



**CUY-90-14.90**

**PID 77332/85531**

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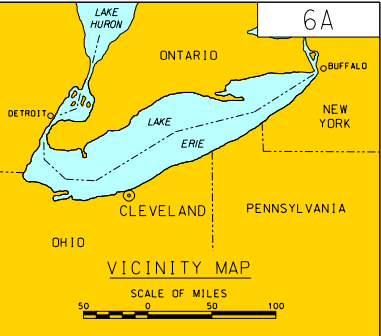
**APPENDIX ST-04**

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**Bulkhead Reference Information  
(Reference Document)**

State of Ohio  
Department of Transportation  
Jolene M. Molitoris, Director

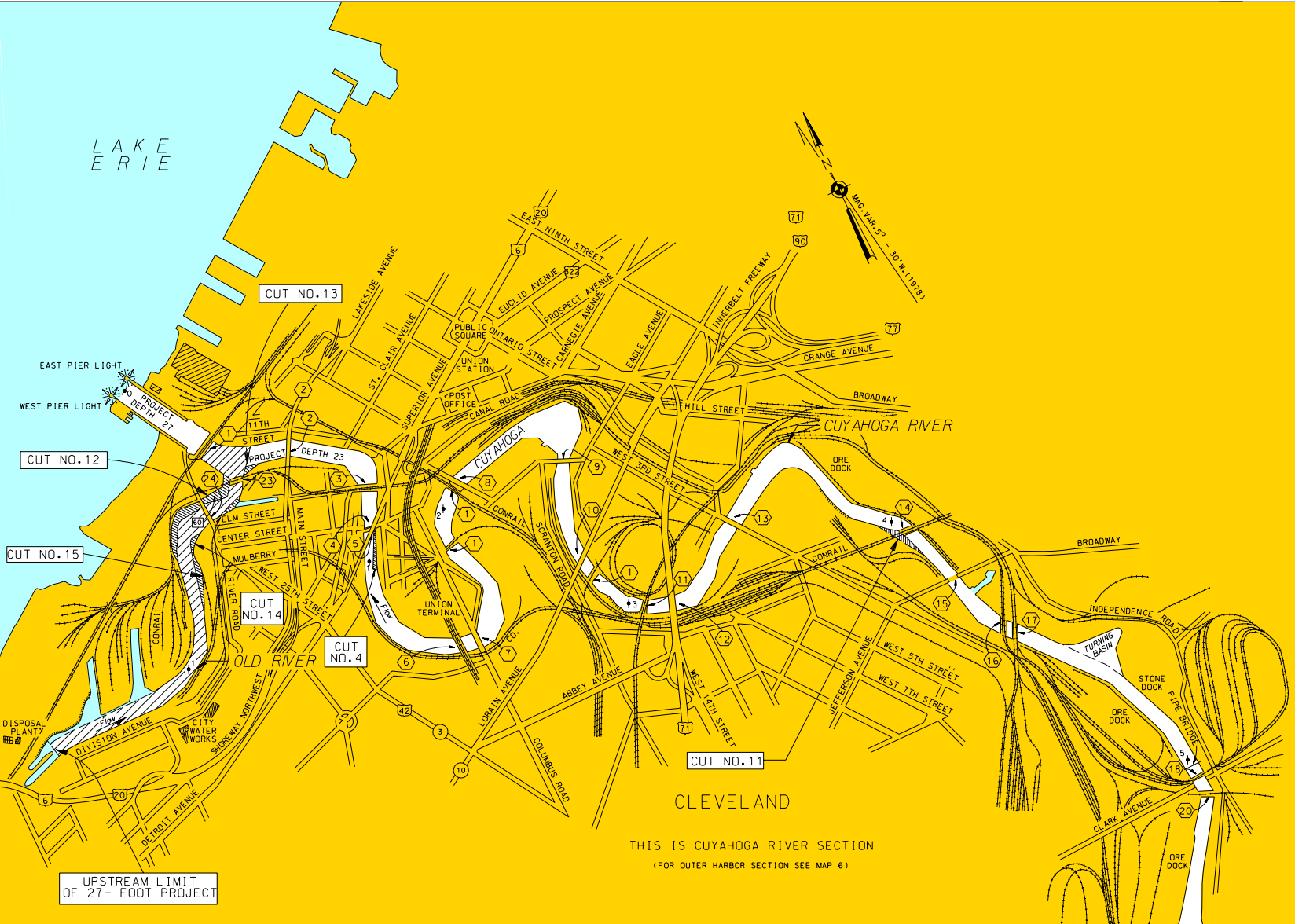
**Innerbelt Bridge  
Construction Contract Group 1 (CCG1)**



INDEX TO BRIDGES

SHOWN THUS (1)

- \* 1 CONRAIL
  - 2 MAIN AVE. HIGH LEVEL BRIDGE
  - \* 3 FLATS DEVELOPMENT INC.
  - 4 CENTER STREET BRIDGE
  - 5 DETROIT SUPERIOR HIGH LEVEL BRIDGE
  - 6 UNION TERMINAL (RAILWAY) HIGH LEVEL BRIDGE
  - 7 COLUMBUS RD. BRIDGE
  - 8 CARTER RD. BRIDGE
  - 9 EAGLE AVE. BRIDGE
  - 10 LORAIN CARNEGIE HIGH LEVEL BRIDGE
  - \*11 NORFOLK AND WESTERN RAILWAY
  - 12 INNER BELT FREEWAY HIGH LEVEL BRIDGE
  - 13 3RD. ST. BRIDGE
  - \*14 CONRAIL
  - 15 JEFFERSON AVE. BRIDGE SUPERSTRUCTURE REMOVED
  - 16 NEWBURG AND SOUTH SHORE RAILWAY BRIDGE
  - 17 BALTIMORE AND OHIO RAILWAY BRIDGE
  - 18 RIVER TERMINAL RAILWAY BRIDGE
  - \*19 NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 2 (L) WESTERN AND LAKE ERIE RAILROAD (O)
  - 20 NORFOLK AND WESTERN RAILWAY, BRIDGE NO. 3 (L) WESTERN AND LAKE ERIE RAILROAD (O)
  - 21 NEWBURG AND SOUTH SHORE RAILWAY BRIDGE
  - \*22 FLATS DEVELOPMENT INC. } OLD RIVER
  - \*23 WILLOW AVE. BRIDGE
- NOTE: FEDERAL PARTICIPATION IN REPLACEMENT  
 \* COMPLETED  
 \*\* AUTHORIZED



THIS IS CUYAHOGA RIVER SECTION  
 (FOR OUTER HARBOR SECTION SEE MAP 6)

NOTES

**PROJECT DEPTHS**  
 27.0 FEET IN LOWER CUYAHOGA RIVER TO JUNCTION WITH OLD RIVER AND 23.0 FEET IN REMAINDER OF CUYAHOGA RIVER.  
 18.0 FEET IN TURNING BASIN AT MILE 4.8 ON CUYAHOGA RIVER.  
 27.0 FEET IN OLD RIVER.

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM ELEVATION 569.2 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (IGLD 1985) (INTERNATIONAL GREAT LAKES DATUM 1985)

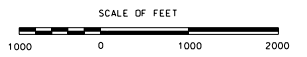
MILES ABOVE WEST PIER LIGHT AT OUTER END OF WEST PIER SHOWN THUS 2+  
 (2) INDICATES U.S. ROUTES  
 (10) INDICATES STATE ROUTES  
 (77) INDICATES INTERSTATE ROUTE

AREAS PARTIALLY DREDGED

CUYAHOGA RIVER PARTIALLY DREDGED TO 23.0 FEET UPSTREAM OF BRIDGE NO. 1 TO JUNCTION WITH OLD RIVER.

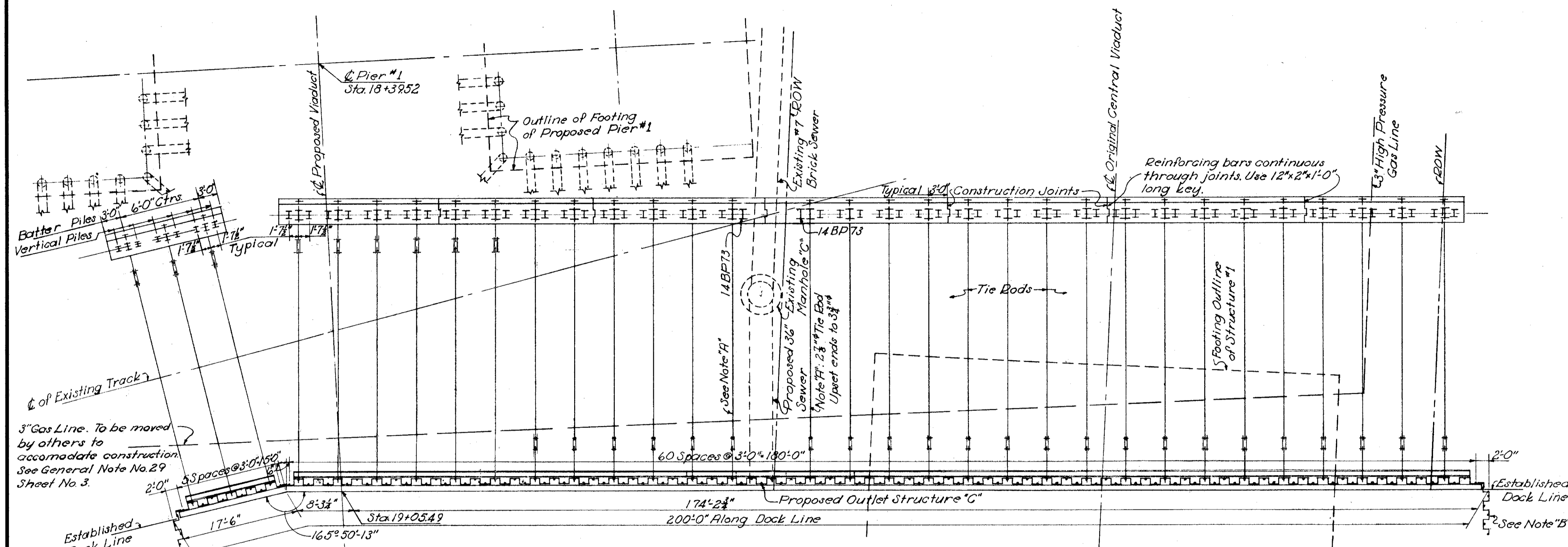
OLD RIVER PARTIALLY DREDGED TO 23.0 FEET FROM JUNCTION WITH CUYAHOGA RIVER TO OPPOSITE SAND PRODUCTS CORP. DOCK. REMAINDER DREDGED TO 21.0 FEET

CLEVELAND HARBOR OHIO



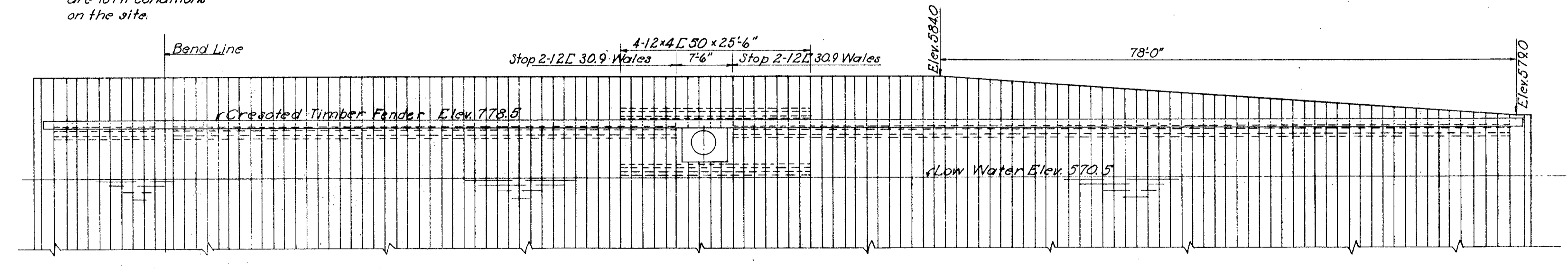
U.S. ARMY ENGINEER DISTRICT BUFFALO  
 MAY 2000

CUYAHOGA COUNTY  
CITY OF CLEVELAND  
INNER BELT FREEWAY  
CENTRAL VIADUCT  
CUY-42R-17.50

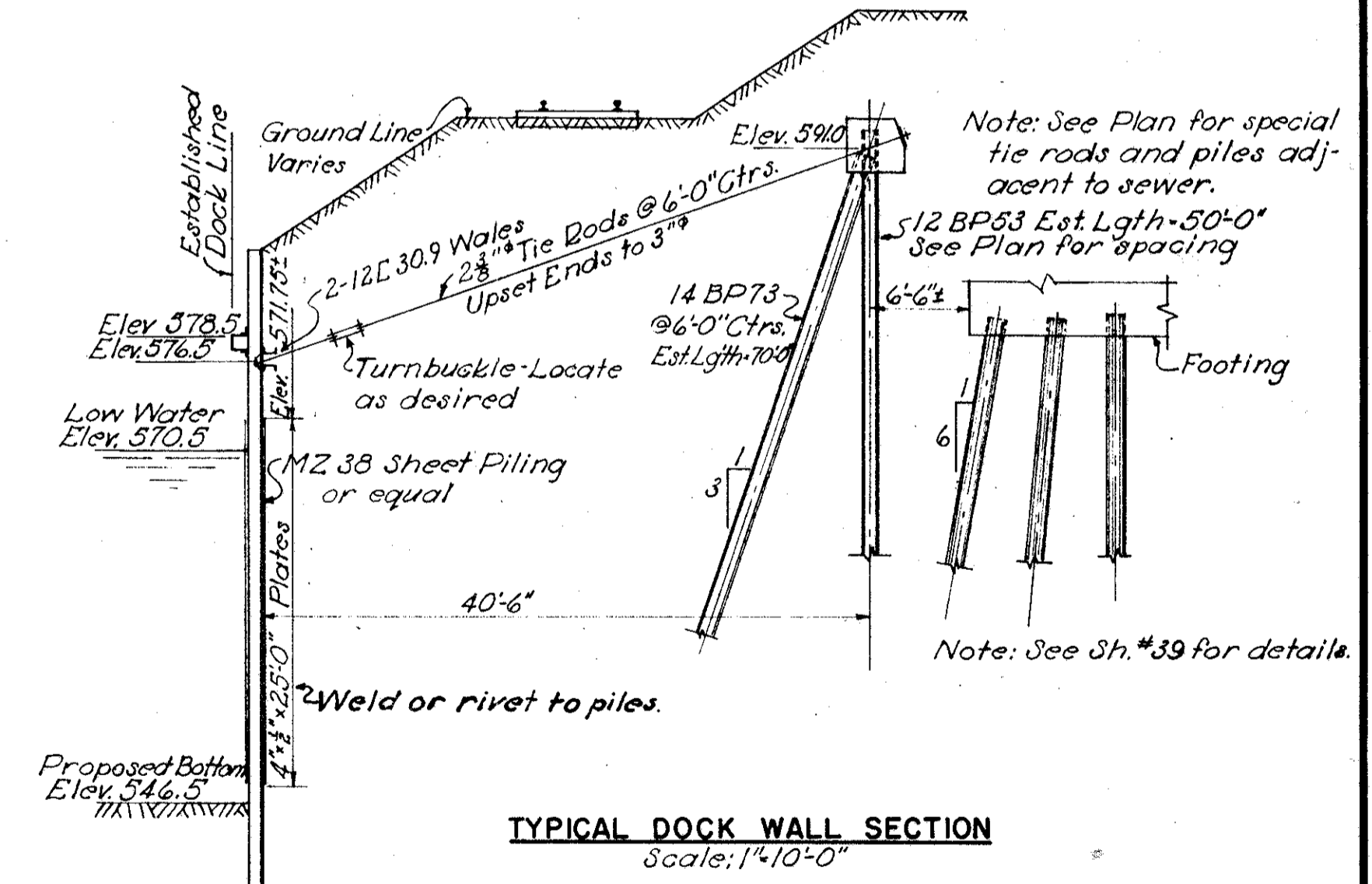


**GENERAL NOTES**  
All splice plates to be fitted welded in shop to structural members. All bolted connections, including anchor rods, shall have the threads jammed to form a definite lock. The concrete anchor pile cap must be constructed in sections. Bar splices for the six construction joints shown are included in the estimated quantities. Locations may be shifted to any typical position.

**LOCATION PLAN**  
Scale: 1"=10'-0"



**FRONT ELEVATION**  
Scale: 1"=10'-0"



**TYPICAL DOCK WALL SECTION**  
Scale: 1"=10'-0"

Superseded by Sheet 38 A  
2-15-55

PART 2

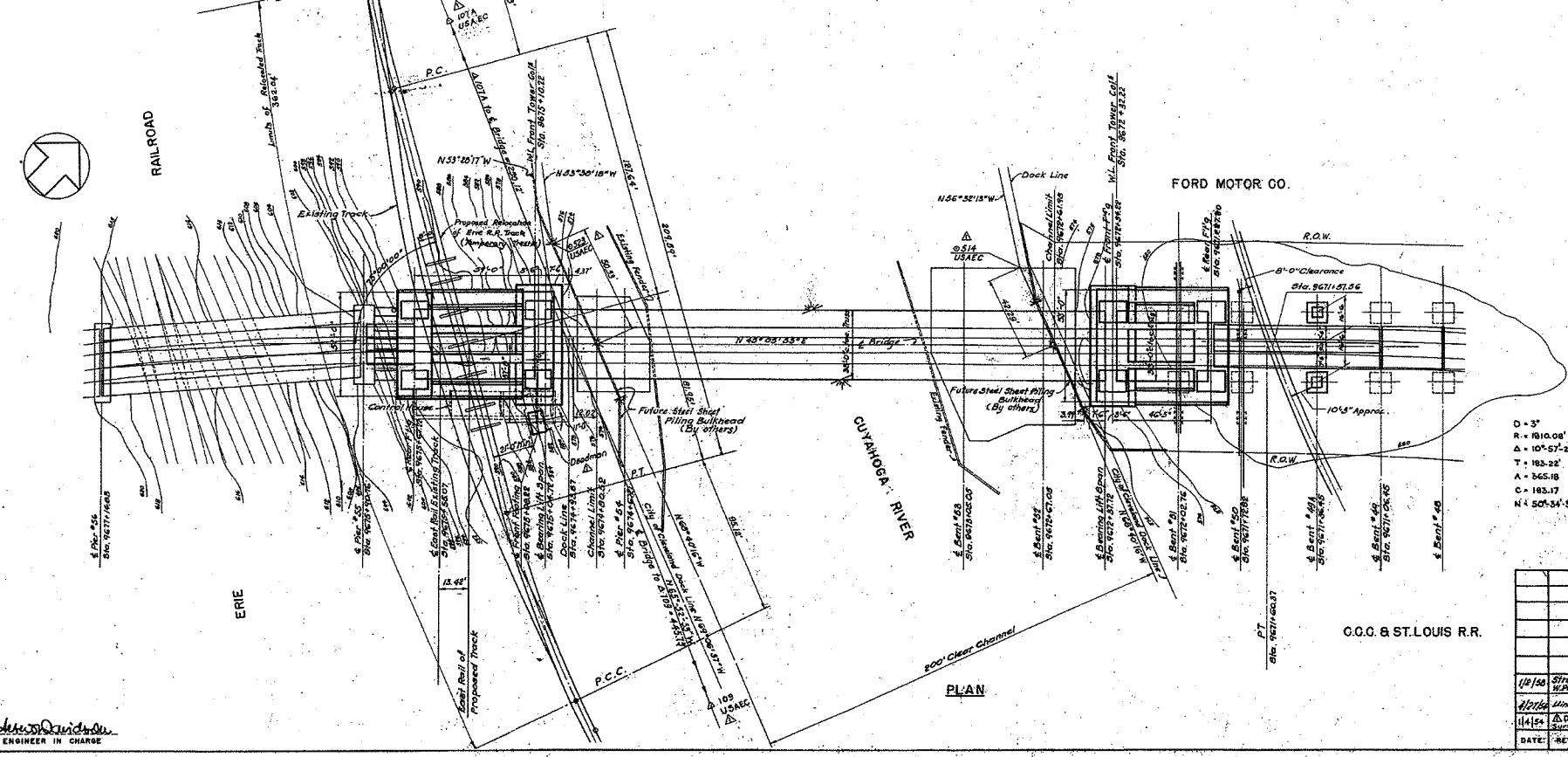
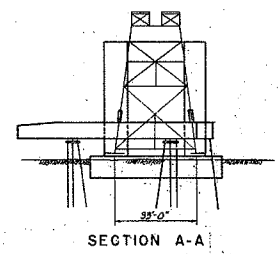
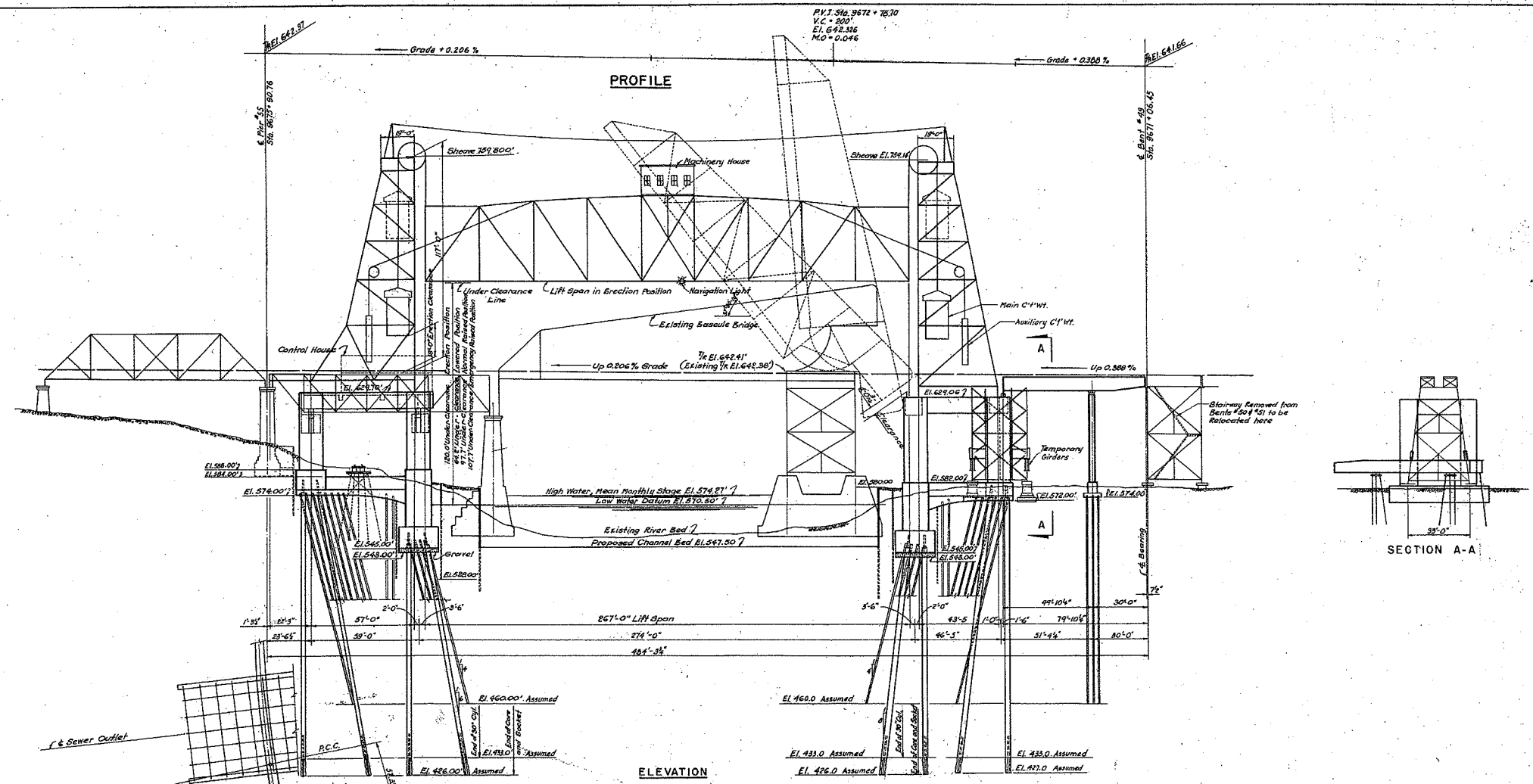
U. S. ROUTE 42 RELOCATION  
**INNER BELT FREEWAY - CENTRAL VIADUCT**

