NPS Form 10-900
(Oct. 1990)

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INTERAGENCY RESOURCES DIVISION
NATIONAL PARK SERVICE

OMB No. 10024-0018

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations for individual properties and districts. See instructions in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials, and areas of significance, enter only categories and subcategories from the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name Tacoma Narrows Bridge

other names/site number

2. Location

street & number Spanning the Tacoma Narrows ☐ not for publication

city or town Tacoma ☐ vicinity

state Washington code WA county Pierce code 053 zip code

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I hereby certify that this ☒ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☒ meets ☐ does not meet the National Register criteria. I recommend that this property be considered significant ☒ nationally ☐ statewide ☐ locally. (☐ See continuation sheet for additional comments.)

Mary M. Thompson

Signature of certifying official/Title Date

State of Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. (☐ See continuation sheet for additional comments.)

Signature of certifying official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that the property is: Signature of the Keeper Date of Action

☐ entered in the National Register.
☐ See continuation sheet.

☐ determined eligible for the National Register
☐ See continuation sheet.

☐ determined not eligible for the National Register.

☐ removed from the National Register.

☐ other, (explain:)

Tacoma Narrows Bridge
Name of Property

Pierce Co., WA
County and State

5. Classification

Ownership of Property
(Check as many boxes as apply)

- ☐ private
- ☐ public-local
- ☒ public-State
- ☐ public-Federal

Category of Property
(Check only one box)

- ☐ building(s)
- ☐ district
- ☐ site
- ☒ structure
- ☐ object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
		buildings
		sites
1		structures
		objects
1		Total

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing.)

Bridges and Tunnels of Washington State

Number of contributing resources previously listed in the National Register

none

6. Function or Use

Historic Functions
(Enter categories from instructions)

TRANSPORTATION: road-related (vehicular)

Current Functions
(Enter categories from instructions)

TRANSPORTATION: road-related (vehicular)

7. Description

Architectural Classification
(Enter categories from instructions)

Suspension bridge

Materials
(Enter categories from instructions)

foundation concrete

walls

roof

other metal cables

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets.)

8. Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

☒ **A** Property is associated with events that have made a significant contribution to the broad patterns of our history.

☒ **B** Property is associated with the lives of persons significant in our past.

☒ **C** Property embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

☐ **D** Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria Considerations
(Mark "x" in all the boxes that apply.)

Property is:

☐ **A** owned by a religious institution or used for religious purposes.

☐ **B** removed from its original location.

☐ **C** a birthplace or grave.

☐ **D** a cemetery.

☐ **E** a reconstructed building, object, or structure.

☐ **F** a commemorative property.

☒ **G** less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

Bridge engineering
Transportation

Period of Significance

1950-1960

Significant Dates

1950

Significant Person
(Complete if Criterion B is marked above)

Charles E. Andrew; W.A. Bugge; F.B. Farquharsc

Cultural Affiliation

Architect/Builder

Bethlehem Pacific Coast Steel Corp.
John A. Roeblings Sons Co.

Narrative Statement of Significance
(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographical References

Bibilography
(Cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS):

☐ preliminary determination of individual listing (36 CFR 67) has been requested
☐ previously listed in the National Register
☐ previously determined eligible by the National Register
☐ designated a National Historic Landmark
☐ recorded by Historic American Buildings Survey # ______
☐ recorded by Historic American Engineering Record # ______

Primary location of additional data:

☐ State Historic Preservation Office
☒ Other State agency
☐ Federal agency
☐ Local government
☐ University
☐ Other

Name of repository:
WA State Dept. of Transportation

Tacoma Narrows Bridge
Name of Property

Pierce Co., WA
County and State

10. Geographical Data

Acreage of Property ca. 15 acres

UTM References
(Place additional UTM references on a continuation sheet.)

	Zone	Easting	Northing	
1	10	534730	5234160	south end
2	10	533420	5233690	north end
3				
4				

☐ See continuation sheet

Verbal Boundary Description
(Describe the boundaries of the property on a continuation sheet.)

Boundary Justification
(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Robert H. Krier, retired WSDOT Bridge Engineer; edited by Craig Holstine, historian

organization Archaeological & Historical Services date May 1993
Eastern Washington University

street & number Monroe Hall, Room 313, M.S. 168 telephone (509) 359-2239

city or town Cheney state WA zip code 99004

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps

A **USGS map** (7.5 or 15 minute series) indicating the property's location.

A **Sketch map** for historic districts and properties having large acreage or numerous resources.

Photographs

Representative **black and white photographs** of the property.

Additional items
(Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of SHPO or FPO.)

name Washington State Department of Transportation

street & number Highway Transportation Building telephone 206-705-7480

city or town Olympia state WA zip code 98504

Tacoma Narrows Bridge
Pierce County, WA

Description

As one of the longest suspension bridges of its type in the United States, the Tacoma Narrows Bridge spans a swift-moving body of tidal water located in southern Puget Sound. Its length of over one mile gracefully connects the City of Tacoma and surrounding areas with the Kitsap Peninsula and, via highways and a floating bridge to the north, with the more distant Olympic Peninsula.

The nominated property includes the entire bridge assembly, as well as all accessory features that were part of the 1950 design: the bridge structure, the two-story concrete North and South buildings, the concrete stairways and railings, the sidewalk at the upper level, and the roadway, paths and plantings areas at the lower level. The original toll booths and toll plaza were later removed, although the toll houses remain at the south end of the bridge.

Starting from the west end, the bridge consists of a 164-foot-long concrete anchor block and gallery; three 150-foot-long steel plate girder approach spans; a 1,100-foot-long steel suspended side span; the 2,800 foot center suspension span; a 1,100 foot suspended side span; four east approach spans consisting of concrete tee-beams with spans 47 feet 7 inches, 42 feet 5 inches, 45 feet, and 45 feet; and an anchor block and gallery 185 feet long. The suspension cables are 60 feet center to center. The sides or stiffening trusses are 33 feet in depth and, at the time of construction, were deeper than those on any other known suspension bridge. The principal geometrics of the bridge consist of the following:

Total structure length	5,979 feet
Suspension bridge	5,000 feet
Center suspension span	2,800 feet
Shore suspension spans (2), each	1,100 feet
East approach and anchorage	365 feet
West approach and anchorage	614 feet
Center span height above water	187.5 feet
Width of roadway	49 feet 10 inches
Width of sidewalks (2), each	3 feet 10 inches
Diameter of suspension cables	20¼ inches
Weight of suspension cables	5,441 tons
Total length of single wire	20,000 miles
Suspended weight sustained by cables (in excess of)	18,160 tons
Number of No. 6 wires, each cable	8,705
Shore anchors for cables, weight	66,000 tons

Tacoma Narrows Bridge
Pierce County, WA

Description (continued)

Towers

Height above piers	467 feet
Weight of each tower	2,675 tons

Piers on Which Towers Rest

Area	118 feet 11 inches by 65 feet 11 inches
Total height of east pier	265 feet
Depth of water, east pier	135 feet
East pier penetration at bottom	90 feet
Total height of west pier	215 feet
Depth of water, west pier	120 feet
West pier penetration at bottom	55 feet

Every reasonable precaution was taken to stabilize the structure and insure against any possibility of noticeable motion. One of those precautions, and a feature unique to this bridge, is in the design of the roadway deck. Open steel grid slots were installed between each of the four traffic lanes and at both curbs. These open steel gratings function as vents to relieve the alternating up and down impulses which are a principal factor in causing oscillation created by the passing wind. The gratings are bonded to the concrete so as to preserve slab continuity across the full roadway. The use of these slots was found in tests to be a most effective method of reducing the forces which cause oscillation and, consequently, constitute a large factor in stabilizing the structure.

Another precaution against torsional motion is that the ratio of the depth of stiffening truss to span length is greater than normally used in suspension bridges. Also, the trusses are provided with a double lateral system. In nearly all suspension bridges of that era, only one lateral system of horizontal bracing was used to connect the bottom chords of the trusses. In this bridge horizontal bracing is installed between both the top and bottom chords of the stiffening

Tacoma Narrows Bridge
Pierce County, WA

Description (continued)

trusses. These features greatly increase the resistance of the suspended structure to the torsional or twisting motion that occurred in the original structure.

A third precautionary and unique design feature was the installation of double acting hydraulic jacks that function in much the same manner as shock absorbers in an automobile. These members act as energy absorbing devices and provide a damping effect in the event the bridge should begin to oscillate and cause differential horizontal movement between the cables and the truss. These devices are located in a longitudinal, diagonal position at the center of the main span on each side and connect the main cables to the top chords of the stiffening trusses. Additional jacks are installed in the tower legs connecting the top chords of the main span to the top chords of the side spans, which are then rigidly connected to the anchorages. Beneath the bottom chords adjacent to the main towers (Nos. 4 & 5) are diagonal jacks connecting the bottom chords to the towers to complete the couple with the top chord jacks. This system of energy absorption provides added protection against the possibility of oscillation from excessive wind forces.

The two main channel piers (Nos. 4 & 5) were undamaged during the failure of the original bridge and were used to support the second bridge with only minor modifications to the concrete pedestals under the new steel tower legs. The original construction of Pier 5 was one of the most difficult ever attempted, establishing a world record for depth of water in which a caisson had ever been landed. Water depth, along with tidal currents of nine miles per hour at the site, required extreme caution and ingenuity on the part of the engineers and contractors. Thirty concrete anchors, each weighing approximately 600 tons and connected to the caisson with 90 one-inch diameter wire cables, were required to hold the caisson against the current. At times the level of water at one end of the caisson would be seven to eight feet higher than at the other. Holding construction barges alongside the caisson was extremely difficult. Steel cutting edges were attached to the bottom of the caisson. After the caisson was lowered to the bottom of the channel in 135 feet of water, the cutting edges assisted in penetrating through 90 feet of sand, gravel, and boulders where the bottom of the caisson was finally positioned at a depth of 225 feet below mean low tide.

Tacoma Narrows Bridge
Pierce County, WA

Description (continued)

Light weight concrete was used in the roadway deck of the second (present) bridge to lessen the load on the piers. However, the total superstructure weight of the second bridge exceeded the first bridge by approximately 1.6 times per lineal foot. The designers determined that this additional weight would not cause excessive overloading of the foundations. The original anchor blocks were also used in the second bridge, but had to be modified substantially due to the greater weight of the superstructure. This weight increased the horizontal force in the main cables from the original 28 million pounds to 36 million pounds. In addition, the new cables were spaced 60 feet apart compared to the original 39 feet. The concrete anchorage was modified by removing the sides of the anchor by blasting down to the top of the footing blocks, installing new anchor bars to attach the main cables, adding eight feet of concrete on each side, and extending the back of the anchor 20 feet to its full height. The additional width and length, in effect, provided a yolk or "U" configuration around the old concrete core that remained.

Several features were incorporated into the bridge for maintenance purposes. One leg of each of the main towers contains an elevator that travels the full height of the towers to carry personnel and supplies. Maintenance travelers powered by gasoline motor generators were attached to the underside of the steel portions of the superstructure for traveling the length of the bridge.

Statement of Significance

Summary of Significance

When completed in 1950, the Tacoma Narrows Bridge was the third longest suspension bridge in the world. Its innovative design features contributed to the body of knowledge of suspension bridge engineering. Although many longer suspension spans have been constructed since its completion, the Tacoma Narrows Bridge still remains one of the grandest structures of its type in the United States. As of 1991, it was the fifth longest suspension span in North America. Thus the bridge is significant under Criterion C as an important representative of a bridge type

Tacoma Narrows Bridge
Pierce County, WA

Statement of Significance (continued)

(suspension bridges) identified in the Multiple Property Documentation (MPD) listing "Bridges and Tunnels in Washington State" (1980) and the "Amendment to Bridges and Tunnels in Washington State" (1991). The structure is significant under Criterion A for its vital role in serving transportation needs in the Puget Sound area. The bridge is also significant under Criterion B for its association with several engineers whose reputations extended beyond the State of Washington. Although the bridge is less than fifty years old, it is of exceptional importance and thus meets the eligibility requirement of Criteria Consideration G.

Historical Background and Significance

The Tacoma Narrows Bridge is one of the world's longest suspension bridges. Spanning a deep, swift body of water called "The Narrows," where tidal flows of Puget Sound reach nine miles per hour through this nearly mile-wide passage, the bridge serves as a major transportation corridor between the City of Tacoma on the Puget Sound mainland and the Kitsap Peninsula. Prior to the construction of the bridge, the mode of transportation between these two destinations was either by ferry or by a circuitous highway route around the lower end of Puget Sound through the City of Olympia, a distance of more than 100 miles. Spanning the gap between the two land masses, the structure connects the Bremerton metropolitan area, which includes the Puget Sound Naval Shipyard, with Tacoma, and thereby plays an important role in supporting the economy of Puget Sound.

Bridging Puget Sound across the Narrows had long been a dream of both the City of Tacoma and the western region of Washington, which includes the Olympic and Kitsap peninsulas. In ca. 1923 a corporation attempted to build a bridge as a private venture at a location south of the present structure. For various reasons, principally financing, the project did not materialize. Their dream was finally, if briefly, realized with the construction by the Washington State Department of Highways of a suspension bridge, which opened to traffic on July 1, 1940. High winds in the Narrows caused excessive motion and undulations that induced violent torsional oscillations of the new structure, leading local observers to christen the bridge "Galloping Gertie." These movements created stresses in the members far in excess of what the bridge

Tacoma Narrows Bridge
Pierce County, WA

Statement of Significance (continued)

could withstand, resulting in a catastrophic collapse of the superstructure on November 7, 1940. Although such forces had not been considered at that time as critical in suspension bridge design, it was reported later that the aerodynamic effect of wind on similar structures had been demonstrated by similar failures in England 100 years before, and in truth, forgotten by all suspension bridge engineers engaged in modern design.

The high volume of traffic that used the first bridge during its short period of existence clearly demonstrated the necessity for a bridge. Undaunted by the failure, the Washington Toll Bridge Authority (no longer in existence), then headed by Governor Arthur Langlie, authorized an engineering study to determine the possibility of safely bridging the Narrows. A Board of Consulting Engineers was appointed to perform the study and provide recommendations. The Board consisted of Charles E. Andrew, Chairman; Glenn B. Woodruff; John I. Parcel of Sverdrup & Parcel; and Dr. Theodore von Karman, noted aerodynamicist of Pasadena, California.

The efforts that went into the design of the second Narrows Bridge were unique and had an important effect on the design of suspension and similar structures that were to follow. Approximately four years were spent in original research to study aerodynamics and design features to achieve stability of a new structure. The Consulting Board at the beginning of the study recognized that the question of aerodynamic stability of suspension bridges would have to be resolved to achieve a safe design. Although the development of aerodynamics in the 1940s was not unique as applied to aircraft, there had been no previous scientific effort devoted to the dynamic effect of winds passing over a bridge structure, whose geometrics are entirely different from those of an airplane wing. The studies consisted of construction of a special wind tunnel at the University of Washington and testing three-dimensional bridge models - the first time such models had ever been built. A 1:50 three-dimensional model of the original bridge was built to prove that wind velocities acting on models scaled to match the bridge's form and elastic properties would create the same motions as those actually measured and recorded in the field on the prototype. If similitude could be proven by testing the first model, then a scaled model

Tacoma Narrows Bridge
Pierce County, WA

Statement of Significance (continued)

of a proposed form of a new bridge structure would be built to predict the behavior of its prototype.

The first test proved the theory of similitude between model and prototype with almost perfect accuracy, establishing confidence in tests on other and different designs. In conducting the research, all available knowledge of aerodynamics was used as a guide. Many modifications were necessary and the tests were spread over nearly four years during the shortages of World War II, with its attendant handicaps, before the desired degree of stability was found. Methods and devices necessary to obtain the required stability were also determined. Tests were performed under the general direction of Charles E. Andrew with the approval of the Board of Consulting Engineers. Professor F.B. Farquharson of the University of Washington directed building of the wind tunnel and bridge models. Dr. Theodore von Karman supervised testing of the models in the wind tunnel. Test results formed the basis for a continuing study by a national committee comprised of many engineers in the country interested in suspension bridges.

Because of the extreme shortage of steel and wire during World War II, it was decided to salvage all remaining material from the first bridge to every extent possible. Ironically, it would have been more economical for the state to have dropped the remaining portions of the structure into the deep waters of the Puget Sound.

Designs for the new bridge were completed in 1947 and checked aerodynamically by the use of models. Contracts were let for construction on March 31 and April 1, 1948. The primary contractors for construction of the bridge were the Bethlehem Pacific Coast Steel Corporation and John A. Roeblings Sons Company. Both of these firms were notable for their innovative construction skills in the fabrication and erection of steel bridges.

The Tacoma Narrows Bridge opened to traffic on October 14, 1950; all components of the structure were finally in place by November 1951. Construction was financed through a $14,000,000 bond issue. The bridge operated as a toll facility until the bonds were retired, at which time the tolls were removed along with the toll plaza and booths (although the toll houses

Tacoma Narrows Bridge
Pierce County, WA

Statement of Significance (continued)

remain off the south end of the bridge). The toll for an automobile and driver was 50 cents. Each additional passenger paid 10 cents.

The successful building of this bridge was a combined effort of the many engineers who had a part in its design and construction; the members of the Washington Toll Bridge Authority in their support of the judgment of the engineers; members of the Washington Legislature, who passed the necessary legislation and appropriations; the residents of Tacoma, Kitsap and Pierce counties for their loyal support and financial guarantees; the contractors who risked their capital and resources to guarantee its final construction; and to organized labor, who actually put together the steel and concrete which forms the final structure.

