



Illinois Department of Transportation

Memorandum

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STUDIES & PLANS	
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S&P ENG	D.B.
ENVIRONMENT	
ESTIMATOR	
GEOMETRICS	
HYDRAULICS	X SF
LOCATIONS	
PLANS ENG	
SEE ME	
SEC	
CO-ORD	

To: Paul A. Loete, Dist. 3
From: D. Carl Puzey
Subject: Hydraulic Report
Date: June 14, 2013

Attn: David
By: David C. Paul

FAS Route 1279 (IL-178)
Section (1)BR&1
LaSalle County

P-93-035-01
SN 050-0088 (Exist.)
050-0256 (Prop.)

Illinois 178 over the Illinois River at Utica

Reply is made to your memorandum of March 13, 2013 in which you submitted the revised Hydraulic Report (HR) for a proposed 1158' long, 3-span bridge with a 10 degree skew to replace a 1158' long, 7-span structure with a 10 degree skew. The HR was prepared by Parsons Brinkerhoff. Attached are copies of the approved waterway information table and pertinent documents.

The Illinois River is classified as a Public Body of Water by the Illinois Department of Natural Resources-Office of Water Resources (IDNR-OWR). The proposed bridge construction will require an Individual Permit issued by IDNR-OWR because of its Public Body classification and also because of the upstream sensitive flood receptors. Please provide the completed Joint Application Form before submittal to IDNR-OWR is required.

The proposed bridge meets the IDOT vertical clearance criteria, but not the freeboard criteria. The freeboard waiver is approved based upon the justifications provided in the HR.

The proposed scour analysis produced deep scour depths. It is understood that non-weathered limestone or dolomite occurs above the calculated scour elevations. The geotechnical analysis will adjust the scour for that condition. However, the existing channel piers 3 and 4 and proposed piers 1 and 2 could undergo additional scour, due to the close proximity of the existing structure to the proposed, if a flood should occur before demolition of the existing bridge.

The proposed structure is subject to refinement in the TS&L phase.

If you have any questions, please contact Neil VanBebber at 217-782-2714.

NV/kkt0500088e0256p-20130614

Existing Bridge Specifics

- Drainage Area = 11060 square miles total watershed.
- Existing structure is a 1158' bk. to bk. 7-span bridge with 10 degree skew.
- Existing Low Beam elevation = 496.40
- Existing Low Grade elevation = 465.18
- Flowline elevation = 424.9
- The Hydraulic Report (HR) provides little information on the history or the potential for debris accumulation. Hydraulic Report Data Sheets indicate little or no potential. The narrative states build-up of debris on Pier 2 cap.
- The bridge is considered to be in an urbanized or urbanizing area.
- Tops of footings of Piers 3 and 4 are nearly exposed.
- Starved Rock Lock and Dam is approximately 7000' upstream.
- Discharges were obtained from an USACE report.
- There have been no reports of ice jams at this structure.

Historical Flooding

- There have been 10 floods in the last 33 years according to the Waterway Center with the last one occurring in 2008. The highwater at the bridge was Elev. 466.3 during the 2008 flood and was on IL 178 at a low spot south of Utica. **According to the gages upstream and downstream of the site, the record flood occurred April, 2013 after the current submittal. The gage data indicates that the April flood stage was approximately 467.**

Estimated Water Surface Elevation

- The flat pool elevation on the downstream side of the Starved Rock Lock is 440.3 at river mile 230.9 according to an USACE website.

Sensitive Flood Receptors

- There are at least 3 sensitive flood receptors as follows: Strip Mall; 463.79, Knights of Columbus building; 463.32, and House at 502 Clark Street; 462.19.

Alternatives Analyzed

- Option 1: 1158' bk. to bk. - 3-span bridge with a 10 degree skew angle and a low beam elevation of 494.5. Profile across bridge will need to be raised approximately 5' to maintain the existing low beam elevation.

Existing Scour Rating Analysis

- The existing bridge is rated 5, calculated scour acceptable.

Proposed Scour Analysis

- The raw scour analysis indicated the potential for deep scour at the proposed bridge. The geotechnical review will determine if the actual soil/rock conditions can be used to reduce the raw scour depths. The raw scour depths for the proposed bridge piers are 31', 38', 41', and 44' for the 10, 50, 100, and 500 year floods respectively.

If you have any questions please contact Neil VanBebber at 217-782-2714.



