

# **APPENDIX I**

## **Lackawanna Cut-Off Restoration – Passenger Rail Study**

### **UNDERWATER INSPECTION REPORT**

**Underwater Inspection of  
Delaware River Viaduct over Delaware River  
October 10, 2019  
For  
Pennsylvania Northeast Regional Rail Authority  
(PNRRA) and The Lackawanna County Planning  
Commission**



*(South Elevation of Bridge)*

**By  
GPI/Greenman-Pedersen, Inc.**

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## General Data

### Structure Location and Data Information

Facility:	Delaware River Viaduct
Feature:	Delaware River
County:	Lackawanna County
GPS Coordinates	Latitude: 40 Deg 56 Min 15.72 Sec Longitude: 75 Deg 06 Min 21.63 Sec

### Substructure Data - General Information

Superstructure Type:	Concrete Spandrel Arch
Total Overall Length:	1480 ft.
Piers:	Concrete Piers founded on concrete footings

## Inspection Information

### Crew and Equipment Information

Team Leader-Diver:	Eric Thorkildsen, P.E.
Inspection Team:	Michael Nitchman Maxwell Faulkner
Type of Equipment Used:	Commercial Scuba

### Inspection Information

Date of Inspection:	October 10, 2019
Water Temperature:	65 Degrees F
Waterway Velocity (Current):	5 ft./sec. flow from north to south at time of inspection.
Depth Turbidity (Visibility):	Approximately 10 feet
Channel Bottom Material:	River rock / cobbles and gravel over bedrock
Scour Countermeasures:	N/A
Extent of Marine Growth:	Light algae growth.
Substructures Inspected:	Piers 3 (west), 4 (center) and 5 (east).
Water Elevation Datum:	Measured to top of downstream ledge of Pier 3 (see photo 10).
Water Surface Elevation:	Approximately 13.6' feet below datum location to WSE.

## **Description of Structure**

The Delaware River Viaduct is an inactive railroad bridge over the Delaware River just north of Portland, Pennsylvania along Slateford Rd. The viaduct is a nine-span concrete spandrel arch structure with concrete piers founded on concrete footings. The river piers are constructed out of concrete with masonry stone armoring on the front nose. The concrete footings supporting the piers generally follow the outline of the pier with an enlarged measured width of between 1' and 4.5' horizontally off the pier face. The piers do not appear to be reinforced with steel. Pier 3 (west), Pier 4 (center) and Pier 5 (east) are located within the Delaware River waterway during normal flow conditions. See Photograph 1. The other piers and abutments are located out of the waterway. Plans were not available to indicate the original bridge construction. Delaware River is relatively shallow along this section of the river but flows from north to south in the direct vicinity of the bridge.

## **Inspection Operations**

The underwater inspection was performed by Greenman-Pedersen Inc. on October 10, 2019. As there are no known previous underwater inspection reports, this inspection performed appears to be the initial underwater inspection in its history. The underwater inspection was performed utilizing a qualified dive team, including a professional engineer (PA and NJ). All operations were governed by the OSHA regulations for Commercial Diving – 29 CFR Part 1910 Subpart T. The inspection focused on the submerged elements of the pier up to indications of a high-water mark utilizing 100% Level I (visual/tactile) and a 10% Level II (cleaning of select areas) inspection techniques. All soundings were referenced to a common datum. Soundings were taken where the current allowed around the piers using a survey rod. Soundings taken along the bridge facia were not possible due to high current flow. All substructure units inspected that were submerged are labeled from rear (West) to forward (East) abutment, Pier 3 (West), Pier 4 (Center) and Pier 5 (East). Piers 1, 2, 6 and 7 were not inspected during this underwater inspection. At the time of inspection, Piers 1, 2, 6, 7 and both abutments were located outside of the waterway within dry areas. Due to difficulty in directly accessing and transferring equipment to Piers 4 and 5 from the shore adjacent to Pier 3, the inspection was performed using a 14' workboat, launched at a public boat launch facility Kittatinny Point Visitor Center accessible from Interstate 80 Southbound, approximately 2.75 miles to the north of the bridge.

