HYDRAULIC REPORT

PROJECT ROUTE:	Interstate 55 (Stevenson Expressway)
SECTION:	n/a
LIMITS:	Station 907+46 to Station 916+05
WATERWAY CROSSING:	Chicago Sanitary and Ship Canal
MUNICIPALITY/COUNTY:	Summit/Cook County
JOB NUMBER:	P-91-762-10
EXISTING STRUCTURE NOS.:	016-0014 and 016-0015
PROPOSED STRUCTURE NO.:	n/a

Prepared for:

Illinois Department of Transportation
201 West Center Court
Schaumburg, Illinois 6019-1096

Prepared by:

Christopher B. Burke Engineering, Ltd.
9575 West Higgins Road
Rosemont, IL 60018
847-823-0500

CBBEL Project No. 110203.00001

DRAFT
August 2017
Rev. November 2017
Rev. January 2018
Rev. May 2018
FINAL February 2019

Ilene A. Dailey, PE, CFM
idailey@cbbel.com
Illinois Registered Professional Engineer
No. 062-047420

TABLE OF CONTENTS

Tab 1

SECTION 1

NARRATIVE

SECTION 1

NARRATIVE

A. PROJECT DESCRIPTION

The Illinois Department of Transportation (IDOT) is currently preparing a Preliminary Engineering and Environmental Study (Phase 1) for the Interstate 55 (I-55) Managed Lanes Project. The project study area includes the I-55 corridor (Stevenson Expressway) from I-355 to I-90/94 at the east.

This project is proposed to add two managed lanes in each direction. The term 'Managed Lanes' includes the implementation of travel lanes for High Occupancy Vehicle (HOV), High Occupancy Toll (HOT), Congestion Pricing, as well as other concepts to improve the overall flow of traffic. This project has been identified in the Chicago Metropolitan Area for Planning (CMAP) Go To 2040 Plan as a priority project.

This report provides hydraulic evaluation of the existing and proposed bridges carrying eastbound and westbound I-55 over the Chicago Sanitary and Ship Canal (CSSC), Structure Numbers 016-0014 and 016-0015 respectively. The bridges are located in the Village of Summit, Lyons Township, Cook County, Illinois. The subject 5-span steel bridges are located along the CSSC between IL Route 171 and IL Route 43. Due to previous widening, there is no space between the bridges, so they are treated as a single structure in the hydraulic model. The CSSC is a navigational canal with specific requirements for horizontal and vertical clearances. To minimize disturbance to navigation, the proposed bridge widening will be accomplished by constructing cantilever-type extensions to the existing pier caps to support the widened bridge deck. The resulting construction will not affect the waterway opening area, horizontal clearance, or vertical clearance for any flood event. Refer to Exhibit 4.1 for the project location shown on the USGS Quadrangle Map.

B. DESCRIPTION OF EXISTING STRUCTURE AND FLOODPLAIN

SITE DESCRIPTION

The upstream limit of the study is located approximately 1075 ft northeast of the I-55 crossing. The CSSC flows southwesterly through industrial areas and vegetated areas in Summit, Cook County. Canal Bank Road and a railroad cross under the western end of the bridge, and an unnamed gravel road crosses under the eastern end. The I-55 bridges are high-level crossings with design clearance in excess of 29 ft above the 50-year flood water surface elevation.

Downstream of I-55, the CSSC continues southwest. 1870 ft downstream of the I-55 crossing, the CSSC crosses under the 5-span bridge carrying the NB IL Route 171 to NB I-

55 Ramp (Ramp D), Structure Number 016-2408. After passing under Ramp D, the CSSC continues flowing southwest. Approximately 2220 ft southwest of the I-55 crossing, the CSSC crosses under two seven-span structures carrying NB IL Route 171 and SB IL Route 171, Structure Numbers 016-0487 and 016-0486 respectively. The study limits extend 3310 ft downstream of the I-55 crossing.

STRUCTURE DESCRIPTION

The existing bridge structures carry eastbound and westbound I-55 (Stevenson Expressway) over the CSSC and roadways and a railroad located at the tops of the banks of the CSSC. The CSSC is a navigational canal with specific requirements for horizontal and vertical clearances. Both structures were originally constructed as part of F.A.I. Route 55 Section 0707-616-B, Project I 0557081277, dated 1964. The structures were reconstructed as part of FAI Route 55 Project Section 0404-640.ETC Project 55-7(196)279, dated 2000. Historic plan excerpts are provided in Section 10.A. The eastbound structure is noted as IDOT structure number 016-0014 while the westbound structure is noted as IDOT structure number 016-0015.

Each structure is a five-span steel bridge crossing the CSSC. The center span is 240.5 ft wide measured along the roadway centerline. The I-55 roadway has a 45° skew relative to the road. The structure width of the two structures combined is 150.1 ft out to out deck, measured perpendicular to the centerline of road. The length of the structure is 692 ft face-to-face of abutments, with span lengths from west to east of 49.94’ – 176’ – 240.5’ – 176’ – 49.61’ measured along the centerline of road. There are armored slopewalls at 2H:1V slope under the bridge as shown on photos on Section 5 and the historic plans in Section 10.A.

FLOODPLAIN DESCRIPTION

The CSSC is a well-defined man-made channel that is found to be between 250’ and 350’ in width and consists of consistent cross sections throughout the study limits. The channel consists of a gravelly bottom with heavy trees and brush on the banks. The I-55 bridge crossing is located in an area that is part of the Lockport Pool, upstream of the Lockport Lock and Dam.

The CSSC is capable of handling regulatory flows within its channel up to and including the 500-yr storm event. There is a mapped Federal Emergency Management Agency (FEMA) floodplain for the Chicago Sanitary and Ship Canal, extending upstream and downstream of the subject crossing. The CSSC floodplain is mapped as Zone A by FEMA with no defined base flood elevations. The Flood Insurance Rate Map (FIRM) Panel No. 17031C0487J for Cook County, Illinois and Incorporated Areas, effective August 19, 2008 is included in Section 4 as Exhibit 4.4.

C. FIELD OBSERVATIONS

The CSSC field survey was performed by CBBEL in June 2017. A follow up inspection was done by CBBEL in July 2017. The stream bed consists of exposed dirt and exposed rocks and stones. The stream banks at the I-55 crossing are composed of some vegetation along with some exposed rocks. The western overbank consists of a paved frontage road and railroad while the eastern overbank consists of a gravel road and some exposed dirt and rocks. Upstream of the I-55 crossing, the channel banks are lined with trees and brush along with some exposed rocks. Downstream of the I-55 crossing, the channel banks are lined with trees and brush. Photographs are included in Section 5 and survey notes are included in Section 18.

D. HISTORICAL OBSERVATIONS/RECORDS

The 1967 Hydrologic Investigations Atlas HA-252 (Berwyn), prepared by the United States Geological Survey (USGS) in cooperation with the Northeastern Illinois Metropolitan Area Planning Commission, is plotted on a 1963 USGS base map that predates the construction of I-55. The portion of HA-252 showing the project area is provided as Exhibit 4.2 with I-55 overlaid for reference only. Flood elevations could not be determined because the HA does not include a flood profile for the CSSC.

There are no records of flooding on the I-55 Pavement at the CSSC. As part of the Ciorba Group 2011 Hydraulic Report (HR), Ciorba obtained a recorded high water elevation from the Metropolitan Water Reclamation District (MWRD). MWRD records information at two gages along the CSSC, including the gage at 31st Street and Western Avenue, approximately 7 river miles upstream of the I-55 crossing. The gage datum is 0.00 CCD where 0.00 CCD is approximately 579.48 feet (NGVD29). A recorded peak gage height of +4.1 feet was recorded on June 30, 1977. The projected peak water surface elevation is therefore 579.48 feet + 4.1 feet = 583.58 feet NGVD29 assuming a level pool. A corresponding peak discharge could not be determined, because MWRD only monitors elevation data. The correspondence between MWRD and IDOT is included in Section 20 of this report.

Stream gage USGS 05536140 CHICAGO SANITARY AND SHIP CANAL AT STICKNEY, IL is identified as the nearest gage to the I-55 crossing and is approximately 3.3 river miles upstream of the project vicinity. The drainage area at the gage is 296 square miles. The gage was established in 2007 and is currently active. Partial records are available from this location for water years 1976-1977. The gage datum is 579.48 ft (NGVD29) and the peak gage height of 4.64 feet was recorded on July 24, 2010. The projected peak water surface elevation is therefore 579.48 feet + 4.64 feet = 584.12 feet NGVD29. As part of the partial data for the water years of 1976-1977, a maximum measured discharge of 4,670 cfs was recorded on February 27, 1977 with no corresponding gage height given. The USGS gage summary is included in Section 20 of this report.

E. OTHER STUDIES & AFFECTED AGENCIES

According to Federal Emergency Management Agency (FEMA) FIRM 17031C0487J for Cook County and Incorporated Areas, effective August 19, 2008, the CSSC is mapped as Zone A without defined Base Flood Elevations at the proposed project site. The FIRM has been provided as Exhibit 4-3 in Section 4.

A hydraulic report prepared by Ciorba Group was completed in 2011 for the IL Route 171 (First Avenue) bridge over the CSSC. This report performed detailed hydraulic analysis from downstream of the I-55 bridge to downstream of the Il Route 171 crossing over the CSSC, and was completed in NAVD 88. Since the proposed project has been constructed, the Ciorba proposed conditions were used as the baseline model for the hydraulic modeling for this report. Ciorba Group obtained starting water surface elevations and peak flows at Mile 313 for the CSSC from a study performed by the United States Army Corps of Engineers (USACE) in the late 90's. The correspondence between IDOT and USACE is included in Section 6 of this report. The location of Mile 313 is just downstream of the IL Route 171 bridge. The CBBEL hydraulic model survey starts farther upstream, adding the I-55 bridge and additional cross sections.

F. DATUM CORRELATION

A continuous SONAR streambed survey was conducted by Collins Engineers, Inc. within 1000 feet upstream and downstream of the I-55 crossing. CBBEL surveyed overbank cross sections near the bridge faces and at approximately 500' intervals upstream and downstream along the CSSC. Lin Engineering surveyed the bridge low beam data. All survey was completed in June 2017. The Cross-Section Location Map found in Section 9 shows the CSSC cross-section locations and topography along the entire length of the hydraulic modeling. The North American Vertical Datum 1988 (NAVD 88) is the basis for the surveys and the hydraulic modeling used in this report. The 2011 Ciorba Study was done in NAVD 88. Water surface elevations obtained from the USACE and MWRD used National Geodetic Vertical Datum (NGVD29). In order to use the proper starting water surface elevations, a conversion factor of -0.29 feet from NGVD 29 to NAVD 88 was applied. The datum conversion details from the NOAA VERTCON website and field survey notes are provided in Section 18.

G. SENSITIVE FLOOD RECEPTORS

There are no potential flood receptors located within the floodplain or project limits.

H. HYDROLOGIC METHODOLOGY

As part of the Ciorba Group 2011 HR, Ciorba obtained flow rates from the USACE. The flow rates given by USACE were used as part of Ciorba Group's hydraulic modeling for the 2011 HR. The summary of these flow rates is found in Table H-1.

Location and Analysis Method	10-year Peak Flow (cfs)	50-year Peak Flow (cfs)	100-year Peak Flow (cfs)	500-year Peak Flow (cfs)
CSSC River Mile 313, from USACOE	8,500	11,300	12,800	16,100

Table H-1 Peak Flow Summary

I. HYDRAULIC METHODOLOGY

As part of Ciorba Groups 2011 HR, starting water surface elevations were obtained from the USACE. Water surface elevations provided by USACE used National Geodetic Vertical Datum (NGVD29) so a conversion factor was applied to convert the elevations to North American Vertical Datum 1988 (NAVD 88). Additional information for the conversion factor can be found in Section F of this narrative. Ciorba Group used USACE water surface elevation without datum conversion as part of their hydraulic modeling for their 2011 HR. The summary of the converted starting water surface elevations is found in Table I-1. The location of CSSC River Mile 313 is shown on the Cross Section location map that is included in section 9 of this report.

Location and Analysis Method	10-year WSE (ft)	50-year WSE (ft)	100-year WSE (ft)	500-year WSE (ft)
CSSC River Mile 313, from USACOE	583.61	586.71	587.71	591.11

Table I-1 Starting Water Surface Elevation Summary (NAVD 88)

Manning's n-values for the additional CSSC cross sections were taken from the 2011 Ciorba report. These n-values were re-verified using field notes, aerial photography, and photographs. Base values for 'n' were computed using the FHWA methodology presented in Chapter 5 of the IDOT Drainage Manual, as follows:

$$n = (n_b + n_1 + n_2 + n_3 + n_4) * m.$$

Channel

The channel bottom consists of a gravelly mixture of dense silty sand, and has minor irregularities, alternates gradually, negligible obstructions, small vegetation, and minor meandering. Therefore,

$$n = (0.025 + 0.002 + 0.000 + 0.001 + 0.002) * (1) = 0.030$$

Channel Sides and Overbanks – Heavy Vegetation

The floodplain consists of a mixture of dense silty sand and light rocks, and has minor irregularities, alternates occasionally, minor obstructions, large/heavy vegetation, and minor meandering. Therefore,

$$n = (0.035 + 0.005 + 0.0 + 0.005 + 0.035) * (1) = 0.080$$

J. SUMMARY OF BASELINE MODEL

Ciorba Group's model titled "SHIP CANAL - UPDATED", prepared as part of their 2011 HR, was used as the baseline model for this study. The Ciorba Group model begins approximately 1000 ft downstream of the I-55 crossing and ends approximately 3500 ft downstream of the I-55 crossing. The Ciorba Group model includes the IL 171 crossing and Ramp D crossing which are approximately 2100 ft downstream of the I-55 crossing. A HEC-RAS plan, titled Duplicate, was prepared as a duplicate of Ciorba Group's proposed model conditions. Proposed conditions of the Ciorba model were used because at the time of this report the proposed improvements had been completed. After duplicating Ciorba Group's model in HEC-RAS, the results from the duplicate plan matched the original output of Ciorba Group's model. A HEC-RAS input and output of the duplicate plan is included in Section 13.A of this report.

K. SUMMARY OF EXISTING CONDITIONS HYDRAULIC ANALYSIS

A new HEC-RAS plan, titled Existing, was created to represent exiting conditions at the I-55 crossing over the Chicago Sanitary and Ship Canal. Surveyed cross sections along with the surveyed and historic plan information for the I-55 bridge structure were input into the Duplicate model. The starting water surface elevations were converted to NAVD88 and the model was run. Cross-sections 9374.5 and 9141.67 were interpolated using HEC-RAS in order to accurately model the location of the 20-foot diameter cells directly upstream and downstream of the bridge piers. The 20-foot diameter cells were modeled as blocked obstructions. The Cross-Section Location Map can be found in Section 9 and presents the location of all cross sections and existing bridges used in the model. Existing Conditions HEC-RAS input and output are

provided in Section 13.B of this report. The results of this plan were used to calculate the created head under existing conditions for the Waterway Information Table (WIT).

L. SUMMARY OF NATURAL CONDITIONS HYDRAULIC ANALYSIS

A HEC-RAS plan, titled Natural, was created to reflect the natural profile of the stream. The geometry information for the bridge carrying I-55 and the blocked obstructions reflecting the pier cells was removed. The natural water surface elevations were determined for the Waterway Information Table. Input/output for this natural plan are provided in Section 13.C.

M. PROPOSED STRUCTURE ANALYSIS

As part of the proposed improvements, the existing bridge pier caps are proposed to be extended and cantilevered by 11.83 feet upstream and 10.23 feet downstream. In addition, web walls will be constructed between some pier columns. No piers will be added or extended, and the existing pier width will not change. The proposed pier cap work will take place above the 10-year flood elevation. The proposed deck width of the new structure is approximately 172.5 feet, measured perpendicular to centerline of the road. The proposed widening of the superstructure does not impact the existing bridge's overall length or span lengths. The waterway opening area remains the same in both the existing and proposed conditions. The proposed low beam will not be lower than the existing low beam. The low edges of pavement will be approximately 2 inches lower than the that of the existing bridge. Available proposed plans and plots are included in Section 10.B. of this report.

A new HEC-RAS plan, titled Proposed, reflects the proposed conditions of this study. The pier caps were lengthened per the preliminary plans and plots. The plan titled Proposed demonstrates that the proposed structure does not cause an increase in water surface elevations with respect to the existing conditions. Input/output for the proposed plan are provided in Section 13.D.

N. SCOUR ANALYSIS

Scour analysis for the existing bridge is included in Section 14. The abutments at the subject crossing are in the overbank and do not see any flow for any of the storm events included in this study. Therefore, the abutments are not subject to scour.

Contraction and pier scour calculations have been performed using spreadsheets incorporating the formulas from the current 2012 5th Edition of HEC-18. Only Piers 2 and 3 are within the channel. Like the abutments, Piers 1 and 4 are in the overbank and do not see any flow for any

of the storm events included in this study. Additionally, piers 1 and 4 are partially protected from channel scour by the channel slopewall and adjacent roadway pavements. As no current soil data was available for this crossing, the soil D50 was conservatively assumed to be the minimum recommended value of 0.2 mm. If the streambed is gravellier, as was reported in the Ciorba Hydraulic Report for IL Route 171, computed scour depths would be reduced. The proposed structure produces no hydraulic impacts; therefore, the existing scour is the same as the proposed. Scour results are shown below in Table N-1.

Event	Abutment/ Contraction Scour[1]	Pier Scour For Pier 2 Pier 3	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	6.6	2.0	8.6
Q_{200}	N/A	6.8	2.1	8.8

Note 1. NCHRP Method includes both Contraction and Abutment Scour

Note 2. Includes Pier and Contraction Scour

Table N-1 Scour Depth Summary

Scour calculations were also done to determine the impact of the blocking cells. The blocking cell has a width of 20.64'. This width was used as the width of the pier to determine its scour impacts. All other values remain the same. These scour values have been provided below in Table N-2.

Event	Abutment/ Contraction Scour[1]	Pier Scour For Blocking Cell 1 and 2	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	15.7	2.0	17.7
Q_{200}	N/A	16.1	2.1	18.2

Note 1. NCHRP Method includes both Contraction and Abutment Scour

Note 2. Includes Pier and Contraction Scour

Table N-2 Scour Depth Summary

Scour calculations and input values from HEC-RAS are provided in Section 14.

The existing bridge piers have caissons that extend approximately 24.5 ft below the bridge pier footing. The caissons extend down to a layer of bedrock located at an elevation of 550.85 ft. Detailed plans of existing bridge piers 2 and 3 are included in Section 10 of this report. No scour countermeasures are recommended at this time.

O. COMPENSATORY STORAGE

The I-55 bridge over the CSSC is in a Zone A floodplain as mapped on the Flood Insurance Rate Map, Exhibit 4.3. It does not have designated floodway. The CSSC at the I-55 bridge has a tributary area of greater than 640 acres in an urban area, and is regulated under the IDNR-OWR Part 3700 Rules. The Part 3700 Rules do not require compensatory storage for proposed fill, and the IDOT Permit Summary Form is not required.

Section 1-302.03.2 of the IDOT Drainage Manual states, *"Crossing (or Transverse) Fill of Mapped Floodplain: Storage facilities shall be provided whenever fill in the floodway is proposed and the hydraulic analysis indicates that there is a significant change in flood stage and/or velocity that will cause or contribute to flood damage."*

The proposed fill associated with the bridge pier web wall work and pier cap extensions has been evaluated and causes no change in flood stage and/or velocity.

P. IDNR-OWR FLOODWAY CONSTRUCTION PERMIT REQUIREMENTS

The I-55 bridge over the CSSC is in a Zone A floodplain as mapped on the Flood Insurance Rate Map, Exhibit 4.3. It does not have designated floodway. The CSSC at the I-55 bridge has a tributary area of greater than 640 acres in an urban area, and is regulated under the IDNR-OWR Part 3700 Rules. Section 3700.70 Special Provisions for Bridges and Culverts stipulates that a bridge reconstruction project that meets the provisions of b) below is permissible:

> *b) General Standards for Bridge and Culvert Reconstruction*
> *A bridge or culvert reconstruction project that would meet the following provisions will be permissible. A reconstruction project that would not meet these provisions must either comply with the general standards for new bridges and culverts or be designed to reduce the induced flood damages to the fullest practicable extent.*
> 1) *The reconstruction (including approach roads) shall be no more restrictive to normal and flood flows than the existing bridge or culvert crossing; and*
> 2) *Documentation must be provided that the existing crossing has not caused demonstrable flood damage. In the case of public projects, certification by a District Engineer of the Department of Transportation's Division of Highways, a County Engineer (if a Professional Engineer), or a Municipal Engineer (if a Professional Engineer) that the existing crossing has not caused demonstrable flood damage will be adequate documentation.*

The proposed pier web wall and cantilever pier cap deck construction meets the requirements of 3700.70 b) and is permissible.

The CSSC is designated as a "Public Body of Water" by the IDNR-OWR and is regulated under the Part 3704 Rules. A permit is required for work on the bridges and, more specifically, in the channel itself. Because the project is in a Public Body of water, this permit will need to be requested from, and issued by, IDNR-OWR.

The CSSC requires sign-off from the U.S. Coast Guard for any work below low steel of the bridges. A letter outlining the preliminary proposed scope of work with documentation of the Phase I plan set will be sent to the Coast Guard for their review. The horizontal clearance will not be impacted as part of the proposed improvements. The USACE-cited low steel elevation for navigational clearance in the channel is 619.9 (NGVD 29), which provides 42.4' of clearance above the normal pool elevation of 577.5 (NGVD 29). The proposed changes will not impact the clearance. See Section 3 for supporting information for USACE Illinois Waterway clearances. The USACE-cited low steel elevation is different than the surveyed low beam elevation, since the surveyed low beam is taken at the piers. If the proposed Phase I scope of work on this bridge changes, a follow up letter addressing the proposed structural changes will need to be forwarded to the Coast Guard.

Q. FREEBOARD/CLEARANCE

The IDOT Drainage Manual dated July 2011 states that a flood frequency of 50 year should be used for design purposes. The existing crossing was analyzed for the 50-year storm event, and checked for the 10-year, 100-year, and 500-year storm events. The Design Headwater Elevation (HWE) is based on the 50-year event and is shown on the Waterway Information Table located in Section 2.

Freeboard is calculated as the distance from the Design HWE to the lowest edge of pavement (EOP) of the roadway within the floodplain. The IDOT freeboard policy requires a minimum freeboard distance of 3 feet for the 50-year storm event. The existing structure provides 37.6 feet of freeboard for the 50-year event, meeting the IDOT freeboard requirement. The proposed low EOP will be approximately 2 inches below existing. The proposed structure will provide 37.4 feet of freeboard for the 50-year event, meeting the IDOT freeboard requirement.

Clearance is calculated as the distance from the Natural Design HWE to the low beam elevation within the floodplain. The IDOT clearance policy requires that the minimum clearance must be 2 feet for the 50-year storm event, and the all-time WSE must be at or below the low beam elevation of the bridge. The existing structure provides 29.3 feet of clearance between the Natural Design HWE and the low beam elevation. The all-time WSE at the bridge is approximately 583.84 feet NAVD 88 recorded in July 2010, approximately 32.31 feet below the

existing low beam elevation. The proposed low beam elevation will not be reduced, continuing to provide 29.3 feet of clearance between the Natural Design HWE and the low beam elevation and approximately 32.31 feet between the all-time WSE and the low beam elevation. These findings demonstrate that the existing and proposed bridge meet the IDOT clearance requirements.

R. CONCLUSION

The hydraulic analysis has determined that the existing and proposed I-55 five-span bridge over the CSSC meets IDOT Drainage Manual criteria for freeboard and clearance.

The proposed work is designed so that all pier cap, web wall, and deck work will occur above the 10-year flood elevation. The proposed bridge opening area matches the existing area for all flood events. No channel modification is proposed. No scour countermeasures are required. No compensatory storage excavation is required, as there is no designated floodway. The proposed work meets IDNR-OWR requirements for Construction in a Floodway under the Part 3700 Rules and work in a Public Body of Water under the Part 3704 Rules.

The proposed bridge work also requires sign-off from the U.S. Coast Guard for any work below low steel of the bridges. There will be no reduction in low beam elevation and navigational clearances will be unchanged.

Tab 2

SECTION 2

WATERWAY INFORMATION TABLE AND SUPPORTING CALCULATIONS

Illinois Department of Transportation

Bridge Waterway Information Table

Route:	Interstate 55 (Stevenson Expressway)	Existing SN:	016-0014 and 016-0015
Waterway:	Chicago Sanitary and Ship Canal	Proposed SN:	-
Section:	P-91-762-10	Prepared by:	FDM/EMB Date: 01/26/2018
County:	Cook	Checked by:	IAD Date: 05/16/2018

Drainage Area = >296 square miles

Existing Overtopping Elev. = 628.2 ft at Sta. 909+00

Proposed Overtopping Elev. = 628.4 ft at Sta. 909+00

Flood Event	Freq. Yr.	Discharge ft^3/s	Waterway Opening - ft^2		Natural H.W.E. - ft	Head - ft		Headwater Elevation – ft	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	8500	5054	5054	583.7	0.0	0.0	583.7	583.7
Design	50	11300	5948	5948	586.8	0.1	0.1	586.9	586.9
Base	100	12800	6247	6247	587.8	0.1	0.1	587.9	587.9
Scour Design Check	200	14200	6714	6714	589.3	0.2	0.2	589.5	589.5
Overtop Existing	>500	-	-	-	-	-	-	-	-
Overtop Proposed	>500	-	-	-	-	-	-	-	-
Max. Calc.	500	16100	7337	7337	591.2	0.3	0.3	591.5	591.5

Datum: NAVD 88

All-Time H.W.E. & Date: 583.84 ft. July 2010 (NAVD 88)

Surveyed Normal Water Level: 577.38 ft. June 5-7,2017

10-Year Velocity through Existing Structure = 1.68 ft/s

10-Year Velocity through Proposed Structure = 1.68 ft/s

2-Yr. Flow Rate = 5525 ft^3/s

EXISTING STRUCTURE

Type:	5 - Span Steel Bridge
Length/Width[1]:	Length = 692.05 ft F-F along CL, Width = 150.1 ft
# Spans/Cells[1]:	5 @ 49.94 ft – 176 ft – 240.5 ft – 176 ft – 49.61 ft
Low Chord:	616.15 ft
Skew:	45° (relative to road)
Clearance:	29.3 ft
Bridge Flow Line:	557.08 ft (u/s) 557.33 ft (d/s)
Low E.O.P:	624.5 ft
Freeboard:	37.6 ft

PROPOSED STRUCTURE

Type:	5 – Span Steel Bridge
Length Of Span[1]:	Length = 692.05 ft F-F along CL, Width = 172.5 ft
# Spans[1]:	5 @ 49.94 ft – 176 ft – 240.5 ft – 176 ft – 49.61 ft
Low Chord:	616.15 ft
Skew:	45° (relative to road)
Clearance:	29.3
Bridge Flow Line:	557.08' (u/s) 557.33' (d/s)
Low E.O.P:	624.33 ft
Freeboard:	37.4 ft

NOTE: Proposed Structure Details Are Preliminary; Subject To Refinement In TSL Stage. Bridge pavement is superelevated.

[1] Overall Length and Span Lengths measured parallel to the centerline of road. Width measured perpendicular to centerline of road.

BACK-UP CALCULATIONS FOR WIT

Route: **I-55** Computed: FDM/EMB Date: 1/25/2018
Waterway: **CSSC** Checked: IAD Date: 5/16/2018

Calculate Created Head

Frequency	Natural H.W.E. (ft)[1]		Greatest Created Head (ft)[2] Upstream of Culvert	Greatest Created Head (ft)[2] Upstream of Culvert	Existing Headwater Elevation @ Upstream Face (ft)[2]	Proposed Headwater Elevation @ Upstream Face (ft)[2]
	U/S Face of Structure	Approach Sect. (9529 U/S)	From Summary Tables Comparing Natural WSE to Existing WSE	From Summary Tables Comparing Natural WSE to Proposed WSE		
10-year	583.7	583.7	0.0	0.0	583.7	583.7
50-year	586.8	586.8	0.1	0.1	586.9	586.9
100-year	587.8	587.8	0.1	0.1	587.9	587.9
200-year	589.3	589.3	0.2	0.2	589.5	589.5
500-year	591.2	591.2	0.3	0.3	591.5	591.5

(1) The natural highwater elevation is the water surface elevation at the upstream side of the crossing as modeled in the stream natural condition, without the structure.

(2) The created head is calculated at the cross section upstream of the bridge/culvert which has the greatest difference between the natural and proposed conditions. This difference in elevation is then added to the Natural H.W.E. at the U/S face of the structure. This method of calcuating created head is only required for bridges and some major culvert crossings. Also, the preferred created head should never be negative. headwater elevations = The natural highwater elevation + the created head

CALCULATE FREEBOARD AND CLEARANCE

Low Road Elevation (ft)[3]			
Existing	Station	Proposed	Station
624.50	916+05	624.33	916+05

Low Beam Elevation (ft)				
Existing	Station	Proposed	Station	
616.15	913+80 (SB)	616.15	913+80 (SB)	(@ Pier 3)

Existing Freeboard (ft)				
10-year	50-year[4]	100-year	200-year	500-year
40.82	37.62	36.60	35.00	33.03

Existing Natural Clearance (ft)				
10-year	50-year[5]	100-year	200-year	500-year
32.48	29.37	28.36	26.81	24.96

Proposed Freeboard (ft)				
10-year	50-year[4]	100-year	200-year	500-year
40.65	37.45	36.44	34.83	32.86

Proposed Natural Clearance (ft)				
10-year	50-year[5]	100-year	200-year	500-year
32.48	29.37	28.36	26.81	24.96

(3) Low road elevation is calculated at the edge of pavement, and on the low side of the roadway.

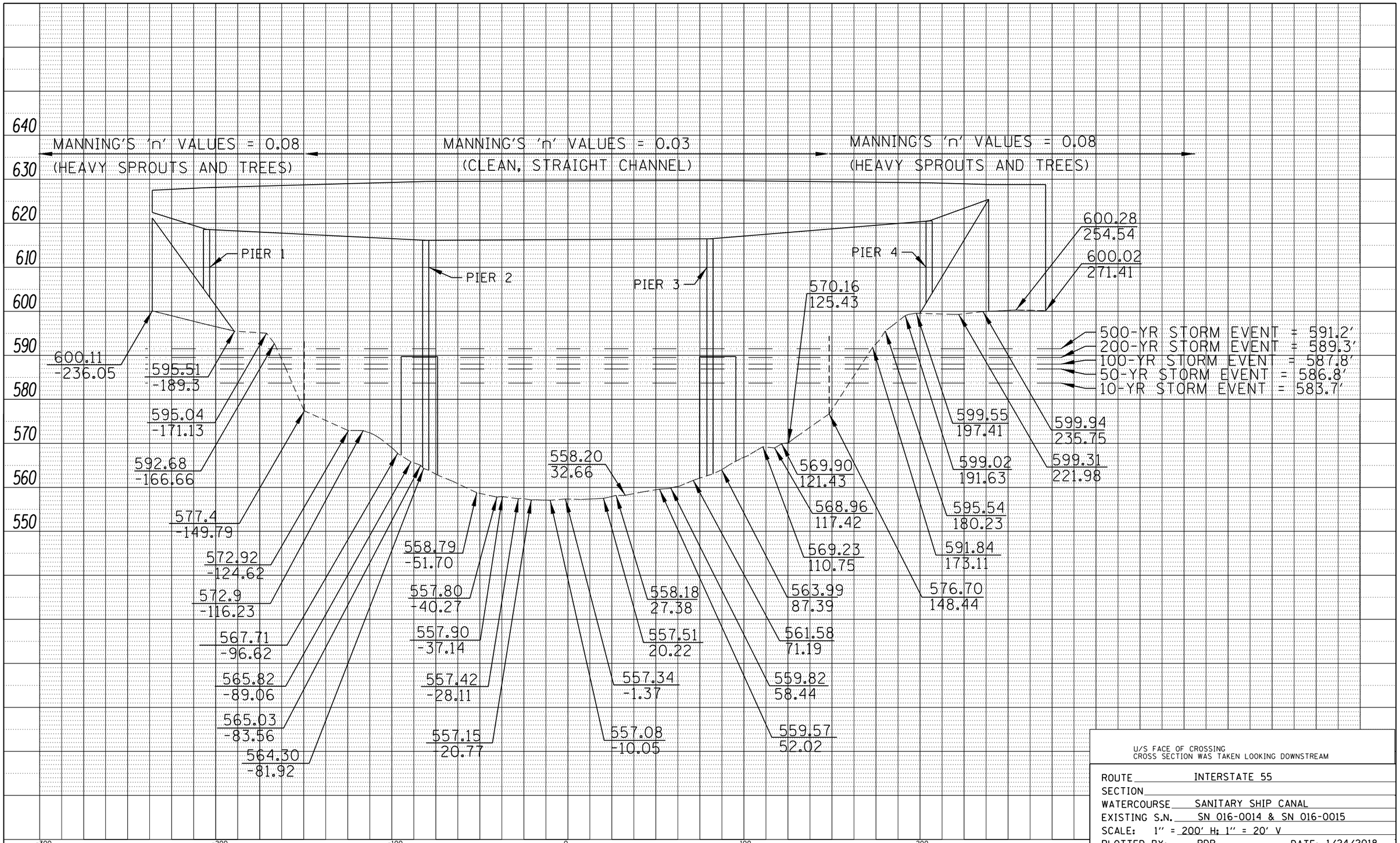
(4) Freeboard is calculated from the 50-year design headwater elevation to the low road elevation in the floodplain.

(5) Vertical clearance is calculated from the 50-year natural high-water elevation to the low chord (beam) bridge elevation (2 ft minimum requirement)

CALCULATE EFFECTIVE WATERWAY OPENING

Structure Length (ft)	
Existing	Proposed
694 F to F	694 F to F

Waterway Opening Area (ft^2)		
Frequency	Existing	Proposed
10-year	5054	5054
50-year	5948	5948
100-year	6247	6247
200-year	6714	6714
500-year	7337	7337
	by CAD	by CAD



PLAN — DATE — BY — SURVEYED — PLOTTED — CHANGES CHECKED — R.O.W. CHECKED — R.T. OF WAY CHECKED — CADD FILE NAME — NOTE BOOK — NO.

PROFILE — DATE — BY — SURVEYED — PLOTTED — CHANGES CHECKED — B.M. NOTED — STRUCTURE NOTATNS CHKD — NOTE BOOK — NO.

CBBEL XS STA. XX+XX

XS STA. XX+XX

LEGEND

CBBEL SURVEYED CROSS SECTIONS 06/2016

SURVEYED CROSS SECTIONS FROM 2011 CIORBA H.R. (BY OTHERS)

U/S FACE OF CROSSING
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1" = 200' H; 1" = 20' V
PLOTTED BY: PDR DATE: 1/24/2018
CHECKED BY: IAD DATE: 1/24/2018
SURVEY DATE: 06-27-17

FILE NAME =	USER NAME = eburke	DESIGNED -	REVISED -
N:\Idot\110203.00001\Drain\P1110203-sht-xssht-CSSC.dgn		DRAWN -	REVISED -
Default	PLOT SCALE = 100'	CHECKED -	REVISED -
	PLOT DATE = 1/24/2018	DATE - 1/24/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

FLOW AREAS FOR
I-55 OVER CHICAGO SANITARY AND SHIP CANAL

SCALE: | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.

CONTRACT NO.

ILLINOIS | FED. AID PROJECT

I-55 OVER CHICAGO SANITARY AND SHIP CANAL

N

℄ I-55

OVERTOPPING
STA 909+00
OFF 75.2' LT
ELEV. 628.2

LOW EOP
STA 916+05
OFF 77.4' LT
ELEV. 624.5

CHICAGO SANITARY AND SHIP CANAL

CHICAGO SANITARY AND SHIP CANAL

LOW EOP
STA 907+46
OFF 72.2' LT
ELEV. 625.8

OVERTOPPING
STA 914+46
OFF 73.5' RT
ELEV. 628.3

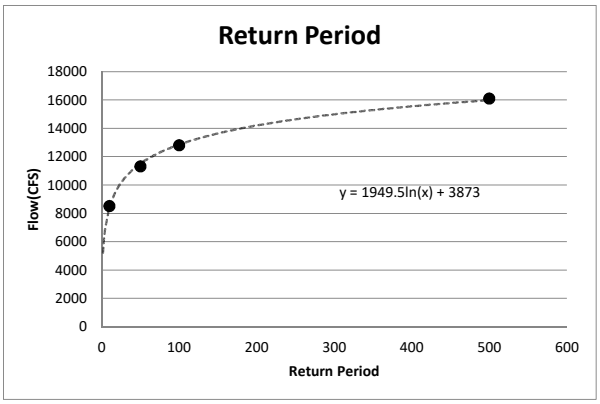
I-55 MANAGED LANE PROJECT	USER NAME = EEOM	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	I-55 MANAGED LANE STUDY DRAINAGE SUPPLEMENT	F.A. RTE.:	SECTION / COUNTY / TOTAL SHEETS / SHEET NO.
		DRAWN -	REVISED -				1 / 1
	PLOT SCALE = 100.0000 ' / in.	CHECKED -	REVISED -				CONTRACT NO. P92917
	PLOT DATE = 8/11/2017	DATE -	REVISED -		SCALE: _____ SHEET ___ OF ___ SHEETS STA. _____ TO STA. _____		ILLINOIS FED. AID PROJECT

FILE NAME = I:\1786\active\17860037_IDOT_I-55_2Lanes\civil\drainage\drawings\DIP91762l0-mod-TempExhibits.dgn

Regression Equation - Solve for Q for 2-Yr and 200-Yr event
I-55 over CSSC

Input Data	
Return Period	Actual Discharge (cfs)
10	8500
50	11300
100	12800
500	16100

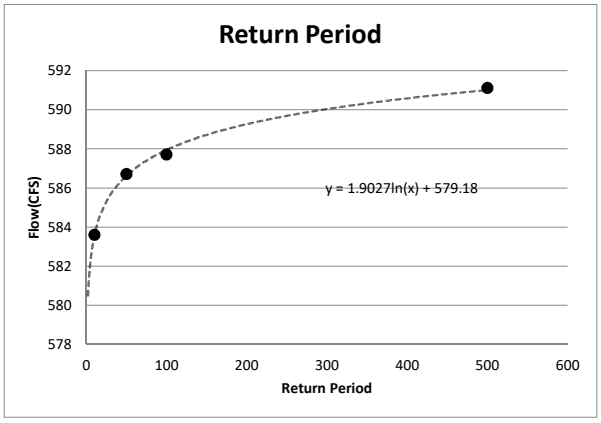
Calculated Data		
Return Period	Actual Discharge (cfs)	Calculated Discharge (cfs)
2	-	5224.29
10	8500	8361.89
50	11300	11499.49
100	12800	12850.78
200	-	14202.07
500	16100	15988.38



Regression Equation - Solve for Water Surafce Elevation for 2-Yr and 200-Yr event
I-55 over CSSC

Input Data	
Return Period	Water Surface Elevation (ft)
10	583.61
50	586.71
100	587.71
500	591.11

Calculated Data		
Return Period	Actual Water Surface Elevation (ft)	Calculated Water Surface Elevation (ft)
2	-	580.50
10	583.61	583.56
50	586.71	586.62
100	587.71	587.94
200	-	589.26
500	591.11	591.00



BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 10-YEAR NATURAL WSE TO EXISTING WSE			
Cross Section	Natural Condition WSE	Existing Condition WSE	WSE Difference
10377	583.68	583.69	0.01
9888	583.67	583.68	0.01
9529	583.67	583.68	0.01
9374.5	583.67	583.66	-0.01
9266	I-55 Crossing		
9141.67	583.66	583.66	0.00
9083	583.66	583.66	0.00
8659	583.66	583.66	0.00
8550	583.66	583.66	0.00
8175	583.65	583.65	0.00
8030	583.65	583.65	0.00
7570	583.64	583.64	0.00
7460	583.63	583.63	0.00
7459	Ramp D		
7410	583.63	583.63	0.00
7250	583.63	583.63	0.00
7160	583.63	583.63	0.00
7098	IL 171		
7015	583.62	583.62	0.00
6910	583.63	583.63	0.00
6550	583.62	583.62	0.00
6000	583.61	583.61	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 50-YEAR NATURAL WSE TO EXISTING WSE			
Cross Section	Natural Condition WSE	Existing Condition WSE	WSE Difference
10377	586.79	586.89	0.10
9888	586.78	586.88	0.10
9529	586.78	586.88	0.10
9374.5	586.78	586.86	0.08
9266	I-55 Crossing		
9141.67	586.77	586.76	-0.01
9083	586.77	586.77	0.00
8659	586.76	586.76	0.00
8550	586.77	586.77	0.00
8175	586.76	586.76	0.00
8030	586.75	586.75	0.00
7570	586.75	586.75	0.00
7460	586.74	586.74	0.00
7459	Ramp D		
7410	586.73	586.73	0.00
7250	586.74	586.74	0.00
7160	586.74	586.74	0.00
7098	IL 171		
7015	586.72	586.72	0.00
6910	586.73	586.73	0.00
6550	586.72	586.72	0.00
6000	586.71	586.71	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 100-YEAR NATURAL WSE TO EXISTING WSE			
Cross Section	Natural Condition WSE	Existing Condition WSE	WSE Difference
10377	587.8	587.94	0.14
9888	587.79	587.93	0.14
9529	587.79	587.93	0.14
9374.5	587.79	587.91	0.12
9266	I-55 Crossing		
9141.67	587.78	587.77	-0.01
9083	587.78	587.78	0.00
8659	587.77	587.77	0.00
8550	587.78	587.78	0.00
8175	587.77	587.77	0.00
8030	587.76	587.76	0.00
7570	587.75	587.75	0.00
7460	587.74	587.74	0.00
7459	Ramp D		
7410	587.73	587.73	0.00
7250	587.74	587.74	0.00
7160	587.74	587.74	0.00
7098	IL 171		
7015	587.72	587.72	0.00
6910	587.73	587.73	0.00
6550	587.72	587.72	0.00
6000	587.71	587.71	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **Flag Creek**

SUMMARY TABLE COMPARING 200-YEAR NATURAL WSE TO EXISTING WSE			
Cross Section	Natural Condition WSE	Existing Condition WSE	WSE Difference
10377	589.35	589.56	0.21
9888	589.35	589.55	0.20
9529	589.34	589.54	0.20
9374.5	589.34	589.52	0.18
9266	I-55 Crossing		
9141.67	589.34	589.32	-0.02
9083	589.34	589.34	0.00
8659	589.33	589.33	0.00
8550	589.33	589.33	0.00
8175	589.32	589.32	0.00
8030	589.31	589.31	0.00
7570	589.31	589.31	0.00
7460	589.29	589.29	0.00
7459	Ramp D		
7410	589.28	589.28	0.00
7250	589.3	589.3	0.00
7160	589.29	589.29	0.00
7098	IL 171		
7015	589.27	589.27	0.00
6910	589.28	589.28	0.00
6550	589.27	589.27	0.00
6000	589.26	589.26	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **Flag Creek**

SUMMARY TABLE COMPARING 500-YEAR NATURAL WSE TO EXISTING WSE			
Cross Section	Natural Condition WSE	Existing Condition WSE	WSE Difference
10377	591.21	591.48	0.27
9888	591.2	591.48	0.28
9529	591.19	591.47	0.28
9374.5	591.19	591.45	0.26
9266	I-55 Crossing		
9141.67	591.19	591.18	-0.01
9083	591.19	591.19	0.00
8659	591.18	591.18	0.00
8550	591.19	591.19	0.00
8175	591.17	591.17	0.00
8030	591.16	591.16	0.00
7570	591.16	591.16	0.00
7460	591.14	591.14	0.00
7459	Ramp D		
7410	591.13	591.13	0.00
7250	591.15	591.15	0.00
7160	591.14	591.14	0.00
7098	IL 171		
7015	591.12	591.12	0.00
6910	591.13	591.13	0.00
6550	591.12	591.12	0.00
6000	591.11	591.11	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 10-YEAR NATURAL WSE TO PROPOSED WSE			
Cross Section	Natural Condition WSE	Proposed Condition WSE	WSE Difference
10377	583.68	583.69	0.01
9888	583.67	583.68	0.01
9529	583.67	583.68	0.01
9374.5	583.67	583.66	-0.01
9266	I-55 Crossing		
9141.67	583.66	583.66	0.00
9083	583.66	583.66	0.00
8659	583.66	583.66	0.00
8550	583.66	583.66	0.00
8175	583.65	583.65	0.00
8030	583.65	583.65	0.00
7570	583.64	583.64	0.00
7460	583.63	583.63	0.00
7459	Ramp D		
7410	583.63	583.63	0.00
7250	583.63	583.63	0.00
7160	583.63	583.63	0.00
7098	IL 171		
7015	583.62	583.62	0.00
6910	583.63	583.63	0.00
6550	583.62	583.62	0.00
6000	583.61	583.61	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 50-YEAR NATURAL WSE TO PROPOSED WSE			
Cross Section	Natural Condition WSE	Proposed Condition WSE	WSE Difference
10377	586.79	586.89	0.10
9888	586.78	586.88	0.10
9529	586.78	586.88	0.10
9374.5	586.78	586.86	0.08
9266	I-55 Crossing		
9141.67	586.77	586.76	-0.01
9083	586.77	586.77	0.00
8659	586.76	586.76	0.00
8550	586.77	586.77	0.00
8175	586.76	586.76	0.00
8030	586.75	586.75	0.00
7570	586.75	586.75	0.00
7460	586.74	586.74	0.00
7459	Ramp D		
7410	586.73	586.73	0.00
7250	586.74	586.74	0.00
7160	586.74	586.74	0.00
7098	IL 171		
7015	586.72	586.72	0.00
6910	586.73	586.73	0.00
6550	586.72	586.72	0.00
6000	586.71	586.71	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **CSSC**

SUMMARY TABLE COMPARING 100-YEAR NATURAL WSE TO PROPOSED WSE			
Cross Section	Natural Condition WSE	Proposed Condition WSE	WSE Difference
10377	587.8	587.94	0.14
9888	587.79	587.93	0.14
9529	587.79	587.93	0.14
9374.5	587.79	587.91	0.12
9266	I-55 Crossing		
9141.67	587.78	587.77	-0.01
9083	587.78	587.78	0.00
8659	587.77	587.77	0.00
8550	587.78	587.78	0.00
8175	587.77	587.77	0.00
8030	587.76	587.76	0.00
7570	587.75	587.75	0.00
7460	587.74	587.74	0.00
7459	Ramp D		
7410	587.73	587.73	0.00
7250	587.74	587.74	0.00
7160	587.74	587.74	0.00
7098	IL 171		
7015	587.72	587.72	0.00
6910	587.73	587.73	0.00
6550	587.72	587.72	0.00
6000	587.71	587.71	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **Flag Creek**

SUMMARY TABLE COMPARING 200-YEAR NATURAL WSE TO PROPOSED WSE			
Cross Section	Natural Condition WSE	Proposed Condition WSE	WSE Difference
10377	589.35	589.56	0.21
9888	589.35	589.55	0.20
9529	589.34	589.54	0.20
9374.5	589.34	589.52	0.18
9266	I-55 Crossing		
9141.67	589.34	589.32	-0.02
9083	589.34	589.34	0.00
8659	589.33	589.33	0.00
8550	589.33	589.33	0.00
8175	589.32	589.32	0.00
8030	589.31	589.31	0.00
7570	589.31	589.31	0.00
7460	589.29	589.29	0.00
7459	Ramp D		
7410	589.28	589.28	0.00
7250	589.3	589.3	0.00
7160	589.29	589.29	0.00
7098	IL 171		
7015	589.27	589.27	0.00
6910	589.28	589.28	0.00
6550	589.27	589.27	0.00
6000	589.26	589.26	0.00

BACK-UP CALCULATIONS FOR WIT

Route: **I-55**

Waterway: **Flag Creek**

SUMMARY TABLE COMPARING 500-YEAR NATURAL WSE TO PROPOSED WSE			
Cross Section	Natural Condition WSE	Proposed Condition WSE	WSE Difference
10377	591.21	591.48	0.27
9888	591.2	591.48	0.28
9529	591.19	591.47	0.28
9374.5	591.19	591.45	0.26
9266	I-55 Crossing		
9141.67	591.19	591.18	-0.01
9083	591.19	591.19	0.00
8659	591.18	591.18	0.00
8550	591.19	591.19	0.00
8175	591.17	591.17	0.00
8030	591.16	591.16	0.00
7570	591.16	591.16	0.00
7460	591.14	591.14	0.00
7459	Ramp D		
7410	591.13	591.13	0.00
7250	591.15	591.15	0.00
7160	591.14	591.14	0.00
7098	IL 171		
7015	591.12	591.12	0.00
6910	591.13	591.13	0.00
6550	591.12	591.12	0.00
6000	591.11	591.11	0.00

Tab 3

SECTION 3

HYDRAULIC REPORT DATA SHEETS

Illinois Department of Transportation

Hydraulic Report Data Sheets

Route	Interstate 55	P or D #	P-91-762-10
Section	Chicago Sanitary and Ship Canal	PTB #	158-002
County	Cook		
Exist SN	016-0014 and 016-0015		
Prop SN	n/a		

General Information

1. Name of the Stream: Chicago Sanitary and Ship Canal

2. Location of the Structure: NE ¼ of the SE ¼ of Section 12 Township 38N Rang 12E of the 3rd P.M.

3. Hydraulic Report Prepared By: ☒ Consultant Christopher B. Burke Engineering, Ltd.
   ☐ District

4. Hydraulic Report Approval Authority: ☐ District – Post PDF of HR to BBS Hydraulics SharePoint Server
   ☒ BBS Hydraulics - Submit 2 hard copies of HR to BBS Hydraulics

Site Design Data

5. Drainage Area (sq. mi.): N/A

6. Highway Classification:
   ☐ Rural ☒ Principal Arterial
   ☒ Urban ☐ Minor Arterial
   ☐ Other ☐ Collector
   ☐ Local

7. Design Frequency: ☐ 30 yr ☒ 50 Yr. ☐ Other

8. Number of Waterway Information Tables (WIT): 1
   If more than one, explain:

Hydrologic & Hydraulic Analysis

9. Hydrology Modeling (check all that apply): ☐ USGS/Stream Stats ☐ FIS ☐ Gage Data
   ☒ Other United States Army Corps of Engineers

10. Hydraulic Modeling (check all that apply):
    a. Method: ☒ HEC-RAS ☐ WSPRO ☐ Other
    b. Manning's "n" values determined as per IDOT DM CH.5? ☒ Yes ☐ No
       If no, explain:
    c. Source of Starting WSE: United States Army Corps of Engineers
    d. Non- IDOT encroachments in Survey? ☐ Yes ☒ No
       If yes, are they accounted for? ☐ Yes ☐ No
    e. Does the Tailwater Control? ☐ Yes ☒ No
       If yes, list:

f. Were the Expansion/Contraction cones properly addressed? ☐ Yes ☐ No ☒ N/A

If No or N/A, explain: Structure opening is greater than waterway width up to and including the 500-yr storm event

g. What Expansion and Contraction Rates were used? Expansion: n/a

Contraction n/a

IDNR – OWR Floodway Permit

11. Is area experiencing urbanization or expected to urbanize within 10 years? ☒ Yes ☐ No

12. Are there any sensitive flood receptors located upstream within possible backwater influence? ☐ Yes ☒ No
If yes, list and describe critical upstream flood damageable properties and their elevations.

13. Is there any History of Flooding or Overtopping problems? ☐ Yes ☒ No
Sources of Observed Highwater:
USGS gage 05536140 at Stickney, Elev. 583.84' NAVD 88.
(Assumed level pool above Lockport Lock & Dam. Normal pool = 577.2' NAVD 88.)

14. Is the structure hydraulically connected to or within the floodway of an IDNR-OWR designated Public Body of Water? ☒ Yes ☐ No

15. Required IDNR - OWR Permit type:
☐ Individual ☐ SWP #2 ☒ SWP #12 ☐ Floodway
☐ None ☐ Other

Proposed Structure Data

16. Project Scope (check all that apply):
a. ☐ Complete Replacement
b. ☐ Superstructure Replacement
c: ☒ Superstructure Widening; Length of Pier Extension in the water:
U/S 11.83' D/S 10.23'
d. ☒ Bridge ☐ Culvert
e. ☐ New Alignment
f. Work Planned Below Q_{100} HWE? ☒ Yes ☐ No
g. ☐ Profile Raise

17. If a bridge is proposed, supply:

Flow line elevation (ft):	557.08 NAVD88	Abutment type:	Open stub
Preliminary low beam elevation (ft):	616.15 ft	Skew (degrees):	45°
Width of deck (ft):	172.5' ⊥ to road	Number of spans:	5
Total length from face to face of abutment (ft)	692.05' along road		

18. If a culvert is proposed, supply:

Type and size:	N/A	Length (ft):	N/A
Upstream invert elevation (ft):	N/A	Entrance type:	N/A
Downstream invert elevation (ft):	N/A	Skew (degrees):	N/A

19. If a three-sided structure is proposed, supply:

Flow line elevation (ft):	N/A	Skew (degrees):	N/A
Span (ft):	N/A	Length (ft):	N/A
Height (ft):	N/A	Number of spans:	N/A

20. a. Is the IDOT Clearance Policy Met? ☒ Yes ☐ No ☐ NA Value (ft): 29.3'
b. Is the IDOT Freeboard Policy Met? ☒ Yes ☐ No ☐ NA Value (ft): 37.4'

21. Type of streambed soil : ☐ Clay ☐ Silt ☐ Sand ☐ Loam ☒ Gravel at downstream IL 171 structure per 2011 Ciorba HR, 0.2 mm min. d50 assumed for scour calculations.

22. Scour/ Migration Problems: None
Comments:

Ice Concerns: None
Comments:

Debris Concerns: None
Comments:

Countermeasures Proposed: None

Existing Structure Data

		IL 43 (Harlem Ave.)	I-55	IL 171 Ramp D
		U/S	Subject Structure	D/S
23.	Distance from proposed structure: (ft.)	3100	0	1807
24.	Type of structure:	1-Span Steel Bascule Bridge	5-Span Steel Bridge	5-Span Steel Bridge
25.	Low beam elevation:	602.1 *	616.15	612.09
26.	Flow line elevation:	555.0 **	557.08	554.91
27.	Maximum known high water elevation:	583.84	583.84	583.58
28.	Date of maximum high water:	July 2010	July, 2010	June, 1977
29.	Cause (backwater, headwater, etc.):	Unknown	Unknown	Unknown
30.	Does structure carry entire design flood flow?	Yes	Yes	Yes
	If not, state area of additional waterway opening: (ft^2)	N/A	N/A	N/A
31.	Type and size of existing overflow structures:	N/A	N/A	N/A
32.	Has adverse scour occurred under or adjacent to the structure?	No	No	No
33.	Classify type of scour and/or aggradation / degradation:	N/A	N/A	N/A

** From USACE 2013 Illinois Waterway Clearances Table. See Section 3.*
*** From USACE 2013 Hydrographic Survey of the Illinois Waterway. See Section 14.*

Required Additional Data

34. Deviations from the General Procedures presented in IDOT DM CH. 2, CH.6, and CH.7:
No.

35. Information regarding high water from other streams, reservoirs, flood control projects, proposed channel changes, or other controls affecting proposed waterway area:

N/A

36. Site Inspection made by: Christopher B. Burke Engineering, Ltd. Date: July 2017

Remarks:
Inspected by Francisco Martinez.

37. Prepared by: Francisco Martinez Date August 2017

Signed (QA/QC): Irene A Dailey Date 05/16/2018

Hydraulic Report Checklist

The District or Consultant should complete the following checklist before submitting the Hydraulic Report for approval.

1. ☒ Title Page
2. ☒ Table of Contents
3. ☒ Narrative - (as outlined in Section 2-601.01 Item #3)
4. ☒ Waterway Information Table (WIT) - (as outlined in Section 2-601.01 Item #4)
5. ☒ Hydraulic Report Data Sheets
6. ☒ Location Map - should show the subject structure along with nearby location defining landmarks (cities, roads, highways, etc.)
7. ☒ USGS Hydraulic Investigation Map (District 1 only)
8. ☒ Photographs - (Minimum: U/S & D/S Structure Faces, Up & Down Channel, Up & Down Roadway Across Structure)
9. ☐ Hydrology (map and calculations)
10. ☒ Streambed Profile
11. ☒ Roadway Profile (existing and proposed)
12. ☒ Cross Section Plots - with plan layout preferably overlayed upon an aerial photo with the contours
13. ☒ Bridge Opening Plots
14. ☒ Natural Condition Analysis
15. ☒ Existing Condition Analysis
16. ☒ Proposed Condition Analysis

When HEC-RAS modeling is being used, ALL Plans (Natural, Existing, & Proposed) shall be included in ONE Project File.

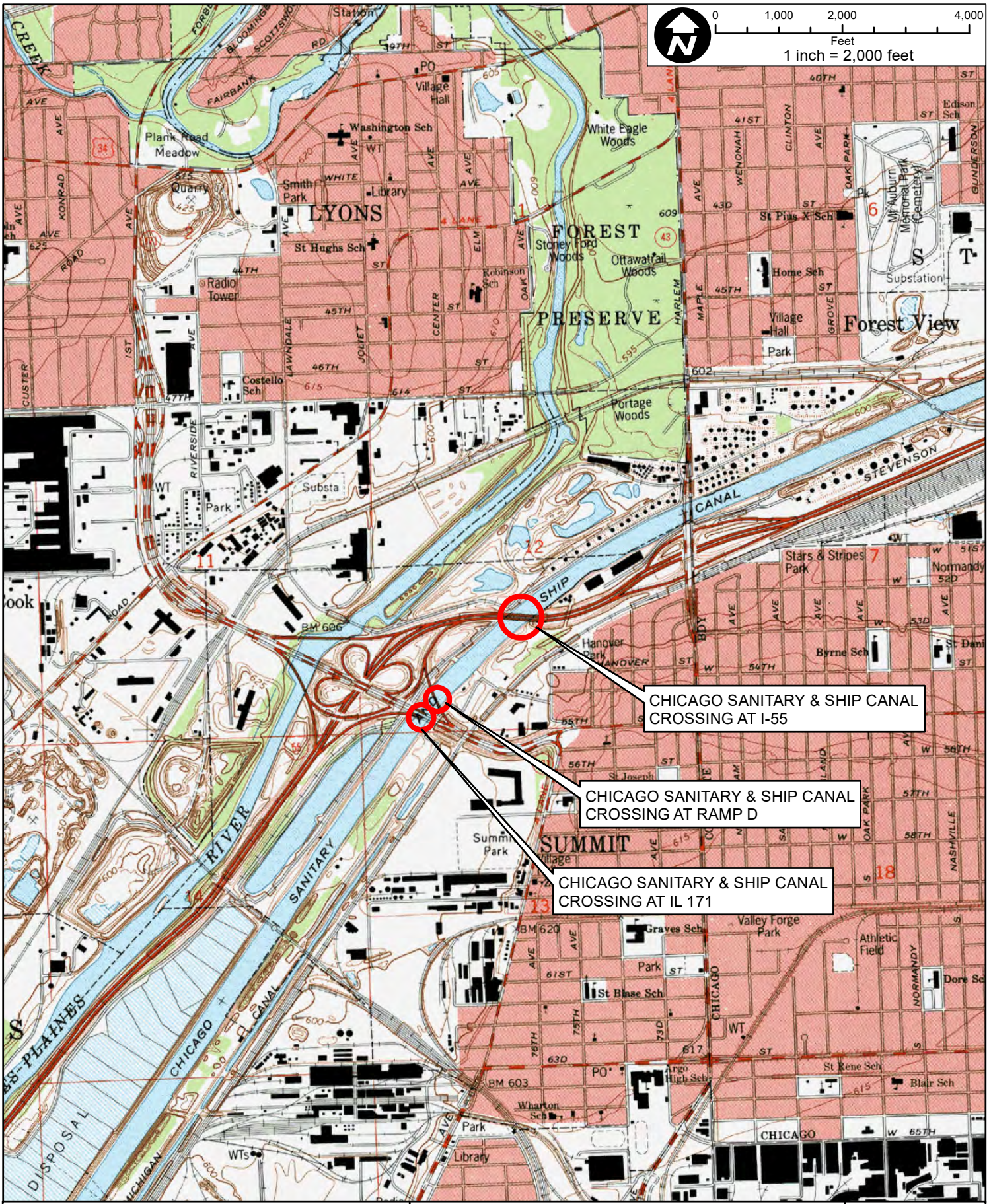
17. ☒ Scour Analysis – Existing and Proposed Conditions
18. ☐ Compensatory Storage Calculations (if required)
19. ☒ Survey Notes (if available, No Electronic Point Files)
20. ☒ Correspondence Notes
21. ☒ CD with Project Files (Include pdf copy of the Hydraulic Report)

Chart Number	Page Index	River Mile	Water Body	Bridge Name	Type	Horizontal Clearance (ft)	Vertical Clearance (ft)	Vertical Clearance Open (ft)	Low Steel Elevation (ft)	Water Surface Elevation (ft)	Water Surface Elevation Reference	Vertical Datum
100	2	296.6	Chicago Sanitary & Ship Canal	Enbridge Energy Oil Pipeline	Pipeline	160.0	42.2		620.2	577.5	Low Operating Level / Flat Pool	NGVD 1929
101	1	300.4	Chicago Sanitary & Ship Canal	Lemont Highway Bridge	Fixed	160.0	49.3		626.8	577.5	Low Operating Level / Flat Pool	NGVD 1929
101	2	300.5	Chicago Sanitary & Ship Canal	Atchison Topeka and Santa Fe Railway Bridge	Swing	160.0	19.7	Does Not Open	597.2	577.5	Low Operating Level / Flat Pool	NGVD 1929
102	1	304.1	Chicago Sanitary & Ship Canal	Sag Highway Bridge	Fixed	160.0	40.0		617.5	577.5	Low Operating Level / Flat Pool	NGVD 1929
102	2	303.9	Calumet Sag Channel	Gulf, Mobile and Ohio Railroad Bridge	Fixed	225.0	24.6		602.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
102	3	304.2	Calumet Sag Channel	Sag Highway Bridge	Fixed	250.0	40.0		617.5	577.5	Low Operating Level / Flat Pool	NGVD 1929
102	4	303.3	Chicago Sanitary & Ship Canal	West Shore Overhead Gasoline Pipeline	Pipeline	160.0	47.8		625.8	577.5	Low Operating Level / Flat Pool	NGVD 1929
103	1	307.9	Chicago Sanitary & Ship Canal	Willow Springs Highway Bridge	Fixed	160.0	41.2		618.7	577.5	Low Operating Level / Flat Pool	NGVD 1929
103	2	309.2	Chicago Sanitary & Ship Canal	Illinois State Toll Highway Bridge	Fixed	240.0	41.5		619.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
103	3	309.3	Chicago Sanitary & Ship Canal	Mannheim Road (Justic Highway) Bridge	Fixed	270.4	40.5		618.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	1	312.3	Chicago Sanitary & Ship Canal	Baltimore and Ohio, Chicago Terminal Railroad Bridge	Fixed	133.7	19.5		597.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	2	313.0	Chicago Sanitary & Ship Canal	Lawndale Avenue Bridge	Fixed	160.0	40.4		617.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	3	313.1	Chicago Sanitary & Ship Canal	Lawndale Avenue Off-Ramp Bridge	Fixed	160.0	43.2		620.7	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	4	313.4	Chicago Sanitary & Ship Canal	Southwest Expressway Bridge	Fixed	162.0	42.4		619.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	5	314.0	Chicago Sanitary & Ship Canal	Southern Harlem Avenue Bridge	Bascule	140.0	24.9	Does Not Open	602.4	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	6	314.8	Chicago Sanitary & Ship Canal	Atchison Topeka and Santa Fe Railway Bridge	Swing	107.0	19.5	Does Not Open	597.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
105	7	316.2	Chicago Sanitary & Ship Canal	Central Avenue Bridge	Fixed	218.0	45.8		623.3	577.5	Low Operating Level / Flat Pool	NGVD 1929
107	1	317.3	Chicago Sanitary & Ship Canal	South Cicero Avenue Bridge Twin Span	Bascule	140.0	18.6		596.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
107	2	317.5	Chicago Sanitary & Ship Canal	Chicago and Western Indiana Railroad Bridge	Swing	97.0	18.6	Does Not Open	596.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
107	3	318.4	Chicago Sanitary & Ship Canal	South Pulaski Road Highway Bridge	Bascule	140.0	31.7		609.2	577.5	Low Operating Level / Flat Pool	NGVD 1929
107	4	318.9	Chicago Sanitary & Ship Canal	Illinois Northern Bridge	Swing	95.0	19.5	Does Not Open	597.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	1	319.5	Chicago Sanitary & Ship Canal	South Kedzie Avenue Bridge	Fixed	130.0	23.0		600.5	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	2	319.6	Chicago Sanitary & Ship Canal	Illinois Chicago Railroad Bridge	Swing	100.0	20.1	Does Not Open	597.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	3	320.0	Chicago Sanitary & Ship Canal	South California Avenue Bridge	Bascule	128.0	19.1		596.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	4	320.4	Chicago Sanitary & Ship Canal	Conrail CSX Railroad Bridge	Bascule	120.0	17.6		595.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	5	320.5	Chicago Sanitary & Ship Canal	Western Avenue Bridge	Fixed	153.3	22.9		600.4	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	6	321.1	Chicago Sanitary & Ship Canal	South Damen Avenue Bridge	Bascule	140.3	28.9		606.4	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	7	321.7	Chicago Sanitary & Ship Canal	Ashland Avenue Highway Bridge	Bascule	183.0	22.2		599.7	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	8	321.9	S Branch Chicago River	Loomis Street Highway Bridge	Bascule	103.0	23.6		601.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	9	322.0	S Branch Chicago River - S Fork	RR Bridge - Bascule Span	Bascule	107.8	18.4		595.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	10	322.1	S Branch Chicago River - S Fork	RR Bridge	Fixed	118.6	18.5		596.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	11	322.2	S Branch Chicago River - S Fork	Adler E. Stevenson Expressway Dual Bridges	Fixed	97.4	34.5		612.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
108	12	322.3	S Branch Chicago River - S Fork	South Archer Avenue Bridge	Fixed	95.3	19.3		596.8	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	13	322.8	S Branch Chicago River	South Halsted Street Bridge	Fixed	163.8	22.1		599.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	14	322.9	S Branch Chicago River	Dan Ryan Expressway Bridge	Bascule	170.0	64.2		641.7	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	15	323.2	S Branch Chicago River	Cermak Highway Bridge	Bascule	129.6	20.4		597.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	16	323.3	S Branch Chicago River	Canal Street Highway Bridge	Bascule	167.0	23.6		601.1	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	17	323.4	S Branch Chicago River	Pittsburg, Fort Wayne and Chicago Railroad Bridge	Lifting	156.0	11.1	120	588.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	18	323.6	S Branch Chicago River	Eighteenth Street Highway Bridge	Bascule	125.0	24.5		602.0	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	19	323.8	S Branch Chicago River	CSX Burlington Northern Santa Fe Illinois Central RR Bridge	Bascule	171.0	22.1		599.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	20	323.9	S Branch Chicago River	Baltimore and Ohio, Chicago Terminal Railroad Bridge	Bascule	171.0	Open			577.5	Low Operating Level / Flat Pool	NGVD 1929
109	21	324.3	S Branch Chicago River	Roosevelt Road Highway Bridge	Bascule	158.7	25.3		602.8	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	22	324.8	S Branch Chicago River	Harrison Street Highway Bridge	Bascule	159.0	23.2		600.7	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	23	324.8	S Branch Chicago River	Eisenhower Expressway Bridge	Bascule	168.0	25.1		602.6	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	24	324.9	S Branch Chicago River	Van Buren Street Highway Bridge	Bascule	166.0	23.4		600.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	25	325.0	S Branch Chicago River	Jackson Boulevard Highway Bridge	Bascule	143.1	20.4		597.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	26	325.1	S Branch Chicago River	Adams Street Highway Bridge	Bascule	148.9	20.3		597.8	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	27	325.2	S Branch Chicago River	Monroe Street Highway Bridge	Bascule	156.0	19.4		596.9	577.5	Low Operating Level / Flat Pool	NGVD 1929
109	28	325.3	S Branch Chicago River	Madison Street Highway Bridge	Bascule	172.1	19.5		597.0	577.5	Low Operating Level / Flat Pool	NGVD 1929

Tab 4

SECTION 4

LOCATION MAP
USGS HYDROLOGIC INVESTIGATIONS ATLAS
REGULATORY FLOOD MAPS



CLIENT:
ILLINOIS DEPARTMENT OF TRANSPORTATION

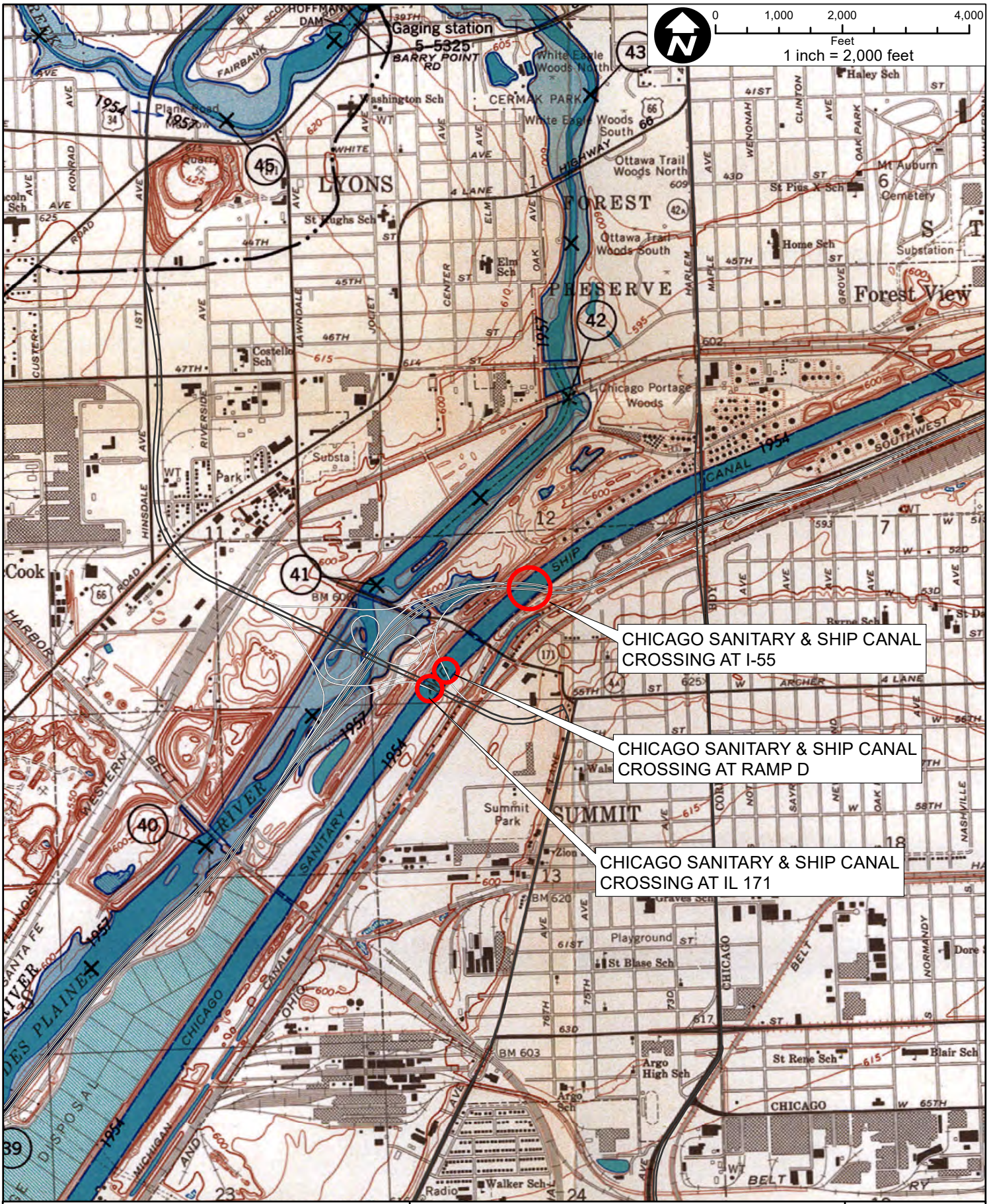
TITLE: GENERAL LOCATION DRAINAGE MAP
CHICAGO SANITARY & SHIP CANAL
BERWYN QUADRANGLE
BASE MAP (USGS) 1980

PROJ. NO. 110203.00001
DATE: 8/4/2017
SHEET 1 OF 1
DRAWING NO.
EXH 4.1

CHRISTOPHER B. BURKE ENGINEERING, LTD.
9575 W. Higgins Road, Suite 600 · Rosemont, Illinois 60018 · (847) 823-0500

DSGN.			SCALE:	1:0
DWN.			AUTHOR:	MHAYES
CHKD.			PLOT DATE:	8/4/2017
FILE:	CS&SC GLDM			

Path: N:\dot\110203.00001\GIS\Exhibits\Chicago Sanitary and Ship Canal\CS&SC GLDM.mxd



CLIENT:
ILLINOIS DEPARTMENT OF TRANSPORTATION

TITLE:
USGS HYDROLOGIC INVESTIGATIONS ATLAS
FLOODS IN BERWYN QUADRANGLE
HA-252 1964
CHICAGO SANITARY & SHIP CANAL

PROJ. NO.	110203.00001
DATE:	8/4/2017
SHEET	1 OF 1
DRAWING NO.	EXH 4.2

CHRISTOPHER B. BURKE ENGINEERING, LTD.
9575 W. Higgins Road, Suite 600 · Rosemont, Illinois 60018 · (847) 823-0500

DSGN.			SCALE:	1:12,000
DWN.			AUTHOR:	MHAYES
CHKD.			PLOT DATE:	8/4/2017
FILE:	CS&SC HADM			

Path: N:\dot\110203.00001\GIS\Exhibits\Chicago Sanitary and Ship Canal\CS&SC HADM.mxd

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0487J

FIRM

FLOOD INSURANCE RATE MAP

COOK COUNTY, ILLINOIS

AND INCORPORATED AREAS

PANEL 487 OF 832

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BEDFORD PARK, VILLAGE OF	171007	0487	J
BROOKFIELD, VILLAGE OF	170066	0487	J
COOK COUNTY	170054	0487	J
HODGKINS, VILLAGE OF	170106	0487	J
LYONS, VILLAGE OF	170120	0487	J
MCCOOK, VILLAGE OF	170121	0487	J
SUMMIT, VILLAGE OF	170167	0487	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17031C0487J

MAP REVISED
AUGUST 19, 2008

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0491J

FIRM

FLOOD INSURANCE RATE MAP

COOK COUNTY, ILLINOIS

AND INCORPORATED AREAS

PANEL 491 OF 832

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CHICAGO, CITY OF	170074	0491	J
COOK COUNTY	170054	0491	J
FOREST VIEW, VILLAGE OF	170093	0491	J
LYONS, VILLAGE OF	170120	0491	J
MCCOOK, VILLAGE OF	170121	0491	J
STICKNEY, VILLAGE OF	170164	0491	J
SUMMIT, VILLAGE OF	170167	0491	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
17031C0491J

MAP REVISED
AUGUST 19, 2008

Federal Emergency Management Agency

0 250 500 1,000 Feet

1 inch = 500 feet

ZONE X

Cook County Unincorporated Areas 170054

ZONE A

ZONE X

ZONE A

ZONE A

ZONE X

Village of Summit 170167

Village of Summit 170167

LAWNDALE AVE

DES PLAINES RIVER

Levee

MC COOK

SUMMIT

12

VILLAGE OF LYONS

VILLAGE OF SUMMIT

55

ADLAI STEVENSON EXPY

PARK AVE

53RD ST

RAILROAD

HUNT AVE

73RD CT

CENTER AVE

DOUGLAS AVE

171

ME1723

ME1724

CHICAGO SANITARY & SHIP CANAL CROSSING AT I-55

CHICAGO SANITARY & SHIP CANAL CROSSING AT RAMP D

CHICAGO SANITARY & SHIP CANAL CROSSING AT IL 171

55TH ST

55TH PL

56TH ST

56TH PL

74TH AVE

73RD AVE

72ND CT

CHICAGO SANITARY AND SHIP CANAL

CHRISTOPHER B. BURKE ENGINEERING LTD.
9575 West Higgins Road, Suite 600
Rosemont, Illinois 60018
(847) 823-0500

CLIENT:

ILLINOIS DEPARTMENT OF TRANSPORTATION

NO.	DATE	NATURE OF REVISION	CHKD.

DSGN.	
DWN:	MHAYES
CHKD.	
SCALE:	1:6,000
MODEL:	ArcGIS 10
PLOT DATE	8/4/2017

FILE NAME: CS&SC FIRM

PATH: N:\Idot\110203.00001\GIS\Exhibits\Chicago Sanitary and Ship Canal\CS&SC FIRM.mxd

TITLE:

FLOOD INSURANCE RATE MAP
CHICAGO SANITARY & SHIP CANAL
COOK COUNTY AND INCORPORATED AREAS
PANELS 0487 & 0491, BASE MAP (FEMA), 2008

PROJ. NO. 00-0000

DATE: 8/4/2017

SHEET 0 OF 0

DRAWING NO.

EXH 4.3

Tab 5

SECTION 5

PHOTOGRAPHS

Chicago Sanitary and Ship Canal, CBBEL, 7/11/2017.

Overview CSSC upstream of I-55

US-0. Looking East at upstream face of I-55 from Northwest bank

US-0 Looking Northeast from Northwest Bank

US 1000 – Looking Southeast from Northwest bank

Overview of CSSC downstream of I-55

DS-0 Looking West at downstream face of I-55 from Southeast bank

DS-500 Looking Southeast from Northwest bank.

Tab 6

SECTION 6

HYDROLOGY

CSSC USACOE Flow Rates and Starting Water Surface Elevations, from Ciorba 2011 IL 171 Hydraulic Report

Dayne M. Morris

From: Masouridis, Eleftherios P [Eleftherios.Masouridis@illinois.gov]
Sent: Tuesday, December 02, 2008 8:44 AM
To: Mark R. Johnson
Subject: FW: I-55 over the Chicago Sanitary and Ship Canal (UNCLASSIFIED)

We were able to obtain flow data for the I&M canal from the USACOE. It is the best information that we were able to obtain.

Please use this information for the Hydraulic Report.

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Masouridis, Eleftherios P
Sent: Tuesday, December 02, 2008 8:37 AM
To: 'Su, Tzuoh-Ying LRC'
Cc: Ackerson, Rick D LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Thanks.

Much appreciated.

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Su, Tzuoh-Ying LRC [mailto:Tzuoh-Ying.Su@usace.army.mil]
Sent: Monday, December 01, 2008 1:03 PM
To: Masouridis, Eleftherios P
Cc: Ackerson, Rick D LRC
Subject: FW: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Perry,

Forwarded are the discharge information you requested. If you have questions, let us know.

Thanks,

TY

-----Original Message-----
From: Ackerson, Rick D LRC
Sent: Monday, December 01, 2008 12:58 PM
To: Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal (UNCLASSIFIED)

TY,

Here are the values rounded to the nearest 100 cfs

10 yr - 8,500 cfs

50 yr - 11,300 cfs

100 yr - 12,800 cfs

500 yr - 16,100 cfs

CSSC Flow Rates

Rick

-----Original Message-----
From: Masouridis, Eleftherios P
[mailto:Eleftherios.Masouridis@illinois.gov]
Sent: Wednesday, November 19, 2008 1:29 PM
To: Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal (UNCLASSIFIED)

Our goal is to perform a hydraulic analysis of the existing bridges to look at created head and scour but we have no flow rates for a steady state analysis. Also depending on the final scope we will have to quantify impacts in order to obtain a permit from IDNR/OWR.

We have time to wait. Would this information be available by the end of the year or mid January?

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Su, Tzuoh-Ying LRC [mailto:Tzuoh-Ying.Su@usace.army.mil]
Sent: Wednesday, November 19, 2008 12:56 PM
To: Masouridis, Eleftherios P
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Perry,

Flow rates were not important for the project we ran the model.
Therefore,
the numbers are not readily available. We have to dive into the old modeling files to extract the information. It will take time... Let me know if you really need it.

Thanks,
TY

-----Original Message-----
From: Masouridis, Eleftherios P
[mailto:Eleftherios.Masouridis@illinois.gov]
Sent: Wednesday, November 19, 2008 12:51 PM
To: Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Thanks, are there flow rates associated with these stages?

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Su, Tzuoh-Ying LRC [mailto:Tzuoh-Ying.Su@usace.army.mil]
Sent: Wednesday, November 19, 2008 8:06 AM
To: Masouridis, Eleftherios P
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Perry,

The following are the information (stages on the CSSC at RM 313) you requested.

500-year: 591.4 ft NGVD
100-year: 588.0 ft NGVD
50-year: 587.0 ft NGVD
10-year: 583.9 ft NGVD

These stages were based on the late '90 UNET modeling. If you have questions, please let me know.

CSSC Starting Water Surface Elevations

Thanks,
TY

-----Original Message-----
From: Masouridis, Eleftherios P
[mailto:Eleftherios.Masouridis@illinois.gov]
Sent: Tuesday, November 18, 2008 12:43 PM
To: Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

We are interested in flood flow estimates for the 10, 50 100 and 500 -yr frequencies if available. Any stage information would also helpful so we could develop starting water surface elevations for a hydraulic analysis of the exiting bridges.

In 1996 your office shared some results (50 and 100-yr) with our office from an ongoing UNET study of the canal. At the time the study was still not complete. Our hope is that this study has been completed by now or that there is more complete information available. Our study ,limits are about 1000'
upstream of I-55 and 1000' downstream of IL 171 on the attached map.

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Su, Tzuoh-Ying LRC [mailto:Tzuoh-Ying.Su@usace.army.mil]
Sent: Tuesday, November 18, 2008 12:32 PM
To: Masouridis, Eleftherios P
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Perry,

Please refresh my memory. Do you need the 100-year stage at the location?

Thanks,
TY

-----Original Message-----
From: Masouridis, Eleftherios P
[mailto:Eleftherios.Masouridis@illinois.gov]
Sent: Tuesday, November 18, 2008 12:30 PM
To: Masouridis, Eleftherios P; Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Sorry I meant Mile 313 where IL 171 crosses the S&S canal.

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Masouridis, Eleftherios P
Sent: Tuesday, November 18, 2008 12:28 PM
To: 'Su, Tzuoh-Ying LRC'
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Here is the area we are interested in near Mile 113.

Thanks

Perry

E. Perry Masouridis, P.E.
Hydrology and Hydraulics Engineer
Illinois Department of Transportation, Region 1 Bureau of Programming, Hydraulics Section
201 West Center Court
Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052
Email: eleftherios.masouridis@illinois.gov

-----Original Message-----
From: Su, Tzuoh-Ying LRC [mailto:Tzuoh-Ying.Su@usace.army.mil]
Sent: Tuesday, November 18, 2008 11:51 AM
To: Masouridis, Eleftherios P
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal
(UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi Perry,

Sorry for the delay. Please send me a location map and I will look into this.

Thanks,
TY

-----Original Message-----
From: Masouridis, Eleftherios P
[mailto:Eleftherios.Masouridis@illinois.gov]
Sent: Tuesday, November 18, 2008 11:44 AM
To: Su, Tzuoh-Ying LRC
Subject: RE: I-55 over the Chicago Sanitary and Ship Canal

Hello Dr. Su,

Have you had a chance to look into this? Would you like a location map or any additional information?

Perry

E. Perry Masouridis, P.E.

Hydrology and Hydraulics Engineer

Illinois Department of Transportation, Region 1

Bureau of Programming, Hydraulics Section

201 West Center Court

Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052

Email: eleftherios.masouridis@illinois.gov

From: Masouridis, Eleftherios P
Sent: Monday, October 27, 2008 3:52 PM
To: 'Tzuoh-Ying.Su@lrc02.usace.army.mil'
Subject: I-55 over the Chicago Sanitary and Ship Canal

Hello Dr. Su,

Some time ago you helped us obtain some information for another project and we are now looking at another site.

We are looking at the above referenced structure located near the Villages of Summit and McCook.

When we last looked at these structures we were able to obtain some flood frequency information from your office based on a 1996 USACOE UNET analysis.
We have contacted both the USGS and MWRD and can not find any additional current information.

Are the flow rates used in the UNET model from 1996 the most currently available or has this analysis been updated. If so could we obtain a summary of the results in this area? We stage discharge data as well as any flood flow frequency data would be useful to us.

Thank you for your assistance.

Perry

E. Perry Masouridis, P.E.

Hydrology and Hydraulics Engineer

Illinois Department of Transportation, Region 1

Bureau of Programming, Hydraulics Section

201 West Center Court

Schaumburg, IL. 60196-1096

Phone: (847) 705-4474 Fax: (847) 221-3052

Email: eleftherios.masouridis@illinois.gov

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

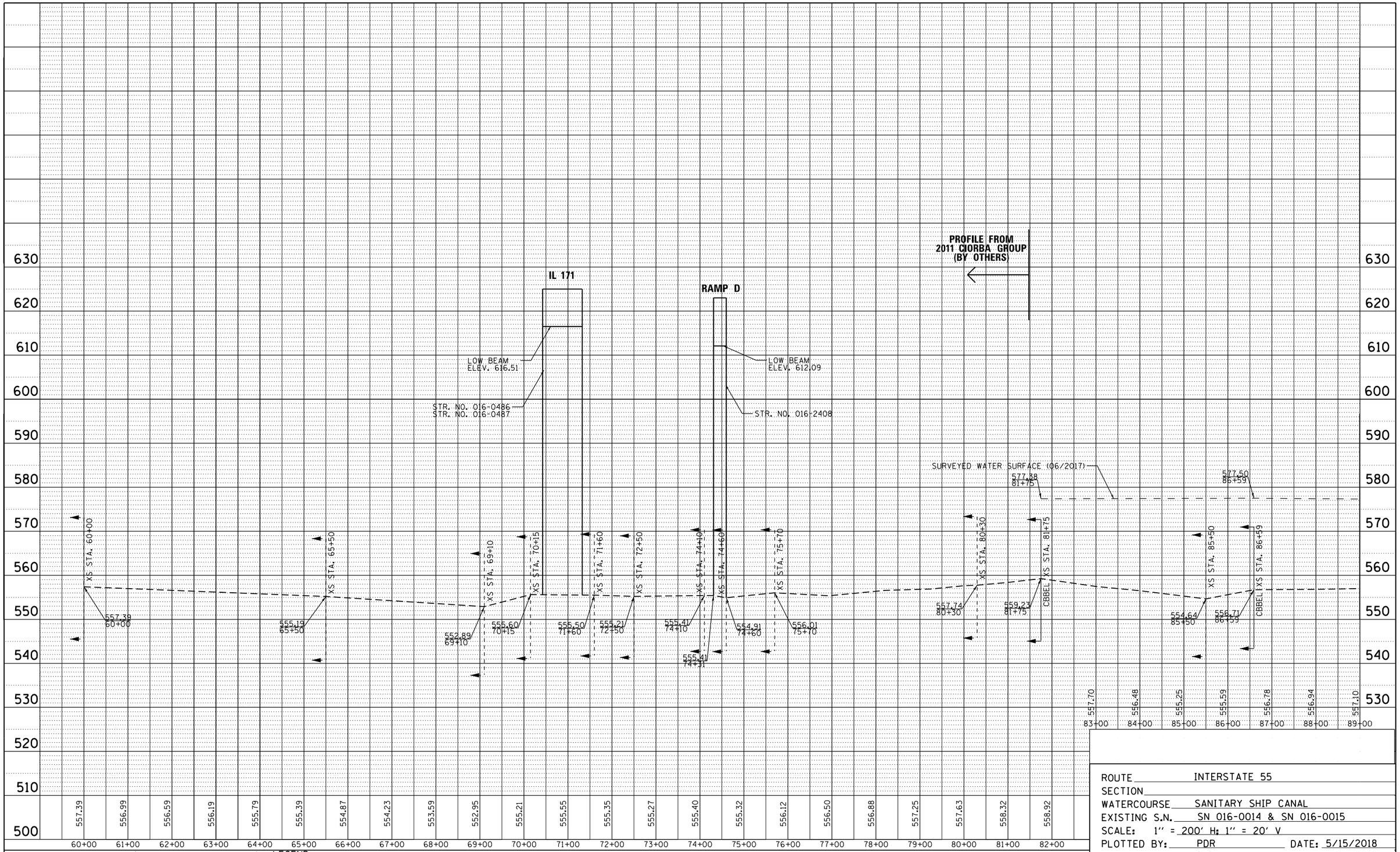
Tab 7

SECTION 7

STREAMBED PROFILE

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
BM. NOTED
STRUCTURE NOTATNS CHKD
NOTE BOOK
NO.
BY
DATE



LEGEND
CBBEL SURVEYED CROSS SECTIONS 06/2017
SURVEYED CROSS SECTIONS FROM 2011 CIORBA H.R. (BY OTHERS)

CBBEL XS STA. XX+XX
XS STA. XX+XX

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 200' H; 1'' = 20' V
PLOTTED BY: PDR DATE: 5/15/2018
CHECKED BY: IAD DATE: 5/15/2018
SURVEY DATE: 06-27-17

FILE NAME = N:\Idot\110203.00001\Drain\P1110203-sht-drng-f03-CSSC.dgn	USER NAME = wbloftus	DESIGNED -	REVISED -
		DRAWN -	REVISED -
	PLOT SCALE = 200.0000 ' / in.	CHECKED -	REVISED -
Default	PLOT DATE = 5/15/2018	DATE - 5/15/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-55 MANAGED LANE STUDY
SANITARY AND SHIP CANAL PROFILE

SCALE: | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
			$TOT	

CONTRACT NO.
ILLINOIS FED. AID PROJECT

PLAN

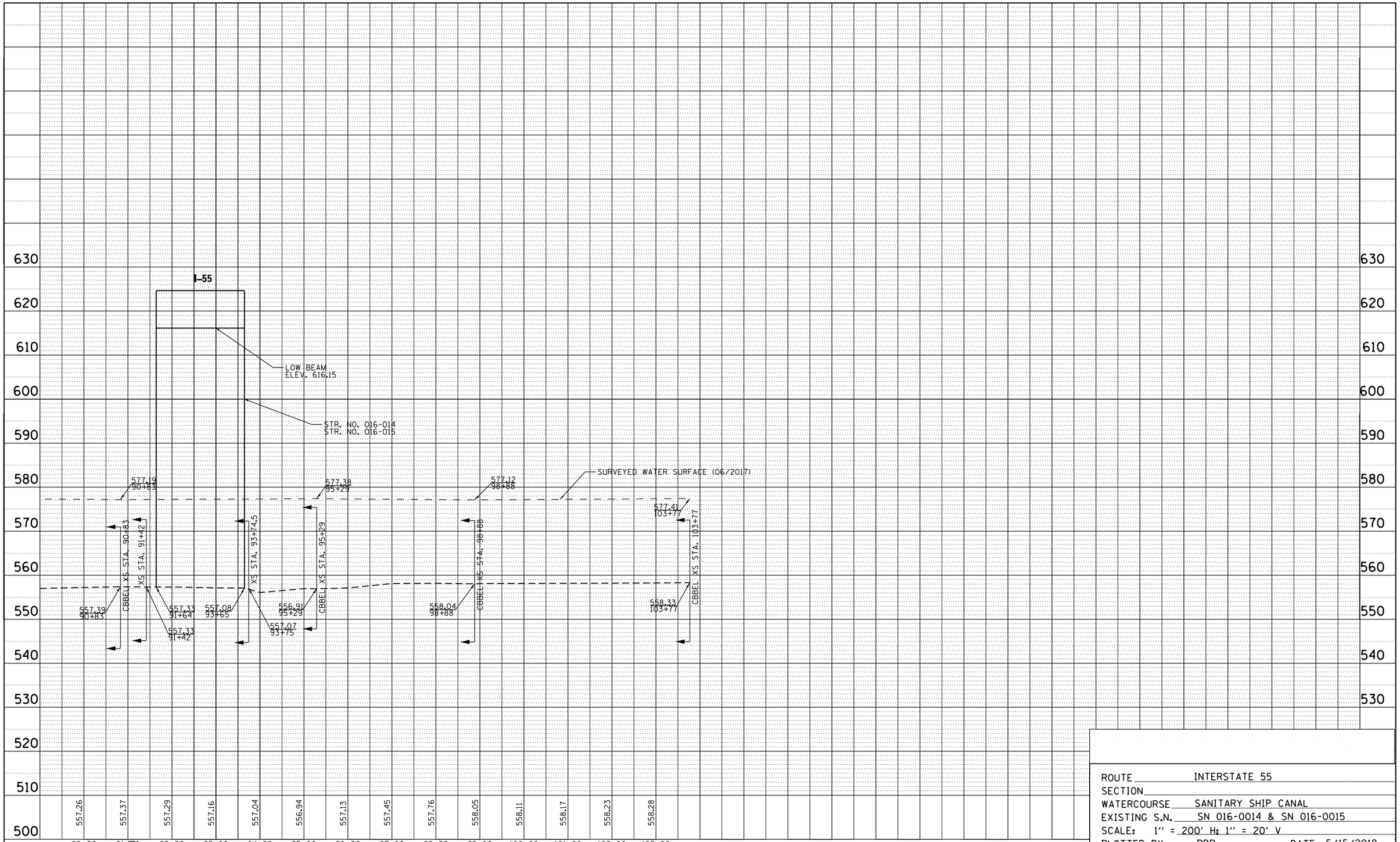
SURVEYED	
PLOTTED	
ALIGNMENT CHECKED	
RT. OF WAY CHECKED	
CADD FILE NAME	
NOTE BOOK	
NO.	

BY	DATE

PROFILE

SURVEYED	
PLOTTED	
GRADES CHECKED	
BM. NOTED	
STRUCTURE NOTATNS CHKD	
NOTE BOOK	
NO.	

BY	DATE



CBBEL XS STA. XX+XX

XS STA. XX+XX

LEGEND
CBBEL SURVEYED CROSS SECTIONS 06/20 7

SURVEYED CROSS SECTIONS FROM 2011 CIORBA H.R. (BY OTHERS)

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 200' H: 1'' = 20' V
PLOTTED BY: PDR DATE: 5/15/2018
CHECKED BY: IAD DATE: 5/15/2018
SURVEY DATE: 06-27-17

FILE NAME = N:\Idot\110203.00001\Drain\P1110203-sht-drngr03-CSSC.dgn	USER NAME = wbloftus	DESIGNED -	REVISED -
		DRAWN -	REVISED -
	PLOT SCALE = 200.0000 ' / in.	CHECKED -	REVISED -
Default	PLOT DATE = 5/15/2018	DATE - 5/15/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I–55 MANAGED LANE STUDY
SANITARY AND SHIP CANAL PROFILE

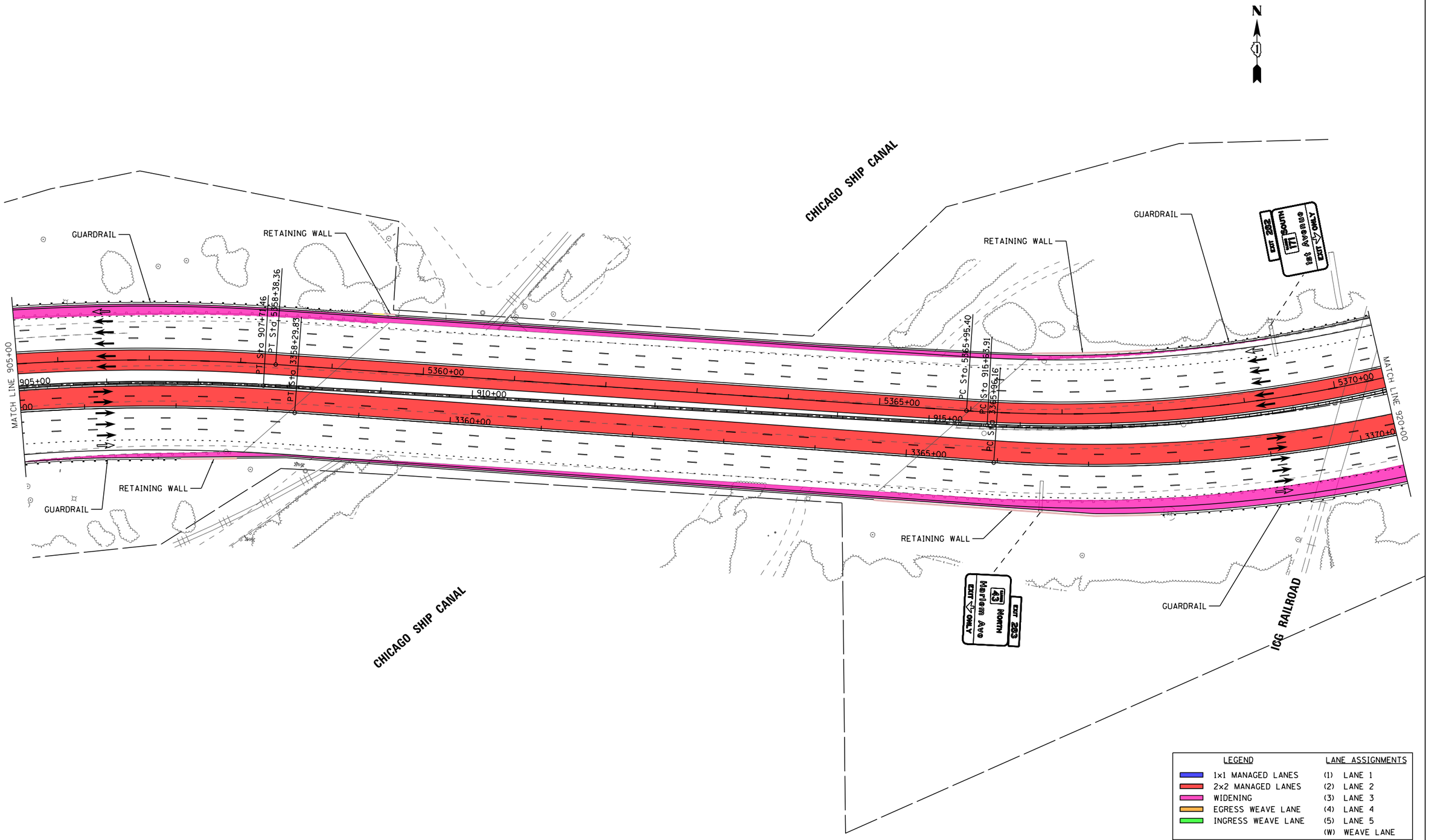
SCALE: | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
			$TOT	
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

TAB 8

SECTION 8

ROADWAY PLAN AND PROFILE



Default
FILE NAME = V:\1786\active\178600037_IDOT_I-55_2Lanes\civil\drawing\sht\plan set\current\control\DIP\P2917_sht_0054.dgn

I-55 MANAGED LANE PROJECT

USER NAME = cteodoro	DESIGNED -	REVISED -
	DRAWN -	REVISED -
PLOT SCALE = 100.0000 ' / in.	CHECKED -	REVISED -
PLOT DATE = 10/26/2017	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-55 MANAGED LANE STUDY
PROPOSED ROADWAY PLANS

SCALE: | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
			97	59
		CONTRACT NO. P92917		
	ILLINOIS FED. AID PROJECT			

PAVEMENT OVERTOPPING (STA. 909+00) @ 628.2
SEE EXHIBIT IN TAB 10 FOR LOCATION

PAVEMENT OVERTOPPING (STA. 914+46) @ 628.3
SEE EXHIBIT IN TAB 10 FOR LOCATION

PROFILE OF I-55 ℄

SURVEYED WATER
EL. (06/2017) = 577.38'

630
625
620
615
610
605
600
595
590
585
580
575
570
565
560
555
550
545

625.55	626.25	626.71	627.24	627.66	628.22	628.47	628.55	628.72	628.29	628.00	627.85	627.83	627.89	627.95	628.02	628.06	628.00	628.20	628.35	628.97	629.18	629.38	629.19	628.87	628.49	628.32	628.17	627.49	627.38	626.71
904+00		905+00		906+00		907+00		908+00		909+00		910+00		911+00		912+00		913+00		914+00		915+00		916+00		917+00		918+00		919+00	

NOTES:

1. BRIDGE IS DOUBLY SUPERELEVATED. APPROXIMATE BRIDGE AT CENTER LINE IS SHOWN.
2. ROADWAY PROFILE FROM STANTEC CENTERLINE.
3. BRIDGE OVERTOPPING POINTS FROM HIGHEST POINTS AT BRIDGE EDGES. SEE EXHIBIT IN TAB 10 FOR PLAN VIEW.
4. BRIDGE PROFILE INCLUDES MEDIAN BARRIER.

PLAN
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
NOTE BOOK
NO.
BY
DATE

PROFILE
SURVEYED
PLOTTED
GRADES CHECKED
BM. NOTED
STRUCTURE NOTATNS CHKD
NOTE BOOK
NO.
BY
DATE

FILE NAME = N:\Idot\110203.00001\Dran\P110203-sht-prf_CSSC.dgn
Default

I-55 MANAGED LANE PROJECT

USER NAME = wbloftus	DESIGNED - EDM	REVISED -	
	DRAWN - MYG	REVISED -	
PLOT SCALE = 100.0000 ' / in.	CHECKED - IAD	REVISED -	
PLOT DATE = 5/16/2018	DATE - 5/16/2018	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-55 MANAGED LANE STUDY
I-55 BRIDGE OVER CSSC PROFILE

SCALE: | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
			$TOT	
		CONTRACT NO.		
		ILLINOIS FED. AID PROJECT		

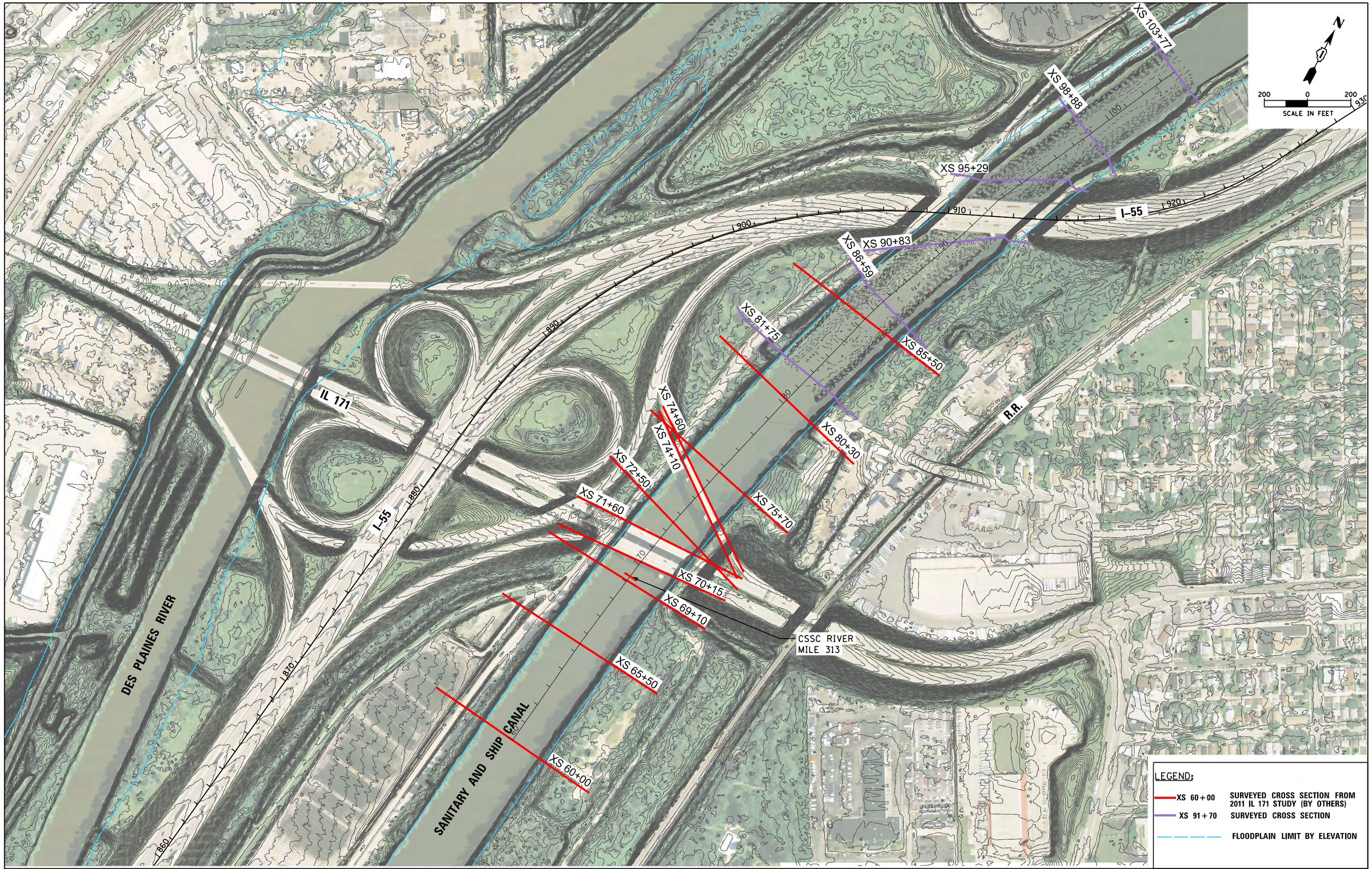
TAB 9

SECTION 9

CROSS SECTION LOCATION MAP AND

STREAM CROSS SECTION PLOTS

FACING DOWNSTREAM



FILE NAME = N:\Idot\110203.00001\Drain\P1110203-sht-drpln01.dgn	USER NAME = mgoldenberg	DESIGNED - IAD	REVISED -
		DRAWN - PDR	REVISED -
	PLOT SCALE =	CHECKED - IAD	REVISED -
Default	PLOT DATE = 11/14/2017	DATE - 11/14/2017	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

I-55 OVER CHICAGO SANITARY AND SHIP CANAL
CROSS SECTION LOCATION MAP

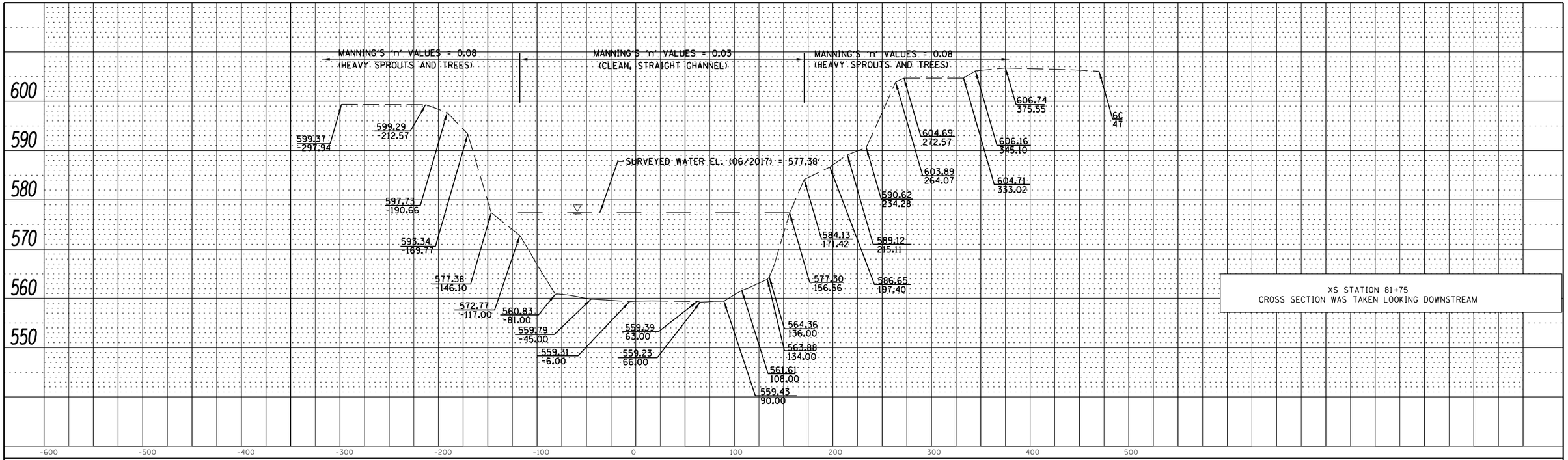
SCALE: 1" =100' | SHEET OF SHEETS | STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
			$TOT	
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

PLAN

SURVEYED	
PLOTTED	
DESIGN CHECKED	
RT. OF WAY CHECKED	
CADD FILE NAME	
NOTE BOOK	
NO.	

BY	DATE

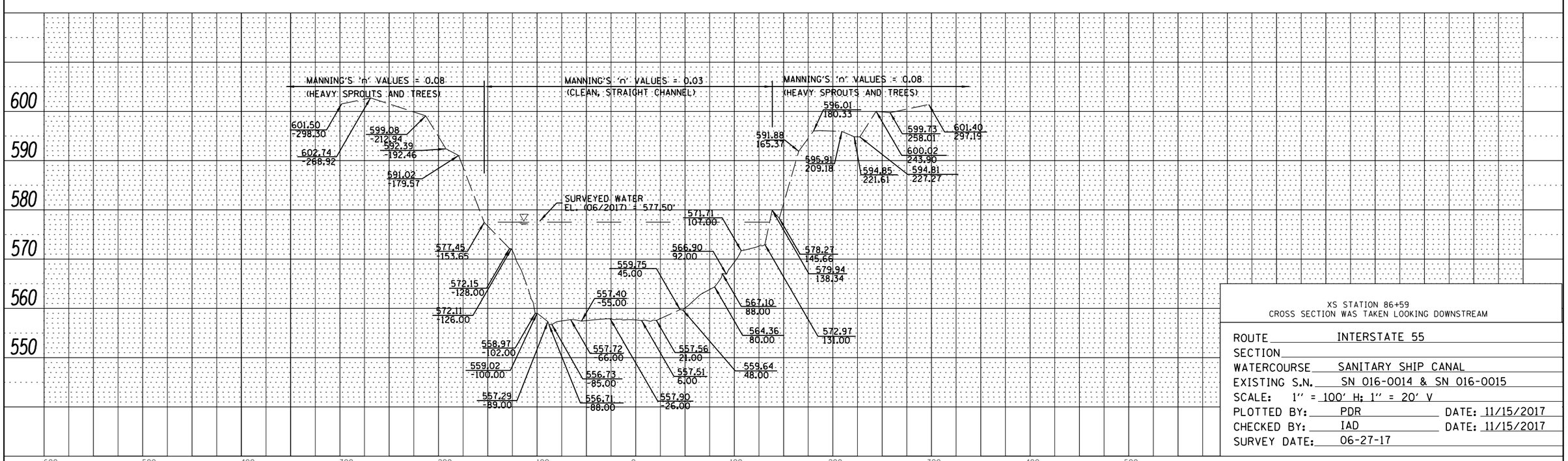


XS STATION 81+75
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

PROFILE

SURVEYED	
PLOTTED	
DESIGN CHECKED	
B.M. NOTED	
STRUCTURE NOTATNS CHKD	
NOTE BOOK	
NO.	