At the time of completion, the Tacoma Narrows Bridge included the third longest suspension span in the world. As of 1991 it ranked as the fifth longest span in North America. This bridge is of major significance because of its numerous unique design features. It was the first time a research program was implemented to investigate the aerodynamic effects of wind acting upon a bridge. In designing this structure, bridge engineers first used wind tunnel tests to determine the behavior and stability of a physical model of a proposed bridge. The research and design provided significant information to suspension bridge engineers nationwide and had an important effect on all suspension bridge designs that followed. The design incorporated unique features into the structure, such as the open steel grid slots, the greater ratio of the depth of stiffening truss to span length, the double lateral system, the hydraulic energy absorbing and damping devices, and the record depth below water at which pier construction occurred with the aid of submerged caissons. Few bridges have received as much engineering significance in technical publications or as much nation-wide attention and publicity, due in part to the failure of the first Tacoma Narrows Bridge. The present structure represents an extraordinary achievement in bridge design and construction engineering, an effort that produced a structure of unprecedented function and stability, and virtually unequaled esthetic attraction spanning one of the country's most challenging crossings. In addition, the bridge established one of the most significant transportation corridors in Washington state by connecting the mainland with the Kitsap and Olympic peninsulas.

Tacoma Narrows Bridge
Pierce County, WA

Statement of Significance (continued)

Significant Persons Associated with the Tacoma Narrows Bridge

The Tacoma Narrows Bridge meets the eligibility requirements under Criterion B due to its association with bridge engineers renowned in their profession. Charles E. Andrew, Principal Engineer in charge of the design and construction of the bridge, was a renowned engineer for his unique and creative bridge designs. He was highly regarded in the engineering profession for his ability to undertake projects that were unique, or of major size and construction difficulty. Other projects that were designed and constructed under his direction included the San Francisco-Oakland Bay Bridge, the Lacey V. Murrow, Evergreen Point, and the Hood Canal floating concrete bridges. Another engineer who achieved outstanding recognition for his contributions to the field of transportation was W.A. Bugge, Director of the Department of Highways during the construction of the second Tacoma Narrows Bridge. Demonstrating outstanding abilities as both engineer and administrator, Bugge went on to play a major role in developing the Bay Area Rapid Transit (BART) tunnel under San Francisco Bay. As a result of his work on the bridge, University of Washington Professor of Engineering F.B. Farquharson received recognition for his outstanding research of the aerodynamic behavior of suspended structures.

Major Bibliographical References

Biennial Reports. State of Washington Department of Highways, Olympia, 1948-1952.

Bridge Condition Unit Files. Washington State Department of Transportation, Olympia.

Tacoma Narrows Bridge
Pierce County, WA

Major Bibliographical References (continued)

Bruce, Robin, Craig Holstine, Robert H. Krier, and J. Byron Barber. Amendment to Historic Bridges and Tunnels in Washington State. National Register of Historic Places Multiple Property Documentation Form. Archaeological and Historical Services, Eastern Washington University, Cheney, Washington, 1991.

Gotchy, Joe. "Bridging the Narrows: A Reminiscence." *Columbia Magazine* Fall 1990:14-17.

Soderberg, Lisa. Historic Bridges and Tunnels of Washington State. National Register of Historic Places Nomination. On file, Office of Archaeology and Historic Preservation, Olympia.

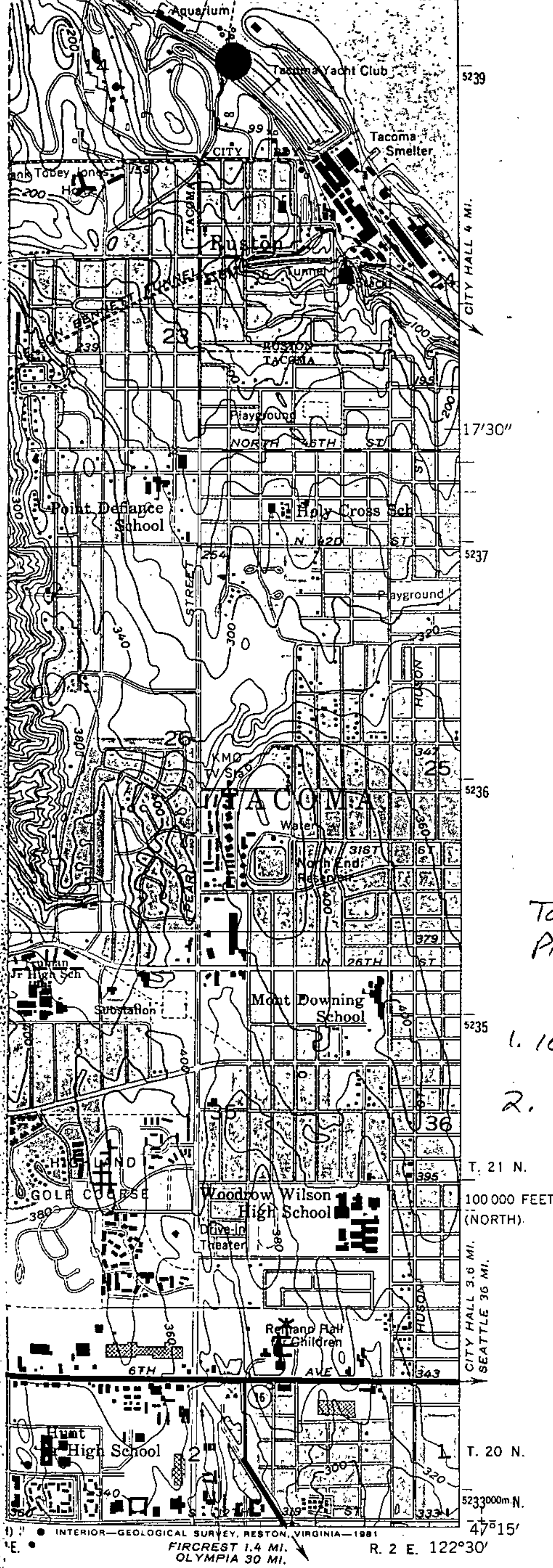
Tacoma Narrows Bridge Brochure. Washington Toll Bridge Authority, Olympia, no date (ca. 1953). On file, Washington State Department of Transportation, Olympia.

Verbal Boundary Description

The boundary encompasses all elements of the bridge structure, and includes the approaches, North and South buildings, concrete stairways and railings, sidewalks, roadway, paths and associated plantings.

Boundary Justification

The boundary is based on the bridge and all associated elements that were part of the original 1950 design.



Tacoma Narrows Bridge
Pierce County, WA
UTM References:
1. 10/534730/5234160
2. 10/533420/523690

ROAD CLASSIFICATION

TACOMA NARROWS BRIDGE
PIERCE COUNTY, WASHINGTON
NRIS Reference Number: 94001438

NATIONAL REGISTER NOMINATION - RETURN
= =
The nomination materials are being returned at this time for the technical and substantive reasons outlined below:

Significance

- The case for "exceptional" significance required for properties less than fifty years old has not been adequately substantiated. With significance proposed at the national level, the nomination should be based upon a well-documented scholarly analysis of the historic context. As noted in the attached memo from Eric DeLony of HAER, the current nomination--while well-written--contains very little discussion of the national context for bridge construction after the collapse of the original Tacoma Bridge. The revised nomination should make use of the large body of scholarly documentation already available (engineering periodicals, general reference works, local sources) to fully substantiate the "exceptional" engineering significance of the Tacoma Bridge under Criteria A and C. Please review Mr. DeLony's letter for other comments concerning the nomination as well.

  The significance of the bridge under Criterion B, in association with the engineers who worked on the project, is also questionable. It is unclear from the current documentation whether or not there are other elements of their individual careers that might be better representative of their significant contributions to the field, particularly in light of the limited context provided and the less than 50-year period of their accomplishments. It is more likely that their significance could be acknowledged under Criterion C, similar to the works of noted architects (i.e. "works of a master").

- Period of Significance. Please provide a explanation for the period of significance, particularly the end date of 1960. This is important with respect to the use of Criteria Consideration G.

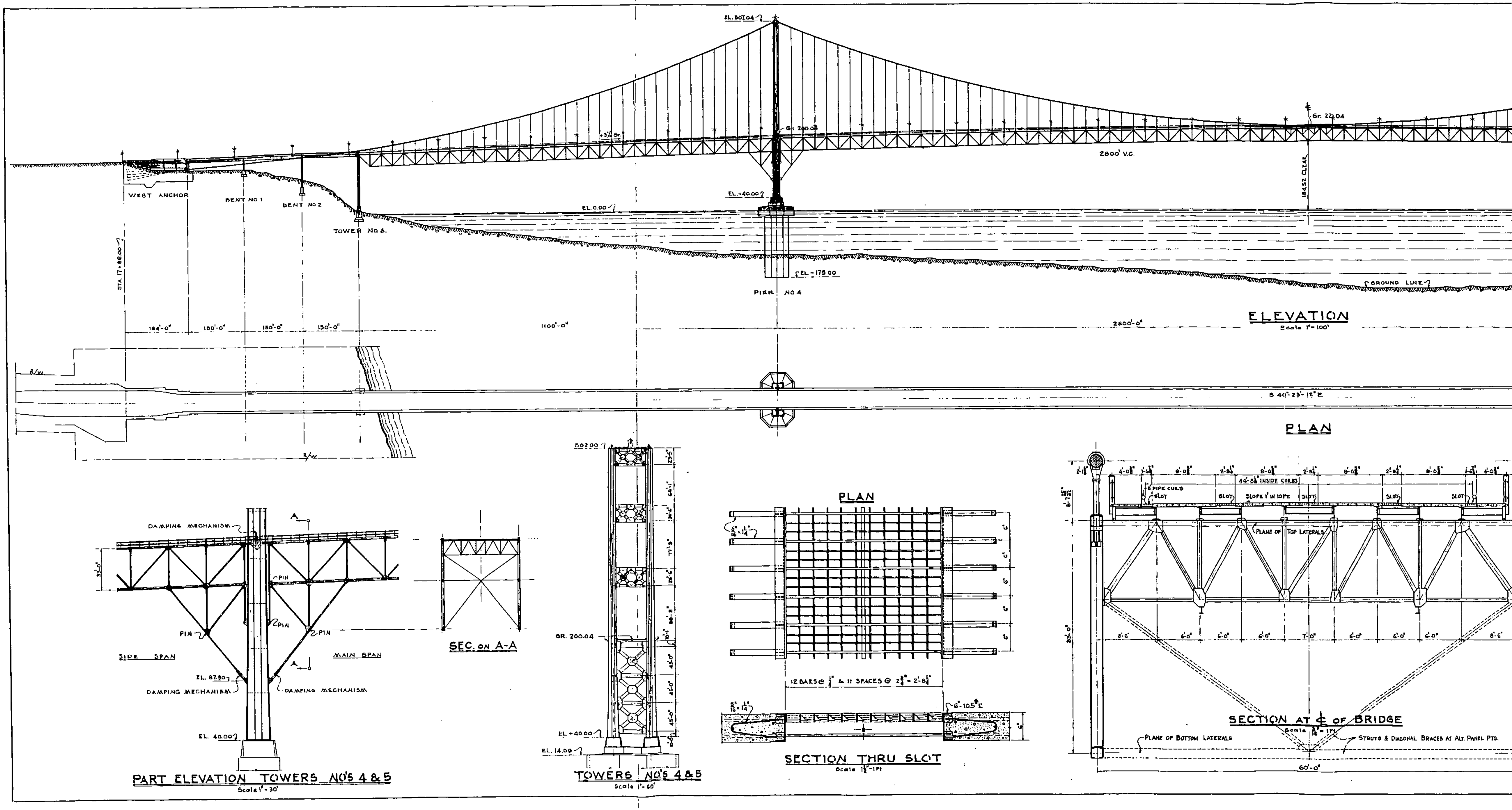
Geographic Data

- U.T.M. Coordinates. The northing value for UTM point Number 2 is incorrect and should be revised on both the map and the form.

Reviewer: Paul R. Lusignan, Historian, NPS, (202) 343-1628

Date: 12/22/94

A:\Tacoma.rtn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TOWER NO 3.
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EL. +40.00
EL. -175.00
PIER NO 4
GROUND LINE
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ELEVATION
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R/W
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PLAN
DAMPING MECHANISM
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PIN
PIN
PIN
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SIDE SPAN
MAIN SPAN
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DAMPING MECHANISM
DAMPING MECHANISM
EL. 40.00
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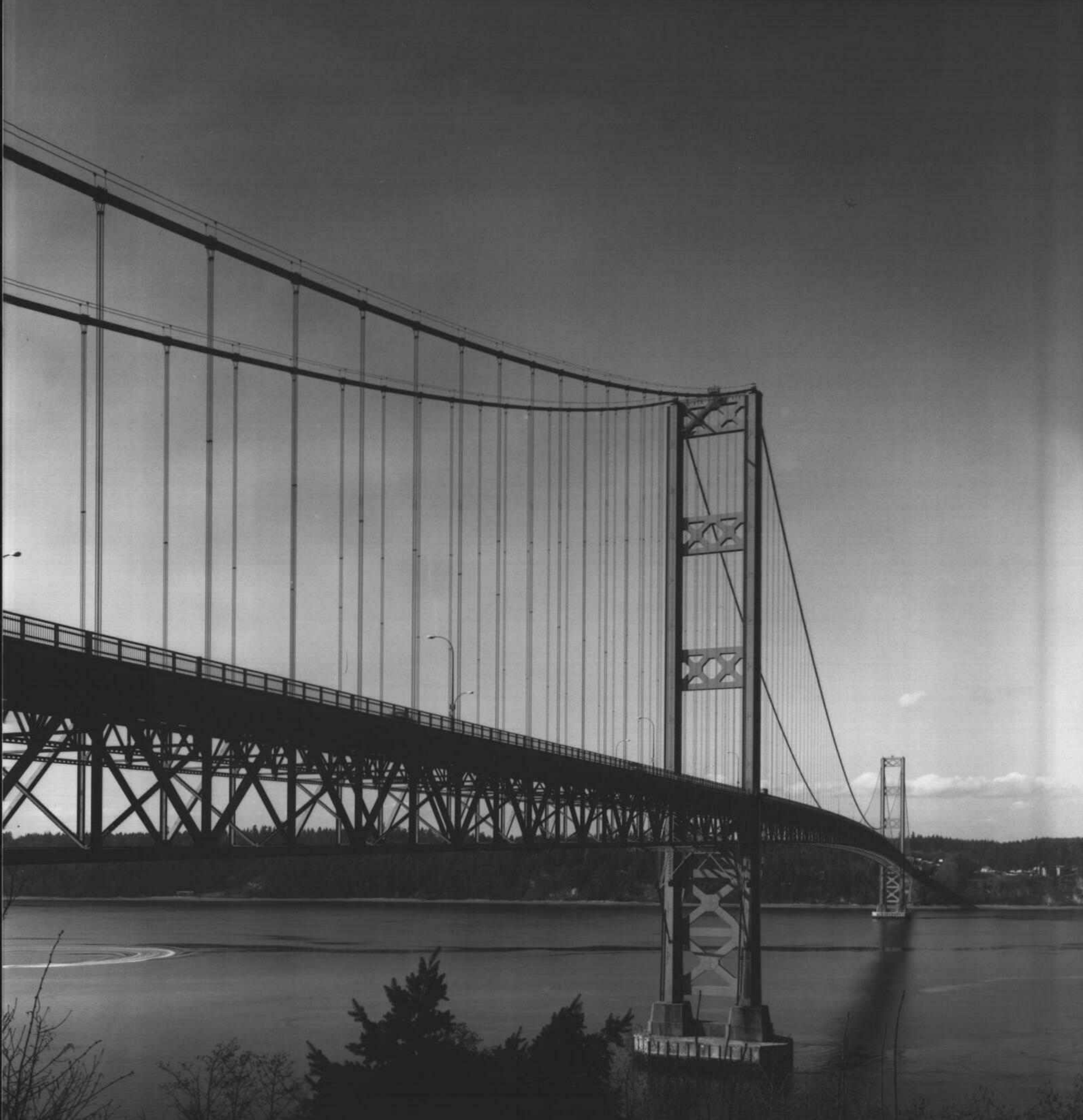
A
PART ELEVATION TOWERS NO'S 4 & 5
Scale 1"=30'
SEC. ON A-A
GR. 200.04
EL. +40.00
EL. 14.00
TOWERS NO'S 4 & 5
Scale 1"=60'
PLAN
12 BARS @ ¼" & 11 SPACES @ 2⅞" = 2'-8¾"
SECTION THRU SLOT
Scale 1½"=1 Ft.
46'-8½" INSIDE CURBS
PIPE CURB
SLOT
SLOPE 1" IN 10 FT.
PLANE OF TOP LATERALS
33'-0"
8'-6"
6'-0"
6'-0"
6'-0"
7'-0"
6'-0"
6'-0"
6'-0"
8'-6"
60'-0"
SECTION AT ℄ OF BRIDGE
PLANE OF BOTTOM LATERALS
STRUTS & DIAGONAL BRACES AT ALT. PANEL PTS.

