result in an adverse effect to the TZB.

East Deck-Truss Spans



For the 13 East Deck Truss Spans, Rehabilitation Options 1 and 2 require strengthening of the circular cofferdams, and significant reconstruction of the superstructure for seismic purposes. Rehabilitation Option 2 also requires widening of the East Deck Truss Spans to accommodate eight highway lanes, two BRT/HOT lanes and two cantilevered Pedestrian and Bicycle Paths. This action physically destroys part of the TZB. It also results in a change to the physical features of the TZB which contribute to its significance. Furthermore, this action alters the East Deck Truss Spans in a manner that would diminish the integrity of the TZB.

It is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the East Deck Truss Spans, a contributing structural element of the TZB. Therefore, alteration of the East Deck Truss Spans under Rehabilitation Options 1 and 2 would result in an adverse effect to the TZB.

Rehabilitation Options 3 and 4 also require significant alterations to the East Deck Truss Spans. Like Rehabilitation Options 1 and 2, the circular cofferdams would be strengthened. The superstructure would be strengthened and modified to accommodate four highway lanes, one BRT/HOT lane, two shoulders, and one cantilevered Pedestrian and Bicycle Path. Furthermore, a Supplemental Bridge would be erected north of the East Deck Truss Spans to carry the TZB westbound lanes. Under Rehabilitation Option 4, this Supplemental Bridge would carry two CRT tracks beneath the bridge deck. This action physically destroys part of the TZB. Furthermore, this action alters the East Deck Truss Spans in a manner that would diminish the integrity of the TZB.

It is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the East Deck Truss Spans' substructure and superstructure, character-defining features of the TZB. Therefore, alteration of the East Deck Truss Spans under Rehabilitation Options 3 and 4 would result in an adverse effect to the TZB.

East Trestle Spans

The seven East Trestle Spans would be altered under Rehabilitation Options 1-4. Under Option 1, the trestles would be widened to accommodate the Pedestrian and Bicycle Path appended to the north side of the TZB. This action would affect the TZB, but if it were designed in a context sensitive manner, may not result in an adverse effect to the East Trestle Spans.

Under Rehabilitation Options 2-4, the East Trestle Spans would be replaced with a special structure. This action physically destroys part of the TZB. It also results in a change to the physical features of the TZB which contribute to its significance. Furthermore, this action alters the East Trestle Spans in a manner that would diminish the integrity of the TZB.

It is not consistent with the *Secretary of the Interior's Standards for Rehabilitation* because it permanently alters the historic form of the East Trestle Spans' substructure and superstructure, character-defining features of the TZB. Therefore, alteration of the East Trestle Spans under the Rehabilitation Options 2-4 would result in an adverse effect to the TZB.

D4.2 Analysis Summary

Overall, all four Rehabilitation Options would adversely affect the National Register-eligible TZB as defined in 36 CFR 800.5 (See Table D-3 on Page D-7). Each option adversely impacts the majority of the five contributing structural elements of the TZB. Adverse effects include:

- Physical destruction of or modification to all or part of the property
- Alteration of the property that is not consistent with the *Secretary of the Interior's Standards for Rehabilitation*
- Introduction of elements that diminish the integrity of the property's significant historic features

Section 106 Consultation

Upon issuance of this report, in accordance with 36 CFR 800.2(b)(2), 36 CFR 800.3 (c)(3), 36 CFR 800.3(e), and 36 CFR 800.3(f), the lead agencies will commence consultation with NYSHPO, the consulting parties, and ACHP, if they wish to participate. The lead agencies will seek input from consulting parties and the public to assist in the identification of historic properties during the cultural resources survey being undertaken in conjunction with the TZB/I-287 Environmental Review DEIS. The lead agencies will also seek input regarding potential impacts that alternatives evaluated in the DEIS may have on historic properties. Finally, in compliance with these regulations, the lead agencies will also conduct consultation throughout the DEIS to devise potential measures to avoid, minimize or mitigate impacts to historic properties.

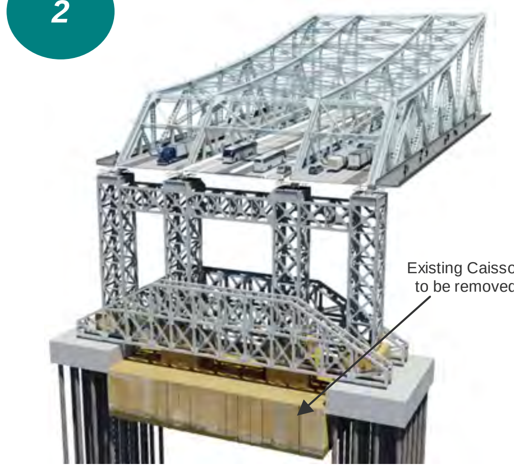
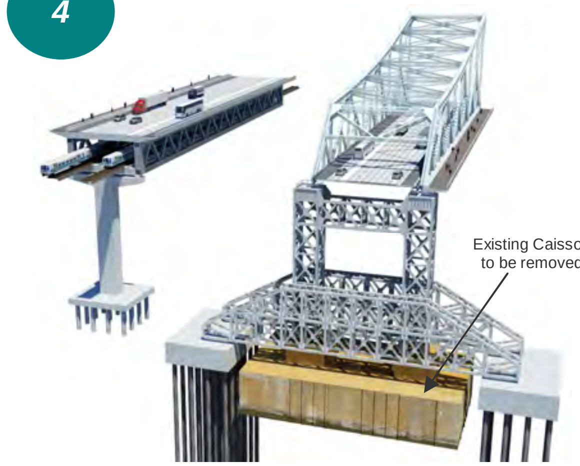
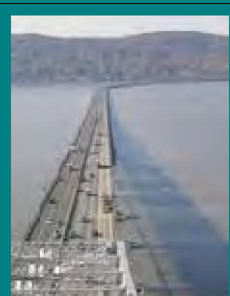
Contributing Structural Element	Rehabilitation Options			
	1 	2 	3 	4 
Causeway Supported by west abutment and piers on timber piles				
	• Replaces Causeway, including timber pile foundations, with two parallel structures with four highway lanes and full-size shoulders • Provides Pedestrian and Bicycle Path on southernmost causeway	• Replaces Causeway, including timber pile foundations, with two parallel structures, each including four highway lanes, one BRT/ HOT lane and full-size shoulders • Provides Pedestrian and Bicycle Path cantilevered from north side of the northernmost causeway and south side of the southernmost causeway	• Replaces Causeway, including timber pile foundations, with two parallel structures, each including four highway lanes, one BRT/HOT lane and full-size shoulders • Provides Pedestrian and Bicycle Path on north side of the northernmost causeway and south side of the southernmost causeway	• Replaces Causeway, including timber pile foundations, with two parallel structures, each including four highway lanes, one BRT/HOT lane and full-size shoulders; westbound causeway accommodates two CRT tracks beneath roadway • Provides Pedestrian and Bicycle Path on north side of the northernmost causeway and south side of the southernmost causeway
Existing Deficiencies/Concerns	1. Deterioration of deck from truck traffic and reduction in associated factor of safety 2. Cyclical deterioration of substructure concrete columns, bearings, and beams from road salts 3. Deterioration of pilecap and piers from marine salts 4. Design seismic event would result in loss of the segment for year(s) 5. Limited fatigue life of stringer welds 6. Potential for timber pile deterioration resulting in loss of foundations			
Section 106 Effects Summary	• Physically destroys part of TZB • Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Physically destroys part of TZB • Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Physically destroys part of TZB • Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Physically destroys part of TZB • Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*