## Inspection Observations

### General Comments

- The piers all have scaling due to abrasion from water and ice flow from the water line up about 10'. Concrete aggregate is exposed typically with ½" to 1" loss of mortar up to 2" penetration (Photograph 12). There was slightly less scaling underwater than above. (Photograph 17) All piers had exposed vertical faces of the supporting footing from 6" up to almost 7'. There was no undermining found, very little spalling and other defects. The concrete appeared to be in generally good condition for the age of the structure. The armoring of the upstream noses with stone masonry exhibited loss of mortar in between the stone layers. (Photograph 22)

### Pier 3 (West Pier)

- Significant crack in concrete larger than 2" in width (Photograph 11) near the downstream west face that continued and surfaced on the back downstream pier nose. Hammer sounding indicated that entire section of concrete to be delaminated from the rest of the pier.
- On the west face near the upstream nose on the footing top there was a steel grate embedded in the top of the footing 18" wide by 20' long. (Photograph 23)
- On the west face near the middle of the pier there were several vertical cracks less than ¼" wide and deemed nonstructural.

### Pier 4 (Center Pier)

- Pier had the most vertical exposure of the footing at close to 7' but there was no undermining found.
- The concrete appeared to be in good condition.
- There was a large log and miscellaneous debris on the upstream nose. This debris can cause constricted flow and lead to local scour around the pier and should be removed when able. (Photograph 13)

### Pier 5 (East Pier)

- Pier exhibited concrete deterioration a bit more extensive than the other two piers, most likely since the pier and footing had less water surrounding it and thereby exposed to weather.
- The west side of the front nose footing on the vertical face had a spall that extended 7' long, 1' high with a 1' penetration into the footing.
- Around the pier there was evidence of aggregation which means soil has been deposited during periods of high-water flow and is causing areas of high elevation (small islands) which can constrict water flow and potentially increase the chances of scour. (Photograph 20)

## **Inspection Observations Continued**

### **Channel/Waterway**

- The channel bottom consisted of gravel, cobbles and small boulders. The channel bottom was deeper than average at the upstream nose of the piers on the faces with high velocity water flow, but these did not appear to indicate a local scour hole. The channel bottom did not appear to be made up of scourable material.
- At the time of inspection, the waterway was flowing primarily through Span 5, between the inner faces of Piers 3 and 4.

## **Comparison to Previous Report and Summary of Inspection**

No previous underwater reports are available for comparison of conditions noted during the inspection. The condition of the underwater portion of the elements inspected is fair. The condition of the channel is good but there is some evidence of aggregation which in the future can restrict channel flow, increase flow velocity and potentially cause scour around the foundations. Timber debris should be removed to allow unmitigated water flow. The maximum height of footing exposure reached about 7' where channel flow was greatest. There was no evidence of undermining of the footing. It would be advantageous to find as-built plans of the bridge or determine the footing depth to see when a critical condition might occur.

## **Conclusions and Recommendations**

The portions of the substructure inspected underwater appear to be in fair condition with no undermining or major deterioration. Water flow has abraded the concrete causing scaling and exposed concrete aggregate which does not affect structural capacity.

The concrete pier walls had areas of small cracks that should be repaired to prevent entrance of water that could freeze and spall the concrete. Some of the cracks are horizontal and appear to be construction joints. There was a wide crack on the downstream end of Pier 3 that should be repaired as a large section of concrete has delaminated. It is unclear if the load carrying capacity of the pier has been reduced due to this crack and should be investigated through structural analysis. The mortar between masonry blocks should be repaired with vegetation removed.

It is recommended that the submerged substructure units be inspected at the normal maximum recommended interval of five (5) years per National Bridge Inspection Standards or after a significant event such as flood, impact or other phenomenon that could affect the structural integrity of the bridge.

