MEMORANDUM

Chicago Waterways Tail Water Conditions Modeling

TO:	Tim Coleman, Phil Bonn, CH2MHILL
FROM:	Marion Kessy, FLUIDCLARITY
DATE:	June 1, 2008
PROJECT NUMBER:	FCL 7000

Purpose

This memorandum is a follow-up to the previous, October 12, 2007 memorandum which discussed methodologies for developing appropriate boundary conditions in the Cal-Sag Channel (CSC).
This memorandum expands on that discussion to include, in addition to the CSC, the Chicago Sanitary and Ship Canal (CSSC), the Illinois-Michigan Canal (I&M), and the South Branch of the Chicago River (SBCR). All of these waterways are components of the Chicago Waterways System (CWS) within the Cal-Sag watershed which do not have established Base Flood Elevations (i.e. unstudied Zone A floodplains).

Flood stages in these waterways can be used as tail water conditions for modeling the tributaries or developing inundation maps for the waterways. This memorandum presents the methodology and hydraulic models FluidClarity developed to establish flood stages in these waterways.

Existing Chicago Waterways Watershed Study

The U.S. Army Corps of Engineers (USACE) developed hydrologic and hydraulic models of the Chicago Waterways System (CWS) as part of the Chicagoland Underflow McCook Reservoir Plan in 1999. The location and extent of the CWS system are depicted in the attached Exhibit 1, Enclosure 1-a. A schematic of the modeled reaches and limits is included in Exhibit 1, Enclosure 1-b. The CWS hydraulic models were based on the USACE UNET model which does not meet the MWRD criteria. The cross section data incorporated in the UNET model were field surveyed.

According to the USACE design report, the flows into the CWS were assembled from three sources:

- Overflows from the combined sewer drop shafts connected to the Underflow System otherwise called TARP
- Discharges from Sanitary Treatment Plants
- Runoff from ungaged areas of the watershed (i.e. direct runoff)

A variety of hydrologic models were employed to determine the flows into the CWS. Because of the complex hydrology of the watershed, some specialized models that may not meet the MWRD criteria were used to determine flows. Flows from the ungaged watersheds were calculated by the USACE HEC-1 model. The sewer outflows were calculated by a combination of the EPA's HSPF continuous simulation model and the locally developed sewer capacity model called SCALP. The SCALP model does not meet MWRD criteria, however, it is a simple model that has been specifically developed for the combined sewer system to calculate over-flows to TARP.
As part of the McCook Reservoir design study, the USACE employed the 'standard project flood' (SPF) methodology to evaluate design alternatives.

The SPF is a synthetic hydrograph that is expected to result from the most severe combination of meteorological and hydrologic conditions which are reasonably characteristic of the watershed, excluding extremely rare combinations. Developing the SPF involves calibration of a synthetic hydrograph to historical records and empirical runoff-relations for the watershed. The advantage of this approach is its simplicity and consistency for evaluating design alternatives.
The USACE calibrated the hydraulic and hydrologic models with meteorological, stage, and flow records collected in the period 1951-1988. For the CWS watershed, the SPF flood was based on a 1957 large flood that extended from January 1 through January 20, 1957. Accordingly, flow and stage hydrographs derived from this SPF have a temporal span of about 20 days. For our modeling needs, we have shifted these dates to the year 2008.

The UNET hydraulic models and hydrologic models for the CWS are described in detail in the project report prepared by the U.S. Army Corps of Engineers (USACE, 1999).

Recommended Methodology

FluidClarity recommends adopting the USACE' existing conditions or baseline models as the basis for stages in the CWS waterways because no major changes have occurred in the watershed since the completion of the USACE CWS study. The merits of adopting the USACE models are:

- Flood stages are derived from a unified hydrology of the whole CWS watershed and associated control structures. The computed flood stages in the CWS and in the associated tributary models will therefore be consistent throughout the watershed. This aspect may be important since the USACE would be a key agency involved in developing and implementing flood mitigation alternatives in the tributaries.

- The HEC-RAS models are derived from the most comprehensive and detailed study of the CWS available. The methodology and approach for the hydrologic and hydraulic conditions are well documented.

- The models contain flood stages for flood-frequencies including the 2-, 5-, 10-, 20-, 50-, 100-, and 500-year floods that are important for developing the DWP.

The CWS UNET base line models are unsteady flow models. For the purposes of establishing flood stages in the CSSC, SBCR and Cal-Sag Channels, FluidClarity recommends developing steady HEC-RAS BC models rather than unsteady models. This recommendation is based on several considerations:

- In FluidClarity's opinion, the benefits of the unsteady flow formulation for the network of waterways do not justify the level of effort required. This especially so since the CWS models are primarily intended to provide tail water conditions for modeling the tributaries.
- Steady flow flood stages along the CWS for various flood frequency contain sufficient information for developing inundation maps that meet FEMA criteria.

- Inflow hydrographs from the ungaged areas of the Des Plaines, Calumet and Cal-Sag watersheds were apparently missing from the input HEC-DSS database obtained from USACE. These missing flows however, were incorporated in the UNET model runs. Using the peak flows from the UNET model results would overcome this limitation.

- As shown in Table 1, a comparison of the UNET unsteady flood stages and steady-flow HECRAS flood stages indicated that they were reasonably close. This agreement is expected because, as shown on the flow profiles, the Lockport dam plays a key role in maintaining water levels in the CSSC, the SBCR and CSC channels.