Waterway Information Table

Route: FAS Route 1279 (IL 178)
Section: (1)BR & 1
County: LaSalle
Date: 3/8/2013

Existing SN: 050-0088
Proposed SN: N/A
Waterway: Illinois River
Prepared by: Parsons Brinckerhoff (PB)

Existing Overtopping Elev. = 465.18 at Sta. 0+00

Proposed Overtopping Elev. = 465.18 at Sta. 0+00

Drainage Area = 11,060 sq.mi		Freq. Yr.	Q Ft ³ /s	Opening - ft ²		Natural H.W.E.	Head - ft.		Headwater Elevation	
				Existing	Proposed		Existing	Proposed	Existing	Proposed
Flood		10	94,000	20231	20734	461.7	0.9	0.8	462.6	462.5
Design		50	124,000	23249	23957	465.1	0.1	0.1	465.2	465.2
Base		100	137,000	24359	25146	466.3	0.1	0.1	466.4	466.4
Overtop Existing		>50								
Overtop Proposed		>50								
Max. Calc.		500	163,000	26323	27240	468.4	0.2	0.1	468.6	468.5

10 YEAR VELOCITY THROUGH EXISTING BRIDGE = 4.65 ft/s

10 YEAR VELOCITY THROUGH PROPOSED BRIDGE = 4.53 ft/s

ALL-TIME H.W.E. & DATE: 466.30 ft on 9/16/2008

Scope of Work: Bridge Replacement

EXISTING STRUCTURE

TYPE: Cantilevered Steel Through-Truss

LENGTH: 1158'-0" back-to-back

SPANS: 7

LOW BEAM: 496.40

SKEW: 10 degrees

LOW E.O.P.: 499.99

PROPOSED STRUCTURE

TYPE: Welded Steel Plate Girder

LENGTH: 1158'0" back-to-back

SPANS: 3

LOW BEAM: 494.5

SKEW: 10 degrees

LOW E.O.P.: 505.76

NOTE: PROPOSED STRUCTURE DETAILS ARE PRELIMINARY; SUBJECT TO REFINEMENT IN TSL STAGE.

Froude #:
Equation:

0.00
HIRE

0.00
HIRE

Combined Scour Depths

Pier Scour + Contraction Scour (ft):

Channel:

31.06

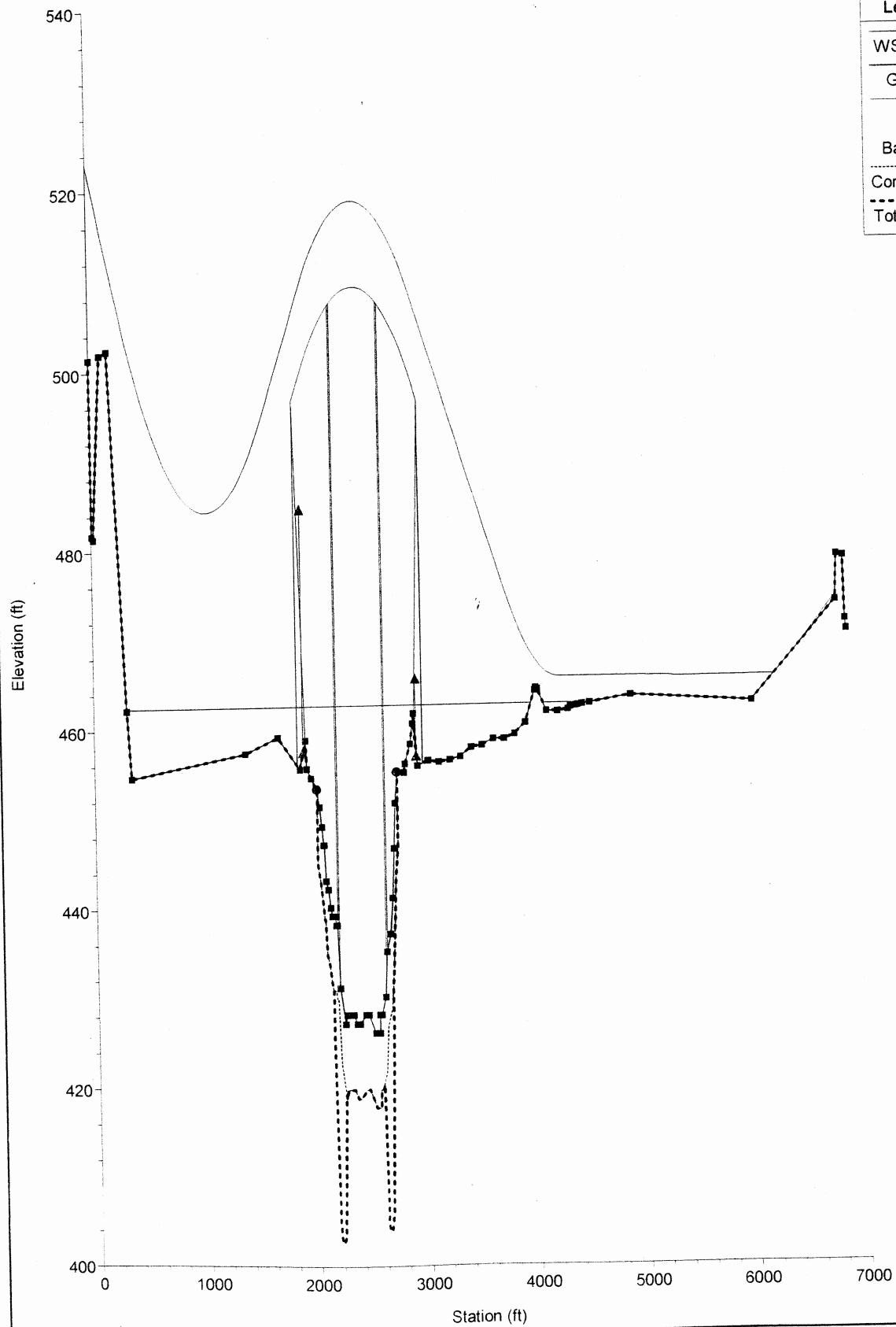
Left abutment scour + contraction scour (ft):

