FHR-8-300 (11-78) FOR DETERMINATION OF ELIGIBILITY ONLY, PURSUANT TO 36 CFR 60.6(s)

United States Department of the Interior
Heritage Conservation and Recreation Service

For HCRS use only
received
date entered

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic: Booth-Kelly Railroad Bridge

and/or common: Hayden Bridge

2. Location

street & number: McKenzie River at the junction of Marcola Road and Camp Creek Road ___ not for publication

city, town: Springfield X vicinity of congressional district: fourth

state: Oregon code: 41 county: Lane code: 039

3. Classification

Category	Ownership	Status	Present Use	
___ district	___ public	___ occupied	___ agriculture	___ museum
___ building(s)	X private	___ unoccupied	___ commercial	___ park
X structure	___ both	___ work in progress	___ educational	___ private residence
___ site	**Public Acquisition**	**Accessible**	___ entertainment	___ religious
___ object	___ in process	___ yes: restricted	___ government	___ scientific
	___ being considered	X yes: unrestricted	___ industrial	X transportation
		___ no	___ military	___ other:

4. Owner of Property

name: Weyerhaeuser Timber Company

street & number: 785 North 42nd

city, town: Springfield ___ vicinity of state: Oregon 97477

5. Location of Legal Description

courthouse, registry of deeds, etc. Lane County Courthouse

street & number: 125 East 8th Street

city, town: Eugene state: Oregon 97401

6. Representation in Existing Surveys

title: Statewide Inventory of Historic Properties has this property been determined elegible? ___ yes X no

date: May 27, 1976 ___ federal X state ___ county ___ local

depository for survey records: State Historic Preservation Office

city, town: Salem state: Oregon 97310

7. Description

Condition
- ___ excellent
- _X_ good
- ___ fair
- ___ deteriorated
- ___ ruins
- ___ unexposed

Check one
- _X_ unaltered
- ___ altered

Check one
- ___ original site
- _X_ moved date 1900

Describe the present and original (if known) physical appearance

The Booth-Kelly Railroad Bridge is of simple construction consisting of a single-span wrought-iron superstructure bolted to granite slabs, which cap rectangular concrete abutments. Rollers are employed at the east end of the bridge truss. The overall truss form is a trapezoid, consisting of 12 panels, each approximately 18 feet in length. The total width measures 18 feet, and the height from the bottom of the cross beams to the top of the truss measures 35 feet. Rail clearance at the end frame measures 14 feet horizontally and 19½ feet vertically. The total span is 224 feet. There is no center pier because the distance between the river bed and the rails at the middle of the span is over 70 feet in height. The total weight of the truss is 312,350 pounds. The original design load was E25, and the current limit posted is 140,000 pounds. Granite caps on the footings helped distribute the load more effectively than the concrete of the day alone could do. The only cast iron in the bridge is found in the pediment decoration.

The unique feature of this type of bridge is its use of diagonals that cross two panels, rather than one, and slope downward in opposite directions from end to center. All diagonal web members and the bottom chord are designed for tension with the columns and top chord in compression. All major horizontal, vertical and diagonal members are pin connected along the bottom of the bridge. The pins have been bolted together and , like other fittings, are made of wrought-iron. The pins act like hinges at the panel points by permitting all members to rotate. This type of construction practically eliminates secondary stresses, which can be induced in various members due to truss deflection. This is a very positive feature since secondary stresses can create major design problems.

The two parallel trusses are joined beneath the tracks by "I" beams which cross at each of the panel points and tie into the pin connections. Extensive riveting was used to form these beams. On top of the cross beams rest two others of similar construction which span the length of the bridge. The railroad ties are bolted directly to these beams. The railroad tracks/ may be original to the site. Raised lettering on their sides indicate they were fabricated at the Colorado Foundry and Iron Works.

Along the outside of the bridge, and in the bottom chords, members are employed in tension. Flat wrought-iron tension bars run between the pin connections. These bars increase in number from one in the first panel to five in the middle panels. Above these chords, tension members connected to the column tops run diagonally downward , tie to adjacent columns to provide lateral support, then continue down to the pin at the base of the next column. Near the bridge ends pairs of flat wrought-iron bars angle from the top of the truss down toward the center. In the middle third of the bridge pairs of tension rods run down toward both outside ends.

Shorter tension rods are used within individual panels. Beneath the bridge they hold the cross beam ends and the base of the columns in place. At the top of the bridge these rods connect diagonally opposing columns. Additionally, columns that are directly opposite each other are connected by rods that run from their tops to points about five feet down columns across the bridge. Circular decorations which were trademark of the Phoenixville Bridge Works have been placed where these rods cross in the top of the portal frames.

Phoenix columns are used to take the compressive loads. These columns are formed from equal flanged sections of rolled wrought-iron which are riveted together through their flanges. The upper horizontal members that run the length of the bridge are Phoenix columns made of six sections. The interior columns are more slender, having been formed from four segments. Even smaller two-segment members run from side to side between the tops of the columns. Raised lettering on the individual rolled segments confirm that they were manufactured by the Phoenix Iron Company.

The overall structure involves essentially two unsymmetrical trusses which have been superimposed on each other. Each of the trusses contain three redundant diagonal members under zero stress for dead load. During a train's passage these members become operative in order to compensate for the unbalanced live loading. The stresses in many of the diagonal members near the center of the span may vary from zero to maximum stress several times during a single passage. Due to deflection of the structure these members become alternately tight and loose. This dynamic effect of the load on the structure can cause these members to vibrate violently. However, at low speeds no appreciable damage is done.[1] As a result, train speeds over the bridge have been limited to 15 miles per hour.

In recent years the guard rails have been removed to reduce the dead load, but otherwise the bridge appears to be unaltered. The superstructure is in good condition and the substructure is in an excellent state of preservation.[2] No significant rust is visible. The Booth-Kelly Bridge is painted silver with an undercoat of red lead paint. Two final details of particular note are the stylized portal decorations, urn finials, and the builder's plates which cap both end frames. Cut out of the builder's plates are the names "Clarke, Reeves & Co." and "Phoenixville Bridge Works, Pa."