BY	DATE



XS STATION 86+59
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 100' H; 1'' = 20' V
PLOTTED BY: PDR DATE: 11/15/2017
CHECKED BY: IAD DATE: 11/15/2017
SURVEY DATE: 06-27-17

FILE NAME =	USER NAME = mgoldenberg	DESIGNED - EMB	REVISED -
N:\Idot\110203.0000\Drain\P1110203-sht-xssht-CSSC.dgn		DRAWN - MYG	REVISED -
	PLOT SCALE = 100'	CHECKED - IAD	REVISED -
Default	PLOT DATE = 11/15/2017	DATE - 11/15/2017	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS-SECTIONS
SANITARY SHIP CANAL

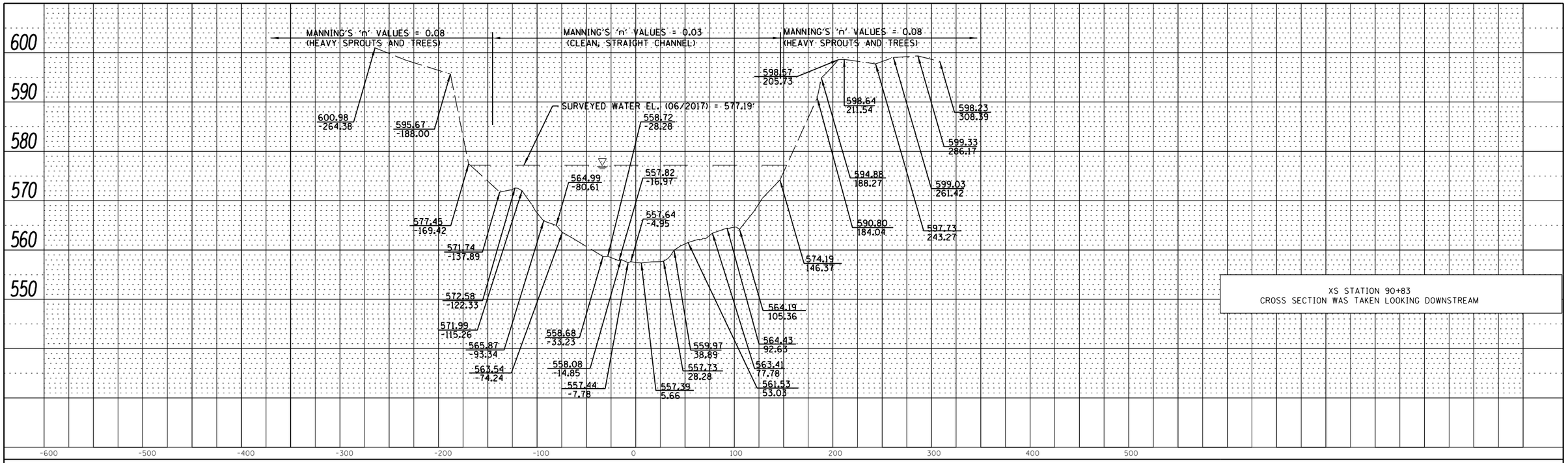
SCALE: 100'H 20'V | SHEET OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

PLAN

BY	DATE

SURVEYED
PLOTTED
DRAWN
CHECKED
NOTE BOOK
NO.
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME

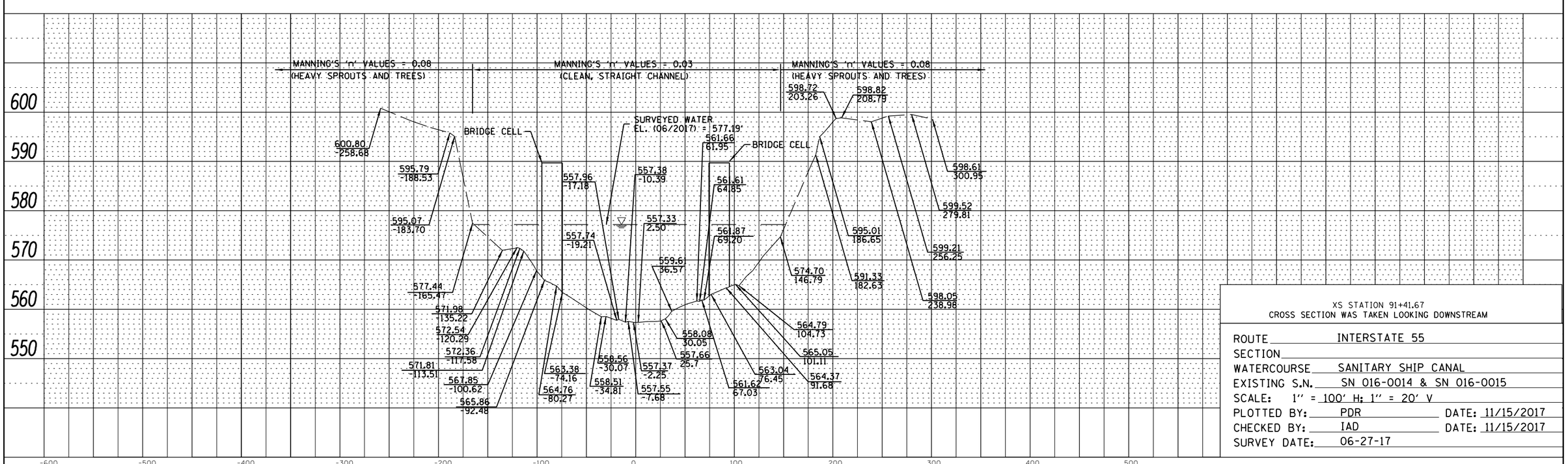


XS STATION 90+83
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

PROFILE

BY	DATE

SURVEYED
PLOTTED
DRAWN
CHECKED
NOTE BOOK
NO.
B.M. NOTED
STRUCTURE NOTATNS CHKD



XS STATION 91+41.67
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 100' H; 1'' = 20' V
PLOTTED BY: PDR DATE: 11/15/2017
CHECKED BY: IAD DATE: 11/15/2017
SURVEY DATE: 06-27-17

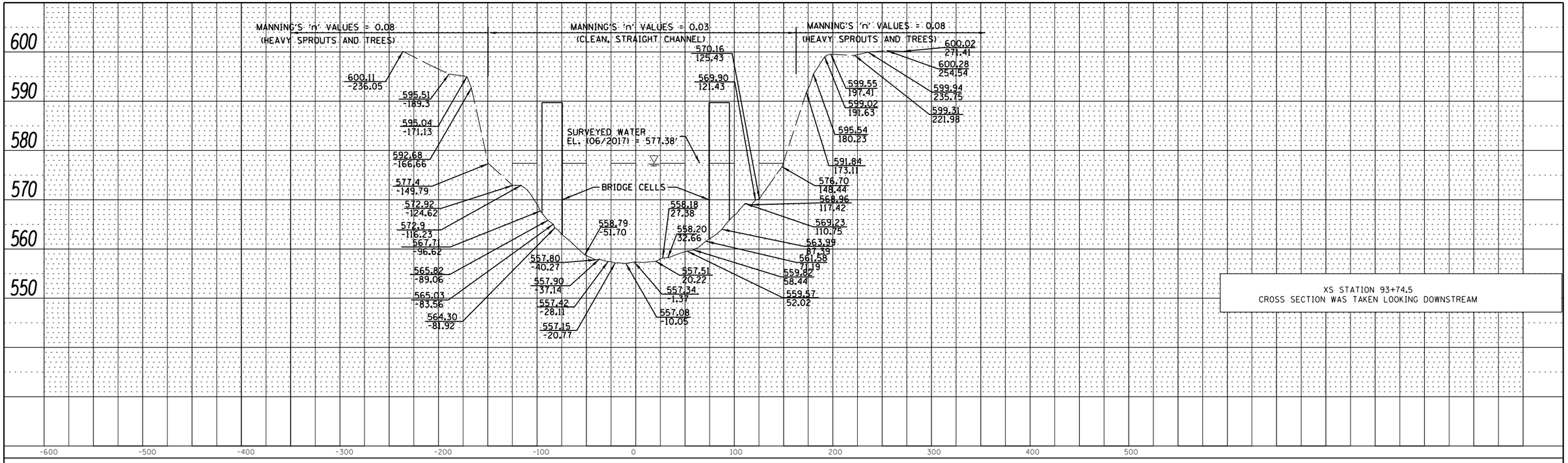
FILE NAME = N:\Idot\110203.0000\Drain\P1110203-sht-xssht-CSSC.dgn	USER NAME = mgoldenberg	DESIGNED - EMB	REVISED -
		DRAWN - MYG	REVISED -
	PLOT SCALE = 100'	CHECKED - IAD	REVISED -
Default	PLOT DATE = 11/15/2017	DATE - 11/15/2017	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS-SECTIONS
SANITARY SHIP CANAL

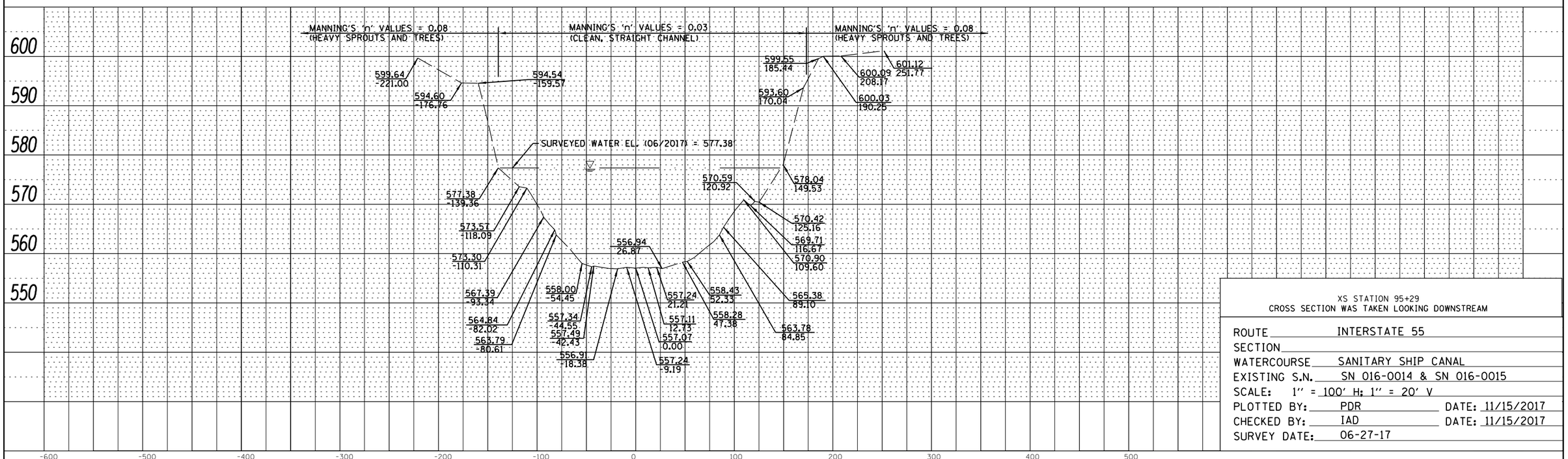
SCALE: 100'H 20'V | SHEET OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			



XS STATION 93+74.5
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

PLAN
DATE
BY
SURVEYED
PLOTTED
ALIGNMENT CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
NOTE BOOK
NO.



PROFILE
DATE
BY
SURVEYED
PLOTTED
CROSS SECTIONS CHECKED
B.M. NOTED
STRUCTURE NOTATNS CHKD
NOTE BOOK
NO.

XS STATION 95+29
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 100' H; 1'' = 20' V
PLOTTED BY: PDR DATE: 11/15/2017
CHECKED BY: IAD DATE: 11/15/2017
SURVEY DATE: 06-27-17

FILE NAME = N:\Idot\110203.0000\Drain\P1110203-sht-xssht-CSSC.dgn	USER NAME = mgoldenberg	DESIGNED - EMB	REVISED -
		DRAWN - MYG	REVISED -
	PLOT SCALE = 100'	CHECKED - IAD	REVISED -
Default	PLOT DATE = 11/15/2017	DATE - 11/15/2017	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS-SECTIONS
SANITARY SHIP CANAL

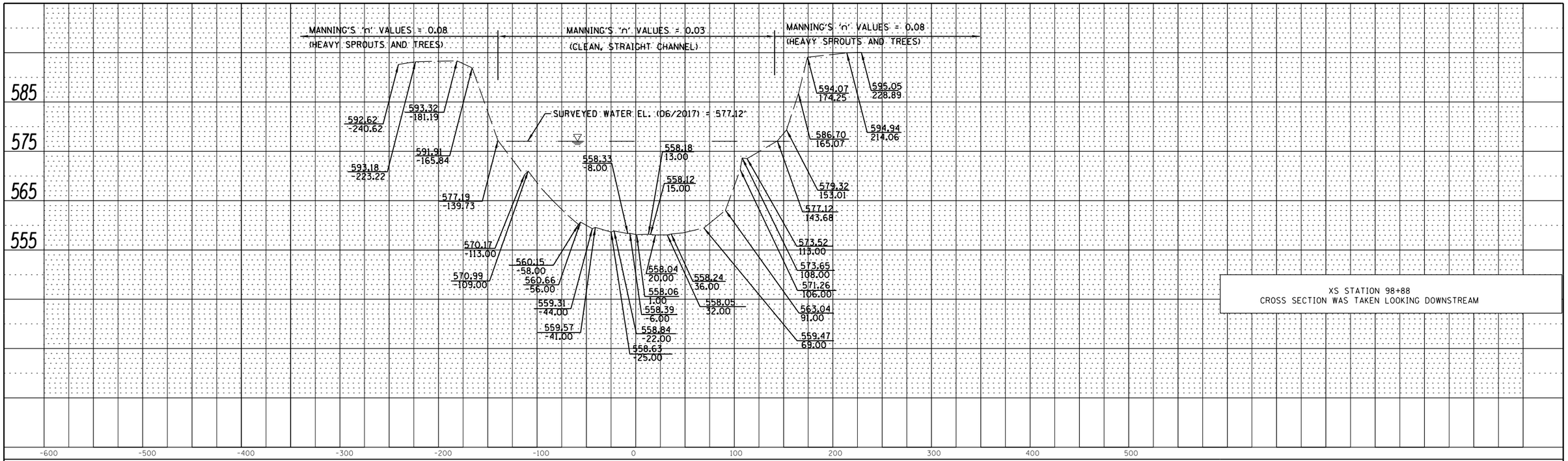
SCALE: 100'H 20'V | SHEET OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

PLAN

SURVEYED	
PLOTTED	
DRAWN	
CHECKED	
NOTE BOOK	
NO.	

BY	DATE
ALIGNMENT CHECKED	
RT. OF WAY CHECKED	
CADD FILE NAME	

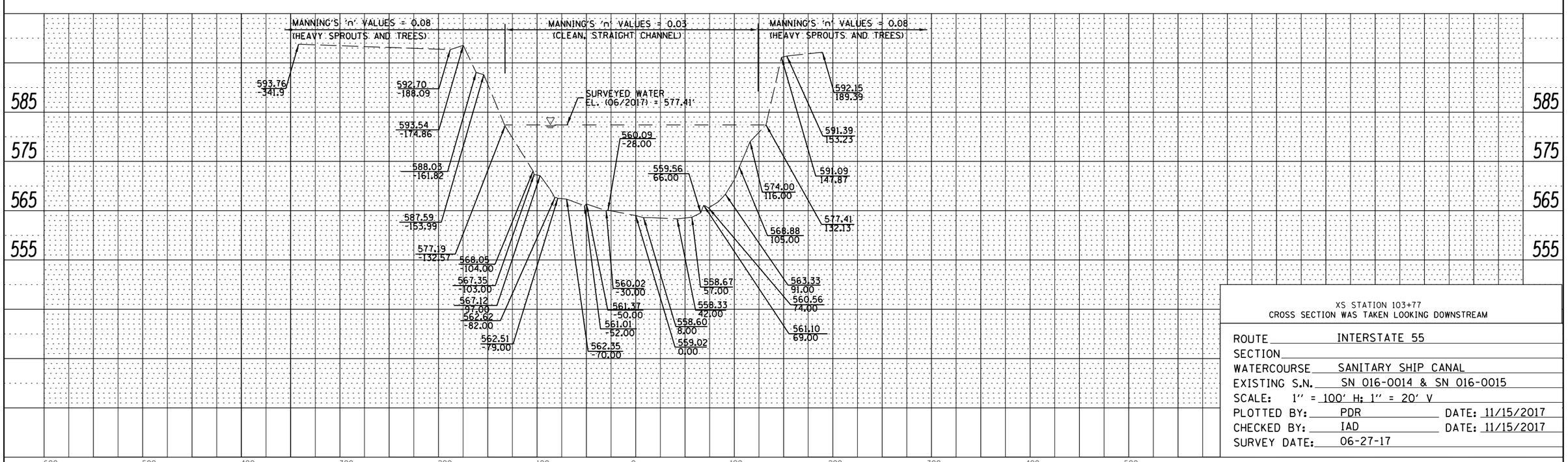


XS STATION 98+88
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

PROFILE

SURVEYED	
PLOTTED	
DRAWN	
CHECKED	
NOTE BOOK	
NO.	

BY	DATE
CROSS SECTIONS CHKD	
B.M. NOTED	
STRUCTURE NOTATNS CHKD	



XS STATION 103+77
CROSS SECTION WAS TAKEN LOOKING DOWNSTREAM

ROUTE INTERSTATE 55
SECTION
WATERCOURSE SANITARY SHIP CANAL
EXISTING S.N. SN 016-0014 & SN 016-0015
SCALE: 1'' = 100' H; 1'' = 20' V
PLOTTED BY: PDR DATE: 11/15/2017
CHECKED BY: IAD DATE: 11/15/2017
SURVEY DATE: 06-27-17

FILE NAME = N:\Idot\110203.0000\Drain\P1110203-sht-xssht-CSSC.dgn	USER NAME = mgoldenberg	DESIGNED - EMB	REVISED -
	PLOT SCALE = 100'	DRAWN - MYG	REVISED -
Default	PLOT DATE = 11/15/2017	CHECKED - IAD	REVISED -
		DATE - 11/15/2017	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS-SECTIONS
SANITARY SHIP CANAL

SCALE: 100'H 20'V | SHEET OF SHEETS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

XS EXCERPTS FROM 2011 CIORBA HYDRAULIC REPORT FOR IL 171 OVER CHICAGO SANITARY AND SHIP CANAL

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

DATE

BY

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 623.12
300.00 LT

ELEV. 620.15
289.78 LT

ELEV. 594.70
199.95 LT

ELEV. 596.21
235.69 LT

ELEV. 595.42
231.82 LT

ELEV. 589.35
181.59 LT

ELEV. 576.40
159.38 LT

ELEV. 572.60
122.67 LT

DOLPHINS

ELEV. 562.40
85.00 LT

ELEV. 555.80
42.50 LT

ELEV. 555.60
0.00 LT

ELEV. 556.80
42.50 RT

ELEV. 560.90
85.00 RT

WATER ELEV. DURING SURVEY

ELEV. 568.20
117.84 RT

ELEV. 574.90
134.26 RT

ELEV. 576.40
158.41 RT

ELEV. 590.81
195.12 RT

ELEV. 592.10
222.16 RT

ELEV. 593.48
226.99 RT

ELEV. 593.21
241.48 RT

ELEV. 609.49
300.00 RT

ELEV. 609.46
299.44 RT

620
610
600
590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

70 + 98.00
SN 016–2408 & 016–0487
BRIDGE D/S OPENING

0 40′ 80′

HORIZONTAL
SCALE: 1″ = 40′

VERTICAL
SCALE: 1″ = 20′

FOR REFERENCE ONLY

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-xsregs.sht

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1–04
HEC–RAS CROSS SECTIONS

SCALE:1″=40′ | SHEET NO. 5 OF 15 SHEETS | STA. 70+15.00 TO STA. 70+15.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	5
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED	BY	DATE
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 626.30
269.49 LT

ELEV. 594.11
161.31 LT

ELEV. 594.96
197.05 LT

ELEV. 589.88
141.02 LT

ELEV. 576.40
128.47 LT

ELEV. 573.10
113.01 LT

ELEV. 562.70
88.86 LT

DOLPHINS

ELEV. 555.50
44.43 LT

WATER ELEV. DURING SURVEY

ELEV. 555.50
0.00 RT

ELEV. 556.50
104.32 RT

ELEV. 557.80
148.75 RT

ELEV. 561.90
159.38 RT

ELEV. 565.40
183.53 RT

ELEV. 574.90
200.91 RT

ELEV. 576.40
207.67 RT

ELEV. 592.58
265.63 RT

ELEV. 593.30
261.77 RT

ELEV. 580.35
221.20 RT

ELEV. 592.11
247.28 RT

ELEV. 593.50
252.11 RT

ELEV. 594.02
300.00 RT

620 610 600 590 580 570 560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

70+98.00
SN 016-2408 & 016-0487
BRIDGE U/S OPENING

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'

VERTICAL
SCALE: 1" = 20'

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED	BY	DATE
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Storm Canal\3347-stream1.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 6 OF 15 SHEETS | STA. 71+50.00 | TO STA. 71+50.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	6
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

DATE	BY

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

DATE	BY

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 620.95
276.42 LT

ELEV. 594.92
225.67 LT

ELEV. 594.44
201.20 LT

ELEV. 592.99
174.01 LT

ELEV. 576.41
130.51 LT

ELEV. 562.91
108.76 LT

ELEV. 562.71
99.69 LT

ELEV. 556.21
48.94 LT

ELEV. 555.41
0.00 LT

DOLPHINS

WATER ELEV. DURING SURVEY

ELEV. 555.41
40.78 RT

ELEV. 561.11
81.57 RT

ELEV. 563.11
109.66 RT

ELEV. 572.71
123.26 RT

ELEV. 576.41
133.23 RT

ELEV. 591.06
183.07 RT

ELEV. 593.59
244.70 RT

ELEV. 594.53
251.95 RT

ELEV. 593.17
202.11 RT

ELEV. 593.58
224.76 RT

ELEV. 594.85
229.30 RT

ELEV. 594.78
239.03 RT

ELEV. 611.41
300.00 RT

620 610 600 590 580 570 560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

74+59.00
SN 016-2408
BRIDGE D/S OPENING

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-xsgraph.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 10 OF 15 SHEETS | STA. 74+10.00 TO STA. 74+10.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	10
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 600.18
300.00 LT

ELEV. 595.70
291.83 LT

ELEV. 593.94
272.80 LT

ELEV. 594.59
260.11 LT

ELEV. 593.07
229.30 LT

DOLPHINS

ELEV. 576.41
193.95 LT

ELEV. 568.61
182.17 LT

ELEV. 562.91
167.67 LT

ELEV. 562.61
149.54 LT

ELEV. 556.61
99.69 LT

ELEV. 556.21
40.78 LT

ELEV. 554.91
0.00 RT

ELEV. 559.81
41.69 RT

ELEV. 564.41
68.88 RT

ELEV. 572.71
84.29 RT

ELEV. 576.41
94.26 RT

ELEV. 591.51
127.79 RT

ELEV. 593.40
142.29 RT

ELEV. 593.96
167.67 RT

ELEV. 595.08
183.07 RT

ELEV. 595.16
173.11 RT

WATER ELEV. DURING SURVEY

ELEV. 595.42
193.95 RT

ELEV. 593.90
191.23 RT

ELEV. 615.93
250.14 RT

ELEV. 614.21
287.27 RT

610
600
590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

74+59.00
SN 016-2408
BRIDGE U/S OPENING

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

FINAL SURVEY / ORIGINAL SURVEY
NOTE BOOK
NO.
BY
DATE
SURVEYED
PLOTTED
TEMPLATE
AREAS
AREAS CHECKED

FILE NAME = N:\PROJ\13470\Drawings\Exhibits\HYD-Scenery and Sign Pages\13470-xsregas.sht

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 11 OF 15 SHEETS | STA. 74+60.00 | TO STA. 74+60.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	11
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

100-YEAR WATER ELEV. = 588.00

WATER ELEV. DURING SURVEY

ELEV. 593.80
300.00 LT

ELEV. 584.11
217.00 LT

ELEV. 576.39
183.00 LT

ELEV. 574.79
178.00 LT

ELEV. 573.99
173.00 LT

ELEV. 562.79
154.00 LT

ELEV. 557.69
54.00 LT

ELEV. 557.39
0.00 LT

ELEV. 557.99
25.00 RT

ELEV. 561.19
75.00 RT

ELEV. 573.19
95.00 RT

ELEV. 576.39
105.00 RT

ELEV. 588.79
139.00 RT

ELEV. 589.48
162.00 RT

ELEV. 590.62
213.00 RT

ELEV. 592.15
170.00 RT

ELEV. 592.95
178.00 RT

ELEV. 593.55
203.00 RT

ELEV. 593.85
246.00 RT

ELEV. 592.53
252.00 RT

ELEV. 592.88
260.00 RT

ELEV. 594.84
263.00 RT

ELEV. 590.28
275.00 RT

ELEV. 592.72
294.00 RT

ELEV. 592.80
300.00 RT

590
580
570
560

60+00.00

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-strcrossx.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 1 OF 15 SHEETS | STA. 60+00.00 TO STA. 60+00.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	1
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

100-YEAR WATER ELEV. = 588.01

WATER ELEV. DURING SURVEY

ELEV. 593.37
300.00 LT

ELEV. 594.83
279.93 LT

ELEV. 576.39
196.25 LT

ELEV. 574.69
191.27 LT

ELEV. 561.39
144.45 LT

ELEV. 560.09
119.54 LT

ELEV. 555.69
69.73 LT

ELEV. 556.09
44.83 LT

ELEV. 555.39
24.91 LT

ELEV. 555.19
0.00 LT

ELEV. 555.99
24.90 RT

ELEV. 565.59
74.71 RT

ELEV. 573.09
91.65 RT

ELEV. 576.39
102.61 RT

ELEV. 590.96
129.50 RT

ELEV. 592.45
196.25 RT

ELEV. 590.20
222.15 RT

ELEV. 593.25
213.19 RT

ELEV. 593.44
192.27 RT

ELEV. 592.70
177.32 RT

ELEV. 596.74
243.07 RT

ELEV. 594.86
255.03 RT

ELEV. 594.79
274.95 RT

590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

65 + 50.00

0 40′ 80′

HORIZONTAL
SCALE: 1″ = 40′
VERTICAL
SCALE: 1″ = 20′

FOR REFERENCE ONLY

FINAL SURVEY	DATE	BY
NOTE BOOK		
NO.		
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

ORIGINAL SURVEY	DATE	BY
NOTE BOOK		
NO.		
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Section and Slug Cases\3347-str-cross.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40′ | SHEET NO. 2 OF 15 SHEETS | STA. 65+50.00 | TO STA. 65+50.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	2
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 594.83
300.00 LT

ELEV. 596.42
264.99 LT

ELEV. 595.93
224.99 LT

ELEV. 595.83
294.87 LT

ELEV. 592.93
247.06 LT

ELEV. 576.39
194.26 LT

ELEV. 574.49
189.28 LT

ELEV. 573.79
184.30 LT

ELEV. 564.59
166.36 LT

ELEV. 556.39
115.56 LT

ELEV. 555.79
90.65 LT

ELEV. 555.39
24.90 LT

ELEV. 552.89
0.00 RT

100-YEAR WATER ELEV. = 588.02

WATER ELEV. DURING SURVEY

ELEV. 552.89
24.91 RT

ELEV. 555.99
50.81 RT

ELEV. 562.39
75.71 RT

ELEV. 576.39
104.60 RT

ELEV. 572.69
98.62 RT

ELEV. 590.85
126.52 RT

ELEV. 592.60
182.30 RT

ELEV. 592.08
161.38 RT

ELEV. 593.58
166.37 RT

ELEV. 593.65
176.33 RT

590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

69 + 10.00

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

DATE	BY	
		SURVEYED
		PLOTTED
		TEMPLATE
		AREAS
		AREAS CHECKED

FINAL SURVEY
NOTE BOOK
NO.

ORIGINAL SURVEY
NOTE BOOK
NO.

FILE NAME = N:\RBD\1347\Drawings\Exhibits\HYD-Sections and Slope Graph\1347-streams.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -	
	DRAWN - DMM	REVISED -	
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -	
PLOT DATE = $DATE$	DATE - $DATE	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

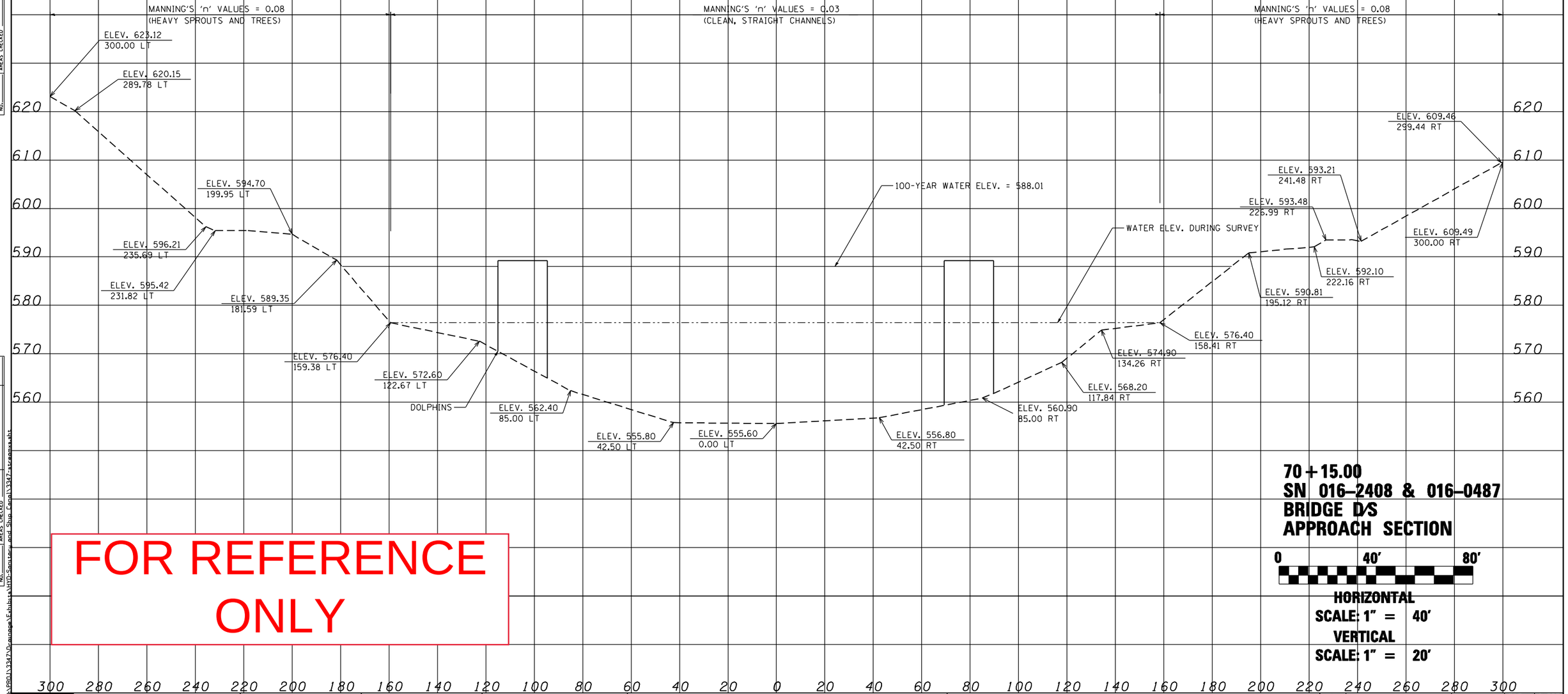
SCALE:1"=40' | SHEET NO. 3 OF 15 SHEETS | STA. 69+10.00 | TO STA. 69+10.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	3
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

LOOKING DOWNSTREAM



70+15.00
SN 016-2408 & 016-0487
BRIDGE D/S
APPROACH SECTION

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

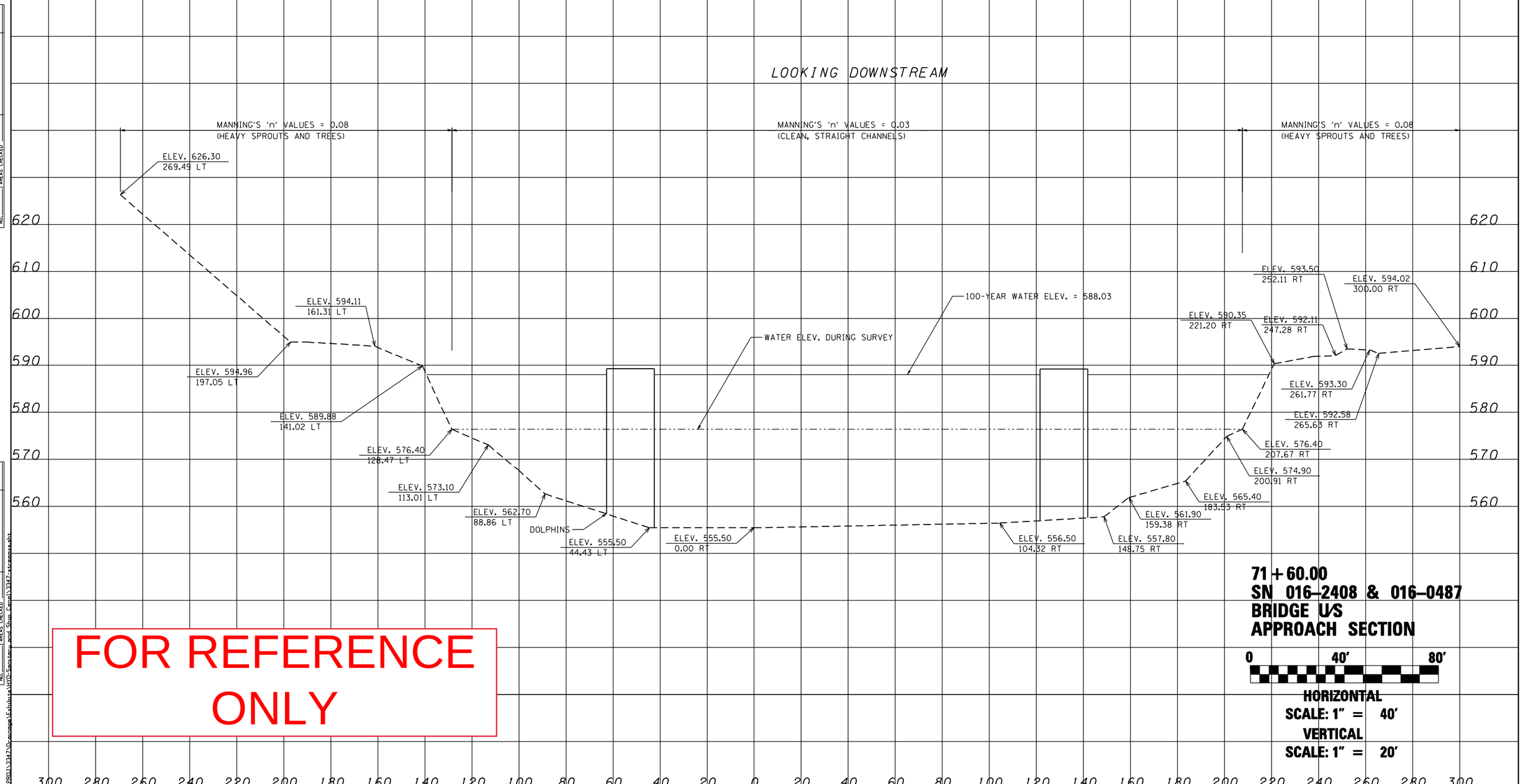
IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 4 OF 15 SHEETS | STA. 70+15.00 TO STA. 70+15.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	4
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-xsregress.dgn

LOOKING DOWNSTREAM



71+60.00
SN 016-2408 & 016-0487
BRIDGE U/S
APPROACH SECTION

0 40′ 80′

HORIZONTAL
SCALE: 1" = 40′
VERTICAL
SCALE: 1" = 20′

FOR REFERENCE ONLY

FINAL SURVEY	NOTE BOOK	NO.	BY	DATE
SURVEYED				
PLOTTED				
TEMPLATE				
AREAS				
AREAS CHECKED				

ORIGINAL SURVEY	NOTE BOOK	NO.	BY	DATE
SURVEYED				
PLOTTED				
TEMPLATE				
AREAS				
AREAS CHECKED				

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Survey and Slug Cond\3347-xsregrss.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40′ | SHEET NO. 7 OF 15 SHEETS | STA. 71+50.00 | TO STA. 71+50.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	7
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

100-YEAR WATER ELEV. = 588.03

WATER ELEV. DURING SURVEY

ELEV. 605.86
300.00 LT

ELEV. 594.69
270.97 LT

ELEV. 591.71
218.17 LT

ELEV. 576.41
196.25 LT

ELEV. 567.31
169.35 LT

ELEV. 557.81
118.55 LT

ELEV. 556.71
93.64 LT

ELEV. 555.21
0.00 LT

ELEV. 555.91
24.90 RT

ELEV. 562.31
74.71 RT

ELEV. 576.41
103.60 RT

ELEV. 573.21
97.63 RT

ELEV. 571.41
92.65 RT

ELEV. 591.56
137.47 RT

ELEV. 592.09
192.27 RT

ELEV. 593.22
198.24 RT

ELEV. 592.81
171.34 RT

ELEV. 593.74
175.33 RT

ELEV. 593.62
185.29 RT

ELEV. 593.78
224.14 RT

620 610 600 590 580 570 560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

72 + 50.00

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

FINAL SURVEY	ORIGINAL SURVEY
NOTE BOOK	NOTE BOOK
NO.	NO.
SURVEYED	SURVEYED
PLOTTED	PLOTTED
TEMPLATE	TEMPLATE
AREAS	AREAS
AREAS CHECKED	AREAS CHECKED
BY	BY
DATE	DATE

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-strcrossx.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 8 OF 15 SHEETS | STA. 72+50.00 | TO STA. 72+50.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	8
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 620.95
276.42 LT

ELEV. 594.92
225.67 LT

ELEV. 594.44
201.20 LT

ELEV. 592.99
174.01 LT

ELEV. 576.41
130.51 LT

ELEV. 562.91
108.76 LT

DOLPHINS

ELEV. 562.71
99.69 LT

ELEV. 556.21
48.94 LT

ELEV. 555.41
0.00 LT

100-YEAR WATER ELEV. = 588.02

WATER ELEV. DURING SURVEY

ELEV. 555.41
40.78 RT

ELEV. 561.11
81.57 RT

ELEV. 563.11
109.66 RT

ELEV. 572.71
123.26 RT

ELEV. 576.41
133.23 RT

ELEV. 591.06
183.07 RT

ELEV. 593.59
244.70 RT

ELEV. 594.53
251.95 RT

ELEV. 593.17
202.11 RT

ELEV. 593.58
224.76 RT

ELEV. 594.85
229.30 RT

ELEV. 594.78
239.03 RT

ELEV. 611.41
300.00 RT

620 610 600 590 580 570 560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

74+10.00
SN 016-2408 BRIDGE D/S
APPROACH SECTION

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FINAL SURVEY — NOTE BOOK — NO. — SURVEYED — PLOTTED — TEMPLATE — AREAS — AREAS CHECKED — BY — DATE

ORIGINAL SURVEY — NOTE BOOK — NO. — SURVEYED — PLOTTED — TEMPLATE — AREAS — AREAS CHECKED — BY — DATE

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Ship Canal\3347-xsgraph.dgn

FOR REFERENCE ONLY

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel: 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 9 OF 15 SHEETS | STA. 74+10.00 | TO STA. 74+10.00

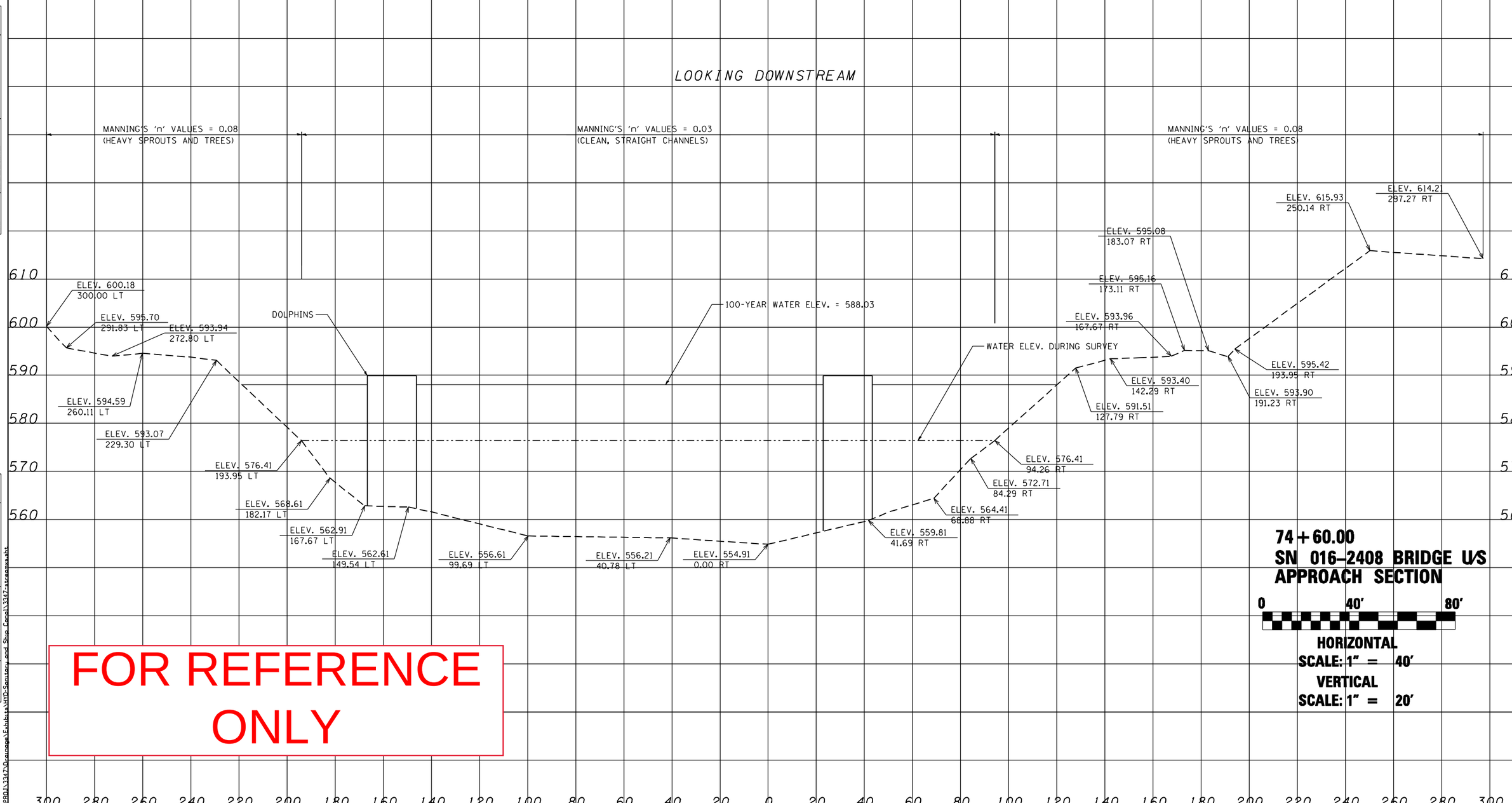
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	9
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)



74+60.00
SN 016-2408 BRIDGE U/S
APPROACH SECTION

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

DATE	BY	SURVEYED	PLOTTED	TEMPLATE	AREAS	AREAS CHECKED	NOTE BOOK	NO.
							FINAL SURVEY	
							ORIGINAL SURVEY	

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sections and Sign Legal\3347-xsregas.sht

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 12 OF 15 SHEETS | STA. 74+60.00 | TO STA. 74+60.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	12
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

BY	DATE

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

BY	DATE

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

ELEV. 592.95
300.00 LT

ELEV. 590.22
228.00 LT

ELEV. 576.41
192.00 LT

ELEV. 567.11
165.00 LT

ELEV. 564.01
140.00 LT

ELEV. 558.91
115.00 LT

ELEV. 557.31
90.00 LT

ELEV. 556.41
40.00 LT

ELEV. 556.01
0.00 RT

100-YEAR WATER ELEV. = 588.04

WATER ELEV. DURING SURVEY

ELEV. 558.11
24.00 RT

ELEV. 561.91
49.00 RT

ELEV. 569.41
76.00 RT

ELEV. 573.11
91.00 RT

ELEV. 576.41
101.00 RT

ELEV. 591.85
136.00 RT

ELEV. 593.53
149.00 RT

ELEV. 594.09
172.00 RT

ELEV. 595.57
175.00 RT

ELEV. 595.26
187.00 RT

ELEV. 607.39
264.00 RT

600
590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

75 + 70.00

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

FOR REFERENCE ONLY

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Scenery and Stop Logs\3347-streams.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -	
	DRAWN - DMM	REVISED -	
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -	
PLOT DATE = $DATE$	DATE - $DATE	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 13 OF 15 SHEETS | STA. 75+70.00 TO STA. 75+70.00

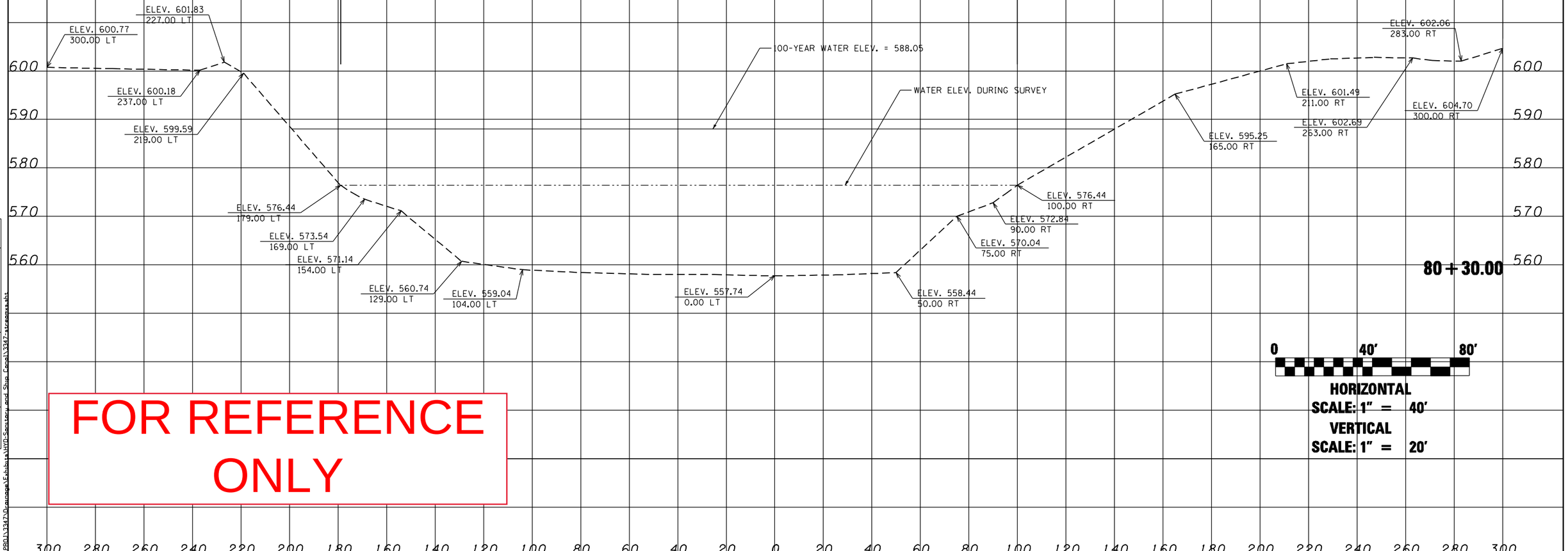
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	13
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)



80 + 30.00

0 40′ 80′

HORIZONTAL
SCALE: 1″ = 40′
VERTICAL
SCALE: 1″ = 20′

FOR REFERENCE ONLY

FINAL SURVEY	NOTE BOOK	NO.
ORIGINAL SURVEY	NOTE BOOK	NO.

	BY	DATE
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Scenic and Sup Cond\3347-xsranges.sht

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 14 OF 15 SHEETS | STA. 80+30.00 | TO STA. 80+30.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	14
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

LOOKING DOWNSTREAM

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

MANNING'S 'n' VALUES = 0.03
(CLEAN, STRAIGHT CHANNELS)

MANNING'S 'n' VALUES = 0.08
(HEAVY SPROUTS AND TREES)

100-YEAR WATER ELEV. = 588.07

WATER ELEV. DURING SURVEY

ELEV. 601.88
300.00 LT

ELEV. 599.95
251.04 LT

ELEV. 576.44
197.25 LT

ELEV. 574.64
192.27 LT

ELEV. 573.84
187.28 LT

ELEV. 562.44
172.34 LT

ELEV. 556.44
147.44 LT

ELEV. 556.94
97.63 LT

ELEV. 556.44
24.90 LT

ELEV. 554.64
0.00 RT

ELEV. 567.44
74.72 RT

ELEV. 574.24
94.64 RT

ELEV. 576.44
99.62 RT

ELEV. 597.32
147.44 RT

ELEV. 596.95
191.27 RT

ELEV. 597.74
178.32 RT

ELEV. 597.17
204.40 RT

ELEV. 601.87
218.17 RT

ELEV. 601.36
236.10 RT

ELEV. 602.52
253.03 RT

ELEV. 603.63
300.00 RT

600
590
580
570
560

300 280 260 240 220 200 180 160 140 120 100 80 60 40 20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

85 + 50.00

0 40' 80'

HORIZONTAL
SCALE: 1" = 40'
VERTICAL
SCALE: 1" = 20'

ORIGINAL SURVEY	FINAL SURVEY
NOTE BOOK	NOTE BOOK
NO.	NO.
SURVEYED	SURVEYED
PLOTTED	PLOTTED
TEMPLATE	TEMPLATE
AREAS	AREAS
AREAS CHECKED	AREAS CHECKED
BY	BY
DATE	DATE

FILE NAME = N:\PROJ\3347\Drawings\Exhibits\HYD-Sanitary and Stm Cond\3347-stmxsxs.dgn

Ciorba Group, Inc.
CONSULTING ENGINEERS
5507 North Cumberland Avenue, Suite 402
Chicago, Illinois 60656
Tel. 773.775.4009 Fax 773.775.4014

USER NAME = $USER$	DESIGNED - DMM	REVISED -
	DRAWN - DMM	REVISED -
PLOT SCALE = $SCALE$	CHECKED - MRJ	REVISED -
PLOT DATE = $DATE$	DATE - $DATE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 171 FROM 47TH ST. TO 55TH ST.
EXHIBIT 1-04
HEC-RAS CROSS SECTIONS

SCALE:1"=40' | SHEET NO. 15 OF 15 SHEETS | STA. 85+50.00 | TO STA. 85+50.00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
372		COOK	4	15
		CONTRACT NO.		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

TAB 10

SECTION 10

BRIDGE LAYOUT / PLAN DRAWING PLOTS

I-55 OVER CHICAGO SANITARY AND SHIP CANAL

N

℄ I-55

OVERTOPPING
STA 909+00
OFF 75.2' LT
ELEV. 628.2

LOW EOP
STA 916+05
OFF 77.4' LT
ELEV. 624.5

CHICAGO SANITARY AND SHIP CANAL

CHICAGO SANITARY AND SHIP CANAL

LOW EOP
STA 907+46
OFF 72.2' LT
ELEV. 625.8

OVERTOPPING
STA 914+46
OFF 73.5' RT
ELEV. 628.3

I-55 MANAGED LANE PROJECT	USER NAME = EEOM	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	I-55 MANAGED LANE STUDY DRAINAGE SUPPLEMENT	F.A. RTE.:	SECTION / COUNTY / TOTAL SHEETS / SHEET NO.
		DRAWN -	REVISED -				1 / 1
	PLOT SCALE = 100.0000 ' / in.	CHECKED -	REVISED -				CONTRACT NO. P92917
	PLOT DATE = 8/11/2017	DATE -	REVISED -		SCALE: _____ SHEET ___ OF ___ SHEETS STA. _____ TO STA. _____		ILLINOIS FED. AID PROJECT

FILE NAME = I:\1786\active\17860037_IDOT_I-55_2Lanes\civil\drainage\drawings\DIP91762l0-mod-TempExhibits.dgn

TAB A

SECTION 10.A

HISTORIC IDOT PLAN EXCERPTS

CELLS

LIST OF DRAWINGS

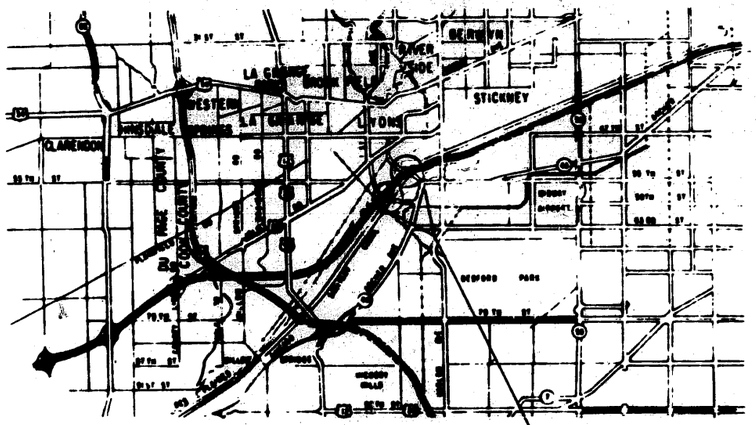
1. TITLE SHEET
2. CELLS
3.-5. CRITICAL PATH SCHEDULE

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

PLANS FOR PROPOSED FEDERAL AID HIGHWAY

SOUTHWEST EXPRESSWAY

F. A. I. ROUTE 55 SECTION 0707-616 I
PROJECT I-55-7 (93)-277
F. A. ROUTE 133 SECTION 0707-626 I
PROJECT U-383 (24)
CELLS
COOK COUNTY

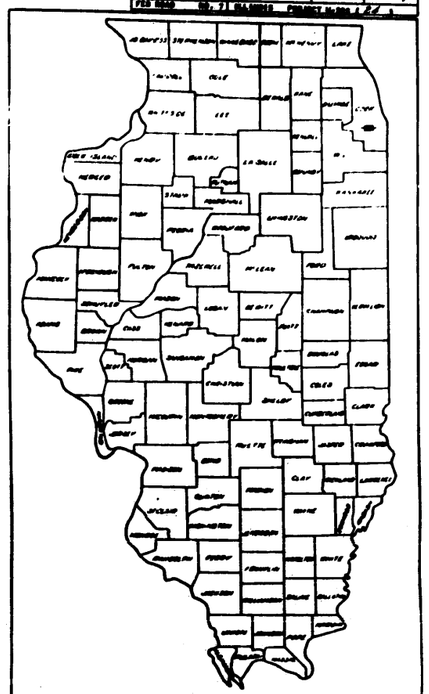


LOCATION OF IMPROVEMENT

SCALE

N

FED. ROAD DIST. NO.	SEC.	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
55	0707-616 I	SOUTHWEST	5	1
FED. ROAD DIST. NO.	STATE	PROJECT	I-55-7 (93)-277	
FED. ROAD DIST. NO.	SEC.	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
133	0707-626 I	SOUTHWEST	5	1
FED. ROAD DIST. NO. 7	STATE	PROJECT		



LOCATION OF SECTION INDICATED THUS:—

APPROVED
FOR STRUCTURAL ADEQUACY ONLY
H E Bauman 6/12/63
Engineer of Bridge & Traffic Structures

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

SUBMITTED 6-7, 1963 — Marshall Sylow, DISTRICT ENGINEER
RECOMMENDED JUNE 20, 1963 — [illegible], ENGINEER OF BRIDGES AND STRUCTURES
PASSED JUNE 20, 1963 — [illegible], CHIEF ENGINEER
APPROVED JUNE 20, 1963 — [illegible], DIRECTOR
APPROVED JUNE 20, 1963 — Thomas H. Kenny, CHAIRMAN

REVIEWED BY: Henry M. Yamanaka 6-6-63 — CENTRAL BUREAU DESIGN ENGINEER
EXAMINED BY: E. Brunker 6-7-63 — DISTRICT CONSTRUCTION ENGINEER
EXAMINED BY: L. U. Lown — DISTRICT MATERIALS ENGINEER
EXAMINED BY: Arthur C. Freeman 6-7-63 — ASST. DIST. ENG'R. - ENGINEERING
EXAMINED BY: Robert E. Krumb 6-6-63 — ASST. DIST. ENG'R. - EXPRESSWAYS
ENTIRE SECTION INSPECTED AND APPROVED AS TO POLICY
BY: Marshall Sylow 6-7-63 — DISTRICT ENGINEER

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED
DIVISION ENGINEER — DATE

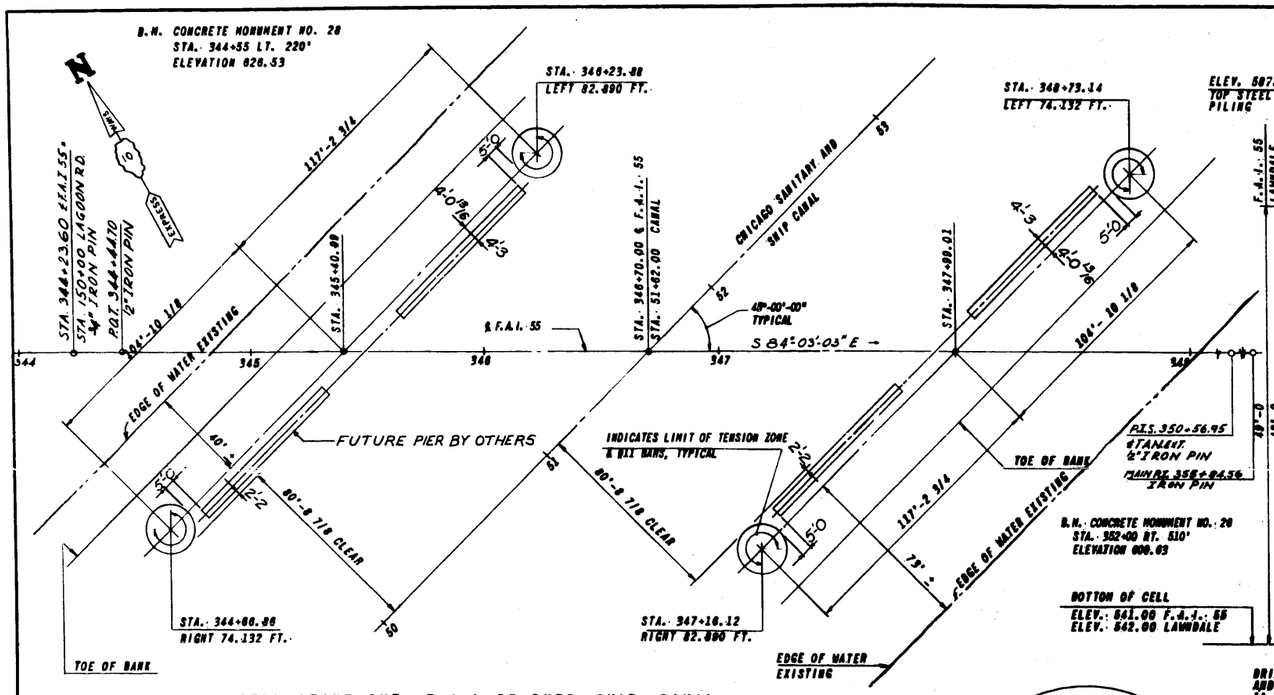
PLANS PREPARED BY
CONSOER TOWNSEND & ASSOCIATES
CONSULTING ENGINEERS
360 EAST GRAND AVE.
CHICAGO, ILL.

Job No. 23186

Carl W. Westphal

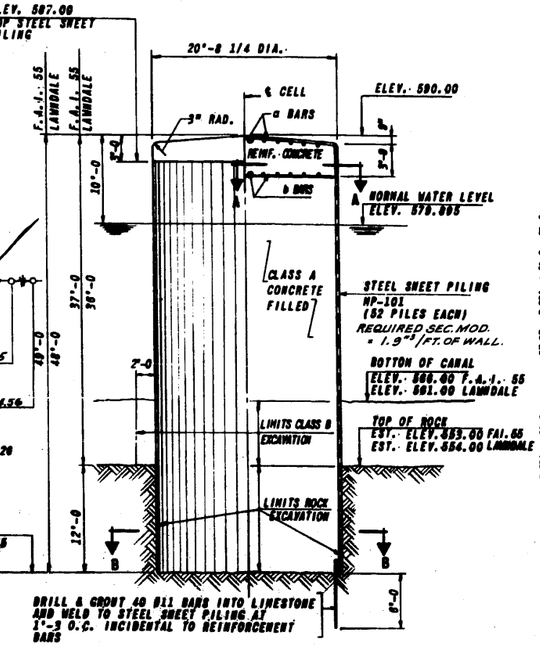
F.A. RTE.	SECTION	EXPRESSWAY	TOTAL SHEETS	SHEET NO.
139	0707-626 I	SOUTHWEST	7	2

F.A.I. RTE.	SECTION	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
55	0707-616 I	SOUTHWEST	5	2
STA.	TO STA.			
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

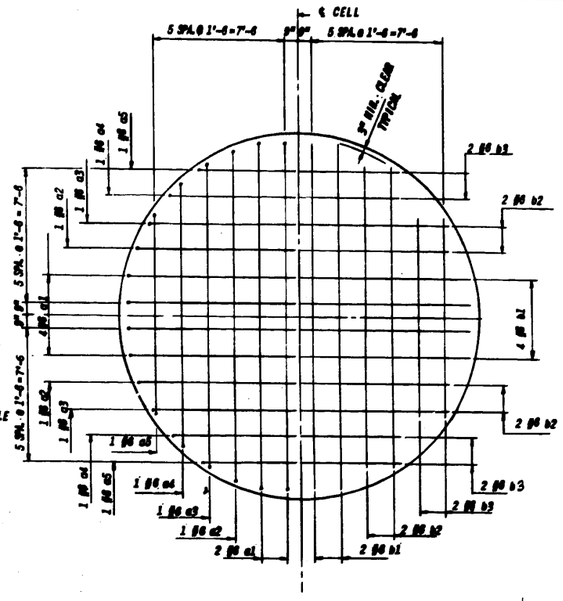


CELL STAKE OUT - F.A.I. 55 OVER SHIP CANAL

F.A.I. ROUTE 55 SECTION 0707 - 616 I

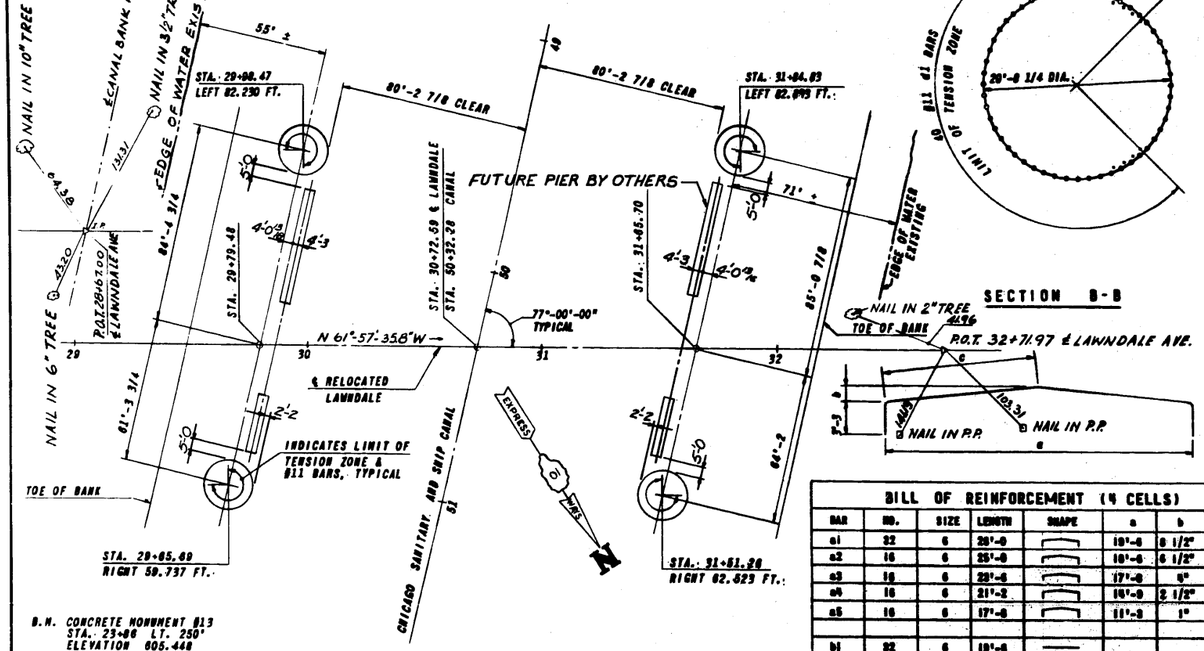


CELL ELEVATION



TOP VIEW SECTION A-A

CELL REINFORCEMENT



SECTION B-B

B.M. CONCRETE MONUMENT 813
STA. 23+86 LT. 250'
ELEVATION 605.448

CELL STAKE OUT - RELOCATED LAWNDALE OVER SHIP CANAL

F.A. ROUTE 139 SECTION 0707 - 626 I

SUMMARY OF QUANTITIES

CODE NO.	ITEM / LOCATION OF WORK / CONSTRUCTION TYPE CODE	UNIT	TOTAL QUANTITY	I-55-7(215)277 CELLS STA. 346+70.00 TO 347	J-389(24) CELLS STA. 30+72.59 TO 30+32.36
				Y007	Y007
060002	CLASS B EXCAVATION FOR STRUCTURES	CU.YD.	1,618	922	696
060003	ROCK EXCAVATION FOR STRUCTURES	CU.YD.	1,196	596	596
063002	CLASS A CONCRETE	CU.YD.	5,884.0	2,982.0	2,902.0
080001	REINFORCEMENT BARS	POUND	24,960	12,480	12,480
080095	STEEL SHEET PILING	SQ.FT.	23,686	11,958	11,698

ALL ELEVATIONS ARE ON UNITED STATES GEOLOGICAL SURVEY DATA.

BILL OF REINFORCEMENT (4 CELLS)

BAR	NO.	SIZE	LENGTH	SHAPE	a	b	c
a1	32	6	29'-0		19'-6	8 1/2"	9'-0
a2	16	6	25'-6		16'-6	6 1/2"	9'-3
a3	16	6	23'-6		17'-6	6"	5'-6
a4	16	6	21'-2		16'-9	2 1/2"	7'-4
a5	16	6	17'-6		11'-9	1"	5'-7
b1	32	6	19'-6				
b2	32	6	17'-9				
b3	32	6	15'-3				
d1	100	11	9'-0				

BILL OF MATERIAL FOR F.A.I. 55 (4 CELLS)

CLASS B EXCAVATION FOR STRUCTURES	CU.YD.	922.
ROCK EXCAVATION FOR STRUCTURES	CU.YD.	596.
CLASS A CONCRETE	CU.YD.	2,982.0
REINFORCEMENT BARS	LBS.	12,480.
STEEL SHEET PILING	SQ.FT.	11,958.

BILL OF MATERIAL FOR LAWNDALE (4 CELLS)

CLASS B EXCAVATION FOR STRUCTURES	CU.YD.	696.
ROCK EXCAVATION FOR STRUCTURES	CU.YD.	596.
CLASS A CONCRETE	CU.YD.	2,902.0
REINFORCEMENT BARS	LBS.	12,560.
STEEL SHEET PILING	SQ.FT.	11,698.

DESIGN DATA

DESIGN SPECIFICATIONS: DESIGN MANUAL HARBOR AND COASTAL FACILITIES NAVYDOCKS DM-26, U.S. NAVY

STRUCTURAL STEEL
ASTM A7 f_s = 18,000 psi

REINFORCING STEEL f_s = 20,000 psi

CONCRETE
ULTIMATE COMPRESSION f'_c = 3,500 psi
MODULAR RATIO n = 10

REVISIONS	
NAME	DATE
DESIGNED ST.	
REVIEWED C.W.W.	

ILLINOIS DIVISION OF HIGHWAYS

SOUTHWEST EXPRESSWAY

F.A.I. 55 AND LAWNDALE AVE. OVER CHICAGO SANITARY AND SHIP CANAL SECTION 0707-616 I AND 0707-626 I CELLS

SCALE: HORIZ. VERT. DRAWN BY J.S.

DATE 5-21-68 CHECKED BY L.P.B.

016-0014
016-0015
Reel 0-57

Sheets 4, 5 and 33 Were Not To Scanning

FEDERAL AID ROUTE NO.	SEC.	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
55	0707-616B	SOUTHWEST	75	1
FED. ROAD DIST. NO. 7	ILLINOIS	PROJECT	I-55-7(81)-277	

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

PLANS FOR PROPOSED FEDERAL AID HIGHWAY

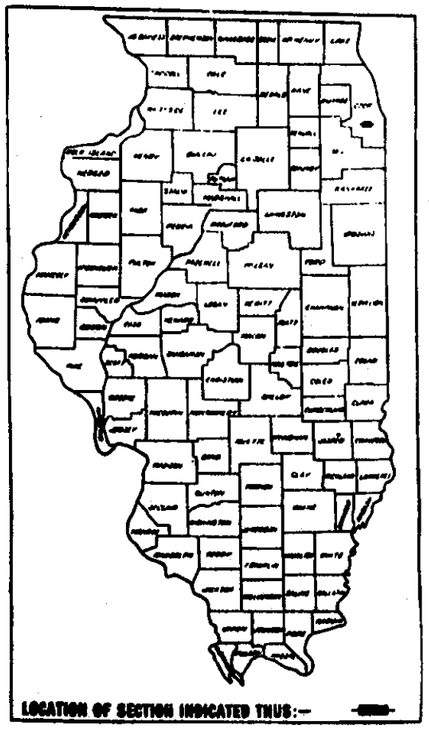
F.A.I. ROUTE 55 SECTION 0707- 616B

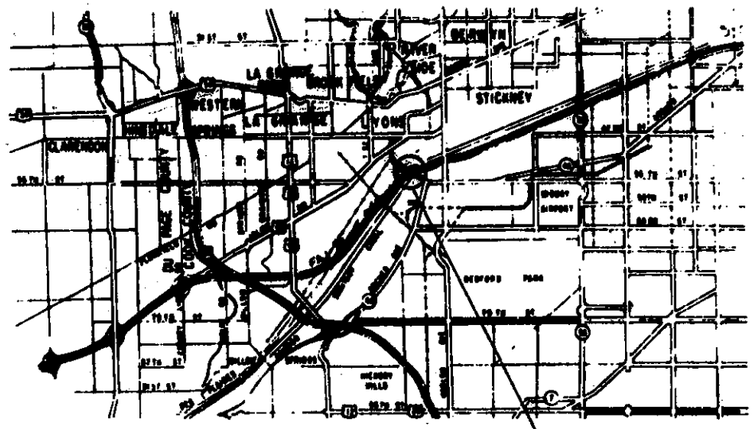
SOUTHWEST EXPRESSWAY

F.A.I. ROUTE 55 OVER SANITARY AND SHIP CANAL

PROJECT I-55-7 (81)-277

COOK COUNTY





DESCRIPTION OF WORK
THE WORK UNDER THIS CONTRACT CONSISTS OF THE FURNISHING OF ALL MATERIALS AND THE COMPLETE CONSTRUCTION OF THE DUAL STRUCTURES CARRYING FAI ROUTE 55 SOUTHWEST EXPRESSWAY OVER THE CHICAGO SANITARY AND SHIP CANAL. SPANS EACH: 2 @ 50'-3", 2 @ 176'-0" AND 1 @ 240'-6" AT STATION 346+70 IN McCOOK

NOTE:
FOR SUMMARY OF QUANITIES AND INDEX OF SHEETS SEE SHEET NO. 2

REVIEWED BY:	ENGINEERING DIVISION ENGINEER	9-16-63
EXAMINED BY:	DISTRICT CONSTRUCTION ENGINEER	9-16-63
EXAMINED BY:	DISTRICT MAINTENANCE ENGINEER	9-16-63
EXAMINED BY:	ASS'T. ENG'R. - ENGINEERING	9-16-63
EXAMINED BY:	ASS'T. DIST. ENG'R - EXPRESSWAYS	9-16-63

ENTIRE SECTION INSPECTED AND APPROVED AS TO POLICY

BY: DISTRICT ENGINEER 9-16-63

NET LENGTH PROJ. I-55-7(81) 277 = 700.00 FT. = 0.133 MILE

PLANS PREPARED BY
CONSOER TOWNSEND & ASSOCIATES
CONSULTING ENGINEERS
360 EAST GRAND AVE.
CHICAGO, ILL.

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
DIVISION OF HIGHWAYS

SUBMITTED	9-16-63 Marshall Fulbright
RECOMMENDED	October 8 '63
CONCURRED	October 8 '63
APPROVED	October 8 '63
APPROVED	October 8 '63

APPROVED
FOR STRUCTURAL ADEQUACY ONLY
9/10/63
ENGINEER OF BRIDGES & STRUCTURAL MAINTENANCE

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED
DIVISION ENGINEER — DATE

CONTRACT NO. 23024

Carl W. Westphal

F.A.I. RTE.	SECTION	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
55	0707—616 B	SOUTHWEST	75	4
STA.		TO STA.		
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT	S-55-7(8)	177

700'-0 BACK TO BACK OF ABUTMENTS @ ℄ BRIDGE

* ALONG TANGENT

ELEV. 619.086
ELEV. 618.919
CROWN GRADE
SUB GRADE
TOP OF ALL PILES
PRESSED APPROACH TIMBER PILES BY BRIDGE CONTRACTOR EST. LENGTH 35'- 79 PILES
1.5 = 1,015 LIN.FT.
W.B. 22-10BP42 STEEL PILES, EST. LENGTH 68' = 1,496 LIN.FT.
1 TEST PILE 10BP42
E.B. 25-10BP42 STEEL PILES, EST. LENGTH 68' = 1,700 LIN.FT.
CONSTRUCTION EMBANKMENT BY OTHERS
EXIST. GROUND LINE @ SECTION B-B
4" CONCRETE SLOPE WALL
W.B. 36-10BP42 STEEL PILES, EST. LENGTH 65' = 1,748 LIN.FT.
1 TEST PILE 10 BP 42
E.B. 39-10BP42 STEEL PILES, EST. LENGTH 66' = 1,794 LIN.FT.
NOTES: APPROACH PILES FRICTION BEARING. NO PREBORING.
WEST ABUTMENT
PIER NO. 1
PIER NO. 2
DESIGN GROUND WATER ELEV.
50'-0
98'-0
372'-0
EXP. BRG.
EXP.
28'-0
50'-0
℄ LAGOON ROAD
27'-0 MIN. CLEARANCE
CLASS A
CLASS B
ELEV. 581.0 EXCAVATION CLASSIFICATION LINE
ELEV. 594.0 TOP OF CRUSHED ROCK BY OTHERS
BOTT. FTG. ELEV. 598.667 N.B.
ELEV. 597.311 S.B.
TOP OF WALL ELEV. 607.00
NORMAL WATER LEVEL ELEV. 579.086
CHANNEL BOTTOM ELEV. 559.00
BOTT. FTG. ELEV. 583.00 EAST BOUND
BOTT. FTG. ELEV. 584.00 WEST BOUND
38'-0 MIN. CLEARANCE
HATCHLINE
640
630
620
610
600
590
580
570
560
550
540

INCREASING STA.
STA. 150+00
EL. 597.41
-0.35%
LAGOON ROAD PROFILE

B.M. CONCRETE MONUMENT 828
STA. 344+55 LT. 220'
ELEV. 626.53

PART ELEVATION
(ALONG SECTION B-B)
QUANTITIES SHOWN W.B. & E.B.

DRESS SLOPE
APPROX. TOE OF EMBANKMENT

PROP. EDGE OF NORMAL WATER BY OTHERS
TOE OF EMBANKMENT CELL (20'-8½ DIA.)
STA. 346+79.66
LT. 63.48 FT.
℄ PIER NO. 2
HATCHLINE STA. 340+50.60
PIER EXTENSION

℄ LAGOON ROAD
PIER NO. 1
4" SLOPEWALL
SHOULDER LINE
CUTTER
12'-0 PAVEMENT
12'-0 SHOULDER
BORING #1
BORING #2
BORING #3
BORING #4
BORING #5
FINGER JOINT
STA. 343+42.50
STA. 343+68.75
STA. 343+94.00
STA. 344+19.25
STA. 344+44.50
STA. 344+69.75
STA. 344+95.00
STA. 345+20.25
STA. 345+45.50
STA. 345+70.75
STA. 345+96.00
STA. 346+21.25
STA. 346+46.50
STA. 346+71.75
STA. 346+97.00
STA. 347+22.25
STA. 347+47.50
Ls = 201.25
Ls = 199
Ls = 201.00
Lv = 200.00
C.S 342+93.60
C.S 343+46.00
℄ WEST BOUND = ℄ GRADE LINE
℄ EAST BOUND = ℄ GRADE LINE
℄ F.A.I. 55 TAN. LIN. EXT. S.T. 344+23.60
B.M. TAN. LIN. EXT. TO S.T. 344+94.22
EXIST. 620.60 ASPHALT FACE
EXIST. 621.00 ASPHALT FACE
EXIST. 621.80 ASPHALT FACE
EXIST. 622.60 CURB
EXIST. 623.00 ASPHALT FACE
EXIST. 623.80 ASPHALT FACE
EXIST. 624.60 ASPHALT FACE
EXIST. 625.00 ASPHALT FACE
EXIST. 625.80 ASPHALT FACE
EXIST. 626.60 ASPHALT FACE
EXISTING WATER LINE
APPROX. TOE OF EMBANKMENT
DRESS SLOPE
STA. 344+44.66
RT. 74.19 FT.
CELL (20'-8½ DIA.) BY OTHERS
PIER EXTENSION
FENDER
PIER EXTENSION 148
℄ F.A.I. 55
FENDER
45°-00'-00" TYPICAL
℄ CHICAGO SANITARY & SHIP CANAL
PLAN

N
RT. 332+74.68
℄ ILLINOIS WATER TRACK
T-BAR
3.5'
MAIN TANGENT
STRUCTURE CARRYING RAILROAD OVER SANITARY & SHIP CANAL
189.03'
MON. 19
32°-15'
CHISELED X ON N. SIDE OF N. RAIL
END OF WEST RAIL
MAIN TANGENT
MAIN P.I. STA. 332+74.68 X-WAY

** ALL HORIZONTAL DIMENSIONS ARE NORMAL TO ℄ OF EACH ROADWAY THROUGHOUT CONSTRUCTION SHOWN THIS SHEET

DESIGN DATA

DESIGN SPECIFICATIONS: AASHO 1941 EDITION
DESIGN LOAD: H20-S16-44 & ALTERNATE
DECK SLAB, PIERS, FOOTINGS AND ABUTMENTS:

STRUCTURAL STEEL:
A.S.T.M. A36 . . . . . fs = 20,000 psi
CARBON STEEL FORGING:
A.S.T.M. A235, CLASS F . . . . . fy = 40,000 psi
CAST STEEL:
A.S.T.M. A27-40, GRADE 65-35 . . . . . fy = 35,000 psi
REINFORCING STEEL (INTERMEDIATE AND HARD GRADE) . fs = 20,000 psi
CONCRETE:
ULTIMATE COMPRESSION . . . . . f'c = 3,000 psi
ALLOWABLE COMPRESSION (WITHOUT EARTH PRESSURE) fc = 1,400 psi
ALLOWABLE COMPRESSION (WITH EARTH PRESSURE). fc = 1,000 psi
MODULAR RATIO. . . . . n = 10
ALLOWABLE SHEAR: BEAMS WITHOUT WEB REINFORCEMENT
LONGITUDINAL BARS ANCHORED . . . . . v = 90 psi
PIER FOOTINGS . . . . . v = 75 psi
TIMBER PIER FENDER
EXTREME FIBER IN BENDING, PARALLEL TO GRAIN f = 3,300 psi
ALLOWABLE HORIZONTAL SHEAR . . . . . v = 400 psi
ALLOWABLE COMPRESSION, PERPENDICULAR TO GRAIN . . . . . f = 1,500 psi
ALLOWABLE COMPRESSION, PARALLEL TO GRAIN . . f = 3,000 psi
EARTH PRESSURE:
HORIZONTAL EARTH PRESSURE = EQUIV. FLUID PRESSURE . . . . . = 40 p/cf
PILES:
STEEL PILE 10 BP 42 55 TONS MIN.
TIMBER PILE CAPACITY @ APPROACH ROADWAY. . . 15 TONS MIN.
DEFLECTION:
MAX. ALLOWABLE LIVE LOAD DEFLECTION, COMPOSITE. . . . . 1/1700 SPAN

REVISIONS	
NAME	DATE
DESIGNED ST	
REVIEWED CWW	

ILLINOIS DIVISION OF HIGHWAYS
SOUTHWEST EXPRESSWAY
F.A.I. RT. 55 OVER
CHICAGO SANITARY AND SHIP CANAL
SECTION 0707— 616B
GENERAL PLAN, WEST PART
SCALE: HORIZ. 1" = 20' VERT. DRAWN BY E G
DATE 6-28-63 CHECKED BY L.D.B.

F.A.I. RTE.	SECTION	EXPRESSWAYS	TOTAL SHEETS	SHEET NO.
55	0707-6168 S	SOUTHWEST	75	5
STA.		TO STA.		
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

700'-0 BACK TO BACK OF ABUTMENTS @ C BRIDGE

WATCH LINE

67'-10

176'-9"

80'-3"

5'-6

35'-0

30'-0

EXP.

EXP. 85'-0

FIX.

EXP.

DENR ELEV.

W.S. ELEV. 618.49E
P.S. ELEV. 619.99S

CROWN GRADE

SUB GRADE

PILE CUT OFF 1'-6 BELOW

CONSTRUCTION EMBANKMENT BY OTHERS

CREOSOTED APPROACH PILES BY BRIDGE CONTRACTOR EST. LENGTH 35' (29 PILES) 29 @ 35'-0 = 1015 LIN. FT.

EXISTING GROUND LINE @ SECTION B-B

14 - 24" RD. CONCRETE PILES DRILLED & CAST IN PLACE (7 W.S. x 7 E.S.)

AT PIER:

W.S. 39-10 BP 42 STEEL PILES
EST. LENGTH 85'-0 (795 LIN. FT.)

E.S. 32-10 BP 42 STEEL PILES
EST. LENGTH 85'-0 (MINIMUM)
STEEL PER 10 BP 42

ELEV. 577.0
END BORING NO. 8
ELEV. 574.4
ELEV. 569.10 ±
ELEV. 561.80

SANITARY SEWER

STA. 156+00
ELEV. 597.66

INCREASING STA.

- 0.89 %

B.M.

CONCRETE MONUMENT 828
STA. 152+00 RT. 510'
ELEV. 600.03

CANAL ROAD PROFILE

ALONG TANGENT

640
630
620
610
600
590
580
570
560
550
540

38'-0 MIN. CLEARANCE

TOP OF WALL EL. 597.00

NORMAL WATER LEVEL ELEV. 579.895

CHANNEL BOTTOM ELEV. 550.00

BOTT. FTG. ELEV. 554.00 EAST & WEST BOUND

2:1 NORMAL

4" CONCRETE SLOPEWALL

℄ CANAL BANK ROAD

2:1 NORMAL

VARIES

EXISTING GROUND LINE @ SECTION B-B

PIER NO. 3

PART ELEVATION
(ALONG SECTION B-B)

PIER NO. 4

EAST ABUTMENT

N

NORTH

WATCH LINE AT STA. 340+30.00

PIER EXTENSION

CELL (20'-0" DIA.) BY OTHERS

TOE OF EMBANKMENT

PROP. EDGE OF NORMAL WATER

℄ PIER NO. 3

℄ PIER NO. 4

CHICAGO SANITARY & SHIP CANAL

℄ CANAL BANK ROAD

SHEET PILE LINE

SHEET PILE LINE

GUTTER

4" SLOPEWALL

SHEET PILE LINE

℄ WEST BOUND = ℄ GRADE LINE

℄ EAST BOUND = ℄ GRADE LINE

FENDER

PIER EXTENSION

℄ F.A.I. 55

45°-00' 00" TYPICAL

FENDER

PIER EXTENSION

CELL (20'-0" DIA.) BY OTHERS

EXISTING WATER LEVEL

SHEET PILE LINE

SHEET PILE LINE

STA. 342+16.12
RT. 82.85 FT.

PLAN

DRESS SLOPE

APPROX. TOE OF EMBANKMENT

ELEV. 620.40
(FROM CAP FACE)

SHEET PILE LINE

APPROXIMATE LOCATION OF EXISTING SANITARY SEWER 6'-0" x 6'-0"

℄ F.A.I. 55 TAN. LIN. EXT. TO T.S. 340+03.88

E.B. TAN. LIN. EXT. TO T.S. 340+34.88

W.B. TAN. LIN. EXT. TO T.S. 340+72.18

S.C. of E.B. TAN. LIN. STA. 339+85.47 Rt. 82.85

S.C. of W.B. TAN. LIN. STA. 339+85.47 Lt. 82.85

S.C. of E.B. TAN. LIN. STA. 339+66.55

APPROX. TOE OF EMBANKMENT

DRESS SLOPE

REVISIONS	
NAME	DATE
DESIGNED S.T.	
REVIEWED C.W.W.	

ILLINOIS DIVISION OF HIGHWAYS
SOUTHWEST EXPRESSWAY
F.A.I. RT 55 OVER
CHICAGO SANITARY AND SHIP CANAL
SECTION 0707— 6168
GENERAL PLAN, EAST PART

SCALE: HORIZ. 1" = 20'
VERT.
DRAWN BY E.G.
DATE 6-26-63
CHECKED BY L.D.B.

6P

016-0014

I-55EB/

San & Ship Canal

F.A.-RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55	-	COOK	578	1
FED. ROAD DIST. NO.	ILLINOIS	PRO. Int. 55-7(220)280		

*(0404-640, ETC, 0711.2) RS-1

D-91-340-93

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

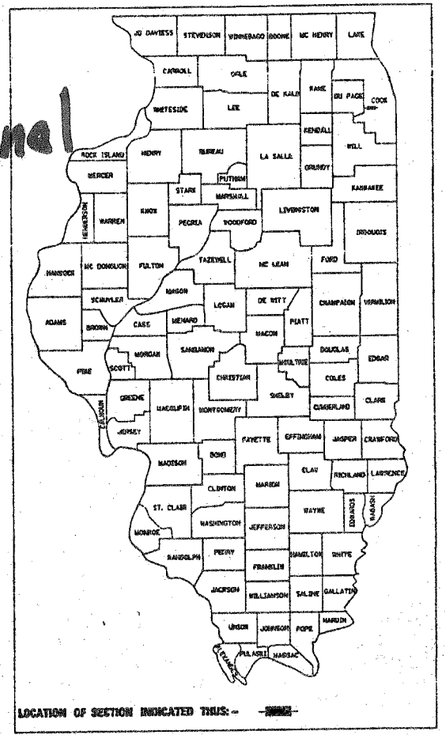
PLANS FOR PROPOSED HIGHWAY

FOR INDEX OF SHEETS, SEE SHEET NO. 2

NOTE: WHEREVER IN THESE PLANS THE *SECTION IS REFERENCED IT SHALL MEAN (0404-640, ETC, 0711.2) RS-1

SCALES { PLAN / PROFILE HORIZ. / PROFILE VERT. / CROSS SECTIONS

F.A.I. ROUTE 55 (STEVENSON EXPRESSWAY)
SECTION: (0404-640, ETC, 0711.2) RS-1
DES PLAINES RIVER TO IL ROUTE 43
RESURFACING, MEDIAN BARRIER, SURVEILLANCE, AND BRIDGE REHABILITATION
PROJECT: IM-55-7(220)280
COOK COUNTY
C-91-340-93



LOCATION OF SECTION INDICATED THUS: - [redacted] -

PROJECT LOCATED IN THE VILLAGES OF:
SUMMIT AND BEDFORD PARK

METRIC RATIOS

1 m 0 2 m — 1 : 50

0 5 m 10 m — 1 : 100

10 m 0 20 m — 1 : 250

5 m 0 20 m — 1 : 500

0 50 m 100 m — 1 : 1000

FULL SIZE PLANS HAVE BEEN PREPARED USING STANDARD ENGINEERING SCALES, REDUCED SIZED PLANS WILL NOT CONFORM TO STANDARD SCALES, IN MAKING MEASUREMENTS ON REDUCED PLANS, THE ABOVE SCALES MAY BE USED.

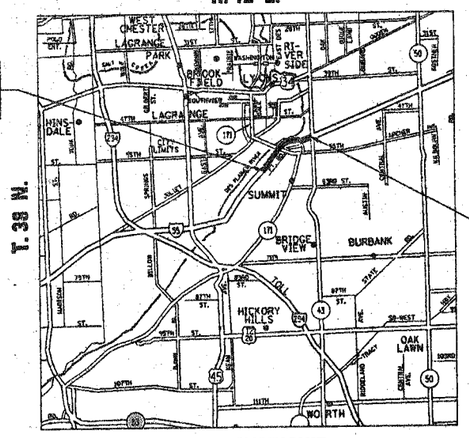
J.U.L.I.E.
JOINT UTILITY LOCATION INFORMATION FOR EXCAVATION
1-800-892-0123

CONTRACT NO. 82458

N

R. 12 E.

T. 38 N.



PROJECT BEGINS STATION 16+250

PROJECT ENDS STATION 21+250

LYONS TOWNSHIP

GROSS AND NET LENGTH OF PROJECT = 5000 METERS = 5.000 KM

BRIDGES:

FAI ROUTE 55 OVER B. & O. C.T. R.R.
STRUCTURE NOS. 016-0013(EB) 016-0012(WB)
STATION 18+435.63
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

FAI ROUTE 55 OVER CHICAGO SANITARY AND SHIP CANAL
STRUCTURE NOS. 016-0014(EB) 016-0015(WB)
STATION 20+513.228
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

NB IL ROUTE 171 TO EB FAI ROUTE 55 OVER SANITARY AND SHIP CANAL
STRUCTURE NO. 016-2408
DECK SCARIFICATION AND CONCRETE OVERLAY

TRAFFIC DATA

ADT (1991) = 134100 VEHICLES
ADT (2010) = 145000 TO 183000 VEHICLES
SPEED LIMIT = 55 MPH

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUBMITTED July 11 19 99
John P. Kos
DISTRICT ENGINEER
19

ENGINEER OF PROJECT DEVELOPMENT AND IMPLEMENTATION
AUGUST 13, 19 99
Bill Junkey
ENGINEER OF DESIGN AND ENVIRONMENT
AUGUST 13, 19 99
DIRECTOR, DIVISION OF HIGHWAYS

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

DIST. 1 - DESIGN /PLAN PREP. ENGINEER /RICK YOUNG /M. GOMEZ (847) 705-4055

Wed Jun 23 08:12:28 1999
s:\projects\pl276\8\typsec.ms2 LVet-83

B.M. #47 - Chiseled "[" on Lowest Step at End of Northeast End Post of Structure No. 016-0014 at 2.192 m Right of Sta. 20+619.790 Elev. 191.573

Existing Structure: S.N. 016-0014 (E.B.) & S.N. 016-0015 (W.B.) Built as F.A.I. Rte 55, Section 0707-616B at Sta. 346+70 (English) in 1964. Deck Wearing Surface Added in 1978. The Superstructure Consists of Five Spans of a Reinforced Concrete Deck on Steel Rolled Beam End Spans and Continuous Steel Plate Girder Interior Spans. The Substructure Consists of a Pile Bent Abutment, a Drilled Shaft Supported Abutment and Four - Three Column Piers. Length = 213.36 m (Back to Back Abutments), Width = 20.257 m (Out to Out Deck). Traffic to be Maintained. During the Rehabilitation of Both Structures, by Stage Construction.

No Salvage

Note: All Dimension are in Millimeters (mm) Except as Noted.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

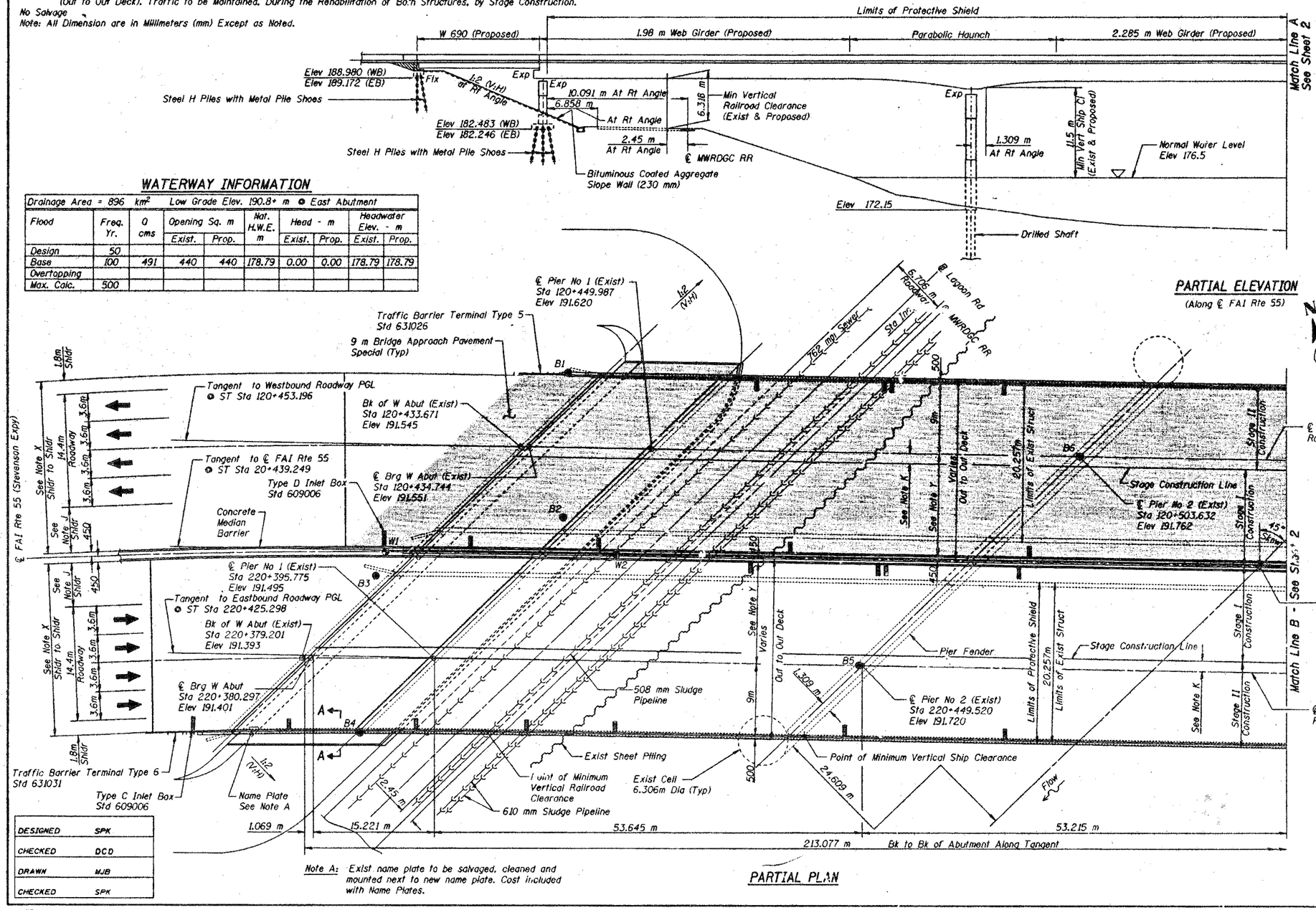
ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	B	COOK	578	312
FED. PROJ. SEQT. NO.	SUBSEQT.	FED. AID PROJECT		

SHEET NO. 1
63 SHEETS

* (0104-640, ETC. 0711.2)RS-1

STATION 20+513.228
REBUILT IN BY
STATE OF ILLINOIS
F.A.I. RT. 55 SEC.0707-616 B
F.A. PROJ.IM-55-7(220)ZEBO
LOADING MS18 & ALT
STR. NO. 016-0014

NAME PLATE
See Std. 515001



WATERWAY INFORMATION

Drainage Area = 896 km² Low Grade Elev. 190.8+ m @ East Abutment

Flood	Freq. Yr.	Q cms	Opening Sq. m		Nat. H.W.E. m	Head - m		Headwater Elev. - m	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
Design	50								
Base	100	491	440	440	178.79	0.00	0.00	178.79	178.79
Overtopping									
Max. Calc.	500								

DESIGNED	SPK
CHECKED	DCD
DRAWN	MJB
CHECKED	SPK

STATE OF ILLINOIS
STEVEN P. KARLOWSKI
91-4663
CHICAGO IL
LICENSED STRUCTURAL ENGINEER

Steven P Karlowski
STEVEN P. KARLOWSKI S.E.
IL. REG. NO. 081-004663
EXP: 11/30/2000
DATE: 3/27/98

Notes:

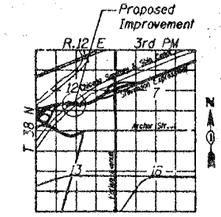
No Open Deck Drains will be Permitted in the Spans over Tracks or within 3 m of Cross Arms of a Railroad Pole Line. For Section A-A See Sheet 2. For Notes J,K,X & Y See Variable Deck Dimension Table on Sheet 8.

● 1962 Soil Borings

◐ 1995 Soil Borings

Indicates Str. No. 016-0015. See sheets 244 thru 308 of 578.

Ralph E. Anderson



LOCATION SKETCH

GENERAL PLAN (WEST PARTIAL)
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)

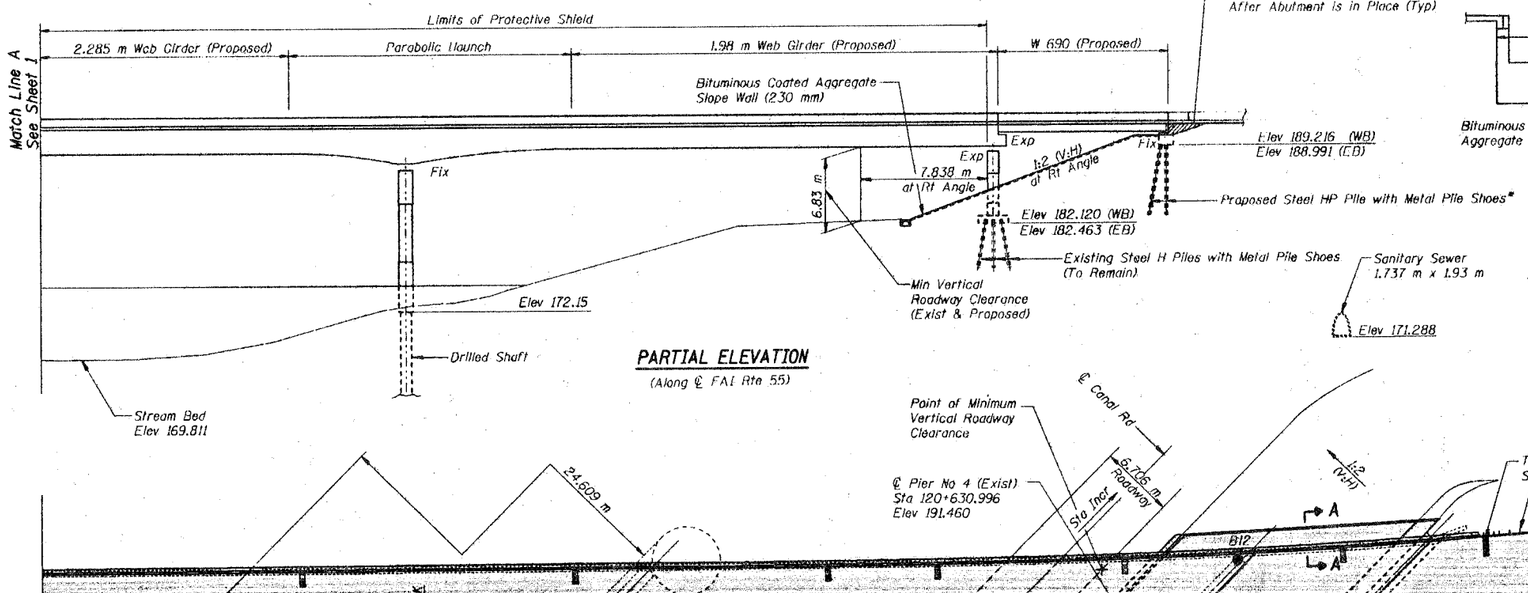
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

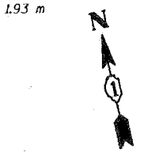
ROUTE NO.	SECTION	COUNTY	SHEET NO.	TOTAL SHEETS
F.A.I. 90	B	COOK	578	313
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

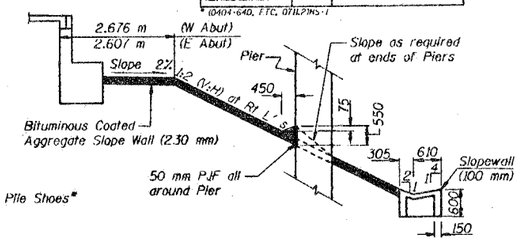
SHEET NO. 2
63 SHEETS

* (0404-640, ETC. OTILPINS-1

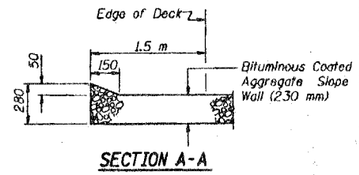
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION







SECTION THRU SLOPE WALL



SECTION A-A

DESIGN SPECIFICATIONS

AASHTO (1992) Standard Specification for Highway Bridges and 1993 - 1995 Interims.

Seismic Retrofitting Manual for Highway Bridges FHWA-RD-94-052 May 1995

LOADING MS18 & ALT

Allow 1.2 kN/m² for future wearing surface.

DESIGN STRESSES

f'_c = 24 MPa
f_s = 138 MPa (Existing Reinforcement)
f_y = 400 MPa (New Reinforcement)
f_y = 250 MPa (Exist Structural Steel)
f_y = 345 MPa (New Structural Steel, Spans 1 & 5)
f_y = 250 MPa (New Structural Steel, Spans 2-4)

SEISMIC DATA

Seismic Performance Category (SPC) = A
Bedrock Acceleration Coefficient (A) = 0.04g
Site Coefficient (S) = 1.0

Notes:

* Existing 610 mm Drilled Shafts at the East Abutment to remain in place and be incorporated into the new construction. The piles south of ℄ Eastbound Roadway are to be precored to Elev 170.679.

For Notes A & K See Variable Deck Dimension Table on Sheet 8.

● 1962 Soil Borings

◕ 1995 Soil Borings

Indicates Str. No. 016-0015. See sheets 244 thru 308 of 578.

DESIGNED	SPK
CHECKED	DCD
DRAWN	MJB
CHECKED	SPK

GENERAL PLAN (EAST PARTIAL)
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)

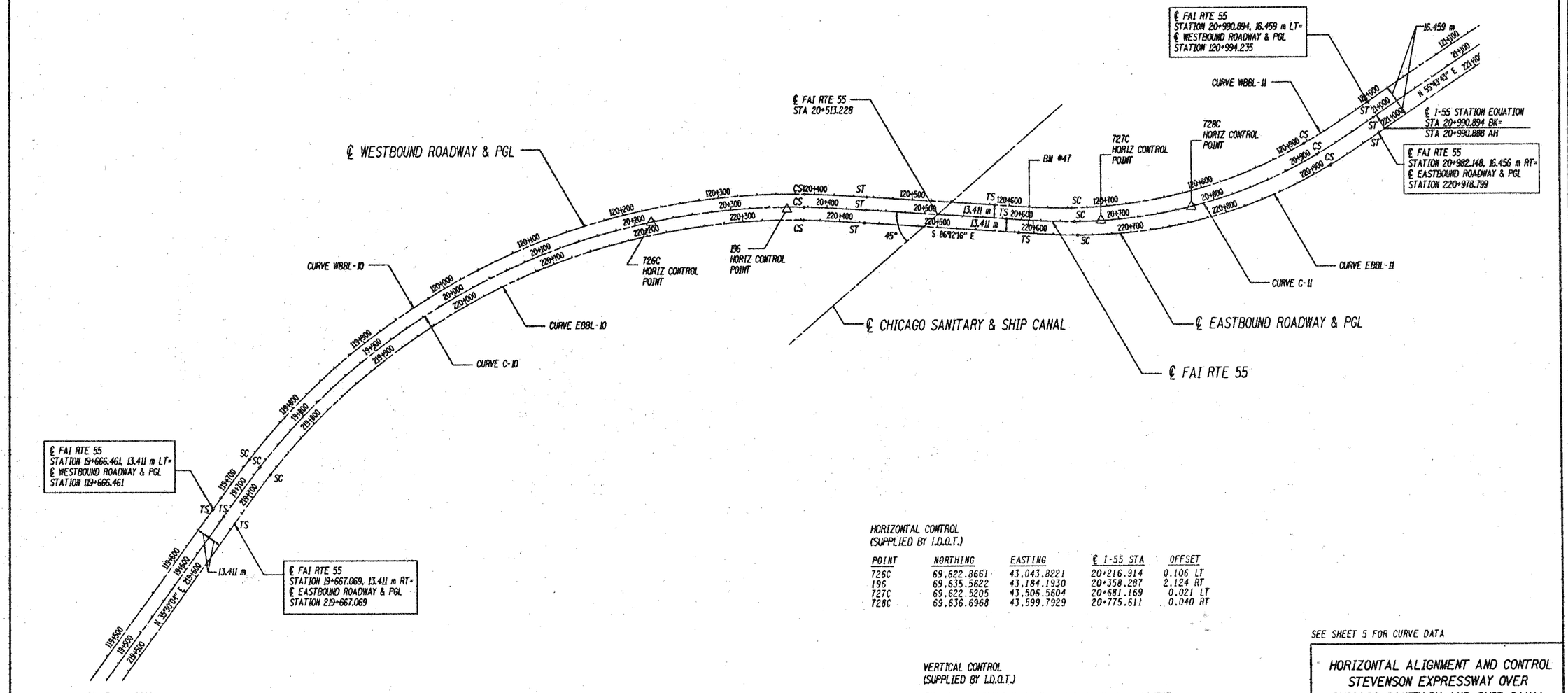
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

FEDERAL NO.	SECTION	COUNTY	TOTAL SHEET NO.	SHEET NO.
F.A.I. 55	0	COOK	578	315
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

SHEET NO. 4
63 SHEETS

* (0404-640, ETC, 0711.2)RS-1



SCALE = 1 : 2000

DESIGNED	GJH
CHECKED	JSN
DRAWN	MJB
CHECKED	JSN

HORIZONTAL CONTROL
(SUPPLIED BY I.D.O.T.)

POINT	NORTHING	EASTING	℄ I-55 STA	OFFSET
726C	69,622.8661	43,043.8221	20+216.914	0.106 LT
196	69,635.5622	43,184.1930	20+358.287	2.124 RT
727C	69,622.5205	43,506.5604	20+681.169	0.021 LT
728C	69,636.6968	43,599.7929	20+775.611	0.040 RT

VERTICAL CONTROL
(SUPPLIED BY I.D.O.T.)

BM #47 CHISELED SQUARE IN NE WING WALL LOWEST TIER OF EB I-55 EAST ABUTMENT.
ELEV.= 191.5732
APPROX. NORTHING = 69,624
EASTING = 43,451

SEE SHEET 5 FOR CURVE DATA

HORIZONTAL ALIGNMENT AND CONTROL
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

6P

016-0015
I-55 WB/
San & Ship Canal

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55	-	COOK	578	1
FED. ROAD DIST. NO.	ILLINOIS			

*(0404-640, ETC, 0711.2) RS-1

D-91-340-93

FOR INDEX OF SHEETS, SEE SHEET NO. 2

PLANS FOR PROPOSED HIGHWAY

NOTE: WHEREVER IN THESE PLANS THE *SECTION IS REFERENCED IT SHALL MEAN (0404-640, ETC, 0711.2) RS-1

SCALES (PLAN / PROFILE HORIZ. / PROFILE VERT. / CROSS SECTIONS)

F.A.I. ROUTE 55 (STEVENSON EXPRESSWAY)
SECTION: (0404-640, ETC, 0711.2) RS-1
DES PLAINES RIVER TO IL ROUTE 43
RESURFACING, MEDIAN BARRIER, SURVEILLANCE, AND BRIDGE REHABILITATION
PROJECT: IM-55-7(220)280
COOK COUNTY
C-91-340-93

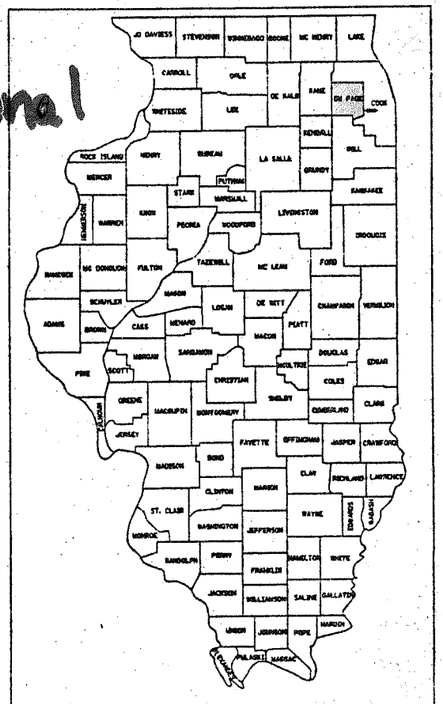
PROJECT LOCATED IN THE VILLAGES OF:
SUMMIT AND BEDFORD PARK

BRIDGES:

FAI ROUTE 55 OVER B. & O. C.T. R.R.
STRUCTURE NOS. 016-0013(EB) 016-0012(WB)
STATION 18+485.65
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

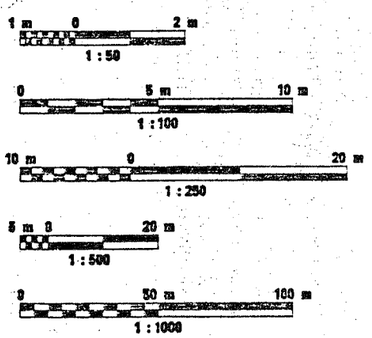
FAI ROUTE 55 OVER CHICAGO SANITARY AND SHIP CANAL
STRUCTURE NOS. 016-0014(EB) 016-0015(WB)
STATION 20+813.228
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

NB IL ROUTE 171 TO EB FAI ROUTE 55 OVER SANITARY AND SHIP CANAL
STRUCTURE NO. 016-2408
DECK SCARIFICATION AND CONCRETE OVERLAY



LOCATION OF SECTION INDICATED THUS: - -----

METRIC RATIOS



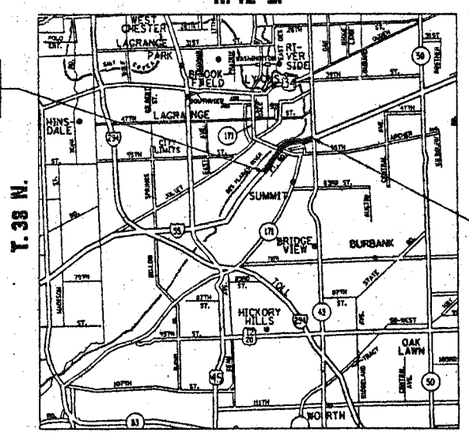
FULL SIZE PLANS HAVE BEEN PREPARED USING STANDARD ENGINEERING SCALES, REDUCED SIZED PLANS WILL NOT CONFORM TO STANDARD SCALES. IN MAKING MEASUREMENTS ON REDUCED PLANS, THE ABOVE SCALES MAY BE USED.

