**NYSDEC Demolition Plan**
*for the*
**Tappan Zee Hudson River Crossing**

**Rev 8**
**December 21, 2018**

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| 12/21/2018 | East Anchor Span Blasting | ERB | 8 |

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## Tables



## Attachments

# 1.0 INTRODUCTION

Tappan Zee Constructions, LLC (TZC) has prepared this Demolition Plan (Plan) Rev 8 to provide the general approach and means and methods that will be utilized to demolish the existing Tappan Zee Bridge. This Plan has been prepared specifically to meet the Tappan Zee Hudson River Crossing Project (Project) demolition requirements and environmental performance commitments (EPCs) provided in the Project DB Contract Documents (Contract No. D214134) Part 3 Project Requirements, Section 3 Environmental Compliance and Section 25 Demolition as Conformed November 2012.

## 1.1 Limits of Demolition

Demolition requirements are included in the Project's Final Environmental Impact Statement (FEIS), July 2012 and Record of Decision (ROD), September 2012 and Project permits, including:

- NYSDEC Permit ID 3-9903-00043/00012-14 modified July 2014;
- NFMS Endangered Species Act Section 7 Consultation Biological Opinion (BO) NER-2017-14375 dated November 1, 2017;
- United States Coast Guard (USCG) Permit dated April 2013;
- United States Army Corps of Engineers (USACE) Permit Number NAN-2012-00090-M10; and
- NMFS Essential Fish Habitat (EFH) Assessment Conservation Recommendations (CR) dated June 2012, Appendix F of the FEIS.

As required by the FEIS and Project permits, all parts of the existing Tappan Zee Bridge across the Hudson River not utilized in the new bridge shall be removed to a minimum of two feet (2') below the river bottom, including:

- Removal of timber piles 2' below river bottom;
- Removal of caisson-supported piers 2' below river bottom; and
- Removal of fenders 2' below river bottom.

## 1.2 Limit of Demolition for Bents 190 and 191

Bents 190 and 191 of the existing Bridge were constructed to the immediate west and east of the Metro North Railroad (MNR) Right of Way (ROW), respectively. These bents are in close proximity to the MNR track foundations and nearby slopes. Removal of the structures to 2' below the river bottom may result in destabilization of the tracks or slopes in the ROW.

TZC is proposing to keep the existing Tappan Zee Bridge Bents 191 and 190 to remain at or above grade and top of caisson, respectively. Please see Attachment A for drawings of the proposed removal and remaining elevations of these existing bridge bents. As described below, allowing these bridge structures to remain will reduce in-water and landward excavation and demolition activities adjacent to the MNR commuter railroad, thereby reducing potential impacts to railroad operations and near-shore areas without adversely impacting other resources.

### 1.2.1 Existing Pier Locations and Conditions

Existing Bent 191 is located immediately east of the MNR ROW in Westchester County. This landside bent consists of two (one north and one south) concrete spread footings founded on rock approximately [redacted] below existing grade. Each footing is approximately [redacted] (L x W x H) and each supports a single [redacted] concrete pier column (one north and one south). The southernmost corner of the south footing is approximately 23 feet east of the MNR Track 3 and is visible above the existing grade (Attachment B: Figures #1 and #2). The northernmost corner of the south footing is not visible and is approximately 10 feet below the existing steeply sloping grade. Removing the concrete columns and footings of existing bridge Bent 191 below the existing ground line would require excavation and demolition, most likely via hydraulic hammer (e.g., hoe ram) or similar impact equipment, below grade and within very close proximity to the MNR tracks.

Existing Bent 190 is located immediately west of the MNR ROW in Westchester County. This waterside bent consists of two (one north and one south) circular, steel sheet pile encased concrete caissons founded on rock approximately [redacted] below the riverbed. Each caisson is approximately [redacted] feet in diameter and each supports a single concrete pier column (one north and one south). The north caisson is surrounded by a square-shaped sheet pile cofferdam. The top of the sheet pile is just visible above the existing shoreline (Attachment B: Figures 2, 3, and 4). The eastern edge of the circular caisson and sheet pile cofferdam is approximately 20 feet from MNR Track 4. The circular caisson is not visible and is buried approximately 1-8 feet below the existing sloping shoreline. Demolition and removal of the north pier caisson would require excavation of the existing shoreline to within approximately 5 feet of MNR Track 4 or require significant support of excavation (e.g., temporary sheeting) be installed between the MNR tracks and the existing caisson.

The south caisson is located approximately 18 feet from the existing shoreline and 9 feet from Pier 42 Eastbound in water depths of 2-4 feet below mean low water (MLW). The top of the south caisson is approximately 1-foot below mean high water (MHW) and remains partially submerged at MHW (Attachment B: Figures 5 and 6). Removing the caisson two feet below the bottom of the existing waterway would require demolition of the concrete caisson, most likely via hydraulic hammer (e.g., hoe ram) or similar impact equipment, and temporary disturbance of the river bottom immediately surrounding the caisson to remove the outer steel sheet pile via cutting or hydraulic shears. The Project FEIS determined sediments within the vicinity of Bent 190 demonstrated elevated levels of metals. The proposed limits of demolition for Bent 190 would minimize disturbance of these sediments within the Hudson River.

### 1.2.2 Proposed Pier Demolition

<u>Bent 191</u> – TZC proposes to remove the existing north and south bent columns to grade via concrete wire saw, hammer or shears and leave the footings in place, thereby avoiding additional excavation and demolition below grade and in close proximity to the MNR tracks. See Attachment A for proposed conditions following pier column demolition.

<u>Bent 190</u> – TZC proposes to remove the existing north bent column to approximately elevation 4.00 to allow for signage and marking for navigation, thereby avoiding additional excavation and demolition below grade and in close proximity to the MNR tracks. See Attachment A for proposed conditions following

column removal. Concrete wire saw or shears would be used to remove the concrete column. Similarly, TZC proposes to remove the south bent column to elevation 4.00. The existing caisson and footing would remain in place, thereby avoiding in-water demolition in this near-shore area. Concrete wire saw or shears would be used to remove the concrete column.

As described above, Bent 190 is in close proximity to the MNR track structure and nearby slopes. Given the proximity of the north caisson of Bent 190 from the edge of Track 4 of MNR, removal of the structures to 2’ below river bottom will impose an unstable slope (1:1) extended from the limits of removal to the edge of the existing railroad track. According to existing boring logs, the top strata consist of very soft organic material with identified weight of rod properties. This material carries minimal to no shear strength and the required excavation can cause major disturbance in the natural state of the existing slope.

### 1.2.3 Assessment of Benefits and Potential Adverse Effects

Existing Bents 191 and 190 are located within NYSTA property and lands underwater, and their respective footings are located under the new bridge structure, near new bridge Piers 42 and 43. Due to their nature (i.e., existing footings mostly buried below existing grades), location and access restrictions, transportation and ecological resources were evaluated to identify the benefits and potential adverse effects of the proposed modification.

Transportation resources near Bents 191 and 190 are the Hudson River and MNR. MNR passes immediately adjacent to both bents, within the existing MNR ROW. Bent 191 is located landward and outside of the MNR ROW; therefore, leaving the pier footings in place at this location would have no effect on future navigation of the Hudson River or MNR operations. Similarly, Bent 190 is located outside of the MNR ROW; therefore, leaving the pier footing in place at this location would have no effect on MNR operations.

The north and south foundation at Bent 190 is located along the existing Hudson River shoreline well outside of the navigation channel or waterway used for navigation. The south caisson footing is located approximately 18 feet from the existing shoreline in shallow water that is well outside of the navigation channel and is not used for navigation purposes. TZC proposes to clearly mark the remaining footing using signage or similar to minimize any hazard to navigation. Given the close proximity of the existing foundations to the new bridge pier foundations, navigation through the area would be subject to security and other restrictions; therefore leaving the Bent 190 foundation in place would not adversely impact navigation or transportation resources of the Hudson River.

There are no ecological resources identified near existing Bent 191, which is located immediately east of the MNR in a maintained and unvegetated ROW. Ecological resources near Bent 190 are the aquatic resources, including threatened and endangered species, and habitat of the Hudson River. Near Bent 190 the aquatic habitat is predominately intertidal and subtidal habitats of varying depths, ranging from shallow intertidal shorelines to shallow subtidal shoals. The benthic habitat is unvegetated consisting of coarse sandy to fine silty sediments.

NMFS identified this region of the Hudson as EFH for 16 federally managed species; and identified two federally endangered fish species that occur in this region of the Hudson River, the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrinchus*). NMFS identified several EFH

Conservation Recommendations to avoid, minimize and mitigate for Project impacts pursuant to Section 305(b)(4)(A) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and provided several Conservation Recommendations pursuant to Section 7(a)(1) of the Endangered Species Act (ESA), as well as reasonable and prudent measures (RPMs) to minimize and monitor impacts of incidental take of listed shortnose and Atlantic sturgeon.

Prior environmental assessments, including the FEIS and ROD, recognized the benefit of removing the existing waterside bridge piers to offset the footprint of the new bridge pier foundations. At existing Bent 190, the south bent foundation occupies approximately [redacted] of open water benthic habitat; the north bent foundation and rectangular cofferdam occupies approximately [redacted] of intertidal and open water benthic habitat. The total in-water footprint of the new bridge is approximately [redacted] acres (NYSTA December 17, 2012 Supplement to the March 26, 2012 Joint Permit Application), well below the alternative replacement bridge footprints assessed in the FEIS and ROD (6.5 and 8 acres for the Long Span and Short Span Options, respectively), resulting in a net gain of open water benthic habitat of 2.4 acres following demolition of the existing bridge. Leaving the Bent 190 foundations in place would diminish this net gain by less than 2% while decreasing the disturbance of impacted sediments in the area.

Given the relatively small size of the Bent 190 foundation footprint as compared to the available soft-sediment benthic habitat in the Tappan Zee region (RMs 24-33), leaving the foundations in place would result in an extremely small loss of soft-bottom benthic or foraging habitat for sturgeon. Sturgeon are only likely to be present in the shallow waters along the shoreline if suitable forage is present. Therefore effects to sturgeon are likely to be limited, insignificant and discountable.

FEIS EPCs, NMFS conservation recommendations, and environmental permits, including the NYSDEC Permit 3-9903-0043 and USACE Permit NAN-2012-00090, recognized the benefit of minimizing the disturbance of bottom sediment to minimize potential impacts to aquatic resources. Leaving the Bent 190 column foundations in place would avoid disturbing the Hudson River bottom in the near shoreline intertidal and subtidal habitat.

## 2.0 EXISTING STRUCTURE

### 2.1 Area Map General

Beginning in Rockland and working east, the existing structure has been divided into six (6) distinct Demolition Areas (see Attachment C) based on structure type, location and interaction with the completion of the permanent structure. Areas 1 and 6 are unique due to the coordination necessary to complete the new structure and because they each have a land and marine portion. The Demolition Areas are as follows:

- Area 1 A/B: Rockland Tie-in
- Area 2: Rockland Approach
- Area 3: Rockland Truss
- Area 4: Main Span

- Area 5: Westchester Truss
- Area 6 A/B: Westchester Tie-in

Attachment D provides bridge structure definitions for each of the Demolition Areas.

## 2.2 Area 1: Rockland Tie-in

The Rockland Tie-in Area is comprised of the on land existing structure terminating at the Rockland Abutment. This is designated at Area 1A, and includes Span 1 over River Road. The marine portion, Area 1B, transitions at Bent 3 and continues thru Pier 30. It shares a partial footprint with the permanent approach spans (Unit 1EB and 2EB). Furthermore, this section of existing structure is bordered to the north by the new bridge and shallow water to the south.