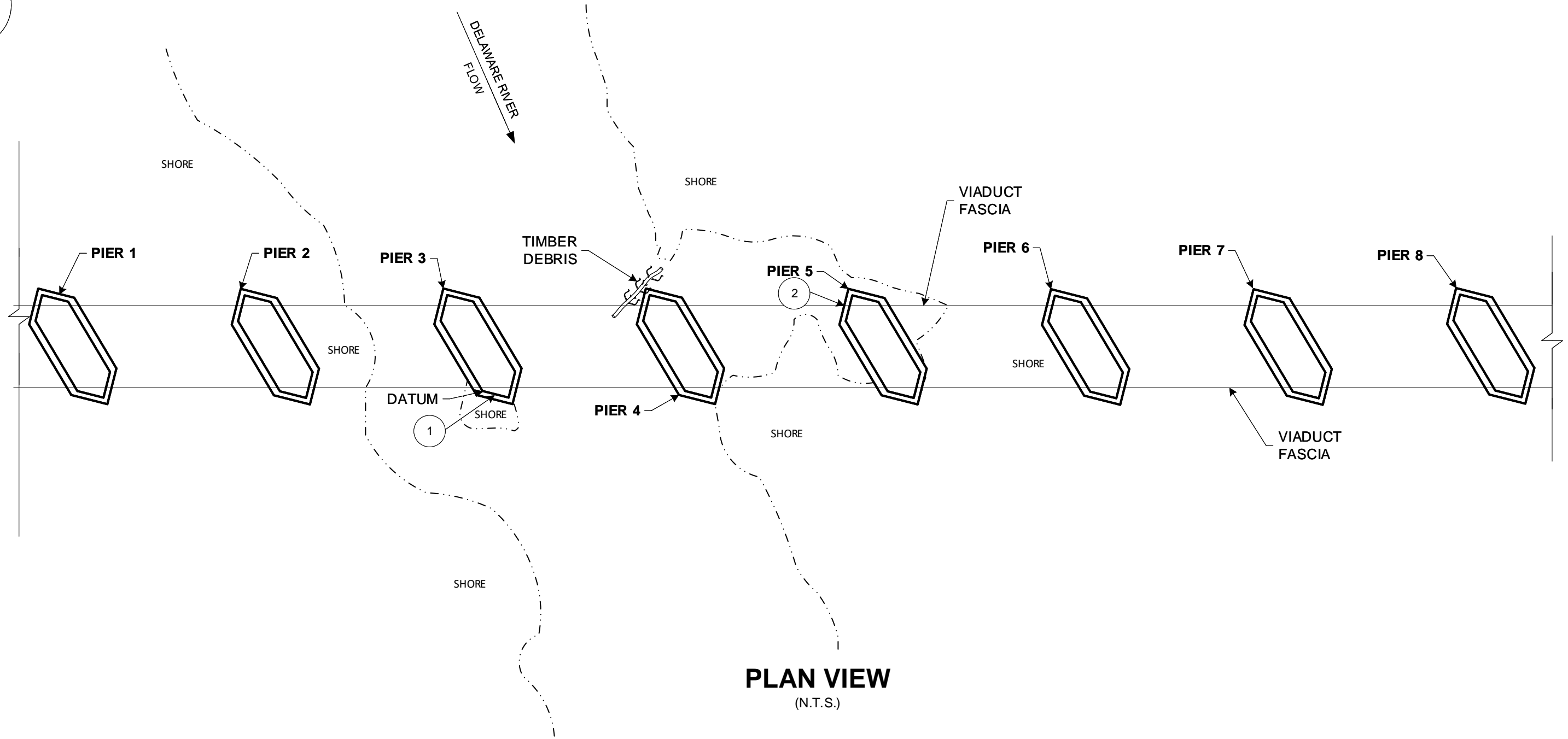
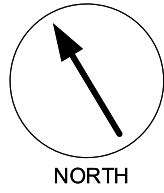
**GPI/Greenman-Pedersen, Inc.**