J.U.L.I.E.
JOINT UTILITY LOCATION INFORMATION FOR EXCAVATION
1-800-892-0123

CONTRACT NO. 82458

N

PROJECT BEGINS
STATION 16+250



LYONS TOWNSHIP

PROJECT ENDS
STATION 21+250

GROSS AND NET LENGTH OF PROJECT = 5000 METERS = 5.000 KM

TRAFFIC DATA

ADT (1991) = 134100 VEHICLES
ADT (2016) = 145000 TO 183000 VEHICLES
SPEED LIMIT = 55 MPH

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUBMITTED July 11 19 99
John P. Kay
DISTRICT ENGINEER

19

ENGINEER OF PROJECT DEVELOPMENT AND IMPLEMENTATION

AUGUST 13, 19 99
Bill Shankey
ENGINEER OF DESIGN AND ENVIRONMENT

AUGUST 13, 19 99
DIRECTOR, DIVISION OF HIGHWAYS

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

DIST. 1 - DESIGN /PLAN PREP. ENGINEER /RICK YOUNG /M. GOMEZ (847) 705-4055

Wed Jun 23 08:26:26 1999
d:\projects\pi2760\typsec.sz LYel-63

B.M. #447 - Chiseled "J" on Lowest Step at End of Northeast End Post of Structure No. 016-0014 at 2.192 m Right of Sta. 20+619.790 Elev. 191.573

Existing Structure: S.N. 016-0014 (E.B.) & S.N. 016-0015 (W.B.) Built as F.A.I. Rte 55, Section 0707-616B at Sta. 346+70 (English) in 1964. Deck Wearing Surface Added in 1978. The Superstructure Consists of Five Spans of a Reinforced Concrete Deck on Steel Rolled Beam End Spans and Continuous Steel Plate Girder Interior Spans. The Substructure Consists of a Pile Bent Abutment, a Drilled Shaft Supported Abutment and Four - Three Column Piers. Length = 213.36 m (Back to Back Abutments), Width = 20.257 m (Out to Out Deck). Traffic to be Maintained, During the Rehabilitation of Both Structures, by Stage Construction.

No Salvage

Note: All Dimension are in Millimeters (mm) Except as Noted.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

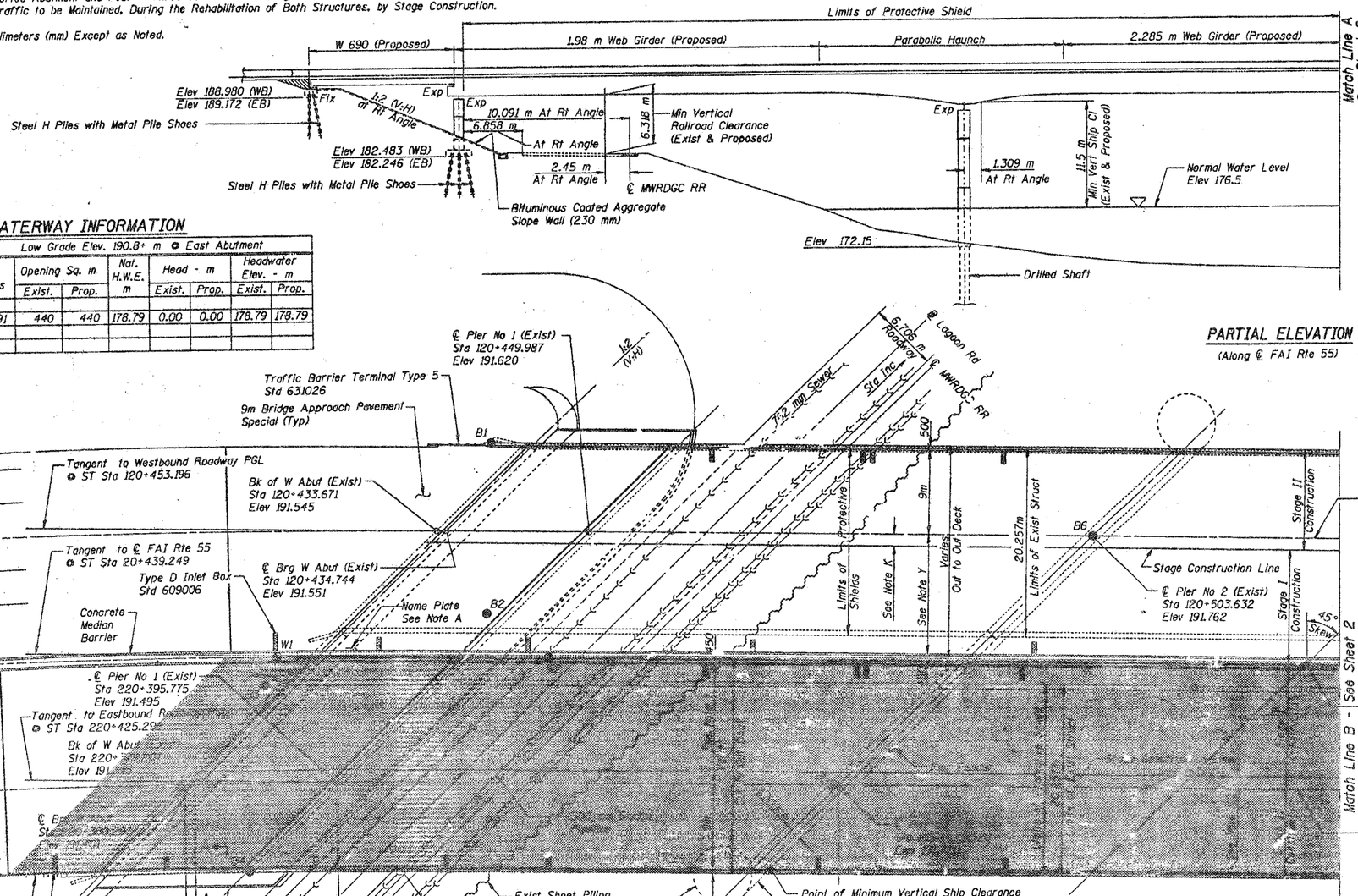
ROUTE	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0	COOK	578	244
FED. ROAD DIST. NO. 9	ILLINOIS	FED. AID PROJECT		

SHEET NO. 1
63 SHEETS

* (0404-640, ETC. 0711.21RS-1

STATION 20+513.228
REBUILT 19 BY
STATE OF ILLINOIS
F.A.I. RT. 55 SEC. 0707-616 B
F.A. PROJ. [illegible]
LOADING MS18 & AIT
STR. NO. 016-0015

NAME PLATE
See Std. 515001



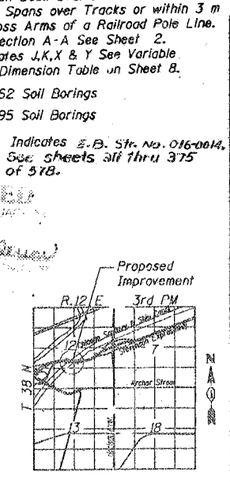
WATERWAY INFORMATION

Drainage Area = 896 km² Low Grade Elev. 190.8+ m ℄ East Abutment

Flood	Freq. Yr.	Q cms	Opening Sq. m Exist.	Opening Sq. m Prop.	Nat. H.W.E. m	Head - m Exist.	Head - m Prop.	Headwater Elev. - m Exist.	Headwater Elev. - m Prop.
Design	50								
Base	100	491	440	440	178.79	0.00	0.00	178.79	178.79
Overtopping									
Max. Calc.	500								

PARTIAL ELEVATION

(Along ℄ FAI Rte 55)



LOCATION SKETCH

STATE OF ILLINOIS
STEVEN P. KARLOWSKI
81-4663
CHICAGO
IL
LICENSED STRUCTURAL ENGINEER

STEVEN P. KARLOWSKI S.E.
IL. REG. NO. 081-004663
EXP: 11/30/2000
DATE: 3/27/98

Notes:

No Open Deck Drains will be Permitted in the Spans over Tracks or within 3 m of Cross Arms of a Railroad Pole Line. For Section A-A See Sheet 2. For Notes J,K,X & Y See Variable Deck Dimension Table on Sheet 8.

● 1962 Soil Borings

● 1995 Soil Borings

Indicates E.B. Str. No. 016-0014. See sheets all thru 375 of 378.

APPROVED
Ralph E. Anderson

DESIGNED	SPK
CHECKED	DCD
DRAWN	MJB
CHECKED	SPK

Note A: Exist name plate to be salvaged, cleaned and mounted next to new name plate. Cost included with Name Plates.

PARTIAL PLAN

GENERAL PLAN (WEST PARTIAL)
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

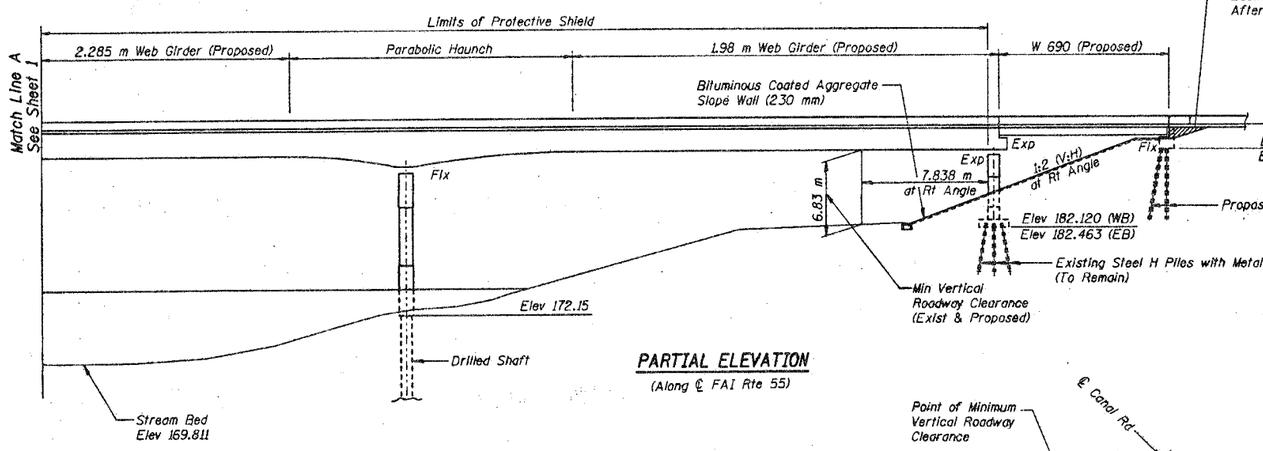
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

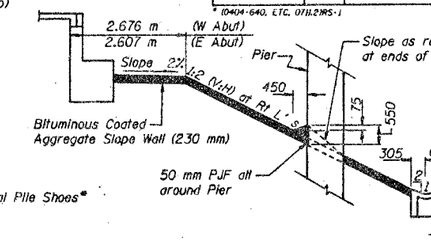
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

COUNTY NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0	COOK	578	245

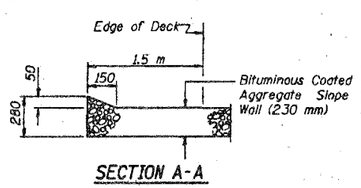
SHEET NO. 2
63 SHEETS

* 10404-640, ETC. 07IL2WRS-1

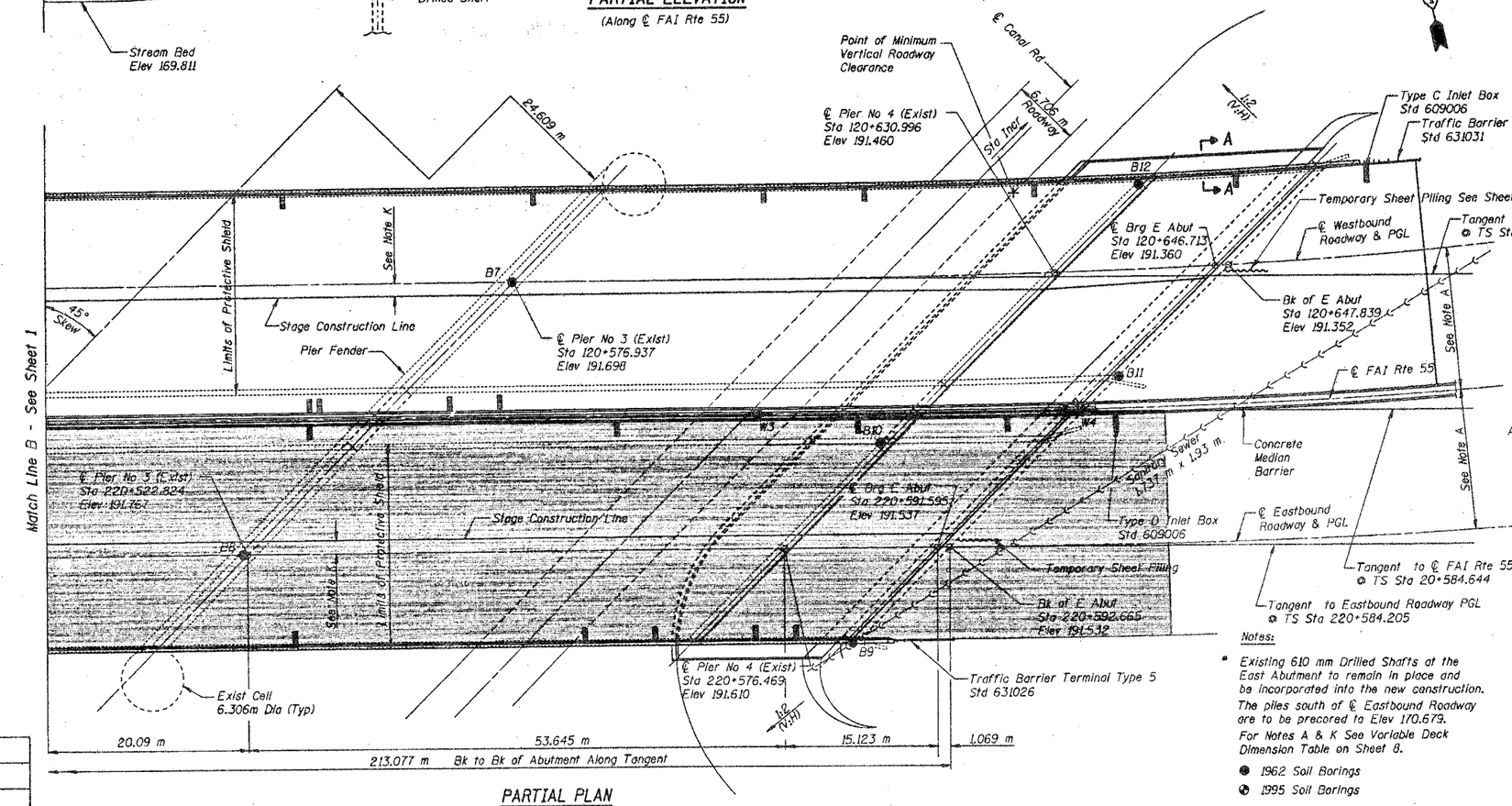




SECTION THRU SLOPE WALL



SECTION A-A



PARTIAL PLAN

DESIGN SPECIFICATIONS

AASHTO (1992) Standard Specification for Highway Bridges and 1993 - 1995 Interims.

Seismic Retrofitting Manual for Highway Bridges FHWA-RD-94-052 May 1995

LOADING MS18 & ALT

Allow 1.2 kN/m² for future wearing surface.

DESIGN STRESSES

f'_c = 24 MPa
f_s = 138 MPa (Existing Reinforcement)
f_y = 400 MPa (New Reinforcement)
f_y = 250 MPa (Exist Structural Steel)
f_y = 345 MPa (New Structural Steel, Spans 1 & 5)
f_y = 250 MPa (New Structural Steel, Spans 2-4)

SEISMIC DATA

Seismic Performance Category (SPC) = A
Bedrock Acceleration Coefficient (A) = 0.04g
Site Coefficient (S) = 1.0

Notes:

* Existing 610 mm Drilled Shafts at the East Abutment to remain in place and be incorporated into the new construction. The piles south of ℄ Eastbound Roadway are to be precored to Elev 170.679.

For Notes A & K See Variable Deck Dimension Table on Sheet 8.

● 1962 Soil Borings
◐ 1995 Soil Borings

Indicates E.B. Str. No. 016-0014. See sheets 311 thru 375 of 578.

DESIGNED	SPK
CHECKED	DCD
DRAWN	MJB
CHECKED	SPK

GENERAL PLAN (EAST PARTIAL)
STEVENSON EXPRESSWAY OVER CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

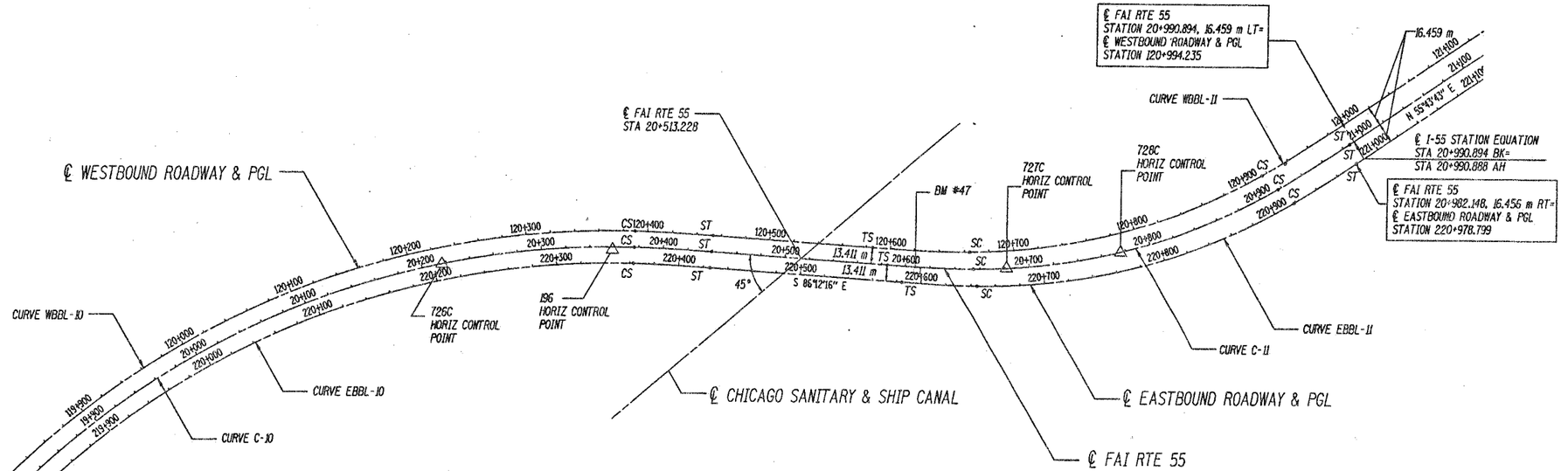
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

AREA NO.	SECTION	COUNTY	STATE SHEET NO.	PROJECT NO.
F.A.I. 55	10	COOK	578	247
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

SHEET NO. 4
63 SHEETS

* 10404-640, ETC, 07IL2IRS-1



HORIZONTAL CONTROL
(SUPPLIED BY I.D.O.T.)

POINT	NORTHING	EASTING	℄ I-55 STA	OFFSET
726C	69,622.8661	43,043.8221	20+216.914	0.106 LT
196	69,635.5622	43,184.1930	20+358.287	2.124 RT
727C	69,622.5205	43,506.5604	20+681.169	0.021 LT
728C	69,636.6968	43,599.7929	20+775.611	0.040 RT

VERTICAL CONTROL
(SUPPLIED BY I.D.O.T.)

BM #47 CHISELED SQUARE IN NE WING WALL LOWEST TIER OF EB I-55 EAST ABUTMENT.
ELEV.= 191.5732
APPROX. NORTHING = 69,624
EASTING = 43,451

SEE SHEET 5 FOR CURVE DATA

DESIGNED	GJH
CHECKED	JSN
DRAWN	MJB
CHECKED	JSN

HORIZONTAL ALIGNMENT AND CONTROL
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

B.M. #47 - Chiseled "[]" on Lowest Step at End of Northeast End Post of Structure No. 016-0014 at 2.192 m Right of Sta. 20+619.790 Elev. 191.573

Existing Structure: S.N. 016-0014 (E.B.) & S.N. 016-0015 (W.B.) Built as F.A.I. Rte 55, Section 0707-616B at Sta. 346+70 (English) in 1964. Deck Wearing Surface Added in 1978. The Superstructure Consists of Five Spans of a Reinforced Concrete Deck on Steel Rolled Beam End Spans and Continuous Steel Plate Girder Interior Spans. The Substructure Consists of a Pile Bent Abutment, a Drilled Shaft Supported Abutment and Four - Three Column Piers. Length = 213.36 m (Back to Back Abutments), Width = 20.257 m (Out to Out Deck). Traffic to be Maintained, During the Rehabilitation of Both Structures, by Stage Construction.

No Salvage

Note: All Dimension are in Millimeters (mm) Except as Noted.

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

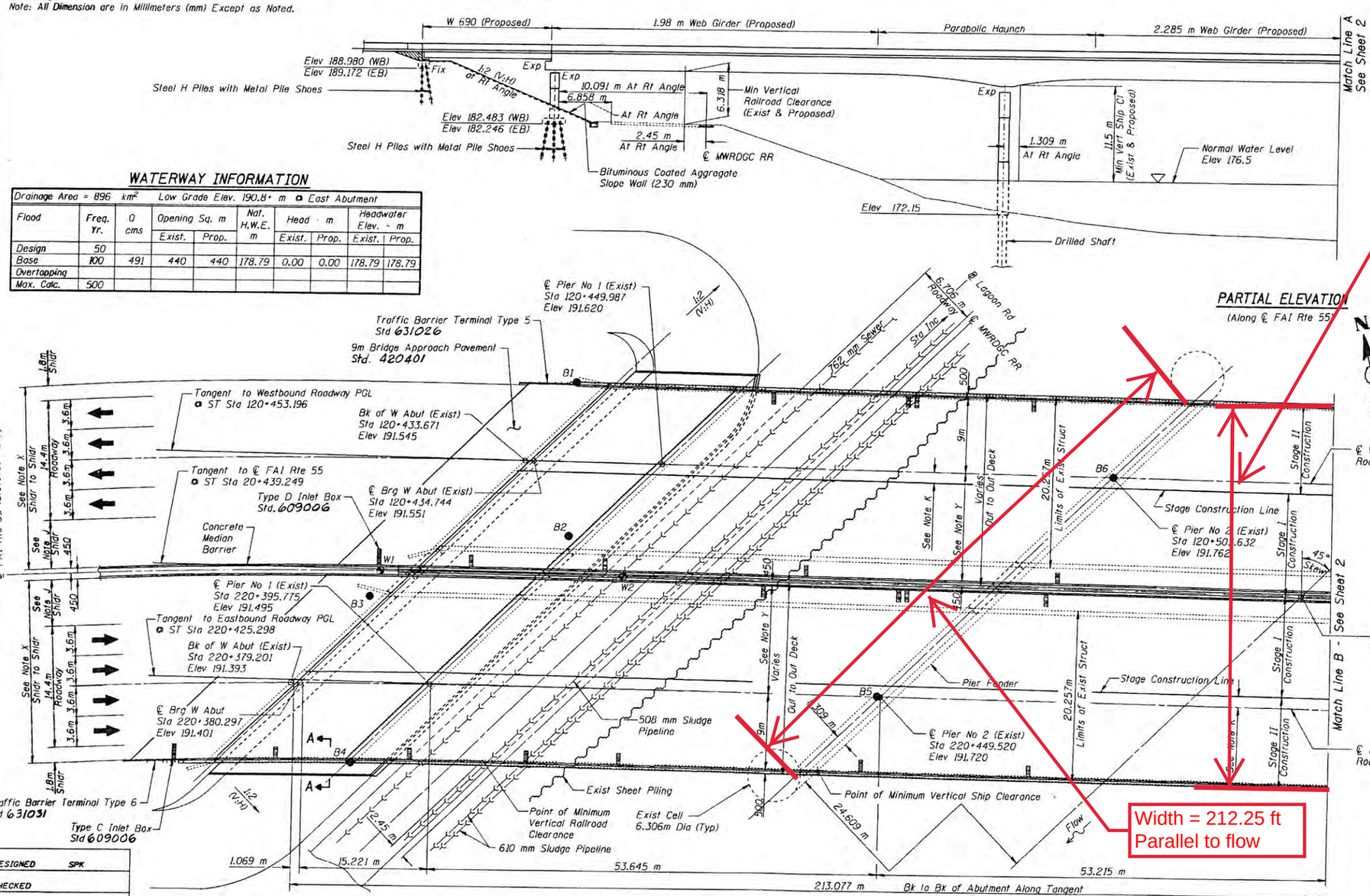
MAP NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0707-616 B	COOK	100	64
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT:		

SHEET NO. 1
36 SHEETS

WATERWAY INFORMATION

Drainage Area = 896 km² Low Grade Elev. 190.8+ m @ East Abutment

Flood	Freq. Yr.	Q cms	Opening Sq. m Exist.	Opening Sq. m Prop.	Nat. H.W.E. m	Head - m Exist.	Head - m Prop.	Headwater Elev. - m Exist.	Headwater Elev. - m Prop.
Design	50								
Base	100	491	440	440	178.79	0.00	0.00	178.79	178.79
Overtopping									
Max. Calc.	500								



Width = 150.1 ft
Perpendicular to centerline of Road

Width = 212.25 ft
Parallel to flow

DESIGNED	SPK
CHECKED	
DRAWN	MJB
CHECKED	SPK

STATE OF ILLINOIS
STEVEN P. KARLOWSKI
081-4663
CHICAGO IL
LICENSED STRUCTURAL ENGINEER

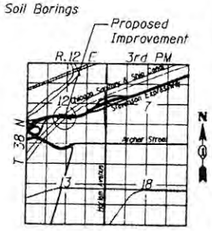
Steven P. Karlowski
STEVEN P. KARLOWSKI S.E.
IL. REG. NO. 081-004663
EXP: 11/30/1998
DATE: 1/10/97

APPROVED AND SEALED
FOR STRUCTURAL ADEQUACY ONLY

Ralph E. Anderson
ENGINEER OF BRIDGES AND STRUCTURES

Notes:
No Open Deck Drains will be Permitted in the Spans over Tracks or within 3 m of Cross Arms of a Railroad Pole Line.
For Section A-A See Sheet 2.
For Notes J,K,X & Y See Variable Deck Dimension Table on Sheet 9.

● 1962 Soil Borings
◕ 1995 Soil Borings



LOCATION SKETCH

GENERAL PLAN (WEST PARTIAL)
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

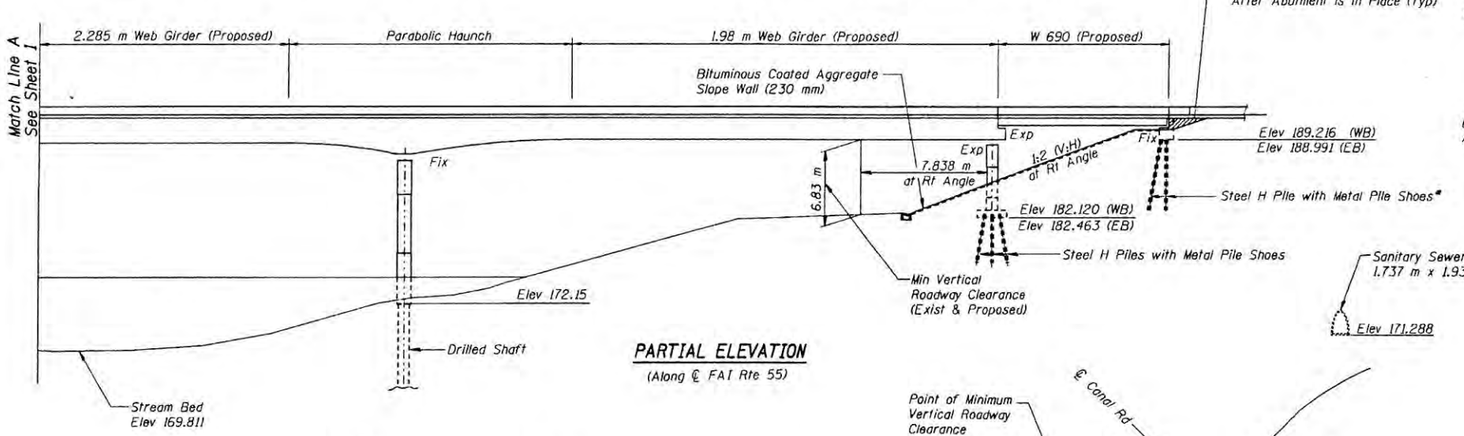
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

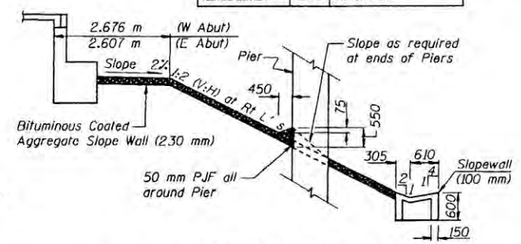
016-0014 (EB) 0015 (WB)

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

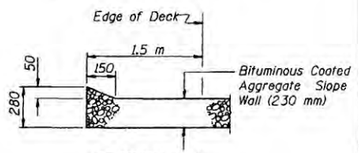
ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0707-616 B	COOK	100	65
F.A.U. ROAD DIST. NO. 1	ILLINOIS	F.A.U. AIR PROJECT		

SHEET NO. 2
36 SHEETS

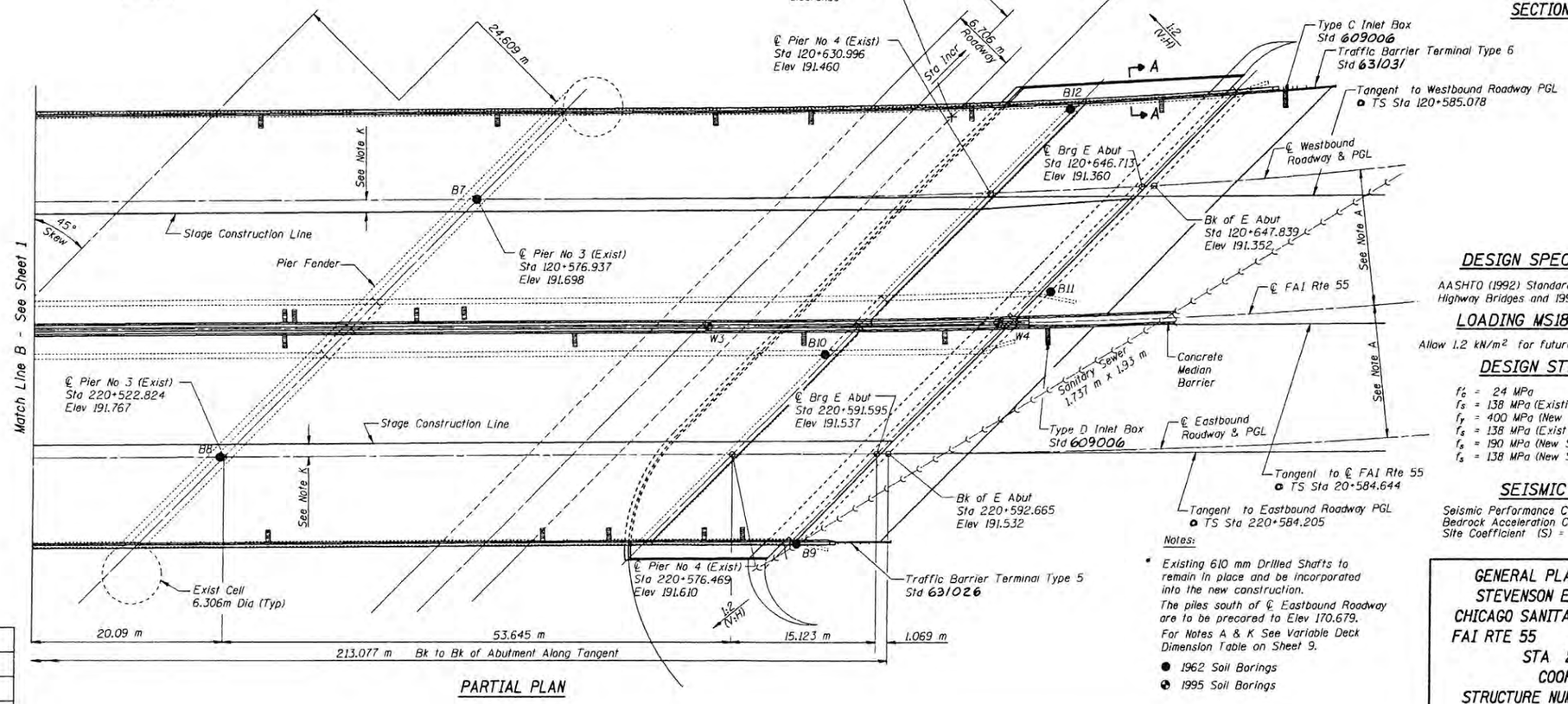




SECTION THRU SLOPE WALL



SECTION A-A



PARTIAL PLAN

DESIGN SPECIFICATIONS

AASHTO (1992) Standard Specification for Highway Bridges and 1993 - 1995 Interims.

LOADING MS18 & ALT

Allow 1.2 kN/m² for future wearing surface.

DESIGN STRESSES

f'_c = 24 MPa
f_s = 138 MPa (Existing Reinforcement)
f_y = 400 MPa (New Reinforcement)
f_s = 138 MPa (Exist Structural Steel)
f_s = 190 MPa (New Structural Steel, Spans 1 & 5)
f_s = 138 MPa (New Structural Steel, Spans 2-4)

SEISMIC DATA

Seismic Performance Category (SPC) = A
Bedrock Acceleration Coefficient (A) = 0.04g
Site Coefficient (S) = 1.0

Notes:

* Existing 610 mm Drilled Shafts to remain in place and be incorporated into the new construction. The piles south of ℄ Eastbound Roadway are to be precored to Elev 170.679. For Notes A & K See Variable Deck Dimension Table on Sheet 9.

● 1962 Soil Borings
◔ 1995 Soil Borings

DESIGNED	SPK
CHECKED	
DRAWN	WJB
CHECKED	SPK

GENERAL PLAN (EAST PARTIAL)
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. 55	0707-616 B	COOK	100	93	SHEET NO. 10
					36 SHEETS

35.35 ft Span 1

124.45 ft Span 2

177.06 ft Span 3

124.45 ft Span 4

35.08 ft Span 5

496.39 ft Face to Face of Abutments

℄ Pier No 1 — ℄ Pier No 2 — ℄ Pier No 3 — ℄ Pier No 4

Back of West Abutment

Back of East Abutment

℄ Lagoon Rd & MWRDGC RR*

℄ Chicago Sanitary & Ship Canal

℄ Canal Road

℄ Westbound Roadway & PGL

℄ FAI Rte 55 (Stevenson Expy)

℄ Eastbound Roadway & PGL

Tangent to ℄ FAI Rte 55 ○ ST Sta 20+439.249

Tangent to Westbound Roadway PGL ○ ST Sta 120+453.196

Sta 120+433.671

Sta 120+449.987

ST (WBBL-10) Sta 120+453.196

Sta 120+503.633

Sta 120+576.937

TS (WBBL-11) Sta 120+585.078

Sta 120+647.839

Tangent to Westbound Roadway PGL ○ TS Sta 120+585.078

Sta 120+630.996

Tangent to ℄ FAI Rte 55 ○ TS Sta 20+584.644

Sta 220+379.201

Sta 220+395.775

ST (EBBL-10) Sta 220+425.298

Sta 220+449.520

Sta 220+522.824

Sta 220+576.469

TS (EBBL-11) Sta 220+584.205

Sta 220+592.665

Tangent to Eastbound Roadway PGL ○ TS Sta 220+584.205

Tangent to Eastbound Roadway PGL ○ ST Sta 220+425.298

Sta 20+513.228 ℄ FAI Rte 55 45° Skew (Typ)

Sta 20+586.944 (℄ FAI Rte 55) Sta 1+500.000 (℄ Canal Road)

Sta 20+438.125 (℄ FAI Rte 55) Sta 2+600.000 (℄ Lagoon Rd & MWRDGC RR)

TS (C-11) Sta 20+584.644

ST (C-10) Sta 20+439.249

13.411 m

3.802 m | 14.865 m | 18.667 m | 4.275 m | 12.510 m | 18.953 m | 10.357 m | 13.624 m | 10.506 m | 18.966 m (Typ) | 12.354 m | 6.612 m

3.682 m | 15.557 m | 19.239 m | 4.275 m | 12.510 m | 18.953 m | 2.168 m | 6.612 m | 12.354 m | 18.966 m (Typ) | 10.506 m | 10.351 m | 13.526 m

10.506 m | 18.966 m | 12.354 m | 6.612 m | 4.275 m | 2.168 m | 4.301 m | 18.953 m | 12.484 m | 11.290 m | 14.843 m | 19.128 m

18.966 m | 12.354 m | 18.953 m | 12.510 m | 18.779 m | 10.351 m | 13.532 m

13.411 m (Typ) | 13.411 m (Typ)

16.29 m | 53.645 m | 73.305 m | 53.645 m | 16.192 m

213.077 m Back to Back of Abutments Along Tangent (Exist)

Note: * See Sheet 6 for Layout of Lagoon Rd & MWRDGC RR and Canal Road

SUBSTRUCTURE LAYOUT

Lengths Parallel To Centerline

DESIGNED	GJH
CHECKED	JSN
DRAWN	MJB
CHECKED	SPK

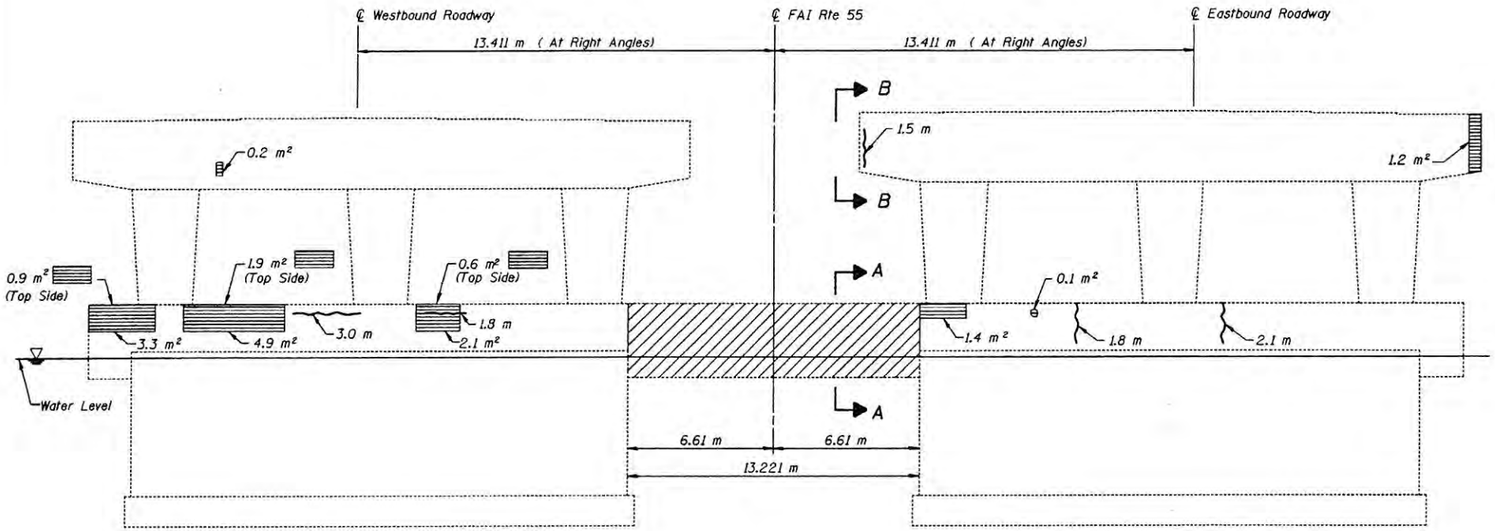
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

SUBSTRUCTURE LAYOUT
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

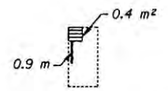
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

ROUTE	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0707-616 B	COOK	100	81
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT-		

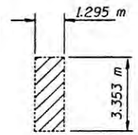
SHEET NO. 18
36 SHEETS



WEST ELEVATION



SECTION B-B



SECTION A-A

Notes:

Existing horizontal reinforcement bars projecting from the piers into the area of concrete removal are to remain in place. The existing reinforcement shall be sandblasted clean, straightened and incorporated into the new construction. Cost included with Concrete Removal.

Repair of the existing pier shall include but not be limited to the areas shown. The actual areas to be repaired will be determined by the Engineer at the time of construction.

Indicates limits of Concrete Removal

Indicates limits of High Performance Shotcrete

Indicates limits of Epoxy Crack Sealing

BILL OF MATERIAL

Item	Unit	Quantity
Concrete Removal	m^3	57.4
High Performance Enhanced Shotcrete	m^2	17.0
Epoxy Crack Sealing	m	11.1

PIER NO 2 REPAIRS & CONCRETE REM
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

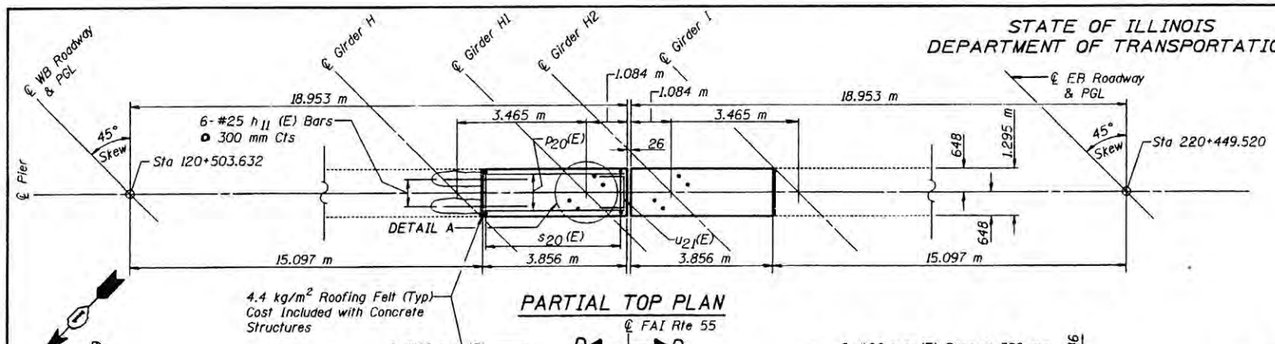
DESIGNED	
CHECKED	
DRAWN	GEW
CHECKED	SPK

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

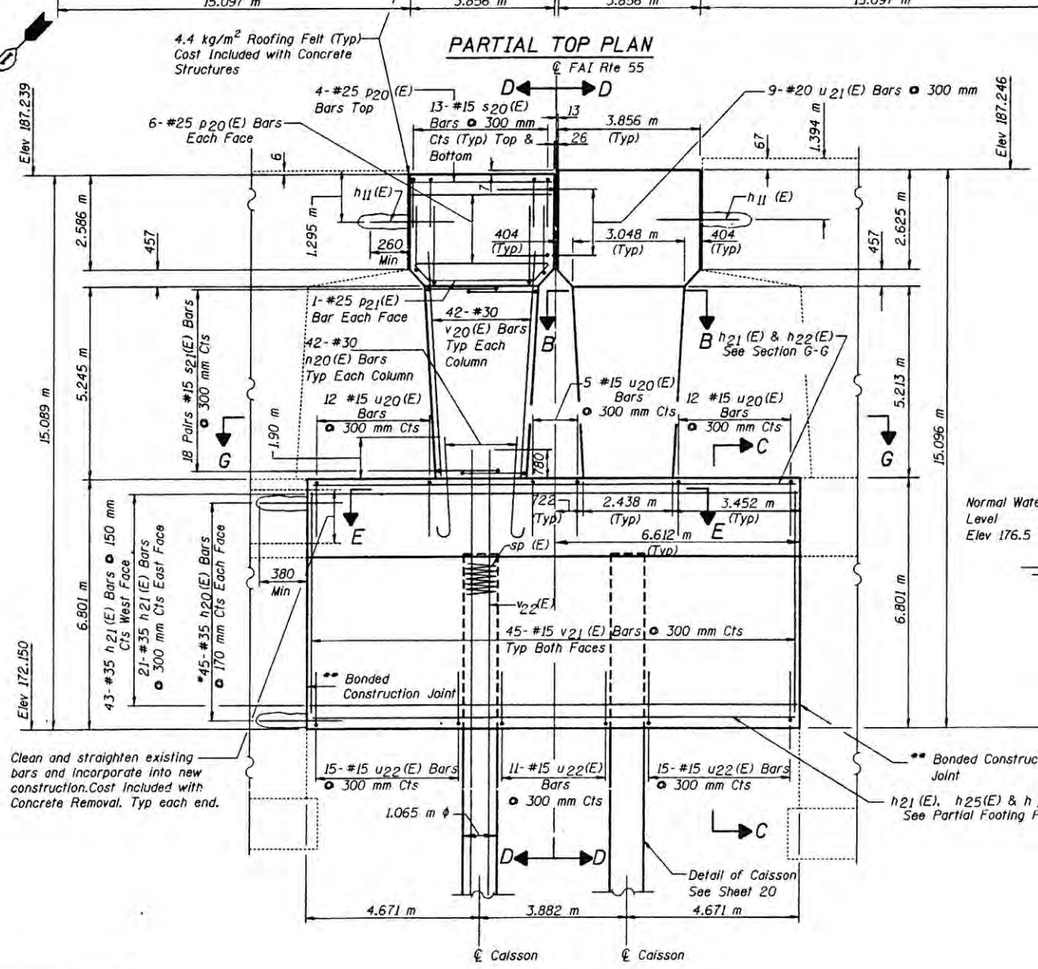
	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0707-616 B	COOK	100	82
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

SHEET NO. 19
36 SHEETS

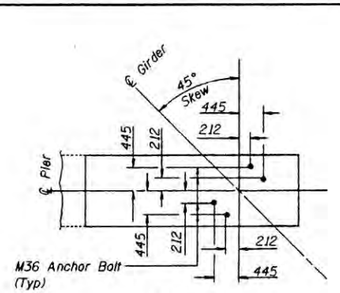
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION



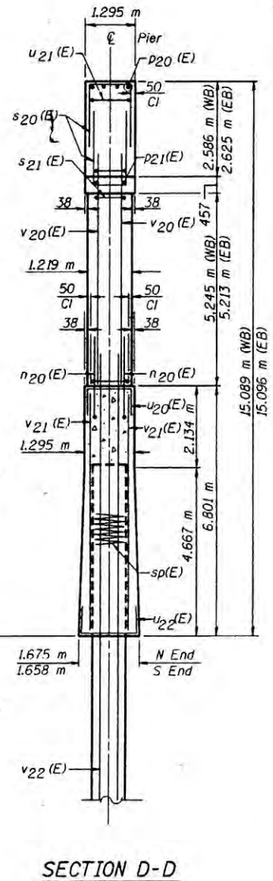
PARTIAL TOP PLAN



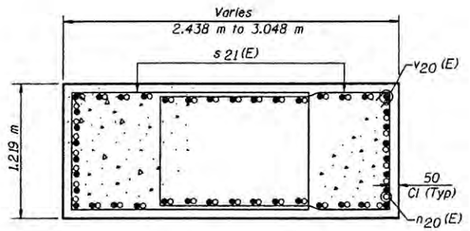
WEST ELEVATION
(LOOKING EAST)



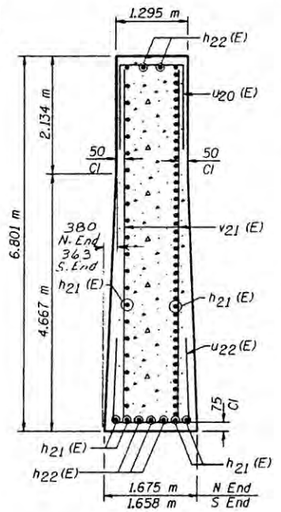
DETAIL A
ANCHOR BOLT LAYOUT (TYP)



SECTION D-D



SECTION B-B



SECTION C-C

Notes:

For Location of Pier Fender Anchor Bolts See Sheet 24.

The M36 Anchor Bolts for the girder's bearings are not part of the Substructure Widening Contract. They are to be furnished and installed by others.

For Partial Footing Plan, Caisson Detail, Section E-E, Section G-G, Bar Details and Bill of Material See Sheet 20.

All Dimensions are in Millimeters (mm) Unless Otherwise Noted.

Bars not shown for Pier 2 (EB) are to be the same as the bars for Pier 2 (WB).

Reinforcement bars that are to be grouted into existing concrete shall be spaced at least 150 mm from the edge of existing concrete. Contractor shall avoid drilling into existing reinforcement.

* Drill and epoxy grout $h_{20}(E)$ bars in 41 mm ϕ x 380 mm (min) holes in existing concrete. Drill and epoxy grout $h_{23}(E)$ bars in 31 mm ϕ x 230 mm (min) holes in existing concrete. The grout and the method of application shall be approved by the Department. (See Standard Specifications.) Cost of hole drilling and epoxy grouting are included with "Reinforcement Bars, Epoxy Coated".

** Construction joint to be bonded in accordance with Article 503.09 (a)(2) of the Standard Specifications.

Min Bar Lap
#35 Bar = 2.64 m

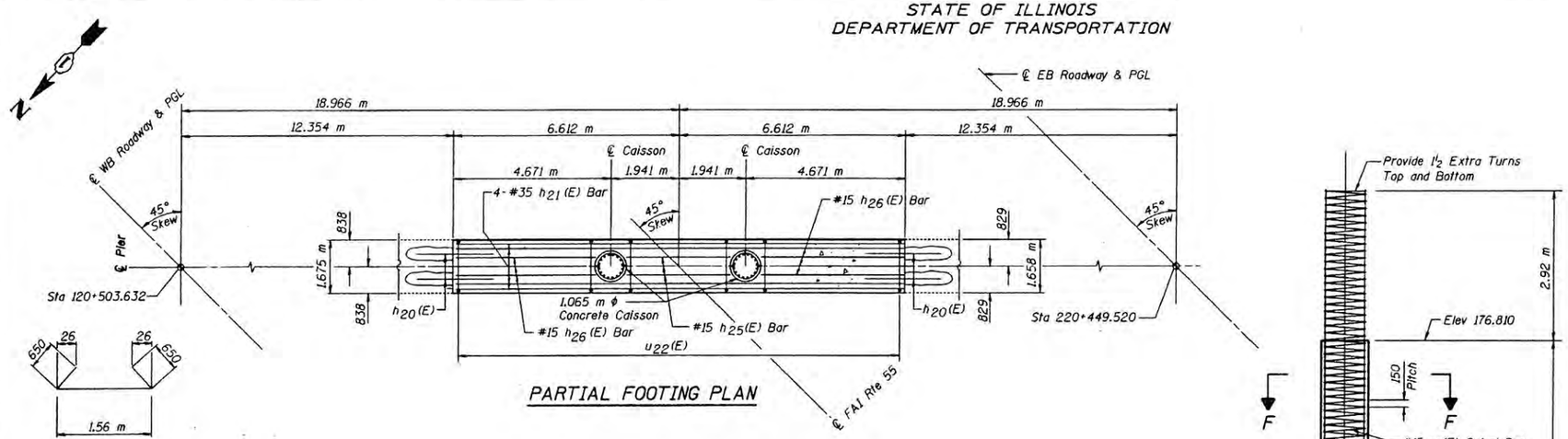
DESIGNED	S KORPI
CHECKED	DWC
DRAWN	MJB
CHECKED	SPK

PIER NO 2 WIDENING
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

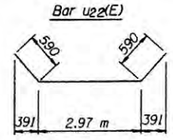
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. 55	0707-616 B	COOK	100	83	SHEET NO. 20
					36 SHEETS

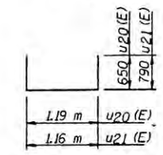


PARTIAL FOOTING PLAN

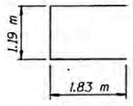
Bar u22(E)



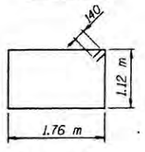
Bar p21(E)



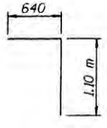
Bars u 20 (E) & u 21 (E)



Bar s20 (E)

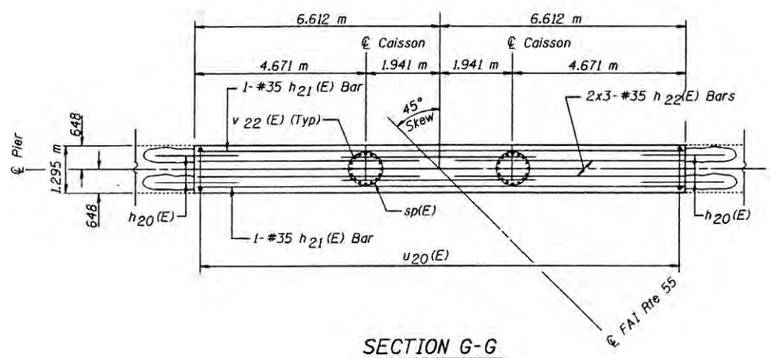


Bar s 21 (E)

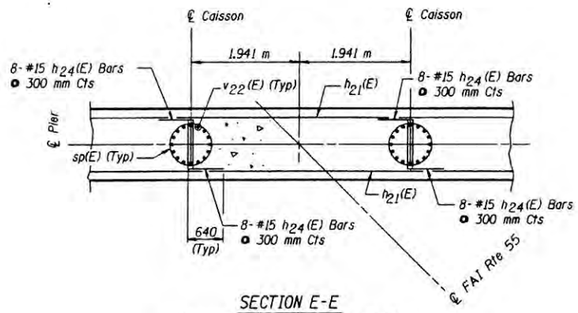


Bar h24 (E)

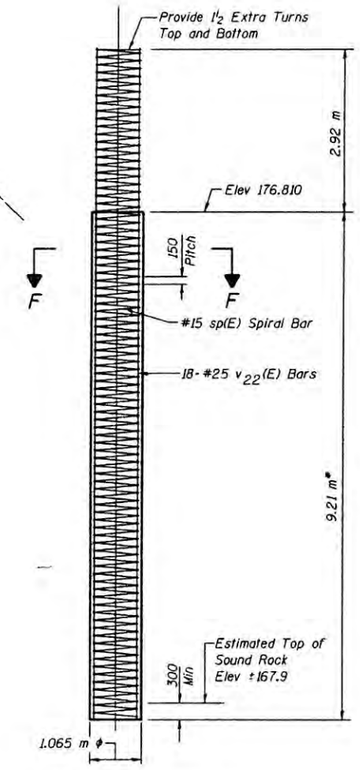
DESIGNED	S KORPI
CHECKED	DWC
DRAWN	MJB
CHECKED	SPK



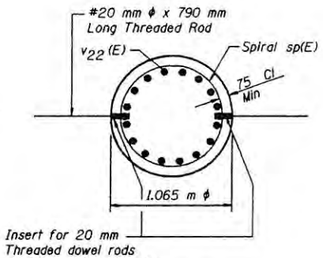
SECTION G-G
TOP OF CRASHWALL



SECTION E-E
Between Elev 178.951 and Elev 176.810



CAISSON DETAIL



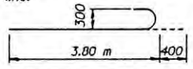
SECTION F-F
Between Elev 176.81 and Elev 172.15

BILL OF MATERIAL

Bar	No.	Size	Length (m)	Shape
h_{11} (E)	12	#25	1.04	—
h_{20}(E)	180	#35	3.07	—
h_{21}(E)	70	#35	13.12	—
h_{22}(E)	6	#35	6.14	—
h_{24}(E)	32	#15	1.74	⌐
h_{25}(E)	3	#15	2.72	—
h_{26}(E)	6	#15	4.04	—
n_{20}(E)	84	#30	4.20	∪
p_{20}(E)	32	#25	3.75	—
p_{21}(E)	4	#25	4.15	∪
s_{20}(E)	52	#15	4.85	⊓
s_{21}(E)	72	#15	6.04	⊓
sp(E)	2	#15	237.55	∿∿∿
u_{20}(E)	29	#15	2.49	⊏
u_{21}(E)	18	#20	2.74	⊏
u_{22}(E)	41	#15	2.86	⊏
v_{20}(E)	84	#30	7.07	—
v_{21}(E)	90	#15	6.68	—
v_{22}(E)	36	#25	12.13	—
Cofferdam Excavation		m^3	220	
Cofferdams		Each	1	
Concrete Structure		m^3	184.7	
Seal Coat Concrete		m^3	175.9	
Reinforcement Bars, Epoxy Coated		kg	22,660	
Caisson Shafts 1065 mm		m^3	16.4	

Reinforcement Bars Designated (E) Shall be Epoxy Coated

Bars indicated thus 2x3-#35 etc indicates 2 lines of bars with 3 lengths per line.



Bar n 20 (E)

Notes:

Minimum spiral lap = 768 mm (48 spiral bar diameters).
Provide 4-#15 spacers or equivalent.
Design loading of caisson = 7.3 MPa.

* Caisson Length Shown is Approximate. Actual Length will be Determined at the Time of Construction.

Cost of all inserts and threaded dowel rods for inserts are included with "Caisson Shafts 1065 mm".

Inserts are to be single coil, flared loop type.
Inserts are to engage the reinforcement cage.

For Cofferdam Layout See Sheet 24A.

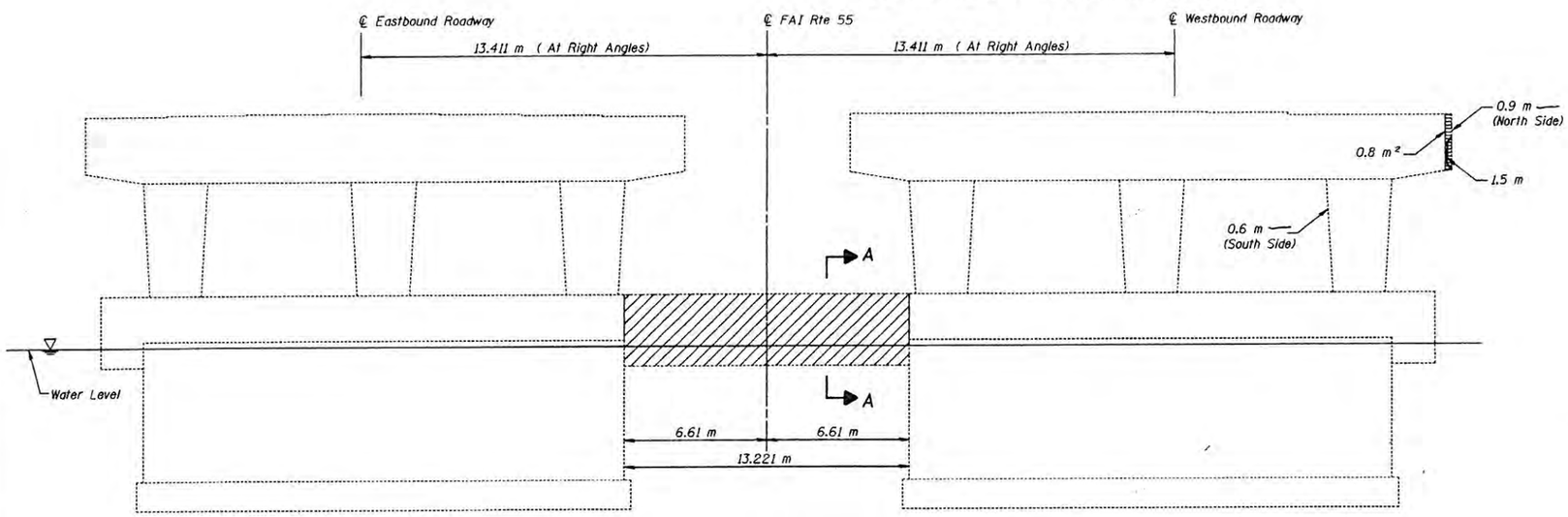
PIER NO 2 DETAILS
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

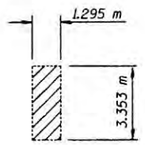
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	0707-616 B	COOK	100	84
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT-		

SHEET NO. 21
36 SHEETS



EAST ELEVATION



SECTION A-A

Notes:

Existing horizontal reinforcement bars projecting from the piers into the area of concrete removal are to remain in place. The existing reinforcement shall be sandblasted clean, straightened and incorporated into the new construction. Cost included with Concrete Removal.

Repair of the existing pier shall include but not be limited to the areas shown. The actual areas to be repaired will be determined by the Engineer at the time of construction.

Indicates limits of Concrete Removal

Indicates limits of High Performance Shotcrete

Indicates limits of Epoxy Crack Sealing

BILL OF MATERIAL

Item	Unit	Quantity
Concrete Removal	m^3	57.4
High Performance Enhanced Shotcrete	m^2	0.8
Epoxy Crack Sealing	m	3.0

DESIGNED	
CHECKED	
DRAWN	GEW
CHECKED	SPK

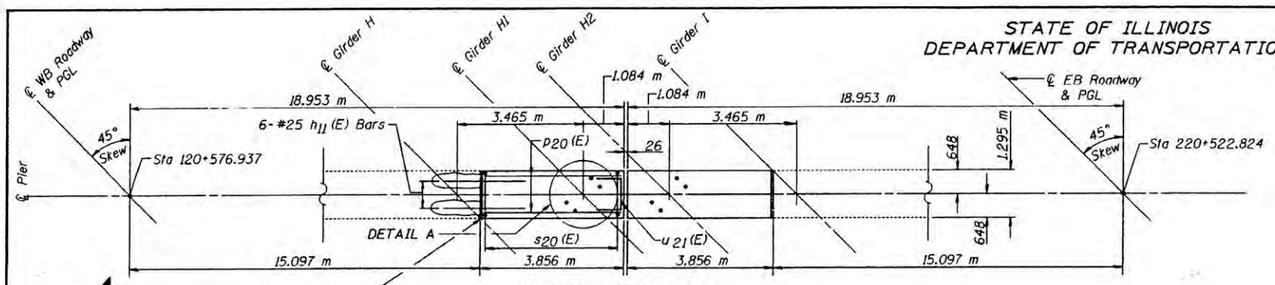
PIER NO 3 REPAIRS & CONCRETE REM
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

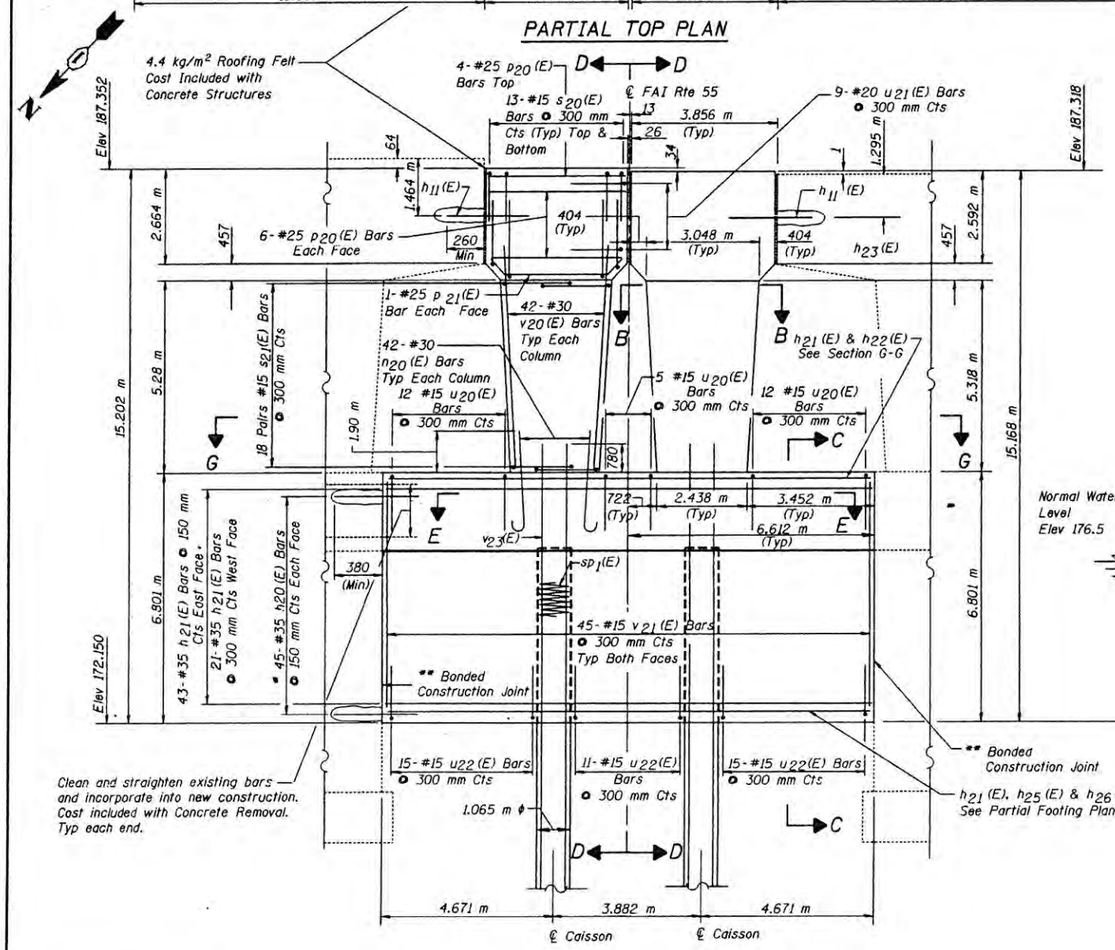
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PROJECT NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 53	0707-616 B	COOK	100	85
FED. ROAD DIST. NO. 7	ILLINOIS	FED. AID PROJECT		

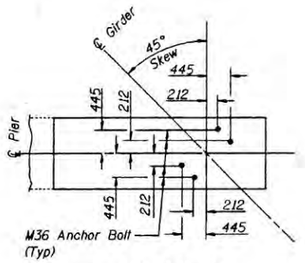
SHEET NO. 22
36 SHEETS



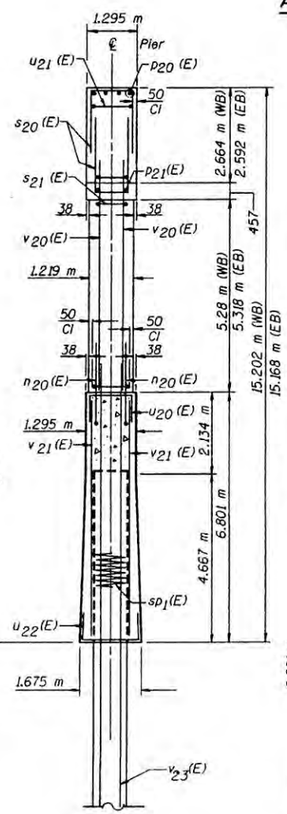
PARTIAL TOP PLAN



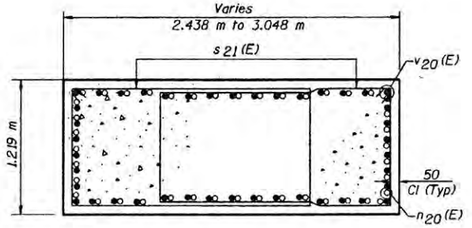
WEST ELEVATION
(LOOKING EAST)



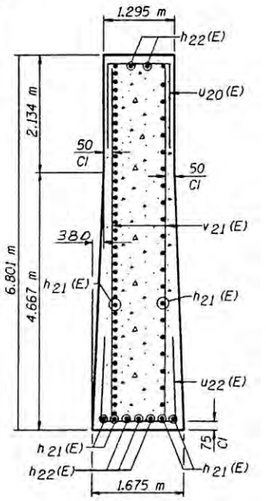
DETAIL A
ANCHOR BOLT LAYOUT (TYP)



SECTION D-D



SECTION B-B



SECTION C-C

Notes:

For Location of Pier Fender Anchor Bolts See Sheet 24.

The M36 Anchor Bolts for the girder's bearings are not part of the Substructure Widening Contract. They are to be furnished and installed by others.

For Partial Footing Plan, Caisson Detail, Section E-E, Section G-G, Bar Details and Bill of Material See Sheet 23.

All Dimensions are in Millimeters (mm) Unless Otherwise Noted.

Bars not shown for Pier 3 (EB) are to be the same as the bars for Pier 3 (WB).

Reinforcement bars that are to be grouted into existing concrete shall be spaced at least 150 mm from the edge of existing concrete. Contractor shall avoid drilling into existing reinforcement.

* Drill and epoxy grout $h_{23}(E)$ bars in 31 mm ϕ x 230 mm (min) holes in existing concrete. Drill and epoxy grout $h_{20}(E)$ bars in 41 mm ϕ x 380 mm (min) holes in existing concrete. The grout and the method of application shall be approved by the Department. (See Standard Specifications.) Cost of hole drilling and epoxy grouting are included with "Reinforcement Bars, Epoxy Coated".

** Construction joint to be bonded in accordance with Article 503.09 (a)(2) of the Standard Specifications.

Min Bar Lap
#35 Bar = 2.64 m

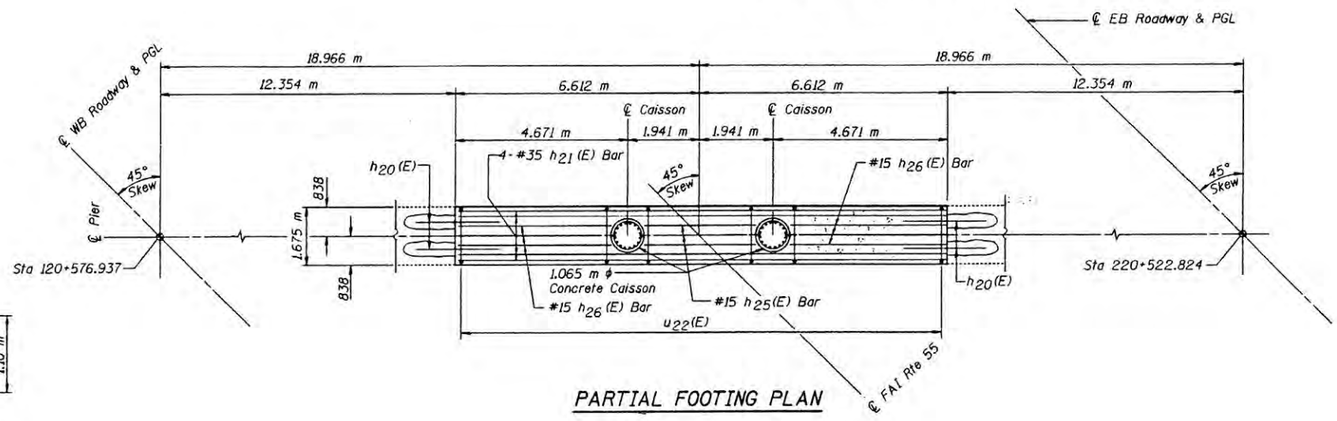
DESIGNED	S KORPI
CHECKED	DWC
DRAWN	MJB
CHECKED	SPK

PIER NO 3 WIDENING
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

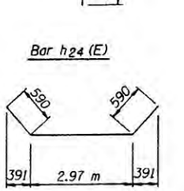
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

					SHEET NO. 23
F.A.I. 55	0707-616 B	COOK	100	86	36 SHEETS
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT:			

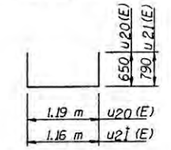


PARTIAL FOOTING PLAN

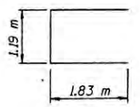


Bar h24 (E)

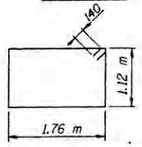
Bar p21(E)



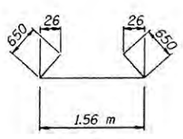
Bars u 20(E) & u21 (E)



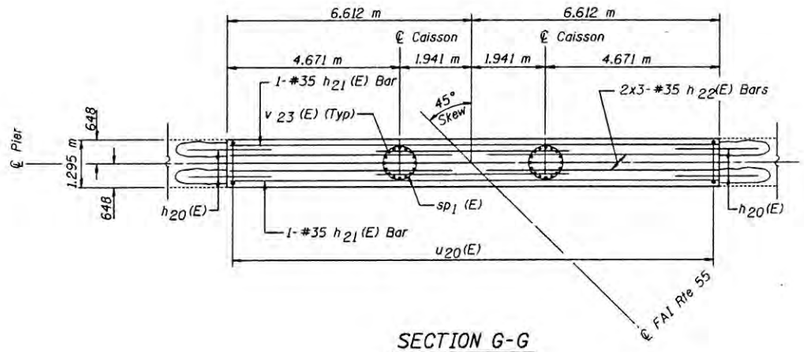
Bar s 20(E)



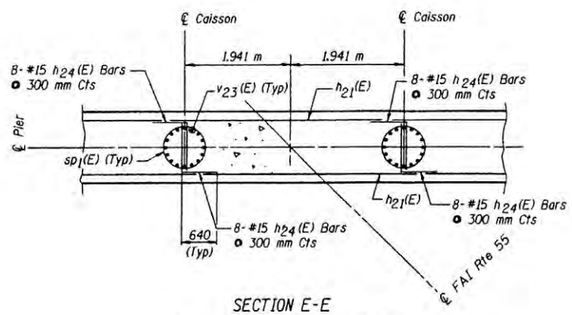
Bar s 21(E)



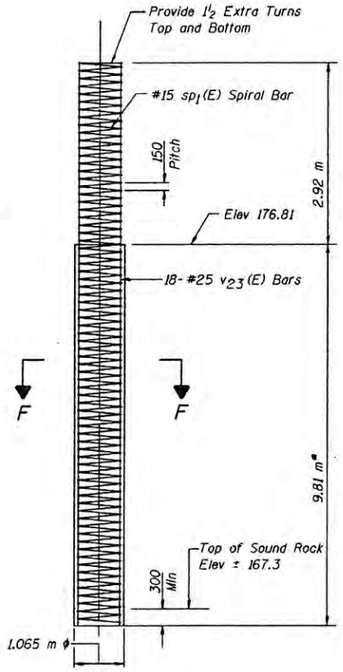
Bar u22(E)



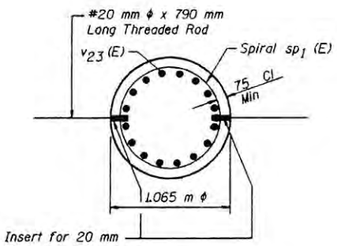
SECTION G-G
TOP OF CRASHWALL



SECTION E-E
Between Elev 178.951 and Elev 176.810



CAISSON DETAIL



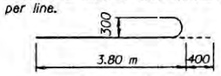
SECTION F-F
Between Elev 176.81 and Elev 172.15

BILL OF MATERIAL

Bar	No.	Size	Length (m)	Shape
h_{11} (E)	12	#25	1.04	—
h_{20}(E)	180	#35	3.07	—
h_{21}(E)	70	#35	13.12	—
h_{22}(E)	6	#35	6.14	—
h_{24}(E)	32	#15	1.74	⌐
h_{25}(E)	3	#15	2.72	—
h_{26}(E)	6	#15	4.04	—
n_{20}(E)	84	#30	4.20	⊃
p_{20}(E)	32	#25	3.75	—
p_{21}(E)	4	#25	4.15	⌒
s_{20}(E)	52	#15	4.85	⊓
s_{21}(E)	72	#15	6.04	□
sp_1(E)	2	#15	248.49	∿∿∿
u_{20}(E)	70	#15	2.49	⊏
u_{21}(E)	18	#20	2.74	⊏
u_{22}(E)	41	#15	2.86	⌐
v_{20}(E)	84	#30	7.07	—
v_{21}(E)	90	#15	6.68	—
v_{23}(E)	36	#25	12.73	—
Cofferdam Excavation		m^3	319	
Cofferdams		Each	1	
Concrete Structure		m^3	185.7	
Seal Coat Concrete		m^3	174.6	
Reinforcement Bars, Epoxy Coated		kg	22,940	
Caisson Shafts 1065 mm		m^3	17.5	

Reinforcement Bars Designated (E) Shall be Epoxy Coated

Bars indicated thus 2x3-#35 etc indicates 2 lines of bars with 3 lengths per line.



Bar n 20(E)

Notes:

Minimum spiral lap = 768 mm (48 spiral bar diameters).
Provide 4-#15 spacers or equivalent.
Design loading of caisson = 7.3 MPa.

* Caisson Length Shown is Approximate. Actual Length will be Determined at the Time of Construction.

Cost of all inserts and threaded dowel rods for inserts are included with "Caisson Shafts 1065 mm".

Inserts are to be single coil, flared loop type.
Inserts are to engage the reinforcement cage.

For Cofferdam Layout See Sheet 24A.

DESIGNED	S KORPI
CHECKED	DWC
DRAWN	MJB
CHECKED	SPK

PIER NO 3 DETAILS
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0014 (E.B.)
STRUCTURE NUMBER 016-0015 (W.B.)

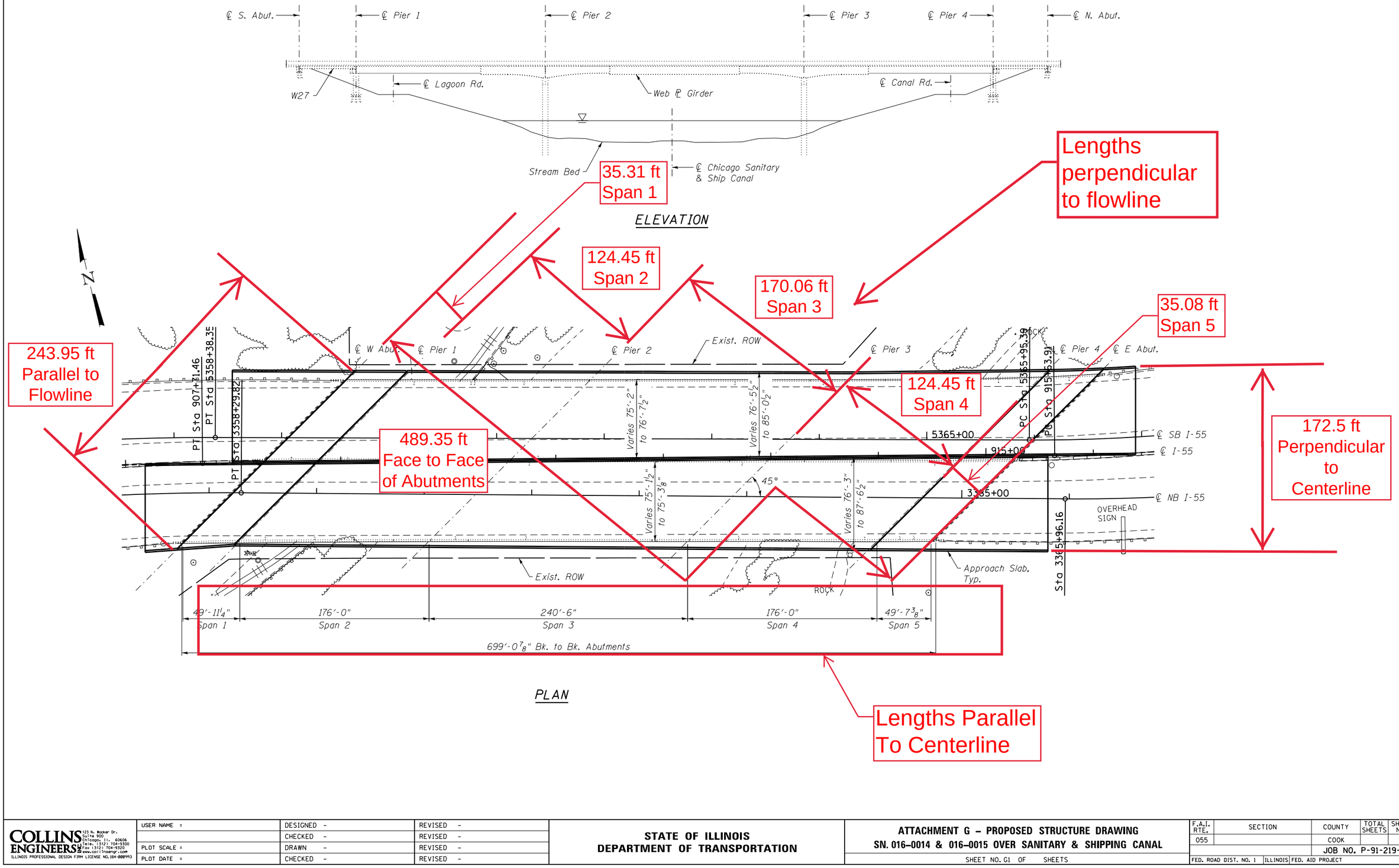
AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

D:\Projects\Cook Co\Dgn\Pier 3 Details.dgn Mar 21, 1997 11:56:42

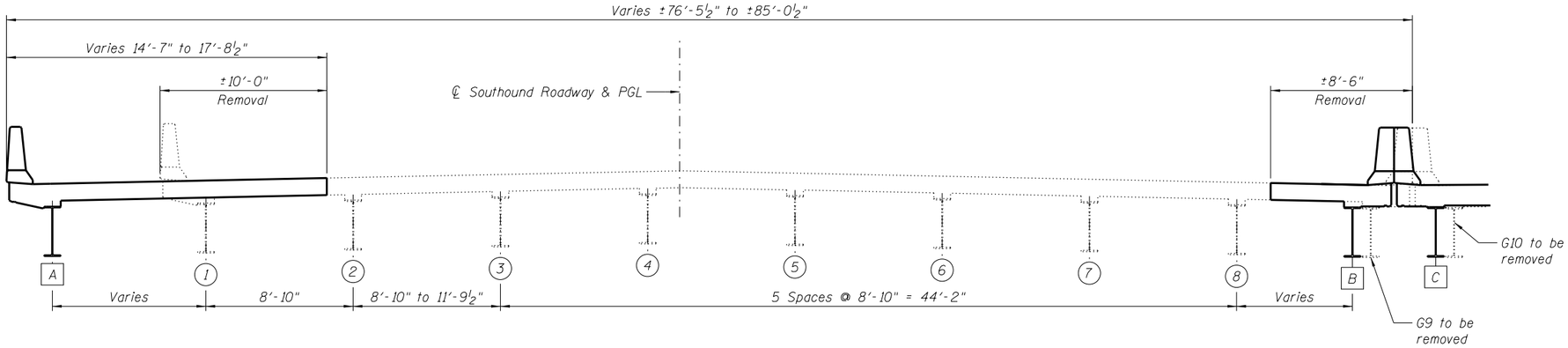
TAB B

SECTION 10.B

COLLINS ENGINEERS
PRELIMINARY STRUCTURE PLANS

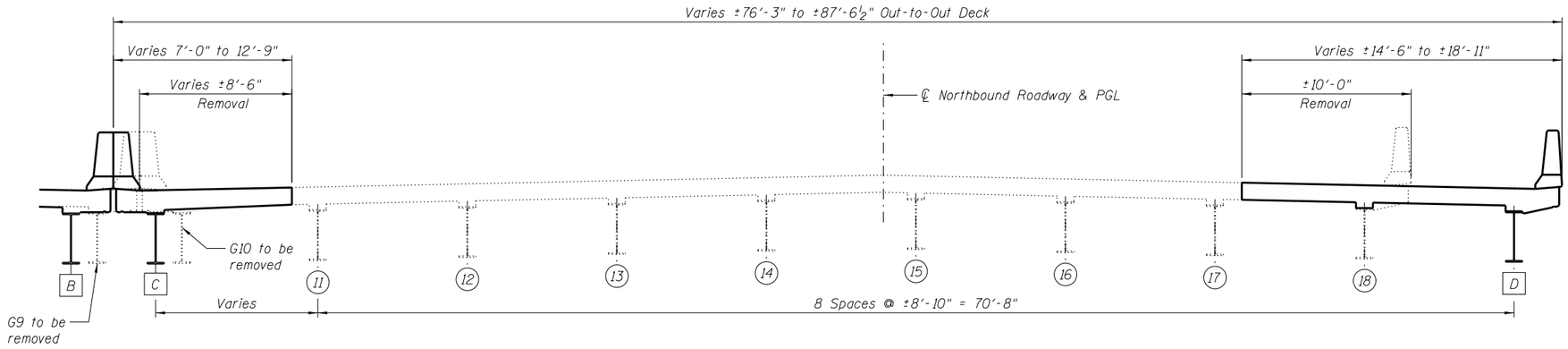


COLLINS ENGINEERS 123 N. Wacker Dr. Suite 900 Chicago, IL. 60606 Tele. (312) 704-9300 Fax (312) 704-9320 www.collinseng.com ILLINOIS PROFESSIONAL DESIGN FIRM LICENSE NO. 184-000993	USER NAME =	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	ATTACHMENT G – PROPOSED STRUCTURE DRAWING SN. 016–0014 & 016–0015 OVER SANITARY & SHIPPING CANAL	F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CHECKED -	REVISED -			055		COOK		
	PLOT SCALE =	DRAWN -	REVISED -					JOB NO. P-91-219-17		
	PLOT DATE =	CHECKED -	REVISED -		SHEET NO. G1 OF SHEETS	FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		



SOUTHBOUND CROSS SECTION

Looking East.
Spans 2-4 shown,
Spans 1 & 5 similar



NORTHBOUND CROSS SECTION

Looking East.
Spans 2-4 shown,
Spans 1 & 5 similar

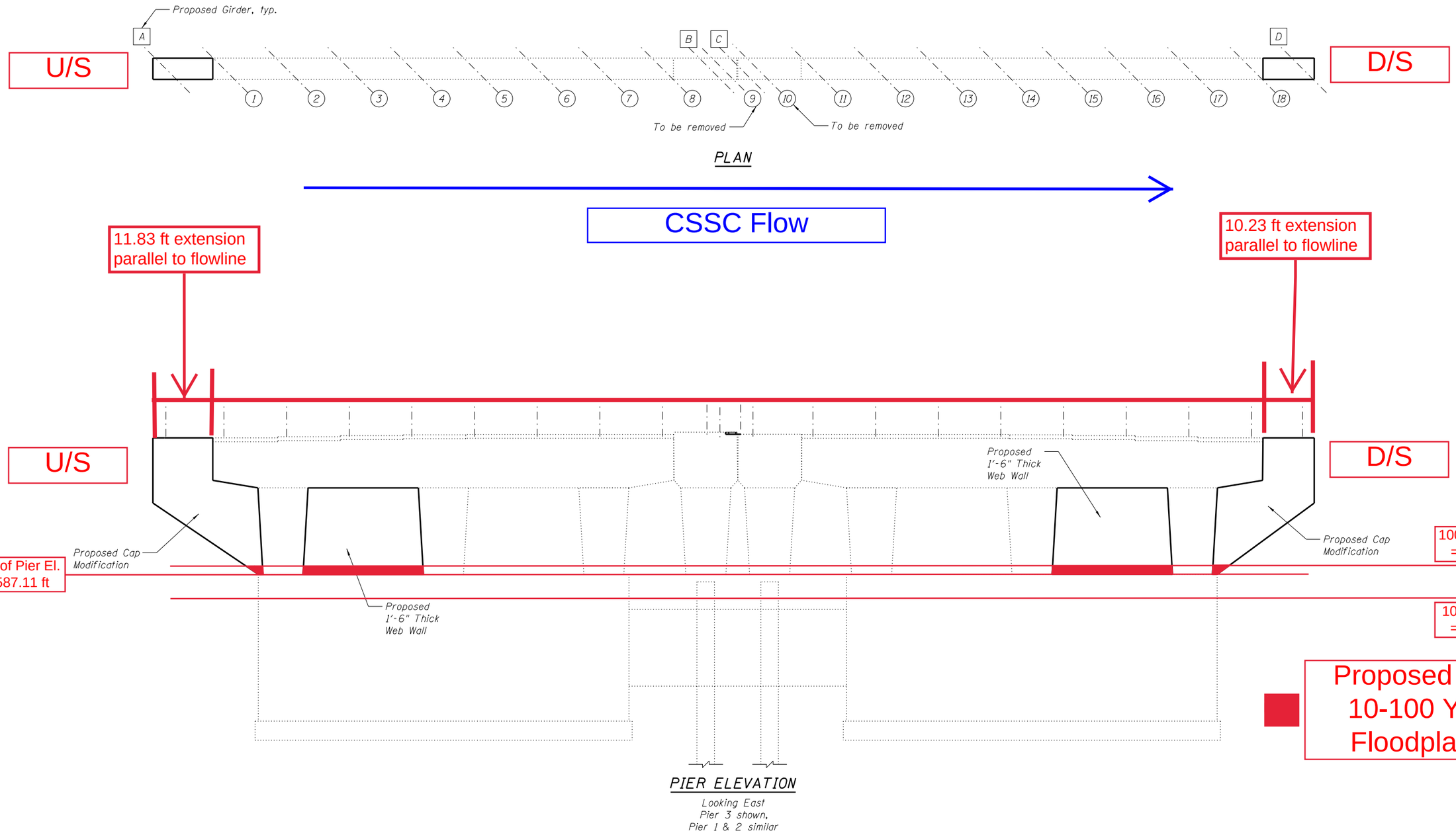
COLLINS ENGINEERS
123 N. Wacker Dr. Suite 900 Chicago, Il. 60606
Tele. (312) 704-1300 Fax (312) 704-9320 www.collinsengr.com
ILLINOIS PROFESSIONAL DESIGN FIRM LICENSE NO. 184-000993

USER NAME =	DESIGNED -	REVISED -
	CHECKED -	REVISED -
PLOT SCALE =	DRAWN -	REVISED -
PLOT DATE =	CHECKED -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

ATTACHMENT G – PROPOSED STRUCTURE DRAWING
SN. 016-0014 & 016-0015 OVER SANITARY & SHIPPING CANAL
SHEET NO. G2 OF SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
055		COOK		
		JOB NO. P-91-219-17		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		



COLLINS ENGINEERS 123 N. Wacker Dr. Suite 900 Chicago, Il. 60606 Phone: (312) 704-9300 Fax: (312) 704-9320 www.collinsengr.com ILLINOIS PROFESSIONAL DESIGN FIRM LICENSE NO.184-000993	USER NAME =	DESIGNED -	REVISED -
		CHECKED -	REVISED -
	PLOT SCALE =	DRAWN -	REVISED -
	PLOT DATE =	CHECKED -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

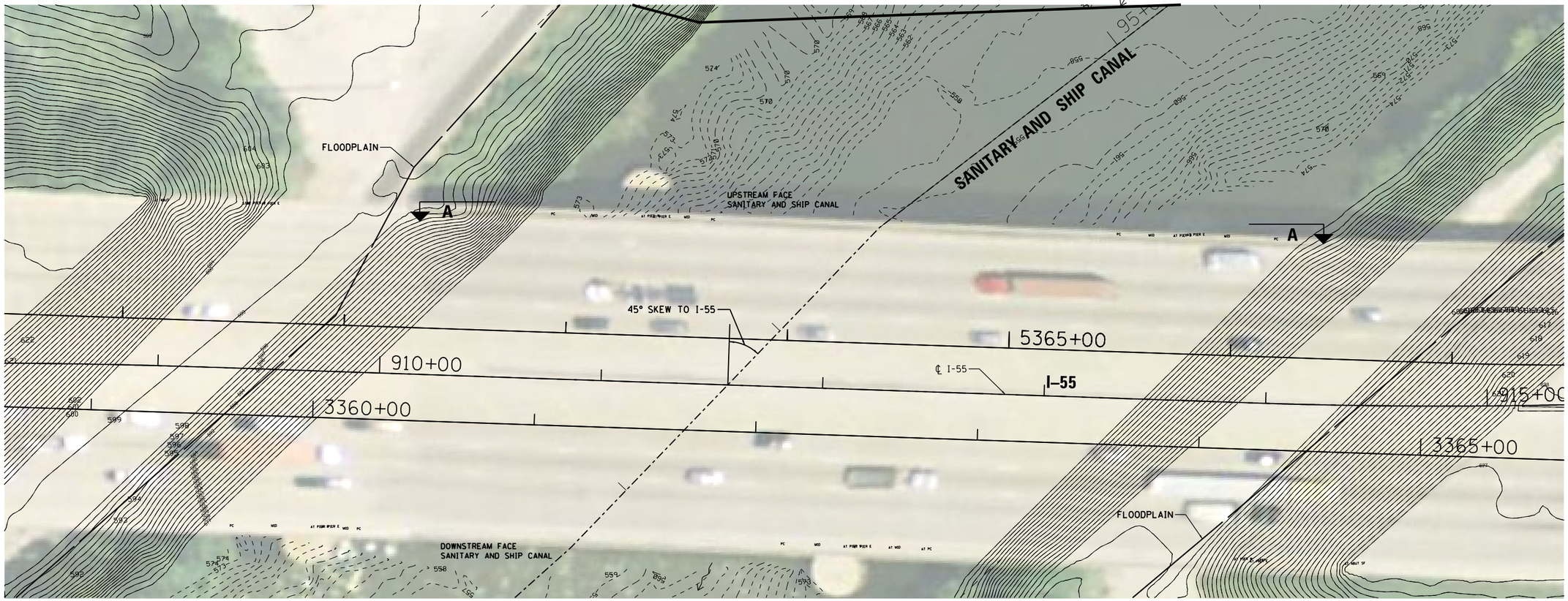
ATTACHMENT G – PROPOSED STRUCTURE DRAWING
SN. 016–0014 & 016–0015 OVER SANITARY & SHIPPING CANAL
SHEET NO. G3 OF SHEETS

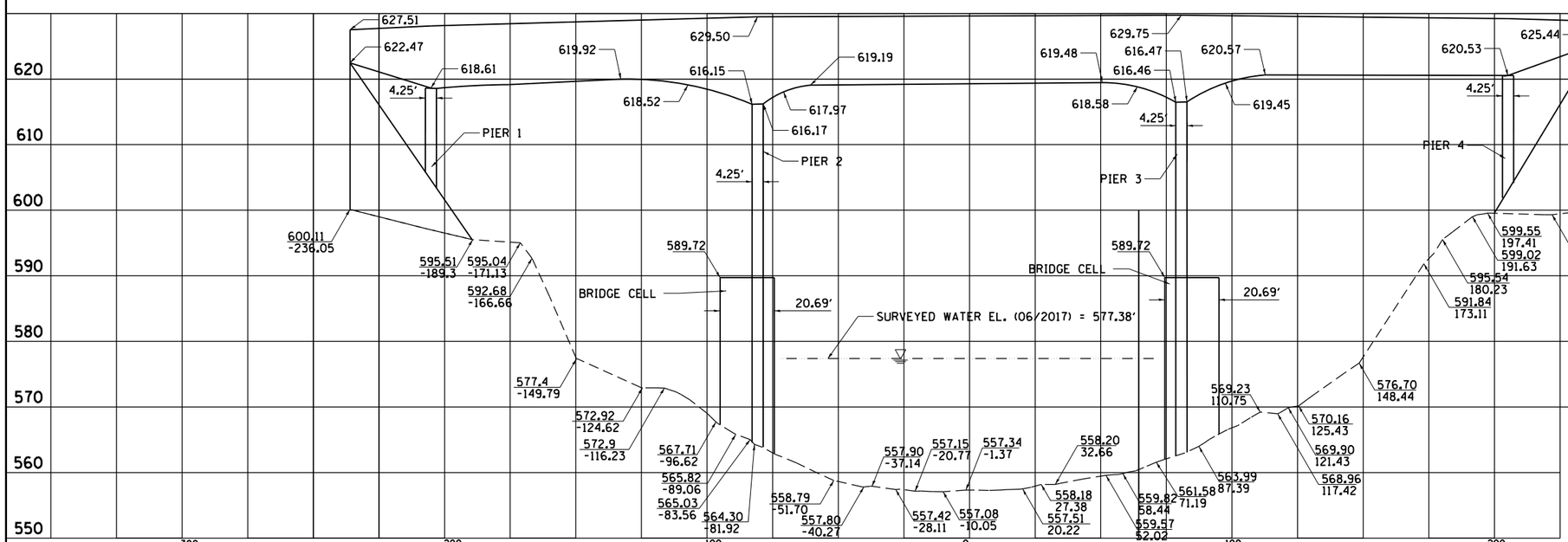
F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
055		COOK		
		JOB NO. P-91-219-17		
FED. ROAD DIST. NO. 1	ILLINOIS	FED. AID PROJECT		

TAB 11

SECTION 11

BRIDGE CROSS SECTION PLOTS – EXISTING CONDITIONS



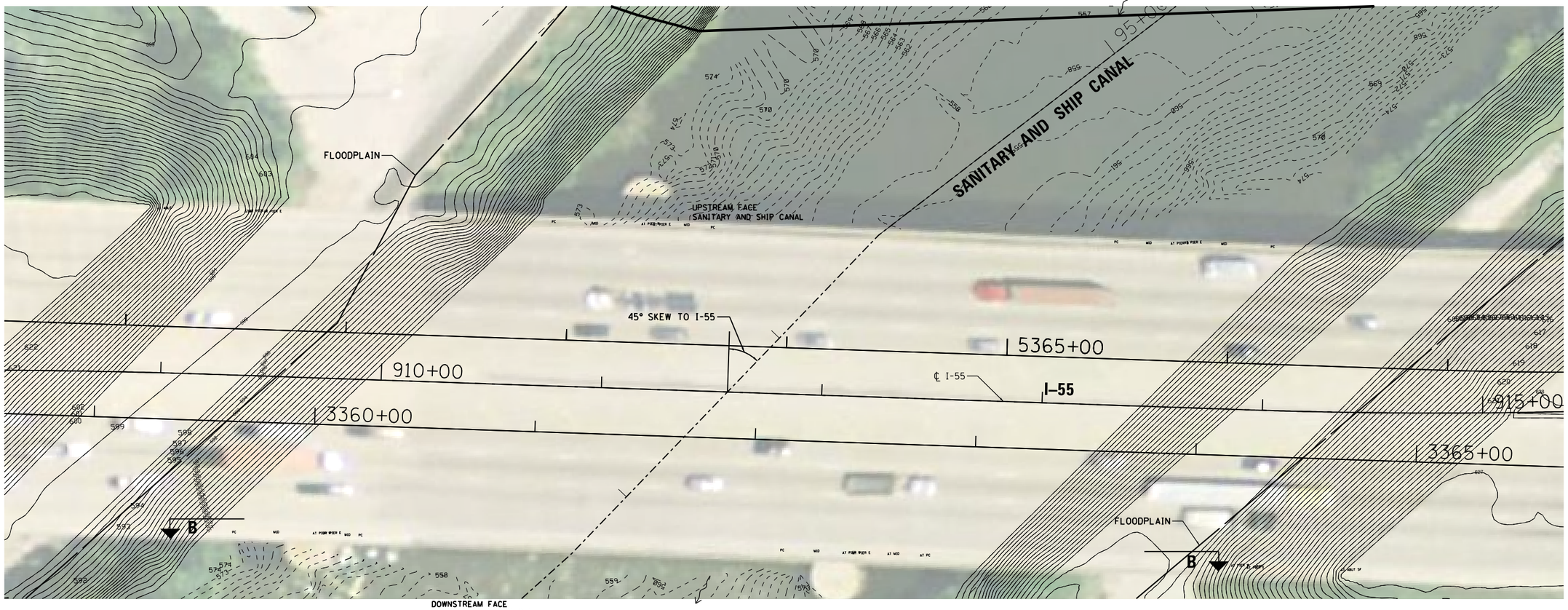


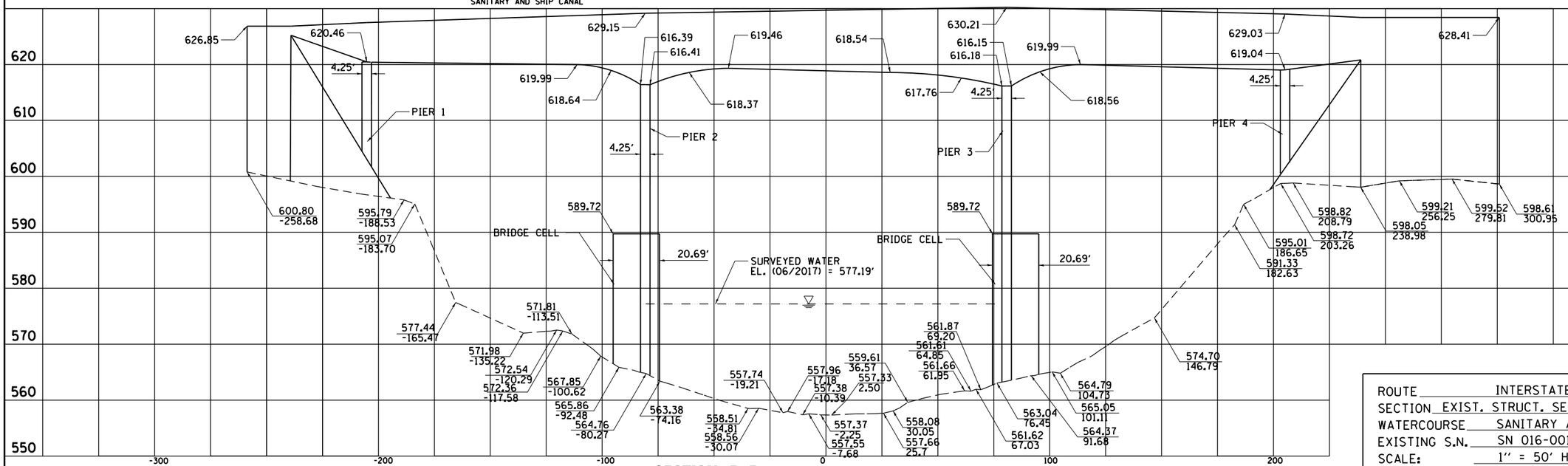
SECTION A–A

(PLOTTED PERPENDICULAR TO THE STREAM, LOOKING DOWNSTREAM)

ROUTE	INTERSTATE 55
SECTION	EXIST. STRUCT. SECTION - UPSTREAM FACE
WATERCOURSE	SANITARY AND SHIP CANAL
EXISTING S.N.	SN 016-0014 & SN 016-0015
SCALE:	1'' = 50' H; 1'' = 20' V
PLOTTED BY:	MYG DATE: 5/15/2018
CHECKED BY:	IAD DATE: 5/15/2018
SURVEY DATE:	06-27-2017

FILE NAME = N:\dot\110203.0000\Drain\P110203-sht-detail_CSSC_US.dgn





SECTION B–B

(PLOTTED PERPENDICULAR TO THE STREAM, LOOKING DOWNSTREAM)

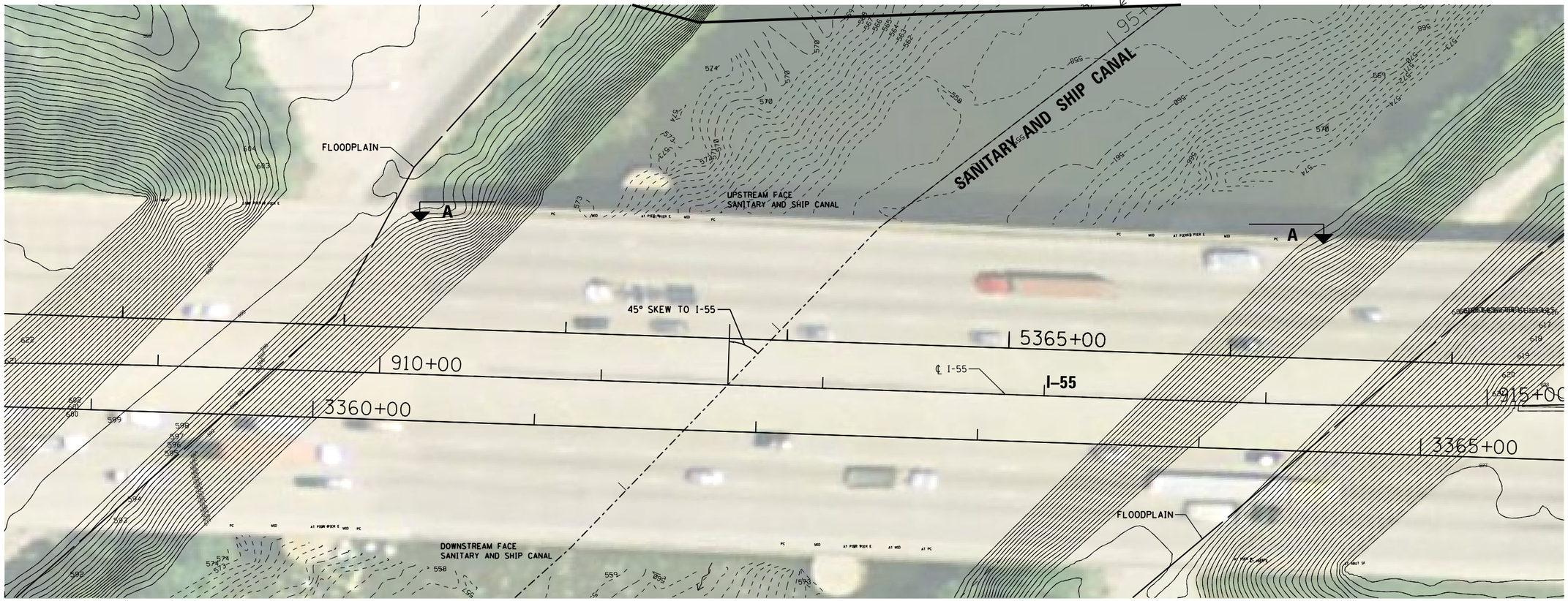
ROUTE	INTERSTATE 55
SECTION	EXIST. STRUCT. SECTION - DOWNSTREAM FACE
WATERCOURSE	SANITARY AND SHIP CANAL
EXISTING S.N.	SN 016-0014 & SN 016-0015
SCALE:	1'' = 50' H; 1'' = 20' V
PLOTTED BY:	MYG DATE: 5/15/2018
CHECKED BY:	IAD DATE: 5/15/2018
SURVEY DATE:	06-27-2017

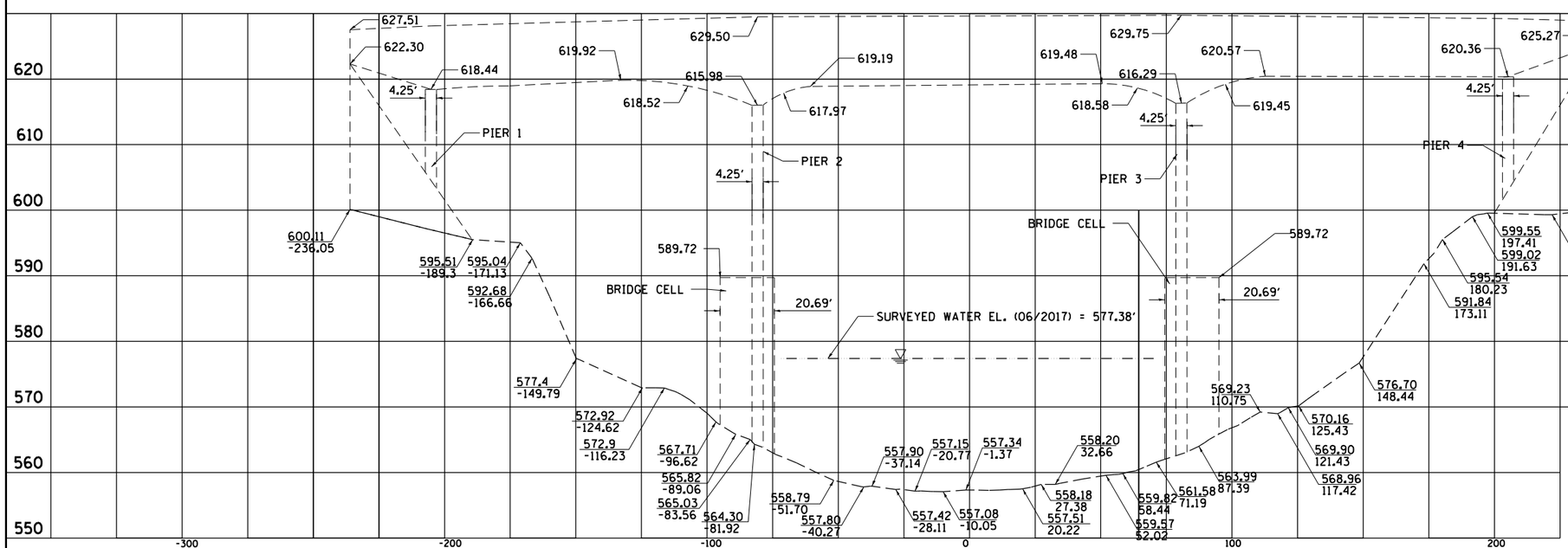
FILE NAME = N:\Idot\110203.0000\Dgn\P110203-sht-detail_CSSC_DS.dgn

TAB 12

SECTION 12

BRIDGE CROSS SECTION PLOTS – PROPOSED CONDITIONS



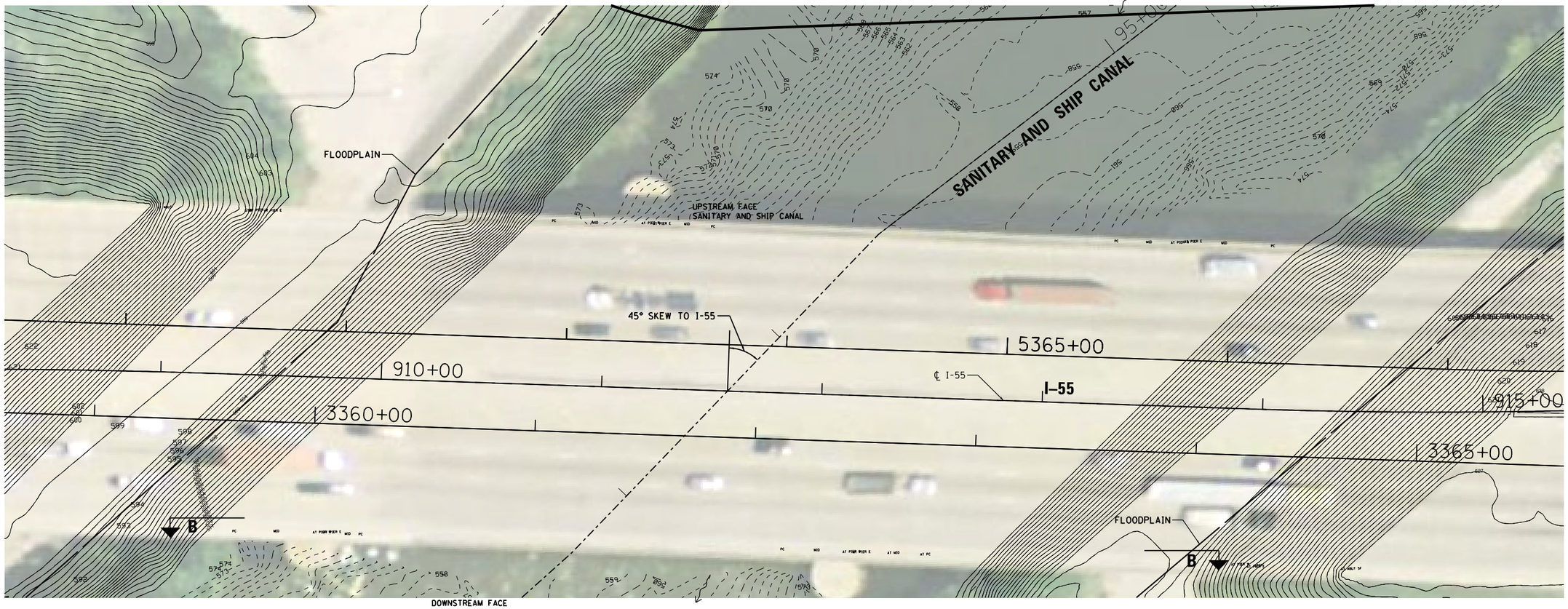


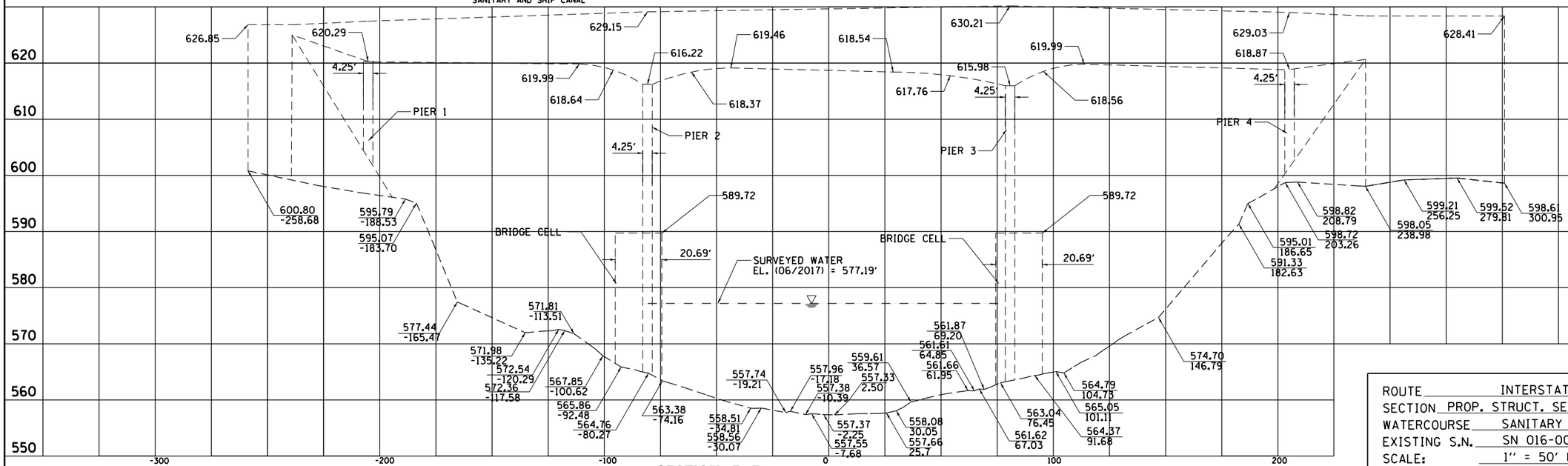
SECTION A–A

(PLOTTED PERPENDICULAR TO THE STREAM, LOOKING DOWNSTREAM)

ROUTE	INTERSTATE 55
SECTION	PROP. STRUCT. SECTION - UPSTREAM FACE
WATERCOURSE	SANITARY AND SHIP CANAL
EXISTING S.N.	SN 016-0014 & SN 016-0015
SCALE:	1'' = 50' H; 1'' = 20' V
PLOTTED BY:	MYG DATE: 5/15/2018
CHECKED BY:	IAD DATE: 5/15/2018
SURVEY DATE:	06-27-2017

FILE NAME = N:\dot\110203.00001\Drain\P110203-sht-detail_CSSC.DS - Prop.dgn





SECTION B–B

(PLOTTED PERPENDICULAR TO THE STREAM, LOOKING DOWNSTREAM)

ROUTE	INTERSTATE 55
SECTION	PROP. STRUCT. SECTION - DOWNSTREAM FACE
WATERCOURSE	SANITARY AND SHIP CANAL
EXISTING S.N.	SN 016-0014 & SN 016-0015
SCALE:	1'' = 50' H; 1'' = 20' V
PLOTTED BY:	MYG DATE: 5/15/2018
CHECKED BY:	IAD DATE: 5/15/2018
SURVEY DATE:	06-27-2017

FILE NAME = N:\Idot\IL02203\00001\Drain\PlI02203-sht-detail_CSSC_DS - Prop.dgn

TAB 13

SECTION 13

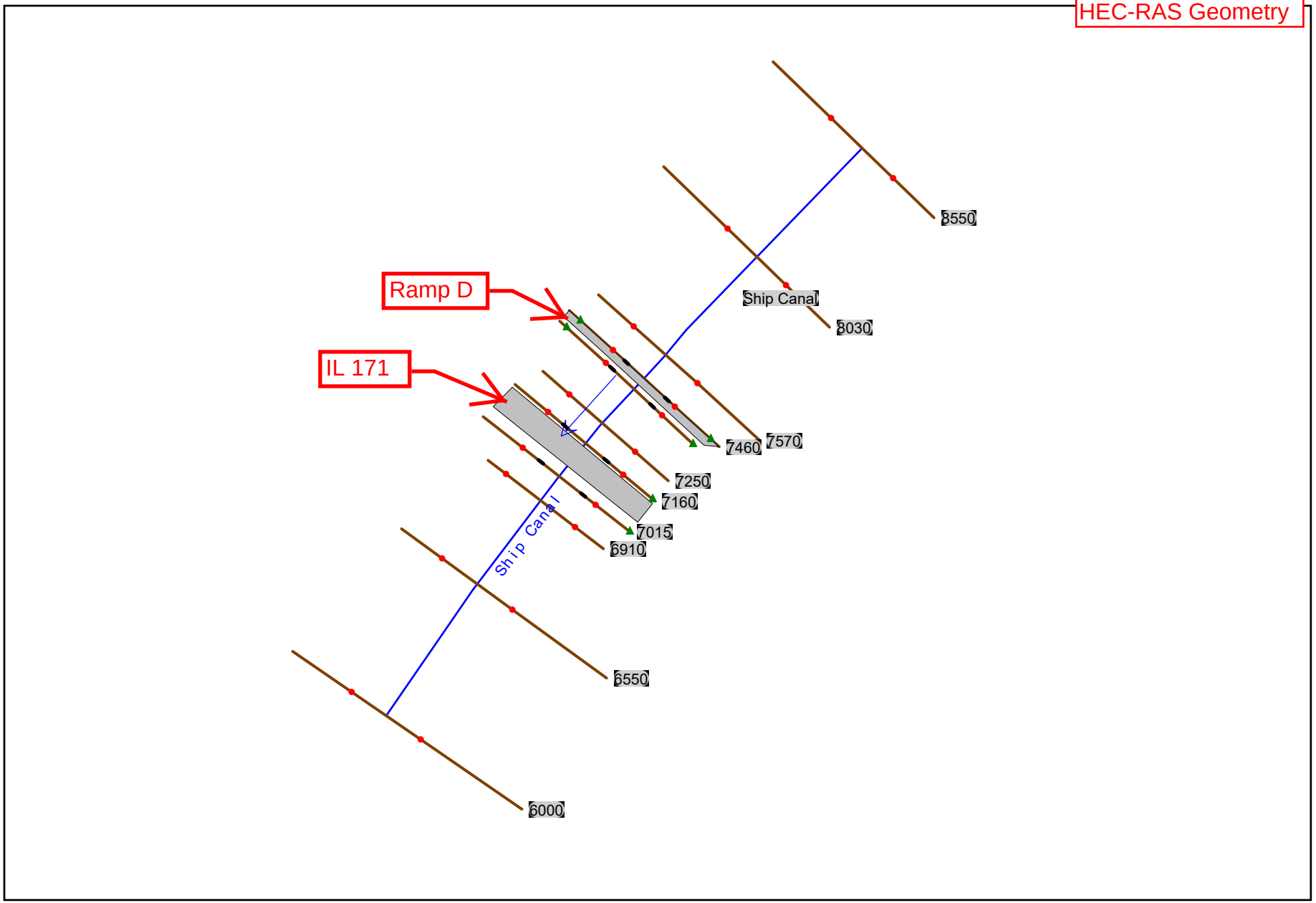
HYDRAULIC ANALYSIS

TAB A

SECTION 13.A

CIORBA DUPLICATE (BASELINE) CONDITIONS

Baseline Conditions
(Ciorba IL 171)
HEC-RAS Geometry



HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Ship Canal - Updated
Project File : ShipCanal-Update.prj
Run Date and Time: 8/16/2017 1:20:38 PM

Project in English units

PLAN DATA

Plan Title: Baseline Ciorba IL 171 over CSSC
Plan File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.p03

Geometry Title: Duplicate
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g03

Flow Title : Duplicate
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f02

Plan Description:
Copy of Ciorba's approved IL 171 proposed condition RAS V.4.1.0 model run in 5.0.3. Results match Ciorba run hardcopy dated 6/24/2010 found in Hydraulic Report dated March 2011.

