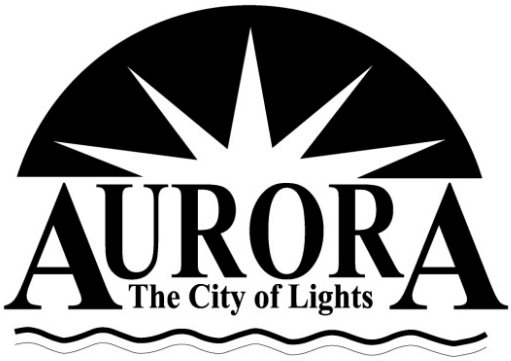
Report–Appendices
(Volume 2 of 2)

Combined Sewer Overflow Long Term Control Plan

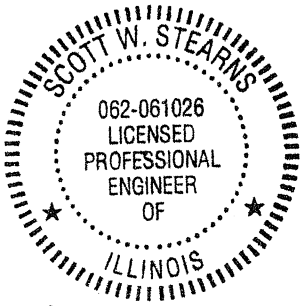


City of
Aurora, IL

March 2010

Report–Appendices (Volume 2 of 2) for
City of Aurora, Illinois

Combined Sewer Overflow
Long Term Control Plan



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Expires 11/30/2011

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March 2010

AURORA
The City of Lights

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APPENDIX A
FLOW MONITORING AND SAMPLING

A.01 BACKGROUND AND PURPOSE

The City of Aurora owns and operates portions of a local combined and separate sanitary sewer system providing wastewater conveyance services within the corporate limits. Aurora's sewer system conveys flows to the Fox Metro intercepting sewer and Water Reclamation Facility (Fox Metro) located south of Aurora in the Village of Oswego. Fox Metro provides wastewater treatment for Aurora, North Aurora, Boulder Hill, Montgomery, Oswego, Sugar Grove, and portions of Yorkville and Batavia.

Of particular interest to this report is Aurora's combined sewer system (CSS). The CSS conveys both sanitary sewerage flow and stormwater flow (generally surface runoff from rainfall or snowmelt). When flows exceed the transport capacity of the CSS, the system overflows into surface waters and ultimately either the Fox River or Indian Creek. Aurora has fifteen designed combined sewer overflow (CSO) locations on the CSS and holds a National Pollutant Discharge Elimination System (NPDES) permit through the Illinois Environmental Protection Agency (IEPA) for the continued operation of these CSOs. Conditions of Aurora's NPDES permit require the City to develop a Long-Term Control Plan (LTCP) to limit CSOs in accordance with Clean Water Act requirements. A copy of the permit can be found in Appendix K.

In order to develop an LTCP, it is necessary to characterize Aurora's CSS. Characterization of the CSS entails collecting data and creating a computer-based model of the CSS to gain an understanding of how the CSS operates, the conditions that cause an overflow, and the magnitude of overflow occurrences. Through that understanding it will then be possible to determine the actions Aurora can take to appropriately limit CSOs.

This Appendix presents the flow monitoring and sampling program that was performed to collect data for characterization of Aurora's CSS. The results of this program will be utilized to:

1. Estimate current flow characteristics of the CSS under various dry weather and wet weather conditions.
2. Calibrate and verify relative accuracy of the CSS computer hydraulic model.
3. Determine relative pollutant loadings in the CSS under dry and wet weather conditions.
4. Provide confidence in the base data used to develop Aurora's LTCP.

A.02 EXISTING FACILITIES

The City of Aurora's CSS generally serves the central region of the city limits with separate sanitary sewer systems serving the perimeter of the city limits. The CSS is generally independent of Aurora's perimeter separate sanitary sewer systems in that the separate sewers do not flow into the CSS. However, there are significant areas of the CSS that have been decombined by Aurora (the stormwater contribution has been removed with construction of new storm sewers) and they convey primarily wastewater flows. These areas are still considered combined sewer areas and their flows are still tributary to Aurora's CSOs. Figure 4.01-1 in the introduction to this report shows the limits of Aurora's combined sewer area and its entire collection system boundary.

Aurora owns and operates the CSS (they do not own the intercepting sewer that conveys flow to the treatment facility). The CSS contains approximately 165 miles of sewer with a drainage area of approximately 7,145 acres. The CSS drainage area is divided by the Fox River into an east side and a west side. The general flow pattern of the east side CSS is from east to west toward the Fox River and an intercepting sewer that runs parallel to the river. The east river intercepting sewer conveys both combined sewer and separate sanitary sewer flows from north to south.

On the west side of the river, the CSS flow pattern is generally from north to south; however, a portion of the west side CSS is conveyed across the river and into the east river intercepting sewer. The east side intercepting sewer eventually crosses the river to the west side and joins up with the majority of the west side CSS at the Fox Metro 69-inch-diameter intercepting sewer on the southern end of the collection system boundary. The 69-inch Fox Metro intercepting sewer conveys the CSS flows along with other separate sewer system flows south to the Fox Metro Water Reclamation Facility.

Excess flows within the CSS are controlled by regulating structures known as combined sewer overflows (CSOs). The CSOs restrict and back up flow from the CSS and eventually overflow when the capacity of the CSS at the CSO is exceeded. The City of Aurora has fifteen CSOs. All but one of the fifteen CSOs overflow into the Fox River. CSO 25 overflows into Indian Creek, which eventually flows into the Fox River. Additionally, Fox Metro operates a wet weather treatment plant on the east side of the Fox River at 400 North Broadway. This facility intercepts overflow from three northeastside CSOs (002, 003A, and 022) and provides storage and treatment of the excess flow. However, if the capacity of this facility is exceeded, it is still possible for overflows to occur at the CSOs as well as the wet weather treatment plant out of CSO 027.

A.03 FLOW MONITORING AND SAMPLING PROGRAM APPROACH

Strand's flow monitoring and sampling program included installation of flow meters at 26 locations and two flow samplers in the City of Aurora's combined sewer system along with four rain gauges spaced across the City. Flow meter installation began on May 1, 2008, with various meter combinations being maintained in the CSS through September 15, 2009. An initial round of flow sampling began on July 14, 2008, and ended on October 13, 2008. However, because the collected data did not appear to be satisfactory for the determination of first flush, flow meters and samplers were reinstalled on May 26, 2009, and sampling continued through September 25, 2009.

In addition to the data collected by Strand, data from Walter E. Deuchler Associates, Inc.'s (WEDA's) ongoing flow metering program for the overflow at fourteen CSOs was obtained. This concurrent data collection was used to develop the computer hydraulic modeling of the system to characterize conditions and magnitudes of overflows.

Following is an explanation of the means and methods employed in the flow monitoring and sampling program.

A. Monitoring Location Determination

The flow monitoring program started with a comprehensive review of Aurora's combined sewer and separate sanitary sewer system mapping. Flow meter locations were based on Aurora's mapping and

discussions with Aurora staff. Project team members from the City of Aurora and Strand Associates evaluated Aurora's combined sewer system and initially identified 24 flow meter locations. The philosophy behind the selected locations was to meter just upstream of each of Aurora's CSOs to provide information on flows tributary to each CSO, while the WEDA data provided information of flow out of the overflows.

A further goal of the flow metering program was to select locations to use the meters to subdivide the CSS service area into smaller subbasins. The smaller subbasins allowed more detailed evaluation of the CSS flow characteristics and eventually a finer calibration and verification of the CSS computer hydraulic model.

Prior to installation of flow meters, Strand performed a field reconnaissance of the proposed meter locations to determine viability of the installations. Most of the locations provided for a stable and reliable meter installation. One proposed meter (FM 20) was located in the middle of the Benton Street and River Street intersection and was not accessible for meter installation. Subsequently it was determined that the upstream sewer system targeted by this meter had been decombined by Aurora and redirected to a separate sewer system no longer tributary to the CSS. Therefore, this meter was not installed.

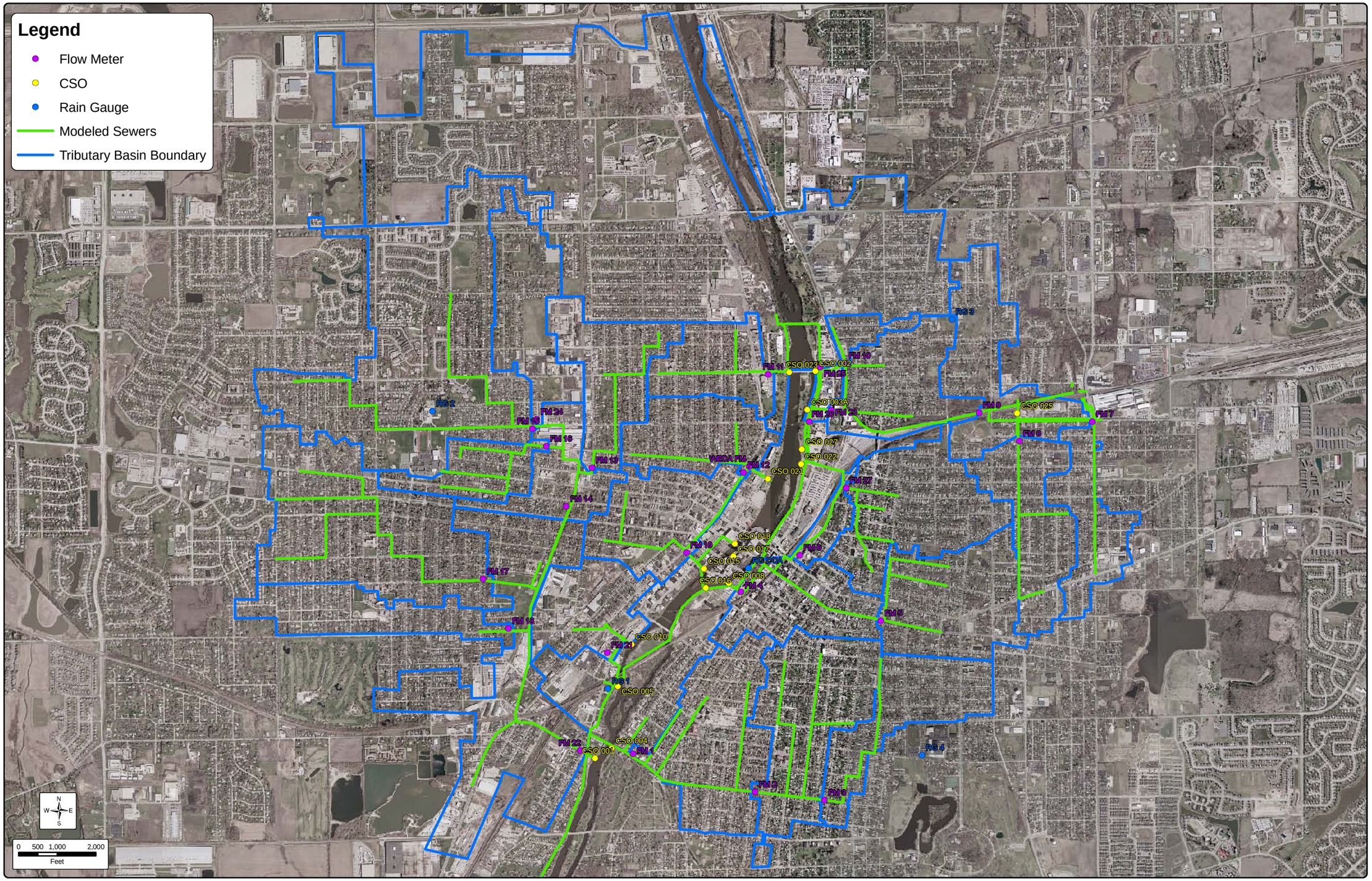
About 5 weeks into the flow metering effort, it was determined that four of the original meters were not producing reliable data. These meters (FMs 10, 11, 16, and 18) were metering relatively small sewer sheds that had been significantly decombined. The flows from these areas were very low, making it difficult for the meters to gather reliable flow information. These four meters were subsequently removed from the system.

It was further determined that there was one area of the CSS upstream of a CSO that was not being metered, so a new meter (FM 27) was added to the system on June 26, 2008. Additionally, it was determined that two meters (FMs 25 and 26) should be installed on the east side intercepting sewer to determine flow conditions that may impact the CSS and operation of the CSOs. These two meters were also installed on June 26, 2008. Thus, for approximately two and one-half months a total of 22 flow meters were in place in the CSS.

Four rain gauges were installed to monitor rainfall across Aurora. The data collected was used to develop a relationship between rainfall to sewer flow characteristics. The gauges were generally installed in the four "corners" of the CSS area to observe the spacial differences in rainfall across the city and to add additional accuracy to the evaluation of rainfall impacts on CSS flow.

Figure A.03-1 shows the locations of all 26 flow meters that were installed in the system at some point during the monitoring program. The overflow metering locations are also shown. Each of the subbasins monitored by a flow meter is delineated in red and labeled with the flow meter number. This figure also shows the location of the four rain gauges.

Table A.03-1 lists each of the flow meters, their general locations, the date of installation, the size of the pipe monitored, and the rain gauge associated with each flow meter. This table also provides the approximate incremental drainage area tributary to each meter.



FLOW METERING AND RAIN GAUGE LOCATIONS

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA
KANE COUNTY, ILLINOIS

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FIGURE A.03-1
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S:\MAD\1100--1199\1181\001\Data\GIS\Figures\Figure A.03-1 Rain Gauge 11x17.mxd

Meter No.	Area (ac)	Installed	General Location	Pipe Size (in)	Rain Gauge
1	256	22-May	Hazel & Broadway	78"	R4 - Southeast
2	262	6-May	Simms & Pearl	52" x 78"	R4 - Southeast
3	176	5-May	Simms & Watson	48"	R4 - Southeast
4	160	22-May	Water & Benton	72"	R4 - Southeast
5	248	15-May	Galena and Spencer	44"x69"	R1 - Southwest
6	37	21-May	New York and Railroad	24"	R1 - Southwest
7	123	21-May	Dearborn and Farnsworth	36"	R3 - Northeast
8	178	6-May	Indian and Trask	42"	R3 - Northeast
9	213	7-May	Dearborn & Ohio	30"	R3 - Northeast
10	33	1-May	Illinois & Aurora	20"	R3 - Northeast
11	133	29-Apr	Illinois & Orchard	27"	R3 - Northeast
12	149	23-May	Lake and Vine	15"	R3 - Northeast
13	175	30-Apr	Highland & Spruce	48"	R2 - Northwest
14	121	22-May	BNRR & Downer Place	72"	R2 - Northwest
15	662	1-May	Lancaster and Plum	48"	R2 - Northwest
16	96	30-Apr	West Park & Lancaster	36"	R2 - Northwest
17	416	22-May	Harrison and Marsellaise	60"	R1 - Southwest
18	153	29-Apr	Prairie & Heywood	18"	R1 - Southwest
19	178	29-Apr	Middle Avenue & Benton	42"	R1 - Southwest
20		Not installed	Benton east of River	42"	R1 - Southwest
21	143	1-May	River Street & 2nd Ave	18"	R1 - Southwest
22	437	23-May	River Street & Rathbone Avenue	96"	R1 - Southwest
23	181	23-May	Pierce and Broadway	48"	R3 - Northeast
24	183	4-Jun	Lancaster and Plum	18"	R2 - Northwest
25	1,651	26-Jun	Illinois & Bridge	30"	R3 - Northeast
26	21	26-Jun	Salvage	36"	R3 - Northeast
27	246	26-Jun	Lincoln and Superior	48"	R4 - Southeast
CSO 001	2,301	Permanent	Rathbone Ave and River St	Weir	R1 - Southwest
CSO 002	39	Permanent	Eastside of Illinois Ave Bridge	Weir	R3 - Northeast
CSO 003A	690	Permanent	Pierce and the Fox River	Weir	R3 - Northeast
CSO 004	775	Permanent	Hazel Ave and the Fox River	Weir	R4 - Southeast
CSO 005	50	Permanent	Third St and River St	Weir	R1 - Southwest
CSO 008	672	Permanent	Eastside of Benton St Bridge	Weir	R4 - Southeast
CSO 010	128	Permanent	Prairie and River	27"	R1 - Southwest
CSO 015	192	Permanent	Westside of Benton St Bridge	Weir	R2 - Northwest
CSO 017	16	Permanent	Stolp Island	18"	R2 - Northwest
CSO 018	192	Permanent	Galena and River	24"	R2 - Northwest
CSO 021	151	Permanent	Park and Lake	27"	R2 - Northwest
CSO 022	253	Permanent	South of 400 N. Broadway	Weir	R3 - Northeast
CSO 023	141	Permanent	Westside of Illinois Ave Bridge	Weir	R2 - Northwest
CSO 025	368	Permanent	Dearborn and Trask	Weir	R3 - Northeast

Table A.03-1 Flow Meters Installed

B. Monitoring Equipment

Most of the flow meters used for the program were ISCO 4150 Area-Velocity flow meters. Three meters were Marsh-McBirney area-velocity flow meters (owned by the City of Aurora). The flow meters consist of a component box and cable attached to a probe. The probe was mounted at the invert of the upstream sewer of each manhole. Area-velocity flow meters measure depth of flow using a pressure

transducer and measure velocity of flow using a Doppler transmitter. The flow meter converts depth and velocity to flow based on the dimensions of the pipe. Measurements of depth and velocity were collected at 10-minute intervals.

The rain gauges used for the program were ISCO 64L Tipping Bucket Rain Gauges. These rain gauges collect rainfall in a small cup (bucket) that tips and triggers an electronic signal for every 0.01 inch of rain collected. The gauge totalized the number of signals triggered every 10 minutes to give total rainfall in 10-minute increments.

C. Monitoring Methods

Installation of flow meters and rain gauges began on May 1, 2008. The flow depth and approximate velocity were checked manually and each flow meter was calibrated. Three days after initial installation, each meter was rechecked for calibration with manual depth and velocity measurements. Thereafter the meters were visited approximately weekly. Each visit included download of data, maintenance of batteries and desiccant, and a visual inspection of the transducer to verify it was not fouled with debris.