# **Attachment A**

## **Location Map and Sketches**

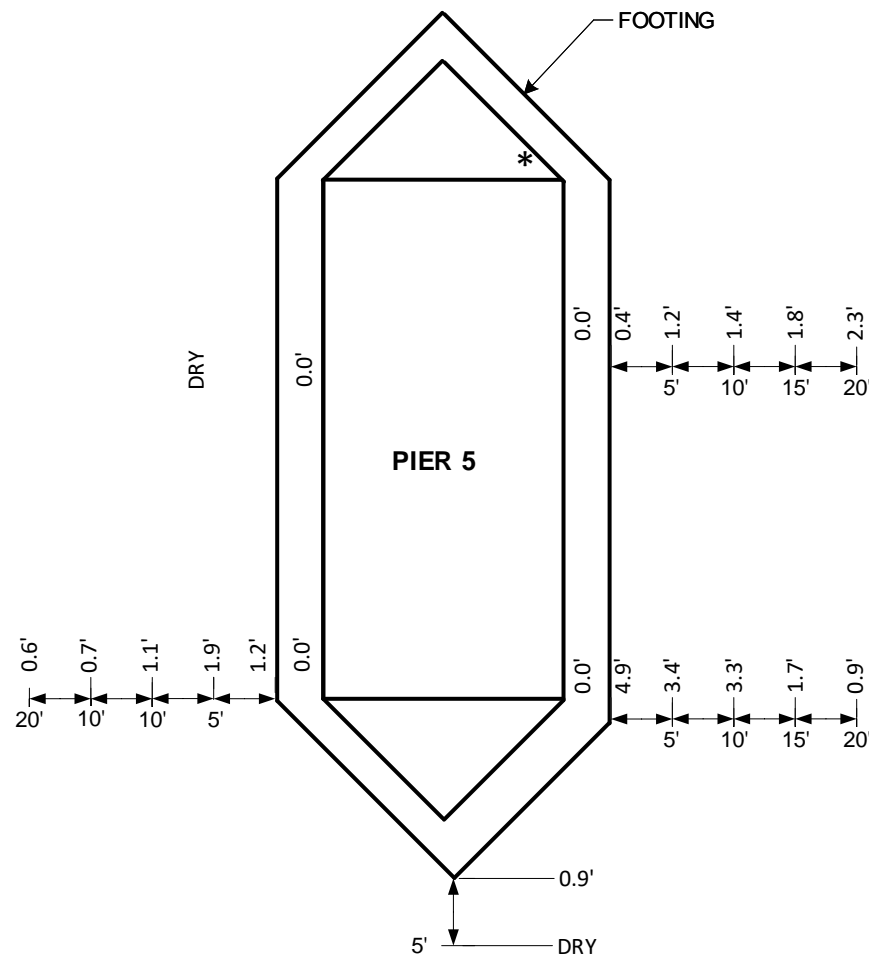
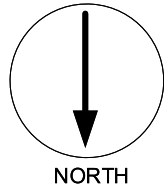