## 2.3 Area 2: Rockland Approach

The Rockland Approach (Piers 31 through 165) consists of the long causeway between the Rockland Tie-in and Rockland Truss sections. This is the largest section by linear footage, and consists of existing structure similar to that described in Area 1. Areas 1 and 2 have been divided due to the construction coordination necessary to perform permanent new bridge work in Area 1. Due to this delineation, work in Area 2 can commence at the beginning of the demolition work window. Area 2 is confined to the north by the new structure with decreasing access from Bents 50 to 30.

## 2.4 Area 3: Rockland Truss

Working east from Rockland County, the first underdeck spans begin in the Rockland Truss section. Transitioning from the [redacted] causeway spans, Area 3 begins at Bent 166 and ends at Bent 172. The spans in this section are typical [redacted] and consist of a steel truss supporting the precast concrete panel road surface. The concrete substructure found in Area 3 can also be considered typical at each bent. An upper, solid concrete strut connecting two (2) hollow concrete columns can be found at each location. The top elevation of each bent will vary slightly, and will contribute to the total volume of column concrete. Both circular and rectangular caissons are found in this area.

## 2.5 Area 4: Main Span

The Main Span (Piers 173, 175, 176, and 178) is a unique structure over the navigable channel. This area is dominated by the steel superstructure cantilever through truss, which is divided into Anchor, Cantilever and Suspended spans. The superstructure supports the precast concrete panel wearing surface, which is a similar design found in Areas 1 – 3. The substructure in this section is unique to this area. Each bent in this area is steel lattice members making up the columns and top strut. The top elevation of each bent varies slightly, and the structure can be considered symmetrical about the centerline of span. The foundations in Area 4 are similar to the rectangular caissons found in Area 3. Specifically, the foundations at Bents 175 and 176 are significantly larger than the anchor bents.

### 2.6 Area 5: East Deck Truss

Area 5 (Piers 179 through 184) shares many structural details with Area 3. Both sections consist of steel underdeck trusses, supported on concrete struts and columns. Similarly, the bents in the Area consist of circular caissons. Due to the horizontal curve of this Area, the span lengths vary. This determines the specific length of the underdeck section. The Exodermic Deck specifics in this Area are similar to those found in Area 6, and substantially different to the deck details in Areas 1 – 4.

### 2.7 Area 6: Westchester Tie-in

Area 6 (Piers 185 through 191) represents the tie-in portion to the Westchester Landing. Similar to Area 1, this section is both divided into water (6A) and land portions (6B), as well as coordinated with the final work (Unit 9EB) of the permanent new bridge. Area 6A is structurally identical to Area 5, sharing features for deck, superstructure truss, concrete substructure and foundations.

## 3.0 SCHEDULE AND SEQUENCING OF WORK

### 3.1 Sequence General and Milestones

Provided in Attachment E is an overview of the major work areas and anticipated schedule for demolition activities. The schedule information provided is based upon the most up to date Project schedule. Demolition operations began in August 2017. Deck removal operations in Areas 2, 4, and 6 began in October 2017 after all traffic was shifted to the new structure. As each section is completed, the associated substructure work will commence. The foundation work will be the last work performed in each Area.

## 4.0 REGULATORY REQUIREMENTS

As further described below, demolition of the existing bridge will be conducted in accordance with the Project's requirements in the FEIS, ROD and Project permits (Refer to Section 1.1 for a list of applicable permits). Specifically, means and methods proposed demonstrate conformity with the NYSDEC Permit ID 3-9903-00043/00012-14 Conditions 45-51, 54-55, 57, and 59 as further described below.

***Condition 46:*** Bridge demolition must be conducted in a manner that minimizes the resuspension of sediment.

> TZC has planned for demolition to be performed in a manner consistent with the means and methods described in the FEIS. During substructure and superstructure removal, the proposed demolition takes advantage of the large equipment available to TZC, allowing large pieces of the structure to be cut and removed to the extent possible, rather than demolishing the structures in-place. During foundation removal, full depth turbidity curtains will be employed in Areas 1 and 6 to minimize sediment resuspension. In addition, the rectangular caisson removal will start from the inside out, allowing concrete material to stay within to the interior of the structure during the onset of removal. Every effort will be made to ensure that demolition debris is confined to the location of foundation removal during

demolition and removal. Where applicable, side scan sonar will be used to identify all material to be removed from the River during demolition. Once identified, this material will be recovered.

For more information about Best Management Practices (BMPs) to be employed during Mechanical Foundation Demolition, please refer to Attachment J of this plan.

TZC is proposing to blast the East Anchor Span, between Piers 176 and 178, in Area 4. Blasting would occur above the water's surface and would not directly cause any resuspension of sediment; however, an increase in turbidity and suspended sediments would occur when the East Anchor Span falls to the river bottom. These effects would be temporary and localized.

In order to minimize sediment resuspension during the removal of the East Anchor Span, TZC has prepared a salvage operation plan utilizing a system of chains to be placed on the river bottom (refer to Section 6.5.1) to aid in the removal of the span from the river bottom. These chains will allow the anchor span structure to be recovered in a shorter duration and with less bottom disturbance than if the fallen span is disassembled in place on the river bottom.

Each chain assembly will be 360 feet long and 0.9ft ($10^{13/16}$") wide, and including the central 100 foot section of double chain, will occupy 0.01 acres of benthic habitat when resting on the bottom. Due to the shifts of the chain during deployment and recovery, an additional 3 foot wide area will be disturbed along the length of each chain. This would result in 0.30 acres of benthic habitat disturbance. If used, the pulling chain assemblies would result in 0.1 acres of benthic disturbance. The maximum area of disturbance associated with all chain assemblies is approximately 0.4 acres. The substrate in the area of impact is dominated by sandy mud based on sediment data acquired from the New York State GIS Clearing house.

The placement and retrieval of the chains and the East Anchor Span structure will result in surficial disturbance to the soft sediments and will not degrade its future quality as habitat. The surficial disturbances to the soft substrates will quickly recover as a result of natural fluvial processes. During the time the chains are in place on the river bottom a small percentage of the total area of benthic habitat will not be available. The chain systems are laid out on barges and are visually inspected regularly for the presence of invasive species and will continue to be inspected prior to deployment. TZC will conduct water quality monitoring, as required by the NYSDEC approved Water Quality Monitoring Plan.

***Condition 47:*** All debris and materials from the demolition of the existing Tappan Zee Bridge must be removed from the bed and banks of the Hudson River.

TZC will perform a pre-demolition bathymetric survey from the Westchester shore to the Rockland shore and between 700 feet north and south of existing bridge centerline to establish pre-demolition baseline conditions. Periodic side scan sonar surveys will be conducted to identify debris that may have entered the River with the potential to affect navigation.

A post-demolition bathymetric survey will be conducted and compared to the pre-demolition bathymetric survey to verify no debris is present. As depicted in Attachment F, a barge mounted excavator or crane with clam bucket attachment, material grapple or bucket will be used to remove the demolition debris. Demolition debris will be bucketed to adjacent debris barges for off-site disposal.

An additional bathymetric survey will be conducted in areas that have received debris recovery after the post-demolition bathymetric survey to verify all debris capable of being identified by the bathymetric survey has been removed from the river bed.

The proposed demolition means and methods have the potential to produce debris from hoe ramming, shearing, wire sawing, drilling, and blasting. Debris size will vary and is described below:

- Hoe ramming operations may generate debris ranging from dust/granular aggregates to pieces equal or larger than the smallest dimension of the structure being demolished. For example, a two foot by two foot column may generate debris two foot in diameter. Solid circular caisson may generate large debris pieces that could be over 6 feet in diameter.

- Shearing operations may generate debris ranging from dust/granular aggregates to pieces equal or less than the smallest dimension of the structure being demolished. For example, a two foot by two foot column may generate debris up two foot in diameter.

- Wire sawing operations will generate fines and may generate spalls around the size of a fist.

- Drilling operations will generate dust/granular aggregates.

- Blasting will result in the felling of the East Anchor Span into the river. Smaller pieces of debris and demolition equipment remaining on the span will also end up in the river during this activity.

Demolition debris and equipment will be removed from the river bottom prior to the completion of demolition activities.

Pier 176 contains equipment previously used during demolition activities. Refer to Attachment M for the location and inventory of the equipment. Due to safety constraints, this equipment cannot be removed or secured prior to blasting. The equipment is expected to fall within a relatively small area. TZC has prepared a Pollution Abatement & Containment Removal Plan (see Attachment N). In addition, a salvage team will collect all equipment, debris and structure from the river, floating or submerged, with cranes and/or divers as required by Condition 47. All recovered equipment will be logged against the existing equipment inventory.

As part of the Pollution Abatement & Containment Removal Plan, TZC's emergency response team has prepared an inventory of necessary material and will be on site on the day of the blast, ready to deploy following an all clear. TZC will implement the above plan to contain and clean up the releases that may occur when the equipment enters the River.

The following steps will be taken to control and contain the potential releases from the equipment:

- Response team to assess source locations of release(s).

- Response team will deploy and contain the release with absorbent boom.

- Response team will collect and properly dispose of absorbent boom.
- Response team will pursue and collect any floating debris, such as equipment and tools, and place on barges with appropriate containment.
- Response team will remain on site and support salvage team until equipment sources have been recovered or release has arrested.
- Salvage team will collect all equipment, debris and structure from the river, floating or submerged, with cranes and/or divers as required by Condition 47. All recovered equipment will be logged against the existing equipment inventory.
- In addition, a salvage contractor will remove the span from the river bed with a system of specialized barges equipped with large chain jacks. It is estimated that it will take approximately 14 days to hoist the East Anchor Span from the river bottom using the chains. The structure will be lifted from the river bed using multiple [redacted] chain pullers, suspending the bridge section between two deck barges. When engaged by the chain jacking barges, the chains will form a cradle that will be used to hoist the span back to the river surface. Once at the surface, the span will be dismantled and disposed of at an approved off-site location.

***Condition 48:*** Piles, caissons, abutments, fenders and other in-water components of the existing Tappan Zee Bridge must be removed to two feet below the mud line. Silt curtains must be deployed during this operation.

In-water components will be removed to the NYSDEC required demolition limits, provided in Attachment K. Full depth turbidity curtains will be used in Areas 1 and 6 during foundation removal (refer to Attachment G). Turbidity curtains, 5-feet deep and anchored to the river bottom, will be employed in Areas 2, 3, 4, and 5 to contain debris and reduce turbidity.

In order to access the foundations to the NYSDEC required demolition limit, sediment would be displaced around the foundations. The proposed displacement would result in a trench of approximately two-feet deep and three-feet wide surrounding the pier. Sediment would be displaced from the area surrounding the pier to the edge of the disturbed area in a small mound. This sediment is anticipated to cover approximately three-feet of previously uncovered benthic habitat surrounding the pier. The total surface area of the benthic area disturbed and the volume of sediment displaced are summarized in Table 1 for the Demolition Areas.