**DOCK WALL**  
LOCATION PLAN AND TYPICAL SECTION

CLEVELAND	CUYAHOGA COUNTY	OHIO
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SCALE: 1"=10'-0"  
MADE C.U.C. DATE: 3-31-54  
TRCD C.U.C. DATE: 2-1-54  
CKD J.K. DATE: 8-31-54

HOWARD, NEEDLES, TAMMEN & BERGENDOFF  
CONSULTING ENGINEERS  
KANSAS CITY CLEVELAND NEW YORK  
914-1A SHEET 1.38

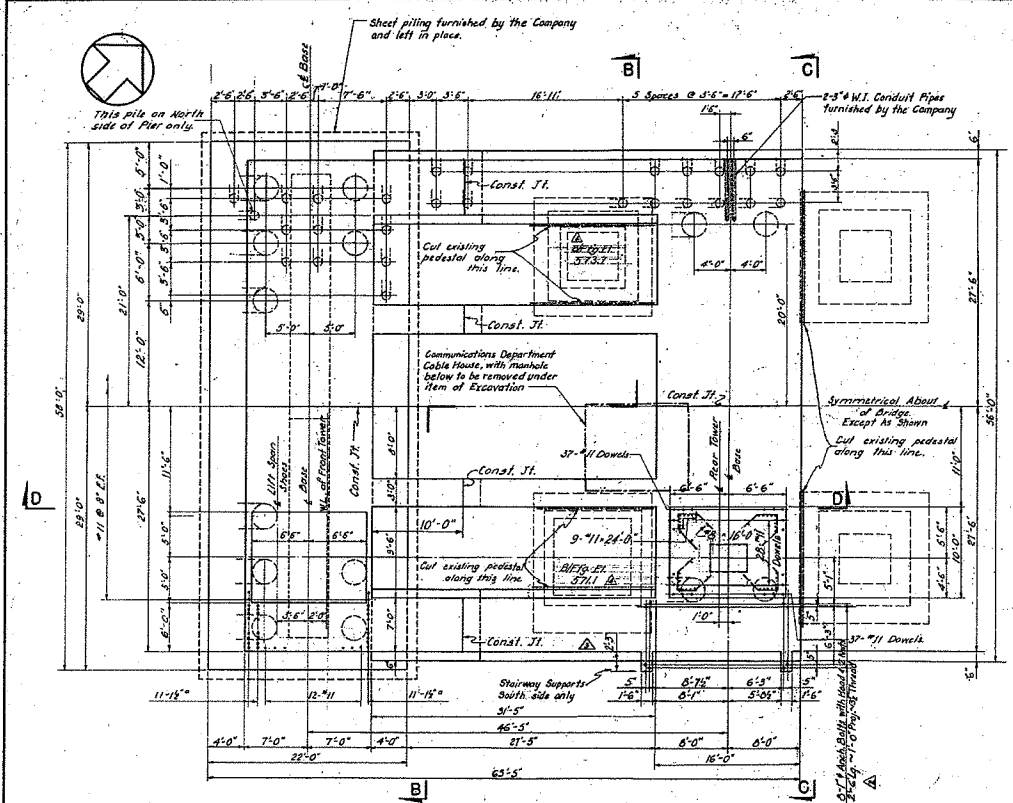


NOTE: All Elevations refer to Mean Tide of New York, El. 0.0 Plane of Reference (Low Water Datum) El. 570.54'

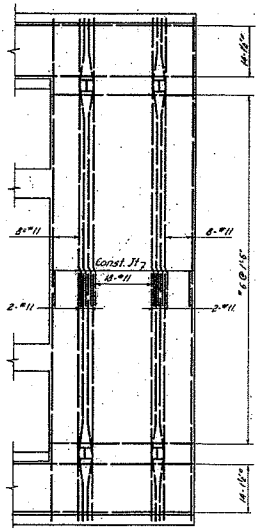
D = 3'  
 R = 1010.00'  
 A = 10° 57' 20"  
 T = 183.22'  
 A = 365.18'  
 C = 183.17'  
 N = S05° 34' 55"

N.Y.C. & ST. L.R.R.		CLEVELAND, OHIO	
MICHIGAN DISTRICT		OFFICE OF CHIEF ENGINEER	
PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE		HARDESTY & HANOVER	
NO. 184.50 (U.S. NO. 15)		CONSULTING ENGINEERS	
OVER CUYAHOGA RIVER, CLEVELAND, OHIO		SCALE: 1" = 30'-0"	
GENERAL PLAN & ELEVATION		SHEET: 1 OF 10	
1/21/30	Struct. between	R.E.	DATE: DEC. 24, 1928
1/21/30	Struct. between	R.E.	NO. N. 184.50 - 52
1/21/30	Struct. between	R.E.	
1/21/30	Struct. between	R.E.	

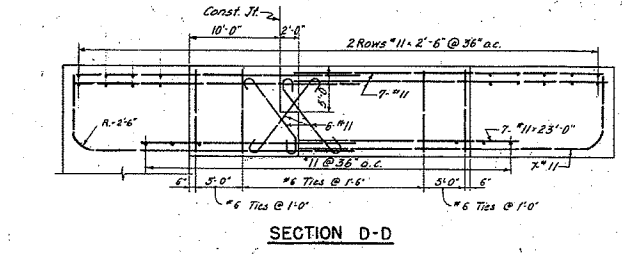
DRAWN: S.F.F.  
 CHECKED: A.D.P.  
 IN CHARGE: S.F.F.  
 ENGINEER IN CHARGE: S.F.F.



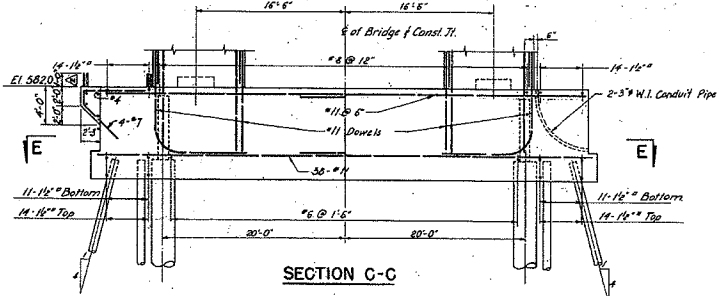
**SECTION A-A**  
 23-10" Pipe Piles  
 14-30" Cylinders  
 10-16" W 211 Cores - Front Base  
 4-14" W 136 Cores - Rear Base



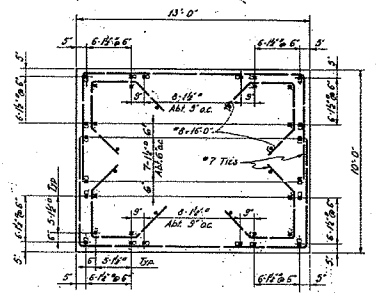
**SECTION E-E**



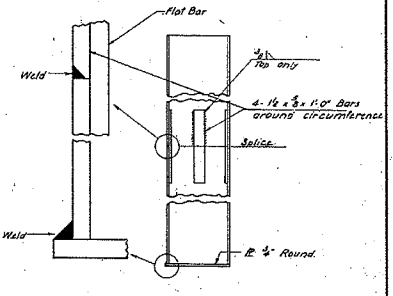
**SECTION D-D**



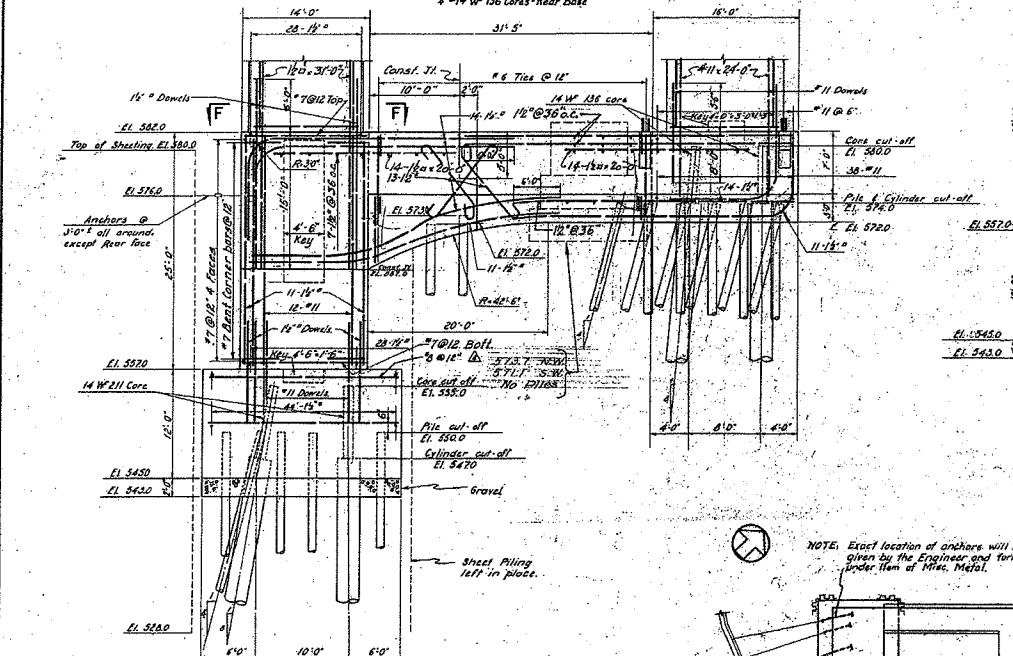
**SECTION C-C**



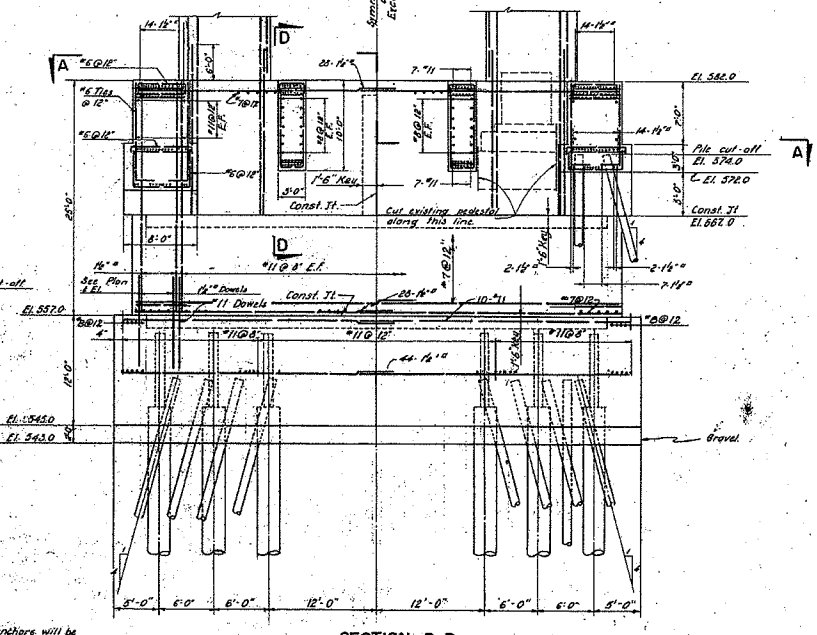
**SECTION F-F**  
 Scale: 1/2" = 1'-0"



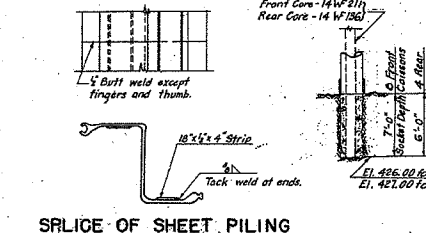
**TYPICAL PILE DETAIL**  
 Scale: 1" = 1'-0"



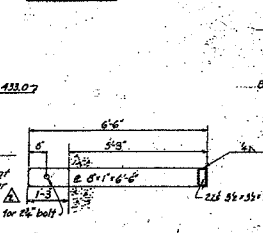
**ELEVATION**



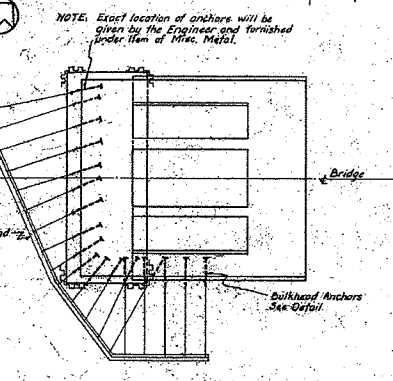
**SECTION B-B**



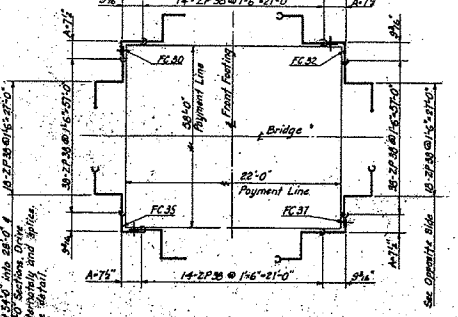
**SPlice OF SHEET PILING**



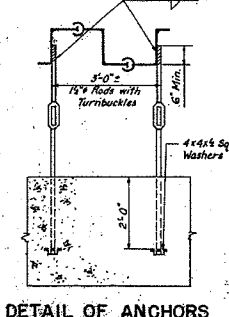
**DETAIL OF BULKHEAD ANCHORS**



**PLAN OF BULKHEAD ANCHORS**  
 Scale: 1" = 30'-0"



**COFFERDAM DETAILS**  
 No Scale



**DETAIL OF ANCHORS FOR COFFERDAM**  
 Scale: 1/2" = 1'-0"

- GENERAL NOTES:**
- Loading: Cooper E-63.
  - Welding in accordance with the current specifications for Welded Highway and Railway Bridges of the American Welding Society.
  - The upper surfaces of bridge seats or other bearing surfaces under metal shall be built up monolithic approximately 1/4 of an inch high and after the concrete has hardened, both hammered or ground to the exact elevations required.
  - Before setting Anchor Bolts the Contractor must verify their position with the Engineer.

- CONCRETE NOTES:**
- The minimum cover of reinforcing bars shall be 4" unless otherwise noted.
  - All dimensions are to the center of reinforcing bars and the surface of finished concrete.
  - The minimum diameter for bars shall be 16 diameters of the bar, except for hooks shall be of the dimensions shown in the following sketch:
- 
- Not less than 6 diameters of the bar.
  - Not less than 16 diameters of the bar.
- Bars are to be securely wired at intersections.
  - All reinforcing bars shall conform ASTM A305-50 T.
  - For splicing, the bars shall be overlapped 48 diameters for plain bars and according to specifications for deformed bars, or as shown.
  - All exposed corners of concrete are to be finished to a 1" bevel, unless otherwise shown.
  - Concrete surfaces to be formed according to specifications.

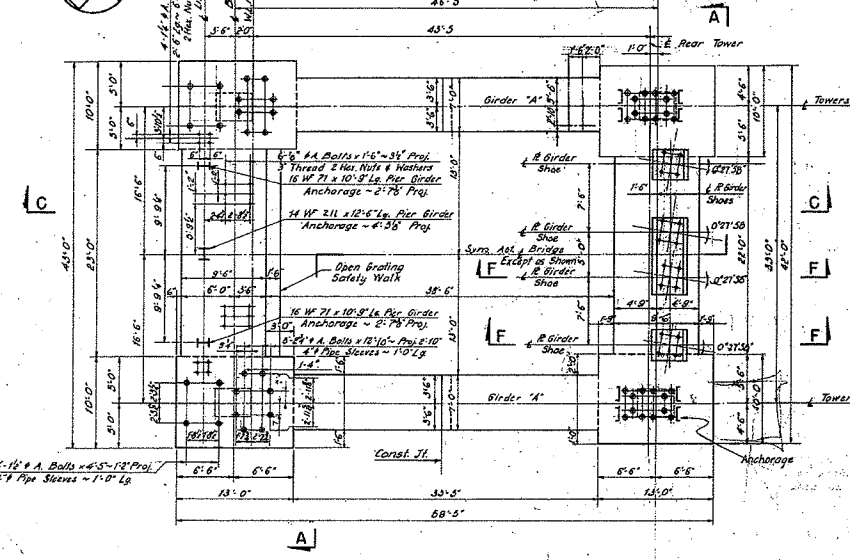
<b>N.Y.C. &amp; ST. L.R.R.</b> NICKEL PLATE DISTRICT			
<b>PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE</b> NO. 18450 (U.S. NO. 15) OVER CUYAHOGA RIVER CLEVELAND, OHIO			
<b>EAST PIER - BASE</b>			
DATE	REVISIONS	BY	NEW YORK, N.Y.
1/12/54	1	J.H.E.	
1/14/54	2	J.H.E.	
1/14/54	3	J.H.E.	
1/14/54	4	J.H.E.	
1/14/54	5	J.H.E.	
1/14/54	6	J.H.E.	
1/14/54	7	J.H.E.	
1/14/54	8	J.H.E.	
1/14/54	9	J.H.E.	
1/14/54	10	J.H.E.	
1/14/54	11	J.H.E.	
1/14/54	12	J.H.E.	
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1/14/54	14	J.H.E.	
1/14/54	15	J.H.E.	
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1/14/54	23	J.H.E.	
1/14/54	24	J.H.E.	
1/14/54	25	J.H.E.	
1/14/54	26	J.H.E.	
1/14/54	27	J.H.E.	
1/14/54	28	J.H.E.	
1/14/54	29	J.H.E.	
1/14/54	30	J.H.E.	
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1/14/54	40	J.H.E.	
1/14/54	41	J.H.E.	
1/14/54	42	J.H.E.	
1/14/54	43	J.H.E.	
1/14/54	44	J.H.E.	
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1/14/54	53	J.H.E.	
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1/14/54	58	J.H.E.	
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1/14/54	60	J.H.E.	
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1/14/54	100	J.H.E.	

DRAWN: J.H. H.  
 CHECKED: M. W.  
 IN CHARGE: *Robert J. H.*  
 ENGINEER IN CHARGE: *Robert J. H.*

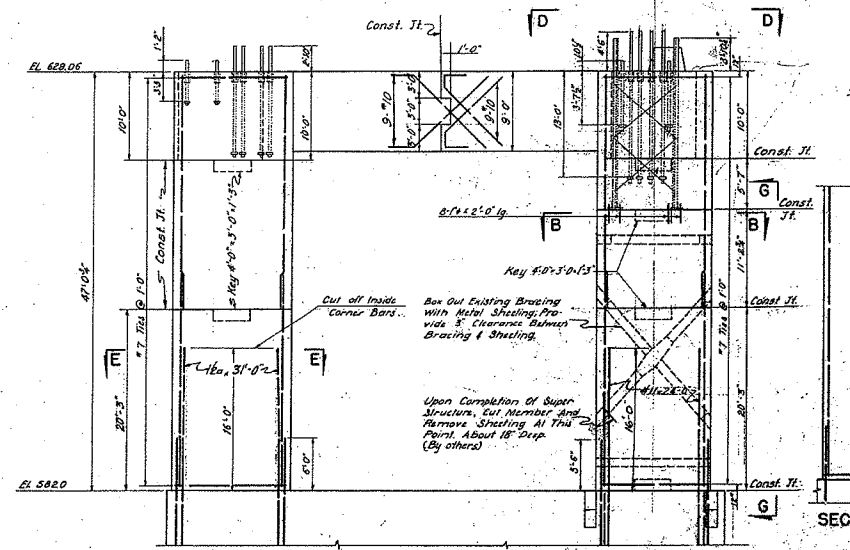
OFFICE OF CHIEF ENGINEER  
 HARDEY & HANOVER  
 CONSULTING ENGINEERS  
 NEW YORK, N.Y.  
 SCALE: 1/8" = 1'-0"  
 SHEET 3 OF 10  
 DATE: DEC. 4 - 1953  
 NO. 18450 - 851



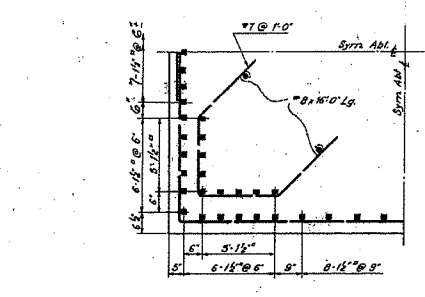
Note: Anchor Bolts & Anchorage furnished by others and set by contractor for details of anchorage, see detail below



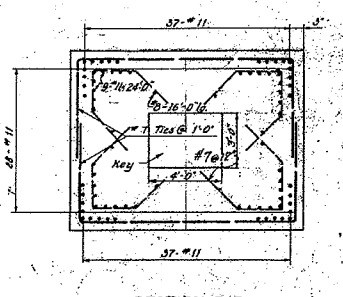
PLAN



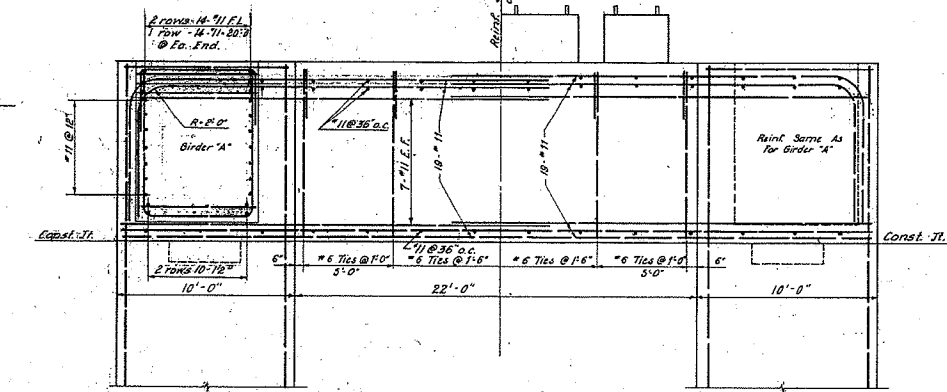
ELEVATION



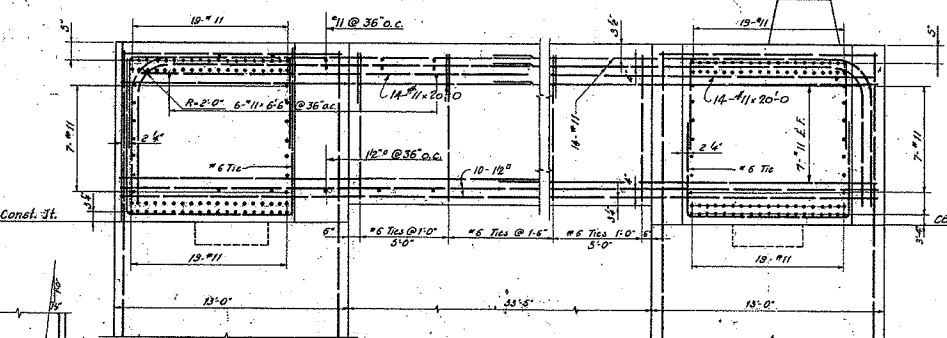
SECTION E-E  
Quarter Section  
Scale: 1/4" = 1'-0"