Data collected from the flow meters was regularly compiled and evaluated in an attempt to identify meter malfunction or poor data collection. Generally the depth, velocity, and flow data were checked on a weekly basis for consistency in data and logical trends.

One quality control activity performed regularly was evaluation of scatter graphs created for each of the meters. Readings of depth and corresponding flow were plotted for each meter on a log-log scale to visualize the relationship and evaluate the strength of the data being retrieved. This relationship is informative in that flow meter accuracy tends to decrease as the flow depth decreases. Typically the meter will record a wide range of flow values for a single depth of flow. But as the depth increases, the value of flow recorded should become more consistent. Scatter graph data for each month of monitoring for each meter was reviewed during the program.

Most of the meters exhibited good performance, but there were some meter failures and periods of low confidence data collection. This is not unusual for mechanical metering devices, and efforts were taken as soon as problems were noticed to fix fouled meters and maintain reliable data collection. Meter components were regularly replaced in response to detected errors or low confidence data, but there were some meter locations that did not produce good data regardless of actions taken.

The operation of two other meters (FMs 3 and 21) proved to be somewhat problematic. FM 3 experienced sediment accumulation during metering. FM 21 experienced excessive turbulence. Although they collected data, it was determined during the modeling program that the collected data was not useful for the calibration process. This was not considered a significant issue for FM 3 since it was relatively far upstream of the CSO location and this basin was covered by downstream meters. FM 21, located in a small basin downstream of CSO 010, experienced some of these difficulties. The CSO 010 meter was utilized to assist in the calibration of the model.

One additional difficulty experienced during metering should be noted. Three of the downstream FM locations (FMs 1, 4, and 22) did not reliably capture velocity information during most of the wet weather calibration events. This meant that calibration relied primarily on hydraulic level at these locations.

Because of this performance issue during the main metering program, during the period of May 26, through September 25, 2009, when WQ samplers were reinstalled in the system, flow meters were again installed at these locations to assess whether additional useful calibration data could be collected.

Since the City of Aurora continued significant sewer decombining, it was determined that any flow metering data collected during the summer of 2009 could not be used for calibration of the XP-SWMM model because it represents a drastically different flow scenario. As a result, the flow metering data collected in 2009 was used only for the first flush analysis.

D. Sampling Location Determination

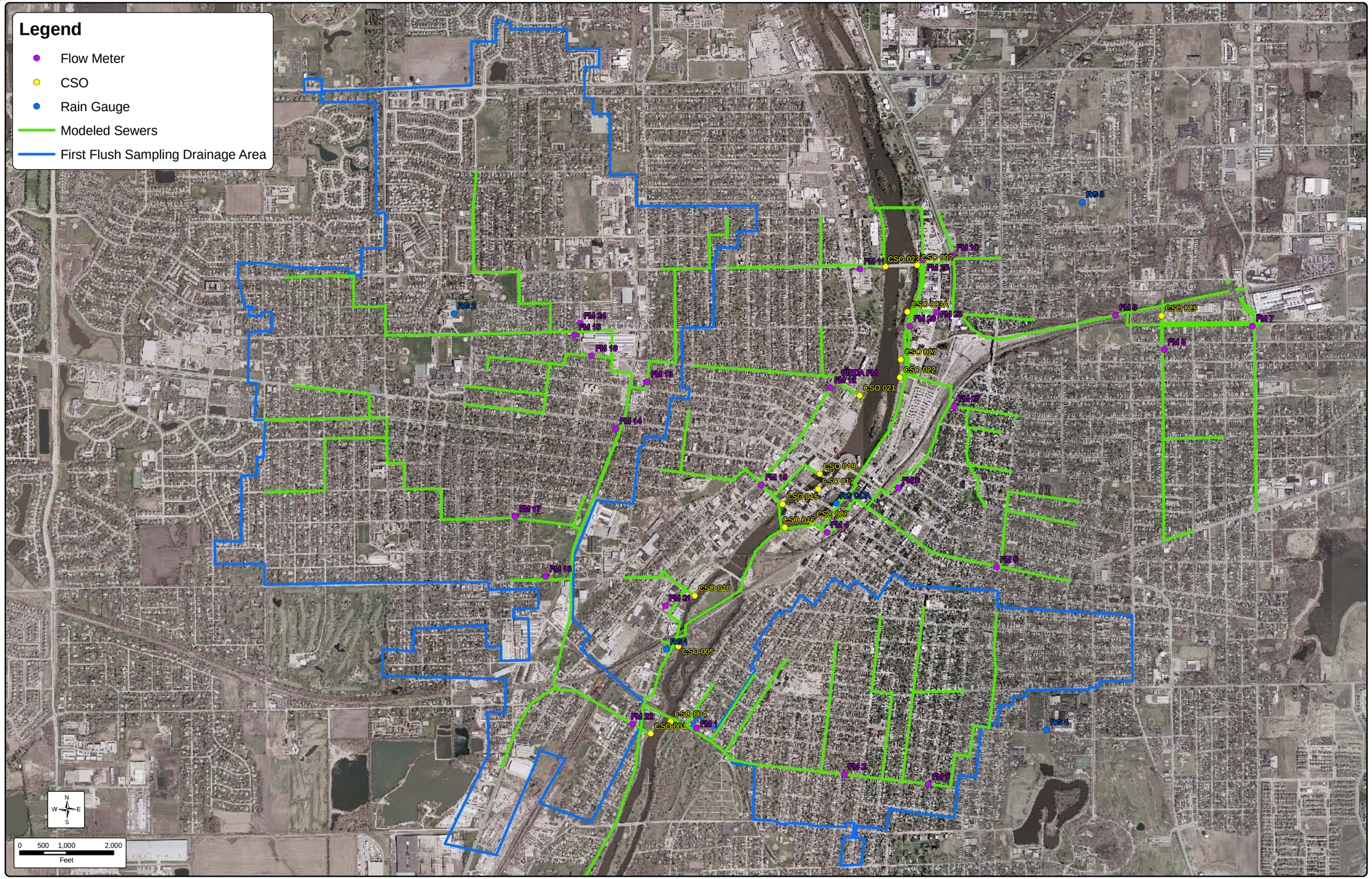
The original flow sampling program was performed concurrently with the flow metering program. However, review of the results of the original program showed that the data set was not considered robust enough to project first flush, and samplers were reinstalled on May 26, 2009. This section discusses the approach and site selection applied in the 2009 follow-up program.

The sampling program included installation of flow samplers in two locations to measure the levels of pollutant loading in the sewer system; five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and volatile suspended solid (VSS) were the parameters measured.

Flow sampling was performed in the summer months in an attempt to collect samples from a rainfall event having an intensity of 1.2 inches per hour [35 Ill. Adm. Code 375.402(a)]. Summer rainfall characteristics are more likely to meet this requirement than other times of the year.

The intention of the flow sampling program was to establish baseline pollutant loading information during an average dry day and compare this baseline with pollutant loading during a rainfall event. In combined sewer systems, during dry weather and corresponding low-flow conditions, pollutants can settle out and remain in the sewer system. During a rainfall event, pollutants on the ground surface (roadways and parking lots for example) are washed into the CSS and the increased flow in the sewer also resuspends pollutants that may have settled out in the sewer. The result is pollutant concentrations tend to increase during the initial phases of a rainfall event. Following the increased pollutant transfer, the pollutant loading tends to drop below the baseline concentrations as the surface pollutants and stuck pollutants are washed away and the system is “cleaned” by the high flows. Of interest in this relationship is the time it takes for the CSS to increase above baseline and then return and cross the baseline, often called the first flush period. Figure A.03-2 illustrates this relationship. Collecting and treating this first flush and not allowing it to overflow from the system is a criterion to be addressed by the LTCP.

The current land use characteristics (residential, commercial, industrial/manufacturing) of the City of Aurora’s CSS area were studied. Sampling locations were identified so that pollutant loading data was collected from areas having different ground cover features. The following two locations were identified and are shown in Figure A.03-3. The sampler number corresponds to the flow meter in the same location.



FIRST FLUSH SAMPLING DRAINAGE AREAS

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FIGURE A.03-3
1181.009

S:\MAD\1100--1199\1181\001\Data\GIS\Figures\Figure A.03-3 Sampling Drainage Areas 11x17.mxd

1. Sampler No. 1: Contains residential and commercial land uses. Primarily residential. Minimal CSS separation work has been completed in this study area. Total watershed area: 694 acres

2. Sampler No. 22: Contains residential, commercial, light industrial, and manufacturing land uses. Some separate sewer in this sewershed but contains sizeable CSS areas. This is the largest basin within the system and appears to represent a good cross section of the overall City. Total watershed area: 2,243 acres

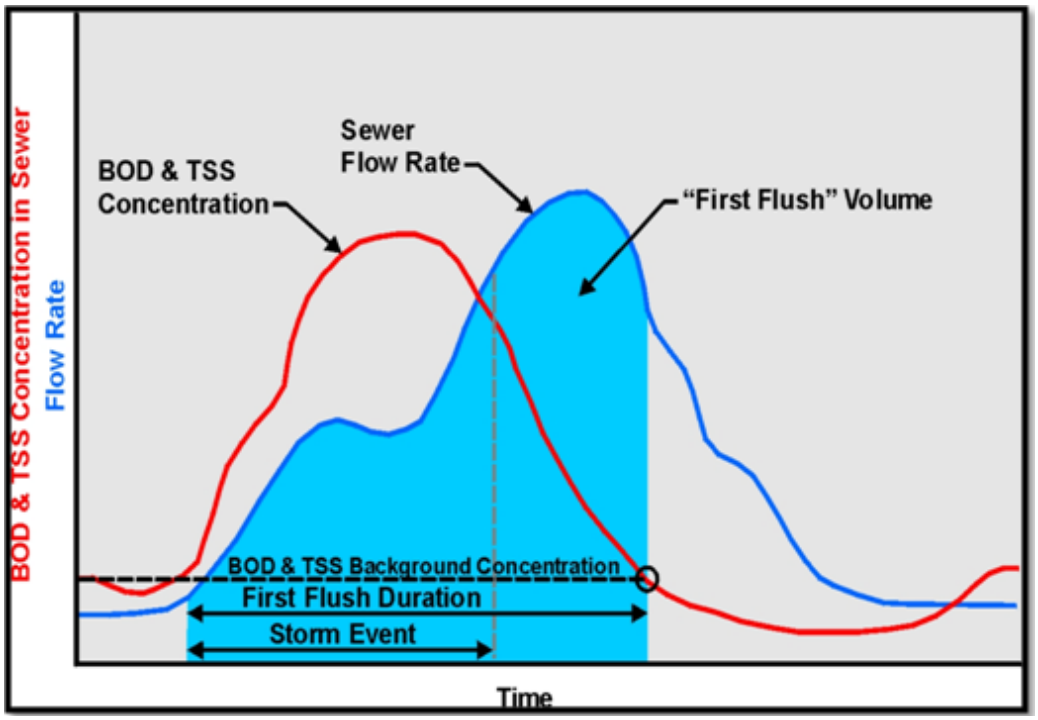


Figure A.03-2 First Flush Determination

E. Sampling Equipment

The samplers used for the sampling program were ISCO 6712 samplers. The samplers hold 24, 1-liter bottles. This allowed for samples to be taken at 15-minute intervals over a 6-hour period. The samplers were placed in the same location as a flow meter so the corresponding flow could be compared to the pollutant sample concentration to establish a relationship of pollutant concentration to flow over time.

The samplers consist of a positive displacement suction pump that draws a predetermined volume of sample (1 liter in this case) through a polyethylene tube and discharges into one of the sample bottles. Once the sample is taken, the discharge rotates to the next sample bottle, ready to draw another sample at the determined interval.

F. Sampling Method

The samplers were installed by hanging them in the selected manholes with the suction tube submerged in the sewer flow but attached to the sewer above the flow line to keep the tube from becoming blocked. For the baseline sampling, each sampler was started manually at which point the sampler automatically pulled a sample at 15-minute intervals. At the end of 6 hours, the sample bottles were removed and replaced with new bottles and the process started again immediately. This allowed for 12 hours of baseline samples.

For the wet weather sampling, weather conditions were monitored closely and upon identification of a potential significant rainfall event, the samplers were manually started just before (or as close as possible) the start of the rainfall. There were instances when sampling was started but the ensuing rainfall was not significant, at which point a decision to stop the sampling was made and the samplers were cleared and reset for the next event.

For the first significant rainfall event, samples were drawn over a 12-hour period. The samples collected were stored in a cooler on ice and transported to a testing laboratory for analysis. Based on the results of the analysis and the corresponding flow metering, a decision was made for the length of the sampling period for subsequent rainfall events. Three separate significant rainfall events were sampled.

A.04 RAINFALL EVENTS

Table A.04-1 provides daily rainfall data for the 2008 metering program. The significant rainfall events recorded during the flow monitoring period are highlighted in blue, including the total rainfall measured at each rain gauge, the event duration, and the approximate recurrence interval (according to *Rainfall Frequency Atlas of the Midwest, Bulletin 71,* Northeastern Illinois) for the rain gauge with the highest intensity. Appendix B provides a detailed tabulation of 10-minute rainfall recordings for all 22 rainfall events recorded over the monitoring period.

As shown by the table, there were several significant rainfall events over the monitoring period. Rainfall intensities ranged from under 2 months to 1.5 years and even a 40-year event occurring on September 13, 2008. In general, the rainfall events recorded provided a very good distribution of rainfall quantity and intensity resulting in a good variation of conditions for analyses and model calibration. The results of the metering program are summarized here, and Appendix B details how the data was applied for model calibration.

A. Dry Weather Flows

Flow data was compiled for all dry days having at least 48 hours of prior dry weather. This data was used to develop the daily average flow characteristics of the CSS. Table A.04-2 lists the minimum, maximum, and average dry weather flow rates at each meter location for each month of the monitoring period.

TABLE A.04-1
DAILY RAINFALL SUMMARY

Date	Rain Gauge Identification: SAI-RL1 SOUTHWEST	SAI-RL2 NORTHWEST	SAI-RL3 NORTHEAST	SAI-RL4 SOUTHEAST	Duration (hours)	Total Rainfall (inches)	Approximate Recurrence Interval (Based on Total Rainfall)	Peak 1-Hour Rainfall (inches)	Approximate Recurrence Interval (Based on Peak Rainfall)
5/1/2008	0.00	0.00	0.00						
5/2/2008	0.10	0.00	0.00						
5/3/2008	0.02	0.00	0.02						
5/4/2008	0.00	0.00	0.00						
5/5/2008	0.00	0.00	0.00						
5/6/2008	0.00	0.00	0.00						
5/7/2008	0.40	0.00	0.16		4:50	0.40	<2 months	0.18	<2 months
5/8/2008	0.00	0.00	0.03						
5/9/2008	0.00	0.00	0.01						
5/10/2008	0.00	0.00	0.00						
5/11/2008	2.00	0.00	2.00		8:20	2.00	1 year	0.42	<2 months
5/12/2008	0.00	0.00	0.00						
5/13/2008	0.17	0.00	0.24		2:30	0.24	<2 months	0.15	<2 months
5/14/2008	0.02	0.00	0.02						
5/15/2008	0.00	0.00	0.00						
5/16/2008	0.00	0.00	0.00						
5/17/2008	0.07	0.07	0.08						
5/18/2008	0.00	0.00	0.00						
5/19/2008	0.00	0.00	0.01						
5/20/2008	0.00	0.00	0.00						
5/21/2008	0.00	0.00	0.00						
5/22/2008	0.00	0.00	0.00						
5/23/2008	0.00	0.01	0.00						
5/24/2008	0.00	0.00	0.00						
5/25/2008	0.20	0.16	0.23		0:30	0.23	<2 months	0.23	<2 months
5/26/2008	1.03	1.08	1.05		3:00	1.08	3 months	0.85	4 months
5/27/2008	0.00	0.00	0.00						
5/28/2008	0.00	0.00	0.01						
5/29/2008	0.03	0.04	0.04						
5/30/2008	0.23	0.22	0.25		2:30	0.23	<2 months	0.15	<2 months
5/31/2008	0.00	0.00	0.00						
6/1/2008	0	0	0						
6/2/2008	0	0	0						
6/3/2008	0.75	0.75	0.54		2:00	0.75	<2 months	0.57	<2 months
6/4/2008	0	0	0						
6/5/2008	0.13	0.08	0.11						
6/6/2008	0	0	0						
6/7/2008	0	0	0						
6/8/2008	0.18	0.56	0.27		2:00	0.75	<2 months	0.57	<2 months
6/9/2008	0.57	0.53	0.7						
6/10/2008	0	0.01	0						
6/11/2008	0	0	0						
6/12/2008	0	0	0						
6/13/2008	0.29	0.35	0.33		3:50	0.34	<2 months	0.19	<2 months
6/14/2008	0	0	0.01						
6/15/2008	0.25	0.33	0.28		1:00	0.32	<2 months	0.31	<2 months
6/16/2008	0	0	0						
6/17/2008	0	0	0						
6/18/2008	0	0	0						
6/19/2008	0	0	0						
6/20/2008	0.49	0.38	0.28	0.95	1:20	0.52	<2 months	0.50	<2 months
6/21/2008	0.03	0.04	0.02	0.03					
6/22/2008	0.01	0	0	0.01					
6/23/2008	0	0	0	0					
6/24/2008	0	0	0	0					
6/25/2008	0.15	0.18	0.16	0.15					
6/26/2008	0	0	0	0					
6/27/2008	0.01	0.01	0.01	0.01					
6/28/2008	0.11	0.09	0.11	0.04					
6/29/2008	0.05	0.09	0.11	0.05					
6/30/2008	0	0.01	0	0					
7/1/2008	0	0	0	0					
7/2/2008	0	0	0	0					
7/3/2008	0	0	0	0					
7/4/2008	0	0	0	0					
7/5/2008	0	0	0	0					
7/6/2008	0	0	0	0					
7/7/2008	0	0	0	0					
7/8/2008	0.3	0.19	0.22	0.24	1:40	0.28	<2 months	0.26	<2 months
7/9/2008	0	0	0	0					
7/10/2008	0.64	0.55	0.71	0.78	7:00	0.71	<2 months	0.48	<2 months
7/11/2008	0.04	0.15	0.13	0.05					
7/12/2008	0.48	0.46	0.52	0.51	2:50	0.52	<2 months	0.23	<2 months
7/13/2008	0	0	0	0					
7/14/2008	0	0	0	0					
7/15/2008	0	0	0	0					
7/16/2008	0	0	0	0.01					
7/17/2008	0	0	0	0					