0.00

Right abutment scour + contraction scour (ft):

0.00

Bridge Scour RS = 229.60



Contraction Scour

Input Data

	Left	Channel	Right
Average Depth (ft):	12.30	31.33	7.43
Approach Velocity (ft/s):	1.54	4.00	0.39
Br Average Depth (ft):	9.44	30.86	7.86
BR Opening Flow (cfs):	689.81	122506.00	804.16
BR Top WD (ft):	110.54	694.12	173.44
Grain Size D50 (mm):	0.60	0.60	0.60
Approach Flow (cfs):	46653.34	67700.42	9646.24
Approach Top WD (ft):	2466.38	540.95	3337.64
K1 Coefficient:	0.590	0.640	0.590

Results

Scour Depth Ys (ft):	0.00	13.54	0.00
Critical Velocity (ft/s):			
Equation:	Live	Live	Live

Pier Scour

Input Data

All piers have the same scour depth

Pier Shape:	Square nose
Pier Width (ft):	10.00
Grain Size D50 (mm):	0.60000
Depth Upstream (ft):	39.03
Velocity Upstream (ft/s):	6.15
K1 Nose Shape:	1.00
Pier Angle:	10.00
Pier Length (ft):	49.83
K2 Angle Coef:	1.49
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	
K4 Armouring Coef:	1.00
Set K1 value to 1.0 because angle > 5 degrees	

Results

Scour Depth Ys (ft):	24.85
Froude #:	0.17
Equation:	CSU equation

Abutment Scour

Input Data

	Left	Right
Station at Toe (ft):	1918.95	2906.74
Toe Sta at appr (ft):	1969.55	3024.71
Abutment Length (ft):	1905.78	3485.30
Depth at Toe (ft):	6.57	4.82
K1 Shape Coef:	1.00 - Vertical abutment	
Degree of Skew (degrees):	90.00	90.00
K2 Skew Coef:	1.00	1.00
Projected Length L' (ft):	1905.78	3485.30
Avg Depth Obstructed Ya (ft):	12.99	8.29
Flow Obstructed Qe (cfs):	40025.90	24352.25
Area Obstructed Ae (sq ft):	24759.05	28888.48