FluidClarity thus developed steady HEC-RAS models from the UNET models in the following steps.

1. We imported the UNET model into HEC-RAS and then removed all the reaches that were not of interest in this study (See Exhibit 1). The downstream limits of the model were Lockport. The upstream limits were the Little Calumet River and the North Branch of the Chicago River.

2. The cross sections imported into HEC-RAS were georeferenced using the Cook County topographic maps, USGS maps and aerial photographic maps. The Manning's roughness values in the main channel were maintained.

3. The UNET Baseline model stages at Lockport were imposed as downstream boundary conditions. Flood stages for the 2-, 5-, 10-, 20-, 50-, 100-, and 500-year frequency storms were obtained from the UNET model results.

4. Peak flows corresponding to the 2-, 5-, 10-, 20-, 50-, 100-, and 500-year frequency storms were applied at appropriate locations along the waterways. The flows were obtained from the USACE UNET results which accounted for tributary flows and all other sources.

Assumptions

The following assumptions apply in developing the CWS HEC-RAS and tributary modeling.

- The baseline, project flood is representative of conditions in the channel for design purposes.
- Tributary and CWS conditions may be treated independently under most conditions since tributaries flood response is shorter compared to that of the CWS waterways.
- The I&M Canal has little hydraulic impact on flow conditions in the CSSC.
- The I&M Canal elevations are represented by the CSSC elevations.

During very large storm events, the tributary and CWS flow conditions may not be dependent of each other, and timing effects may be difficult to evaluate. A sensitivity analysis using the various tail water elevations from the steady flow models should indicate if there are significant unsteady flow effects. However, as discussed, since the primary interest of the study are flood stages in the CWS rather than flow volumes, unsteady flow effects are anticipated to play a minor role.

Findings

The HEC-RAS models for the CSSC, SBCR and CSC and I&M waterways were used to calculate flood stages for the 2-, 5-, 10-, 20-, 50-, 100-, and 500-year flood frequencies. The results are presented in Table 2. The 10-, 50-, 100-, and 500-year flood stages are required if detailed Flood Insurance Rate Maps for the flooding sources would be needed. The 2-, 5-, 20-year profiles are useful for project formulation purposes such as developing flood damage mitigation alternatives.

For reference purposes Table A-11 of Exhibit 1 is an excerpt from the USACE project report that shows a comparison of the UNET baseline model results, historical records, and results that were obtained by continuous simulation using UNET for the period 1951-1988.

Conclusion and Recommendations

HEC-RAS models for simulating flood stages in the CSSC, SBCR and the Cal-Sag Canal were derived from UNET models that the USACE developed for the purposes of developing flood mitigation alternatives in the CWS. The USACE models constitute the best available information in the CWS watershed. The steady-state HEC-RAS models are thus adequate for purposes of developing the Detailed Watershed Plan (DWP). In particular, for purposes identifying alternatives, constant tail water conditions appear adequate for comparing alternatives. The fact that flood-stages of a wide range of flood frequencies are available allows considerable modeling flexibility to fit project needs. This approach is simple and allows focus to be on the unsteady modeling of the tributaries where the problems are.

More detailed approaches, possibly including unsteady flow analyses for the CWS waterways, may be warranted for detailed project design; however, detailed design tasks have been considered outside the scope of the DWP.

Sources of Information

1. U.S. Army Corps of Engineers (USACE). Design Documentation Report, Chicagoland Underflow, McCook Reservoir Plan, 1999.