TABLE A.04-1
DAILY RAINFALL SUMMARY

Date	Rain Gauge Identification: SAI-RL1 SOUTHWEST	SAI-RL2 NORTHWEST	SAI-RL3 NORTHEAST	SAI-RL4 SOUTHEAST	Duration (hours)	Total Rainfall (inches)	Approximate Recurrence Interval (Based on Total Rainfall)	Peak 1-Hour Rainfall (inches)	Approximate Recurrence Interval (Based on Peak Rainfall)
7/18/2008	0	0	0	0					
7/19/2008	0.72	0.58	0.81	0.68	5:50	0.75	<2 months	0.54	<2 months
7/20/2008	0.36	0.42	0.46	0.4	2:40	0.46	<2 months	0.36	<2 months
7/21/2008	0.14	0.15	0.14	0.14					
7/22/2008	0	0	0	0					
7/23/2008	0	0	0.01	0					
7/24/2008	0	0	0	0					
7/25/2008	0	0	0	0					
7/26/2008	0	0	0	0					
7/27/2008	0	0	0	0					
7/28/2008	0	0	0	0					
7/29/2008	0	0	0	0					
7/30/2008	0	0	0	0					
7/31/2008	0	0	0	0					
8/1/2008	0	0	0	0					
8/2/2008	0	0	0	0					
8/3/2008	0	0	0	0					
8/4/2008	1.21	1.44	1.33	1.09	14:00	1.44	3 months	0.75	3 months
8/5/2008	0	0	0	0					
8/6/2008	0	0	0	0					
8/7/2008	0	0	0	0					
8/8/2008	0	0	0	0					
8/9/2008	0.31	0.48	0.34	0.18	0:30	0.48	2 months	0.48	<2 months
8/10/2008	0	0	0	0					
8/11/2008	0	0	0	0					
8/12/2008	0	0	0	0					
8/13/2008	0	0	0	0					
8/14/2008	0	0	0	0					
8/15/2008	0	0	0	0					
8/16/2008	0	0	0	0					
8/17/2008	0	0	0	0					
8/18/2008	0	0	0	0					
8/19/2008	0	0	0	0					
8/20/2008	0	0	0	0					
8/21/2008	0.01	0.01	0.01	0.01					
8/22/2008	0.03	0.03	0.03	0.03					
8/23/2008	0.16	0.18	0.07	0.04					
8/24/2008	0	0	0	0					
8/25/2008	0	0	0	0					
8/26/2008	0	0	0	0					
8/27/2008	0	0	0	0					
8/28/2008	0.12	0.15	0.15	0.12					
8/29/2008	0	0	0	0					
8/30/2008	0	0	0	0					
8/31/2008									
9/1/2008	0	0	0	0					
9/2/2008	1.19	0.26	0.65	1.31	1:50	1.31	9 months	1.07	7 months
9/3/2008	0.01	0.01	0.01	0.01					
9/4/2008	2.23	2.32	2.54	2.39	16:30	2.53	1.5 year	0.42	<2 months
9/5/2008	0	0	0	0					
9/6/2008	0	0.01	0.01	0					
9/7/2008	0	0	0	0					
9/8/2008	1.11	1.09	1.13	1.25	9:00	1.24	2 months	0.23	<2 months
9/9/2008	0	0	0.01	0					
9/10/2008	0	0	0	0					
9/11/2008	0	0	0	0					
9/12/2008	0.55	0.45	0.49	0.59	51:08:00	6.72	40 year	1.19	9 months
9/13/2008	4.04	4.33	4.82	3.58					
9/14/2008	1.3	1.29	1.41	1.32					
9/15/2008	0	0	0	0					
9/16/2008	0	0	0	0					

Flow Meter ID	Minimum (gpm)	Maximum (gpm)	Average (gpm)
1	222	1,596	858
2	152	748	608
3			
4	441	1,268	868
5	164	766	454
6	91	467	294
7	36	174	98
8	9	137	54
9	244	729	467
10			
11	18	72	50
12	37	226	122
13	63	353	167
14	490	2,930	1,254
15	143	1,100	546
16			
17	131	533	310
18			
19	148	769	468
21			
22	690	3,617	1,588
23	213	949	507
24			
25	327	1,280	652
26	1,070	2,434	1,862
27			
Fox Metro - WEDA A	2,840	10,472	6,529

Table A.04-2 Dry Weather Data

B. Wet Weather Flows

Each of the rainfall events collected were studied, and a cross section of events with varying characteristics was as identified. The flow data for each meter were studied for each of the identified rainfall events, and data sets with poor or questionable data were noted. Finally, rainfall events with the highest number of good flow meter data sets were selected for closer study and consideration for calibration and verification of the computer hydraulic model.

Two rainfall events were selected for calibration and validation and are detailed in Table A.04-3. The table shows the peak flow metered during the event and compares this flow to the average dry flow from the 24-hour dry period prior to the start of rainfall. From this comparison, a peaking factor for each meter in response to each rainfall event was determined.

The hydrographs of each meter in response to the calibration events selected are provided at the end of Appendix B.

May 26, 2008			
Flow Meter	Peak Flow (gpm)	Average 24-hour Flow Before (gpm)	Peaking Factor
5	21,276	344	61.8
7	881	111	7.9
8	3,845	66	58.7
9	3,118	555	5.6
12	523	127	4.1
13	5,157	216	23.9
14	17,245	1,746	9.9
15	1,435	502	2.9
17	4,614	308	15.0
23	7,500	709	10.6
69-inch Interceptor	63,782	7,944	8.0
July 10, 2008			
Flow Meter	Peak Flow (gpm)	Average 24-hour Flow Before (gpm)	Peaking Factor
2	6,520	733	8.9
7	330	73	4.5
8	2,034	37	55.0
9	1,714	453	3.8
12	628	121	5.2
13	3,813	112	34.0
14	12,448	1,956	6.4
15	1,062	491	2.2
23	6,227	442	14.1
26	4,547	1,838	2.5
69-inch Interceptor	28,840	6,451	4.5

Table A.04-3 Peak Flow and Peaking Factor for Calibration and Validation Events

A.05 FLOW SAMPLING

The original flow sampling portion of the program did not proceed as well as the flow metering portion. Where the flow metering efforts benefitted from the wet weather experienced over the study period, the flow sampling was hampered by the rainfall. IEPA sampling requirements [35 Ill. Adm. Code 375.404 (b)] recommends sampling to be performed following ten days of dry weather. Such a dry period was not experienced during the initial metering period, and the sampling performed did not appear to collect adequate data to perform a first flush analysis.

Based on the results of this sampling program, a follow-up sampling program was initiated in late May 2009 to improve upon this data. Appendix C provides additional details for the first flush analysis.

APPENDIX B
SYSTEM MODELING

B.01 INTRODUCTION

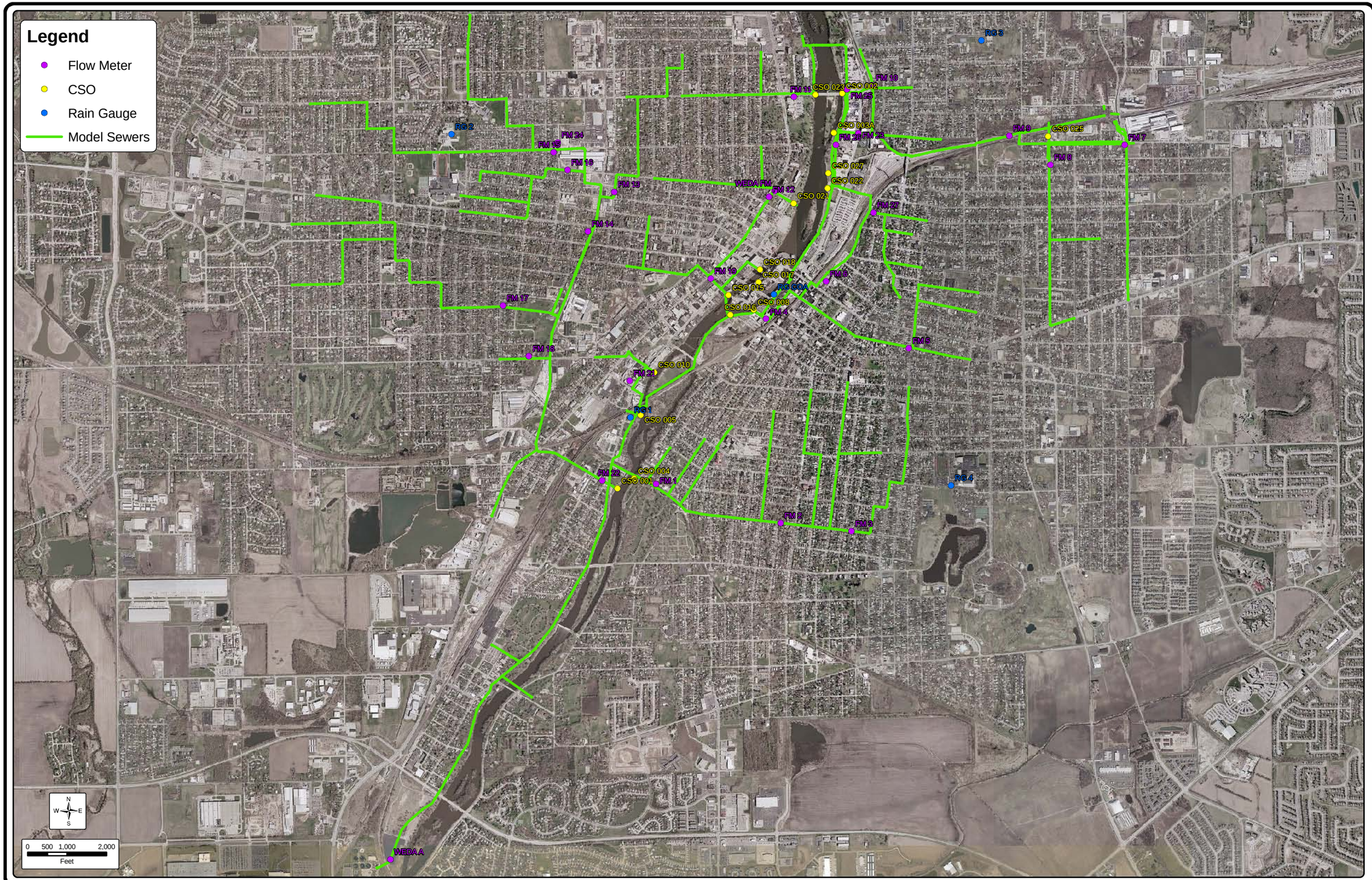
A. Background

As discussed previously in this report, the City of Aurora sewer system consists of both separate and combined sewers. As shown on Figure 4.01-4, the older, central portions of the city along the Fox River are generally combined, with significant areas having been separated through consistent efforts by city staff. The newer portions of the city to the east, west, and north are entirely separate. A hydrologic/hydraulic model of the entire combined portion of the City of Aurora sewers has been constructed to evaluate the combined sewer overflow (CSO) abatement alternatives for this Long-Term Control Plan (LTCP). Figure B.01-1 shows the model constructed for the LTCP, including the CSOs and the flow meter and rain gauge locations used during the metering program.

The model constructed for this LTCP was based both on previously constructed models of specific basins and additional sections of the combined sewer systems (CSS) included in a new flow metering program. Microcomputer-based simulation modeling was performed on the CSS using XP-SWMM, a commercially enhanced version of the United States Environmental Protection Agency (USEPA) Storm Water Management Model (SWMM). This appendix provides a summary of the model (physical information such as pipe sizes and lengths), modeling methods, and results. This work is based in part on the metering program presented in Appendix A.

B. Model Construction and Calibration Approach

Computer modeling of a sewer system requires the validation and input of large amounts of information to develop a useful calibrated model. The model is constructed based on information from topographic mapping, aerial photographs, previous project record drawings, and field verification. Initial assumptions are made for certain system characteristics, such as Manning roughness “n,” percent impervious, and soil infiltration parameters. The model is then used to simulate dry weather and wet weather events that have been characterized by a metering program. Based on how the model results compare to known system flows, input parameters are adjusted until the model results reasonably match the metered peak flow and total volumes. This is termed the “calibration” process. Once a model has been calibrated, an independent rainfall event is modeled. If the model results reasonably match the field flow metering data, the model is considered to be accurately representing the performance of the collection system. This second part of the process is termed the “validation” process. The model validity was also checked by comparing actual rainfall/CSO patterns versus model results over a longer period. Where this process suggests further model improvements are required, the model calibration/validation on the wet weather events was adjusted.



S:\MAD\1100--1199\1181\001\Data\GIS\Figures\Figure B.01-1 Modeled Sewers 11x17.mxd

MODELED SEWERS

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA
KANE COUNTY, ILLINOIS

STRAND ASSOCIATES, INC®
ENGINEERS

FIGURE B.01-1
1181.009

B.02 MODEL CONSTRUCTION AND SYSTEM PHYSICAL DATA

A. Representation of Sewer Infrastructure

To develop the model network in XP-SWMM, the connectivity of the system is constructed through the graphical user interface and the physical information about the sewer system such as elevations, pipe lengths, and pipe sizes is entered. The basis of this information is the previously existing models, the City's AutoCAD maps of the sewer system, surveys performed by the city, numerous record drawings from specific projects, and global positioning system (GPS) surveys performed by Strand for model development. Manholes are represented in the model as "nodes," with a ground surface elevation and an invert elevation. Pipes are represented in the model as "conduits linking" nodes, and important properties of the links include pipe diameter, length, elevations, slopes, depth of sediment in the sewer, and an initial Manning roughness coefficient based on the pipe condition or material of construction.[1] Representation of overflow structures within the system are a little more complex, with an upstream-of-dam node and downstream-of-dam node, connected by a "multilink," which is a special type of conduit.

Where appropriate, sediment depths were included in the conduit data. Especially in sewers that are long and shallowly sloped, and where the utility reports sediment, adding sediment depth to a sewer in the model can both raise the hydraulic grade within the modeled sewer but also decrease its flow capacity. Similar to increasing the Manning roughness factor, this will reduce the flow rate but, in general, would not impact the flow volume.

Each additional link or node in the system adds a computational burden during model calibration, increasing the amount of time it takes to run the model. In order to balance the desire for efficient modeling with accurate representation of the system, it is typical in modeling large systems to model only above a selected size threshold. For the Aurora CSS model, pipes 18 inches and larger were included in the model, based on discussions with the owner prior to the beginning of the project. Based on this simplification, the final model included approximately 640 links and 620 nodes.[2]

Table B.02-1 provides a listing of all modeled links (pipes) with relevant physical information and node connectivity. These links are in upstream to downstream order and are indicated by the street location of each segment.

B. Representation of Wastewater and Stormwater Inputs

Next, the wastewater and stormwater input points into the system are characterized. It is typical in a CSS for many manholes to have catch basin inputs for stormwater, as is the case in the fully combined portions of the Aurora collection system. In addition, sanitary wastewater inputs occur via laterals in the collector and trunk sewers. However, to represent each of these inputs as they physically exist in the system would require a prohibitive amount of computation time. Therefore, to balance computation with accuracy, a reduced number of model input points are used. Actual physical inputs in the CSS that would be distributed along several pipe "links" are instead clustered and represented at selected nodes, typically at the upstream end of the segment in

[1] In previously modeled areas, the Manning roughness of the previous model was initially used. For newly modeled areas, the XP-SWMM default value of 0.014 was initially assumed.
[2] Had the entire CSS been included in the model, it is estimated that model runtimes would have been at least 10 to 20 times longer than the 15 minutes required for each 24-hour simulation.

question. Based on this simplification, the model uses about 220 dry weather input points and 190 wet weather input points.

Catchment areas for each of the clustered inputs are delineated on the AutoCAD mapping and the software program calculates the acreage for each area.

1. Dry Weather Inputs

Dry weather subcatchments (or subbasins) associated with particular input nodes are characterized based on area, population density, per capita waste contributions, and diurnal flow patterns.

If no flow metering data is available for an area, the population density and per capita waste contributions can be estimated based on mapping and diurnal patterns based on literature values. However, where flow metering data were gathered, these basin-specific values were "back calculated" during model calibration to reflect wastewater flows measured during dry weather metering.

Table B.02-2 provides the average population density applied in each flow meter basin and the average and maximum dry weather flow for each flow meter basin.

FM	Population Density (persons/ac)
CSO 002	18.0
FM 1	12.0
FM 2	18.9
FM 4	10.8
FM 5	28.7
FM 6	16.3
FM 7	11.2
FM 8	3.9
FM 9	30.2
FM 11	7.7
FM 12	12.0
FM 13	14.9
FM 14	14.9
FM 15	14.9
FM 17	4.8
FM 19	29.3
FM 21	10.5
FM 22	4.8
FM 23	4.9
FM 25	5.7
FM 26	385[1]

[1] The high value for population equivalent for this flow meter is attributed to the industries within this basin.