Plan Summary Information:

Number of:	Cross Sections	= 11	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 2	Lateral Structures	=	0

Computational Information
- Water surface calculation tolerance = 0.01
- Critical depth calculation tolerance = 0.01
- Maximum number of iterations = 20
- Maximum difference tolerance = 0.3
- Flow tolerance factor = 0.001

Computation Options
- Critical depth computed only where necessary
- Conveyance Calculation Method: At breaks in n values only
- Friction Slope Method: Average Conveyance
- Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Duplicate
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f02

Flow Data (cfs)

River	Reach	RS	10-year	50-year	100-year	500-year
Ship Canal	Ship Canal	8550	8500	11300	12800	16100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Ship Canal	Ship Canal	10-year		Known WS = 583.9
Ship Canal	Ship Canal	50-year		Known WS = 587
Ship Canal	Ship Canal	100-year		Known WS = 588
Ship Canal	Ship Canal	500-year		Known WS = 591.4

GEOMETRY DATA

Geometry Title: Duplicate
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g03

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 8550

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-392.501	600.02	-352.653	601.25	-324.759	602.14	-282.919	601.7	-251.041	599.95
-197.247	576.44	-192.266	574.64	-187.285	573.84	-172.342	562.44	-147.437	556.44
-122.532	556.44	-97.627	556.94	-72.722	556.44	-24.905	556.44	0	554.64
24.905	558.54	49.81	562.84	74.715	567.44	89.658	572.54	94.638	574.24
99.619	576.44	147.437	597.32	154.41	597.48	169.353	597.8	178.319	597.74
191.269	596.95	204.22	597.17	218.167	601.87	231.117	601.9	236.098	601.36
253.033	602.52	311.809	603.91	377.558	605.42				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-392.501	.08	-197.247	.03	99.619	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-197.247	99.619	520	520	.1	.3

Skew Angle = 5

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 8030

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-387	601.61	-343	601.15	-273	600.53	-237	600.18	-227	601.83
-219	599.59	-179	576.44	-174	574.84	-169	573.54	-154	571.14
-129	560.74	-104	559.04	-79	558.44	-50	558.04	-25	558.04
0	557.74	25	557.94	50	558.44	75	570.04	90	572.84
95	574.64	100	576.44	165	595.25	211	601.49	229	602.52
247	602.85	263	602.69	271	602.19	283	602.06	302	605.01
351	606.21	391	605.61	406	605.61				

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -387     .08    -179     .03     100     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -179     100              460     460     460             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7570

INPUT
Description:
Station Elevation Data    num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -481  600.12    -405  596.05    -373  595.99    -267  591.57    -228  590.22
    -192  576.41    -187  575.01    -182  573.31    -165  567.11    -140  564.01
    -115  558.91     -90  557.31     -65  557.01     -40  556.41       0  556.01
      24  558.11      49  561.91      76  569.41      91  573.11     101  576.41
     136  591.85     149  593.53     161  593.85     172  594.09     175  595.57
     187  595.26     264  607.39

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -481     .08    -192     .03     101     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -192     101              110     110     110             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7460

INPUT
Description: SN 016-2408 Upstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-398.775  624.59-335.334  619.54-291.831   595.7-272.799  593.94 -260.11  594.59
-241.078  593.85-229.296  593.07 -193.95  576.41-182.168  568.61-167.667  562.91
-149.541  562.61-140.478  561.71 -99.694  556.61 -40.784  556.21       0  554.91
   41.69  559.81  50.753  561.71  68.879  564.41  84.287  572.71  94.256  576.41
 127.789  591.51  142.29   593.4 154.072  593.66 167.667  593.96 173.105  595.16
 183.074  595.08 191.231   593.9  193.95  595.42 250.141  615.93 297.269  614.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-398.775     .08 -193.95     .03  94.256     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -193.95  94.256              50      50      50             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-398.775    -360   575.6       F
     245 297.269   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -166.64 -146.31   589.9    22.9   43.23   589.9
Skew Angle = 25
```

BRIDGE

RIVER: Ship Canal
REACH: Ship Canal RS: 7459

INPUT
Description: Ramp D (SN 016-2408)
Distance from Upstream XS = 1
Deck/Roadway Width = 28
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-567.43	626.62	0	-476.8	625.85	0	-386.17	625.9	0
-345.03	626.46	0	-345.03	626.46	622.78	-296.85	627.11	618.76
-148.31	628.52	618.74	22.57	626.39	616.44	171.69	620.76	612.09
229.6	618.3	614.54	229.6	618.3	0	248.25	617.51	0
338.88	614.91	0						

Upstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-398.775	624.59	-335.334	619.54	-291.831	595.7	-272.799	593.94	-260.11	594.59
-241.078	593.85	-229.296	593.07	-193.95	576.41	-182.168	568.61	-167.667	562.91
-149.541	562.61	-140.478	561.71	-99.694	556.61	-40.784	556.21	0	554.91
41.69	559.81	50.753	561.71	68.879	564.41	84.287	572.71	94.256	576.41
127.789	591.51	142.29	593.4	154.072	593.66	167.667	593.96	173.105	595.16
183.074	595.08	191.231	593.9	193.95	595.42	250.141	615.93	297.269	614.21

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-398.775	.08	-193.95	.03	94.256	.08

Bank Sta: Left Right Coeff Contr. Expan.
-193.95 94.256 .1 .3
Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-398.775	-360	575.6	F
245	297.269	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-166.64	-146.31	589.9	22.9	43.23	589.9

Skew Angle = 25

Downstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-494.17	626.62	0	-403.54	625.85	0	-312.91	625.9	0
-271.77	626.46	0	-271.77	626.46	622.78	-223.6	627.11	618.76
-75.05	628.52	618.74	95.82	626.39	616.44	244.95	620.76	612.09
302.86	618.3	614.54	302.86	618.3	0	321.5	617.51	0
412.13	614.91	0						

Downstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-276.424	620.95	-225.671	594.92	-220.233	594.36	-201.2	594.44	-183.98	593.88
-174.011	592.99	-130.508	576.41	-118.726	568.91	-108.757	562.91	-99.694	562.71
-90.631	561.91	-48.941	556.21	0	555.41	40.784	555.41	81.568	561.11
90.631	561.21	109.663	563.11	123.258	572.71	133.227	576.41	183.074	591.06
202.107	593.17	212.982	593.34	224.764	593.58	229.296	594.85	239.265	594.66
244.703	593.59	251.954	594.53	311.77	615.54	311.77	618.39	347.116	617.48

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-276.424	.08	-130.508	.03	133.227	.08

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
      -130.508 133.227            .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -345.03  622.78  -340.7  622.78  -340.7       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -271.77  622.78 -267.44  622.78 -267.44       0

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  225.27       0  225.27  614.54   229.6  614.54
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  298.53       0  298.53  614.54  302.86  614.54

Number of Piers =  4

Pier Data
Pier Station     Upstream= -296.85    Downstream=  -223.6
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76

Pier Data
Pier Station     Upstream= -148.31    Downstream=  -75.05
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74

Pier Data
Pier Station     Upstream=    24.9    Downstream=   95.82
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44

Pier Data
Pier Station     Upstream=  171.69    Downstream=  244.95
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09
```

```
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum              Cd   =    1.33
       Yarnell               KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 624.59
       El of the toe of the abutment   = 619.97
    Right Embankment
       El of the top of the embankment = 614.21
       El of the toe of the abutment   = 606.85
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 65
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7410

INPUT
Description: SN 016-2408 Downstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-276.424  620.95-225.671  594.92-220.233  594.36  -201.2  594.44 -183.98  593.88
-174.011  592.99-130.508  576.41-118.726  568.91-108.757  562.91 -99.694  562.71
 -90.631  561.91 -48.941  556.21       0  555.41  40.784  555.41  81.568  561.11
  90.631  561.21 109.663  563.11 123.258  572.71 133.227  576.41 183.074  591.06
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -130.508 133.227             160     160     160             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
```

```
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7250

INPUT
Description:
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-347.672   626.3-275.946  595.55-270.965  594.69-258.014  594.67-242.075  593.91
-218.167  591.71 -196.25  576.41-191.269  574.81-185.292  572.51-169.353  567.31
-144.448  562.21-118.547  557.81 -93.642  556.71 -24.905  555.91       0  555.21
  24.905  555.91   49.81  558.61  74.715  562.31  92.646  571.41  97.627  573.21
 103.604  576.41 137.475  591.56 149.429  592.22 160.387  592.37 171.345  592.81
  175.33  593.74 185.292  593.62 192.266  592.09 198.243  593.22 224.144  593.78

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-347.672     .08 -196.25     .03 103.604     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 103.604               90      90      90             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7160

INPUT
Description: SN 016-0487 & 0486 Upstream Bridge XS
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-269.493   626.3-197.049  594.96-190.287  594.96-175.798  594.57 -161.31  594.11
-141.025  589.88-128.468   576.4-113.013   573.1-100.456   567.9 -88.865   562.7
 -44.433   555.5       0   555.5  104.32   556.5 148.753   557.8 159.378   561.9
 183.526   565.4 200.913   574.9 207.674   576.4 221.197  590.35 237.618  591.91
 247.277  592.11 252.107   593.5 261.766   593.3  265.63  592.58 355.461  596.35

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-269.493     .08-128.468     .03 207.674     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -128.468 207.674              145     145     145             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-269.493    -260   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15
```

BRIDGE

RIVER: Ship Canal
REACH: Ship Canal RS: 7098

INPUT
Description: SN 016-0486 & SN 016-0487 (NB & SB of 171)
Distance from Upstream XS = 12.5
Deck/Roadway Width = 87.33
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 16

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-467.31	628.06	0	-467.31	627.92	0	-419.01	627.74	0
-370.71	627.55	0	-322.42	627.37	0	-274.12	627.18	0
-243.12	627.18	0	-243.12	627.18	622.94	-190.77	627	622.67
-141.91	626.82	622.56	-44.34	626.45	617.71	123.33	625.71	616.51
217.38	625.34	619.24	274.03	625.16	619.85	347.64	624.98	620.85
399.14	624.79	620.63						

Upstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-269.493	626.3	-197.049	594.96	-190.287	594.96	-175.798	594.57	-161.31	594.11
-141.025	589.88	-128.468	576.4	-113.013	573.1	-100.456	567.9	-88.865	562.7
-44.433	555.5	0	555.5	104.32	556.5	148.753	557.8	159.378	561.9
183.526	565.4	200.913	574.9	207.674	576.4	221.197	590.35	237.618	591.91
247.277	592.11	252.107	593.5	261.766	593.3	265.63	592.58	355.461	596.35

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-269.493	.08	-128.468	.03	207.674	.08

Bank Sta: Left Right Coeff Contr. Expan.
-128.468 207.674 .1 .3
Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-269.493	-260	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-62.795	-42.465	589.32	121.58	141.91	589.22

Skew Angle = 15

Downstream Deck/Roadway Coordinates
num= 16

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-519.53	628.06	0	-519.53	627.92	0	-471.24	627.74	0
-422.94	627.55	0	-374.64	627.37	0	-326.35	627.18	0
-295.35	627.18	0	-295.35	627.18	622.94	-243	627	622.67
-194.14	626.82	622.56	-96.56	626.45	617.71	71.1	625.71	616.51
165.15	625.34	619.24	221.81	625.16	619.85	295.41	624.98	620.85
346.91	624.79	620.63						

Downstream Bridge Cross Section Data
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-309.096	625.77	-289.778	620.15	-235.686	596.21	-231.822	595.42	-218.299	595.44
-199.947	594.7	-181.594	589.35	-159.378	576.4	-122.673	572.6	-85.001	562.4
-42.501	555.8	0	555.6	42.501	556.8	85.001	560.9	93.695	562.66
117.843	568.2	134.264	574.9	158.412	576.4	195.117	590.81	210.572	591.63
222.163	592.1	226.993	593.48	237.618	593.56	241.481	593.21	299.437	609.46
331.313	610.92								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-309.096	.08	-159.378	.03	158.412	.08

```
Bank Sta: Left   Right    Coeff Contr.   Expan.
      -159.378 158.412            .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  1

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -243.12  622.94 -238.79  622.94 -238.79       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -295.35  622.94 -291.02  622.94 -291.02       0

Number of Piers =  7

Pier Data
Pier Station     Upstream= -190.77    Downstream=    -243
Upstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67

Pier Data
Pier Station     Upstream= -141.91    Downstream= -194.14
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56

Pier Data
Pier Station     Upstream=  -44.34    Downstream=  -96.56
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71

Pier Data
Pier Station     Upstream=  123.33    Downstream=    71.1
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51

Pier Data
Pier Station     Upstream=  217.38    Downstream=  165.15
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24
```

```
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24

Pier Data
Pier Station     Upstream=  274.03    Downstream=  221.81
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85

Pier Data
Pier Station     Upstream=  347.64    Downstream=  295.41
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum              Cd   =    1.33
       Yarnell               KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Right Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 30.7
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line
```

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 7015

INPUT
Description: SN 016-0487 & 0486 Downstream Bridge XS
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-309.096	625.77	-289.778	620.15	-235.686	596.21	-231.822	595.42	-218.299	595.44
-199.947	594.7	-181.594	589.35	-159.378	576.4	-122.673	572.6	-85.001	562.4
-42.501	555.8	0	555.6	42.501	556.8	85.001	560.9	93.695	562.66
117.843	568.2	134.264	574.9	158.412	576.4	195.117	590.81	210.572	591.63
222.163	592.1	226.993	593.48	237.618	593.56	241.481	593.21	299.437	609.46
331.313	610.92								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-309.096	.08	-159.378	.03	158.412	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-159.378	158.412	105	105	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-309.096	-310	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-115.015	-94.685	589.22	69.35	89.68	589.26

Skew Angle = 15

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 6910

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-316.79	589.99	-305.832	593.7	-294.874	595.83	-282.919	596.06	-264.988	596.42
-247.056	592.93	-225.14	595.93	-194.258	576.39	-189.277	574.49	-184.296	573.79
-166.365	564.59	-141.46	559.99	-115.559	556.39	-90.654	555.79	-74.715	556.39
-49.81	556.19	-24.905	555.39	0	552.89	24.905	552.89	50.806	555.99
75.711	562.39	92.646	570.49	98.623	572.69	104.6	576.39	126.517	590.85
136.479	591.38	148.433	591.77	161.384	592.08	166.365	593.58	176.326	593.65
182.304	592.6								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-316.79	.08	-194.258	.03	104.6	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-194.258	104.6	360	360	.1	.3

Skew Angle = 5

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 6550

INPUT
Description:
Station Elevation Data num= 36

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-595.724	603.77	-570.82	602.98	-524.995	600.59	-425.375	593.95	-304.836	593.02
-279.931	594.83	-196.25	576.39	-191.269	574.69	-186.288	573.89	-170.349	569.09
-144.448	561.39	-119.543	560.09	-94.638	557.69	-69.734	555.69	-44.829	556.09
-24.905	555.39	0	555.19	24.905	555.99	49.81	560.99	74.715	565.59

```
   91.65  573.09  96.631  574.39 102.608  576.39 129.505  590.96 150.425  592.01
 163.376  592.61 177.323   592.7 181.307  593.55 192.266  593.44  196.25  592.45
 202.228  593.24 213.186  593.25 222.151   590.2 243.072  596.74 255.026  594.86
  274.95  594.79

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-595.724     .08 -196.25     .03 102.608     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 102.608              550     550     550             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6000

INPUT
Description:
Station Elevation Data    num=      40
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -605  603.03    -581  602.58    -554  602.83    -485  597.16    -433  598.72
    -399  598.84    -348  599.41    -217  584.11    -183  576.39    -178  574.79
    -173  573.99    -154  562.79    -129  561.39    -104  559.89     -79  558.69
     -54  557.69     -50  557.69     -25  557.59       0  557.39      25  557.99
      50  559.49      75  561.19      95  573.19     100  574.69     105  576.39
     139  588.79     162  589.48     170  592.15     178  592.95     192  593.47
     203  593.55     213  590.62     221   593.6     246  593.85     252  592.53
     260  592.88     263  594.84     275  590.28     294  592.72     351  593.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -605     .08    -183     .03     105     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -183     105                0       0       0             .1       .3


SUMMARY OF MANNING'S N VALUES

River:Ship Canal

      Reach          River Sta.       n1        n2        n3

 Ship Canal           8550              .08       .03       .08
 Ship Canal           8030              .08       .03       .08
 Ship Canal           7570              .08       .03       .08
 Ship Canal           7460              .08       .03       .08
 Ship Canal           7459         Bridge
 Ship Canal           7410              .08       .03       .08
 Ship Canal           7250              .08       .03       .08
 Ship Canal           7160              .08       .03       .08
 Ship Canal           7098         Bridge
 Ship Canal           7015              .08       .03       .08
 Ship Canal           6910              .08       .03       .08
 Ship Canal           6550              .08       .03       .08
 Ship Canal           6000              .08       .03       .08
```

SUMMARY OF REACH LENGTHS

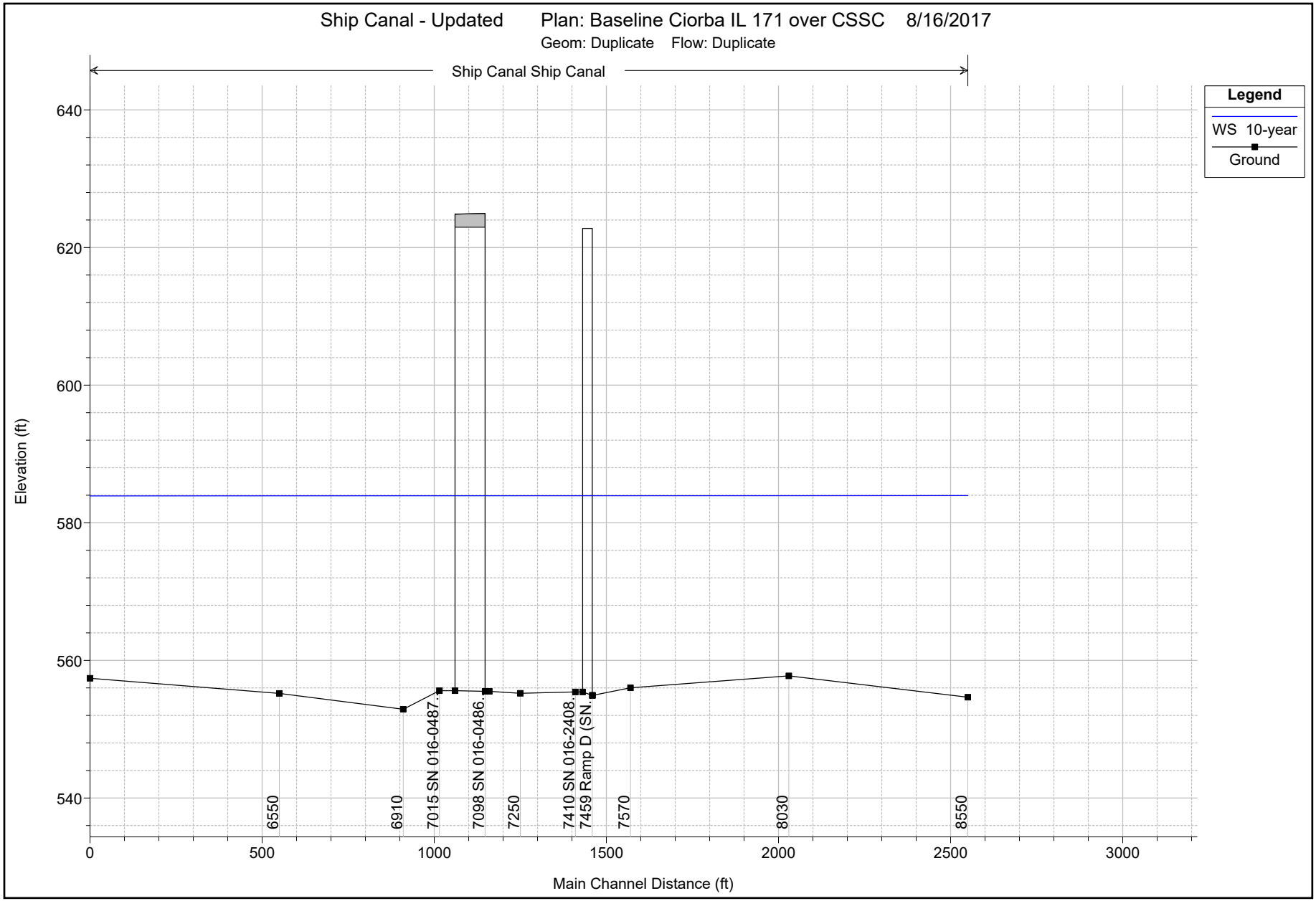
River: Ship Canal

Reach	River Sta.	Left	Channel	Right
Ship Canal	8550	520	520	520
Ship Canal	8030	460	460	460
Ship Canal	7570	110	110	110
Ship Canal	7460	50	50	50
Ship Canal	7459	Bridge		
Ship Canal	7410	160	160	160
Ship Canal	7250	90	90	90
Ship Canal	7160	145	145	145
Ship Canal	7098	Bridge		
Ship Canal	7015	105	105	105
Ship Canal	6910	360	360	360
Ship Canal	6550	550	550	550
Ship Canal	6000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Ship Canal

Reach	River Sta.	Contr.	Expan.
Ship Canal	8550	.1	.3
Ship Canal	8030	.1	.3
Ship Canal	7570	.1	.3
Ship Canal	7460	.1	.3
Ship Canal	7459	Bridge	
Ship Canal	7410	.1	.3
Ship Canal	7250	.1	.3
Ship Canal	7160	.1	.3
Ship Canal	7098	Bridge	
Ship Canal	7015	.1	.3
Ship Canal	6910	.1	.3
Ship Canal	6550	.1	.3
Ship Canal	6000	.1	.3

10-Year Ciorba Duplicate (Baseline)



1 in Horiz. = 400 ft 1 in Vert. = 20 ft

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	8550	10-year	8500.00	554.64	583.95		583.97	0.000009	1.21	7164.56	331.24	0.04
Ship Canal	8030	10-year	8500.00	557.74	583.93		583.96	0.000014	1.40	6202.61	317.84	0.05
Ship Canal	7570	10-year	8500.00	556.01	583.93	561.79	583.96	0.000012	1.31	6604.17	329.65	0.05
Ship Canal	7460	10-year	8500.00	554.91	583.92	561.24	583.96	0.000020	1.45	5972.04	280.17	0.05
Ship Canal	7459		Bridge									
Ship Canal	7410	10-year	8500.00	555.41	583.91	561.30	583.95	0.000023	1.58	5523.94	268.30	0.06
Ship Canal	7250	10-year	8500.00	555.21	583.92	560.69	583.95	0.000009	1.20	7168.04	327.42	0.04
Ship Canal	7160	10-year	8500.00	555.50	583.92	560.30	583.95	0.000014	1.22	6997.04	309.78	0.04
Ship Canal	7098		Bridge									
Ship Canal	7015	10-year	8500.00	555.60	583.91	561.69	583.94	0.000023	1.49	5814.65	309.13	0.06
Ship Canal	6910	10-year	8500.00	552.89	583.92		583.94	0.000008	1.15	7491.63	322.16	0.04
Ship Canal	6550	10-year	8500.00	555.19	583.91		583.93	0.000010	1.24	7001.33	346.86	0.05
Ship Canal	6000	10-year	8500.00	557.39	583.90	562.57	583.93	0.000011	1.31	6690.71	341.67	0.05

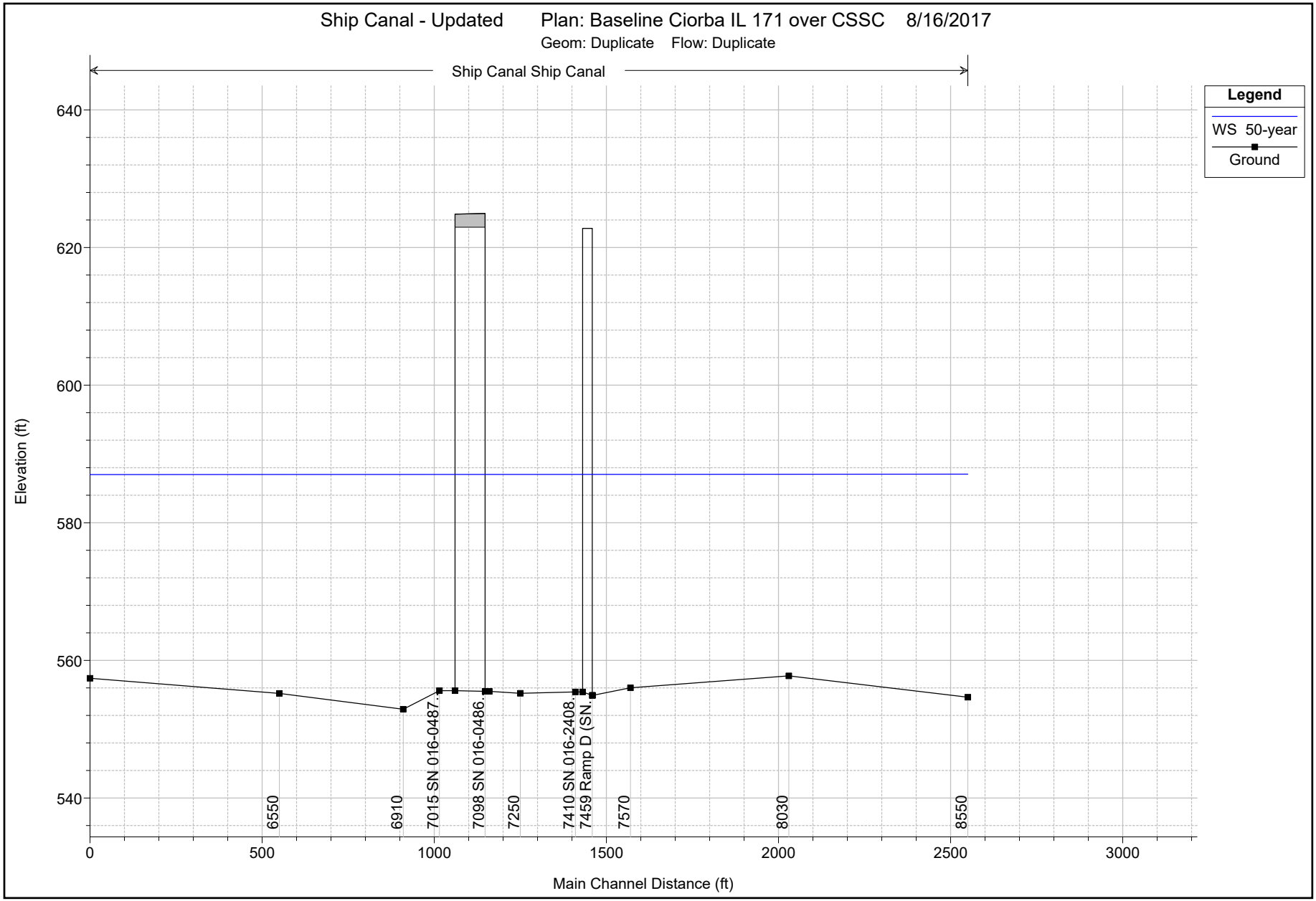
HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	8550	10-year	583.97	583.95	0.02	0.01	0.00	8.19	8483.61	8.20	331.24
Ship Canal	8030	10-year	583.96	583.93	0.03	0.01	0.00	7.27	8477.13	15.59	317.84
Ship Canal	7570	10-year	583.96	583.93	0.03	0.00	0.00	10.76	8480.01	9.23	329.65
Ship Canal	7460	10-year	583.96	583.92	0.03	0.00	0.00	11.19	8477.03	11.78	280.17
Ship Canal	7459		Bridge								
Ship Canal	7410	10-year	583.95	583.91	0.04	0.00	0.00	15.34	8464.41	20.25	268.30
Ship Canal	7250	10-year	583.95	583.92	0.02	0.00	0.00	4.76	8487.27	7.98	327.42
Ship Canal	7160	10-year	583.95	583.92	0.02	0.00	0.00	3.43	8492.95	3.62	309.78
Ship Canal	7098		Bridge								
Ship Canal	7015	10-year	583.94	583.91	0.03	0.00	0.00	9.37	8476.00	14.63	309.13
Ship Canal	6910	10-year	583.94	583.92	0.02	0.00	0.00	4.98	8490.28	4.74	322.16
Ship Canal	6550	10-year	583.93	583.91	0.02	0.01	0.00	17.89	8475.32	6.79	346.86
Ship Canal	6000	10-year	583.93	583.90	0.03			18.42	8470.40	11.18	341.67

Errors Warnings and Notes for Plan : Ciorba IL171

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

50-Year Ciorba Duplicate (Baseline)



1 in Horiz. = 400 ft 1 in Vert. = 20 ft

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	8550	50-year	11300.00	554.64	587.06		587.09	0.000011	1.41	8216.83	345.48	0.05
Ship Canal	8030	50-year	11300.00	557.74	587.04		587.08	0.000015	1.62	7215.13	333.95	0.06
Ship Canal	7570	50-year	11300.00	556.01	587.04	562.72	587.07	0.000013	1.52	7651.88	344.79	0.05
Ship Canal	7460	50-year	11300.00	554.91	587.03	562.26	587.07	0.000024	1.70	6862.48	293.64	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	50-year	11300.00	555.41	587.02	562.25	587.07	0.000029	1.85	6384.90	286.99	0.06
Ship Canal	7250	50-year	11300.00	555.21	587.03	561.55	587.06	0.000010	1.41	8202.22	338.80	0.05
Ship Canal	7160	50-year	11300.00	555.50	587.03	561.19	587.06	0.000017	1.44	7967.80	315.68	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	50-year	11300.00	555.60	587.01	562.74	587.05	0.000026	1.71	6793.76	322.35	0.06
Ship Canal	6910	50-year	11300.00	552.89	587.02		587.05	0.000009	1.35	8506.16	331.77	0.05
Ship Canal	6550	50-year	11300.00	555.19	587.01		587.04	0.000011	1.45	8107.88	366.66	0.05
Ship Canal	6000	50-year	11300.00	557.39	587.00	563.34	587.04	0.000013	1.52	7801.57	375.84	0.05

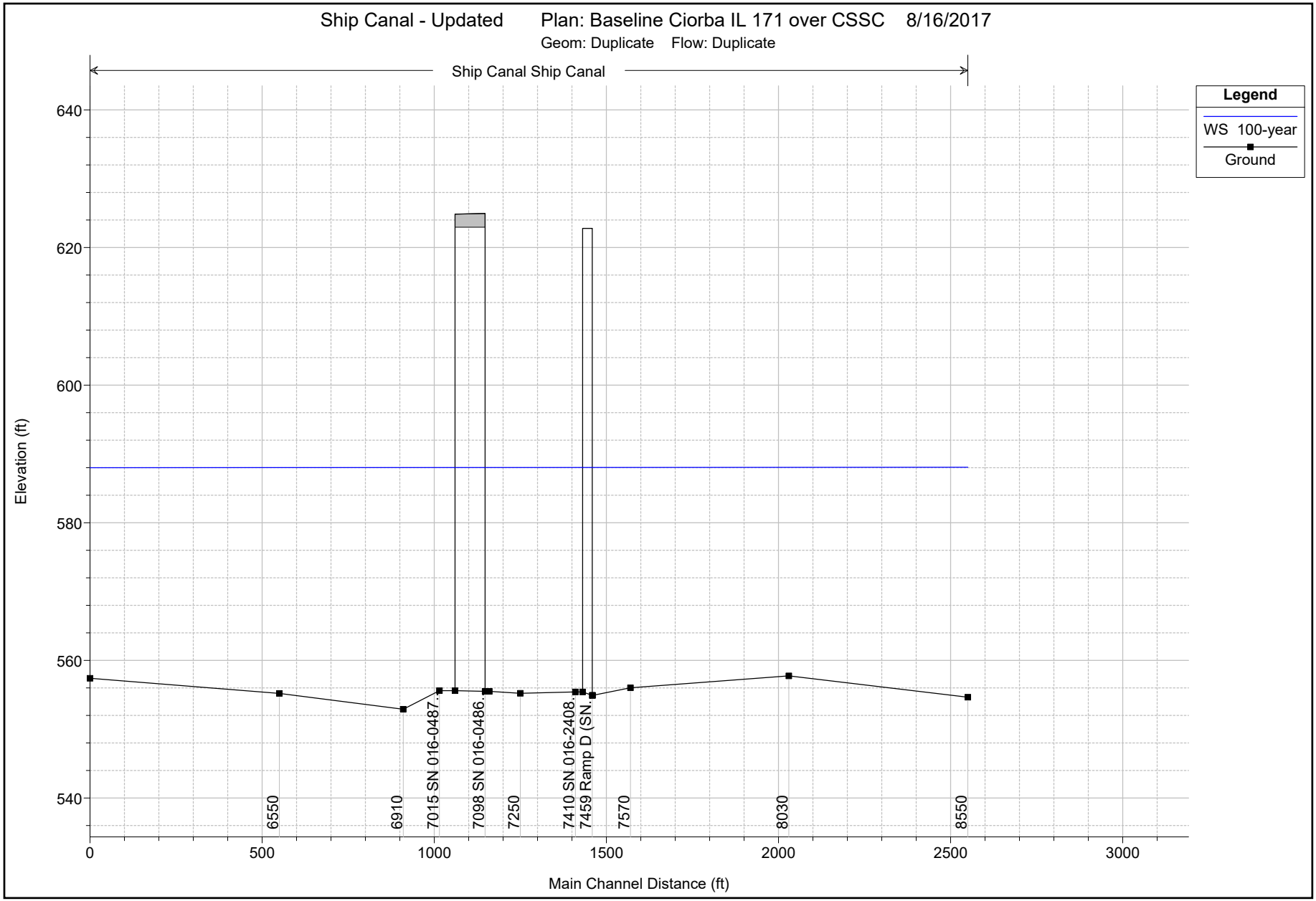
HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	8550	50-year	587.09	587.06	0.03	0.01	0.00	22.30	11255.37	22.32	345.48
Ship Canal	8030	50-year	587.08	587.04	0.04	0.01	0.00	19.46	11238.82	41.72	333.95
Ship Canal	7570	50-year	587.07	587.04	0.04	0.00	0.00	28.81	11246.48	24.71	344.79
Ship Canal	7460	50-year	587.07	587.03	0.04	0.00	0.00	31.09	11236.19	32.72	293.64
Ship Canal	7459		Bridge								
Ship Canal	7410	50-year	587.07	587.02	0.05	0.00	0.01	42.78	11200.76	56.46	286.99
Ship Canal	7250	50-year	587.06	587.03	0.03	0.00	0.00	12.92	11265.42	21.66	338.80
Ship Canal	7160	50-year	587.06	587.03	0.03	0.00	0.00	9.49	11280.50	10.01	315.68
Ship Canal	7098		Bridge								
Ship Canal	7015	50-year	587.05	587.01	0.05	0.00	0.01	25.28	11235.27	39.45	322.35
Ship Canal	6910	50-year	587.05	587.02	0.03	0.00	0.00	13.64	11273.38	12.97	331.77
Ship Canal	6550	50-year	587.04	587.01	0.03	0.01	0.00	48.17	11233.56	18.27	366.66
Ship Canal	6000	50-year	587.04	587.00	0.04			47.78	11222.19	30.04	375.84

Errors Warnings and Notes for Plan : Ciorba IL171

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

100-Year Ciorba Duplicate (Baseline)



1 in Horiz. = 400 ft 1 in Vert. = 20 ft

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	8550	100-year	12800.00	554.64	588.07		588.10	0.000012	1.54	8567.50	350.09	0.05
Ship Canal	8030	100-year	12800.00	557.74	588.05		588.09	0.000017	1.77	7553.63	339.16	0.06
Ship Canal	7570	100-year	12800.00	556.01	588.04	563.17	588.09	0.000015	1.66	8001.05	349.70	0.06
Ship Canal	7460	100-year	12800.00	554.91	588.03	562.71	588.08	0.000028	1.85	7159.27	298.00	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	100-year	12800.00	555.41	588.02	562.77	588.08	0.000033	2.02	6675.33	293.02	0.07
Ship Canal	7250	100-year	12800.00	555.21	588.03	561.98	588.07	0.000012	1.54	8544.22	342.49	0.05
Ship Canal	7160	100-year	12800.00	555.50	588.03	561.63	588.07	0.000019	1.57	8285.55	317.59	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	100-year	12800.00	555.60	588.01	563.25	588.06	0.000030	1.86	7118.52	326.62	0.07
Ship Canal	6910	100-year	12800.00	552.89	588.02		588.05	0.000010	1.48	8840.31	334.87	0.05
Ship Canal	6550	100-year	12800.00	555.19	588.01		588.05	0.000013	1.58	8478.25	373.05	0.05
Ship Canal	6000	100-year	12800.00	557.39	588.00	563.71	588.04	0.000015	1.65	8183.06	387.14	0.06

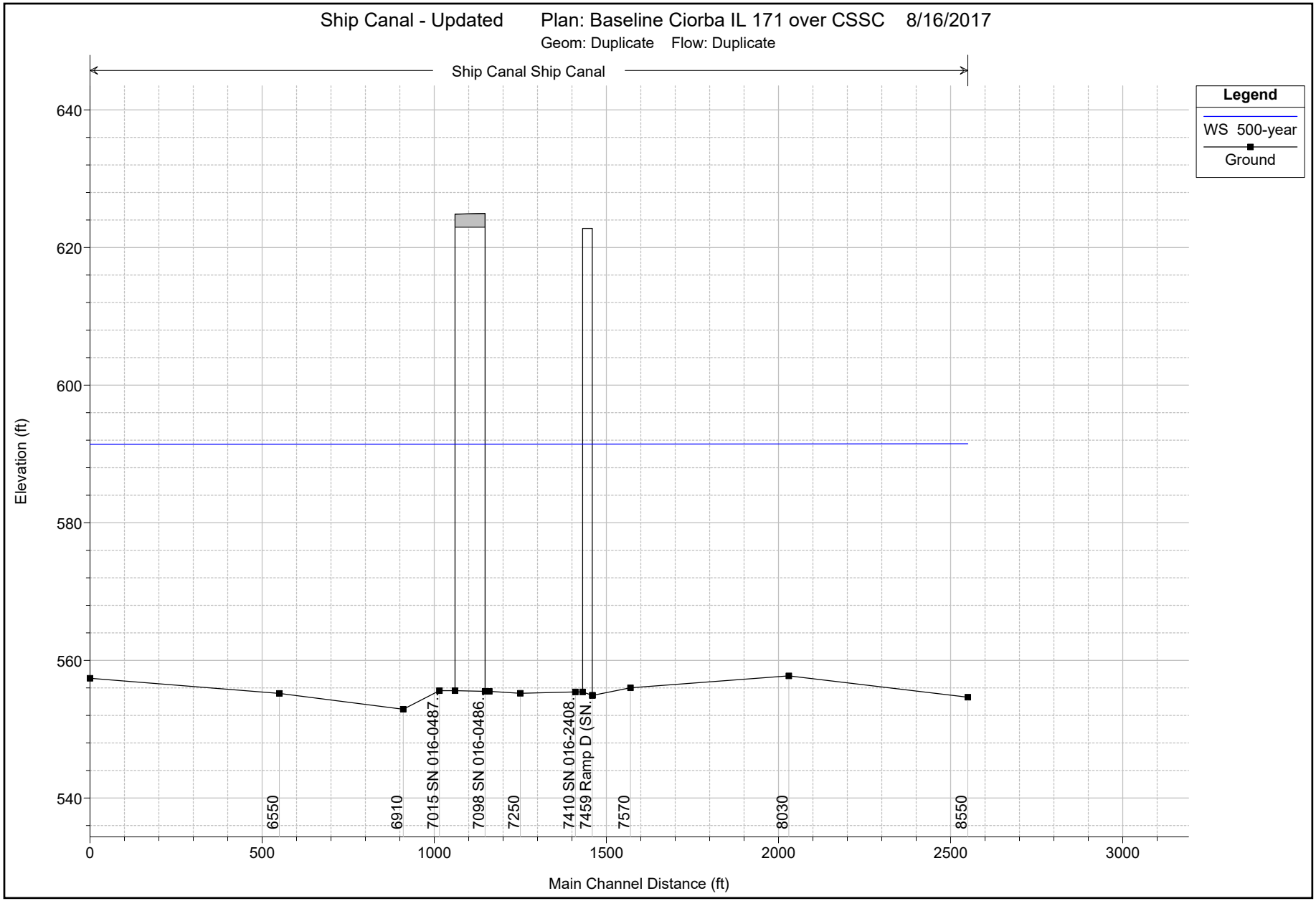
HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	8550	100-year	588.10	588.07	0.04	0.01	0.00	30.23	12739.51	30.26	350.09
Ship Canal	8030	100-year	588.09	588.05	0.05	0.01	0.00	26.24	12717.49	56.26	339.16
Ship Canal	7570	100-year	588.09	588.04	0.04	0.00	0.00	38.87	12727.79	33.34	349.70
Ship Canal	7460	100-year	588.08	588.03	0.05	0.00	0.00	42.40	12712.97	44.62	298.00
Ship Canal	7459		Bridge								
Ship Canal	7410	100-year	588.08	588.02	0.06	0.00	0.01	58.39	12664.56	77.06	293.02
Ship Canal	7250	100-year	588.07	588.03	0.04	0.00	0.00	17.50	12753.16	29.34	342.49
Ship Canal	7160	100-year	588.07	588.03	0.04	0.00	0.00	12.93	12773.42	13.65	317.59
Ship Canal	7098		Bridge								
Ship Canal	7015	100-year	588.06	588.01	0.05	0.00	0.01	34.19	12712.45	53.36	326.62
Ship Canal	6910	100-year	588.05	588.02	0.03	0.00	0.00	18.52	12763.87	17.61	334.87
Ship Canal	6550	100-year	588.05	588.01	0.04	0.01	0.00	65.06	12710.27	24.68	373.05
Ship Canal	6000	100-year	588.04	588.00	0.04			66.12	12693.36	40.53	387.14

Errors Warnings and Notes for Plan : Ciorba IL171

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

500-Year Ciorba Duplicate (Baseline)



1 in Horiz. = 400 ft 1 in Vert. = 20 ft

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	8550	500-year	16100.00	554.64	591.47		591.52	0.000013	1.72	9786.57	365.69	0.05
Ship Canal	8030	500-year	16100.00	557.74	591.45		591.51	0.000018	1.95	8738.19	356.81	0.06
Ship Canal	7570	500-year	16100.00	556.01	591.45	564.08	591.50	0.000015	1.84	9239.63	398.55	0.06
Ship Canal	7460	500-year	16100.00	554.91	591.43	563.68	591.50	0.000034	2.05	8260.63	353.44	0.07
Ship Canal	7459		Bridge									
Ship Canal	7410	500-year	16100.00	555.41	591.42	563.73	591.49	0.000041	2.23	7768.54	356.18	0.08
Ship Canal	7250	500-year	16100.00	555.21	591.44	562.81	591.48	0.000013	1.72	9730.80	354.97	0.05
Ship Canal	7160	500-year	16100.00	555.50	591.43	562.53	591.48	0.000023	1.74	9475.44	381.06	0.06
Ship Canal	7098		Bridge									
Ship Canal	7015	500-year	16100.00	555.60	591.41	564.29	591.47	0.000034	2.03	8348.72	395.08	0.07
Ship Canal	6910	500-year	16100.00	552.89	591.42		591.46	0.000011	1.66	10003.04	360.01	0.05
Ship Canal	6550	500-year	16100.00	555.19	591.41		591.46	0.000014	1.76	9790.21	410.38	0.06
Ship Canal	6000	500-year	16100.00	557.39	591.40	564.47	591.45	0.000015	1.83	9621.35	463.60	0.06

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	8550	500-year	591.52	591.47	0.05	0.01	0.00	62.05	15975.84	62.11	365.69
Ship Canal	8030	500-year	591.51	591.45	0.06	0.01	0.00	53.11	15933.04	113.85	356.81
Ship Canal	7570	500-year	591.50	591.45	0.05	0.00	0.00	83.59	15948.83	67.58	398.55
Ship Canal	7460	500-year	591.50	591.43	0.06	0.00	0.00	93.04	15909.06	97.90	353.44
Ship Canal	7459		Bridge								
Ship Canal	7410	500-year	591.49	591.42	0.08	0.00	0.01	128.88	15804.84	166.28	356.18
Ship Canal	7250	500-year	591.48	591.44	0.05	0.00	0.00	35.90	16003.93	60.18	354.97
Ship Canal	7160	500-year	591.48	591.43	0.05	0.00	0.00	25.67	16049.58	24.75	381.06
Ship Canal	7098		Bridge								
Ship Canal	7015	500-year	591.47	591.41	0.06	0.00	0.01	69.86	15930.08	100.06	395.08
Ship Canal	6910	500-year	591.46	591.42	0.04	0.00	0.00	38.41	16031.32	30.27	360.01
Ship Canal	6550	500-year	591.46	591.41	0.05	0.01	0.00	132.54	15923.42	44.04	410.38
Ship Canal	6000	500-year	591.45	591.40	0.05			148.44	15870.83	80.73	463.60

Errors Warnings and Notes for Plan : Ciorba IL171

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 6910 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: Ship Canal Reach: Ship Canal RS: 6550 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 6000 Profile: 500-year
Warning:	Divided flow computed for this cross-section.

Structure Tables

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Ship Canal	7459	10-year	583.96	622.42	20362.21		8500.00	617.49		0.00	
Ship Canal	7459	50-year	587.07	622.42	20362.21		11300.00	617.49		0.00	
Ship Canal	7459	100-year	588.08	622.42	20362.21		12800.00	617.49		0.00	
Ship Canal	7459	500-year	591.50	622.42	20362.21		16100.00	617.49		0.00	
Ship Canal	7098	10-year	583.95	622.92	22774.72		8500.00	624.96		0.00	
Ship Canal	7098	50-year	587.06	622.92	22774.72		11300.00	624.96		0.00	
Ship Canal	7098	100-year	588.07	622.92	22774.72		12800.00	624.96		0.01	
Ship Canal	7098	500-year	591.48	622.92	22774.72		16100.00	624.96		0.01	

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Ship Canal	7459	10-year	583.96	583.92	Energy only	583.96			583.95			
Ship Canal	7459	50-year	587.07	587.03	Energy only	587.07			587.07			
Ship Canal	7459	100-year	588.08	588.03	Energy only	588.08			588.08			
Ship Canal	7459	500-year	591.50	591.43	Energy only	591.50			591.49			
Ship Canal	7098	10-year	583.95	583.92	Energy only	583.95			583.94			
Ship Canal	7098	50-year	587.06	587.03	Energy only	587.06			587.05			
Ship Canal	7098	100-year	588.07	588.03	Energy only	588.07			588.06			
Ship Canal	7098	500-year	591.48	591.43	Energy only	591.48			591.47			

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7570	10-year	583.96	583.93	561.79	0.00	0.00	329.65	10.76	8480.01	9.23	1.31
Ship Canal	7570	50-year	587.07	587.04	562.72	0.00	0.00	344.79	28.81	11246.48	24.71	1.52
Ship Canal	7570	100-year	588.09	588.04	563.17	0.00	0.00	349.70	38.87	12727.79	33.34	1.66
Ship Canal	7570	500-year	591.50	591.45	564.08	0.00	0.00	398.55	83.59	15948.83	67.58	1.84
Ship Canal	7460	10-year	583.96	583.92	561.24	0.00	0.00	280.17	11.19	8477.03	11.78	1.45
Ship Canal	7460	50-year	587.07	587.03	562.26	0.00	0.00	293.64	31.09	11236.19	32.72	1.70
Ship Canal	7460	100-year	588.08	588.03	562.71	0.00	0.00	298.00	42.40	12712.97	44.62	1.85
Ship Canal	7460	500-year	591.50	591.43	563.68	0.00	0.00	353.44	93.04	15909.06	97.90	2.05
Ship Canal	7459 BR U	10-year	583.96	583.92	561.24	0.00	0.00	280.17	11.19	8477.03	11.78	1.45
Ship Canal	7459 BR U	50-year	587.07	587.03	562.26	0.00	0.00	293.64	31.09	11236.19	32.72	1.70
Ship Canal	7459 BR U	100-year	588.08	588.03	562.71	0.00	0.00	298.00	42.40	12712.97	44.62	1.85
Ship Canal	7459 BR U	500-year	591.50	591.43	563.68	0.00	0.00	345.44	93.00	15909.14	97.86	2.05
Ship Canal	7459 BR D	10-year	583.95	583.92	561.30	0.00	0.00	268.30	15.34	8464.41	20.25	1.58
Ship Canal	7459 BR D	50-year	587.07	587.02	562.25	0.00	0.00	286.99	42.78	11200.75	56.47	1.85
Ship Canal	7459 BR D	100-year	588.08	588.02	562.77	0.00	0.00	293.03	58.39	12664.54	77.07	2.02
Ship Canal	7459 BR D	500-year	591.49	591.42	563.73	0.00	0.00	348.19	128.83	15804.97	166.20	2.23
Ship Canal	7410	10-year	583.95	583.91	561.30	0.00	0.00	268.30	15.34	8464.41	20.25	1.58
Ship Canal	7410	50-year	587.07	587.02	562.25	0.00	0.01	286.99	42.78	11200.76	56.46	1.85
Ship Canal	7410	100-year	588.08	588.02	562.77	0.00	0.01	293.02	58.39	12664.56	77.06	2.02
Ship Canal	7410	500-year	591.49	591.42	563.73	0.00	0.01	356.18	128.88	15804.84	166.28	2.23
Ship Canal	7250	10-year	583.95	583.92	560.69	0.00	0.00	327.42	4.76	8487.27	7.98	1.20
Ship Canal	7250	50-year	587.06	587.03	561.55	0.00	0.00	338.80	12.92	11265.42	21.66	1.41
Ship Canal	7250	100-year	588.07	588.03	561.98	0.00	0.00	342.49	17.50	12753.16	29.34	1.54
Ship Canal	7250	500-year	591.48	591.44	562.81	0.00	0.00	354.97	35.90	16003.93	60.18	1.72
Ship Canal	7160	10-year	583.95	583.92	560.30	0.00	0.00	309.78	3.43	8492.95	3.62	1.22
Ship Canal	7160	50-year	587.06	587.03	561.19	0.00	0.00	315.68	9.49	11280.50	10.01	1.44
Ship Canal	7160	100-year	588.07	588.03	561.63	0.00	0.00	317.59	12.93	12773.42	13.65	1.57
Ship Canal	7160	500-year	591.48	591.43	562.53	0.00	0.00	381.06	25.67	16049.58	24.75	1.74
Ship Canal	7098 BR U	10-year	583.95	583.92	560.31	0.00	0.00	309.78	3.43	8492.95	3.62	1.22

HEC-RAS Plan: Ciorba IL171 River: Ship Canal Reach: Ship Canal (Continued)

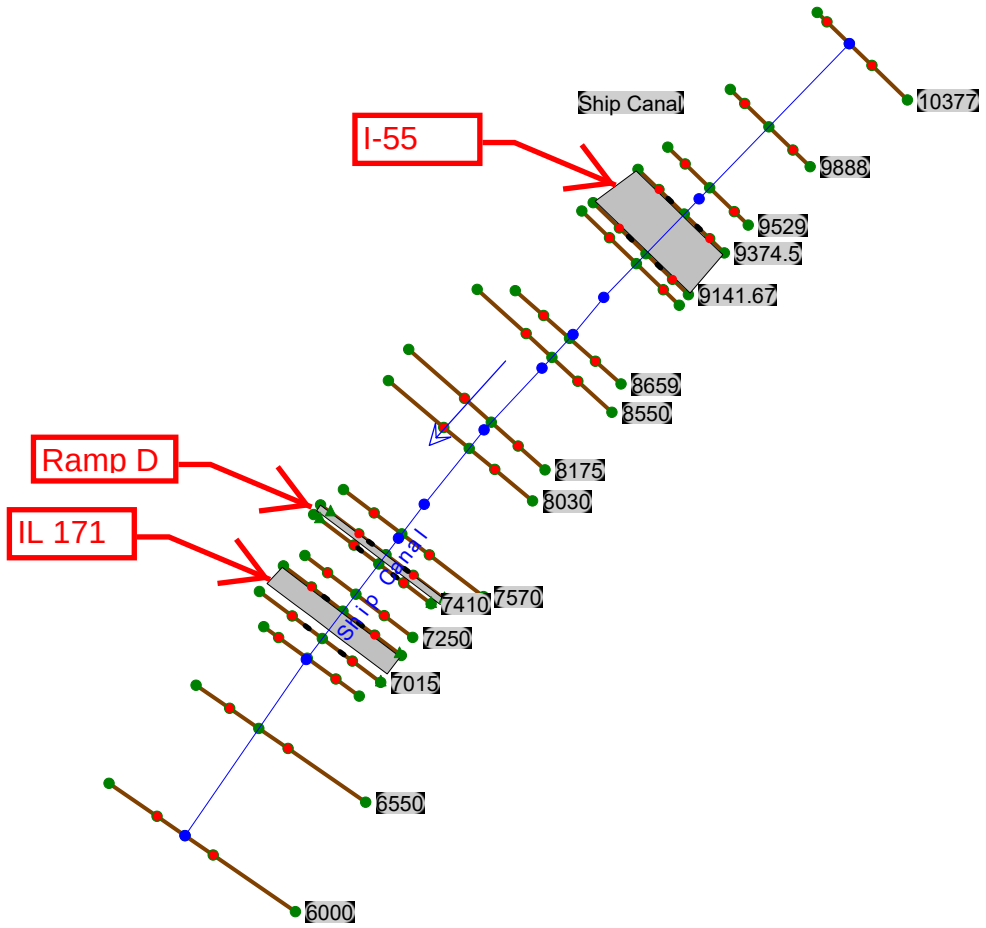
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7098 BR U	50-year	587.06	587.03	561.19	0.00	0.00	313.21	9.49	11281.00	9.51	1.44
Ship Canal	7098 BR U	100-year	588.07	588.03	561.63	0.00	0.00	314.15	12.93	12774.75	12.31	1.57
Ship Canal	7098 BR U	500-year	591.48	591.43	562.53	0.00	0.00	366.30	27.67	16049.90	22.43	1.74
Ship Canal	7098 BR D	10-year	583.94	583.91	561.69	0.00	0.00	305.38	9.38	8482.41	8.21	1.49
Ship Canal	7098 BR D	50-year	587.05	587.01	562.74	0.00	0.00	318.60	25.32	11253.10	21.58	1.72
Ship Canal	7098 BR D	100-year	588.06	588.01	563.25	0.00	0.00	322.87	34.26	12736.37	29.36	1.86
Ship Canal	7098 BR D	500-year	591.47	591.41	564.30	0.00	0.00	384.10	70.44	15969.40	60.16	2.04
Ship Canal	7015	10-year	583.94	583.91	561.69	0.00	0.00	309.13	9.37	8476.00	14.63	1.49
Ship Canal	7015	50-year	587.05	587.01	562.74	0.00	0.01	322.35	25.28	11235.27	39.45	1.71
Ship Canal	7015	100-year	588.06	588.01	563.25	0.00	0.01	326.62	34.19	12712.45	53.36	1.86
Ship Canal	7015	500-year	591.47	591.41	564.29	0.00	0.01	395.08	69.86	15930.08	100.06	2.03
Ship Canal	6910	10-year	583.94	583.92		0.00	0.00	322.16	4.98	8490.28	4.74	1.15
Ship Canal	6910	50-year	587.05	587.02		0.00	0.00	331.77	13.64	11273.38	12.97	1.35
Ship Canal	6910	100-year	588.05	588.02		0.00	0.00	334.87	18.52	12763.87	17.61	1.48
Ship Canal	6910	500-year	591.46	591.42		0.00	0.00	360.01	38.41	16031.32	30.27	1.66

TAB B

SECTION 13.B

EXISTING CONDITIONS

Existing Conditions
HEC-RAS Geometry



HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Ship Canal - Updated
Project File : ShipCanal-Update.prj
Run Date and Time: 11/9/2017 10:36:39 AM

Project in English units

PLAN DATA

Plan Title: Existing
Plan File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.p01

Geometry Title: Existing
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g01

Flow Title : Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Plan Description:
Existing conditions I-55 over CSSC per survey added to approved IL 171 baseline model. Starting WSEs updated to NAVD88.

Plan Summary Information:
Number of: Cross Sections = 19 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 3 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed at all cross sections
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Flow Data (cfs)

River	Reach	RS	10-year	50-year	100-year	200-year	500-year
Ship Canal	Ship Canal	10377	8500	11300	12800	14200	16100
Ship Canal	Ship Canal	8550	8500	11300	12800	14200	16100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Ship Canal	Ship Canal	10-year		Known WS = 583.61
Ship Canal	Ship Canal	50-year		Known WS = 586.71
Ship Canal	Ship Canal	100-year		Known WS = 587.71
Ship Canal	Ship Canal	200-year		Known WS = 589.26
Ship Canal	Ship Canal	500-year		Known WS = 591.11

GEOMETRY DATA

Geometry Title: Existing
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g01

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 10377

INPUT
Description: Sta. 103+77
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-341.9	593.764	-188.09	592.696	-174.86	593.546	-161.82	588.031	-153.99	587.59
-132.57	577.194	-104	568.05	-103	567.35	-97	567.12	-87	564.38
-82	562.62	-81	562.74	-79	562.51	-70	562.35	-52	561.01

```
     -50  561.37     -30  560.02     -28  560.09       0  559.02       8   558.6
      16  558.58      42  558.33      57  558.67      66  559.56      68  560.66
      69   561.1      74  560.56      84  561.82      91  563.33     101   566.6
     103  567.64     105  568.88     111  571.63     114     573     116     574
  132.13 577.407  147.87 591.091  153.23 591.392  189.39 592.153

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -341.9     .08 -132.57     .03  132.13     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -132.57  132.13              489     489     489             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9888

INPUT
Description: Sta. 98+88
Station Elevation Data    num=      41
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -240.62 592.615 -223.22 593.176 -181.19 593.324 -165.84 591.908 -139.73 577.192
    -113  570.17    -109  570.99     -95  567.33     -84     565     -69  562.06
     -58  560.15     -56  560.66     -44  559.31     -41  559.57     -25  558.63
     -22  558.84      -8  558.33      -6  558.39       0  558.13       1  558.06
       2  558.09      13  558.18      15  558.12      20  558.04      32  558.05
      35  558.18      36  558.24      48  558.45      69  559.47      76  560.58
      91  563.04     106  571.26     108  573.65     109  573.61     113  573.52
  143.68 577.117  153.01 579.318  165.07 586.702174.2481 594.073214.0618  594.94
228.8899  595.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -240.62     .08 -139.73     .03  143.68     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -139.73  143.68              359     359     359             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9529

INPUT
Description: Sta. 95+29
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-221.006 599.645-176.763   594.6-159.566 594.543-149.072 585.989-139.364 577.379
-118.087  573.57-110.309   573.3-106.066  572.01 -96.167  568.66 -93.338  567.39
 -87.681  565.97 -82.024  564.84  -80.61  563.79 -66.468  560.89 -59.397  559.14
 -54.447     558 -44.548  557.34 -42.426  557.49  -26.87  556.97 -18.385  556.91
  -9.192  557.24       0  557.07   7.778  557.24  12.728  557.11  21.213  557.24
   26.87  556.94  47.376  558.28  52.326  558.43  59.397  559.19  70.711  561.12
  79.196  562.44  84.853  563.78  89.095  565.38  96.167  567.48 101.116  568.91
 109.602   570.9 116.673  569.71 120.915  570.59 125.158  570.42 149.532  578.04
 170.045 593.595 185.446 599.548 188.882  599.86 190.254  600.03 208.172 600.086
 251.772 601.122

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
-221.006     .08-139.364     .03 149.532     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -139.364 149.532           154.66  154.66  154.66             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9374.5

INPUT
Description: Sta. 93+74.5
SN 016-0014 & SN 016-0015 Upstream Bridge XS
HEC
             RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -236.05  600.11 -207.21   597.2  -189.3  595.51 -171.13  595.04 -166.66  592.68
 -160.04  586.87 -149.79   577.4 -148.55  577.19 -125.21  572.98 -124.62  572.92
 -119.54  572.91 -116.23   572.9 -114.46  572.63  -112.2  572.36 -111.33  572.19
 -109.94  571.91 -106.56  571.09  -99.89     569  -98.66  568.54  -96.62  567.71
  -95.83  567.47  -90.09  566.04  -89.06  565.82  -83.56  565.03  -81.92   564.3
   -78.9  563.86  -73.82  562.76  -71.57   562.4  -65.92  561.46  -65.59  561.41
  -57.42  559.84   -51.7  558.79  -41.09  557.84  -40.27   557.8  -37.82   557.9
   -37.7   557.9  -37.14   557.9  -28.11  557.42  -26.41  557.48  -20.77  557.15
  -19.85  557.16  -18.51   557.2  -14.56  557.12     -14  557.11  -10.05  557.08
   -1.37  557.34     1.9  557.32     7.3  557.26   11.46  557.33   14.65   557.4
   15.44   557.4   19.32  557.47   20.22  557.51    23.4  557.75   27.33  558.18
   27.38  558.18   32.66   558.2   34.55  558.36   43.31  559.01   52.02  559.57
   55.26  559.69   56.69  559.71   58.44  559.82   60.83  560.11   63.22  560.25
   63.36  560.27   66.41  560.77   71.19  561.58   74.04  561.97   82.05  563.01
   87.39  563.99   87.91  564.14    89.5  564.53   91.39  565.06   93.48  565.52
   98.07   566.5   98.26  566.54  102.24  567.17  102.74  567.31  107.02  568.35
  110.75  569.23  117.42  568.96  118.17  569.12  121.43   569.9  125.43  570.16
  128.53  571.12  131.71  572.03  142.86  575.16  148.44   576.7  173.11  591.84
  177.03  593.45  180.23  595.54  184.14   596.7  191.63  599.02  193.49   599.3
  195.76  599.43  197.41  599.55   197.9  599.55  218.97  599.31  221.98  599.31
  235.75  599.94  254.54  600.28  271.41  600.12

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -236.05     .08 -149.79     .03  148.44     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -149.79  148.44            232.7   232.7   232.7             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -95.038 -74.396 589.715  74.396  95.038 589.715

BRIDGE


RIVER: Ship Canal
REACH: Ship Canal         RS: 9266

INPUT
Description: SN 016-0014 & SN 016-0015 (EB & WB of I-55)
Distance from Upstream XS =   11.93
Deck/Roadway Width        =     212
```

```
Weir Coefficient          =     2.6
Bridge Deck/Roadway Skew  =      45
Upstream  Deck/Roadway Coordinates
    num=       7
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
-239.051  627.45 622.844-205.191  628.11 618.613  -80.74   629.5 616.148
   80.74  629.75 616.461 205.191  629.22  620.53 239.051  628.82 625.436
  271.41  628.82

Upstream Bridge Cross Section Data
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -236.05  600.11 -207.21   597.2  -189.3  595.51 -171.13  595.04 -166.66  592.68
 -160.04  586.87 -149.79   577.4 -148.55  577.19 -125.21  572.98 -124.62  572.92
 -119.54  572.91 -116.23   572.9 -114.46  572.63  -112.2  572.36 -111.33  572.19
 -109.94  571.91 -106.56  571.09  -99.89     569  -98.66  568.54  -96.62  567.71
  -95.83  567.47  -90.09  566.04  -89.06  565.82  -83.56  565.03  -81.92   564.3
   -78.9  563.86  -73.82  562.76  -71.57   562.4  -65.92  561.46  -65.59  561.41
  -57.42  559.84   -51.7  558.79  -41.09  557.84  -40.27   557.8  -37.82   557.9
   -37.7   557.9  -37.14   557.9  -28.11  557.42  -26.41  557.48  -20.77  557.15
  -19.85  557.16  -18.51   557.2  -14.56  557.12     -14  557.11  -10.05  557.08
   -1.37  557.34     1.9  557.32     7.3  557.26   11.46  557.33   14.65   557.4
   15.44   557.4   19.32  557.47   20.22  557.51    23.4  557.75   27.33  558.18
   27.38  558.18   32.66   558.2   34.55  558.36   43.31  559.01   52.02  559.57
   55.26  559.69   56.69  559.71   58.44  559.82   60.83  560.11   63.22  560.25
   63.36  560.27   66.41  560.77   71.19  561.58   74.04  561.97   82.05  563.01
   87.39  563.99   87.91  564.14    89.5  564.53   91.39  565.06   93.48  565.52
   98.07   566.5   98.26  566.54  102.24  567.17  102.74  567.31  107.02  568.35
  110.75  569.23  117.42  568.96  118.17  569.12  121.43   569.9  125.43  570.16
  128.53  571.12  131.71  572.03  142.86  575.16  148.44   576.7  173.11  591.84
  177.03  593.45  180.23  595.54  184.14   596.7  191.63  599.02  193.49   599.3
  195.76  599.43  197.41  599.55   197.9  599.55  218.97  599.31  221.98  599.31
  235.75  599.94  254.54  600.28  271.41  600.12

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -236.05     .08 -149.79     .03  148.44     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       -149.79  148.44             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -95.038 -74.396 589.715  74.396  95.038 589.715

Downstream  Deck/Roadway Coordinates
    num=       8
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -258.68  626.85        -239.051  626.85 625.205-205.191  627.48 620.456
  -80.74  629.15  616.39   80.74  630.21 616.151 205.191  629.03 619.043
 239.051  628.41 620.831  300.95  628.41

Downstream Bridge Cross Section Data
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -258.68   600.8 -227.52   598.2 -208.17  596.88 -188.53  595.79  -183.7  595.07
 -176.55  588.19 -165.47  577.44 -163.98  577.19 -135.93   572.1 -135.22  571.98
 -129.11  572.18 -125.13  572.31    -123  572.33 -120.29  572.54 -119.24  572.47
 -117.58  572.36 -113.51  571.81  -105.5  569.52 -104.01  569.08 -101.57  568.19
 -100.62  567.85  -93.71  566.16  -92.48  565.86  -85.86  565.32   -83.9  565.06
  -80.27  564.76  -74.16  563.38  -71.45  563.07  -64.66  562.24  -64.26  562.18
  -54.44  560.88  -47.57  559.98  -34.81  558.51  -33.83   558.5  -30.88  558.52
  -30.74  558.51  -30.07  558.56  -19.21  557.74  -17.18  557.96  -10.39  557.38
```

```
   -9.28  557.45   -7.68  557.55   -2.93   557.4   -2.25  557.37     2.5  557.33
    10.4   557.5   13.37  557.54   18.29  557.54   22.07  557.57   24.98  557.65
    25.7  557.66   29.23     558   30.05  558.08   32.95  558.62   36.52   559.6
   36.57  559.61   41.38   560.1    43.1   560.3   51.08  561.02      59   561.5
   61.95  561.66   63.26  561.63   64.85  561.62   67.03  561.93    69.2  561.87
   69.33  561.89    72.1  562.31   76.45  563.04   79.06  563.26   86.35  563.86
   91.21  564.32   91.68  564.37   93.13  564.39   94.85  564.57   96.76  564.74
  100.93  565.03  101.11  565.05  104.73  564.79  105.18  564.91  109.08   565.9
  112.47  566.72  118.55  567.82  119.23  567.99   122.2  568.85  125.84  569.77
  128.66  570.64  131.56  571.32  141.71  573.59  146.79   574.7  177.72  589.19
  182.63  591.33  186.65  595.01  191.55  596.03  200.94  598.23  203.26  598.72
  206.12  598.77  208.19  598.82  208.79  598.82  235.21  598.14  238.98  598.05
  256.25  599.21  279.81  599.52  300.95  598.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -258.68     .08 -165.47     .03  146.79     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       -165.47  146.79             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-95.0838-74.3962 589.715 74.3962 95.0838 589.715

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
 -239.05 622.844-189.553  595.53
Downstream     num=       2
     Sta    Elev     Sta    Elev
 -239.05  625.21-194.541  596.13

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
 199.905   599.5  239.05 625.436
Downstream     num=       2
     Sta    Elev     Sta    Elev
 198.491  597.67  239.05 620.831

Number of Piers =  4

Pier Data
Pier Station     Upstream=-205.191    Downstream=-205.191
Upstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 618.613
Downstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 620.456

Pier Data
```

```
Pier Station     Upstream=  -80.74    Downstream=  -80.74
Upstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.148
Downstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25  616.39

Pier Data
Pier Station     Upstream=   80.74    Downstream=   80.74
Upstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.461
Downstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.151

Pier Data
Pier Station     Upstream= 205.191    Downstream= 205.191
Upstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25  620.53
Downstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 619.043

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 627.45
       El of the toe of the abutment   = 600.11
    Right Embankment
       El of the top of the embankment = 628.82
       El of the toe of the abutment   = 600.01
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 212
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
```

```
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9141.67

INPUT
Description: Sta. 91+41.67
SN 016-0014 & SN 016-0015 Downstream Bridge XS
HEC
             RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -258.68   600.8 -227.52   598.2 -208.17  596.88 -188.53  595.79  -183.7  595.07
 -176.55  588.19 -165.47  577.44 -163.98  577.19 -135.93   572.1 -135.22  571.98
 -129.11  572.18 -125.13  572.31    -123  572.33 -120.29  572.54 -119.24  572.47
 -117.58  572.36 -113.51  571.81  -105.5  569.52 -104.01  569.08 -101.57  568.19
 -100.62  567.85  -93.71  566.16  -92.48  565.86  -85.86  565.32   -83.9  565.06
  -80.27  564.76  -74.16  563.38  -71.45  563.07  -64.66  562.24  -64.26  562.18
  -54.44  560.88  -47.57  559.98  -34.81  558.51  -33.83   558.5  -30.88  558.52
  -30.74  558.51  -30.07  558.56  -19.21  557.74  -17.18  557.96  -10.39  557.38
   -9.28  557.45   -7.68  557.55   -2.93   557.4   -2.25  557.37     2.5  557.33
    10.4   557.5   13.37  557.54   18.29  557.54   22.07  557.57   24.98  557.65
    25.7  557.66   29.23     558   30.05  558.08   32.95  558.62   36.52   559.6
   36.57  559.61   41.38   560.1    43.1   560.3   51.08  561.02      59   561.5
   61.95  561.66   63.26  561.63   64.85  561.62   67.03  561.93    69.2  561.87
   69.33  561.89    72.1  562.31   76.45  563.04   79.06  563.26   86.35  563.86
   91.21  564.32   91.68  564.37   93.13  564.39   94.85  564.57   96.76  564.74
  100.93  565.03  101.11  565.05  104.73  564.79  105.18  564.91  109.08   565.9
  112.47  566.72  118.55  567.82  119.23  567.99   122.2  568.85  125.84  569.77
  128.66  570.64  131.56  571.32  141.71  573.59  146.79   574.7  177.72  589.19
  182.63  591.33  186.65  595.01  191.55  596.03  200.94  598.23  203.26  598.72
  206.12  598.77  208.19  598.82  208.79  598.82  235.21  598.14  238.98  598.05
  256.25  599.21  279.81  599.52  300.95  598.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -258.68     .08 -165.47     .03  146.79     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -165.47  146.79            58.64   58.64   58.64             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-95.0838-74.3962 589.715 74.3962 95.0838 589.715

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9083

INPUT
Description: Sta. 90+83
Station Elevation Data    num=      62
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -264.38  600.98-232.638  598.45-187.998  595.67-169.423  577.45-167.874  577.19
-137.886  571.74-131.522  571.99-125.158  572.25-122.329  572.58-119.501  572.48
-115.258  571.99-105.359  569.22-101.823  567.95 -93.338  565.87  -80.61  564.99
```

```
 -74.246  563.54 -71.418  563.24 -64.347  562.43 -33.234  558.68 -28.991  558.67
 -28.284  558.72 -16.971  557.82 -14.849  558.08  -7.778  557.44   -4.95  557.64
       0  557.47    .707  557.44   5.657  557.39  16.263  557.59  24.749  557.63
  28.284  557.73  32.527  558.23  35.355  558.84  38.891  559.97  45.255  560.79
  53.033  561.53   63.64  562.16  66.468  562.07  68.589  562.39  70.711  562.28
  73.539   562.7  77.782  563.41  92.631  564.43  94.045  564.36  97.581  564.54
 101.823  564.67 105.359  564.19 109.602  565.28 119.501   567.7 128.693  570.52
 131.522  571.14 141.421   573.2 146.371  574.19 184.039   590.8 188.267  594.88
 193.415  595.86 205.726  598.57 211.538  598.64 243.266  597.73 261.417  599.03
 286.173  599.33  308.39  598.23

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -264.38     .08-169.423     .03 146.371     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -169.423 146.371              424     424     424             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8659

INPUT
Description: Sta. 86+59
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  -298.3   601.5 -268.92  602.74 -212.94  599.08 -192.46  592.39 -179.57  591.02
 -153.65  577.45    -128  572.15    -126  572.11    -123  570.84    -121  569.65
    -116  567.76    -109  563.97    -107  562.57    -106  561.92    -104  561.25
    -102  558.97    -100  559.02     -89  557.29     -88  556.71     -85  556.73
     -80   557.3     -66  557.72     -63  557.69     -60  557.64     -55   557.4
     -43  557.67     -31  557.85     -26   557.9     -22   557.7     -20  557.75
     -16  557.84     -13  557.63      -7  557.73       0  557.67       6  557.51
       9  557.64      15  557.36      18  557.62      21  557.56      45  559.75
      48  559.64      49  559.96      53   560.5      65  562.71      69  563.24
      69  563.19      80  564.36      84  565.36      87  566.27      88   567.1
      92   566.9      94  567.76     101  569.63     104   570.5     107  571.71
     109  571.75     123  572.46     126  572.74     129   572.7     131  572.97
  138.34  579.94  145.66  578.27  165.37  591.88  180.33  596.01  186.66  596.09
  209.18  595.91  221.61  594.85  227.27  594.81   243.9  600.02  258.01  599.73
  297.19   601.4

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -298.3     .08 -153.65     .03  138.34     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -153.65  138.34              109     109     109             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8550

INPUT
Description: Sta. 85+50
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
-392.501  600.02-352.653  601.25-324.759  602.14-282.919   601.7-251.041  599.95
-197.247  576.44-192.266  574.64-187.285  573.84-172.342  562.44-147.437  556.44
-122.532  556.44 -97.627  556.94 -72.722  556.44 -24.905  556.44       0  554.64
  24.905  558.54   49.81  562.84  74.715  567.44  89.658  572.54  94.638  574.24
  99.619  576.44 147.437  597.32  154.41  597.48 169.353   597.8 178.319  597.74
 191.269  596.95  204.22  597.17 218.167  601.87 231.117   601.9 236.098  601.36
 253.033  602.52 311.809  603.91 377.558  605.42

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-392.501     .08-197.247     .03  99.619     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -197.247  99.619              375     375     375             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8175

INPUT
Description: Sta. 81+75
Station Elevation Data    num=      48
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -297.94  599.37 -212.57  599.29 -190.66  597.73 -169.77  593.34  -146.1  577.38
    -117  572.77    -108  569.79     -99  566.63     -90  563.75     -81  560.83
     -78  560.88     -67  560.64     -59  560.36     -50     560     -45  559.79
     -43  559.82     -30  559.69      -6  559.31       0  559.42      17  559.49
      61  559.36      63  559.39      66  559.23      73   559.3      80  559.39
      90  559.43     102  560.89     108  561.61     117  562.32     131   563.6
     134  563.88     136  564.36     138  565.29     139  565.86     141   566.8
  156.56 577.296  171.42 584.133   197.4 586.651  215.11 589.124  234.28 590.624
  252.28 598.491  264.07 603.893  272.57 604.688  333.02 604.706   345.1 606.155
  375.55 606.742  442.22 606.389  470.34 606.091

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -297.94     .08  -146.1     .03  156.56     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -146.1  156.56              145     145     145             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8030

INPUT
Description: Sta. 80+30
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -387  601.61    -343  601.15    -273  600.53    -237  600.18    -227  601.83
    -219  599.59    -179  576.44    -174  574.84    -169  573.54    -154  571.14
    -129  560.74    -104  559.04     -79  558.44     -50  558.04     -25  558.04
       0  557.74      25  557.94      50  558.44      75  570.04      90  572.84
      95  574.64     100  576.44     165  595.25     211  601.49     229  602.52
     247  602.85     263  602.69     271  602.19     283  602.06     302  605.01
     351  606.21     391  605.61     406  605.61
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -387     .08    -179     .03     100     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -179     100              460     460     460             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7570

INPUT
Description: Sta. 75+70
Station Elevation Data    num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -481  600.12    -405  596.05    -373  595.99    -267  591.57    -228  590.22
    -192  576.41    -187  575.01    -182  573.31    -165  567.11    -140  564.01
    -115  558.91     -90  557.31     -65  557.01     -40  556.41       0  556.01
      24  558.11      49  561.91      76  569.41      91  573.11     101  576.41
     136  591.85     149  593.53     161  593.85     172  594.09     175  595.57
     187  595.26     264  607.39

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -481     .08    -192     .03     101     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -192     101              110     110     110             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7460

INPUT
Description: SN 016-2408 Upstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-398.775  624.59-335.334  619.54-291.831   595.7-272.799  593.94 -260.11  594.59
-241.078  593.85-229.296  593.07 -193.95  576.41-182.168  568.61-167.667  562.91
-149.541  562.61-140.478  561.71 -99.694  556.61 -40.784  556.21       0  554.91
   41.69  559.81  50.753  561.71  68.879  564.41  84.287  572.71  94.256  576.41
 127.789  591.51  142.29   593.4 154.072  593.66 167.667  593.96 173.105  595.16
 183.074  595.08 191.231   593.9  193.95  595.42 250.141  615.93 297.269  614.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-398.775     .08 -193.95     .03  94.256     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -193.95  94.256              50      50      50             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-398.775    -360   575.6       F
     245 297.269   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -166.64 -146.31   589.9    22.9   43.23   589.9
Skew Angle = 25
```

BRIDGE

RIVER: Ship Canal
REACH: Ship Canal RS: 7459

INPUT
Description: Ramp D (SN 016-2408)
Distance from Upstream XS = 1
Deck/Roadway Width = 28
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-567.43	626.62	0	-476.8	625.85	0	-386.17	625.9	0
-345.03	626.46	0	-345.03	626.46	622.78	-296.85	627.11	618.76
-148.31	628.52	618.74	22.57	626.39	616.44	171.69	620.76	612.09
229.6	618.3	614.54	229.6	618.3	0	248.25	617.51	0
338.88	614.91	0						

Upstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-398.775	624.59	-335.334	619.54	-291.831	595.7	-272.799	593.94	-260.11	594.59
-241.078	593.85	-229.296	593.07	-193.95	576.41	-182.168	568.61	-167.667	562.91
-149.541	562.61	-140.478	561.71	-99.694	556.61	-40.784	556.21	0	554.91
41.69	559.81	50.753	561.71	68.879	564.41	84.287	572.71	94.256	576.41
127.789	591.51	142.29	593.4	154.072	593.66	167.667	593.96	173.105	595.16
183.074	595.08	191.231	593.9	193.95	595.42	250.141	615.93	297.269	614.21

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-398.775	.08	-193.95	.03	94.256	.08

Bank Sta: Left Right Coeff Contr. Expan.
-193.95 94.256 .1 .3
Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-398.775	-360	575.6	F
245	297.269	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-166.64	-146.31	589.9	22.9	43.23	589.9

Skew Angle = 25

Downstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-494.17	626.62	0	-403.54	625.85	0	-312.91	625.9	0
-271.77	626.46	0	-271.77	626.46	622.78	-223.6	627.11	618.76
-75.05	628.52	618.74	95.82	626.39	616.44	244.95	620.76	612.09
302.86	618.3	614.54	302.86	618.3	0	321.5	617.51	0
412.13	614.91	0						

Downstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-276.424	620.95	-225.671	594.92	-220.233	594.36	-201.2	594.44	-183.98	593.88
-174.011	592.99	-130.508	576.41	-118.726	568.91	-108.757	562.91	-99.694	562.71
-90.631	561.91	-48.941	556.21	0	555.41	40.784	555.41	81.568	561.11
90.631	561.21	109.663	563.11	123.258	572.71	133.227	576.41	183.074	591.06

```
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -130.508 133.227             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -345.03  622.78  -340.7  622.78  -340.7       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -271.77  622.78 -267.44  622.78 -267.44       0

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  225.27       0  225.27  614.54   229.6  614.54
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  298.53       0  298.53  614.54  302.86  614.54

Number of Piers =  4

Pier Data
Pier Station     Upstream= -296.85    Downstream=  -223.6
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76

Pier Data
Pier Station     Upstream= -148.31    Downstream=  -75.05
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74
Downstream     num=       2
    Width   Elev    Width   Elev
```

```
       4       0       4  618.74

Pier Data
Pier Station     Upstream=    24.9    Downstream=   95.82
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44

Pier Data
Pier Station     Upstream=  171.69    Downstream=  244.95
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 624.59
       El of the toe of the abutment   = 619.97
    Right Embankment
       El of the top of the embankment = 614.21
       El of the toe of the abutment   = 606.85
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 65
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION
```

```
RIVER: Ship Canal
REACH: Ship Canal         RS: 7410

INPUT
Description: SN 016-2408 Downstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-276.424  620.95-225.671  594.92-220.233  594.36  -201.2  594.44 -183.98  593.88
-174.011  592.99-130.508  576.41-118.726  568.91-108.757  562.91 -99.694  562.71
 -90.631  561.91 -48.941  556.21       0  555.41  40.784  555.41  81.568  561.11
  90.631  561.21 109.663  563.11 123.258  572.71 133.227  576.41 183.074  591.06
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -130.508 133.227              160     160     160             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7250

INPUT
Description: Sta. 72+50
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-347.672   626.3-275.946  595.55-270.965  594.69-258.014  594.67-242.075  593.91
-218.167  591.71 -196.25  576.41-191.269  574.81-185.292  572.51-169.353  567.31
-144.448  562.21-118.547  557.81 -93.642  556.71 -24.905  555.91       0  555.21
  24.905  555.91   49.81  558.61  74.715  562.31  92.646  571.41  97.627  573.21
 103.604  576.41 137.475  591.56 149.429  592.22 160.387  592.37 171.345  592.81
  175.33  593.74 185.292  593.62 192.266  592.09 198.243  593.22 224.144  593.78

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-347.672     .08 -196.25     .03 103.604     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 103.604               90      90      90             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7160

INPUT
```

```
Description: SN 016-0487 & 0486 Upstream Bridge XS
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-269.493   626.3-197.049  594.96-190.287  594.96-175.798  594.57 -161.31  594.11
-141.025  589.88-128.468   576.4-113.013   573.1-100.456   567.9 -88.865   562.7
 -44.433   555.5       0   555.5  104.32   556.5 148.753   557.8 159.378   561.9
 183.526   565.4 200.913   574.9 207.674   576.4 221.197  590.35 237.618  591.91
 247.277  592.11 252.107   593.5 261.766   593.3  265.63  592.58 355.461  596.35

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-269.493     .08-128.468     .03 207.674     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -128.468 207.674              145     145     145             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-269.493    -260   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15

BRIDGE


RIVER: Ship Canal
REACH: Ship Canal         RS: 7098

INPUT
Description: SN 016-0486 & SN 016-0487 (NB & SB of 171)
Distance from Upstream XS =     8.5
Deck/Roadway Width        =   91.33
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      16
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -467.31  628.06       0 -467.31  627.92       0 -419.01  627.74       0
 -370.71  627.55       0 -322.42  627.37       0 -274.12  627.18       0
 -243.12  627.18       0 -243.12  627.18  622.94 -190.77     627  622.67
 -141.91  626.82  622.56  -44.34  626.45  617.71  123.33  625.71  616.51
  217.38  625.34  619.24  274.03  625.16  619.85  347.64  624.98  620.85
  399.14  624.79  620.63

Upstream Bridge Cross Section Data
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-269.493   626.3-197.049  594.96-190.287  594.96-175.798  594.57 -161.31  594.11
-141.025  589.88-128.468   576.4-113.013   573.1-100.456   567.9 -88.865   562.7
 -44.433   555.5       0   555.5  104.32   556.5 148.753   557.8 159.378   561.9
 183.526   565.4 200.913   574.9 207.674   576.4 221.197  590.35 237.618  591.91
 247.277  592.11 252.107   593.5 261.766   593.3  265.63  592.58 355.461  596.35

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-269.493     .08-128.468     .03 207.674     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -128.468 207.674             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-269.493    -260   575.6       F
```

```
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15

Downstream  Deck/Roadway Coordinates
    num=      16
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -519.53  628.06       0 -519.53  627.92       0 -471.24  627.74       0
 -422.94  627.55       0 -374.64  627.37       0 -326.35  627.18       0
 -295.35  627.18       0 -295.35  627.18  622.94    -243     627  622.67
 -194.14  626.82  622.56  -96.56  626.45  617.71    71.1  625.71  616.51
  165.15  625.34  619.24  221.81  625.16  619.85  295.41  624.98  620.85
  346.91  624.79  620.63

Downstream Bridge Cross Section Data
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -159.378 158.412             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  1

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -243.12  622.94 -238.79  622.94 -238.79       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -295.35  622.94 -291.02  622.94 -291.02       0

Number of Piers =  7

Pier Data
Pier Station     Upstream= -190.77    Downstream=    -243
Upstream     num=       2
```

```
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67

Pier Data
Pier Station     Upstream= -141.91    Downstream= -194.14
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56

Pier Data
Pier Station     Upstream=  -44.34    Downstream=  -96.56
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71

Pier Data
Pier Station     Upstream=  123.33    Downstream=    71.1
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51

Pier Data
Pier Station     Upstream=  217.38    Downstream=  165.15
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24

Pier Data
Pier Station     Upstream=  274.03    Downstream=  221.81
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85

Pier Data
Pier Station     Upstream=  347.64    Downstream=  295.41
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85

Number of Bridge Coefficient Sets =  1
```

```
Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Right Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Abtument Type                      = 1 Vert. abutments and vert. embankments with or without
wingwalls
    Slope of abutments                 =
    Top with of embankment             = 30.7
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7015

INPUT
Description: SN 016-0487 & 0486 Downstream Bridge XS
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -159.378 158.412              105     105     105             .1       .3
```

```
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6910

INPUT
Description: Sta.69+10
Station Elevation Data    num=      31
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -316.79  589.99-305.832   593.7-294.874  595.83-282.919  596.06-264.988  596.42
-247.056  592.93 -225.14  595.93-194.258  576.39-189.277  574.49-184.296  573.79
-166.365  564.59 -141.46  559.99-115.559  556.39 -90.654  555.79 -74.715  556.39
  -49.81  556.19 -24.905  555.39       0  552.89  24.905  552.89  50.806  555.99
  75.711  562.39  92.646  570.49  98.623  572.69   104.6  576.39 126.517  590.85
 136.479  591.38 148.433  591.77 161.384  592.08 166.365  593.58 176.326  593.65
 182.304   592.6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -316.79     .08-194.258     .03   104.6     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -194.258   104.6              360     360     360             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6550

INPUT
Description: Sta. 65+50
Station Elevation Data    num=      36
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-595.724  603.77 -570.82  602.98-524.995  600.59-425.375  593.95-304.836  593.02
-279.931  594.83 -196.25  576.39-191.269  574.69-186.288  573.89-170.349  569.09
-144.448  561.39-119.543  560.09 -94.638  557.69 -69.734  555.69 -44.829  556.09
 -24.905  555.39       0  555.19  24.905  555.99   49.81  560.99  74.715  565.59
   91.65  573.09  96.631  574.39 102.608  576.39 129.505  590.96 150.425  592.01
 163.376  592.61 177.323   592.7 181.307  593.55 192.266  593.44  196.25  592.45
 202.228  593.24 213.186  593.25 222.151   590.2 243.072  596.74 255.026  594.86
  274.95  594.79

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-595.724     .08 -196.25     .03 102.608     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 102.608              550     550     550             .1       .3
Skew Angle = 5

CROSS SECTION
```

RIVER: Ship Canal
REACH: Ship Canal RS: 6000

INPUT
Description: Sta. 60+00
Station Elevation Data num= 40

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-605	603.03	-581	602.58	-554	602.83	-485	597.16	-433	598.72
-399	598.84	-348	599.41	-217	584.11	-183	576.39	-178	574.79
-173	573.99	-154	562.79	-129	561.39	-104	559.89	-79	558.69
-54	557.69	-50	557.69	-25	557.59	0	557.39	25	557.99
50	559.49	75	561.19	95	573.19	100	574.69	105	576.39
139	588.79	162	589.48	170	592.15	178	592.95	192	593.47
203	593.55	213	590.62	221	593.6	246	593.85	252	592.53
260	592.88	263	594.84	275	590.28	294	592.72	351	593.49

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-605	.08	-183	.03	105	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-183	105	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Ship Canal

Reach	River Sta.	n1	n2	n3
Ship Canal	10377	.08	.03	.08
Ship Canal	9888	.08	.03	.08
Ship Canal	9529	.08	.03	.08
Ship Canal	9374.5	.08	.03	.08
Ship Canal	9266	Bridge		
Ship Canal	9141.67	.08	.03	.08
Ship Canal	9083	.08	.03	.08
Ship Canal	8659	.08	.03	.08
Ship Canal	8550	.08	.03	.08
Ship Canal	8175	.08	.03	.08
Ship Canal	8030	.08	.03	.08
Ship Canal	7570	.08	.03	.08
Ship Canal	7460	.08	.03	.08
Ship Canal	7459	Bridge		
Ship Canal	7410	.08	.03	.08
Ship Canal	7250	.08	.03	.08
Ship Canal	7160	.08	.03	.08
Ship Canal	7098	Bridge		
Ship Canal	7015	.08	.03	.08
Ship Canal	6910	.08	.03	.08
Ship Canal	6550	.08	.03	.08
Ship Canal	6000	.08	.03	.08

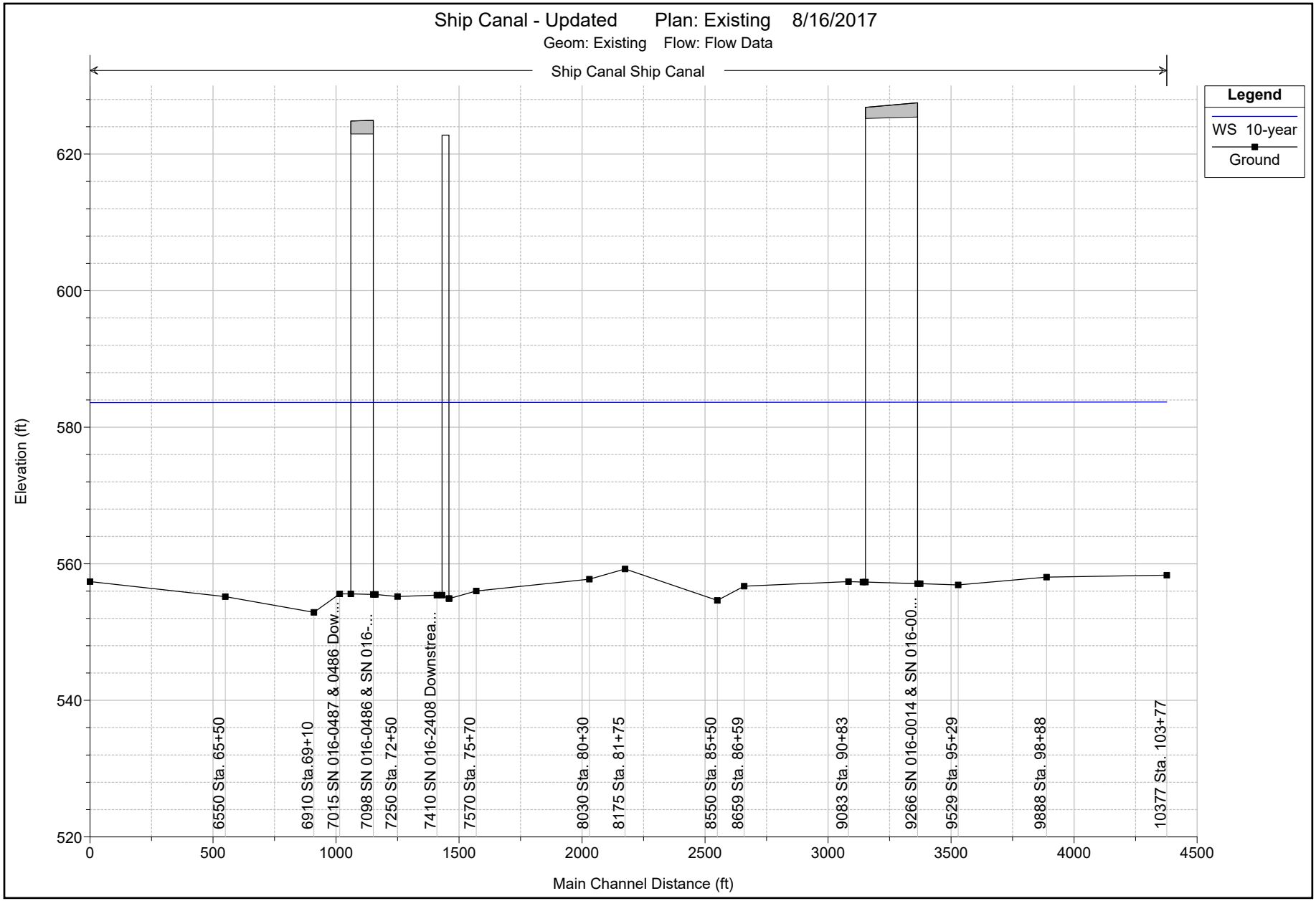
SUMMARY OF REACH LENGTHS

River: Ship Canal

Reach	River Sta.	Left	Channel	Right
Ship Canal	10377	489	489	489
Ship Canal	9888	359	359	359
Ship Canal	9529	154.66	154.66	154.66
Ship Canal	9374.5	232.7	232.7	232.7
Ship Canal	9266	Bridge		
Ship Canal	9141.67	58.64	58.64	58.64
Ship Canal	9083	424	424	424
Ship Canal	8659	109	109	109
Ship Canal	8550	375	375	375
Ship Canal	8175	145	145	145
Ship Canal	8030	460	460	460
Ship Canal	7570	110	110	110
Ship Canal	7460	50	50	50
Ship Canal	7459	Bridge		
Ship Canal	7410	160	160	160
Ship Canal	7250	90	90	90
Ship Canal	7160	145	145	145
Ship Canal	7098	Bridge		
Ship Canal	7015	105	105	105
Ship Canal	6910	360	360	360
Ship Canal	6550	550	550	550
Ship Canal	6000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Ship Canal

Reach	River Sta.	Contr.	Expan.
Ship Canal	10377	.1	.3
Ship Canal	9888	.1	.3
Ship Canal	9529	.1	.3
Ship Canal	9374.5	.1	.3
Ship Canal	9266	Bridge	
Ship Canal	9141.67	.1	.3
Ship Canal	9083	.1	.3
Ship Canal	8659	.1	.3
Ship Canal	8550	.1	.3
Ship Canal	8175	.1	.3
Ship Canal	8030	.1	.3
Ship Canal	7570	.1	.3
Ship Canal	7460	.1	.3
Ship Canal	7459	Bridge	
Ship Canal	7410	.1	.3
Ship Canal	7250	.1	.3
Ship Canal	7160	.1	.3
Ship Canal	7098	Bridge	
Ship Canal	7015	.1	.3
Ship Canal	6910	.1	.3
Ship Canal	6550	.1	.3
Ship Canal	6000	.1	.3


Ship Canal - Updated Plan: Existing 8/16/2017
Geom: Existing Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 10-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 016-00...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	10-year	8500.00	558.33	583.69	564.29	583.73	0.000020	1.60	5383.05	285.31	0.06
Ship Canal	9888	10-year	8500.00	558.04	583.68	563.72	583.72	0.000019	1.54	5612.01	311.38	0.06
Ship Canal	9529	10-year	8500.00	556.91	583.68	562.85	583.71	0.000018	1.49	5731.79	303.43	0.06
Ship Canal	9374.5	10-year	8500.00	557.08	583.66	563.37	583.71	0.000032	1.70	5055.68	275.07	0.07
Ship Canal	9266		Bridge									
Ship Canal	9141.67	10-year	8500.00	557.33	583.66	564.16	583.70	0.000031	1.65	5251.22	296.41	0.07
Ship Canal	9083	10-year	8500.00	557.39	583.66	564.55	583.69	0.000016	1.42	6102.00	343.61	0.06
Ship Canal	8659	10-year	8500.00	556.71	583.66	562.50	583.69	0.000015	1.42	6065.42	318.96	0.06
Ship Canal	8550	10-year	8500.00	554.64	583.66	560.59	583.68	0.000009	1.22	7069.42	329.92	0.04
Ship Canal	8175	10-year	8500.00	559.23	583.65	563.73	583.68	0.000014	1.36	6302.96	325.77	0.05
Ship Canal	8030	10-year	8500.00	557.74	583.65	562.51	583.68	0.000014	1.42	6111.06	316.35	0.05
Ship Canal	7570	10-year	8500.00	556.01	583.64	561.79	583.67	0.000012	1.33	6509.14	328.25	0.05
Ship Canal	7460	10-year	8500.00	554.91	583.63	561.24	583.67	0.000021	1.47	5891.22	278.91	0.05
Ship Canal	7459		Bridge									
Ship Canal	7410	10-year	8500.00	555.41	583.63	561.30	583.67	0.000024	1.60	5446.57	266.56	0.06
Ship Canal	7250	10-year	8500.00	555.21	583.63	560.69	583.66	0.000009	1.22	7073.55	326.36	0.04
Ship Canal	7160	10-year	8500.00	555.50	583.63	560.30	583.66	0.000015	1.24	6907.58	309.23	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	10-year	8500.00	555.60	583.62	561.69	583.65	0.000024	1.51	5725.28	307.90	0.06
Ship Canal	6910	10-year	8500.00	552.89	583.63	559.34	583.65	0.000008	1.16	7398.54	321.26	0.04
Ship Canal	6550	10-year	8500.00	555.19	583.62	561.06	583.64	0.000010	1.26	6901.12	345.01	0.05
Ship Canal	6000	10-year	8500.00	557.39	583.61	562.58	583.64	0.000012	1.32	6591.91	339.59	0.05

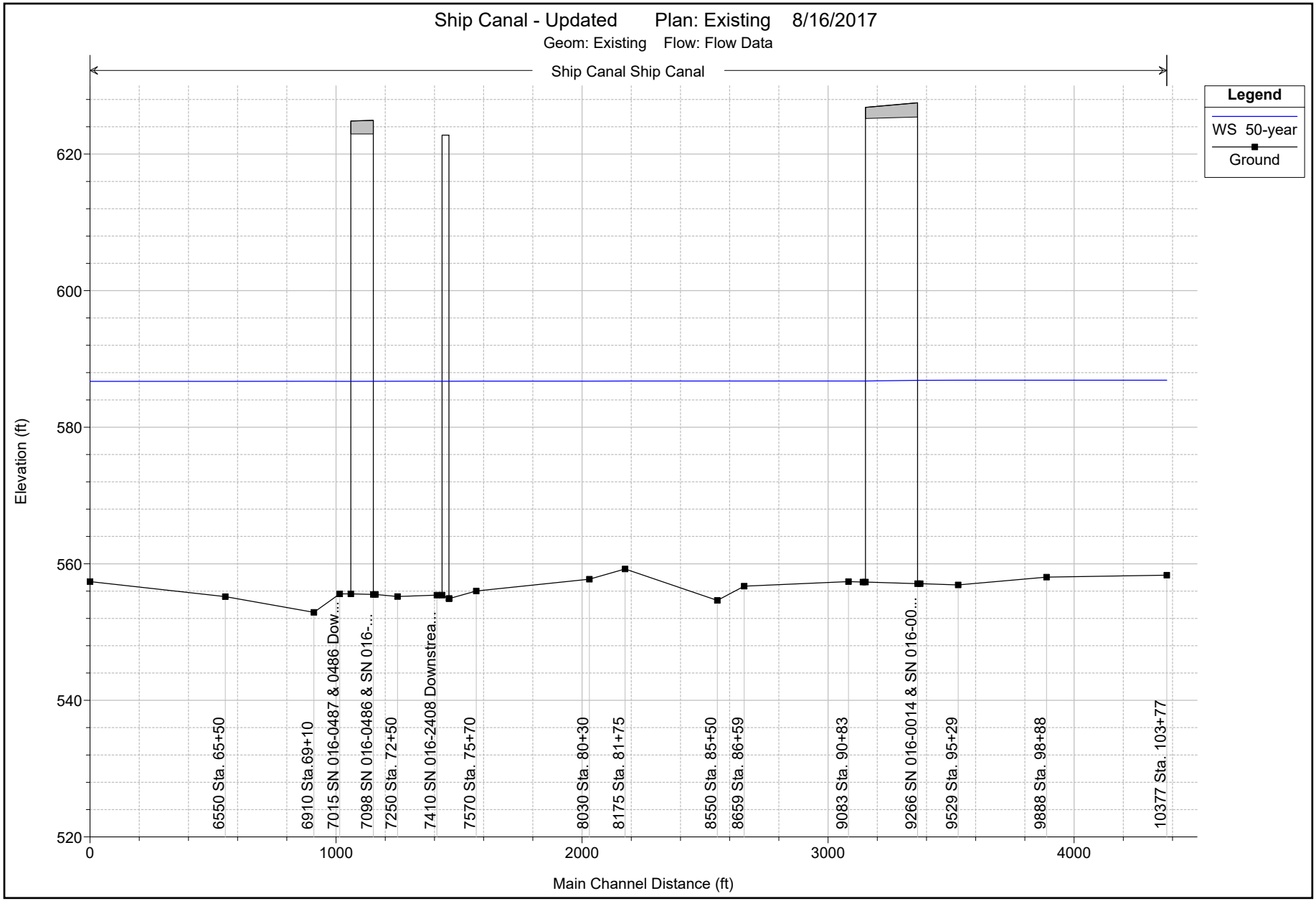
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	10-year	583.73	583.69	0.04	0.01	0.00	7.30	8489.38	3.32	285.31
Ship Canal	9888	10-year	583.72	583.68	0.04	0.01	0.00	6.05	8481.04	12.91	311.38
Ship Canal	9529	10-year	583.71	583.68	0.03	0.00	0.00	3.08	8494.13	2.79	303.43
Ship Canal	9374.5	10-year	583.71	583.66	0.04	0.00	0.00	3.90	8487.49	8.61	275.07
Ship Canal	9266		Bridge								
Ship Canal	9141.67	10-year	583.70	583.66	0.04	0.00	0.00	3.51	8474.02	22.47	296.41
Ship Canal	9083	10-year	583.69	583.66	0.03	0.01	0.00	2.52	8477.08	20.40	343.61
Ship Canal	8659	10-year	583.69	583.66	0.03	0.00	0.00	5.25	8486.18	8.57	318.96
Ship Canal	8550	10-year	583.68	583.66	0.02	0.00	0.00	7.53	8484.92	7.54	329.92
Ship Canal	8175	10-year	583.68	583.65	0.03	0.00	0.00	3.80	8490.06	6.14	325.77
Ship Canal	8030	10-year	583.68	583.65	0.03	0.01	0.00	6.70	8478.94	14.36	316.35
Ship Canal	7570	10-year	583.67	583.64	0.03	0.00	0.00	9.91	8481.59	8.50	328.25
Ship Canal	7460	10-year	583.67	583.63	0.03	0.00	0.00	10.27	8478.92	10.81	278.91
Ship Canal	7459		Bridge								
Ship Canal	7410	10-year	583.67	583.63	0.04	0.00	0.01	14.07	8467.37	18.57	266.56
Ship Canal	7250	10-year	583.66	583.63	0.02	0.00	0.00	4.37	8488.29	7.33	326.36
Ship Canal	7160	10-year	583.66	583.63	0.02	0.00	0.00	3.15	8493.53	3.32	309.23
Ship Canal	7098		Bridge								
Ship Canal	7015	10-year	583.65	583.62	0.04	0.00	0.00	8.62	8477.92	13.46	307.90
Ship Canal	6910	10-year	583.65	583.63	0.02	0.00	0.00	4.58	8491.07	4.35	321.26
Ship Canal	6550	10-year	583.64	583.62	0.02	0.01	0.00	16.46	8477.30	6.24	345.01
Ship Canal	6000	10-year	583.64	583.61	0.03			16.95	8472.76	10.29	339.59