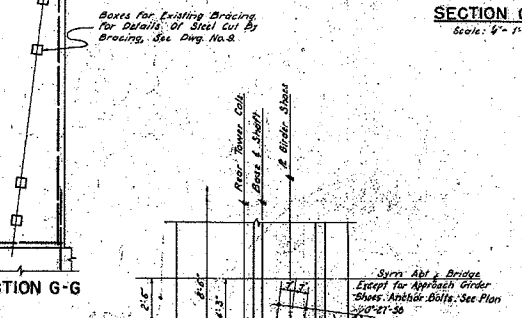
SECTION B-B  
Scale: 1/4" = 1'-0"



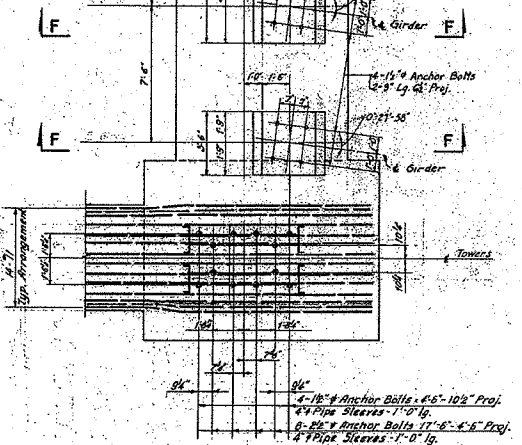
SECTION A-A  
Scale: 1/4" = 1'-0"



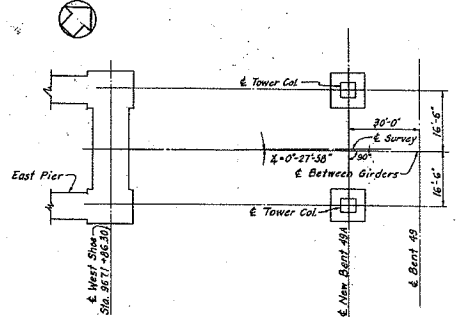
SECTION C-C  
Scale: 1/4" = 1'-0"



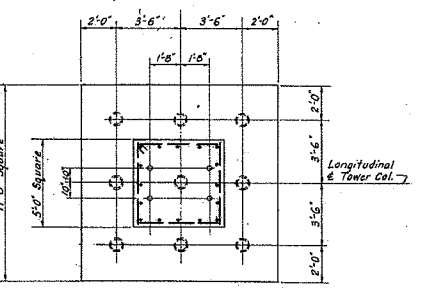
SECTION G-G  
Scale: 1/4" = 1'-0"



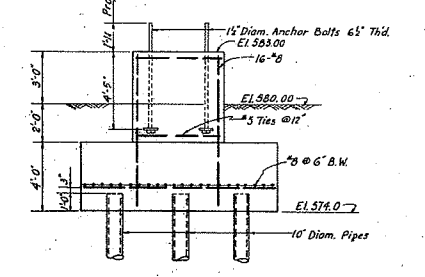
SECTION D-D  
Scale: 1/4" = 1'-0"



LOCATION PLAN BENT 49-A  
Scale: 1" = 20'-0"

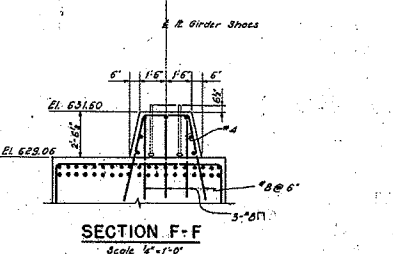


PLAN

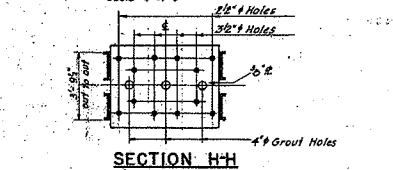


ELEVATION

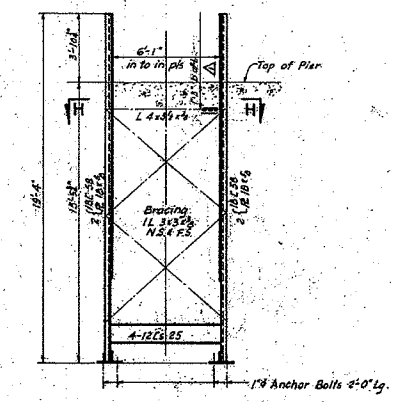
DETAILS OF PEDESTALS FOR BENT 49-A  
Scale: 1/4" = 1'-0"



SECTION F-F  
Scale: 1/4" = 1'-0"



SECTION H-H  
Scale: 1/4" = 1'-0"

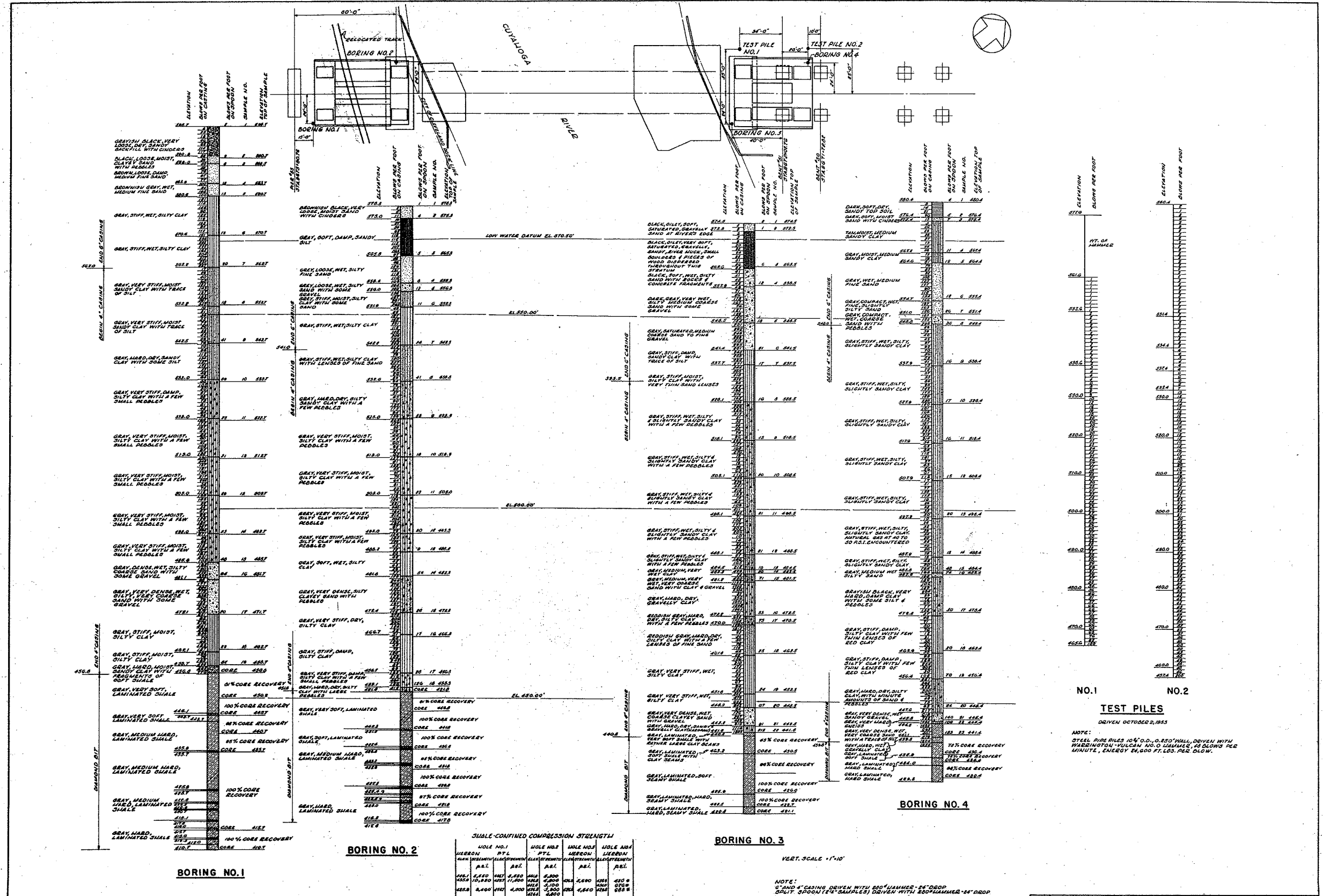


REAR TOWER LEG ANCHORAGE  
Scale: 1/4" = 1'-0"

NOTE:  
For General Notes, See Dwg. No. 3.

DRAWN: M.H.  
CHECKED: M.H.  
IN CHARGE: *Robert J. ...*  
ENGINEER IN CHARGE: *Robert J. ...*

N.Y.C. & ST. L.R.R. MIGUEL PLATE DISTRICT			
PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE NO. 184.50 (U.S. NO. 15) OVER CUYAHOGA RIVER CLEVELAND, OHIO			
EAST PIER-SHAFTS AND GIRDERS EAST APPROACH PEDESTALS			
DATE:	REVISIONS:	BY:	DATE:
11/15/50	1	M.H.	11/15/50
11/15/50	2	M.H.	11/15/50
11/15/50	3	M.H.	11/15/50
11/15/50	4	M.H.	11/15/50
11/15/50	5	M.H.	11/15/50
11/15/50	6	M.H.	11/15/50
11/15/50	7	M.H.	11/15/50
11/15/50	8	M.H.	11/15/50
11/15/50	9	M.H.	11/15/50
11/15/50	10	M.H.	11/15/50
11/15/50	11	M.H.	11/15/50
11/15/50	12	M.H.	11/15/50
11/15/50	13	M.H.	11/15/50
11/15/50	14	M.H.	11/15/50
11/15/50	15	M.H.	11/15/50
11/15/50	16	M.H.	11/15/50
11/15/50	17	M.H.	11/15/50
11/15/50	18	M.H.	11/15/50
11/15/50	19	M.H.	11/15/50
11/15/50	20	M.H.	11/15/50
11/15/50	21	M.H.	11/15/50
11/15/50	22	M.H.	11/15/50
11/15/50	23	M.H.	11/15/50
11/15/50	24	M.H.	11/15/50
11/15/50	25	M.H.	11/15/50
11/15/50	26	M.H.	11/15/50
11/15/50	27	M.H.	11/15/50
11/15/50	28	M.H.	11/15/50
11/15/50	29	M.H.	11/15/50
11/15/50	30	M.H.	11/15/50
11/15/50	31	M.H.	11/15/50
11/15/50	32	M.H.	11/15/50
11/15/50	33	M.H.	11/15/50
11/15/50	34	M.H.	11/15/50
11/15/50	35	M.H.	11/15/50
11/15/50	36	M.H.	11/15/50
11/15/50	37	M.H.	11/15/50
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11/15/50	82	M.H.	11/15/50
11/15/50	83	M.H.	11/15/50
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11/15/50	92	M.H.	11/15/50
11/15/50	93	M.H.	11/15/50
11/15/50	94	M.H.	11/15/50
11/15/50	95	M.H.	11/15/50
11/15/50	96	M.H.	11/15/50
11/15/50	97	M.H.	11/15/50
11/15/50	98	M.H.	11/15/50
11/15/50	99	M.H.	11/15/50
11/15/50	100	M.H.	11/15/50



BRANCH: P.S.S. & M.H.  
 DRAWN: P.S.S.  
 CHECKED: P.S.S.  
 IN CHARGE: P.S.S.

**N.Y.C. & ST. L.R.R.**  
 NICKEL PLATE DISTRICT

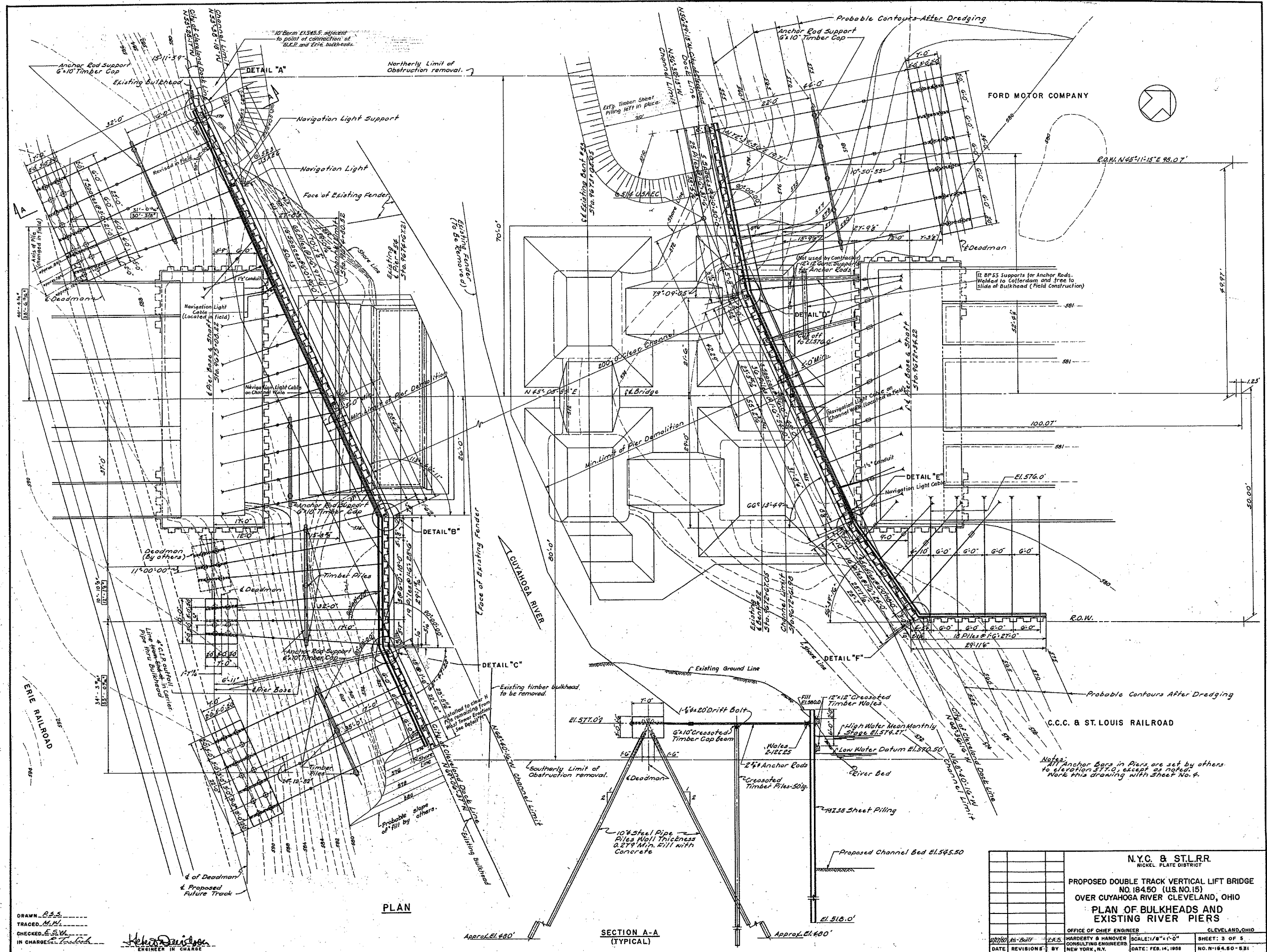
**PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE  
 NO. 184.50 (U.S. NO. 15)  
 OVER GUYAHOGA RIVER CLEVELAND, OHIO**

**BORINGS AND TEST PILES**

OFFICE OF CHIEF ENGINEER: HARDESTY & SANDOVER  
 CONSULTING ENGINEERS: NEW YORK, N.Y.

SCALE: 1" = 30'  
 DATE: FEB. 14, 1928

SHEET: 2 OF 5  
 NO. N-18450-52



DRAWN *R.S.S.*  
 TRACED *M.H.L.*  
 CHECKED *E.S.V.*  
 IN CHARGE *E.S.V.*

*Heard*  
 ENGINEER IN CHARGE

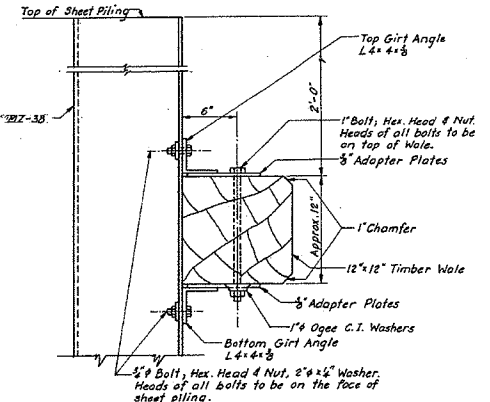
PLAN

SECTION A-A  
(TYPICAL)

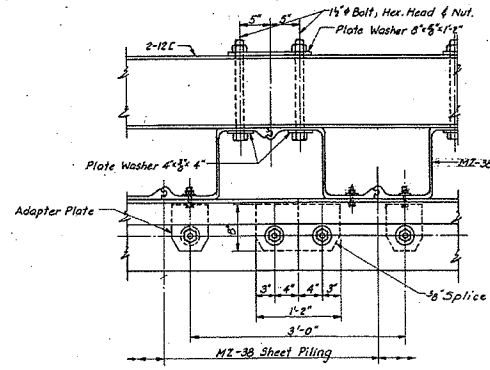
<b>NYC. &amp; STL.R.R.</b> NICKEL PLATE DISTRICT			
<b>PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE</b> NO. 18450 (U.S. NO. 15) OVER CUYAHOGA RIVER CLEVELAND, OHIO			
<b>PLAN OF BULKHEADS AND</b> <b>EXISTING RIVER PIERS</b>			
OFFICE OF CHIEF ENGINEER HARDEN & HANOVER CONSULTING ENGINEERS NEW YORK, N.Y.		CLEVELAND, OHIO SCALE: 1/8" = 1'-0" DATE: FEB. 14, 1928 SHEET: 3 OF 5 NO. N-18450-531	



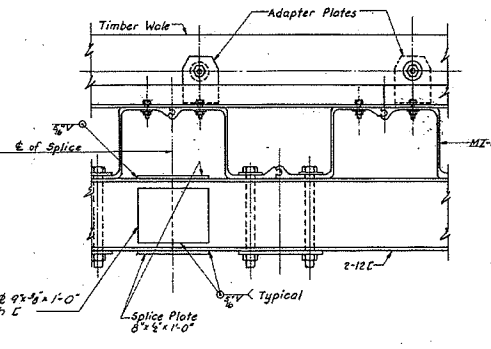
NOTE: The line of the timber wale shall be approximately straight. Any space between the face of the steel sheet piling and the back of the wale angles shall be filled at each bolt with a 4" x 4" x 4" steel plate washers.



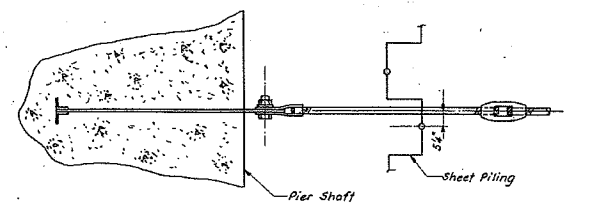
SECTION - TIMBER WALE  
Scale: 1/2" = 1'-0"



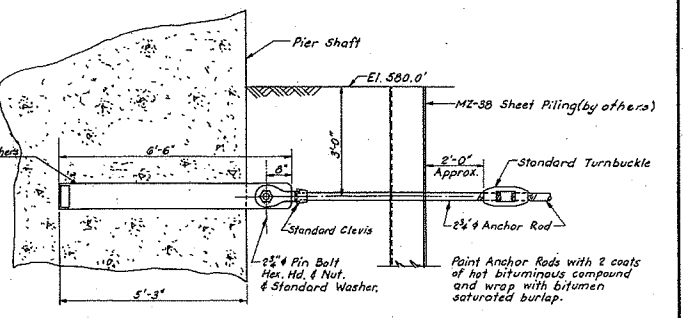
TYPICAL TIMBER WALE SPLICE



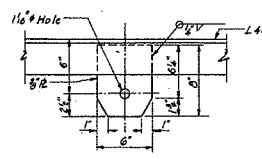
TYPICAL CHANNEL SPLICE



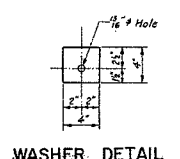
PLAN - TYPICAL ANCHOR BAR DETAIL  
Scale: 1/2" = 1'-0"



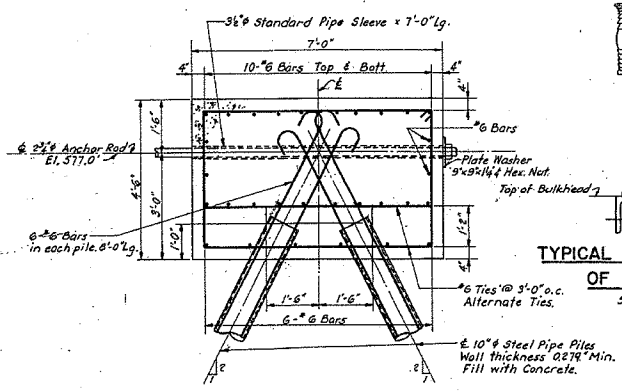
SECTION - TYPICAL ANCHOR BAR DETAIL  
Scale: 1/2" = 1'-0"



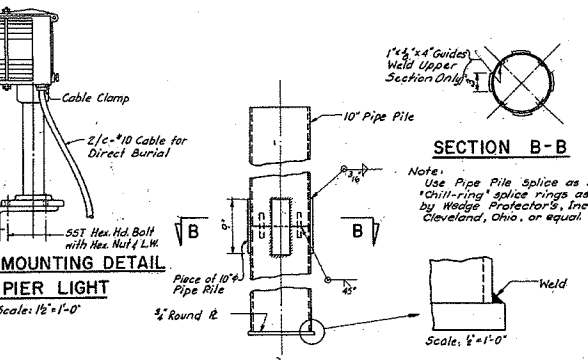
ADAPTER PLATE DETAIL  
Scale: 1/2" = 1'-0"



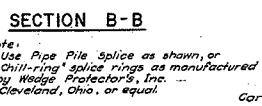
WASHER DETAIL  
Scale: 1/2" = 1'-0"