**Table 1 – Surface Area and Volume of Disturbed Sediments**

| Demolition Area | Surface Area Acre | Volume (CY) |
|---|---|---|
| 3 – Rockland Truss: Bents 166 – 172 | 1.2 | 880 |
| 4 – Main Span: Bents 173 – 178 | 1.0 | 800 |
| 5 – Westchester Truss: Bents 179 – 186 | 1.0 | 700 |
| 6 – Westchester Tie-in: Bents 187 – 190 | 0.4 | 400 |
| **Total** | **3.6** | **2,780** |

Displacement of benthic sediments, as described above, is necessary to achieve removal of the TZB in accordance with the contract and Project permits. The foundation types, including the circular caissons and the floating caissons require external access in order to perform the necessary work. For example, the metal sheet piles wrapping the circular caissons would be cut using a shear or diver which would be accessed from outside of the footprint of the pier. Sediment displacement would allow access to these components of the existing bridge to the NYSDEC required demolition limit with minimal sediment disturbance.

In order to minimize sediment resuspension, an open excavator bucket would be utilized to pull back sediment around the foundations rather than lifting sediment up into the water column. This method could result in isolated resuspension of benthic sediments. Hand jetting may be used to expose steel sheet and pipe pile to facilitate cutting by divers. The hand jetting method will use either pressurized air or water in order to displace the sediment to reach the necessary elevations.

Extensive water quality monitoring during the Project has demonstrated that resuspension of bottom sediments associated with activities such as dredging and pile driving infrequently resulted in exceedances of the Project's NYSDEC Permit conditions. Furthermore, any observed exceedances were also typically temporary in nature.

Benthic habitat could be disturbed by the collapse of the East Anchor Span and the placement and recovery of the chain systems used to salvage it. When the East Anchor Span falls onto the river bed, there will be temporary and localized impacts on the benthic habitat. Benthic organisms would be buried by displaced sediments and might be crushed by the bridge span. This activity would not be likely to significantly impact sturgeon foraging habitat or prey resources because similar benthic habitat and prey taxa are present throughout the Tappan Zee region. Based on the dimensions of the East Anchor Span, approximately 1.8 acres of benthic habitat would be impacted. Additionally, it is estimated that lifting the span out of the river with the chain jacking system would disturb less than 0.4 acres of benthic habitat. A small portion of the footprint of the chains would occur within the same footprint of the East Anchor Span. This disturbance would be insignificant given the soft sediments; any temporary disturbance to the sediment surface from the chains will be smoothed over by natural processes (currents, sediment deposition, etc.). The placing and ultimate retrieval of the chains and East Anchor Span structure will result in surficial disturbance to the soft sediments and will not degrade its future quality as habitat. The surficial disturbances to the soft substrates will quickly recover as a result of natural fluvial processes. During the time that the chains are in place on the river bottom a small percentage of the total area of benthic habitat will not be available as habitat for benthic organisms or as foraging habitat for benthic-foraging fishes, including shortnose and Atlantic sturgeon. Given that the Hudson River is approximately three miles wide in this area, suitable habitat is available above and below the project site.

***Condition 49:*** A floating containment booms and/or silt curtains must be deployed around all active substructure demolition areas to control and contain debris and discharges to meet water quality standards.

TZC will utilize means and methods that will minimize the likelihood of debris entering the River. Specifically, TZC intends to remove substructure in large modular components minimizing potential for generation of small pieces of debris at risk of falling into the River. Visual observations of activities will be conducted by a barge-based or vessel-based observer during demolition activities as required per the Water Quality Monitoring Plan. If turbidity is observed that extends beyond the 500-ft mixing zone, corrective actions will be implemented to comply with water quality standards.

***Condition 50:*** A debris containment net must be deployed and maintained at all times during demolition of the bridge deck and superstructure.

TZC will remove the existing Tappan Zee Bridge deck and superstructure in modular components, minimizing risk of debris generation during superstructure removal operations. TZC will utilize access systems during the superstructure removal stage to provide access for workers to separate deck panels, stringer beams and diaphragms from the supporting bridge structure. These access systems serve dual purpose by providing debris containment for anchor bolt, stringer beam and diaphragm separation for deck removal operations. Deck preparation in Areas 2, 3, 5 and 6 will occur while over debris containment. Deck rigging and removal in Areas 2, 3, 5, and 6 may occur without debris containment. Area 4 deck preparation and deck removal will occur over debris containment. These areas are further described below. Containment measures are detailed in Attachment H.

<u>Rockland Causeway (Areas 1 and 2):</u>

Superstructure consists of a composite deck/superstructure element made up of deck panels precast integrally over bridge beams. Panels/beams sit directly on top of the bridge column/caps and will be removed in modular pieces by crane in the following steps:

- Separate panels with top side deck saws. Vacuums will be used to control water generated during the operation.
- Deck Preparation - Drill out lifting holes/attach lifting lugs at corner points of panel. Cut bolt connecting panel to pier cap.
- Rig and lift panel off pier, set onto barge.

<u>Truss Spans (Areas 3, 5, and 6):</u>

Superstructure consists of simple span truss elements with precast deck panels secured on top framing of truss. Deck removal will be similar to the Rockland Causeway described above, removing enough deck to rig and lift the entire truss span [redacted] in the following steps:

- Separate panels with top side deck saws. Vacuums will be used to control water generated during the operation.
- Deck Preparation - Drill out lifting holes/attach lifting lugs at corner points of panel. Cut bolt connecting panel to truss.
- Rig and lift panel off truss, set onto barge.
- Install lifting lug on truss at four points.

- Rig truss with Barge Mounted Derrick Crane.
- Lift truss off piers, set onto barge.

Main Span (Area 4)

Superstructure consists of a suspended, cantilever and anchor truss elements with precast deck panels secured on floor beam framing of truss. Deck removal will be similar to the Rockland Causeway described above, removing deck prior to truss removal.

- Separate panels with top side deck saws. Vacuums will be used to control water generated during the operation.
- Deck Preparation - Drill out lifting holes/attach lifting lugs at corner points of panel. Cut bolt connecting panel to truss.
- Rig and lift panel off truss, set onto barge.
- Install falsework, access, and strand jacking equipment
- Lower with strand jacks to barges. Truss removal and lowering is not anticipated to produce debris as it is a large modular component. In the event debris were to be produced, the truss sections are lowered onto barges, which would provide debris containment.

Rigging and lifting of deck panels from the above described structures to barges is not anticipated to produce debris. In the event debris is generated during the lifting operation, the method will be reevaluated and updated to address the conditions of the operation.

***Condition 51:*** Blasting for bridge demolition is prohibited.

Following the unexpected events of September 7, 2018, the East Anchor Span, between Bents 176 and 178, unexpectedly shifted. This shift raised immediate concerns about the structural integrity of the span, which in turn raised safety concerns for demolition crews dismantling the bridge, vessels in the navigation channel, and the travelling public on the new Governor Mario M. Cuomo Bridge, constructed less than [redacted] away from the original Tappan Zee Bridge. These concerns stemmed from the potential for the East Anchor Span to fall, which could cause one or more of the following scenarios:

- **Navigation channel blockage**: The East Anchor Span is adjacent to the federal navigation channel. The span is currently stable, but key members are highly stressed and there is currently a risk of collapse. The east half of the channel, has been closed since September 8, 2018.In the event of a collapse, the structure is expected to fall within the established safety zone which could impact the area adjacent to the navigation channel. The navigation channel sees over 15,000 commercial vessels per year.

- **Damage to the new eastbound Governor Mario M. Cuomo Bridge:** The East Anchor Span is [redacted] away from the new eastbound bridge. There is a remote possibility that certain members could strike the pile cap and lower leg of the new eastbound Governor Mario Cuomo Bridge. However, it has been determined that this type of impact would not compromise the structural integrity of the bridge hence vehicular traffic across the span is deemed safe.

Since the East Anchor Span became compromised, ongoing monitoring of the East Anchor Span has continued and concerns remain regarding the stability of the span through this winter. Winter weather conditions such as freezing and thawing, high winds [redacted]), rapid fluctuations in temperature, or the combination of these factors could further weaken the span. If a collapse were to occur during the winter, retrieval of the span debris could be delayed, due to river ice and weather conditions that could prevent marine operations. After considering safety and logistics, a controlled blast is proposed for the demolition of the East Anchor Span (see Attachment O for the Preliminary Blast Plan). This involves explosive charges to cut the superstructure and substructure at Bents 176 and 178 (all explosive charges would be above-water) and drop the span into the Hudson River in a controlled manner, then use a chain system, which would be placed in the river prior to blasting, to raise the span from the bottom of the river for dismantling.

Using controlled, explosive charges was considered the best approach because it would entail a predictable, controlled collapse A salvage operation has been developed (see Attachment P for the Salvage Plan) that allows for the span to be removed from the river using a chain system where it would then be dismantled on a barge.

The East Anchor Span is located in Area 4, which is the Main Span which traverses the navigable channel between Bent 173 and Bent 178. The proposed change to the demolition means and methods previously proposed for this structure will only impact removal of the superstructure for the East Anchor Span between Bents 176 and 178. The deck has already been sawcut and removed. The demolition and removal of the pier will proceed as planned. The rectangular caisson foundations will be demolished as described in section 8.4 below. Vessel traffic from barges and tugboats associated with demolition of the East Anchor Span will not change from the methods previously assessed.

Controlled blasting places the anchor span structure in a controlled manner into a portion of the river away from the federal navigation channel. Having the chain jacking system greatly facilitates the recovery and safety compared to an uncontrolled collapse of the structure. Controlled blasting is the safest alternative as it does not require manpower to access the anchor span structure. The blasting charges would be placed [redacted], which can be accessed by adjacent barges or directly from the bridge foundations. Overall, the Controlled Blasting Alternative would provide the best solution from a safety perspective by avoiding dangerous situations, risks of loss of human lives, impacts to the new bridge operations, and vessels below. Please see Attachment Q for a summary of blast parameters and Attachment R for a summary of the environmental effects associated with the blasting.

Blasting is not being proposed for demolition of any other areas of the existing Tappan Zee Bridge.

***Condition 54:*** Within 60 days of completion of bridge demolition, a hydrographic survey of the river bottom beneath the footprint of the demolished bridge must be submitted to the Department. For comparison purposes a pre-demolition survey must be provided with the post-construction survey.

TZC will conduct a pre- and post-bathymetric survey of the riverbed from Westchester shore to Rockland shore and between 700 feet north and south of the existing bridge centerline within 60 days of completion of Bridge demolition. The bathymetric survey will be conducted on a 10ft grid and referenced to the North American Vertical Datum (NAVD88).

***Condition 55:*** The Permittee must minimize disturbance to Peregrine Falcons during all phases of the bridge replacement project. All activities must maintain the maximum distance from the peregrine falcon nest on the existing bridge as practical. No less than 30 days before starting the Authorize Activity the Permittee must submit a plan for protection of the falcon nest to the department

A Peregrine Falcon Protection Plan has been prepared for the Project which describes demolition activities. TZC will schedule coordination meetings with the NYSDEC two (2) months prior to demolition on the existing Main Span to discuss issues related to the falcon nest. TZC will provide necessary cooperation and access to the NYSDEC to facilitate the evaluation of the peregrine falcons nesting activity during each year of demolition to determine if a pair is active on the territory, are nesting and the success of that nest.

***Condition 57:*** The Permittee must evaluate Peregrine Falcon nesting activity during each year of construction and demolition to determine if a pair is active on the territory, are nesting, and the success of that nest. Any reports of impacts to the nest should be reported to the wildlife manager at the NYSDEC Region 3 Headquarters in New Paltz, NY.

A Peregrine Falcon Protection Plan has been prepared for the Project which describes demolition activities. TZC will provide necessary cooperation and access to the NYSDEC to facilitate the evaluation of the peregrine falcons nesting activity during each year of demolition to determine if a pair is active on the territory, are nesting and the success of that nest. Any reports of impact to the nest will be reported according to the approved Plan.