Table D-6

Impacts to Five Contributing Structural Elements of TZB

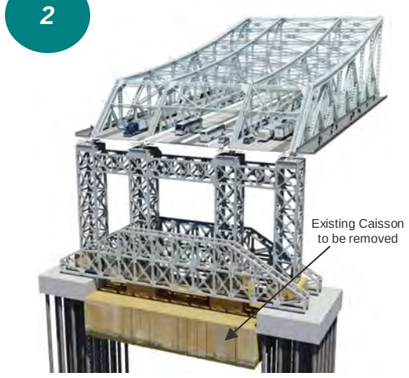
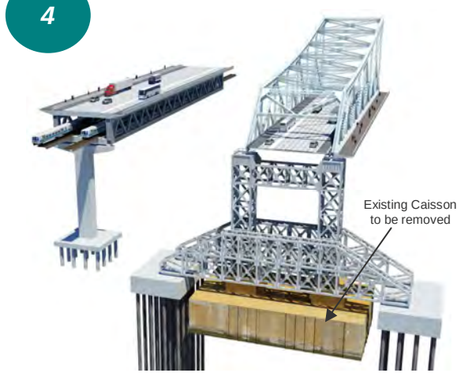
Contributing Structural Element	Rehabilitation Options			
	1 	2 	3 	4 
West Deck Truss Spans **Seven spans supported by piers on circular cofferdams and piers on four Buoyant Foundations**				
 	• Strengthens and seismically upgrades the circular cofferdam foundations and removes and replaces Buoyant Foundations with seismically upgraded foundations • Strengthens and upgrades seven West Deck Truss Spans for seismic purposes • Alters superstructure to accommodate tie-in of replacement causeway • Removes and reconstructs 1,250 feet of seven-lane bridge deck; widens westernmost deck-truss • Provides Pedestrian and Bicycle Path cantilevered from north side of West Deck Truss Spans	• Strengthens and seismically upgrades the circular cofferdam foundations and removes and replaces Buoyant Foundations with seismically upgraded foundations • Strengthens and upgrades seven West Deck Truss Spans for seismic purposes • Removes and reconstructs 1,000 feet of bridge deck • Widens west deck-truss spans from 91 feet to 216 feet to accommodate eight highway lanes, two BRT/HOT lanes and four shoulders. • Provides Pedestrian and Bicycle Path cantilevered from the north and south sides of West Deck Truss Spans	• Strengthens and seismically upgrades the circular cofferdam foundations. and removes and replaces Buoyant Foundations with seismically upgraded foundations • Strengthens and upgrades seven West Deck Truss Spans for seismic purposes • Reconfigures Seven West Deck Truss Spans to accommodate four highway lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of West Deck Truss Spans • Supplemental Bridge erected north of West Deck Truss • Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, and Pedestrian and Bicycle Path	• Strengthens and seismically upgrades the circular cofferdam foundations and removes and replaces Buoyant Foundations with seismically upgraded foundations • Strengthens and upgrades seven West Deck Truss Spans for seismic purposes • Reconfigures seven West Deck Truss Spans to accommodate four lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of West Deck Truss Spans • Supplemental Bridge erected north of West Deck-Truss Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, Pedestrian and Bicycle Path, and two CRT tracks beneath roadway
Existing Deficiencies/Concerns	1. Deterioration of deck from truck traffic and reduction in associated factor of safety 2. Cyclical deterioration of superstructure steel truss from road salts, specifically deterioration of steel plys within built-up steel sections 3. Cyclical deterioration of substructure concrete columns and bearings from road salts 4. Deterioration of columns and foundations from marine salts 5. Design seismic event would result in loss of the segment for year(s) 6. Limited pier protection for Buoyant Caissons 7. Vulnerability of Buoyant Caissons 8. Lack of redundancy and robustness in superstructure			
Section 106 Effects Summary	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*

Table D-6 (con't)

Impacts to Five Contributing Structural Elements of TZB

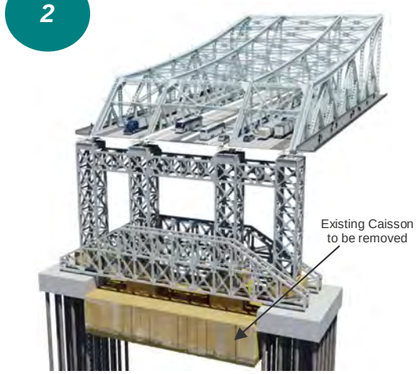
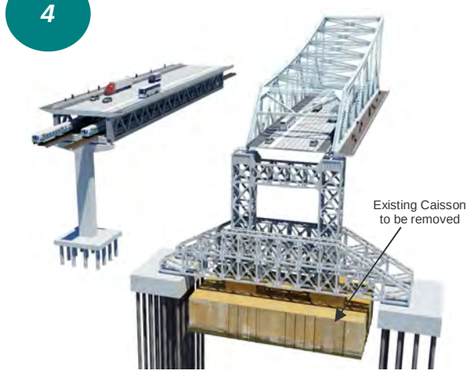
Contributing Structural Element	Rehabilitation Options			
	1 	2 	3 	4 
Main Spans **Three spans supported by piers on 4 Buoyant Caissons, including two cantilever anchor spans and one suspended span**	 	• Removes the Buoyant Foundations and replaces them with seismically upgraded foundations • Strengthens and upgrades three Main Spans for seismic purposes • Provides Pedestrian and Bicycle Path cantilevered from north side of Main Spans	• Removes the Buoyant Foundations and replaces them with seismically upgraded foundations • Strengthens and upgrades three Main Spans for seismic purposes • Widens three Main Spans from 93 feet to 248 feet to accommodate new thru-truss sections appended to the north and south sides of the original thru-trusses; widened deck will accommodate eight highway lanes, two BRT/HOT lanes and four shoulders • Provides Pedestrian and Bicycle Path cantilevered from the north and south sides of Main Spans	• Removes the Buoyant Foundations and replaces them with seismically upgraded foundations • Strengthens and upgrades three Main Spans for seismic purposes • Reconfigures three Main Spans to accommodate four highway lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of Main Spans • Supplemental Bridge erected north of Main Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, and Pedestrian and Bicycle Path	• Removes the Buoyant Foundations and replaces them with seismically upgraded foundations • Strengthens and upgrades three Main Spans for seismic purposes • Reconfigures three Main Spans to accommodate four highway lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of Main Spans • Supplemental Bridge erected north of Main Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, Pedestrian and Bicycle Path, and two CRT tracks beneath roadway
Existing Deficiencies/Concerns	1. Deterioration of deck from truck traffic and reduction in associated factor of safety. 2. Cyclical deterioration of superstructure steel truss from road salts, specifically deterioration of steel plys within built-up steel sections 3. Cyclical deterioration of substructure concrete columns and bearings from road salts 4. Deterioration of columns and foundations from marine salts 5. Design seismic event would result in loss of the segment for year(s) 6. Limited pier protection for Buoyant Caissons 7. Vulnerability of Buoyant Caissons 8. Lack of redundancy and robustness in superstructure			
Section 106 Effects Summary	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Physically destroys part of the TZB • Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*

Table D-6 (con't)

Impacts to Five Contributing Structural Elements of TZB

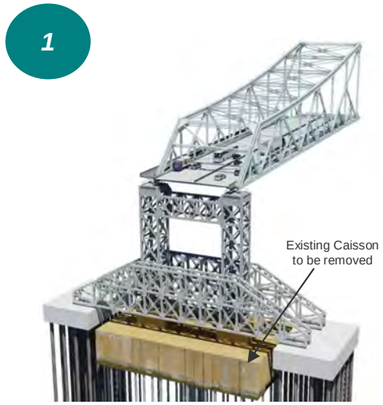
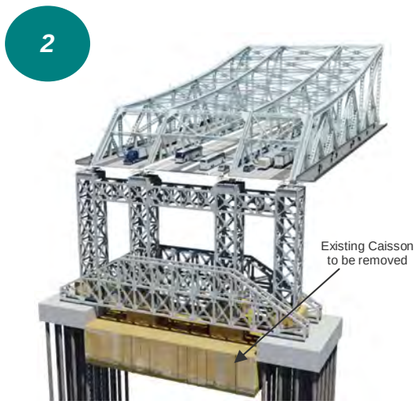
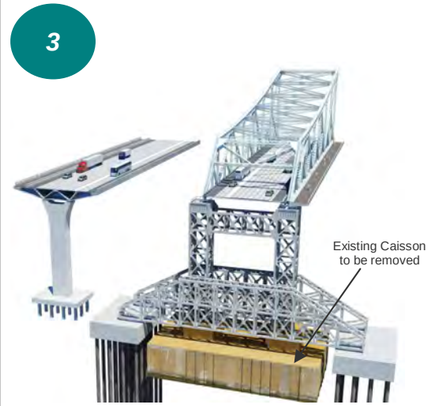
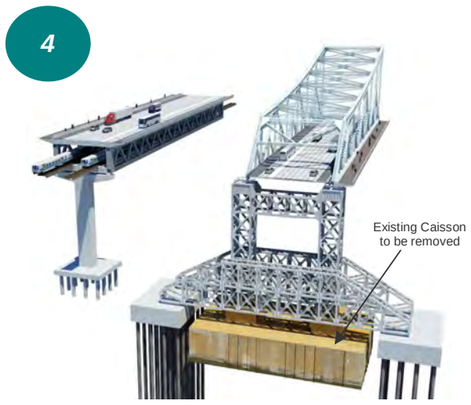
Contributing Structural Element	Rehabilitation Options			
	1 	2 	3 	4 
East Deck Truss Spans **Thirteen spans supported by piers on circular cofferdams**				
	• Strengthens circular cofferdam foundations with seismically upgraded foundations • Strengthens and upgrades thirteen East Deck Truss Spans for seismic purposes • Provides Pedestrian and Bicycle Path cantilevered from north side of the deck-trusses	• Strengthens circular cofferdam foundations with seismically upgraded foundations • Strengthens and upgrades thirteen East Deck Truss Spans for seismic purposes • Widens thirteen East Deck-Truss Spans from 91 feet to 216 feet to accommodate eight highway lanes, two BRT/HOT lanes and four shoulders • Provides Pedestrian and Bicycle Path cantilevered from the north and south sides of the deck-trusses	• Strengthens circular cofferdam foundations with seismically upgraded foundations • Strengthens and upgrades thirteen East Deck Truss Spans for seismic purposes • Reconfigures thirteen East Deck Truss Spans to accommodate four highway lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of the deck-trusses • Supplemental bridge erected north of East Deck Truss Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, and Pedestrian and Bicycle Path	• Strengthens circular cofferdam foundations with seismically upgraded foundations • Strengthens and upgrades thirteen East Deck Truss Spans for seismic purposes • Reconfigures thirteen East Deck Truss Spans to accommodate four highway lanes, one BRT/HOT lane and two shoulders • Provides Pedestrian and Bicycle Path cantilevered from the south side of the deck-trusses • Supplemental bridge erected north of East Deck-Truss Spans to accommodate four highway lanes, one BRT/HOT lane, two shoulders, Pedestrian and Bicycle Path, and two CRT tracks beneath roadway
Existing Deficiencies/Concerns	1. Cyclical deterioration of superstructure steel truss from road salts, specifically deterioration of steel plys within built-up steel sections 2. Cyclical deterioration of substructure concrete columns and bearings from road salts 3. Deterioration of columns and foundations from marine salts 4. Design seismic event would result in loss of the segment for year(s) 5. Lack of redundancy and robustness in superstructure			
Section 106 Effects Summary	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*