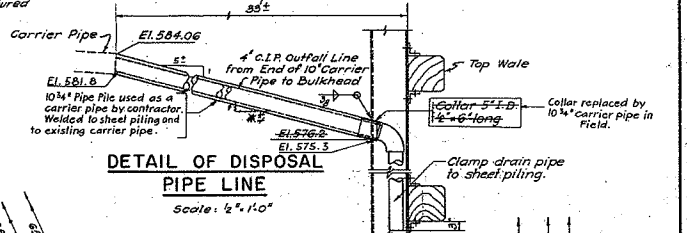
TYPICAL MOUNTING DETAIL OF PIER LIGHT  
Scale: 1/2" = 1'-0"



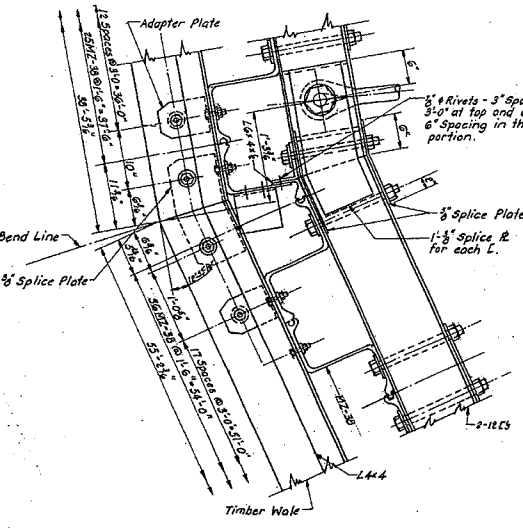
TYPICAL PIPE PILE SPLICE DETAIL  
Scale: 1/2" = 1'-0"



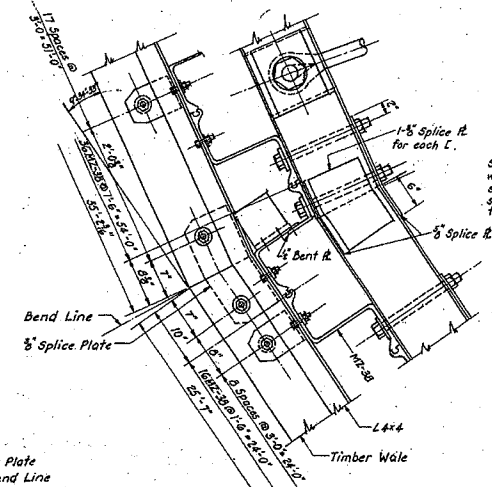
SECTION B-B  
Scale: 1/2" = 1'-0"



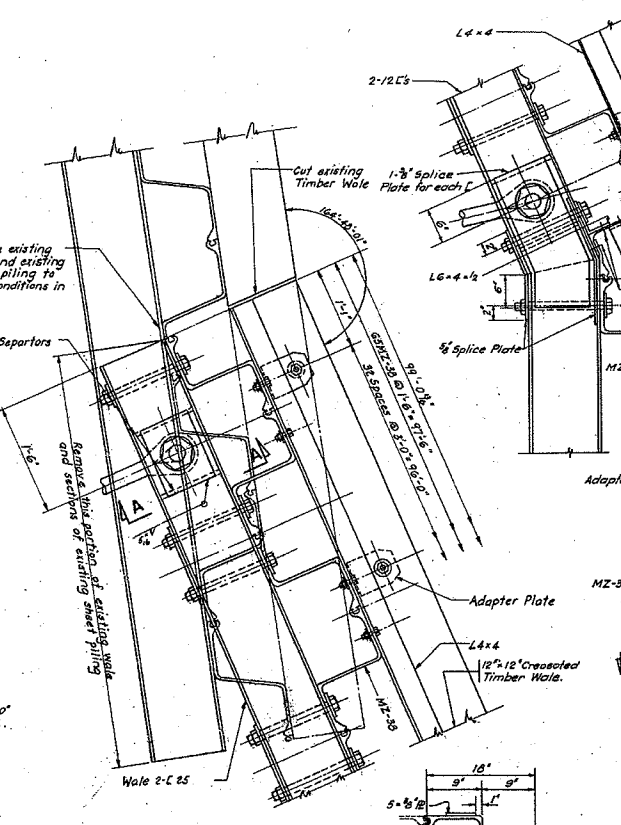
DETAIL OF DISPOSAL PIPE LINE  
Scale: 1/2" = 1'-0"



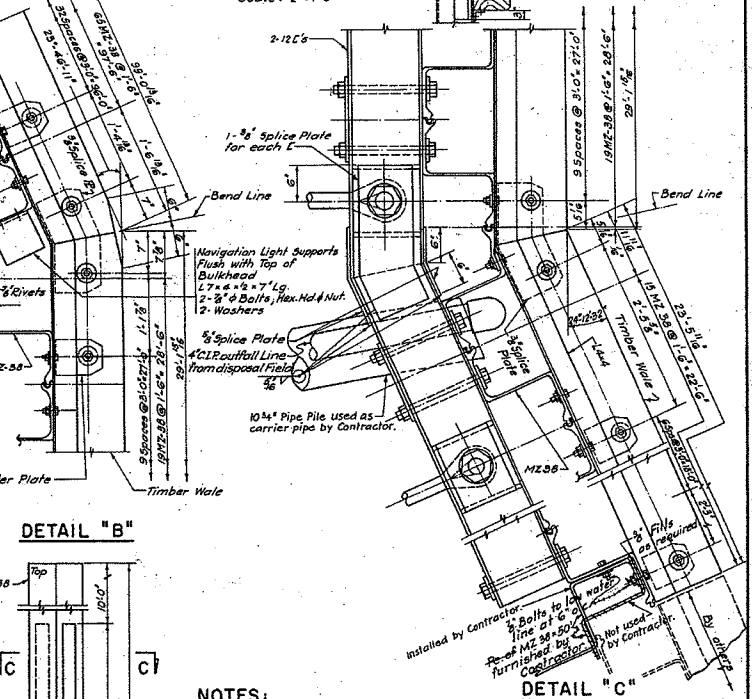
DETAIL "D"



DETAIL "E"

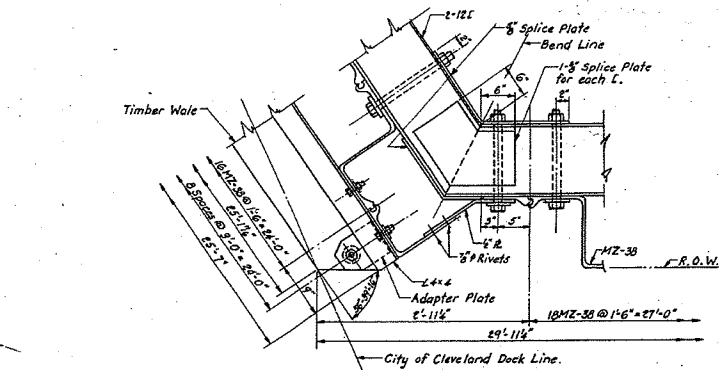


DETAIL "A"

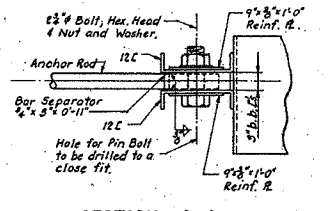


DETAIL "B"

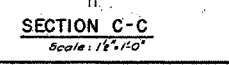
DETAIL "C"



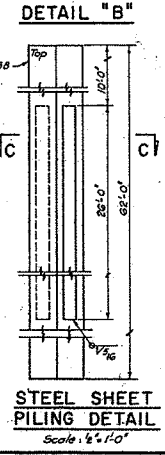
DETAIL "F"



SECTION A-A



SECTION C-C  
Scale: 1/2" = 1'-0"

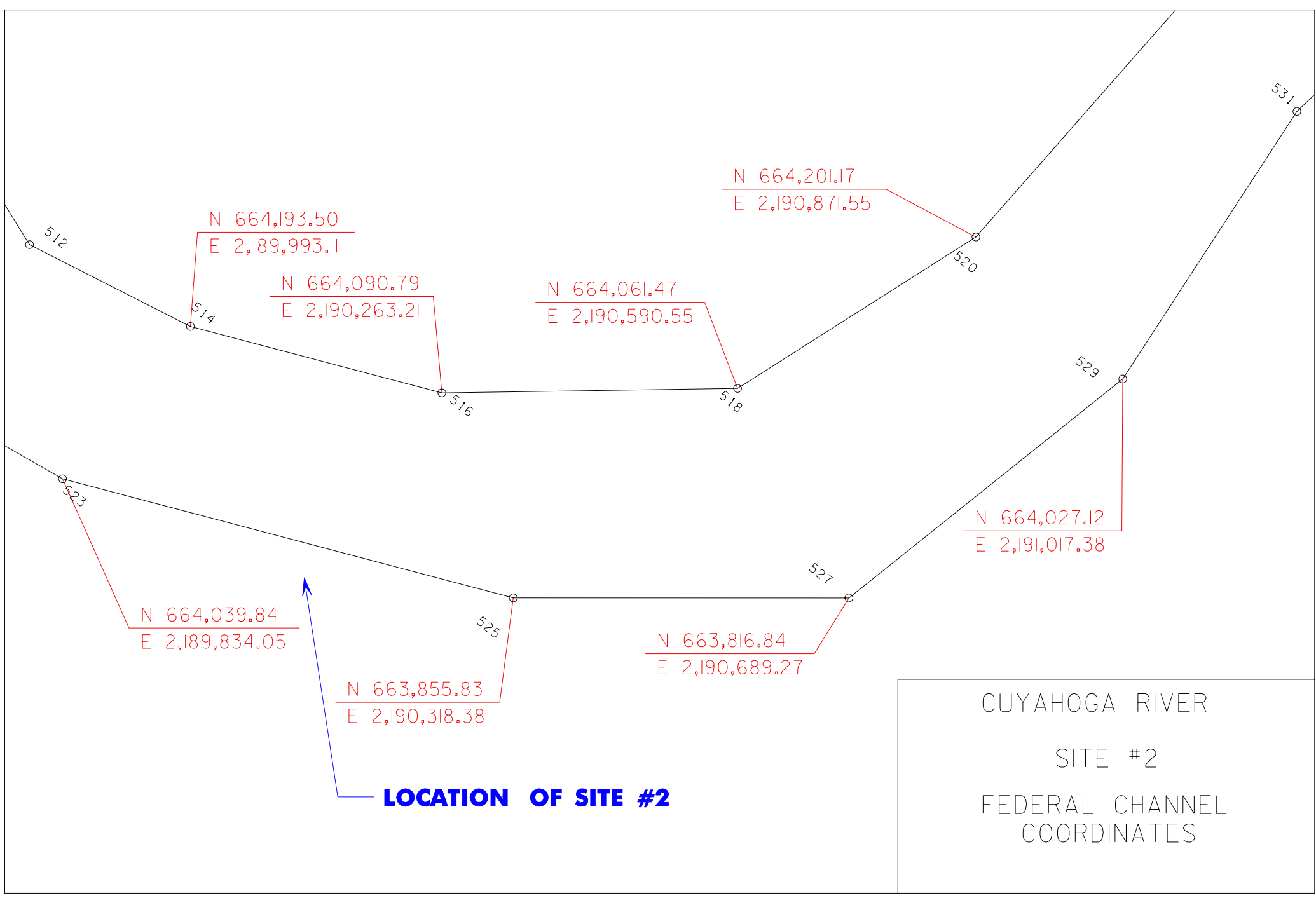


STEEL SHEET PILING DETAIL  
Scale: 1/2" = 1'-0"

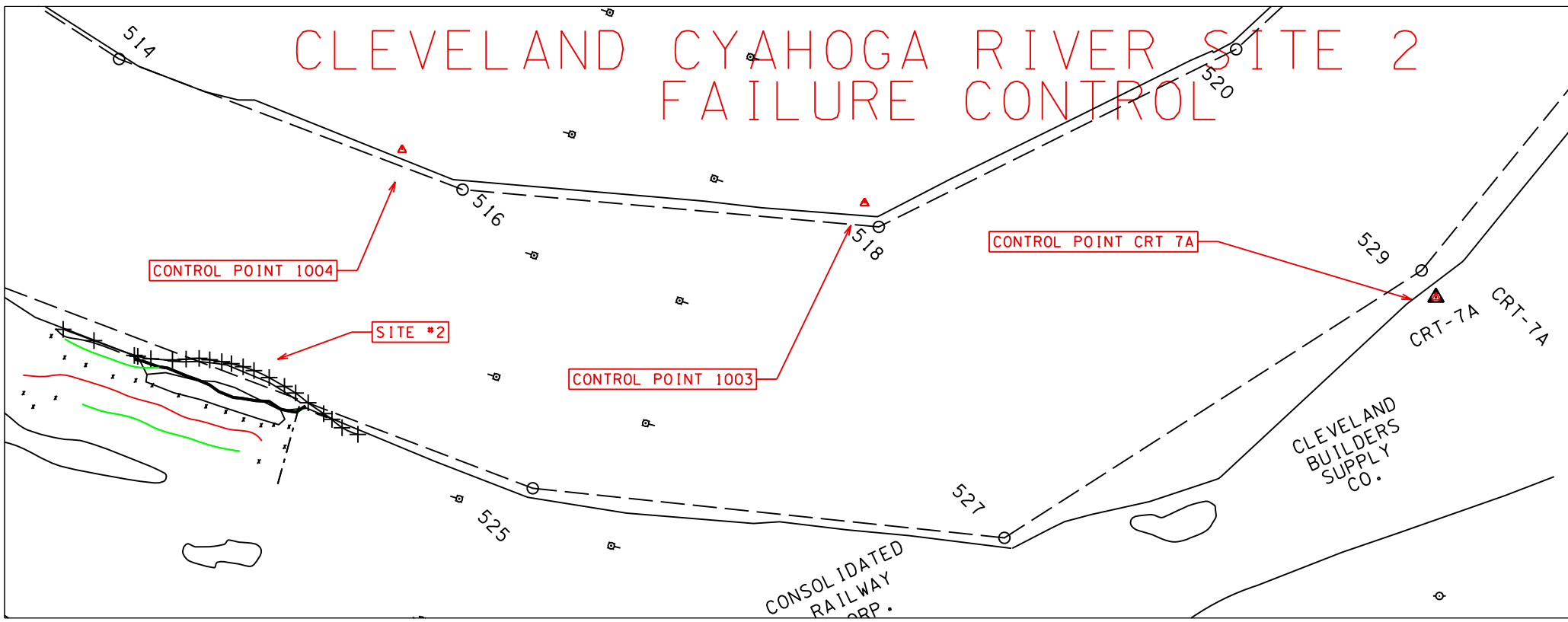
NOTES:  
Work this drawing with Sheet No. 3.

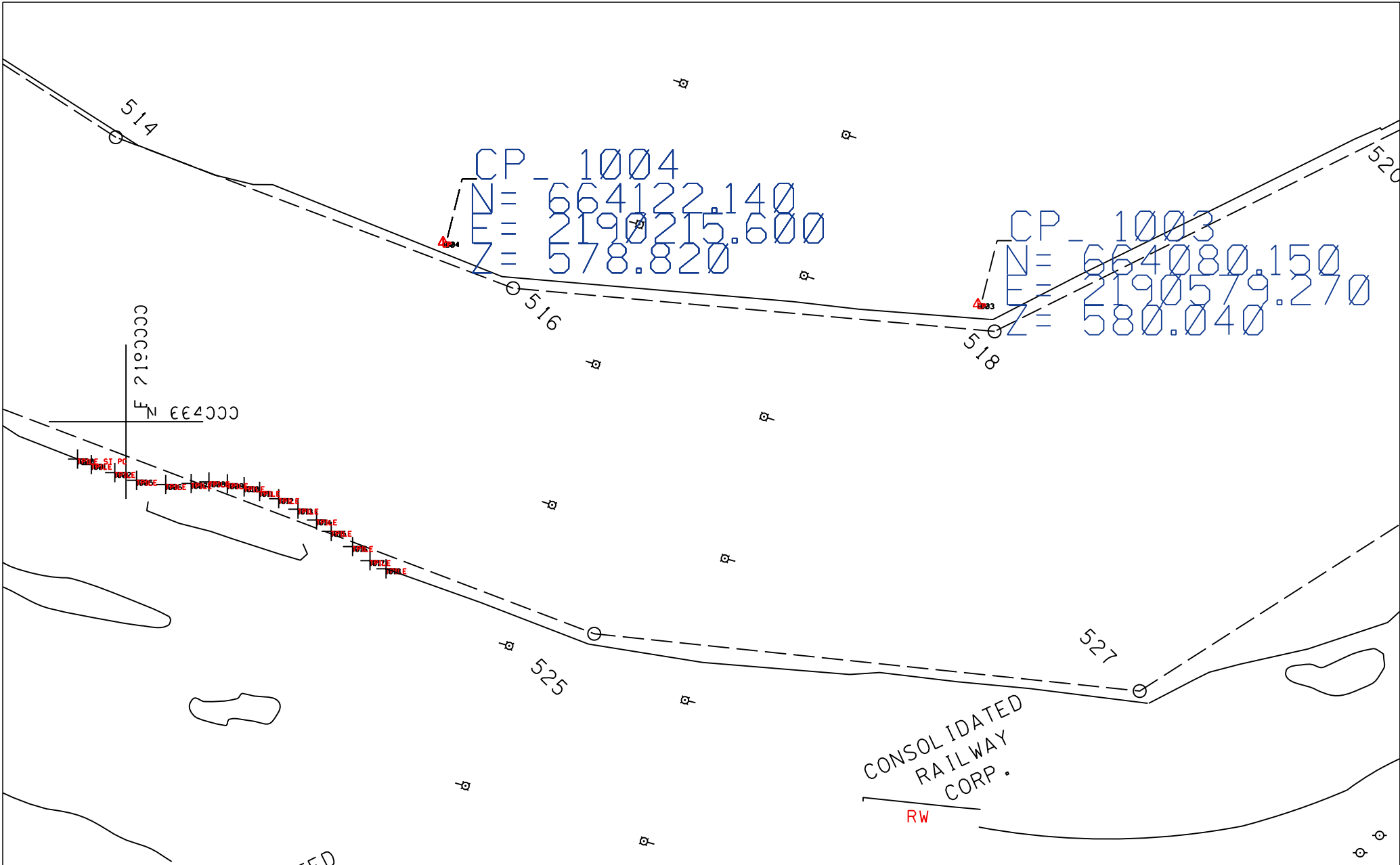
N.Y.C. & ST.L.R.R. NICKEL PLATE DISTRICT PROPOSED DOUBLE TRACK VERTICAL LIFT BRIDGE NO. 184.50 (U.S. NO. 15) OVER CUYAHOGA RIVER CLEVELAND, OHIO BULKHEAD DETAILS			
OFFICE OF CHIEF ENGINEER	HARDESTY & HANOVER CONSULTING ENGINEERS NEW YORK, N. Y.	SCALE: 1/2" = 1'-0" DATE: FEB. 14, 1958	CLEVELAND, OHIO SHEET: 4 OF 3 NO. N-184.50-531
DATE	REVISIONS	BY	

DRAWN: P.S.S.  
TRACED: P.L.  
CHECKED: E.S.W.  
IN CHARGE: *Heinrich*  
ENGINEER IN CHARGE



# CLEVELAND CVAHOGA RIVER SITE 2 FAILURE CONTROL





# CONTROL STATION RECORD

McINTOSH & McINTOSH P.C.

429 PINE STREET LOCKPORT, NEW YORK

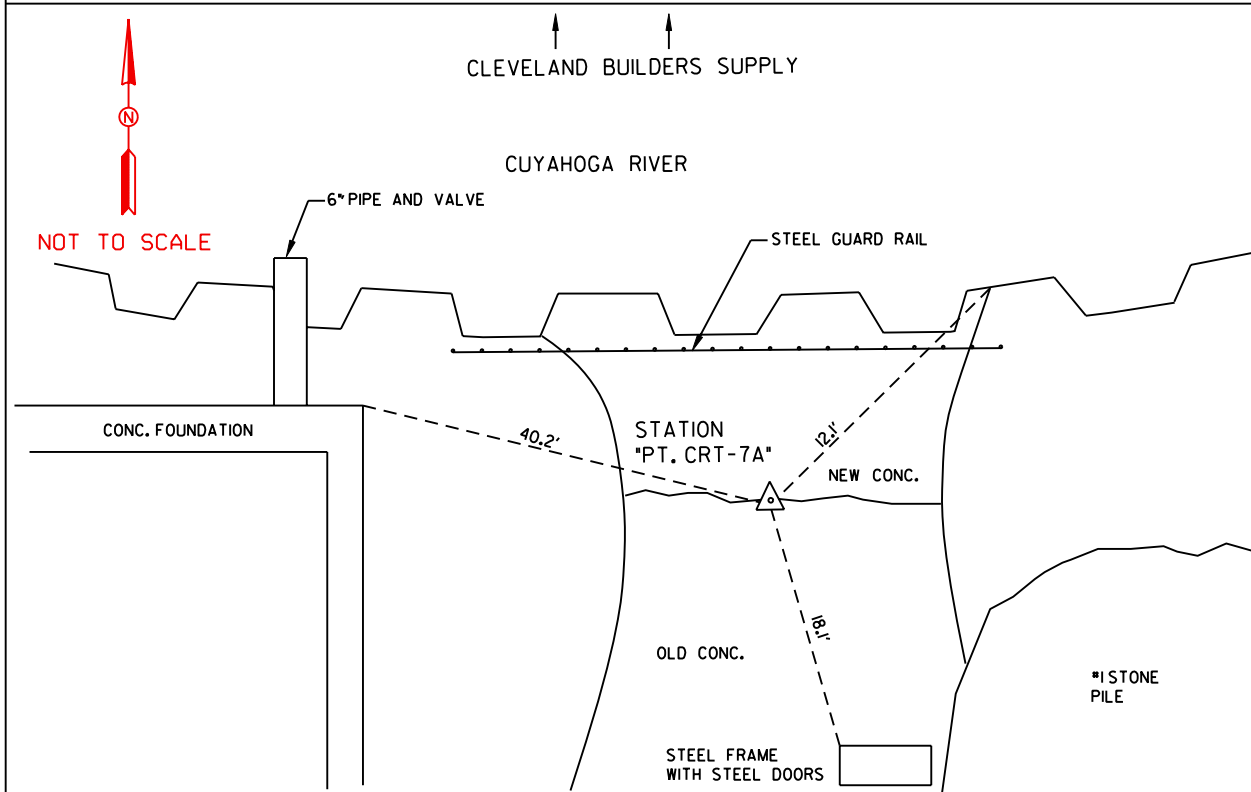
Town CITY OF CLEVELAND County CUYAHOGA Party Chief FJD  
 Draftsman EMO  
 Job No. 6159-C Date 8-15-95 Station PT. CRT-7A Checked By RCS  
 Sheet No. 22 OF 43

DATUM NAD 83

LATITUDE 41°-29'-10.92625" LONGITUDE 81°-41'-16.06431"  
 NORTHING (Y) 202,389.443 M. EASTING (X) 667,826.870 M.  
 ELEVATION N.A. COORDINATE SYSTEM OHIO - NORTH ZONE

DATUM NAD 83 FEET

LATITUDE \_\_\_\_\_ LONGITUDE \_\_\_\_\_  
 NORTHING (Y) 664,006.030 FEET EASTING (X) 2,191,028.654 FEET  
 ELEVATION 577.73 FEET IGLD 1985 COORDINATE SYSTEM OHIO - NORTH ZONE



**STATION DESCRIPTION:** STATION IS A P.K. NAIL SET IN THE JOINT BETWEEN THE NEW AND CONCRETE.

**TO REACH DESCRIPTION:** FROM ROUTE I-90 AND ROUTE 2, EXIT AT MARTIN LUTHER KING PKWY., TRAVEL NORTH TO GORDON PARK MUNICIPAL BOAT DOCKS, ACCESS BY BOAT. TRAVEL WEST THROUGH THE EAST BASIN TO THE CUYAHOGA RIVER. TRAVEL UP THE RIVER FOR \*2 MILES. STATION IS ON THE SOUTH SIDE OF THE RIVER ACROSS FROM CLEVELAND BUILDERS SUPPLY.