Tacoma Narrows Bridge
Pierce County, WA
H.S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
view to SW
#1



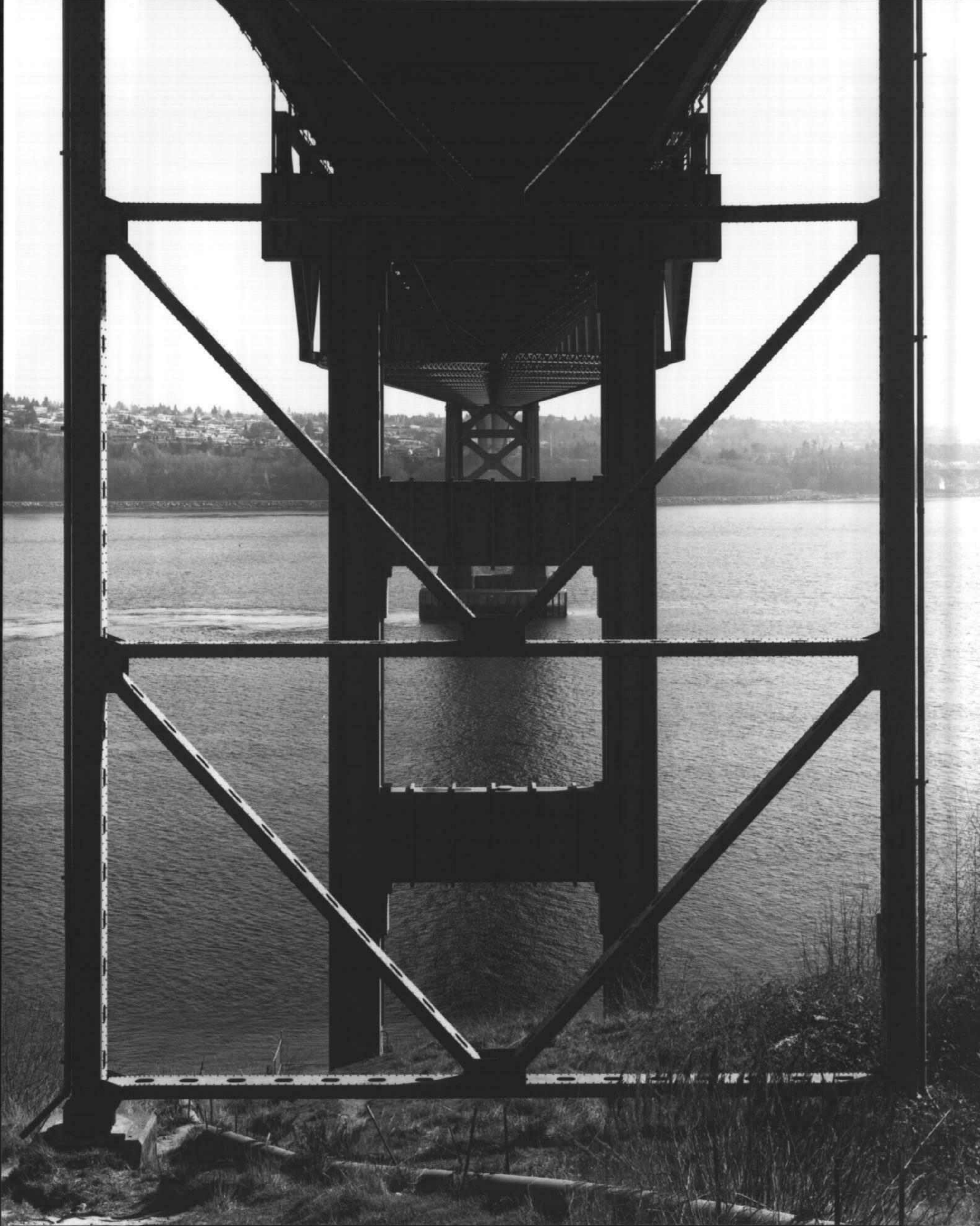
Tacoma Narrows Bridge
Pierce County, WA
H.S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
View to west
#2


DO NOT CHANGE
LANES ON BRIDGE

Tacoma Narrows Bridge
Pierce County, WA
H.S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
View to west
#3

Tacoma Narrows Bridge
Pierce County, WA
H.S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
View to east
#4

Tacoma Narrows Bridge
Pierce County, WA
H.S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
View to west
#5



Tacoma Narrows Bridge
Pierce County, WA
H. S. Rice, photographer
March 1993
AHS, EWU, Cheney, WA
View to SE
#6

1. SITE I.D. NO

NAER INVENTORY PI00259

U.S. Department of the Interior
Heritage Conservation and Recreation Service

2. INDUSTRIAL CLASSIFICATION
Bridges, Trestles, and Aqueducts
Suspension | 7 | 6 | 1 | 0

3. PRIORITY 1

4. DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

5. DATE 1939/1950

6. GOVT SOURCE OF THREAT OWNER ADMIN

7. OWNER/ADMIN
State Department of Transportation

8. NAME(S) OF STRUCTURE
Tacoma Narrows Bridge

9. OWNER'S ADDRESS
Highway Administration Building 55496
Olympia, Washington 98504

10. STATE W A **COUNTY** 0 5 3 **COUNTY NAME** Pierce **CITY/VICINITY** Tacoma **CONG. DIST.** 0 3

STATE COUNTY COUNTY NAME CITY/VICINITY CONG. DIST.

11. SITE ADDRESS (STREET & NO.)
Rt. 16/7.3 N. Jct. SR 5
28/33/34 T 21 02E

12. EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER–I ☐ HAER ☐ NPS ☐ CL6 ☐ CONF ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

13. SPECIAL FEATURES (DESCRIBE BELOW) ☐ INTERIOR INTACT ☐ EXTERIOR INTACT ☐ ENVIRONS INTACT

14. UTM ZONE	EASTING	NORTHING	SIGN	SCALE	QUAD NAME
1 0	5 3 3 5 7 0	5 2 3 5 5 6 0		☒ 1:24 ☐ 1:62.5 ☐ OTHER	Gig Harbor, Washington
1 0	5 3 4 7 0 0	5 2 3 4 1 8 0		☒ 1:24 ☐ 1:62.5 ☐ OTHER	Gig Harbor, Washington

15. CONDITION. 70 ☐ EXCELLENT 71 ☐ GOOD 72 ☐ FAIR 73 ☐ DETERIORATED 74 ☐ RUINS 75 ☐ UNEXPOSED 76 ☐ ALTERED ☐ DESTROYED 85 ☐ DEMOLISHED

16. INVENTORIED BY Lisa Soderberg **AFFILIATION** HAER/Washington State Bridge Inventory **DATE** April 1979

17. DESCRIPTION AND BACKGROUND HISTORY, INCLUDING CONSTRUCTION DATE(S), HISTORICAL DATE(S), PHYSICAL DIMENSIONS, MATERIALS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ENGINEERS, ETC.

In 1939, it was reported that false-bottom caissons used for a record water depth of 120 feet provide the outstanding construction feature on the 2800 foot suspension bridge being built over the Tacoma Narrows. Although the piers were of standard design and construction, they were adopted in a location where the water depth was more than double the previous record for this type of pier construction.

However, ultimately it was not the unusual pier construction that brought fame to the Tacoma Narrows Bridge. At the time that the graceful, ribbonlike bridge was opened to traffic on July 1, 1940, it was the third longest suspension bridge in the world. It was designed by Leon S. Moisseff, a renowned bridge engineer, who helped design the Manhattan suspension bridge between New York and Brooklyn in 1909, and was a consulting engineer for the construction of the Golden Gate Bridge, as well as for other major bridge projects of the first half of the 20th century.

(CONT OVER)

18. ORIGINAL USE vehicular **PRESENT USE** vehicular **ADAPTIVE USE**

19. REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

State Department of Transportation bridge files.
David Jacobs and Anthony E. Neville, Bridges, Canals, and Tunnels, (Washington, DC, 1968), pp. 113-121.
Carl Condit, American Building Art, 2 Vols., (New York, 1961), 2:129.
David B. Steinman and Sara Ruth Watson, Bridges and their Builders, (New York, 1941), pp. 353-360.

(CONT OVER)

20. URBAN AREA 50,000 POP. OR MORE? ☒ YES ☐ NO **21.** N W **22. PUBLIC ACCESSIBILITY** ☐ YES, LIMITED ☒ YES, UNLIMITED ☐ NO ☐ UNKNOWN **23. EDITOR INDEXER**

89

24. LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO NAME DISTRICT I.D. NO

55496

Description (continued)

The design of the Tacoma Narrows Bridge followed the mainline of development in the evolution of the suspension bridge. It represented a culmination of the trend to increase the span length, to reduce the width of the deck, and to minimize the depth of the stiffening components, which simplified and distilled the bridge form; it represented the epitome of a move towards a suspension bridge of slender proportions that placed a premium of economy on flexibile design.

However, on November 7, 1940 only four months after the opening of the bridge, the design ended in disaster. Gale force winds created torsional oscillations in the bridge that eventually reached catastrophic proportions causing the sinuous main span to break away from the undulating mass and plunge into the water below. The collapse of the bridge initiated a deluge of scientific investigation. Studies revealed that the bridge was destroyed by a combination of factors, factors that were more pronounced in the Tacoma span than in any other modern suspension bridge.

One critical factor was the vertical slenderness and resulting vertical flexibility of the structure which was caused by the construction of high flexible towers and a thin suspended span. The engineer, David B. Steinman wrote that a generation earlier, authorities had recommended that the minimum depth of the stiffening trusses should be one fortieth of the total span length. This recommendation was reduced to a range from one ninetieth to one fiftieth for spans between 2,000 and 3,000 feet in length. In contrast to these recommendations, the eight foot depth of the stiffening girder in the Tacoma Narrows bridge was one three-hundred-and fiftieth of the 2800 foot span. The natural oscillation periods of the high flexible towers in combination with those of the main span made the structure susceptible to the generation of harmonic motions of dangerous amplitude.

Another flaw in the design of the bridge was the use of slender, solid, web plate girders to stiffen the deck rather than the use of the complex and conventional truss. The steel truss acts like a sieve to the forces of the wind. However, the wind could not penetrate the solid wall of the girder. In addition, a solid bridge floor was framed into the plate girders. Because the span was highly flexible, the cross-section of the solid plate girders in combination with a solid floor was particularly sensitive to aerodynamic forces. The characteristics of this cross-section caused small undulations of the bridge to amplify. "There is then a tendency for the undulations to change into a twisting motion, with further progressive increase of amplitude until these torsional oscillations reach dangerous or destructive proportions." It was exactly these harmonic motions that eventually proved fatal to the bridge. These motions were evident even before the structure was completed. During construction, the motions of the bridge were so violent that the workers became seasick.

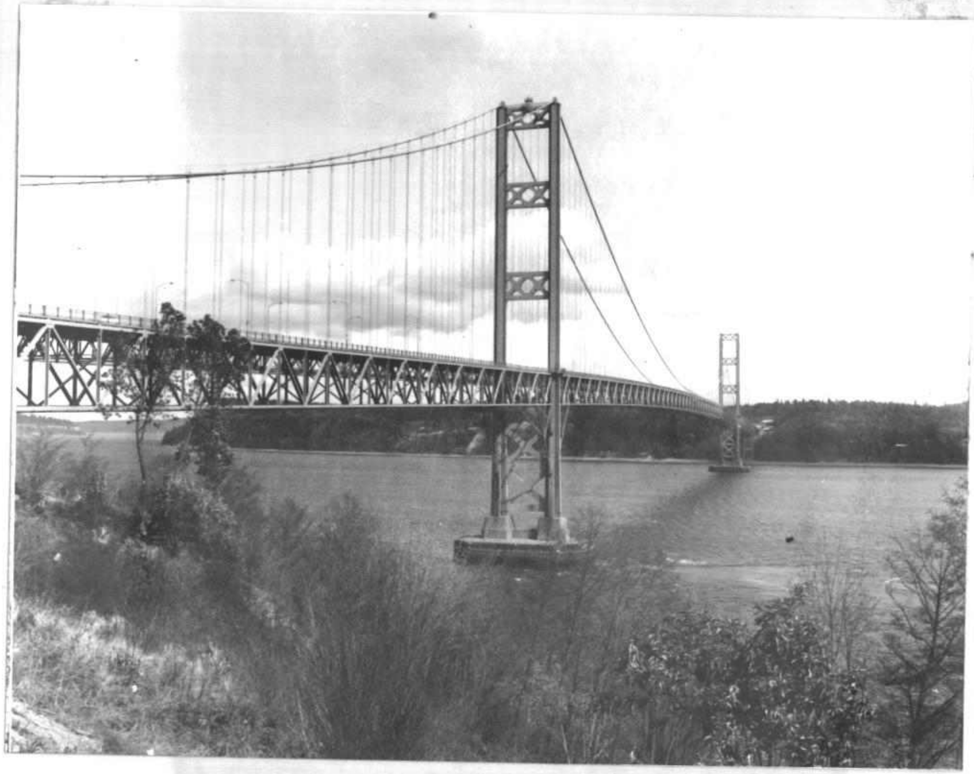
Other bridge designs did benefit from the mistakes made in the construction of the Tacoma Narrows Bridge. The noted engineer, Ottmar H. Amman, who had designed the recently completed Bronx-Whitestone Bridge in New York with stiffening girders, quickly replaced them with trusses. The knowledge gained from the research following the disaster was valuable to the entire engineering profession in terms of understanding the importance of aerodynamics in suspension bridge design.

On October 15, 1950 a second Tacoma Narrows Bridge was opened to traffic. The dimensions of the present bridge are identical to those of the first. There is a 2800 foot suspended span, and two 1100 foot spans. The main piers, part of the west approach spans, and the anchor blocks of the first structure were utilized in the existing structure.

ABSTRACT

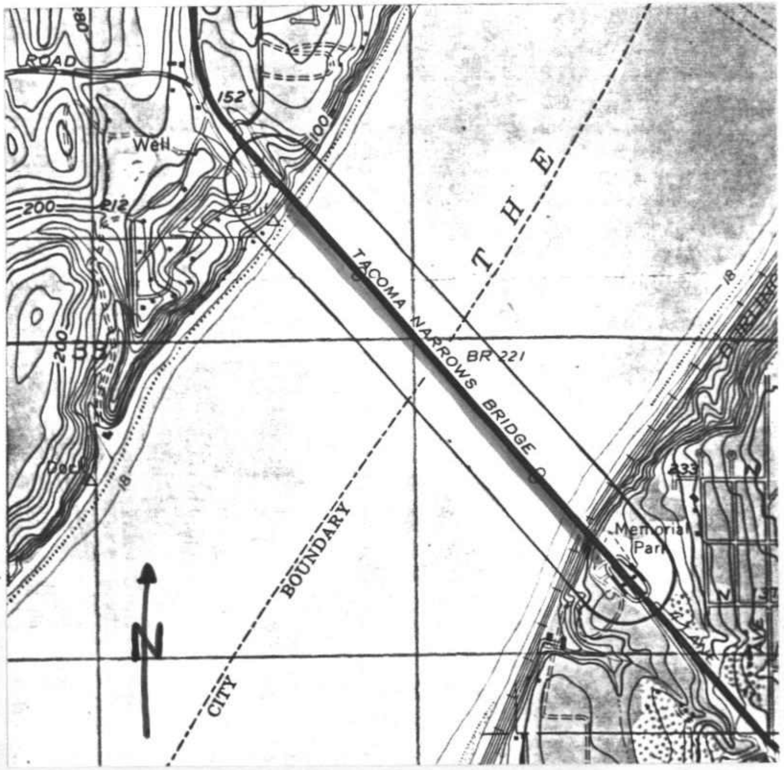
HAER NO LC TECH REPORT HIST REPORT CONTEMP PHOTO HIST PHOTO CONTEMP DRWG HIST DRWG COLOR PLATE PHOTOGRAM SW FILM