[1]Smith, Dexter, Engineering Report on the Southern Pacific Railroad Bridge, p. 5.

[2]Ibid. p. 10.

8. Significance

Period	Areas of Significance—Check and justify below			
___ prehistoric	___ archeology-prehistoric	___ community planning	___ landscape architecture	___ religion
___ 1400–1499	___ archeology-historic	___ conservation	___ law	___ science
___ 1500–1599	___ agriculture	___ economics	___ literature	___ sculpture
___ 1600–1699	___ architecture	___ education	___ military	___ social/ humanitarian
___ 1700–1799	___ art	_X_ engineering	___ music	___ theater
_X_ 1800–1899	___ commerce	___ exploration/settlement	___ philosophy	_X_ transportation
___ 1900–	___ communications	_X_ industry	___ politics/government	___ other (specify)
		___ invention		

Specific dates 1882 **Builder/Architect** Clarke, Reeves & Co., Phoenixville Bridge Works, Pennsylvania

Statement of Significance (in one paragraph)

The Booth-Kelly Railroad Bridge crossing the McKenzie River in the vicinity of Springfield, Oregon is significant as one of three Phoenix-column double intersection through truss iron bridges and the second longest span of its type in the state. It was fabricated by the Phoenixville Bridge Works in Pennsylvania and erected on the Bear River crossing of the Central Pacific Railroad near Corrine, Utah in 1882. In 1900 it was dismantled and reassembled at its present location to serve a spur line connecting the operations of the Booth-Kelly Lumber Company at Wendling on the upper Mohawk River to the Springfield branch of the Southern Pacific Railroad. The Booth-Kelly Lumber Co., formed in 1895, established its operation at Wendling in 1899. The bridge was acquired by its present owner, Weyerhaeuser Timber Co., in 1961, and the rail line is still in use.

Notwithstanding its relocation at the turn of the century, the Booth-Kelly Bridge embodies the distinctive characteristics of its construction type, it is a comparatively rare and intact example in the West of the work of its manufacturer, and it possesses integrity of design, setting, material, workmanship, feeling, and association with the logging industry in western Oregon.

The Booth-Kelly Railroad Bridge is a rare example of a Phoenix column, double intersection through truss iron bridge. The type of construction is more simply known as a Whipple Truss. Such trusses are noted for being the first scientifically designed trusses in the world. The bridge is also noteworthy for its use of Phoenix columns. These members were very commonly used in Whipple Truss railroad bridges during the late 19th century due to their highly efficient form. They were fabricated by the Phoenixville Bridge Works of Pennsylvania, one of the foremost historic bridge manufacturing companies in America. Only three of these bridges are known to remain in the Pacific Northwest. One of the examples spans approximately 170 feet over the North Santiam River near Mill City, Oregon and has been adapted for use as a public foot bridge. Another spans approximately 250 feet over the Calapooia River near Brownsville, Oregon. Major reinforcement has been added to latter, which is inaccessible to the public. The bridge proposed for nomination was first erected near Corrine, Utah in 1882. It replaced a wood trestle built 13 years earlier as part of the first American transcontinental rail line. In 1900, the iron bridge was moved to its present location on the McKenzie River, northeast of Springfield, Oregon. It remains unaltered and in regular use on a logging spur line that runs between the Mohawk Valley and Weyerhaeuser Timber Company's Springfield mill.

The Booth-Kelly Railroad Bridge is a trapezoid-shaped double intersection through truss. This system evolved from a bow-string truss created in 1840 by the New York engineer Squire Whipple. Whipple was the most renowned of American bridge truss inventors. His analysis of the strains on bridges were a notable advance from design methods that had until then been based on empirical knowledge. Whipple worked out an accurate method for calculating the nature and magnitude of forces acting on individual members of a truss. Knowing the strength of a material, he could determine the allowable unit strength in tension or compression and then calculate the size of members for given loadings. In 1846, Whipple modified his bow-string design into a trapezoid and obtained a patent the following year. The first bridge built according to this design was for the Rensselaer & Saratoga Railroad near Troy, New York in 1853. Around 1865, John W. Murphy, Chief Engineer of the Lehigh Valley Railroad, introduced the idea of using eyebars, all pin connections, and an all iron version of the Whipple truss.[3] The innovations of this truss, which the nominated bridge represents, quickly made it the standard railroad truss of the late 19th century. Practically all long spans in this period were this type. Some of these bridges had single spans of over 500 feet, which is more than twice the length of the nominated bridge. One of the major attractions of these bridges was their ease of assembly. Erection could be completed in a very short time since field riveting was almost eliminated. Nevertheless, numerous disadvantages, including the large number of members required, large amounts of costly work done in the shop, difficult analysis, and lack of rigidity resulted in this type of construction being replaced with a simpler type of truss by the turn of the century.

The use of Phoenix columns is another of the bridge's significant features. These members were devised by Wendel Bollman, a bridge engineer with the Baltimore and Ohio Railroad, for the supporting bents of a bridge erected in Havana, Cuba. In 1858, Bollman, realizing the inherent weakness of long slender cast-iron members in compression, had riveted specially-rolled wrought-iron segments into hollow circular columns, somewhat like the staves of a barrel. The load-bearing capacity of such columns could be increased by simply adding more segments. The flanges where individual segments were riveted together provided excellent connections, enabled lateral bracing and increased rigidity against bending. These columns were highly efficient in relation to their weight. Bollman had shown this idea to Samuel Reeves of the engineering firm Clarke, Reeves & Company (the predecessor of the Phoenixville Bridge Works), and a patent was taken out in Reeves' name in 1862.[4] Reeves was the grandson of the founder of the Phoenix Iron Company of Phoenixville, Pennsylvania, the foundry which was to manufacture Phoenix columns. Many different columns were patented and manufactured by other companies, but Phoenix columns were the most widely used. They were employed in numerous towers, elevated railroad piers, iron frame buildings, and even in the tower-like interior frame of the Washington Monument. Their most common use was in Whipple Truss railroad bridges. Clarke, Reeves, & Company and the Phoenixville Bridge Works were among the foremost American bridge manufacturers, yet comparatively few of the bridges produced by them have survived. In 1883, shortly after Clarke, Reeves & Company built the nominated bridge,Thomas Curtis Curtis Clarke moved on to the New Union Bridge Company in New York. There he worked as Chief Engineer on the Poughkeepsie Bridge, the long spans of which over the Hudson River made it one of the more significant bridge-building achievements of the 19th century.