***Condition 59:*** At least 45 days before starting dredging activities; decanting activities; removal of large debris fields; pile driving in zone C; channel armoring; cofferdam construction; removal of the existing bridge; or any other activity that may cause resuspension of the bottom sediments, Permittee must submit a water quality monitoring plan to the department. If activities occur concurrently in multiple locations, each activity that may cause resuspension of bottom sediments must be monitored separately. The Plan must be in effect at all times during these activities. The above activities may start when the Department has given written approval of the plan.

Water Quality Monitoring Plan (WQMP) Rev10 was submitted to and approved by the NYSDEC in May 2018. Water Quality Monitoring will be conducted during the blast operations, once an All Clear is given. As required, the WQMP will be updated to reflect conditions that may change as demolition progresses.

## 5.0 REMOVAL OF DECK SUPERSTRUCTURE

### 5.1 Superstructure Deck General

The existing deck consists of three (3) structural types; Precast, Exodermic and Cast in Place. The Precast deck variety accounts for the majority of the existing span and can be found in Areas 1 – 4. Areas 5 and 6A, to include Span 191, represent the locations of the Exodermic Deck. Finally, the Area 6B Tie-in on land is constructed with a Cast in Place deck system. Each type will be removed similarly, saw cut from the supporting structure and lofted free. The unique details, and necessary steps to free the deck, will be described in this section. As these activities will require the cutting and removal of steel members, adherence to the OSHA Lead Exposure requirements for personnel protection and monitoring, OSHA 1926.62(d)(2)(iv), will be necessary. In addition to the wearing surface itself, this section outlines the necessary components to be removed prior to the deck activities. Contractual requirements for NYSTA Salvageable components will dictate individual bridge components to be removed and stored at NYSTA locations. Once panel sections are free from the structure, they will be landed on trailers or barges for processing.

### 5.2 Deck Miscellaneous Sections

In addition to the deck itself, there exists miscellaneous items that will be disconnected and removed from the structure. As mentioned above, contractual requirements for NYSTA Salvageable components will dictate individual bridge components to be removed and stored at NYSTA locations. Utilities will be decommissioned prior to the start of all demolition activities. Outside of the bridge demolition footprint the utility source will be de-energized, locked and tagged per approved Project plans. This will allow the safe demolition and removal of all light poles, sign structures, conduit and bridge lighting. Bridge barriers will also be removed at this time. Side and mobile barriers can be removed prior to saw cutting panel joints. Barrier sections will be rigged and disconnected from the concrete deck. These sections will be loaded on trailers and later, transferred to barges.

### 5.3 Precast Panels

Precast panels are found in Areas 1 – 4. The panels in Areas 1 and 2 are [redacted] in length and [redacted] in weight. Panels in Area 3 are approximately [redacted] in length and [redacted] in weight. The precast panel stringers are connected to the main floor beam truss members, in addition to the panel to panel diaphragm channel connections. At approximately [redacted], the Area 4 Main Span panels are longer and heavier than the Area 3 panels. These panels average [redacted] and are supported at each end at the floor beam members. The bolted seat connection and the diaphragm connections require under deck access to facilitate full panel removal.

#### 5.3.1 Demo sequence Areas 2 and 3

The typical sequence of work is outlined in the steps below:

1. Working underneath the deck, torch cut the diaphragms connecting the individual panels and the anchor bolts tying the panels to the substructure.

2. Separate the panels along the transverse and parallel joints with concrete deck saws. Open lifting holes with drills.
3. Rig and loft panels onto deck barges for off-site disposal.

#### 5.3.2 Demo Sequence Area 4

The typical sequence of work is outlined in the steps below:

1. Assemble and install underdeck debris and access shielding.
2. Access the precast panels from the underdeck shielding and torch cut diaphragms and anchor bolts from main floor beams.
3. Separate the panels along the transverse and parallel joints with concrete deck saws. Open lifting holes with drills.
4. Rig and loft panels onto deck barges for off-site disposal.

### 5.4 Exodermic Panels

The Exodermic Deck sections in Areas 5 and 6 have a variable width depending on lane location. Between Bents 178 and 190, the typical Exodermic Deck Panels are [redacted] in length, with main bearing bars running the width (transverse to traffic) and distribution bars fabricated perpendicular. The steel grid is topped (precast) with concrete and paved with a [redacted] -inch asphalt wearing surface.

#### 5.4.1 Demo Sequence Areas 5 and 6

The typical sequence of work is outlined in the steps below:

1. Saw cut exodermic deck into panels.
2. Install lifting lugs to the panels utilizing drop in anchors.
3. Rig and loft panels onto deck barges for off-site disposal.

## 6.0 REMOVAL OF STEEL SUPERSTRUCTURE

### 6.1 Superstructure Steel General

Existing steel superstructure includes the Main Span Truss and the Approach Underdeck Trusses in Areas 3 through 6. The removal of steel structural members will require adherence to the OSHA Lead Exposure requirements for personnel protection and monitoring, OSHA 1926.62(d)(2)(iv). The dismantling will be performed by removing large sections of existing truss, lowering to barges for off-site disposal. This will be utilized for all twenty (20) underdeck trusses, as well as the two (2) approach and one (1) suspended Main Spans. Only the cantilevered portions of the Main Span will be removed incrementally.

### 6.2 Underdeck Truss Removal Sequence

The typical sequence of work is outlined in the steps below:

1. Install lifting lugs at lifting points.
2. Position Left Coast Lifter (LCL) at confirmed radius of pick.
3. Lift truss and place on barge for off-site disposal.

## 6.3 Main Span – Suspended Span Removal Sequence

The typical sequence of work is outlined in the steps below:

1. Modify existing members and install falsework systems and access.
2. Install Strand Jacking system.
3. Close channel for a period estimated at 48 hours to allow lowering of the Suspended span, tie-down (lashing and securing) to the transport barges and towing away from the main channel. This channel closure will be coordinated with the USCG and other Regulatory agencies, as appropriate.
4. Lower span to barge and secure for dismantling and disposal.

## 6.4 Main Span – Cantilever Span Removal Sequence

The typical sequence of work is outlined in the steps below:

1. Modify existing members, install falsework systems and access, and finally cut and loft members.
2. Prepare rigging locations for each pick. Take the load with the crane prior to performing the final torch cuts.
3. Cut the section free, swing and land the section on the adjacent material barge.
4. Coordinate stages that will impact or alter the navigable channel with the USCG and other Regulatory agencies, as appropriate.

## 6.5 Main Span – Anchor Spans Removal Sequence

The typical sequence of work is outlined in the steps below:

1. Modify existing members and install falsework systems and access.
2. Install Strand Jacking system.
3. Lower span and secure to barges for dismantling and disposal.

### 6.5.1 East Anchor Span Blasting

As further described in Condition 51, TZC is proposing to blast the East Anchor Span, following the events of September 7, 2018. The use of explosives, or blasting, would entail removing the bridge span by inducing structural failure at the base of the steel tower legs. Charges would be placed on [redacted] that support the East Anchor Span. The blast charges would sever the steel towers and cause the span to fall into the river. The tower legs can be accessed by adjacent barges or directly from the bridge foundations to place the blasting charges.

To allow for the controlled and directed failure of the structure, the tower legs would be strategically torch cut and weakened prior to the use of cutting explosives. A high capacity pulling system ([redacted]) would be used to topple the structure in the desired direction at the time of explosive cutting. Prior to blasting, a combination of cables and chains would be used to apply tension to the span and direct the falling span east toward Bent 182 and away from the navigation channel.

The blasting charges would be placed on [redacted] the bridge span and would be detonated [redacted] The use of the delayed blasting caps would mitigate peak overpressure[1] generated by the detonation. The blast sequence will be initiated at one end of the bridge and will progress to the other end. Charge initiation [redacted] will be separated with a minimum delay [redacted]; therefore, the planned maximum of explosives detonating per delay will not exceed [redacted] The charges will be encased in a protective cover consisting of multiple layers of strandboard and corded conveyer belting to prevent fly of debris resulting from the detonation. That at-source blast protection will then be wrapped with 16 oz geotextile fabric to contain fly of at-source protection materials. Refer to Attachment O for additional information and depictions of the proposed blasting. Blasting activities will be performed in strict adherence with all industry standards applying to control of blasting and blast vibrations.

### 6.5.2 East Anchor Span Salvage Operation

TZC has prepared a Salvage Plan (see Attachment P) to remove the East Anchor Span from the river bottom, dismantle it and prepare for proper disposal.

A system of large chains and two parallel chain pulling barges will be employed to recover the structure from the river bottom. Ten 360 foot lengths of heavy chain will be laid across the river bed beneath the anchor span. The central 100 feet of these chains will consist of a double section of chain that is connected to the exterior lengths by steel plate rigging. These chain systems will be connected to two 300’ x 100’ specialized chain pulling barges located on both sides of and parallel to the span (Refer to Attachment L for detailed depictions). When tensioned these chains will form a sling beneath the structure so it can be lifted off the river bottom when the chain pullers on each barge are engaged.

This approach allows the majority of the structure to be promptly recovered in one large piece and will allow for disassembly to occur at the surface. The chains will be preplaced and the ends of the chains will be secured to marker buoys allowing for retrieval from the river bottom and connection to the chain pulling barges.

In addition, TZC is placing pulling chains, in addition to the lifting chains, to support the proposed blasting of the span. The system of pulling chains (two 720 foot length chains) will be used to direct the fall of the

[1] Overpressure or blast wave is the sudden onset of a pressure wave after an explosion, caused by the energy released in the initial explosion—the bigger the initial explosion, the more damaging the pressure wave. Pressure waves are nearly instantaneous, traveling at the speed of sound (NOAA 2018).

structure eastward and away from the navigation channel. These pulling chains assemblies will feed into a chain puller mounted to an anchored barge positioned to the east of the span.

The pulling chains will be removed by crane from the river after demolition of the bridge. The lifting chains will be removed from the river once the span is lifted from the river bottom, which is an estimated 2 weeks after the blasting event. Following retrieval, the chains will be placed on barges and removed from the project site.

# 7.0 REMOVAL OF SUBSTRUCTURE

## 7.1 Existing Substructure General

Existing substructure, bridge wide, is defined as a system of concrete columns tied together at the top by a concrete strut(s), also referred to as a pier cap. The Substructure is further defined as the portion of the bridge above the foundations and below the superstructure/deck. Areas 1, 2, 3, 5, and 6 are concrete while Area 4 is steel.

## 7.2 Areas 1 and 2

The typical sequence of work is outlined in the steps below:

1. Rig concrete struts and columns with crane.
2. Separate reinforced concrete connection by hammering, cutting or shearing.
3. Loft sections and land on debris barges for off-site disposal

## 7.3 Areas 3, 5, and 6

The typical sequence of work is outlined in the steps below:

1. Rig concrete struts and columns with crane.
2. Separate reinforced concrete connection with wire saw.
3. Loft sections and land on debris barges; downsize for off-site disposal.
4. The bottom 30-feet of the substructure will remain in place and be demolished with the foundation as described below.

## 7.4 Area 4 Steel Lattice Substructure

The typical sequence of work is outlined in the steps below:

1. Remove Icebreaker/Fender assemblies. Prepare rigging locations for each pick section.
2. Take the load with the crane and torch cut the pier sections.
3. Land the section with the crane on the adjacent material barge for off-site disposal.

# 8.0 REMOVAL OF BRIDGE FOUNDATION AND PILES

## 8.1 Foundation General

There are (3) major foundation types on the existing structure.