25. Photos and Sketch Map of Location



looking northwest

55496



55496

Tacoma Narrows Bridge

looking southeast

89

Tacoma Narrows Bridge

south tower

89

Tacoma Narrows Bridge
cable connection

89

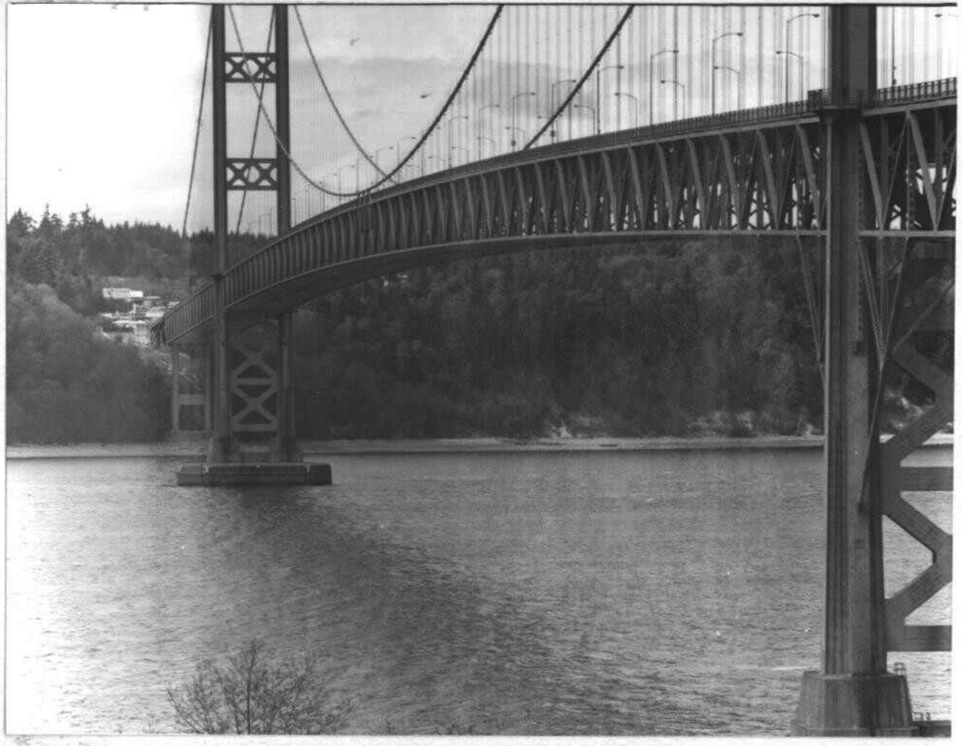
Tacoma Narrows Bridge

south approach

89

55496

Tacoma Narrows Bridge



55496

Tacoma Narrows Bridge

looking southeast

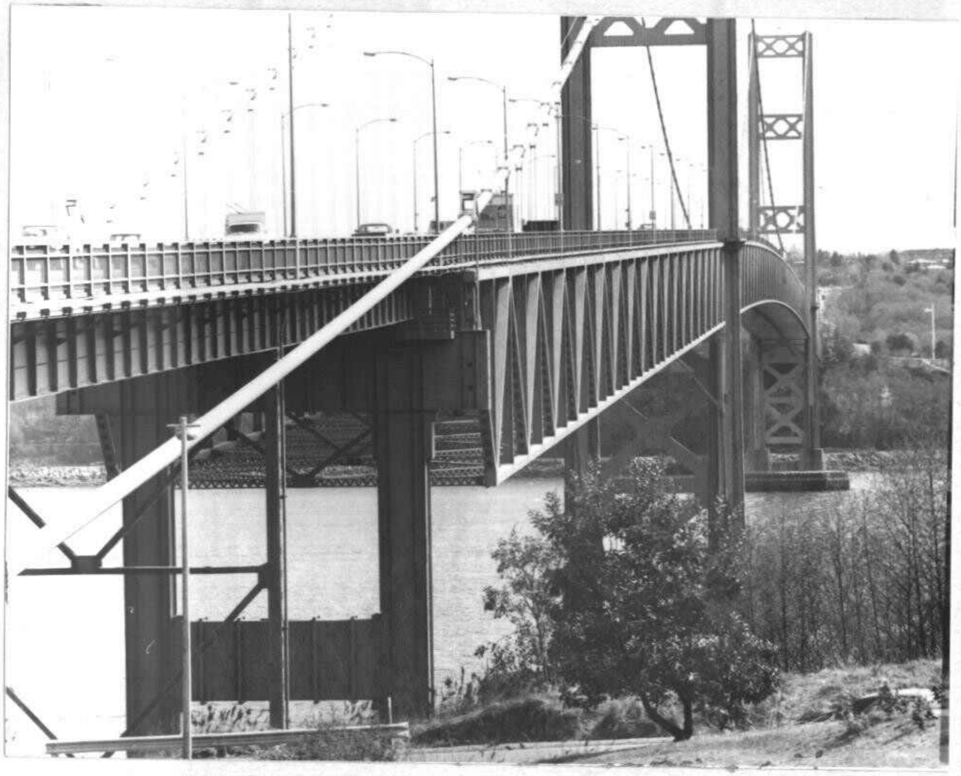
89

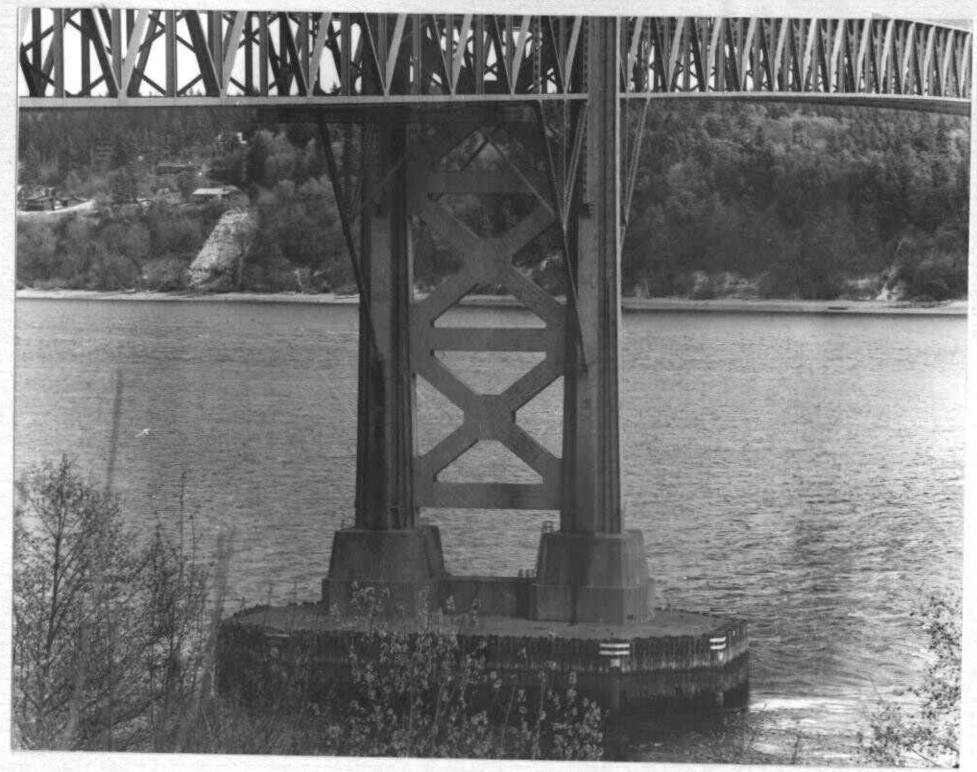
Tacoma Narrows Bridge

south pier

89

55496





25. Photos and Sketch Map of Location

27 2 1

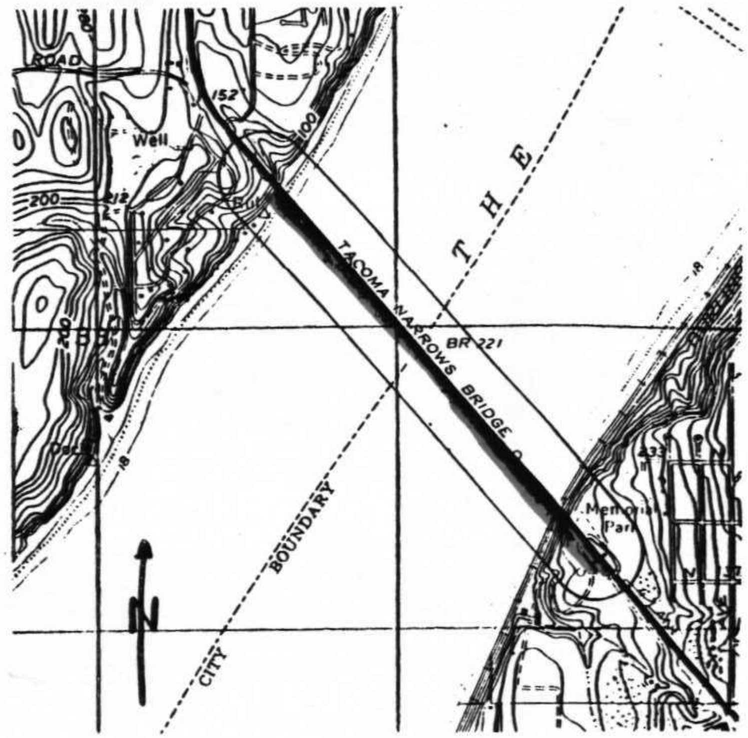
27 2 4

27 2 2

27 2 5

27 2 3

27 2 6



55 496

27 2 7

27 2 10

27 2 8

27 2 11

27 2 9

Historic Property Inventory Report

Location

Field Site No. DAHP No. PI00259

Historic Name: Tacoma Narrows Bridge

Common Name:

Property Address: Route 16, 7.3 N Jct SR 5, Tacoma, WA

Comments:

Tax No./Parcel No.

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T21R02E	28			Pierce	
T21R02E	33				
T21R02E	34				

Coordinate Reference

Easting: #Error

Northing: #Error

Projection: Washington State Plane South

Datum: HARN (feet)

Historic Property Inventory Report

Identification

Survey Name: Legacy for City of Tacoma

Date Recorded: 11/08/1994

Field Recorder:

Owner's Name: WA State DOT

Owner Address: Hihgway Transportation Bldg.

City: Olympia

State: WA

Zip: 98504

Classification: Structure

Resource Status: State Register

Comments:

Within a District?

Contributing?

National Register: Tacoma Narrows Bridge

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use:

Current Use:

Plan:

Stories:

Structural System:

Changes to Plan:

Changes to Interior:

Changes to Original Cladding:

Changes to Windows:

Changes to Other:

Other (specify):

Style:

Cladding:

Roof Type:

Roof Material:

Foundation:

Form/Type:

Narrative

Study Unit

Other

Date of Construction:

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places:

Property is located in a potential historic district (National and/or local):

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:

Description of Physical Appearance:

Major Bibliographic References:

Photos

Historic Property Inventory Report

Identification

Survey Name: Legacy for City of Tacoma   Date Recorded: 01/01/1900

Field Recorder:

Owner's Name:

Owner Address:

City: State: Zip:

Classification:

Resource Status: Comments:

Within a District?

Contributing?

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use: Current Use:

Plan: Stories: Structural System:

Changes to Plan: Changes to Interior:

Changes to Original Cladding: Changes to Windows:

Changes to Other:

Other (specify):

Style: Cladding: Roof Type: Roof Material:

Foundation: Form/Type:

Narrative

Study Unit   Other

Date of Construction: Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places:

Property is located in a potential historic district (National and/or local):

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:

Description of Physical Appearance:

Major Bibliographic References:

Photos

Historic Register Report

Historic Name: Tacoma Narrows Bridge

Address: Spanning the Tacoma Narrows
City: Tacoma
County: Pierce

Download nomination form

Historic Use: Transportation
Style: None
Built: 1950
Architect:
Builder: Bethlehem P.C. Steeel; John A. Roeblings Sons and Co

Smithsonian Number: 45PI00259
Date Listed: 9/15/1994
Listing Status: WHR
Classification: STR
Resource Count: 1
Area of Significance: Engineering
Level of Significance: Local
Listing Criteria:

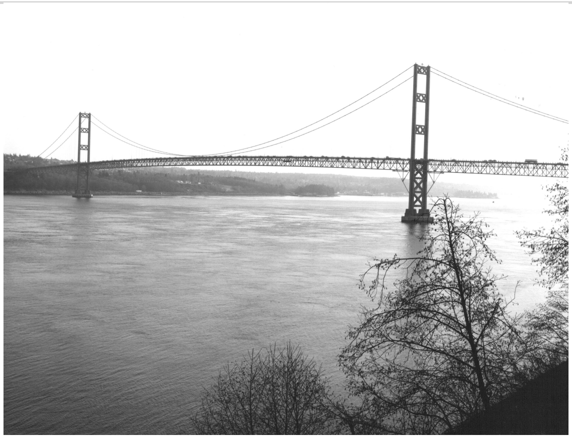
Statement of Significance

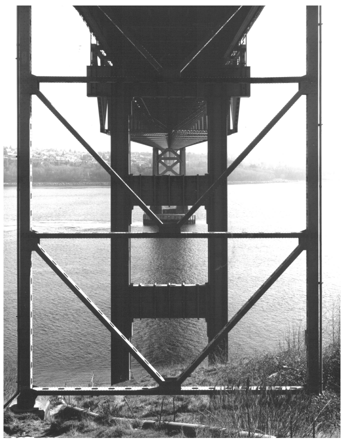
Designs for the new bridge were completed in 1947 to replace the ill fated "galloping Gurtie" bridge were checked aerodynamically with the use of models. Contracts were let for construction on March 31 and April 1, 1948. The primary contractors for construction of the bridge were the Bethlehem Pacific Coast Steel Corporation and John A. Roeblings Sons Company. Both of these firms were notable for their innovative construction skills in the fabrication and erection of steel bridges.

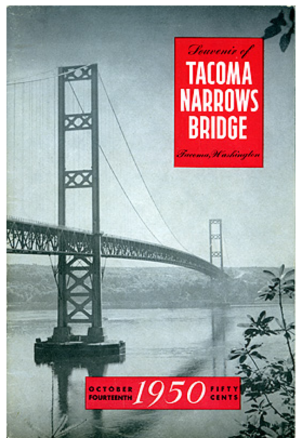
The Tacoma Narrows Bridge opened to traffic on October 14, 1950; all components of the structure were finally in place by November 1951. Construction was financed through a $14,000,000 bond issue. The bridge operated as a toll facility until the bonds were retired, at which time the tolls were removed along with the toll plaza and booths (although the toll houses remain off the south end of the bridge). The toll for an automobile and driver was 50 cents. Each additional passenger paid 10 cents.

At the time of completion, the Tacoma Narrows Bridge included the third longest suspension span in the world. As of 1991 it ranked as the fifth longest span in North America. This bridge is of major significance because of its numerous unique design features. It was the first time a research program was implemented to investigate the aerodynamic effects of wind acting upon a bridge. In designing this structure, bridge engineers first used wind tunnel tests to determine the behavior and stability of a physical model of a proposed bridge. The research and design provided significant information to suspension bridge engineers nationwide and had an important effect on all suspension bridge designs that followed. The design incorporated unique features into the structure, such as the open steel grid slots, the greater ratio of the depth of stiffening truss to span length, the double lateral system, the hydraulic energy absorbing and damping devices, and the record depth below water at which pier construction occurred with the aid of submerged caissons. Few bridges have received as much engineering significance in technical publications or as much nation-wide attention and publicity, due largely to the failure of the first Tacoma Narrows Bridge. The present structure represents an extraordinary achievement in bridge design and construction engineering. This effort produced a structure of unprecedented function, stability, and virtually unequaled esthetic attraction spanning one of the country's most challenging crossings. In addition, the bridge established one of the most significant transportation corridors in Washington State by connecting the mainland with the Kitsap and Olympic peninsulas.

Photos






Souvenir of
TACOMA
NARROWS
BRIDGE
Tacoma, Washington
OCTOBER FOURTEENTH 1950 FIFTY CENTS

FILE COPY DO NOT REMOVE

NPS Form 10-900
(Rev. 8-86)

OMB No. 1024-0018

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

P1 601

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See Instructions in *Guidelines for Completing National Register Forms* (National Register Bulletin 16). Complete each item by marking "x" in the appropriate box or by entering the requested information. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, styles, materials, and areas of significance, enter only the categories and subcategories listed in the instructions. For additional space use continuation sheets (Form 10-900-a). Type all entries.

1. Name of Property

historic name Tacoma Narrows Bridge Ruins

other names/site number Galloping Gertie

2. Location

street & number Highway 16 over the Tacoma Narrows ☐ not for publication

city, town Tacoma ☐ vicinity

state Washington code WA county Pierce code 053 zip code

3. Classification

Ownership of Property
☐ private
☐ public-local
☒ public-State
☐ public-Federal

Category of Property
☐ building(s)
☐ district
☒ site
☐ structure
☐ object

Number of Resources within Property

Contributing	Noncontributing	
		buildings
1		sites
		structures
		objects
1	0	Total

Name of related multiple property listing: N/A

Number of contributing resources previously listed in the National Register 0

4. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ☒ nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ☒ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet.

Mary M. Thompson — 6/30/92

Signature of certifying official — Date

Washington State Office of Archaeology and Historic Preservation

State or Federal agency and bureau

In my opinion, the property ☐ meets ☐ does not meet the National Register criteria. ☐ See continuation sheet.

Signature of commenting or other official — Date

State or Federal agency and bureau

5. National Park Service Certification

I, hereby, certify that this property is:

☐ entered in the National Register.
 ☐ See continuation sheet.
☐ determined eligible for the National Register. ☐ See continuation sheet.
☐ determined not eligible for the National Register.

☐ removed from the National Register.
☐ other, (explain:)

Signature of the Keeper — Date of Action

6. Function or Use

Historic Functions (enter categories from instructions)
Transportation/road-related/bridge

Current Functions (enter categories from instructions)
Other: underwater ruins

7. Description

Architectural Classification
(enter categories from instructions)

N/A

Materials (enter categories from instructions)

foundation N/A
walls N/A
roof N/A
other N/A

Describe present and historic physical appearance.

The first Tacoma Narrows Bridge was revolutionary in its design and historic in its collapse. Its failure on November 7, 1940 marked the end of a trend in bridge engineering towards a maximum of lightness, grace and flexibility. Since the turn of the century, suspension bridge construction valued structural grace and slenderness to achieve an artistic appearance. With its shallow stiffening trusses and slender towers, the bridge across the Narrows was the epitome of artistry in bridge construction.

Prior to the Narrows Bridge, conventional engineering wisdom recommended that stiffening trusses on a suspension bridge be a minimum of 1:40 in depth and that the minimum roadway width compared to the length of the span be 1:30. The eight foot stiffening girders supporting the 2,800 foot span on the Narrows bridge was 1:350 and the roadway to length of span ratio was 1:72. This lightweight design and long center span gave the bridge unparalleled flexibility and beauty.