The nominated bridge was fabricated in Pennsylvania and erected in 1882, on the Bear River crossing, near the town of Corrine, Utah. There it replaced a wooden trestle built in 1869, which had been part of the nation's first transcontinental rail line built by the Central Pacific (later called Southern Pacific) and Union Pacific Railroads. Just before the turn of the century, workmen dismantled the iron bridge at Bear River, and the bridge was shipped to Oregon for re-assembly on the McKenzie River. It was opened to traffic by 1901.

Moving of the bridge was a significant event but a fairly common practice of railroad companies which moved bridges to accommodate the demands of heavier loads and increased traffic. In 1887, connections had been established between Eugene, Portland, San Francisco and Eastern markets. At the time the nominated bridge was relocated, Eugene was becoming a rail center for the region. During this period most wooden bridges and trestles were being replaced with iron structures.

The Booth-Kelly Railroad Bridge reflects the trend, of the period, although it was actually the first bridge on its site. The spur line on which it is located was not built until around 1900. The purpose of this line was to connect the Booth-Kelly lumber operations at Wendling, on the upper Mohawk River, to the Springfield branch of the Southern Pacific. John F. Kelly and Robert Booth had formed their lumber company in 1895, and they built their first mill four years later at Wendling.[5] Originally they had manufactured rail ties which the Southern Pacific used to expand its rail system throughout Oregon. For a short while the Southern Pacific trains hauled only ties across the bridge. They began hauling logs to another Booth-Kelly mill erected in Springfield in 1912. The present owner, Weyerhaeuser Timber Company, purchased the bridge and the rest of the Mohawk Valley system in 1961. The rail line is still used regularly to carry logs.

The bridge's site is significant as a historic crossing point. The McKenzie River becomes unusually narrow as it passes between the Cascade foothills and a butte that was once part of the Mohawk Valley wall. Older roads ran along this edge, avoiding the central flood plain, and crossed the river here via a covered bridge. The bridge is a landmark situated near the junction of three well traveled roads, and it is easily viewed from the adjacent Marcola Road Bridge.

[3] Plowden, David, Bridges: The Spans of North America, p. 83.

[4] Ibid. p. 85.

[5] Portrait and Biographical Record of the Willamette Valley, Oregon, p. 1420. Note on John F. Kelly.

9. Major Bibliographical References

See continuation sheet

10. Geographical Data

Acreage of nominated property less than one

Quadrangle name Springfield, Oregon — Quadrangle scale 1:24,000

UMT References

	Zone	Easting	Northing		Zone	Easting	Northing
A	1 0	5 0 2 9 6 0	4 8 7 9 6 4 0	B			
C				D			
E				F			
G				H			

Verbal boundary description and justification The Booth-Kelly Railroad Bridge is located in SW¼ Sec. 20, T. 17S., R. 2W., W.M., in Lane County, Oregon. It crosses the McKenzie River near the junction of Marcola Road and Camp Creek Road. Bridge abutments are within 100-foot-wide strip of railroad right-of-way. The area nominated is a corridor (see continuation sheet)

List all states and counties for properties overlapping state or county boundaries

state	code	county	code
state	code	county	code

11. Form Prepared By

name/title David Kariel, Student

organization School of Architecture and Allied Arts — date June 24, 1980

street & number University of Oregon 765 East 18th — telephone (503) 344-8336

city or town Eugene — state Oregon 97403

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

___ national X state ___ local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89–665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the Heritage Conservation and Recreation Service.

State Historic Preservation Officer signature [signature]

title Deputy State Historic Preservation Officer — date June 30, 1981

For HCRS use only

I hereby certify that this property is included in the National Register

date

Keeper of the National Register

Attest: date

Chief of Registration

FHR-8-300 (11-78)

United States Department of the Interior
Heritage Conservation and Recreation Service

National Register of Historic Places Inventory—Nomination Form

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date entered

Continuation sheet | Item number 9 | Page 1

Major Bibliographic References

1. Condit, Carl W. American Building. Chicago: University of Chicago Press, 1968.

2. Portrait and Biographical Record of the Willamette Valley, Oregon. Chicago: Chapman Publishing Company, 1904. Note on John F. Kelly.

3. Lane County Archives, Railroad Collection.

4. Plowden, David. Bridges: The Spans of North America. New York: Viking Press, 1974.

5. Smith, Dexter R. Engineering Report on the Southern Pacific Railroad Bridge over The McKenzie River Near Springfield, Oregon. Prepared for Weyerhaeuser Timber Company, January 1959.