Table B.02-2 Population Density Information

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link1	Node1	670.3	Node2	668.6	312.3	20	0.013	0.544
Link2	Node2	668.6	Node3	664.9	445.0	24	0.013	0.829
Link3	Node3	664.9	Node4	663.3	464.0	30	0.013	0.347
Link4	Node4	663.3	Node5	660.9	441.0	36	0.013	0.544
Link669	Node5	660.9	Node636	659.7	775.5	42	0.013	0.155
Link659	Node7	659.3	Node8	659.2	47.7	42	0.013	0.210
Link8	Node8	659.2	Node9	658.7	592.6	42	0.013	0.084
Link297	Node9	658.7	Node10	658.6	57.5	42	0.013	0.174
Link10	Node10	658.6	Node11	658.5	253.4	42	0.013	0.039
Link11	Node11	658.5	Node12	658.2	40.2	48	0.013	0.747
Link12	Node12	658.2	Node13	657.8	634.8	48	0.013	0.063
Link298	Node13	657.8	Node14	657.7	60.3	48	0.013	0.199
Link14	Node14	657.7	Node15	656.8	382.2	48	0.013	0.230
Link15	Node15	656.8	Node16	656.6	328.7	48	0.013	0.061
FM 3	Node16	656.6	Node635	656.4	321.0	48	0.013	0.062
Link668	Node18	655.5	Node19	655.1	438.0	78	0.013	0.096
FM 2	Node19	655.1	Node20	654.6	435.0	78	0.013	0.115
Link20	Node20	654.6	Node21	653.8	429.9	78	0.013	0.186
Link21	Node21	653.8	Node22	653.1	348.5	78	0.013	0.209
Link22	Node22	653.1	Node23	652.1	347.4	78	0.013	0.279
Link23	Node23	652.1	Node24	651.5	408.5	78	0.013	0.147
Link24	Node24	651.5	Node25	651.1	162.8	78	0.013	0.246
Link25	Node25	651.1	Node26	646.8	249.8	78	0.013	1.721
Link26	Node26	646.8	Node27	634.4	411.8	68	0.013	3.011
Link62	Node27	634.4	Node63	633.1	213.7	78	0.018	0.608
Link29	Node29	627.0	Node30	623.2	281.3	78	0.018	1.340
FM 1	Node30	623.2	Node31	620.2	294.0	72	0.015	1.034
Link360	Node31	617.8	Node340	613.2	244.0	12	0.012	1.914
Link360	Node31	617.8	Node340	613.2	244.0	16	0.012	1.914
Link31	Node32	662.3	Node33	661.7	257.6	18	0.013	0.245
Link32	Node33	661.7	Node34	661.2	58.9	18	0.013	0.849
Link33	Node34	661.2	Node35	660.0	414.0	24	0.013	0.290
Link34	Node35	660.0	Node36	660.0	32.6	24	0.013	0.000
Link35	Node36	660.0	Node37	659.0	325.5	45	0.013	0.304
Link36	Node37	659.0	Node38	658.3	722.0	45	0.013	0.100
Link37	Node38	658.3	Node39	658.2	89.7	45	0.013	0.134
Link38	Node39	658.2	Node40	657.9	465.3	45	0.013	0.058
Link39	Node40	657.9	Node41	656.8	662.0	45	0.013	0.166
Link666	Node41	656.8	Node634	656.4	664.0	45	0.013	0.057
Link41	Node42	661.1	Node43	660.1	394.3	20	0.013	0.246
Link42	Node43	660.1	Node44	659.5	333.0	24	0.013	0.180
Link43	Node44	659.5	Node38	658.3	338.0	24	0.013	0.358
Link44	Node45	667.8	Node46	665.8	304.3	15	0.013	0.657
Link45	Node46	665.8	Node47	663.8	302.5	15	0.013	0.661
Link46	Node47	663.8	Node48	662.1	562.3	18	0.013	0.302
Link47	Node48	662.1	Node49	661.6	341.8	20	0.013	0.146
Link48	Node49	661.6	Node50	661.3	92.1	20	0.013	0.315
Link49	Node50	661.3	Node51	660.2	439.1	22	0.013	0.253
Link50	Node51	660.2	Node52	659.6	388.8	22	0.013	0.154
Link51	Node52	659.6	Node53	658.7	373.5	24	0.013	0.241
Link52	Node53	658.7	Node54	658.0	369.4	24	0.013	0.190
Link53	Node54	658.0	Node55	657.4	350.0	24	0.013	0.171
Link663	Node55	657.4	Node18	655.5	322.0	24	0.013	0.584
Link55	Node56	666.7	Node57	664.2	517.2	18	0.018	0.478
Link56	Node57	664.1	Node58	663.5	358.1	18	0.018	0.182
Link57	Node58	663.6	Node59	662.0	343.5	24	0.018	0.451
Link58	Node59	661.9	Node60	660.6	348.5	24	0.018	0.376
Link59	Node60	660.5	Node61	658.7	339.7	24	0.018	0.536
Link65	Node61	658.5	Node62	656.0	402.2	24	0.018	0.612
Link61	Node62	656.1	Node21	653.8	483.0	24	0.018	0.478
Link63	Node63	633.1	Node64	631.7	389.3	78	0.018	0.360
Link64	Node64	631.7	Node29	627.0	352.9	78	0.018	1.341
Link66	Node65	666.0	Node66	660.6	513.9	15	0.018	1.045
Link67	Node66	660.6	Node67	660.2	182.4	21	0.018	0.252
Link68	Node67	660.2	Node68	659.0	469.7	24	0.018	0.249

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link70	Node68	659.0	Node70	656.9	520.8	24	0.018	0.397
Link71	Node70	656.9	Node71	656.4	367.8	24	0.018	0.150
Link72	Node71	656.4	Node72	654.3	346.1	24	0.018	0.598
Link73	Node72	654.3	Node73	648.2	240.1	24	0.018	2.541
Link74	Node73	648.2	Node63	634.3	254.4	24	0.018	5.472
Link75	Node74	660.2	Node75	658.8	327.9	15	0.018	0.430
Link76	Node75	658.8	Node76	657.0	320.3	15	0.018	0.571
Link77	Node76	657.0	Node77	650.9	600.3	18	0.018	1.019
Link78	Node77	650.9	Node64	631.7	437.2	18	0.018	4.385
Link81	Node80	633.7	Node81	628.6	582.4	18	0.018	0.870
Link82	Node81	628.6	Node30	623.2	454.6	18	0.018	1.186
Link86	Node85	631.2	Node86	631.1	76.7	30	0.02	0.156
Link813	Node86	631.1	Node91	630.1	1,109.2	30	0.02	0.089
Link105	Node89	628.9	Node105	628.5	250.0	36	0.014	0.180
Link797	Node90	631.6	Node674	631.5	11.0	24	0.014	0.909
FM 25	Node91	630.1	Node92	630.2	88.7	30	0.02	-0.241
Link93	Node92	630.1	Node93	629.9	368.4	30	0.018	0.046
Link809	Node93	629.9	Node95	629.7	380.9	30	0.018	0.053
Link731	Node95	629.7	Node96	629.3	312.7	30	0.018	0.128
Link97	Node96	629.3	Node97	629.0	242.4	36	0.018	0.132
FM 26	Node97	628.9	Node98	628.9	36.5	36	0.018	0.079
Link99	Node98	628.9	Node99	628.9	39.8	36	0.018	0.079
Link100	Node99	628.9	Node100	628.7	413.6	36	0.018	0.048
Link101	Node100	628.7	Node101	627.9	181.2	36	0.014	0.422
Link102	Node101	627.9	Node102	627.8	22.7	36	0.014	0.441
Link103	Node102	627.8	Node103	627.8	64.0	36	0.014	0.063
Link104	Node103	627.8	Node104	627.6	282.0	36	0.014	0.060
Link115	Node104	627.6	Node115	627.6	50.0	36	0.014	0.060
Link106	Node105	628.5	Node106	628.1	206.3	36	0.014	0.179
Link107	Node106	628.1	Node107	627.9	156.3	36	0.014	0.128
Link734	Node107	627.9	Node678	627.5	230.0	36	0.014	0.152
Link111	Node109	626.2	Node111	625.6	138.9	48	0.014	0.425
Link798	Node110	627.0	Node677	626.5	58.0	36	0.014	0.897
Link738	Node111	625.6	Node680	625.0	188.9	48	0.014	0.328
Link113	Node112	624.0	Node113	623.3	225.0	48	0.014	0.347
Link114	Node113	623.3	Node114	622.0	100.9	48	0.014	1.348
Link780	Node114	621.9	Node735	621.7	68.0	48	0.014	0.176
Link116	Node115	627.5	Node116	627.2	333.8	36	0.014	0.091
Link117	Node116	627.2	Node117	626.9	381.6	36	0.014	0.091
Link118	Node117	626.9	Node118	626.4	580.0	36	0.014	0.091
Link119	Node118	626.4	Node119	625.2	130.0	36	0.014	0.909
Link120	Node119	625.2	Node120	625.0	232.0	36	0.014	0.091
Link277	Node120	625.0	Node122	624.0	1,045.1	36	0.017	0.091
Link123	Node122	624.0	Node123	623.8	218.0	36	0.017	0.098
Link124	Node123	623.8	Node124	623.8	64.0	36	0.017	0.098
Link125	Node124	623.8	Node125	623.7	16.6	36	0.017	0.098
Link126	Node125	623.7	Node126	623.4	385.1	36	0.017	0.094
Link127	Node126	623.4	Node127	623.4	22.0	36	0.017	0.094
Link128	Node127	623.4	Node128	622.9	445.7	36	0.017	0.094
Link129	Node128	622.9	Node129	622.7	11.3	36	0.017	2.481
Link130	Node129	622.4	Node130	621.2	59.7	36	0.017	2.026
Link131	Node130	621.6	Node131	621.7	170.7	72	0.017	-0.082
Link717	Node131	621.7	Node134	621.1	314.9	54	0.013	0.216
Link289	Node134	621.1	Node279	620.7	367.5	54	0.013	0.093
Link715	Node136	620.7	Node138	620.2	673.5	54	0.013	0.074
Link139	Node138	620.2	Node139	618.8	620.9	54	0.013	0.219
Link284	Node139	618.8	Node140	618.7	290.6	54	0.013	0.056
Link141	Node140	616.8	Node141	615.8	195.1	24	0.017	0.512
Link141	Node140	618.7	Node141	615.8	195.0	24	0.017	1.513
Link141	Node140	620.3	Node141	615.8	195.0	24	0.017	2.333
Link142	Node141	616.9	Node142	616.6	445.8	54	0.013	0.058
Link143	Node142	616.6	Node143	616.4	499.9	54	0.013	0.059
Link291	Node143	616.4	Node145	616.1	460.4	54	0.013	0.059
Link146	Node145	614.4	Node146	612.9	189.0	24	0.017	0.794
Link146	Node145	616.1	Node146	612.9	189.0	24	0.017	1.693

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link146	Node145	617.6	Node146	612.9	189.0	24	0.017	2.487
Link147	Node146	614.3	Node147	614.2	171.7	54	0.01	0.058
Link149	Node147	614.2	Node149	614.2	46.0	54	0.01	0.059
Link150	Node149	614.2	Node150	613.8	479.6	54	0.013	0.075
Link800	Node150	613.8	Node152	613.3	641.6	54	0.013	0.075
Link801	Node152	613.3	Node341	613.1	299.9	54	0.013	0.077
Link155	Node154	613.1	Node155	613.0	340.3	54	0.013	0.021
Link287	Node155	611.8	Node157	611.6	651.2	69	0.013	0.029
Link158	Node157	611.6	Node158	611.4	492.1	69	0.013	0.029
Link159	Node158	611.4	Node158a	611.3	507.0	69	0.013	0.029
Link160	Node159	610.3	Node160	610.1	620.0	69	0.013	0.029
Link162	Node160	610.1	Node162	609.4	2,400.0	69	0.013	0.029
Link163	Node162	609.4	Flo Tote	608.7	2,436.7	69	0.013	0.029
Link839	Flo Tote	608.7	Fox Metro	608.2	517.0	162	0.013	0.099
Link165	Node165	668.4	Node166	667.7	385.0	24	0.017	0.187
Link166	Node166	667.5	Node167	665.9	399.0	39	0.017	0.399
Link167	Node167	665.8	Node168	663.9	396.0	45	0.017	0.480
Link168	Node168	663.9	Node169	661.8	446.0	45	0.017	0.457
FM 5	Node169	661.4	Node170	661.1	230.0	72	0.017	0.148
Link170	Node170	661.1	Node171	660.4	331.0	48	0.013	0.224
Link171	Node171	660.4	Node172	659.8	398.0	48	0.013	0.143
Link172	Node172	659.7	Node173	658.8	520.0	48	0.013	0.173
Link173	Node173	658.8	Node174	657.5	334.0	54	0.013	0.386
Link174	Node174	657.4	Node175	656.3	548.0	54	0.013	0.192
Link175	Node175	656.3	Node176	655.4	406.0	54	0.013	0.229
Link176	Node176	655.4	Node177	630.0	446.0	54	0.013	5.679
Link177	Node177	629.7	Node178	625.3	294.1	54	0.013	1.489
Link178	Node178	625.3	Node179	624.4	26.6	54	0.013	3.389
Link179	Node179	624.4	Node180	624.0	413.2	66	0.013	0.114
Link180	Node180	624.0	Node181	623.8	21.0	66	0.013	0.668
Link182	Node181	623.8	Node183	622.9	489.6	66	0.013	0.192
FM 4	Node183	622.9	Node184	622.1	230.6	72	0.014	0.334
Link184	Node184	622.1	Node130	621.5	35.8	72	0.014	1.564
Link185	Node185	636.1	Node186	632.5	167.0	24	0.016	2.173
Link186	Node186	632.5	Node187	631.4	52.0	36	0.016	2.058
Link187	Node187	631.4	Node177	630.1	425.0	36	0.013	0.313
Link188	Node188	684.3	Node189	676.5	433.0	18	0.017	1.818
Link189	Node189	676.3	Node190	670.0	435.0	22	0.017	1.437
Link190	Node190	669.9	Node191	666.6	341.8	24	0.017	0.986
Link191	Node191	666.5	Node169	663.0	279.9	24	0.017	1.247
Link192	Node192	675.3	Node193	673.3	419.0	18	0.017	0.492
Link193	Node193	673.1	Node194	670.4	455.0	18	0.017	0.593
Link194	Node194	670.2	Node166	667.8	631.0	18	0.017	0.376
Link195	Node195	682.6	Node196	677.5	483.0	18	0.017	1.054
Link196	Node196	677.5	Node197	673.4	396.0	18	0.017	1.033
Link197	Node197	673.2	Node165	668.8	625.6	18	0.017	0.706
Link299	Node198	672.2	Node199	667.6	331.0	21	0.015	1.384
Link199	Node199	667.5	Node200	661.6	329.0	22	0.015	1.787
Link200	Node200	661.5	Node201	649.1	402.0	24	0.015	3.080
FM 27	Node201	648.5	Node202	644.4	344.4	48	0.015	1.211
Link693	Node202	643.5	Node203	641.9	78.0	48	0.015	1.987
Link776	Node202	0.1	Node716	0.0	10.0	1	0.015	0.000
Link203	Node203	641.5	Node204	640.4	418.0	22	0.015	0.258
Link204	Node204	639.9	Node205	639.1	258.0	22	0.015	0.283
Link205	Node205	639.1	Node206	638.4	257.0	22	0.015	0.288
Link206	Node206	638.4	Node207	638.3	252.0	22	0.015	0.052
Link208	Node207	638.3	Node211	637.4	245.0	21	0.015	0.331
Link209	Node211	637.4	Node212	636.8	518.0	22	0.015	0.133
FM 6	Node212	636.8	Node185	636.1	445.0	24	0.015	0.139
Link211	Node213	662.6	Node214	659.4	280.0	45	0.015	1.136
Link302	Node214	659.1	Node215	657.6	325.0	45	0.015	0.465
Link213	Node215	657.6	Node216	655.9	405.0	45	0.015	0.425
Link214	Node216	655.9	Node217	653.9	265.0	45	0.015	0.736
Link716	Node217	653.9	Node219	649.8	546.0	45	0.015	0.745
Link300	Node219	649.8	Node201	648.5	424.0	42	0.015	0.307