2. USACE UNET models input and output files

3. Cook County 2-ft contour topographic maps (2005)

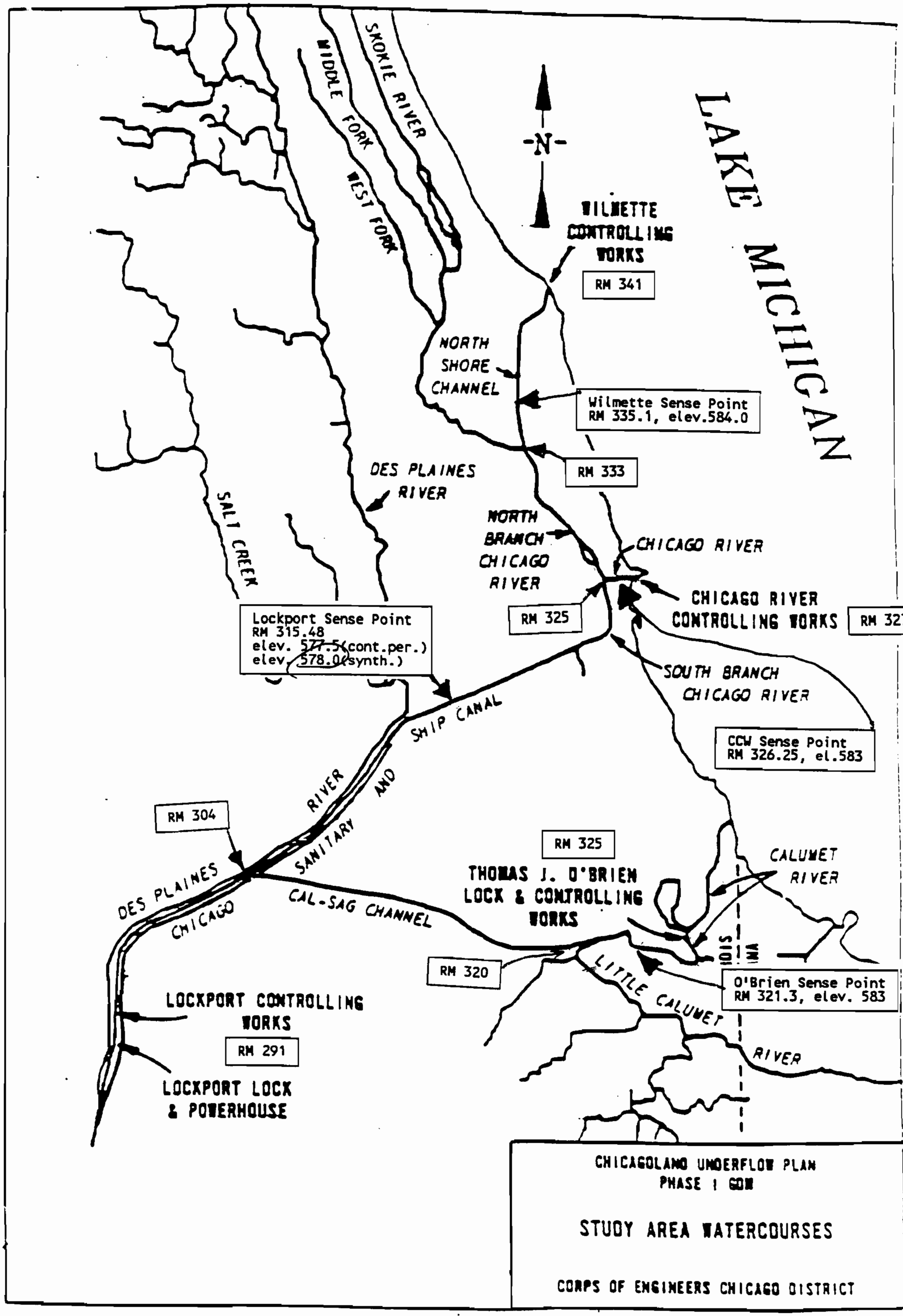
4. USACE, Publication EM 1110-2-1411: STANDARD PROJECT FLOOD DETERMINATIONS , March 1965

Acknowledgement

Rick Ackerman and Dave Kiel of the USACE Chicago District gave invaluable assistance in searching; collating and furnishing the UNET models and various other documents that were used to prepare the HEC-RAS models discussed in this memorandum.

Attachments
EXHIBIT 1

HEC-RAS Models : These have been separately submitted.