6 Scott, Harvey W. History of the Oregon Country, Vol. 4. Cambridge, Massachusetts: Riverside Press, 1924.

7. Southern Pacific Railroad Company Records.

8. Weyerhaeuser Timber Company Records.

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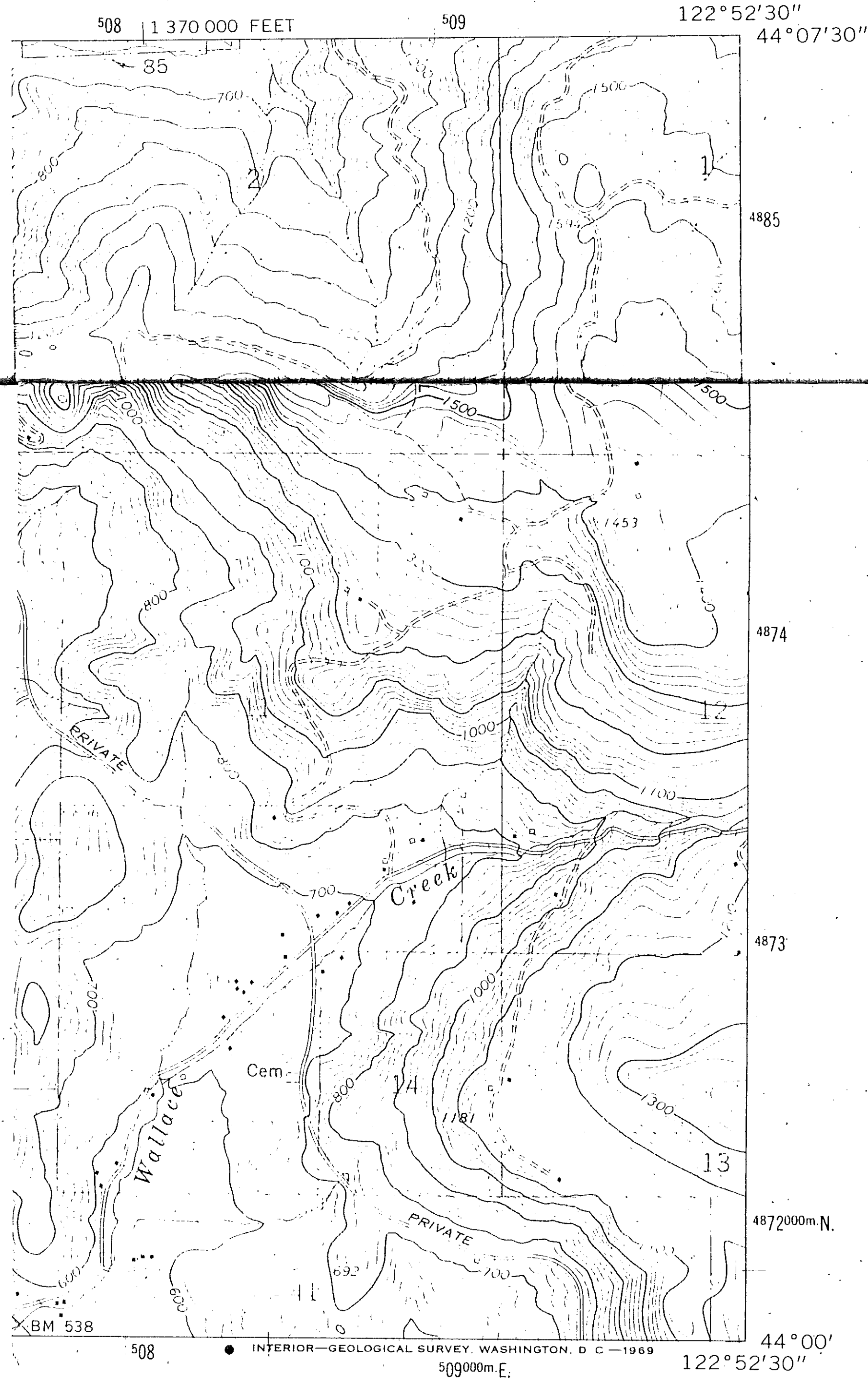
the width of the right-of-way extending 254' to include the bridge and its abutments and a few feet additional at either end of the crossing.

SPRINGFIELD QUADRANGLE
OREGON—LANE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 MARCOLA 15' QUADRANGLE

(MARCOLA 1:62
1472 III



(LOWELL 1:62 500)
1471 IV

ROAD CLASSIFICATION

Heavy-duty .... Light-duty ....
Medium-duty .... Unimproved dirt ....