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link220	Node222	669.0	Node223	664.9	331.0	18	0.015	1.214
Link221	Node223	664.7	Node219	650.3	351.0	24	0.015	4.080
Link222	Node224	672.0	Node225	669.2	332.0	18	0.015	0.843
Link223	Node225	669.0	Node226	664.1	330.0	18	0.015	1.491
Link224	Node226	663.7	Node216	656.9	172.0	22	0.015	3.930
Link225	Node227	691.4	Node228	681.6	321.6	15	0.014	3.053
Link226	Node228	681.6	Node229	665.3	362.9	15	0.014	4.486
Link227	Node229	665.3	Node230	653.3	248.3	15	0.014	4.850
Link276	Node230	653.3	Node231	650.7	79.3	18	0.014	3.279
Link229	Node231	650.6	Node232	646.7	369.8	24	0.014	1.063
Link230	Node232	646.7	Node233	644.6	248.7	24	0.014	0.836
Link231	Node233	644.7	Node234	640.0	460.0	24	0.014	1.024
Link232	Node234	640.0	Node235	639.1	43.4	24	0.014	1.957
Link233	Node235	639.0	Node236	636.7	17.0	24	0.014	13.353
Link234	Node236	634.4	Node237	632.8	182.4	48	0.016	0.850
Link235	Node237	632.8	Node238	631.9	227.9	48	0.016	0.430
FM 23	Node238	631.9	Node239	630.0	330.0	48	0.016	0.552
Link720	Node239	630.0	Node669	629.6	63.0	48	0.018	0.651
Link239	Node241	648.5	Node242	646.1	292.8	30	0.014	0.820
Link240	Node242	646.1	Node243	643.7	423.8	30	0.014	0.576
Link822	Node243	643.7	Node245	641.2	272.7	20	0.014	0.902
Link243	Node245	641.2	Node246	639.1	43.3	20	0.014	4.917
Link244	Node246	639.1	Node247	636.5	188.8	20	0.014	1.356
Link245	Node247	636.4	Node248	634.3	118.8	20	0.014	1.801
Link694	Node248	634.0	Node655	631.2	313.0	24	0.014	0.901
Link247	Node249	677.6	Node250	676.6	192.1	18	0.014	0.521
Link248	Node250	676.5	Node251	675.5	244.1	18	0.014	0.389
Link249	Node251	675.3	Node252	673.5	332.1	18	0.014	0.545
Link250	Node252	673.4	Node253	673.4	49.2	18	0.014	0.020
Link251	Node253	673.4	Node254	667.4	347.0	18	0.014	1.732
Link252	Node254	667.5	Node255	647.8	397.3	18	0.014	4.959
Link253	Node255	647.6	Node235	638.9	191.3	24	0.014	4.532
Link254	Node256	661.8	Node257	660.2	352.2	30	0.025	0.460
link 254	Node257	660.2	Node258	658.4	351.9	30	0.025	0.520
FM 9	Node258	658.4	Node259	656.9	284.3	30	0.025	0.510
Link275	Node259	656.9	Node261	656.1	168.0	30	0.014	0.476
Link259	Node261	656.1	Node262	654.7	274.0	30	0.014	0.511
Link260	Node262	654.7	Node263	652.6	379.0	30	0.014	0.546
Link261	Node263	652.6	Node264	650.6	369.1	30	0.014	0.550
Link262	Node264	650.6	Node265	648.7	391.8	30	0.014	0.490
Link263	Node265	648.7	Node266	647.6	187.7	30	0.014	0.570
Link264	Node266	647.6	Node267	645.8	24.0	30	0.014	7.628
Link746	Node267	645.6	Node269	640.8	152.8	30	0.014	3.200
Link267	Node269	640.8	Node270	640.0	121.0	30	0.014	0.612
Link269	Node270	640.0	Node272	638.5	320.8	30	0.014	0.480
Link270	Node272	638.5	Node273	636.8	315.1	30	0.014	0.530
Link271	Node273	636.8	Node274	636.5	36.0	30	0.014	0.778
Link272	Node274	636.5	Node275	635.6	128.0	30	0.014	0.719
Link273	Node275	635.6	Node276	635.5	14.0	30	0.014	0.929
Link274	Node276	635.5	Node236	634.9	112.0	30	0.014	0.500
Link288	Node278	621.3	Node279	620.7	14.0	24	0.014	4.360
Link290	Node279	620.7	Node136	620.7	56.3	54	0.013	0.071
Link305	Node285	710.7	Node286	709.5	328.1	27	0.018	0.357
Link306	Node286	709.2	Node287	708.2	453.1	30	0.018	0.221
Link307	Node287	708.2	Node288	706.9	434.9	30	0.018	0.317
Link308	Node288	707.0	Node289	706.0	338.3	30	0.018	0.293
Link309	Node289	705.9	Node290	703.7	426.8	30	0.018	0.504
Link310	Node290	703.4	Node291	701.5	421.0	36	0.018	0.458
Link311	Node291	701.4	Node292	700.5	382.1	42	0.018	0.238
Link312	Node292	700.5	Node293	697.1	398.8	42	0.018	0.840
Link313	Node293	697.0	Node294	692.4	394.6	36	0.018	1.166
Link 314	Node294	692.4	Node295	687.7	398.8	36	0.018	1.166
FM 7	Node295	687.7	Node296	686.5	98.7	36	0.018	1.175
Link316	Node296	686.0	Node297	685.7	29.5	12	0.016	0.373
Link859	Node296	687.0	Node308	686.2	48.2	12	0.014	1.723

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link701	Node296	0.1	Node659	0.0	10.0	1	0.016	0.000
Link317	Node297	685.8	Node298	684.9	202.9	12	0.017	0.000
Link318	Node298	684.9	Node299	682.1	316.8	12	0.017	0.909
Link796	Node299	682.0	Node301	681.2	348.8	12	0.017	0.229
Link321	Node301	681.1	Node302	680.6	347.4	12	0.017	0.135
Link322	Node302	680.4	Node303	679.9	312.7	12	0.017	0.147
Link323	Node303	679.9	Node304	679.1	304.3	12	0.017	0.266
Link324	Node304	679.1	Node305	678.8	48.7	12	0.025	0.000
Link325	Node305	678.9	Node306	678.5	28.0	12	0.017	1.466
Link326	Node306	678.0	Node307	677.4	347.4	18	0.025	0.181
Link762	Node306	678.2	Node704	678.7	22.3	18	0.017	-2.165
Link804	Node307	677.4	Node728	676.2	336.8	18	0.025	0.341
Link328	Node308	686.2	Node309	685.0	184.8	12	0.017	0.633
Link329	Node309	685.0	Node310	683.0	314.0	12	0.017	0.637
Link330	Node310	681.4	Node311	680.6	330.7	12	0.017	0.230
Link331	Node311	680.5	Node312	680.2	330.7	12	0.017	0.112
Link332	Node312	680.0	Node313	679.4	328.0	12	0.017	0.162
Link333	Node313	679.4	Node314	678.6	353.0	12	0.017	0.235
Link334	Node314	678.6	Node306	678.6	32.3	12	0.017	0.093
Link335	Node315	686.8	Node316	686.7	20.0	15	0.017	0.500
Link337	Node315	688.8	Node317	688.1	17.7	12	0.014	4.075
Link707	Node316	686.7	Node306	680.5	344.6	15	0.017	1.819
Link338	Node317	687.5	Node318	679.0	342.9	42	0.017	2.505
Link339	Node318	675.9	Node319	675.9	272.3	51	0.017	0.000
Link341	Node321	723.1	Node322	722.1	269.1	30	0.016	0.368
Link342	Node322	722.1	Node323	722.0	326.5	30	0.016	0.043
Link343	Node323	722.1	Node324	721.6	57.9	30	0.016	0.760
Link344	Node324	721.5	Node325	721.1	276.2	30	0.016	0.157
Link345	Node325	721.1	Node326	720.6	330.3	30	0.016	0.157
Link346	Node326	720.6	Node327	719.1	300.6	30	0.016	0.512
Link347	Node327	719.1	Node328	717.7	267.7	30	0.016	0.501
Link348	Node328	717.7	Node329	708.7	438.7	27	0.016	2.063
Link349	Node329	708.7	Node330	707.6	561.9	36	0.016	0.198
Link350	Node330	707.4	Node331	706.1	413.2	42	0.016	0.305
Link351	Node331	706.1	Node332	704.0	398.4	42	0.016	0.545
Link352	Node332	704.0	Node333	698.7	435.5	42	0.016	1.210
Link353	Node333	698.7	Node334	692.6	398.4	42	0.016	1.536
FM 8	Node334	692.5	Node315	687.0	398.9	42	0.016	1.381
Link355	Node335	719.6	Node336	717.5	332.8	18	0.016	0.628
Link356	Node336	717.5	Node337	715.1	325.1	24	0.016	0.741
Link357	Node337	715.1	Node338	713.2	365.3	27	0.016	0.520
Link358	Node338	712.9	Node339	710.6	200.8	27	0.016	1.150
Link359	Node339	710.6	Node330	709.6	59.2	27	0.016	1.605
Link361	Node340	614.2	Node341	613.1	494.1	24	0.009	0.212
Link363	Node341	613.1	Node154	613.1	169.4	54	0.013	0.020
Link364	Node342	640.2	Node343	639.3	212.9	18	0.014	0.404
Link365	Node343	639.0	Node344	638.5	255.4	24	0.014	0.204
Link366	Node344	638.5	Node345	637.5	291.5	24	0.014	0.333
Link367	Node345	637.3	Node346	636.3	80.3	24	0.014	1.146
Link368	Node346	636.3	Node347	635.8	67.0	24	0.014	0.776
Link369	Node347	635.8	Node348	631.6	220.7	24	0.014	1.903
Link370	Node348	631.6	Node349	626.7	292.6	27	0.014	1.699
Link371	Node349	626.7	Node350	626.1	74.5	27	0.014	0.765
Link372	Node350	626.0	Node351	626.1	35.2	27	0.014	-0.284
Link374	Node350	625.5	Node353	625.1	323.0	15	0.014	0.142
Link373	Node351	626.1	Node352	626.1	35.0	20	0.014	0.000
Link842	Node355	617.8	Node146	616.3	341.5	18	0.014	0.439
Link378	Node356	659.6	Node357	655.4	442.2	18	0.014	0.959
Link379	Node357	654.7	Node358	649.7	431.8	18	0.014	1.146
Link380	Node358	649.8	Node359	643.2	393.4	18	0.014	1.680
Link382	Node359	643.2	Node361	634.9	1,258.5	84	0.013	0.661
Link383	Node361	634.9	Node362	627.3	951.8	84	0.013	0.796
Link384	Node362	627.3	Node363	626.4	115.6	96	0.013	0.796
Link385	Node363	626.4	Node364	626.1	99.2	96	0.013	0.276
Link386	Node364	626.1	Node365	625.1	365.4	96	0.017	0.276

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link387	Node365	625.1	Node366	623.4	346.3	96	0.017	0.502
Link388	Node366	623.4	Node367	617.4	907.9	96	0.017	0.656
Link 389	Node367	617.4	Node368	616.1	205.2	96	0.017	0.653
FM 22	Node368	616.1	Node745	614.8	160.5	96	0.017	0.810
Link391	Node369	680.8	Node370	680.2	320.4	20	0.019	0.194
Link392	Node370	679.9	Node371	679.5	316.7	27	0.019	0.126
Link393	Node371	679.4	Node372	678.6	315.4	30	0.019	0.247
Link394	Node372	678.6	Node373	678.0	276.8	33	0.019	0.210
Link395	Node373	678.0	Node374	677.9	76.4	33	0.019	0.223
Link396	Node374	677.9	Node375	676.9	452.4	36	0.019	0.212
Link397	Node375	676.9	Node376	676.1	552.1	36	0.019	0.154
Link398	Node376	676.0	Node377	675.8	93.0	36	0.019	0.237
Link399	Node377	675.8	Node378	675.2	260.5	42	0.019	0.207
Link400	Node378	675.2	Node379	674.7	317.9	42	0.019	0.148
Link401	Node379	674.7	Node380	673.9	322.8	48	0.019	0.260
Link402	Node380	673.9	Node381	673.5	315.3	48	0.019	0.143
Link403	Node381	673.5	Node382	673.3	95.0	48	0.019	0.140
Link422	Node382	673.3	Node401	672.1	462.4	54	0.019	0.264
Link404	Node383	683.5	Node384	683.1	312.9	18	0.019	0.121
Link405	Node384	683.0	Node385	682.0	320.4	20	0.019	0.334
Link406	Node385	681.7	Node386	680.8	314.1	27	0.019	0.290
Link407	Node386	680.8	Node387	679.9	325.4	27	0.019	0.280
Link408	Node387	679.8	Node388	679.4	320.3	30	0.019	0.119
Link409	Node388	679.3	Node389	678.4	315.4	30	0.019	0.298
Link410	Node389	678.3	Node390	677.5	386.4	33	0.019	0.202
Link411	Node390	677.1	Node391	676.7	251.8	42	0.019	0.187
Link412	Node391	676.7	Node392	676.3	100.4	42	0.019	0.349
Link413	Node392	676.3	Node382	673.3	392.6	42	0.019	0.759
Link414	Node393	685.2	Node394	684.1	317.1	20	0.019	0.366
Link415	Node394	684.1	Node395	683.6	324.8	24	0.019	0.142
Link416	Node395	683.6	Node396	682.9	324.5	24	0.019	0.216
Link417	Node396	682.9	Node397	682.3	321.0	27	0.019	0.181
Link418	Node397	682.3	Node398	681.6	254.8	27	0.019	0.275
Link419	Node398	681.6	Node399	681.1	108.5	27	0.019	0.525
Link420	Node399	681.1	Node400	680.0	378.9	27	0.019	0.280
Link421	Node400	680.0	Node390	679.4	102.4	27	0.019	0.615
Link423	Node401	672.2	Node402	671.7	72.0	54	0.019	0.458
Link424	Node402	671.4	Node403	671.1	250.7	54	0.019	0.144
Link425	Node403	671.1	Node404	670.7	102.6	54	0.019	0.419
Link426	Node404	670.7	Node405	669.3	445.0	60	0.019	0.312
Link427	Node405	669.3	Node406	668.5	413.4	60	0.019	0.177
Link428	Node406	668.5	Node407	667.9	341.5	60	0.019	0.173
Link429	Node407	667.9	Node408	667.3	107.2	60	0.019	0.597
Link430	Node408	667.3	Node409	666.7	550.9	60	0.019	0.102
Link431	Node409	666.7	Node410	666.6	77.1	60	0.019	0.247
Link432	Node410	666.6	Node411	664.2	324.1	60	0.019	0.716
Link433	Node411	664.2	Node412	663.2	381.5	60	0.019	0.280
Link434	Node412	663.2	Node413	661.7	381.5	60	0.019	0.372
Link435	Node413	661.7	Node414	660.4	367.8	60	0.019	0.364
FM 17	Node414	658.9	Node415	658.7	406.2	60	0.019	0.042
Link437	Node415	658.7	Node416	658.7	390.5	60	0.014	0.000
Link438	Node416	656.6	Node417	651.1	556.1	54	0.014	1.000
Link439	Node417	651.1	Node418	650.1	99.8	66	0.014	1.000
Link440	Node418	650.1	Node419	649.4	57.3	66	0.014	1.135
Link441	Node419	649.4	Node420	647.8	409.2	84	0.014	0.399
Link442	Node420	647.8	Node359	643.2	659.4	84	0.014	0.698
Link443	Node421	655.5	Node422	654.0	393.1	24	0.014	0.363
Link444	Node422	654.0	Node423	653.2	243.5	27	0.014	0.363
Link445	Node423	653.2	Node417	651.1	44.6	27	0.019	4.665
Link446	Node424	675.1	Node425	672.6	232.7	18	0.013	1.079
Link447	Node425	672.6	Node426	666.1	60.1	18	0.013	10.743
Link451	Node426	666.1	Node430	665.7	298.7	42	0.013	0.131
Link448	Node427	667.3	Node428	666.9	333.8	42	0.013	0.129
Link449	Node428	666.9	Node429	666.6	312.6	42	0.013	0.093
Link450	Node429	666.6	Node426	666.1	85.1	42	0.013	0.541

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link452	Node430	665.6	Node431	664.9	422.0	42	0.013	0.171
Link453	Node431	664.9	Node432	664.6	114.3	42	0.013	0.228
Link454	Node432	664.6	Node433	663.6	415.4	42	0.013	0.229
Link455	Node433	663.5	Node434	662.8	373.9	42	0.013	0.179
Link456	Node434	662.8	Node435	661.7	376.2	42	0.013	0.271
Link457	Node435	661.7	Node436	661.1	268.2	42	0.013	0.205
Link458	Node436	661.4	Node437	660.6	276.3	48	0.013	0.282
Link459	Node437	660.5	Node438	659.9	267.3	48	0.013	0.209
Link460	Node438	659.9	Node439	659.5	317.7	48	0.013	0.142
FM 13	Node439	659.4	Node440	658.6	312.9	48	0.013	0.400
Link462	Node440	658.6	Node441	657.4	341.3	72	0.014	0.354
Link463	Node441	657.4	Node442	656.8	432.2	72	0.014	0.153
Link464	Node442	656.8	Node443	655.4	454.0	72	0.014	0.293
FM 14	Node443	655.4	Node444	654.8	438.8	72	0.014	0.153
Link466	Node444	654.8	Node445	654.1	388.6	72	0.019	0.172
Link819	Node445	654.1	Node419	649.4	1,173.5	72	0.014	0.399
Link469	Node447	658.8	Node442	664.7	13.7	12	0.014	-43.535
Link470	Node447	658.1	Node448	656.7	453.4	18	0.018	0.320
Link471	Node448	656.7	Node449	655.1	440.5	21	0.018	0.363
Link818	Node448	656.7	Node443	656.2	13.3	12	0.014	3.167
Link472	Node449	655.1	Node444	655.0	15.4	12	0.014	0.714
Link473	Node449	655.1	Node450	653.8	401.8	24	0.019	0.304
Link474	Node450	653.8	Node445	654.1	22.7	12	0.019	-1.144
Link475	Node451	680.5	Node452	679.5	403.8	20	0.014	0.253
Link803	Node452	679.5	Node454	677.0	606.8	20	0.014	0.404
Link478	Node454	677.0	Node455	676.5	379.9	27	0.014	0.126
Link479	Node455	676.4	Node456	676.8	246.4	27	0.014	-0.162
Link480	Node456	677.0	Node457	675.9	101.4	27	0.014	1.015
Link481	Node457	675.9	Node458	675.2	338.7	27	0.014	0.218
Link488	Node458	674.9	Node465	674.3	364.5	33	0.014	0.154
Link482	Node459	685.0	Node460	684.3	212.5	15	0.014	0.344
Link483	Node460	684.3	Node461	683.2	220.1	15	0.014	0.500
Link484	Node461	683.0	Node462	682.4	310.5	18	0.014	0.206
Link485	Node462	682.4	Node463	681.6	294.1	18	0.014	0.258
Link486	Node463	681.6	Node464	680.8	362.9	20	0.014	0.201
Link487	Node464	680.8	Node458	679.8	328.6	20	0.014	0.304
Link489	Node465	674.3	Node466	673.7	256.3	36	0.014	0.211
Link490	Node466	673.8	Node467	672.0	74.0	36	0.014	2.446
Link497	Node467	672.0	Node474	671.0	223.9	36	0.014	0.429
Link491	Node468	675.4	Node469	675.4	206.3	24	0.014	0.010
Link492	Node469	675.4	Node470	672.9	61.1	24	0.014	4.044
Link493	Node470	672.9	Node471	674.6	256.1	27	0.014	-0.652
Link494	Node471	674.6	Node472	674.0	315.6	27	0.014	0.181
Link495	Node472	673.9	Node473	673.2	342.5	27	0.014	0.225
Link496	Node473	673.2	Node467	672.0	389.6	27	0.014	0.313
Link498	Node474	671.0	Node475	670.5	84.0	36	0.014	0.631
Link499	Node475	670.5	Node476	669.5	130.1	36	0.014	0.762
Link500	Node476	669.5	Node477	668.9	78.5	36	0.014	0.762
Link501	Node477	668.9	Node478	666.0	565.6	36	0.014	0.513
Link502	Node478	665.9	Node479	662.9	342.6	36	0.014	0.870
Link503	Node479	662.9	Node480	661.3	48.0	36	0.014	3.375
Link504	Node480	661.3	Node481	660.8	240.3	60	0.014	0.202
Link505	Node481	660.8	Node482	660.7	37.4	60	0.016	0.187
Link506	Node482	660.7	Node483	659.9	360.9	60	0.014	0.244
Link507	Node483	659.9	Node440	658.6	345.1	72	0.014	0.354
Link508	Node484	686.8	Node485	685.9	250.3	18	0.018	0.360
Link509	Node485	685.8	Node486	685.2	365.4	18	0.018	0.178
Link510	Node486	685.2	Node487	684.1	412.0	18	0.018	0.262
Link511	Node487	684.1	Node488	683.3	405.7	18	0.018	0.195
Link512	Node488	683.1	Node489	682.2	363.4	18	0.018	0.264
Link513	Node489	682.2	Node490	681.2	296.8	18	0.018	0.327
Link514	Node490	681.1	Node491	680.3	334.6	18	0.018	0.233
Link515	Node491	680.5	Node492	679.4	351.0	18	0.018	0.308
Link516	Node492	679.4	Node493	678.7	278.8	18	0.018	0.262
Link802	Node493	678.6	Node495	677.9	346.3	18	0.018	0.191