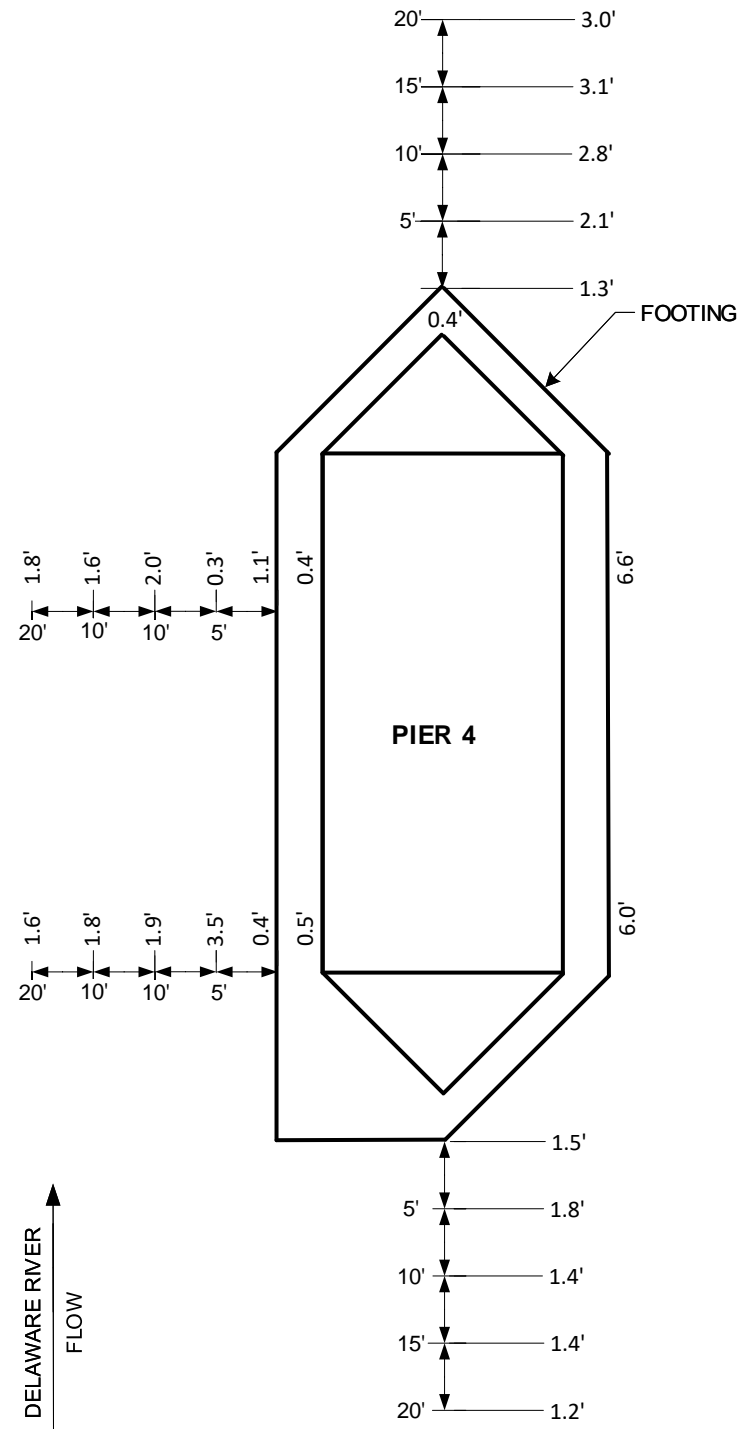
**Notes:**

1. Structural crack up to 2" W x 12' H. Crack continues through end of pier causing the entire section to be delaminated from pier.
2. Spall that extended 7' long, 1' high with a 1' penetration into the footing.

<b>GPI</b> Greenman-Pedersen, Inc. Engineering and Construction Services	<b>PLAN VIEW</b>
	DELAWARE RIVER VIADUCT OVER DELAWARE RIVER LACKAWANNA COUNTY