Table D-6 (con't)

Impacts to Five Contributing Structural Elements of TZB

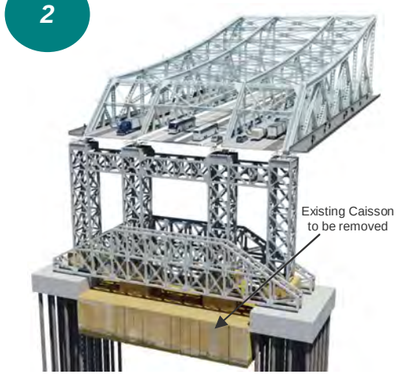
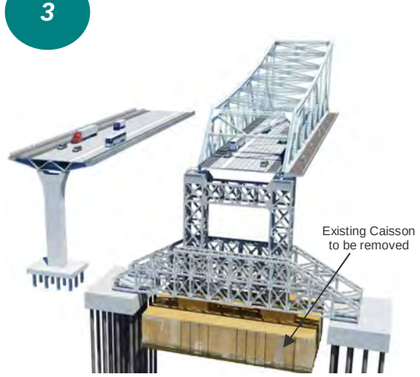
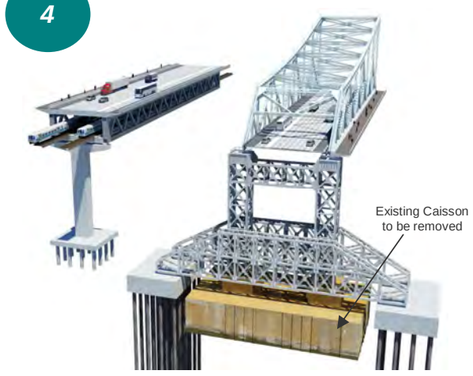
Contributing Structural Element	Rehabilitation Options			
	1 	2 	3 	4 
East Trestle Spans **Seven spans supported by east abutment and piers** 	• Width increased from 91 feet to 110 feet to accommodate northern Pedestrian and Bicycle Path	• Widened and replaced with special structure	• Widened and replaced with special structure	• Widened and replaced with special structure
Existing Deficiencies/Concerns	1. Deterioration of deck from truck traffic and reduction in associated factor of safety 2. Cyclical deterioration of substructure concrete columns, bearings and beams from road salts 3. Design seismic event would result in loss of the segment for month(s)			
Section 106 Effects Summary	• Changes features of TZB that contribute to its significance	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*	• Changes features of TZB that contribute to its significance • Introduces elements that diminish integrity of TZB • Non-compliant with *Secretary of the Interior's Standards for Rehabilitation*

Table D-6 (con't)

Impacts to Five Contributing Structural Elements of TZB

D5 Potential Impacts of the Rehabilitation Options – Section 4(f) Evaluation

The four bridge Rehabilitation Options were developed for analysis as described in Chapter 3 of this report (Figure D-2). Here, in Chapter D5 the impacts of the four options on the TZB are analyzed in accordance with Section 4(f).

Requirements

Section 4(f) of the Department of Transportation Act (with implementing regulations at 23 CFR Part 774) states that the lead federal transportation agency, in this case the FHWA and Federal Transit Administration (FTA) shall not approve a transportation program or project requiring the use of any land in a public park, recreation area, wildlife or waterfowl refuge, or historic site unless there is no feasible and prudent avoidance alternative to the use of such land, and the program or project includes all possible planning to minimize harm. Table D-7 defines feasible and prudent avoidance alternatives according to 23 CFR 774.17.

Section 4(f) defines an historic site as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register." As indicated in Chapter D3, the TZB was determined eligible for listing in the National Register by NYSHPO in 2003. Furthermore, in 2006, the FHWA included the TZB on the list of 22 features in New York State considered to be nationally and exceptionally significant features of the federal interstate highway system.

All options described in this report result in a Section 4(f) use of the TZB. Therefore, this preliminary Section 4(f) evaluation has been prepared to demonstrate that there are no feasible and prudent alternatives available that avoid use of the TZB.

D5.1 No Build Alternative

An evaluation of feasibility and prudence of No Build Alternative, according to the definitions featured in Table D-7, is provided below.

Feasibility

A primary goal of the TZB/I-287 Environmental Review is to address the safety, mobility and capacity needs of the I-287 Corridor. The TZB is a critical piece of the regional infrastructure and carries the Thruway (I-87/I-287) over the Hudson River between Rockland and Westchester Counties. When it opened to traffic in 1955, the TZB carried approximately 18,000 vehicles per day. Today, the TZB carries approximately 135,000 vehicles daily with volumes as high as 170,000 on some peak days.

As a critical piece of the regional infrastructure, the TZB affects the lives of millions of users, as well as the economic vitality of the whole region. Accordingly, it is held to the highest performance standards, and it is required that the Bridge is safe for continued traffic use well into the future.

The existing TZB has multiple deficiencies that would not be addressed by the No Build Alternative. These include:

- High deterioration rate.
- Lack of structural redundancy.
- Scale and complexity of ongoing maintenance.
- High volume of truck traffic that is detrimental to the Bridge and the bridge deck.
- Inability of TZB to meet current seismic performance standards for critically important bridges.
- Ongoing vulnerabilities and risks associated with concrete and steel details; continued safe operation of the Buoyant Foundations; ship collision; and deliberate intent.
- Accident rate four times higher on TZB than other portions of the Thruway.

Based on the ongoing maintenance requirements of NYSTA and assessments of the TZB conducted for this report, rehabilitation or replacement of the TZB is considered essential if it is to remain in operation in the future. Therefore, while adoption of the No Build Alternative may be feasible, it is neither prudent nor reasonable as described immediately below.

Prudence

The No Build Alternative is not a prudent avoidance alternative because it fails the prudence test with respect to selected aspects of Purpose and Need, engineering criteria, design requirements, cost criteria, and transportation criteria set forth in the report and this appendix.