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link519	Node495	677.6	Node496	677.1	300.5	21	0.018	0.176
Link520	Node496	677.1	Node497	676.6	320.2	21	0.018	0.144
Link521	Node497	676.6	Node498	676.0	294.2	21	0.018	0.207
Link522	Node498	676.0	Node499	675.7	334.6	21	0.018	0.093
Link523	Node499	675.7	Node500	675.4	260.9	21	0.018	0.127
Link524	Node500	675.4	Node501	674.6	363.4	21	0.018	0.226
Link525	Node501	674.5	Node502	674.2	311.5	21	0.018	0.100
Link526	Node502	673.8	Node503	669.6	331.2	24	0.018	1.286
Link527	Node503	669.5	Node504	667.7	338.5	27	0.018	0.535
Link528	Node504	667.4	Node505	665.9	331.1	30	0.018	0.447
Link529	Node505	666.0	Node506	665.2	332.9	36	0.018	0.240
Link547	Node506	665.2	Node524	664.4	327.5	42	0.018	0.250
Link530	Node507	675.2	Node508	674.9	290.8	21	0.018	0.103
Link531	Node508	674.9	Node509	674.6	144.4	21	0.018	0.229
Link532	Node509	674.6	Node510	674.5	203.6	21	0.018	0.059
Link533	Node510	674.5	Node511	674.2	177.4	15	0.018	0.158
Link534	Node511	674.6	Node512	673.8	523.5	21	0.018	0.157
Link535	Node512	673.7	Node513	673.3	420.1	21	0.018	0.095
Link536	Node513	673.1	Node514	673.0	351.7	21	0.018	0.014
Link537	Node514	673.0	Node515	673.0	22.5	21	0.018	0.000
Link538	Node515	673.1	Node516	672.4	315.0	21	0.018	0.216
Link539	Node516	672.4	Node517	672.6	320.2	21	0.018	-0.072
Link540	Node517	672.5	Node518	671.5	331.1	21	0.018	0.284
Link541	Node518	671.2	Node519	670.0	320.4	16	0.018	0.356
Link542	Node519	670.0	Node520	670.0	378.7	16	0.018	-0.018
Link543	Node520	670.0	Node521	669.1	319.4	21	0.018	0.282
Link544	Node521	669.1	Node522	668.2	331.0	21	0.018	0.260
Link545	Node522	668.3	Node523	667.8	310.3	21	0.018	0.139
Link546	Node523	667.8	Node506	667.2	306.8	21	0.018	0.196
FM 15	Node524	663.9	Node525	663.8	330.2	48	0.018	0.039
Link549	Node525	664.1	Node526	663.5	326.8	48	0.014	0.174
Link550	Node526	663.3	Node527	662.8	283.0	48	0.014	0.194
Link551	Node527	662.7	Node528	662.4	86.3	48	0.014	0.336
Link552	Node528	662.4	Node480	661.3	563.2	48	0.014	0.202
Link553	Node529	670.4	Node530	669.5	333.5	24	0.013	0.288
Link554	Node530	669.5	Node531	668.9	389.6	21	0.013	0.151
Link555	Node531	668.9	Node532	667.8	361.6	30	0.013	0.304
Link556	Node532	667.8	Node533	667.3	335.0	30	0.013	0.134
Link557	Node533	667.3	Node427	667.3	46.2	30	0.013	0.000
Link574	Node550	633.1	Node551	633.0	162.9	24	0.02	0.049
Link575	Node551	633.0	Node552	632.8	69.0	24	0.02	0.333
Link576	Node552	632.6	Node553	631.6	459.8	14	0.02	0.222
Link576	Node552	632.6	Node553	631.6	459.8	14	0.02	0.222
Link577	Node553	631.6	Node85	631.2	300.7	18	0.02	0.140
Link578	Node554	674.7	Node555	673.4	448.2	18	0.012	0.299
Link579	Node555	673.2	Node556	671.7	439.6	22	0.012	0.350
Link580	Node556	671.6	Node557	669.8	395.9	24	0.012	0.447
Link581	Node557	669.6	Node558	668.0	353.9	26	0.012	0.441
Link582	Node558	667.8	Node559	666.2	355.4	28	0.012	0.459
FM 11	Node559	666.0	Node563	661.9	593.7	33	0.012	0.680
Link583	Node560	671.8	Node561	670.2	327.3	18	0.012	0.483
Link584	Node561	670.3	Node562	669.7	434.9	24	0.012	0.145
Link585	Node562	669.7	Node559	667.6	307.8	22	0.012	0.656
Link587	Node563	661.9	Node564	645.2	353.8	27	0.014	4.725
Link588	Node564	645.2	Node565	633.8	355.4	27	0.014	3.205
Link590	Node565	636.2	Node567	635.8	66.7	16	0.014	0.555
Link589	Node565	0.1	Node566	0.0	71.0	1	0.014	0.000
Link814	Node566	633.6	Node731	633.6	33.0	27	0.014	0.000
Link591	Node567	635.8	Node568	635.3	244.0	16	0.02	0.217
Link592	Node568	635.3	Node569	634.8	409.2	16	0.02	0.127
Link593	Node569	634.8	Node570	634.2	259.9	16	0.02	0.200
Link594	Node570	634.2	Node571	633.7	228.7	16	0.02	0.232
Link595	Node571	633.7	Node551	633.0	34.7	16	0.02	2.020
Link596	Node572	670.4	Node573	668.9	387.0	20	0.02	0.377
Link597	Node573	668.9	Node574	665.8	662.0	33	0.02	0.470

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link608	Node574	665.5	Node585	664.1	304.0	48	0.02	0.457
Link598	Node575	676.5	Node576	675.0	441.0	15	0.02	0.340
Link599	Node576	675.0	Node577	672.6	339.0	15	0.02	0.720
Link600	Node577	672.5	Node578	672.1	91.0	15	0.02	0.451
Link601	Node578	672.1	Node579	670.9	326.0	33	0.02	0.380
Link602	Node579	670.8	Node580	670.2	113.0	33	0.02	0.560
Link603	Node580	670.1	Node581	669.2	315.0	33	0.02	0.300
Link604	Node581	669.2	Node582	667.9	450.0	36	0.02	0.000
Link605	Node582	667.8	Node583	666.8	228.0	36	0.02	0.434
Link606	Node583	666.8	Node584	666.6	86.0	36	0.02	0.233
Link607	Node584	666.5	Node574	665.6	383.0	36	0.02	0.230
Link609	Node585	664.9	Node586	664.5	139.0	21	0.02	0.245
FM 12	Node585	664.1	Node611	663.4	358.0	15	0.02	0.108
Link610	Node586	664.4	CSO Reg 21	642.8	352.0	27	0.014	6.134
Link611	CSO Reg 21	642.4	node	641.7	70.8	27	0.014	0.918
Link772	node	641.7	CSO 21 Outfall	627.5	227.4	24	0.014	6.239
Link629	Node605	621.1	Node278	621.3	511.5	12	0.014	-0.047
Link629	Node605	621.1	Node278	621.3	511.5	24	0.014	-0.047
Link631	Node606	632.7	CSO Reg 18	631.8	416.0	24	0.014	0.214
Link632	CSO Reg 18	630.8	Node608	630.1	448.0	36	0.014	0.147
Link692	CSO Reg 18	632.3	CSO Struct 18	621.0	351.5	18	0.014	3.214
Link633	Node608	630.1	Node609	626.6	488.0	36	0.014	0.734
Link634	Node609	626.1	Node610	623.3	127.0	42	0.014	2.228
Link758	Node610	622.6	Node605	621.1	88.8	24	0.014	1.700
Link637	Node611	663.6	Node612	662.9	43.0	15	0.014	1.558
Link638	Node612	662.9	Node613	660.8	362.0	15	0.014	0.575
Link639	Node613	660.7	Node614	659.3	356.0	18	0.014	0.407
Link640	Node614	658.6	Node615	653.3	236.0	18	0.014	2.263
Link641	Node615	653.2	Node616	651.8	153.0	18	0.014	0.961
Link642	Node616	651.8	Node617	643.3	417.0	24	0.014	2.022
Link643	Node617	643.3	Node618	640.7	379.2	36	0.014	0.696
Link713	Node618	640.7	Node668	639.3	143.0	42	0.014	0.965
Link645	Node619	636.1	Node620	635.7	10.0	42	0.009	4.300
Link646	Node620	635.7	Node621	630.3	249.0	42	0.009	2.161
FM 19	Node621	630.3	Node609	626.1	185.0	42	0.009	2.259
Link649	Node623	639.8	Node619	636.1	361.0	39	0.009	1.028
Link650	Node624	669.2	Node625	667.1	398.0	18	0.009	0.530
Link651	Node625	667.1	Node626	654.0	470.0	21	0.009	2.781
Link652	Node626	654.0	Node627	645.1	260.2	21	0.009	3.420
Link653	Node627	645.1	Node628	643.6	157.1	21	0.009	0.942
Link654	Node628	643.7	Node629	642.2	185.1	24	0.009	0.797
Link655	Node629	642.2	Node630	641.8	51.2	24	0.009	0.797
Link656	Node630	641.8	Node623	640.0	340.0	39	0.009	0.538
Link667	Node634	656.4	Node18	655.5	408.0	78	0.013	0.221
Link665	Node635	656.4	Node18	655.5	408.0	42	0.013	0.216
Link670	Node636	659.7	Node7	659.3	254.0	42	0.013	0.157
Link673	Node639	620.0	Node82	613.9	31.0	48	0.014	19.613
Link675	Node641	614.8	Node156	610.1	216.4	96	0.014	2.159
Link691	Node650	621.4	Node651	621.4	31.2	72	0.014	0.128
Link810	Node655	631.5	Node92	631.5	10.0	8	0.014	0.000
Link699	Node655	0.1	Node657	0.0	10.0	1	0.014	0.000
Link698	Node657	629.6	Node89	629.6	24.0	24	0.014	0.333
Link702	Node659	687.3	Node660	683.7	225.0	36	0.014	1.640
Link703	Node660	683.6	Node661	681.6	295.0	36	0.014	0.647
Link704	Node661	680.8	Node705	680.4	333.0	48	0.014	0.198
Link705	Node662	679.7	Node663	679.0	333.0	48	0.014	0.066
Link706	Node663	679.0	Node318	678.9	337.0	48	0.014	0.142
Link710	Node665	673.3	Node666	671.4	392.0	15	0.009	0.490
Link711	Node666	671.3	Node667	669.5	482.0	21	0.009	0.365
Link712	Node667	669.6	Node625	667.2	440.0	21	0.009	0.541
Link714	Node668	639.3	Node619	636.1	315.0	42	0.014	1.010
Link721	Node669	629.4	Node96	628.9	24.2	20	0.014	2.190
Link722	Node670	627.5	Node109	627.3	29.0	42	0.014	0.621
Link729	Node675	627.2	Node110	627.0	27.0	42	0.014	0.704
Link735	Node678	627.5	Node109	627.2	193.8	36	0.014	0.186

TABLE B.02-1 MODEL INFORMATION

Link Name	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	Length (ft)	Diameter (inches)	Roughness	Conduit Slope (ft/ft)
Link737	Node679	624.7	Node112	624.0	175.0	48	0.014	0.389
Link739	Node680	625.0	Node679	624.7	69.4	48	0.014	0.360
Link740	Node682	622.9	Node683	622.8	45.7	36	0.014	0.241
Link741	Node683	622.7	Node684	622.2	196.0	36	0.014	0.265
Link779	Node684	622.1	Node735	621.7	131.0	48	0.014	0.260
Link743	Node685	630.2	Node682	627.2	172.0	48	0.014	1.709
Link744	Node686	630.5	Node685	630.2	28.8	48	0.014	1.251
Link747	Node689	631.9	Node690	631.6	339.5	18	0.014	0.103
Link748	Node690	631.6	Node691	630.9	358.7	24	0.014	0.173
Link749	Node691	630.9	Node692	630.2	379.8	27	0.014	0.208
Link750	Node692	630.2	Node693	629.1	417.2	27	0.014	0.250
Link817	Node693	629.1	Node363	626.4	615.8	36	0.014	0.445
Link753	Node696	671.8	Node256	664.4	113.3	12	0.02	6.557
Link759	Node701	632.4	Node686	631.9	61.9	60	0.014	0.807
Link760	Node702	641.0	Node703	639.9	191.7	48	0.014	0.569
Link761	Node703	639.9	Node701	632.4	440.9	48	0.014	1.699
Link763	Node704	0.1	Node318	0.0	10.0	1	0.014	0.000
Link764	Node705	680.3	Node662	679.8	333.0	48	0.014	0.156
Link765	Node706	672.6	Node707	672.0	262.6	15	0.016	0.217
Link766	Node707	672.1	Node708	670.6	252.1	15	0.016	0.615
Link767	Node708	670.6	Node709	668.9	430.8	15	0.016	0.404
Link768	Node709	669.0	Node710	666.9	344.3	15	0.016	0.616
Link769	Node710	666.9	Node711	665.7	278.5	18	0.016	0.438
Link770	Node711	665.6	Node712	664.0	258.0	18	0.016	0.601
Link771	Node712	663.6	Node256	662.9	112.8	18	0.016	0.656
Link777	Node716	643.5	Node702	641.6	381.2	48	0.014	0.496
Link820	Node717	632.5	Node733	632.2	60.0	39	0.014	0.417
Link807	Node721	629.3	Node722	629.3	10.0	39	0.014	0.000
Link808	Node722	627.9	Node718	627.9	126.9	48	0.014	0.000
Link805	Node728	676.2	Node696	672.2	155.1	18	0.013	2.593
Link806	Node729	673.6	Node706	672.7	241.5	15	0.014	0.348
Link821	Node733	625.5	Node734	624.7	123.0	54	0.014	0.650
Link676	Node745	615.8	Node155	615.4	1.0	15	0.01	35.000
Link835	Node745	618.9	Node641	618.9	1.3	0	0.015	0.800
Link863	Node747	617.4	Node159	617.3	470.0	33	0.014	0.032
Link375	Node353	625.1	Node354	624.1	343.0	15	0.014	0.292
Link815	Node354	624.1	Node732	622.5	56.5	15	0.014	2.796
Link848	Node732	621.5	Node355	617.8	236.0	18	0.014	1.576
Link787	Node643	619.2	Node720	617.5	239.8	20	0.014	0.721
Link854	Node748	619.3	Node749	618.7	2,000.0	24	0.014	0.029
Link855	Node749	618.7	Node159	618.0	2,400.0	24	0.014	0.029
Link159d	Node158d	611.9	Node158e	611.8	366.0	69	0.013	0.029
Link159b	Node158b	611.1	Node158c	611.0	500.0	69	0.013	0.029
Link159a	Node158a	611.3	Node158b	611.1	500.0	69	0.013	0.029
Link159g	Node158g	610.5	Node158h	610.5	200.0	69	0.013	0.029
Link159f	Node158f	610.7	Node158g	610.5	497.0	69	0.013	0.029
Link159i	Node158i	610.4	Node159	610.3	508.6	69	0.013	0.029
Link159c	Node158c	612.0	Node158d	611.9	250.0	69	0.013	0.029
Link159h	Node158h	610.5	Node158i	610.4	250.0	69	0.013	0.029
Link159e	Node158e	610.8	Node158f	610.7	447.0	69	0.013	0.029

2. Wet Weather Inputs

Subcatchment areas for wet weather inputs are initially characterized by their subbasin area, percent impervious area, and subbasin width and slope. In addition, each subcatchment can be characterized by pervious infiltration characteristics, depression storage for both pervious and impervious areas, and Manning n factor for both the pervious and impervious surface areas. Individual wet weather input points may have up to five subcatchment areas allocated to it with different assigned characteristics. These inputs can be used to represent inflow from stormwater catch basins, but they may also be used to simulate infiltration of groundwater though pipe and manhole imperfections. In the Aurora model, the first four allocated subcatchments for each wet weather input node were used to represent stormwater inflow. The fifth allocated subcatchment was reserved for the modeling of infiltration. In areas of the CSS model that have been decombined, there are no wet weather inputs to the model other than the fifth infiltration subcatchment.

a. Impervious Area

Impervious area represents those areas of the catchment that would experience complete runoff; these include streets, driveways, parking lots, and rooftops (where connected to the CSS rather than discharging to pervious areas). The initial percent impervious area input may be estimated visually based on land use or visual review of aerial photography. Impervious area percentage is typically adjusted during calibration so that the model results are consistent with metering data.