U. S. Route

BOOTH-KELLY RAILROAD BRIDGE

SPRINGFIELD, OREG.
SW/4 MARCOLA 15' QUADRANGLE
N4400—W12252.5/7.5

1967

AMS 1472 III SW—SERIES V892

ATION

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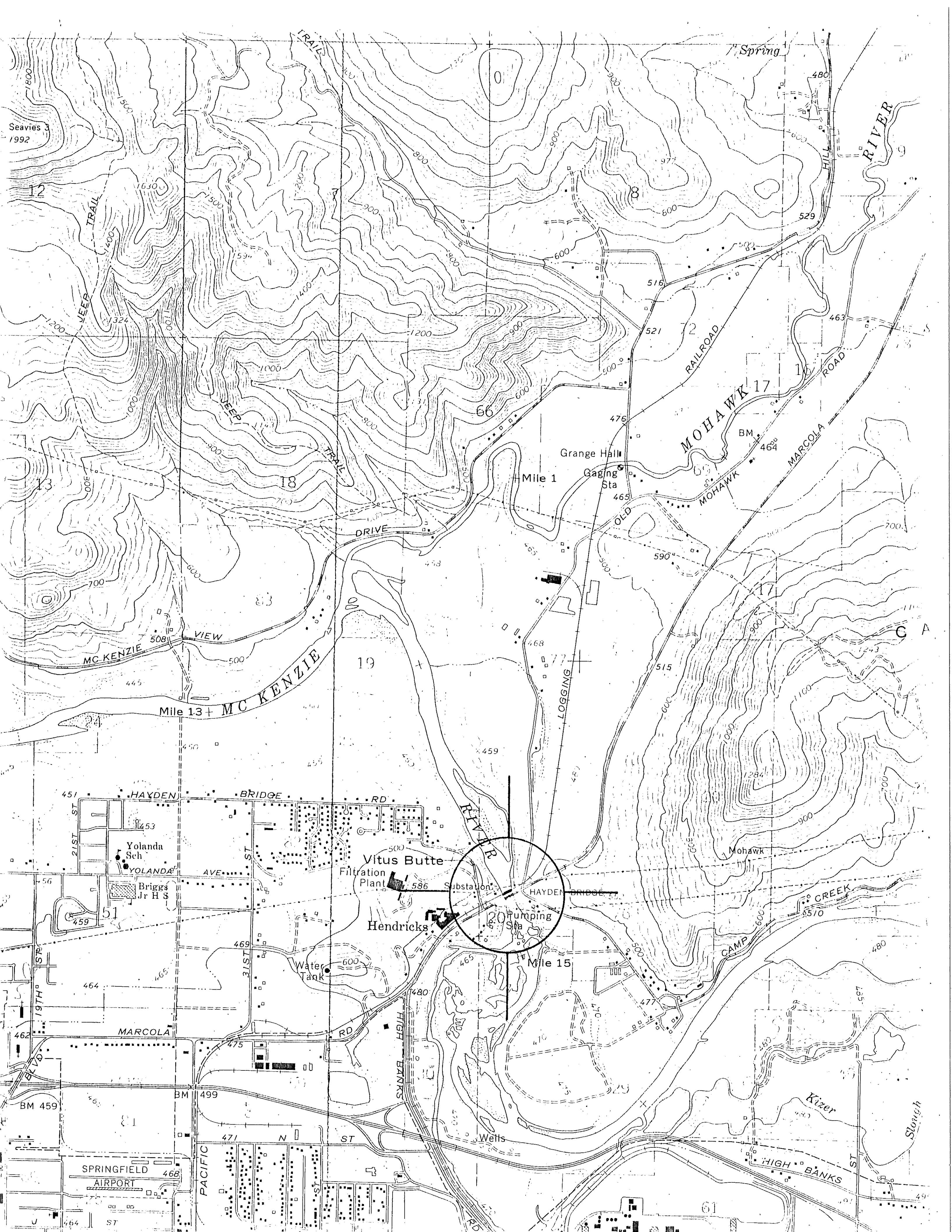
Spring
RIVER
HILL
Seavies 3
1992
TRAIL
JEEP
RAILROAD
MOHAWK
ROAD
MARCOLA
Grange Hall
Gaging Sta
Mile 1
OLD
DRIVE
LOGGING
MC KENZIE
VIEW
Mile 13
MC KENZIE