The original plan for the first bridge was designed by Clark Eldridge, an engineer with the Washington State Department of Highways. His design called for a 5,000-foot, two-lane suspension bridge. The two approach (side) spans were 1,100 feet long, the center span 2,800. Two 425-foot towers rested on deep piers of the cellular caisson deign. When completed, the structure was the third longest suspension bridge in the world (The George Washington Bridge in New York City and the Golden Gate Bridge in San Francisco being longer).

Eldridge's plans were reviewed by a State-appointed engineering consultant, Moran and Proctor, who suggested major revisions to the design. These revisions were ultimately scrapped during the bidding process when a group of contractors informed the State that the revised substructure specifications could not be built. Eldridge's plan for the substructure was reintroduced into the design. In addition, the State retained Leon S. Moisseiff, a world-renowned bridge designer (Golden Gate Bridge) to examine the design of the superstructure. Moisseiff substituted Eldridge's 25-foot deep, open stiffening truss with an eight foot, shallow plate grid.

The contract was awarded to the Pacific Bridge Company for their bid of $5,594,730.40 and the associate contractor was Bethlehem Steel Company for the steel and wire. The bridge was opened July 1, 1940. The specifications are listed on the next page.

[X] See continuation sheet

Today the center span and other debris lie on the floor of Puget Sound, where they fell. A site plan of these remains, developed from sonar soundings of the Narrows, is attached. The remains of the center span are readily identifiable on the plan. The videotape "Gertie Gallops Again," prepared by Tacoma Municipal Television for the show "CityScape," is also submitted with the nomination for the historic footage of the collapse and the underwater filming of the present remains.

The side spans were removed and salvaged for their high resale value during the war effort. The original piers were used for the second bridge (1952), and new towers were constructed.

SPECIFICATIONS OF THE FIRST TACOMA NARROWS BRIDGE:

Total length	5,939 feet
Suspension bridge section	5,000 feet
Center span	2,800 feet
Shore suspension spans, each	1,100 feet
East approach and anchorage	345 feet
West approach and anchorage	594 feet
Center span height above water	195 feet
Width of roadway	26 feet
Width of sidewalks, each	5 feet
Diameter of main suspension cable	17-1/2 inches
Weight of main suspension cable	3,817 tons
Weight sustained by cables	11,250 tons
Number of No. 6 wires each cable	6,308
Weight shore anchors	52,500 tons
Towers:	
Height above piers	425 feet
Weight of each tower	1,927 tons
Piers:	
Area	118 feet, 11 inches x 65 feet, 11 inches
East pier, total height	247 feet
Depth of water	140 feet
West pier, total height	198 feet
Depth of water	120 feet

8. Statement of Significance

Certifying official has considered the significance of this property in relation to other properties:
☒ nationally ☐ statewide ☐ locally

Applicable National Register Criteria ☒ A ☐ B ☐ C ☐ D

Criteria Considerations (Exceptions) ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F ☐ G

Areas of Significance (enter categories from instructions)
Engineering

Period of Significance
1940

Significant Dates
1940

Cultural Affiliation
N/A

Significant Person
N/A

Architect/Builder
N/A

State significance of property, and justify criteria, criteria considerations, and areas and periods of significance noted above.

The significance of the first Tacoma Narrows Bridge is derived directly from its startling collapse on November 7, 1940, which brought engineers world-wide to the realization that aerodynamic phenomena in suspension bridges were not adequately understood in the profession nor had they been addressed in this design. New research was necessary to understand and predict these forces. The official investigation into the collapse (Farquharson et al., 1949-54) recommended the use of wind-tunnel tests to aid in the design of the second Tacoma Narrows Bridge and resulted in the testing of all existing and future bridges across the country. New mathematical theories of vibration in suspension bridges were published as a result of the bridge failure (Bleich et al., 1950) and continues today (Peterson, 1990). Aerodynamics, wave phenomena, and harmonics were all part of the new studies. "Based on these investigations (Farquharson, et al., Bleich et al.), procedures for the design of suspension bridges for aerodynamic excitations were set up, and became in important part of the design process for all major cable supported bridges to be built in the future,"[1] wrote Danish engineer Niels J. Gimsung.

The film of the bridge collapsing is a dramatic and on-going teaching tool shown to engineering and physics students, both here and abroad. Physics professors Zollman and Fuller (1982) describe the film as providing "physics teachers with the most captivating demonstration of wave phenomena ever devised."[2] Ivars Peterson, engineer, describes the film as "among the most dramatic and widely known images in science and engineering."[3]

The collapse of the Tacoma Narrows Bridge was a singular event in the history of engineering with far-reaching implications in the development of aerodynamics and bridge design, implications which extend beyond political borders and are part of the evolution of civil engineering. The collapse was a failure, but "the most important and spectacular failure in suspension bridge history."[4] As is common in much of human history, we often learn more from our failures than from our successes. For these reasons, the first Tacoma Narrows Bridge is worthy of listing in the National Register by virtue of its role in the history of civil engineering and bridge design.

☒ See continuation sheet

HISTORICAL BACKGROUND:

There is one point in the 20,000 square miles of Puget Sound where the Washington mainland and the Olympic Peninsula are close - the Narrows at Tacoma. For years, it had been clear to State officials that the Narrows would have to be bridged in order to open up the spectacular and thinly populated Peninsula. Aware of this situation, the Washington State Legislature created the Washington Toll Bridge Authority in 1937, with a mandate to finance, construct and operate toll bridges.

The City of Tacoma and Pierce County Board of Commissioners asked the State to construct a bridge across the Narrows. The legislature appropriated $25,000 to study the request. Satisfied with the results of the study, on May 23, 1938, the State of Washington submitted an application to the Public Works Administration (PWA) requesting funds for construction of a bridge.

Between the time the state legislature authorized the money to study the proposal and the completion of that study, Lacey Murrow, Director of the Washington State Department of Highways, had given Clark Eldridge, a bridge engineer with the department, a green light to design a bridge to span the Narrows. Eldridge went to work, and when he finished, his plan called for a 5,000 foot, two-lane suspension bridge. When completed, the structure would be the third longest suspension bridge in the world (only the George Washington Bridge in New York City and the Golden Gate Bridge in San Francisco were longer).

After examination of Eldridge's plans in May of 1938, the Public Works Administration agreed to finance 45 percent of the construction, provided that the State of Washington retain a board of independent engineering consultants to reexamine Eldridge's design. The State complied and employed the firm of Moran and Proctor to study the plans for the substructure. Furthermore, the State retained Leon S. Moisseiff, the world-renowned suspension bridge builder who had designed the Golden Gate Bridge, to examine the plans concerning the superstructure. Both Moran and Proctor and Moisseiff made significant alterations to Eldridge's original design. Specifically, Moran and Proctor wanted an entirely different substructure. As to Moiseiff, he substituted the 25 foot deep open stiffening truss with an eight foot, shallow plate girder, resulting in a much lighter bridge. His international stature as a builder of suspension bridges was immense; his plans for the Narrows Bridge were the culmination of Moiseiff's efforts to combine grace, lightness and flexibility in suspension bridge construction. The Narrows Bridge was "to stretch like a taut ribbon" across the Narrows.

Prior to the opening of the construction bids, a group of contractors notified the engineers they could not meet the specifications for the substructure. As a result, Moran and Proctor's plans for the substructure were scrapped, and Eldridge's original plans for the substructure were reintroduced. After consultation with Moiseiff, it was agreed that Eldridge's design for the substructure would be used in conjunction with Moiseiff's plans for the superstructure. This modified plan was approved by the Public Works Administration and bids for construction were opened on September 27, 1938. The Pacific Bridge Company's low bid of $5,594,730.40 was accepted. The Bethlehem Steel Company was an associate contractor which supplied and erected the steel and wire. Work on the bridge began in early 1939. On July 1, 1940, the $6.4 million bridge opened; the link between the Washington mainland and the Olympic Peninsula was complete.

Vertical oscillations of the roadbed occurred even during the construction phase and raised questions about the structure's stability. Some breezes as low as four miles per hour caused oscillations, while stronger breezes often had no effect. Hydraulic buffers were installed at the towers to control the stresses, prior to the bridge's opening. The undulations continued, however, and further studies were undertaken at the University of Washington. Their recommendation of the installation of tie-down cables in the side spans were implemented, but to little effect.

Local folks lost no time in nicknaming the bridge "Galloping Gertie." Fascinated by Gertie, thousands of people drove hundreds of miles to experience the sensation of crossing the rolling center span, an experience often times highlighted by the disappearance and then reappearance of cars up ahead. For four months, the Washington Toll Bridge Authority thrived as traffic had trebled from what had been expected. Although concerns about the bridge's stability had been voiced, bridge officials were so confident of the structure, they considered cancelling the insurance policies in order to obtain reduced rates on a new one.

Throughout the early morning hours of Thursday, November 7, 1940, the center span had been undulating three to five feet in winds of 35 to 46 miles per hour. Alarmed by this constant motion, highway officials and state police closed the bridge at 10:00 A.M. Shortly afterwards, the character of the motion dramatically changed from a rhythmic rising and falling to a two-wave twisting motion. The twisting motion grew stronger with each twist; span movement had gone from three to five foot undulations to 25 to 28 foot rises and falls caused by the twisting motion. At this point, the roadbed tilted 45 degrees from horizontal one way, and then 45 degrees from horizontal the other way.

For about 30 minutes, the center span endured the twisting. At about 10:30 A.M., a center span floor panel dropped into the water 195 feet below. The roadbed was breaking up, and chunks of concrete were raining into the Sound. At 11:02 A.M., 600 feet of the western end of the span twisted free, flipped over, and plunged down into the water. Engineers on the scene hoped that once this had happened, the remainder of the span would settle down. This was not to be. The twisting continued, and at 11:09 A.M., the remainder ripped free and thundered down into the Sound. When this happened, the 1,100 foot side spans dropped 60 feet, only to bounce up and then settle into a sag of 30 feet. As for the center span, it rested on the dark and tide-swept bottom of the Narrows.

The spectacular failure was news around the world and was highlighted by the photographs, reports, and film from reports and engineers on the scene. The shock to the engineering profession created much interest in studies of the cause of the collapse. The official investigation team was composed of a prestigious group of engineers from across the country, lead by Professor F. B. Farquharson of the University of Washington, whose studies for the bridge authority began before the bridge's opening. The professional civil engineering society and the U.S. Department of Commerce authorized an Advisory Board on the Investigation of Suspension Bridges, as it was dramatically evident that oscillation and wind effects were not adequately understood.

Although there had been no suspension bridge failures for 51 years, ten suspension bridges were destroyed or damaged by wind in the 19th century, five of these in Great Britain, with the effect that no suspension bridges were built there for over 100 years. During this half century, the trend in bridge design was for spans of ever-increasing length and load-carrying ability, a thin, ribbon-like, artistic appearance, and a belief that a bridge could withstand wind if designed for a static wind pressure of 30 pounds per square foot. The Tacoma Narrows Bridge had met this specification and had been expected to withstand winds greater than the ones which destroyed it.

The aerodynamic studies done after the collapse were the first extensive studies on the effect of wind on bridges. The result was the discovery that the shape of the bridge structure has a primary effect on the bridge's ability to handle wind eddies and stress. The solid floor deck and side panels of Galloping Gertie, when combined with the wind of November 7, 1940, caused stresses which the bridge was not designed to handle. The second Tacoma Narrows Bridge was designed with open side railings and steel grid on the floor deck for the wind to pass through.

The new research stated that the lack of suspension bridge failures for the previous 51 years was due more to a lack of optimum winds for a sufficient period of time than to the design of those bridges. Bridge authorities around the country carried out tests on their suspension bridges with resulting modifications to many structures. Wind tunnel testing became an integral part of the design process for new bridges and for testing existing ones.

The collapse of the Tacoma Narrows Bridge was a hallmark in the history of bridge design and civil engineering. Its impact is still felt in the profession today. The bridge's remains at the bottom of the Sound are a permanent record of man's capacity to build structures without fully understanding the implications of the design and the forces of nature.

FOOTNOTES:

[1]Gimsung, Niels J., Cable Supported Bridges: Concept and Design. New York City: John Wiley and Sons, 1983, p. 21.

[2]Zollman, Dean and Fuller, Robert, "The Puzzle of the Tacoma Narrows Bridge Collapse: An Interactive Videodisc Program for Physics Instruction," Creative Computing, Vol. 8, No. 10, October, 1982, p. 100.

[3]Peterson, Ivars, "Rock and Roll Bridge: A New Analysis Challenges the Common Explanation for a Famous Collapse," Science News, Vol. 137, June 2, 1990, p. 344.

[4]Bleich, Friedrich, et al., The Mathematical Theory of Vibration in Suspension Bridges. Washington: U.S. Government Printing Office, 1950, p. 8.

9. Major Bibliographical References

See continuation sheet.

☒ See continuation sheet

Previous documentation on file (NPS):
- ☐ preliminary determination of individual listing (36 CFR 67) has been requested
- ☐ previously listed in the National Register
- ☐ previously determined eligible by the National Register
- ☐ designated a National Historic Landmark
- ☐ recorded by Historic American Buildings Survey # ________
- ☐ recorded by Historic American Engineering Record # ________

Primary location of additional data:
- ☐ State historic preservation office
- ☐ Other State agency
- ☐ Federal agency
- ☐ Local government
- ☐ University
- ☐ Other

Specify repository: ________

10. Geographical Data

Acreage of property Approximately 20

UTM References

	Zone	Easting	Northing
A	10	533620	5235420
B	10	534500	5234440
C			
D			

☐ See continuation sheet

Verbal Boundary Description

The nominated property is described as that underwater property outlined on the attached site plan, drawn to a scale of 1mm = 3.48 feet. The site is generally described as that underwater area between the east and west pilings of the bridge, and beneath the extant new Tacoma Narrows Bridge.

☐ See continuation sheet

Boundary Justification

The nominated property includes the underwater area that contains the remains of the collapsed Tacoma Narrows Bridge, as documented by underwater sonar soundings and video photography. The nominated area is generally defined by the east and west pilings of the bridge and the expanse between, now spanned by the new Tacoma Narrows Bridge.

☐ See continuation sheet

11. Form Prepared By

Name/title Valerie Sivinski/Penny Chatfield Sodhi/John M. Simpson
organization Tacoma Office of Historic Preservation/consultants date January 1991
street & number 747 Market Street, Room 900 telephone (206) 591-5220
city or town Tacoma state Washington zip code 98402

*U.S.GPO:1988-0-223-918

Advisory Board on the Investigation of Suspension Bridges, The Failure of the Tacoma Narrows Bridge. College Station, Texas: School of Engineering, Texas Engineering Experiment Station, 1944.

Andrews, Charles E., Final Report on Tacoma Narrows Bridge, Tacoma, Washington. N.P., June, 1952.

Bleich, Friedrich, et al., The Mathematical Theory of Vibration in Suspension Bridges. Washington, D.C.: Department of Commerce, U.S. Government Printing Office, 1950.

Blumenfeld, Irving, Sturdy Gertie: The Test Tube Bridge. N.P., December 7, 1960.

"Fall of the First Tacoma Narrows Bridge," Washington Highways, December 21, 1964, pp.1-3.

Farquharson, F. B., et al., A Dynamic Model for the Tacoma Narrows Suspension Bridge. Seattle: University of Washington, 1940.

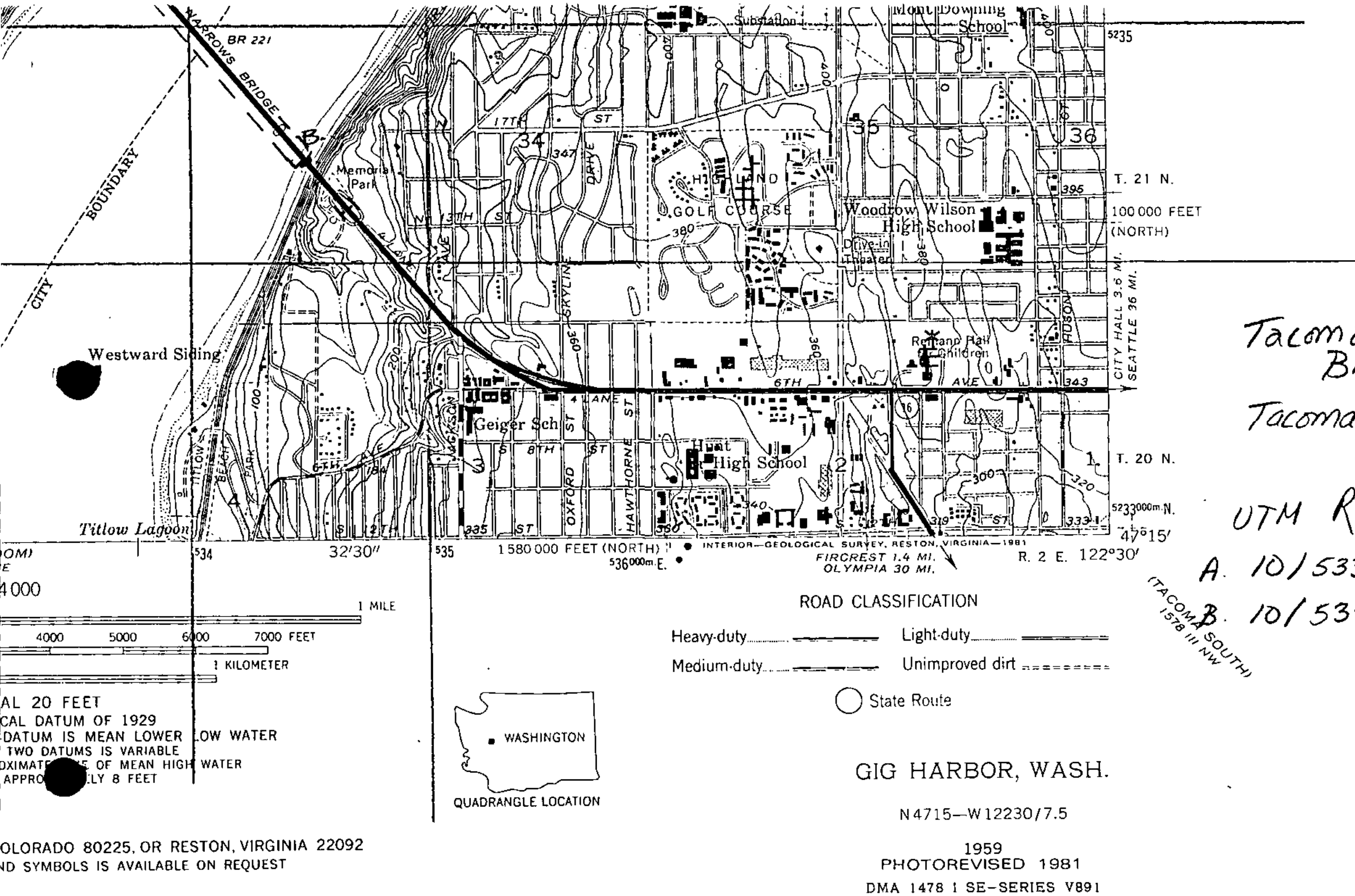
Gimsung, Niels R., Cable Supported Bridges: Concept and Design. New York: John Wiley and Sons, 1983.