Enclosure 1-a

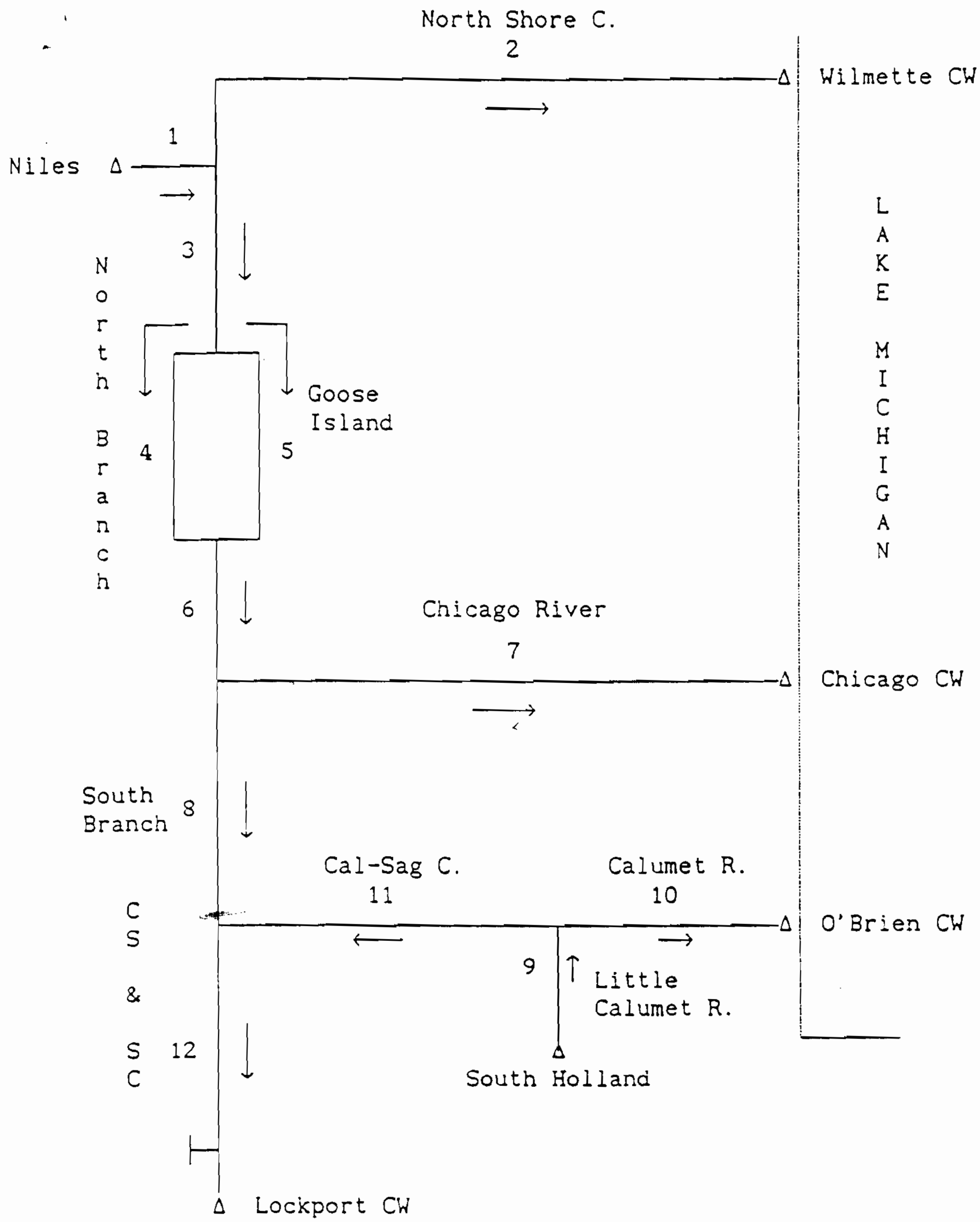


Figure 2.2. Reach numbering scheme for the Chicago Canal model.

Enclosure 1-b

Table A-11. Canal System Observed and Modeled Maximum Water Surface Elevations

Location	Approx. River Mile	Maximum Water Surface Elevation (ft NGVD)						
			Modeled for Water Years 1951-1988			Modeled 1% Chance Exceedance Event		
		Observed, 1965 to present (Date)	Existing (Date)	Stage 1 Project (Date)	Stage 2 Project (Date)	Existing	Stage 1 Project	Stage 2 Project
Wilmette - NSC @ Sheridan Rd.	341.2	586.7 (4/18/75)	592.6 (7/57)	591.3 (7/57)	590.5 (7/57)	589.4	589.1	587.6
North Side SW - NSC @ Howard St.	336.8	588.4 (8/14/87)	594.9 (7/57)	593.1 (7/57)	592.6 (7/57)	591.8	590.9	589.5
North Branch PS - NSC @ Lawrence St.	333.0	588.8 (8/16/97)	594.6 (7/57)	592.2 (7/57)	592.2 (7/57)	591.7	589.8	588.4
Chicago River Controlling Works - Chicago River @ Lk Michigan*	325.6	583.6 (8/16/97)	589.1 (7/57)	585.3 (10/54)	583.9 (10/54)	588.2	585.0	583.2
31st & Western - CS&SC @ Willow Springs Rd.	320.5	583.6 (6/30/77)	589.6 (7/57)	585.4 (10/54)	583.9 (10/54)	588.7	585.1	583.0
Willow Springs - CS&SC @ Willow Springs Rd.	307.9	582.7 (7/18/96)	587.2 (7/57)	584.0 (10/54)	583.0 (10/54)	586.7	584.1	582.4
Sag Junction - Confluence of CS&SC and CSC	304.2	582.2 (7/18/96)	585.0 (7/57)	582.6 (10/54)	581.9 (10/54)	584.7	582.8	581.6
O'Brien Lock - Calumet River Downstream (south) of O'Brien Lock	325.8	583.8 (7/18/96)	585.0 (7/57)	584.6 (7/57)	584.6 (7/57)	584.7	584.0	583.8
Southwest Highway - CSC @ Southwest Hwy	310.8	583.7 (7/18/96)	585.0 (7/57)	584.3 (10/54)	584.3 (10/54)	585.0	583.5	583.1

*The approximated river mile is for the junction of the Chicago River and its North and South Branch.

NSC = North Shore Channel
CS&SC = Chicago Sanitary and Ship Canal
CSC = Calumet Sag Channel

Table A-12. Index of Major Bridges and Confluences for Chicago Canal Model

Reach Scheme (Canal Model)	Tributary Stream	Bridge Name	River Mile
2	North Shore Channel	Sheridan Road Lock	341.2 1/
2	"	Central Street	340.4
2	"	Green Bay Road	339.8
2	"	Church Street	338.7
2	"	Dempster, Il 58	338.2
2	"	Oakton Street	337.2
2	"	Touhy Avenue	336.2
2	"	Devon Avenue	335.2
2	"	Peterson, US 14	334.7
2	"	Foster Avenue	333.6
2	"	Jct. North Branch	333.5
1	North Branch	Touhy	51.4 2/
1		(05536000 gage)	
1	"	Devon Avenue	49.2
1	"	Edens Expwy.	46.2
1	"	Cicero Avenue	46.1
1	"	Foster Avenue	44.5
1	"	Kimball Avenue	43.9
1	"	Kedzie Avenue	43.6
1	"	Jct. North Shore Channel	43.3
3	"	Jct. North Shore Channel	333.5
3	"	Lawrence Ave.	333.1
3	"	Montrose Ave.	332.5
3	"	Irving Park Rd.	332.0
3	"	Addison Street	331.4
3	"	Belmont Ave.	330.9
3	"	Western Ave.	330.6
3	"	Diversy Ave.	330.2
3	"	Damen Ave.	329.9
3	"	Fullerton Ave.	329.5
3	"	Ashland Ave.	329.1
3	"	Cortland Street	328.6
3	"	North Ave.	327.9
4	North Br. (Goose Island West)	Division Street	327.4
4	"	Ogden Ave.	326.9
4	"	Halsted Street	326.6
5	North Br. (Goose Island East)	Division Street	327.0
5	"	Ogden Ave.	326.9
5	"	Halsted Street	326.85
6	North Branch	Chicago Ave.	326.4
6	"	Ohio/Kennedy Expwy.	326.1
6	"	Grand Ave.	326.0
6	"	Kinzie Street	325.8
6	"	Jct. South Branch	325.6
7	Chicago River	Franklin Street	325.65
7	"	Wells Street	325.7
7	"	LaSalle Street	325.8
7	"	Clark Street	325.9
7	"	Dearborn Street	326.0
7	"	State Street	326.1
7	"	Wabash Ave.	326.3
7	"	Michigan Ave.	326.4
7	"	Lake Shore Drive	326.9
8	South Branch	Lake Street	325.6
8	"	Randolph Street	325.5
8	"	Washington Street	325.4
8	"	Madison Street	325.3
8	"	Monroe Street	325.1
8	"	Adams Street	325.0