HAYDEN
BRIDGE
RD
RIVER
Yolanda Sch
YOLANDA
AVE
Briggs Jr H S
Vitus Butte
Filtration Plant
Substation
Hendricks
Pumping Sta
Mohawk
CREEK
CAMP
Mile 15
Water Tank
MARCOLA
RD
HIGH BANKS
BLVD
BM 459
BM 499
Kizer
Slough
471 N ST
Wells
PACIFIC
SPRINGFIELD AIRPORT
HIGH BANKS
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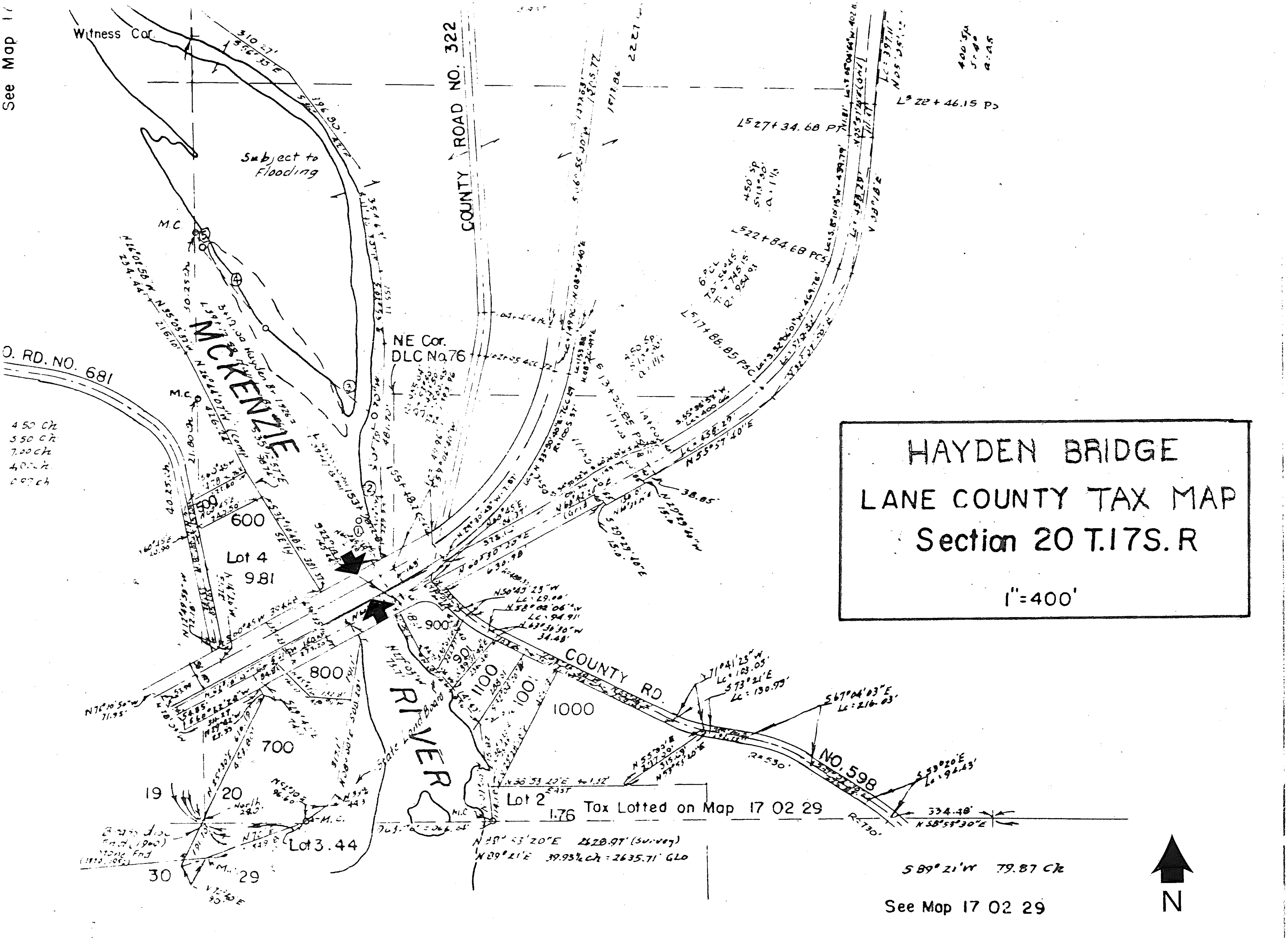
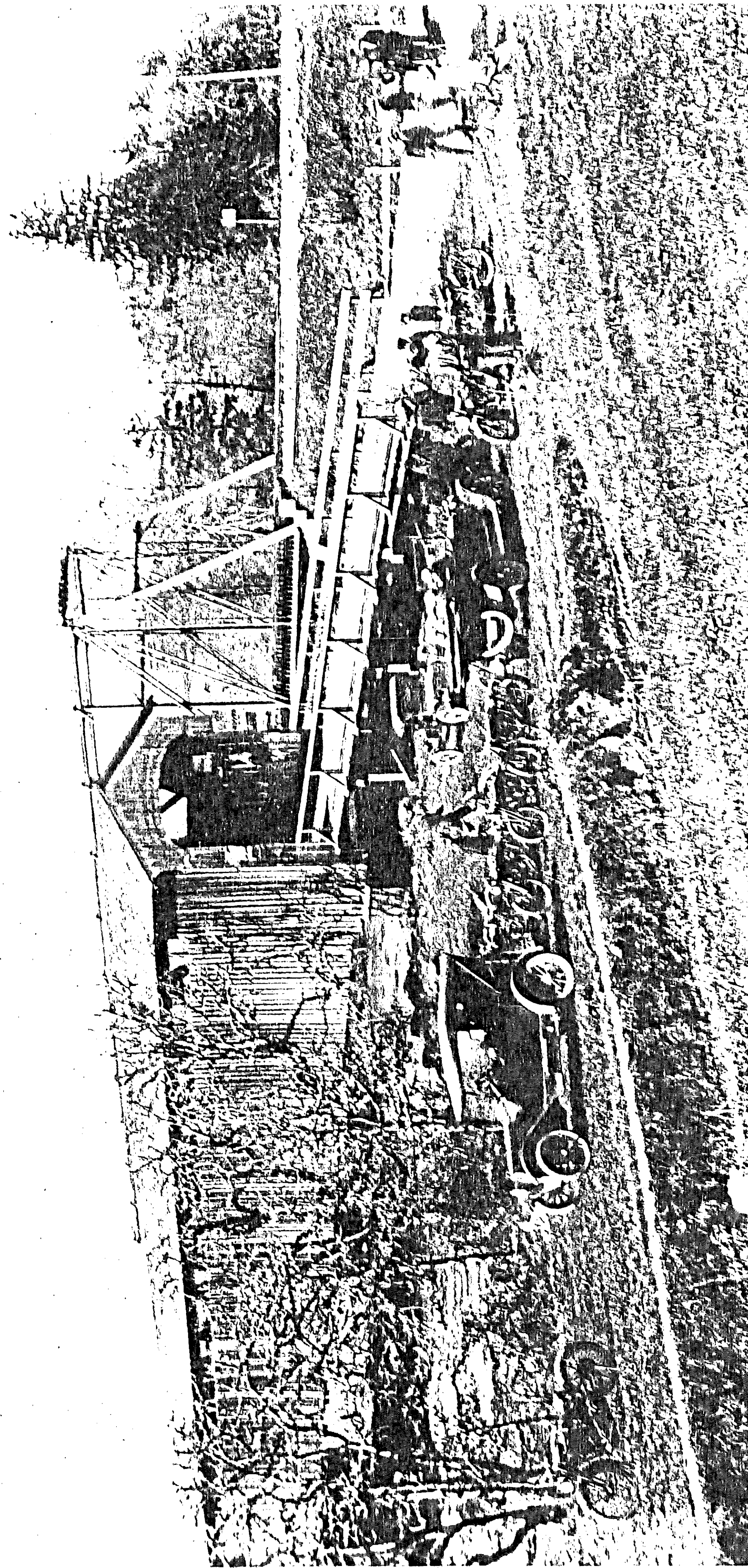