Peterson, Ivars, "Rock and Roll Bridge," Science News, Vol. 137, June 2, 1990, pp. 344-346.

University of Washington Structural Research Laboratory (Farquharson, F.B. et al.), Aerodynamic Stability of Suspension Bridges With Special Reference to the Tacoma Narrows Bridge; a Report of an Investigation Conducted by the Structural Research Laboratory, University of Washington. Seattle: University of Washington Press, 1949-54.

Wardlaw, Robert L., "The Wind Resistant Design of Cable-Stayed Bridges," Cable Stayed Bridges. New York: American Society of Civil Engineers, 1988.

Zollman, Dean and Fuller, Robert, "The Puzzle of the Tacoma Narrows Bridge Collapse: An Interactive Videodisc Program for Physics Instruction," Creative Computing, Vol. 8, No. 10, October, 1982, pp. 100-109.



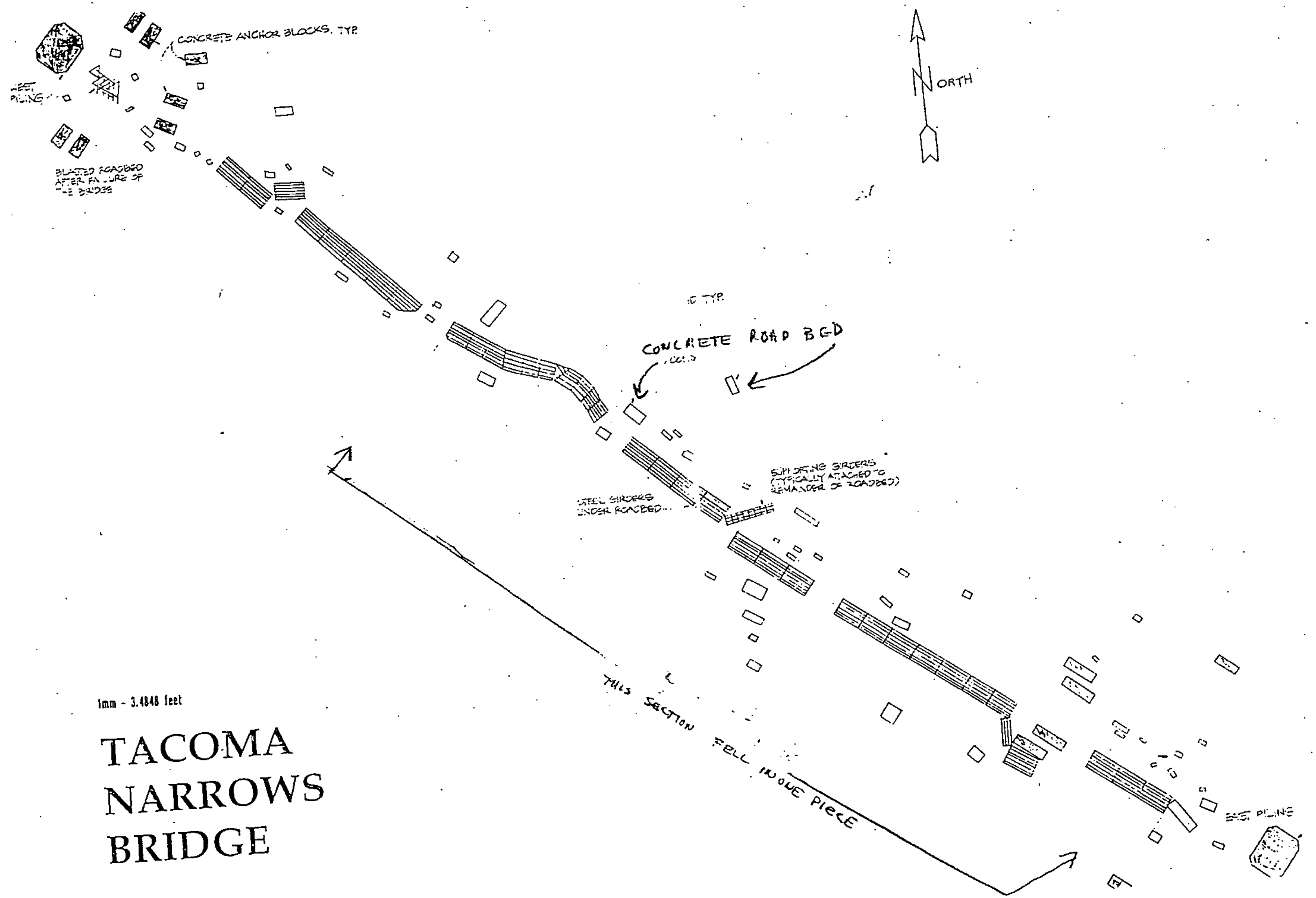
Tacoma Narrows
Bridge Ruins
Tacoma, Pierce Co,
WA

UTM References:

A. 10/533620/5235420

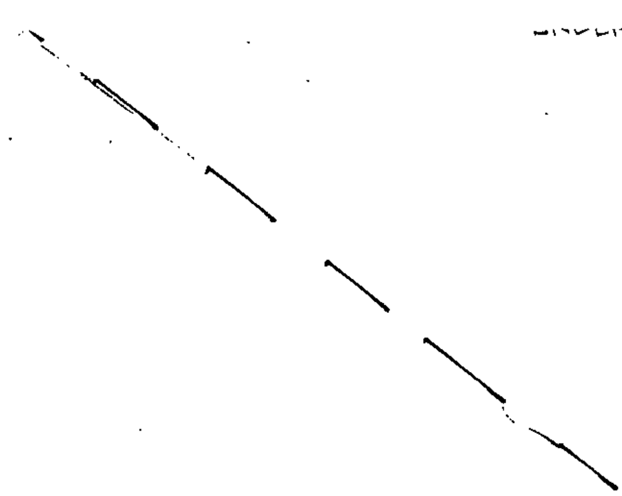
B. 10/534500/5234440

(TACOMA SOUTH)
1578 III NW



1mm - 3.4848 feet

TACOMA NARROWS BRIDGE



ım - 3.4848 feet

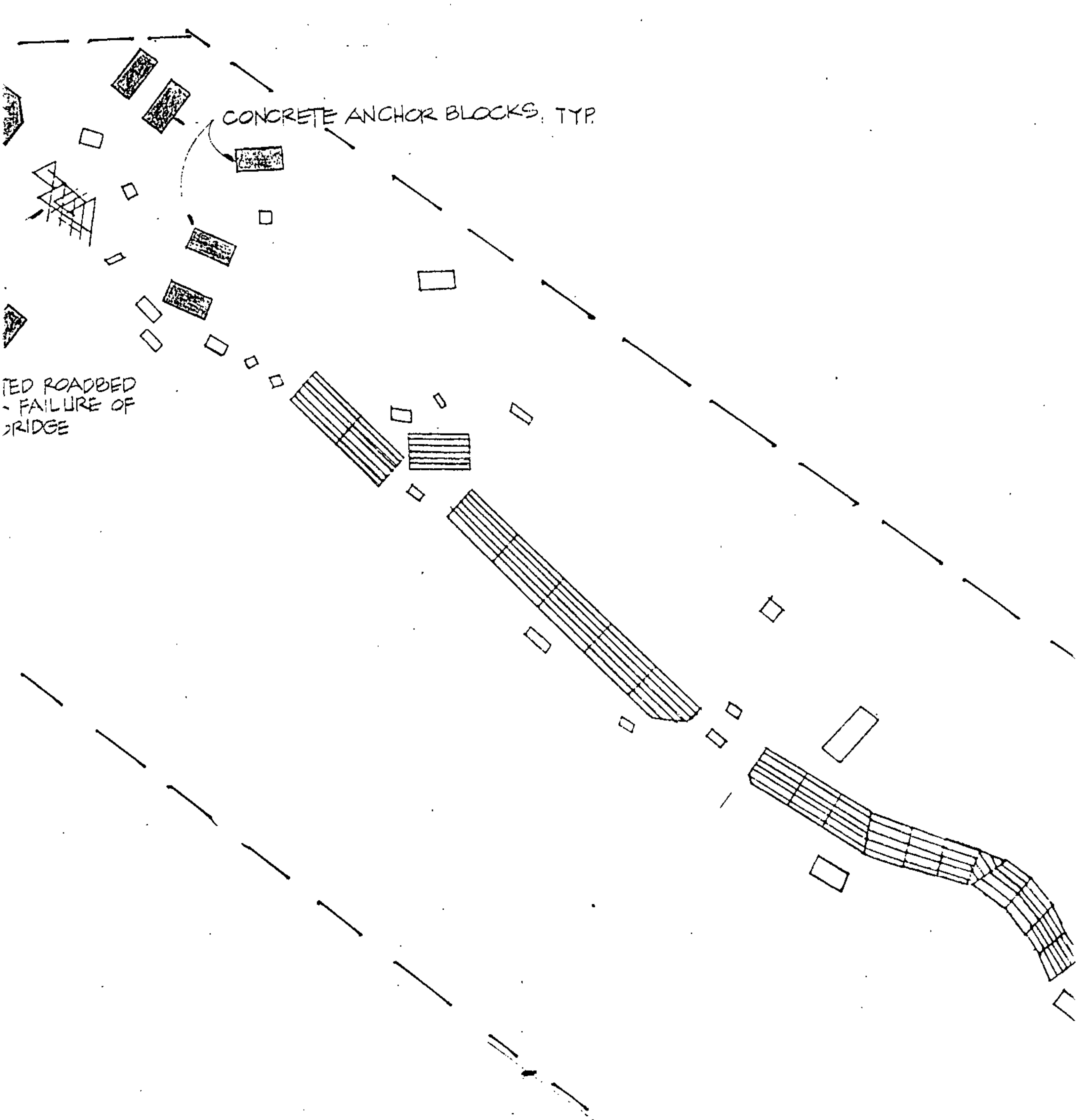
TACOMA NARROWS BRIDGE

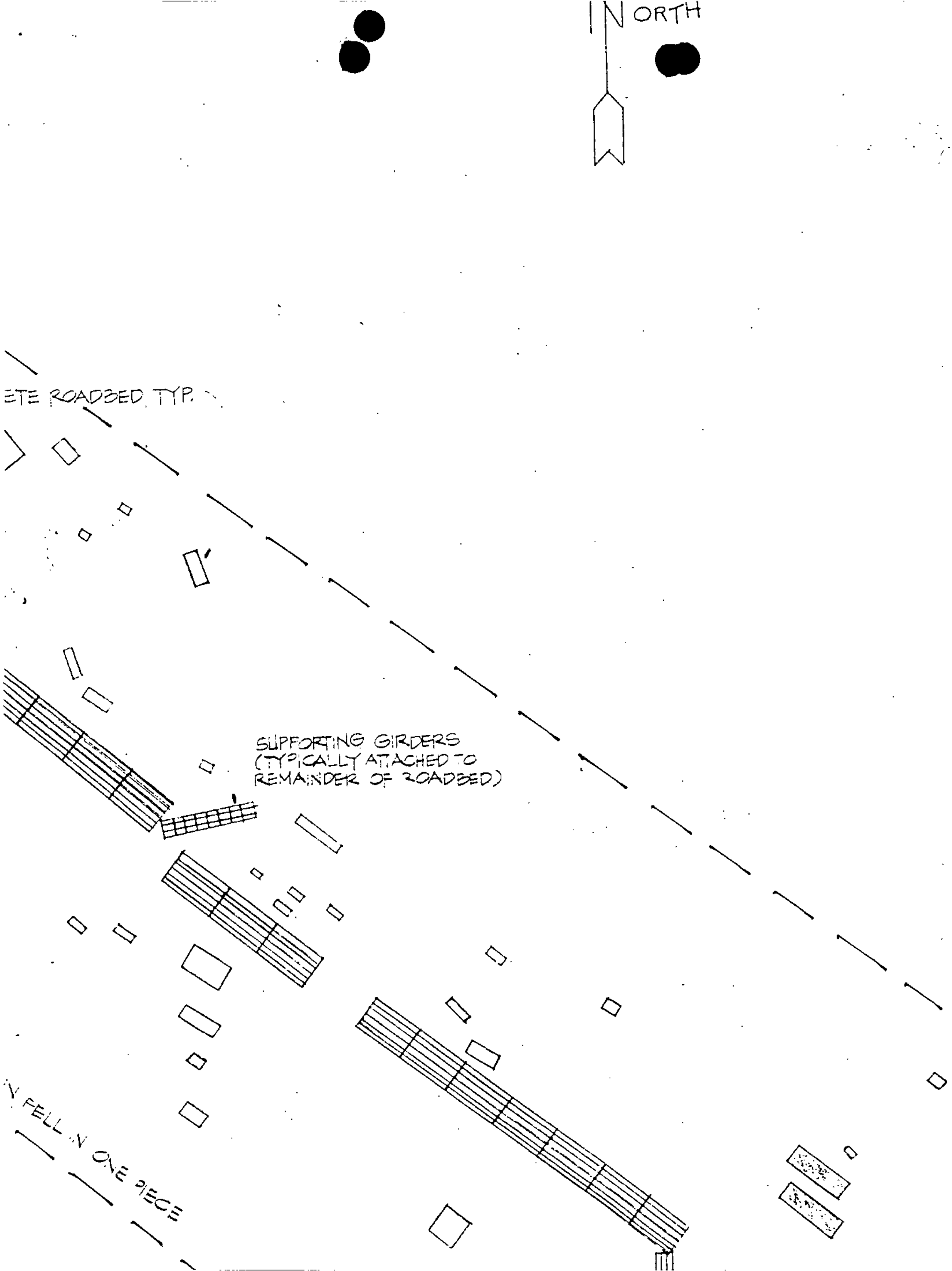
SONAR MAP OF BRIDGE REMAINS

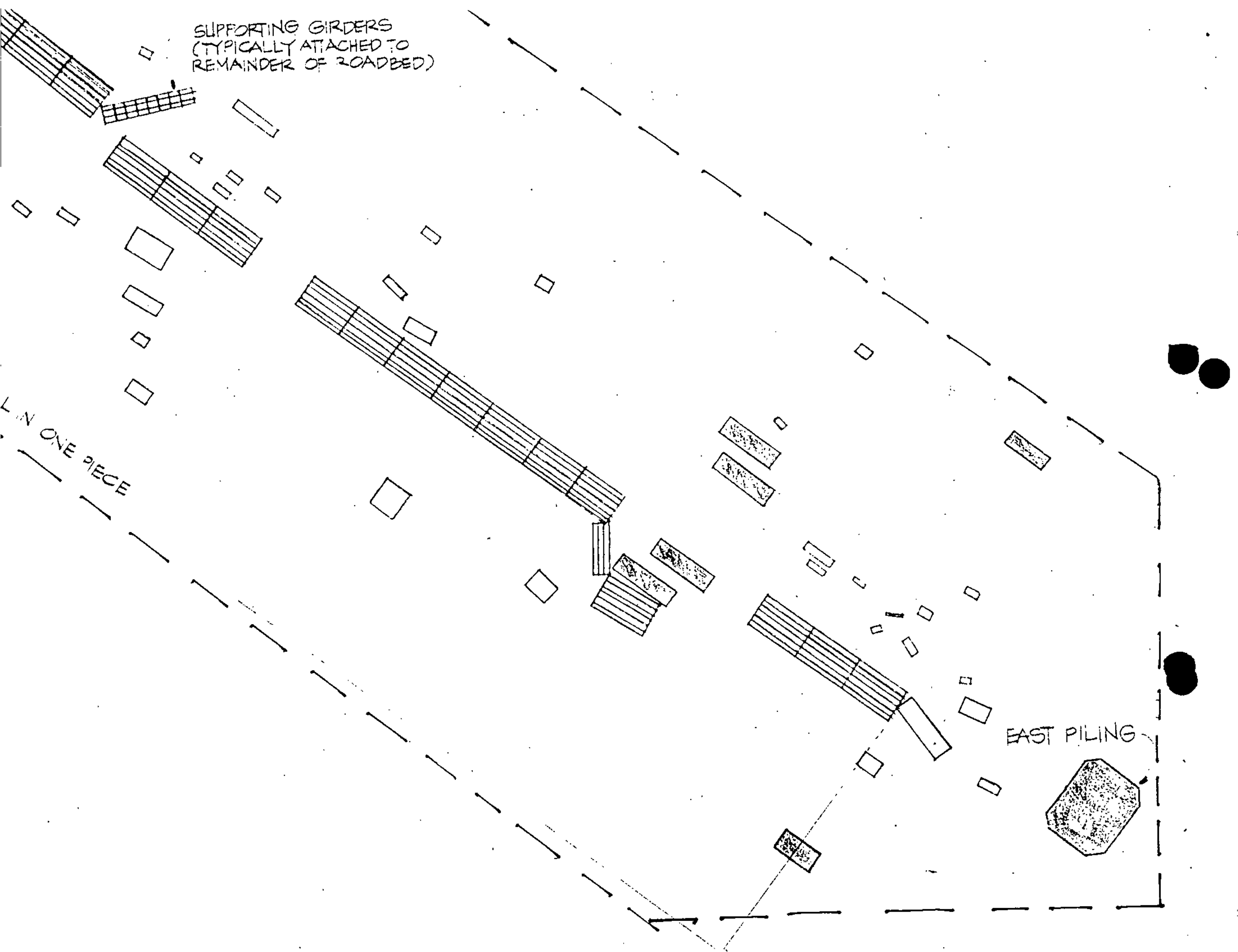
FAILED NOVEMBER 7, 1940

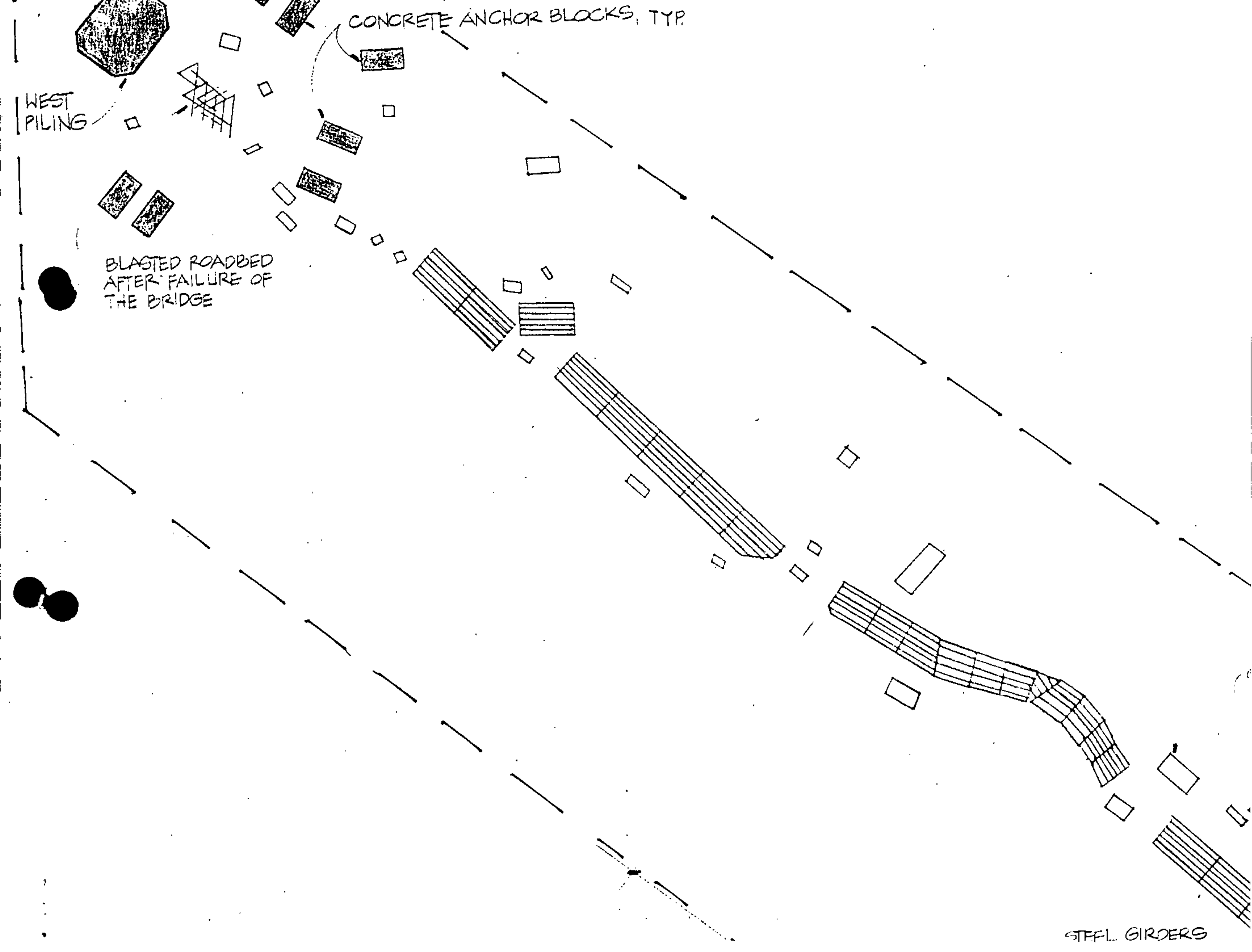
Tacoma Narrow Bridge Ruins
Tacoma, Pierce County, WA
Sonar Map of Submerged Ruins
Scale: 1mm= 3.48 feet
-----= nomination boundary