Table A-12. Index of Major Bridges and Confluences for Chicago Canal Model (cont'd)

Reach Scheme (Canal Model)	Tributary Stream	Bridge Name	River Mile
8	South Branch (cont.)	Jackson Blvd.	324.9
8	"	Eisenhower Expwy.	324.7
8	"	Roosevelt Road	324.2
8	"	18th Street	323.6
8	"	Canal Street	323.3
8	"	Cermak Road	323.1
8	"	Halsted Street	322.6
8	"	Loomis Ave.	321.8
8	"	Damen Ave.	321.0
8	Chicago Sanitary Ship Canal	Western Ave.	320.5
8	"	California Ave.	319.9
8	"	Kedzie Ave.	319.4
8	"	Pulaski Road	318.3
8	"	Cicero Ave.	317.2
8	"	Central Ave.	316.2
8	"	Harlem Ave.	313.9
8	"	Stevenson Expwy.	313.3
8	"	US Hwy 45	309.3
8	"	Willow Springs Rd.	307.7
8	"	IL Rt. 83	304.0
8	"	Jct. Cal. Sag Channel	303.3
9	L. Calumet River	Cottage Grove Ave. (So. Holland 05536290)	6.81
9	"	Indiana Ave.	5.21
9	"	147th Street	4.35
9	"	Halsted Street	3.45
9	"	Ashland Ave.	2.09
9	"	Roll Ave.	1.15
9	"	Jct. Cal. Sag Channel	0.00
10	Calumet River	Jct. Cal. Sag Channel	319.6
10	"	Halsted Street	320.1
10	"	Calumet Expressway	324.8
10	"	Thomas O'Brien L&D	326.4
11	Calumet Sag Channel	Jct. Chi. San. Ship	303.3
11	"	IL Rt. 83	303.9
11	"	104th Ave.	307.3
11	"	US Hwy 45	308.3
11	"	Southwest Hwy 7	310.7
11	"	Harlem Ave.	311.5
11	"	Richland Ave.	312.5
11	"	Cicero Ave.	314.9
11	"	Crawford	316.0
11	"	Kedzie	317.0
11	"	Ashland Ave.	319.0
11	"	Jct. L. Cal. R.	319.6
12	Chicago Sanitary Ship Canal	Jct. Cal. Sag Channel	303.3
12	"	Stephen Street	300.4
12	"	Romeoville Road	296.1
12	"	Jct. Controlling Wks.	293.2
12	"	IL Hwy 7	292.7
12	"	Lockport Lock & Dam	291.0

1/ miles upstream of the Illinois R. confluence with the Mississippi at Grafton, IL

2/ miles upstream of the Des Plaines R. confluence with the Chicago Sanitary Ship Canal at Joliet, IL

TABLE 1 — **A Comparison of UNET and HEC-RAS Models Flood Stages along the Cal-Sag Channel**

No.	Location Along Cal-Sag Channel	XSECTION STATION		PREDICTED ELEVATION (FT, NAVD 88)								
				2-YR			5-YR			10-YR		
		UNET	HEC-RAS	UNET	HEC-RAS	DIFF*	UNET	HEC-RAS	DIFF*	UNET	HEC-RAS	DIFF*
1	Jct. Little Calumet River	RS 319.6	RS 84463.18	580.80	580.22	-0.58	582.16	581.70	-0.46	582.88	582.66	-0.22
2	East Stoney Creek	RS 317.6	RS 73903.18	580.67	580.04	-0.63	582.03	581.50	-0.53	582.77	582.44	-0.33
3	Midlothian Creek	RS 314.6	RS 58063.18	580.47	579.78	-0.69	581.81	581.20	-0.61	582.55	582.14	-0.41
4	Tinley Creek	RS 314.6	RS 58063.18	580.47	579.69	-0.78	581.81	581.10	-0.71	582.55	582.03	-0.52
5	Navajo Creek	RS 312.6	RS 47503.18	580.31	579.60	-0.71	581.62	580.99	-0.63	582.37	581.93	-0.44
6	Cal-Sag Channel - Tributary B	RS 310.6	RS 36943.18	580.12	579.40	-0.72	581.40	580.76	-0.64	582.16	581.70	-0.46
7	West Stoney Creek	RS 309.6	RS 31663.18	580.02	579.30	-0.72	581.27	580.65	-0.62	582.04	581.58	-0.46
8	Mill Creek	RS 308.6	RS 26383.18	579.94	579.16	-0.78	581.13	580.48	-0.65	581.90	581.42	-0.48
9	Sag Jct. (CSC @ CS&SC)	RS 304.2	RS 2079.42	579.51	578.28	-1.23	580.31	579.45	-0.86	581.08	580.45	-0.63
10	Confluence CS&SC	RS 303.6	RS 0.00	579.47	578.20	-1.27	580.22	579.36	-0.86	580.99	580.37	-0.62