Definition
(1) A feasible and prudent avoidance alternative avoids using Section 4(f) property and does not cause other severe problems of a magnitude that substantially outweighs the importance of protecting the Section 4(f) property. In assessing the importance of protecting the Section 4(f) property, it is appropriate to consider the relative value of the resource to the preservation purpose of the statute. (2) An alternative is not feasible if it cannot be built as a matter of sound engineering judgment. (3) An alternative is not prudent if: (i) It compromises the project to a degree that it is unreasonable to proceed with the project in light of its stated purpose and need; (ii) It results in unacceptable safety or operational problems; (iii) After reasonable mitigation, it still causes: (A) Severe social, economic, or environmental impacts; (B) Severe disruption to established communities; (C) Severe disproportionate impacts to minority or low income populations; or (D) Severe impacts to environmental resources protected under other Federal statutes; (iv) It results in additional construction, maintenance, or operational costs of an extraordinary magnitude; (v) It causes other unique problems or unusual factors; or (vi) It involves multiple factors in paragraphs (3)(i) through (3)(v) of this definition, that while individually minor, cumulatively cause unique problems or impacts of extraordinary magnitude.
Source: 23 CFR 774.17, *Definitions.*

Table D-7

Feasible and Prudent Avoidance Alternative Definition

Purpose and Need

The No Build Alternative is not prudent because it compromises the project to a degree that it is unreasonable to proceed with the project in light of its stated Purpose and Need. The first goal of the project is to "[i]mprove the mobility of people, goods and services for travel markets served by the corridor" via multiple methods,

including provision of "modal travel alternatives not subject to roadway congestion." The No Build Alternative does not include modal travel alternatives.

The No Build Alternative also does not meet the second goal of the project, "[m]aximize the flexibility and adaptability of new transportation infrastructure to accommodate changing long-term demand." Because this option does not incorporate modal travel alternatives, it is unable to accommodate changing long-term demand.

In addition, the No Build Alternative fails to fully meet the fourth goal of the project, "[i]mprove safety and security of the transportation system" by reducing accidents; improving roadway geometry to current standards; and improving the likelihood that the TZB would withstand a severe natural or man-made event. The No Build Alternative falls short of meeting the safety and security goals of the project.

Thus, the No Build Alternative fails to fully meet the Purpose and Need of the project, including goals 1, 2 and 4. Therefore, this option is not prudent because it compromises the project to a degree that it is unreasonable to proceed.

Engineering Criteria

The No Build Alternative would not meet the engineering criteria set forth in the report for the TZB. These criteria include structural integrity, vulnerability, seismic, redundancy, emergency response, navigation, construction impacts, and life span. Therefore, this alternative is not prudent because unacceptable safety and operational problems would not be addressed if the TZB were to remain in place.

Engineering Criteria/Design Requirements

Other operational problems include compliance with the life span engineering criterion and NYSTA design requirements. The NYSTA specified no major component replacement for 100-years and a 150-year life span for economic/maintenance purposes. The No Build Alternative fails to meet these objectives and would require major repairs or replacement within 100 years. Therefore, this alternative is not prudent because unacceptable safety and operational problems would not be addressed if the TZB were to remain in place.

Cost Criteria

In terms of cost criteria, the No Build Alternative is also not prudent because it results in ongoing maintenance costs of an extraordinary magnitude when compared to Rehabilitation and Replacement Options that address deficiencies of the TZB. Such high maintenance costs render the No Build Alternative not prudent.

Transportation Criteria

Finally, the No Build Alternative is also not prudent because it fails to meet transportation criteria set forth in this report. The alternative would not address ongoing traffic safety concerns. Therefore, this alternative is not prudent because unacceptable safety and operational problems would not be addressed if the TZB were to remain in place.

D5.2 Avoidance Alternatives

During the alternatives analysis phase of the TZB/I-287 Environmental Review, multiple alternatives were developed that included construction of a Supplemental Bridge on a remote northern alignment, a remote southern alignment or an alignment immediately north of the TZB. These alternatives could qualify as avoidance alternatives under Section 4(f) if the existing bridge was retained and rehabilitated in accordance with the *Secretary of the Interior's Standards for Rehabilitation*.

Construction of a Supplemental Bridge on another alignment and retention and rehabilitation of the TZB in a manner that would preserve its historic integrity, and permit its continued use as a vehicular crossing, presents multiple challenges. From an administrative perspective, the TZB would no longer form part of the federal interstate highway system. As a result, the agency or agencies that would secure funding and accept ownership, operation, and maintenance responsibilities for the TZB would have to be identified. From a navigation perspective, retaining the existing TZB would preclude increasing the navigation clearance.

From an engineering perspective, design modifications coupled with maintenance projects, would be necessary to retain the TZB in safe working order for local traffic. In effect, the TZB would become classified as an Urban Local Arterial under the avoidance alternatives. General implications for the TZB are as follows:

- It would be necessary to construct a new access roadway system in South Nyack and Tarrytown to accommodate local traffic that is either coming off the Supplemental Bridge or intends to cross the river. The impact of connecting the TZB to the local road network would be greatest in the case of the adjacent alignment since both the Supplemental Bridge and the TZB would touch down in the same, congested locations
- Toll collection facilities would have to be constructed for both the Supplemental Bridge and the TZB when the TZB is converted to an Urban Local Arterial. Absent toll collections, the TZB would tend to become a Thruway by-pass road
- As a bridge supporting a local road, the TZB would not be classified a critical lifeline structure. However, it would still cross the Hudson River navigation channel and its failure during a seismic event could completely impede river traffic. Consequently, as a critical bridge, the eight Buoyant Caissons that support a portion of the West Deck Truss Spans and fully support the Main Spans would have to be replaced in a manner comparable to that envisioned under Rehabilitation Options 1-4. Replacing them would entail construction of outriggers; installation of a structural load transfer system; and removal of the Buoyant Caissons
- Since the TZB would no longer be a critical lifeline structure, the Causeway would not have to be replaced for seismic reasons. However, to comply with NYSDOT standards to avoid collapse, the Causeway substructure would require new supports on each side of the existing 166 piers. Also, it is anticipated that replacement of the Causeway in-kind may be necessary within the next 50 years as result of Marine Borer activity
- Finally, as a result of the marine environment within which it is situated and the continued use of roadway de-icing salts, the concrete substructure piers and steel superstructure of the TZB would require a sustained and high level of repair
- The cost of converting the TZB to an Urban Local Arterial and maintaining it as such is approximately $3.8 billion with about 78% associated with physical modifications. This includes $2.57 billion in initial modifications and $410 million (net present value) to remove and replace the existing Causeway. The net present value of maintenance costs would be $860 million

Converting the TZB into an Urban Local Arterial could not be undertaken in accordance with the *Secretary's Standard's for Rehabilitation* because it would be necessary to alter key contributing structural elements of the TZB. Alterations would include:

- Construction of new supports on each side of the 166 piers that support the Causeway
- Removal and replacement of the four Buoyant Caissons that partially support the West Deck Truss Spans
- Removal and replacement of the four Buoyant Caissons that fully support the Main Spans

In addition, the concrete substructure piers and steel superstructure would be subject to ongoing maintenance. It is anticipated that the Causeway could also need to be replaced in-kind within the next 50 years. While these projects could be undertaken in accordance with the *Secretary of the Interior's Standards for Rehabilitation*, key contributing structural elements would have already been altered in a non-compliant manner as noted above.

An evaluation of the feasibility and prudence of erecting a new Thruway crossing on another alignment and retaining and rehabilitating the TZB for local use is provided below.

D5.2.1 Remote Northern and Southern Alignments

During the Level I screening process established for the TZB/I-287 Environmental Review, northern and southern crossings well-removed from the I-287 Corridor were examined. The TZB would be retained and

rehabilitated as outlined in sub-Chapter 5.2. The remote northern and southern crossings are briefly described below, based on their description in the *Level I Screening Process Report* (NYSTA, et al., October 2003).

A remote northern crossing, approximately 3 miles north of the TZB, would require a new 2-mile corridor in Rockland County, diverging from I-287 near Interchange 12 and extending to the west banks of the Hudson River in Nyack. The crossing would require a tunnel to avoid impacts and displacements associated with a new highway through Nyack. Furthermore, in Westchester County, the river crossing would require a new ½-mile long roadway from the Hudson River to State Route 117 at its interchange with US Route 9. This remote crossing would pass directly through Rockefeller State Park Preserve and result in direct impacts to this park. Furthermore, State Route 117 would be widened to a new interchange at the National Register-listed Taconic State Parkway. (NYSTA, et al., October 2003).

A remote southern crossing would be in the vicinity of Snedens Landing in Rockland County, about 4 miles south of the TZB. A 6-mile structure would be erected between Snedens Landing and Dobbs Ferry in Westchester County to meet I-87 at Interchange 7. This remote crossing would result in direct impacts to the National Register-listed Palisades Interstate Parkway and the Hudson River ecosystem because of the proximity of the alignment to the Piermont Marsh, a New York State Significant Coastal Habitat. In addition, community impacts would occur in both Rockland and Westchester counties where numerous property acquisitions would occur (NYSTA, et al., October 2003).

D5.2.2 Construction of an Adjacent Bridge

Construction of a new adjacent bridge to the north of the TZB that would carry the Thruway across the Hudson River was studied during the Level 2 screening process. The TZB would be retained and rehabilitated as outlined in sub-Chapter 5.2.