SURVEYING METHOD	ALL TIES
GPS <input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/>	DIRECT <input checked="" type="checkbox"/> LEVELED <input type="checkbox"/>

DATE 16 Jan 03 / 28 Jan 03 FILE No. Cleve - 635

PROJECT Cleveland Cuyahoga River

SURVEY BY William J. ...

NATURE OF NOTES

Level Run 52-1001-8 to CRT 74

Ties for Control Points 1003-1009

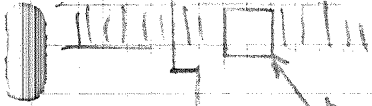
PLOTTED BY \_\_\_\_\_ MAP FILE No. \_\_\_\_\_



CP 1003

PK Top of 9th Ballard up  
River from NS RR Bridge #2  
NEAR W 3 ST LIFT BRIDGE

CP 1004



16356

BRIDGE SUPPORT

River

4.8' from BOLLARD

PK in CONCRETE

15350

Route 90 Bridge

BRIDGE SUPPORT



C-23-N



**CITY OF CLEVELAND**  
**DIVISION OF ENGINEERING & CONSTRUCTION**

CUYAHOGA RIVER

DOCK LINE MAP

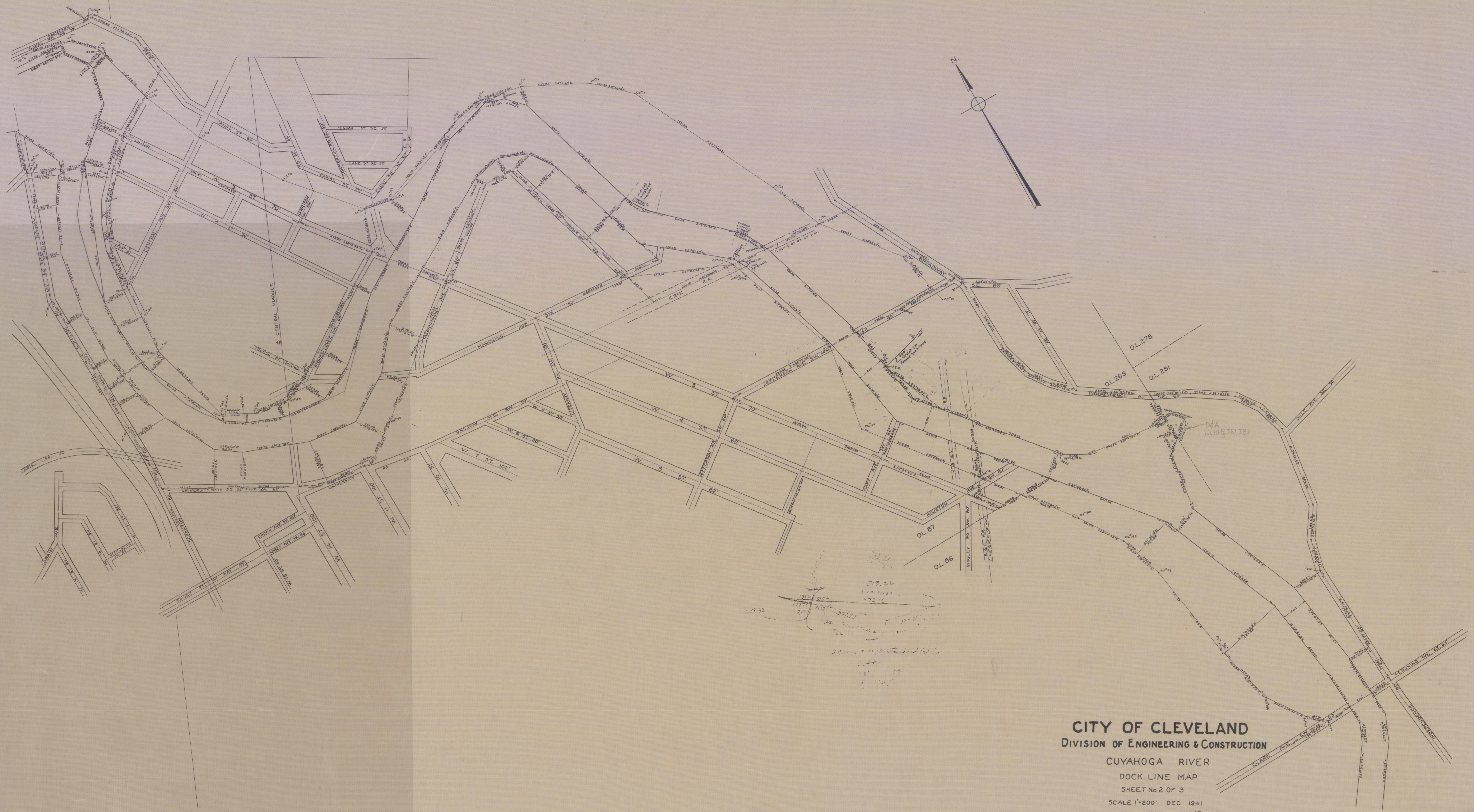
SHEET No. 1 OF 3

SCALE 1"=200' DEC. 1941

J.B.

C-23-N

C-55-15



**CITY OF CLEVELAND**  
 DIVISION OF ENGINEERING & CONSTRUCTION  
 CUYAHOGA RIVER  
 DOCK LINE MAP  
 SHEET No 2 OF 3  
 SCALE 1"=200' DEC. 1941  
 J.B.

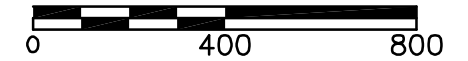
**REFERENCES:**

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y. AUGUST-SEPTEMBER 2009.

**LEGEND**

- PARCEL LINE
- PARCEL IDENTIFICATION NUMBER
- BATHYMETRIC SOUNDING DEPTH

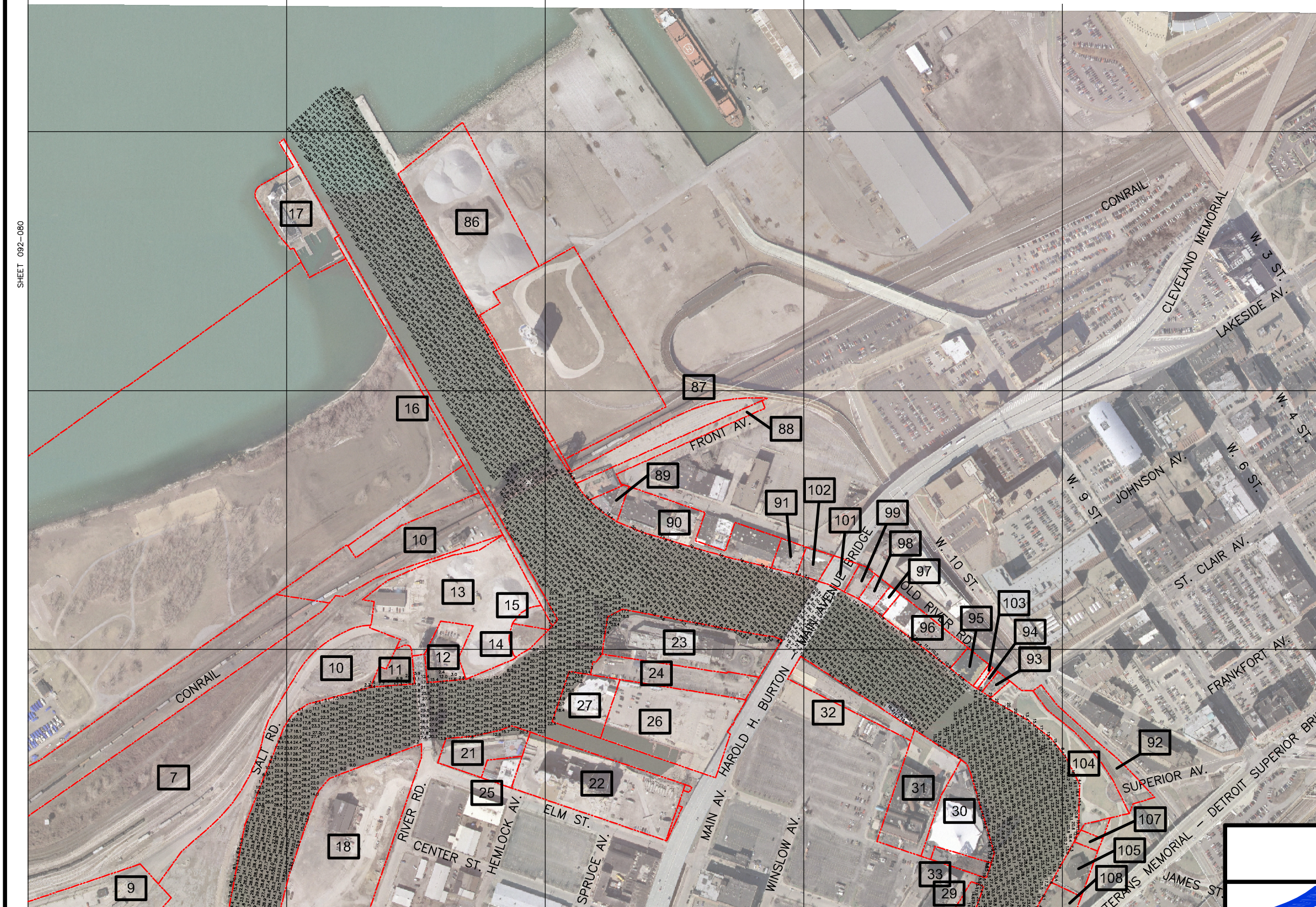
SCALE IN FEET



ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
7	PENNSYLVANIA LINES LLC	58		
9	CARGILL INCORP	565		
10	Ontario Stone Co	1968		
11	City Of Cleveland 886115	172		
12	Ontario Stone Corp	144		
13	Ontario Stone Corp	210		
14	Flats Development Inc Sale 703	162		
15	Flats Development Inc Sale 703	30		
16	U S Of America	1735		
17	River'S End Marina // Development Inc.	436		
18	Ontario Stone Corp	2700		
21	PENNSYLVANIA LINES LLC	347		
22	General Portland Inc	632		
23	Flats Dev Inc	836		
24	Sugar Warehouse	93		
25	Salvaras Dean	0		
26	SYCAMORE SLIP PARKING LLC	382		
27	1180 MAIN AVENUE, LLC	485		
29	Cleveland City Of	400		
30	Jacobs Richard E	433		
31	Nautica Phase 2 Ltd	524		
32	Flats Dev Inc	214		
33	Baltimore & Ohio Rr Co	60		
86	Cleveland Port Authority	309		
87	FLATS EAST DEVELOPMENT LLC	750		
88	FLATS EAST DEVELOPMENT, LLC	83		
89	FLATS EAST DEVELOPMENT LLC	136		
90	CITY OF CLEVELAND, OHIO	626		
91	FLATS EAST DEVELOPMENT LLC	103		
92	FLATS EAST DEVELOPMENT, LLC	117		
93	TELECOM ACQUISITION CORP	34		
94	Samsel Realty Inc	24		
95	Samsel Realty Co	107		
96	1290 LLC	207		
97	SAMSEL, FRANK J TRUSTEE LC&S, SAMSEL FAMILY TRUST HUSBANDS SHARE	126		
98	Telecom Acquisition Corp, 1, Inc	48		
99	Telecom Acquisition Corp, 1, Inc	68		
101	Cuy County Bd Of Comm	105		
102	FLATS EAST DEVELOPMENT, LLC	92		
104	Cleveland City Of, Dept Of Parks Rec & Prop	683		
105	Glazer, Robert R	161		
107	Inlarb, Inc. An Ohio Corp	42		
108	Cleveland City Of	132		

SHEET 092-080

SHEET 092-090






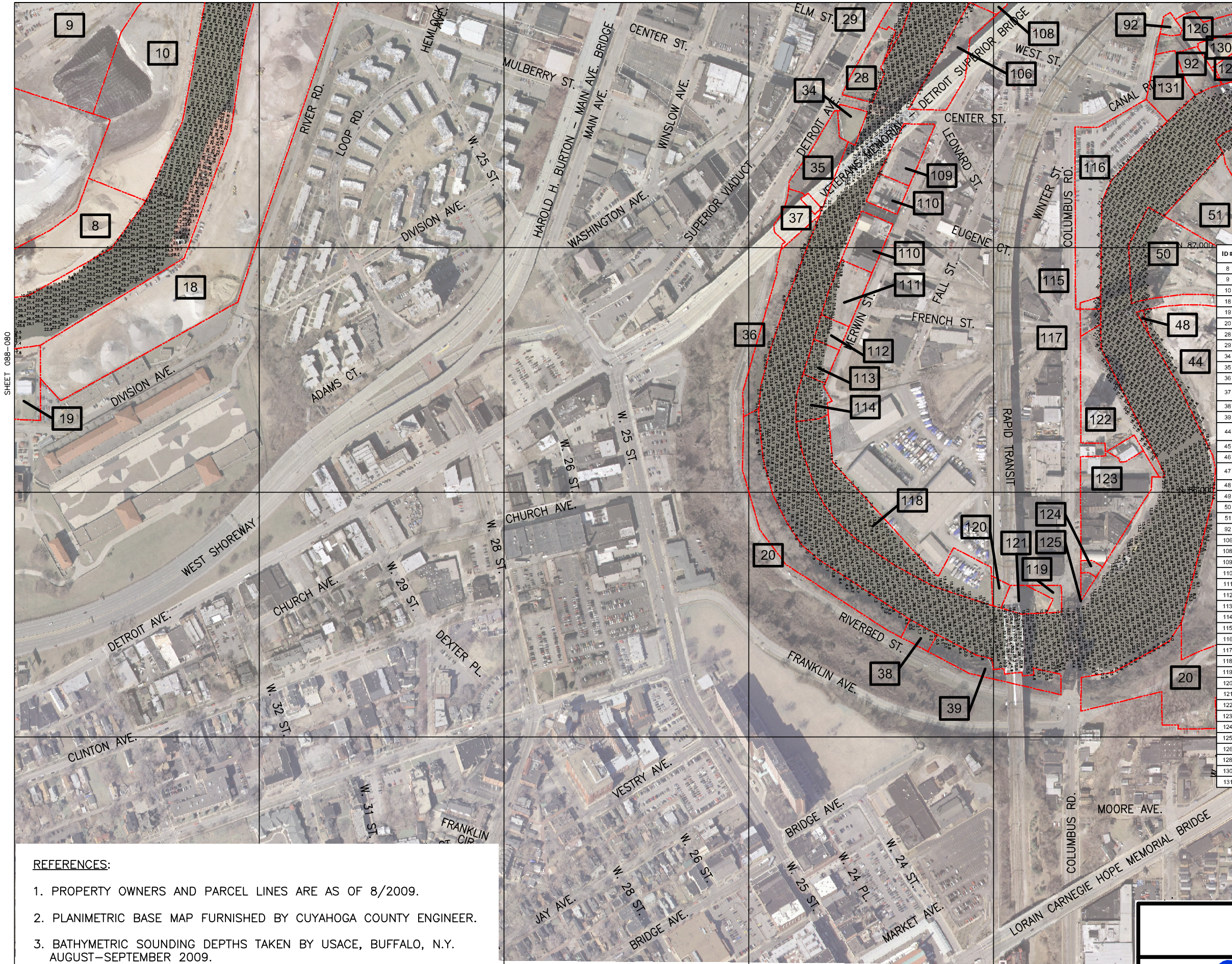
**CLEVELAND HARBOR STUDY** APRIL 2010



**PLATE 1**  
SHEET 092-085

**LEGEND**

-  PARCEL LINE
-  PARCEL IDENTIFICATION NUMBER
-  BATHYMETRIC SOUNDING DEPTH



ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
8	Sand Prods Corp	1226		
9	CARGILL INCORP	565		
10	Ontario Stone Co	1968		
18	Ontario Stone Corp	2700		
19	City Of Cleve-Waterworks 115	360		
20	WESTBANK DEVELOPMENT COORP	1673		
28	City Of Cleveland 896115	177		
29	Cleveland City Of	400		
34	Cleveland City	181		
35	Stonebridge Waterfront, Inc.	317		
36	RIVERBED AARQUE, LLC	835		
37	STONEBRIDGE WATERFRONT & DEVELOPMENT COORP	10		
38	Cleveland Metropolitan Housing Authority	122		
39	No Cuyahoga Valley Corridor	608		
44	Carter Peninsula, Inc., An Ohio Corporation	1251		
45	W & M Properties	1608		
46	Cleveland City Of	110		
47	RIVERSIDE RESIDENTIAL ASSOCIATES LLC	683		
48	Pennsylvania Lines Llc	47		
49	Cleveland City Of	163		
50	Carter Peninsula INC.	496		
51	Scranton-Aversil, Inc.	345		
92	FLATS EAST DEVELOPMENT, LLC	117		
106	Cuy County Bd Of Comm	503		
108	Cleveland City Of	132		
109	MARLIN INVESTMENT GROUP LLC	228		
110	Cereal Food Processors Inc	340		
111	Cleveland City Of	244		
112	Cleveland City Of	102		
113	Cleveland City Of	150		
114	Cleveland City Of	198		
115	Columbus Rd Realty	54		
116	Columbus Rd Realty	815		
117	Consolidated Rail Corp.	54		
118	Cleveland City Of	1175		
119	No Cuyahoga Valley Corridor	248		
120	No Cuyahoga Valley Corridor	45		
121	Cleveland City Of	134		
122	ST. BARBARA CEMENT, INC.	696		
123	Pipeline Devel Co	488		
124	Pipeline Devel Co	46		
125	Cleveland City Of	104		
126	Shenwin Williams Co	514		
128	Shenwin Williams Co	170		
130	Shenwin Williams Co	10		
131	Shenwin Williams Co	155		

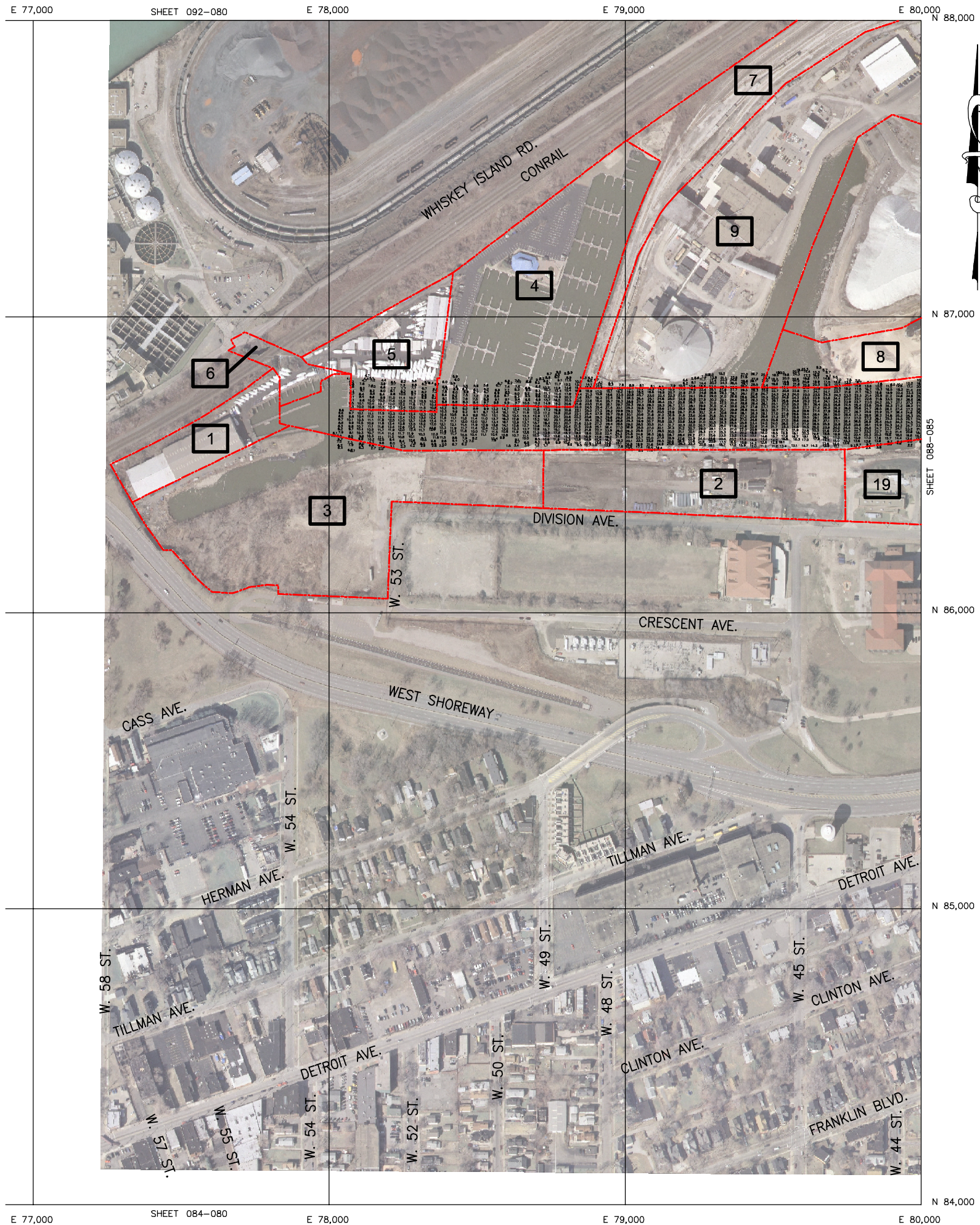
**REFERENCES:**

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y. AUGUST-SEPTEMBER 2009.



**CLEVELAND HARBOR STUDY** APRIL 2010





### LEGEND

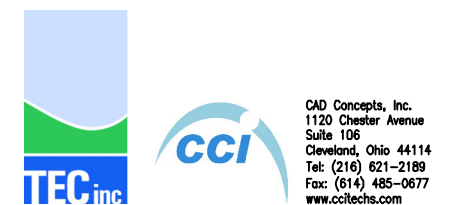
- PARCEL LINE
- 123 PARCEL IDENTIFICATION NUMBER
- $21.9$  BATHYMETRIC SOUNDING DEPTH



ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
1	CHANNEL PARK MARINA, INC.	93		
2	Cleveland Cuy County Port Authority	1027		
3	CITY OF CLEVELAND	870		
4	LISTED WITH 00302301	517		
5	CHANNEL PARK MARINA, INC.	480		
6	Cleveland City Of	247		
7	PENNSYLVANIA LINES LLC	58		
8	Sand Prods Corp	1226		
9	CARGILL INCORP	565		
19	City Of Cleve-Waterworks 115	360		

### REFERENCES:

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y., AUGUST-SEPTEMBER 2009.