This parameter, if increased, would increase the runoff volume and rate for small storms, since it is impervious area that prevents infiltration into the ground. Although it would also impact the flows and volumes early on in large or intense rain events, the percentage impact may be smaller, since large events may exceed the infiltration capacity of the soil and even pervious area begins to act as impervious area.

b. Soil Characteristics of the Pervious Area

Although pervious areas such as lawns, parks, and golf courses have the ability to infiltrate some amount of rainfall, after they become saturated during significant rainfall events, runoff is also generated from these areas. Among other methods, XP-SWMM offers the Horton Equation for determining the amount of rainfall that will infiltrate versus the amount that will run off. The Horton Equation estimates infiltration into the soil will be limited by:

$f(t)= f_o + (f_o–f_c) \times e^{-kt}$,

where:

$f(t)=$ the maximum amount of rainfall infiltration that will occur at time t (in/hour)
$f_o =$ the initial (maximum) infiltration rate (in/hour)
$f_c =$ the final (minimum) infiltration rate (in/hour)
$k =$ decay rate of infiltration (1/sec)

Table B.02-3 shows typical guideline values for f_o and f_c, based on National Resources Conservation Service (NRCS) soil types A through D. Within Aurora, the western two-thirds of the CSS is within type B soils, with the eastern one third within type C soils, as shown on Figure 4.02-4. (The demarcation line between these two zones stretches from Mastodon Lake in the southeastern part of the city to St. Michael Cemetery in the north. Some patches of type D soils appear in relatively limited areas within the CSS.)

Soil Type	General Description	Soil	f_o (in/hour)	f_c (in/hour)
A	High Infiltration	Coarse Sand	5	0.30-0.40
B	Moderate Infiltration	Fine Sand	3-4	0.15-0.30
C	Limited Infiltration	Loam	3	0.05-0.15
D	Little or No Infiltration	Clay	1	0.00-0.05

Table B.02-3 Typical Infiltration Characteristics for NRCS Soil Types

Initial values for the Horton parameters may be set based on the soil types and typical ranges in Table B.02-3. However, the infiltration parameters are often adjusted to achieve good calibration and may end up outside the typical ranges for the soils types in the area.

The parameter would be adjusted to increase or decrease the threshold at which runoff begins to occur from pervious areas. Adjusting this parameter downward will increase runoff rate and volume from a storm as long as the peak one-hour rainfall rate for the event is higher than the minimum infiltration. Because of this, this parameter would affect the flow results for larger storms and less so or not at all for smaller storms.

c. Depression Storage

This parameter may be used within individual subcatchments to represent the small depressions in pavement and detention areas that store runoff. This parameter would have the same volumetric impact on each basin and would have the most significant impact (in terms of percentage) on smaller or short duration storms. Increasing depression storage would decrease the flow rate and volume at the outset of a storm, but would not have any effect later in the storm.

d. Manning “n” Factor

The Manning n factor is applied in two areas in XP-SWMM. As discussed previously, the Manning n factor is used to represent the roughness of pipes in the hydraulic model. When modeling stormwater flows into the sewer system, the “n” factor also is used to represent the roughness of the ground surface, that is, how much resistance there is to overland flow. This may be estimated based on land use from aerial

photography. Impervious surfaces are given a default value of 0.015, while grassy areas have a higher default value of 0.30. These factors are typically adjusted during calibration.

Whether applied for the overland flow or for flow in pipes, increasing the Manning roughness would tend to slow down the flow rate and delay its arrival to a particular point in the model. Generally it should have no effect on the total volume of flow unless reduction in flow capacity allows flow to be lost out of the system because of surcharging beyond the ground surface.

e. Catchment Dimensions and Slope

In hydrologic modeling, determination of the dimensions and overall slope of each subcatchment area is necessary to assess how much "overland flow" is occurring before stormwater enters the sewer system. However, this calculation is somewhat nuanced. If Aurora's XP-SWMM model represented all stormwater input points and all sewer segments, the length of the subcatchment would simply be the longest overland flow distance from the input node to the farthest point in the catchment. The width would then be the total subcatchment area divided by this overland flow length.

However, as discussed above, not all inputs and sewer pipes are represented in the model, and the subcatchment in question may actually have one or more small diameter sewers and several catch basins within it. If this basin were represented as described in the paragraph above, the model would interpret all flow as "overland" and overestimate the time of concentration. In order to model the actual catchment conditions more accurately, the "length" of the subcatchment is set at the farthest overland flow path between a point in the subcatchment and its nearest system catch basin (whether or not that catch basin or sewer is represented in the model). Again, the "width" of the catchment is simply the subcatchment area divided by the above described "length." The slope is found using the longest overland flow path and the elevation difference between its two endpoints, which is available on the topographic mapping.

The initial values for these parameters are estimated by the modeler based on the geography of the basins and sewers. Since the catchment dimensions and slope are not literal field dimensions, these values may be adjusted to achieve model calibration. Increasing these parameters will increase how quickly runoff enters the sewer system, without affecting the total volume.

B.03 FLOW METERING RESULTS AND RAINFALL EVENT SELECTION

As discussed in Appendix A, the purpose of metering was to establish actual field flows that occur under various dry weather and wet weather conditions. Flow meters were located in the downstream segment of distinct sewersheds and upstream of CSOs and at the CSOs. As with the Aurora metering program, an attempt is generally made to represent each major basin within the

system; particularly large basins (such as on Aurora's west side) may be subdivided into smaller basins to achieve a more refined model (see Figure B.01-1 for illustration). In addition to flow meters, rain gauges were placed in key locations across the project area. At the end of the metering program, all data was reviewed to determine which time periods would serve as dry weather and wet weather calibration events.

A. Dry Weather Event Selection

Selection of dry weather events depends on (1) there being a dry period of approximately 48 hours before the selected calibration period and (2) meter operation throughout the calibration period.

Table A.04-1 presents a detailed daily rainfall calendar for the May through September calibration period. Dry weather calibration events were selected based on meter operation and antecedent conditions.

B. Wet Weather Event Selection

Wet weather calibration events are selected in a similar fashion. Rainfall data is reviewed to determine which events may represent the more extreme conditions, although smaller storms are also useful for calibration; generally, the more diverse array of storms used to calibrate a model, the more reliable the model will be. While the most useful kinds of wet weather calibration events are those that come closest to mimicking a regulatory "design storm" (such as 1.2 in/hour for 1-hour first flush design storm in Illinois), typical summer-long metering programs rarely capture such ideal storms.

Another important criteria for identifying calibration events is rainfall uniformity. It is important to select events where the rainfall distribution and volume are consistent between rain gauges, which provides greater confidence that areas between the gauges experienced similar rainfall. For example, if one rain gauge reads 0.75 inches for a storm event and another reads 0.2 inches for the same storm, it is difficult to characterize how much rain fell between the two meters. On the other hand, two separate rain gauge readings of 0.7 and 0.75 inches give a much better sense of the rainfall in between.

Table A.04-1 identifies all the rainfall events considered for wet weather calibration. Based on the rainfall patterns and meter operation, two of these events were selected for calibration and validation: May 26 and July 19, 2008.[3] The characteristics of these events are described more fully here:

1. May 26, 2008

   This event was selected as the event for calibration, since it was a spatially uniform event, the majority of the flow meters were operating well, and the total (1.08 inches over 3 hours) and hourly peak rainfall (0.85 in/hour) for the event correspond to about a 4-month

[3] Details of the 10-minute rainfall patterns during these events are provided at the end of this appendix.

recurrence interval storm. In addition, many of the CSOs were active, which is necessary to be able to calibrate the CSO discharge characteristics.

2. July 19, 2008

This event was selected as the validation event for the same general reasons that May 26, 2008, was selected for calibration–uniform rainfall, operational flow meters, and CSO activity. In addition, both events were preceded by a period of wet weather, which meant that the soil moisture parameters used for each scenario tended to be similar and did not require a change when running the validation scenario through the model, thereby eliminating one area of potential variability.

For each of the rainfall events, a spreadsheet-based "rainfall file" is developed for each rain gauge, based on the 10-minute rainfall data provided at the end of this appendix, and imported into XP-SWMM. This is referred to as the rainfall hyetograph.

These three primary calibration events were used for comparing metered and modeled flow patterns over time. In addition to these three main events, secondary wet weather calibration events were modeled and compared with meter data for peak flow and total volume.

B.04 DRY WEATHER CALIBRATION

The purpose of a dry weather calibration is to establish baseline dry weather flow conditions. This is an important step because wet weather that occurs during peak base diurnal conditions may result in greater overflow quantities than storms occurring at the periods of lowest diurnal flow.

For each of the metering basins, a "typical" dry average day was created. This typical dry weather day was created by selecting a number of dry weather days and averaging the 15-minute hydrograph readings. This averaging process has the result of more accurately depicting flow conditions in the system during dry weather as opposed to trying to select one day that depicts dry weather flow in the system. If a single day is used, there is a chance the day selected has flow anomalies associated with it, so it is not really a "typical" day. For example, during periods of high groundwater, dry day flows will tend to be higher due to infiltration. Selecting a series of dry weather days and averaging them minimizes the potential for any one day to skew the results of the analysis.

Following the creation of an average dry weather day, the overall average flow for the dry weather calibration day is calculated. Based on the total meter basin acreage and the average flow for a typical dry weather day for each flow meter, a flow per acre is calculated. Applying a typical value of 100 gallons per capita per day (gcd), an estimated population density for the metering area is determined. Using that basinwide population density, the individual input subbasin areas, and the assumed per capita flow contributions, the average dry weather flow for each of the inputs is calculated. The net result of this overall process allows the user to allocate metered dry weather flows to upstream input nodes based on known acreage and population densities.

Daily dry weather sanitary flows typically follow a diurnal pattern with high flow in the morning, decreasing to lower levels during the middle of the day, increasing again in the evening, and then

finally reaching their lowest values in the middle of the night. To mimic this pattern, XP-SWMM applies a user-determined temporal variation, which assigns a scaling factor relative to the average flow for each hour of the day. For example, if the average flow rate for the flow-metered basin is 500 gpm, an hourly temporal variation value of 1.5 would result in that hourly flow rate being scaled to 750 gpm. Temporal variation is established on an hour-by-hour basis for each individual flow meter basin based on flow metering results. Because the inputs are spatially separated, the diurnal flow pattern for the meter represents a partial attenuation of the input flow pattern. Therefore, the multipliers used for the individual subbasins would likely be more extreme than that observed at the meter. This is taken into account during the dry weather calibration process.

In some cases, flow meters may be located downstream of other flow meters, and the input of the upstream flow meter affects the dry weather calibration of the downstream flow meters. In these cases, the upstream flow pattern is adjusted for time of travel between the two meters and then subtracted out of the downstream dry weather flows. The above-described process is then repeated to determine the incremental flow contributions of the downstream flow metering subbasins.

With this process complete, the model is run and the model results are graphically compared to the flow metering data. The criteria used for comparison are the flow, velocity, and level under maximum, average, and minimum conditions. In addition, the overall shapes of the model hydrograph versus meter hydrograph are compared–adjustments may be made to diurnal flow to match the overall pattern. Where the calibration match does not appear satisfactory, adjustments are made to the Manning pipe roughness, depth of sediment, and, in some locations where it appears reasonable, pipe shape. The Manning roughness may reasonably be adjusted from a generally model-assumed value of 0.014 to anywhere in the range of 0.013 and 0.018. Where necessary for model calibration and where construction materials, age and condition suggest it is reasonable, this value may be adjusted as high as 0.02.

Table B.04-1 provides a tabular summary and comparison of metered flows to flow rates generated by the hydraulic model. Attachment B-1 contains graphics that document the results of the dry weather calibration process.

B.05 WET WEATHER CALIBRATION

Once the dry weather calibration is completed, the next step is to perform wet weather calibration. XP-SWMM models wet weather based on (1) an input rainfall hyetograph and the combination of previously mentioned adjustable parameters, including percent impervious; (2) soil infiltration characteristics; (3) depression storage; (4) subbasin area, width and slope; and (5) surface Manning “n” factor. Based on the rainfall file and the surface parameters described, XP-SWMM utilizes the Runoff Layer to determine input hydrographs for each of the wet weather input nodes of the model. The model’s hydraulic layer (Extran) is then utilized to determine how these input hydrographs affect the hydraulic levels and flows within the sewer system.

TABLE B.04-1

DRY WEATHER CALIBRATION SUMMARY

Meter Number	Metered Data		Modeled Data		Percent Difference	
	Average Flow (cfs)	Peak Flow (cfs)	Average Flow (cfs)	Peak Flow (cfs)	Average Flow	Peak Flow
1	1.844	2.445	1.868	2.424	-1.32%	0.86%
2	1.354	1.667	1.329	1.591	1.80%	4.56%
4	1.933	2.228	1.904	2.19	1.51%	1.69%
5	1.012	1.17	1.013	1.171	-0.11%	-0.08%
6	0.655	0.904	0.656	0.898	-0.17%	0.62%
7	0.219	0.266	0.219	0.264	-0.01%	0.93%
8	0.12	0.162	0.12	0.16	-0.32%	1.51%
9	1.042	1.253	1.043	1.252	-0.09%	0.06%
11	0.111	0.13	0.11	0.13	1.44%	-0.06%
12	0.272	0.346	0.273	0.344	-0.27%	0.47%
14	2.795	3.402	2.792	3.351	0.10%	1.50%
19	1.043	1.254	1.044	1.253	-0.07%	0.09%
21	0.227	0.267	0.227	0.267	0.01%	0.14%
22	3.539	4.127	3.519	4.093	0.58%	0.82%
23	1.131	1.432	1.137	1.431	-0.60%	0.07%
25	1.454	2.096	1.449	2.066	0.29%	1.42%
26	4.15	4.964	4.131	5.025	0.45%	-1.23%
69-inch Interceptor	14.545	17.461	14.739	17.233	-1.33%	1.30%

As with the dry weather calibration, the model is run with assumed parameters and the results compared at the flow meter locations. In most cases, large rain events do not necessarily display the same rainfall response characteristics as do smaller rainfall events. The key difference between large and small events is the contribution of pervious land area toward runoff. If a rain event's intensity remains below the Horton equation's infiltration parameters described above, there will be no runoff from the pervious areas into the CSS; the only runoff generated in the system will be from impervious surfaces (pavement, rooftops).

However, if the rain event is large enough, the pervious area will become "fully saturated." At that point, any additional rain over and above the Horton minimum infiltration parameter that falls on those areas will generate overland runoff and end up in the CSS. Since design storms will typically be for higher intensity events that exceed the Horton minimum infiltration value, calibration on larger storms, where available, is particularly useful for development of an accurate model. The rainfall events selected for the calibration/validation process meet this desired criteria.

During the calibration process, the input rainfall file for the closest rain gauge to the meter subbasin is applied. For each of the nodes in the model that correspond to a flow meter location, the model is used to automatically create output hydrographs that document hydraulic level, velocity, and flow rate over the course of the rainfall event. These resulting hydrographs are exported to a spreadsheet and graphed to allow for a visual comparison to the flow meter data. Tabular comparisons are also made. The primary goal of the calibration process involves matching the modeled and metered peak flow rates (values and timing of peak) and total flow volumes. Flow levels are also compared, and are of particular importance at CSO structures, where flow levels typically trigger overflow events.

Based on the calibration comparisons discussed above, model parameters were adjusted as necessary to improve the calibration.

Table B.05-1 presents a tabular summary of peak flow rates and total flow volumes corresponding to the calibrated model. As with the calibration step, the overall goal for calibration was a correlation between peak metered and modeled flows of ±20 percent. Attachment B-3 contains graphics that present a comparison of peak flow rates and the overall timing of the wet weather response.

B.06 WET WEATHER VALIDATION

As discussed in Section B.01, the next step in the process is the validation process. Validation is the process of testing a calibrated model using one or more independent rainfall events. The model is run under the validation rainfall scenario without making any further adjustments to model parameters. The results of the model output are compared to the metering results collected during the validation event. If the results are reasonably close, the model is considered to be validated.

Table B.06-1 presents a tabular summary of peak flow rates and total flow volumes corresponding to the calibrated model. For purposes of developing this LTCP model, the overall goal for calibration was a correlation between peak metered and modeled flows of ±20 percent. Attachment B-2 contains graphics that present a comparison of peak flow rates and the overall timing of the wet weather response.