The new crossing would be located approximately 250-300 feet north of the TZB and consist, at a minimum, of a ten-lane bridge (eight general purpose lanes; two BRT/HOT lanes) or a ten-lane bridge with accommodation for two CRT tracks. The new crossing would result in acquisition of properties in South Nyack and Grandview-on-Hudson in Rockland County, and Tarrytown in Westchester County. Impacts to cultural resources would also occur in both counties.

D5.2.3 Feasibility and Prudence

From a transportation-planning perspective, construction of a new Thruway crossing on a remote northern or southern alignment would require the development of new travel corridors and would not make good use of the existing I-287 Corridor in Rockland and Westchester counties. From a traffic perspective, once the rehabilitated TZB is connected to the local roadway system in South Nyack/Grand View-on-Hudson and Tarrytown, it has the potential to become a conduit for motorists seeking to bypass the new Thruway crossing, particularly in peak traffic periods. From a transit perspective, the existing I-287 Corridor provides the optimal alignment to maintain efficient cross-corridor service. Diverging from the I-287 Corridor to accommodate a remote northern or southern alignment would penalize transit service performance by requiring additional travel time.

Constructing a new Thruway crossing on an adjacent alignment would also require connecting the TZB to the local road network in South Nyack/Grand View-on Hudson and Tarrytown. However, in this case, local road connections would be undertaken in an area already congested with ramps and other structural features associated with the new crossing. Furthermore, to avoid motorists bypassing the new Thruway crossing, toll plazas would be needed in Tarrytown to serve both bridges. These duplicative toll facilities would be built in an area that would be fully developed to accommodate the new crossing. Connecting the TZB back to the Thruway may also prove to be an intractable problem without acquisition of considerable residential and commercial properties for new interchanges. Therefore, while this alternative may be feasible, as describe further below it is considered neither prudent nor reasonable.

Construction of a new Thruway crossing on a remote northern, southern or adjacent alignment fails the prudence test with respect to the overall goals of the project. In particular, the fifth goal of the project is, in part, to:

> *Avoid, minimize and or mitigate any significant adverse environmental impacts caused by feasible and prudent corridor improvements [and] minimize community disruption, displacements and relocations, as well as adverse impacts to public parks, visual resources and aesthetics resulting from mobility improvements in the corridor.*

These avoidance alternatives result in significant environmental and social impacts. Both remote northern and southern alignments would require development of new highway corridors. Specifically, the remote northern alignment would directly impact Rockefeller State Park Preserve and the National Register-listed Taconic State Parkway. The remote southern alignment would directly impact the National Register-listed Palisades Interstate Parkway and Piermont Marsh, a significant coastal habitat. It would also entail property acquisitions and result in considerable community disruption.

Constructing a new Thruway crossing adjacent to the TZB would cause both severe disruption to established communities and impacts to environmental and cultural resources in South Nyack/Grand View-on-Hudson and Tarrytown. Specifically, it would require acquisition of two buildings that accommodate approximately 24 housing units and three single-family houses in South Nyack and Grand View-on-Hudson. In addition, it would also impact the recommended National Register-eligible River Road Historic District in Grand View-on-Hudson. In Tarrytown, it would require acquisition of two buildings that accommodate multi-family housing and property from an office building. Additionally, it would require acquisition of an over 50-year-old NYSTA building that will be evaluated for National Register eligibility in the DEIS.

Thus, while in concept, a new Thruway crossing could be constructed on another alignment with the intention of rehabilitating the TZB in accordance with the *Secretary of the Interior's Standards for Rehabilitation*, in reality, substantial structural improvements would be required that would alter the TZB's key contributing structural elements. In comparison to Rehabilitation Options 1-4, these avoidance alternatives cause the least overall harm to the TZB. However, it would be neither prudent nor reasonable to modify the regional transportation network as would be the case if a Thruway river crossing on a new alignment were to constructed with its associated impacts to communities, cultural resources, parks, and the environment.

D5.3 Rehabilitation Option 1

An evaluation of feasibility and prudence of Rehabilitation Option 1, according to the definition featured in Table D-7 is provided below.

D5.3.1 Feasibility

Rehabilitation Option 1 requires alteration of five contributing structural elements of the TZB as described in Table D-6. These elements must be altered to ensure that the rehabilitated bridge would meet relevant engineering criteria, and operating criteria and design requirements described in this appendix and report.

Per NYSDOT criteria, the TZB must undergo extensive upgrades to attempt to meet current structural integrity and seismic requirements. As a result, the following actions would occur:

- Causeway and its foundations must be replaced with two parallel structures
- Cofferdam foundations must be strengthened and the Buoyant Foundations, the most unique aspect of the TZB, must be removed and replaced
- West Deck Truss Spans, Main Spans, and East Deck Truss Spans must be strengthened and modified
- East Trestle Spans must be modified

Rehabilitation Option 1 cannot be implemented in compliance with the *Secretary of the Interior's Standards for Rehabilitation*. Furthermore, in spite of the vast modifications, including substantial removal of the existing bridge structural elements, Rehabilitation Option 1 fails to meet the Purpose and Need of the TZB/I-287 Environmental Review. As indicated in the report, it is recommended that Rehabilitation Option 1 not be carried forward for analysis into the DEIS. The deficiencies of Rehabilitation Option 1 are described in the report and

briefly addressed in the following section regarding prudence. Thus, while Rehabilitation Option 1 may be feasible, it is neither prudent nor reasonable as discussed in the following text.

D5.3.2 Prudence

Rehabilitation Option 1 is not a prudent avoidance alternative because it fails the prudence test with respect to selected aspects of the Purpose and Need, engineering criteria, design requirements, cost criteria, and transportation criteria set forth in this report and appendix. These issues are summarized below:

1. Purpose and Need

Rehabilitation Option 1 is not prudent because it fails to meet the project's stated Purpose and Need. The first goal of the project is to "[i]mprove the mobility of people, goods and services for travel markets served by the corridor" via multiple methods, including provision of "modal travel alternatives not subject to roadway congestion." Rehabilitation Option 1 does not include modal travel alternatives.

Rehabilitation Option 1 also does not meet the second goal of the project, "[m]aximize the flexibility and adaptability of new transportation infrastructure to accommodate changing long-term demand." Because this option does not incorporate modal travel alternatives, it is unable to accommodate changing long-term demand.

In addition, Rehabilitation Option 1 fails to fully meet the fourth goal of the project, "[i]mprove safety and security of the transportation system" by reducing accidents; improving roadway geometry to current standards; and improving the likelihood that the TZB would withstand a severe natural or man-made event. Rehabilitation Option 1 also falls short of meeting the safety and security goals of the project.

Thus, Rehabilitation Option 1 fails to fully meet the Purpose and Need of the project, including goals 1, 2 and 4. Therefore, this option is not prudent because it compromises the project to a degree that it is unreasonable to proceed.

1. Engineering Criteria

In terms of engineering criteria, Rehabilitation Option 1 fails to fully meet the redundancy and vulnerability criterion. Specifically, damage or collapse of the Main Spans could result in the loss of the TZB for several years. Under Rehabilitation Option 1, multiple layers of redundancy are not present in the retained East Deck Truss Spans, West Deck Truss Spans, and Main Spans. This option is deficient in terms of the redundancy and vulnerability criteria. Thus, it is not prudent because unacceptable safety and operational problems are inherent in its design.

In terms of the emergency response engineering criterion, the TZB rehabilitation in accordance with Rehabilitation Option 1 would still be subject to traffic congestion. Despite rehabilitation efforts, shoulders would still be absent over approximately half of the crossing resulting in the potential for severe traffic congestion and safety issues. Traffic congestion would also result in the event of a full directional closure. Thus, this option is not prudent because unacceptable safety and operational problems are inherent in its design.