1. Timber pile supported pile cap foundations are found in Areas 1 and 2.
2. Paired solid concrete circular caissons founded on H Pile are found in Areas 3, 5, and 6, at Bents 166 – 168 and 179 – 190. These foundations are fully or partially enclosed by steel sheet pile.
3. Hollow rectangular caissons are found at in Areas 3, 4, and 5, at Bents 169 – 178. These foundations consist of cellular rooms separated by concrete walls and ceilings. Each of these foundations are founded on either H Pile or H Pile encapsulated inside circular piles.

## 8.2 Areas 1 and 2 – Timber Pile Caps

The typical sequence of work is as follows in Area 1B:

1. Demolish pile caps in place using hydraulic hammers and shears. Bucket rubblized material from the river bottom and place in adjacent debris barge for transport for off-site disposal.
2. Snap timber piles at the NYSDEC required demolition limit using barge mounted excavators equipped with a bucket and thumb or grapples.

The typical sequence of work is as follows in Area 2:

1. Demolish in place using hydraulic hammers and shears. Bucket rubblized material from the river bottom and place in adjacent debris barge for transport for off-site disposal.
2. Snap timber piles at the NYSDEC required demolition limit using barge mounted excavators equipped with a bucket and thumb or grapples.

## 8.3 Circular Caissons

The typical sequence of work is as follows:

1. Displace existing material from the river bottom with an excavator or jetting to expose sheet pile at demolition limit.
2. Mark and torch cut sheet pile at demolition limit with divers.
3. Hoe ram the remaining 30-feet of concrete column substructure, if applicable.
4. Hammer and bucket caisson to debris barges for off-site disposal.
5. Sheet pile removal shall occur at any time during this operation.
6. If applicable, cut and remove H pile at the base of caisson.

### 8.4 Rectangular Caissons

The typical sequence of work is as follows:

1. Install temporary [redacted] spuds as needed around pier perimeter with vibratory pile driver/ extractor. Piles are for mooring/fendering of work barges.
2. To the extent possible start demolition inside of the exterior walls, beginning with the roof of the caisson and continuing to the intermediate floors and interior walls.
3. Advance demolition and removal of the exterior walls.
4. Demolish via hoe ramming, cutting and shearing.
5. Remove debris throughout the operation via bucketing. All debris will be removed to the NYSDEC required demolition limit.

## 9.0 REMOVAL OF ICEBREAKER AND FENDER

### 9.1 Timber Pile Clusters – Bents 4 – 165

The typical sequence of events is as follows:

1. Install full depth turbidity curtains prior to work commencing at Bents 4 – 30.
2. Snap timber piles at the NYSDEC required demolition limit with excavators equipped with a bucket and thumb or grapples.
3. Any timbers that break above the required depth below the river bottom may be removed during the demolition of the pile caps.

### 9.2 Timber/Steel Fender Frame – Bents 169 – 173 and 178

The typical sequence of events is as follows:

1. Rig sections of the timber/steel fender with barge mounted crane or excavator.
2. Displace material to expose pile to the NYSDEC required demolition limit.
3. Cut pile supports to the NYSDEC required demolition limit with divers or excavator mounted shear.
4. Torch cut and loft section to debris barge for off-site disposal.
5. Alternatively to cutting pile, pile may be extracted with a vibratory hammer.

### 9.3 Triangular Concrete Icebreakers

The typical sequence of events is as follows:

1. Displace existing material from the river bottom with an excavator or jetting to expose sheet pile.

2. Mark and torch cut sheet piles at demolition limits by divers.
3. Hammer and bucket concrete to debris barges for off-site disposal.
4. Sheet pile removal shall occur at any time during this operation.
5. If applicable, cut and remove H pile and or timber pile at the base of ice breaker.

### 9.4 Main Span Fender

The typical sequence of events is as follows:

1. Wire saw or otherwise cut fender into sections, remaining supported by [redacted] steel pile.
2. Drill and/or install rigging locations.
3. Rig sections with barge mounted crane.
4. Perform additional wire sawing, if applicable.
5. Separate rigged precast section from [redacted] pile with wire saw, shear, torch or other cutting method, if applicable.
6. Loft and land section on debris barge for off-disposal.
7. Displace existing material from the river bottom with a bucket or jetting to the NYSDEC required demolition limit
8. Torch cut or shear remaining [redacted] pile at the NYSDEC required demolition limit and place on debris barge for off-disposal.

## 10.0 BARGE TRANSFER OF MATERIALS

Materials not reused or recycled will be transported to an appropriate, permitted off-site disposal facility. TZC has awarded the following disposal contracts for the disposal of demolition material:

- **ACK Marine and General Contracting, LLC.**
  - Disposal Location: Port of Coeymans, New York
  - Distance from Tappan Zee Bridge Site: 100 Nautical Miles
  - Demolition Material: Concrete Rubble
  - Estimated Number of Shipments: 160
  - Disposal Shipping Method: Barge
- **CS Construction Logistics, LLC.**
  - Disposal Location: Port of Coeymans, New York
  - Distance from Tappan Zee Bridge Site: 100 Nautical Miles
  - Demolition Material: Timber Pile (Creosote/CCA treated and untreated,)

- Estimated Number of Shipments: 74
- Disposal Shipping Method: Barge

- **SIMS Metal Management**
  - Disposal Locations:
    - SIMS Albany, New York
      - Distance from Tappan Zee Bridge Site: 101 Nautical Miles
      - Estimated Number of Shipments: 24
    - SIMS New Jersey
      - Distance from Tappan Zee Bridge Site: 30 Nautical Miles
      - Estimated Number of Shipments: 20
  - Demolition Material: Steel Lattice, Underdeck Truss, Anchor Span Truss, Suspended Span Truss and Cantilever Span
  - Disposal Shipping Method: Barge

- **Weeks Marine Inc.**
  - Disposal Contract Date: October 20, 2017
  - Disposal Locations:
    - Perth Amboy, NJ
      - Distance from Tappan Zee Bridge Site: 44 Nautical Miles
      - Estimated Number of Shipments: 75
      - Demolition Material: Precast Deck Panels, exodermic deck panels, concrete substructure, concrete pile caps and precast concrete fenders
      - Disposal Shipping Method: Barge
      - Processed Concrete will be disposed of as follows:
        - Fire Island Reef
          - Distance from Perth Amboy: 49 Nautical Miles
          - Estimated Number of Shipments: 4
        - Moriches Reef
          - Distance from Perth Amboy:71 Nautical Miles
          - Estimated Number of Shipments: 2
        - Shinnecock Reef
          - Distance from Perth Amboy: 85 Nautical Miles
          - Estimated Number of Shipments: 1

- ➢ Rockaway Reef
  - Distance from Perth Amboy: 20 Nautical Miles
  - Estimated Number of Shipments: 2
- ➢ Hempstead Reef
  - Distance from Perth Amboy: 34 Nautical Miles
  - Estimated Number of Shipments: 5

- ▪ Port of Coeymans, NY
  - Distance from Tappan Zee Bridge Site: 100 Nautical Miles
  - Estimated Number of Shipments: 15
  - Demolition Material: substructure and substructure caps
  - Disposal Shipping Method: Barge
- ▪ Jersey City, NJ
  - Distance from Tappan Zee Bridge Site: 30 Nautical Miles
  - Estimated Number of Shipments: 15
  - Demolition Material: Precast Deck Panels, exodermic deck panels, concrete substructure, concrete pile caps and precast concrete fenders
  - Disposal Shipping Method: Barge

- **Sterling Equipment Inc.**
  - Disposal Locations:
    - ▪ Bayshore Recycling , Keasby, New Jersey
      - Distance from Tappan Zee Bridge Site: 45 Nautical Miles
      - Estimated Number of Shipments: 8
  - Demolition Material: Concrete rubble, steel, rebar, timbers
  - Disposal Shipping Method: Barge

# Attachment A

# Bents 190/191 Plans and Sections

# NO CHANGE FROM REVISION 6

# Attachment B
# Bents 190/191 Site Photos

# NO CHANGE FROM REVISION 6

# Attachment C
# Area Map and Designations

# NO CHANGE FROM REVISION 6

# Attachment D
# Bridge Structure Definitions

# NO CHANGE FROM REVISION 6

# Attachment E
# Demolition Schedule

# NO CHANGE FROM REVISION 6

# Attachment F
# Debris Removal Depiction

## NO CHANGE FROM REVISION 6

# Attachment G
# Turbidity Curtain Detail

# NO CHANGE FROM REVISION 6

# Attachment H
# Debris Containment

## NO CHANGE FROM REVISION 6

# Attachment I
# Timber Pile Removal

# NO CHANGE FROM REVISION 6

# Attachment J

# Sitewide and Area 2 Rockland Causeway Foundation Removal Best Management Practices

# NO CHANGE FROM REVISION 6

# Attachment K
# NYSDEC Required Demolition Limits

# NO CHANGE FROM REVISION 6

# Attachment L
# Salvage Procedure

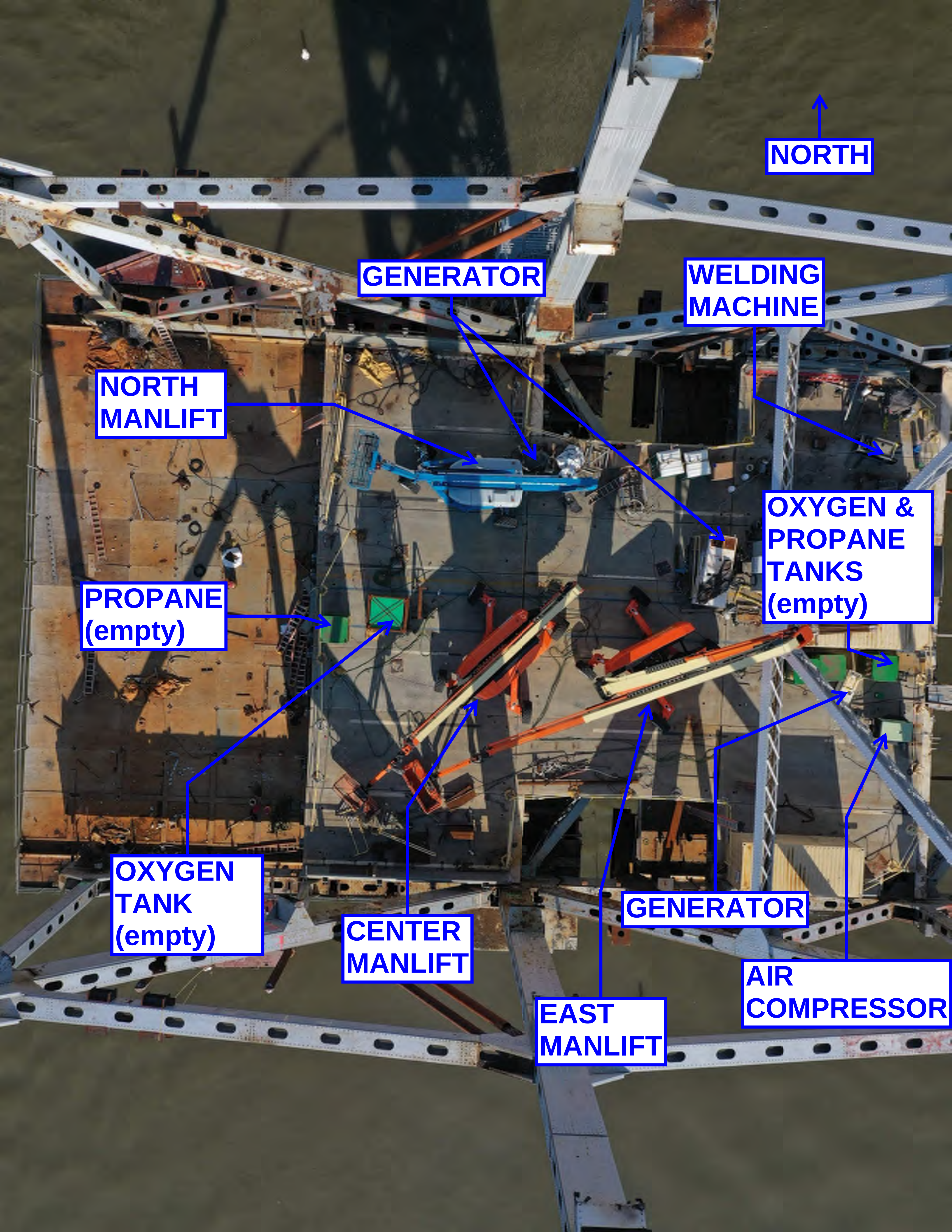
# NO CHANGE FROM REVISION 7

# Attachment M
# Demolition Equipment on East Anchor Span

Tappan Zee Constructors, LLC
CONSTRUCTION WORK PLAN
Tappan Zee Hudson River Crossing Project
Contract D214134 PIN 8TZ1.00 TANY