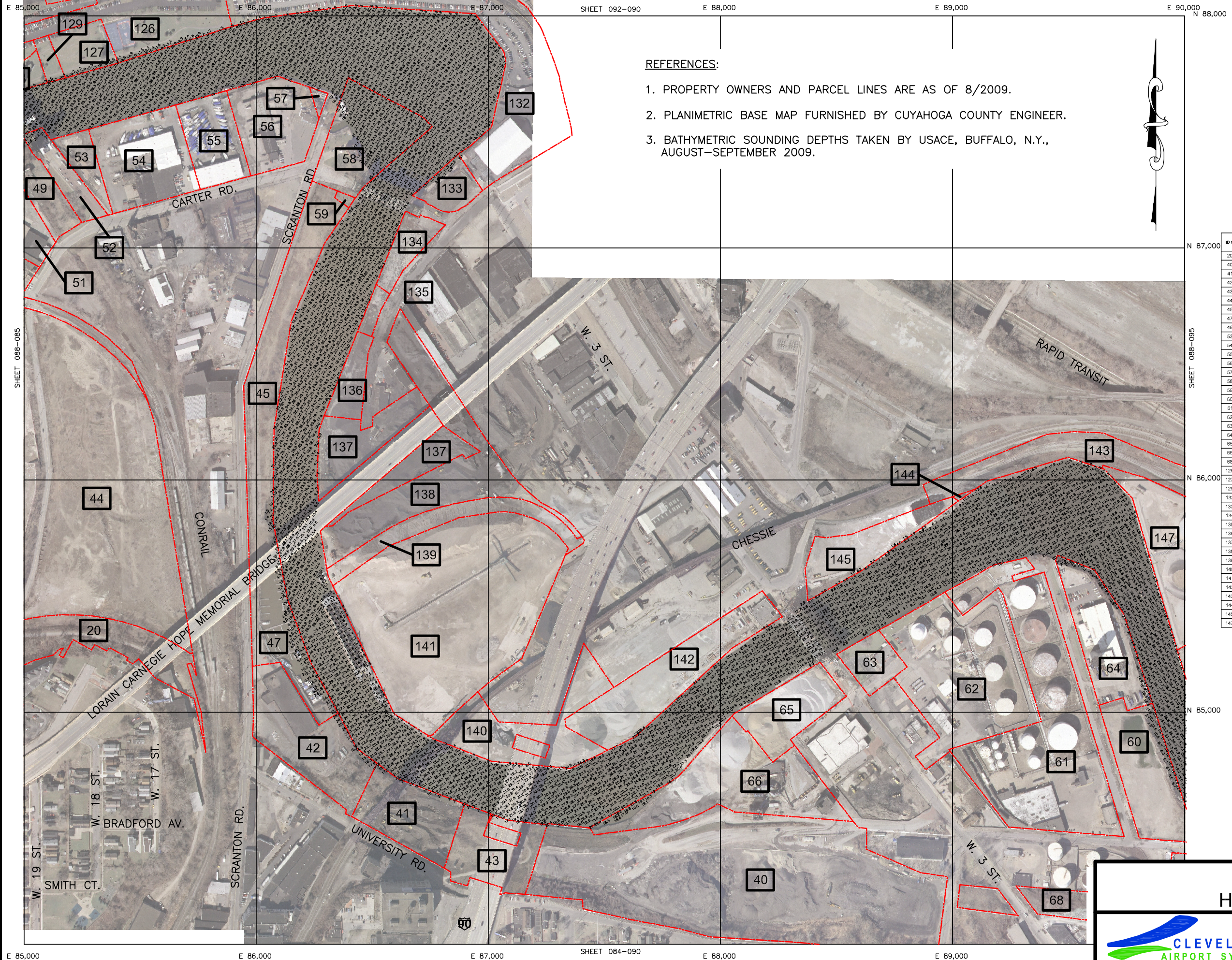


**CLEVELAND  
HARBOR STUDY**

APRIL 2010

**PLATE 2**

SHEET 088-080



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SHEET 088-085

SHEET 088-095

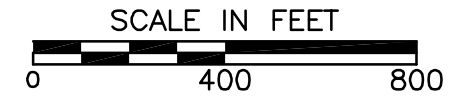
E 85,000 E 86,000 E 87,000 SHEET 084-090 E 88,000 E 89,000

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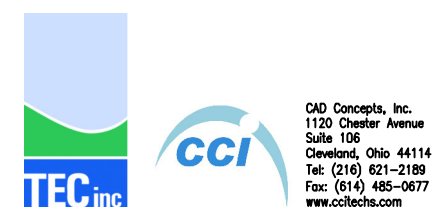
1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y., AUGUST-SEPTEMBER 2009.

**LEGEND**

- PARCEL LINE
- 123 PARCEL IDENTIFICATION NUMBER
- BATHYMETRIC SOUNDING DEPTH






ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
20	WESTBANK DEVELOPMENT CORP	1673		
40	EMERALD DOCK INC	182		
41	UNIVERSITY-CUYAHOGA INC	415		
42	RIVERSIDE RESIDENTIAL ASSOCIATES LLC	295		
43	STATE OF OHIO	370		
44	Carter Peninsula, Inc., An Ohio Corporation	1251		
45	W & M Properties	1608		
47	RIVERSIDE RESIDENTIAL ASSOCIATES LLC	683		
49	Cleveland City Of	163		
53	Scranton Aerial Inc	164		
54	Scranton Aerial Inc	392		
55	Scranton Aerial Inc	224		
56	Scranton Aerial Inc	375		
57	Scranton Aerial Inc	84		
58	Cleveland City Of	984		
59	Cel Co	62		
60	Grand River Enterprises Inc	608		
61	ARC TERMINALS HOLDINGS LLC	390		
62	BUCKEYE TERMINALS LLC	332		
63	BUCKEYE TERMINALS LLC	210		
64	Samsil Realty Company	810		
65	LAFARGE Corp.	443		
66	LAFARGE Corp.	791		
68	Concrete, Inc.	177		
126	Sherwin Williams Co	514		
127	Sherwin Williams Co	235		
129	Sherwin Williams Co	97		
132	Southridge Corp	1780		
133	Mid-Continent Coal & Coke Co	295		
134	Mid-Continent Coal & Coke Co	343		
135	Cleveland City Of	216		
136	Mid-Continent Coal & Coke Co	386		
137	Mid-Continent Coal & Coke Co	384		
138	Mid-Continent Coal & Coke Co	170		
139	River Dock Inc	76		
140	Csub Corporation	819		
141	River Dock Inc	790		
142	Csub Corporation	957		
143	Baltimore & Ohio Rr Co, Ctr Branch	682		
144	Norfolk & Western, Railway Co.	100		
145	Ontario Stone Corp	770		
147	Marathon Ashland Petro Llc	862		

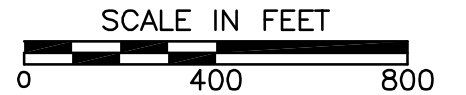


**CLEVELAND HARBOR STUDY** APRIL 2010

**PLATE 4**  
SHEET 088-090

**LEGEND**

-  PARCEL LINE
-  PARCEL IDENTIFICATION NUMBER
-  BATHYMETRIC SOUNDING DEPTH



**REFERENCES:**

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y., AUGUST-SEPTEMBER 2009.



ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
67	Concrete, Inc.	598		
68	Concrete, Inc.	177		
143	Baltimore & Ohio Rr Co, Civ Branch	662		
146	T-35 Asphalt Paving Co	1417		
147	Marathon Ashland Petro Llc	862		
148	Concrete, Inc.	112		



**CLEVELAND HARBOR STUDY** APRIL 2010



**PLATE 5**  
SHEET 088-095



ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
68	Concrete, Inc.	177		
69	St Marys Cement, Inc.	787		
70	Csub Corporation	466		
71	Cuyahoga Asphalt Co. An Ohio Corp.	215		
72	CHEMTRADE LOGISTICS ( U S ), INC.	390		
73	Balt & Ohio Rr Co. C T & V Branch	60		
74	Saratoga Of Ohio Ltd.	196		
75	International Bulk Storage Group LLC	275		
76	International Bulk Storage Group LLC	2268		
77	Norfolk & Western Railway Co	100		
78	IS G CLEVELAND	1050		
82	IS G CLEVELAND WEST	10678		
143	Baltimore & Ohio Rr Co. Ctv Branch	662		
149	T-35 Asphalt Paving Co	855		
150	Cuyahoga Concrete Co.	269		
151	Concrete, Inc., A Corp.	87		
152	Bp America Inc., A Delaware Corporation	109		
153	Zackon Inc	257		
154	Koch Fuels, Inc., A Delaware Corporation	583		
155	Zackon Inc	231		
156	Zackon Inc	1034		
157	INDEPENDENCE ROAD LLC	1185		



N 83,000

**LEGEND**

- PARCEL LINE
- 123 PARCEL IDENTIFICATION NUMBER
- 21.9 BATHYMETRIC SOUNDING DEPTH



**REFERENCES:**

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y., AUGUST-SEPTEMBER 2009.

N 81,000

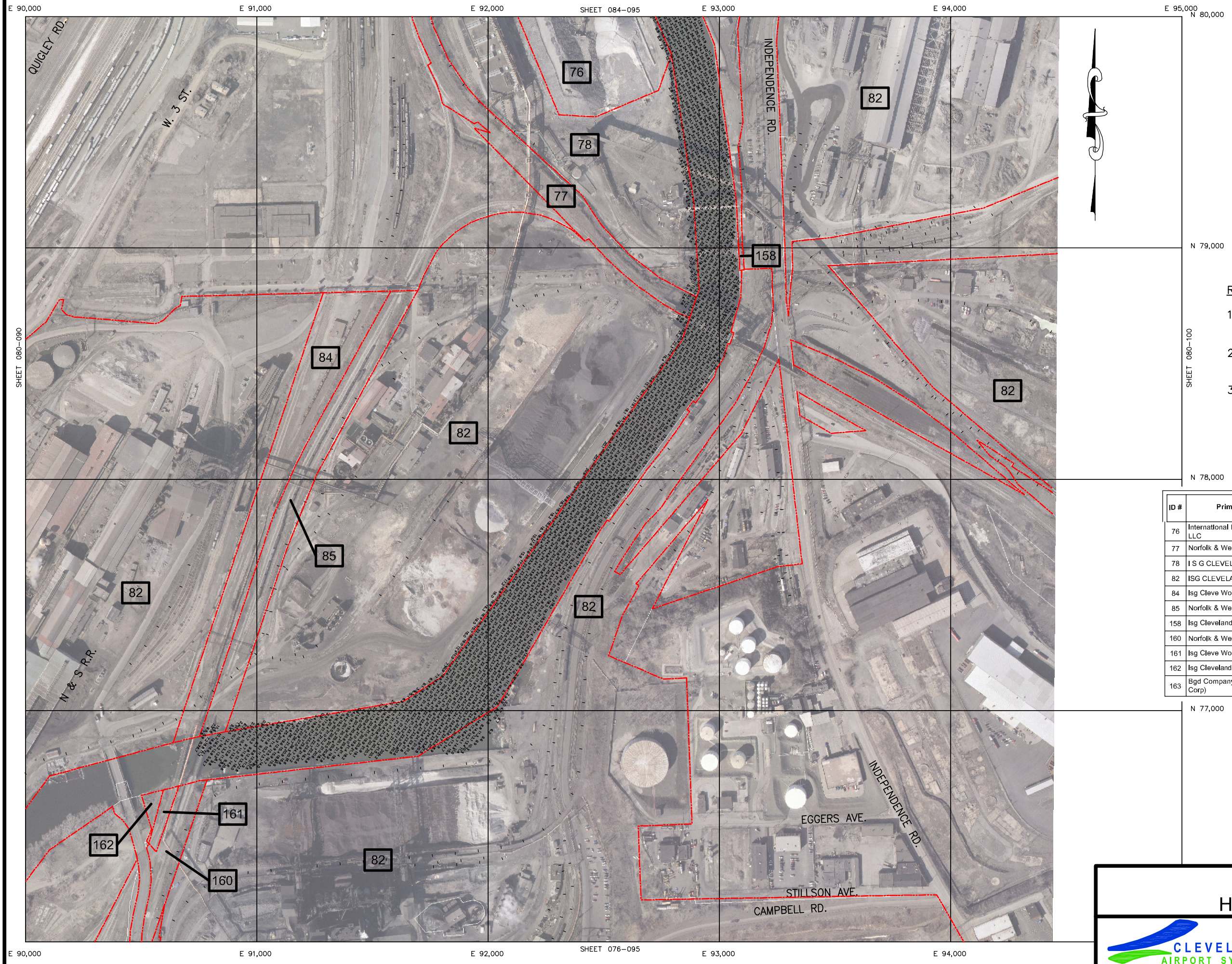
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**CLEVELAND HARBOR STUDY** APRIL 2010



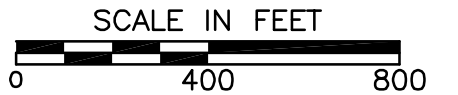
**PLATE 6**  
 SHEET 084-095





**LEGEND**

- PARCEL LINE
- 123 PARCEL IDENTIFICATION NUMBER
- BATHYMETRIC SOUNDING DEPTH



REFERENCES:

1. PROPERTY OWNERS AND PARCEL LINES ARE AS OF 8/2009.
2. PLANIMETRIC BASE MAP FURNISHED BY CUYAHOGA COUNTY ENGINEER.
3. BATHYMETRIC SOUNDING DEPTHS TAKEN BY USACE, BUFFALO, N.Y., AUGUST-SEPTEMBER 2009.

ID #	Primary Owner	River Frontage (Linear Feet)	River Frontage Facilities	River Frontage Facilities Condition
76	International Bulk Storage Group LLC	2268		
77	Norfolk & Western Railway Co	100		
78	IS G CLEVELAND	1050		
82	ISG CLEVELAND WEST	10878		
84	Isg Cleve Works Railway Co	113		
85	Norfolk & Western Railway Co	112		
158	Isg Cleveland Works Railway Co.	1713		
160	Norfolk & Western Rr	130		
161	Isg Cleve Works Railway Inc	58		
162	Isg Cleveland Inc.	108		
163	Bgd Company, (A Delaware Corp)	1070		



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**CLEVELAND HARBOR STUDY** APRIL 2010



**PLATE 7**  
 SHEET 080-095

# Summary Report

CUYAHOGA RIVER BULKHEAD STUDY  
CLEVELAND, OHIO



US Army Corps  
of Engineers.  
Buffalo District

APRIL 1999



US Army Corps  
of Engineers  
Buffalo District

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Summary Report  
Cuyahoga River Bulkhead Study  
Cleveland, Ohio

April 1999

# EXECUTIVE SUMMARY

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## *Project Authorization*

This study was authorized by Public Laws 100-202, 101-101, and the Water Resources Development Act (WRDA) of 1996, Section 438. The purposes of the study were to evaluate the integrity of the bulkhead system located along the Federal channel on the Cuyahoga and Old Rivers in the vicinity of Cleveland, Ohio, and provide to the non-Federal interests an analysis of costs and repairs of the bulkhead system.

## *Study Approach*

The study was conducted in two Phases. The *Phase 1* consisted of visual inspection of the above water steel sheet pile (SSP) wall on both sides of the Cuyahoga River which has a navigable length of 5.6 miles. It also included both shorelines of the Old River about one mile long from its intersection with Cuyahoga River. The data gathered during Phase 1 included an inventory of the bulkheads, available engineering data and historical information provided by property owners and records obtained from the Federal bulkhead construction permits. All observable distresses such as misalignment, settlement, cavities, interlock separation, holes, dents and cracks were also obtained during Phase 1. The information was used to calculate the functional Condition Index (CI). The CI is a number (from 1 to 100) that characterizes the overall state of each bulkhead section inspected under a program called Repair, Evaluation, Maintenance and Rehabilitation (REMR) developed by the Corps of Engineers. A CI of 70 to 100 indicates very good to excellent condition; 40 to 69 is fair to good and below 40 is poor to very poor condition. The Phase 1 was completed in 1997. Copies of the Phase 1 Report were sent to property owners and other interested parties in February 1998.

The *Phase 2* consisted of measuring the thickness and corrosion rate of the SSP wall below the water line. Due to funding limitations, it was not possible to take underwater measurements of the entire bulkhead system. Hence, only twelve sites were selected for underwater measurements. The twelve sites were chosen based on where bulkhead failure would be most detrimental to navigation (i.e., at river bends), as recommended by the Flats Oxbow Association. Ultrasonic measuring devices developed by the Construction Engineering Research Laboratory (CERL), Corps of Engineers, were the primary means of underwater data acquisition. The Phase 2 was completed in February 1999.

## *Findings and Recommendations*

About 74 percent of the bulkhead system are in very good to excellent condition; 20 percent are in fair to good condition and the rest are in poor to very poor condition. The underwater measurements indicated moderate to significant corrosion at all twelve sites. While the underwater measurements represent only a small portion of the entire bulkhead system, it provides a pattern of corrosion that is probably typical in other areas along the Cuyahoga and Old Rivers, particularly those constructed in the 1940's. Preliminary designs and cost estimates for typical bulkhead and fender replacement are included in this report. The estimated replacement cost for bulkheads in the very poor to poor condition is \$17,700,000 (Table 4) and \$33,300,000 for bulkheads in fair to good condition (Table 6). Cost estimates are based on typical bulkhead replacement details and should only be used to assist planning efforts.

This report also provides helpful recommendations for future technical engineering considerations. It is good practice to inspect any marine bulkhead at a minimum of every five years. This is because bulkheads at six of the twelve underwater test sites with high condition indices (very good to excellent) also showed moderate to significant amount of thickness loss and corrosion. Thickness loss of over twenty percent should be considered critical and loss of ten to twenty percent could be critical in high stress areas that are typically below the water surface.

This report completes the Federal action as authorized by the project authorization.

\*\*\*

**SUMMARY REPORT  
CUYAHOGA RIVER BULKHEAD STUDY  
CLEVELAND, OHIO**

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**FIGURE**

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PLATE 3 – TYPE A FENDER SYSTEM  
PLATE 4 – TYPE B FENDER SYSTEM

**ATTACHMENT**

PHASE 2 REPORT, CUYAHOGA RIVER BULKHEAD STUDY, Robotic Underwater Corrosion Inspection/Assessment of Sheet Pile along the Cuyahoga and Old Rivers in Cleveland Ohio, USACERL, April 1999

**SUMMARY REPORT  
CUYAHOGA RIVER BULKHEAD STUDY  
CLEVELAND, OHIO**

**1. GENERAL**

The U.S. Army Corps of Engineers (USACE), Buffalo District was authorized to conduct a study evaluating the integrity of the bulkhead system along the Federal channel on the Cuyahoga and Old Rivers in the vicinity of Cleveland, Ohio, and to provide nonfederal interests with an analysis of costs and repairs of the bulkhead system. The study area includes the entire length of the 23- and 27-foot deep Federal channels on the Cuyahoga and Old Rivers. Buffalo District contracted the engineering firm of URS Greiner, Inc. of Buffalo, N.Y. to conduct Phase 1 of this study. After completion of the Phase 1 report, the U. S. Army Corps of Engineers, Construction Research Engineering Laboratories (CERL) conducted Phase 2, a thickness and corrosion analysis of twelve selected bulkheads on the Cuyahoga River. The results of both Phase 1 and Phase 2 of this study were then used by Buffalo District to conduct the final phase of this study and prepare the Summary Report. The Summary Report contains recommendations of further study, repair, and/or replacement for the bulkheads based on assessment of current bulkhead condition and expected life.

**2. PHASE 1**

Phase 1 of the Cuyahoga River Bulkhead Study was conducted during 1997. The Phase 1 report was completed during January 1998. Phase 1 work consisted of preparing an inventory of all bulkheads along the Federal channel on the Cuyahoga and Old Rivers, gathering available engineering data, performing visual inspections of each bulkhead, and performing preliminary evaluations of each bulkhead using the USACE Repair, Evaluation, Maintenance, and Rehabilitation (REMR) Research program's report entitled "Maintenance and Repair of Steel Sheet Pile Structures" (USACE Technical Report REMR-OM-9, December 1990). Using the REMR computer program, a functional condition index (CI) was determined for each bulkhead based upon historical and field data collected including observed distresses. The CI varies from 0 to 100 and generalizes the overall state of each bulkhead section inspected. The calculated condition indices serve to alert bulkhead owners of potential structural problems that could affect the function of the bulkhead and the need for further more detailed evaluations. The portion of the bulkheads visibly available for inspection was very limited. Due to the limited state of the inspections, the calculated condition indices should be considered approximate and could change with more detailed bulkhead inspections.

The Phase 1 evaluations using the REMR program based on bulkhead lengths found:

- 74 percent was in very good to excellent condition (CI = 70-100)
- 2 percent was in good condition (CI = 55-69)
- 18 percent was in fair condition (CI = 40-54)
- 6 percent was in very poor to poor condition (CI = 0-39).

### 3. PHASE 2

Phase 2 of the Cuyahoga River Bulkhead Study was conducted during August 1998. To provide additional field information not available during the Phase 1 inspection, CERL was tasked by Buffalo District to perform additional inspections of the bulkheads. Field work involved taking thickness and corrosion rate measurements of several sheet pile bulkheads. Due to funding limitations and complexity of the inspections to be performed, it was necessary to limit the inspections to twelve sites. Thickness measurements were taken underwater on the outer surface of a single sheet pile at each site, using several ultrasonic measuring devices. Corrosion rate measurements were taken by a certified corrosion engineer. Collected field data was analyzed and presented in CERL's report on Phase 2, entitled "Robotic Underwater Corrosion Inspection/Assessment of Sheet Pile along the Cuyahoga and Old Rivers in Cleveland Ohio", dated March 1999, which is included as an attachment to this report. Figure 1 shows the locations of the twelve selected sites, listed below as described in Appendix A of CERL's report.

Site 1: Parks 1/Parks 3, City of Cleveland Parks and Recreation, next to Frank Morrison and Son, just north of marker 540 on east shore.

Site 2: Glazer 4/City of Cleveland 32 or City of Cleveland 31, approximately 400 feet south of Site 1, between markers 540 and 548 on east shore.

Site 3: Cereal 1/Cereal 2 or Cereal Food Processors 3, just north of marker 559 on the east shore.

Site 4: Mid-Continental Coal/Coke 2, halfway between markers 640 and 650 on the east shore.

Site 5: Erie RR 10/STA Realty 2, on outcropping between 660 and 670, closer to 670 on the west shore.

Site 6: River Terminal 6, just north of marker 760 on southwest shore.

Site 7: Carter 1, between Samsel Realty and Carter Peninsula, just south of marker 610 on the east shore.

Site 8: B&O RR 1/Tower City 1, between Tower City and F.C. Southridge Corp., between markers 620 and 630 on the north shore.

Site 9: B&O RR 1/Mid-Continental 5, between markers 630 and 640, on the east shore.

Site 10: Republic Steel 7/LTV Steel 31, between 800 and 810 on the east shore.