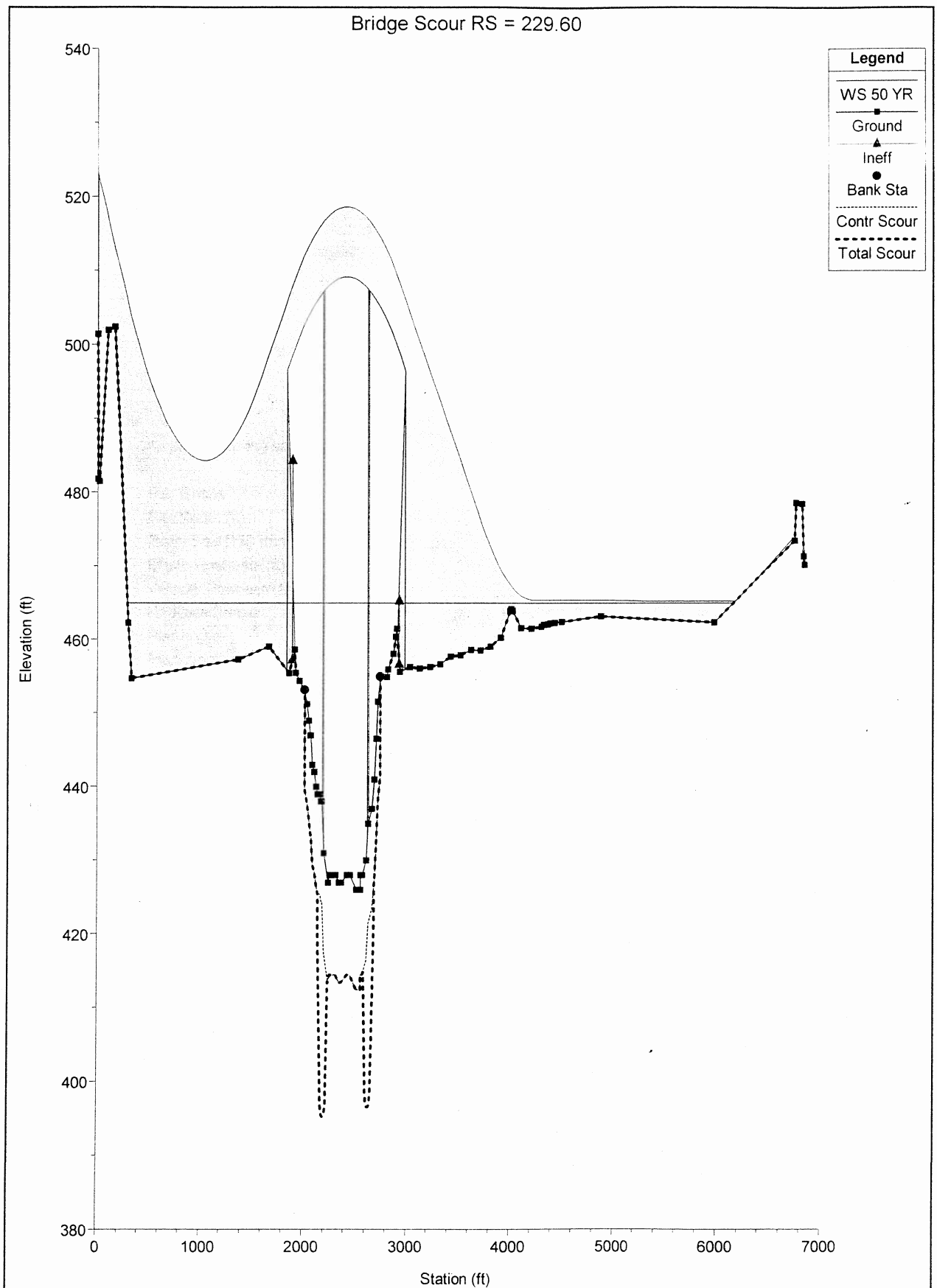
Results

Scour Depth Ys (ft):	0.00	0.00
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Froude #:	0.00	0.00
Equation:	HIRE	HIRE

Combined Scour Depths

Pier Scour + Contraction Scour (ft):	Channel:	38.39
Left abutment scour + contraction scour (ft):	0.00	
Right abutment scour + contraction scour (ft):	0.00	



100-yr Proposed

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	13.40	32.57	8.55
Approach Velocity (ft/s):	1.56	4.11	0.43
Br Average Depth (ft):	10.40	32.04	1.42
BR Opening Flow (cfs):	857.48	134522.90	1619.64
BR Top WD (ft):	112.89	694.12	2324.30
Grain Size D50 (mm):	0.60	0.60	0.60
Approach Flow (cfs):	52258.21	72395.48	12346.31
Approach Top WD (ft):	2493.05	540.95	3390.50
K1 Coefficient:	0.590	0.640	0.590
Results			
Scour Depth Ys (ft):	0.00	15.18	0.45
Critical Velocity (ft/s):			
Equation:	Live	Live	Live

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Square nose
Pier Width (ft):	10.00
Grain Size D50 (mm):	0.60000
Depth Upstream (ft):	40.21
Velocity Upstream (ft/s):	6.50
K1 Nose Shape:	1.00
Pier Angle:	10.00
Pier Length (ft):	49.83
K2 Angle Coef:	1.49
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	
K4 Armouring Coef:	1.00
Set K1 value to 1.0 because angle > 5 degrees	