East Anchor Span Demolition
Bent 176 Equipment Information
12/19/2018

| EQUIPMENT STAGED NEAR PIER 176 | | | | | | |
|---|---|---|---|---|---|---|
| ***Item*** | ***Quantity*** | ***Power Source*** | ***Fuel/Gas Volume*** | ***Hydraulic Fluid Volume*** | ***Engine Oil Volume*** | ***Coolant Fluid Volume*** |
| | ***[#]*** | ***[-]*** | ***[-]*** | ***[gal]*** | ***[gal]*** | ***[gal]*** |
| JLG 1500 AJP Manlift | 1 | Diesel | 45 gal | 93 | 3.8 | 4.7 |
| JLG 1500 AJP Manlift | 1 | Diesel | 45 gal | 93 | 3.8 | 4.7 |
| Genie ZX135/70 Manlift | 1 | Diesel | 40 gal | 65 | 2.4 | 2.8 |
| Praxair Liquid Oxygen Pod | 1 | | 0 $ft^3$ | | | |
| Gas Oxygen Cylinders | 60 | | 0 $ft^3$ | | | |
| Propane Gas Cylinders | 6 | | 0 gal | | | |
| 150 kW Generator (DCA150SSCU) | 1 | Diesel | 100 gal | | 4.6 | 11.4 |
| 15 kW Generator | 1 | Diesel | 16 gal | | 1.48 | 1.85 |
| 185 CFM Air Compressor | 1 | | 27 gal | | 1.825 | 2.75 |
| 400 Amp Welding Machine | 1 | Diesel | 20 gal | | 2.8 | 2 |
| Totals | | | 293 | 251 | 20.71 | 30.2 |



NORTH
GENERATOR
WELDING MACHINE
NORTH MANLIFT
OXYGEN & PROPANE TANKS (empty)
PROPANE (empty)
OXYGEN TANK (empty)
CENTER MANLIFT
GENERATOR
EAST MANLIFT
AIR COMPRESSOR


JLG
ULTRA

# Attachment N
# Pollution Abatement & Containment Removal Plan

# NO CHANGE FROM REVISION 7

# Attachment O
# Preliminary Blast Plan

# Attachment P
# Salvage Plan

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# TAPPAN ZEE BRIDGE EAST SPAN

## Salvage Plan

Prepared by:

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For:

**Blake Yaffee**

**Demolition Area Manager**

**Tappan Zee Constructors**

555 White Plains Road, Suite 400, Tarrytown NY 10591

| **Job#:180904** | | | | **Date: 01 Nov 2018** | |
|---|---|---|---|---|---|
| **Doc#: Tappan Zee Bridge East Span Salvage Plan** | | | | **By: RMS** | |
| **REVISION LIST** | | | | | |
| Rev. | Chapter/Revised page | Revision Promoter | Approved by | Revision Reason | Revision Date |
| 2 | Various updates | RMS | TS | Various updates | 11/01/18 |

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## 1. EXECUTIVE SUMMARY

The United States Department of Transportation approved the replacement of the original Tappan Zee bridge in 2012 to be built by Tappan Zee Constructors (TZC). In 2013, construction of the replacement bridge was started. In 2018, the replacement bridge, named Governor Mario M. Cuomo Bridge was opened for traffic. The original Tappan Zee bridge was officially closed on Oct. 6, 2017, and demolition of the original bridge began.

On September 8, 2018, the remaining eastern anchor span of the original Tappan Zee bridge span unexpectedly shifted. This shift has brought up concerns about the structural integrity of the remaining bridge spans and safety concerns for the nearby new Governor Mario M. Cuomo bridge, located less than 160 ft from the original bridge spans.

RESOLVE has been tasked by TZC in developing the plan for the demolition and removal of the subject bridge span. After discussions with Tappan Zee Constructors, a site visit, and an initial engineering review of the structure RESOLVE has developed a plan for the use of demolition explosives to drop the remaining bridge span supported by Bent 176 & 178 into the water and topple the bents towards the east. The planned explosive procurement, installation, and detonation will be conducted by and through the currently nominated demolition contractor Controlled Demolition, Inc. (CDI).

RESOLVE chain pullers will then be connected from two barges to lift the bridge span from the river bottom and transport the bridge spans away from the bridge site for disposal. It may be necessary to begin dismantling at the current site prior to shifting the barges. The planned methods and equipment are commonly used in the salvage industry when conducting demolition and wreck removal projects.

RESOLVE will further develop detailed work plans for the individual tasks and procedures needed to conduct the bridge demolition and span removal. The work plans are being developed in close coordination with TZC management, engineers, superintendents, and supervisors to facilitate effective synergy between the involved organizations.

CDI as the demolition contractor with their partner Sigma Engineering Solutions (Sigma) will perform the demolition engineering.

This document describes the methodology, contingencies, and considerations for the felling and removal of the bridge span. Attached appendices include CDI Blast Design, RESOLVE engineering drawings for elaborating on project execution details.

It must be noted that the planned technical procedures as listed within this document are based on RESOLVE using their due diligence to carry out the operations on a severely compromised structure and RESOLVE is in no manner guaranteeing any exact results. We believe that the methods proposed represent the best available techniques for handling the structure, but the exact condition of the truss throughout the operation including how it lands after demolition and the resulting structural condition and geometry after felling are unpredictable to a large extent and may directly affect the subsequent recovery methods and efficiency of the same.

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## 2. PROJECT OVERVIEW

The Tappan Zee Bridge is a highway traffic steel cantilever bridge spanning the Hudson River in New York. Prior to partial demolition the bridge was more than 2,400ft long, and consisted of a 1,212ft long main span over the Hudson River. By September 2018, more than 550ft of the original bridge had been removed. The eastern end of the bridge spanning between bent 176 and 178 has been found to be unstable and needs to be demolished in a safe and controlled manner.

[redacted]

*Figure 1: Project Arrangement Profile View Span Bent 176 & 178 Looking North*

RESOLVE and CDI propose to topple the span by inducing structural failure in the columns of the bents. To facilitate toppling in the preferred direction, the bents will be structurally weakened prior to the use of cutting explosives, further RESOLVE will connect a high capacity pulling system (up to 600 tons) to topple the structure in the desired direction at time of explosive cutting. This bridge span section, once dropped into the water, is expected to be lifted from the river bed (structural condition and truss geometry permitting) using multiple RESOLVE patented 300T chain pullers, suspending the bridge sections between two deck barges. As the structure is demolished using standard topside cutting techniques the pullers are planned to continually lift the structure out of the water until it is fully cut apart. RESOLVE's lift barges can be used to assist with the removal of the toppled bents from the river bed if required.

## 3. TECHNICAL PLAN

### 3.1. ENGINEERING AND PLANNING SERVICES

Resolve's demolition subcontractor CDI, along with their engineering partner Sigma is in the process of delivering the following engineering/technical services:

1. Develop an Implosion Plan & Procedure, provide labor/materials and perform those operations noted herein to assist the Contractor in felling the structure via a combination of explosives and mechanical methods

2. Arrange for the following scope of work to be performed by Sigma Engineering Solutions (Sigma):

a. Assist the Contractor/CDI with an understanding of the existing condition of the compromised structure toward developing their access plan to or around the structure which minimizes duration and nature of exposure to personnel during the preparation of the structure for explosives operations by CDI and pulling, to the east, by the Contractor.

b. Develop an independent elastic finite-element analysis model based on existing structural conditions, as-built plan information, specified design material information, and material testing information, as made available by TZC via the Contractor. The intent of this modeling effort is to identify and develop an improved understanding of the current and anticipated load path in the affected structure, as well as confirmation of the anticipated member forces associated with the behavior of the structure in its affected state.

c. Develop an elastic pier bent model for Bents #176 and #178 to aid in the analysis and investigation of the proposed pre-demolition preparatory cuts/preparations, as required, to support the development of the blasting and demolition plan.

d. Develop estimates of critical member demand/capacity ratios (based on the yield strength of the material) for comparison purposes against previously developed analytical models.

e. Develop and share an opinion of the “residual” capacity available in the affected structure based on the latest modeling and investigation work, for consideration during the development of the demolition plan.

f. Develop “local” models of critical joint(s), or member(s), that may play a vital role in the development of the eventual collapse mechanism of the structure. These models will be based on linearly elastic models, and may include non-linear investigation of critical elements.

g. Develop and share an opinion on the most likely failure mode, and estimates and nature of required forces necessary to induce a loss of structural stability in the existing structure and imminent collapse, to be considered in the development of the demolition plan.

h. Provide participation and engineering input with the project safety team to support the development of the demolition plan.

i. Provide input and estimates to be considered regarding the magnitude and implementation of the proposed directional pull during toppling.

RESOLVE Engineers are working closely with both CDI and TZC’s engineering team and subcontractors in development of the comprehensive work plans needed to conduct the demolition operation, these Work Plans cover details such as vessel layouts, access plans to the damaged structure, and hazard analyses for the various tasks required for safe completion. In addition, RESOLVE engineers will develop the following deliverables:

1) Pull System Design; develop plan for components, placement, and orientation of pulling system to facilitate smooth directionally controlled toppling immediately after explosively cutting bent column structure. RESOLVE planned rigging and pulling capacity based on TZC western columns failure analysis.
2) Lift System; development of plan for lift geometry, detailing specifics of rigging, lift points, and pre-laid lifting chain orientation.
3) Vessel layouts; coordinate with TZC on required space and equipment for demolishing the bridge span once lifted, develop installation requirements of RESOLVE lifting equipment, develop General Arrangement for lifting barges and pull barge.
4) Mooring Analysis; develop vessel mooring plan for lift barges and pull barges.

The following tasks will be a joint effort among Resolve, CDI and Sigma with review and approval from TZC:

A. Conduct Risk Assessment for safe access to the work site to allow for implementation of the demo plan
B. Conduct detailed project risk assessment for explosive demo operation including simulation of dynamic toppling and assessment of implications of various 'worst case' scenarios.