In terms of the seismic engineering criterion, the TZB rehabilitated in accordance with Rehabilitation Option 1 could meet the seismic requirements of relevant codes but the extent of the changes required to ensure compliance are vast with major modifications to all parts of the existing structure. Compared to other structures, these changes are amplified because of multiple issues, including poor soil conditions; the existing structure's forms; the absence of seismic standards in the original design; and the reduced lateral capabilities associated with the Buoyant Foundations, which support the Main Spans and some West Deck Truss Spans. For example, on the Main Spans, the extent of modifications would impact all parts of the structure as follows:

- New foundations would be constructed on either side of those existing to provide reliable and predictable performance. The existing foundations would need to be removed to avoid physical impact with the new foundations during a seismic event
- The existing piers would be enlarged greatly. The piers, which currently have a width of approximately 100 feet, would be reconfigured to reach the replacement foundations over a width of 300 feet
- Extensive steelwork members and connections would be reconfigured in the trusses. To reduce demands on the foundations, the trusses would be seismically isolated with a consequent change to the original TZB articulated form. The trusses would no longer act as cantilevers, as originally designed, but instead would be a continuous form

The current seismic standards require that after the upper level 2,500-year event (an event that has an approximate 6 percent probability of occurring during the 150-year anticipated economic life span), that the TZB be opened to emergency vehicles within 48 hours and general traffic within months. Should the seismic event be greater than the standard design requirements, there is potential for major loss. Unlike modern bridges, the performance of the TZB is based on strength and not ductility, and is therefore prone to the unexpected. In modern bridges, inherent ductility (the ability to accommodate repeated deformation) provides a measure of protection for even the largest events. The details that ensure ductility were not included in the original design of the TZB as seismic events were not considered a major factor.

The designation of the TZB as a critical bridge is at odds with its behavior as a non-ductile structure, with potential for undesirable performance. Even after all the seismic modifications are implemented in this option, a seismic event that is not constituted exactly as predicted, or is marginally larger than has been included in the design, has the potential to result in extended closure of the crossing because of the non-ductile behavior of the bridge form.

2. Engineering Criteria/Design Requirements

Other operational problems include compliance with the life span engineering criterion and NYSTA design requirements. The NYSTA requires there be no replacement of major components for 100 years and a 150-year life span for economic/maintenance purposes. Rehabilitation Option 1 conflicts with this objective and would require major repair or replacement within 100 years. Therefore, Rehabilitation Option 1 is not prudent because unacceptable safety and operational problems are inherent in its design.

3. Cost Criteria

In terms of cost criteria, Rehabilitation Option 1 is also not prudent because it results in additional maintenance costs of an extraordinary magnitude. Maintenance costs are based on a projected 150-year economic life span. As indicated in Table 8-3 in Chapter 8 of the report, maintenance costs for this option are estimated at $1.1 billion, and include ongoing steel and concrete repairs, steel painting, and provision of a substantial maintenance crew to achieve this work. Because aspects of the aging TZB would be retained under this option (i.e., concrete piers, steel trusses), maintenance costs for Replacement Options are typically 40 to 50 percent of the Rehabilitation Options, resulting in a significant cost savings. These high maintenance costs render Rehabilitation Option 1 not prudent.

4. Transportation Criteria

Finally, Rehabilitation Option 1 is also not prudent because it fails to meet transportation criteria set forth in the report. Implementation of the option would result in ongoing traffic safety concerns, posing both unacceptable safety and operational problems. As indicated in the report, Rehabilitation Option 1 would still retain several features that compromise traffic safety, including:

- Lack of shoulders
- Eastbound lane drop
- Moveable median barrier

- Non-standard lane widths
- Horizontal transition curve at the connection from the replacement Causeway to the Main Spans that lacks continuity during peak traffic periods
- Vertical Alignment – grades

These deficiencies further render Rehabilitation Option 1 not prudent.

D5.4 Rehabilitation Option 2

An evaluation of feasibility and prudence of Rehabilitation Option 2, according to the definitions featured in Table D-7, is provided below.

D5.4.1 Feasibility

Rehabilitation Option 2 requires alteration of all of the contributing structural elements of the TZB as described in Table D-6. These features must be altered to ensure that the rehabilitated bridge would meet the relevant engineering criteria, and operating criteria and design requirements described in this appendix and the report.

Therefore, the Bridge must undergo extensive upgrades to attempt to meet current structural integrity and seismic requirements, among others. As a result, the following actions would occur:

- Causeway and its foundations must be replaced with two parallel structures
- Cofferdam foundations must be strengthened and the Buoyant Caissons, the most unique aspect of the TZB, must be removed and replaced with expanded foundations
- West Deck Truss Spans, East Deck Truss Spans, and Main Spans must be strengthened and modified, and significantly widened to accommodate BRT/HOT lanes
- East Trestle Spans must be replaced with a special structure

Rehabilitation Option 2 cannot be implemented in conformance with the *Secretary of the Interior's Standards for Rehabilitation*. Furthermore, in spite of the vast structural modifications needed to implement Rehabilitation Option 2, it is recommended that this option not be carried forward as it not considered feasible based on sound engineering judgement. Construction and traffic maintenance difficulties resulting from the need to modify every piece of steel in the retained superstructures of the Main Spans and both the East and West Deck Trusses are unacceptable compared to the Rehabilitation Options 3 and 4.

In addition, this option does not meet the goals of the project because of vulnerability issues, traffic safety concerns at the Main Spans, and costs risks.

D5.4.2 Prudence

Rehabilitation Option 2 is not considered prudent because it fails to fully meet project goals and also fails to meet select engineering criteria, design requirements, cost criteria, and transportation criteria set forth in the report and this appendix. These issues are summarized below.

1. Purpose and Need

Rehabilitation Option 2 fails to fully meet the fourth goal of the project, "[i]mprove safety and security of the transportation system" by reducing accidents; improving roadway geometry to current standards; and improving the likelihood that the Bridge would withstand a severe natural or man-made event. As indicated below, , Rehabilitation Option 2 falls short of meeting the safety and security goals of the project.

2. Engineering Criteria

Rehabilitation Option 2 is not prudent because it results in several unacceptable safety and operational problems. For example, Rehabilitation Option 2, similar to Rehabilitation Option 1, fails to fully meet two engineering criteria, namely redundancy and vulnerability. Under Rehabilitation Option 2, major damage to the Main Spans could result in the loss of the TZB for several years. As noted in Table 5-8 in the report, an explosion caused by an accident or deliberate attack on the rehabilitated bridge could result in potential loss of all highway capacity for one or more years. Under Rehabilitation Option 2, multiple layers of structural redundancy are not present in the retained East and West Deck Truss Spans and Main Spans.

In terms of the seismic engineering criterion, the TZB rehabilitated in accordance with Rehabilitation Option 2 could meet the seismic requirements of relevant codes but the extent of the changes required to ensure compliance are vast with major modifications to all parts of the existing structure. Compared to other structures, these changes are amplified because of multiple issues, including poor soil conditions; the existing structure's forms; the absence of seismic standards in the original design; and the reduced lateral capabilities associated with the Buoyant Caissons which support the Main Spans and some of the West Deck Truss Spans. For example, on the Main Spans, the extent of modifications would impact all parts of the structure as follows:

- New foundations would be constructed on either side of those existing to provide reliable and predictable performance. The existing foundations would need to be removed to avoid physical impact with the new foundations during a seismic event
- The existing piers would be enlarged greatly. The piers, which currently have a width of approximately 100 feet, would be reconfigured to reach the replacement foundations over a width of 300 feet
- Extensive steelwork members and connections would be reconfigured in the trusses. To reduce demands on the foundations the trusses would be seismically isolated with a consequent change to the original TZB articulated form. The trusses would no longer act as cantilevers, as originally designed, but instead would be a continuous form

The current seismic standards require that after the upper level 2,500-year event (an event that has an approximate 6 percent probability of occurring during the 150-year anticipated economic life span), that the TZB be opened to emergency vehicles within 48 hours and general traffic within months. Should, the seismic event be greater than the standard design requirements, there is potential for major loss. Unlike modern bridges, the performance of the TZB is based on strength and not ductility, and is therefore prone to the unexpected. In modern bridges, inherent ductility (the ability to accommodate repeated deformation) provides a measure of protection for even the largest events. The details that ensure ductility were not included in the original design of the TZB as seismic events were not considered a major factor.

The designation of the TZB as a critical bridge is at odds with its behavior as a non-ductile structure, with potential for undesirable performance. Even after all the seismic modifications are implemented in this option, a seismic event that is not constituted exactly as predicted, or is marginally larger than has been included in the design, has the potential to result in extended closure of the crossing because of the non-ductile behavior of the TZB form.

In addition, Rehabilitation Option 2 is not prudent because it causes other unique problems or unusual factors. In terms of the construction impact engineering criterion, construction duration would occur over the course of 10 to 12 years, the longest duration compared to the other options under consideration (Option 1 would take 7 to 8 years; Options 3 and 4 would take 6 to 7 years). In addition, the maintenance and protection of traffic during construction would require modifications to the edge of both sides of the East and West Deck Truss Spans and Main Spans. This would result in major disruption of traffic for a number of years. The construction risks associated with the modification of every piece of steel in all members, and at all connections in the Main Spans were considered too great, and in combination these factors, could be deemed sufficient to eliminate this option when compared to Rehabilitation Options 3 and 4. Thus, the unprecedented nature of Rehabilitation Option 2 results in an unusual factor which renders this option not prudent.