No.	Location Along Cal-Sag Channel	XSECTION STATION		PREDICTED ELEVATION (FT, NAVD 88)								
				20-YR			50-YR			100-YR		
		UNET	HEC-RAS	UNET	HEC-RAS	DIFF*	UNET	HEC-RAS	DIFF*	UNET	HEC-RAS	DIFF*
1	Jct. Little Calumet River	RS 319.6	RS 84463.18	583.86	584.15	0.29	584.39	584.85	0.46	584.92	585.58	0.66
2	East Stoney Creek	RS 317.6	RS 73903.18	583.81	583.90	0.09	584.37	584.67	0.30	584.91	585.43	0.52
3	Midlothian Creek	RS 314.6	RS 58063.18	583.65	583.56	-0.09	584.28	584.41	0.13	584.84	585.18	0.34
4	Tinley Creek	RS 314.6	RS 58063.18	583.65	583.44	-0.21	584.28	584.32	0.04	584.84	585.10	0.26
5	Navajo Creek	RS 312.6	RS 47503.18	583.49	583.32	-0.17	584.18	584.23	0.05	584.77	585.02	0.25
6	Cal-Sag Channel - Tributary B	RS 310.6	RS 36943.18	583.31	583.06	-0.25	584.05	584.04	-0.01	584.67	584.83	0.16
7	West Stoney Creek	RS 309.6	RS 31663.18	583.20	582.93	-0.27	583.98	583.94	-0.04	584.61	584.74	0.13
8	Mill Creek	RS 308.6	RS 26383.18	583.09	582.79	-0.30	583.89	583.83	-0.06	584.54	584.64	0.10
9	Sag Jct. (CSC @ CS&SC)	RS 304.2	RS 2079.42	582.37	582.02	-0.35	583.39	583.23	-0.16	584.13	584.13	0.00
10	Confluence CS&SC	RS 303.6	RS 0.00	582.29	581.96	-0.33	583.33	583.19	-0.14	584.09	584.10	0.01

No.	Location Along Cal-Sag Channel	XSECTION STATION		PREDICTED ELEVATION (FT, NAVD 88)								
				500-YR						**25-YR** ***		
		UNET	HEC-RAS	UNET	HEC-RAS	DIFF*				UNET	HEC-RAS	DIFF*
1	Jct. Little Calumet River	RS 319.6	RS 84463.18	587.65	588.46	0.81				583.90	584.18	0.28
2	East Stoney Creek	RS 317.6	RS 73903.18	587.65	588.39	0.74				583.87	583.95	0.08
3	Midlothian Creek	RS 314.6	RS 58063.18	587.61	588.25	0.64				583.74	583.67	-0.07
4	Tinley Creek	RS 314.6	RS 58063.18	587.61	588.20	0.59				583.74	583.56	-0.17
5	Navajo Creek	RS 312.6	RS 47503.18	587.56	588.16	0.60				583.58	583.45	-0.13
6	Cal-Sag Channel - Tributary B	RS 310.6	RS 36943.18	587.49	588.06	0.57				583.44	583.29	-0.14
7	West Stoney Creek	RS 309.6	RS 31663.18	587.45	588.01	0.56				583.34	583.12	-0.22
8	Mill Creek	RS 308.6	RS 26383.18	587.40	587.95	0.55				583.17	583.02	-0.15
9	Sag Jct. (CSC @ CS&SC)	RS 304.2	RS 2079.42	587.10	587.64	0.54				582.58	582.26	-0.32
10	Confluence CS&SC	RS 303.6	RS 0.00	587.07	587.62	0.55				582.53	582.22	-0.32

Note:

* DIFF = ELEVATION $_{HEC\text{-}RAS}$ - ELEVATION $_{UNET}$

CSC = Cal-Sag Channel

CS&SC = Chicago Sanitary and Ship Canal

Jct. = Junction

NAVD 88 (North American Vertical Datum 1988, FT) = NGVD 29 (National Geodetic Vertical Datum of 1929, FT) - 0.29 FT, in this case. Refer to: http://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.prl