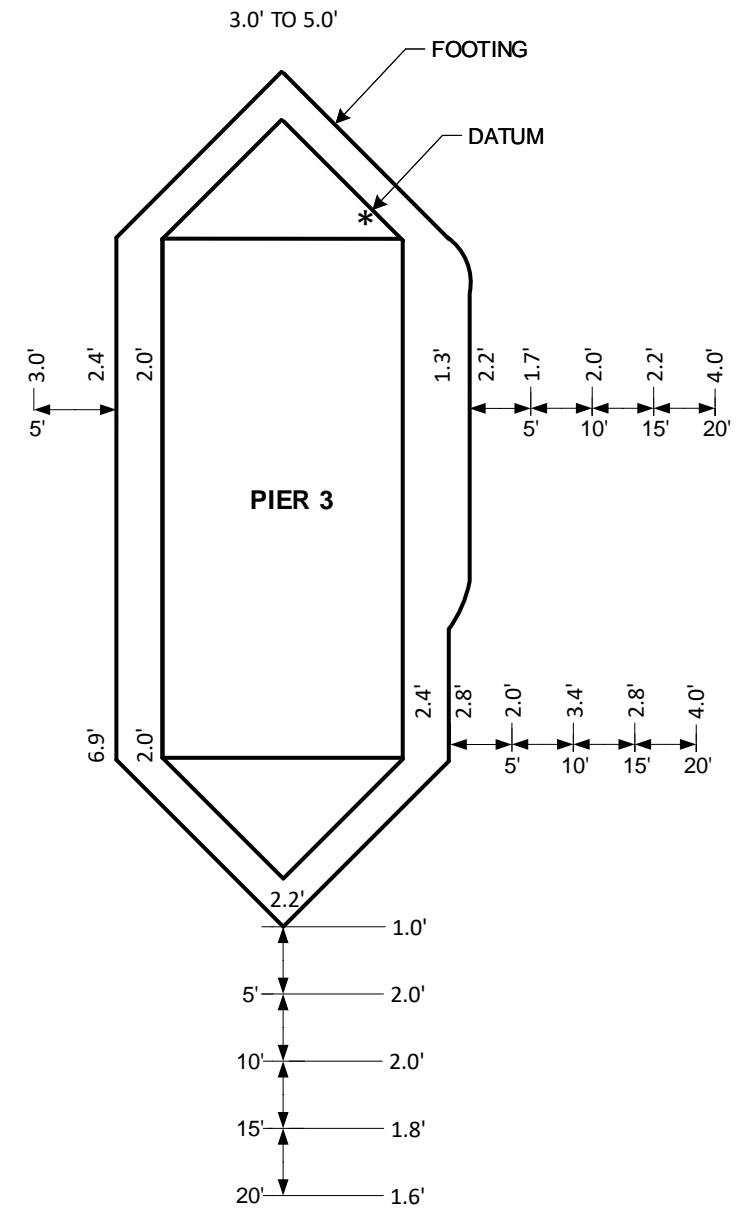


**PIER 5 SOUNDINGS**  
(N.T.S.)



**PIER 4 SOUNDINGS**  
(N.T.S.)

**CURRENT  
TOO STRONG  
TO OBTAIN  
SOUNDINGS**



**PIER 3 SOUNDINGS**  
(N.T.S.)

**Legend**  
WATER DEPTH IN FEET/CHANNEL 2.0'  
DATUM \*

**Notes:**  
1. WATER LINE REFERENCE ELEVATION TAKEN FROM TOP OF DOWNSTREAM LEDGE OF PIER 3. ON OCTOBER 10, 2019 THIS DISTANCE WAS 13.6 FEET.