Errors Warnings and Notes for Plan : Existing

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9266 Profile: 10-year
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

50-Year Existing


Ship Canal - Updated Plan: Existing 8/16/2017
Geom: Existing Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 50-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 016-00...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	50-year	11300.00	558.33	586.89	565.19	586.94	0.000021	1.83	6312.53	295.58	0.07
Ship Canal	9888	50-year	11300.00	558.04	586.88	564.66	586.93	0.000020	1.75	6626.01	322.22	0.06
Ship Canal	9529	50-year	11300.00	556.91	586.88	563.86	586.92	0.000019	1.71	6715.41	311.35	0.06
Ship Canal	9374.5	50-year	11300.00	557.08	586.86	564.35	586.92	0.000036	1.94	5948.92	283.74	0.07
Ship Canal	9266		Bridge									
Ship Canal	9141.67	50-year	11300.00	557.33	586.76	565.26	586.82	0.000034	1.88	6187.88	306.25	0.07
Ship Canal	9083	50-year	11300.00	557.39	586.77	565.52	586.81	0.000017	1.62	7186.73	353.84	0.06
Ship Canal	8659	50-year	11300.00	556.71	586.76	563.45	586.81	0.000017	1.64	7073.33	329.40	0.06
Ship Canal	8550	50-year	11300.00	554.64	586.77	561.44	586.80	0.000011	1.43	8117.62	344.16	0.05
Ship Canal	8175	50-year	11300.00	559.23	586.76	564.51	586.80	0.000015	1.57	7361.30	358.18	0.06
Ship Canal	8030	50-year	11300.00	557.74	586.75	563.34	586.79	0.000016	1.64	7118.97	332.45	0.06
Ship Canal	7570	50-year	11300.00	556.01	586.75	562.72	586.79	0.000014	1.54	7552.54	343.39	0.05
Ship Canal	7460	50-year	11300.00	554.91	586.74	562.26	586.78	0.000025	1.72	6777.79	292.39	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	50-year	11300.00	555.41	586.73	562.25	586.78	0.000030	1.87	6302.16	285.25	0.06
Ship Canal	7250	50-year	11300.00	555.21	586.74	561.55	586.77	0.000011	1.42	8104.48	337.74	0.05
Ship Canal	7160	50-year	11300.00	555.50	586.74	561.19	586.77	0.000018	1.45	7876.63	315.13	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	50-year	11300.00	555.60	586.72	562.74	586.76	0.000027	1.74	6700.56	321.11	0.06
Ship Canal	6910	50-year	11300.00	552.89	586.73	560.18	586.76	0.000009	1.37	8410.31	330.87	0.05
Ship Canal	6550	50-year	11300.00	555.19	586.72	561.97	586.75	0.000012	1.47	8001.96	364.81	0.05
Ship Canal	6000	50-year	11300.00	557.39	586.71	563.34	586.75	0.000013	1.54	7693.06	372.56	0.05

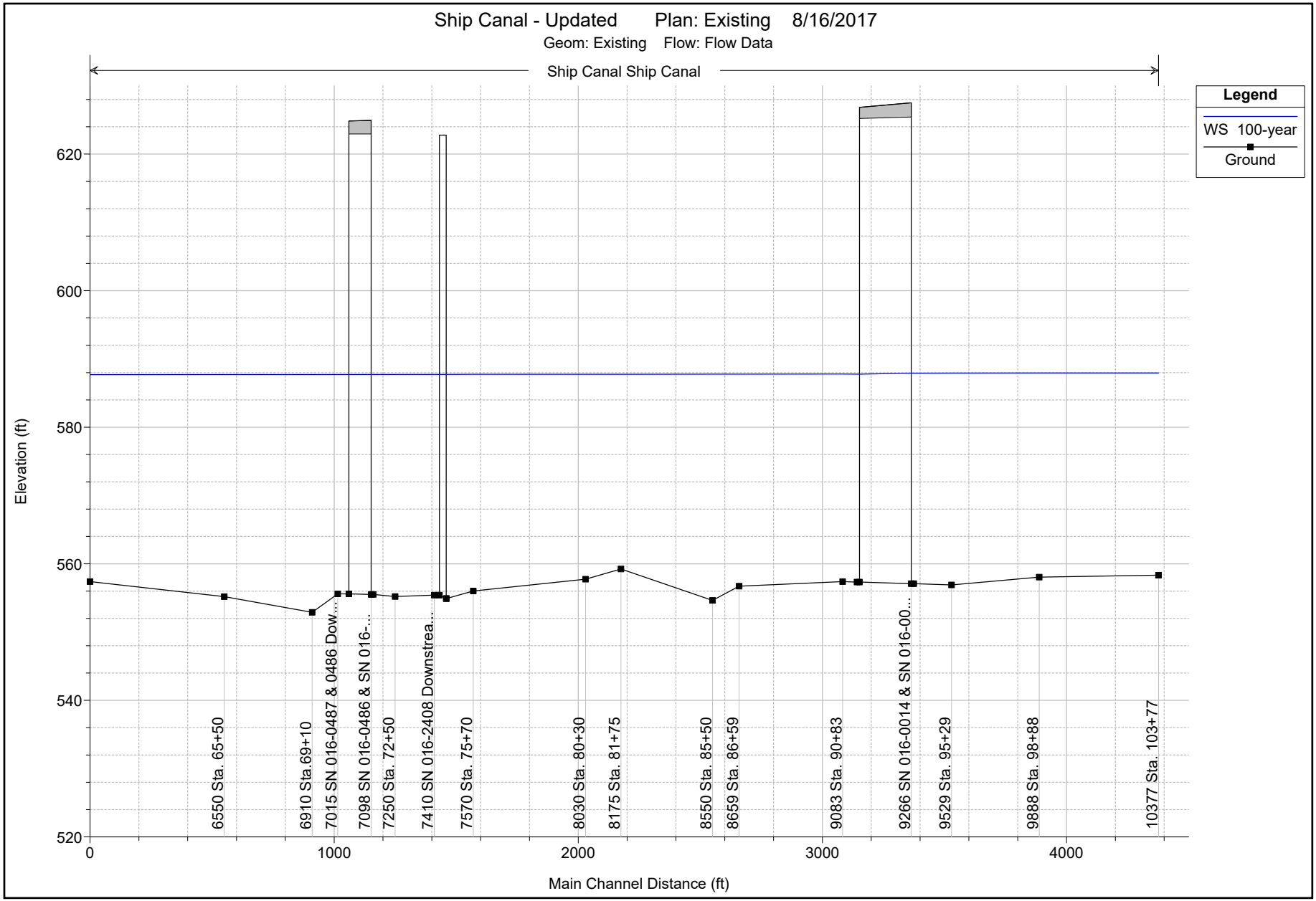
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	50-year	586.94	586.89	0.05	0.01	0.00	22.05	11267.64	10.32	295.58
Ship Canal	9888	50-year	586.93	586.88	0.05	0.01	0.00	18.13	11249.50	32.37	322.22
Ship Canal	9529	50-year	586.92	586.88	0.05	0.00	0.00	10.03	11280.39	9.58	311.35
Ship Canal	9374.5	50-year	586.92	586.86	0.06			12.37	11262.74	24.89	283.74
Ship Canal	9266		Bridge								
Ship Canal	9141.67	50-year	586.82	586.76	0.05	0.00	0.00	10.91	11236.66	52.43	306.25
Ship Canal	9083	50-year	586.81	586.77	0.04	0.01	0.00	7.67	11247.55	44.78	353.84
Ship Canal	8659	50-year	586.81	586.76	0.04	0.00	0.00	16.25	11260.19	23.57	329.40
Ship Canal	8550	50-year	586.80	586.77	0.03	0.00	0.00	21.11	11257.77	21.13	344.16
Ship Canal	8175	50-year	586.80	586.76	0.04	0.00	0.00	11.68	11269.85	18.46	358.18
Ship Canal	8030	50-year	586.79	586.75	0.04	0.01	0.00	18.44	11242.03	39.53	332.45
Ship Canal	7570	50-year	586.79	586.75	0.04	0.00	0.00	27.29	11249.29	23.41	343.39
Ship Canal	7460	50-year	586.78	586.74	0.05	0.00	0.00	29.36	11239.74	30.90	292.39
Ship Canal	7459		Bridge								
Ship Canal	7410	50-year	586.78	586.73	0.05	0.00	0.01	40.38	11206.33	53.29	285.25
Ship Canal	7250	50-year	586.77	586.74	0.03	0.00	0.00	12.23	11267.28	20.50	337.74
Ship Canal	7160	50-year	586.77	586.74	0.03	0.00	0.00	8.96	11281.58	9.46	315.13
Ship Canal	7098		Bridge								
Ship Canal	7015	50-year	586.76	586.72	0.05	0.00	0.01	23.93	11238.74	37.33	321.11
Ship Canal	6910	50-year	586.76	586.73	0.03	0.00	0.00	12.90	11274.84	12.27	330.87
Ship Canal	6550	50-year	586.75	586.72	0.03	0.01	0.00	45.60	11237.10	17.30	364.81
Ship Canal	6000	50-year	586.75	586.71	0.04			44.98	11226.58	28.44	372.56

Errors Warnings and Notes for Plan : Existing

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

100-Year Existing


Ship Canal - Updated Plan: Existing 8/16/2017
Geom: Existing Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 100-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 016-00...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	100-year	12800.00	558.33	587.94	565.64	588.00	0.000023	1.98	6626.30	304.48	0.07
Ship Canal	9888	100-year	12800.00	558.04	587.93	565.13	587.99	0.000022	1.90	6966.64	325.39	0.07
Ship Canal	9529	100-year	12800.00	556.91	587.93	564.33	587.98	0.000021	1.85	7044.19	314.02	0.07
Ship Canal	9374.5	100-year	12800.00	557.08	587.91	564.83	587.98	0.000040	2.09	6248.00	286.64	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	100-year	12800.00	557.33	587.77	565.73	587.84	0.000038	2.03	6498.07	309.44	0.07
Ship Canal	9083	100-year	12800.00	557.39	587.78	565.96	587.83	0.000019	1.75	7545.46	357.15	0.06
Ship Canal	8659	100-year	12800.00	556.71	587.77	563.94	587.82	0.000019	1.78	7407.00	332.79	0.06
Ship Canal	8550	100-year	12800.00	554.64	587.78	561.82	587.82	0.000012	1.56	8467.07	348.78	0.05
Ship Canal	8175	100-year	12800.00	559.23	587.77	564.89	587.81	0.000017	1.71	7726.35	366.88	0.06
Ship Canal	8030	100-year	12800.00	557.74	587.76	563.78	587.81	0.000018	1.79	7456.04	337.67	0.06
Ship Canal	7570	100-year	12800.00	556.01	587.75	563.17	587.80	0.000015	1.68	7900.36	348.29	0.06
Ship Canal	7460	100-year	12800.00	554.91	587.74	562.71	587.79	0.000029	1.87	7073.41	296.75	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	100-year	12800.00	555.41	587.73	562.77	587.79	0.000034	2.04	6590.86	291.28	0.07
Ship Canal	7250	100-year	12800.00	555.21	587.74	561.98	587.78	0.000012	1.55	8445.43	341.43	0.05
Ship Canal	7160	100-year	12800.00	555.50	587.74	561.63	587.78	0.000020	1.58	8193.85	317.04	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	100-year	12800.00	555.60	587.72	563.25	587.77	0.000031	1.88	7024.09	325.38	0.07
Ship Canal	6910	100-year	12800.00	552.89	587.73	560.60	587.77	0.000011	1.49	8743.56	333.97	0.05
Ship Canal	6550	100-year	12800.00	555.19	587.72	562.40	587.76	0.000013	1.60	8370.50	371.20	0.05
Ship Canal	6000	100-year	12800.00	557.39	587.71	563.71	587.75	0.000015	1.67	8071.27	383.86	0.06

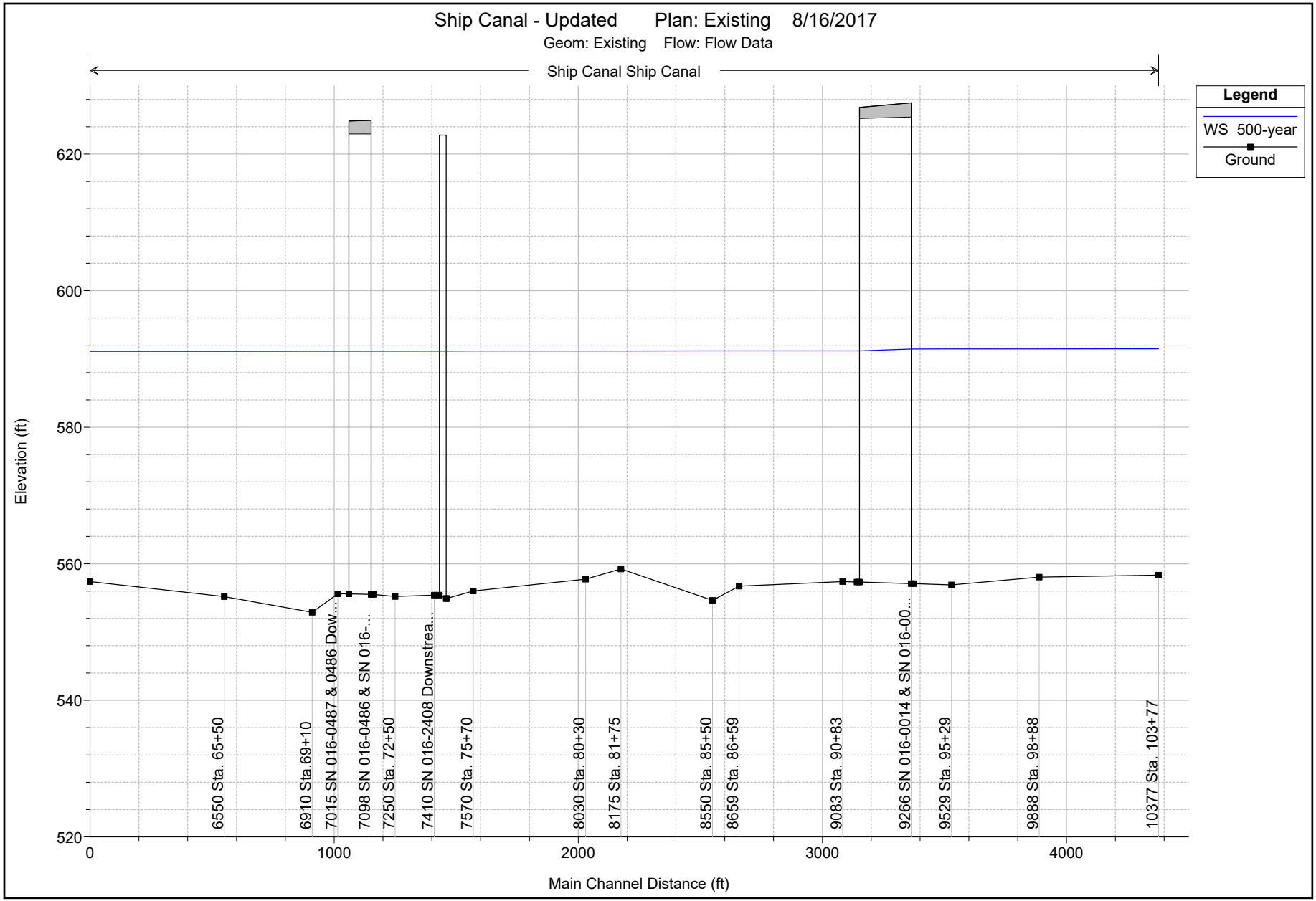
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	100-year	588.00	587.94	0.06	0.01	0.00	27.08	12758.55	14.37	304.48
Ship Canal	9888	100-year	587.99	587.93	0.06	0.01	0.00	25.05	12731.95	43.00	325.39
Ship Canal	9529	100-year	587.98	587.93	0.05	0.00	0.00	14.46	12771.96	13.58	314.02
Ship Canal	9374.5	100-year	587.98	587.91	0.07			17.31	12748.47	34.22	286.64
Ship Canal	9266		Bridge								
Ship Canal	9141.67	100-year	587.84	587.77	0.06	0.00	0.00	15.18	12716.10	68.72	309.44
Ship Canal	9083	100-year	587.83	587.78	0.05	0.01	0.00	10.60	12731.61	57.80	357.15
Ship Canal	8659	100-year	587.82	587.77	0.05	0.00	0.00	22.56	12745.87	31.57	332.79
Ship Canal	8550	100-year	587.82	587.78	0.04	0.01	0.00	28.78	12742.41	28.81	348.78
Ship Canal	8175	100-year	587.81	587.77	0.05	0.00	0.00	16.19	12754.35	29.45	366.88
Ship Canal	8030	100-year	587.81	587.76	0.05	0.01	0.00	25.01	12721.37	53.62	337.67
Ship Canal	7570	100-year	587.80	587.75	0.04	0.00	0.00	37.04	12731.19	31.77	348.29
Ship Canal	7460	100-year	587.79	587.74	0.05	0.00	0.00	40.28	12717.34	42.39	296.75
Ship Canal	7459		Bridge								
Ship Canal	7410	100-year	587.79	587.73	0.06	0.00	0.01	55.44	12671.39	73.17	291.28
Ship Canal	7250	100-year	587.78	587.74	0.04	0.00	0.00	16.65	12755.42	27.92	341.43
Ship Canal	7160	100-year	587.78	587.74	0.04	0.00	0.00	12.29	12774.75	12.97	317.04
Ship Canal	7098		Bridge								
Ship Canal	7015	100-year	587.77	587.72	0.05	0.00	0.01	32.54	12716.67	50.78	325.38
Ship Canal	6910	100-year	587.77	587.73	0.03	0.00	0.00	17.61	12765.64	16.75	333.97
Ship Canal	6550	100-year	587.76	587.72	0.04	0.01	0.00	61.95	12714.55	23.50	371.20
Ship Canal	6000	100-year	587.75	587.71	0.04			62.47	12698.93	38.60	383.86

Errors Warnings and Notes for Plan : Existing

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

500-Year Existing


Ship Canal - Updated Plan: Existing 8/16/2017
Geom: Existing Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 500-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 016-00...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	500-year	16100.00	558.33	591.48	566.56	591.56	0.000023	2.17	7732.69	327.51	0.07
Ship Canal	9888	500-year	16100.00	558.04	591.48	566.08	591.54	0.000022	2.07	8138.16	336.09	0.07
Ship Canal	9529	500-year	16100.00	556.91	591.47	565.33	591.53	0.000021	2.02	8172.48	323.04	0.07
Ship Canal	9374.5	500-year	16100.00	557.08	591.45	565.85	591.53	0.000046	2.26	7352.00	337.73	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	500-year	16100.00	557.33	591.18	566.75	591.25	0.000044	2.20	7631.28	361.94	0.08
Ship Canal	9083	500-year	16100.00	557.39	591.19	566.84	591.25	0.000019	1.91	8781.28	367.87	0.07
Ship Canal	8659	500-year	16100.00	556.71	591.18	564.87	591.24	0.000019	1.96	8559.92	345.41	0.07
Ship Canal	8550	500-year	16100.00	554.64	591.19	562.69	591.23	0.000013	1.74	9681.72	364.37	0.06
Ship Canal	8175	500-year	16100.00	559.23	591.17	565.67	591.23	0.000017	1.88	9036.27	402.09	0.06
Ship Canal	8030	500-year	16100.00	557.74	591.16	564.63	591.22	0.000018	1.97	8635.61	355.31	0.06
Ship Canal	7570	500-year	16100.00	556.01	591.16	564.08	591.21	0.000016	1.86	9126.06	389.57	0.06
Ship Canal	7460	500-year	16100.00	554.91	591.14	563.68	591.21	0.000035	2.07	8158.74	352.18	0.07
Ship Canal	7459		Bridge									
Ship Canal	7410	500-year	16100.00	555.41	591.13	563.73	591.21	0.000043	2.25	7666.00	352.81	0.08
Ship Canal	7250	500-year	16100.00	555.21	591.15	562.81	591.19	0.000013	1.73	9628.47	353.91	0.06
Ship Canal	7160	500-year	16100.00	555.50	591.14	562.53	591.19	0.000024	1.75	9365.98	376.63	0.06
Ship Canal	7098		Bridge									
Ship Canal	7015	500-year	16100.00	555.60	591.12	564.29	591.18	0.000035	2.05	8235.23	388.63	0.07
Ship Canal	6910	500-year	16100.00	552.89	591.13	561.46	591.18	0.000012	1.68	9900.04	352.77	0.05
Ship Canal	6550	500-year	16100.00	555.19	591.12	563.27	591.17	0.000014	1.77	9672.69	401.52	0.06
Ship Canal	6000	500-year	16100.00	557.39	591.11	564.44	591.16	0.000016	1.85	9488.07	455.45	0.06

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	500-year	591.56	591.48	0.07	0.01	0.00	69.33	16005.56	25.11	327.51
Ship Canal	9888	500-year	591.54	591.48	0.07	0.01	0.00	53.24	15965.71	81.05	336.09
Ship Canal	9529	500-year	591.53	591.47	0.06	0.00	0.00	32.74	16036.61	30.65	323.04
Ship Canal	9374.5	500-year	591.53	591.45	0.08			40.15	15984.09	75.76	337.73
Ship Canal	9266		Bridge								
Ship Canal	9141.67	500-year	591.25	591.18	0.07	0.00	0.01	34.65	15929.68	135.66	361.94
Ship Canal	9083	500-year	591.25	591.19	0.06	0.01	0.00	22.59	15972.15	105.26	367.87
Ship Canal	8659	500-year	591.24	591.18	0.06	0.00	0.00	47.57	15990.74	61.69	345.41
Ship Canal	8550	500-year	591.23	591.19	0.05	0.01	0.00	59.87	15980.20	59.93	364.37
Ship Canal	8175	500-year	591.23	591.17	0.05	0.00	0.00	34.85	15979.58	85.57	402.09
Ship Canal	8030	500-year	591.22	591.16	0.06	0.01	0.00	51.29	15938.75	109.96	355.31
Ship Canal	7570	500-year	591.21	591.16	0.05	0.00	0.00	79.51	15955.23	65.26	389.57
Ship Canal	7460	500-year	591.21	591.14	0.07	0.00	0.00	89.98	15915.34	94.69	352.18
Ship Canal	7459		Bridge								
Ship Canal	7410	500-year	591.21	591.13	0.08	0.00	0.01	124.65	15811.62	163.73	352.81
Ship Canal	7250	500-year	591.19	591.15	0.05	0.00	0.00	34.63	16007.32	58.05	353.91
Ship Canal	7160	500-year	591.19	591.14	0.05	0.00	0.00	24.86	16050.73	24.41	376.63
Ship Canal	7098		Bridge								
Ship Canal	7015	500-year	591.18	591.12	0.06	0.00	0.01	67.71	15930.37	101.92	388.63
Ship Canal	6910	500-year	591.18	591.13	0.04	0.00	0.00	36.97	16031.37	31.66	352.77
Ship Canal	6550	500-year	591.17	591.12	0.05	0.01	0.00	127.89	15926.22	45.89	401.52
Ship Canal	6000	500-year	591.16	591.11	0.05			142.13	15882.06	75.81	455.45

Errors Warnings and Notes for Plan : Existing

Location:	River: Ship Canal Reach: Ship Canal RS: 9266 Profile: 500-year
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	energy inside of the bridge deck. This is not physically possible. Please review your bridge data
	and results for reasonableness.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 6910 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: Ship Canal Reach: Ship Canal RS: 6550 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 6000 Profile: 500-year

Errors Warnings and Notes for Plan : Existing (Continued)

Warning:	Divided flow computed for this cross-section.

Structure Tables

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Ship Canal	9266	10-year	583.71	625.44	17731.18		8500.00	627.52		0.01	
Ship Canal	9266	50-year	586.92	625.44	17731.18		11300.00	627.52		0.10	
Ship Canal	9266	100-year	587.98	625.44	17731.18		12800.00	627.52		0.14	
Ship Canal	9266	500-year	591.53	625.44	17731.18		16100.00	627.52		0.27	
Ship Canal	7459	10-year	583.67	622.42	20362.21		8500.00	617.49		0.00	
Ship Canal	7459	50-year	586.78	622.42	20362.21		11300.00	617.49		0.00	
Ship Canal	7459	100-year	587.79	622.42	20362.21		12800.00	617.49		0.00	
Ship Canal	7459	500-year	591.21	622.42	20362.21		16100.00	617.49		0.00	
Ship Canal	7098	10-year	583.66	622.92	22774.72		8500.00	624.96		0.00	
Ship Canal	7098	50-year	586.77	622.92	22774.72		11300.00	624.96		0.00	
Ship Canal	7098	100-year	587.78	622.92	22774.72		12800.00	624.96		0.01	
Ship Canal	7098	500-year	591.19	622.92	22774.72		16100.00	624.96		0.01	

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Ship Canal	9266	10-year	583.71	583.66	Energy only	583.71		583.70	583.70			
Ship Canal	9266	50-year	586.92	586.86	Momentum	586.83	586.92	586.82	586.82			
Ship Canal	9266	100-year	587.98	587.91	Momentum	587.85	587.98	587.84	587.84			
Ship Canal	9266	500-year	591.53	591.45	Momentum	591.27	591.53	591.26	591.26			
Ship Canal	7459	10-year	583.67	583.63	Energy only	583.67			583.66			
Ship Canal	7459	50-year	586.78	586.74	Energy only	586.78			586.78			
Ship Canal	7459	100-year	587.79	587.74	Energy only	587.79			587.79			
Ship Canal	7459	500-year	591.21	591.14	Energy only	591.21			591.20			
Ship Canal	7098	10-year	583.66	583.63	Energy only	583.66			583.66			
Ship Canal	7098	50-year	586.77	586.74	Energy only	586.77			586.77			
Ship Canal	7098	100-year	587.78	587.74	Energy only	587.78			587.78			
Ship Canal	7098	500-year	591.19	591.14	Energy only	591.19			591.19			

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	9529	10-year	583.71	583.68	562.85	0.00	0.00	303.43	3.08	8494.13	2.79	1.49
Ship Canal	9529	50-year	586.92	586.88	563.86	0.00	0.00	311.35	10.03	11280.39	9.58	1.71
Ship Canal	9529	100-year	587.98	587.93	564.33	0.00	0.00	314.02	14.46	12771.96	13.58	1.85
Ship Canal	9529	500-year	591.53	591.47	565.33	0.00	0.00	323.04	32.74	16036.61	30.65	2.02
Ship Canal	9374.5	10-year	583.71	583.66	563.37	0.00	0.00	275.07	3.90	8487.49	8.61	1.70
Ship Canal	9374.5	50-year	586.92	586.86	564.35			283.74	12.37	11262.74	24.89	1.94
Ship Canal	9374.5	100-year	587.98	587.91	564.83			286.64	17.31	12748.47	34.22	2.09
Ship Canal	9374.5	500-year	591.53	591.45	565.85			337.73	40.15	15984.09	75.76	2.26
Ship Canal	9266 BR U	10-year	583.71	583.66	563.37	0.01	0.00	275.07	3.90	8487.49	8.61	1.70
Ship Canal	9266 BR U	50-year	586.92	586.86	564.35			283.74	12.37	11262.74	24.89	1.94
Ship Canal	9266 BR U	100-year	587.98	587.91	564.83			286.64	17.31	12748.47	34.22	2.09
Ship Canal	9266 BR U	500-year	591.53	591.45	565.85			329.23	40.19	15983.99	75.82	2.27
Ship Canal	9266 BR D	10-year	583.70	583.66	564.16	0.00	0.00	296.41	3.51	8474.02	22.47	1.65
Ship Canal	9266 BR D	50-year	586.82	586.77	565.26			306.25	10.91	11236.66	52.43	1.88
Ship Canal	9266 BR D	100-year	587.84	587.77	565.73			309.44	15.18	12716.09	68.73	2.03
Ship Canal	9266 BR D	500-year	591.25	591.18	566.75			353.44	34.61	15929.91	135.48	2.20
Ship Canal	9141.67	10-year	583.70	583.66	564.16	0.00	0.00	296.41	3.51	8474.02	22.47	1.65
Ship Canal	9141.67	50-year	586.82	586.76	565.26	0.00	0.00	306.25	10.91	11236.66	52.43	1.88
Ship Canal	9141.67	100-year	587.84	587.77	565.73	0.00	0.00	309.44	15.18	12716.10	68.72	2.03
Ship Canal	9141.67	500-year	591.25	591.18	566.75	0.00	0.01	361.94	34.65	15929.68	135.66	2.20
Ship Canal	9083	10-year	583.69	583.66	564.55	0.01	0.00	343.61	2.52	8477.08	20.40	1.42
Ship Canal	9083	50-year	586.81	586.77	565.52	0.01	0.00	353.84	7.67	11247.55	44.78	1.62
Ship Canal	9083	100-year	587.83	587.78	565.96	0.01	0.00	357.15	10.60	12731.61	57.80	1.75
Ship Canal	9083	500-year	591.25	591.19	566.84	0.01	0.00	367.87	22.59	15972.15	105.26	1.91
Ship Canal	7570	10-year	583.67	583.64	561.79	0.00	0.00	328.25	9.91	8481.59	8.50	1.33
Ship Canal	7570	50-year	586.79	586.75	562.72	0.00	0.00	343.39	27.29	11249.29	23.41	1.54
Ship Canal	7570	100-year	587.80	587.75	563.17	0.00	0.00	348.29	37.04	12731.19	31.77	1.68
Ship Canal	7570	500-year	591.21	591.16	564.08	0.00	0.00	389.57	79.51	15955.23	65.26	1.86
Ship Canal	7460	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7460	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72

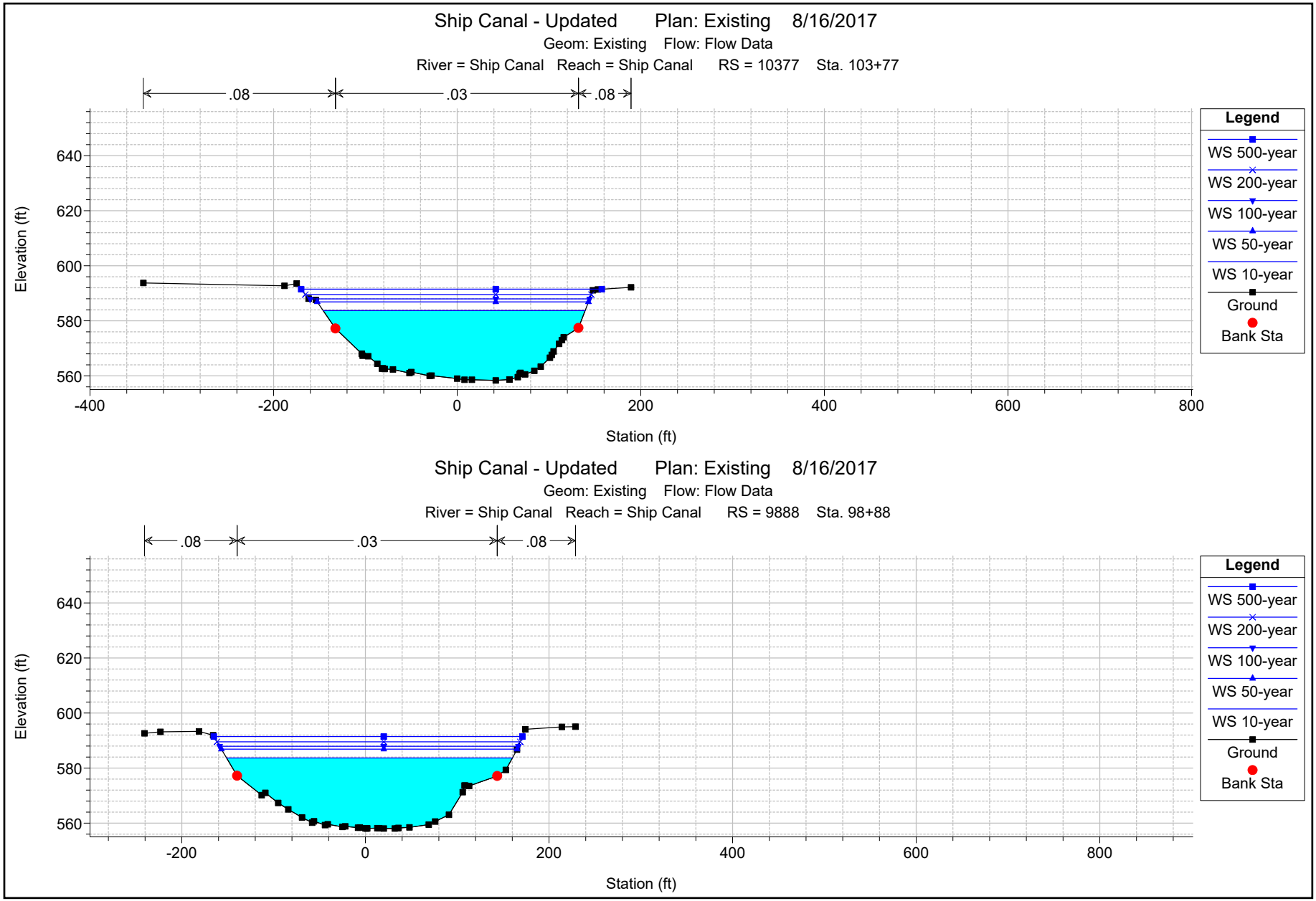
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7460	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7460	500-year	591.21	591.14	563.68	0.00	0.00	352.18	89.98	15915.34	94.69	2.07
Ship Canal	7459 BR U	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7459 BR U	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72
Ship Canal	7459 BR U	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7459 BR U	500-year	591.21	591.14	563.68	0.00	0.00	344.18	89.73	15915.85	94.42	2.07
Ship Canal	7459 BR D	10-year	583.67	583.63	561.30	0.00	0.00	266.56	14.07	8467.36	18.57	1.60
Ship Canal	7459 BR D	50-year	586.78	586.73	562.25	0.00	0.00	285.25	40.39	11206.32	53.30	1.87
Ship Canal	7459 BR D	100-year	587.79	587.73	562.77	0.00	0.00	291.29	55.45	12671.38	73.18	2.04
Ship Canal	7459 BR D	500-year	591.21	591.13	563.73	0.00	0.00	344.82	124.28	15812.48	163.24	2.26
Ship Canal	7410	10-year	583.67	583.63	561.30	0.00	0.01	266.56	14.07	8467.37	18.57	1.60
Ship Canal	7410	50-year	586.78	586.73	562.25	0.00	0.01	285.25	40.38	11206.33	53.29	1.87
Ship Canal	7410	100-year	587.79	587.73	562.77	0.00	0.01	291.28	55.44	12671.39	73.17	2.04
Ship Canal	7410	500-year	591.21	591.13	563.73	0.00	0.01	352.81	124.65	15811.62	163.73	2.25
Ship Canal	7250	10-year	583.66	583.63	560.69	0.00	0.00	326.36	4.37	8488.29	7.33	1.22
Ship Canal	7250	50-year	586.77	586.74	561.55	0.00	0.00	337.74	12.23	11267.28	20.50	1.42
Ship Canal	7250	100-year	587.78	587.74	561.98	0.00	0.00	341.43	16.65	12755.42	27.92	1.55
Ship Canal	7250	500-year	591.19	591.15	562.81	0.00	0.00	353.91	34.63	16007.32	58.05	1.73
Ship Canal	7160	10-year	583.66	583.63	560.30	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7160	50-year	586.77	586.74	561.19	0.00	0.00	315.13	8.96	11281.58	9.46	1.45
Ship Canal	7160	100-year	587.78	587.74	561.63	0.00	0.00	317.04	12.29	12774.75	12.97	1.58
Ship Canal	7160	500-year	591.19	591.14	562.53	0.00	0.00	376.63	24.86	16050.73	24.41	1.75
Ship Canal	7098 BR U	10-year	583.66	583.63	560.31	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7098 BR U	50-year	586.77	586.74	561.19	0.00	0.00	312.94	8.96	11281.94	9.10	1.45
Ship Canal	7098 BR U	100-year	587.78	587.74	561.63	0.00	0.00	313.88	12.29	12775.83	11.88	1.58
Ship Canal	7098 BR U	500-year	591.19	591.14	562.53	0.00	0.00	361.88	26.79	16051.43	21.78	1.76
Ship Canal	7098 BR D	10-year	583.65	583.62	561.69	0.00	0.00	304.15	8.63	8483.74	7.62	1.51
Ship Canal	7098 BR D	50-year	586.77	586.72	562.74	0.00	0.00	317.37	23.97	11255.64	20.40	1.74
Ship Canal	7098 BR D	100-year	587.78	587.72	563.25	0.00	0.00	321.64	32.61	12739.50	27.89	1.89
Ship Canal	7098 BR D	500-year	591.19	591.12	564.30	0.00	0.00	377.65	68.13	15972.26	59.61	2.06

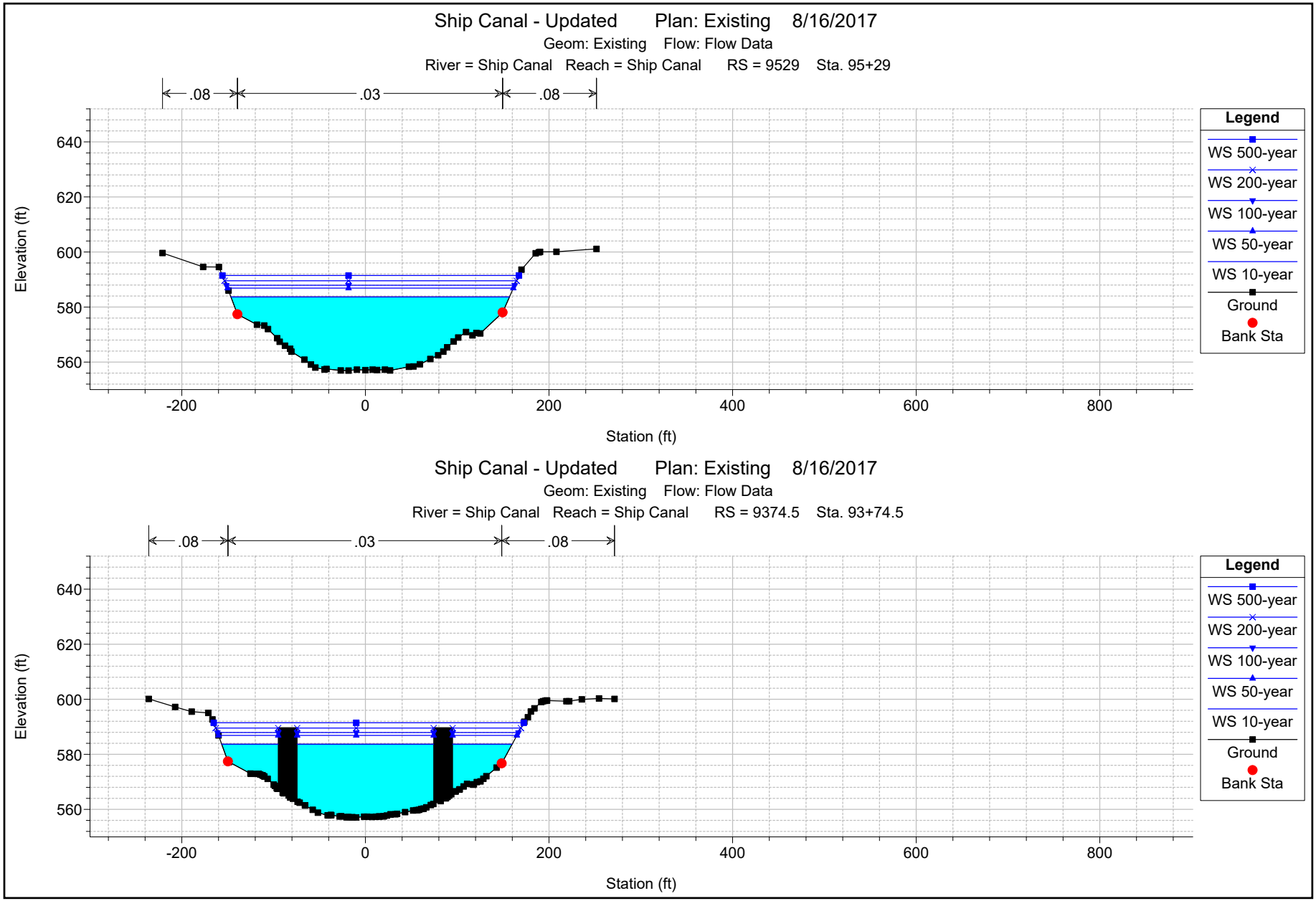
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal (Continued)

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7015	10-year	583.65	583.62	561.69	0.00	0.00	307.90	8.62	8477.92	13.46	1.51
Ship Canal	7015	50-year	586.76	586.72	562.74	0.00	0.01	321.11	23.93	11238.74	37.33	1.74
Ship Canal	7015	100-year	587.77	587.72	563.25	0.00	0.01	325.38	32.54	12716.67	50.78	1.88
Ship Canal	7015	500-year	591.18	591.12	564.29	0.00	0.01	388.63	67.71	15930.37	101.92	2.05
Ship Canal	6910	10-year	583.65	583.63	559.34	0.00	0.00	321.26	4.58	8491.07	4.35	1.16
Ship Canal	6910	50-year	586.76	586.73	560.18	0.00	0.00	330.87	12.90	11274.84	12.27	1.37
Ship Canal	6910	100-year	587.77	587.73	560.60	0.00	0.00	333.97	17.61	12765.64	16.75	1.49
Ship Canal	6910	500-year	591.18	591.13	561.46	0.00	0.00	352.77	36.97	16031.37	31.66	1.68

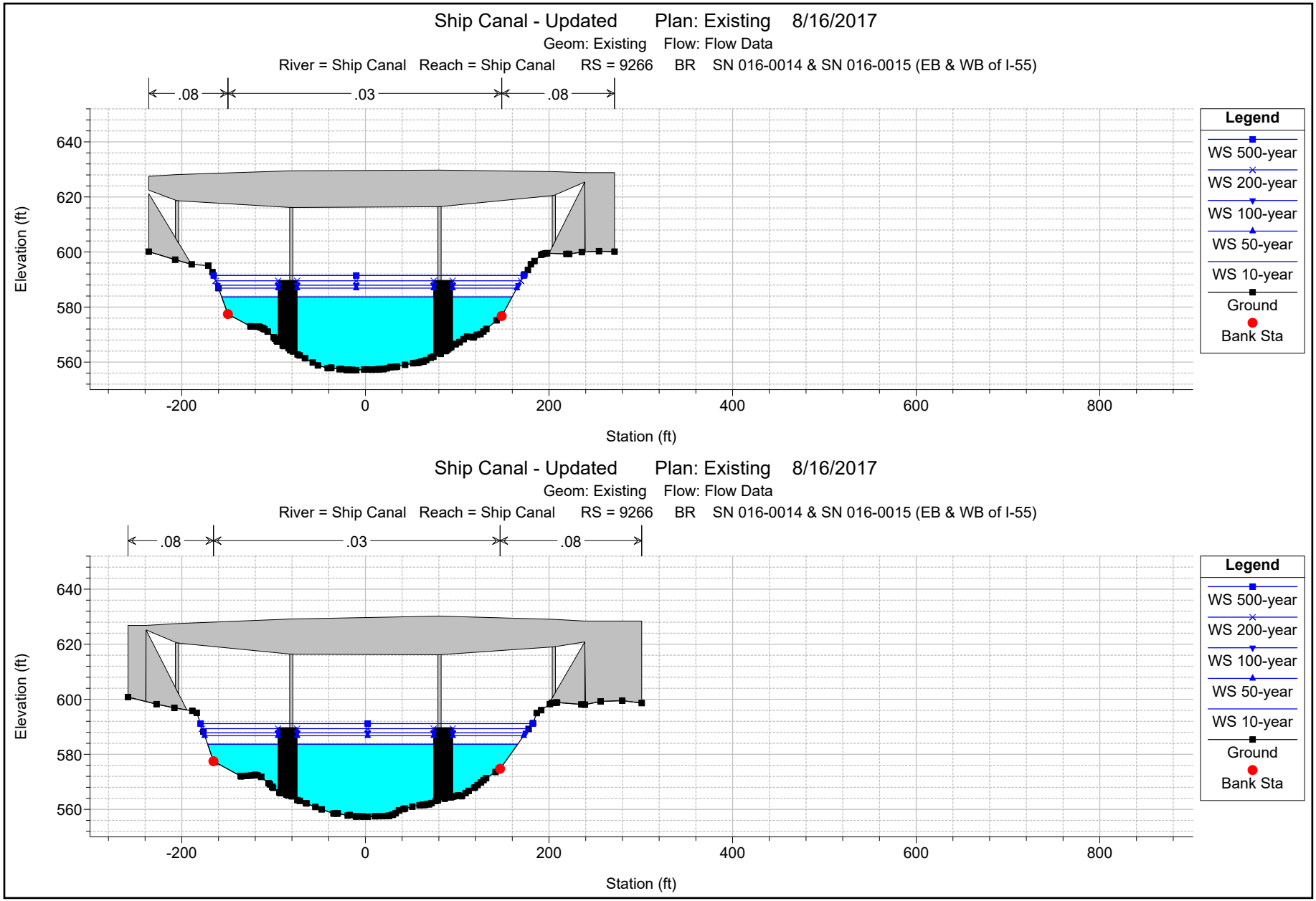
HEC-RAS Plotted Cross Sections



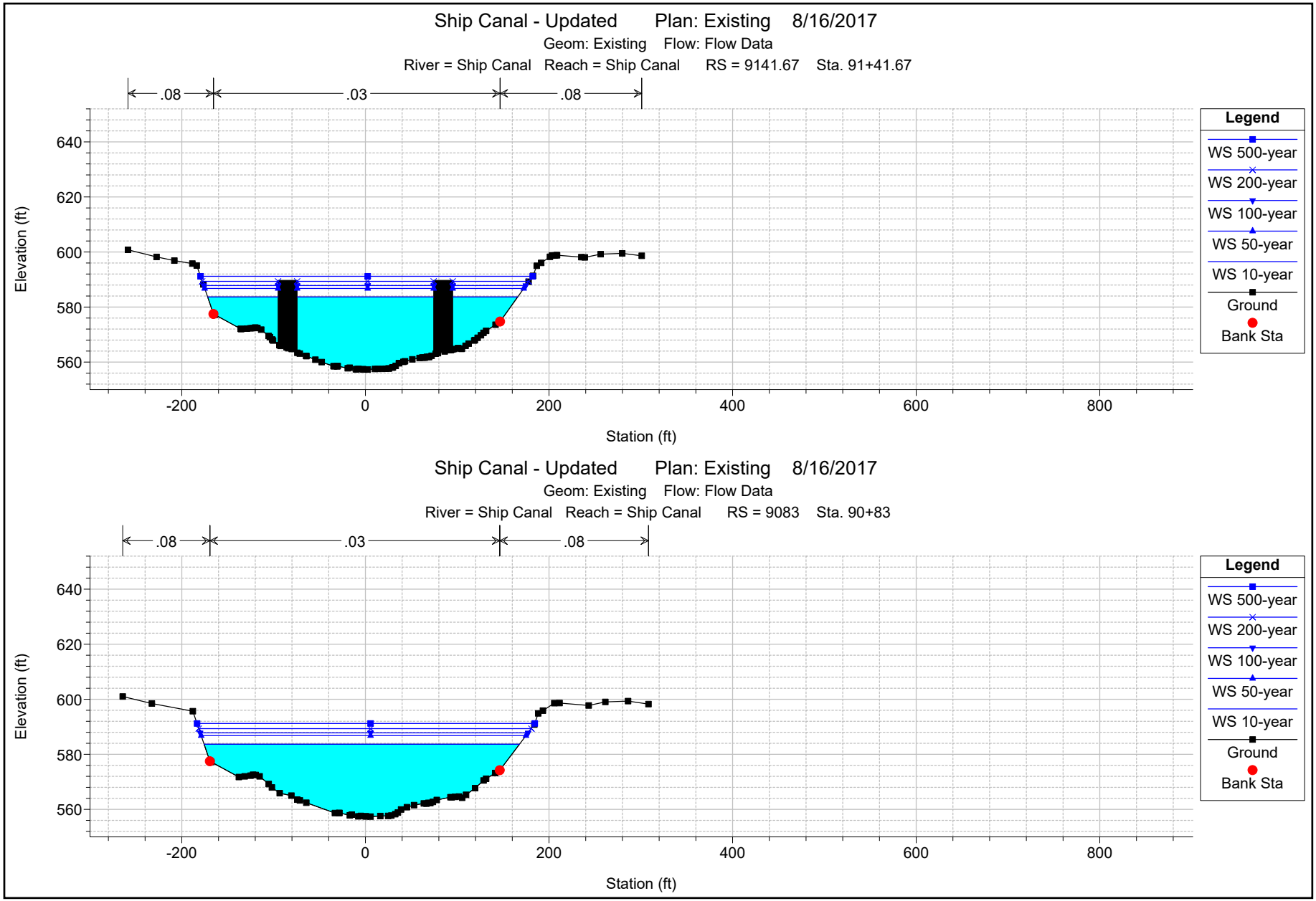
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



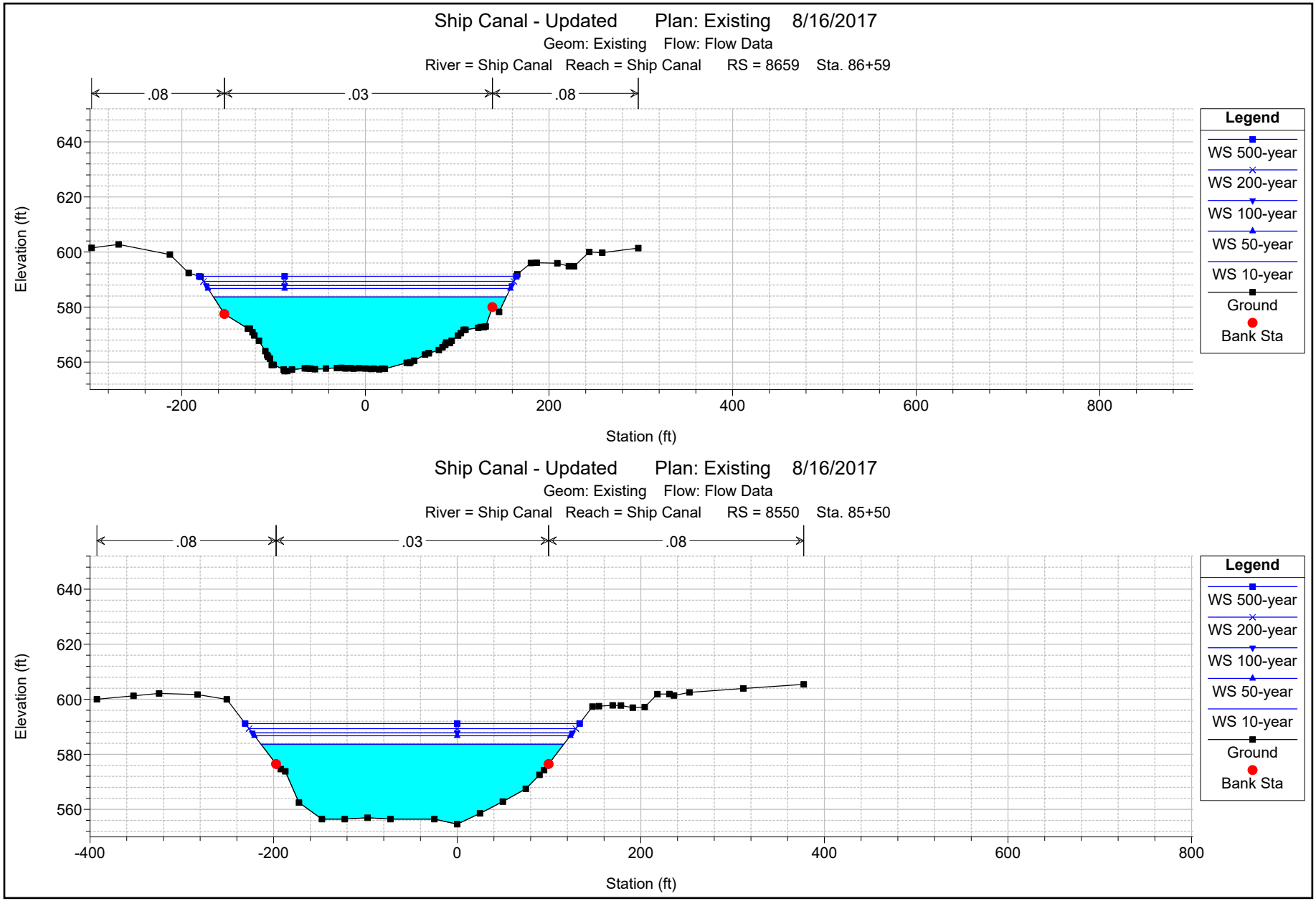
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



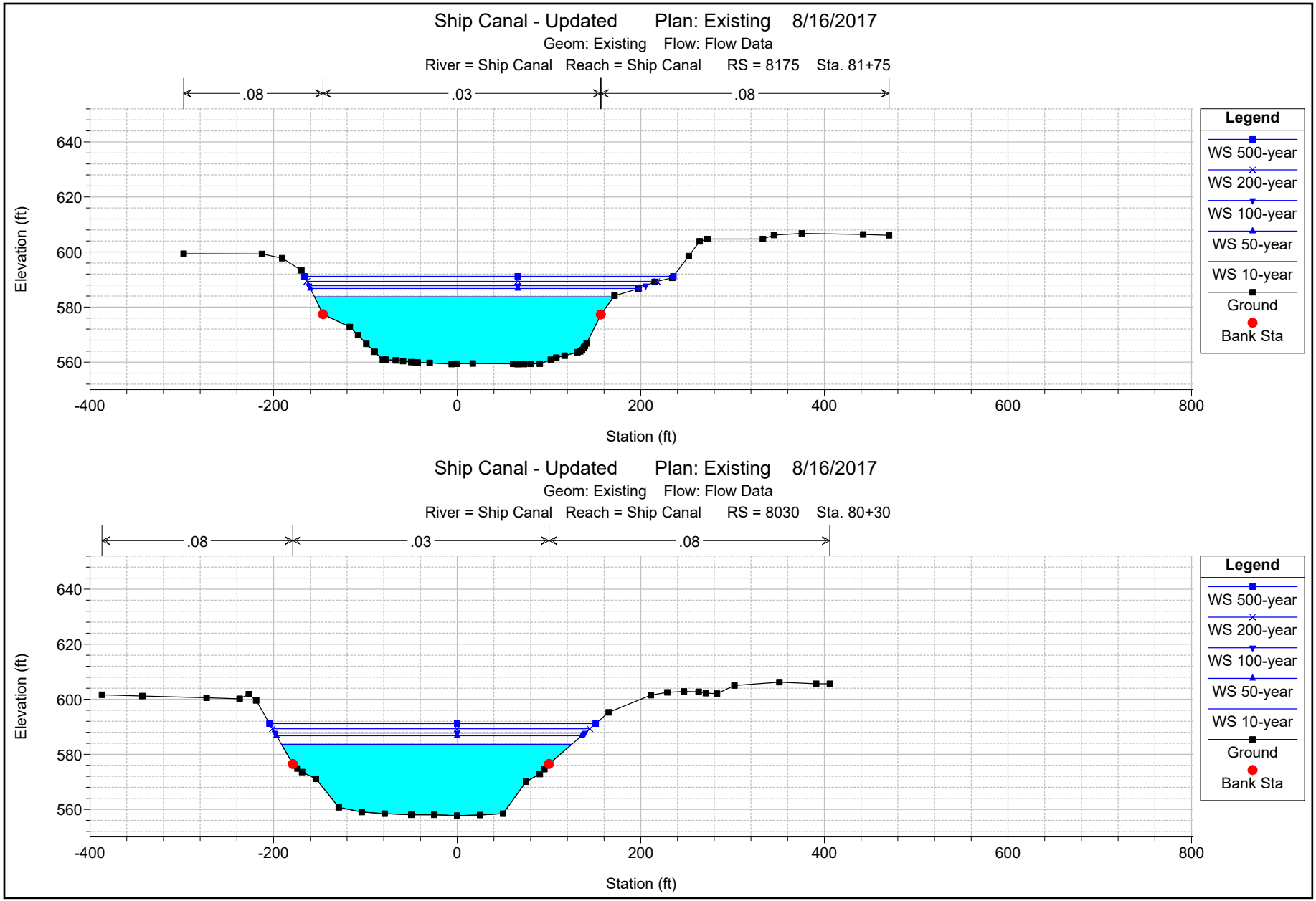
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



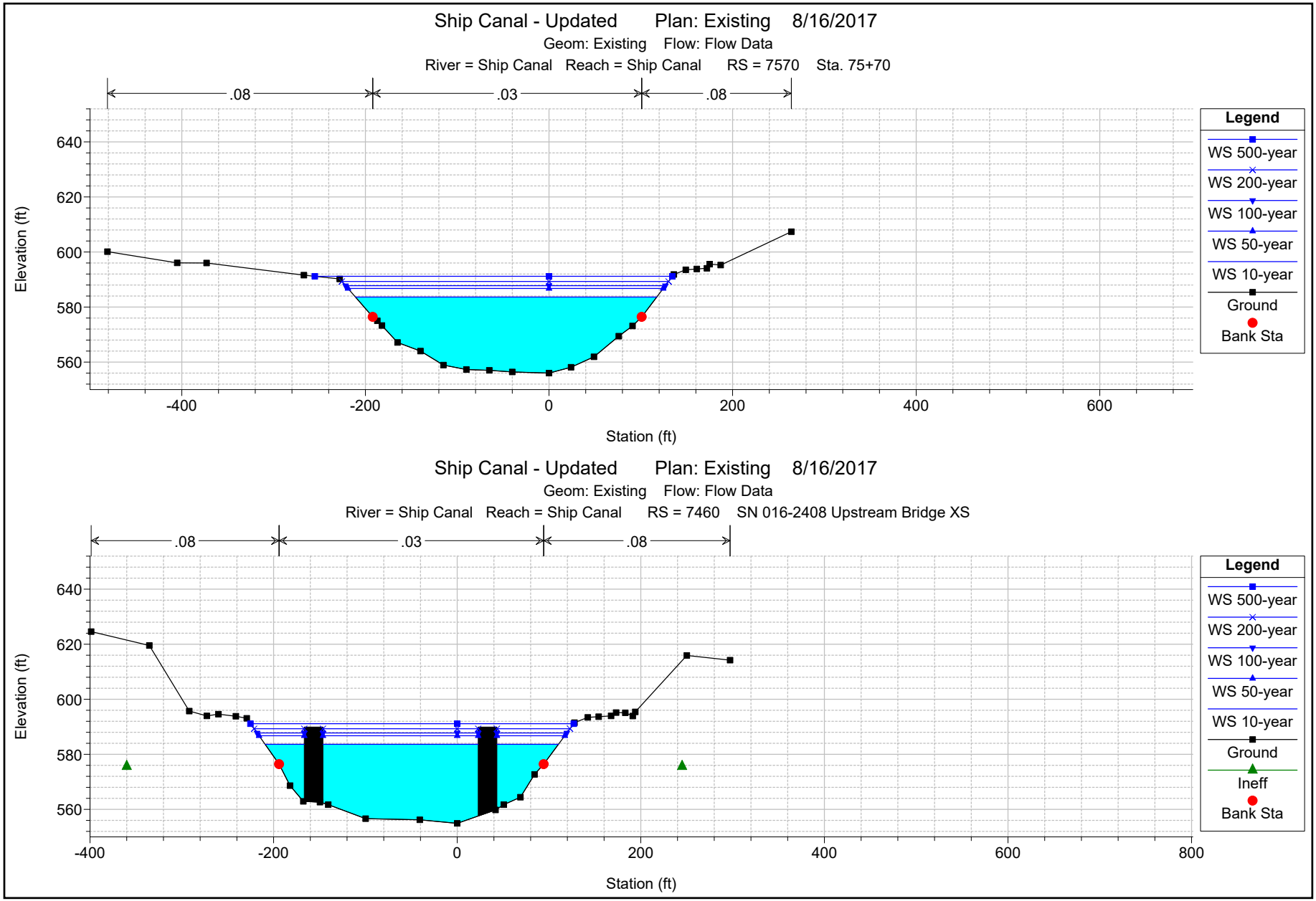
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



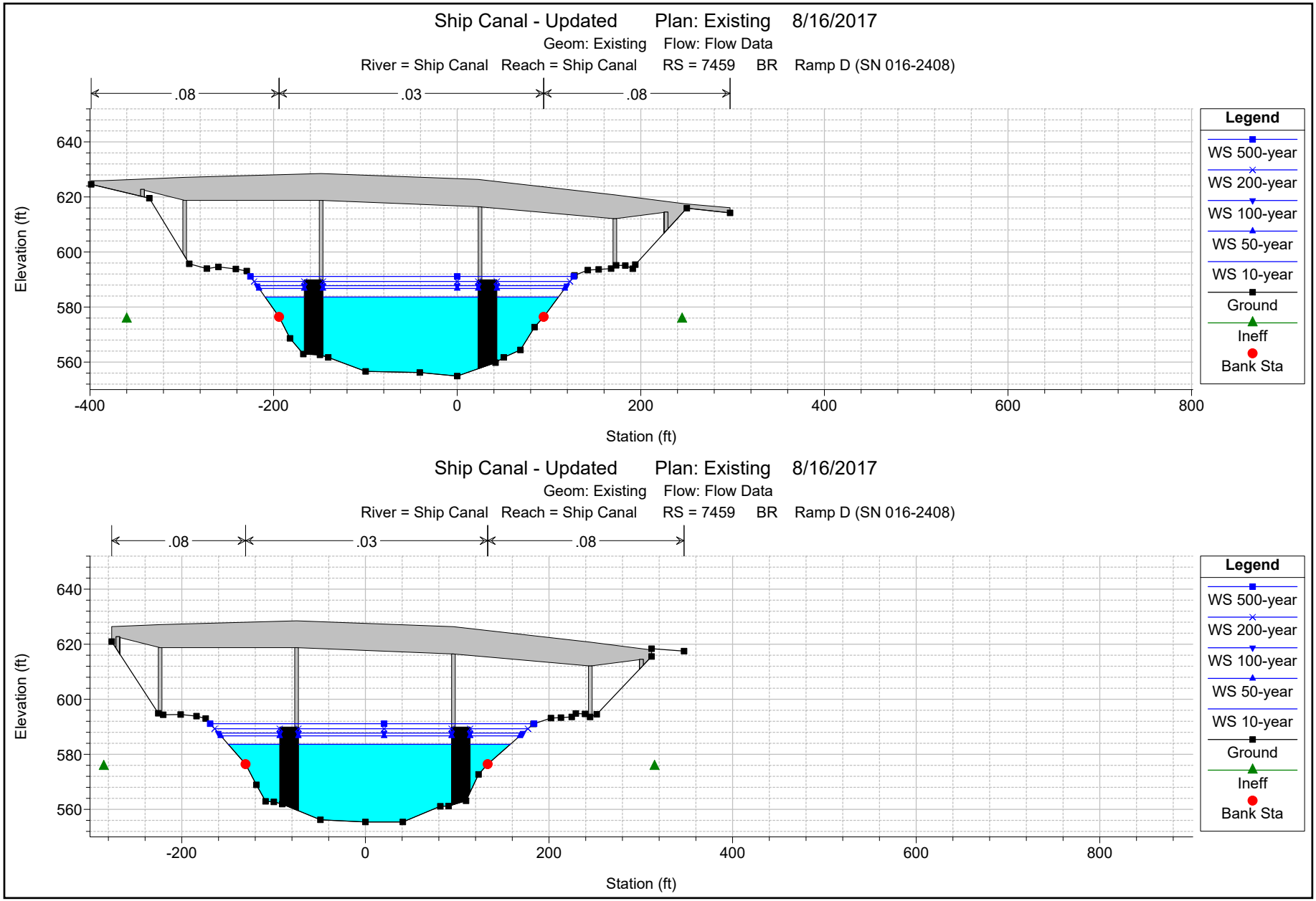
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



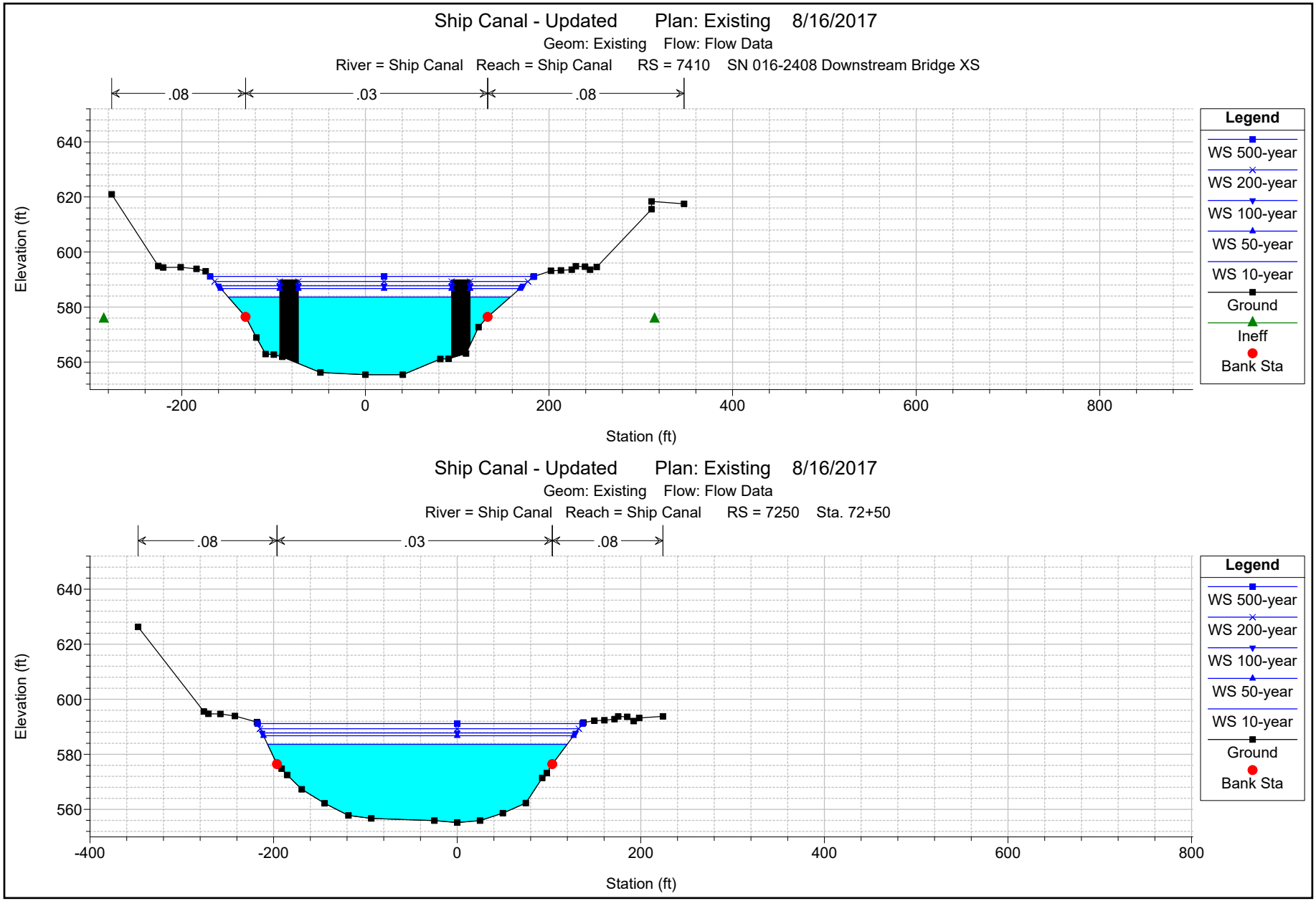
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



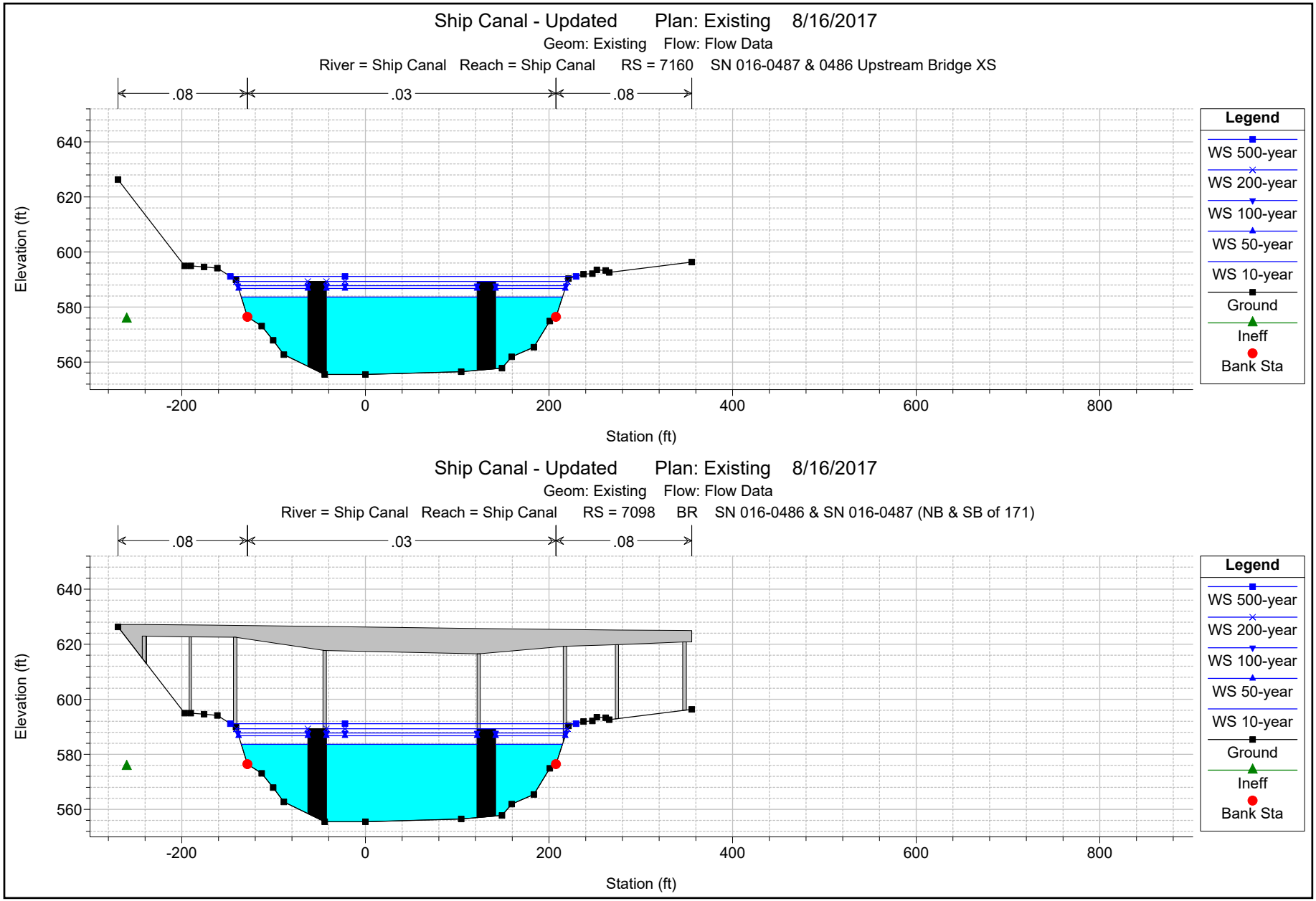
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



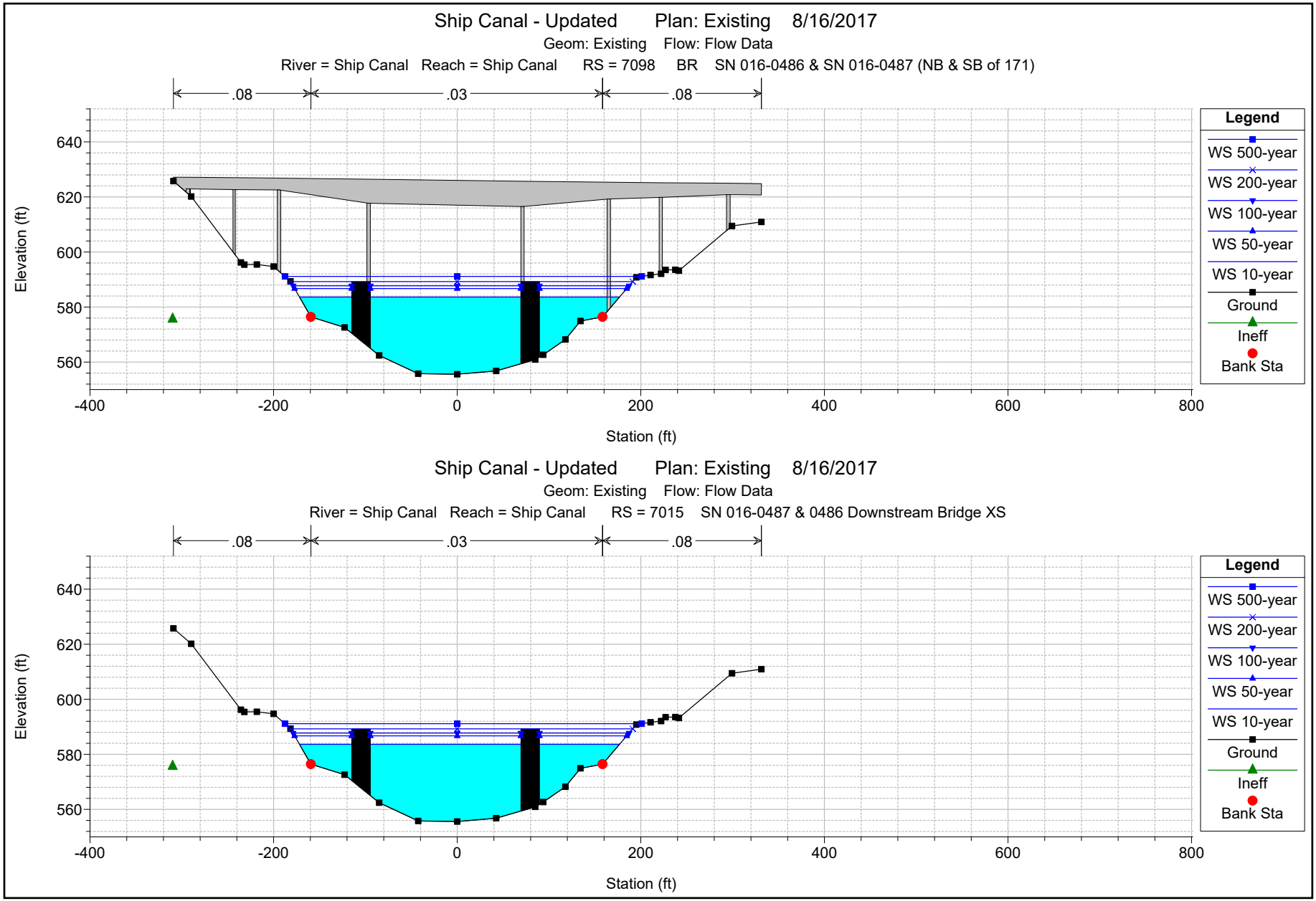
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



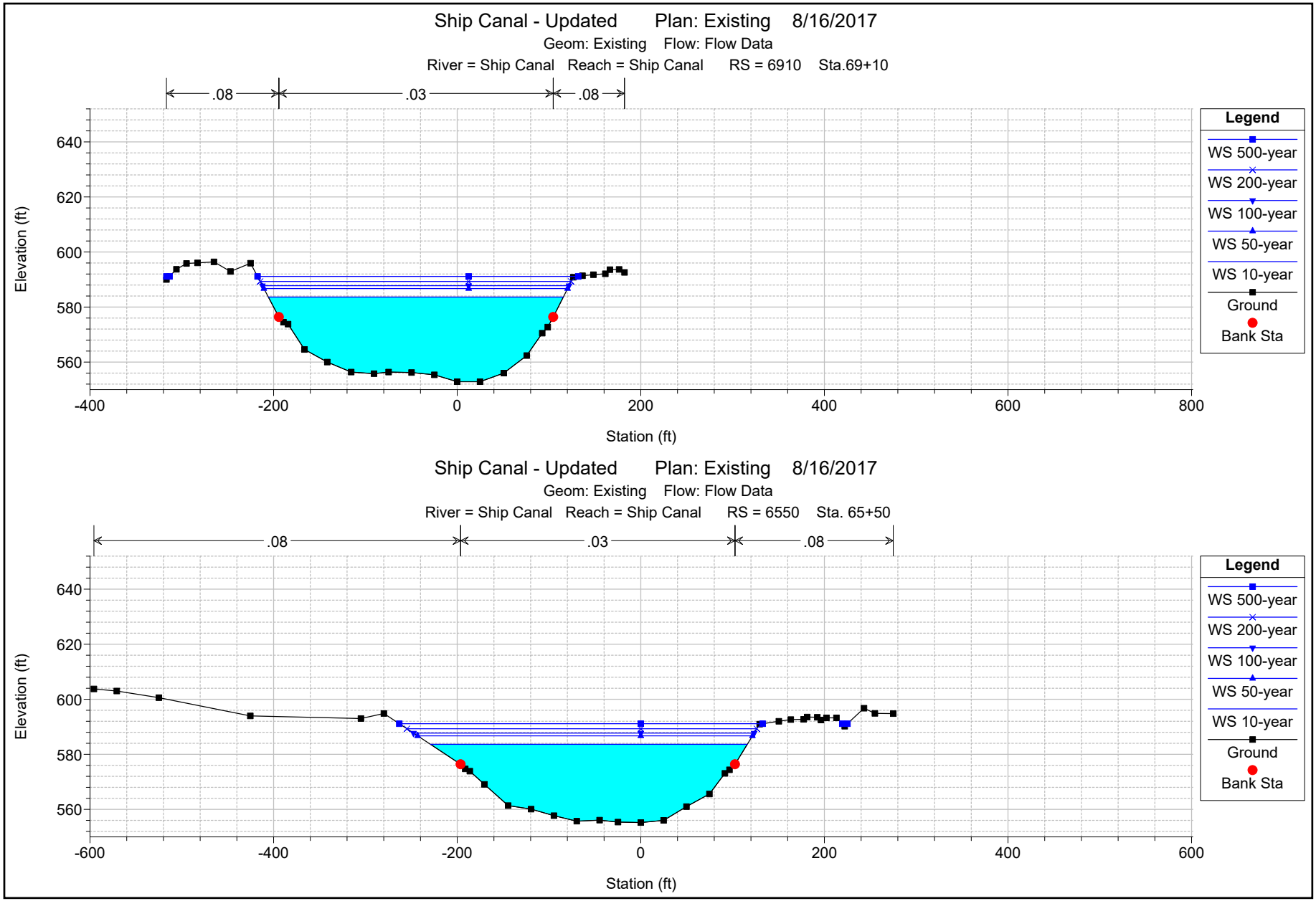
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



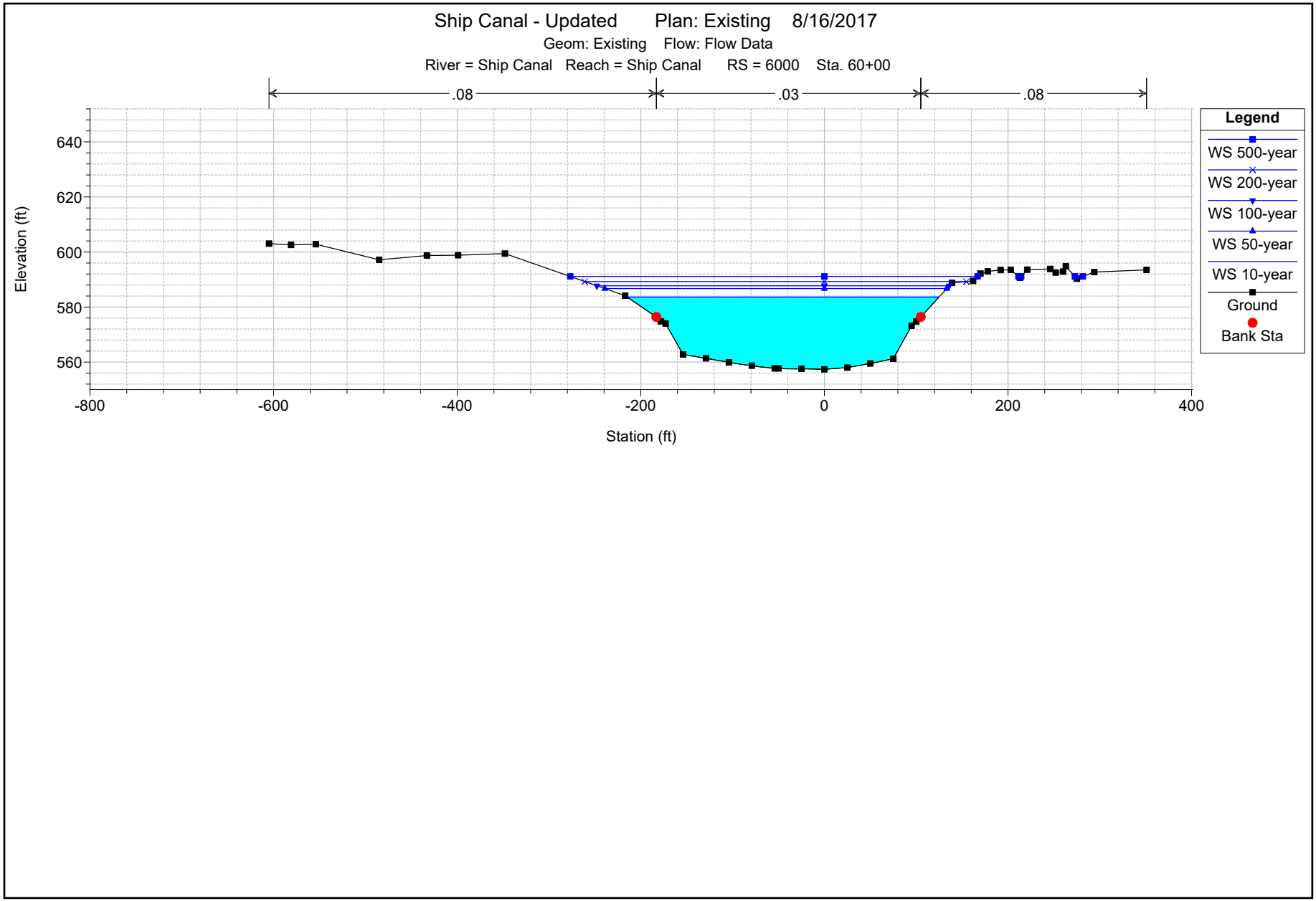
1 in Horiz. = 150 ft 1 in Vert. = 50 ft



1 in Horiz. = 150 ft 1 in Vert. = 50 ft



1 in Horiz. = 150 ft 1 in Vert. = 50 ft



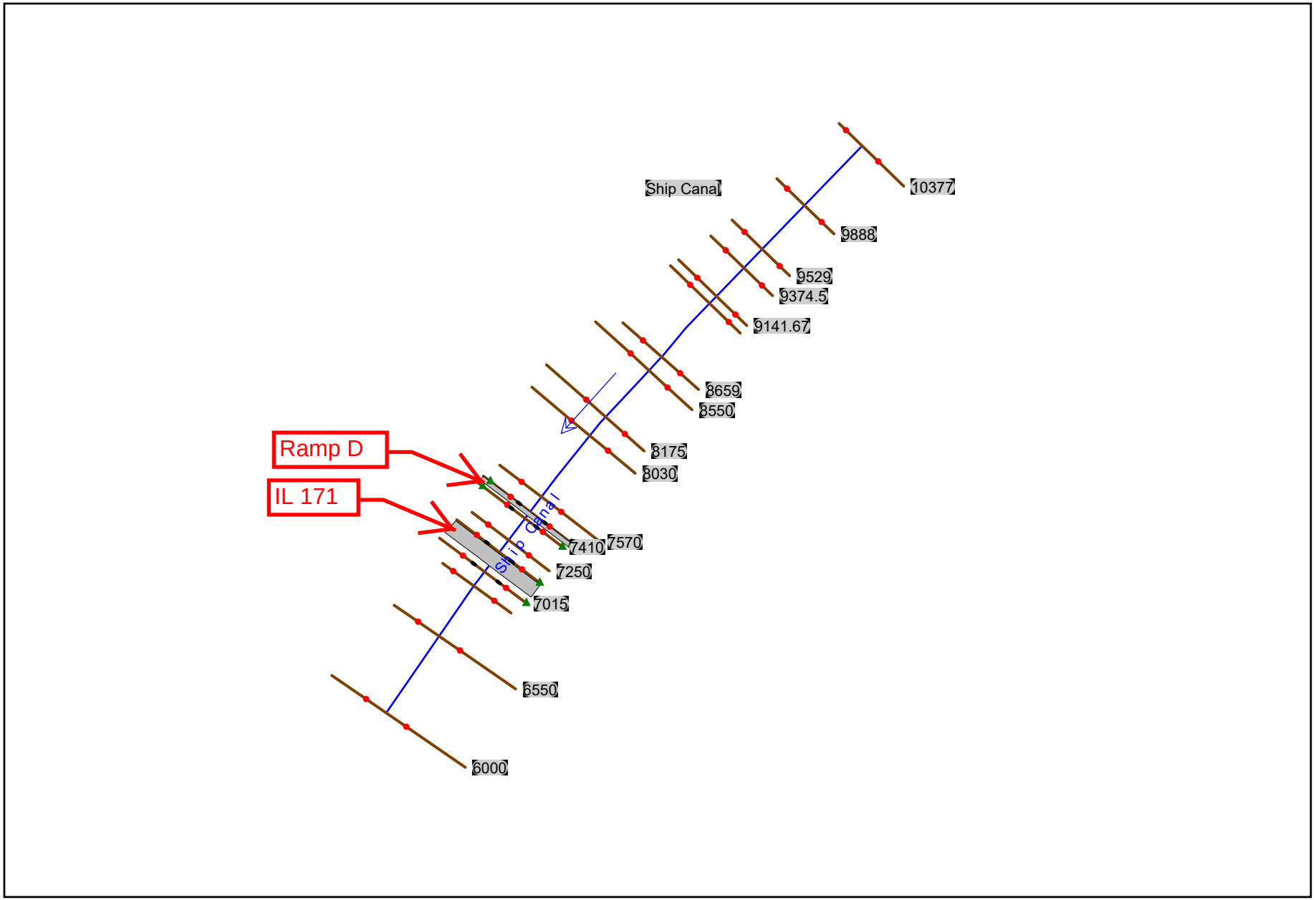
1 in Horiz. = 150 ft 1 in Vert. = 50 ft

TAB C

SECTION 13.C

NATURAL CONDITIONS

Natural Conditions
(without I-55)
HEC-RAS Geometry



HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Ship Canal - Updated
Project File : ShipCanal-Update.prj
Run Date and Time: 8/16/2017 5:04:41 PM

Project in English units

PLAN DATA

Plan Title: Natural
Plan File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.p02

Geometry Title: Natural
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g04

Flow Title : Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Plan Description:
Natural conditions CSSC without I-55 bridge per survey added to approved IL 171 baseline model. Starting WSEs updated to NAVD88.

Plan Summary Information:

Number of:	Cross Sections	= 19	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 2	Lateral Structures	=	0

Computational Information
- Water surface calculation tolerance = 0.01
- Critical depth calculation tolerance = 0.01
- Maximum number of iterations = 20
- Maximum difference tolerance = 0.3
- Flow tolerance factor = 0.001

Computation Options
- Critical depth computed at all cross sections
- Conveyance Calculation Method: At breaks in n values only
- Friction Slope Method: Average Conveyance
- Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Flow Data (cfs)

River	Reach	RS	10-year	50-year	100-year	200-year	500-year
Ship Canal	Ship Canal	10377	8500	11300	12800	14200	16100
Ship Canal	Ship Canal	8550	8500	11300	12800	14200	16100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Ship Canal	Ship Canal	10-year		Known WS = 583.61
Ship Canal	Ship Canal	50-year		Known WS = 586.71
Ship Canal	Ship Canal	100-year		Known WS = 587.71
Ship Canal	Ship Canal	200-year		Known WS = 589.26
Ship Canal	Ship Canal	500-year		Known WS = 591.11

GEOMETRY DATA

Geometry Title: Natural
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g04

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 10377

INPUT
Description: Sta. 103+77
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-341.9	593.764	-188.09	592.696	-174.86	593.546	-161.82	588.031	-153.99	587.59
-132.57	577.194	-104	568.05	-103	567.35	-97	567.12	-87	564.38
-82	562.62	-81	562.74	-79	562.51	-70	562.35	-52	561.01
-50	561.37	-30	560.02	-28	560.09	0	559.02	8	558.6
16	558.58	42	558.33	57	558.67	66	559.56	68	560.66
69	561.1	74	560.56	84	561.82	91	563.33	101	566.6
103	567.64	105	568.88	111	571.63	114	573	116	574
132.13	577.407	147.87	591.091	153.23	591.392	189.39	592.153		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-341.9	.08	-132.57	.03	132.13	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-132.57	132.13	489	489	.1	.3

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 9888

INPUT
Description: Sta. 98+88
Station Elevation Data num= 41

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-240.62	592.615	-223.22	593.176	-181.19	593.324	-165.84	591.908	-139.73	577.192
-113	570.17	-109	570.99	-95	567.33	-84	565	-69	562.06
-58	560.15	-56	560.66	-44	559.31	-41	559.57	-25	558.63
-22	558.84	-8	558.33	-6	558.39	0	558.13	1	558.06
2	558.09	13	558.18	15	558.12	20	558.04	32	558.05
35	558.18	36	558.24	48	558.45	69	559.47	76	560.58

```
      91  563.04     106  571.26     108  573.65     109  573.61     113  573.52
  143.68 577.117  153.01 579.318  165.07 586.702174.2481 594.073214.0618  594.94
228.8899  595.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -240.62     .08 -139.73     .03  143.68     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -139.73  143.68              359     359     359             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9529

INPUT
Description: Sta. 95+29
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-221.006 599.645-176.763   594.6-159.566 594.543-149.072 585.989-139.364 577.379
-118.087  573.57-110.309   573.3-106.066  572.01 -96.167  568.66 -93.338  567.39
 -87.681  565.97 -82.024  564.84  -80.61  563.79 -66.468  560.89 -59.397  559.14
 -54.447     558 -44.548  557.34 -42.426  557.49  -26.87  556.97 -18.385  556.91
  -9.192  557.24       0  557.07   7.778  557.24  12.728  557.11  21.213  557.24
   26.87  556.94  47.376  558.28  52.326  558.43  59.397  559.19  70.711  561.12
  79.196  562.44  84.853  563.78  89.095  565.38  96.167  567.48 101.116  568.91
 109.602   570.9 116.673  569.71 120.915  570.59 125.158  570.42 149.532  578.04
 170.045 593.595 185.446 599.548 188.882  599.86 190.254  600.03 208.172 600.086
 251.772 601.122

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-221.006     .08-139.364     .03 149.532     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -139.364 149.532           154.66  154.66  154.66             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9374.5

INPUT
Description: Sta. 93+74.5
SN 016-0014 & SN 016-0015 Upstream Bridge XS
HEC
            RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -236.05  600.11 -207.21   597.2  -189.3  595.51 -171.13  595.04 -166.66  592.68
 -160.04  586.87 -149.79   577.4 -148.55  577.19 -125.21  572.98 -124.62  572.92
 -119.54  572.91 -116.23   572.9 -114.46  572.63  -112.2  572.36 -111.33  572.19
 -109.94  571.91 -106.56  571.09  -99.89     569  -98.66  568.54  -96.62  567.71
  -95.83  567.47  -90.09  566.04  -89.06  565.82  -83.56  565.03  -81.92   564.3
   -78.9  563.86  -73.82  562.76  -71.57   562.4  -65.92  561.46  -65.59  561.41
  -57.42  559.84   -51.7  558.79  -41.09  557.84  -40.27   557.8  -37.82   557.9
   -37.7   557.9  -37.14   557.9  -28.11  557.42  -26.41  557.48  -20.77  557.15
  -19.85  557.16  -18.51   557.2  -14.56  557.12     -14  557.11  -10.05  557.08
   -1.37  557.34     1.9  557.32     7.3  557.26   11.46  557.33   14.65   557.4
   15.44   557.4   19.32  557.47   20.22  557.51    23.4  557.75   27.33  558.18
   27.38  558.18   32.66   558.2   34.55  558.36   43.31  559.01   52.02  559.57
   55.26  559.69   56.69  559.71   58.44  559.82   60.83  560.11   63.22  560.25
   63.36  560.27   66.41  560.77   71.19  561.58   74.04  561.97   82.05  563.01
   87.39  563.99   87.91  564.14    89.5  564.53   91.39  565.06   93.48  565.52
   98.07   566.5   98.26  566.54  102.24  567.17  102.74  567.31  107.02  568.35
  110.75  569.23  117.42  568.96  118.17  569.12  121.43   569.9  125.43  570.16
  128.53  571.12  131.71  572.03  142.86  575.16  148.44   576.7  173.11  591.84
```

```
  177.03  593.45  180.23  595.54  184.14   596.7  191.63  599.02  193.49   599.3
  195.76  599.43  197.41  599.55   197.9  599.55  218.97  599.31  221.98  599.31
  235.75  599.94  254.54  600.28  271.41  600.12

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -236.05     .08 -149.79     .03  148.44     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -149.79  148.44            232.7   232.7   232.7             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9141.67

INPUT
Description: Sta. 91+41.67
SN 016-0014 & SN 016-0015 Downstream Bridge XS
HEC
             RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -258.68   600.8 -227.52   598.2 -208.17  596.88 -188.53  595.79  -183.7  595.07
 -176.55  588.19 -165.47  577.44 -163.98  577.19 -135.93   572.1 -135.22  571.98
 -129.11  572.18 -125.13  572.31    -123  572.33 -120.29  572.54 -119.24  572.47
 -117.58  572.36 -113.51  571.81  -105.5  569.52 -104.01  569.08 -101.57  568.19
 -100.62  567.85  -93.71  566.16  -92.48  565.86  -85.86  565.32   -83.9  565.06
  -80.27  564.76  -74.16  563.38  -71.45  563.07  -64.66  562.24  -64.26  562.18
  -54.44  560.88  -47.57  559.98  -34.81  558.51  -33.83   558.5  -30.88  558.52
  -30.74  558.51  -30.07  558.56  -19.21  557.74  -17.18  557.96  -10.39  557.38
   -9.28  557.45   -7.68  557.55   -2.93   557.4   -2.25  557.37     2.5  557.33
    10.4   557.5   13.37  557.54   18.29  557.54   22.07  557.57   24.98  557.65
    25.7  557.66   29.23     558   30.05  558.08   32.95  558.62   36.52   559.6
   36.57  559.61   41.38   560.1    43.1   560.3   51.08  561.02      59   561.5
   61.95  561.66   63.26  561.63   64.85  561.62   67.03  561.93    69.2  561.87
   69.33  561.89    72.1  562.31   76.45  563.04   79.06  563.26   86.35  563.86
   91.21  564.32   91.68  564.37   93.13  564.39   94.85  564.57   96.76  564.74
  100.93  565.03  101.11  565.05  104.73  564.79  105.18  564.91  109.08   565.9
  112.47  566.72  118.55  567.82  119.23  567.99   122.2  568.85  125.84  569.77
  128.66  570.64  131.56  571.32  141.71  573.59  146.79   574.7  177.72  589.19
  182.63  591.33  186.65  595.01  191.55  596.03  200.94  598.23  203.26  598.72
  206.12  598.77  208.19  598.82  208.79  598.82  235.21  598.14  238.98  598.05
  256.25  599.21  279.81  599.52  300.95  598.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -258.68     .08 -165.47     .03  146.79     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -165.47  146.79            58.64   58.64   58.64             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9083

INPUT
Description: Sta. 90+83
Station Elevation Data    num=      62
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -264.38  600.98-232.638  598.45-187.998  595.67-169.423  577.45-167.874  577.19
-137.886  571.74-131.522  571.99-125.158  572.25-122.329  572.58-119.501  572.48
-115.258  571.99-105.359  569.22-101.823  567.95 -93.338  565.87  -80.61  564.99
 -74.246  563.54 -71.418  563.24 -64.347  562.43 -33.234  558.68 -28.991  558.67
 -28.284  558.72 -16.971  557.82 -14.849  558.08  -7.778  557.44   -4.95  557.64
       0  557.47    .707  557.44   5.657  557.39  16.263  557.59  24.749  557.63
  28.284  557.73  32.527  558.23  35.355  558.84  38.891  559.97  45.255  560.79
  53.033  561.53   63.64  562.16  66.468  562.07  68.589  562.39  70.711  562.28
```

```
  73.539   562.7  77.782  563.41  92.631  564.43  94.045  564.36  97.581  564.54
 101.823  564.67 105.359  564.19 109.602  565.28 119.501   567.7 128.693  570.52
 131.522  571.14 141.421   573.2 146.371  574.19 184.039   590.8 188.267  594.88
 193.415  595.86 205.726  598.57 211.538  598.64 243.266  597.73 261.417  599.03
 286.173  599.33  308.39  598.23

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -264.38     .08-169.423     .03 146.371     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -169.423 146.371              424     424     424             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8659

INPUT
Description: Sta. 86+59
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  -298.3   601.5 -268.92  602.74 -212.94  599.08 -192.46  592.39 -179.57  591.02
 -153.65  577.45    -128  572.15    -126  572.11    -123  570.84    -121  569.65
    -116  567.76    -109  563.97    -107  562.57    -106  561.92    -104  561.25
    -102  558.97    -100  559.02     -89  557.29     -88  556.71     -85  556.73
     -80   557.3     -66  557.72     -63  557.69     -60  557.64     -55   557.4
     -43  557.67     -31  557.85     -26   557.9     -22   557.7     -20  557.75
     -16  557.84     -13  557.63      -7  557.73       0  557.67       6  557.51
       9  557.64      15  557.36      18  557.62      21  557.56      45  559.75
      48  559.64      49  559.96      53   560.5      65  562.71      69  563.24
      69  563.19      80  564.36      84  565.36      87  566.27      88   567.1
      92   566.9      94  567.76     101  569.63     104   570.5     107  571.71
     109  571.75     123  572.46     126  572.74     129   572.7     131  572.97
  138.34  579.94  145.66  578.27  165.37  591.88  180.33  596.01  186.66  596.09
  209.18  595.91  221.61  594.85  227.27  594.81   243.9  600.02  258.01  599.73
  297.19   601.4

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -298.3     .08 -153.65     .03  138.34     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -153.65  138.34              109     109     109             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8550

INPUT
Description: Sta. 85+50
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-392.501  600.02-352.653  601.25-324.759  602.14-282.919   601.7-251.041  599.95
-197.247  576.44-192.266  574.64-187.285  573.84-172.342  562.44-147.437  556.44
-122.532  556.44 -97.627  556.94 -72.722  556.44 -24.905  556.44       0  554.64
  24.905  558.54   49.81  562.84  74.715  567.44  89.658  572.54  94.638  574.24
  99.619  576.44 147.437  597.32  154.41  597.48 169.353   597.8 178.319  597.74
 191.269  596.95  204.22  597.17 218.167  601.87 231.117   601.9 236.098  601.36
 253.033  602.52 311.809  603.91 377.558  605.42

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-392.501     .08-197.247     .03  99.619     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -197.247  99.619              375     375     375             .1       .3
```

Skew Angle = 5

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 8175

INPUT
Description: Sta. 81+75
Station Elevation Data num= 48

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-297.94	599.37	-212.57	599.29	-190.66	597.73	-169.77	593.34	-146.1	577.38
-117	572.77	-108	569.79	-99	566.63	-90	563.75	-81	560.83
-78	560.88	-67	560.64	-59	560.36	-50	560	-45	559.79
-43	559.82	-30	559.69	-6	559.31	0	559.42	17	559.49
61	559.36	63	559.39	66	559.23	73	559.3	80	559.39
90	559.43	102	560.89	108	561.61	117	562.32	131	563.6
134	563.88	136	564.36	138	565.29	139	565.86	141	566.8
156.56	577.296	171.42	584.133	197.4	586.651	215.11	589.124	234.28	590.624
252.28	598.491	264.07	603.893	272.57	604.688	333.02	604.706	345.1	606.155
375.55	606.742	442.22	606.389	470.34	606.091				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-297.94	.08	-146.1	.03	156.56	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-146.1	156.56	145	145	.1	.3

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 8030

INPUT
Description: Sta. 80+30
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-387	601.61	-343	601.15	-273	600.53	-237	600.18	-227	601.83
-219	599.59	-179	576.44	-174	574.84	-169	573.54	-154	571.14
-129	560.74	-104	559.04	-79	558.44	-50	558.04	-25	558.04
0	557.74	25	557.94	50	558.44	75	570.04	90	572.84
95	574.64	100	576.44	165	595.25	211	601.49	229	602.52
247	602.85	263	602.69	271	602.19	283	602.06	302	605.01
351	606.21	391	605.61	406	605.61				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-387	.08	-179	.03	100	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-179	100	460	460	.1	.3

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 7570

INPUT
Description: Sta. 75+70
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-481	600.12	-405	596.05	-373	595.99	-267	591.57	-228	590.22
-192	576.41	-187	575.01	-182	573.31	-165	567.11	-140	564.01
-115	558.91	-90	557.31	-65	557.01	-40	556.41	0	556.01
24	558.11	49	561.91	76	569.41	91	573.11	101	576.41
136	591.85	149	593.53	161	593.85	172	594.09	175	595.57
187	595.26	264	607.39						

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -481     .08    -192     .03     101     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -192     101              110     110     110             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7460

INPUT
Description: SN 016-2408 Upstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-398.775  624.59-335.334  619.54-291.831   595.7-272.799  593.94 -260.11  594.59
-241.078  593.85-229.296  593.07 -193.95  576.41-182.168  568.61-167.667  562.91
-149.541  562.61-140.478  561.71 -99.694  556.61 -40.784  556.21       0  554.91
   41.69  559.81  50.753  561.71  68.879  564.41  84.287  572.71  94.256  576.41
 127.789  591.51  142.29   593.4 154.072  593.66 167.667  593.96 173.105  595.16
 183.074  595.08 191.231   593.9  193.95  595.42 250.141  615.93 297.269  614.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-398.775     .08 -193.95     .03  94.256     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -193.95  94.256              50      50      50             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-398.775    -360   575.6       F
     245 297.269   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -166.64 -146.31   589.9    22.9   43.23   589.9
Skew Angle = 25

BRIDGE


RIVER: Ship Canal
REACH: Ship Canal         RS: 7459

INPUT
Description: Ramp D (SN 016-2408)
Distance from Upstream XS =       1
Deck/Roadway Width        =      28
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -567.43  626.62       0  -476.8  625.85       0 -386.17   625.9       0
 -345.03  626.46       0 -345.03  626.46  622.78 -296.85  627.11  618.76
 -148.31  628.52  618.74   22.57  626.39  616.44  171.69  620.76  612.09
   229.6   618.3  614.54   229.6   618.3       0  248.25  617.51       0
  338.88  614.91       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-398.775  624.59-335.334  619.54-291.831   595.7-272.799  593.94 -260.11  594.59
-241.078  593.85-229.296  593.07 -193.95  576.41-182.168  568.61-167.667  562.91
-149.541  562.61-140.478  561.71 -99.694  556.61 -40.784  556.21       0  554.91
   41.69  559.81  50.753  561.71  68.879  564.41  84.287  572.71  94.256  576.41
 127.789  591.51  142.29   593.4 154.072  593.66 167.667  593.96 173.105  595.16
 183.074  595.08 191.231   593.9  193.95  595.42 250.141  615.93 297.269  614.21
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-398.775     .08 -193.95     .03  94.256     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       -193.95  94.256             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-398.775    -360   575.6       F
     245 297.269   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -166.64 -146.31   589.9    22.9   43.23   589.9
Skew Angle = 25

Downstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -494.17  626.62       0 -403.54  625.85       0 -312.91   625.9       0
 -271.77  626.46       0 -271.77  626.46  622.78  -223.6  627.11  618.76
  -75.05  628.52  618.74   95.82  626.39  616.44  244.95  620.76  612.09
  302.86   618.3  614.54  302.86   618.3       0   321.5  617.51       0
  412.13  614.91       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-276.424  620.95-225.671  594.92-220.233  594.36  -201.2  594.44 -183.98  593.88
-174.011  592.99-130.508  576.41-118.726  568.91-108.757  562.91 -99.694  562.71
 -90.631  561.91 -48.941  556.21       0  555.41  40.784  555.41  81.568  561.11
  90.631  561.21 109.663  563.11 123.258  572.71 133.227  576.41 183.074  591.06
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -130.508 133.227             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -345.03  622.78  -340.7  622.78  -340.7       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -271.77  622.78 -267.44  622.78 -267.44       0

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  225.27       0  225.27  614.54   229.6  614.54
```

```
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  298.53       0  298.53  614.54  302.86  614.54

Number of Piers =  4

Pier Data
Pier Station     Upstream= -296.85    Downstream=  -223.6
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76

Pier Data
Pier Station     Upstream= -148.31    Downstream=  -75.05
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74

Pier Data
Pier Station     Upstream=    24.9    Downstream=   95.82
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44

Pier Data
Pier Station     Upstream=  171.69    Downstream=  244.95
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum              Cd   =    1.33
       Yarnell               KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 624.59
       El of the toe of the abutment   = 619.97
    Right Embankment
       El of the top of the embankment = 614.21
       El of the toe of the abutment   = 606.85
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 65
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =
```

```
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7410

INPUT
Description: SN 016-2408 Downstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-276.424  620.95-225.671  594.92-220.233  594.36  -201.2  594.44 -183.98  593.88
-174.011  592.99-130.508  576.41-118.726  568.91-108.757  562.91 -99.694  562.71
 -90.631  561.91 -48.941  556.21       0  555.41  40.784  555.41  81.568  561.11
  90.631  561.21 109.663  563.11 123.258  572.71 133.227  576.41 183.074  591.06
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -130.508 133.227              160     160     160             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7250

INPUT
Description: Sta. 72+50
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-347.672   626.3-275.946  595.55-270.965  594.69-258.014  594.67-242.075  593.91
-218.167  591.71 -196.25  576.41-191.269  574.81-185.292  572.51-169.353  567.31
-144.448  562.21-118.547  557.81 -93.642  556.71 -24.905  555.91       0  555.21
  24.905  555.91   49.81  558.61  74.715  562.31  92.646  571.41  97.627  573.21
 103.604  576.41 137.475  591.56 149.429  592.22 160.387  592.37 171.345  592.81
  175.33  593.74 185.292  593.62 192.266  592.09 198.243  593.22 224.144  593.78

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-347.672     .08 -196.25     .03 103.604     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 103.604               90      90      90             .1       .3
Skew Angle = 5
```

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 7160

INPUT
Description: SN 016-0487 & 0486 Upstream Bridge XS
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-269.493	626.3	-197.049	594.96	-190.287	594.96	-175.798	594.57	-161.31	594.11
-141.025	589.88	-128.468	576.4	-113.013	573.1	-100.456	567.9	-88.865	562.7
-44.433	555.5	0	555.5	104.32	556.5	148.753	557.8	159.378	561.9
183.526	565.4	200.913	574.9	207.674	576.4	221.197	590.35	237.618	591.91
247.277	592.11	252.107	593.5	261.766	593.3	265.63	592.58	355.461	596.35

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-269.493	.08	-128.468	.03	207.674	.08

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
-128.468 207.674 145 145 145 .1 .3
Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-269.493	-260	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-62.795	-42.465	589.32	121.58	141.91	589.22

Skew Angle = 15

BRIDGE

RIVER: Ship Canal
REACH: Ship Canal RS: 7098

INPUT
Description: SN 016-0486 & SN 016-0487 (NB & SB of 171)
Distance from Upstream XS = 8.5
Deck/Roadway Width = 91.33
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 16

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-467.31	628.06	0	-467.31	627.92	0	-419.01	627.74	0
-370.71	627.55	0	-322.42	627.37	0	-274.12	627.18	0
-243.12	627.18	0	-243.12	627.18	622.94	-190.77	627	622.67
-141.91	626.82	622.56	-44.34	626.45	617.71	123.33	625.71	616.51
217.38	625.34	619.24	274.03	625.16	619.85	347.64	624.98	620.85
399.14	624.79	620.63						

Upstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-269.493	626.3	-197.049	594.96	-190.287	594.96	-175.798	594.57	-161.31	594.11
-141.025	589.88	-128.468	576.4	-113.013	573.1	-100.456	567.9	-88.865	562.7
-44.433	555.5	0	555.5	104.32	556.5	148.753	557.8	159.378	561.9
183.526	565.4	200.913	574.9	207.674	576.4	221.197	590.35	237.618	591.91
247.277	592.11	252.107	593.5	261.766	593.3	265.63	592.58	355.461	596.35

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-269.493	.08	-128.468	.03	207.674	.08

Bank Sta: Left Right Coeff Contr. Expan.
-128.468 207.674 .1 .3
Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
-269.493	-260	575.6	F

```
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15

Downstream  Deck/Roadway Coordinates
    num=      16
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -519.53  628.06       0 -519.53  627.92       0 -471.24  627.74       0
 -422.94  627.55       0 -374.64  627.37       0 -326.35  627.18       0
 -295.35  627.18       0 -295.35  627.18  622.94    -243     627  622.67
 -194.14  626.82  622.56  -96.56  626.45  617.71    71.1  625.71  616.51
  165.15  625.34  619.24  221.81  625.16  619.85  295.41  624.98  620.85
  346.91  624.79  620.63

Downstream Bridge Cross Section Data
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -159.378 158.412            .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  1

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -243.12  622.94 -238.79  622.94 -238.79       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -295.35  622.94 -291.02  622.94 -291.02       0

Number of Piers =  7

Pier Data
Pier Station     Upstream= -190.77    Downstream=    -243
Upstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67
```

```
Pier Data
Pier Station     Upstream= -141.91    Downstream= -194.14
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56

Pier Data
Pier Station     Upstream=  -44.34    Downstream=  -96.56
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71

Pier Data
Pier Station     Upstream=  123.33    Downstream=    71.1
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51

Pier Data
Pier Station     Upstream=  217.38    Downstream=  165.15
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24

Pier Data
Pier Station     Upstream=  274.03    Downstream=  221.81
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85

Pier Data
Pier Station     Upstream=  347.64    Downstream=  295.41
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum              Cd   =    1.33
       Yarnell               KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Right Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
```

```
Abtument Type                      = 1 Vert. abutments and vert. embankments with or without
wingwalls
    Slope of abutments                =
    Top with of embankment            = 30.7
    Centroid station of bridge opening =
    Wing Wall Type                    = No wing walls present
       Width                          =
       Angle                          =
       Radius                         =
    Guide Banks Type                  = No Guide Bank present
       Length                         =
       Offset                         =
       Angle                          =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7015

INPUT
Description: SN 016-0487 & 0486 Downstream Bridge XS
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -159.378 158.412              105     105     105             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6910

INPUT
Description: Sta.69+10
Station Elevation Data    num=      31
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -316.79  589.99-305.832   593.7-294.874  595.83-282.919  596.06-264.988  596.42
-247.056  592.93 -225.14  595.93-194.258  576.39-189.277  574.49-184.296  573.79
-166.365  564.59 -141.46  559.99-115.559  556.39 -90.654  555.79 -74.715  556.39
  -49.81  556.19 -24.905  555.39       0  552.89  24.905  552.89  50.806  555.99
```

```
  75.711  562.39  92.646  570.49  98.623  572.69   104.6  576.39 126.517  590.85
 136.479  591.38 148.433  591.77 161.384  592.08 166.365  593.58 176.326  593.65
 182.304   592.6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -316.79     .08-194.258     .03   104.6     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -194.258   104.6              360     360     360             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6550