HAYDEN BRIDGE
LANE COUNTY TAX MAP
Section 20 T.17S. R
1"=400'
N
See Map 17 02 29
Tax Lotted on Map 17 02 29
COUNTY ROAD NO. 322
COUNTY RD.
NO. 598
RD. NO. 681
MCKENZIE
RIVER
NE Cor.
DLC No. 76
Subject to Flooding
Witness Cor.
State Land Board
Lot 4
9.81
Lot 2
1.76
Lot 3.44
600
700
800
900
901
1000
1001
1100
19
20
29
30
M.C.
S 89° 21' W 79.87 Ch
See Map 1



View from west bank of the McKenzie River, with south elevation of railroad bridge in background (near Springfield, Ore.).

Photographer unknown

Approximate date 1920

1 of 4 Booth-Kelly Railroad Bridge
McKenzie River, Springfield vicinity
Lane County, Oregon. Photo ca. 1920.
Historic view and negative stored:
Lane County Museum, Eugene, Oregon

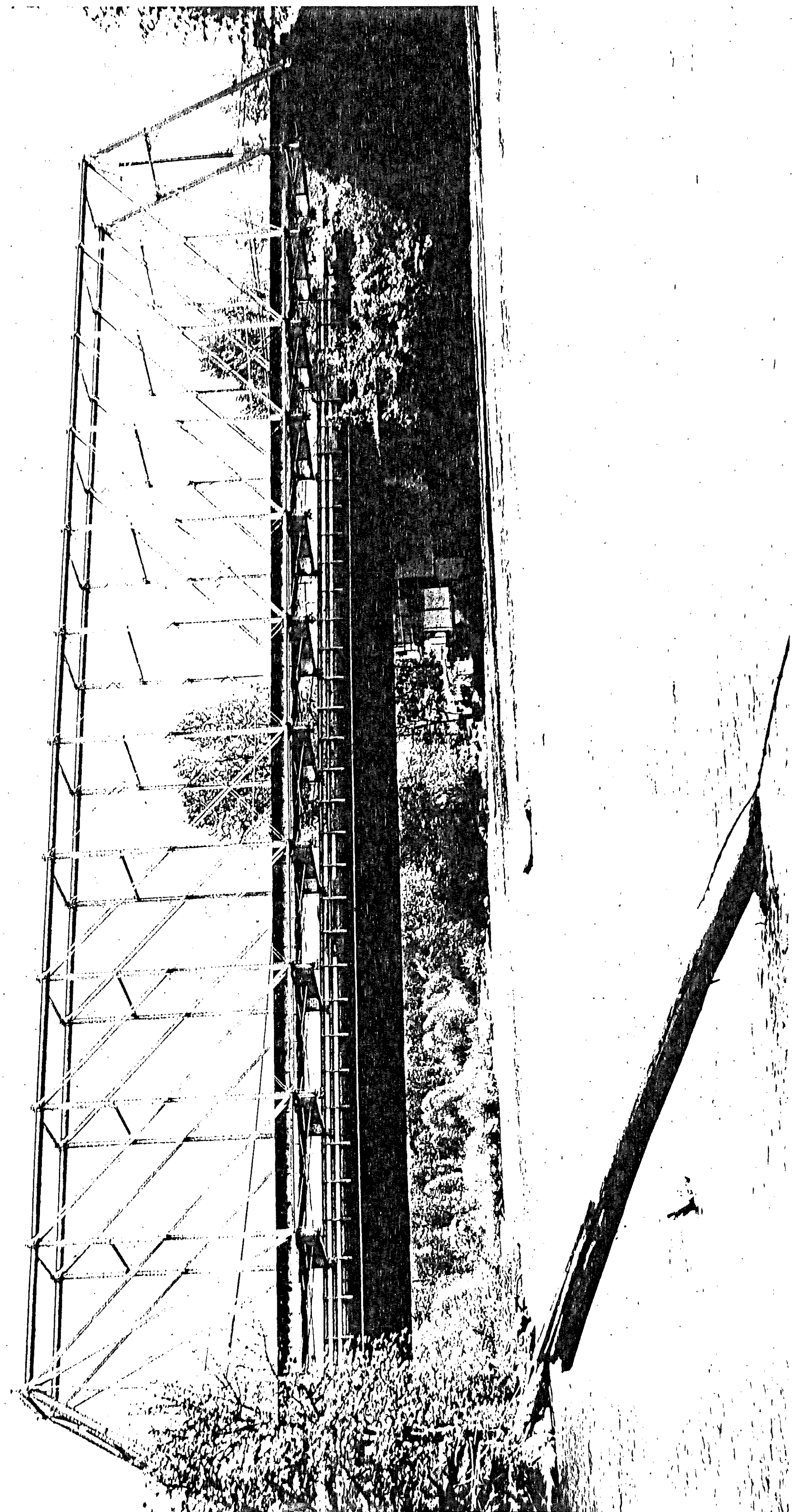

DANGER
NO TRESPASSING
VIOLATORS WILL

East elevation of railroad bridge near Springfield, Ore.

Photograph by David Kariel
765 East 18th Ave.
Eugene, OR 97403

May 1980

2 of 4 Booth-Kelly Railroad Bridge
McKenzie River, Sprinfield vicinity
Lane County, Oregon

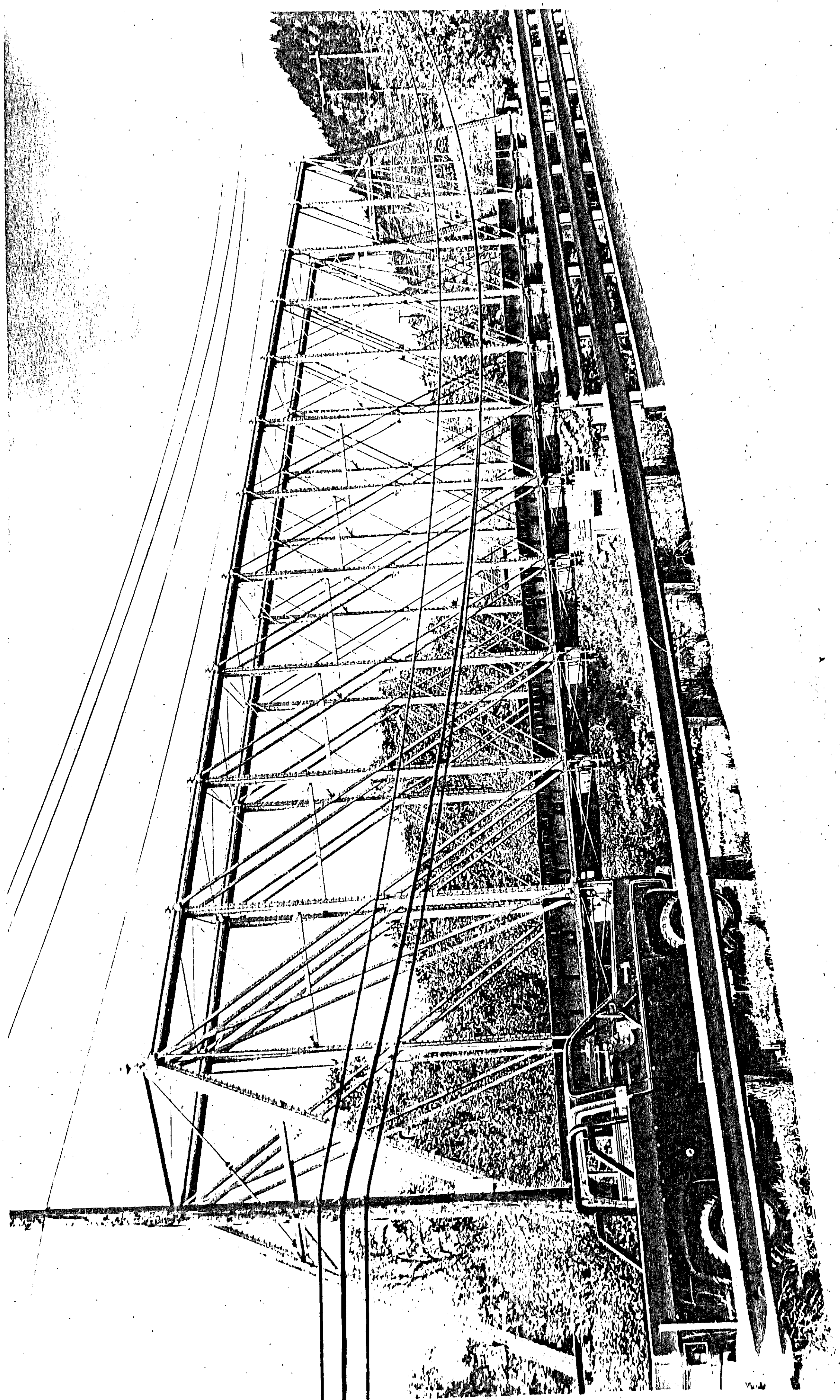


North elevation of railroad
bridge in Springfield, Ore.