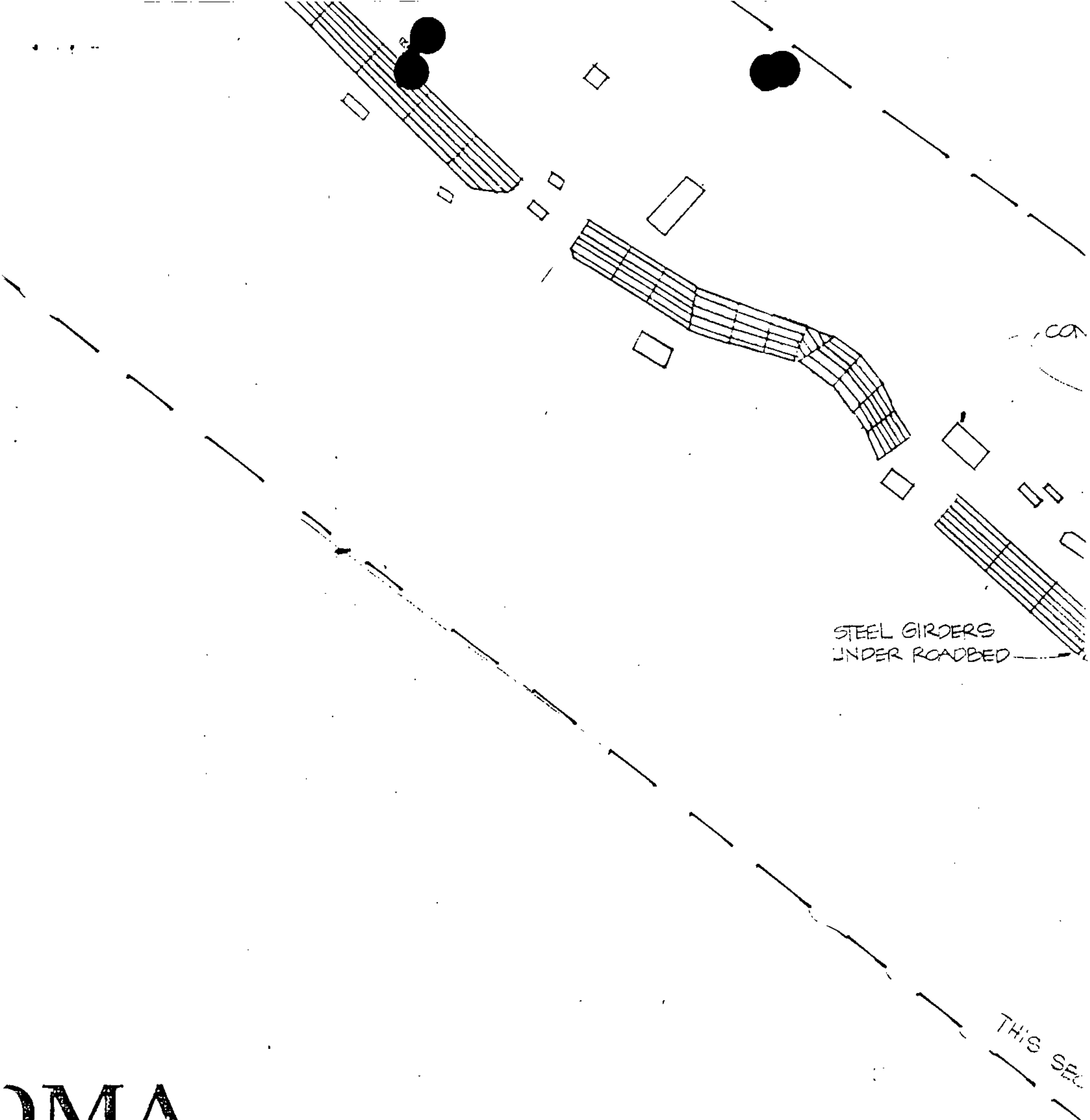
N


CONCRETE ANCHOR BLOCKS, TYP.
TED ROADBED
- FAILURE OF
RIDGE

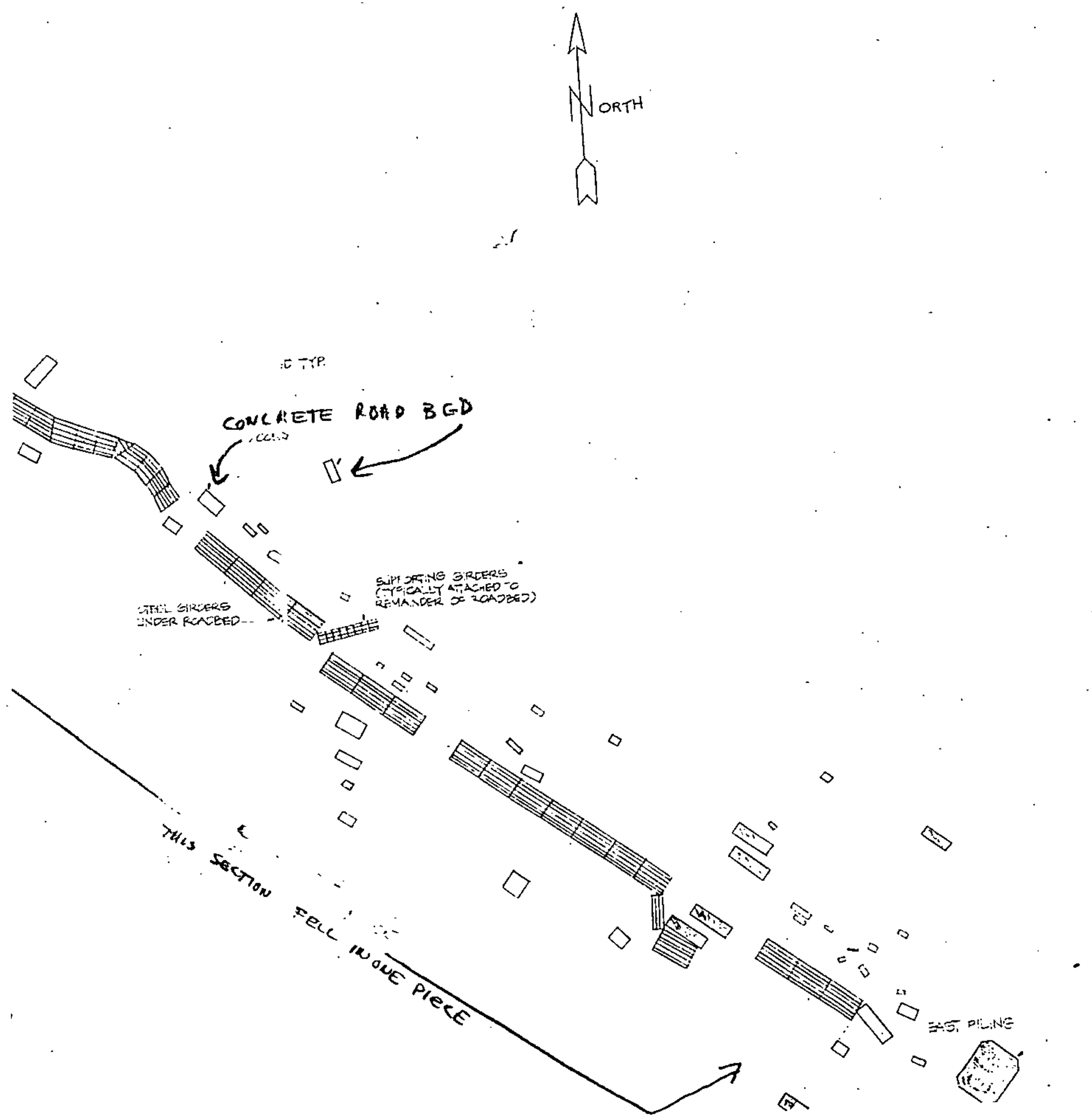

NORTH
ETE ROADBED, TYP.
SUPPORTING GIRDERS
(TYPICALLY ATTACHED TO
REMAINDER OF ROADBED)
N FELL IN ONE PIECE

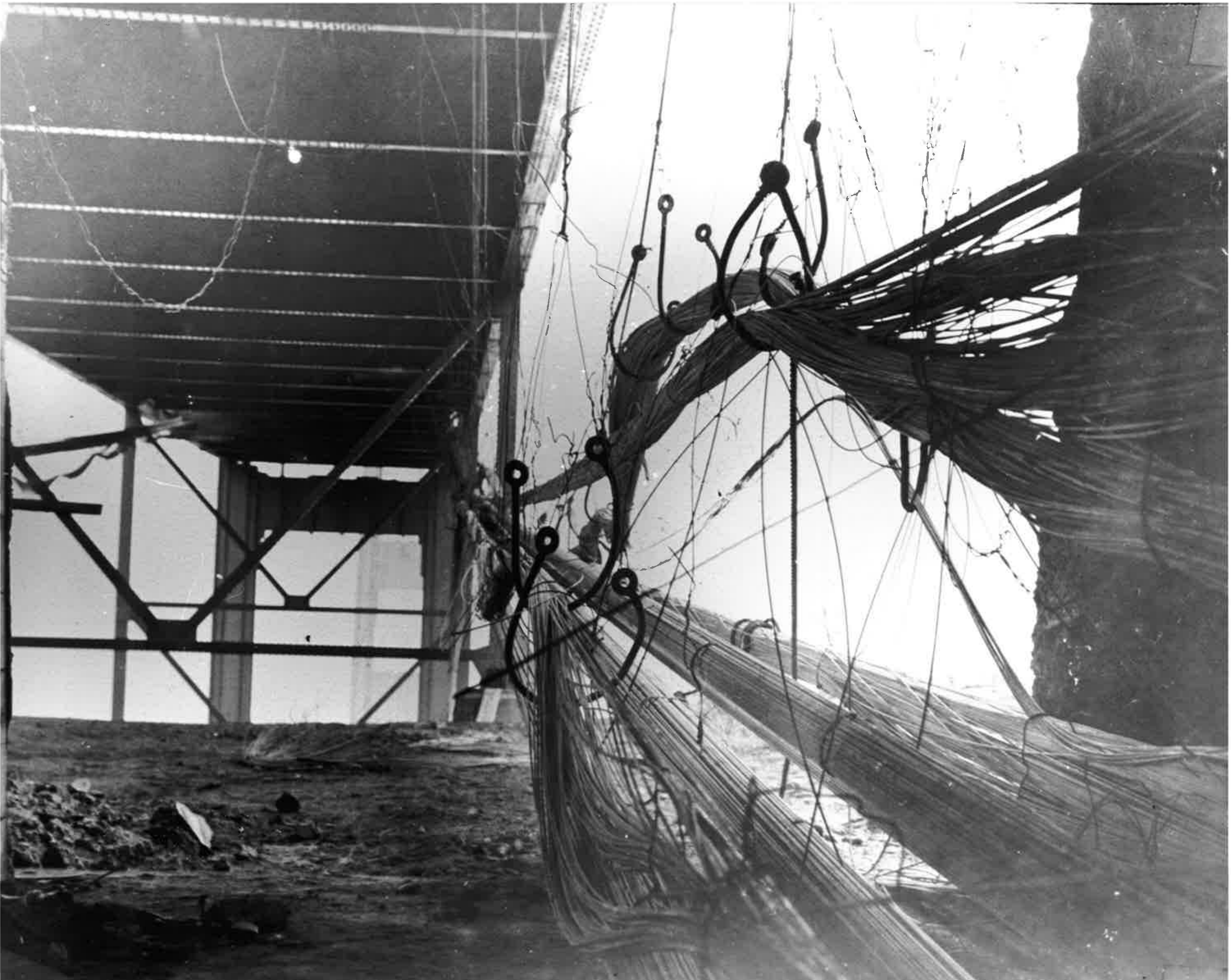

SUPPORTING GIRDERS
(TYPICALLY ATTACHED TO
REMAINDER OF ROADBED)
IN ONE PIECE
EAST PILING


CONCRETE ANCHOR BLOCKS, TYP.
WEST PILING
BLASTED ROADBED AFTER FAILURE OF THE BRIDGE
STEEL GIRDERS

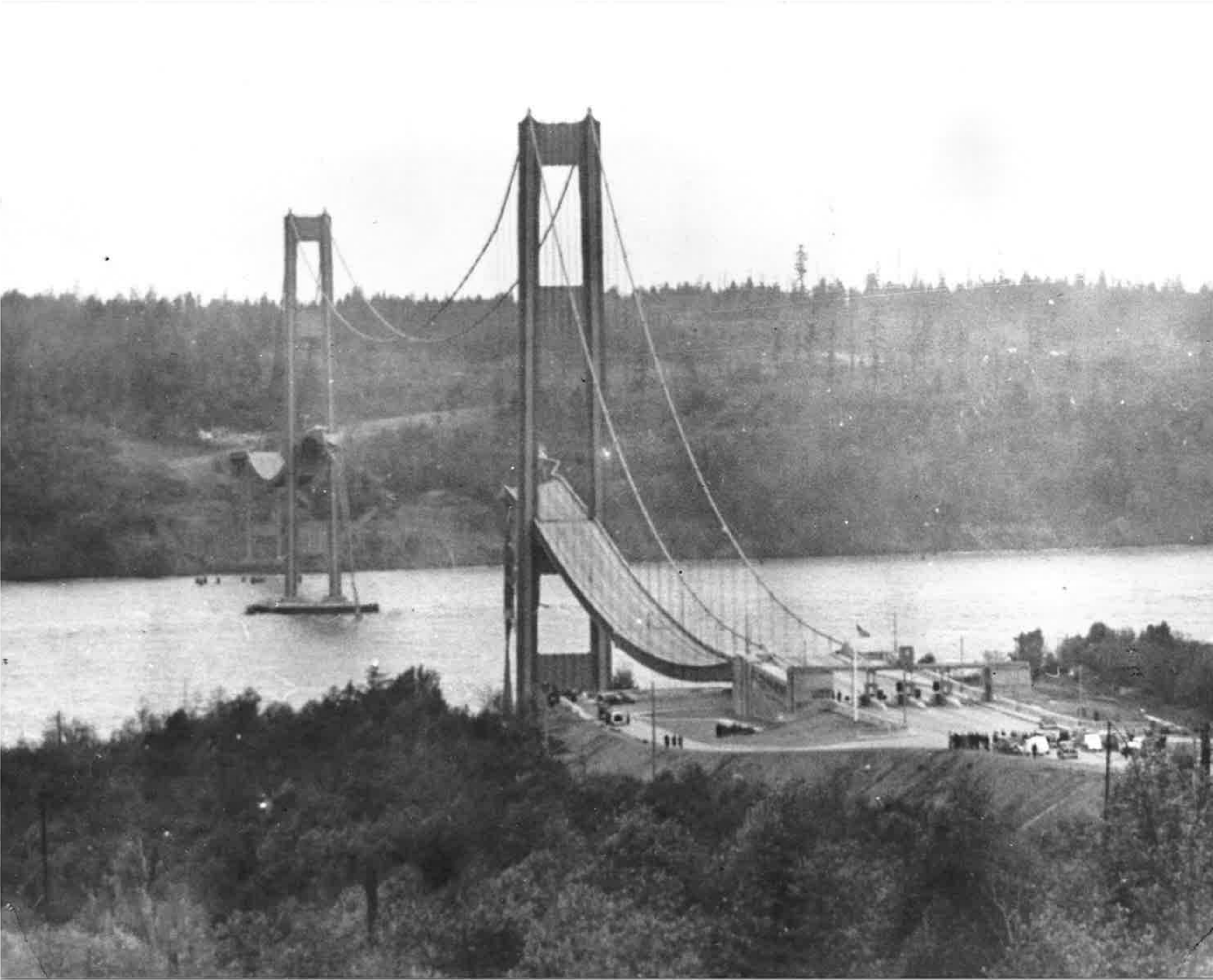


OMA
ROWS
GE


NORTH
CONCRETE ROAD BED
SUPPORTING GIRDERS (TYPICALLY ATTACHED TO REMAINDER OF ROADBED)
STEEL GIRDERS UNDER ROADBED
THIS SECTION FELL IN ONE PIECE
EAST PILING



11/10/40




P.W.A.


COLMAN DOCK
SUNDE & ERLAND CO.
SAIL MAKERS - SHIP CHANDLERS

HISTORIC PROPERTY INVENTORY FORM

~~27-04715~~ PI00601

State of Washington, Office of Community Development
Office of Archaeology and Historic Preservation
1063 S. Capitol Way, Suite 106 – Olympia, WA 98501
PO BOX 48343 - Olympia, WA 98504-8343 (360) 586-3065 FAX 586-3067

IDENTIFICATION SECTION

Field Site No. OAHP No. DATE RECORDED4/22/03
Site Name: Historic Tacoma Narrows Bridge Rubble
Common Same
Field RecorderTrent DeBoer
Owner's NameWashington Department of Transportation
Address
City/State/Zip CodeOlympia, WA

32605

LOCATION SECTION

AddressRte 16
City/Town/County/Zip CodePierce County
Twp.21N Range2E ¼ SectionSE 28 ¼ Section
Tax No./Parcel No. Acreage Less than one acre
Quadrangle or map name Gig Harbor
UTM References Zone 10 Easting533618 Northing5235494
Plat/Block/Lot
Supplemental Map(s)

Status
- ☒ Survey/Inventory
- ☐ National Register
- ☐ State Register
- ☐ Determined Eligible
- ☒ Determined Not Eligible Rq
- ☐ Other (HABS, HAER, NHL)
- ☐ Local Designation

Classification
- ☐ District
- ☐ Site
- ☐ Building
- ☐ Structure
- ☒ Object

District/Thematic Nomination Theme

District Status
- ☐ NR
- ☐ SR
- ☐ LR
- ☐ INV

- ☐ Contributing
- ☐ Non-Contributing

060303-12-FHWA

Photography
Photography Neg. No.
(Roll No. & Frame No.)
View of
Date4/22/2003

DESCRIPTION SECTION

Materials & Features/Structural Types
Building TypeBridge Rubble
Planirregular
Structural Systemreinforced concrete
No. of Stories

Roof Type
- ☐ Gable
- ☐ Flat
- ☐ Monitor
- ☐ Gambrel
- ☐ Hip
- ☐ Pyramidal
- ☐ Shed
- ☐ Other (specify)

Roof Material
- ☐ Wood Shingle
- ☐ Composition
- ☐ Wood
- ☐ Build-Up
- ☐ Tile
- ☐ Metal (specify)
- ☐ Other (specify)
- ☐ Not visible

Foundation
- ☐ Log
- ☐ Post & Pier
- ☐ Stone
- ☐ Brick
- ☐ Concrete
- ☐ Block
- ☐ Poured
- ☐ Other (specify)
- ☐ Not visible

Cladding (Exterior Wall Surfaces)
- ☐ Log
- ☐ Horizontal Wood Siding:
- ☐ Rustic/Drop
- ☐ Wood Shingle
- ☐ Board and Batten
- ☐ Vertical Board
- ☐ Asbestos/Asphalt
- ☒ Concrete/Concrete reinforced
- ☐ Vinyl/Aluminum Siding
- ☐ Stucco
- ☐ Clapboard
- ☐ Brick
- ☐ Stone
- ☐ Terra Cotta
- ☐ Metal (specify)
- ☐ Other (specify)

High Styles/Forms
- ☐ Greek Revival
- ☐ Revival/Mediterranean
- ☐ Gothic Revival
- ☐ Italianate
- ☐ Second Empire
- ☐ Romanesque Revival
- ☐ Stick Style
- ☐ Queen Anne
- ☐ Shingle Style
- ☐ Colonial Revival
- ☐ Beaux Arts/Neoclassical
- ☐ Chicago/Commercial Style
- ☐ American Foursquare
- ☐ Mission Revival
- ☐ Northwest Style
- ☐ Commercial Vernacular
- ☐ International Style
- ☐ Spanish Colonial
- ☐ Tudor Revival
- ☐ Craftsman/Arts & Crafts
- ☐ Bungalow
- ☐ Prairie Style
- ☐ Art Deco/Art Modern
- ☐ Rustic Style
- ☐ Residential Vernacular (below)
- ☐ Other (specify)

Integrity *Include detailed descriptions in Description of Physical Appearance*

	Intact	Slight	Moderate	Extensive
Changes to plan	☐	☐	☐	☒
Changes to windows	☐	☐	☐	☐
Changes to original cladding	☐	☐	☐	☒
Changes to interior	☐	☐	☐	☐
Other (specify)	☐	☐	☐	☐

Vernacular House Types
- ☐ Gable front
- ☐ Gable front and wing
- ☐ Side gable
- ☐ Cross gable
- ☐ Pyramidal/Hipped
- ☐ Other (specify)

NARRATIVE SECTION

Study Unit Themes

- ☐ Agriculture
- ☐ Architecture/Landscape Architecture
- ☐ Arts
- ☐ Commerce
- ☐ Communications
- ☐ Community Planning
- ☐ Arts
- ☐ Conservation
- ☐ Education
- ☐ Entertainment/Recreation
- ☐ Ethnic Heritage (specify)
- ☐ Health/Medicine
- ☐ Manufacturing/Industry
- ☐ Military
- ☐ Politics/Government Law
- ☐ Religion
- ☒ Science & Engineering
- ☐ Social Movements/Organizations
- ☒ Transportation
- ☐ Other (specify)
- ☐ Study Unit Sub-Theme(s) (specify)

Statement of Significance:

Date of Construction 1940

Architect/Engineer/BuilderLeon Moissieff, Principal Engineer

☐ In the opinion of the surveyor, this property appears to meet the criteria of the National Register of Historic Places

☐ In the opinion of the surveyor, this property is located in a potential historic district (National and/or local)

On 7 November 1940 the Tacoma Narrows Bridge collapsed spectacularly into Puget Sound, barely four months after the opening of the 5,000-foot long suspension bridge. Dubbed "Galloping Gertie" because of the longitudinal oscillations that afflicted the structure in the lightest of breezes, the bridge's failure stemmed from its structural lightness and the build up of wind pressure against it's plate girder and deck. The bridge, designed in accordance with current engineering practice, which failed to account for the dynamic effect of wind load, lacked the stiffening necessary to prevent longitudinal "galloping." This design oversight, combined with the large length-to-width ratio of the structure, contributed to the twisting motion that destroyed the bridge.

The second Tacoma Narrows Bridge, built between 1948 and 1951, incorporated design elements intended to prevent the twisting and galloping motions that destroyed the first bridge. These included open trusses, instead of shallow plate girders, for greater stiffness; deck grating between the traffic lanes to lessen wind resistance; and a larger roadway width-to-span length to increase resistance to twisting.

The second Tacoma Narrows Bridge reused the anchor blocks and tower piers of the first bridge. The first bridge carried only two lanes of traffic, but the new bridge was designed to carry four lanes. The new design required wider pedestals at each pier. The pedestals were also lengthened 18 feet to raise the new tower legs above salt spray. Similarly, the first bridge's anchorages, spaced 39 feet apart, were retrofitted to accommodate the new bridge's 60-foot separation between cables. The original anchorages served as the cores of the new, heavier and wider 54,000-ton anchor blocks.

The ruins of the first Tacoma Narrows Bridge, popularly known as "Galloping Gertie," were listed in the National Register of Historic Places on 31 August 1992. The nominated property consists of the underwater remains of the bridge, and is roughly located between the piers of the current bridge. The existing bridge has been determined eligible for listing in the National Register of Historic Places.

The concrete and steel rubble consists of those portions of the original west anchorage that were removed and discarded when the anchorage was retrofitted for the present bridge. This debris is not associated with the bridge superstructure and was not a factor in the failure of the original structure.

Description of Physical Appearance:

Concrete and steel rubble associated with the west anchorage of the first Tacoma Narrows Bridge is evident along the beach and steep slope beneath the current bridge on the west side of Tacoma Narrows. The rubble consists of those portions of the original west anchorage that were removed and discarded when the anchorage was retrofitted for the present bridge. The portions of the rubble that are along the beach are covered with kelp, barnacles, and other marine life. Some rubble pieces above the high tide line display smooth, finished surfaces that were originally part of the exterior surfaces of the anchorage. Other pieces are entirely unfinished, with exposed aggregate, indicating that they were not originally visible surfaces. Some rubble pieces include bits of steel reinforcing. The largest piece of steel within the rubble is a shattered, x-braced beam still embedded in concrete.

Major Bibliographic References:

Tacoma Narrows Bridge: HAER No. WA-99

32605

Tacoma Narrow Bridge Rubble. View to Northwest.

Tacoma Narrow Bridge Rubble. View to west.

32605

Historic Property Inventory Report

Location

Field Site No. DAHP No. PI00601

Historic Name: Tacoma Narrows Bridge Ruins

Common Name:

Property Address: Highway 16 over the Tacoma Narrows, Tacoma, WA

Comments:

Tax No./Parcel No.

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T21R02E				Pierce	

Coordinate Reference

Easting: 1130177

Northing: 713663

Projection: Washington State Plane South

Datum: HARN (feet)

Historic Property Inventory Report

Identification

Survey Name: Legacy for City of Tacoma

Date Recorded: 04/22/2003

Field Recorder: Trent DeBoer

Owner's Name: WA DOT

Owner Address:

City: Olympia

State: WA

Zip:

Classification: Structure

Resource Status:

National Register

State Register

Comments:

Within a District?

Contributing?

National Register: Tacoma Narrows Bridge

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use:

Current Use:

Plan:

Stories:

Structural System:

Changes to Plan:

Changes to Interior:

Changes to Original Cladding:

Changes to Windows:

Changes to Other:

Other (specify):

Style:

Cladding:

Roof Type:

Roof Material:

Foundation:

Form/Type:

Narrative

Study Unit

Other

Date of Construction:

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places:

Property is located in a potential historic district (National and/or local):

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:

Description of Physical Appearance:

Major Bibliographic References:

Photos

Historic Property Inventory Report

Identification

Survey Name: Legacy for City of Tacoma

Date Recorded: 01/01/1900

Field Recorder:

Owner's Name:

Owner Address:

City: State: Zip:

Classification:

Resource Status: Comments:

Within a District?

Contributing?

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Not Determined - SHPO

Determination Date: 1/1/0001

Determination Comments:

Description

Historic Use: Current Use:

Plan: Stories: Structural System:

Changes to Plan: Changes to Interior:

Changes to Original Cladding: Changes to Windows:

Changes to Other:

Other (specify):

Style: Cladding: Roof Type: Roof Material:

Foundation: Form/Type:

Narrative

Study Unit	Other

Date of Construction: Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places:

Property is located in a potential historic district (National and/or local):

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:

Description of Physical Appearance:

Major Bibliographic References:

Photos

Historic Register Report

Historic Name: Tacoma Narrows Bridge Ruins (Galloping Gertie)
Address: Highway 16 Over the Tacoma Narrows
City: Tacoma
County: Pierce

Download nomination form

Historic Use: Transportation
Style: None
Built: 1940
Architect: Eldridge, Clark H.
Builder:

Smithsonian Number: 45PI00601
Date Listed: 8/31/1992
Listing Status: WHR/NR
Classification: SITE
Resource Count: 1
Area of Significance: Engineering
Level of Significance: Local
Listing Criteria: A

Statement of Significance

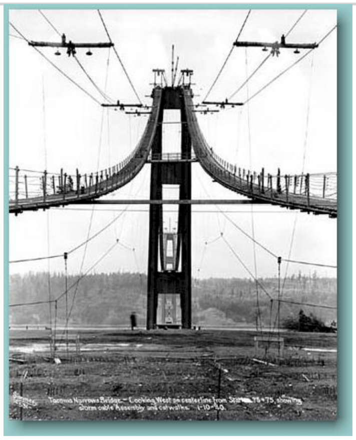
The original Tacoma Narrows Bridge was built between November 1938 and July 1, 1940. Lauded as an essential economic and military portal to the Olympic peninsula, its completion was called a triumph of man's ingenuity and perseverance. Four months after it opened to the public it fell, in what was later called "the Pearl Harbor of engineering."

Contemporary accounts appeared to be shocked by the collapse although the bridge began exhibiting wavelike motions during the final stages of construction. Soon after its official opening the bridge gained a reputation for this movement and became informally christened 'Galloping Gertie.' Professor F.B. Farquharson, an engineering professor at the University of Washington, and other University engineers were hired to suggest methods to reduce the movement on the bridge. Over the next few months experiments were conducted on a scale model but a solution to the problem proved elusive.

On November 7, 1940 Professor Farquharson was there to witness and document the spectacular collapse of what had been the third longest suspension bridge in the world with the longest single span in the country. In the aftermath many theories were discussed concerning the cause of the bridge's collapse. Ultimately an investigative board for the Washington State Toll Bridge Authority announced the failure was due to the bridge's design reacting to the wind in the Narrows.

Although rebuilding the bridge was immediately suggested, investigations on the wreckage found that the entire superstructure to be unusable. The onset of World War II further stalled attempts to rebuild. Salvage activity continued on the bridge through 1942 with the materials going to the U.S. war effort and the profits saved for the construction of a new bridge.

Photos


Tacoma Narrows Bridge – Looking West on centerline from
storm cable Assembly and catwalks. 1-10-40.