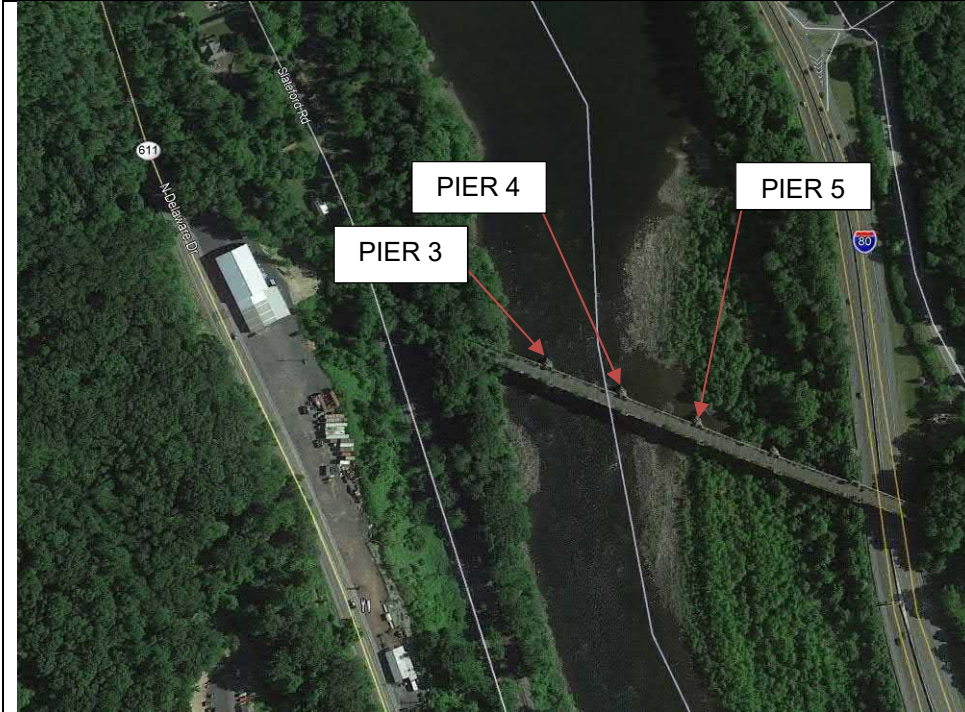
**SOUNDING PLAN**

**GPI**  
Greenman-Pedersen, Inc.  
Engineering and Construction Services

**DELAWARE RIVER VIADUCT  
OVER DELAWARE RIVER  
LACKAWANNA COUNTY**

# **Attachment B**

## **Photographs**



Photograph 1

Location of piers inspected.



Photograph 2

View of the North /  
Upstream Elevation,  
Looking South



Photograph 3  
View of the South /  
Downstream Elevation,  
Looking North



Photograph 4  
Overall View of the  
North / Upstream  
Channel, Looking North



Photograph 5

Overall View of the South / Downstream Channel, Looking South



Photograph 6

View of Pier 3 West Elevation.





Photograph 7  
View of Pier 3 East  
Elevation



Photograph 8  
View of Pier 3  
Downstream nose



Photograph 9

View of Pier 3 Upstream nose



Photograph 10

View of Datum (13.6') location on Pier 3 West Elevation



Photograph 11  
Structural Crack Pier 3  
West elevation. 2" wide  
full penetration to back  
side of pier wall  
downstream



Photograph 12  
View of Pier 4, scaling up  
to 2" penetration above  
water. Typical of all piers.



Photograph 13  
View of Pier 4 Upstream  
nose with timber debris



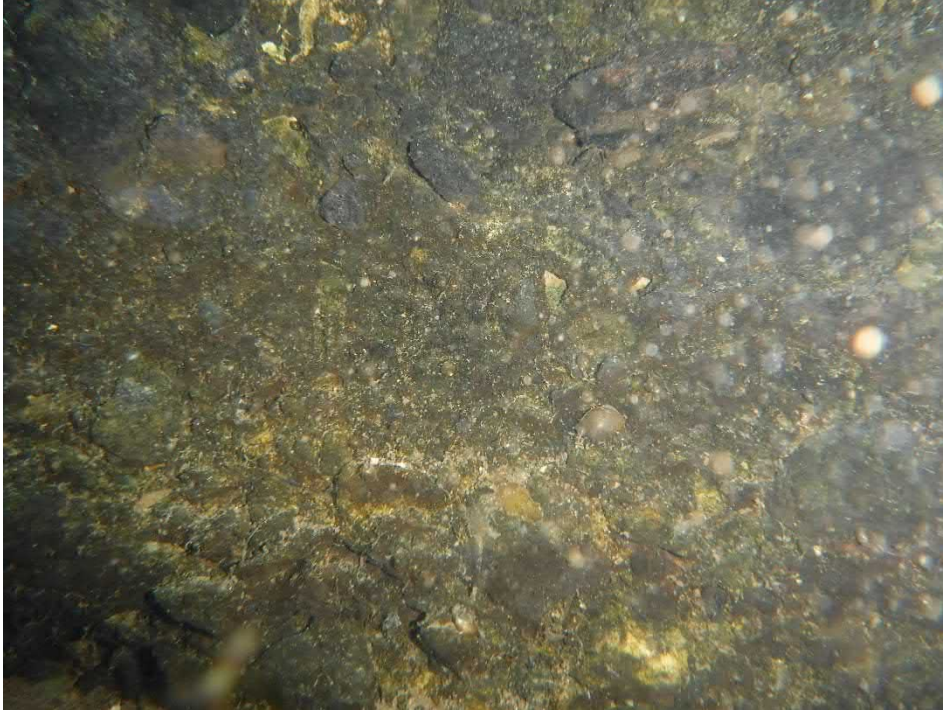
Photograph 14  
View of Pier 4  
Downstream nose