Results

Scour Depth Ys (ft):	25.56
Froude #:	0.18
Equation:	CSU equation

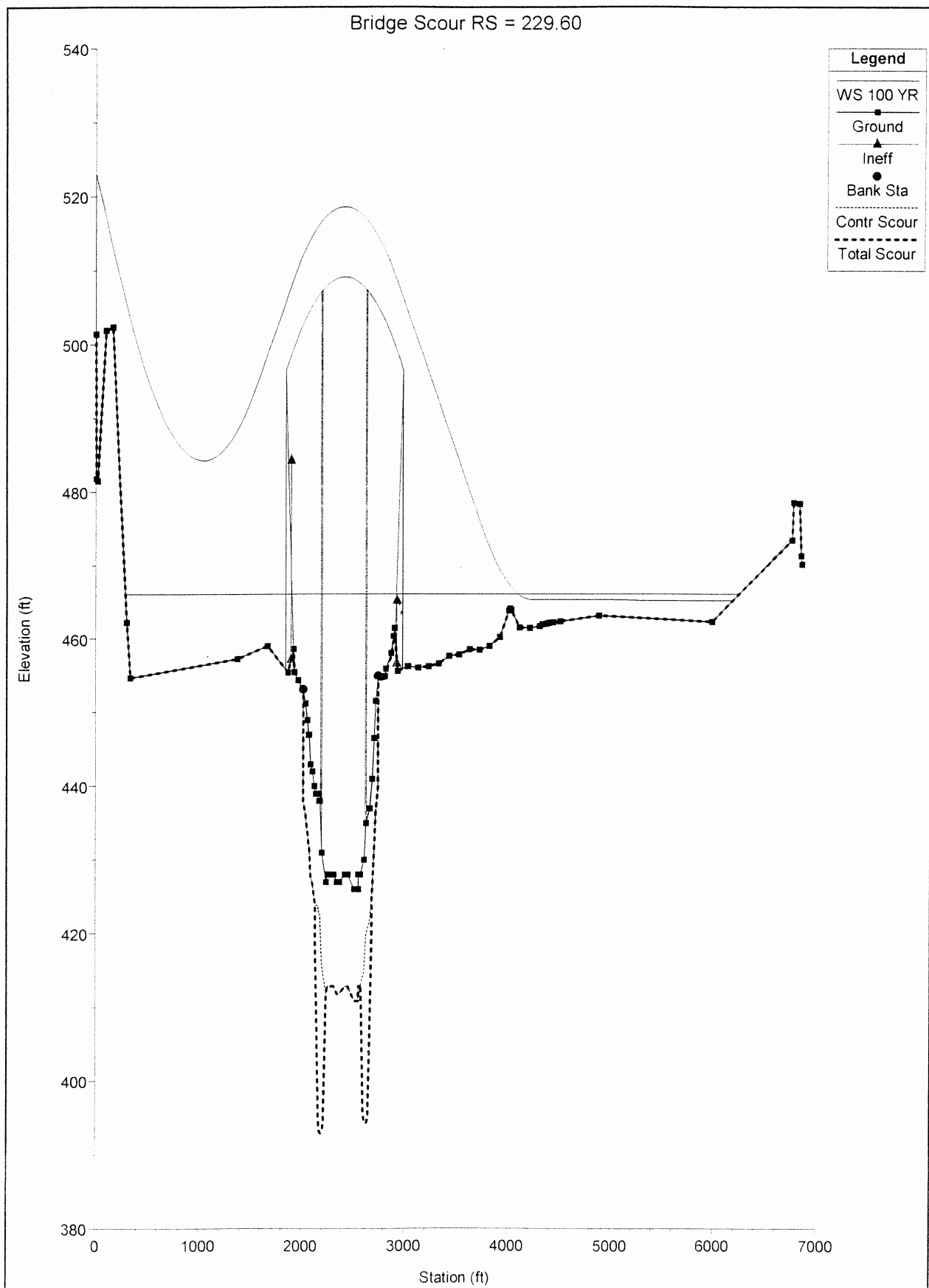
Abutment Scour

	Left	Right
Input Data		
Station at Toe (ft):	1918.95	2906.74
Toe Sta at appr (ft):	1969.55	3024.71
Abutment Length (ft):	1925.89	3538.15
Depth at Toe (ft):	7.75	6.00
K1 Shape Coef:	1.00 - Vertical abutment	
Degree of Skew (degrees):	90.00	90.00
K2 Skew Coef:	1.00	1.00
Projected Length L' (ft):	1925.89	3538.15
Avg Depth Obstructed Ya (ft):	14.09	9.40
Flow Obstructed Qe (cfs):	44562.68	28222.25
Area Obstructed Ae (sq ft):	27134.43	33242.55
Results		
Scour Depth Ys (ft):	0.00	0.00

Froude #:	0.00	0.00
Equation:	HIRE	HIRE

Combined Scour Depths

Pier Scour + Contraction Scour (ft):	Channel:	40.74
Left abutment scour + contraction scour (ft):	0.00	
Right abutment scour + contraction scour (ft):	0.45	



500-yr Proposed

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	15.32	34.73	10.02
Approach Velocity (ft/s):	1.64	4.36	0.48
Br Average Depth (ft):	12.08	34.13	3.25
BR Opening Flow (cfs):	1189.70	155148.70	6661.56
BR Top WD (ft):	117.06	694.12	2602.00
Grain Size D50 (mm):	0.60	0.60	0.60
Approach Flow (cfs):	63589.92	81874.99	17535.08
Approach Top WD (ft):	2536.32	540.95	3647.00
K1 Coefficient:	0.590	0.640	0.590
Results			
Scour Depth Ys (ft):	0.00	17.07	2.09
Critical Velocity (ft/s):			
Equation:	Live	Live	Live

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Square nose
Pier Width (ft):	10.00
Grain Size D50 (mm):	0.60000
Depth Upstream (ft):	42.32
Velocity Upstream (ft/s):	6.98
K1 Nose Shape:	1.00
Pier Angle:	10.00
Pier Length (ft):	49.83
K2 Angle Coef:	1.49
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	
K4 Armouring Coef:	1.00
Set K1 value to 1.0 because angle > 5 degrees	