File: W: \7008\Modeling\04\Output\Profile Tables_060208_c.xls

TABLE 2 **FLOOD STAGES (FT, NAVD 88) IN THE CHICAGO WATERWAYS SYSTEM WITHIN THE CAL-SAG WATERSHED***

Cal-Sag Channel

No.	Location Descriptions**	Stationing	2-Yr	5-Yr	10-Yr	20-Yr	50-Yr	100-Yr	500-Yr	25-Yr
1	Jct. Little Calumet River	84463.18	580.22	581.70	582.66	584.15	584.85	585.58	588.46	584.18
2		79183.18	580.11	581.59	582.53	584.02	584.76	585.52	588.45	584.07
3		78655.74	580.10	581.58	582.52	584.00	584.74	585.50	588.44	584.07
4	East Stoney Creek	73903.18	580.04	581.50	582.44	583.90	584.67	585.43	588.39	583.95
5		68623.18	579.95	581.40	582.34	583.79	584.58	585.35	588.34	583.84
6		63343.18	579.87	581.30	582.24	583.68	584.50	585.26	588.30	583.79
7	Midlothian Creek/ Tinley Creek	58063.18	579.78	581.20	582.14	583.56	584.41	585.18	588.25	583.67
8		52783.18	579.69	581.10	582.03	583.44	584.32	585.10	588.20	583.56
9	Navajo Creek	47503.18	579.60	580.99	581.93	583.32	584.23	585.02	588.16	583.45
10		42223.18	579.50	580.88	581.82	583.20	584.14	584.93	588.11	583.34
11		37998.92	579.42	580.79	581.72	583.09	584.06	584.85	588.07	583.29
12	Cal-Sag Channel - Tributary B	36943.18	579.40	580.76	581.70	583.06	584.04	584.83	588.06	583.29
13	West Stoney Creek	31663.18	579.30	580.65	581.58	582.93	583.94	584.74	588.01	583.12
14	Mill Creek	26383.18	579.16	580.48	581.42	582.79	583.83	584.64	587.95	583.02
15		21103.18	578.99	580.29	581.24	582.64	583.71	584.54	587.89	582.86
16		15823.18	578.82	580.08	581.05	582.49	583.59	584.44	587.83	582.71
17		10543.18	578.64	579.86	580.84	582.33	583.47	584.33	587.77	582.56
18		5263.18	578.44	579.63	580.62	582.16	583.33	584.22	587.70	582.42
19	Sag Jct. (CSC @ CS&SC)	2079.42	578.28	579.45	580.45	582.02	583.23	584.13	587.64	582.26
20	Confluence CS&SC	CSSC Jct	578.20	579.36	580.37	581.96	583.19	584.10	587.62	582.22

South Branch of Chicago River (SBCR)

No.	Location Descriptions	Stationing	2-Yr	5-Yr	10-Yr	20-Yr	50-Yr	100-Yr	500-Yr	25-Yr
1	U/S of SBCR	190341	583.94	585.09	585.52	586.82	588.81	590.08	593.87	587.38
2		187913	583.93	585.08	585.52	586.81	588.80	590.08	593.86	587.38
3	(~ Jackson Blvd, RS 324.9)	187649	583.92	585.08	585.52	586.81	588.80	590.08	593.86	586.85
4	(~ Roosevelt Rd, RS 324.2)	184903	583.91	585.07	585.51	586.80	588.79	590.07	593.86	587.38
5	(~ 18th Street, RS 323.6)	181629	583.90	585.06	585.50	586.79	588.78	590.06	593.85	587.38
6	(~ Canal ST, RS 323.3)	178197	583.88	585.04	585.49	586.78	588.77	590.05	593.85	587.38
7	(~ Cermak Rd, RS 323.1)	177933	583.88	585.04	585.48	586.78	588.77	590.05	593.85	587.32
8	(~ Halsted ST, RS 322.6)	175979	583.87	585.03	585.48	586.77	588.76	590.05	593.84	587.32
9		172917	583.86	585.03	585.47	586.77	588.76	590.04	593.84	587.32
10		172653	583.85	585.03	585.47	586.77	588.76	590.04	593.84	587.32
11	(~ Loomis Ave, RS 321.8)	170066	583.84	585.01	585.45	586.75	588.75	590.03	593.83	587.26
12	(~ Damen Ave, RS 321.0)	166159	583.80	584.97	585.42	586.72	588.73	590.02	593.82	587.26
13	Western Ave	163836	583.78	584.95	585.41	586.71	588.71	590.00	593.81	587.26
14		163572	583.77	584.95	585.40	586.70	588.71	590.00	593.81	587.20
15		163044	583.76	584.93	585.39	586.70	588.70	590.00	593.81	587.20
16	(~ California Ave, RS 319.9)	161143	583.73	584.90	585.36	586.67	588.68	589.98	593.79	587.15
17		158292	583.69	584.85	585.33	586.64	588.65	589.96	593.76	587.15
18	(~ Kedzie Ave, RS 319.4)	158028	583.68	584.85	585.32	586.63	588.65	589.95	593.75	587.09
19		155282	583.64	584.80	585.28	586.60	588.62	589.93	593.73	587.03
20		152748	583.58	584.75	585.23	586.55	588.58	589.90	593.68	586.97
21	(~ Pulaski Rd, RS 318.3)	152484	583.58	584.74	585.23	586.55	588.58	589.89	593.68	586.97
22		150372	583.55	584.71	585.20	586.53	588.56	589.88	593.66	586.97
23		147890	583.52	584.69	585.18	586.51	588.54	589.86	593.64	586.91
24	(~ Cicero Ave, RS 317.2)	147626	583.51	584.67	585.17	586.49	588.52	589.83	593.60	586.91
25		144986	583.44	584.59	585.10	586.43	588.45	589.74	593.50	587.04
26		142082	583.33	584.48	584.99	586.35	588.34	589.62	593.36	586.98
27	(~ Central Ave, RS 316.2)	139812	583.26	584.41	584.93	586.29	588.28	589.54	593.27	586.92
28		137067	583.18	584.32	584.85	586.23	588.20	589.44	593.16	586.81
29	LCWCP	136803	583.18	584.32	584.85	586.22	588.19	589.44	593.16	586.86
30		133213	583.05	584.17	584.72	586.11	588.05	589.27	592.98	586.56
31	(~ Harlem Ave, RS 313.9)	129463	582.91	584.02	584.58	585.99	587.90	589.11	592.81	586.44
32		125239	582.78	583.87	584.44	585.88	587.75	588.94	592.63	586.32
33	(~ Stevenson Expwy., RS 313.3)	124975	582.78	583.87	584.44	585.87	587.75	588.94	592.62	586.32
34		120487	582.64	583.72	584.30	585.75	587.59	588.76	592.44	586.21
35		116844	582.56	583.63	584.22	585.67	587.49	588.65	592.32	586.15
36		116580	582.55	583.62	584.21	585.66	587.48	588.64	592.31	586.15
37		111722	582.46	583.52	584.13	585.58	587.38	588.53	592.19	585.90
38		109612	582.32	583.39	584.01	585.46	587.25	588.40	592.06	585.84
39		102114	581.80	582.88	583.54	585.02	586.76	587.89	591.54	585.37
40	(~ US Hwy 45, RS 309.3)	101850	581.78	582.87	583.53	585.00	586.74	587.87	591.53	585.37
41	(IM Trib D)	99000	581.60	582.69	583.37	584.85	586.58	587.69	591.36	585.26
42		96783	581.44	582.54	583.23	584.72	586.42	587.53	591.19	585.14
43	Willow Springs	94463	581.27	582.37	583.08	584.58	586.27	587.38	591.04	584.96
44		87283	580.50	581.63	582.41	583.94	585.54	586.62	590.27	584.25
45		85330	580.25	581.38	582.19	583.72	585.28	586.33	589.97	584.07
46		81898	579.81	580.95	581.79	583.34	584.82	585.84	589.45	583.59
47		79153	579.43	580.57	581.45	583.00	584.42	585.41	588.98	583.17
48		76408	578.99	580.14	581.06	582.62	583.96	584.92	588.46	582.88
49	(~ IL Rt. 83, RS 304.0)	73558	578.55	579.71	580.68	582.25	583.52	584.44	587.95	582.40
50		71078	578.19	579.36	580.37	581.94	583.14	584.03	587.52	582.04
51	D/S of SBCR	70708	578.14	579.30	580.32	581.90	583.08	583.97	587.45	581.98