INPUT
Description: Sta. 65+50
Station Elevation Data    num=      36
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-595.724  603.77 -570.82  602.98-524.995  600.59-425.375  593.95-304.836  593.02
-279.931  594.83 -196.25  576.39-191.269  574.69-186.288  573.89-170.349  569.09
-144.448  561.39-119.543  560.09 -94.638  557.69 -69.734  555.69 -44.829  556.09
 -24.905  555.39       0  555.19  24.905  555.99   49.81  560.99  74.715  565.59
   91.65  573.09  96.631  574.39 102.608  576.39 129.505  590.96 150.425  592.01
 163.376  592.61 177.323   592.7 181.307  593.55 192.266  593.44  196.25  592.45
 202.228  593.24 213.186  593.25 222.151   590.2 243.072  596.74 255.026  594.86
  274.95  594.79

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-595.724     .08 -196.25     .03 102.608     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 102.608              550     550     550             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6000

INPUT
Description: Sta. 60+00
Station Elevation Data    num=      40
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -605  603.03    -581  602.58    -554  602.83    -485  597.16    -433  598.72
    -399  598.84    -348  599.41    -217  584.11    -183  576.39    -178  574.79
    -173  573.99    -154  562.79    -129  561.39    -104  559.89     -79  558.69
     -54  557.69     -50  557.69     -25  557.59       0  557.39      25  557.99
      50  559.49      75  561.19      95  573.19     100  574.69     105  576.39
     139  588.79     162  589.48     170  592.15     178  592.95     192  593.47
     203  593.55     213  590.62     221   593.6     246  593.85     252  592.53
     260  592.88     263  594.84     275  590.28     294  592.72     351  593.49

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -605     .08    -183     .03     105     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -183     105                0       0       0             .1       .3
```

SUMMARY OF MANNING'S N VALUES

River:Ship Canal

Reach	River Sta.	n1	n2	n3
Ship Canal	10377	.08	.03	.08
Ship Canal	9888	.08	.03	.08
Ship Canal	9529	.08	.03	.08
Ship Canal	9374.5	.08	.03	.08
Ship Canal	9141.67	.08	.03	.08
Ship Canal	9083	.08	.03	.08
Ship Canal	8659	.08	.03	.08
Ship Canal	8550	.08	.03	.08
Ship Canal	8175	.08	.03	.08
Ship Canal	8030	.08	.03	.08
Ship Canal	7570	.08	.03	.08
Ship Canal	7460	.08	.03	.08
Ship Canal	7459	Bridge		
Ship Canal	7410	.08	.03	.08
Ship Canal	7250	.08	.03	.08
Ship Canal	7160	.08	.03	.08
Ship Canal	7098	Bridge		
Ship Canal	7015	.08	.03	.08
Ship Canal	6910	.08	.03	.08
Ship Canal	6550	.08	.03	.08
Ship Canal	6000	.08	.03	.08

SUMMARY OF REACH LENGTHS

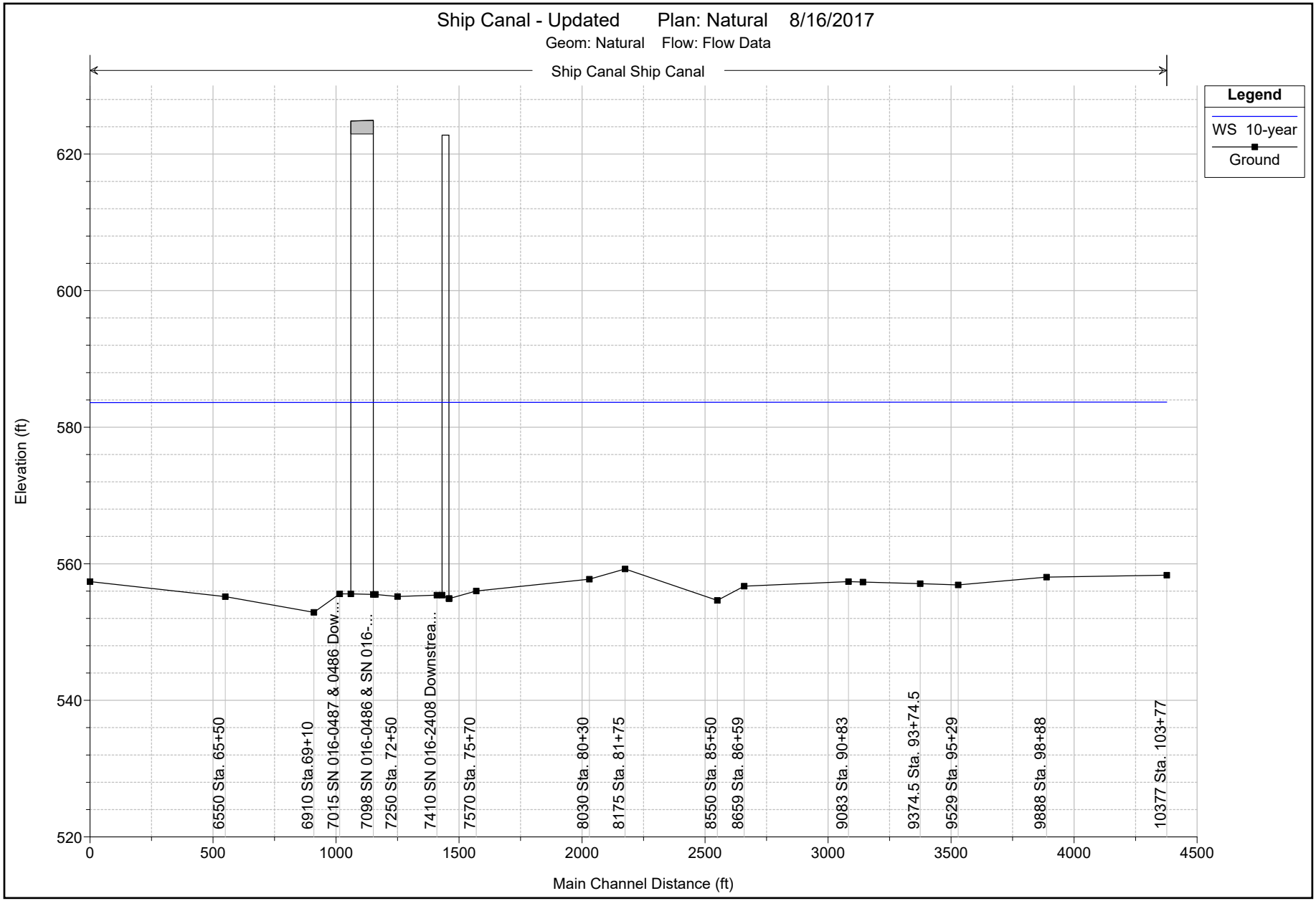
River: Ship Canal

Reach	River Sta.	Left	Channel	Right
Ship Canal	10377	489	489	489
Ship Canal	9888	359	359	359
Ship Canal	9529	154.66	154.66	154.66
Ship Canal	9374.5	232.7	232.7	232.7
Ship Canal	9141.67	58.64	58.64	58.64
Ship Canal	9083	424	424	424
Ship Canal	8659	109	109	109
Ship Canal	8550	375	375	375
Ship Canal	8175	145	145	145
Ship Canal	8030	460	460	460
Ship Canal	7570	110	110	110
Ship Canal	7460	50	50	50
Ship Canal	7459	Bridge		
Ship Canal	7410	160	160	160
Ship Canal	7250	90	90	90
Ship Canal	7160	145	145	145
Ship Canal	7098	Bridge		
Ship Canal	7015	105	105	105
Ship Canal	6910	360	360	360
Ship Canal	6550	550	550	550
Ship Canal	6000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Ship Canal

Reach	River Sta.	Contr.	Expan.
Ship Canal	10377	.1	.3
Ship Canal	9888	.1	.3
Ship Canal	9529	.1	.3
Ship Canal	9374.5	.1	.3
Ship Canal	9141.67	.1	.3
Ship Canal	9083	.1	.3
Ship Canal	8659	.1	.3
Ship Canal	8550	.1	.3
Ship Canal	8175	.1	.3
Ship Canal	8030	.1	.3
Ship Canal	7570	.1	.3
Ship Canal	7460	.1	.3
Ship Canal	7459	Bridge	
Ship Canal	7410	.1	.3
Ship Canal	7250	.1	.3
Ship Canal	7160	.1	.3
Ship Canal	7098	Bridge	
Ship Canal	7015	.1	.3
Ship Canal	6910	.1	.3
Ship Canal	6550	.1	.3
Ship Canal	6000	.1	.3

10-Year Natural


Ship Canal - Updated Plan: Natural 8/16/2017
Geom: Natural Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 10-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9374.5 Sta. 93+74.5
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	10-year	8500.00	558.33	583.68	564.29	583.72	0.000020	1.60	5380.56	285.28	0.06
Ship Canal	9888	10-year	8500.00	558.04	583.67	563.72	583.71	0.000019	1.54	5609.27	311.35	0.06
Ship Canal	9529	10-year	8500.00	556.91	583.67	562.85	583.70	0.000018	1.49	5729.13	303.41	0.06
Ship Canal	9374.5	10-year	8500.00	557.08	583.67	563.44	583.70	0.000017	1.47	5853.95	316.36	0.06
Ship Canal	9141.67	10-year	8500.00	557.33	583.66	564.27	583.69	0.000017	1.43	6050.10	337.81	0.06
Ship Canal	9083	10-year	8500.00	557.39	583.66	564.55	583.69	0.000016	1.42	6102.00	343.61	0.06
Ship Canal	8659	10-year	8500.00	556.71	583.66	562.50	583.69	0.000015	1.42	6065.42	318.96	0.06
Ship Canal	8550	10-year	8500.00	554.64	583.66	560.59	583.68	0.000009	1.22	7069.42	329.92	0.04
Ship Canal	8175	10-year	8500.00	559.23	583.65	563.73	583.68	0.000014	1.36	6302.96	325.77	0.05
Ship Canal	8030	10-year	8500.00	557.74	583.65	562.51	583.68	0.000014	1.42	6111.06	316.35	0.05
Ship Canal	7570	10-year	8500.00	556.01	583.64	561.79	583.67	0.000012	1.33	6509.14	328.25	0.05
Ship Canal	7460	10-year	8500.00	554.91	583.63	561.24	583.67	0.000021	1.47	5891.22	278.91	0.05
Ship Canal	7459		Bridge									
Ship Canal	7410	10-year	8500.00	555.41	583.63	561.30	583.67	0.000024	1.60	5446.57	266.56	0.06
Ship Canal	7250	10-year	8500.00	555.21	583.63	560.69	583.66	0.000009	1.22	7073.55	326.36	0.04
Ship Canal	7160	10-year	8500.00	555.50	583.63	560.30	583.66	0.000015	1.24	6907.58	309.23	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	10-year	8500.00	555.60	583.62	561.69	583.65	0.000024	1.51	5725.28	307.90	0.06
Ship Canal	6910	10-year	8500.00	552.89	583.63	559.34	583.65	0.000008	1.16	7398.54	321.26	0.04
Ship Canal	6550	10-year	8500.00	555.19	583.62	561.06	583.64	0.000010	1.26	6901.12	345.01	0.05
Ship Canal	6000	10-year	8500.00	557.39	583.61	562.58	583.64	0.000012	1.32	6591.91	339.59	0.05

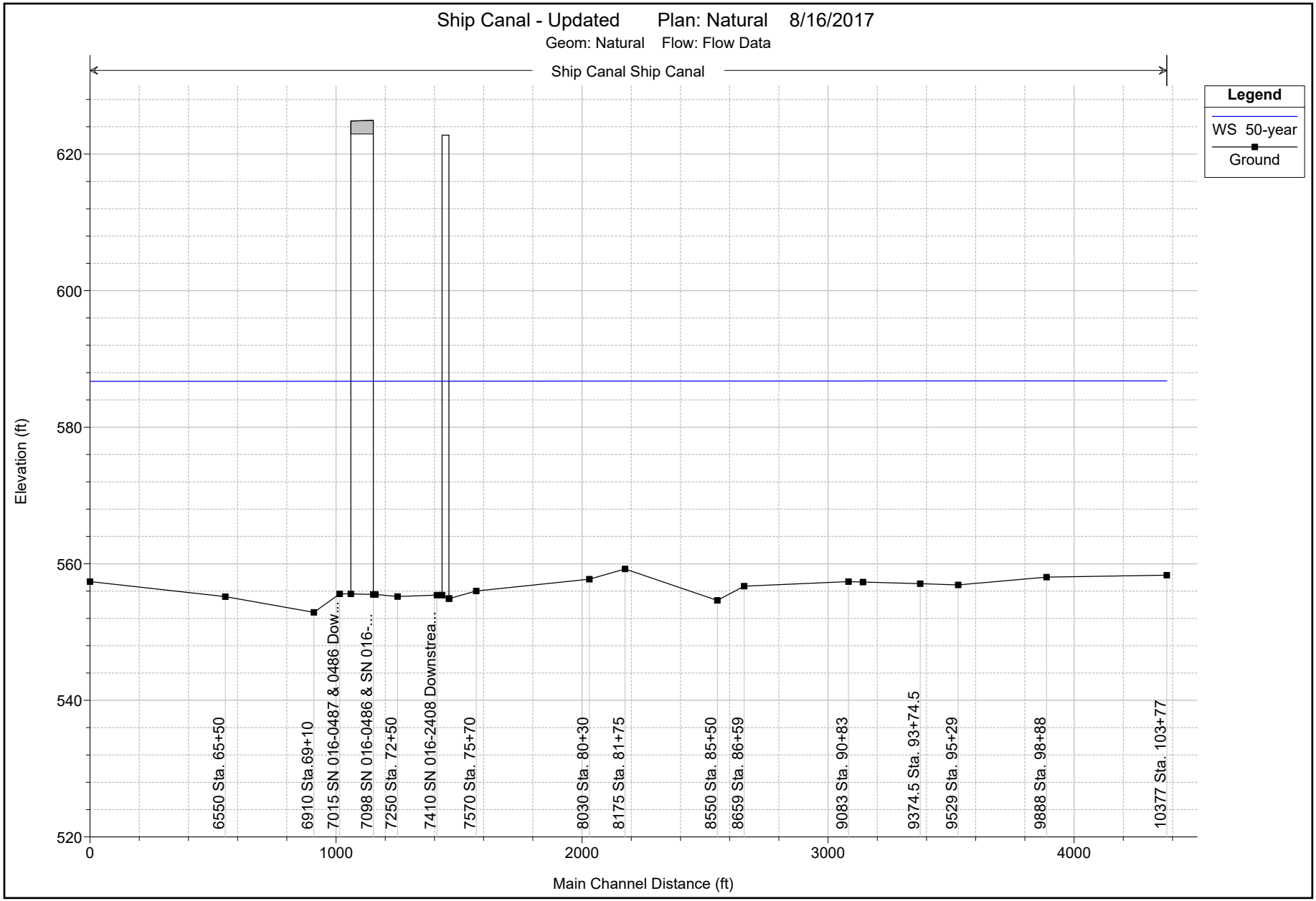
HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	10-year	583.72	583.68	0.04	0.01	0.00	7.28	8489.41	3.31	285.28
Ship Canal	9888	10-year	583.71	583.67	0.04	0.01	0.00	6.03	8481.08	12.88	311.35
Ship Canal	9529	10-year	583.70	583.67	0.03	0.00	0.00	3.07	8494.15	2.78	303.41
Ship Canal	9374.5	10-year	583.70	583.67	0.03	0.00	0.00	2.84	8490.89	6.27	316.36
Ship Canal	9141.67	10-year	583.69	583.66	0.03	0.00	0.00	2.58	8480.92	16.50	337.81
Ship Canal	9083	10-year	583.69	583.66	0.03	0.01	0.00	2.52	8477.08	20.40	343.61
Ship Canal	8659	10-year	583.69	583.66	0.03	0.00	0.00	5.25	8486.18	8.57	318.96
Ship Canal	8550	10-year	583.68	583.66	0.02	0.00	0.00	7.53	8484.92	7.54	329.92
Ship Canal	8175	10-year	583.68	583.65	0.03	0.00	0.00	3.80	8490.06	6.14	325.77
Ship Canal	8030	10-year	583.68	583.65	0.03	0.01	0.00	6.70	8478.94	14.36	316.35
Ship Canal	7570	10-year	583.67	583.64	0.03	0.00	0.00	9.91	8481.59	8.50	328.25
Ship Canal	7460	10-year	583.67	583.63	0.03	0.00	0.00	10.27	8478.92	10.81	278.91
Ship Canal	7459		Bridge								
Ship Canal	7410	10-year	583.67	583.63	0.04	0.00	0.01	14.07	8467.37	18.57	266.56
Ship Canal	7250	10-year	583.66	583.63	0.02	0.00	0.00	4.37	8488.29	7.33	326.36
Ship Canal	7160	10-year	583.66	583.63	0.02	0.00	0.00	3.15	8493.53	3.32	309.23
Ship Canal	7098		Bridge								
Ship Canal	7015	10-year	583.65	583.62	0.04	0.00	0.00	8.62	8477.92	13.46	307.90
Ship Canal	6910	10-year	583.65	583.63	0.02	0.00	0.00	4.58	8491.07	4.35	321.26
Ship Canal	6550	10-year	583.64	583.62	0.02	0.01	0.00	16.46	8477.30	6.24	345.01
Ship Canal	6000	10-year	583.64	583.61	0.03			16.95	8472.76	10.29	339.59

Errors Warnings and Notes for Plan : Natural

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

50-Year Natural


Ship Canal - Updated Plan: Natural 8/16/2017
Geom: Natural Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 50-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9374.5 Sta. 93+74.5
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	50-year	11300.00	558.33	586.79	565.19	586.84	0.000021	1.84	6283.30	295.27	0.07
Ship Canal	9888	50-year	11300.00	558.04	586.78	564.66	586.83	0.000020	1.76	6594.13	321.92	0.07
Ship Canal	9529	50-year	11300.00	556.91	586.78	563.86	586.82	0.000019	1.71	6684.58	311.09	0.06
Ship Canal	9374.5	50-year	11300.00	557.08	586.78	564.41	586.82	0.000018	1.68	6850.99	324.80	0.06
Ship Canal	9141.67	50-year	11300.00	557.33	586.77	565.33	586.81	0.000018	1.63	7116.16	347.65	0.06
Ship Canal	9083	50-year	11300.00	557.39	586.77	565.52	586.81	0.000017	1.62	7186.73	353.84	0.06
Ship Canal	8659	50-year	11300.00	556.71	586.76	563.45	586.81	0.000017	1.64	7073.33	329.40	0.06
Ship Canal	8550	50-year	11300.00	554.64	586.77	561.44	586.80	0.000011	1.43	8117.62	344.16	0.05
Ship Canal	8175	50-year	11300.00	559.23	586.76	564.51	586.80	0.000015	1.57	7361.30	358.18	0.06
Ship Canal	8030	50-year	11300.00	557.74	586.75	563.34	586.79	0.000016	1.64	7118.97	332.45	0.06
Ship Canal	7570	50-year	11300.00	556.01	586.75	562.72	586.79	0.000014	1.54	7552.54	343.39	0.05
Ship Canal	7460	50-year	11300.00	554.91	586.74	562.26	586.78	0.000025	1.72	6777.79	292.39	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	50-year	11300.00	555.41	586.73	562.25	586.78	0.000030	1.87	6302.16	285.25	0.06
Ship Canal	7250	50-year	11300.00	555.21	586.74	561.55	586.77	0.000011	1.42	8104.48	337.74	0.05
Ship Canal	7160	50-year	11300.00	555.50	586.74	561.19	586.77	0.000018	1.45	7876.63	315.13	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	50-year	11300.00	555.60	586.72	562.74	586.76	0.000027	1.74	6700.56	321.11	0.06
Ship Canal	6910	50-year	11300.00	552.89	586.73	560.18	586.76	0.000009	1.37	8410.31	330.87	0.05
Ship Canal	6550	50-year	11300.00	555.19	586.72	561.97	586.75	0.000012	1.47	8001.96	364.81	0.05
Ship Canal	6000	50-year	11300.00	557.39	586.71	563.34	586.75	0.000013	1.54	7693.06	372.56	0.05

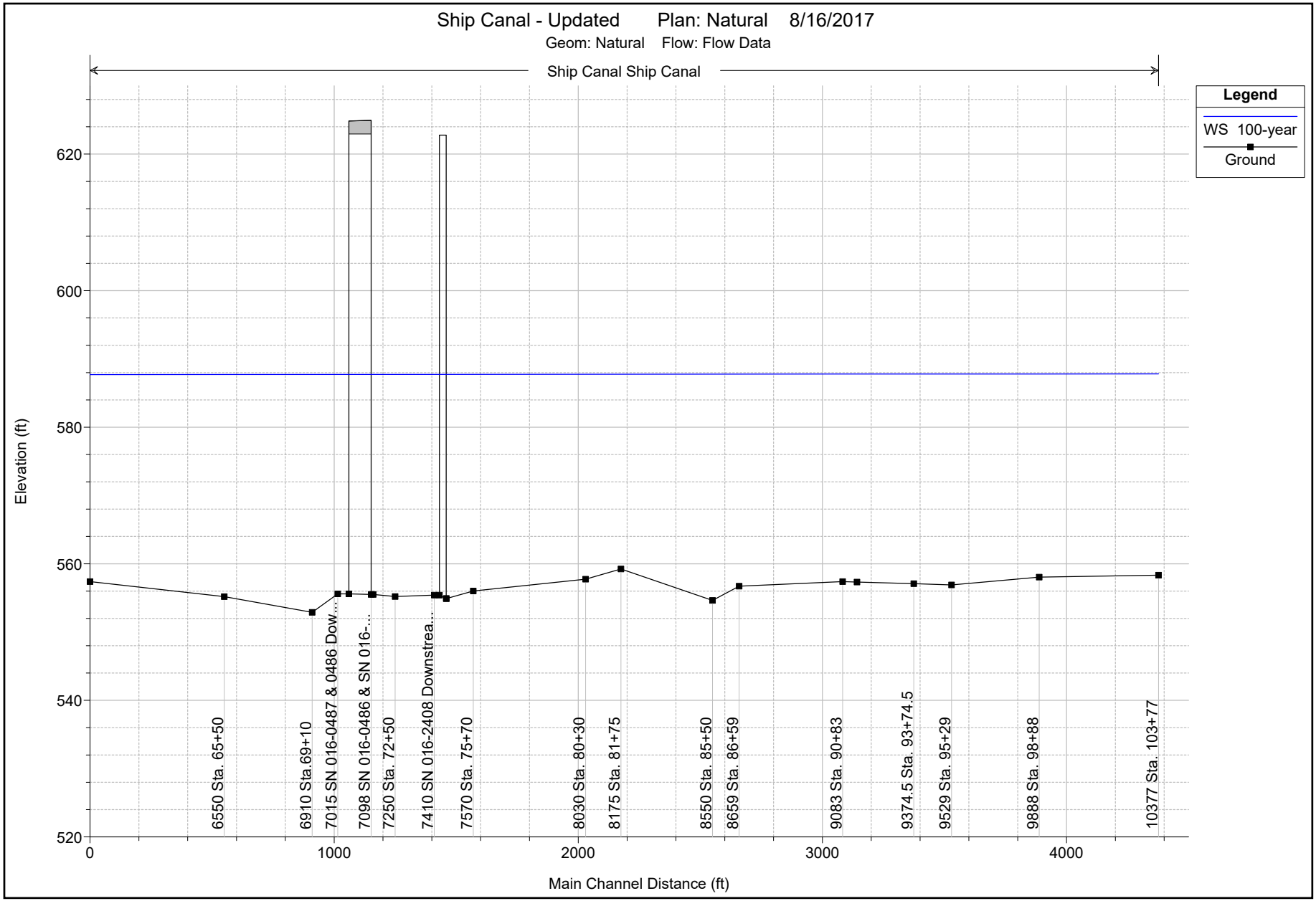
HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	50-year	586.84	586.79	0.05	0.01	0.00	21.61	11268.29	10.10	295.27
Ship Canal	9888	50-year	586.83	586.78	0.05	0.01	0.00	17.78	11250.38	31.85	321.92
Ship Canal	9529	50-year	586.82	586.78	0.05	0.00	0.00	9.31	11281.33	9.36	311.09
Ship Canal	9374.5	50-year	586.82	586.78	0.04	0.00	0.00	8.63	11273.97	17.39	324.80
Ship Canal	9141.67	50-year	586.81	586.77	0.04	0.00	0.00	7.84	11254.51	37.65	347.65
Ship Canal	9083	50-year	586.81	586.77	0.04	0.01	0.00	7.67	11247.55	44.78	353.84
Ship Canal	8659	50-year	586.81	586.76	0.04	0.00	0.00	16.25	11260.19	23.57	329.40
Ship Canal	8550	50-year	586.80	586.77	0.03	0.00	0.00	21.11	11257.77	21.13	344.16
Ship Canal	8175	50-year	586.80	586.76	0.04	0.00	0.00	11.68	11269.85	18.46	358.18
Ship Canal	8030	50-year	586.79	586.75	0.04	0.01	0.00	18.44	11242.03	39.53	332.45
Ship Canal	7570	50-year	586.79	586.75	0.04	0.00	0.00	27.29	11249.29	23.41	343.39
Ship Canal	7460	50-year	586.78	586.74	0.05	0.00	0.00	29.36	11239.74	30.90	292.39
Ship Canal	7459		Bridge								
Ship Canal	7410	50-year	586.78	586.73	0.05	0.00	0.01	40.38	11206.33	53.29	285.25
Ship Canal	7250	50-year	586.77	586.74	0.03	0.00	0.00	12.23	11267.28	20.50	337.74
Ship Canal	7160	50-year	586.77	586.74	0.03	0.00	0.00	8.96	11281.58	9.46	315.13
Ship Canal	7098		Bridge								
Ship Canal	7015	50-year	586.76	586.72	0.05	0.00	0.01	23.93	11238.74	37.33	321.11
Ship Canal	6910	50-year	586.76	586.73	0.03	0.00	0.00	12.90	11274.84	12.27	330.87
Ship Canal	6550	50-year	586.75	586.72	0.03	0.01	0.00	45.60	11237.10	17.30	364.81
Ship Canal	6000	50-year	586.75	586.71	0.04			44.98	11226.58	28.44	372.56

Errors Warnings and Notes for Plan : Natural

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

100-Year Natural


Ship Canal - Updated Plan: Natural 8/16/2017
Geom: Natural Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 100-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9374.5 Sta. 93+74.5
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	100-year	12800.00	558.33	587.80	565.64	587.86	0.000024	1.99	6583.56	301.81	0.07
Ship Canal	9888	100-year	12800.00	558.04	587.79	565.13	587.85	0.000023	1.91	6920.73	324.97	0.07
Ship Canal	9529	100-year	12800.00	556.91	587.79	564.33	587.84	0.000021	1.86	6999.82	313.66	0.07
Ship Canal	9374.5	100-year	12800.00	557.08	587.79	564.91	587.84	0.000020	1.82	7180.16	327.59	0.07
Ship Canal	9141.67	100-year	12800.00	557.33	587.78	565.79	587.83	0.000019	1.76	7468.58	350.85	0.06
Ship Canal	9083	100-year	12800.00	557.39	587.78	565.96	587.83	0.000019	1.75	7545.46	357.15	0.06
Ship Canal	8659	100-year	12800.00	556.71	587.77	563.94	587.82	0.000019	1.78	7407.00	332.79	0.06
Ship Canal	8550	100-year	12800.00	554.64	587.78	561.82	587.82	0.000012	1.56	8467.07	348.78	0.05
Ship Canal	8175	100-year	12800.00	559.23	587.77	564.89	587.81	0.000017	1.71	7726.35	366.88	0.06
Ship Canal	8030	100-year	12800.00	557.74	587.76	563.78	587.81	0.000018	1.79	7456.04	337.67	0.06
Ship Canal	7570	100-year	12800.00	556.01	587.75	563.17	587.80	0.000015	1.68	7900.36	348.29	0.06
Ship Canal	7460	100-year	12800.00	554.91	587.74	562.71	587.79	0.000029	1.87	7073.41	296.75	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	100-year	12800.00	555.41	587.73	562.77	587.79	0.000034	2.04	6590.86	291.28	0.07
Ship Canal	7250	100-year	12800.00	555.21	587.74	561.98	587.78	0.000012	1.55	8445.43	341.43	0.05
Ship Canal	7160	100-year	12800.00	555.50	587.74	561.63	587.78	0.000020	1.58	8193.85	317.04	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	100-year	12800.00	555.60	587.72	563.25	587.77	0.000031	1.88	7024.09	325.38	0.07
Ship Canal	6910	100-year	12800.00	552.89	587.73	560.60	587.77	0.000011	1.49	8743.56	333.97	0.05
Ship Canal	6550	100-year	12800.00	555.19	587.72	562.40	587.76	0.000013	1.60	8370.50	371.20	0.05
Ship Canal	6000	100-year	12800.00	557.39	587.71	563.71	587.75	0.000015	1.67	8071.27	383.86	0.06

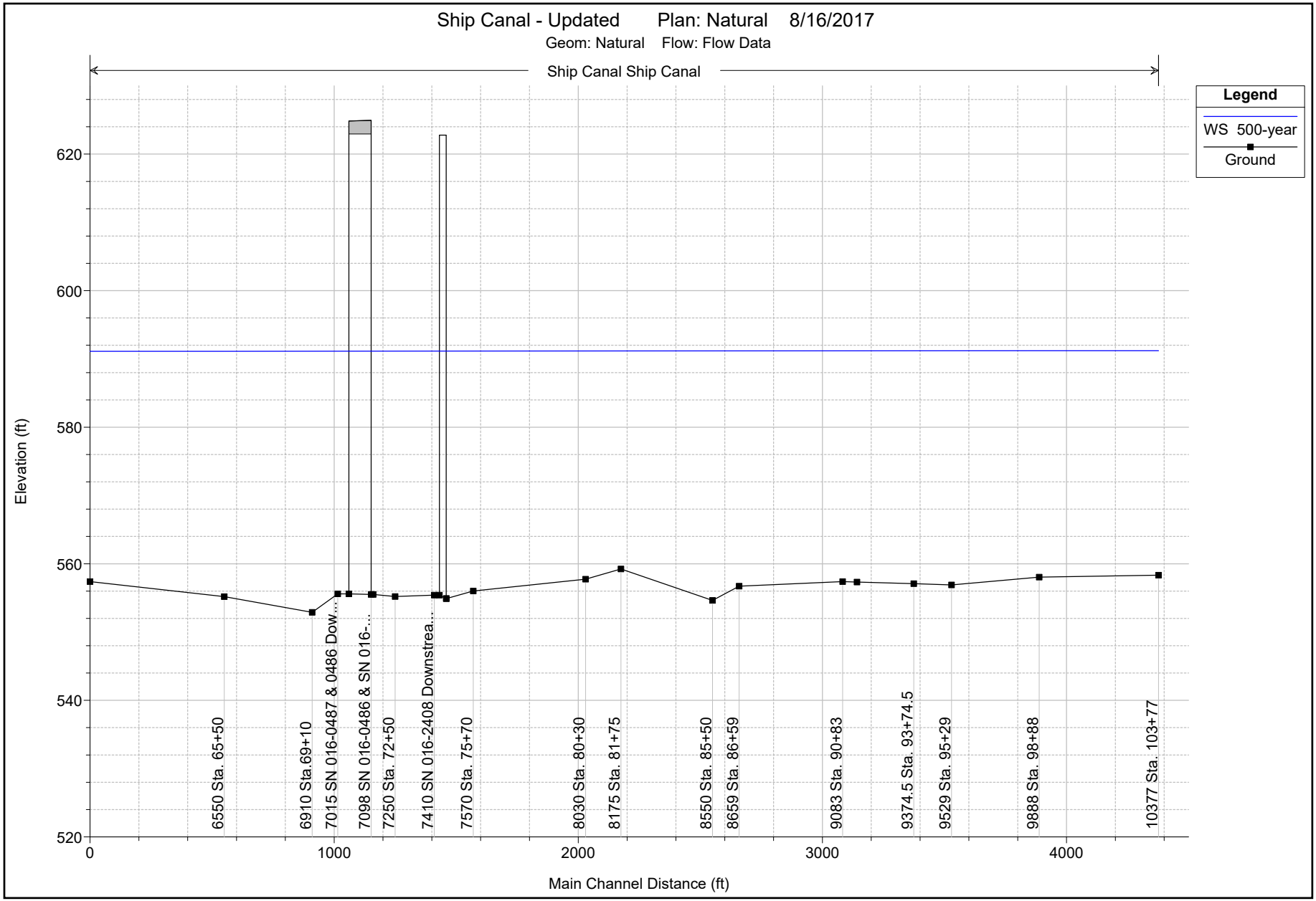
HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	100-year	587.86	587.80	0.06	0.01	0.00	27.49	12758.51	14.00	301.81
Ship Canal	9888	100-year	587.85	587.79	0.06	0.01	0.00	24.42	12733.43	42.15	324.97
Ship Canal	9529	100-year	587.84	587.79	0.05	0.00	0.00	12.87	12773.93	13.20	313.66
Ship Canal	9374.5	100-year	587.84	587.79	0.05	0.00	0.00	11.92	12764.47	23.61	327.59
Ship Canal	9141.67	100-year	587.83	587.78	0.05	0.00	0.00	10.83	12740.15	49.02	350.85
Ship Canal	9083	100-year	587.83	587.78	0.05	0.01	0.00	10.60	12731.61	57.80	357.15
Ship Canal	8659	100-year	587.82	587.77	0.05	0.00	0.00	22.56	12745.87	31.57	332.79
Ship Canal	8550	100-year	587.82	587.78	0.04	0.01	0.00	28.78	12742.41	28.81	348.78
Ship Canal	8175	100-year	587.81	587.77	0.05	0.00	0.00	16.19	12754.35	29.45	366.88
Ship Canal	8030	100-year	587.81	587.76	0.05	0.01	0.00	25.01	12721.37	53.62	337.67
Ship Canal	7570	100-year	587.80	587.75	0.04	0.00	0.00	37.04	12731.19	31.77	348.29
Ship Canal	7460	100-year	587.79	587.74	0.05	0.00	0.00	40.28	12717.34	42.39	296.75
Ship Canal	7459		Bridge								
Ship Canal	7410	100-year	587.79	587.73	0.06	0.00	0.01	55.44	12671.39	73.17	291.28
Ship Canal	7250	100-year	587.78	587.74	0.04	0.00	0.00	16.65	12755.42	27.92	341.43
Ship Canal	7160	100-year	587.78	587.74	0.04	0.00	0.00	12.29	12774.75	12.97	317.04
Ship Canal	7098		Bridge								
Ship Canal	7015	100-year	587.77	587.72	0.05	0.00	0.01	32.54	12716.67	50.78	325.38
Ship Canal	6910	100-year	587.77	587.73	0.03	0.00	0.00	17.61	12765.64	16.75	333.97
Ship Canal	6550	100-year	587.76	587.72	0.04	0.01	0.00	61.95	12714.55	23.50	371.20
Ship Canal	6000	100-year	587.75	587.71	0.04			62.47	12698.93	38.60	383.86

Errors Warnings and Notes for Plan : Natural

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.

500-Year Natural


Ship Canal - Updated Plan: Natural 8/16/2017
Geom: Natural Flow: Flow Data
Ship Canal Ship Canal
Legend
WS 500-year
Ground
Elevation (ft)
620
600
580
560
540
520
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 0486 Dow...
7098 SN 016-0486 & SN 016-...
7250 Sta. 72+50
7410 SN 016-2408 Downstrea...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9374.5 Sta. 93+74.5
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	500-year	16100.00	558.33	591.21	566.56	591.28	0.000024	2.19	7643.32	319.23	0.07
Ship Canal	9888	500-year	16100.00	558.04	591.20	566.08	591.27	0.000023	2.09	8045.00	335.25	0.07
Ship Canal	9529	500-year	16100.00	556.91	591.19	565.33	591.26	0.000021	2.04	8082.87	322.33	0.07
Ship Canal	9374.5	500-year	16100.00	557.08	591.19	565.93	591.25	0.000020	1.99	8312.07	337.02	0.07
Ship Canal	9141.67	500-year	16100.00	557.33	591.19	566.69	591.25	0.000019	1.93	8682.62	361.98	0.07
Ship Canal	9083	500-year	16100.00	557.39	591.19	566.84	591.25	0.000019	1.91	8781.28	367.87	0.07
Ship Canal	8659	500-year	16100.00	556.71	591.18	564.87	591.24	0.000019	1.96	8559.92	345.41	0.07
Ship Canal	8550	500-year	16100.00	554.64	591.19	562.69	591.23	0.000013	1.74	9681.72	364.37	0.06
Ship Canal	8175	500-year	16100.00	559.23	591.17	565.67	591.23	0.000017	1.88	9036.27	402.09	0.06
Ship Canal	8030	500-year	16100.00	557.74	591.16	564.63	591.22	0.000018	1.97	8635.61	355.31	0.06
Ship Canal	7570	500-year	16100.00	556.01	591.16	564.08	591.21	0.000016	1.86	9126.06	389.57	0.06
Ship Canal	7460	500-year	16100.00	554.91	591.14	563.68	591.21	0.000035	2.07	8158.74	352.18	0.07
Ship Canal	7459		Bridge									
Ship Canal	7410	500-year	16100.00	555.41	591.13	563.73	591.21	0.000043	2.25	7666.00	352.81	0.08
Ship Canal	7250	500-year	16100.00	555.21	591.15	562.81	591.19	0.000013	1.73	9628.47	353.91	0.06
Ship Canal	7160	500-year	16100.00	555.50	591.14	562.53	591.19	0.000024	1.75	9365.98	376.63	0.06
Ship Canal	7098		Bridge									
Ship Canal	7015	500-year	16100.00	555.60	591.12	564.29	591.18	0.000035	2.05	8235.23	388.63	0.07
Ship Canal	6910	500-year	16100.00	552.89	591.13	561.46	591.18	0.000012	1.68	9900.04	352.77	0.05
Ship Canal	6550	500-year	16100.00	555.19	591.12	563.27	591.17	0.000014	1.77	9672.69	401.52	0.06
Ship Canal	6000	500-year	16100.00	557.39	591.11	564.44	591.16	0.000016	1.85	9488.07	455.45	0.06

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	500-year	591.28	591.21	0.07	0.01	0.00	66.26	16005.33	28.41	319.23
Ship Canal	9888	500-year	591.27	591.20	0.07	0.01	0.00	51.41	15969.65	78.94	335.25
Ship Canal	9529	500-year	591.26	591.19	0.06	0.00	0.00	27.78	16042.72	29.49	322.33
Ship Canal	9374.5	500-year	591.25	591.19	0.06	0.00	0.00	25.56	16026.09	48.35	337.02
Ship Canal	9141.67	500-year	591.25	591.19	0.06	0.00	0.00	23.10	15986.48	90.42	361.98
Ship Canal	9083	500-year	591.25	591.19	0.06	0.01	0.00	22.59	15972.15	105.26	367.87
Ship Canal	8659	500-year	591.24	591.18	0.06	0.00	0.00	47.57	15990.74	61.69	345.41
Ship Canal	8550	500-year	591.23	591.19	0.05	0.01	0.00	59.87	15980.20	59.93	364.37
Ship Canal	8175	500-year	591.23	591.17	0.05	0.00	0.00	34.85	15979.58	85.57	402.09
Ship Canal	8030	500-year	591.22	591.16	0.06	0.01	0.00	51.29	15938.75	109.96	355.31
Ship Canal	7570	500-year	591.21	591.16	0.05	0.00	0.00	79.51	15955.23	65.26	389.57
Ship Canal	7460	500-year	591.21	591.14	0.07	0.00	0.00	89.98	15915.34	94.69	352.18
Ship Canal	7459		Bridge								
Ship Canal	7410	500-year	591.21	591.13	0.08	0.00	0.01	124.65	15811.62	163.73	352.81
Ship Canal	7250	500-year	591.19	591.15	0.05	0.00	0.00	34.63	16007.32	58.05	353.91
Ship Canal	7160	500-year	591.19	591.14	0.05	0.00	0.00	24.86	16050.73	24.41	376.63
Ship Canal	7098		Bridge								
Ship Canal	7015	500-year	591.18	591.12	0.06	0.00	0.01	67.71	15930.37	101.92	388.63
Ship Canal	6910	500-year	591.18	591.13	0.04	0.00	0.00	36.97	16031.37	31.66	352.77
Ship Canal	6550	500-year	591.17	591.12	0.05	0.01	0.00	127.89	15926.22	45.89	401.52
Ship Canal	6000	500-year	591.16	591.11	0.05			142.13	15882.06	75.81	455.45

Errors Warnings and Notes for Plan : Natural

Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream
	energy. The program defaulted to the next valid (user selected) method. If the Yarnell method
	was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the
	downstream energy. This is not physically possible, the momentum answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7
	or greater than 1.4. This may indicate the need for additional cross sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water
	surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 6910 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: Ship Canal Reach: Ship Canal RS: 6550 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 6000 Profile: 500-year
Warning:	Divided flow computed for this cross-section.

Structure Tables

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Ship Canal	7459	10-year	583.67	622.42	20362.21		8500.00	617.49		0.00	
Ship Canal	7459	50-year	586.78	622.42	20362.21		11300.00	617.49		0.00	
Ship Canal	7459	100-year	587.79	622.42	20362.21		12800.00	617.49		0.00	
Ship Canal	7459	200-year	589.35	622.42	20362.21		14200.00	617.49		0.00	
Ship Canal	7459	500-year	591.21	622.42	20362.21		16100.00	617.49		0.00	
Ship Canal	7098	10-year	583.66	622.92	22774.72		8500.00	624.96		0.00	
Ship Canal	7098	50-year	586.77	622.92	22774.72		11300.00	624.96		0.00	
Ship Canal	7098	100-year	587.78	622.92	22774.72		12800.00	624.96		0.01	
Ship Canal	7098	200-year	589.33	622.92	22774.72		14200.00	624.96		0.01	
Ship Canal	7098	500-year	591.19	622.92	22774.72		16100.00	624.96		0.01	

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Ship Canal	7459	10-year	583.67	583.63	Energy only	583.67			583.66			
Ship Canal	7459	50-year	586.78	586.74	Energy only	586.78			586.78			
Ship Canal	7459	100-year	587.79	587.74	Energy only	587.79			587.79			
Ship Canal	7459	200-year	589.35	589.29	Energy only	589.35			589.34			
Ship Canal	7459	500-year	591.21	591.14	Energy only	591.21			591.20			
Ship Canal	7098	10-year	583.66	583.63	Energy only	583.66			583.66			
Ship Canal	7098	50-year	586.77	586.74	Energy only	586.77			586.77			
Ship Canal	7098	100-year	587.78	587.74	Energy only	587.78			587.78			
Ship Canal	7098	200-year	589.33	589.29	Energy only	589.33			589.33			
Ship Canal	7098	500-year	591.19	591.14	Energy only	591.19			591.19			

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7570	10-year	583.67	583.64	561.79	0.00	0.00	328.25	9.91	8481.59	8.50	1.33
Ship Canal	7570	50-year	586.79	586.75	562.72	0.00	0.00	343.39	27.29	11249.29	23.41	1.54
Ship Canal	7570	100-year	587.80	587.75	563.17	0.00	0.00	348.29	37.04	12731.19	31.77	1.68
Ship Canal	7570	200-year	589.35	589.31	563.56	0.00	0.00	355.86	52.41	14102.62	44.97	1.75
Ship Canal	7570	500-year	591.21	591.16	564.08	0.00	0.00	389.57	79.51	15955.23	65.26	1.86
Ship Canal	7460	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7460	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72
Ship Canal	7460	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7460	200-year	589.35	589.29	563.14	0.00	0.00	303.48	57.95	14081.08	60.98	1.96
Ship Canal	7460	500-year	591.21	591.14	563.68	0.00	0.00	352.18	89.98	15915.34	94.69	2.07
Ship Canal	7459 BR U	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7459 BR U	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72
Ship Canal	7459 BR U	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7459 BR U	200-year	589.35	589.29	563.14	0.00	0.00	303.48	57.95	14081.08	60.98	1.96
Ship Canal	7459 BR U	500-year	591.21	591.14	563.68	0.00	0.00	344.18	89.73	15915.85	94.42	2.07
Ship Canal	7459 BR D	10-year	583.67	583.63	561.30	0.00	0.00	266.56	14.07	8467.36	18.57	1.60
Ship Canal	7459 BR D	50-year	586.78	586.73	562.25	0.00	0.00	285.25	40.39	11206.32	53.30	1.87
Ship Canal	7459 BR D	100-year	587.79	587.73	562.77	0.00	0.00	291.29	55.45	12671.38	73.18	2.04
Ship Canal	7459 BR D	200-year	589.35	589.28	563.22	0.00	0.00	300.63	79.87	14014.72	105.41	2.14
Ship Canal	7459 BR D	500-year	591.21	591.13	563.73	0.00	0.00	344.82	124.28	15812.48	163.24	2.26
Ship Canal	7410	10-year	583.67	583.63	561.30	0.00	0.01	266.56	14.07	8467.37	18.57	1.60
Ship Canal	7410	50-year	586.78	586.73	562.25	0.00	0.01	285.25	40.38	11206.33	53.29	1.87
Ship Canal	7410	100-year	587.79	587.73	562.77	0.00	0.01	291.28	55.44	12671.39	73.17	2.04
Ship Canal	7410	200-year	589.35	589.28	563.22	0.00	0.01	300.62	79.86	14014.74	105.40	2.14
Ship Canal	7410	500-year	591.21	591.13	563.73	0.00	0.01	352.81	124.65	15811.62	163.73	2.25
Ship Canal	7250	10-year	583.66	583.63	560.69	0.00	0.00	326.36	4.37	8488.29	7.33	1.22
Ship Canal	7250	50-year	586.77	586.74	561.55	0.00	0.00	337.74	12.23	11267.28	20.50	1.42
Ship Canal	7250	100-year	587.78	587.74	561.98	0.00	0.00	341.43	16.65	12755.42	27.92	1.55
Ship Canal	7250	200-year	589.34	589.30	562.35	0.00	0.00	347.12	23.71	14136.55	39.75	1.63
Ship Canal	7250	500-year	591.19	591.15	562.81	0.00	0.00	353.91	34.63	16007.32	58.05	1.73

HEC-RAS Plan: Natural River: Ship Canal Reach: Ship Canal (Continued)

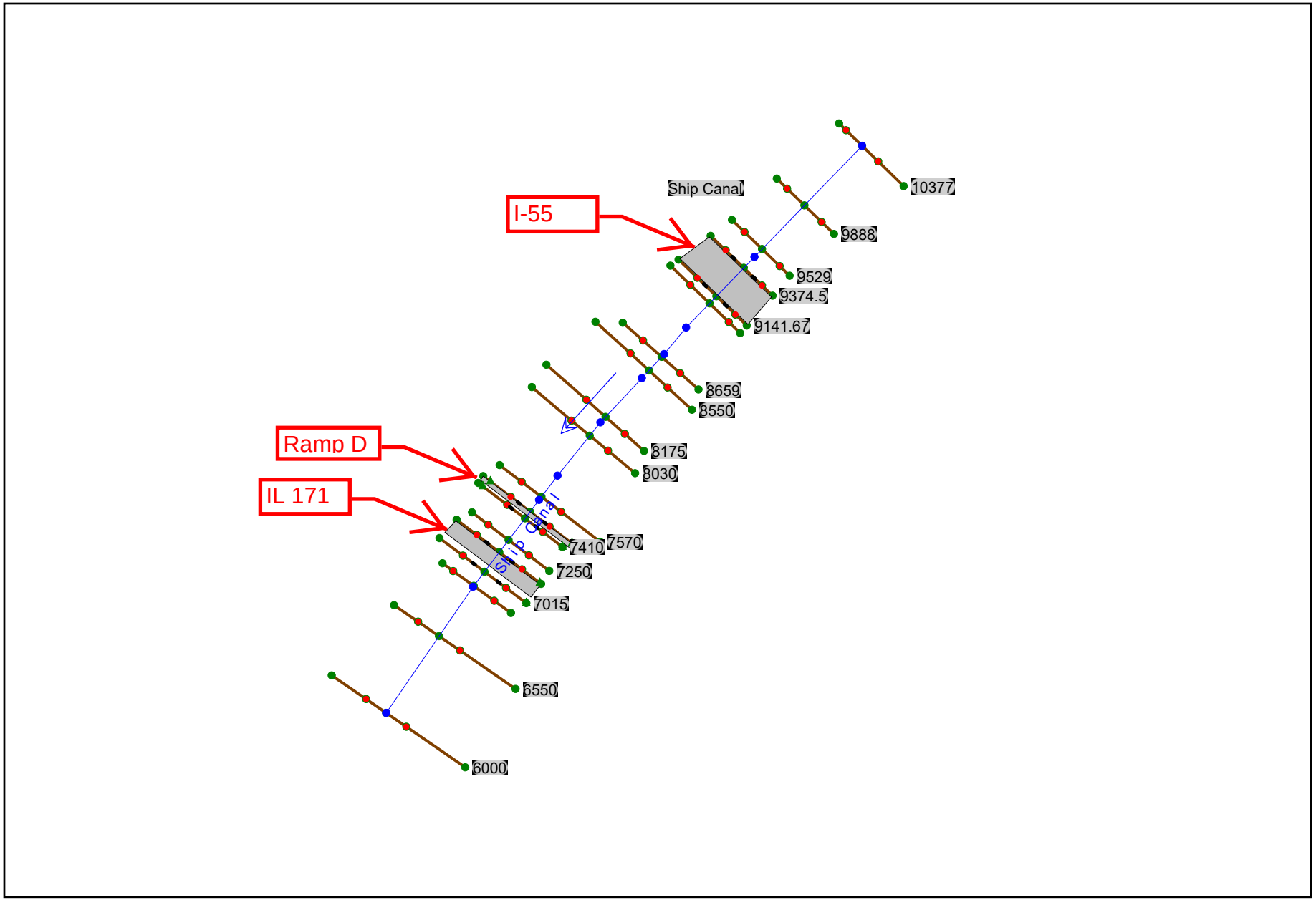
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7160	10-year	583.66	583.63	560.30	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7160	50-year	586.77	586.74	561.19	0.00	0.00	315.13	8.96	11281.58	9.46	1.45
Ship Canal	7160	100-year	587.78	587.74	561.63	0.00	0.00	317.04	12.29	12774.75	12.97	1.58
Ship Canal	7160	200-year	589.33	589.29	562.01	0.00	0.00	340.32	18.20	14162.59	19.21	1.66
Ship Canal	7160	500-year	591.19	591.14	562.53	0.00	0.00	376.63	24.86	16050.73	24.41	1.75
Ship Canal	7098 BR U	10-year	583.66	583.63	560.31	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7098 BR U	50-year	586.77	586.74	561.19	0.00	0.00	312.94	8.96	11281.94	9.10	1.45
Ship Canal	7098 BR U	100-year	587.78	587.74	561.63	0.00	0.00	313.88	12.29	12775.83	11.88	1.58
Ship Canal	7098 BR U	200-year	589.33	589.29	562.02	0.00	0.00	332.63	18.19	14165.76	16.04	1.66
Ship Canal	7098 BR U	500-year	591.19	591.14	562.53	0.00	0.00	361.88	26.79	16051.43	21.78	1.76
Ship Canal	7098 BR D	10-year	583.65	583.62	561.69	0.00	0.00	304.15	8.63	8483.74	7.62	1.51
Ship Canal	7098 BR D	50-year	586.77	586.72	562.74	0.00	0.00	317.37	23.97	11255.64	20.40	1.74
Ship Canal	7098 BR D	100-year	587.78	587.72	563.25	0.00	0.00	321.64	32.61	12739.50	27.89	1.89
Ship Canal	7098 BR D	200-year	589.33	589.27	563.70	0.00	0.00	361.65	49.05	14108.44	42.51	1.96
Ship Canal	7098 BR D	500-year	591.19	591.12	564.30	0.00	0.00	377.65	68.13	15972.26	59.61	2.06
Ship Canal	7015	10-year	583.65	583.62	561.69	0.00	0.00	307.90	8.62	8477.92	13.46	1.51
Ship Canal	7015	50-year	586.76	586.72	562.74	0.00	0.01	321.11	23.93	11238.74	37.33	1.74
Ship Canal	7015	100-year	587.77	587.72	563.25	0.00	0.01	325.38	32.54	12716.67	50.78	1.88
Ship Canal	7015	200-year	589.33	589.27	563.71	0.00	0.01	372.65	49.48	14073.32	77.21	1.96
Ship Canal	7015	500-year	591.18	591.12	564.29	0.00	0.01	388.63	67.71	15930.37	101.92	2.05
Ship Canal	6910	10-year	583.65	583.63	559.34	0.00	0.00	321.26	4.58	8491.07	4.35	1.16
Ship Canal	6910	50-year	586.76	586.73	560.18	0.00	0.00	330.87	12.90	11274.84	12.27	1.37
Ship Canal	6910	100-year	587.77	587.73	560.60	0.00	0.00	333.97	17.61	12765.64	16.75	1.49
Ship Canal	6910	200-year	589.32	589.28	560.98	0.00	0.00	338.77	25.16	14150.91	23.93	1.57
Ship Canal	6910	500-year	591.18	591.13	561.46	0.00	0.00	352.77	36.97	16031.37	31.66	1.68

TAB D

SECTION 13.D

PROPOSED CONDITIONS

Proposed Conditions
HEC-RAS Geometry



HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: Ship Canal - Updated
Project File : ShipCanal-Update.prj
Run Date and Time: 11/15/2017 9:05:58 AM

Project in English units

PLAN DATA

Plan Title: Proposed
Plan File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.p04

Geometry Title: Proposed
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g02

Flow Title : Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Plan Description:
Proposed conditions I-55 over CSSC extended existing pier lenghts per
prliminary proposed design.

Plan Summary Information:
Number of: Cross Sections = 19 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 3 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance

Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Flow Data
Flow File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.f01

Flow Data (cfs)

River	Reach	RS	10-year	50-year	100-year	200-year	500-year
Ship Canal	Ship Canal	10377	8500	11300	12800	14200	16100
Ship Canal	Ship Canal	8550	8500	11300	12800	14200	16100

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Ship Canal	Ship Canal	10-year		Known WS = 583.61
Ship Canal	Ship Canal	50-year		Known WS = 586.71
Ship Canal	Ship Canal	100-year		Known WS = 587.71
Ship Canal	Ship Canal	200-year		Known WS = 589.26
Ship Canal	Ship Canal	500-year		Known WS = 591.11

GEOMETRY DATA

Geometry Title: Proposed
Geometry File : n:\Idot\110203.00001\Drain\Model\I-55 over CSSC 5.0.3 Aug 2017\ShipCanal-Update.g02

CROSS SECTION

RIVER: Ship Canal
REACH: Ship Canal RS: 10377

INPUT
Description: Sta. 103+77
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-341.9	593.764	-188.09	592.696	-174.86	593.546	-161.82	588.031	-153.99	587.59
-132.57	577.194	-104	568.05	-103	567.35	-97	567.12	-87	564.38
-82	562.62	-81	562.74	-79	562.51	-70	562.35	-52	561.01

```
     -50  561.37     -30  560.02     -28  560.09       0  559.02       8   558.6
      16  558.58      42  558.33      57  558.67      66  559.56      68  560.66
      69   561.1      74  560.56      84  561.82      91  563.33     101   566.6
     103  567.64     105  568.88     111  571.63     114     573     116     574
  132.13 577.407  147.87 591.091  153.23 591.392  189.39 592.153

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -341.9     .08 -132.57     .03  132.13     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -132.57  132.13              489     489     489             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9888

INPUT
Description: Sta. 98+88
Station Elevation Data    num=      41
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -240.62 592.615 -223.22 593.176 -181.19 593.324 -165.84 591.908 -139.73 577.192
    -113  570.17    -109  570.99     -95  567.33     -84     565     -69  562.06
     -58  560.15     -56  560.66     -44  559.31     -41  559.57     -25  558.63
     -22  558.84      -8  558.33      -6  558.39       0  558.13       1  558.06
       2  558.09      13  558.18      15  558.12      20  558.04      32  558.05
      35  558.18      36  558.24      48  558.45      69  559.47      76  560.58
      91  563.04     106  571.26     108  573.65     109  573.61     113  573.52
  143.68 577.117  153.01 579.318  165.07 586.702174.2481 594.073214.0618  594.94
228.8899  595.05

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -240.62     .08 -139.73     .03  143.68     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -139.73  143.68              359     359     359             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9529

INPUT
Description: Sta. 95+29
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-221.006 599.645-176.763   594.6-159.566 594.543-149.072 585.989-139.364 577.379
-118.087  573.57-110.309   573.3-106.066  572.01 -96.167  568.66 -93.338  567.39
 -87.681  565.97 -82.024  564.84  -80.61  563.79 -66.468  560.89 -59.397  559.14
 -54.447     558 -44.548  557.34 -42.426  557.49  -26.87  556.97 -18.385  556.91
  -9.192  557.24       0  557.07   7.778  557.24  12.728  557.11  21.213  557.24
   26.87  556.94  47.376  558.28  52.326  558.43  59.397  559.19  70.711  561.12
  79.196  562.44  84.853  563.78  89.095  565.38  96.167  567.48 101.116  568.91
 109.602   570.9 116.673  569.71 120.915  570.59 125.158  570.42 149.532  578.04
 170.045 593.595 185.446 599.548 188.882  599.86 190.254  600.03 208.172 600.086
 251.772 601.122

Manning's n Values        num=       3
```

```
     Sta   n Val     Sta   n Val     Sta   n Val
-221.006     .08-139.364     .03 149.532     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -139.364 149.532           154.66  154.66  154.66             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9374.5

INPUT
Description: Sta. 93+74.5
SN 016-0014 & SN 016-0015 Upstream Bridge XS
HEC
             RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -236.05  600.11 -207.21   597.2  -189.3  595.51 -171.13  595.04 -166.66  592.68
 -160.04  586.87 -149.79   577.4 -148.55  577.19 -125.21  572.98 -124.62  572.92
 -119.54  572.91 -116.23   572.9 -114.46  572.63  -112.2  572.36 -111.33  572.19
 -109.94  571.91 -106.56  571.09  -99.89     569  -98.66  568.54  -96.62  567.71
  -95.83  567.47  -90.09  566.04  -89.06  565.82  -83.56  565.03  -81.92   564.3
   -78.9  563.86  -73.82  562.76  -71.57   562.4  -65.92  561.46  -65.59  561.41
  -57.42  559.84   -51.7  558.79  -41.09  557.84  -40.27   557.8  -37.82   557.9
   -37.7   557.9  -37.14   557.9  -28.11  557.42  -26.41  557.48  -20.77  557.15
  -19.85  557.16  -18.51   557.2  -14.56  557.12     -14  557.11  -10.05  557.08
   -1.37  557.34     1.9  557.32     7.3  557.26   11.46  557.33   14.65   557.4
   15.44   557.4   19.32  557.47   20.22  557.51    23.4  557.75   27.33  558.18
   27.38  558.18   32.66   558.2   34.55  558.36   43.31  559.01   52.02  559.57
   55.26  559.69   56.69  559.71   58.44  559.82   60.83  560.11   63.22  560.25
   63.36  560.27   66.41  560.77   71.19  561.58   74.04  561.97   82.05  563.01
   87.39  563.99   87.91  564.14    89.5  564.53   91.39  565.06   93.48  565.52
   98.07   566.5   98.26  566.54  102.24  567.17  102.74  567.31  107.02  568.35
  110.75  569.23  117.42  568.96  118.17  569.12  121.43   569.9  125.43  570.16
  128.53  571.12  131.71  572.03  142.86  575.16  148.44   576.7  173.11  591.84
  177.03  593.45  180.23  595.54  184.14   596.7  191.63  599.02  193.49   599.3
  195.76  599.43  197.41  599.55   197.9  599.55  218.97  599.31  221.98  599.31
  235.75  599.94  254.54  600.28  271.41  600.12

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -236.05     .08 -149.79     .03  148.44     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -149.79  148.44            232.7   232.7   232.7             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -95.038 -74.396 589.715  74.396  95.038 589.715

BRIDGE


RIVER: Ship Canal
REACH: Ship Canal         RS: 9266

INPUT
Description: SN 016-0014 & SN 016-0015 (EB & WB of I-55)
Distance from Upstream XS =      .1
Deck/Roadway Width        =  231.67
```

Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 45
Upstream Deck/Roadway Coordinates
num= 7

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-239.051	627.45	622.67	-205.191	628.11	618.44	-80.74	629.5	615.98
80.74	629.75	616.29	205.191	629.22	620.36	239.051	628.82	625.27
271.41	628.82							

Upstream Bridge Cross Section Data
Station Elevation Data num= 103

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-236.05	600.11	-207.21	597.2	-189.3	595.51	-171.13	595.04	-166.66	592.68
-160.04	586.87	-149.79	577.4	-148.55	577.19	-125.21	572.98	-124.62	572.92
-119.54	572.91	-116.23	572.9	-114.46	572.63	-112.2	572.36	-111.33	572.19
-109.94	571.91	-106.56	571.09	-99.89	569	-98.66	568.54	-96.62	567.71
-95.83	567.47	-90.09	566.04	-89.06	565.82	-83.56	565.03	-81.92	564.3
-78.9	563.86	-73.82	562.76	-71.57	562.4	-65.92	561.46	-65.59	561.41
-57.42	559.84	-51.7	558.79	-41.09	557.84	-40.27	557.8	-37.82	557.9
-37.7	557.9	-37.14	557.9	-28.11	557.42	-26.41	557.48	-20.77	557.15
-19.85	557.16	-18.51	557.2	-14.56	557.12	-14	557.11	-10.05	557.08
-1.37	557.34	1.9	557.32	7.3	557.26	11.46	557.33	14.65	557.4
15.44	557.4	19.32	557.47	20.22	557.51	23.4	557.75	27.33	558.18
27.38	558.18	32.66	558.2	34.55	558.36	43.31	559.01	52.02	559.57
55.26	559.69	56.69	559.71	58.44	559.82	60.83	560.11	63.22	560.25
63.36	560.27	66.41	560.77	71.19	561.58	74.04	561.97	82.05	563.01
87.39	563.99	87.91	564.14	89.5	564.53	91.39	565.06	93.48	565.52
98.07	566.5	98.26	566.54	102.24	567.17	102.74	567.31	107.02	568.35
110.75	569.23	117.42	568.96	118.17	569.12	121.43	569.9	125.43	570.16
128.53	571.12	131.71	572.03	142.86	575.16	148.44	576.7	173.11	591.84
177.03	593.45	180.23	595.54	184.14	596.7	191.63	599.02	193.49	599.3
195.76	599.43	197.41	599.55	197.9	599.55	218.97	599.31	221.98	599.31
235.75	599.94	254.54	600.28	271.41	600.12				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-236.05	.08	-149.79	.03	148.44	.08

Bank Sta: Left Right Coeff Contr. Expan.
-149.79 148.44 .1 .3
Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-95.038	-74.396	589.715	74.396	95.038	589.715

Downstream Deck/Roadway Coordinates
num= 8

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-258.68	626.85		-239.051	626.85	625.04	-205.191	627.48	620.29
-80.74	629.15	616.22	80.74	630.21	615.98	205.191	629.03	618.87
239.051	628.41	620.66	300.95	628.41				

Downstream Bridge Cross Section Data
Station Elevation Data num= 103

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-258.68	600.8	-227.52	598.2	-208.17	596.88	-188.53	595.79	-183.7	595.07
-176.55	588.19	-165.47	577.44	-163.98	577.19	-135.93	572.1	-135.22	571.98
-129.11	572.18	-125.13	572.31	-123	572.33	-120.29	572.54	-119.24	572.47
-117.58	572.36	-113.51	571.81	-105.5	569.52	-104.01	569.08	-101.57	568.19
-100.62	567.85	-93.71	566.16	-92.48	565.86	-85.86	565.32	-83.9	565.06
-80.27	564.76	-74.16	563.38	-71.45	563.07	-64.66	562.24	-64.26	562.18
-54.44	560.88	-47.57	559.98	-34.81	558.51	-33.83	558.5	-30.88	558.52
-30.74	558.51	-30.07	558.56	-19.21	557.74	-17.18	557.96	-10.39	557.38

```
   -9.28  557.45   -7.68  557.55   -2.93   557.4   -2.25  557.37     2.5  557.33
    10.4   557.5   13.37  557.54   18.29  557.54   22.07  557.57   24.98  557.65
    25.7  557.66   29.23     558   30.05  558.08   32.95  558.62   36.52   559.6
   36.57  559.61   41.38   560.1    43.1   560.3   51.08  561.02      59   561.5
   61.95  561.66   63.26  561.63   64.85  561.62   67.03  561.93    69.2  561.87
   69.33  561.89    72.1  562.31   76.45  563.04   79.06  563.26   86.35  563.86
   91.21  564.32   91.68  564.37   93.13  564.39   94.85  564.57   96.76  564.74
  100.93  565.03  101.11  565.05  104.73  564.79  105.18  564.91  109.08   565.9
  112.47  566.72  118.55  567.82  119.23  567.99   122.2  568.85  125.84  569.77
  128.66  570.64  131.56  571.32  141.71  573.59  146.79   574.7  177.72  589.19
  182.63  591.33  186.65  595.01  191.55  596.03  200.94  598.23  203.26  598.72
  206.12  598.77  208.19  598.82  208.79  598.82  235.21  598.14  238.98  598.05
  256.25  599.21  279.81  599.52  300.95  598.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -258.68     .08 -165.47     .03  146.79     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
       -165.47  146.79             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-95.0838-74.3962 589.715 74.3962 95.0838 589.715

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
 -239.05 622.844-189.553  595.53
Downstream     num=       2
     Sta    Elev     Sta    Elev
 -239.05  625.21-194.541  596.13

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
 199.905   599.5  239.05 625.436
Downstream     num=       2
     Sta    Elev     Sta    Elev
 198.491  597.67  239.05 620.831

Number of Piers =  4

Pier Data
Pier Station     Upstream=-205.191    Downstream=-205.191
Upstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 618.613
Downstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 620.456

Pier Data
```

```
Pier Station     Upstream=  -80.74    Downstream=  -80.74
Upstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.148
Downstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25  616.39

Pier Data
Pier Station     Upstream=   80.74    Downstream=   80.74
Upstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.461
Downstream     num=       4
    Width   Elev    Width   Elev    Width   Elev    Width   Elev
     5.5       0     5.5  564.79    4.25  581.26    4.25 616.151

Pier Data
Pier Station     Upstream= 205.191    Downstream= 205.191
Upstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25  620.53
Downstream     num=       2
    Width   Elev    Width   Elev
    4.25       0    4.25 619.043

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 627.45
       El of the toe of the abutment   = 600.11
    Right Embankment
       El of the top of the embankment = 628.82
       El of the toe of the abutment   = 600.01
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 212
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
```

```
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9141.67

INPUT
Description: Sta. 91+41.67
SN 016-0014 & SN 016-0015 Downstream Bridge XS
HEC
             RAS Interpolated
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -258.68   600.8 -227.52   598.2 -208.17  596.88 -188.53  595.79  -183.7  595.07
 -176.55  588.19 -165.47  577.44 -163.98  577.19 -135.93   572.1 -135.22  571.98
 -129.11  572.18 -125.13  572.31    -123  572.33 -120.29  572.54 -119.24  572.47
 -117.58  572.36 -113.51  571.81  -105.5  569.52 -104.01  569.08 -101.57  568.19
 -100.62  567.85  -93.71  566.16  -92.48  565.86  -85.86  565.32   -83.9  565.06
  -80.27  564.76  -74.16  563.38  -71.45  563.07  -64.66  562.24  -64.26  562.18
  -54.44  560.88  -47.57  559.98  -34.81  558.51  -33.83   558.5  -30.88  558.52
  -30.74  558.51  -30.07  558.56  -19.21  557.74  -17.18  557.96  -10.39  557.38
   -9.28  557.45   -7.68  557.55   -2.93   557.4   -2.25  557.37     2.5  557.33
    10.4   557.5   13.37  557.54   18.29  557.54   22.07  557.57   24.98  557.65
    25.7  557.66   29.23     558   30.05  558.08   32.95  558.62   36.52   559.6
   36.57  559.61   41.38   560.1    43.1   560.3   51.08  561.02      59   561.5
   61.95  561.66   63.26  561.63   64.85  561.62   67.03  561.93    69.2  561.87
   69.33  561.89    72.1  562.31   76.45  563.04   79.06  563.26   86.35  563.86
   91.21  564.32   91.68  564.37   93.13  564.39   94.85  564.57   96.76  564.74
  100.93  565.03  101.11  565.05  104.73  564.79  105.18  564.91  109.08   565.9
  112.47  566.72  118.55  567.82  119.23  567.99   122.2  568.85  125.84  569.77
  128.66  570.64  131.56  571.32  141.71  573.59  146.79   574.7  177.72  589.19
  182.63  591.33  186.65  595.01  191.55  596.03  200.94  598.23  203.26  598.72
  206.12  598.77  208.19  598.82  208.79  598.82  235.21  598.14  238.98  598.05
  256.25  599.21  279.81  599.52  300.95  598.61

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -258.68     .08 -165.47     .03  146.79     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -165.47  146.79            58.64   58.64   58.64             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-95.0838-74.3962 589.715 74.3962 95.0838 589.715

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 9083

INPUT
Description: Sta. 90+83
Station Elevation Data    num=      62
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -264.38  600.98-232.638  598.45-187.998  595.67-169.423  577.45-167.874  577.19
-137.886  571.74-131.522  571.99-125.158  572.25-122.329  572.58-119.501  572.48
-115.258  571.99-105.359  569.22-101.823  567.95 -93.338  565.87  -80.61  564.99
```

```
 -74.246  563.54 -71.418  563.24 -64.347  562.43 -33.234  558.68 -28.991  558.67
 -28.284  558.72 -16.971  557.82 -14.849  558.08  -7.778  557.44   -4.95  557.64
       0  557.47    .707  557.44   5.657  557.39  16.263  557.59  24.749  557.63
  28.284  557.73  32.527  558.23  35.355  558.84  38.891  559.97  45.255  560.79
  53.033  561.53   63.64  562.16  66.468  562.07  68.589  562.39  70.711  562.28
  73.539   562.7  77.782  563.41  92.631  564.43  94.045  564.36  97.581  564.54
 101.823  564.67 105.359  564.19 109.602  565.28 119.501   567.7 128.693  570.52
 131.522  571.14 141.421   573.2 146.371  574.19 184.039   590.8 188.267  594.88
 193.415  595.86 205.726  598.57 211.538  598.64 243.266  597.73 261.417  599.03
 286.173  599.33  308.39  598.23

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -264.38     .08-169.423     .03 146.371     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -169.423 146.371              424     424     424             .1       .3
Skew Angle = 45

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8659

INPUT
Description: Sta. 86+59
Station Elevation Data    num=      71
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  -298.3   601.5 -268.92  602.74 -212.94  599.08 -192.46  592.39 -179.57  591.02
 -153.65  577.45    -128  572.15    -126  572.11    -123  570.84    -121  569.65
    -116  567.76    -109  563.97    -107  562.57    -106  561.92    -104  561.25
    -102  558.97    -100  559.02     -89  557.29     -88  556.71     -85  556.73
     -80   557.3     -66  557.72     -63  557.69     -60  557.64     -55   557.4
     -43  557.67     -31  557.85     -26   557.9     -22   557.7     -20  557.75
     -16  557.84     -13  557.63      -7  557.73       0  557.67       6  557.51
       9  557.64      15  557.36      18  557.62      21  557.56      45  559.75
      48  559.64      49  559.96      53   560.5      65  562.71      69  563.24
      69  563.19      80  564.36      84  565.36      87  566.27      88   567.1
      92   566.9      94  567.76     101  569.63     104   570.5     107  571.71
     109  571.75     123  572.46     126  572.74     129   572.7     131  572.97
  138.34  579.94  145.66  578.27  165.37  591.88  180.33  596.01  186.66  596.09
  209.18  595.91  221.61  594.85  227.27  594.81   243.9  600.02  258.01  599.73
  297.19   601.4

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  -298.3     .08 -153.65     .03  138.34     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -153.65  138.34              109     109     109             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8550

INPUT
Description: Sta. 85+50
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
-392.501  600.02-352.653  601.25-324.759  602.14-282.919   601.7-251.041  599.95
-197.247  576.44-192.266  574.64-187.285  573.84-172.342  562.44-147.437  556.44
-122.532  556.44 -97.627  556.94 -72.722  556.44 -24.905  556.44       0  554.64
  24.905  558.54   49.81  562.84  74.715  567.44  89.658  572.54  94.638  574.24
  99.619  576.44 147.437  597.32  154.41  597.48 169.353   597.8 178.319  597.74
 191.269  596.95  204.22  597.17 218.167  601.87 231.117   601.9 236.098  601.36
 253.033  602.52 311.809  603.91 377.558  605.42

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-392.501     .08-197.247     .03  99.619     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -197.247  99.619              375     375     375             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8175

INPUT
Description: Sta. 81+75
Station Elevation Data    num=      48
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -297.94  599.37 -212.57  599.29 -190.66  597.73 -169.77  593.34  -146.1  577.38
    -117  572.77    -108  569.79     -99  566.63     -90  563.75     -81  560.83
     -78  560.88     -67  560.64     -59  560.36     -50     560     -45  559.79
     -43  559.82     -30  559.69      -6  559.31       0  559.42      17  559.49
      61  559.36      63  559.39      66  559.23      73   559.3      80  559.39
      90  559.43     102  560.89     108  561.61     117  562.32     131   563.6
     134  563.88     136  564.36     138  565.29     139  565.86     141   566.8
  156.56 577.296  171.42 584.133   197.4 586.651  215.11 589.124  234.28 590.624
  252.28 598.491  264.07 603.893  272.57 604.688  333.02 604.706   345.1 606.155
  375.55 606.742  442.22 606.389  470.34 606.091

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -297.94     .08  -146.1     .03  156.56     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -146.1  156.56              145     145     145             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 8030

INPUT
Description: Sta. 80+30
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -387  601.61    -343  601.15    -273  600.53    -237  600.18    -227  601.83
    -219  599.59    -179  576.44    -174  574.84    -169  573.54    -154  571.14
    -129  560.74    -104  559.04     -79  558.44     -50  558.04     -25  558.04
       0  557.74      25  557.94      50  558.44      75  570.04      90  572.84
      95  574.64     100  576.44     165  595.25     211  601.49     229  602.52
     247  602.85     263  602.69     271  602.19     283  602.06     302  605.01
     351  606.21     391  605.61     406  605.61
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -387     .08    -179     .03     100     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -179     100              460     460     460             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7570

INPUT
Description: Sta. 75+70
Station Elevation Data    num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -481  600.12    -405  596.05    -373  595.99    -267  591.57    -228  590.22
    -192  576.41    -187  575.01    -182  573.31    -165  567.11    -140  564.01
    -115  558.91     -90  557.31     -65  557.01     -40  556.41       0  556.01
      24  558.11      49  561.91      76  569.41      91  573.11     101  576.41
     136  591.85     149  593.53     161  593.85     172  594.09     175  595.57
     187  595.26     264  607.39

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -481     .08    -192     .03     101     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          -192     101              110     110     110             .1       .3

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7460

INPUT
Description: SN 016-2408 Upstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-398.775  624.59-335.334  619.54-291.831   595.7-272.799  593.94 -260.11  594.59
-241.078  593.85-229.296  593.07 -193.95  576.41-182.168  568.61-167.667  562.91
-149.541  562.61-140.478  561.71 -99.694  556.61 -40.784  556.21       0  554.91
   41.69  559.81  50.753  561.71  68.879  564.41  84.287  572.71  94.256  576.41
 127.789  591.51  142.29   593.4 154.072  593.66 167.667  593.96 173.105  595.16
 183.074  595.08 191.231   593.9  193.95  595.42 250.141  615.93 297.269  614.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-398.775     .08 -193.95     .03  94.256     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -193.95  94.256              50      50      50             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-398.775    -360   575.6       F
     245 297.269   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -166.64 -146.31   589.9    22.9   43.23   589.9
Skew Angle = 25
```

BRIDGE

RIVER: Ship Canal
REACH: Ship Canal RS: 7459

INPUT
Description: Ramp D (SN 016-2408)
Distance from Upstream XS = 1
Deck/Roadway Width = 28
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-567.43	626.62	0	-476.8	625.85	0	-386.17	625.9	0
-345.03	626.46	0	-345.03	626.46	622.78	-296.85	627.11	618.76
-148.31	628.52	618.74	22.57	626.39	616.44	171.69	620.76	612.09
229.6	618.3	614.54	229.6	618.3	0	248.25	617.51	0
338.88	614.91	0						

Upstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-398.775	624.59	-335.334	619.54	-291.831	595.7	-272.799	593.94	-260.11	594.59
-241.078	593.85	-229.296	593.07	-193.95	576.41	-182.168	568.61	-167.667	562.91
-149.541	562.61	-140.478	561.71	-99.694	556.61	-40.784	556.21	0	554.91
41.69	559.81	50.753	561.71	68.879	564.41	84.287	572.71	94.256	576.41
127.789	591.51	142.29	593.4	154.072	593.66	167.667	593.96	173.105	595.16
183.074	595.08	191.231	593.9	193.95	595.42	250.141	615.93	297.269	614.21

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-398.775	.08	-193.95	.03	94.256	.08

Bank Sta: Left Right Coeff Contr. Expan.
-193.95 94.256 .1 .3
Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-398.775	-360	575.6	F
245	297.269	575.6	F

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
-166.64	-146.31	589.9	22.9	43.23	589.9

Skew Angle = 25

Downstream Deck/Roadway Coordinates
num= 13

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-494.17	626.62	0	-403.54	625.85	0	-312.91	625.9	0
-271.77	626.46	0	-271.77	626.46	622.78	-223.6	627.11	618.76
-75.05	628.52	618.74	95.82	626.39	616.44	244.95	620.76	612.09
302.86	618.3	614.54	302.86	618.3	0	321.5	617.51	0
412.13	614.91	0						

Downstream Bridge Cross Section Data
Station Elevation Data num= 30

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-276.424	620.95	-225.671	594.92	-220.233	594.36	-201.2	594.44	-183.98	593.88
-174.011	592.99	-130.508	576.41	-118.726	568.91	-108.757	562.91	-99.694	562.71
-90.631	561.91	-48.941	556.21	0	555.41	40.784	555.41	81.568	561.11
90.631	561.21	109.663	563.11	123.258	572.71	133.227	576.41	183.074	591.06

```
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -130.508 133.227             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -345.03  622.78  -340.7  622.78  -340.7       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -271.77  622.78 -267.44  622.78 -267.44       0

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  225.27       0  225.27  614.54   229.6  614.54
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
  298.53       0  298.53  614.54  302.86  614.54

Number of Piers =  4

Pier Data
Pier Station     Upstream= -296.85    Downstream=  -223.6
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.76

Pier Data
Pier Station     Upstream= -148.31    Downstream=  -75.05
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  618.74
Downstream     num=       2
    Width   Elev    Width   Elev
```

```
       4       0       4  618.74

Pier Data
Pier Station     Upstream=    24.9    Downstream=   95.82
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  616.44

Pier Data
Pier Station     Upstream=  171.69    Downstream=  244.95
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  612.09

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 624.59
       El of the toe of the abutment   = 619.97
    Right Embankment
       El of the top of the embankment = 614.21
       El of the toe of the abutment   = 606.85
    Abtument Type                      = 2 Vert. abutments and sloping embankments
    Slope of abutments                 =
    Top with of embankment             = 65
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION
```

```
RIVER: Ship Canal
REACH: Ship Canal         RS: 7410

INPUT
Description: SN 016-2408 Downstream Bridge XS
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-276.424  620.95-225.671  594.92-220.233  594.36  -201.2  594.44 -183.98  593.88
-174.011  592.99-130.508  576.41-118.726  568.91-108.757  562.91 -99.694  562.71
 -90.631  561.91 -48.941  556.21       0  555.41  40.784  555.41  81.568  561.11
  90.631  561.21 109.663  563.11 123.258  572.71 133.227  576.41 183.074  591.06
 202.107  593.17 212.982  593.34 224.764  593.58 229.296  594.85 239.265  594.66
 244.703  593.59 251.954  594.53  311.77  615.54  311.77  618.39 347.116  617.48

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-276.424     .08-130.508     .03 133.227     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -130.508 133.227              160     160     160             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
-276.424    -285   575.6       F
     315 347.116   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
  -93.38  -73.05   589.9   93.82  114.15   589.9
Skew Angle = 25

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7250

INPUT
Description: Sta. 72+50
Station Elevation Data    num=      30
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-347.672   626.3-275.946  595.55-270.965  594.69-258.014  594.67-242.075  593.91
-218.167  591.71 -196.25  576.41-191.269  574.81-185.292  572.51-169.353  567.31
-144.448  562.21-118.547  557.81 -93.642  556.71 -24.905  555.91       0  555.21
  24.905  555.91   49.81  558.61  74.715  562.31  92.646  571.41  97.627  573.21
 103.604  576.41 137.475  591.56 149.429  592.22 160.387  592.37 171.345  592.81
  175.33  593.74 185.292  593.62 192.266  592.09 198.243  593.22 224.144  593.78

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-347.672     .08 -196.25     .03 103.604     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 103.604               90      90      90             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7160

INPUT
```

```
Description: SN 016-0487 & 0486 Upstream Bridge XS
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-269.493   626.3-197.049  594.96-190.287  594.96-175.798  594.57 -161.31  594.11
-141.025  589.88-128.468   576.4-113.013   573.1-100.456   567.9 -88.865   562.7
 -44.433   555.5       0   555.5  104.32   556.5 148.753   557.8 159.378   561.9
 183.526   565.4 200.913   574.9 207.674   576.4 221.197  590.35 237.618  591.91
 247.277  592.11 252.107   593.5 261.766   593.3  265.63  592.58 355.461  596.35

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-269.493     .08-128.468     .03 207.674     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -128.468 207.674              145     145     145             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-269.493    -260   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15

BRIDGE


RIVER: Ship Canal
REACH: Ship Canal         RS: 7098

INPUT
Description: SN 016-0486 & SN 016-0487 (NB & SB of 171)
Distance from Upstream XS =     8.5
Deck/Roadway Width        =   91.33
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      16
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -467.31  628.06       0 -467.31  627.92       0 -419.01  627.74       0
 -370.71  627.55       0 -322.42  627.37       0 -274.12  627.18       0
 -243.12  627.18       0 -243.12  627.18  622.94 -190.77     627  622.67
 -141.91  626.82  622.56  -44.34  626.45  617.71  123.33  625.71  616.51
  217.38  625.34  619.24  274.03  625.16  619.85  347.64  624.98  620.85
  399.14  624.79  620.63

Upstream Bridge Cross Section Data
Station Elevation Data    num=      25
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-269.493   626.3-197.049  594.96-190.287  594.96-175.798  594.57 -161.31  594.11
-141.025  589.88-128.468   576.4-113.013   573.1-100.456   567.9 -88.865   562.7
 -44.433   555.5       0   555.5  104.32   556.5 148.753   557.8 159.378   561.9
 183.526   565.4 200.913   574.9 207.674   576.4 221.197  590.35 237.618  591.91
 247.277  592.11 252.107   593.5 261.766   593.3  265.63  592.58 355.461  596.35

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-269.493     .08-128.468     .03 207.674     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -128.468 207.674             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-269.493    -260   575.6       F
```

```
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 -62.795 -42.465  589.32  121.58  141.91  589.22
Skew Angle = 15

Downstream  Deck/Roadway Coordinates
    num=      16
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 -519.53  628.06       0 -519.53  627.92       0 -471.24  627.74       0
 -422.94  627.55       0 -374.64  627.37       0 -326.35  627.18       0
 -295.35  627.18       0 -295.35  627.18  622.94    -243     627  622.67
 -194.14  626.82  622.56  -96.56  626.45  617.71    71.1  625.71  616.51
  165.15  625.34  619.24  221.81  625.16  619.85  295.41  624.98  620.85
  346.91  624.79  620.63

Downstream Bridge Cross Section Data
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
      -159.378 158.412             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  1

Abutment Data
Upstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -243.12  622.94 -238.79  622.94 -238.79       0
Downstream     num=       3
     Sta    Elev     Sta    Elev     Sta    Elev
 -295.35  622.94 -291.02  622.94 -291.02       0

Number of Piers =  7

Pier Data
Pier Station     Upstream= -190.77    Downstream=    -243
Upstream     num=       2
```

```
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5       0     2.5  622.67

Pier Data
Pier Station     Upstream= -141.91    Downstream= -194.14
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  622.56

Pier Data
Pier Station     Upstream=  -44.34    Downstream=  -96.56
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  617.71

Pier Data
Pier Station     Upstream=  123.33    Downstream=    71.1
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  616.51

Pier Data
Pier Station     Upstream=  217.38    Downstream=  165.15
Upstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24
Downstream     num=       2
    Width   Elev    Width   Elev
    3.75       0    3.75  619.24

Pier Data
Pier Station     Upstream=  274.03    Downstream=  221.81
Upstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85
Downstream     num=       2
    Width   Elev    Width   Elev
     3.5       0     3.5  619.85

Pier Data
Pier Station     Upstream=  347.64    Downstream=  295.41
Upstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85
Downstream     num=       2
    Width   Elev    Width   Elev
       4       0       4  620.85

Number of Bridge Coefficient Sets =  1
```

```
Low Flow Methods and Data
       Energy
       Momentum               Cd   =    1.33
       Yarnell                KVal =      .9
       W.S. Pro Method

  W.S.Pro Data
    Left Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Right Embankment
       El of the top of the embankment = 626.3
       El of the toe of the abutment   = 613.02
    Abtument Type                      = 1 Vert. abutments and vert. embankments with or without
wingwalls
    Slope of abutments                 =
    Top with of embankment             = 30.7
    Centroid station of bridge opening =
    Wing Wall Type                     = No wing walls present
       Width                           =
       Angle                           =
       Radius                          =
    Guide Banks Type                   = No Guide Bank present
       Length                          =
       Offset                          =
       Angle                           =

Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 7015

INPUT
Description: SN 016-0487 & 0486 Downstream Bridge XS
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-309.096  625.77-289.778  620.15-235.686  596.21-231.822  595.42-218.299  595.44
-199.947   594.7-181.594  589.35-159.378   576.4-122.673   572.6 -85.001   562.4
 -42.501   555.8       0   555.6  42.501   556.8  85.001   560.9  93.695  562.66
 117.843   568.2 134.264   574.9 158.412   576.4 195.117  590.81 210.572  591.63
 222.163   592.1 226.993  593.48 237.618  593.56 241.481  593.21 299.437  609.46
 331.313  610.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-309.096     .08-159.378     .03 158.412     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -159.378 158.412              105     105     105             .1       .3
```

```
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
-309.096    -310   575.6       F
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
-115.015 -94.685  589.22   69.35   89.68  589.26
Skew Angle = 15

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6910

INPUT
Description: Sta.69+10
Station Elevation Data    num=      31
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -316.79  589.99-305.832   593.7-294.874  595.83-282.919  596.06-264.988  596.42
-247.056  592.93 -225.14  595.93-194.258  576.39-189.277  574.49-184.296  573.79
-166.365  564.59 -141.46  559.99-115.559  556.39 -90.654  555.79 -74.715  556.39
  -49.81  556.19 -24.905  555.39       0  552.89  24.905  552.89  50.806  555.99
  75.711  562.39  92.646  570.49  98.623  572.69   104.6  576.39 126.517  590.85
 136.479  591.38 148.433  591.77 161.384  592.08 166.365  593.58 176.326  593.65
 182.304   592.6

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -316.79     .08-194.258     .03   104.6     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      -194.258   104.6              360     360     360             .1       .3
Skew Angle = 5

CROSS SECTION


RIVER: Ship Canal
REACH: Ship Canal         RS: 6550

INPUT
Description: Sta. 65+50
Station Elevation Data    num=      36
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
-595.724  603.77 -570.82  602.98-524.995  600.59-425.375  593.95-304.836  593.02
-279.931  594.83 -196.25  576.39-191.269  574.69-186.288  573.89-170.349  569.09
-144.448  561.39-119.543  560.09 -94.638  557.69 -69.734  555.69 -44.829  556.09
 -24.905  555.39       0  555.19  24.905  555.99   49.81  560.99  74.715  565.59
   91.65  573.09  96.631  574.39 102.608  576.39 129.505  590.96 150.425  592.01
 163.376  592.61 177.323   592.7 181.307  593.55 192.266  593.44  196.25  592.45
 202.228  593.24 213.186  593.25 222.151   590.2 243.072  596.74 255.026  594.86
  274.95  594.79

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
-595.724     .08 -196.25     .03 102.608     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -196.25 102.608              550     550     550             .1       .3
Skew Angle = 5