Results

Scour Depth Ys (ft):	26.54
Froude #:	0.19
Equation:	CSU equation

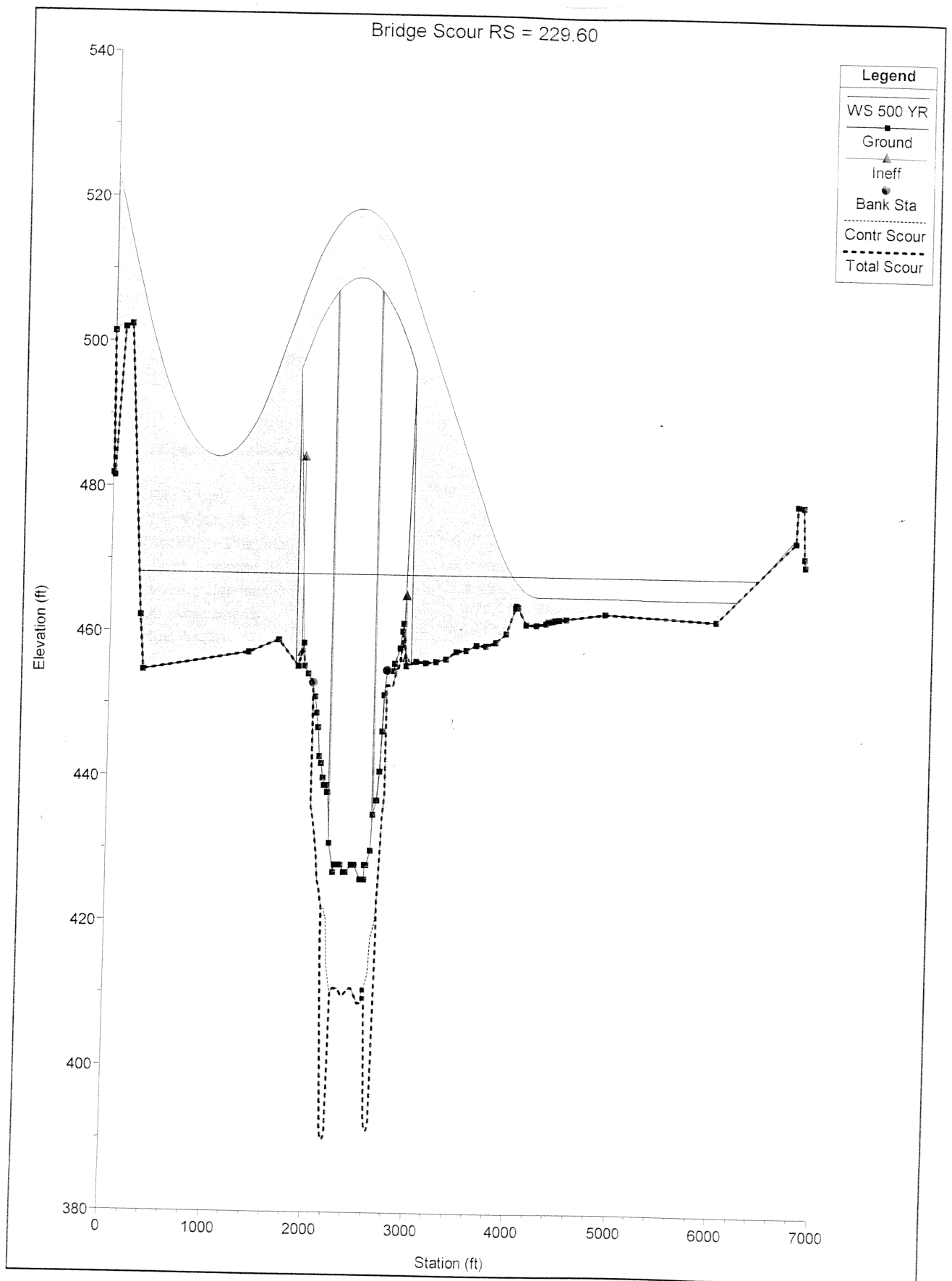
Abutment Scour

	Left	Right
Input Data		
Station at Toe (ft):	1918.95	2906.74
Toe Sta at appr (ft):	1969.55	3024.71
Abutment Length (ft):	1957.70	3656.94
Depth at Toe (ft):	9.85	8.11
K1 Shape Coef:	1.00 - Vertical abutment	
Degree of Skew (degrees):	90.00	90.00
K2 Skew Coef:	1.00	1.00
Projected Length L' (ft):	1957.70	3656.94
Avg Depth Obstructed Ya (ft):	16.01	11.23
Flow Obstructed Qe (cfs):	53718.95	35755.66
Area Obstructed Ae (sq ft):	31343.80	41060.90
Results		
Scour Depth Ys (ft):	0.00	0.00