Chicago Ship & Sanitary Canal, IM& Canal

No.	Location Descriptions	Stationing	2-Yr	5-Yr	10-Yr	20-Yr	50-Yr	100-Yr	500-Yr	25-Yr
1	U/S of CS&SC	70707	578.12	579.27	580.27	581.83	583.03	583.92	587.39	581.92
2		68667	577.91	579.05	580.03	581.58	582.77	583.65	587.09	581.75
3		63387	577.31	578.43	579.38	580.89	582.05	582.91	586.27	580.98
4	(IM Trib B)	59217	576.85	577.95	578.87	580.35	581.48	582.32	585.62	580.57
5	(~ Stephan Street, RS 300.4) (IM Trib A)	52792	576.07	577.13	578.00	579.43	580.52	581.32	584.52	579.82
6		46142	575.22	576.23	577.06	578.42	579.46	580.23	583.31	578.45
7		41282	574.56	575.53	576.31	577.62	578.63	579.36	582.34	577.81
8		36002	573.65	574.58	575.30	576.54	577.50	578.18	581.05	576.57
9	AVM Site (~ Romeoville Rd, RS 296.1)	31802	572.89	573.78	574.45	575.64	576.56	577.21	579.98	575.64
10		24872	571.60	572.40	573.01	574.10	574.92	575.52	578.07	574.12
11		20482	570.69	571.42	571.97	572.98	573.74	574.28	576.68	573.11
12	RM 293.5	17542	569.99	570.68	571.19	572.14	572.85	573.34	575.62	572.28
13	(~ Jct. Controlling Wks, RS 293.2)	16132	569.84	570.53	571.04	572.00	572.72	573.22	575.53	572.11
14		15332	568.96	569.60	570.07	570.97	571.63	572.09	574.28	571.10
15	(~ IL Hwy 7, RS 292.7)	13240	567.91	568.55	569.03	569.92	570.53	570.96	572.85	570.06
16		11900	566.81	567.45	567.93	568.79	569.40	569.82	571.56	569.19
17		10540	565.58	566.17	566.61	567.37	567.96	568.37	569.96	567.51
18		6540	562.01	562.38	562.66	563.13	563.51	563.77	564.81	563.16
19	Lockport CW	5840	558.90	559.12	559.28	559.56	559.79	559.95	560.61	559.63
20	(~ Lockport Lock & Dam, RS 291.0)	4840	538.97	539.11	539.22	539.44	539.64	539.79	540.46	539.49
21		2640	538.56	538.62	538.68	538.79	538.88	538.96	539.32	538.82
22	D/S Limit of CS&SC	800	538.21	538.21	538.21	538.21	538.21	538.21	538.21	538.21

*Source: USACE McCook Reservoir, Final Design Report, 1999, Appendix A
** ( ) RS are approximate stationing close to the described feature
*** 25-Yr data are interpolated data

File: W: \7008\Modeling\04\Output\Profile Tables_060208_c.xls