CROSS SECTION
```

RIVER: Ship Canal
REACH: Ship Canal RS: 6000

INPUT
Description: Sta. 60+00
Station Elevation Data num= 40

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-605	603.03	-581	602.58	-554	602.83	-485	597.16	-433	598.72
-399	598.84	-348	599.41	-217	584.11	-183	576.39	-178	574.79
-173	573.99	-154	562.79	-129	561.39	-104	559.89	-79	558.69
-54	557.69	-50	557.69	-25	557.59	0	557.39	25	557.99
50	559.49	75	561.19	95	573.19	100	574.69	105	576.39
139	588.79	162	589.48	170	592.15	178	592.95	192	593.47
203	593.55	213	590.62	221	593.6	246	593.85	252	592.53
260	592.88	263	594.84	275	590.28	294	592.72	351	593.49

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-605	.08	-183	.03	105	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
-183	105	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Ship Canal

Reach	River Sta.	n1	n2	n3
Ship Canal	10377	.08	.03	.08
Ship Canal	9888	.08	.03	.08
Ship Canal	9529	.08	.03	.08
Ship Canal	9374.5	.08	.03	.08
Ship Canal	9266	Bridge		
Ship Canal	9141.67	.08	.03	.08
Ship Canal	9083	.08	.03	.08
Ship Canal	8659	.08	.03	.08
Ship Canal	8550	.08	.03	.08
Ship Canal	8175	.08	.03	.08
Ship Canal	8030	.08	.03	.08
Ship Canal	7570	.08	.03	.08
Ship Canal	7460	.08	.03	.08
Ship Canal	7459	Bridge		
Ship Canal	7410	.08	.03	.08
Ship Canal	7250	.08	.03	.08
Ship Canal	7160	.08	.03	.08
Ship Canal	7098	Bridge		
Ship Canal	7015	.08	.03	.08
Ship Canal	6910	.08	.03	.08
Ship Canal	6550	.08	.03	.08
Ship Canal	6000	.08	.03	.08

SUMMARY OF REACH LENGTHS

River: Ship Canal

Reach	River Sta.	Left	Channel	Right
Ship Canal	10377	489	489	489
Ship Canal	9888	359	359	359
Ship Canal	9529	154.66	154.66	154.66
Ship Canal	9374.5	232.7	232.7	232.7
Ship Canal	9266	Bridge		
Ship Canal	9141.67	58.64	58.64	58.64
Ship Canal	9083	424	424	424
Ship Canal	8659	109	109	109
Ship Canal	8550	375	375	375
Ship Canal	8175	145	145	145
Ship Canal	8030	460	460	460
Ship Canal	7570	110	110	110
Ship Canal	7460	50	50	50
Ship Canal	7459	Bridge		
Ship Canal	7410	160	160	160
Ship Canal	7250	90	90	90
Ship Canal	7160	145	145	145
Ship Canal	7098	Bridge		
Ship Canal	7015	105	105	105
Ship Canal	6910	360	360	360
Ship Canal	6550	550	550	550
Ship Canal	6000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Ship Canal

Reach	River Sta.	Contr.	Expan.
Ship Canal	10377	.1	.3
Ship Canal	9888	.1	.3
Ship Canal	9529	.1	.3
Ship Canal	9374.5	.1	.3
Ship Canal	9266	Bridge	
Ship Canal	9141.67	.1	.3
Ship Canal	9083	.1	.3
Ship Canal	8659	.1	.3
Ship Canal	8550	.1	.3
Ship Canal	8175	.1	.3
Ship Canal	8030	.1	.3
Ship Canal	7570	.1	.3
Ship Canal	7460	.1	.3
Ship Canal	7459	Bridge	
Ship Canal	7410	.1	.3
Ship Canal	7250	.1	.3
Ship Canal	7160	.1	.3
Ship Canal	7098	Bridge	
Ship Canal	7015	.1	.3
Ship Canal	6910	.1	.3
Ship Canal	6550	.1	.3
Ship Canal	6000	.1	.3

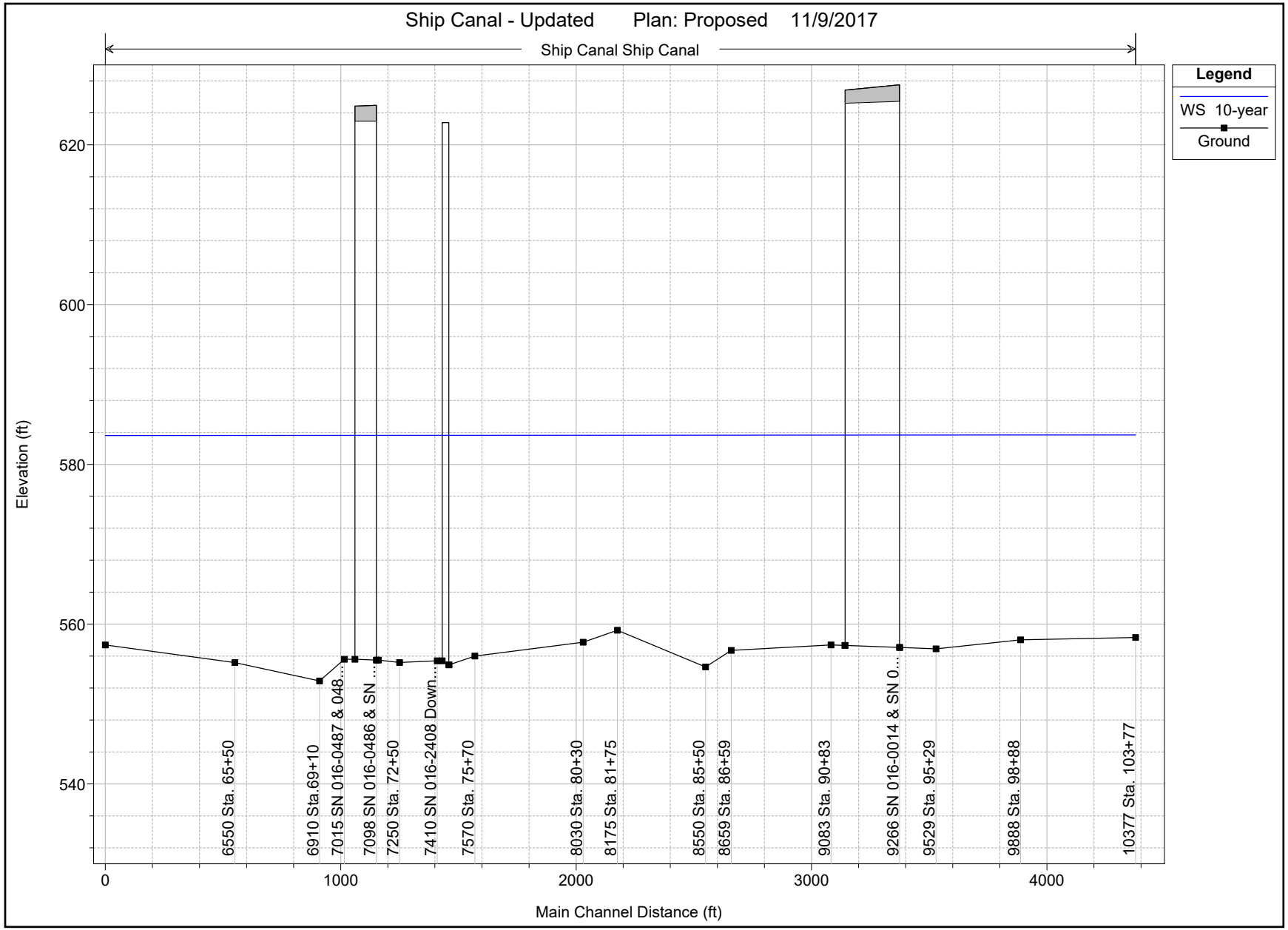
10-Year Proposed

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	10-year	8500.00	558.33	583.69		583.73	0.000020	1.60	5383.05	285.31	0.06
Ship Canal	9888	10-year	8500.00	558.04	583.68		583.72	0.000019	1.54	5612.01	311.38	0.06
Ship Canal	9529	10-year	8500.00	556.91	583.68	562.82	583.71	0.000018	1.49	5731.79	303.43	0.06
Ship Canal	9374.5	10-year	8500.00	557.08	583.66	563.36	583.71	0.000032	1.70	5055.68	275.07	0.07
Ship Canal	9266		Bridge									
Ship Canal	9141.67	10-year	8500.00	557.33	583.66		583.70	0.000031	1.65	5251.22	296.41	0.07
Ship Canal	9083	10-year	8500.00	557.39	583.66		583.69	0.000016	1.42	6102.00	343.61	0.06
Ship Canal	8659	10-year	8500.00	556.71	583.66		583.69	0.000015	1.42	6065.42	318.96	0.06
Ship Canal	8550	10-year	8500.00	554.64	583.66		583.68	0.000009	1.22	7069.42	329.92	0.04
Ship Canal	8175	10-year	8500.00	559.23	583.65		583.68	0.000014	1.36	6302.96	325.77	0.05
Ship Canal	8030	10-year	8500.00	557.74	583.65		583.68	0.000014	1.42	6111.06	316.35	0.05
Ship Canal	7570	10-year	8500.00	556.01	583.64	561.79	583.67	0.000012	1.33	6509.14	328.25	0.05
Ship Canal	7460	10-year	8500.00	554.91	583.63	561.24	583.67	0.000021	1.47	5891.22	278.91	0.05
Ship Canal	7459		Bridge									
Ship Canal	7410	10-year	8500.00	555.41	583.63	561.30	583.67	0.000024	1.60	5446.57	266.56	0.06
Ship Canal	7250	10-year	8500.00	555.21	583.63	560.69	583.66	0.000009	1.22	7073.55	326.36	0.04
Ship Canal	7160	10-year	8500.00	555.50	583.63	560.30	583.66	0.000015	1.24	6907.58	309.23	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	10-year	8500.00	555.60	583.62	561.69	583.65	0.000024	1.51	5725.28	307.90	0.06
Ship Canal	6910	10-year	8500.00	552.89	583.63		583.65	0.000008	1.16	7398.54	321.26	0.04
Ship Canal	6550	10-year	8500.00	555.19	583.62		583.64	0.000010	1.26	6901.12	345.01	0.05
Ship Canal	6000	10-year	8500.00	557.39	583.61	562.57	583.64	0.000012	1.32	6591.91	339.59	0.05

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 10-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	10-year	583.73	583.69	0.04	0.01	0.00	7.30	8489.38	3.32	285.31
Ship Canal	9888	10-year	583.72	583.68	0.04	0.01	0.00	6.05	8481.04	12.91	311.38
Ship Canal	9529	10-year	583.71	583.68	0.03	0.00	0.00	3.08	8494.13	2.79	303.43
Ship Canal	9374.5	10-year	583.71	583.66	0.04	0.00	0.00	3.90	8487.49	8.61	275.07
Ship Canal	9266		Bridge								
Ship Canal	9141.67	10-year	583.70	583.66	0.04	0.00	0.00	3.51	8474.02	22.47	296.41
Ship Canal	9083	10-year	583.69	583.66	0.03	0.01	0.00	2.52	8477.08	20.40	343.61
Ship Canal	8659	10-year	583.69	583.66	0.03	0.00	0.00	5.25	8486.18	8.57	318.96
Ship Canal	8550	10-year	583.68	583.66	0.02	0.00	0.00	7.53	8484.92	7.54	329.92
Ship Canal	8175	10-year	583.68	583.65	0.03	0.00	0.00	3.80	8490.06	6.14	325.77
Ship Canal	8030	10-year	583.68	583.65	0.03	0.01	0.00	6.70	8478.94	14.36	316.35
Ship Canal	7570	10-year	583.67	583.64	0.03	0.00	0.00	9.91	8481.59	8.50	328.25
Ship Canal	7460	10-year	583.67	583.63	0.03	0.00	0.00	10.27	8478.92	10.81	278.91
Ship Canal	7459		Bridge								
Ship Canal	7410	10-year	583.67	583.63	0.04	0.00	0.01	14.07	8467.37	18.57	266.56
Ship Canal	7250	10-year	583.66	583.63	0.02	0.00	0.00	4.37	8488.29	7.33	326.36
Ship Canal	7160	10-year	583.66	583.63	0.02	0.00	0.00	3.15	8493.53	3.32	309.23
Ship Canal	7098		Bridge								
Ship Canal	7015	10-year	583.65	583.62	0.04	0.00	0.00	8.62	8477.92	13.46	307.90
Ship Canal	6910	10-year	583.65	583.63	0.02	0.00	0.00	4.58	8491.07	4.35	321.26
Ship Canal	6550	10-year	583.64	583.62	0.02	0.01	0.00	16.46	8477.30	6.24	345.01
Ship Canal	6000	10-year	583.64	583.61	0.03			16.95	8472.76	10.29	339.59


Ship Canal - Updated Plan: Proposed 11/9/2017
Ship Canal Ship Canal
Legend
WS 10-year
Ground
Elevation (ft)
620
600
580
560
540
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 048...
7098 SN 016-0486 & SN ...
7250 Sta. 72+50
7410 SN 016-2408 Down...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 0...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

Errors Warnings and Notes for Plan : Proposed

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9266 Profile: 10-year
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 10-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 10-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

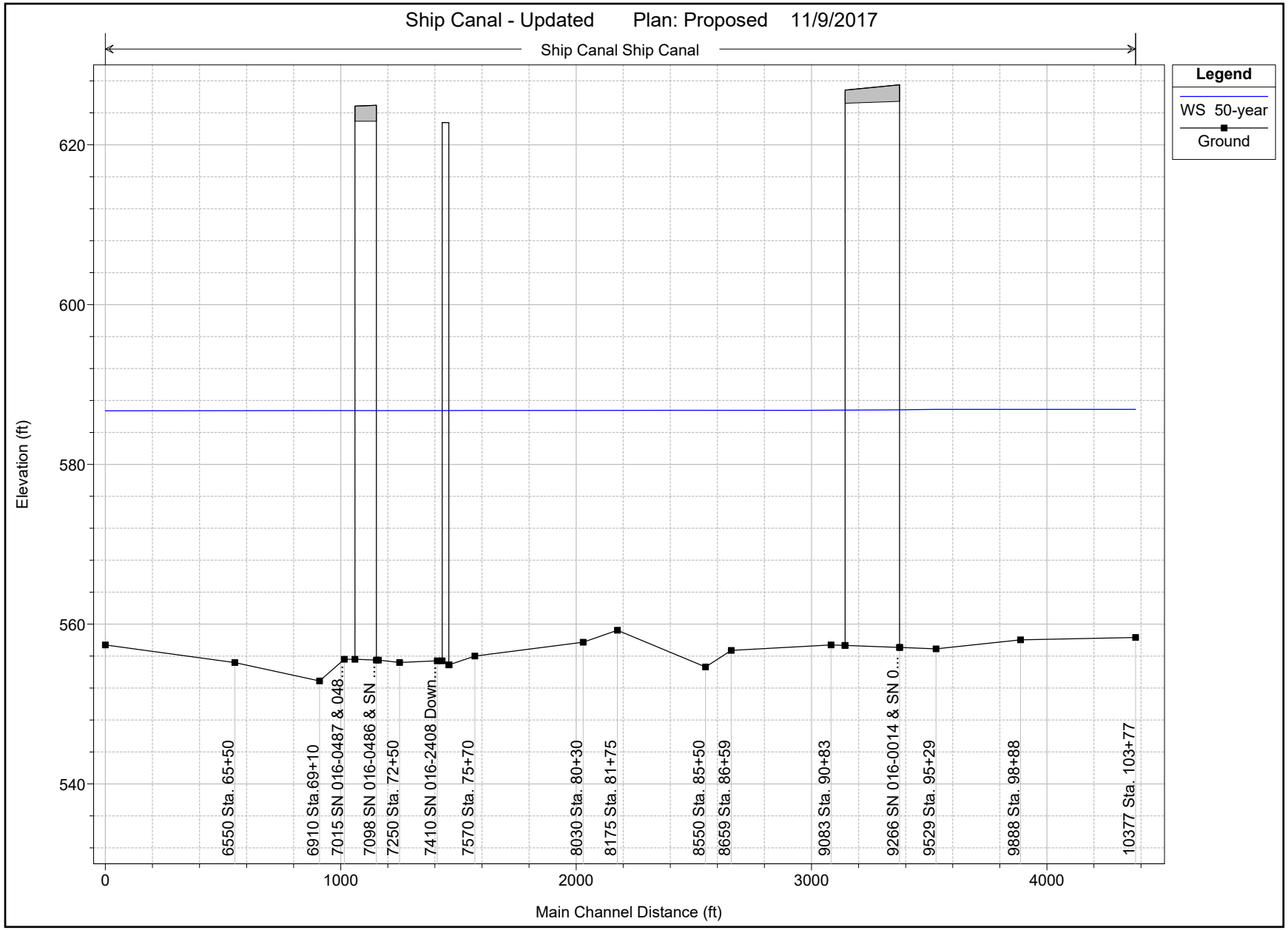
50-Year Proposed

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	50-year	11300.00	558.33	586.89		586.94	0.000021	1.83	6312.62	295.58	0.07
Ship Canal	9888	50-year	11300.00	558.04	586.88		586.93	0.000020	1.75	6626.13	322.22	0.06
Ship Canal	9529	50-year	11300.00	556.91	586.88	563.85	586.92	0.000019	1.71	6715.53	311.35	0.06
Ship Canal	9374.5	50-year	11300.00	557.08	586.86	564.33	586.92	0.000036	1.94	5949.02	283.74	0.07
Ship Canal	9266		Bridge									
Ship Canal	9141.67	50-year	11300.00	557.33	586.76		586.82	0.000034	1.88	6187.88	306.25	0.07
Ship Canal	9083	50-year	11300.00	557.39	586.77		586.81	0.000017	1.62	7186.73	353.84	0.06
Ship Canal	8659	50-year	11300.00	556.71	586.76		586.81	0.000017	1.64	7073.33	329.40	0.06
Ship Canal	8550	50-year	11300.00	554.64	586.77		586.80	0.000011	1.43	8117.62	344.16	0.05
Ship Canal	8175	50-year	11300.00	559.23	586.76		586.80	0.000015	1.57	7361.30	358.18	0.06
Ship Canal	8030	50-year	11300.00	557.74	586.75		586.79	0.000016	1.64	7118.97	332.45	0.06
Ship Canal	7570	50-year	11300.00	556.01	586.75	562.72	586.79	0.000014	1.54	7552.54	343.39	0.05
Ship Canal	7460	50-year	11300.00	554.91	586.74	562.26	586.78	0.000025	1.72	6777.79	292.39	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	50-year	11300.00	555.41	586.73	562.25	586.78	0.000030	1.87	6302.16	285.25	0.06
Ship Canal	7250	50-year	11300.00	555.21	586.74	561.55	586.77	0.000011	1.42	8104.48	337.74	0.05
Ship Canal	7160	50-year	11300.00	555.50	586.74	561.19	586.77	0.000018	1.45	7876.63	315.13	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	50-year	11300.00	555.60	586.72	562.74	586.76	0.000027	1.74	6700.56	321.11	0.06
Ship Canal	6910	50-year	11300.00	552.89	586.73		586.76	0.000009	1.37	8410.31	330.87	0.05
Ship Canal	6550	50-year	11300.00	555.19	586.72		586.75	0.000012	1.47	8001.96	364.81	0.05
Ship Canal	6000	50-year	11300.00	557.39	586.71	563.32	586.75	0.000013	1.54	7693.06	372.56	0.05

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 50-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	50-year	586.94	586.89	0.05	0.01	0.00	22.05	11267.64	10.32	295.58
Ship Canal	9888	50-year	586.93	586.88	0.05	0.01	0.00	18.14	11249.49	32.37	322.22
Ship Canal	9529	50-year	586.92	586.88	0.05	0.00	0.00	10.03	11280.39	9.58	311.35
Ship Canal	9374.5	50-year	586.92	586.86	0.06			12.38	11262.74	24.89	283.74
Ship Canal	9266		Bridge								
Ship Canal	9141.67	50-year	586.82	586.76	0.05	0.00	0.00	10.91	11236.66	52.43	306.25
Ship Canal	9083	50-year	586.81	586.77	0.04	0.01	0.00	7.67	11247.55	44.78	353.84
Ship Canal	8659	50-year	586.81	586.76	0.04	0.00	0.00	16.25	11260.19	23.57	329.40
Ship Canal	8550	50-year	586.80	586.77	0.03	0.00	0.00	21.11	11257.77	21.13	344.16
Ship Canal	8175	50-year	586.80	586.76	0.04	0.00	0.00	11.68	11269.85	18.46	358.18
Ship Canal	8030	50-year	586.79	586.75	0.04	0.01	0.00	18.44	11242.03	39.53	332.45
Ship Canal	7570	50-year	586.79	586.75	0.04	0.00	0.00	27.29	11249.29	23.41	343.39
Ship Canal	7460	50-year	586.78	586.74	0.05	0.00	0.00	29.36	11239.74	30.90	292.39
Ship Canal	7459		Bridge								
Ship Canal	7410	50-year	586.78	586.73	0.05	0.00	0.01	40.38	11206.33	53.29	285.25
Ship Canal	7250	50-year	586.77	586.74	0.03	0.00	0.00	12.23	11267.28	20.50	337.74
Ship Canal	7160	50-year	586.77	586.74	0.03	0.00	0.00	8.96	11281.58	9.46	315.13
Ship Canal	7098		Bridge								
Ship Canal	7015	50-year	586.76	586.72	0.05	0.00	0.01	23.93	11238.74	37.33	321.11
Ship Canal	6910	50-year	586.76	586.73	0.03	0.00	0.00	12.90	11274.84	12.27	330.87
Ship Canal	6550	50-year	586.75	586.72	0.03	0.01	0.00	45.60	11237.10	17.30	364.81
Ship Canal	6000	50-year	586.75	586.71	0.04			44.98	11226.58	28.44	372.56


Ship Canal - Updated Plan: Proposed 11/9/2017
Ship Canal Ship Canal
Legend
WS 50-year
Ground
Elevation (ft)
620
600
580
560
540
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 048...
7098 SN 016-0486 & SN ...
7250 Sta. 72+50
7410 SN 016-2408 Down...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 0...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

Errors Warnings and Notes for Plan : Proposed

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 50-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 50-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

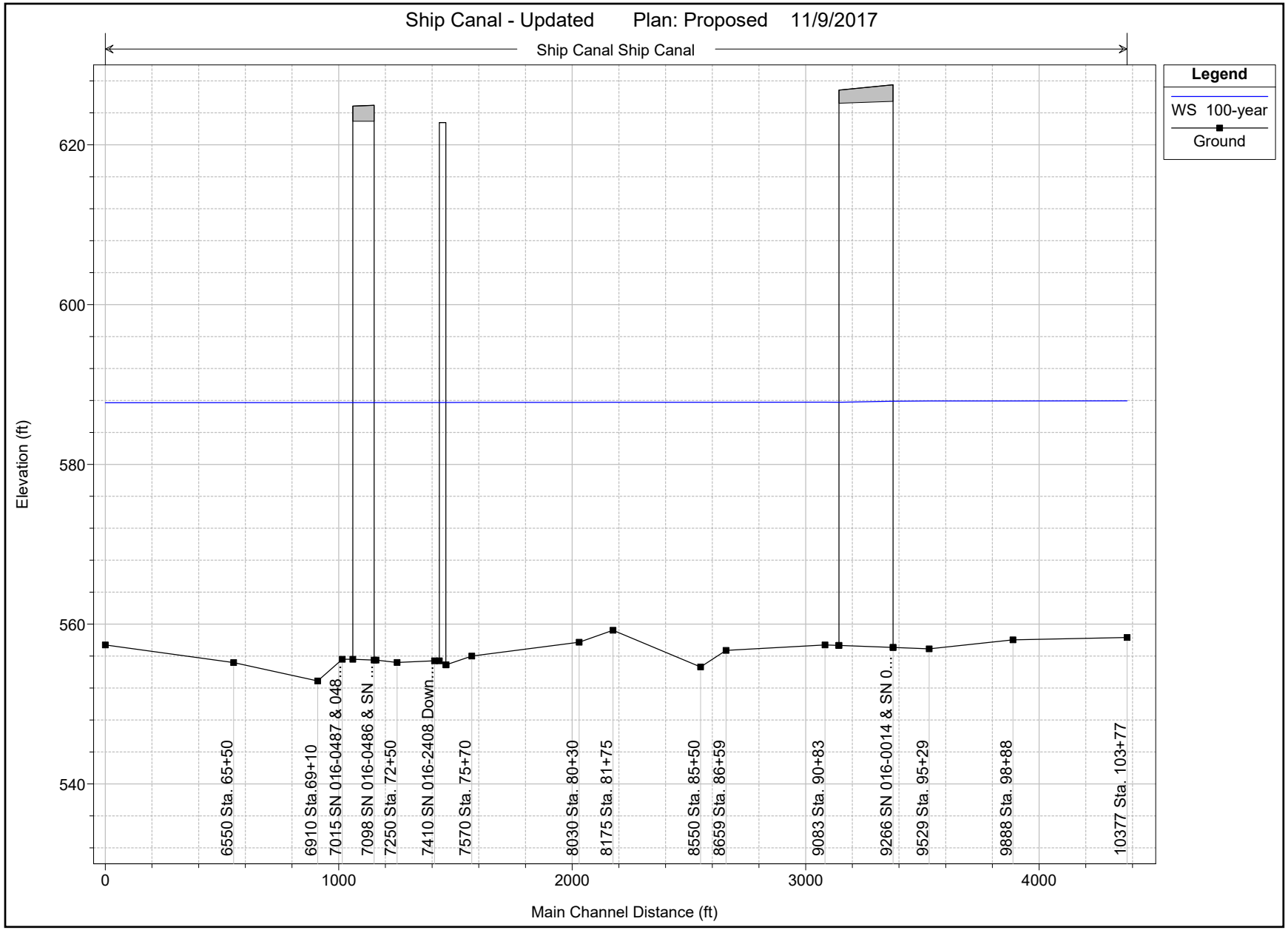
100-Year Proposed

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	100-year	12800.00	558.33	587.94		588.00	0.000023	1.98	6626.43	304.49	0.07
Ship Canal	9888	100-year	12800.00	558.04	587.93		587.99	0.000022	1.90	6966.77	325.39	0.07
Ship Canal	9529	100-year	12800.00	556.91	587.93	564.30	587.98	0.000021	1.85	7044.32	314.02	0.07
Ship Canal	9374.5	100-year	12800.00	557.08	587.91	564.82	587.98	0.000040	2.09	6248.12	286.64	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	100-year	12800.00	557.33	587.77		587.84	0.000038	2.03	6498.07	309.44	0.07
Ship Canal	9083	100-year	12800.00	557.39	587.78		587.83	0.000019	1.75	7545.46	357.15	0.06
Ship Canal	8659	100-year	12800.00	556.71	587.77		587.82	0.000019	1.78	7407.00	332.79	0.06
Ship Canal	8550	100-year	12800.00	554.64	587.78		587.82	0.000012	1.56	8467.07	348.78	0.05
Ship Canal	8175	100-year	12800.00	559.23	587.77		587.81	0.000017	1.71	7726.35	366.88	0.06
Ship Canal	8030	100-year	12800.00	557.74	587.76		587.81	0.000018	1.79	7456.04	337.67	0.06
Ship Canal	7570	100-year	12800.00	556.01	587.75	563.17	587.80	0.000015	1.68	7900.36	348.29	0.06
Ship Canal	7460	100-year	12800.00	554.91	587.74	562.71	587.79	0.000029	1.87	7073.41	296.75	0.06
Ship Canal	7459		Bridge									
Ship Canal	7410	100-year	12800.00	555.41	587.73	562.77	587.79	0.000034	2.04	6590.86	291.28	0.07
Ship Canal	7250	100-year	12800.00	555.21	587.74	561.98	587.78	0.000012	1.55	8445.43	341.43	0.05
Ship Canal	7160	100-year	12800.00	555.50	587.74	561.63	587.78	0.000020	1.58	8193.85	317.04	0.05
Ship Canal	7098		Bridge									
Ship Canal	7015	100-year	12800.00	555.60	587.72	563.25	587.77	0.000031	1.88	7024.09	325.38	0.07
Ship Canal	6910	100-year	12800.00	552.89	587.73		587.77	0.000011	1.49	8743.56	333.97	0.05
Ship Canal	6550	100-year	12800.00	555.19	587.72		587.76	0.000013	1.60	8370.50	371.20	0.05
Ship Canal	6000	100-year	12800.00	557.39	587.71	563.70	587.75	0.000015	1.67	8071.27	383.86	0.06

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 100-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	100-year	588.00	587.94	0.06	0.01	0.00	27.08	12758.55	14.37	304.49
Ship Canal	9888	100-year	587.99	587.93	0.06	0.01	0.00	25.05	12731.95	43.00	325.39
Ship Canal	9529	100-year	587.98	587.93	0.05	0.00	0.00	14.46	12771.96	13.58	314.02
Ship Canal	9374.5	100-year	587.98	587.91	0.07			17.31	12748.47	34.22	286.64
Ship Canal	9266		Bridge								
Ship Canal	9141.67	100-year	587.84	587.77	0.06	0.00	0.00	15.18	12716.10	68.72	309.44
Ship Canal	9083	100-year	587.83	587.78	0.05	0.01	0.00	10.60	12731.61	57.80	357.15
Ship Canal	8659	100-year	587.82	587.77	0.05	0.00	0.00	22.56	12745.87	31.57	332.79
Ship Canal	8550	100-year	587.82	587.78	0.04	0.01	0.00	28.78	12742.41	28.81	348.78
Ship Canal	8175	100-year	587.81	587.77	0.05	0.00	0.00	16.19	12754.35	29.45	366.88
Ship Canal	8030	100-year	587.81	587.76	0.05	0.01	0.00	25.01	12721.37	53.62	337.67
Ship Canal	7570	100-year	587.80	587.75	0.04	0.00	0.00	37.04	12731.19	31.77	348.29
Ship Canal	7460	100-year	587.79	587.74	0.05	0.00	0.00	40.28	12717.34	42.39	296.75
Ship Canal	7459		Bridge								
Ship Canal	7410	100-year	587.79	587.73	0.06	0.00	0.01	55.44	12671.39	73.17	291.28
Ship Canal	7250	100-year	587.78	587.74	0.04	0.00	0.00	16.65	12755.42	27.92	341.43
Ship Canal	7160	100-year	587.78	587.74	0.04	0.00	0.00	12.29	12774.75	12.97	317.04
Ship Canal	7098		Bridge								
Ship Canal	7015	100-year	587.77	587.72	0.05	0.00	0.01	32.54	12716.67	50.78	325.38
Ship Canal	6910	100-year	587.77	587.73	0.03	0.00	0.00	17.61	12765.64	16.75	333.97
Ship Canal	6550	100-year	587.76	587.72	0.04	0.01	0.00	61.95	12714.55	23.50	371.20
Ship Canal	6000	100-year	587.75	587.71	0.04			62.47	12698.93	38.60	383.86


Ship Canal - Updated Plan: Proposed 11/9/2017
Ship Canal Ship Canal
Legend
WS 100-year
Ground
Elevation (ft)
620
600
580
560
540
0
1000
2000
3000
4000
Main Channel Distance (ft)
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 048...
7098 SN 016-0486 & SN ...
7250 Sta. 72+50
7410 SN 016-2408 Down...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 0...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

Errors Warnings and Notes for Plan : Proposed

Location:	River: Ship Canal Reach: Ship Canal RS: 9374.5 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 100-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 100-year
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

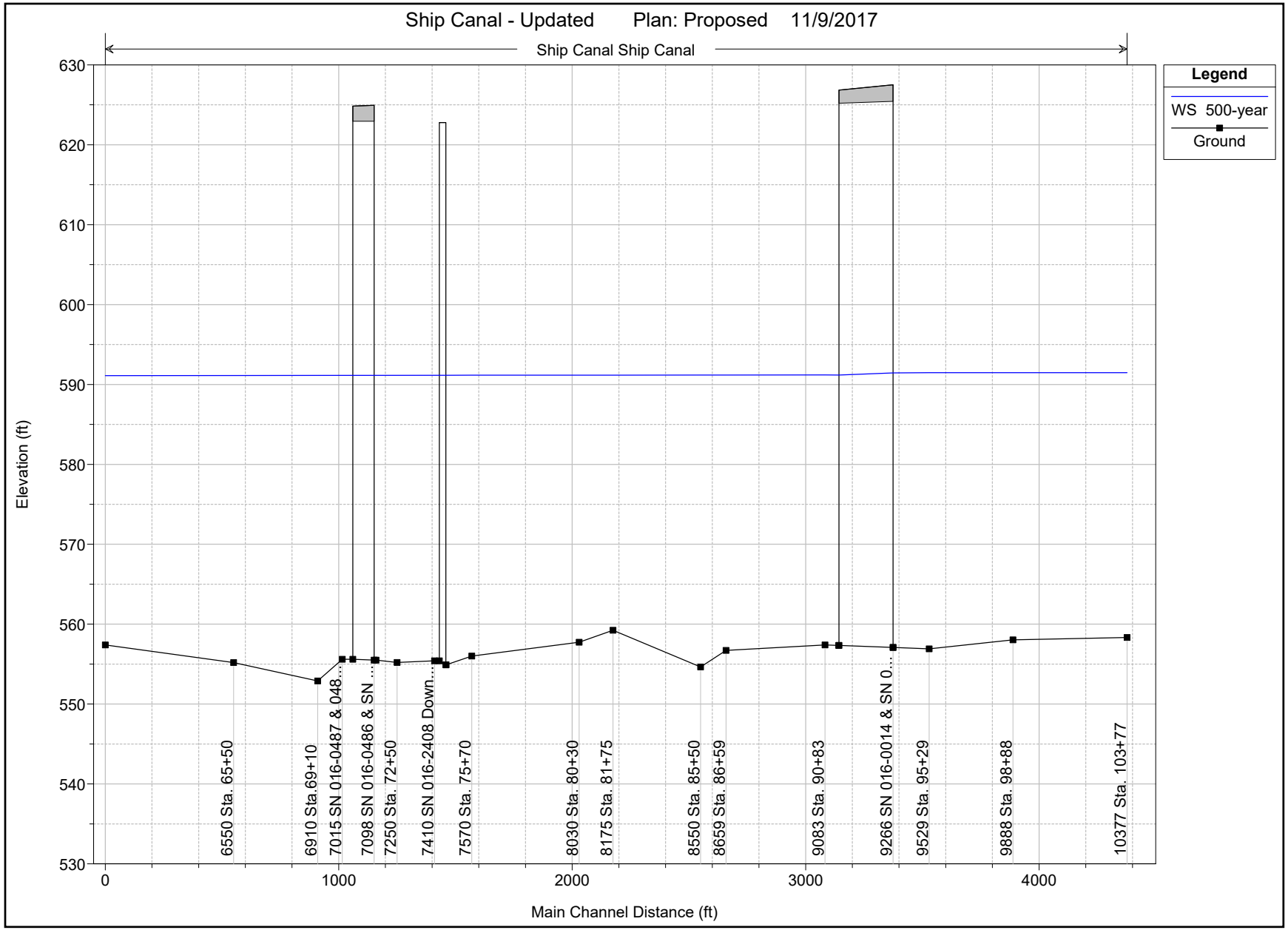
500-Year Proposed

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	10377	500-year	16100.00	558.33	591.48		591.56	0.000023	2.17	7732.85	327.53	0.07
Ship Canal	9888	500-year	16100.00	558.04	591.48		591.54	0.000022	2.07	8138.32	336.09	0.07
Ship Canal	9529	500-year	16100.00	556.91	591.47	565.31	591.53	0.000021	2.02	8172.64	323.04	0.07
Ship Canal	9374.5	500-year	16100.00	557.08	591.45	565.82	591.53	0.000046	2.26	7352.16	337.73	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	500-year	16100.00	557.33	591.18		591.25	0.000044	2.20	7631.28	361.94	0.08
Ship Canal	9083	500-year	16100.00	557.39	591.19		591.25	0.000019	1.91	8781.28	367.87	0.07
Ship Canal	8659	500-year	16100.00	556.71	591.18		591.24	0.000019	1.96	8559.92	345.41	0.07
Ship Canal	8550	500-year	16100.00	554.64	591.19		591.23	0.000013	1.74	9681.72	364.37	0.06
Ship Canal	8175	500-year	16100.00	559.23	591.17		591.23	0.000017	1.88	9036.27	402.09	0.06
Ship Canal	8030	500-year	16100.00	557.74	591.16		591.22	0.000018	1.97	8635.61	355.31	0.06
Ship Canal	7570	500-year	16100.00	556.01	591.16	564.08	591.21	0.000016	1.86	9126.06	389.57	0.06
Ship Canal	7460	500-year	16100.00	554.91	591.14	563.68	591.21	0.000035	2.07	8158.74	352.18	0.07
Ship Canal	7459		Bridge									
Ship Canal	7410	500-year	16100.00	555.41	591.13	563.73	591.21	0.000043	2.25	7666.00	352.81	0.08
Ship Canal	7250	500-year	16100.00	555.21	591.15	562.81	591.19	0.000013	1.73	9628.47	353.91	0.06
Ship Canal	7160	500-year	16100.00	555.50	591.14	562.53	591.19	0.000024	1.75	9365.98	376.63	0.06
Ship Canal	7098		Bridge									
Ship Canal	7015	500-year	16100.00	555.60	591.12	564.29	591.18	0.000035	2.05	8235.23	388.63	0.07
Ship Canal	6910	500-year	16100.00	552.89	591.13		591.18	0.000012	1.68	9900.04	352.77	0.05
Ship Canal	6550	500-year	16100.00	555.19	591.12		591.17	0.000014	1.77	9672.69	401.52	0.06
Ship Canal	6000	500-year	16100.00	557.39	591.11	564.46	591.16	0.000016	1.85	9488.07	455.45	0.06

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal Profile: 500-year

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Ship Canal	10377	500-year	591.56	591.48	0.07	0.01	0.00	69.33	16005.56	25.10	327.53
Ship Canal	9888	500-year	591.54	591.48	0.07	0.01	0.00	53.24	15965.71	81.05	336.09
Ship Canal	9529	500-year	591.53	591.47	0.06	0.00	0.00	32.74	16036.61	30.65	323.04
Ship Canal	9374.5	500-year	591.53	591.45	0.08			40.16	15984.08	75.76	337.73
Ship Canal	9266		Bridge								
Ship Canal	9141.67	500-year	591.25	591.18	0.07	0.00	0.01	34.65	15929.68	135.66	361.94
Ship Canal	9083	500-year	591.25	591.19	0.06	0.01	0.00	22.59	15972.15	105.26	367.87
Ship Canal	8659	500-year	591.24	591.18	0.06	0.00	0.00	47.57	15990.74	61.69	345.41
Ship Canal	8550	500-year	591.23	591.19	0.05	0.01	0.00	59.87	15980.20	59.93	364.37
Ship Canal	8175	500-year	591.23	591.17	0.05	0.00	0.00	34.85	15979.58	85.57	402.09
Ship Canal	8030	500-year	591.22	591.16	0.06	0.01	0.00	51.29	15938.75	109.96	355.31
Ship Canal	7570	500-year	591.21	591.16	0.05	0.00	0.00	79.51	15955.23	65.26	389.57
Ship Canal	7460	500-year	591.21	591.14	0.07	0.00	0.00	89.98	15915.34	94.69	352.18
Ship Canal	7459		Bridge								
Ship Canal	7410	500-year	591.21	591.13	0.08	0.00	0.01	124.65	15811.62	163.73	352.81
Ship Canal	7250	500-year	591.19	591.15	0.05	0.00	0.00	34.63	16007.32	58.05	353.91
Ship Canal	7160	500-year	591.19	591.14	0.05	0.00	0.00	24.86	16050.73	24.41	376.63
Ship Canal	7098		Bridge								
Ship Canal	7015	500-year	591.18	591.12	0.06	0.00	0.01	67.71	15930.37	101.92	388.63
Ship Canal	6910	500-year	591.18	591.13	0.04	0.00	0.00	36.97	16031.37	31.66	352.77
Ship Canal	6550	500-year	591.17	591.12	0.05	0.01	0.00	127.89	15926.22	45.89	401.52
Ship Canal	6000	500-year	591.16	591.11	0.05			142.13	15882.06	75.81	455.45


Ship Canal - Updated Plan: Proposed 11/9/2017
Ship Canal Ship Canal
Legend
WS 500-year
Ground
Elevation (ft)
Main Channel Distance (ft)
630
620
610
600
590
580
570
560
550
540
530
0
1000
2000
3000
4000
6550 Sta. 65+50
6910 Sta.69+10
7015 SN 016-0487 & 048...
7098 SN 016-0486 & SN ...
7250 Sta. 72+50
7410 SN 016-2408 Down...
7570 Sta. 75+70
8030 Sta. 80+30
8175 Sta. 81+75
8550 Sta. 85+50
8659 Sta. 86+59
9083 Sta. 90+83
9266 SN 016-0014 & SN 0...
9529 Sta. 95+29
9888 Sta. 98+88
10377 Sta. 103+77

Errors Warnings and Notes for Plan : Proposed

Location:	River: Ship Canal Reach: Ship Canal RS: 9266 Profile: 500-year
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the energy inside of the bridge deck. This is not physically possible. Please
	review your bridge data and results for reasonableness.
Location:	River: Ship Canal Reach: Ship Canal RS: 9141.67 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Location:	River: Ship Canal Reach: Ship Canal RS: 7460 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7459 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7410 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7160 Profile: 500-year
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year
Warning:	The Yarnell method gave an invalid answer. The upstream energy was less than the downstream energy. The program defaulted to the next valid (user selected) method.
	If the Yarnell method was the only one selected, the program will default to an energy based solution.
Warning:	For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum
	answer has been disregarded.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Upstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7098 Profile: 500-year Downstream
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 7015 Profile: 500-year
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross
	sections.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Location:	River: Ship Canal Reach: Ship Canal RS: 6910 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Warning:	The cross-section end points had to be extended vertically for the computed water surface.
Location:	River: Ship Canal Reach: Ship Canal RS: 6550 Profile: 500-year
Warning:	Divided flow computed for this cross-section.
Location:	River: Ship Canal Reach: Ship Canal RS: 6000 Profile: 500-year
Warning:	Divided flow computed for this cross-section.

Structure Tables

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Ship Canal	9266	10-year	583.71	625.44	17731.18		8500.00	627.52		0.01	
Ship Canal	9266	50-year	586.92	625.44	17731.18		11300.00	627.52		0.10	
Ship Canal	9266	100-year	587.98	625.44	17731.18		12800.00	627.52		0.14	
Ship Canal	9266	500-year	591.53	625.44	17731.18		16100.00	627.52		0.28	
Ship Canal	7459	10-year	583.67	622.42	20362.21		8500.00	617.49		0.00	
Ship Canal	7459	50-year	586.78	622.42	20362.21		11300.00	617.49		0.00	
Ship Canal	7459	100-year	587.79	622.42	20362.21		12800.00	617.49		0.00	
Ship Canal	7459	500-year	591.21	622.42	20362.21		16100.00	617.49		0.00	
Ship Canal	7098	10-year	583.66	622.92	22774.72		8500.00	624.96		0.00	
Ship Canal	7098	50-year	586.77	622.92	22774.72		11300.00	624.96		0.00	
Ship Canal	7098	100-year	587.78	622.92	22774.72		12800.00	624.96		0.01	
Ship Canal	7098	500-year	591.19	622.92	22774.72		16100.00	624.96		0.01	

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Ship Canal	9266	10-year	583.71	583.66	Energy only	583.71		583.70	583.70			
Ship Canal	9266	50-year	586.92	586.86	Momentum	586.83	586.92	586.82	586.82			
Ship Canal	9266	100-year	587.98	587.91	Momentum	587.85	587.98	587.84	587.84			
Ship Canal	9266	500-year	591.53	591.45	Momentum	591.27	591.53	591.26	591.26			
Ship Canal	7459	10-year	583.67	583.63	Energy only	583.67			583.66			
Ship Canal	7459	50-year	586.78	586.74	Energy only	586.78			586.78			
Ship Canal	7459	100-year	587.79	587.74	Energy only	587.79			587.79			
Ship Canal	7459	500-year	591.21	591.14	Energy only	591.21			591.20			
Ship Canal	7098	10-year	583.66	583.63	Energy only	583.66			583.66			
Ship Canal	7098	50-year	586.77	586.74	Energy only	586.77			586.77			
Ship Canal	7098	100-year	587.78	587.74	Energy only	587.78			587.78			
Ship Canal	7098	500-year	591.19	591.14	Energy only	591.19			591.19			

HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	9529	10-year	583.71	583.68	562.82	0.00	0.00	303.43	3.08	8494.13	2.79	1.49
Ship Canal	9529	50-year	586.92	586.88	563.85	0.00	0.00	311.35	10.03	11280.39	9.58	1.71
Ship Canal	9529	100-year	587.98	587.93	564.30	0.00	0.00	314.02	14.46	12771.96	13.58	1.85
Ship Canal	9529	500-year	591.53	591.47	565.31	0.00	0.00	323.04	32.74	16036.61	30.65	2.02
Ship Canal	9374.5	10-year	583.71	583.66	563.36	0.00	0.00	275.07	3.90	8487.49	8.61	1.70
Ship Canal	9374.5	50-year	586.92	586.86	564.33			283.74	12.38	11262.74	24.89	1.94
Ship Canal	9374.5	100-year	587.98	587.91	564.82			286.64	17.31	12748.47	34.22	2.09
Ship Canal	9374.5	500-year	591.53	591.45	565.82			337.73	40.16	15984.08	75.76	2.26
Ship Canal	9266 BR U	10-year	583.71	583.66	563.37	0.01	0.00	275.07	3.90	8487.49	8.61	1.70
Ship Canal	9266 BR U	50-year	586.92	586.86	564.35			283.74	12.38	11262.74	24.89	1.94
Ship Canal	9266 BR U	100-year	587.98	587.91	564.83			286.64	17.31	12748.47	34.22	2.09
Ship Canal	9266 BR U	500-year	591.53	591.45	565.85			329.23	40.19	15983.98	75.83	2.27
Ship Canal	9266 BR D	10-year	583.70	583.66	564.16	0.00	0.00	296.41	3.51	8474.02	22.47	1.65
Ship Canal	9266 BR D	50-year	586.82	586.76	565.26			306.25	10.91	11236.66	52.43	1.88
Ship Canal	9266 BR D	100-year	587.84	587.77	565.73			309.44	15.18	12716.10	68.72	2.03
Ship Canal	9266 BR D	500-year	591.25	591.18	566.75			353.44	34.61	15929.92	135.48	2.20
Ship Canal	9141.67	10-year	583.70	583.66		0.00	0.00	296.41	3.51	8474.02	22.47	1.65
Ship Canal	9141.67	50-year	586.82	586.76		0.00	0.00	306.25	10.91	11236.66	52.43	1.88
Ship Canal	9141.67	100-year	587.84	587.77		0.00	0.00	309.44	15.18	12716.10	68.72	2.03
Ship Canal	9141.67	500-year	591.25	591.18		0.00	0.01	361.94	34.65	15929.68	135.66	2.20
Ship Canal	9083	10-year	583.69	583.66		0.01	0.00	343.61	2.52	8477.08	20.40	1.42
Ship Canal	9083	50-year	586.81	586.77		0.01	0.00	353.84	7.67	11247.55	44.78	1.62
Ship Canal	9083	100-year	587.83	587.78		0.01	0.00	357.15	10.60	12731.61	57.80	1.75
Ship Canal	9083	500-year	591.25	591.19		0.01	0.00	367.87	22.59	15972.15	105.26	1.91
Ship Canal	7570	10-year	583.67	583.64	561.79	0.00	0.00	328.25	9.91	8481.59	8.50	1.33
Ship Canal	7570	50-year	586.79	586.75	562.72	0.00	0.00	343.39	27.29	11249.29	23.41	1.54
Ship Canal	7570	100-year	587.80	587.75	563.17	0.00	0.00	348.29	37.04	12731.19	31.77	1.68
Ship Canal	7570	500-year	591.21	591.16	564.08	0.00	0.00	389.57	79.51	15955.23	65.26	1.86
Ship Canal	7460	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7460	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72

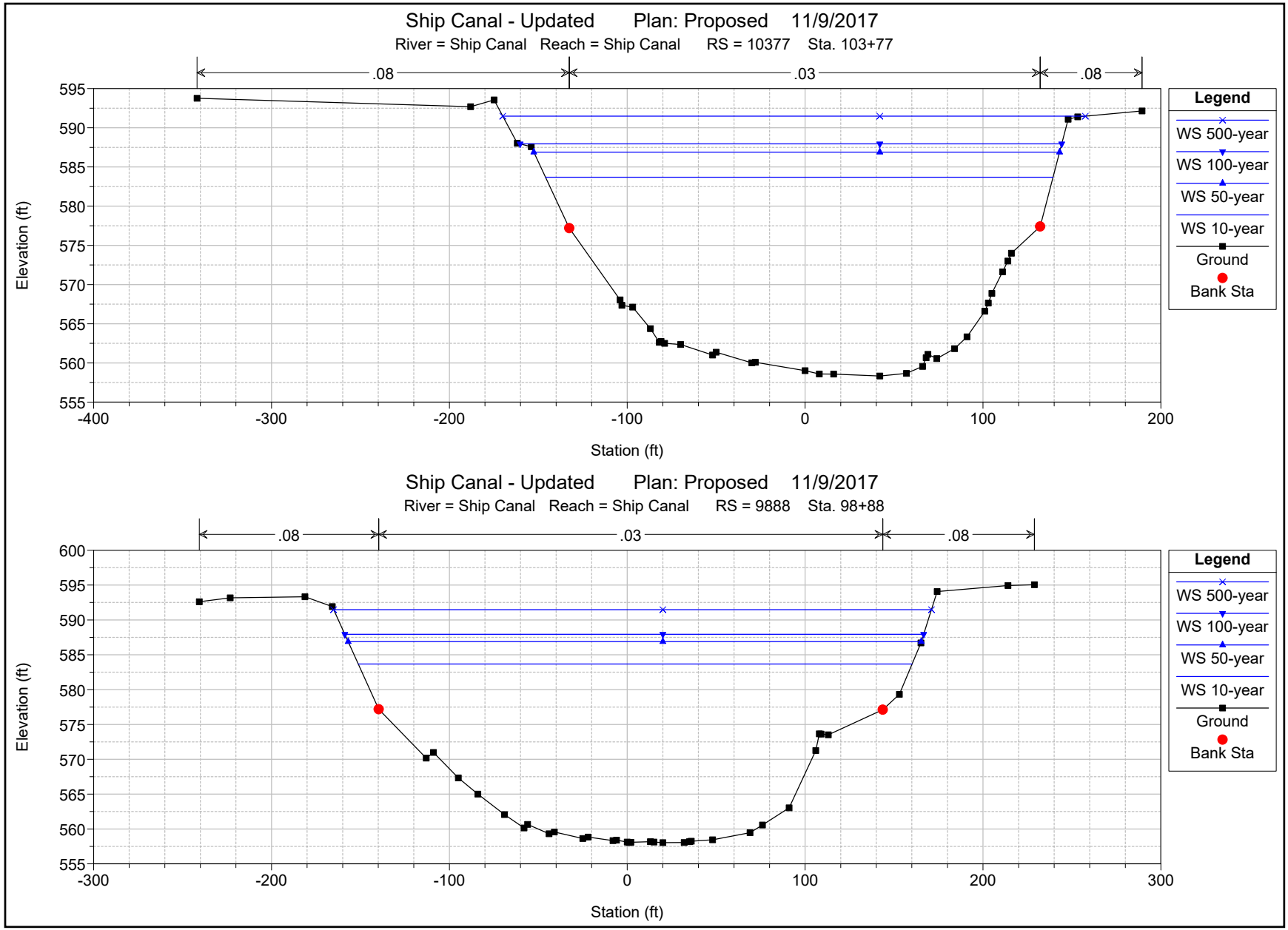
HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal (Continued)

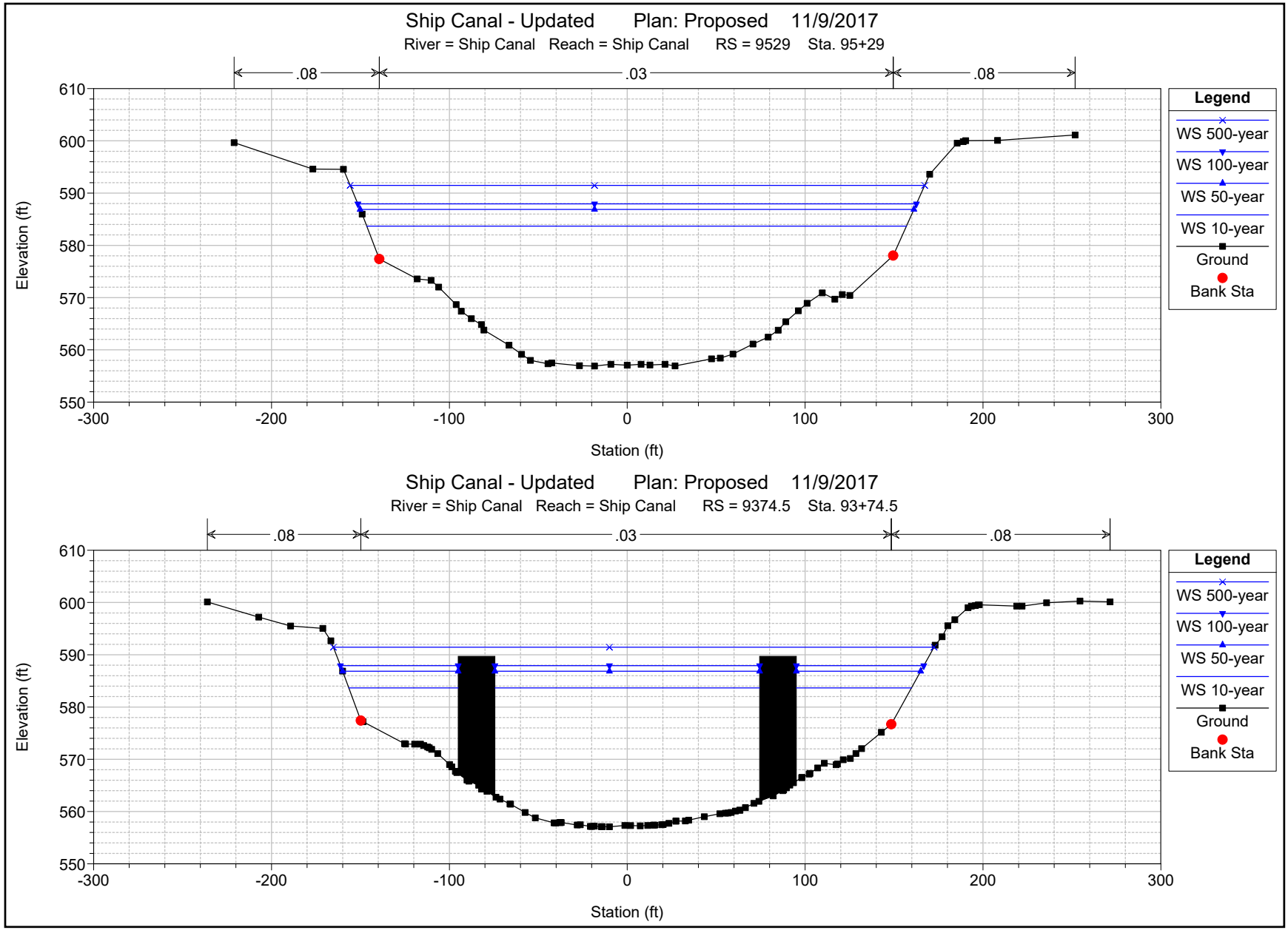
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7460	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7460	500-year	591.21	591.14	563.68	0.00	0.00	352.18	89.98	15915.34	94.69	2.07
Ship Canal	7459 BR U	10-year	583.67	583.63	561.24	0.00	0.00	278.91	10.27	8478.92	10.81	1.47
Ship Canal	7459 BR U	50-year	586.78	586.74	562.26	0.00	0.00	292.39	29.36	11239.74	30.90	1.72
Ship Canal	7459 BR U	100-year	587.79	587.74	562.71	0.00	0.00	296.75	40.28	12717.34	42.39	1.87
Ship Canal	7459 BR U	500-year	591.21	591.14	563.68	0.00	0.00	344.18	89.73	15915.85	94.42	2.07
Ship Canal	7459 BR D	10-year	583.67	583.63	561.30	0.00	0.00	266.56	14.07	8467.36	18.57	1.60
Ship Canal	7459 BR D	50-year	586.78	586.73	562.25	0.00	0.00	285.25	40.39	11206.32	53.30	1.87
Ship Canal	7459 BR D	100-year	587.79	587.73	562.77	0.00	0.00	291.29	55.45	12671.38	73.18	2.04
Ship Canal	7459 BR D	500-year	591.21	591.13	563.73	0.00	0.00	344.82	124.28	15812.48	163.24	2.26
Ship Canal	7410	10-year	583.67	583.63	561.30	0.00	0.01	266.56	14.07	8467.37	18.57	1.60
Ship Canal	7410	50-year	586.78	586.73	562.25	0.00	0.01	285.25	40.38	11206.33	53.29	1.87
Ship Canal	7410	100-year	587.79	587.73	562.77	0.00	0.01	291.28	55.44	12671.39	73.17	2.04
Ship Canal	7410	500-year	591.21	591.13	563.73	0.00	0.01	352.81	124.65	15811.62	163.73	2.25
Ship Canal	7250	10-year	583.66	583.63	560.69	0.00	0.00	326.36	4.37	8488.29	7.33	1.22
Ship Canal	7250	50-year	586.77	586.74	561.55	0.00	0.00	337.74	12.23	11267.28	20.50	1.42
Ship Canal	7250	100-year	587.78	587.74	561.98	0.00	0.00	341.43	16.65	12755.42	27.92	1.55
Ship Canal	7250	500-year	591.19	591.15	562.81	0.00	0.00	353.91	34.63	16007.32	58.05	1.73
Ship Canal	7160	10-year	583.66	583.63	560.30	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7160	50-year	586.77	586.74	561.19	0.00	0.00	315.13	8.96	11281.58	9.46	1.45
Ship Canal	7160	100-year	587.78	587.74	561.63	0.00	0.00	317.04	12.29	12774.75	12.97	1.58
Ship Canal	7160	500-year	591.19	591.14	562.53	0.00	0.00	376.63	24.86	16050.73	24.41	1.75
Ship Canal	7098 BR U	10-year	583.66	583.63	560.31	0.00	0.00	309.23	3.15	8493.53	3.32	1.24
Ship Canal	7098 BR U	50-year	586.77	586.74	561.19	0.00	0.00	312.94	8.96	11281.94	9.10	1.45
Ship Canal	7098 BR U	100-year	587.78	587.74	561.63	0.00	0.00	313.88	12.29	12775.83	11.88	1.58
Ship Canal	7098 BR U	500-year	591.19	591.14	562.53	0.00	0.00	361.88	26.79	16051.43	21.78	1.76
Ship Canal	7098 BR D	10-year	583.65	583.62	561.69	0.00	0.00	304.15	8.63	8483.74	7.62	1.51
Ship Canal	7098 BR D	50-year	586.77	586.72	562.74	0.00	0.00	317.37	23.97	11255.64	20.40	1.74
Ship Canal	7098 BR D	100-year	587.78	587.72	563.25	0.00	0.00	321.64	32.61	12739.50	27.89	1.89
Ship Canal	7098 BR D	500-year	591.19	591.12	564.30	0.00	0.00	377.65	68.13	15972.26	59.61	2.06

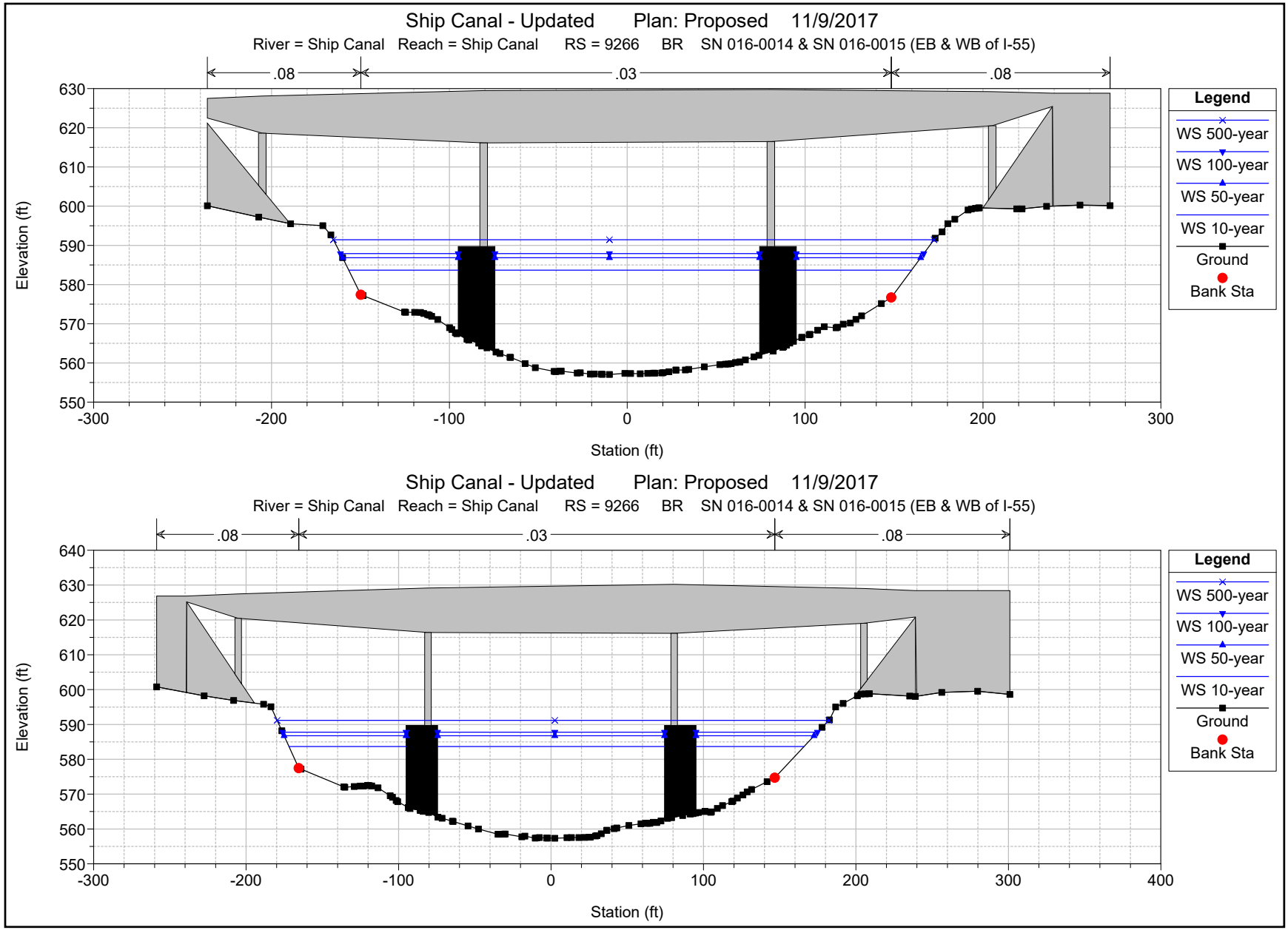
HEC-RAS Plan: Proposed River: Ship Canal Reach: Ship Canal (Continued)

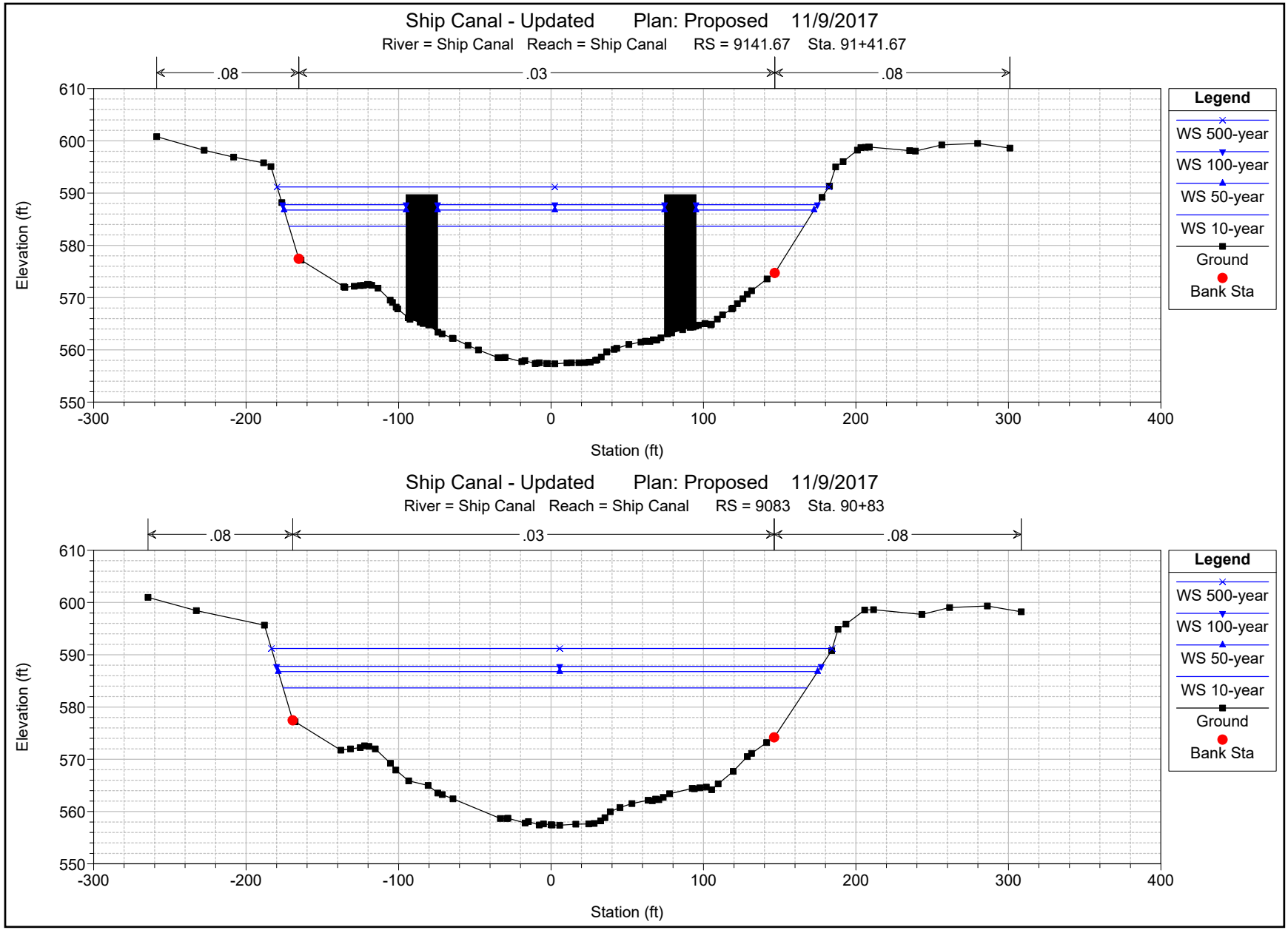
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Ship Canal	7015	10-year	583.65	583.62	561.69	0.00	0.00	307.90	8.62	8477.92	13.46	1.51
Ship Canal	7015	50-year	586.76	586.72	562.74	0.00	0.01	321.11	23.93	11238.74	37.33	1.74
Ship Canal	7015	100-year	587.77	587.72	563.25	0.00	0.01	325.38	32.54	12716.67	50.78	1.88
Ship Canal	7015	500-year	591.18	591.12	564.29	0.00	0.01	388.63	67.71	15930.37	101.92	2.05
Ship Canal	6910	10-year	583.65	583.63		0.00	0.00	321.26	4.58	8491.07	4.35	1.16
Ship Canal	6910	50-year	586.76	586.73		0.00	0.00	330.87	12.90	11274.84	12.27	1.37
Ship Canal	6910	100-year	587.77	587.73		0.00	0.00	333.97	17.61	12765.64	16.75	1.49
Ship Canal	6910	500-year	591.18	591.13		0.00	0.00	352.77	36.97	16031.37	31.66	1.68

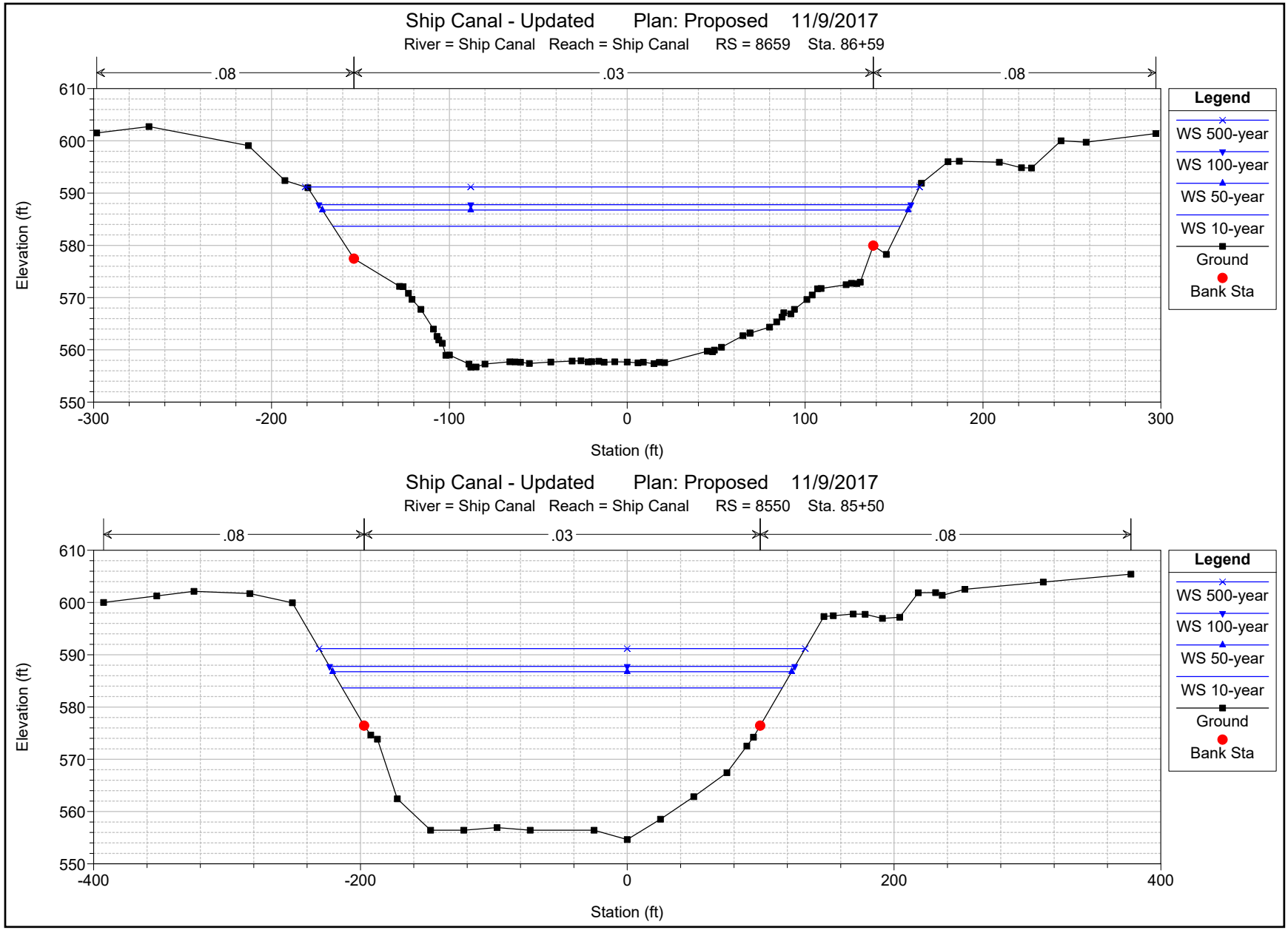
HEC-RAS Plotted Cross Sections

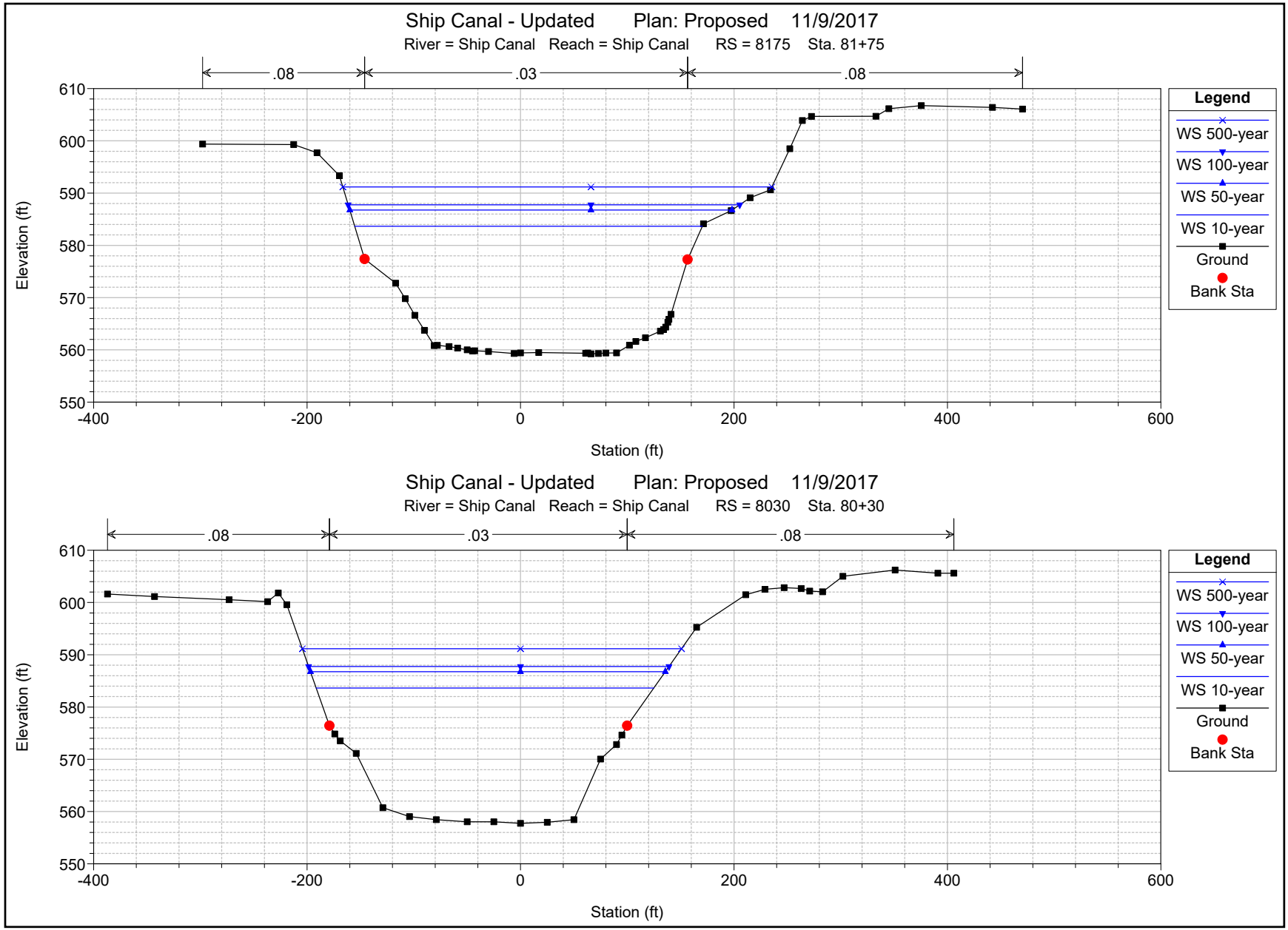

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 10377 Sta. 103+77
.08
.03
.08
Elevation (ft)
595
590
585
580
575
570
565
560
555
-400
-300
-200
-100
0
100
200
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9888 Sta. 98+88
.08
.03
.08
Elevation (ft)
600
595
590
585
580
575
570
565
560
555
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

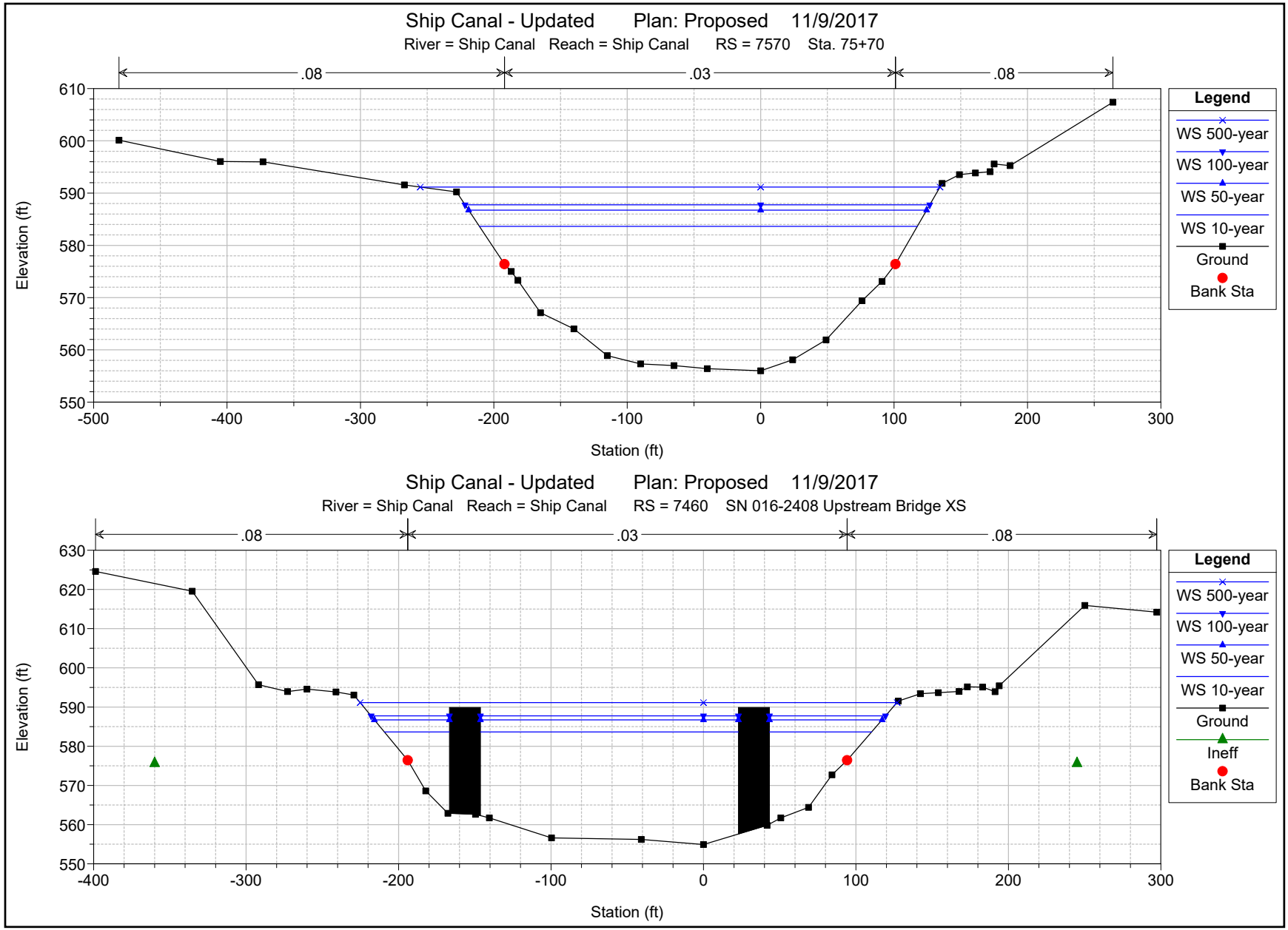

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9529 Sta. 95+29
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9374.5 Sta. 93+74.5
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

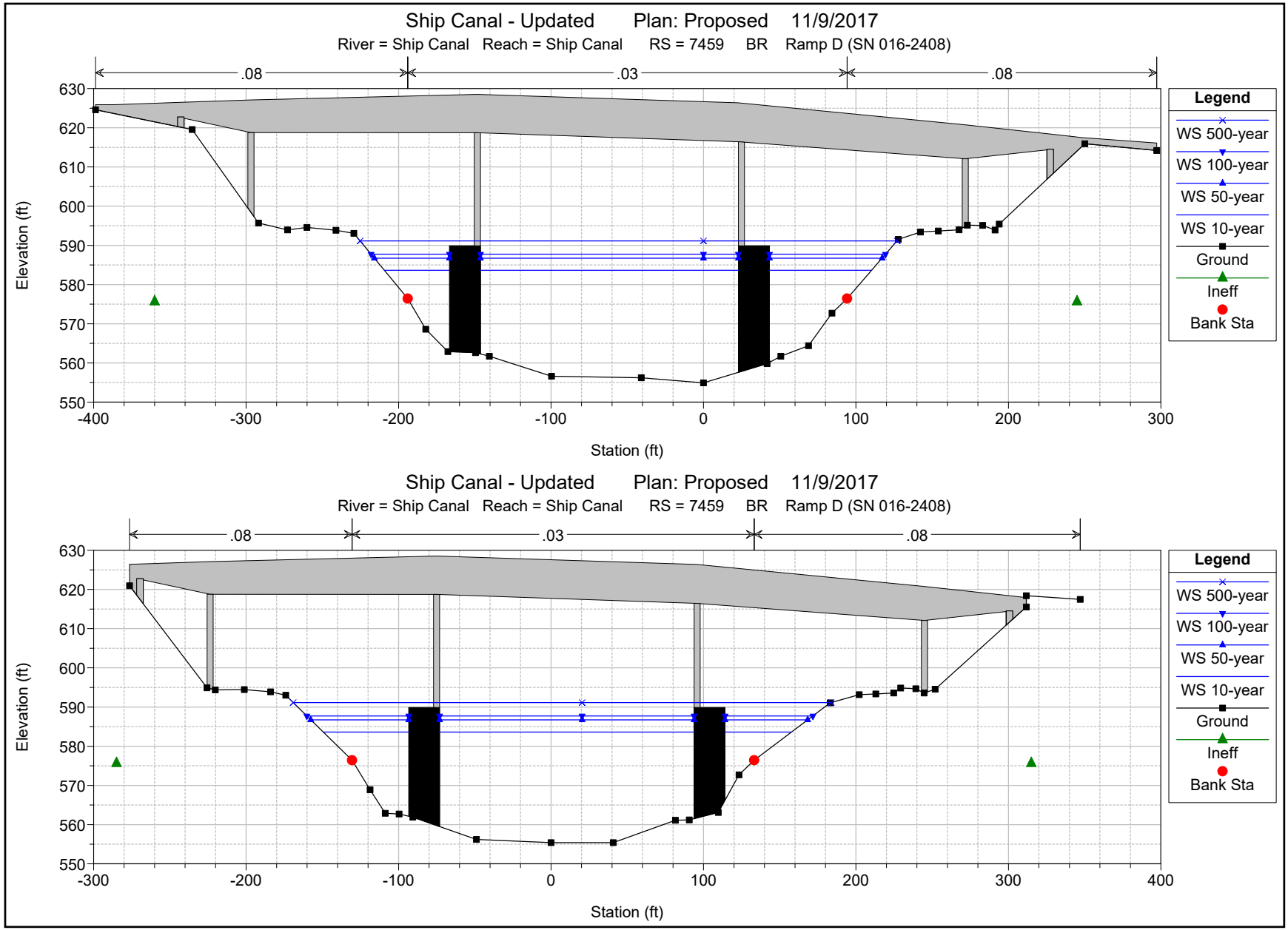

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9266 BR SN 016-0014 & SN 016-0015 (EB & WB of I-55)
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9266 BR SN 016-0014 & SN 016-0015 (EB & WB of I-55)
.08
.03
.08
Elevation (ft)
640
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

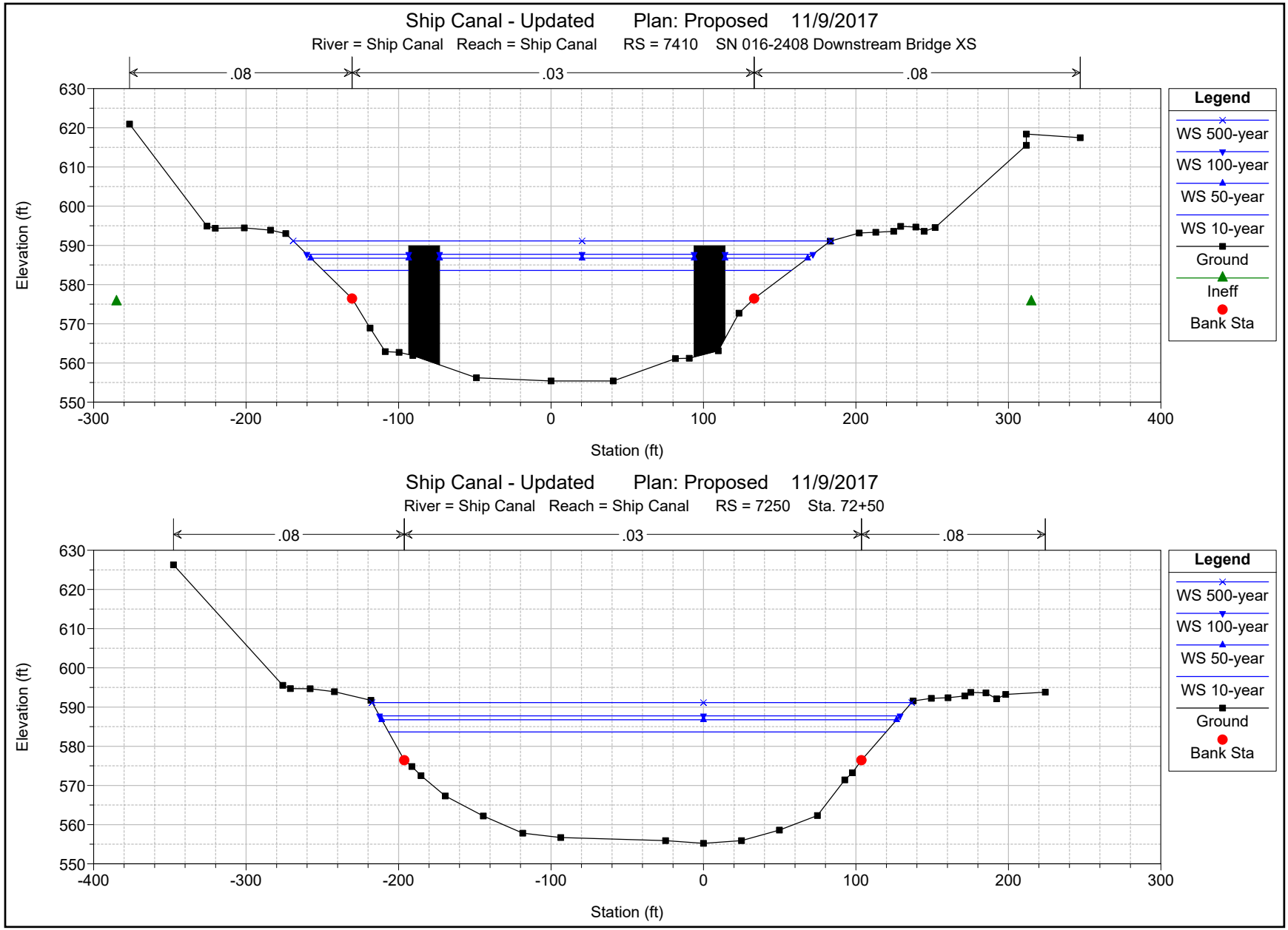

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9141.67 Sta. 91+41.67
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 9083 Sta. 90+83
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

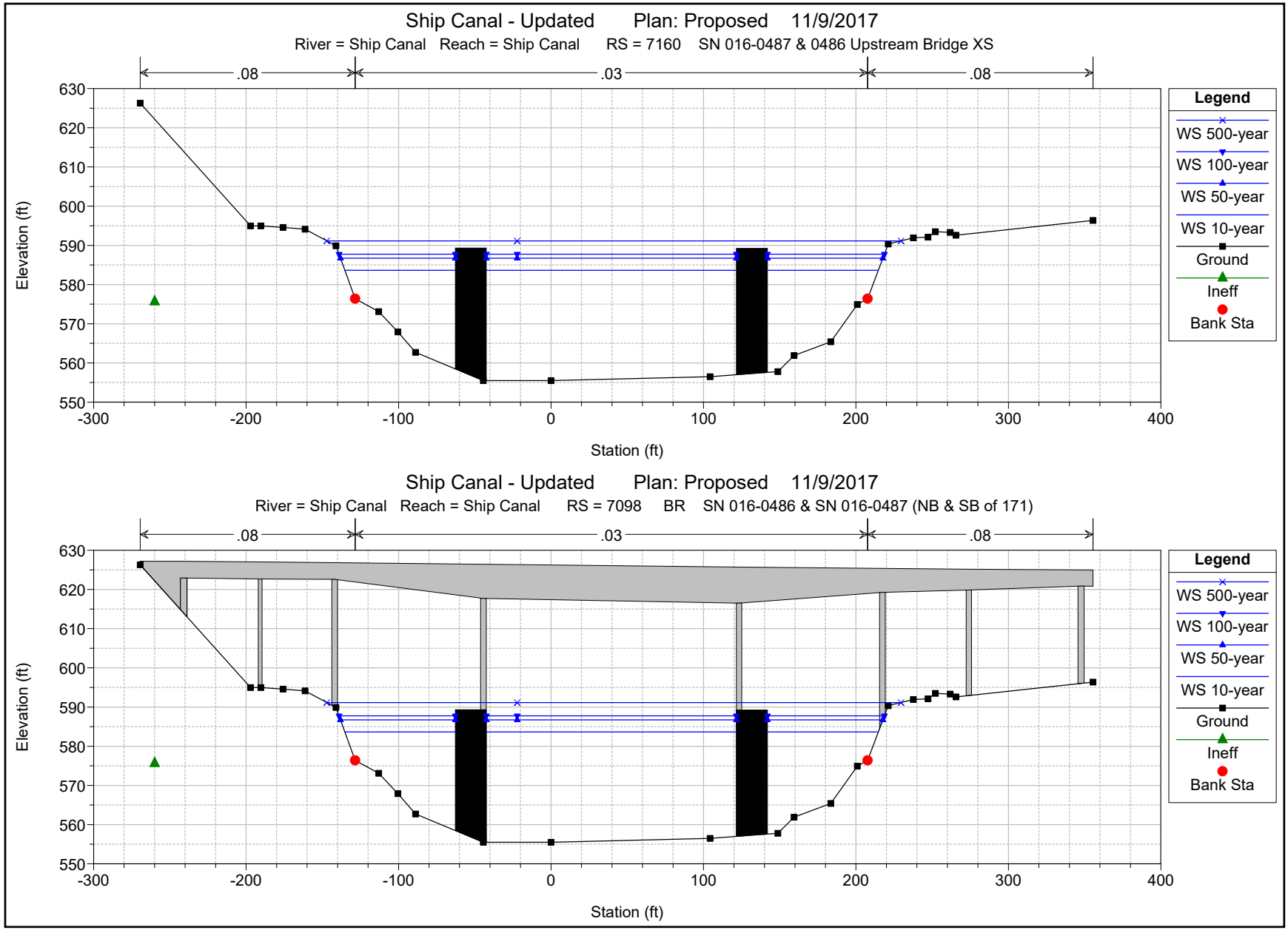

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 8659 Sta. 86+59
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 8550 Sta. 85+50
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-400
-200
0
200
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

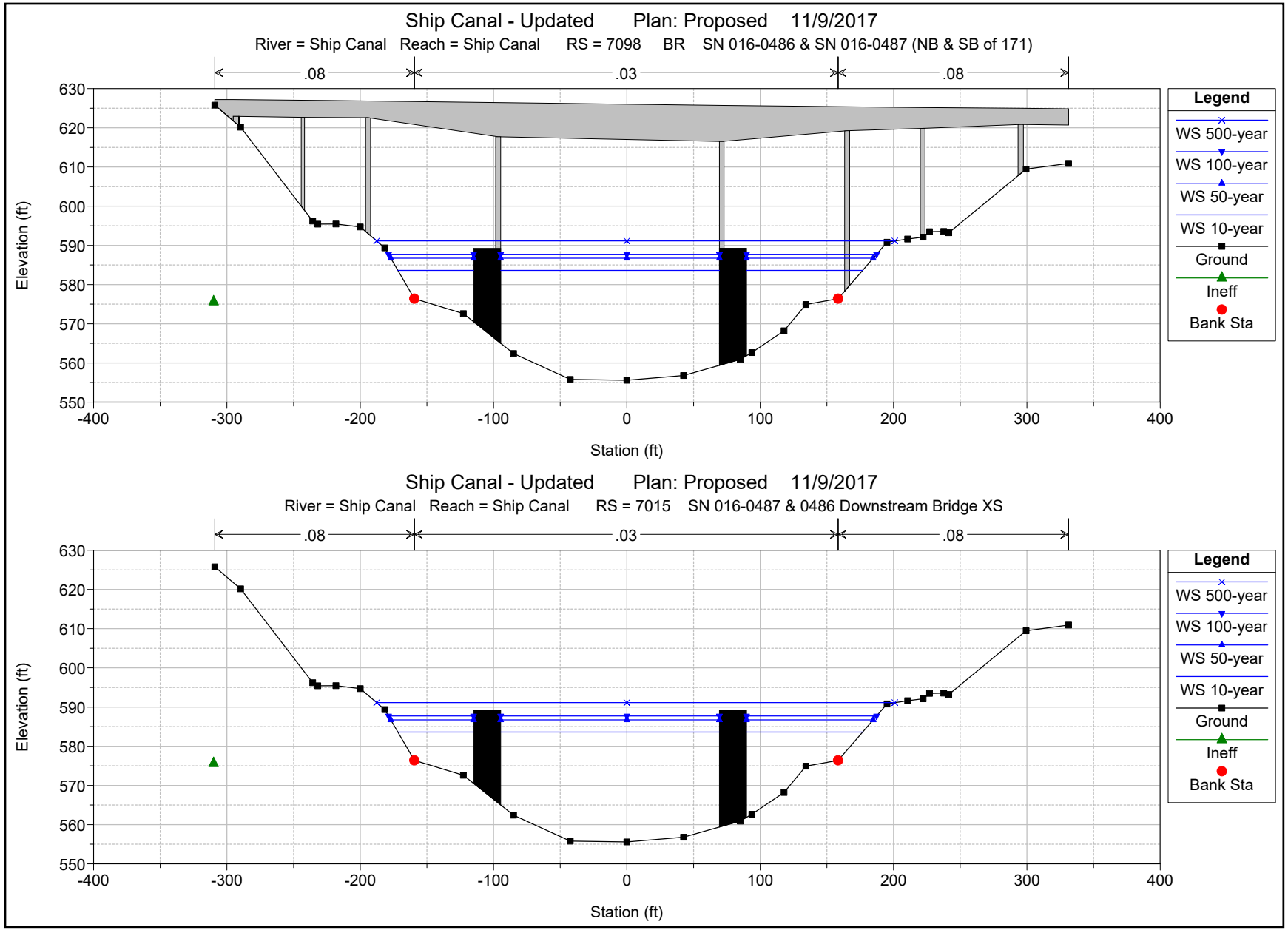

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 8175 Sta. 81+75
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-400
-200
0
200
400
600
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 8030 Sta. 80+30
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-400
-200
0
200
400
600
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

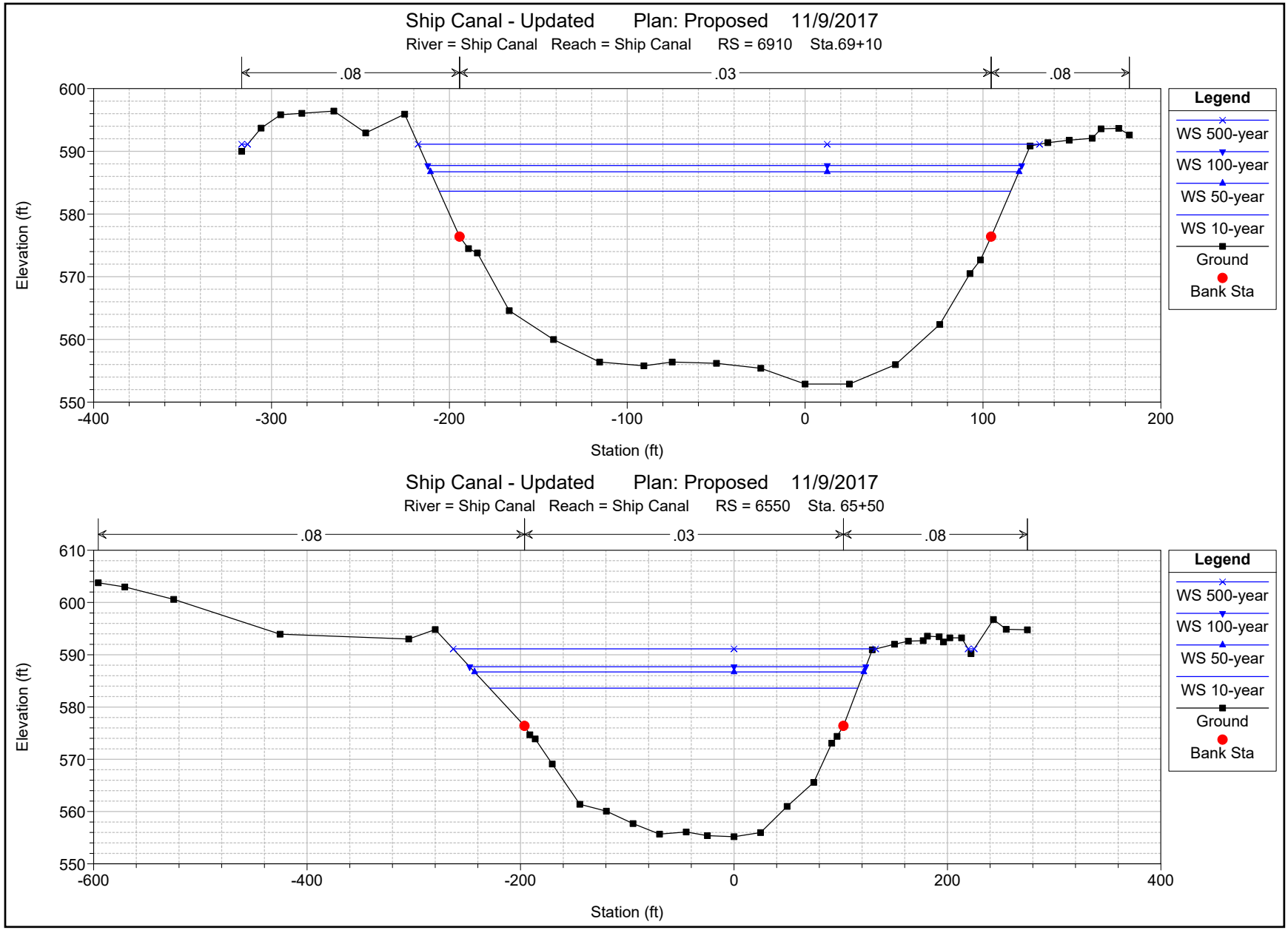

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7570 Sta. 75+70
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-500
-400
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7460 SN 016-2408 Upstream Bridge XS
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta

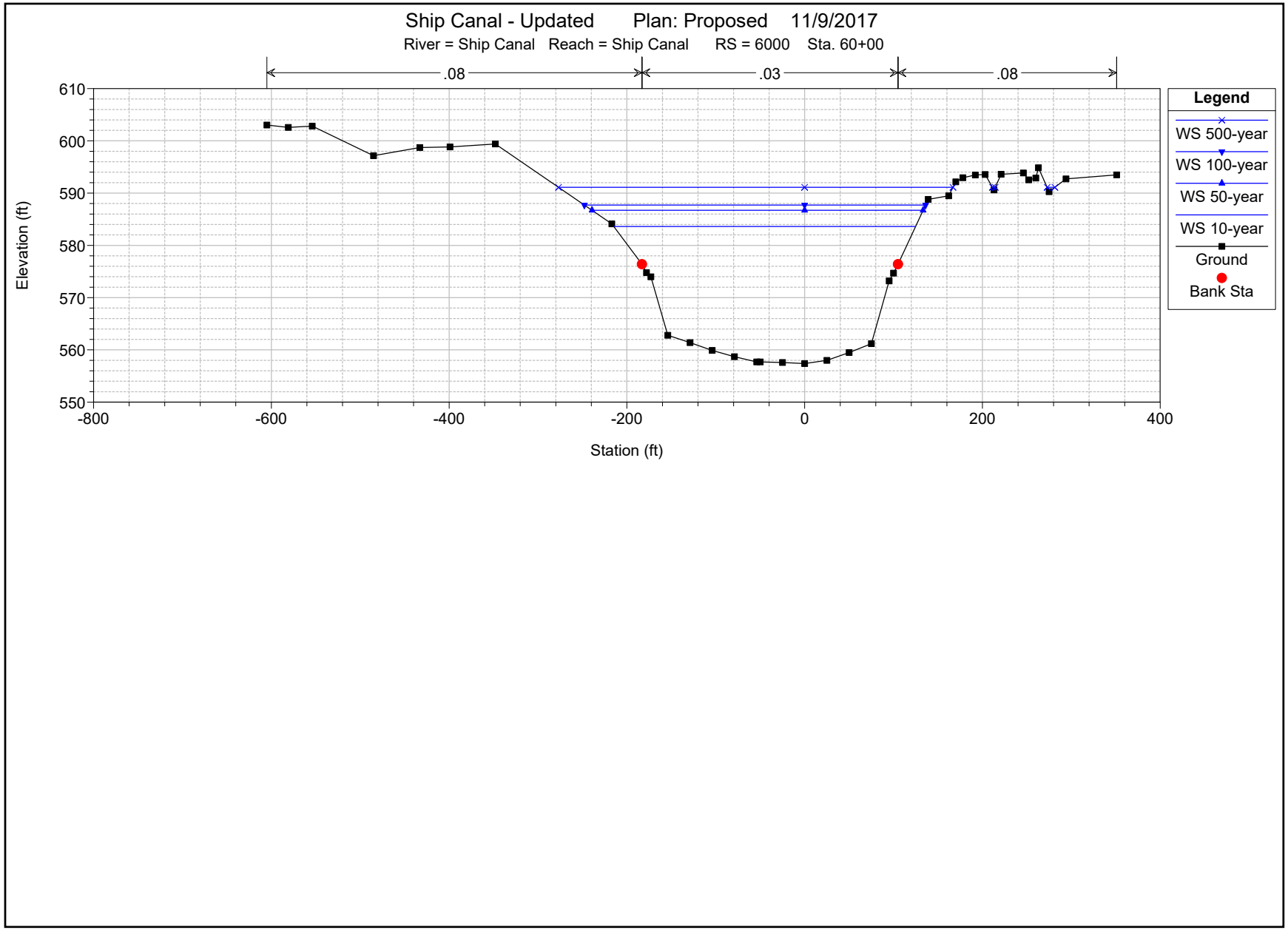

Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7459 BR Ramp D (SN 016-2408)
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7459 BR Ramp D (SN 016-2408)
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta


Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7410 SN 016-2408 Downstream Bridge XS
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7250 Sta. 72+50
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
300
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta


Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7160 SN 016-0487 & 0486 Upstream Bridge XS
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7098 BR SN 016-0486 & SN 016-0487 (NB & SB of 171)
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta


Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7098 BR SN 016-0486 & SN 016-0487 (NB & SB of 171)
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 7015 SN 016-0487 & 0486 Downstream Bridge XS
.08
.03
.08
Elevation (ft)
630
620
610
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
300
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Ineff
Bank Sta


Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 6910 Sta.69+10
.08
.03
.08
Elevation (ft)
600
590
580
570
560
550
-400
-300
-200
-100
0
100
200
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta
Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 6550 Sta. 65+50
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-600
-400
-200
0
200
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta


Ship Canal - Updated Plan: Proposed 11/9/2017
River = Ship Canal Reach = Ship Canal RS = 6000 Sta. 60+00
.08
.03
.08
Elevation (ft)
610
600
590
580
570
560
550
-800
-600
-400
-200
0
200
400
Station (ft)
Legend
WS 500-year
WS 100-year
WS 50-year
WS 10-year
Ground
Bank Sta

TAB 14

SECTION 14

SCOUR ANALYSIS

Stream: **CSSC** **By:**
Route \ County: **I-55\Cook** **Checked:**

I-55 Over the Chicago Sanitary and Ship Canal Scour Summary
Existing Conditions- Pier
November 2017 Submittal

Event	Abutment/ Contraction Scour[1]	Pier Scour	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	6.6	2.0	8.6
Q_{200}	N/A	6.8	2.1	8.9

Note 1. Abutments are above and outside of flood limits.

Note 2. Includes Pier and Contraction Scour

Stream: **CSSC** **By:** **EMB**
Route \ County: **I-55\Cook** **Checked:**

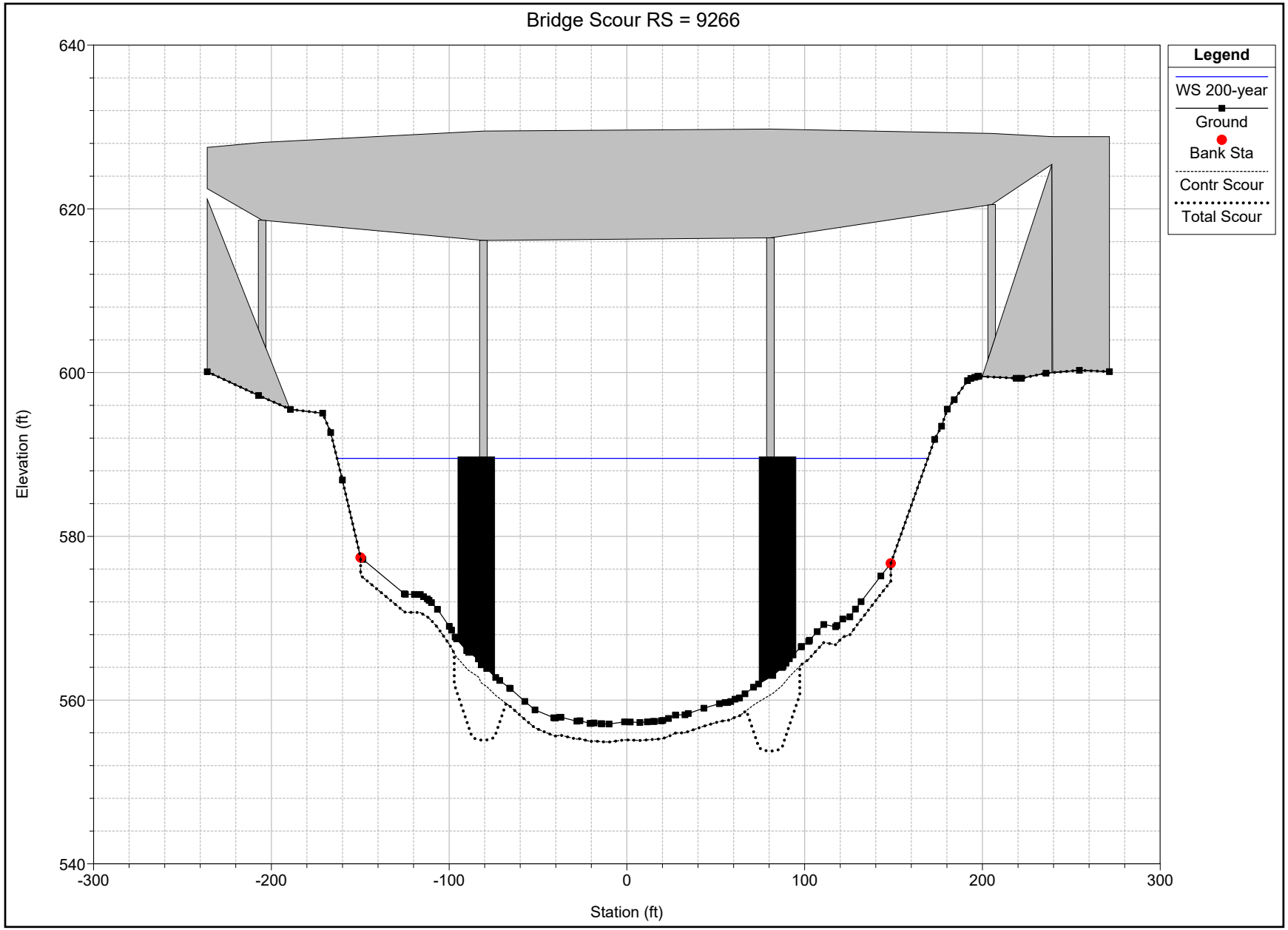
I-55 Over the Chicago Sanitary and Ship Canal Scour Summary
Existing Conditions - Blocking Cell
January 2018 Submittal

Event	Abutment/ Contraction Scour[1]	Pier Scour	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	15.7	2.0	17.7
Q_{200}	N/A	16.1	2.1	18.2

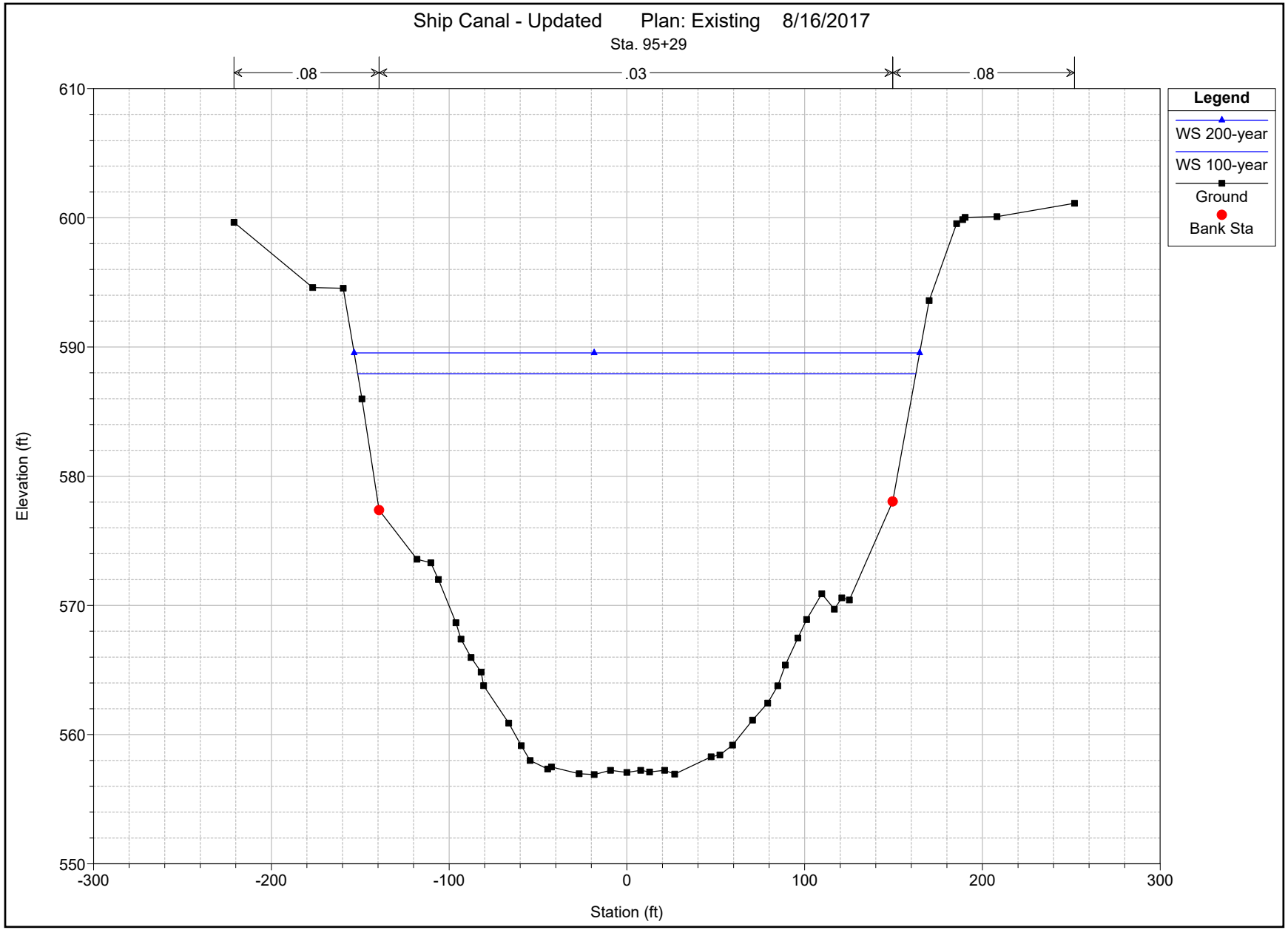
Note 1. Abutments are above and outside of flood limits.

Note 2. Includes Pier and Contraction Scour

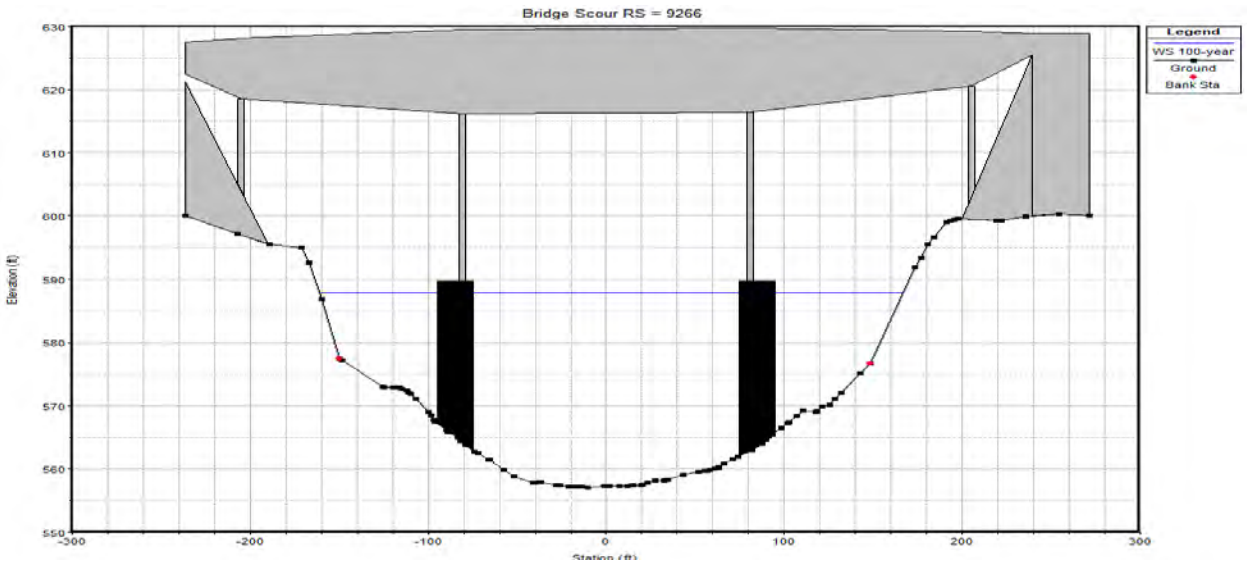
Existing Conditions
Approximate Scour Limits Plot



Approach XS 95+29



100-YR EXISTING HEC RAS OUTPUT



Contraction | Pier | Abutment

	LOB	Channel	ROB
Y1:	5.21	23.94	4.94
V1:	0.23	1.85	0.21
Y0:	5.23	23.69	5.60
Q2:	17.31	12748.47	34.22
W2:	11.43	256.95	18.26
D50:	0.20	0.20	0.20
Equation:	Defau	Defau	Defau

Live Bed Specific Data

Q1:	14.46	12771.96	13.58
W1:	12.09	288.90	13.04
K1:	K1 ...		

Approach XS River Sta.: 9529

Contraction | Pier | Abutment

Maximum V1 Y1 | Local V1 Y1

Pier # Apply to All Piers

Shape: Round nose

a: 3.50 D50: 0.20

Y1: 23.69 V1: 2.09 Fr1: 0.076

Method CSU equation

CSU's Eqn. Specific Data

K1: 1.00

Angle: 0.00 L: 212.00

K2: 1.00

K3: 1.1 - Clear-Water Scour

D95: 0.50 K4: 1.00

Froelich's Eqn. Specific Data

a': Phi: 1.00

Profile Output Table - Standard Table 1

File Options Std. Tables User Tables Locations Help

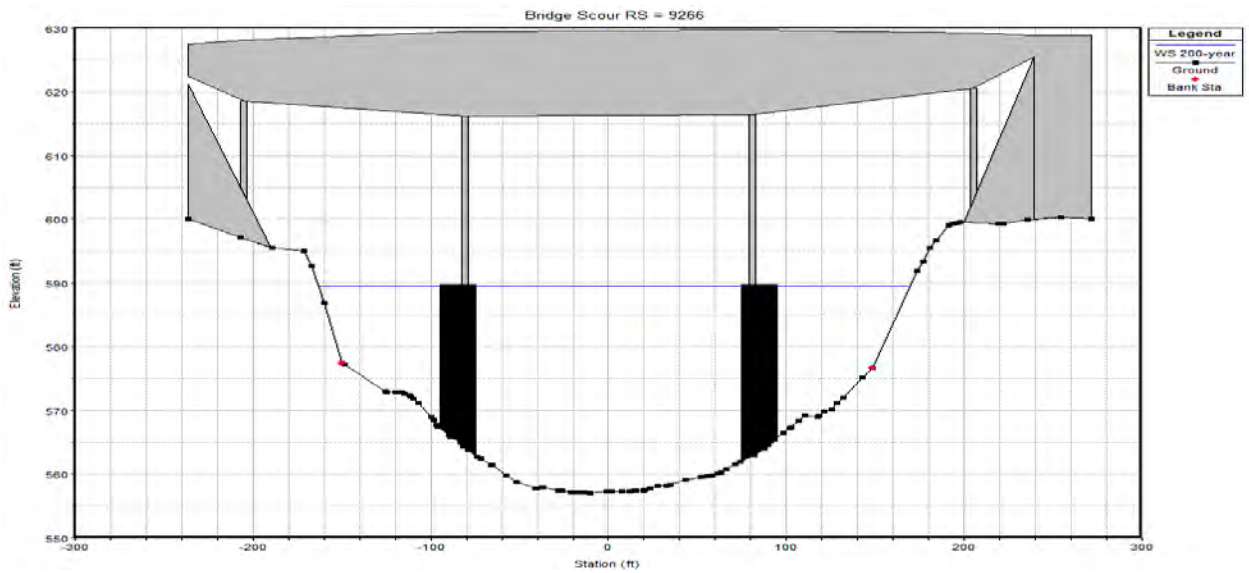
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 100-year

Reload Data

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	9529	100-year	12800.00	556.91	587.93	564.33	587.98	0.000021	1.85	7044.19	314.02	0.07
Ship Canal	9374.5	100-year	12800.00	557.08	587.91	564.83	587.98	0.000040	2.09	6248.00	286.64	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	100-year	12800.00	557.33	587.77	565.73	587.84	0.000038	2.03	6498.07	309.44	0.07

Total flow in cross section.

200-YR EXISTING HEC RAS OUTPUT



Contraction | Pier | Abutment

	LOB	Channel	ROB
Y1:	5.97	25.56	5.75
V1:	0.26	1.92	0.23
Y0:	6.01	25.30	6.41
Q2:	25.49	14125.29	49.22
W2:	13.27	256.95	20.89
D50:			
Equation:	Defau	Defau	Defau

Live Bed Specific Data

Q1:	21.67	14158.12	20.21
W1:	14.07	288.90	15.17
K1:	K1 ...		

Approach XS River Sta.: 9529

Contraction | Pier | Abutment

Maximum V1 Y1 | Local V1 Y1

Pier #: Apply to All Piers

Shape: Round nose

a: 3.50 D50: 0.20

Y1: 25.30 V1: 2.17 Fr1: 0.076

Method: CSU equation

CSU's Eqn. Specific Data

K1: 1.00

Angle: 0 L: 212.00

K2: 1.00

K3: 1.1 - Plane bed and Antidunes

D95: 0.50 K4: 1.00

Froelich's Eqn. Specific Data

a': Phi: 1.00

Profile Output Table - Standard Table 1

File Options Std. Tables User Tables Locations Help

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 200-year

Reload Data

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	9529	200-year	14200.00	556.91	589.54	564.76	589.60	0.000020	1.92	7554.84	318.14	0.07
Ship Canal	9374.5	200-year	14200.00	557.08	589.52	565.27	589.60	0.000041	2.17	6714.40	291.11	0.08
Ship Canal	9266		Bridge									

Total flow in cross section.

FHWA HEC-18, "Evaluating Scour at Bridges", Fifth Edition, April 2012

Chapter 6.2.1 Critical Velocity for Clear Water vs. Live Bed Contraction Scour

Stream: **Chicago Sanitary and Ship Canal** **By:** FDM 08/03/17
Route \ County: **I-55\Cook** **Checked:**
S.N.: **016-0014 and 016-0015**

$$V_c = K_u\, y^{1/6}\, D^{1/3}$$ Eq. 6.1

K_u =	11.17	English units
y =	23.94	Average depth of flow upstream of the bridge, ft
D_{50} =	0.2	Grain size, mm
V_{100} =	1.85	Mean velocity, channel or overbank, fps

V_c =	1.65	ft/s

100-Year channel or overbank

If $V_c > V_{100}$, clear water scour exists.

If $V_{100} > V_c$, live bed scour exists.

FHWA HEC-18, "Evaluating Scour at Bridges", Fifth Edition, April 2012

Chapter 6.2.1 Critical Velocity for Clear Water vs. Live Bed Contraction Scour

Stream: **Chicago Sanitary and Ship Canal** **By:** FDM 08/03/17
Route \ County: **I-55\Cook** **Checked:**
S.N.: **016-0014 and 016-0015**

$$V_c = K_u\, y^{1/6}\, D^{1/3}$$ Eq. 6.1

K_u =	11.17	English units
y =	25.56	Average depth of flow upstream of the bridge, ft
D_{50} =	0.2	Grain size, mm
V_{200} =	1.92	Mean velocity, channel or overbank, fps

V_c =	1.67	ft/s

200-Year channel or overbank

If $V_c > V_{200}$, clear water scour exists.

If $V_{200} > V_c$, live bed scour exists.

Pier Scour

Pier # 2 and 3

Stream: Chicago Sanitary and Ship Canal **By:** FDM 11/10/2017

Route \ County: I-55\Cook **Checked:**

S.N.: 016-0014 and 016-0015

				Q_{100}	Q_{200}
Attack angle of flow	(theta)	deg.		0	0
Length of pier	(L)	ft		212	212
Width of pier	(a)	ft		5.5	5.5
Average Velocity	(V)	fps		2.09	2.17
Depth of flow at pier	(y_1)	ft		23.69	25.3
Pier type code		(1 thru 5)		2	2
(maximum = 12)		L/a =		12	12
		K_1 =		1.0	1.0
		K_2 =		1.0	1.0
		K_3 =		1.1	1.1
		Fr =		0.076	0.076
Depth of Pier Scour, y_s =				**6.6**	**6.8**
				{ft}	{ft}	{ft}

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 \left(\frac{y_1}{a}\right)^{0.35} Fr^{0.43}$$

$$Fr = \frac{V}{(g y_1)^{\frac{1}{2}}}$$

assumptions \ directions:

- **The correction factor for pier nose shape is taken from HEC-18 Table 7.1. However, for an attack angle > 5 degrees, K_1 is equal to unity. In that case, use pier type code 2.**
- **K_2 is computed with the formula located below Table 7.2.**
- **K_3 is set at 1.1, which represents the absence of dunes or a dune bed configuration with crest heights under 10 feet. (See Table 7.3 from HEC-18.) Adjust this accordingly for dune heights > 10 feet.**

NOTE: This spreadsheet computes pier scour under the assumption the footing or pile cap is not exposed by some combination of contraction scour, long-term degradation or stream migration. If that is not the case, then scour due to the footing or pile cap may control. See Ch. 6 of HEC-18.

Pier Scour

Pier # 2 and 3 Protective Cells

Stream: Chicago Sanitary and Ship Canal **By:** EMB 1 /24/2018

Route \ County: I-55\Cook **Checked:**

S.N.: 016-0014 and 016-0015

				Q_{100}	Q_{200}
Attack angle of flow	(theta)	deg.		0	0
Length of pier	(L)	ft		231.67	231.67
Width of pier	(a)	ft		20.64	20.64
Average Velocity	(V)	fps		2.09	2.17
Depth of flow at pier	(y_1)	ft		23.69	25.3
Pier type code		(1 thru 5)		2	2
(maximum = 12)		L/a =		11	11
		K_1 =		1.0	1.0
		K_2 =		1.0	1.0
		K_3 =		1.1	1.1
		Fr =		0.076	0.076
Depth of Pier Scour, y_s =				**15.7**	**16.1**
			{ft}	{ft}	{ft}

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 \left(\frac{y_1}{a}\right)^{0.35} Fr^{0.43}$$

$$Fr = \frac{V}{(g y_1)^{\frac{1}{2}}}$$

assumptions \ directions:

- **The correction factor for pier nose shape is taken from HEC-18 Table 7.1. However, for an attack angle > 5 degrees, K_1 is equal to unity. In that case, use pier type code 2.**
- **K_2 is computed with the formula located below Table 7.2.**
- **K_3 is set at 1.1, which represents the absence of dunes or a dune bed configuration with crest heights under 10 feet. (See Table 7.3 from HEC-18.) Adjust this accordingly for dune heights > 10 feet.**

NOTE: This spreadsheet computes pier scour under the assumption the footing or pile cap is not exposed by some combination of contraction scour, long-term degradation or stream migration. If that is not the case, then scour due to the footing or pile cap may control. See Ch. 6 of HEC-18.

Contraction Scour

Stream:	Chicago Sanitary and Ship Canal
Route \ County:	I-55\ Cook
S.N. :	016-0014 and 016-0015

By: FDM 8/3/17

Checked:

			Q_{100}	Q_{200}
Hydraulic Depth @ APPR XS 9529	(y_1)	ft	23.94	25.56
Channel TopWidth @ APPR XS 9529	(W_1)	ft	288.9	288.9
Channel Top Width @ BRIDG XS 9266U	(W_2)	ft	256.95	256.95
Contracted Channel Flow @ BRIDG XS 9266U	(Q_2)	cfs	12748.47	14125.29
Main Channel Flow @ APPR XS 9529	(Q_1)	cfs	12771.96	14158.12
Slope of Energy Grade line @ APPR XS 9529	(S_1)		0.000021	0.000020
	V_*		0.127	0.128
Vratio; ShearV/FallV			2.5	2.5
	k_1	=	0.69	0.69
	k_2	=	0.37	0.37
	y_2	=	25.9	27.7
Depth of Contraction Scour,	$y_{(scour)}$	=	**2.0**	**2.1**
			{ft}	{ft} {ft}

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_{(scour)} = y_2 - y_o$$

Vratio; V_*/ω	k_1	k_2	Mode of Bed Material Transport
<0.50	0.59	0.066	Mostly contact bed material discharge
0.50 to 2.0	0.64	0.21	Some suspended bed material discharge
>2.0	0.69	0.37	Mostly suspended bed material discharge

$$V_* = (g y_1 S_1)^{\frac{1}{2}}$$

V_* = Shear velocity (ShearV) in upstream section, (fps)

ω = Median fall velocity (FallV) of bed material based on the D_{50}, (fps)

g = Acceleration of gravity, (32.2 ft/s^2)

S_1 = Slope of energy grade line of main channel, (ft/ft)

D_{50} = median diameter of the bed material, (ft)

assumptions \ directions:

* **$y_o = y_1$ (y_o = existing depth at bridge section before scour)**
* **To be conservative, V_*/ω can be assumed to be 2.5**

Based on HEC-18; Evaluating Scour at Bridges
April 2012 5th Edition
Eq. 6.2 (Live bed scour)

Stream: **CSSC** **By:** FDM 11/10/2017
Route \ County: **I-55\Cook** **Checked:**

I-55 Over the Chicago Sanitary and Ship Canal Scour Summary
Proposed Conditions-Pier
August 2017 Submittal

Event	Abutment/ Contraction Scour[1]	Pier Scour	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	6.6	2.0	8.6
Q_{200}	N/A	6.8	2.1	8.9

Note 1. Abutments are above and outside of flood limits.

Note 2. Includes Pier and Contraction Scour

Stream: **CSSC** **By:** EMB 1/24/2018
Route \ County: **I-55\Cook** **Checked:**

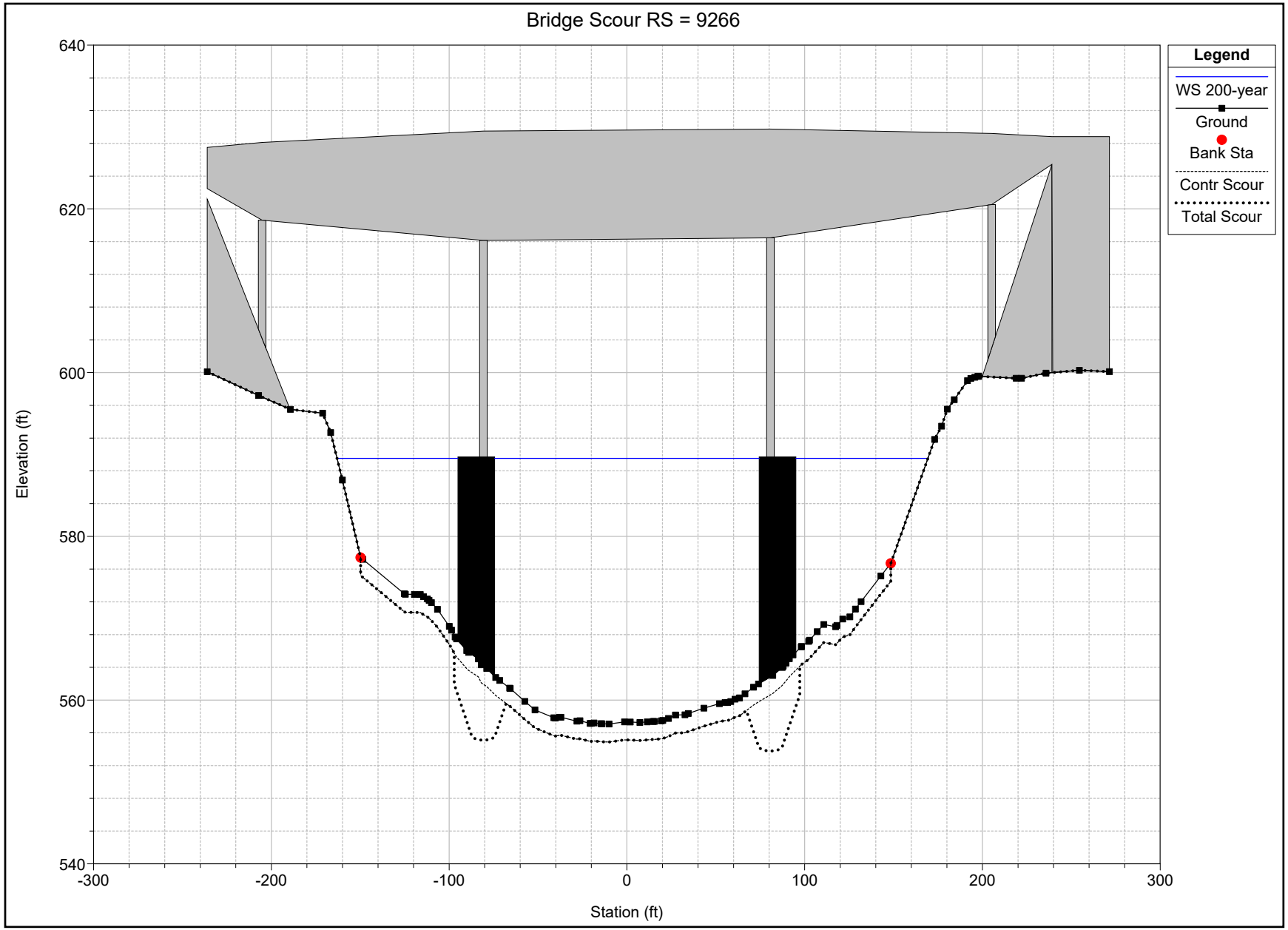
I-55 Over the Chicago Sanitary and Ship Canal Scour Summary
Proposed Conditions- Blocking Cell
August 2017 Submittal

Event	Abutment/ Contraction Scour[1]	Pier Scour	Contraction Scour	Total Pier Scour Depth[2]
Q_{100}	N/A	15.7	2.0	17.7
Q_{200}	N/A	16.1	2.1	18.2

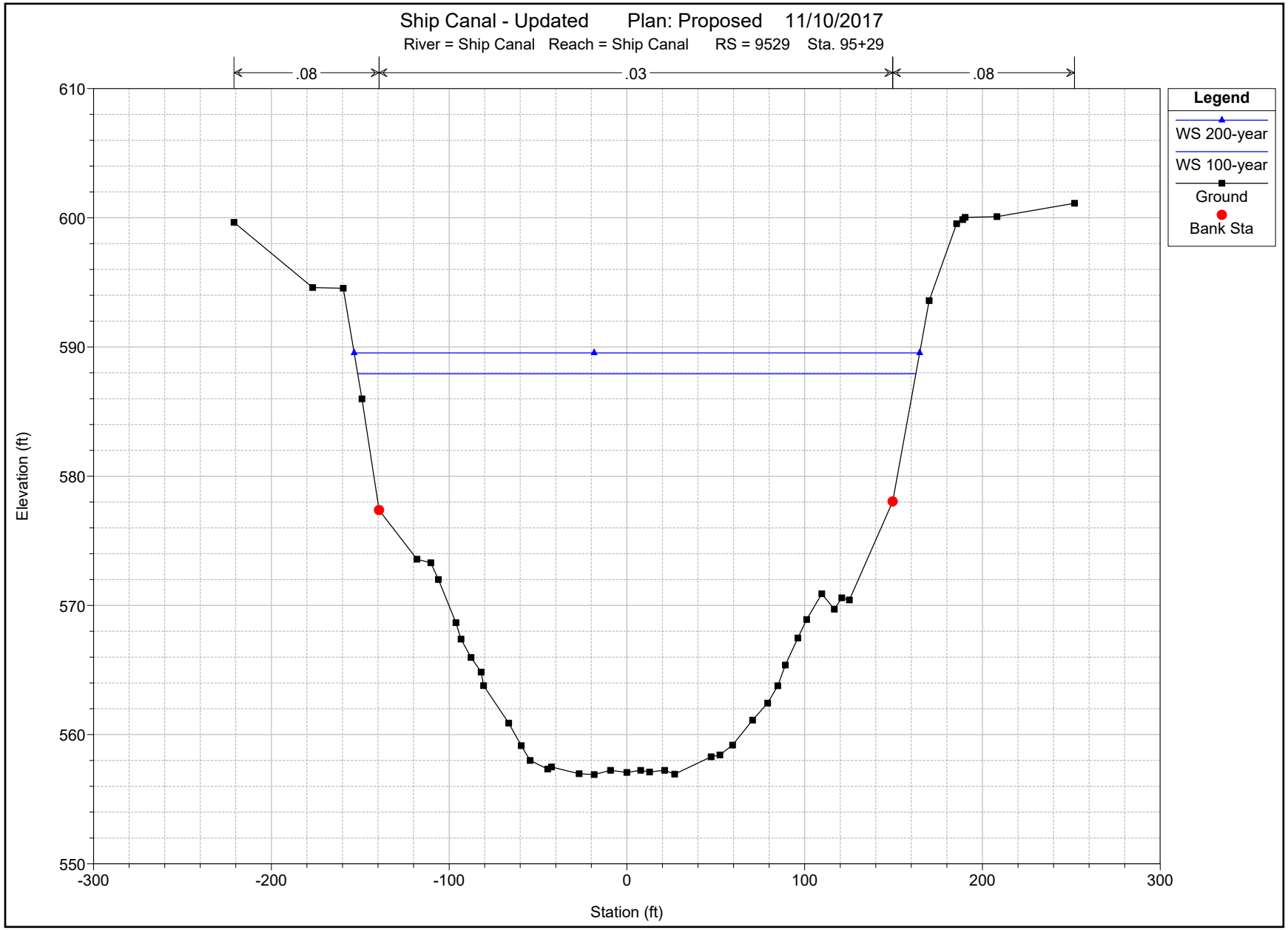
Note 1. Abutments are above and outside of flood limits.

Note 2. Includes Pier and Contraction Scour

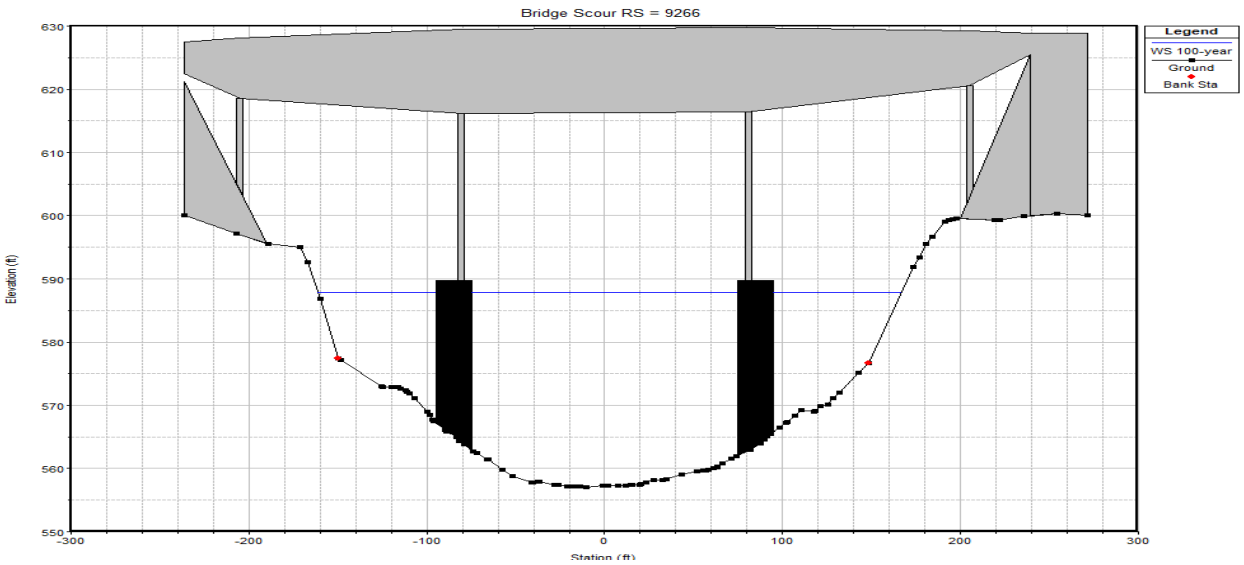
Proposed Conditions
Approximate Scour Limits Plot



Approach XS 95+29



100-YR PROPOSED HEC RAS OUTPUT



Contraction | Pier | Abutment

	LOB	Channel	ROB
Y1:	5.21	23.94	4.94
V1:	0.23	1.85	0.21
Y0:	5.23	23.69	5.60
Q2:	17.31	12748.47	34.22
W2:	11.43	256.95	18.26
D50:	0.20	0.20	0.20
Equation:	Defau	Defau	Defau

Live Bed Specific Data

Q1:	14.46	12771.96	13.58
W1:	12.09	288.90	13.04
K1:	K1 ...		

Approach XS River Sta.: 9529

Contraction | Pier | Abutment

Maximum V1 Y1 | Local V1 Y1

Pier #: #2 (CL = -80.74)

Shape: Round nose

a: 5.50 D50: 0.20

Y1: 23.69 V1: 2.09 Fr1: 0.076

Method: CSU equation

CSU's Eqn. Specific Data

K1: 1.00

Angle: 0.00 L: 231.67

K2: 1.00

K3: 1.1 - Clear-Water Scour

D95: 0.50 K4: 1.00

Froelich's Eqn. Specific Data

a': Phi: 1.00

Profile Output Table - Standard Table 1

File Options Std. Tables User Tables Locations Help

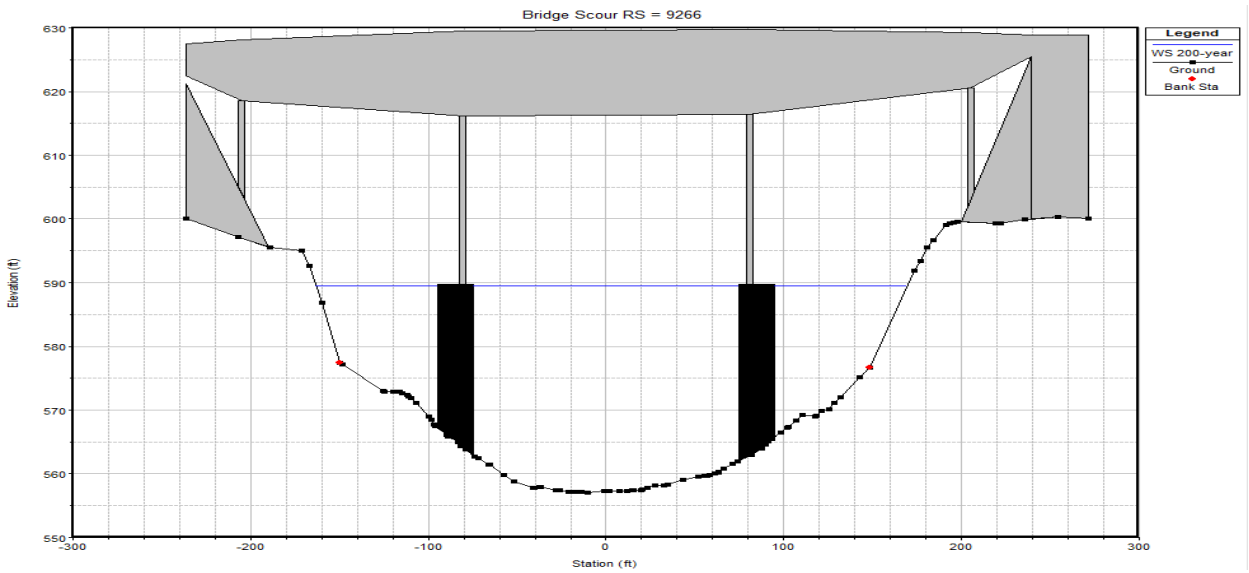
HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 100-year

Reload Data

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	9529	100-year	12800.00	556.91	587.93	564.33	587.98	0.000021	1.85	7044.19	314.02	0.07
Ship Canal	9374.5	100-year	12800.00	557.08	587.91	564.83	587.98	0.000040	2.09	6248.00	286.64	0.08
Ship Canal	9266		Bridge									
Ship Canal	9141.67	100-year	12800.00	557.33	587.77	565.73	587.84	0.000038	2.03	6498.07	309.44	0.07

Total flow in cross section.

200-YR PROPOSED HEC RAS OUTPUT



Contraction | Pier | Abutment

	LOB	Channel	ROB
Y1:	5.97	25.56	5.75
V1:	0.26	1.92	0.23
Y0:	6.01	25.30	6.41
Q2:	25.49	14125.29	49.22
W2:	13.27	256.95	20.89
D50:			
Equation:	Defau	Defau	Defau

Live Bed Specific Data

Q1:	21.67	14158.12	20.21
W1:	14.07	288.90	15.17
K1:	K1 ...		

Approach XS River Sta.: 9529

Contraction | Pier | Abutment

Maximum V1 Y1 | Local V1 Y1

Pier #: #2 (CL = -80.74)

Shape: Round nose

a: 5.50 D50: 0.20

Y1: 25.30 V1: 2.17 Fr1: 0.076

Method: CSU equation

CSU's Eqn. Specific Data

K1: 1.00

Angle: 0.00 L: 231.67

K2: 1.00

K3: 1.1 - Clear-Water Scour

D95: 0.50 K4: 1.00

Froelich's Eqn. Specific Data

a': Phi: 1.00

Profile Output Table - Standard Table 1

File Options Std. Tables User Tables Locations Help

HEC-RAS Plan: Existing River: Ship Canal Reach: Ship Canal Profile: 200-year

Reload Data

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Ship Canal	9529	200-year	14200.00	556.91	589.54	564.76	589.60	0.000020	1.92	7554.84	318.14	0.07
Ship Canal	9374.5	200-year	14200.00	557.08	589.52	565.27	589.60	0.000041	2.17	6714.40	291.11	0.08
Ship Canal	9266		Bridge									

Total flow in cross section.

FHWA HEC-18, "Evaluating Scour at Bridges", Fifth Edition, April 2012

Chapter 6.2.1 Critical Velocity for Clear Water vs. Live Bed Contraction Scour

Stream: Chicago Sanitary and Ship Canal **By:** FDM 11/10/17
Route \ County: I-55\Cook **Checked:**
S.N.: 016-0014 and 016-0015

$$V_c = K_u \, y^{1/6} \, D^{1/3}$$ Eq. 6.1

K_u =	11.17	English units
y =	23.94	Average depth of flow upstream of the bridge, ft
D_{50} =	0.2	Grain size, mm
V_{100} =	1.85	Mean velocity, channel or overbank, fps

V_c =	1.65	ft/s

100-Year channel or overbank

If $V_c > V_{100}$, clear water scour exists.

If $V_{100} > V_c$, live bed scour exists.

FHWA HEC-18, "Evaluating Scour at Bridges", Fifth Edition, April 2012

Chapter 6.2.1 Critical Velocity for Clear Water vs. Live Bed Contraction Scour

Stream: Chicago Sanitary and Ship Canal **By:** FDM 11/10/17
Route \ County: I-55\Cook **Checked:**
S.N.: 016-0014 and 016-0015

$$V_c = K_u \, y^{1/6} \, D^{1/3}$$ Eq. 6.1

K_u =	11.17	English units
y =	25.56	Average depth of flow upstream of the bridge, ft
D_{50} =	0.2	Grain size, mm
V_{200} =	1.92	Mean velocity, channel or overbank, fps

V_c =	1.67	ft/s

200-Year channel or overbank

If $V_c > V_{200}$, clear water scour exists.

If $V_{200} > V_c$, live bed scour exists.

Pier Scour

Pier # 2 and 3

Stream: Chicago Sanitary and Ship Canal **By:** FDM 11/10/2017

Route \ County: I-55\Cook **Checked:**

S.N.: 016-0014 and 016-0015

				Q_{100}	Q_{200}
Attack angle of flow	(theta)	deg.		0	0
Length of pier	(L)	ft		231.67	231.67
Width of pier	(a)	ft		5.5	5.5
Average Velocity	(V)	fps		2.09	2.17
Depth of flow at pier	(y_1)	ft		23.69	25.3
Pier type code		(1 thru 5)		2	2
(maximum = 12)		L/a =		12	12
		K_1 =		1.0	1.0
		K_2 =		1.0	1.0
		K_3 =		1.1	1.1
		Fr =		0.076	0.076
Depth of Pier Scour, y_s =				**6.6**	**6.8**
				{ft}	{ft}

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 \left(\frac{y_1}{a}\right)^{0.35} Fr^{0.43}$$

$$Fr = \frac{V}{(g y_1)^{\frac{1}{2}}}$$

assumptions \ directions:

- **The correction factor for pier nose shape is taken from HEC-18 Table 7.1. However, for an attack angle > 5 degrees, K_1 is equal to unity. In that case, use pier type code 2.**
- **K_2 is computed with the formula located below Table 7.2.**
- **K_3 is set at 1.1, which represents the absence of dunes or a dune bed configuration with crest heights under 10 feet. (See Table 7.3 from HEC-18.) Adjust this accordingly for dune heights > 10 feet.**

NOTE: This spreadsheet computes pier scour under the assumption the footing or pile cap is not exposed by some combination of contraction scour, long-term degradation or stream migration. If that is not the case, then scour due to the footing or pile cap may control. See Ch. 6 of HEC-18.

Pier Scour

Pier # 2 and 3 Protective Cells

Stream: Chicago Sanitary and Ship Canal **By:** EMB 1 /24/2018

Route \ County: I-55\Cook **Checked:**

S.N.: 016-0014 and 016-0015

				Q_{100}	Q_{200}
Attack angle of flow	(theta)	deg.		0	0
Length of pier	(L)	ft		231.67	231.67
Width of pier	(a)	ft		20.64	20.64
Average Velocity	(V)	fps		2.09	2.17
Depth of flow at pier	(y_1)	ft		23.69	25.3
Pier type code		(1 thru 5)		2	2
(maximum = 12)		L/a =		11	11
		K_1 =		1.0	1.0
		K_2 =		1.0	1.0
		K_3 =		1.1	1.1
		Fr =		0.076	0.076
Depth of Pier Scour, y_s =				**15.7**	**16.1**
			{ft}	{ft}	{ft}

$$\frac{y_s}{a} = 2.0 K_1 K_2 K_3 \left(\frac{y_1}{a}\right)^{0.35} Fr^{0.43}$$

$$Fr = \frac{V}{(g y_1)^{\frac{1}{2}}}$$

assumptions \ directions:

- **The correction factor for pier nose shape is taken from HEC-18 Table 7.1. However, for an attack angle > 5 degrees, K_1 is equal to unity. In that case, use pier type code 2.**
- **K_2 is computed with the formula located below Table 7.2.**
- **K_3 is set at 1.1, which represents the absence of dunes or a dune bed configuration with crest heights under 10 feet. (See Table 7.3 from HEC-18.) Adjust this accordingly for dune heights > 10 feet.**

NOTE: This spreadsheet computes pier scour under the assumption the footing or pile cap is not exposed by some combination of contraction scour, long-term degradation or stream migration. If that is not the case, then scour due to the footing or pile cap may control. See Ch. 6 of HEC-18.

Contraction Scour

Stream:	Chicago Sanitary and Ship Canal
Route \ County:	I-55\ Cook
S.N. :	016-0014 and 016-0015

By: FDM 11/10/17

Checked:

			Q_{100}	Q_{200}
Hydraulic Depth @ APPR XS 9529	(y_1)	ft	23.94	25.56
Channel TopWidth @ APPR XS 9529	(W_1)	ft	288.9	288.9
Channel Top Width @ BRIDG XS 9266U	(W_2)	ft	256.95	256.95
Contracted Channel Flow @ BRIDG XS 9266U	(Q_2)	cfs	12748.47	14125.29
Main Channel Flow @ APPR XS 9529	(Q_1)	cfs	12771.96	14158.12
Slope of Energy Grade line @ APPR XS 9529	(S_1)		0.000021	0.000020
	V_*		0.127	0.128
Vratio; ShearV/FallV			2.5	2.5
	k_1	=	0.69	0.69
	k_2	=	0.37	0.37
	y_2	=	25.9	27.7
Depth of Contraction Scour,	$y_{(scour)}$	=	**2.0**	**2.1**
			{ft}	{ft} {ft}

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_{(scour)} = y_2 - y_o$$

Vratio; V_*/ω	k_1	k_2	Mode of Bed Material Transport
<0.50	0.59	0.066	Mostly contact bed material discharge
0.50 to 2.0	0.64	0.21	Some suspended bed material discharge
>2.0	0.69	0.37	Mostly suspended bed material discharge

$$V_* = (g y_1 S_1)^{\frac{1}{2}}$$

V_* = Shear velocity (ShearV) in upstream section, (fps)

ω = Median fall velocity (FallV) of bed material based on the D_{50}, (fps)