Photograph 15  
View of Pier 4 West  
Elevation.



Photograph 16  
View of Pier 4 East  
Elevation.



Photograph 17

View of Pier 4, scaling up to 1" penetration underwater. Typical of all piers.



Photograph 18

View of Pier 5  
Downstream nose



Photograph 19  
View of Pier 5 Upstream  
nose



Photograph 20  
View of of Pier 5 East  
Elevation.



Photograph 21

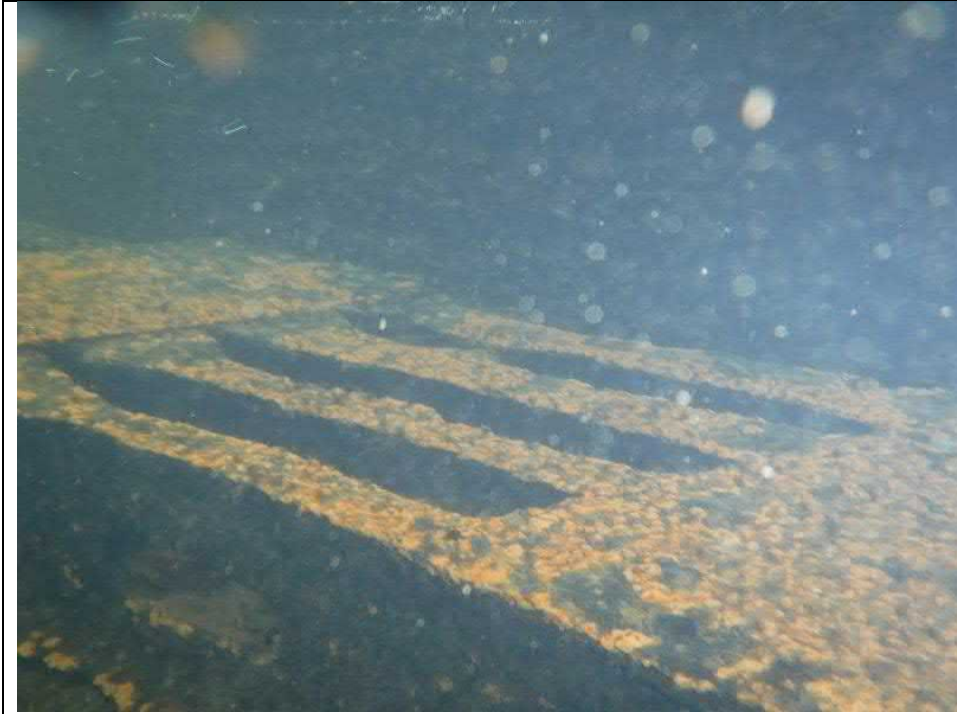
View of Pier 5 West  
Elevation.



Photograph 22

View of typical pointing  
missing from Masonry  
blocks





Photograph 23

View of steel grate  
embedded in top of  
footer of Pier 3 West  
face.