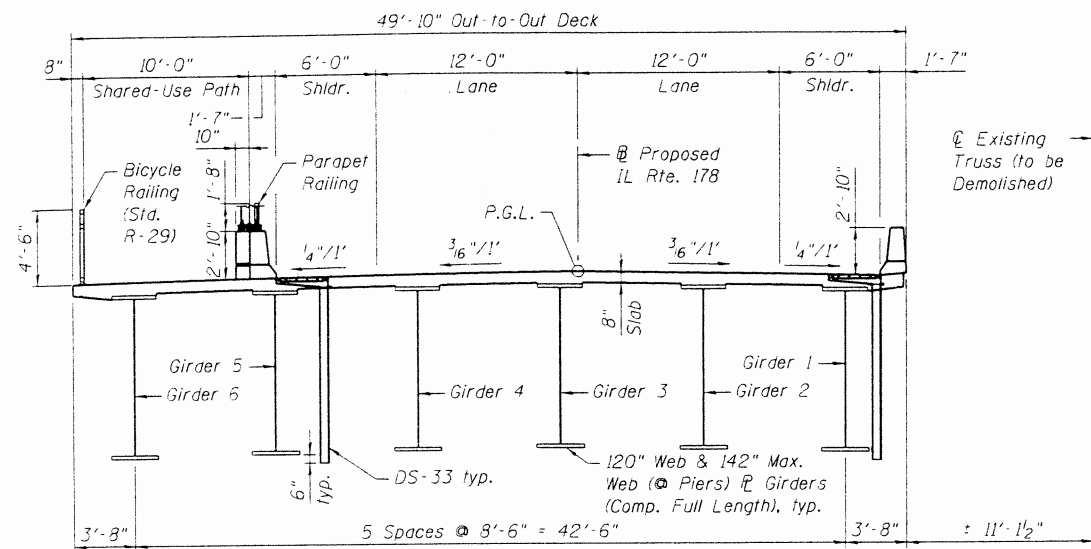
Froude #:	0.00	0.00
Equation:	HIRE	HIRE

Combined Scour Depths

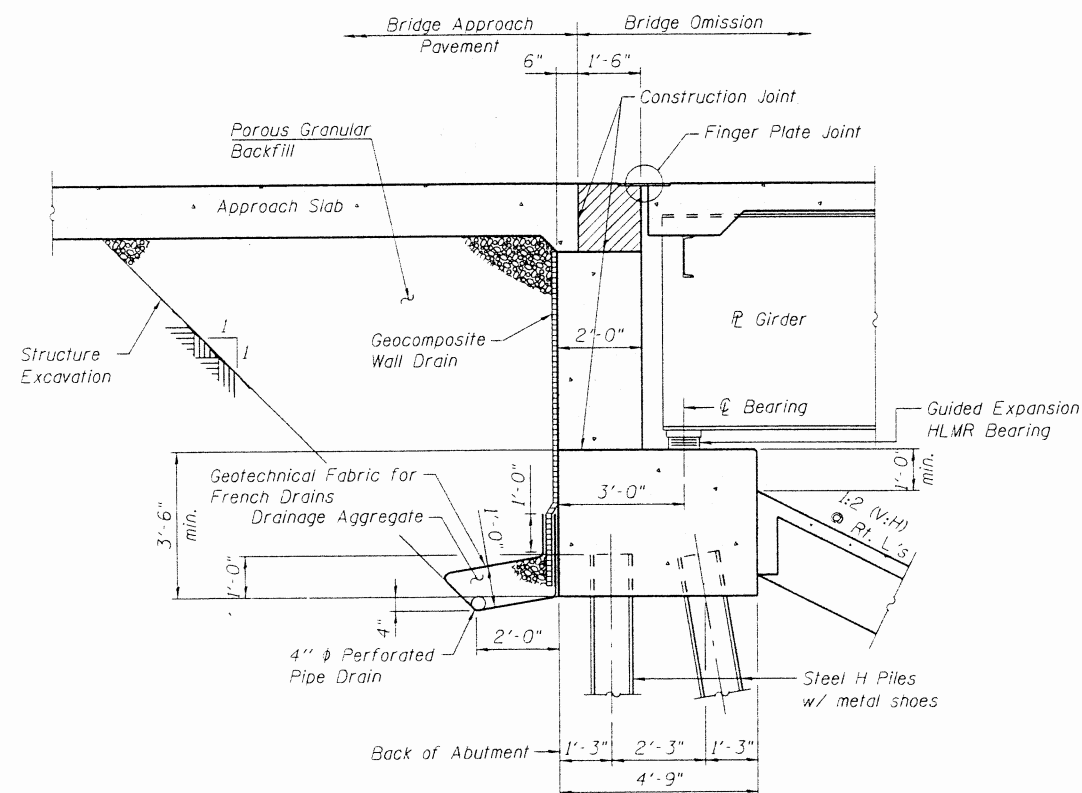
Pier Scour + Contraction Scour (ft):	Channel:	43.62
Left abutment scour + contraction scour (ft):	0.00	
Right abutment scour + contraction scour (ft):	2.09	



F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
178	(1)BR & 1	LASALLE		
CONTRACT NO. 66992				
ILLINOIS FED. AID PROJECT				

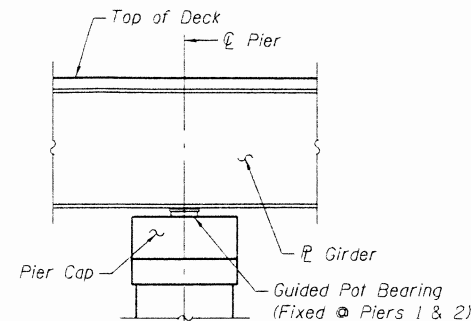


SECTION A-A
(Looking South)

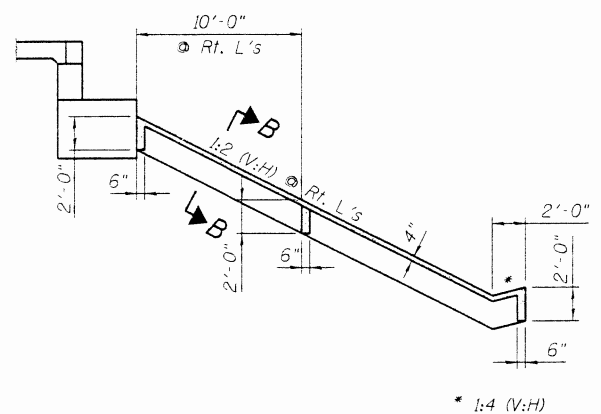


All drainage system components shall extend to 2'-0" from the end of each wingwall except an outlet pipe shall extend until intersecting with the side slopes. The pipes shall drain into concrete headwalls. See Article 601.05 of the Standard Specifications and Highway Standards, 601.01.