3. Engineering Criteria/Design Requirements

Other operational problems include compliance with the life span engineering criterion and NYSTA design requirements. The NYSTA requires there be no replacement of major components for 100 years and a 150-year life span for economic/maintenance purposes. Rehabilitation Option 2 conflicts with this objective and would require major repair or replacement within 100 years. Therefore, Rehabilitation Option 2 is not prudent because unacceptable safety and operational problems are inherent in its design.

4. Cost Criteria

In terms of cost criteria, Rehabilitation Option 2 is not prudent because it results in the highest construction costs of the four Rehabilitation Options. As indicated in Table 8-1 in the report, the estimated capital cost of construction of Rehabilitation Option 2 is $6.4 billion, while Option 1 is estimated $3.4 billion, Option 3 estimated at $5.1 billion, and Option 4 estimated at $6.3 billion. Option 2 has the highest construction costs because of the complexities and risks associated with the modification of every piece of steel in all members and at all connections in the Main Spans.

Rehabilitation Option 2 also results in additional maintenance costs of an extraordinary magnitude. Maintenance costs are based on a projected 150-year economic life span. As indicated in Table 8-3 in the report, costs for this option are estimated at $1.5 billion, $400 million higher than Rehabilitation Option 1, because of the increased number of steel members and associated painting requirements. Because aspects of the aging TZB would be retained under this option (i.e., concrete piers, steel trusses), maintenance costs for Replacement Options are typically 40 to 50 percent of the Rehabilitation Options, resulting in a significant cost savings. These high construction and maintenance costs render Rehabilitation Option 2 not prudent.

5. Transportation Criteria

Other unacceptable safety problems concern traffic safety, a component of transportation criteria. As indicated in the report, intrinsic traffic safety concerns would remain at the Main Spans under Rehabilitation Option 2. Specifically, a major traffic safety issue concerns the viability of the split in the highway lanes around the Main Spans in each direction. The presence of the split between the two inner general purpose lanes, the change in grade at the west approach to the Main Spans, the high curvature and super-elevation in the east approach, and the traffic maneuvers required in the approach to the toll plaza, are all undesirable factors that are sufficient to create unsafe driving conditions at the posted speed limit. Such concerns would result in unacceptable safety problems and render the option imprudent.

D5.5 Rehabilitation Options 3 and 4

Rehabilitation Options 3 and 4 share similar design features, including replacement of the Causeway and construction of a Supplemental Bridge. Therefore, the feasibility and prudence of both options is analyzed together, according to the definitions featured in Table D-7.

D5.5.1 Feasibility

Rehabilitation Options 3 and 4 require alteration of all of the contributing structural elements of the TZB as described in Table D-6. These features must be altered to ensure that the rehabilitated bridge would meet as many of the relevant engineering criteria, and operating criteria and design requirements as possible.

The TZB must undergo extensive upgrades to attempt to meet current structural integrity and seismic requirements, among others. As a result, the following actions would occur:

- Causeway and its foundations must be replaced with two parallel structures
- Cofferdam foundations must be strengthened and the Buoyant Foundations, the most unique aspect of the TZB, must be removed and replaced with expanded foundations
- West Deck Truss Spans, East Deck Truss Spans, and Main Spans must be strengthened and modified to accommodate BRT/HOT lanes
- East Trestle Spans must be replaced with a special structure

Rehabilitation Options 3 and 4 cannot be implemented in compliance with the *Secretary of the Interior's Standards for Rehabilitation*. In particular, when Rehabilitation Options 3 and 4 are completed, 80 percent of the final crossing would be new, including the replacement Causeway and Supplemental Bridge. As indicated in the report, there is little point in retaining the remaining 20 percent of the structure, given its inherent vulnerabilities. These deficiencies are described in the report and briefly addressed in Sub-Chapter D5.5.2. Thus, while Rehabilitation Options 3 and 4 may be feasible options, they are considered neither prudent nor reasonable.

D5.5.2 Prudence

Rehabilitation Options 3 and 4 are not prudent because they fail to fully meet project goals and also fail to meet select engineering criteria, design requirements, and cost criteria set forth in the report and this appendix. These issues are summarized below.

1. Purpose and Need

Rehabilitation Options 3 and 4 fail to fully meet the fourth goal of the project, "[i]mprove safety and security of the transportation system" by improving the likelihood that the TZB would withstand a severe natural or man-made event. As indicated below, these options fall short of fully meeting the safety and security goals of the project.

2. Engineering Criteria

Rehabilitation Options 3 and 4 are not prudent because they result in several unacceptable safety or operational problems. For example, Rehabilitation Options 3 and 4, similar to Rehabilitation Options 1 and 2, fail to fully meet two engineering criteria, namely redundancy and vulnerability. As noted in Table 5-8 in the report, an explosion caused by an accident or deliberate attack on the rehabilitated bridge could result in potential loss of half of the TZB for one or more years. On the surviving half of the structure, shoulders could be used to provide up to seven lanes temporarily. However, under Rehabilitation Options 3 and 4, multiple layers of redundancy are not present in the retained East and West Deck Truss Spans and Main Spans. These options are deficient in terms of the redundancy and vulnerability criteria. Thus, they are not prudent because unacceptable safety and operational problems are inherent in their design.

In terms of the seismic engineering criterion, the TZB, rehabilitated in accordance with Rehabilitation Option 3 and 4, could meet the seismic requirements of relevant codes but the extent of the changes required to ensure compliance are vast with major modifications to all parts of the existing structure. Compared to other structures, these changes are amplified because of multiple issues, including poor soil conditions; the existing structure's forms; and the absence of seismic standards in the original design. For example, on the Main Spans, the extent of modifications would impact all parts of the structure as follows:

- New foundations would be constructed on either side of those existing to provide reliable and predictable performance. The existing foundations would need to be removed to avoid physical impact with the new foundations during a seismic event
- The existing piers would be enlarged greatly. The piers, which currently have a width of approximately 100 feet, would be reconfigured to reach the replacement foundations over a width of 300 feet
- Extensive steelwork members and connections would be reconfigured in the trusses. To reduce demands on the foundations the trusses would be seismically isolated with a consequent change to the original TZB articulated form. The trusses would no longer act as cantilevers, as originally designed, but instead would be a continuous form

The current seismic standards require that after the upper level 2,500-year event (an event that has an approximate 6 percent probability of occurring during the 150-year anticipated economic life span), that

the Bridge be opened to emergency vehicles within 48 hours and general traffic within months. Should, the seismic event be greater than the standard design requirements, there is potential for major loss. Unlike modern bridges, the performance of the TZB is based on strength and not ductility, and is therefore prone to the unexpected. In modern bridges, inherent ductility (the ability to accommodate repeated deformation) provides a measure of protection for even the largest events. The details that ensure ductility were not included in the original design of the TZB as seismic events were not considered a major factor.

The designation of the TZB as a critical bridge is at odds with its behavior as a non-ductile structure, with potential for undesirable performance. Even after all the seismic modifications are implemented in this option, a seismic event that is not constituted exactly as predicted, or is marginally larger than has been included in the design, has the potential to result in extended closure of half the crossing because of the non-ductile behavior of the bridge form.

3. Engineering Criteria/Design Requirements

Other operational problems include compliance with the life span engineering criterion and NYSTA design requirements. The NYSTA requires there be no replacement of major components for 100 years and a 150-year life span for economic/maintenance purposes. Rehabilitation Options 3 and 4 conflict with this objective and would require major repair or replacement of the rehabilitated bridge, rather than the Supplemental Bridge, within 100 years. Therefore, Rehabilitation Options 3 and 4 are not prudent because unacceptable safety and operational problems are inherent in their design.

4. Cost Criteria

In terms of cost criteria, Rehabilitation Options 3 and 4 are also not prudent because they result in additional maintenance costs of an extraordinary magnitude. Maintenance costs are based on a projected 150-year economic life span. As indicated in Table 8-3 in the report, costs for these options are estimated at $1.1 billion (Option 3) and $1.4 billion (Option 4) and are lower than Rehabilitation Option 2 ($1.5 billion) but higher than Rehabilitation Option 1 ($1.1 billion). Because aspects of the aging TZB would be retained under this option (i.e., concrete piers, steel trusses), maintenance costs for Replacement Options are typically 40 to 50 percent of the Rehabilitation Options, resulting in a significant cost savings. These high maintenance costs render Rehabilitation Options 3 and 4 not prudent.