Site 11: B&O Railroad 7/B&O Railroad 5, just east of marker 700 on the north shore.

Site 12: Erie RR 6/Ontario Stone 4, between markers 320 and 310 on the south shore.

The purpose of this analysis was to determine average thickness loss and corrosion rates for several bulkheads considered representative of most of the bulkheads on the Cuyahoga River based on age and current condition. The selected bulkheads varied in age from less than ten years to more than fifty years. Condition indices as determined in Phase 1 of this study varied from poor to excellent. The amount of sheet pile investigated (one pile at each of the twelve sites) by CERL was a very small percentage of the total bulkhead along the Cuyahoga River. The results of the CERL corrosion investigation were used to identify possible corrosion trends along the entire bulkhead system of the Cuyahoga River. The average percent of thickness loss at each sheet pile site is presented in Table 1. Average percent thickness loss is based on all individual thickness measurements taken by CERL at each of the twelve sites. Thickness measurements at each site varied along the sheet pile, both vertically and horizontally, indicating nonuniform corrosion at most locations.



**TABLE 1 – AVERAGE PERCENT SHEET PILE THICKNESS LOSS**

SITE	AVERAGE % THICKNESS LOSS	CONDITION INDEX	YEAR BULKHEAD CONSTRUCTED
1	29.4	100- Excellent	1990
2	24.2	100- Excellent	1940's (estimated)
3	25.3	100- Excellent	1940's (estimated)
4	36.0	28 - Poor	1940's (estimated)
5	37.6	46 - Fair	1948
6	33.0	95 - Excellent	1960's (estimated)
7	18.4	100- Excellent	1950's (estimated)
8	18.4	20 - Poor	1945
9	40.0	47 - Fair	1940's (estimated)
10	36.0	99 - Excellent	1942
11	53.2	47 - Fair	1949
12	46.4	45 - Fair	1945

Corrosion rates at several of the sites are presented in Table 2. Maximum and minimum rates are presented where multiple rates were identified. The current average sheet pile thickness measured at each site is also presented. Projected sheet pile thicknesses are presented using the assumed ongoing corrosion rate of about 0.01 inch/year and current maximum and minimum thicknesses determined from the averages plus and minus standard deviations per Appendix B of CERL's report. It should be noted as stated above that thicknesses varied considerably along each sheet pile. Maximum and minimum thicknesses are projected at ten-year intervals based on Figures 9-21 of CERL's report. Actual future thicknesses will vary along the sheet pile. The higher corrosion rates are most likely very localized over only a very small area of sheet pile. This can be seen in various photographs in the Phase 1 Report.

**TABLE 2 – SHEET PILE CORROSION DATA**

SITE	CORROSION RATE, MIN., MAX. (inch/year)	ORIGINAL THICKNESS (inch)	THICKNESS 1998 AVG., STD.DEV. (inch)	THICKNESS 10 YEARS MAX., MIN. (inch)	THICKNESS 20 YEARS MAX., MIN. (inch)	THICKNESS 30 YEARS MAX., MIN. (inch)
1	0.001844	0.50	0.353, 0.100	0.35, 0.15	0.25, 0.05	0.15, 0
2	0, 0.051982	0.50	0.379, 0.040	0.32, 0.24	0.22, 0.14	0.12, 0.04
3	0.001082, 0.034750	0.375	0.280, 0.094	0.27, 0.09	0.17, 0	0.07, 0
4	0.005071, 0.018977	0.50	0.320, 0.092	0.31, 0.13	0.21, 0.03	0.11, 0
5	0.003992	0.375	0.234, 0.119	0.25, 0.02	0.15, 0	0.05, 0
6	0.003043, 0.008113	0.375	0.251, 0.054	0.20, 0.09	0.10, 0	0, 0
7	0.000055, 0.010920	0.375	0.306, 0.043	0.25, 0.16	0.15, 0.06	0.05, 0
8	0.010963	0.375	0.306, 0.048	0.25, 0.16	0.15, 0.06	0.05, 0
11	0.004795	0.50	0.234, 0.109	0.24, 0.03	0.14, 0	0.04, 0

12	0.001675, 0.008086	0.375	0.201, 0.091	0.19, 0.01	0.09, 0	0, 0
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#### 4. DISCUSSION OF RESULTS FROM PHASE 1 AND PHASE 2

The above results from Phase 2 show moderate to significant corrosion at all twelve sites. Although the Phase 1 condition indices show many of the older bulkheads to be in very good to excellent condition, these ratings are based on only visible inspection of the portion of the sheet pile bulkheads above the water surface and do not include thickness measurements. The visible portion of the sheet pile above the water surface is a very small percentage of the overall length of the sheet pile. If the number of observed distresses in the visible portion of the sheet pile is low, the condition index will be high. Observable distresses, in the order of severity, include misalignment, corrosion, settlement, cavities, interlock separation, holes, dents, and cracks. The Phase 1 visible inspections have identified the number and magnitude of visible distresses in each the bulkheads. The computer program calculated a condition index for each bulkhead using the supplied information on distresses. For bulkheads rated by the condition index computer program as poor or fair, there were a large number of distresses that were confirmed by visual observations. It is clear that bulkheads in fair or poor condition require further attention such as additional study, repair, or replacement. For bulkheads rated by the condition index computer program as very good to excellent, there were no significant distresses observed above the water surface. It can not always be concluded that bulkheads rated in very good to excellent condition require no additional attention. Other information, such as the bulkhead's age and investigations of other similar bulkheads, needs to be taken into account. The Phase 2 sheet pile thickness and corrosion analyses were performed by CERL to provide additional information for making assessments of the bulkheads that were visible during the Phase 1 inspections. It can be assumed that corrosion at the twelve sites investigated by CERL is probably typical in other areas along the Cuyahoga River, particularly at the older bulkheads constructed in the 1940's.

#### 5. RECOMMENDATIONS

The recommendations given below are based on the Phase 1 condition indices and information obtained from the Phase 2 thickness and corrosion analyses.

##### 5.1 Bulkheads In Very Poor to Poor Condition (CI = 0-39)

The recommended actions include performing a detailed evaluation of the existing bulkhead condition and determining the need for repair, rehabilitation or reconstruction. A safety evaluation of present conditions is also recommended. Qualified professional engineers should perform the detailed evaluation. The type and extent of the evaluation would be determined by the professional engineers and could include all or some of the following:

- Thorough above water visual inspection
- Alignment measurements and monitoring
- Underwater inspection
- Subsurface exploration and testing
- Ultrasonic thickness measurements

- Determination of current and future bulkhead use and loading conditions
- Structural analysis of existing bulkhead
- Determination of need of repair or replacement

If the detailed evaluation determines that the existing bulkhead is no longer functional and/or can not safely carry present or future loads, then repair or replacement of the bulkhead should be considered. The bulkheads listed in Table 3 were determined in Phase 1 to be in poor to very poor condition and should receive a detailed evaluation. Further description and location of these bulkheads are given in the Phase 1 report.

**TABLE 3 – BULKHEADS IN VERY POOR TO POOR CONDITION**

BULKHEAD	LENGTH (FEET)	FUNCTIONAL CONDITION INDEX	STATIONING
F.C. Southridge – 1,2,3	860	20	625.0 to 633.8
LTV Steel – 19	460	20	779.4 to 784.0
River West Dock – 1	330	25	674.1 to 677.0
Mid-Continental Coal/Coke – 2	1,000	28	641.5 to 652.2
Zaclon – 2, 3	908	30	755.2 to 761.9
LTV Steel – 21	1,102	31	766.0 to 778.5
LTV Steel - 48	70	39	764.6 to 765.3

Until a detailed evaluation of each bulkhead is performed, it is not known whether only repairs to the bulkhead or total bulkhead replacement are necessary. At some of the above sites, replacement of the bulkhead may be necessary, particularly if there are many significant distresses and very high surcharges on the bulkhead. Typical total replacement costs have been estimated for each of the bulkheads listed in Table 3 to assist planning efforts. Details of a typical bulkhead replacement are shown on Plate 1. The bulkhead replacement details are similar to that used for the Corps of Engineers' Dock 20 and West Pier repair project at the mouth of the Cuyahoga River, except for modifications due to change in channel depth. Estimated bulkhead replacement costs are given in Table 4, based on an estimated cost (February 1999 price level) per linear foot of wall at \$3,750 (23-foot channel).

**TABLE 4 – BULKHEAD REPLACEMENT COSTS**

BULKHEAD	LENGTH (FEET)	STATIONING	CHANNEL DEPTH (FT)	REPLACEMENT COST
F.C. Southridge – 1,2,3	860	625.0 to 633.8	23	\$3,225,000
LTV Steel – 19	460	779.4 to 784.0	23	\$1,725,000
River West Dock – 1	330	674.1 to 677.0	23	\$1,238,000
Mid-Continental Coal/Coke – 2	1,000	641.5 to 652.2	23	\$3,750,000
Zaclon – 2, 3	908	755.2 to 761.9	23	\$3,405,000
LTV Steel – 21	1,102	766.0 to 778.5	23	\$4,133,000
LTV Steel - 48	70	764.6 to 765.3	23	\$263,000

The total replacement cost for the bulkheads in very poor to poor condition is approximately \$17,700,000.

## 5.2 Bulkheads In Fair to Good Condition (CI = 40-69)

The recommended action includes performing detailed above water visual and underwater inspections of the bulkhead by a qualified professional engineer. During the above water inspection, particular attention should be given to bulkhead alignment, corrosion and the other various distresses noted in the Phase 1 report. As much of the bulkhead should be inspected underwater for distresses as practical. If possible, the underwater inspection should include ultrasonic thickness measurements. Determination of current and future bulkhead use and loading conditions should be made. If the observed distresses are considered significant enough to adversely effect the current and/or future function of the bulkhead, then a detailed evaluation of the bulkhead as described in previous paragraph is recommended. The detailed evaluation will provide the necessary information to determine whether repair or replacement of the bulkhead is necessary. The bulkheads listed in Table 5 were determined in Phase 1 to be in good to fair condition. Further description and location of these bulkheads are given in the Phase 1 report.

**TABLE 5 – BULKHEADS IN FAIR TO GOOD CONDITION**

BULKHEAD	LENGTH (FEET)	FUNCTIONAL CONDITION INDEX	STATIONING
International Salt -1	220	40	346.0 to 348.2
Sherwin Williams - 9	140	42	609.7 to 611.0
W&M Properties -2	217	43	652.4 to 655.1
Ontario Stone - 10	500	44	516.6 to 301.3
LTV Steel - 11	580	45	796.2 to 802.0
CSUB Corporation - 2	224	45	682.5 to 684.9
CSUB Corporation - 4	351	45	677.0 to 680.6
Ontario Stone - 1	540	45	320.6 to 326.0
Ontario Stone - 5	214	45	312.0 to 315.0
Cleveland Port Auth.- 1	830	46	503.6 to 511.8
STA Realty -2	265	46	664.5 to 666.8
B&O Railroad - 5	635	47	698.5 to 704.0
City of Cleveland - 10	130	47	637.0 to 639.3
Carter Peninsula - 1	270	47	604.9 to 609.0
Mid-Continental - 5	720	47	633.8 to 639.0
River Dock - 2, 3	590	48	660.0 to 665.9
LTV Steel - 44	380	48	778.2 to 782.0
Sherwin Williams - 7	105	49	613.9 to 615.1
CSUB Corporation -10	475	49	736.8 to 742.0
Ontario Stone - 4	195	50	315.0 to 317.9
Cereal Food Proc. - 1	250	52	559.5 to 561.5
St. Mary's Enter. - 3	10	58	732.8 to 732.9
Ontario Stone - 9	50	61	301.3 to 301.8

City of Cleveland - 44	230	66	336.0 to 338.1
City of Cleveland - 50	390	67	332.1 to 336.0
Richard Jacobs - 2	6	68	541.0 to 541.1

Until the visual inspection and detailed evaluation (if necessary) of each bulkhead is performed, it is not known whether repair or replacement of the bulkhead is necessary. Typical total replacement costs have been estimated for each of the bulkheads listed in Table 5 to assist long range planning efforts. Details of a typical bulkhead replacement are shown on Plates 1 (along the 23-foot deep Federal channel) and 2 (along the 27-foot deep Federal channel). Estimated bulkhead replacement costs are given in Table 6, based on estimated costs (February 1999 price level) per linear foot of wall at \$3,750 (23-foot channel) and \$4,170 (27-foot channel).

**TABLE 6 - BULKHEAD REPLACEMENT COSTS**

BULKHEAD	LENGTH (FEET)	STATIONING	CHANNEL DEPTH (FT)	REPLACEMENT COST
International Salt - 1	220	346.0 to 348.2	27	\$917,000
Sherwin Williams - 9	140	609.7 to 611.0	23	\$525,000
W&M Properties - 2	217	652.4 to 655.1	23	\$814,000
Ontario Stone - 10	500	516.6 to 301.3	27	\$2,085,000
LTV Steel - 11	580	796.2 to 802.0	23	\$2,175,000
CSUB Corporation - 2	224	682.5 to 684.9	23	\$840,000
CSUB Corporation - 4	351	677.0 to 680.6	23	\$1,316,000
Ontario Stone - 1	540	320.6 to 326.0	27	\$2,252,000
Ontario Stone - 5	214	312.0 to 315.0	27	\$892,000
Cleveland Port Auth. 1	830	503.6 to 511.8	27	\$3,461,000
STA Realty - 2	265	664.5 to 666.8	23	\$994,000
B&O Railroad - 5	635	698.5 to 704.0	23	\$2,381,000
City of Cleveland - 10	130	637.0 to 639.3	23	\$488,000
Carter Peninsula - 1	270	604.9 to 609.0	23	\$1,012,000
Mid-Continental - 5	720	633.8 to 639.0	23	\$2,700,000
River Dock - 2, 3	590	660.0 to 665.9	23	\$2,212,000
LTV Steel - 44	380	778.2 to 782.0	23	\$1,425,000
Sherwin Williams - 7	105	613.9 to 615.1	23	\$394,000
CSUB Corporation-10	475	736.8 to 742.0	23	\$1,781,000
Ontario Stone - 4	195	315.0 to 317.9	27	\$813,000
Cereal Food Proc. - 1	250	559.5 to 561.5	23	\$938,000
St. Mary's Enter. - 3	10	732.8 to 732.9	23	\$38,000
Ontario Stone - 9	50	301.3 to 301.8	27	\$208,000
City of Cleveland - 44	230	336.0 to 338.1	27	\$959,000
City of Cleveland - 50	390	332.1 to 336.0	27	\$1,626,000
Richard Jacobs - 2	6	541.0 to 541.1	23	\$22,000

The total replacement cost for the bulkheads in fair to good condition is approximately \$33,300,000.

### 5.3 Bulkheads In Very Good to Excellent Condition (CI = 70-100)

Normally, immediate action would not be expected to be required for bulkheads with condition indices of very good to excellent. However, the Phase 2 thickness and corrosion analyses indicate that there is a moderate to significant amount of thickness loss and corrosion at all of the twelve test sites. Bulkheads at six of the twelve test sites had condition indices of excellent, but also showed moderate to significant amount of thickness loss and corrosion. Since the condition index is based mainly on the portion of the bulkhead visible above the waterline, it is possible that some of the bulkheads may have critical distresses undetected in the Phase 1 inspections. Thickness loss over twenty percent should be considered critical and loss of ten to twenty percent could be critical in high stress areas which are typically below the water surface. Percent thickness losses listed in Table 1 for bulkheads rated excellent vary between eighteen and fifty-three percent. It should be noted that the percent thickness loss is based only on the average thickness measurements taken at individual locations on the sheet pile. It is not known if this is also the percent of area loss across the entire sheet pile section at other locations on the pile. Many of the bulkheads in this rating category are nearing or have reached fifty years of age, which is typically considered the effective life of a structure of this type.

Based on the reasons given above, it is recommended that additional inspections of some of the bulkheads rated as very good to excellent be performed. Inspections of bulkheads, as described in previous paragraph, are recommended. Making the decision to inspect each bulkhead is the responsibility of the bulkhead owner. The decision to inspect the bulkhead should be based on the following:

- Age of the bulkhead. Corrosion will be more extensive in older bulkheads.
- Distresses visible above the water line.
- Current and future use of the bulkhead.
- Consequences of failure.
- Surcharge and other loadings.

It is good practice to inspect any marine bulkhead at a minimum of every five years since its construction. Bulkheads in very good to excellent condition are listed in Table 7. Refer to the Phase 1 report for more specific information on each bulkhead.

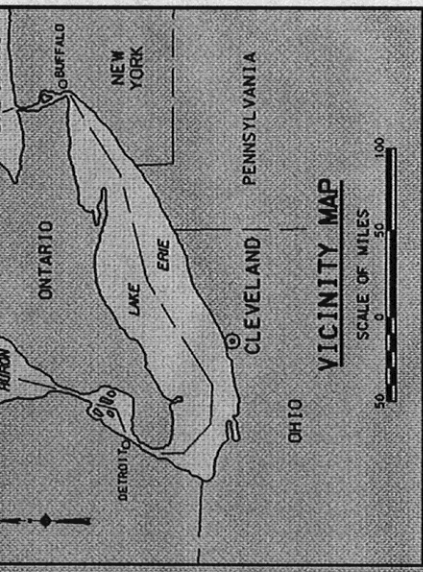
**TABLE 7 – BULKHEADS IN VERY GOOD TO EXCELLENT CONDITION**

BULKHEAD	FUNCTIONAL CONDITION INDEX	BULKHEAD	FUNCTIONAL CONDITION INDEX
B&O Railroad 1-4, 6-11	80-100	Medusa Corporation 1-2	98-100
Charles Bacon 1-2	99-100	Mid-Continental Coal/Coke Company 1, 3-4	89-100
B.P. America 1	100	Frank Morrison & Son 1-2	100
Carnegie Management 1	100	Ohio Dept. of Trans. 1-2	100
Carter Peninsula 2-3	93-95	Ontario Stone 2-3, 6-8	96-100

CEI 1	100	Pipeline Develop. Co. 1-2	100
Cereal Food Processors 2-4	96-100	Prime Properties 1	100
CIL Corporation 1	100	River Dock Inc. 1, 4	97-99
City of Cleveland 1-9, 11-43, 45-49, 51-55	73-100	River Terminal Railroad Company 1-6	83-100
City of Cleveland Parks 2-3	100	River West Dock Inc. 2-3	96-98
Commodore's Club 1-2	100	Lois Samsel 1	99
Consolidated Railroad 1-6	100	Samsel Realty 1-6	100
CPWW Partnership 1	100	Scranton Averell Inc. 1-2	99-100
CSUB Corporation 1, 3, 5-9	97-100	Shell Oil Company 1	100
Erie Railroad 1-4	80-100	Sherwin Williams Company 1-6, 8, 10-11	92-100
Flats Development Inc. 1	76	STA Realty Inc. 1, 3-4	100
Forest City Publishing 1-2	100	St. Mary's Enter. 1-2, 4-10	100
Great Lakes Towing 1-3	100	Tower City Properties 1-3	99-100
Richard Jacobs 1	99	Trust for Public Land 1	100
Koch Fuels Inc. 1	100	W&M Properties 1, 3-6	96-100
LTV Steel 1-10, 12-18, 20, 22-43, 45-47, 49-50	88-100	Wolstein Group, Ltd. 1	95
Marathon Petroleum Co. 1-2	100	Zaclon Inc. 1, 4-5	95-100

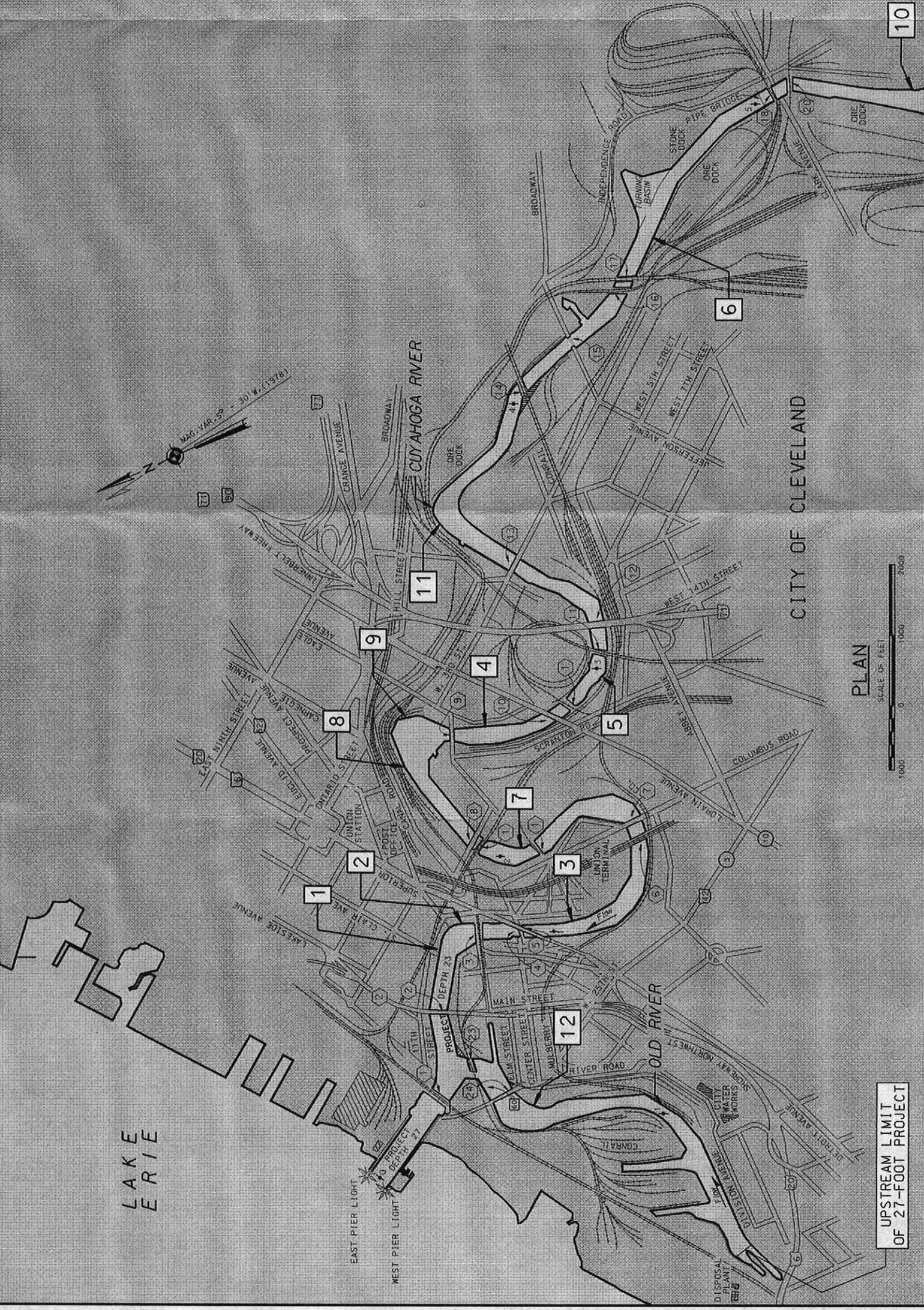
#### 5.4 Fendering Systems

Many of the bulkheads along the Cuyahoga River do not have fendering or have timber fendering in various stages of deterioration. The lack of fendering or ineffective fendering makes the bulkheads susceptible to damage from vessel impact. It is recommended, where applicable, that bulkhead owners assess the need for new fendering along their bulkheads. Rubber fendering, either horizontal, vertical, or a combination is recommended where needed. Fendering can be rigidly attached to the bulkhead or hung by chains or wire rope, depending on the fendering type. Details of fendering used by the Port Authority (Type A) and USACE (Type B) at the mouth of the Cuyahoga River are shown on Plates 3 and 4, respectively. These are only two of the various types of fendering systems that are available. Details and costs are provided for planning purposes. Based on the actual bids received for the Corps of Engineers' Dock 20 and West Pier repair project at the mouth of the Cuyahoga River, the installed costs for fendering (March 1999 price level) are \$3,060 for each complete Type A assembly and \$150 per linear foot for Type B.