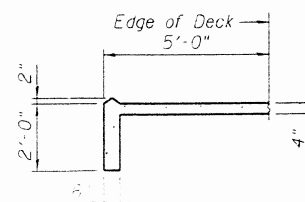
**SECTION THRU PILE SUPPORTED
STUB ABUTMENT**
(Horiz. dim. @ Rt. L's)



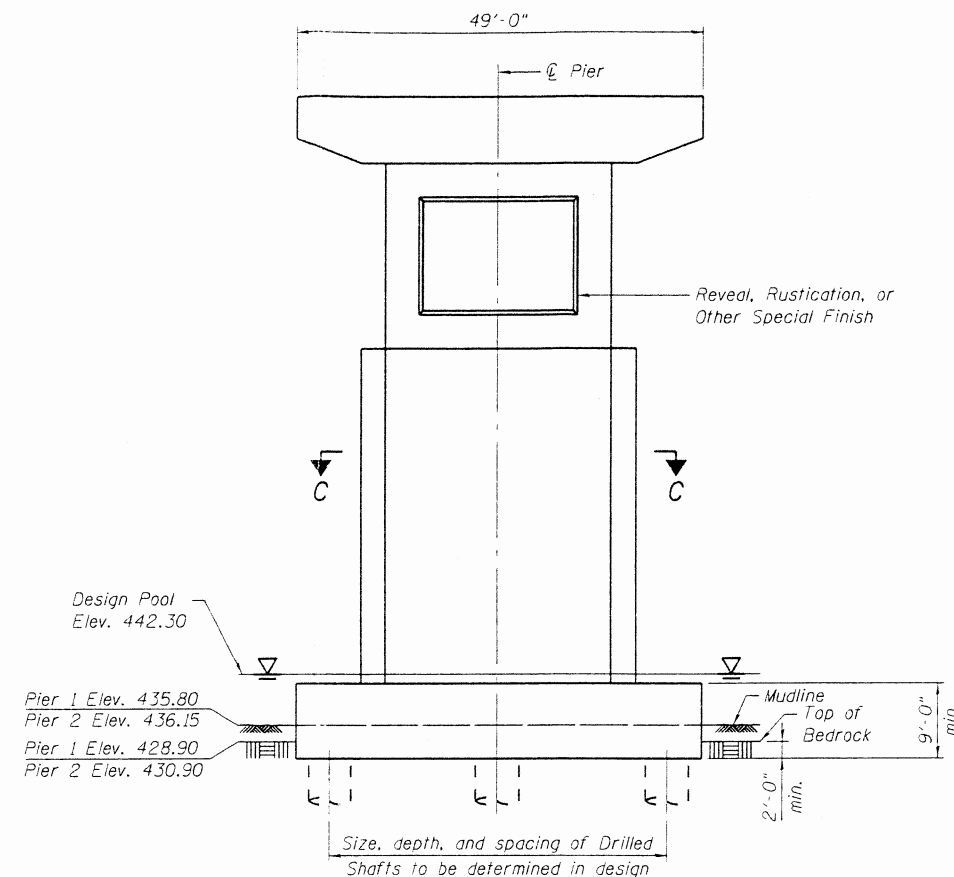
**SECTION THRU
PIER 1 & 2**



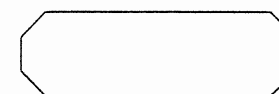
SECTION THRU SLOPEWALL



SECTION B-B



PIER SKETCH
(Piers 1 & 2)



SECTION C-C

DETAILS
IL 178 OVER
ILLINOIS RIVER (PUBLIC WATER)
F.A.S. ROUTE 1279 - SEC. (1)BR & 1
LASALLE COUNTY,
STATION 29+19.53
STRUCTURE NO. 050-0256

T:\16970\StructCadd\16970-002.dgn
06-MAR-2013 15:55

**PARSONS
BRINCKERHOFF**

FILE NAME : 0500088-66992-TSL-002.dgn	DESIGNED - Y. Ali	REVISED -
PLOT SCALE : NONE	CHECKED - A. Hammad	REVISED -
PLOT DATE : 3/6/2013	DRAWN - D. C. Patel	REVISED -
	CHECKED - Y. Ali	REVISED -

**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

DETAILS

SHEET NO. 2 OF 2 SHEETS

F.A.S. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
178	(1)BR & 1	LASALLE		
CONTRACT NO. 66992				
ILLINOIS FED. AID PROJECT				