### 3.2. SHORING OF LOWER CHORDS

Through SIGMA's structural analysis of the truss they have come to the conclusion that shimming between the column caps of bent 176 and the lower disconnected chords L17-L18 greatly increases the structural integrity of the truss. Their modeling indicates the placement of the shores increases the residual capacity of the critically stressed members up to 800%. SIGMA has further developed an engineering plan for the shim system which will be implemented by RESOLVE and CDI at the earliest possible time. The work plan for this installation will be developed in coordination between RESOLVE, CDI, and SIGMA.

### 3.3. STRUCTURAL MONITORING

RESOLVE via CDI/Sigma will provide and install a structural monitoring system that will provide real time monitoring and immediate alarm capability to work crews near the bridge and will support the risk assessment to provide for safe access for workers to the site. Components of the system will be spec'd out to provide the widest range of useful data without causing undue risk to technicians tasked with physical installation. System components being considered include weldable strain gauges, inertial motion sensors, potentiometers, laser motion detectors, and acoustic monitoring devices.

### 3.4. MOBILIZATION AND PREPARATION ACTIVITIES

Mobilization and preparation involves numerous steps:

1. Procure and mobilize critical path materials including shape charges, high strength pull rigging, lifting chains, etc.
2. Initiate required project planning and engineering by Resolve, CDI, and Sigma to complete the various engineering and planning tasks required
3. Mobilize lift barges and lifting spread

4. Initiate site preparations
    a. Lifting chain deployment (by TZC with Resolve oversight)
    b. Installation of Motion monitoring system
    c. Pulling gear installation and pulling barge set up
    d. Bents 176 pulling connection
    e. Bent 178 load transfer blocking between truss and bent
    f. Preparations for Implosion Plan and Procedure (CDI)
        - Pre-cutting as required
        - Setting charges
        - Placing conveyor belting for blast protection

### 3.5. LIFT BARGE SETUP

RESOLVE has mobilized two 300x100 barges to be used as lift barges. The barges are currently at RESOLVE's U.S. Gulf Facility in Mobile, Al. Each barge is being out fitted with [redacted] chain puller packages, as well as a variety of support equipment including a crane on 1 barge, moorings system, and HPU's.

The barges are being laid out in such a way that clear deck space is available for TZC equipment to be outfitted if needed to assist with demolition. Once the barges are fully laid out and operational for their intended purpose they will be towed to site in New York.

[redacted]

*Figure 2: Lift Barge departure Arrangement (crane fitted one barge only)*

### 3.6. PULL BARGE

It is planned to outfit two pullers with 3" chain and Plasma (HMPE) pull rigging along with all required support equipment onto the deck of the barge SEI 180-5, a 180x54 spud barge. RESOLVE intends to utilize the existing bridge foundation pier 182 to the east of Bent 178 to provide the restraining force for the pullers. The barge will be spudded in place and the pullers will have chain hold backs wrapped around the reinforced concrete pier columns. The columns will serve as the anchor point for the pullers, absorbing the [redacted] pull force. It is currently understood that two chain pullers – complete with necessary pull rigging – are able to provide the necessary

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capacity to topple the structure. Additional pullers can be outfitted if additional analysis determines the increase in capacity is required. (see appendix for justification). The following figures depict the planned operational arrangement.

[redacted]

*Figure 3: Pull Barge Layout*

[redacted]

*Figure 4: Pull Barge Overview*

[redacted]

*Figure 5: Pull Barge Orientation Looking South - Two pullers on barge, each connected to concrete piling hold back*

### 3.7. RIGGING INSTALLATION

RESOLVE engineering team will lead the development of the needed work plans and diagrams for the installation of the toppling rigging and the lift rigging. Resolve will work with TZC staff to develop the work plans for these operations including required personnel and equipment. In addition to providing the rigging schematics, a RESOLVE engineer or salvage master will be onsite at time of installation to ensure acceptable QA/QC.

To conduct the toppling operation two lengths of high strength synthetic lines (Plasma 12x12) will be connected to the upper members of Bent 176. The line will be connected to a synthetic sling that will be shackled into padeyes burned into the vertical columns of the bent. The soft line will then be run to the east where it will connect into 700' of 3" chain that feeds into RESOLVE's chain pullers. A roller bearing at the top of Bent 178 supports the bridge span, therefore a positive connection between the top of Bent 178 and the lower chord of the bridge span will be installed to transmit the pulling force to the top of the bent. Details of this positive connection will be developed by Resolve's engineering team in coordination with CDI and SIGMA engineering.

The Plasma line will be rigged essentially without any personnel or equipment working under the span. The rigging will be installed from man lift barges moored alongside the span, crane support will be utilized as required and detailed in the specific rigging installation work plan.

To lift the toppled bridge span, lifting chain will be placed under the span prior to toppling the bridge. The exact lengths and locations the chains to be run will be specified in a detailed rigging schematic, but generalizing, ten 360' lengths of 3" grade k4 lifting chain will be run under the bridge span. The spacing of the chain will be specified to coincide with the placement of the chain pullers on the lifting barges. Messenger lines and marker buoys will be connected to the bitter ends so recovery and connections can be made to the [redacted] chain pullers rapidly after the toppling operation is complete.

### 3.8. MOORING INSTALLATION

RESOLVE engineers will conduct a mooring analysis based on anticipated onsite conditions to determine the required capacity and geometry of the mooring systems to be installed on each of the lift barges and pull barge. The mooring system will be a standard offshore style 4-point winch systems with hanging anchors; anchor and wire sizing will be determined by the mooring analysis. Efforts will be made to keep the moorings well clear of the adjacent shipping channel. If this is not possible, approval will be received from relevant authorities prior to deployment of any equipment within the boundaries of the channel.

### 3.9. STRUCTURAL PREPARATIONS

CDI will perform necessary pre-cutting operations as dictated by the final engineering analysis and detailed demo plan. (preliminary plan appended)

### 3.10. DEMOLITION EXPLOSIVES

CDI will develop and implement the final implosion and blast plan with direct input from Sigma. This plan covers explosive installation, cut geometry, anticipated failure mode, and implemented safety precautions. (preliminary plans/report appended).

### 3.11. BRIDGE SPAN TOPPLING

Figures 6 - 9 show the generalized sequence of toppling the bridge span; several advanced failure models are in development with additional details presented in CDI and Sigma's demolition plans.

The toppling process will involve tensioning the pulling rigging to the predetermined loading. It is expected that this horizontal force will confine the toppling direction towards the east. At time of detonation of the cutting charges, the preload force combined with the self-weight of the structure will induce a bending/buckling failure in the eight western columns of Bent 176 & 178. RESOLVE will carry out these operations utilizing due diligence. No guarantees can be made.

The toppling operation work plan is being developed in corporation with applicable authorities to ensure operation is conducted in full compliance with relevant regulations and statutes, as well as to facilitate the coordination of the various closures needed, i.e. waterways, roads, airspace, etc, that will be implemented preceding detonation.

Once the span is toppled a team of TZC and RESOLVE engineers will conduct a stability survey of the span, assisted by experienced divers as necessary. This survey will be the basis for proceeding with the subsequent lift and dismantling plan and will determine the extent if any required for demo or clearance of structure prior to lifting.

[redacted]

*Figure 6: Pulling Arrangement (Looking South)*

[redacted]

*Figure 7: Puller Force Applied*

[redacted]

*Figure 8: Marked Lower Members Breached w/ Explosives *Toppling Begins**

[redacted]

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### 3.12. SPAN REMOVAL VIA LIFT BARGES

Once the bridge section is dropped to the river bed using demolition explosives, a detailed survey will be performed to evaluate the stability and structural integrity of the truss for lifting operations.

Provided all is suitable for proceeding as planned with the barge lifting, RESOLVE will utilize two (2) deck barges (approximately 300ft x 100ft), each fitted with ten [redacted] chain pullers, to lift the bridge span from the river bed. Ten individual lengths of lift rigging will pass from chain pullers on one barge under the bridge span to chain pullers on the opposing barge, this will lift the bridge span in a ‘basket’ rigging arrangement. The bridge span will be securely held between the two deck barges during the lift of the structure to the surface. RESOLVE has used this lifting technique many times, including recently when 6,000T of lifting force via 20 – 300T chain pullers raised the sunken Derrick barge TOPS DB-1 from the sea floor in the Gulf of Mexico.

Lifting chains underneath the bridge span will be double chain basket arrangements. A single chain leader will come from each puller and connect into a delta lifting plate, the plate will connect into two legs of lifting chain. When lifting the delta plate will sit just above the corner of the chord. The following figure depicts the chain arrangement. This configuration is utilized to better distribute the lift force over the lower chord of the truss. A concentrated load from a single chain leg point loading on the chord’s hard corner increases the likelihood of inducing localized failure of the chord structure or damaging a chain link, the double chain basket reduces the stresses in the links and chord member. Once the rigging is in place, if conditions allow, visual survey of the rigging may be used to verify link positioning or measurements will be taken to determine the chains position in relation to the chord corner.

It is anticipated that once the bridge span is lifted, the barges will be shifted with the bridge section suspended between the barges to a suitable location for follow on demolition activity.

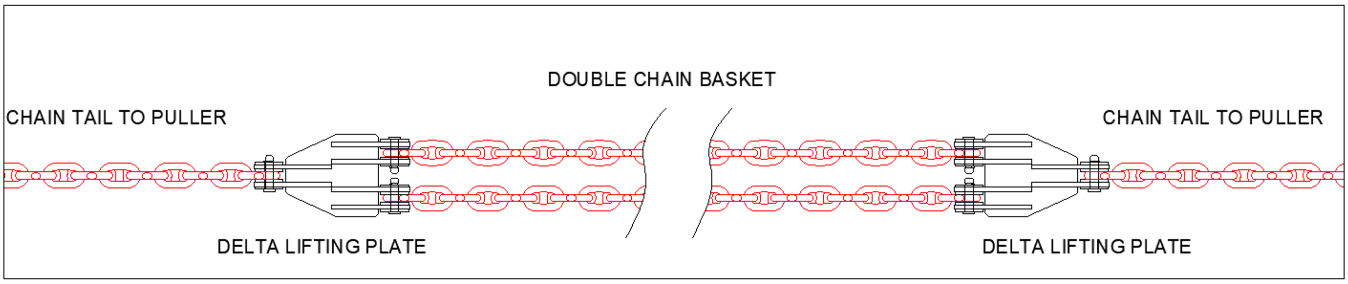


*Figure 10: Lifting Chain Arrangement*

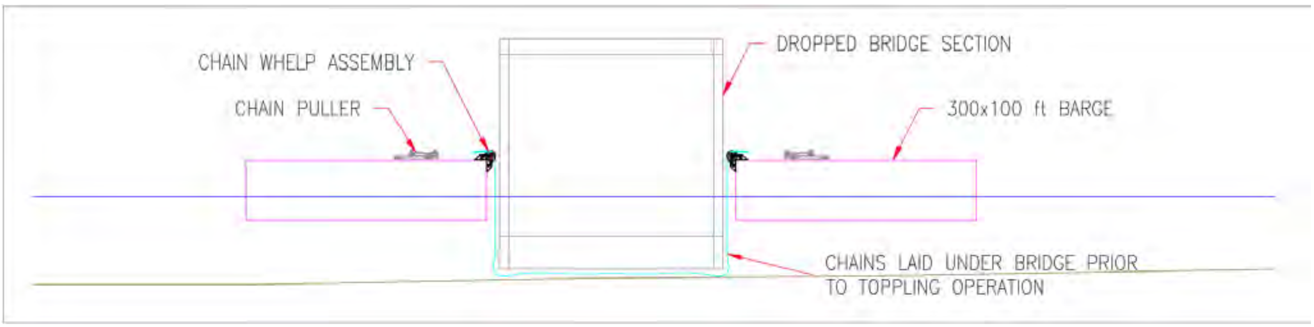


*Figure 11: Chain in Basket Arrangement*

[redacted]

*Figure 12: Plan View of Two Barge Lift*

Several options are available for the bridge span disposal. Factors outside of RESOLVE's control will contribute to determining the final method of disposal once the span is supported between the lift barges. Resolve will continue to work with TZC to develop and support the final disposal plan. In general, the span will be supported between the two lift barges as depicted below in support of the various options that are available including in place dismantling, or placement on a submersible barge for subsequent dismantling or offshore disposal.