- INDEX TO UNDERWATER SITES**  
SHOWN THUS **8**
- 1 EAST SHORE, PARKS 1 & 3, NEAR FOOT OF ST. CLAIR
  - 2 EAST SHORE, GLAZER 4/CITY OF CLEVELAND 31 & 32, APPROXIMATELY 400 FEET SOUTH OF SITE 1
  - 3 EAST SHORE, CEREAL 1 & 2 OR CEREAL FOOD PROCESSORS
  - 4 EAST SHORE, MID-CONTINENTAL COAL/COKE
  - 5 WEST SHORE, ERIE RAILROAD 10/ST. REALTY, INC.
  - 6 EAST SHORE, CARTER PENINSULA, BY THE CONSOLIDATED RAILROAD BRIDGE
  - 7 EAST SHORE, B&O RAILROAD, BETWEEN TOWER CITY AND F.C. SOUTHRIDGE CORP.
  - 8 EAST SHORE, B&O RAILROAD, MID-CONTINENTAL COAL/COKE
  - 9 EAST SHORE, REPUBLIC STEEL/CITY STEEL
  - 10 EAST SHORE, SOUTH SHORE, ERIE RAILROAD/ONTARIO STONE
  - 11 OLD RIVER, SOUTH SHORE, ERIE RAILROAD/ONTARIO STONE
  - 12 OLD RIVER, SOUTH SHORE, ERIE RAILROAD/ONTARIO STONE

**CUYAHOGA RIVER BULKHEAD STUDY**  
**CLEVELAND, OHIO**  
**PHASE 2**  
**UNDERWATER SITES**  
U.S. ARMY ENGINEER DISTRICT BUFFALO  
APRIL 1999



**AREAS PARTIALLY DREDGED**

CUYAHOGA RIVER PARTIALLY DREDGED TO 23.0 FEET UPSTREAM OF BRIDGE NO. 1 TO JUNCTION WITH OLD RIVER.

OLD RIVER PARTIALLY DREDGED TO 23.0 FEET FROM JUNCTION WITH CUYAHOGA RIVER TO OPPOSITE SAND PRODUCTS CORP. DOCK, REMAINDER DREDGED TO 21.0 FEET

**NOTES**

**PROJECT DEPTHS**  
27.0 FEET IN LOWER CUYAHOGA RIVER TO JUNCTION WITH OLD RIVER AND 23.0 FEET IN REMAINDER OF CUYAHOGA RIVER.  
18.0 FEET IN TURNING BASIN AT MILE 4.8 ON CUYAHOGA RIVER.  
21.0 FEET IN OLD RIVER.

**PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM ELEVATION 569.2 FEET ABOVE MEAN WATER LEVEL AT RIMOUSKI, QUEBEC (IGLD 1985) (INTERNATIONAL GREAT LAKES DATUM 1985)**

MILES ABOVE WEST PIER LIGHT AT OUTER END OF WEST PIER SHOWN THUS 24

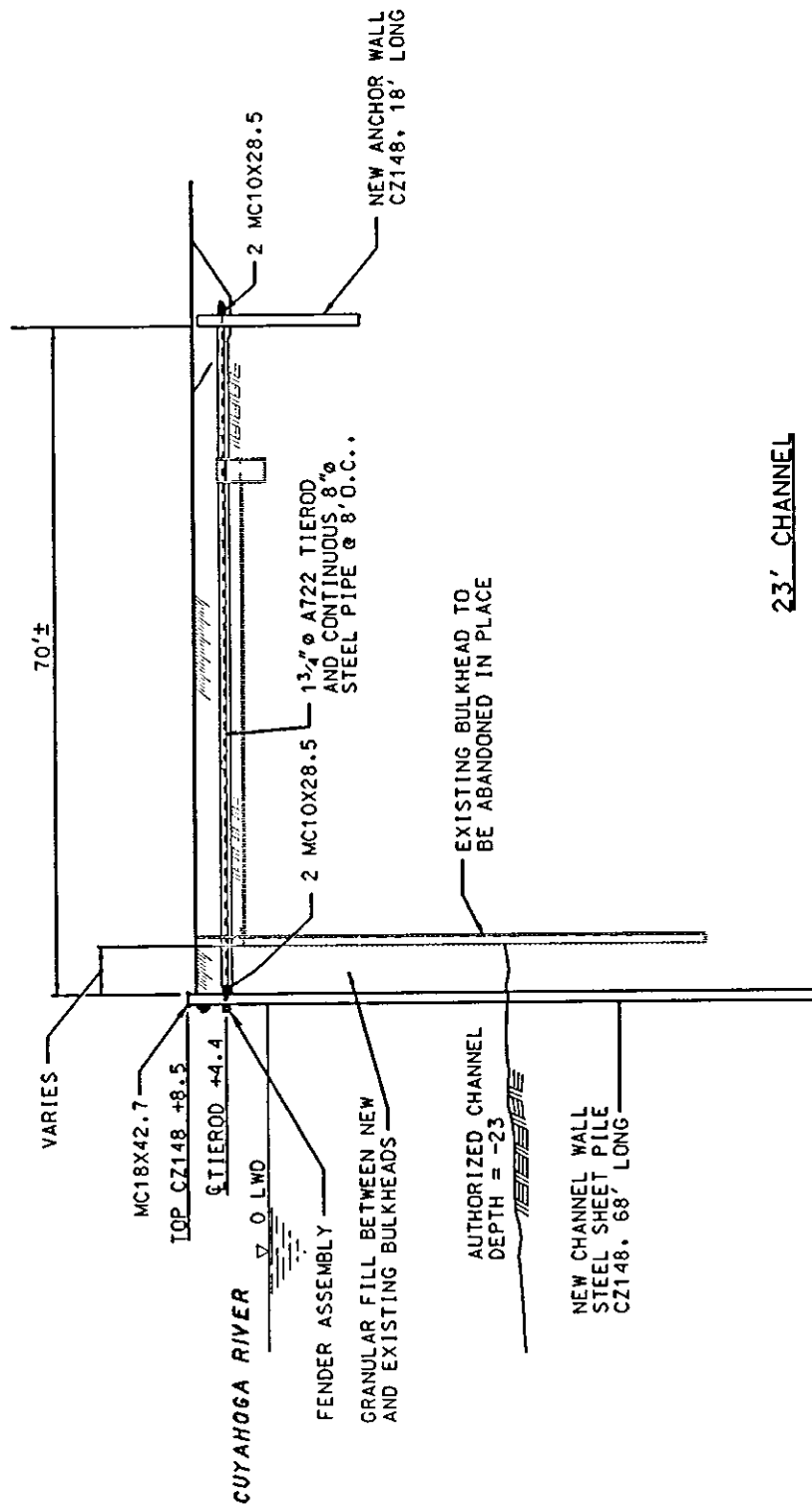
INDICATES U.S. ROUTES

INDICATES STATE ROUTES

INDICATES INTERSTATE ROUTE







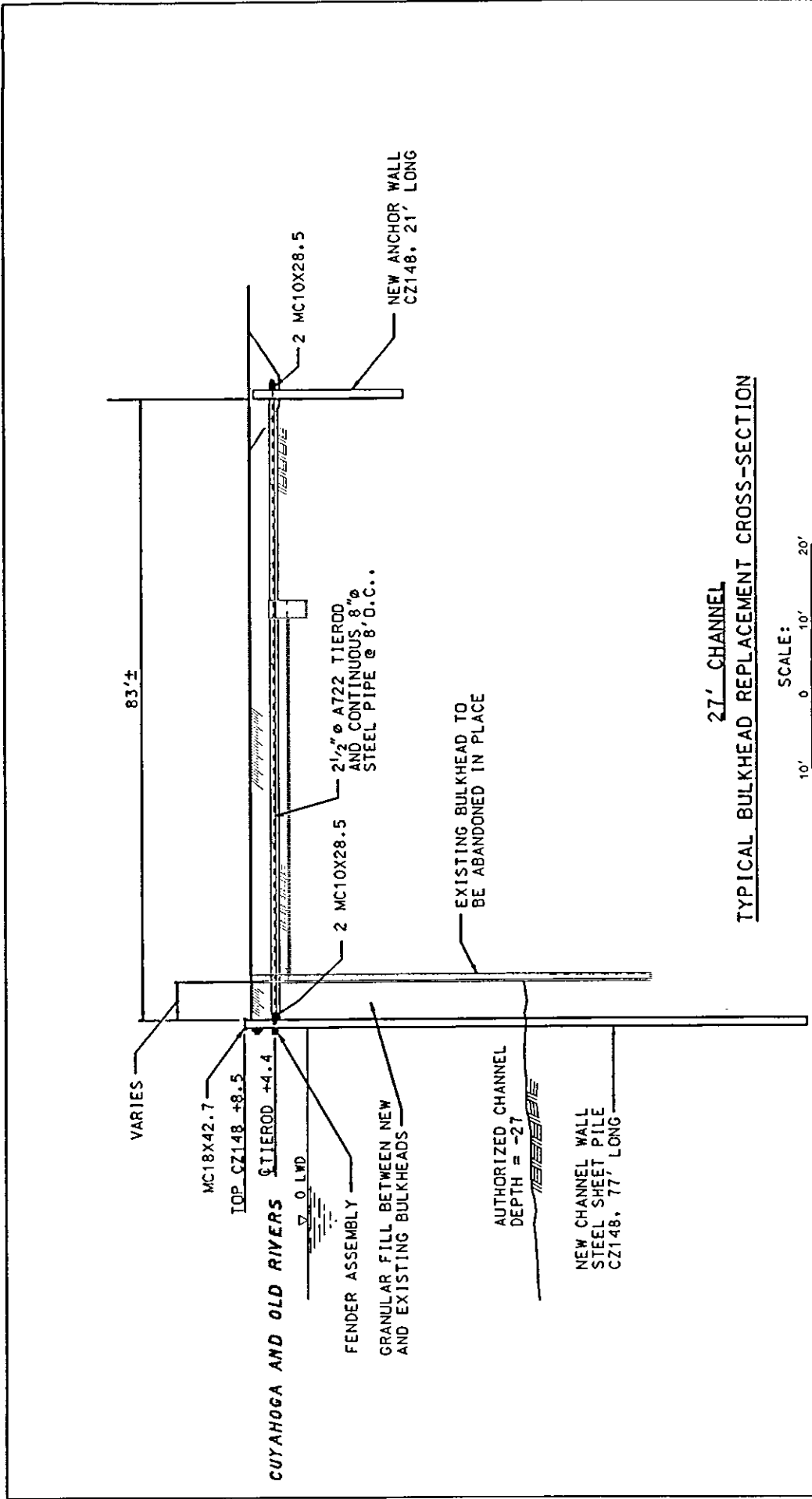
**23' CHANNEL**  
**TYPICAL BULKHEAD REPLACEMENT CROSS-SECTION**



- NOTES:
1. TYPICAL BULKHEAD REPLACEMENT CROSS-SECTION IS SHOWN FOR ILLUSTRATIVE AND COST ESTIMATING PURPOSES ONLY. ACTUAL DETAILS AT EACH SITE MAY VARY. BULKHEAD ELEVATIONS, SHEET PILE PENETRATION AND SECTION, TYPE OF ANCHORAGE, OFFSET FROM EXISTING BULKHEAD, AND OTHER BULKHEAD DETAILS WILL BE BASED ON THE SPECIFIC REQUIREMENTS OF EACH SITE. OTHER ANCHORAGE SUCH AS BATTER PILES, EARTH ANCHORS, OR CONCRETE DEADMAN MAY BE USED INSTEAD OF ANCHORAGE SHOWN.
  2. 23' DEEP FEDERAL CHANNEL STARTS AT THE CONFLUENCE OF THE CUYAHOGA AND OLD RIVERS AND EXTENDS UPSTREAM ALONG THE CUYAHOGA RIVER TO STATION 821+60.

CUYAHOGA RIVER BULKHEAD STUDY  
 TYPICAL BULKHEAD  
 REPLACEMENT DETAILS

U.S. ARMY ENGINEER DISTRICT BUFFALO

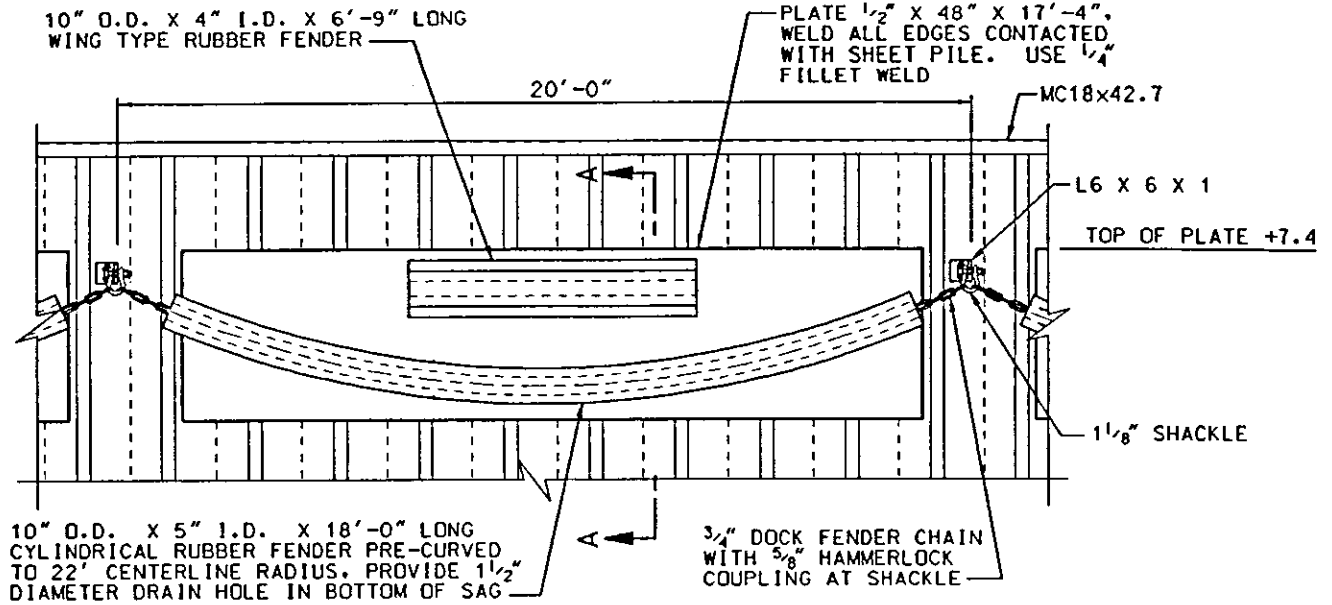


**27' CHANNEL**  
**TYPICAL BULKHEAD REPLACEMENT CROSS-SECTION**

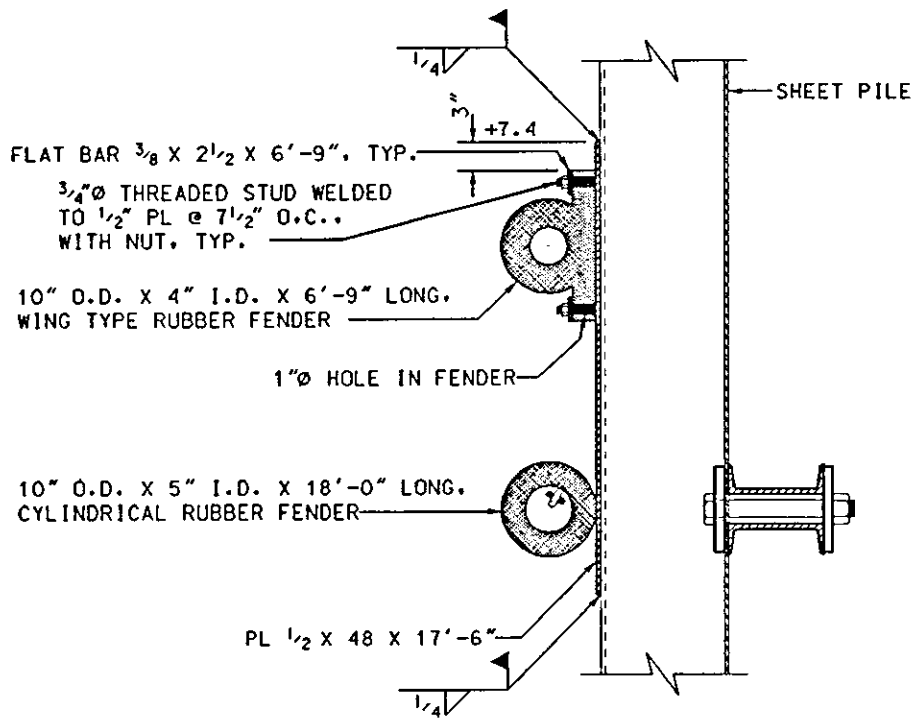
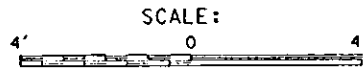


- NOTES:
1. TYPICAL BULKHEAD REPLACEMENT CROSS-SECTION IS SHOWN FOR ILLUSTRATIVE AND COST ESTIMATING PURPOSES ONLY, ACTUAL DETAILS AT EACH SITE MAY VARY. BULKHEAD ELEVATIONS, SHEET PILE PENETRATION AND SECTION, TYPE OF ANCHORAGE, OFFSET FROM EXISTING BULKHEAD, AND OTHER BULKHEAD DETAILS WILL BE BASED ON THE SPECIFIC REQUIREMENTS OF EACH SITE. OTHER ANCHORAGE SUCH AS BATTER PILES, EARTH ANCHORS, OR CONCRETE DEADMAN MAY BE USED INSTEAD OF ANCHORAGE SHOWN.
  2. 27' DEEP FEDERAL CHANNEL EXTENDS FROM THE MOUTH OF THE CUYAHOGA RIVER UPSTREAM TO THE CONFLUENCE OF THE CUYAHOGA AND OLD RIVERS AND ALONG THE ENTIRE LENGTH OF THE OLD RIVER.

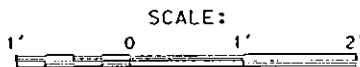
CUYAHOGA RIVER BULKHEAD STUDY  
 TYPICAL BULKHEAD  
 REPLACEMENT DETAILS  
 U.S. ARMY ENGINEER DISTRICT BUFFALO



**FENDER ASSEMBLY DETAIL**



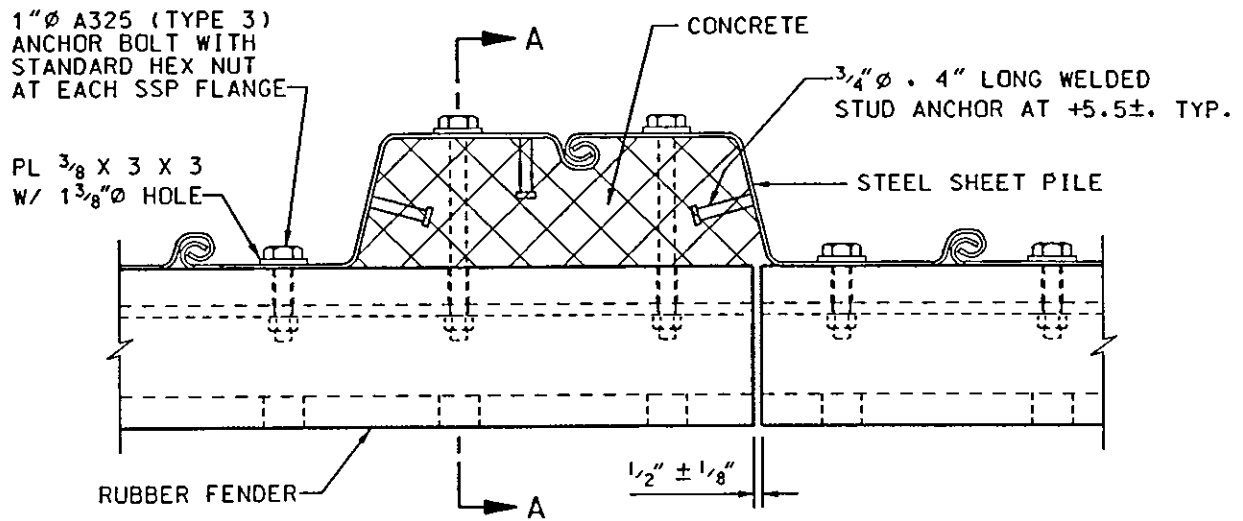
**SECTION A-A**



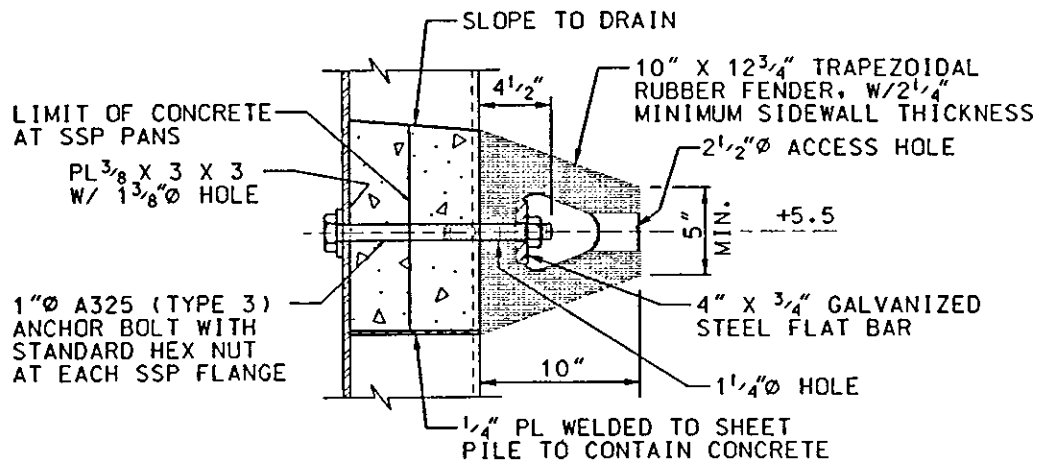
CUYAHOGA RIVER BULKHEAD STUDY

TYPE A  
FENDERING SYSTEM

U.S. ARMY ENGINEER DISTRICT BUFFALO



TYPICAL PLAN



SECTION A-A

TYPICAL TRAPIZOIDAL RUBBER FENDER ASSEMBLY

NOT TO SCALE

CUYAHOGA RIVER BULKHEAD STUDY

TYPE B  
FENDERING SYSTEM

U.S. ARMY ENGINEER DISTRICT BUFFALO