D5.6 Evaluation Summary

The No Build and Bridge on Another Alignment alternatives avoid use of the TZB, but are not considered prudent avoidance alternatives. The four Rehabilitation Options require use of the TZB, including its five contributing structural elements. They cannot be implemented in accordance with the *Secretary of the Interior's Standards for Rehabilitation*. Rehabilitation Option one fails to meet the project's Purpose and Need and Rehabilitation Option 2 is not feasible. With regard to the remaining Rehabilitation Options 3 and 4, 80 percent of the final crossing would be new, including the replacement Causeway and Supplemental Bridge; there is little point to retaining the remaining 20 percent of the structure, given its inherent vulnerabilities.

D6 Analysis Summary

Preliminary Section 106 Effects Analysis Summary

Overall, all four Rehabilitation Options would adversely affect the National Register-eligible TZB as defined in 36 CFR 800.5 (See Table D-3 on Page D-7). Each option adversely impacts the majority of the five contributing structural elements of the TZB. Adverse effects include:

- Physical destruction of or modification to all or part of the property
- Alteration of the property that is not consistent with the *Secretary of the Interior's Standards for Rehabilitation*
- Introduction of elements that diminish the integrity of the property's significant historic features

Preliminary Section 4(f) Evaluation Summary

The No Build and Bridge on Another Alignment alternatives avoid use of the TZB, but are not considered prudent avoidance alternatives. The four Rehabilitation Options require use of the TZB, including its five contributing structural elements. They cannot be implemented in accordance with the *Secretary of the Interior's Standards for Rehabilitation*. Rehabilitation Option one fails to meet the project's Purpose and Need and Rehabilitation Option 2 is not feasible. With regard to the remaining Rehabilitation Options 3 and 4, 80 percent of the final crossing would be new, including the replacement Causeway and Supplemental Bridge; there is little point to retaining the remaining 20 percent of the structure, given its inherent vulnerabilities.

Section 106 and Section 4(f) Next Steps

It should be noted that this is a preliminary analysis in accordance with 23 CFR 774 and the requirements of both Section 106 and Section 4(f) will be further considered in the TZB/I-287 Environmental Review DEIS. All possible planning to minimize harm in accordance with 23 CFR 774.3(a)(2) will be documented in the DEIS and the final Section 4(f) evaluation. These documents will include a summary of mitigation schemes mutually agreeable to the lead agencies, NYSHPO, and other consulting parties in accordance with 36 CFR 800.6.

Upon issuance of this report to consulting parties, cooperating and participating agencies, and the public, a consultation/comment period will commence in accordance with Section 106. Comments received will be considered and documented. Final recommendations will be offered to federal agencies (FHWA and FTA) with a request for their acceptance at the conclusion of the TZB/I-287 Environmental Review scoping phase. Efforts to mitigate adverse effects to the TZB will be documented in the DEIS.

Additionally, in compliance with Section 106, specifically, 36 CFR 800.4(b)(2), a preliminary list of cultural resources within the I-287 Corridor has been compiled and will be shared with NYSHPO and the consulting parties. These resources will be evaluated during preparation of the DEIS.

In accordance with Section 4(f), a preliminary list of Section 4(f) resources such as public parks, recreation areas, wildlife or waterfowl refuges and historic sites other than the TZB has also been compiled. These resources will be evaluated in accordance with Section 4(f) during preparation of the DEIS.

D7 References

Personal Communications and Correspondence

Shaver, Peter D., Historic Preservation Program Analyst, New York State Office of Parks, Recreation and Historic Preservation, Historic Preservation Field Services Bureau to Christopher A. Waite, Executive Project Manager, New York State Thruway Authority regarding the Request for Determination of Eligibility for State Register Listing for the Tappan Zee Bridge. October 30, 2003.

Internet Resources

- NYSTA-A. "Thruway Fact Book," n.d., <http://www.nysthruway.gov/about/factbook/index.html>. [October 11, 2007].
- Rensselaer Polytechnic Institute Alumni Hall of Fame. "Emil Praeger," n.d., <http://www.rpi.edu/about/hof/praeger.html>. [April 8, 2008].
- Waymarking. "Governor Malcolm Wilson Tappan Zee Bridge," n.d., <http://www.waymarking.com/waymarks/WM300W>. [April 21, 2008].

Unpublished Documents

- Lowe, John III. "Floating Caisson Foundations." n.d. On file at New York State Thruway Authority, Albany, New York.
- NYSTA-B. "New York State Thruway TZB." n.d. On file at New York State Thruway Authority, Albany, New York.

Reports

- Mead & Hunt. *New York State Department of Transportation Historic Bridge Management Plan*. Prepared for NYSDOT and FHWA. 2002.
- NYSTA and MTA Metro-North Railroad. *Level I Screening Process, Tappan Zee Bridge/I-287 Environmental Review, D213123, Alternatives Definition and Screening*. October 2003.

Articles

- *New York Times*. "Thruway Span Rising In Hudson; Big Concrete Boxes to Go In Soon." August 20, 1953.

Technical Guidance

- US Department of the Interior. *Secretary of the Interior's Standards for Treatment of Historic Properties*. 1991. Washington, DC: US Department of the Interior

Appendix D- Attachment A

Correspondence from New York State Office of Parks, Recreation and Historic Preservation

New York State Office of Parks, Recreation and Historic Preservation
Historic Preservation Field Services Bureau
Peebles Island, PO Box 189, Waterford, New York 12188-0189 518-237-8643

Bernadette Castro
Commissioner

October 30, 2003

Christopher A. Waite
Executive Project Manager
Tappan Zee Bridge/I-287 Environmental Review
New York State Thruway Authority
200 Southern Boulevard
Albany, NY 12209

Re: FHWA/FTA/NR/NYSTA
Tappan Zee Bridge/I-287 Corridor Project,
Rockland and Westchester Counties
03R00385

Dear Mr. Waite:

Thank you for sending the materials about the history of the Tappan Zee Bridge. We are commenting in accordance with Section 106 of the National Historic Preservation Act of 1966 and the relevant implementing regulations. .

It is the SHPO's opinion that the Tappan Zee Bridge is eligible for listing on the State and National Registers of Historic Places. Please see the attached "Resource Evaluation."

We look forward to continuing consultation on the project. It is my understanding that our director, Ruth Pierpont, and head of our technical unit, Julian Adams, will continue to be the principal contacts here regarding our role in the project. If you have any questions, please call me at (518) 237-8643, extension 3264.

Sincerely,

Peter D. Shaver
Historic Preservation
Progam Analyst

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Tappan Zee Bridge / I-287
Environmental Review Process

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RESOURCE EVALUATION

Date:	October 27, 2003	Staff:	Peter Shaver
Property:	Tappan Zee Bridge	MCD:	Tarrytown, Grand View
Address:	NYS Thruway	County:	Westchester, Rockland
Project Ref. No.:	**03PR00385**	USN:	08748.000028, 11950.000388

I. ☐ Property is individually listed on SR/NR :
Name of listing :
☐ Property is a contributing component of a SR/NR district:
Name of District:

II. ☑ Property meets eligibility criteria
☐ Property contributes to a district which appears to meet eligibility criteria.
Pre SRB: ☐ Post SRB: ☐ SRB Date

Criteria for inclusion in the National Register.

A ☑ **Associated** with events that have made a significant contribution to the broad patterns of our history;

B ☐ **Associated** with the lives of persons significant in our past;

C ☑ Embodies the distinctive characteristics of a type, period or method of construction; or represents the work of a master; or possess high artistic values; or represents a significant and distinguishable entity whose component may lack individual distinction;

D ☐ **Have** yielded, or may be likely to yield information important in prehistory or history.

STATEMENT OF SIGNIFICANCE:

Based on the information provided, it is the opinion of the State Historic Preservation Office that the Tappan Zee Bridge is significant in the areas of transportation and engineering as one of the state's most important bridges. Built between 1952 and 1955, the 3.2-mile long highway bridge has a unique caisson system supporting the piers and deck. It is the longest bridge in the state and one of the longest in the country, as well as having the world's ninth longest cantilever span, at 1,212 feet. The bridge is an essential component of the NYS Thruway system, with 135,000 vehicles crossing the bridge daily to and from the New York Metropolitan area. The bridge has received minor modifications since 1955, including the replacement of the concrete deck.

If you have any questions concerning this Determination of Eligibility, please call Peter Shaver at 518-237-8643. ext 3264

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Tappan Zee Bridge / I-287
Environmental Review Process

http://sphinx/PR/PMReadForm.asp?iPrn=1&iFId=5477&sSFile=form1.htm 10/30/03