[redacted]

*Figure 13: Bridge Span Lifting – Connecting Rigging to Barges*

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[redacted]

*Figure 14: Bridge Span Lifting – Lifting Span*

[redacted]

*Figure 15: Bridge Span Lifting – Freeing Span from Entangled Structure for Transport*

### 3.13. REMAINING BRIDGE BENT DISPOSAL

Once the bridge span has been lifted and removed from the site, a plan for removing the remaining Bents 176 & 178 will be finalized and implemented at the request of TZC.

### 3.14. PROJECT TIMELINE

A detailed schedule and Gantt chart will be maintained by RESOLVE throughout the project as a working document. However, the following is an initial schedule overview with ESTIMATED task duration:

| | |
|---|---|
| 1) Mobe Package A: Order critical material/engineering | 31 days |
| 2) Mobe Package B: Lift Barge Preparation | 28 days |
| a. Layout of two 300'x100' lifting barges: | 14 days |
| b. Barge transit to New York: | 14 days |
| 3) TZC/Resolve to deploy lifting chains | 10 days |
| 4) CDI Pre-Cutting of Structure | 10 days |
| 5) TZC/Resolve Setup of Pull Rigging and Pull Barge: | 7 days |
| 6) On-site set up of lift barges after arrival and prior to lift | 3 days |
| 7) Explosive Installation: | 5 days |
| 8) Truss Lifting and Transport: | 7 days (subject condition after toppling) |

## 4. APPENDIX A: CDI PRELIMINARY BLAST GEOMETRY

# Attachment Q
# Blast Parameters

# Blast Parameters

1. The blasting charges would be placed on the [redacted] bridge span, [redacted] above water, and would be detonated sequentially using internal delay type non-electric blasting caps.

2. The blast sequence will be initiated at one end of the bridge and will progress to the other end.

3. Charge initiation [redacted] will be separated with a minimum delay [redacted] therefore, the planned maximum of explosives detonating per delay will not exceed [redacted]

4. The charges will be encased in a protective cover consisting of multiple layers of strandboard and corded conveyer belting to prevent fly of debris resulting from the detonation. That at-source blast protection will then be wrapped with 16 oz geotextile fabric to contain fly of at-source protection materials.

5. Blasting activities will be performed in strict adherence with all industry standards applying to control of blasting and blast vibrations.

6. Underwater sound calculations presented below assumed [redacted] each in the same location, [redacted] above the water, detonated [redacted] apart, moving east to west on the structure. These values represent the maximum charge number, weight and minimum delay based on the preliminary blast plan.

# Attachment R
# Summary of Environmental Factors

# Summary of Environmental Factors:

**Estimated Distances from the Above-Water Explosion for the Demolition of the East Anchor Span to NMFS Underwater Sound Thresholds for Physiological Impacts on Sturgeon**

| Water Depth (meters)* | Estimated Distances (meters) to NMFS Physiological Impact Thresholds | |
|---|---|---|
| | **206 dB re 1 µPa SPL peak** | **187 dB re 1 µPa$^2$-s cSEL** |
| 4.6 | <12.5 | 22 |
| 18 | <50 | <50 |

*River depths evaluated by range of depths within vicinity of East Anchor Span.

**Table of Estimated Distances from the Above-Water Explosion for the Demolition of the East Anchor Span to Various Peak Pressures**

| Peak Pressure (pounds per square inch [psi]) | Radial Distance from Blast (feet) |
|---|---|
| 145 | at surface |
| 95 | 5 |
| 81.2 | 7.4 |
| 76[a] | 8.5 |
| 55.5 | 15 (bottom) |
| 40 | 24 |
| 34.2 | 30 (bottom) |

[a] The distance to where pressure from the blast could cause injury based on a pressure of 75.6 psi.

**Estimated Take: Number of Fish Exposed to Impacts**

| | **Atlantic Sturgeon** | **Shortnose Sturgeon** |
|---|---|---|
| Probability of Fish Occurring in the Impact Area During the Blast (Product of the Fish Presence, Blast Duration, Spatial Extent probabilities) | 0.0000042 | 0.0000006 |
| Estimated number of fish present | 42 | 65 |
| Estimated Number of fish exposed to impacts | 0.0002 | 0.00004 |

# NYSTA

# Attachment S

# Environmental Monitoring during the Controlled Blasting Event

**Environmental Monitoring during the Controlled Blasting Event**

NYSTA will conduct monitoring during controlled demolition of the East Anchor Span. Monitoring will include the use of acoustic telemetry, vessel transect monitoring and underwater noise monitoring as described below. The purpose of the monitoring is to

a. determine if any acoustic-tagged sturgeon are present immediately before the event;
b. validate the distances to the sound pressure levels (decibel (dB) and pounds per square inch (psi)) predicted by acoustic modeling and used to estimate the spatial extent of underwater acoustic impacts and incidental take of sturgeon; and

**1. Acoustic telemetry monitoring**

Monitoring will include the use of acoustic telemetry prior to the demolition event. The purpose of the monitoring is to determine if any acoustic-tagged sturgeon are present immediately before demolition.

A telemetry receiver will be used to listen for acoustic-tagged sturgeon in the Hudson River in the vicinity of the Span on the morning of the demolition event. The monitoring vessel will be positioned in the navigation channel within approximately 300 meters (1,000 feet) of the East Anchor Span and the receiver will be deployed over the side of the vessel. Acoustic monitoring for sturgeon will continue until the closure of the exclusion zone, which will occur 2 to 3 hours prior to the event. At that time, the monitoring vessel will be repositioned down-current of the Span and outside of the exclusion zone in preparation for post-demolition transect monitoring. While at this location, sturgeon detection data collected by the receiver will be examined to determine if any acoustic-tagged sturgeon are currently present within the detection area of the receiver, which would encompass a portion of the navigation channel immediately to the west of the Span. NYSTA will advise FHWA of any acoustic-tagged sturgeon detected during that monitoring.

**2. Vessel transect monitoring**

Following the blasting event, NYSTA will run vessel transects 8 miles upriver and 8 miles downriver of the Span to look for any injured or dead sturgeon. The extent of this monitoring area was delineated based on the results of a two-year drift study that tracked drifting sturgeon carcasses released at the Tappan Zee Bridge. The results of that study (*January 3, 2018 Executive Summary – Sturgeon Carcass Drift Study*[1]), demonstrated that all of carcasses were located within 8 miles of the bridge during the initial 24-hour tracking period. The monitoring vessel will conduct zig-zag transects back and forth across the river, as well as a centerline transect through the navigation channel and shoreline transects along the east and west sides of the river. Monitoring will continue until dusk or until low light conditions prevent effective observation of sturgeon. A final sweep of the monitoring area will be conducted the following day to ensure that any observable sturgeon are collected and documented. Any dead or injured sturgeon that are found will

[1] The final report summarizing this study is currently in internal review, but will be completed by February 1, 2019.

be documented in accordance with the *Sturgeon Monitoring Plan for the New NY Bridge Project at the Tappan Zee, Revision 2, dated September 8, 2017* and will be reported immediately to FHWA. If necessary, dead sturgeon will be transported to Cornell University for necropsy to determine if the mortality was associated with the demolition event. Non-sturgeon fish species observed either injured or dead during this monitoring will be identified and recorded as well.

### 3. Underwater noise monitoring

TZC will conduct underwater noise monitoring during demolition of the Span to validate the distances to the sound pressure levels described in the Biological Evaluation: decibel (dB) and pounds per square inch (psi) predicted by acoustic modeling and used to estimate the spatial extent of underwater acoustic impacts and incidental take of sturgeon. Prior to the blasting event, TZC will deploy instrumentation suitable for measuring/recording underwater peak sound pressure level (dB SPL re: 1µPa and psi) and cumulative sound exposure level (dB cSEL re: $1\mu Pa^2 \cdot sec$) produced as a result of the blast. At least two monitoring instruments will be deployed to provide redundancy in the event of instrument failure. Monitoring instruments will be placed at the appropriate distance (e.g., 50 meters) from the East Anchor Span to determine if the biological thresholds have been exceeded at the distances estimated in Table 3 of the *Biological Evaluation of East Anchor Span Demolition for the Existing Tappan Zee Bridge, Revision 0*, dated November 20, 2018 (see below). However, this monitoring will not provide the specific distance to the thresholds. dB levels will be measured as unweighted (Z-weighted) levels. Peak pressure level (psi) will be calculated using the measured SPL to determine if underwater pressure levels exceed 75.6 psi. TZC will provide the raw signal data and appropriate calibration information for each instrument.

**Table 3. Estimated Distances from the Above-Water Explosion for the Demolition of the East Anchor Span to NMFS Underwater Sound Thresholds for Physiological Impacts on Sturgeon**

| Water Depth (meters)* | Estimated Distances (meters) to NMFS Physiological Impact Thresholds | |
|---|---|---|
| | 206 dB re 1 µPa SPL peak | 187 dB re 1 $\mu Pa^2$-s cSEL |
| 4.6 | <12.5 | 22 |
| 18 | <50 | <50 |

*River depths evaluated by range of depths within vicinity of East Anchor Span.

# NYSTA

# Attachment T

# TZC's Plan for the use of Scare Charges during the January 2019 Demolition of the Anchor Span

## TZC’s Plan for the use of Scare Charges during the January 2019 Demolition of the Anchor Span
## January 2, 2019

As requested by NOAA-NMFS, TZC will provide in-water scare/warning charges to scare fish away before the structure actually falls.

There will be three scare charges; these charges will escalate from 3 grams Net Explosives Weight (NEW) to 5 grams NEW and 7 grams NEW. The charges will consist of 18-grain detonation cord. See Table below for TNT equivalency of PETN (Det cord explosive material)

<table>
<tr><th>Net Explosive Weight of PETN Det Cord Scare Charge (g)</th><th>TNT Equivalency of PETN</th><th>TNT equivalceny weight of individual scare charge (g)</th><th>USACE 2009 EFH Scare charge TNT Equivalent weight max</th></tr>
<tr><td>3</td><td>1.24</td><td>3.72</td><td>.1 lb or 45.36 g</td></tr>
<tr><td>5</td><td>1.24</td><td>6.2</td><td>.1 lb or 45.36 g</td></tr>
<tr><td>7</td><td>1.24</td><td>8.68</td><td>.1 lb or 45.36 g</td></tr>
<tr><td colspan="4">Each individual scare charge is well under the 0.1lb individual charge maximum referenced in USACE 2009 EFH project.</td></tr>
<tr><td colspan="4">TNT equivalency data for PETN: https://en.wikipedia.org/wiki/Pentaerythritol_tetranitrate</td></tr>
<tr><td colspan="4">Weights of each charge from Preliminary Blast Plan</td></tr>
</table>

The charges will be provided in the water, beneath the span and will be detonated approximately 15-20 seconds prior to the main blast.