Photograph by David Kariel
765 EAST 18TH AVE.
EUGENE, OR 97403

May 1980

3 of 4 Booth-Kelly Railroad Bridge
McKenzie River, Springfield vicinity
Lane County, Oregon



South elevation of railroad bridge in Springfield, Ore.

Photograph by David Kariel
765 EAST 18TH AVE.
EUGENE, OR 97403

May 1980

4 of 4 Booth-Kelly Railroad Bridge
McKenzie River, Springfield vicinity
Lane County, Oregon

Bob Gehrman

Interoffice Communication

Weyerhaeuser Company
Wood Products Group

Date April 5, 1967

Location Springfield Area

Subject Hayden Bridge - Mohawk R.R.

To

This bridge was designed 99 years ago by Clarke-Reeves Co. of Phoenixville, Pennsylvania. It is a pin connected truss span of 226 feet. It was built for the Central Pacific R.R. and erected over the Bear River, Utah Territory near the town of Corrine and opened to traffic in April, 1869.

The bridge was dismantled and in 1900, re-erected at its present location. In recent years, the guard rails were removed in order to reduce the dead load on the bridge and a live load limit of 140,000 pounds was posted.

This bridge is the weakest and most vulnerable point in our entire transportation system for timber from the Mohawk unit to the mill. Thus far, we have been fortunate to escape failure of the bridge in two instances. In the first instance, an overwidth load fractured one tension rod and severly bent two tension flat bars. Had the exterior mates to these bars also been broken, the bridge would have collapsed. The S.P. bridge crew was engaged to make the necessary repairs. Immediately following this "near catastrophe", guide posts or "tattle tales" were installed in the yards at the transfer and at the Mohawk River Bridge. These posts are 4"x4", painted alternate black and red and set in the ground at each side of the track with two inches less clearance on each side than the Hayden Bridge. The entire train crew has been instructed to observe the condition of these posts at each passing and report the condition of them on their daily time slips. These posts, however, proved insufficient in the most recent incident. A top log became partially displaced before reaching the guideposts at the Mohawk Bridge. The log merely knocked the post out of plumb in a North-South position leaving it practically plumb in an East-West position. This irregularity could not be observed by the crewman riding the caboose. Somehow, between the guideposts and Hayden Bridge, the log became further dislodged and raked all of the bridge members on the inside of the West truss of the bridge. Some members were bent, but no apparent structural damage was observed. However, if the head end of the log, rather than the rear end, had protruded, then the damage could have been major and resulted in complete failure of the bridge.

IC-22

Due to the load and restricted clearance, it is not feasible to install any practical armor for the tension members. This total clearance is now fourteen feet, whereas the required R.R. and I.C.C. minimum has been sixteen feet for many years.

Recently, the Oregon Bridge Co. made a study of a replacement bridge both upstream and downstream from the present bridge, but within our 100 foot right-of-way. The preliminary estimate for a single span, truss bridge, 260 feet long, downstream, was $377,000. For a 225 foot span upstream, the estimate was $290,000. Additional study will, I am certain, show that a bridge upstream could be reduced to a maximum 200 foot span.

Inasmuch as the average water depth of the river at this point is 72 feet, a center pier is prohibitive. The limited high water clearance does not lend itself to a continuous plate girder. Therefore, the selection of a truss bridge is the most practical. From the above figures, a similar bridge 200 feet long should cost proportionately, $230,000.

It is possible that there are some abandoned R.R. bridges that may fit into the picture. Several sections of main line have been relocated that have bridges on them. Such a bridge even with the cost of dismantling and shipping would certainly be less expensive than new steel. Another point; such a bridge could be purchased and undoubtedly left standing or stockpiled until needed. The elimination of the cost of design would more than balance any loss of interest on money tied up. Delivery on new steel is very slow, even without present war conditions. All of these bridges are designed for Cooper E-72 loading which is the main line standard and equal to our new Mohawk River Bridge. With this type of bridge, there would be no weak spots in our system.

The study mentioned above was made at the request of Lane County. The county wishes to replace the present Hayden county road bridge with a new one. They requested permission to construct the new bridge paralell to our bridge upstream and within our right-of-way. I objected to this because if and when we replace our bridge, it should be located upstream in order to shorten the span.

When Oregon Bridge Engineering Co. came up with their estimates of a new R.R. bridge downstream, Lane County gave up the idea of reimbursing us for a new bridge downstream in order to obtain the upstream right-of-way from us. Lane County has now decided to construct their new bridge upstream from the E.W.E.B. pumping station.

In summary, it would appear that -

(1) A failure of the present bridge would disrupt the Mohawk log transportation system from six to eight months.

(2) Further study should be made in the very near future of -

- (a) Possible foundations and length of required minimum span.
- (b) Availability of used bridges applicable.
- (c) Steel delivery if new bridge required.
- (d) Cost of approaches and rail relocation.
- (e) Cost of armor of effluent and E.W.E.B. water lines.
- (f) Total cost and time factors.

(3) An estimate of per diem or per F.B.M. cost of inoperative railroad transportation should be made.

(4) An inquiry be made as to the possible participation of the Southern Pacific Co. in this project.

Del Hilliard

DHH:rs

Del Hilliard