g = Acceleration of gravity, (32.2 ft/s^2)

S_1 = Slope of energy grade line of main channel, (ft/ft)

D_{50} = median diameter of the bed material, (ft)

assumptions \ directions:

* **$y_o = y_1$ (y_o = existing depth at bridge section before scour)**
* **To be conservative, V_*/ω can be assumed to be 2.5**

Based on HEC-18; Evaluating Scour at Bridges
April 2012 5th Edition
Eq. 6.2 (Live bed scour)

ILLINOIS DEPARTMENT OF TRANSPORTATION

I-55 HYDROGRAPHIC SURVEYS

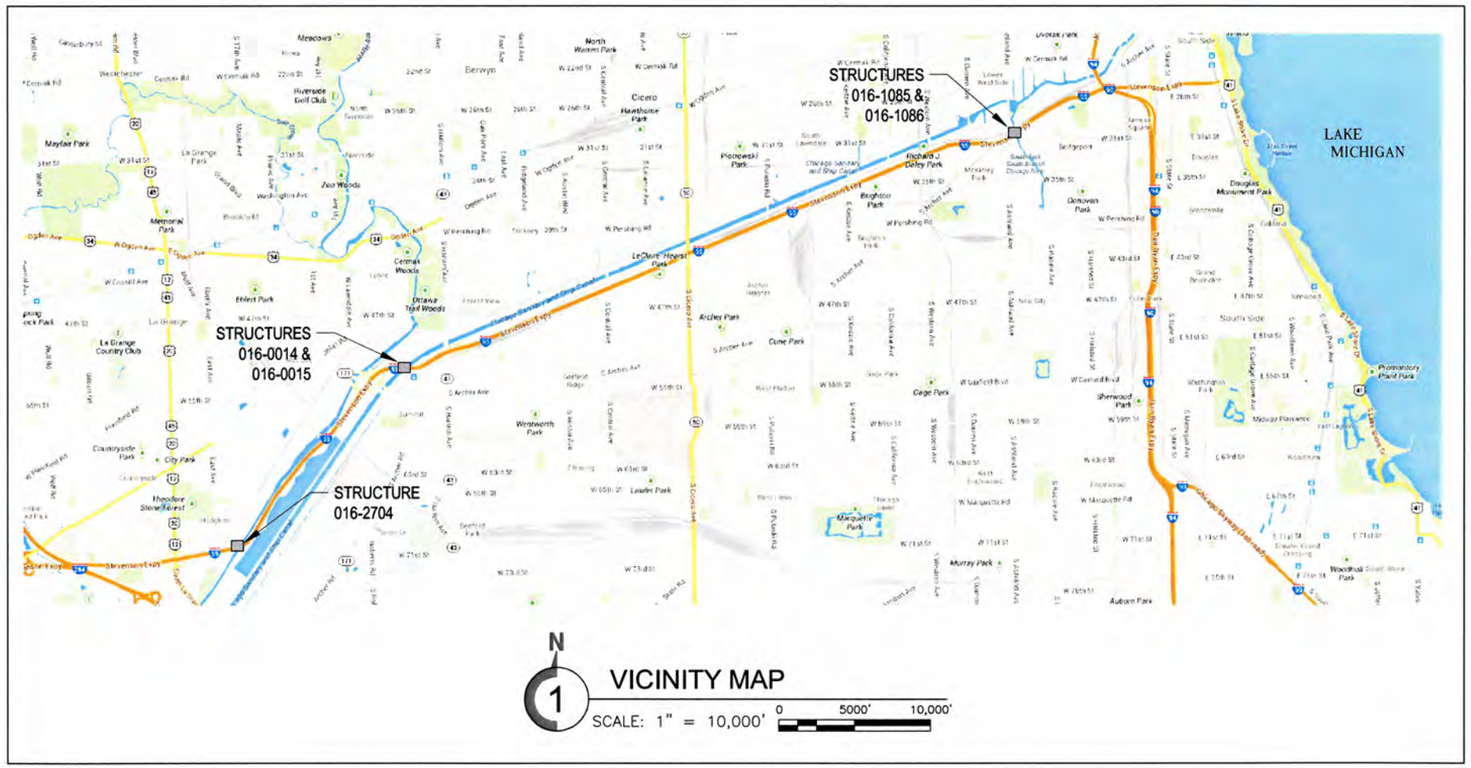
OVER THE SOUTH FORK OF THE CHICAGO RIVER,
THE CHICAGO SANITARY AND SHIP CANAL AND
THE DES PLANES RIVER
COOK COUNTY, IL

CLIENT:
STANTEC
JOHN V. O'HOLLERAN, P.E.
135 S. LA SALLE ST
SUITE 3100
CHICAGO, IL 60603
312-262-2400
JOHN.OHOLLERAN@STANTEC.COM

CIVIL ENGINEER/SURVEYOR:
COLLINS ENGINEERS, INC.
NICHOLAS R. TRIANDAFILOU, P.E., S.E.
123 N WACKER DR.
SUITE 900
CHICAGO, IL 60606
312-236-7004
NTRIANDAFILOU@COLLINSENGR.COM

Nicholas R. Triandafilou
062-060449
LICENSED PROFESSIONAL ENGINEER OF ILLINOIS
EXP. 11-30-2013

INDEX OF DRAWINGS



COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

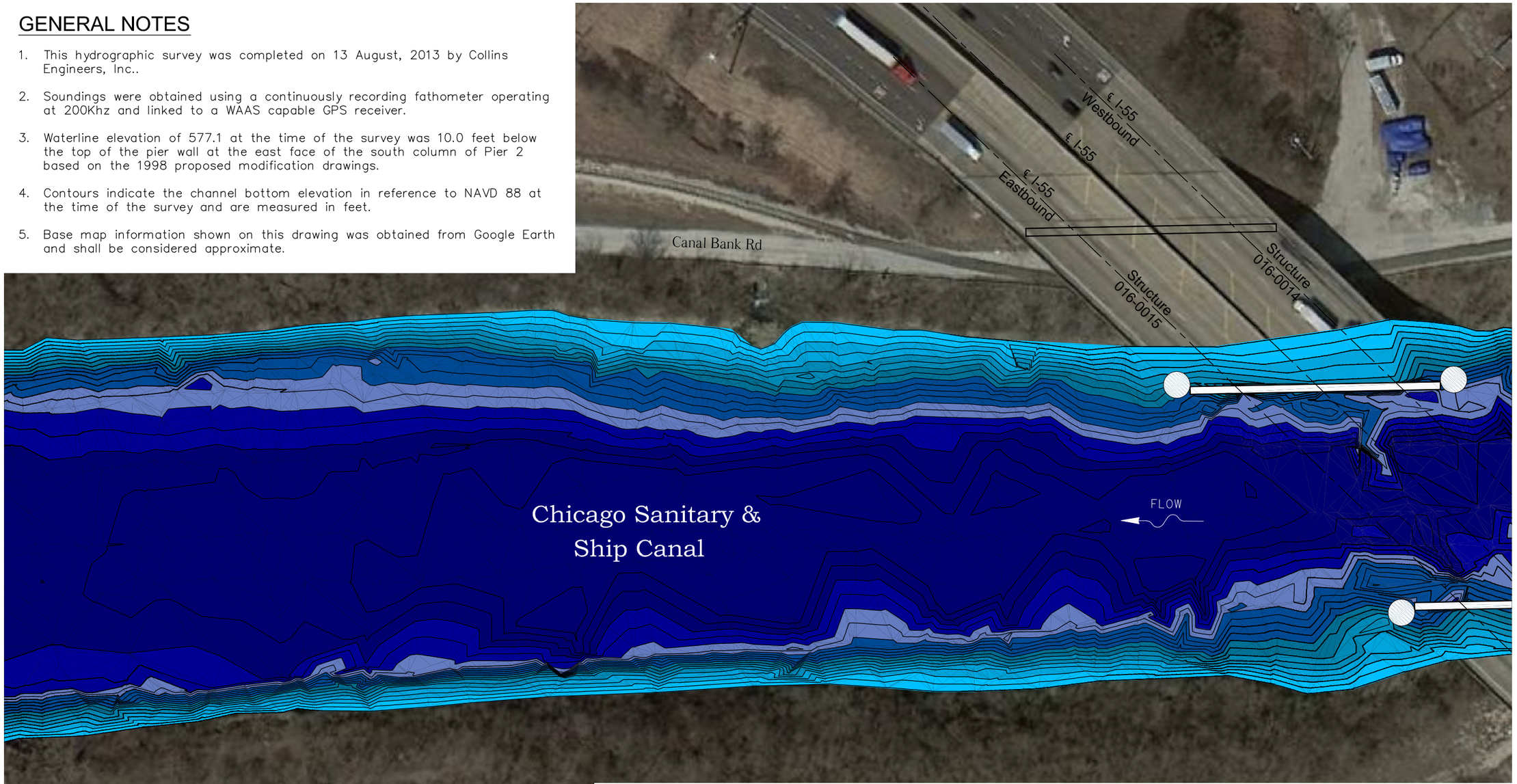
I-55 Hydrographic Surveys
Title Sheet
Cook County, IL

CEI PROJECT	10-08095
SURVEYED BY:	CSH
DRAWN BY:	CSH
CHECKED BY:	NRT
DATE:	13 AUG 2013
SHEET NO:	H-01

G:\8095-10 I-55 CHANNEL SURVEYS\CAD\SHEET DRAWINGS\8095 - TITLE.DWG 09/30/2013 03:22:25 PM

GENERAL NOTES

1. This hydrographic survey was completed on 13 August, 2013 by Collins Engineers, Inc..
2. Soundings were obtained using a continuously recording fathometer operating at 200Khz and linked to a WAAS capable GPS receiver.
3. Waterline elevation of 577.1 at the time of the survey was 10.0 feet below the top of the pier wall at the east face of the south column of Pier 2 based on the 1998 proposed modification drawings.
4. Contours indicate the channel bottom elevation in reference to NAVD 88 at the time of the survey and are measured in feet.
5. Base map information shown on this drawing was obtained from Google Earth and shall be considered approximate.



1 HYDROGRAPHIC SURVEY - SOUTH HALF

SCALE: 1" = 80' (0, 40', 80')

ELEVATION KEY		
Max. Elev.	Min. Elev.	Color
577.1	575.0	
575.0	573.0	
573.0	571.0	
571.0	569.0	
569.0	565.0	
565.0	563.0	
563.0	561.0	
561.0	557.0	

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

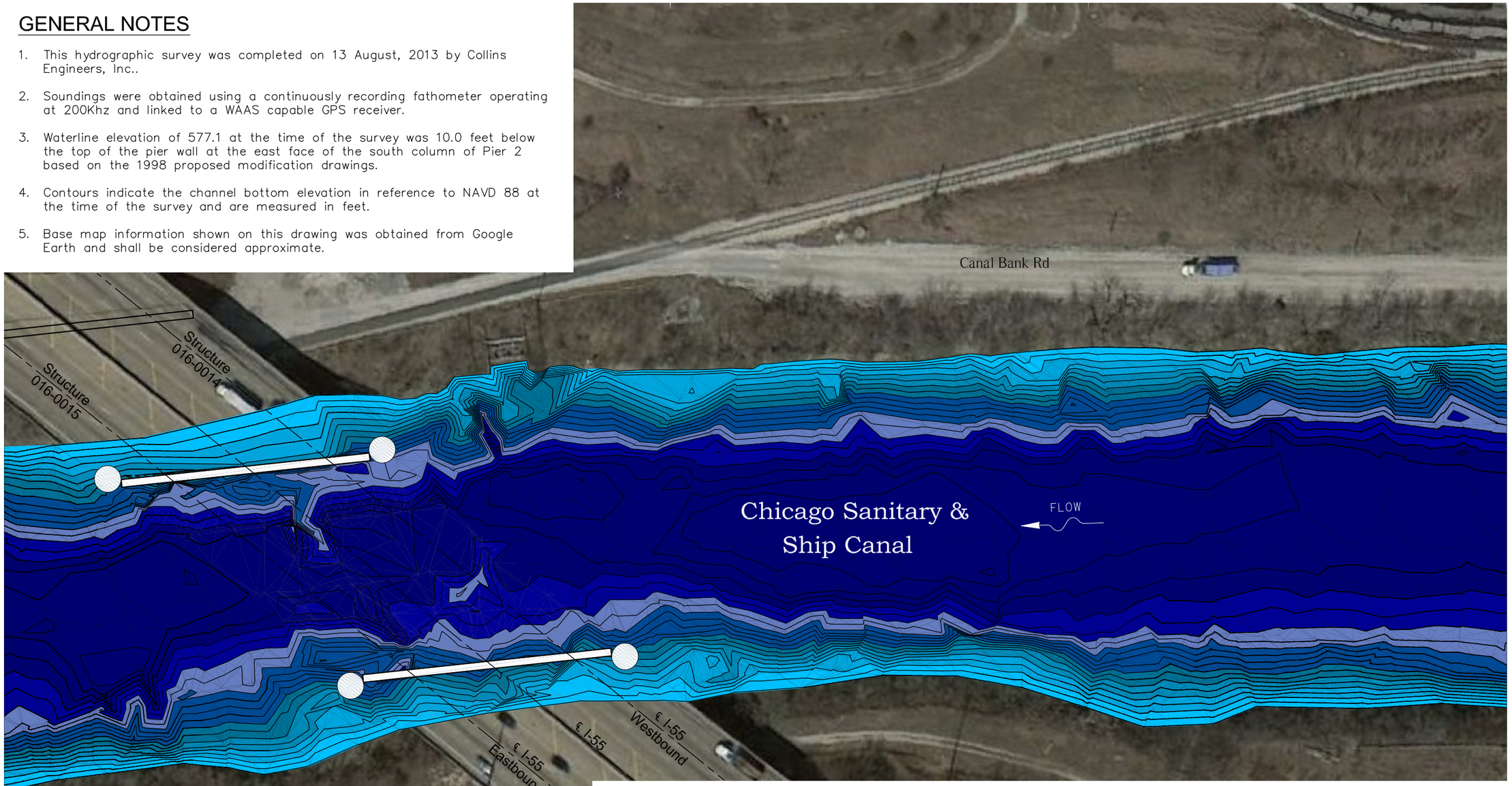
Illinois Department of Transportation

I-55 Hydrographic surveys
Structures 016-0014 & 016-0015
Overall - South Half
Cook County, IL

CEI PROJECT	10-08095
SURVEYED BY:	CSH
DRAWN BY:	CSH
CHECKED BY:	NRT
DATE:	13 AUG 2013
SHEET NO:	H-08

GENERAL NOTES

1. This hydrographic survey was completed on 13 August, 2013 by Collins Engineers, Inc..
2. Soundings were obtained using a continuously recording fathometer operating at 200Khz and linked to a WAAS capable GPS receiver.
3. Waterline elevation of 577.1 at the time of the survey was 10.0 feet below the top of the pier wall at the east face of the south column of Pier 2 based on the 1998 proposed modification drawings.
4. Contours indicate the channel bottom elevation in reference to NAVD 88 at the time of the survey and are measured in feet.
5. Base map information shown on this drawing was obtained from Google Earth and shall be considered approximate.



1 HYDROGRAPHIC SURVEY - NORTH HALF

SCALE: 1" = 80' 0 40' 80'

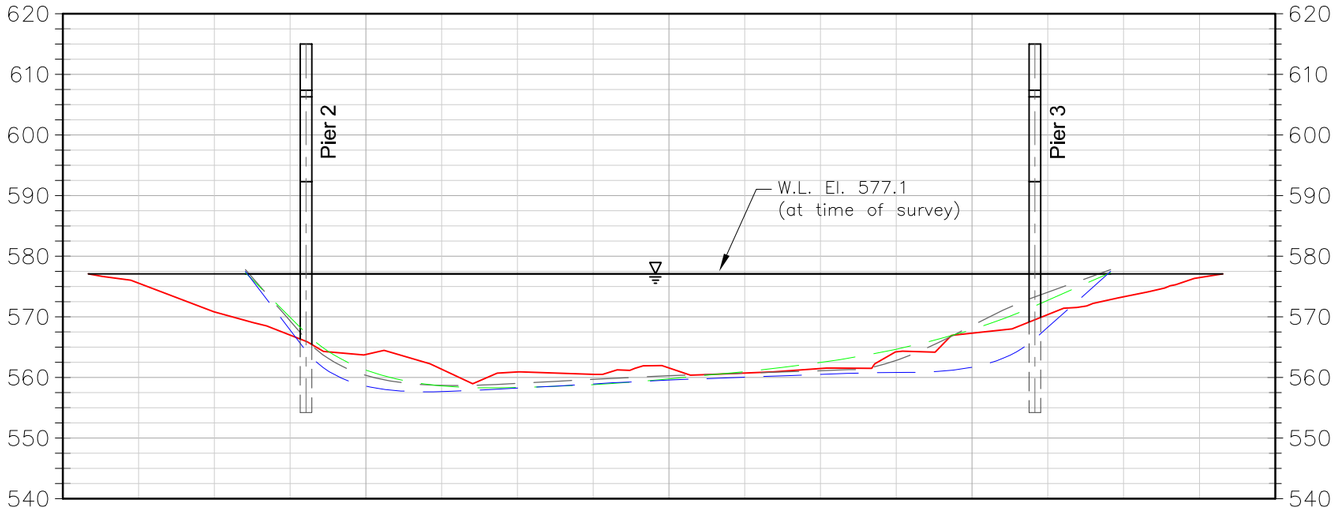
ELEVATION KEY		
Max. Elev.	Min. Elev.	Color
577.1	575.0	
575.0	573.0	
573.0	571.0	
571.0	569.0	
569.0	565.0	
565.0	563.0	
563.0	561.0	
561.0	557.0	

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

I-55 Hydrographic Surveys
Structure 016-0014 & 016-0015
Overall - North Half
Cook County, IL

CEI PROJECT	10–08095
SURVEYED BY:	CSH
DRAWN BY:	CSH
CHECKED BY:	NRT
DATE:	13 AUG 2013
SHEET NO:	H-09



UPSTREAM FASCIA
CHANNEL CROSS SECTION
(LOOKING NORTH)

1

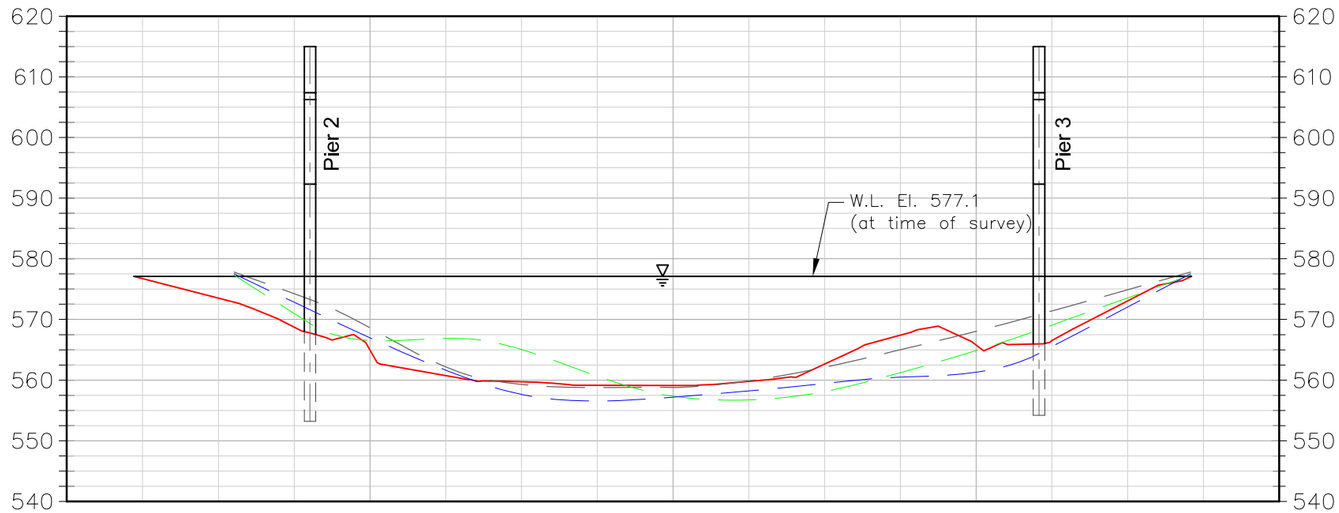
SCALE: H:1" = 50' V:1" = 25'

LEGEND

- 2013 Channel Bottom
- 2011 Channel Bottom
- 2007 Channel Bottom
- 2002 Channel Bottom

GENERAL NOTES

1. This hydrograpic survey was completed on 13 August, 2013 by Collins Engineers, Inc..
2. Soundings were obtained using a continuously recording fathometer operating at 200Khz and linked to a WAAS capable GPS receiver.
3. Waterline elevation of 577.1 at the time of the survey was 10 feet below the top of the pier wall at the east face of the south column of Pier 2 based on the 1998 proposed modification drawings.
4. Channel bottom data prior to 2013 was taken from previous routine underwater inspection reports by Collins Engineers, Inc.



DOWNSTREAM FASCIA
CHANNEL CROSS SECTION
(LOOKING NORTH)

2

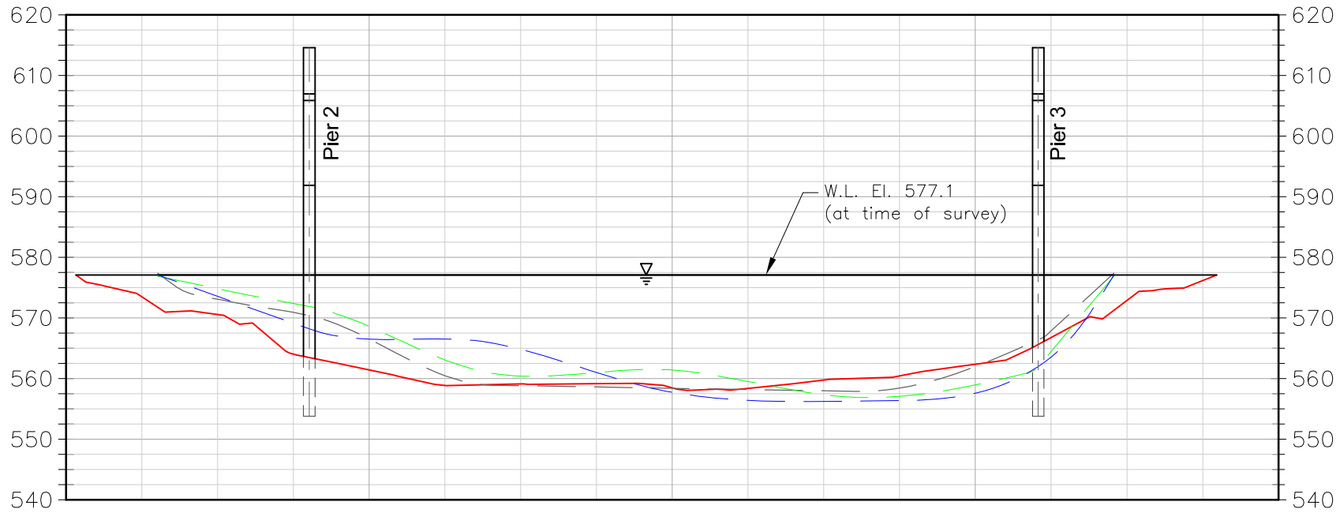
SCALE: H:1" = 50' V:1" = 25'

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

I-55 Hydrographic Surveys
Structures 016-0014 & 016-0015
Channel Cross Sections
Cook County, IL

CEI PROJECT	10–08095
SURVEYED BY:	CSH
DRAWN BY:	CSH
CHECKED BY:	NRT
DATE:	13 AUG 2013
SHEET NO:	H-10



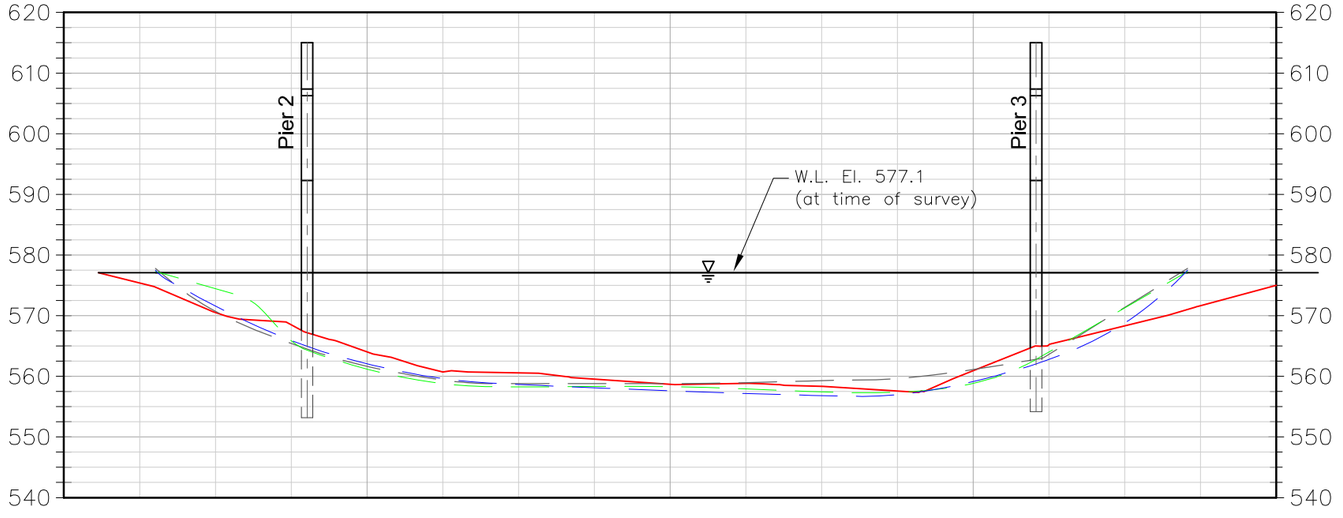
LEGEND

- 2013 Channel Bottom
- 2011 Channel Bottom
- 2007 Channel Bottom
- 2002 Channel Bottom

100' UPSTREAM CHANNEL CROSS SECTION (LOOKING NORTH)

1

SCALE: H:1" = 50' V:1" = 25'



100' DOWNSTREAM CHANNEL CROSS SECTION (LOOKING NORTH)

2

SCALE: H:1" = 50' V:1" = 25'

GENERAL NOTES

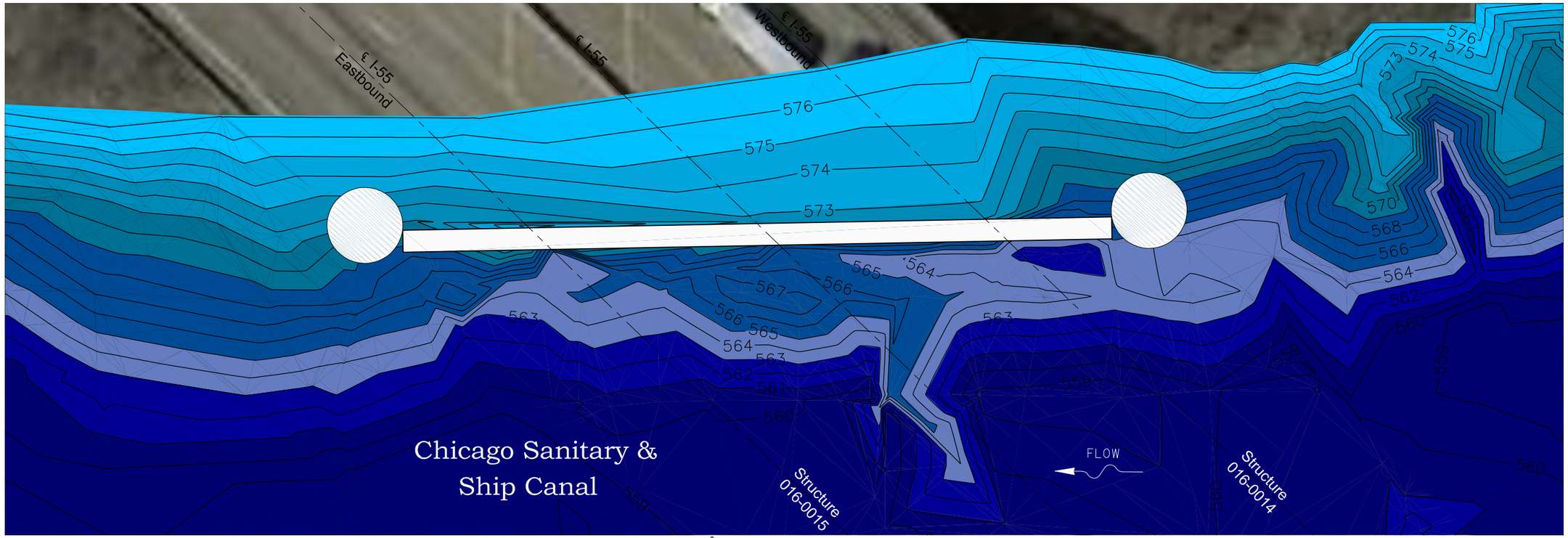
1. This hydrograpic survey was completed on 13 August, 2013 by Collins Engineers, Inc..
2. Soundings were obtained using a continuously recording fathometer operating at 200Khz and linked to a WAAS capable GPS receiver.
3. Waterline elevation of 577.1 at the time of the survey was 10 feet below the top of the pier wall at the east face of the south column of Pier 2 based on the 1998 proposed modification drawings.
4. Channel bottom data prior to 2013 was taken from previous routine underwater inspection reports by Collins Engineers, Inc.

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

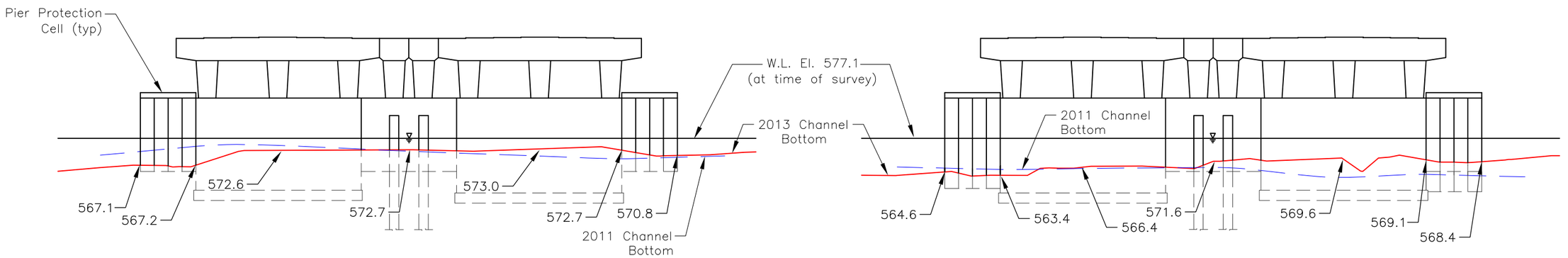
I-55 Hydrographic Surveys
Structures 016-0014 & 016-0015
Channel Cross Sections
Cook County, IL

CEI PROJECT	10–08095
SURVEYED BY:	CSH
DRAWN BY:	CSH
CHECKED BY:	NRT
DATE:	13 AUG 2013
SHEET NO:	H-11



1 PIER 2 PLAN VIEW

SCALE: 1" = 30' 0 15' 30'



2 PIER 2 WEST FACE

SCALE: 1" = 40' 0 20' 40'

3 PIER 2 EAST FACE

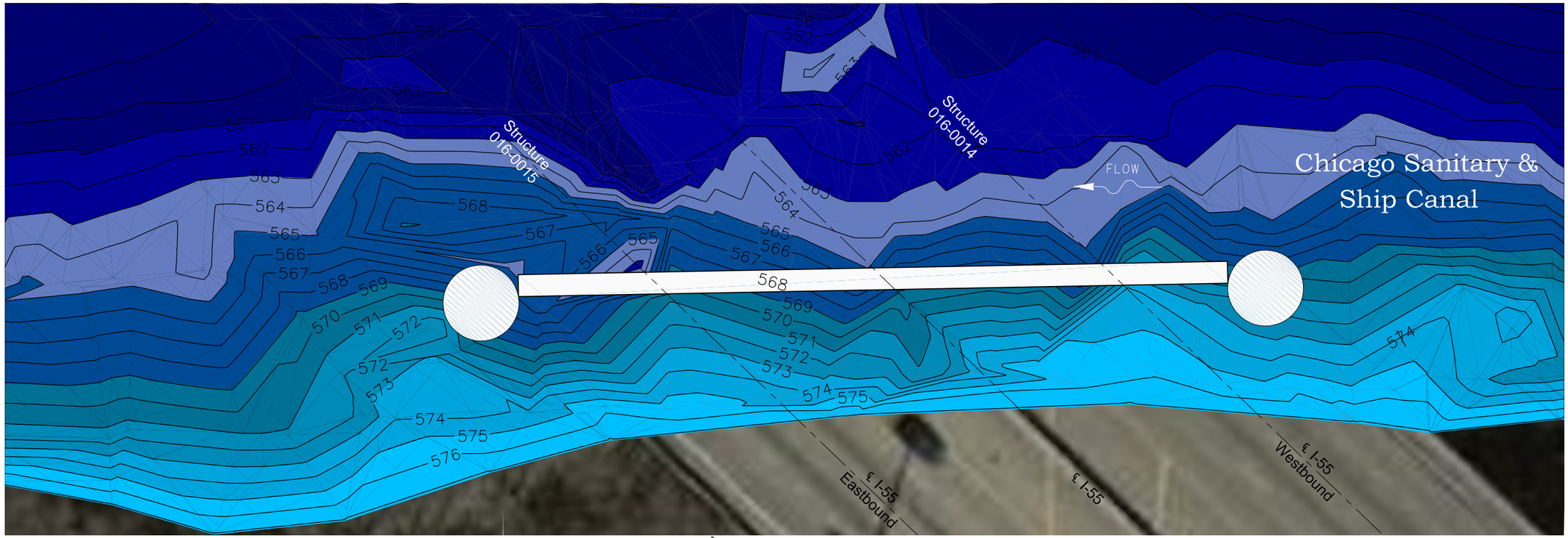
SCALE: 1" = 40' 0 20' 40'

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

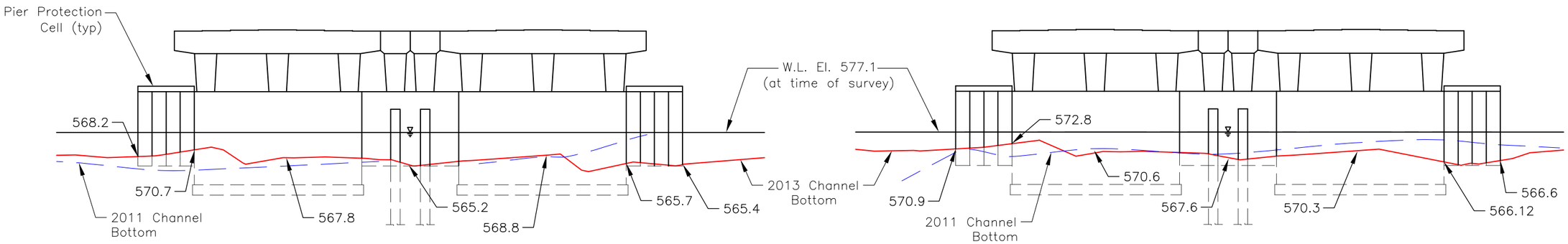
I-55 Hydrographic Surveys
Structures 016-0014 & 016-0015
Pier 2 Details
Cook County, IL

CEI PROJECT 10–08095
SURVEYED BY: CSH
DRAWN BY: CSH
CHECKED BY: NRT
DATE: 13 AUG 2013
SHEET NO: H-12



1 PIER 3 PLAN VIEW

SCALE: 1" = 30' 0 15' 30'



2 PIER 3 WEST FACE

SCALE: 1" = 40' 0 20' 40'

3 PIER 3 EAST FACE

SCALE: 1" = 40' 0 20' 40'

COLLINS ENGINEERS
123 N Wacker Dr.
Suite. 900
Chicago, IL 60606
www.collinsengr.com

Illinois Department of Transportation

I-55 Hydrographic Surveys
Structures 016-0014 & 016-0015
Pier 3 Details
Cook County, IL

CEI PROJECT 10–08095
SURVEYED BY: CSH
DRAWN BY: CSH
CHECKED BY: NRT
DATE: 13 AUG 2013
SHEET NO: H-13

USACE 2013 Hydrographic Survey of the Illinois Waterway

Ramp D CSSC Crossing

I-55 CSSC Crossing

Harlem Avenue CSSC Crossing at River Mile 314

IL 171 CSSC Crossing at River Mile 313

E 1124000.00
N 1868000.00
E 1126000.00
N 1872000.00
E 1128000.00
N 1870000.00
N 1866000.00
E 1130000.00
N

200 0 200 400 600

Scale 1" = 200'

Multi-Transducer Survey with Complete Coverage

Channel Contour Color Fill Legend

-10' - -1'
0' - 8'
9'
10'
11' - 19'
20' - 29'
30' - 50'

Location	Stage	Flat Pool
Morris	4.3 =	482.8
LaSalle	10.2 =	440.2
Peoria	11.6 =	440.0
Havana	4.8 =	429.2
Beardstown	9.1 =	429.0

Hydrographic Survey of the Illinois Waterway Ortho photography flown 1995

Horizontal Projection: State Plane, NAD1983, Illinois East - 1201 U.S. Survey Feet

Vertical Datum: NGVD 1929 U.S. Survey Feet. All soundings adjusted to Flat Pool: 577.5

Water Surface at time of survey: 576.8 / Water Stage: -0.7 Feet

Survey Vessel: MV Holling

Conducted by: Justin Coldwater and Lee Schweiger

Processed in AutoCAD Civil 3D 2012 by Bob Adams on 24 Apr 2013

File Name: IWW_LP_3130-3140_13A.dwg

US ARMY CORPS OF ENGINEERS
MVR-ROCK ISLAND DISTRICT
OPERATIONS DIVISION - TECH SUPPORT BRANCH

Stevenson Expressway Upper

Survey Date: 16 Apr 2013

IWW / Sanitary & Ship Canal - Reach River Miles: 313.0 - 314.0

I/LF

6P

016-0015
I-55 WB/
San & Ship Canal

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55	-	COOK	578	1
FED. ROAD DIST. NO.	ILLINOIS			

*(0404-640, ETC, 0711.2) RS-1

D-91-340-93

FOR INDEX OF SHEETS, SEE SHEET NO. 2

PLANS FOR PROPOSED HIGHWAY

NOTE: WHEREVER IN THESE PLANS THE *SECTION IS REFERENCED IT SHALL MEAN (0404-640, ETC, 0711.2) RS-1

SCALES (PLAN, PROFILE HORIZ., PROFILE VERT., CROSS SECTIONS)

F.A.I. ROUTE 55 (STEVENSON EXPRESSWAY)
SECTION: (0404-640, ETC, 0711.2) RS-1
DES PLAINES RIVER TO IL ROUTE 43
RESURFACING, MEDIAN BARRIER, SURVEILLANCE, AND BRIDGE REHABILITATION
PROJECT: IM-55-7(220)280
COOK COUNTY
C-91-340-93

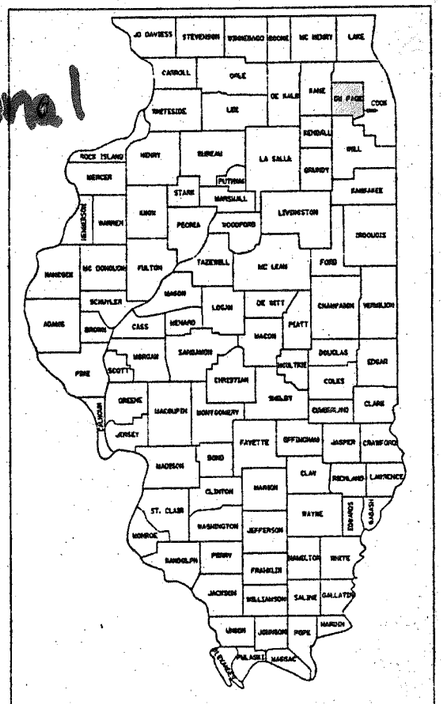
PROJECT LOCATED IN THE VILLAGES OF:
SUMMIT AND BEDFORD PARK

BRIDGES:

FAI ROUTE 55 OVER B. & O. C.T. R.R.
STRUCTURE NOS. 016-0013(EB) 016-0012(WB)
STATION 18+485.63
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

FAI ROUTE 55 OVER CHICAGO SANITARY AND SHIP CANAL
STRUCTURE NOS. 016-0014(EB) 016-0015(WB)
STATION 20+813.228
REMOVE EXISTING DECK, REPAIR SUBSTRUCTURE AND REPLACE SLOPEWALLS, CONSTRUCT DECK

NB IL ROUTE 171 TO EB FAI ROUTE 55 OVER SANITARY AND SHIP CANAL
STRUCTURE NO. 016-2408
DECK SCARIFICATION AND CONCRETE OVERLAY



LOCATION OF SECTION INDICATED THUS:- -[redacted]-

METRIC RATIOS

1 m 0 2 m — 1 : 50
0 5 m 10 m — 1 : 100
10 m 0 20 m — 1 : 250
5 m 0 20 m — 1 : 500
0 50 m 100 m — 1 : 1000

FULL SIZE PLANS HAVE BEEN PREPARED USING STANDARD ENGINEERING SCALES, REDUCED SIZED PLANS WILL NOT CONFORM TO STANDARD SCALES, IN MAKING MEASUREMENTS ON REDUCED PLANS, THE ABOVE SCALES MAY BE USED.

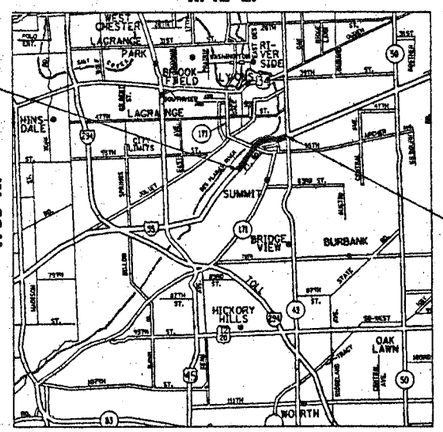
J.U.L.I.E.
JOINT UTILITY LOCATION INFORMATION FOR EXCAVATION
1-800-892-0123

CONTRACT NO. 82458

N

R. 12 E.

T. 38 N.



LYONS TOWNSHIP

GROSS AND NET LENGTH OF PROJECT = 5000 METERS = 5.000 KM

TRAFFIC DATA

ADT (1991) = 134100 VEHICLES
ADT (2010) = 145000 TO 183000 VEHICLES
SPEED LIMIT = 55 MPH

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

SUBMITTED July 11 19 99
John P. Kay
DISTRICT ENGINEER
_____ 19 _____
ENGINEER OF PROJECT DEVELOPMENT AND IMPLEMENTATION
AUGUST 13, 19 99
Bill Junkley
ENGINEER OF DESIGN AND ENVIRONMENT
AUGUST 13, 19 99
DIRECTOR, DIVISION OF HIGHWAYS

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

DIST. 1 - DESIGN /PLAN PREP. ENGINEER /RICK YOUNG /M. GOMEZ (847) 705-4055

Wed Jun 23 08:12:26 1999
d:\projects\pi27640\typsec.m32 Typ1-03

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. 55	*	COOK	578	307A	SHEET NO. 62A
					63 SHEETS

* STATE - FED. ETC. (TITLE) AS -1

BORING LOG

Wang Engineering, INC.
450 Fenton, Unit 901B • West Chicago, Illinois 60185 • 708/231-7733

Boring No. W-1
Job No. 255-02-01
Client American Consulting Engineers
Project I-55 Over CS & SC SN016-0044(EB) & (SWB)
Location T38N, R12E, SEC 12, Cook Co, IL
Surface Elevation 189.9
Datum USGS
Station 20+397.404
Offset CL

Profile	Bottom Elevation of Stratum	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.3m)	Qu (kPa)	Moisture Content (%)
	189.3	Very stiff brown CLAY LOAM FILL (A-6 FILL)						
	189.0	Loose CRUSHED STONE FILL (A-1-a FILL)						
	188.4	Hard gray SILTY CLAY FILL (A-4 FILL)						
		Very stiff to hard brown, gray and black CLAY FILL, trace gravel (A-6 FILL)						
	180.6	Loose to medium dense CRUSHED STONE FILL (A-1-a FILL)						
	176.3	Hard gray SILTY CLAY, trace to little gravel - Hardpan						

Sampler	Sample Number	N Values (blows/.3m)	Qu (kPa)	Moisture Content (%)
1	2 4 4	263.3 P		8.0
2	4 6 5	NP		12.0
3	3 5 6	229.8 B		20.0
4	3 5 6	306.4 A		17.0
5	3 6 7	344.7 B		20.0
6	3 6 8	335.2 B		18.0
7	15 13 12	NP		17.0
8	4 100/5"	430.9 B		19.0
9	4 6 7	392.6 B		13.0
10	4 5 8	363.9 B		18.0
11	3 4 12	306.4		18.0
12	4 5 8	373.5		17.0
13	16 8 8	NP		3.0
14	4 4 8	NP		3.0
15	7 7 9	NP		4.0
16	5 7 8	NP		3.0
17	10 9 14	NP		4.0
18	7 9 17	NP		10.0
19	31	430.9		9.0

578.41

GENERAL NOTES

Begin Drilling 6/7/95 Complete Drilling 6/7/95
Contractor Wang Engineering, Inc. Drill Rig CME-55
Driller R. Bell Logger J. Titzer Checked by CTF
Drilling Method 8.25-Inch ID HSA, CME Auto Hammer, Boring backfilled after 24 hours

WATER LEVEL DATA

While Drilling ▼
End of Boring ▼ 12.9 m
Time After Drilling 24 Hours
Depth to Water ▼ 13.1m ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

BORING LOG

Wang Engineering, INC.
450 Fenton, Unit 901B • West Chicago, Illinois 60185 • 708/231-7733

Boring No. W 1
Job No. 255-02-01
Client American Consulting Engineers
Project I-55 Over CS & SC SN016-0044(EB) & (SWB)
Location T38N, R12E, SEC 12, Cook Co, IL
Surface Elevation 189.9
Datum USGS
Station 20+397.404
Offset CL

Profile	Bottom Elevation of Stratum	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.3m)	Qu (kPa)	Moisture Content (%)
		(A-6)			43 45	P		
	173.9	Boring terminated at 16.00 m.	15		20 29 36 44	343.0 S		9.0
					21 34 37 47	378.9 S		5.0

GENERAL NOTES

Begin Drilling 6/7/95 Complete Drilling 6/7/95
Contractor Wang Engineering, Inc. Drill Rig CME-55
Driller R. Bell Logger J. Titzer Checked by CTF
Drilling Method 8.25-Inch ID HSA, CME Auto Hammer, Boring backfilled after 24 hours

WATER LEVEL DATA

While Drilling ▼
End of Boring ▼ 12.9 m
Time After Drilling 24 Hours
Depth to Water ▼ 13.1m ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

DESIGNED	
CHECKED	
DRAWN	CAK
CHECKED	GSP

SOIL BORING LOG W-1

STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PLOTTED BY	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
F.A.I. 55	*	COOK	578	307B
FED. ROAD DIST. NO. 9	ILLINOIS	FED. AID PROJECT		

SHEET NO. 62b
63 SHEETS

* (0404 - 640, ETC. 0711.21 RS - 1

BORING LOG

Wang Engineering, INC.
Boring No. W 2
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOMS-OOMWEB) & I54(WB)
Location T38N, R12E, SEC 12, Cook Co. IL

Surface Elevation 181.9
Datum USGS
Station 20+432.456
Offset CL

450 Fenton, Unit 9018 • West Chicago, Illinois 60185 • 708/231-7733

Profile	Bottom Elevation of Stratum	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.25m)	Qu (kPa)	Moisture Content (%)
	181.7	Asphalt Pavement						
		Brown, black and gray CLAY FILL (A-6 FILL)			1	3 4 6	259.1 P	20.0
					2	2 3 5	306.4 B	24.0
	180.2	Dense CRUSHED LIMESTONE FILL (A-1 FILL)			3	16 23 25	NP	5.0
	179.5	Very stiff, brown and gray mottled CLAY FILL, trace gravel (CL-FILL)			4	2 3 3	220.2 B	22.0
	178.5	Very stiff, black SILTY CLAY FILL, trace gravel (A-7-6 FILL)			5	5 3 4	76.5 P	13.0
	177.7	Loose gray SILTY SAND FILL (A-2-4 FILL)			6	3 3 4	NP	17.0
	177.0	Medium dense, brown medium SAND (SP)	5		7	2 3 7	NP	13.0
	176.2	Hard gray SILTY CLAY, trace gravel (A-6) Disturbed Sample			8	20 24 50/5"	430.9 P	10.0
					9	20 28 34	370.3 S	9.0
		Disturbed Sample			10	20 26 27	430.3 P	9.0
					11	18 24 28	367.2 S	10.0
					12	15 17 22	348.0 S	8.0
			10		13	15 20 20	343.8 S	13.0
					14	24 26 53	412.9 S	10.0
	170.8	Hard gray SILT (A-4)			15	6 8 20	326.3 S	19.0
	170.3	Medium dense gray SILTY SAND (A-2-4)			16	7 10 15	NP	15.0
					17	8 10 12	NP	25.0
	168.8	Dense gray SILTY SAND with Limestone Fragments (A-2-4)			18	18 22 38	NP	8.0
	168.0	Bedrock encountered at			19	100/	NP	

GENERAL NOTES

Begin Drilling 6/7/95 Complete Drilling 6/7/95
Contractor WEI Drill Rig CME 55
Driller R. Bell Logger J. Titzer Checked by CTF
Drilling Method 8.25" Hollow Stem Auger, 3" NX Rock Core, CME Auto-Hammer, Boring Grouted Upon Completion

WATER LEVEL DATA

While Drilling ▽ 8.0 m
End of Boring ▼ NM
Time After Drilling NM
Depth to Water ▽ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

BORING LOG

Wang Engineering, INC.
Boring No. W-2
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOMS-OOMWEB) & I54(WB)
Location T38N, R12E, SEC 12, Cook Co. IL

Surface Elevation 181.9
Datum USGS
Station 20+432.456
Offset CL

450 Fenton, Unit 9018 • West Chicago, Illinois 60185 • 708/231-7733

Profile	Bottom Elevation of Stratum	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.25m)	Qu (kPa)	Moisture Content (%)
		13.95 m. Sampler refusal at 14 m. Light gray Dolomitic Limestone Rock Core Run #1 - 14.1m to 17.2 m Rec - 98% RQD - 94%	15		20	7	92300	-
					21	-	83400	-
		Rock Core Run #2 - 17.2 m to 19.2 m Rec = 100% RQD = 88%						
	162.7	Boring terminated at 19.2 m.	20					

GENERAL NOTES

Begin Drilling 6/7/95 Complete Drilling 6/7/95
Contractor WEI Drill Rig CME 55
Driller R. Bell Logger J. Titzer Checked by CTF
Drilling Method 8.25" Hollow Stem Auger, 3" NX Rock Core, CME Auto-Hammer, Boring Grouted Upon Completion

WATER LEVEL DATA

While Drilling ▽ 8.0 m
End of Boring ▼ NM
Time After Drilling NM
Depth to Water ▽ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

DESIGNED	
CHECKED	
DRAWN	CAK
CHECKED	GSP

SOIL BORING LOG W-2

STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

				SHEET NO. 62C
F.A.I. 55	11	COOK	578	307C	63 SHEETS

* (10404 - 640, ETC, OTILE) RS -1

BORING LOG

Wang Engineering, INC.

Boring No. W-3
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOMS-0044(EB) & (SWB)
Location T38N, R12E, SEC 12, Cook Co, IL

Surface Elevation 181.6
Datum USGS
Station 20+587.904
Offset CL

450 Fenton, Unit 908B • West Chicago, Illinois 60185 • 708/231-7733

Profile	Bottom Elevation of Soil Unit	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.5m)	Qu (kPa)	Moisture Content (%)
	180.4	SILTY SAND & GRAVEL						
		Very stiff to hard, brown and gray CLAY FILL trace gravel and crushed stone (A-6 FILL)			1	4 5 6	130.9+ P	15.0
		Disturbed Sample			2	4 3 3	383.0 P	15.0
		Remolded Sample			3	4 5 7	341 P	18.0
		Disturbed Sample			4	4 6 6	287.3 P	17.0
	178.3	Medium dense to dense CRUSHED LIMESTONE FILL (A-1 FILL)			5	4 5 5	NP	26.0
	177.1	Hard, gray SILTY CLAY FILL, trace gravel (A-6 FILL)			6	10 13 15	NP	7.0
			5		7	10 16 16	NP	5.0
					8	10 12 17	776.8 RS	8.0
					9	12 17 17	1072.5 B	5.0
	172.3	Very stiff to hard gray CLAY (A-6)			10	12 20 20	574.6 RB	10.0
					11	9 13 19	776.8 RB	7.0
					12	8 15 20	776.8 RB	8.0
					13	5 8 12	956.3 RS	23.0
			10		14	5 7 14	574.6 RB	19.0
	170.9	Medium dense, gray SILTY SAND (A-2-4)			15	10 13 18	NP	11.0
	169.7	Dense COBBLES and BOULDERS (A-1)			16	607 6"	NP	24.0
					17	507 0"	NP	14.0

GENERAL NOTES

Begin Drilling 8/15/95 Complete Drilling 8/15/95
Contractor WEI Drill Rig CME 55
Driller R. Bell Logger P Wang Checked by CTF
Drilling Method 8.25" Hollow Stem Auger, 3" NX Rock Core, CME Auto-Hammer, Boring Grouted Upon Completion

WATER LEVEL DATA

While Drilling ▽ 5.64 m
End of Boring ▼ NM
Time After Drilling NM
Depth to Water ▼ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

BORING LOG

Wang Engineering, INC.

Boring No. W-3
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOMS-0044(EB) & (SWB)
Location T38N, R12E, SEC 12, Cook Co, IL

Surface Elevation 181.6
Datum USGS
Station 20+587.904
Offset CL

450 Fenton, Unit 908B • West Chicago, Illinois 60185 • 708/231-7733

Profile	Bottom Elevation of Soil Unit	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.5m)	Qu (kPa)	Moisture Content (%)
	167.7	Bedrock encountered at 14.33 m. Light gray Dolomitic Limestone						
		Rock Core Run #1 - 14.3 m to 16.7 m Rec = 96% RQD = 89%	15		14		30900	-
					15		30800	-
		Rock Core Run #2 - 16.7 m to 18.3 m Rec = 90% RQD = 82 %						
	163.3	Boring terminated at 18.3 m.	20					

GENERAL NOTES

Begin Drilling 8/15/95 Complete Drilling 8/15/95
Contractor WEI Drill Rig CME 55
Driller R. Hall Logger P Wang Checked by CTF
Drilling Method 8.25" Hollow Stem Auger, 3" NX Rock Core, CME Auto-Hammer, Boring Grouted Upon Completion

WATER LEVEL DATA

While Drilling ▽ 5.64 m
End of Boring ▼ NM
Time After Drilling NM
Depth to Water ▼ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

DESIGNED	
CHECKED	
DRAWN	CAK
CHECKED	GSP

SOIL BORING LOG W-3

STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. RTE 55	61	COOK	570	308

SHEET NO. 63
63 SHEETS

* (2404-640, ETC. ILLINOIS)

BORING LOG

Wang Engineering, INC.
450 Fenton, Unit 9018 • West Chicago, Illinois 60185 • 708/231-7733

Boring No. W-4
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOKS-OOMEEB) & (SMRB)
Location T38N, R12E, SEC 12, Cook Co, IL

Surface Elevation 190.8
Datum USGS
Station 20+618.384
Offset CL

Profile	Bottom Elevation of Soil Unit	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.5m)	Qu (kPa)	Moisture Content (%)
		Stiff brown, black & gray CLAY FILL, trace gravel (A-6 FILL)			1	2 2 2	124.5 B	16.0
	189.9	Very stiff to hard brown and gray mottled CLAY FILL (A-6 FILL)			2	1 2 3	430.9 B	20.0
					3	4 3 5	622.4 B	16.0
					4	4 4 5	478.8 B	18.0
					5	3 3 5	392.6 B	21.0
					6	3 4 5	229.8 B	19.0
			5		7	4 6 9	440.5 B	18.0
					8	4 5 7	478.8 B	17.0
					9	3 7 7	229.8 B	15.0
		Very stiff to hard brown and gray mottled CLAY FILL (A-6 FILL)			10	5 6 4	440.5 B	20.0
					11	7 7 9	335.2 B	18.0
					12	4 5 7	584.1 B	17.0
					13	5 6 10	335.2 B	20.0
			10		H	7 8 12	788.2 S	16.0
					15	9 10 H	670.3 B	18.0
					16	7 9 12	632.0 B	15.0
					17	9 9 12	536.3 S	18.0
					18	10 8 13	450.0 B	18.0
					19	7	526.7	17.0

GENERAL NOTES

Begin Drilling 6/8/95 Complete Drilling 6/8/95
Contractor Wang Engineering, Inc. Drill Rig CME-55
Driller R. Bell Logger R. Imarenezor Checked by CTF
Drilling Method 3.25-inch ID HSA to 18.23 m, Mud Rotary
Techniques to 23.16 m, CME Auto Hammer, Boring

WATER LEVEL DATA

While Drilling ▽
End of Boring ▼
Time After Drilling
Depth to Water ▽ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

BORING LOG

Wang Engineering, INC.
450 Fenton, Unit 9018 • West Chicago, Illinois 60185 • 708/231-7733

Boring No. W-4
Job No. 255-02-01

Client American Consulting Engineers
Project I-55 Over CS & SC SNOKS-OOMEEB) & (SMRB)
Location T38N, R12E, SEC 12, Cook Co, IL

Surface Elevation 190.8
Datum USGS
Station 20+618.384
Offset CL

Profile	Bottom Elevation of Soil Unit	SOIL DESCRIPTION and Remarks	Depth (meters)	Sampler	Sample Number	N Values (blows/.5m)	Qu (kPa)	Moisture Content (%)
	176.2	Hard gray SILTY CLAY, trace gravel - Hardpan (A-6)	15	H	20	166.3 S	11.0	
		Stone fragments @ 16.61m			21	20 23 28	H36.4 S	13.0
					22	19 38 100/.13	1446.0 S	9.0
					23	21 26 28	1340.6 S	4.0
					24	13 24 34	830.0 B	10.0
	172.2	Very stiff to hard gray CLAY (A-6)			25	9 20 20	239.4 P	12.0
			20		26	14 13 16	450.0 S	15.0
					27	5 8 9	478.8 B	26.0
	170.1	Medium dense to very dense gray SILT (A-4)			28	7 12	478.8 B	22.0
		Limestone fragments @ 23.16 m			29	12 8 13	NP	24.0
		Sampler refusal /			30	12 25 100/.13	NP	19.0
	167.6	Possible top of bedrock			31	100/.05	NP	15.0
		Boring terminated at 23.16 m.	25					

GENERAL NOTES

Begin Drilling 6/8/95 Complete Drilling 6/8/95
Contractor Wang Engineering, Inc. Drill Rig CME-55
Driller R. Bell Logger R. Imarenezor Checked by CTF
Drilling Method 3.25-inch ID HSA to 18.23 m, Mud Rotary
Techniques to 23.16 m, CME Auto Hammer, Boring

WATER LEVEL DATA

While Drilling ▽
End of Boring ▼
Time After Drilling
Depth to Water ▽ ▼

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

DESIGNED	
CHECKED	DCD
DRAWN	GEW
CHECKED	SPK

SOIL BORING LOG W-4
STEVENSON EXPRESSWAY OVER
CHICAGO SANITARY AND SHIP CANAL
FAI RTE 55 SECTION 0707-616 B
STA 20+513.228
COOK COUNTY
STRUCTURE NUMBER 016-0015 (W.B.)

AMERICAN CONSULTING ENGINEERS, L.L.C.
CONSULTING ENGINEERS & PLANNERS
ROLLING MEADOWS, ILLINOIS

TAB 15

SECTION 15

RIPRAP SIZING

RIPRAP SIZING

No disturbance of the existing bank armoring is proposed. Riprap sizing will be investigated further in Phase II.

Tab 16

SECTION 16

PERMIT SUMMARY FORM (DISTRICT 1) – RELATED EXHIBITS AND CALCULATIONS

PERMIT SUMMARY FORM (District 1) –
RELATED EXHIBITS AND CALCULATIONS

Since there is no FEMA designated floodway, the Permit Summary Form is not required.

Tab 17

SECTION 17

COMPENSATORY STORAGE

COMPENSATORY STORAGE

The proposed work will affect only the piers and superstructures of the I-55 bridges above the 10-year flood elevation. There is no designated floodway and therefore no compensatory storage volume is required..

Minimal floodplain fill is proposed above the 10-year flood elevation at the piers. The proposed work maintains the existing waterway opening, horizontal clearance, and vertical clearance.

Tab 18

SECTION 18

SURVEY NOTES

Questions concerning the VERTCON process may be mailed to NGS

Latitude: 41 47 31.82321

Longitude: 087 48 58.78627

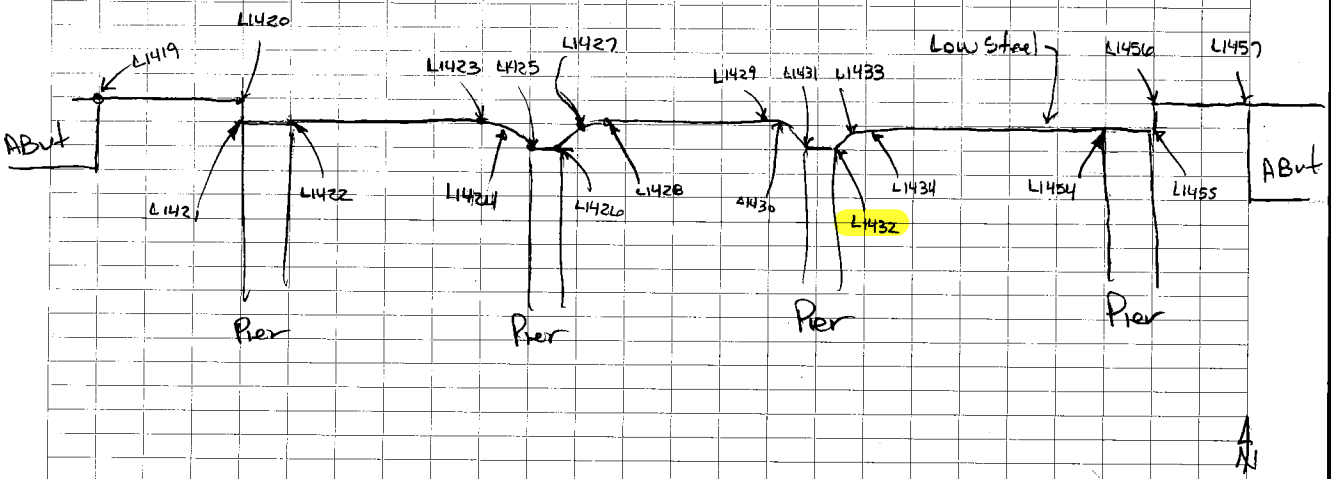
NGVD 29 height: 0.00 FT

Datum shift(NAVD 88 minus NGVD 29): -0.285 feet

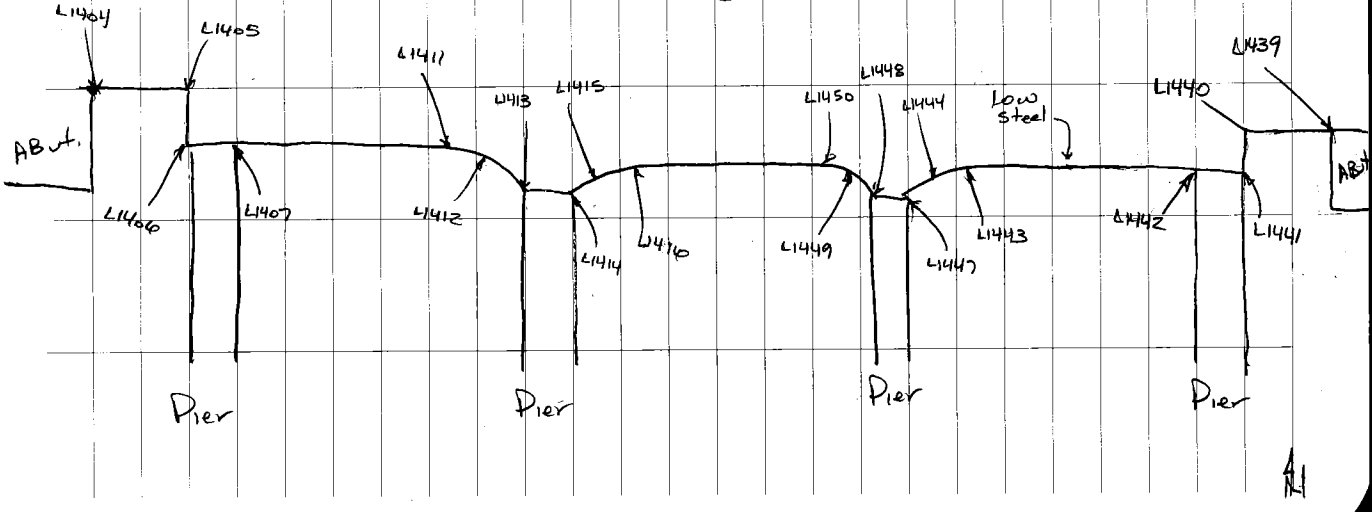
Converted to NAVD 88 height: -0.285 feet

Lin Engineering
Bridge Sketches,
06/09/2017

North Face of I-55 Bridge over Chicago Sanitary



South Face of I-55 Bridge over Chicago Sanitary Looking North



L1419,1868948.7380,1126172.9340,625.4360,627
L1420,1868946.1280,1126212.7070,625.1340,627
L1421,1868946.1280,1126214.7710,620.9040,627
L1422,1868945.6950,1126221.3000,620.5300,627
L1423,1868937.0960,1126351.7190,620.5690,627
L1424,1868935.7160,1126370.0340,619.4530,627
L1425,1868934.7580,1126392.2720,616.4720,627
L1426,1868934.2870,1126397.5280,616.4610,627
L1427,1868933.7720,1126411.5990,618.5760,627
L1428,1868932.2490,1126423.7830,619.4780,627
L1429,1868919.9890,1126606.4830,619.1890,627
L1430,1868919.1160,1126620.8070,617.9710,627
L1431,1868918.4960,1126631.9450,616.1680,627
L1432,1868918.7610,1126638.1080,616.1480,627
L1433,1868917.6100,1126654.8870,618.5160,627
L1434,1868915.5990,1126677.3500,619.9180,627
L1454,1868909.1280,1126811.1160,618.6130,627
L1455,1868908.9750,1126817.4280,618.9190,627
L1456,1868908.6690,1126820.2210,623.0900,627
L1457,1868908.0270,1126863.9740,622.8440,627

L1404,1868812.0830,1126015.7760,623.2430,627
L1405,1868811.1540,1126059.0760,623.5480,627
L1406,1868811.1670,1126061.2410,619.3570,627
L1407,1868810.6320,1126067.3610,619.0430,627
L1411,1868800.8890,1126202.4360,619.9910,627
L1412,1868800.3140,1126221.1150,618.5640,627
L1413,1868799.2180,1126238.8730,616.1510,627
L1414,1868799.1130,1126243.7420,616.1830,627
L1415,1868798.1060,1126253.3690,617.7580,627
L1416,1868797.7350,1126259.6950,618.5400,627
L1439,1868768.1960,1126704.5440,625.2050,627
L1440,1868770.9310,1126665.3650,625.0250,627
L1441,1868770.5260,1126661.8680,620.8350,627
L1442,1868771.7200,1126654.7810,620.4560,627
L1443,1868780.6790,1126513.9390,619.9910,627
L1444,1868781.8210,1126499.1360,618.6350,627
L1447,1868782.6550,1126483.4360,616.3900,627
L1448,1868782.9250,1126478.7860,616.4060,627
L1449,1868784.1620,1126465.8470,618.3710,627
L1450,1868785.0180,1126450.6600,619.4630,627

Collins Engineering
Survey Notes,
06/27/2017

HYDROSURVEY STEPS

RAW DATA FILE WAS SETUP IN THE NUMBERED FORMAT AND POSITIVE VALUES FOR THE LONGITUDE FIELD AND WAS CONVERTED TO NE COORDINATES USING CORPSCON SOFTWARE.

RAW DEPTH MEASUREMENTS WERE ADJUSTED BY ADDING 0.5' (6") TO ACCOUNT FOR SUBMERGENCE OF THE SONAR HEAD.

WATER SURFACE ELEVATION AT TIME OF INSPECTION AT I-55 OVER DESPLAINES RIVER WAS ESTIMATED BY USING PIER 1 BOTTOM OF PIER CAP ELEVATION OF 186.335m = 611.335 ft AND THE MEASURED DISTANCE OF 23.42 ft FROM WATER SURFACE (AT TIME OF INSPECTION) TO PIER 1 BOTTOM OF PIER CAP. WSE AT TIME OF INSPECTION WAS 611.335 FT - 23.42 FT = 587.915 FT.

WATER SURFACE ELEVATION AT TIME OF INSPECTION AT I-55 OVER SANITARY AND SHIP CANAL WAS ESTIMATED BY USING TOP OF PIER WALL ELEVATION OF 178.951 m = 587.109 ft AND THE measured distance of 9.5 ft FROM WATER SURFACE (AT TIME OF INSPECTION) TO TOP OF WALL AT PIER 2. WSE AT TIME OF INSPECTION WAS 587.109 ft - 9.50 ft = 577.61 ft

Tab 19

SECTION 19

EWSE DATA

ESTIMATED WATER SURFACE ELEVATION (EWSE) DATA

Date of CBBEL Overbank Survey: June 5 thru June 7, 2017

Water Surface at XS 9529 = 577.38

Top of Bank at XS 9529 Lt. = 594.54

USGS gage 05536140 on the Chicago Sanitary and Ship Canal at Stickney, IL, is located approximately 3.3 miles upstream of the I-55 crossing.

MWRD records elevation data (no flow data) at USGS gage 05536137 at 31st and Western (approximately 7.2 miles upstream) and at Willow Springs (xx miles downstream. Gage data information and correspondence is included in Section 20 – Correspondence Notes.

Tab 20

SECTION 20

CORRESPONDENCE NOTES

Ilene Dailey

From: O'Holleran, John <John.OHolleran@stantec.com>
Sent: Thursday, April 26, 2018 1:46 PM
To: Smith, Corey J.; Bochte, Kyle; Schilke, Steven E
Cc: Pieniazek, Dave; Book, Dustin; Ilene Dailey; Sayers, Brad
Subject: RE: Sanitary & Ship Canal Clearance Memo

Follow Up Flag: Follow up
Flag Status: Flagged

The BCR will be amended to include a design commitment that the proposed widening of this structure will not reduce the vertical clearance over the Chicago Sanitary & Ship Canal and the MWR RR.

This will also be identified as a Design Commitment in the Project CDR.

From: Smith, Corey J. [mailto:Corey.Smith@Illinois.gov]
Sent: Wednesday, April 18, 2018 3:25 PM
To: O'Holleran, John <John.OHolleran@stantec.com>; Bochte, Kyle <Kyle.Bochte@Illinois.gov>; Schilke, Steven E <Steven.Schilke@illinois.gov>
Cc: Pieniazek, Dave <Dave.Pieniazek@stantec.com>; Book, Dustin <Dustin.Book@stantec.com>; Ilene Dailey <idailey@cbbel.com>
Subject: RE: Sanitary & Ship Canal Clearance Memo

Good afternoon John,

I ran this by Sarah and she said that including a commitment that in Phase II for TS&L plans the bridge vertical clearance will not be reduced is sufficient and no need to include our recommended approach on how to maintain the existing clearance. Please submit an addendum BCR including that commitment to us. Include this memo in the CDR- structures attachments.

Thanks,

Corey Smith, P.E.
Direct: 847.705.4103

From: O'Holleran, John [mailto:John.OHolleran@stantec.com]
Sent: Thursday, April 12, 2018 1:59 PM
To: Smith, Corey J. <Corey.Smith@Illinois.gov>; Bochte, Kyle <Kyle.Bochte@Illinois.gov>; Schilke, Steven E <Steven.Schilke@illinois.gov>
Cc: Pieniazek, Dave <Dave.Pieniazek@stantec.com>; Book, Dustin <Dustin.Book@stantec.com>; Ilene Dailey <idailey@cbbel.com>
Subject: [External] Sanitary & Ship Canal Clearance Memo

As we discussed on yesterday's conference call, attached is a memo summarizing the issues regarding the Subject issue.

John V. O'Holleran, PE
Principal

Direct: 312.262.2400
Mobile: 312.287.1863

Stantec Consulting Services Inc.
350 North Orleans Street
Suite 3100
Chicago IL 60654

Ilene Dailey

Subject: FW: I-55 over Chicago Sanitary and Ship Canal HR

Email excerpt regarding flooding records:

From: Winograd, Esther B [mailto:Esther.Winograd@illinois.gov]
Sent: Monday, August 14, 2017 10:49 AM
To: Ilene Dailey <idailey@cbbel.com>
Cc: Shirani, Agar B <Agar.Shirani@illinois.gov>
Subject: RE: I-55 over Chicago Sanitary and Ship Canal HR

Hi Ilene,

Regarding item 2, Agar looked for additional records and none was found in our office.

Esther Winograd
Hydraulic Section
Bureau of programming
IDOT-DOH
201 West Center Court,
Schaumburg, IL 60196-1096
tel; 847/705-4475

From: Ilene Dailey [mailto:idailey@cbbel.com]
Sent: Thursday, August 03, 2017 12:26 PM
To: Shirani, Agar B
Cc: Winograd, Esther B; Francisco Martinez
Subject: [External] I-55 over Chicago Sanitary and Ship Canal HR

Hi Agar,

We are wrapping up the initial HR submittal for I-55 over the Chicago Sanitary and Ship Canal (CSSC). I'd appreciate your thoughts/concurrence on the following items before submittal:

2. I assume there are no IDOT flooding records for the bridge, but the most recent list I see is from 2013. If you have any correspondence on the matter, we will include it.

If you have any questions or need anything further, please call.

Thanks,
Ilene

Ilene A. Dailey, PE, CFM
Project Manager – Drainage Department
Christopher B. Burke Engineering, Ltd.
9575 W. Higgins Road, Suite 600 Rosemont, IL 60018
Phone: (847) 823-0500 Cell: (847) 533-3044 Fax: (847) 823-0520
E-Mail: idailey@cbbel.com
www.cbbel.com

USGS Water-Year Summary 2016

05536140 CHICAGO SANITARY AND SHIP CANAL AT STICKNEY, IL

LOCATION - Lat 41°49'01", long 87°45'14" referenced to North American Datum of 1983, in NE 1/4 SE 1/4 NW 1/4 sec.4, T.38 N., R.13 E., Cook County, IL, Hydrologic Unit 07120003, on right downstream side of the Laramie Avenue boat dock, approximately 0.5 mi downstream from the Cicero Ave. bridge and at river mile 26.8.

DRAINAGE AREA - 296 mi².

SURFACE-WATER RECORDS

PERIOD OF RECORD -

SURFACE-WATER DISCHARGE AND STAGE

STAGE: October 2007 to current.

PARTIAL RECORD: Miscellaneous discharge measurements, water years 1976-77 (published as "at Cicero Avenue").

GAGE - Water-stage recorder, and phone telemeter. Datum of gage is 579.48 ft above NGVD of 1929 (Chicago City datum) (579.20 ft NAVD 1988). Prior to October 2007, published as "at Cicero Avenue".

REMARKS - Stages regulated by Chicago River Controlling Works about 26 miles downstream from gage.

EXTREMES FOR PERIOD OF RECORD - SURFACE-WATER DISCHARGE AND STAGE: Maximum measured discharge, 4,670 ft³/s, Feb. 27, 1977, gage height unknown; maximum stage, 4.64 ft, July 24, 2010; minimum stage, -4.51 ft, June 12, 2013.

U.S. Department of the Interior
U.S. Geological Survey

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago
100 EAST ERIE STREET CHICAGO, ILLINOIS 60611-3154 312-751-5600

BOARD OF COMMISSIONERS
Terrence J. O'Brien
President
Kathleen Therese Meany
Vice President
Gloria Alitto Majewski
Chairman of Finance
Frank Avila
Patricia Horton
Barbara J. McGowan
Cynthia M. Santos
Debra Shore
Patricia Young

Osoth Jamjun, P.E.
Chief of Maintenance and Operations
312-751-5101 FAX 312-751-5145

June 19, 2008

Ms. Diane M. O'Keefe
Deputy Director of Highways
Region One Engineer
Illinois Department of Transportation
Division of Highways
201 West Center Court
Schaumburg, Illinois 60196-1096

Dear Ms. O'Keefe:

Subject: 1st Avenue Bridge over Chicago Sanitary and Ship Canal (CSSC)

In response to your March 24, 2008 letter, the Metropolitan Water Reclamation District of Greater Chicago (District) has the following to offer:

1. We do not monitor flow data for the CSSC.
2. We do record elevation data on the CSSC. We have gauges at 31st and Western upstream of the bridge, and at Willow Springs downstream of the bridge. Under normal operating conditions, we keep the level at both gauges at approximately -2.25 CCD (where 0.00 CCD = +579.48 feet above sea level). The District typically maintains the canal levels between -1.6 CCD and -3.0 CCD to facilitate navigation. We are allowed by the Army Corps of Engineers to lower the canal to -4.0 CCD in anticipation of a large storm. Since 1965, the highest levels recorded were +4.1 CCD at 31st and Western, and +3.2 CCD at Willow Springs.

If you have any questions, please contact Jim Yurik at (312) 751-5105.

Very truly yours,

Osoth Jamjun
Chief of Maintenance and Operations

TAB A

SECTION 20.A

2011 CIORBA HYDRAULIC REPORT EXCERPTS

Illinois Department of Transportation

HYDRAULIC REPORT

Project Route:	IL 171 (First Avenue) Over the Sanitary and Shipping Canal
Municipality/County:	Cook
Structure Number:	016-0486, 016-0487, 016-2408
Job Number:	P-91-070-08

Prepared For: District One
Bureau of Programming
Hydraulics Section

Date: March 2011

Prepared By: Ciorba Group, Inc.

CIORBA GROUP | Consulting Engineers
5507 N. Cumberland Avenue, Suite 402, Chicago, Illinois 60656
Phone: 773.775.4009 • Fax: 773.775.4014
Email: chicago@ciorba.com • www.ciorba.com

TABLE OF CONTENTS

NARRATIVE

1 INTRODUCTION

The Illinois Department of Transportation (District 1) has initiated a Phase I study for the improvement of Illinois Route 171, First Avenue (IL 171) from 47th Street to 55th Street. This report describes and documents the hydrologic and hydraulic characteristics of the three existing bridges crossing the Sanitary and Shipping Canal. These bridges are located in Lyons Township of Cook County, Sections 11 and 12, Township 38 North, Range 12 East.

2 SITE DESCRIPTION

The IL 171 Bridges in question are part of the IL 171 and I-55 interchange. There are three bridges crossing the Sanitary and Shipping Canal at this location. Two of the bridges are the northbound and southbound IL 171 mainline. The third bridge is the NB IL 171 to NB I-55 Ramp (Ramp D). Further discussion of the bridge geometry can be found in *Section 4: Discussion of Existing Structure Sizing*.

Upstream and downstream of the project site, the stream channel is well defined with normal flows being confined within a defined channel. The stream banks along the project reach are covered with trees and grass and show no signs of erosion. The average slope of the stream upstream from the project site is about 1.00 ft per mile.

The stream reach through the project site is an unstudied area, with no established base flood elevation, but is mapped as Zone A according to the Flood Insurance Rate Map. See *Flood Insurance Rate Map, Exhibit 1-01*. Conversations with IDOT revealed some data concerning historical floods. The Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) has gages for the Sanitary and Shipping Canal near US Route 45 (approximately 3.5 miles downstream); these gages recorded all-time high water levels of 582.94 and 581.94 on August 14, 1978 and July 12, 1981, respectively. (*See Appendix D: Correspondence*) The nearest downstream structure is a Norfolk Southern-CSXT Joint Railroad crossing about 0.6 miles southwest of the project. There are no sensitive flood receptors along the Sanitary and Shipping Canal.

3 ANALYSIS OF HYDRAULIC CHARACTERISTICS

Several information sources were used to establish hydrology for the Sanitary and Shipping Canal. The flow in the Sanitary and Shipping Canal is controlled via a lock-and-dam system at the mouth of the canal on Lake Michigan (Chicago River), by a dam in Lockport, by control pumps at Wilmette Harbor (North Shore Channel) and by the O'Brien Lock in the Calumet River (Cal-Sag Channel).

However; the canal does exhibit highs and lows based on storm events. The following information was obtained from the U.S. Army Corps of Engineers and is used for event data in the hydraulic models.

- 10-Year Flow (Q10) – 8,500 cfs
- 50-Year Flow (Q50) – 11,300 cfs

- 100-Year Flow (Q100) – 12,800 cfs
- 500-Year Flow (Q500) – 16,100 cfs

Accurate topographic maps of the site were unavailable, so a field survey was performed to define the channel cross section geometry for the reach from 1000 feet downstream to 1000 feet upstream of the structures.

The hydraulic characteristics of the floodplain for existing conditions were calculated using the US Army Corps of Engineers HEC-RAS backwater program. Because the reach downstream of the site is natural and because of the lack of available water surface elevations, the normal flow profile was used to start the backwater calculations. Given the well-defined nature of the main channel and the dense vegetation and wooded condition of the overbanks, Manning's values of 0.03 and 0.08 were assigned respectively. The cross sections used for the upstream and downstream bridge faces were made parallel to the bridges. Since the bridges are skewed from the direction of the flow, HEC-RAS was used to skew the cross-sections for proper representation in the model. The estimated storm event profile results and hydraulic characteristics of the existing bridge are discussed in the following section. See *Appendix C: Supporting Documents*.

4 DISCUSSION OF EXISTING STRUCTURE SIZING

The IL 171 crossing over the Sanitary and Shipping Canal consists of 3 separate bridges.

The NB IL 171 to NB I-55 ramp (Ramp D) is designated as SN 016-2408. This structure has a 28' wide deck, is 625' long from the slope wall to slope wall and has a 25° skew. There are 2 piers within the channel banks, both parallel to the direction of flow and both protected by dolphins at the upstream and downstream ends of the piers.

The next two structures downstream are northbound IL 171 (SN 016-0487) and southbound IL 171 (SN 016-0486). The northbound bridge has a 35.5' wide deck, is 481' long from the abutment on the left bank side to the levee on the right bank and has a 0.0° skew. The southbound bridge has a deck width varying from 53' to 62', is 481' long from the abutment on the left bank side to the levee on the right bank and has a 0.0° skew. There are 2 piers within the channel banks, both parallel to the direction of flow and both protected by dolphins at the upstream and downstream ends of the piers. Because the northbound and southbound bridges sit on the same piers within the channel, these two bridges were treated as one in the hydraulic model. The assumption being that the flows would not get high enough in the channel to exhibit low beam impacts, which would require the bridges to be analyzed separately. Table 1 (below) and *Existing Plan, Exhibit 1-05* indicate the existing structure geometry for all three structures over the Sanitary and Shipping Canal.

TABLE 1: Existing Structure Geometry		
	Ramp D (SN 016-2408)	IL 171 (SN 016-0486) (SN 016-0487)
Deck Width (ft)	28	35.5 NB and Varies 53-62 SB
Height (low chord to stream centerline) (ft)	57.18	61.01
Low Beam Chord Elevation	612.09	616.51
Top of Deck Elevation	616.10	624.98
Skew	25.0°	0.0°
Piers (100-year waterway)	2@3.5' 20' dolphins	2@3.5' 20' dolphins

Backwater calculations indicate that all structures readily pass all flood events up to and including the 500-year event of 16,100 cfs without overtopping the road and still meeting IDOT Drainage Manual requirements for clearance and freeboard.

5 PROPOSED IMPROVEMENTS

The project scope at this time is for bridge deck replacement on the IL 171 mainline bridges and deck repairs for the Ramp D Bridge. The northbound IL 171 mainline bridge deck is being widened to bring the structure to current roadway width standards; 40' clear structure width. The proposed improvements would require the addition of a beam on the upstream side of the bridge. The current pier configuration would require slight modification in order to accommodate the additional beam. See the attached Preliminary Pier Sketch. The modified pier configurations and the proposed deck structure were input into the HEC-RAS model, the results are discussed below.

6 DISCUSSION OF MODEL RESULTS

The Natural Conditions and Existing Conditions were modeled using the Army Corps backwater modeling program, HEC-RAS, using the flow data as described above. The Natural and Existing Conditions models vary little in their water surface elevations and velocities. None of the bridges studied have embankments or approaches encroaching on the channel. The only differences seen in the water surface profiles are from losses imparted by the piers in the existing condition. The Proposed Conditions were input into HEC-RAS, using the changes in pier configurations mentioned above. The pier modifications have no impact on the water surface elevation or the velocity through the water opening. A majority of the disruption to the water flow is done by the dolphins preceding the piers and very little effect would be expected. See *Table 3: Scour Results* and *Appendix C: Supporting Documents*.

TABLE 2a: Model Results		
	Ramp D (SN 016-2408)	Proposed Ramp D (SN 016-2408)
Design 50-year Flow (cfs)	11,300	11,300
Clearance 50-year (ft)	25.06	25.06
Top Width 50-year (ft)	293.65	293.65
Waterway Area 50-year (sf)	6,862.45	6,862.45
Velocity 50-year (ft/s)	1.65	1.65
100-year High Water Level	588.03	588.03
Overflow Frequency	>500-year	>500-year

TABLE 2b: Model Results		
	IL 171 (SN 016-0486) (SN 016-0487)	Proposed IL 171 (SN 016-0486) (SN 016-0487)
Design 50-year Flow (cfs)	11,300	11,300
Clearance 50-year (ft)	29.48	29.48
Top Width 50-year (ft)	313.21	313.21
Waterway Area 50-year (sf)	7,964.65	7,964.65
Velocity 50-year (ft/s)	1.42	1.42
100-year High Water Level	588.03	588.03
Overflow Frequency	>500-year	>500-year

A scour analysis is included as part of the hydraulic analysis of the bridges, in order to ascertain the potential for the streambed to scour during storm events. The scour module of HEC-RAS was utilized to calculate scour from the Des Plaines River's hydraulic properties. The river does not contract to meet the existing bridges, so in all bridge cases the contraction scour was 0.0'. See *Table 3: Scour Results* and *Appendix C: Supporting Documents* for detailed results.

Review of the Underwater Investigation provided by IDOT showed a maximum of 18 inches of footing exposure but little other evidence of scour around the piers (See Underwater Investigation). The pier footings in the Sanitary and Shipping Canal are four feet below the streambed and are set on bedrock, pier scour would only occur up to this point. None of the piers on the bridges over the Sanitary and Shipping Canal are considered to be scour critical. See *Table 2: Model Results* and *Appendix C: Supporting Documents*.

TABLE 3: Scour Results – 500-year			
	Contraction Scour (ft)	Abutment Scour (ft)	Pier Scour (ft)
Ramp D (SN 016-2408)	0.0	6.61	5.45 – 17.63
IL 171 NB (SN 016-0486)	0.0	0.0	3.75 – 16.35
IL 171 SB (SN 016-0487)	0.0	0.0	3.75 – 16.35

7 PERMITTING

All three IL 171 Bridges over the Sanitary and Shipping Canal are in a Zone A floodplain as mapped on the Flood Insurance Rate Map. See *Flood Insurance Rate Map, Exhibit 1-01*. The Sanitary and Ship Canal at the IL 171 Bridge crossings has a tributary area of greater than 640 acres, and is therefore under IDNR jurisdiction; meaning the project requires an Illinois Department of Natural Resources/Office of Water Resources Permit under 3700 Rules entitled Construction in Floodways of Rivers, Lakes and Streams. Section 3700.70 Special Provisions for Bridges and Culverts stipulates a bridge reconstruction project that meets either of the provisions a) or b) below is permissible:

a) General Standards for New Bridges and Culverts
Permits will be granted for new bridges and culverts which would not result in flood damages or potential flood damages outside the project right-of-way due to increases in flood heights or velocities. Absent contrary evidence, this standard will be considered met if, for the worst-case analysis, the application shows that:

1) any water surface profile increase would be contained within the channel banks (or within existing vertical extensions of the channel banks such as within the design protection grade of existing levees or floodwalls) or flood easements; or
2) in urban areas, the water surface profile increase would not exceed 0.5 feet at the structure, nor 0.1 foot at a point 1000 feet upstream of the structure as determined by the horizontal projection of the increase and the slope of the hydraulic grade line; or
3) in rural areas, the water surface profile increase would not exceed 1.0 foot at the structure, nor 0.5 feet at a point 1000 feet upstream of the structure as determined by the horizontal projection of the increase and the slope of the hydraulic grade line; and
4) any increase in average channel velocity would not be beyond the scour velocity of the predominant soil type of the channel; or
5) increased scour, erosion and sedimentation would be prevented by the use of riprap or other design measures.

b) General Standards for Bridge and Culvert Reconstruction

A bridge or culvert reconstruction project which would meet the following provisions will be permissible. A reconstruction project which would not meet these provisions must comply with the general standards for new bridges and culverts.

1) The reconstruction (including approach roads) shall be no more restrictive to normal and flood flows than the existing bridge or culvert crossing; and

2) Documentation must be provided that the existing crossing has not caused demonstrable flood damage. In the case of public projects, certification by a District Engineer of the Department of Transportation's Division of Highways, a County Engineer (if a Professional Engineer), or a Municipal Engineer (if a Professional Engineer) that the existing crossing has not caused demonstrable flood damage will be adequate documentation.

The two mainline bridges, which are having their decks replaced as part of this project, meet both the General Standards for New Bridges and Culverts, and the General Standards for Bridge and Culvert Reconstruction enumerated above. The ramp bridge, which only has deck repairs, is exempt from the rules above.

The Sanitary and Shipping Canal is designated as a “Public Body of Water” by the IDNR/OWR in Section 3704. Appendix A: Public Bodies of Water; meaning a permit is required for work on the bridges and, more specifically, on the channel itself.

The Sanitary and Shipping Canal also requires sign-off from the U.S. Coast Guard for any work below low steel of the bridges. A letter stating the preliminary proposed scope of work with documentation of the Phase I plan set has been sent to the Coast Guard for their review. Since the Phase I scope of proposed work on this bridge has changed, a follow up letter, addressing the proposed structural changes will need to be forwarded to the Coast Guard.

8 CONCLUSION

Hydraulic analysis indicates that the existing and proposed structures over the Sanitary and Shipping Canal satisfy all IDOT design criteria for bridges as stated in the Drainage Manual. Changes in the scope of the project may require further hydraulic considerations.

WATERWAY INFORMATION TABLES

WATERWAY INFORMATION TABLE

Route:	NB First Avenue to NB I-55 Ramp	**Exist. S.N.:**	SN 016-2408	**Computed.:**	AL	**DATE:**	6/28/2010
Section:		**Prop. S.N.:**	SN 016-2408	**Checked:**	DMM	**DATE:**	3/29/2011
County:	Cook	**Waterway:**	Sanitary and Shipping Canal				

Drainage Area = N/A **sq. mi.**

Existing Low Grade Elevation = 613.98 **ft. @ Sta.** 35+85

Proposed Low Grade Elevation = 614.07 **ft. @ Sta.** 35+89

Flood	Frequency (yr.)	Discharge (cfs)	Waterway Opening (sq. ft.)		Natural H.W.E.	Created Head (ft.)		Headwater Elevation	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	8500	5972.04	5972.04	583.92	0.01	0.01	583.93	583.93
DESIGN	**50**	11300	6862.45	6862.45	587.03	0.01	0.01	587.04	587.04
BASE	**100**	12800	7159.30	7159.30	588.03	0.01	0.01	588.04	588.04
OVERTOPPING	**>500**								
MAX. CALC.	**500**	16100	8248.25	8248.25	591.43	0.02	0.02	591.45	591.45

10 Year Velocity through Existing Bridge = 1.42 **fps** **10 Year Velocity through Proposed Bridge =** 1.42 **fps**

DATUM: NAVD 88

ALL-TIME H.W.E. & DATE: 583.58 (June 30, 1977)

SCOPE OF WORK:

EXISTING STRUCTURE

TYPE:	Steel Beams
LENGTH:	625 ft
SPANS:	5 Spans
LOW BEAM:	612.09
SKEW:	25°

PROPOSED STRUCTURE

TYPE:	Steel Beams
LENGTH:	625 ft
SPANS:	5 Spans
LOW BEAM:	612.09
SKEW:	25°

COMMENTS:

ALL ELEVATIONS ARE IN HIGHWAY DATUM
PROPOSED STRUCTURE DETAILS ARE PRELIMINARY, SUBJECT TO REFINEMENT IN TSL STAGE.
ALL BRIDGES' LENGTH MEASURED FROM THE ABUTMENT TO THE LEVEE

WATERWAY INFORMATION TABLE

Route:	NB & SB First Avenue	**Exist. S.N.:**	SN 016-0487 & SN 016-0486	**Computed.:**	AL	**DATE:**	6/28/2010
Section:		**Prop. S.N.:**	SN 016-0487 & SN 016-0486	**Checked:**	DMM	**DATE:**	3/29/2011
County:	Cook	**Waterway:**	Sanitary and Shipping Canal				

Drainage Area = N/A **sq. mi.**

Existing Low Grade Elevation = 622.73 **ft. @ Sta.** 39+10

Proposed Low Grade Elevation = 622.74 **ft. @ Sta.** 39+06

Flood	Frequency (yr.)	Discharge (cfs)	Waterway Opening (sq. ft.)		Natural H.W.E.	Created Head (ft.)		Headwater Elevation	
			Existing	Proposed		Existing	Proposed	Existing	Proposed
	10	8500	6997.07	6997.07	583.92	0.00	0.00	583.92	583.92
DESIGN	**50**	11300	7964.65	7964.65	587.03	0.00	0.00	587.03	587.03
BASE	**100**	12800	8279.42	8279.42	588.03	0.00	0.00	588.03	588.03
OVERTOPPING	**>500**								
MAX. CALC.	**500**	16100	9438.92	9438.92	591.43	0.01	0.01	591.44	591.44

10 Year Velocity through Existing Bridge = 1.21 **fps** **10 Year Velocity through Proposed Bridge =** 1.21 **fps**

DATUM: NAVD 88

ALL-TIME H.W.E. & DATE: 583.58 (June 30, 1977)

SCOPE OF WORK:

EXISTING STRUCTURE		**PROPOSED STRUCTURE**	
TYPE:	Steel Beams	**TYPE:**	Steel Beams
LENGTH:	481 ft	**LENGTH:**	481 ft
SPANS:	5 Spans	**SPANS:**	5 Spans
LOW BEAM:	616.51	**LOW BEAM:**	616.51
SKEW:	0°	**SKEW:**	0°

COMMENTS:

ALL ELEVATIONS ARE IN HIGHWAY DATUM
PROPOSED STRUCTURE DETAILS ARE PRELIMINARY, SUBJECT TO REFINEMENT IN TSL STAGE.
ALL BRIDGES' LENGTH MEASURED FROM THE ABUTMENT TO THE LEVEE

Tab 21

SECTION 21

CD

CD POCKET INSERTED HERE