TABLE B.05-1

WET WEATHER CALIBRATION SUMMARY

Meter Number	Metered Data				Modeled Data				Percent Difference		Percent Difference	
	Average Flow (cfs)	Peak Flow (cfs)	Average Depth (ft)	Peak Depth (ft)	Average Flow (cfs)	Peak Flow (cfs)	Average Depth (ft)	Peak Depth (ft)	Average Flow	Peak Flow	Average Depth	Peak Depth
1	N/A	N/A	0.62	3.64	N/A	N/A	0.55	3.37	N/A	N/A	11.5%	7.4%
2	N/A	N/A	0.73	2.63	N/A	N/A	0.75	2.22	N/A	N/A	-2.3%	15.6%
4	N/A	N/A	1.62	5.10	N/A	N/A	1.70	5.20	N/A	N/A	-4.8%	-2.0%
5	3.54	47.41	0.55	4.02	3.45	47.67	0.51	2.79	2.8%	-0.5%	7.1%	30.7%
7	0.82	1.96	0.28	0.46	0.84	1.94	0.26	0.39	-2.5%	1.2%	8.7%	15.0%
8	1.23	8.57	0.27	1.57	0.64	6.89	0.27	1.92	47.8%	19.6%	-0.8%	-22.2%
9	3.16	6.95	0.77	1.07	2.66	5.66	0.74	1.12	15.6%	18.6%	3.1%	-4.0%
11	0.17	0.48	0.12	0.19	0.14	0.62	0.11	0.19	15.2%	-27.4%	7.5%	-1.1%
12	0.37	1.17	0.35	1.01	0.33	1.36	0.43	0.83	10.1%	-16.4%	-23.0%	17.2%
13	1.40	11.49	0.39	1.19	1.13	12.03	0.30	1.26	19.6%	-4.7%	23.4%	-6.2%
14	9.23	38.42	0.90	1.90	7.52	42.08	0.87	2.19	18.6%	-9.5%	3.5%	-15.7%
15	2.41	3.20	1.06	1.52	2.29	3.52	1.01	1.18	5.3%	-10.2%	4.5%	22.2%
17	1.32	10.28	0.25	1.08	0.89	10.80	0.41	1.60	32.8%	-5.0%	-65.2%	-47.9%
22	N/A	N/A	1.62	4.79	N/A	N/A	1.23	4.58	N/A	N/A	24.1%	4.3%
23	4.58	16.71	0.62	1.16	3.76	15.08	0.55	1.15	18.0%	9.8%	12.0%	1.5%
69-inch interceptor	46.61	91.85	3.78	4.39	38.32	90.15	3.64	4.50	17.8%	1.8%	3.6%	-2.3%
CSO 4	6.53	103.66	N/A	N/A	3.91	84.45	N/A	N/A	40.1%	18.5%	N/A	N/A
CSO 5	0.00	0.23	N/A	N/A	0.00	0.26	N/A	N/A	66.0%	-13.1%	N/A	N/A
CSO 8	2.70	84.55	N/A	N/A	3.62	76.18	N/A	N/A	-34.4%	9.9%	N/A	N/A
CSO 10	0.55	18.30	N/A	N/A	0.74	15.64	N/A	N/A	-34.5%	14.5%	N/A	N/A

TABLE B.06-1

WET WEATHER VALIDATION SUMMARY

Meter Number	Metered Data				Modeled Data				Percent Difference		Percent Difference	
	Average Flow (cfs)	Peak Flow (cfs)	Average Depth (ft)	Peak Depth (ft)	Average Flow (cfs)	Peak Flow (cfs)	Average Depth (ft)	Peak Depth (ft)	Average Flow	Peak Flow	Average Depth	Peak Depth
2	2.49	14.53	0.61	2.03	2.19	15.58	0.66	1.99	12.0%	-7.2%	-8.6%	1.9%
7	0.25	0.73	0.16	0.28	0.35	0.72	0.17	0.25	-40.1%	2.4%	-11.2%	10.5%
8	0.22	4.53	0.08	0.49	0.33	4.24	0.16	1.07	-51.1%	6.5%	-93.9%	-118.8%
9	1.47	3.82	0.55	0.87	1.51	4.53	0.57	0.99	-3.3%	-18.7%	-2.6%	-13.7%
12	0.34	1.40	0.37	1.12	0.31	1.71	0.41	0.97	8.4%	-22.0%	-12.8%	13.1%
13	0.66	8.50	0.28	1.03	0.86	9.93	0.27	1.05	-31.2%	-16.8%	3.1%	-2.8%
14	7.06	27.74	0.79	1.69	5.01	32.62	0.72	1.90	29.0%	-17.6%	9.1%	-12.8%
15	1.44	2.37	0.75	1.10	1.67	2.45	0.91	1.04	-16.1%	-3.5%	-21.0%	5.4%
22	N/A	N/A	0.90	4.05	N/A	N/A	0.58	2.00	N/A	N/A	35.7%	50.5%
23	1.94	13.87	0.41	1.19	2.28	16.16	0.43	1.19	-17.9%	-16.4%	-4.7%	-0.2%
25	N/A	N/A	1.74	2.32	N/A	N/A	1.71	2.17	N/A	N/A	1.7%	6.3%
26	3.75	10.13	1.30	2.11	5.08	10.22	1.44	1.83	-35.5%	-0.8%	-10.8%	13.0%
69-inch Interceptor	23.27	67.37	3.35	4.69	26.17	74.40	3.37	4.27	-12.5%	-10.4%	-0.8%	9.0%
CSO 4	1.23	43.36	N/A	N/A	1.12	51.99	N/A	N/A	9.3%	-19.9%	N/A	N/A
CSO 8	0.74	48.77	N/A	N/A	1.13	58.80	N/A	N/A	-52.9%	-20.6%	N/A	N/A
CSO 15	0.74	61.80	N/A	N/A	0.57	52.15	N/A	N/A	22.09%	15.62%	N/A	N/A

B.07 SUPPLEMENTAL MODEL INFORMATION

As with any flow metering and modeling effort, there were certain locations within the CSS where the metering and modeling information correlated well and other locations that presented more of a challenge. The overall goal of the metering/modeling effort was to develop an understanding of how the CSS responds to wet weather events, use that understanding to develop a model, and use that model to predict how the CSS might respond under a variety of rainfall events–typically larger rainfall events than those experienced during the flow metering phase of the project.

In general, the technique used is to balance the metering and modeling results over the entire system. The goal is to not necessarily create a model that achieves a very small percent difference between metering and modeling at one location while sacrificing the results at another location. An acceptable closure between metering and modeling, systemwide, results in a model that can be used as a planning level tool, acceptable for the development of the LTCP. The calibration/validation process, coupled with the model results of the CSS response to larger, theoretical rainfall events, would indicate that this overall goal has been achieved. The model results were always critically analyzed for reasonableness. Model results were also compared to anecdotal information, both numerical (such as CSO results) and nonnumerical (such as City of Aurora staff and their understanding of how the system responds).

One location, however, proved to be very challenging. This location was Rathbone CSO 001. The available data sets for this overflow location consisted of actual CSO data along with flow metering results from the temporary flow meters installed in 2008 and 2009. Also available was flow metering information obtained from the Fox Metro intercepting sewer downstream of CSO 001 and just upstream of the WWTP. When taken together, these three data sets did not seem to correlate.

The configuration of the overflow structure, as shown in Figure J.5-1, is unusual and proved difficult to model accurately. Dry weather flows enter the 69-inch interceptor through two 15-inch openings in the interceptor, which itself serves as the overflow dam. During high flows that cause overflow at CSO 001, combined wastewater flows over the top of the 69-inch pipe/dam and out the CSO. According to the drawing, the overflow meter is situated on the top of that pipe/dam. This has been confirmed by WEDA personnel.

At high flow conditions, the flow velocity through the 15-inch openings is very high and very turbulent, which has proven to be difficult to model accurately. The current model of this CSO suggests flow velocities of 30 fps through these openings, which seems very unlikely. The actual flows and velocities through these openings should be considered quite uncertain. The existing configuration would make these openings virtually impossible to meter.

The flow over the top of the dam is also difficult to model in XP-SWMM. A typical overflow usually consists of a sharp-crested weir or a manhole with an overflow pipe at the desired overflow elevation. These layouts are more easily modeled with XP-SWMM. The existing “dam & orifice” configuration is best characterized as a kind of sloping, very broad-crested weir, which SP-SWMM cannot accurately model with the hydraulics layer.

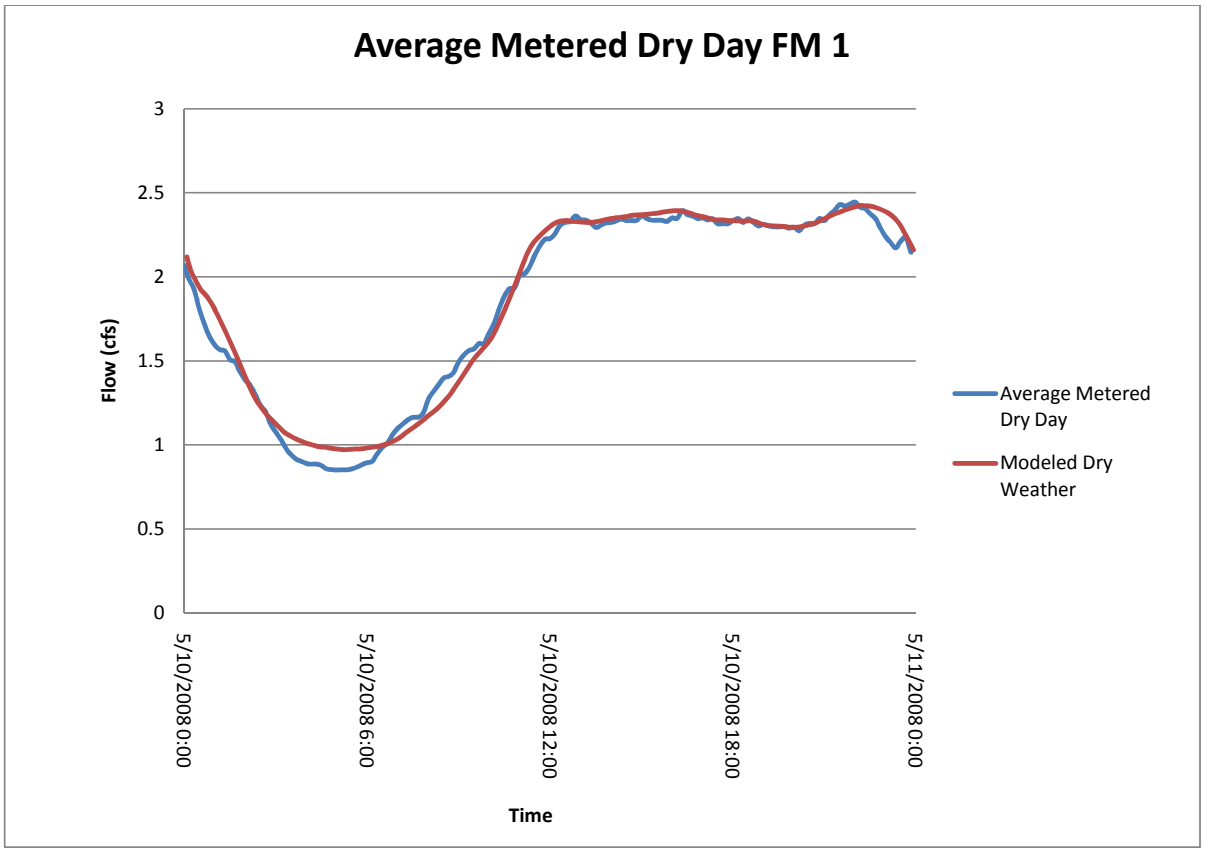
After reviewing the data associated with the operation of the overflow as well as available flow metering information, it was determined that it is likely the model is not accurately representing the hydraulics associated with CSO 001. A comparison of the flow metering data (SAI FM 22, WEDA CSO 001, and WEDA A, located just upstream of the WWTP) also indicates a potential discrepancy in one or more of the flow meters. For purposes of the development of this LTCP, it was determined that a reasonable approximation of the flow rate out of CSO 001 would be the flow rates associated with FM 22. (Note that during the 2009 flow metering program, a duplicate meter was installed just upstream of FM 22. The flow metering results obtained with this duplicate meter showed good reproducibility when compared to FM 22, which would indicate that FM 22 was obtaining reasonable data.) This is especially true during high flow events, when the flows coming down the 96-inch Rathbone interceptor will significantly exceed the capacity of the two 15-inch pipes that connect the Rathbone interceptor to the 69-inch Fox Metro interceptor.

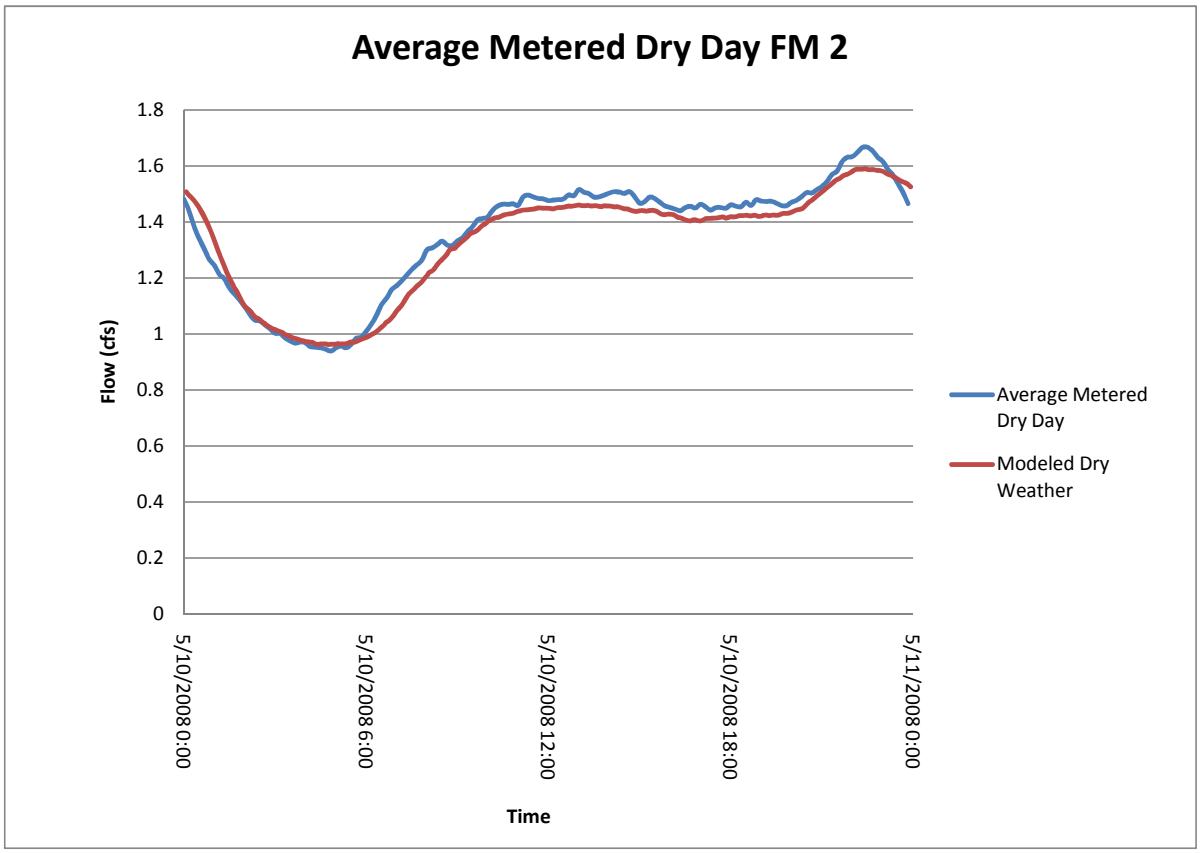
B.08 CONCLUSIONS

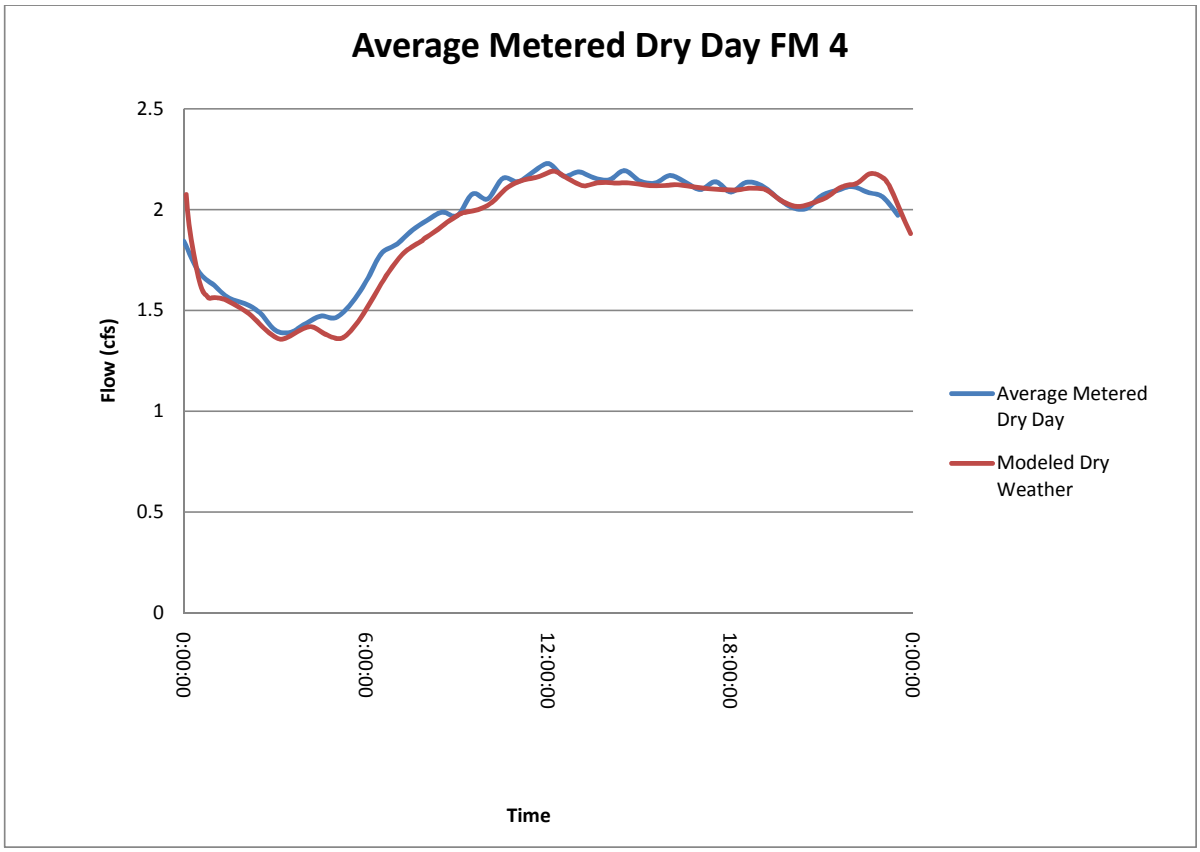
As with any flow metering and modeling undertaking of this magnitude, there were challenges associated with obtaining quality flow metering data, constructing a model that depicts the physical characteristics of the system, and then calibrating and validating the model. Aurora's CSS is a complicated hydraulic system, which does not always lend itself to accurate flow metering and modeling. The goal is to work within the constraints that exist and develop a hydraulic model that reasonably represents the CSS under a variety of flow conditions. Once a calibrated model has been developed, the real power of a hydraulic model can be used. Numerous theoretical rainfall events can be analyzed by the model, allowing the user to develop an understanding of peak flow rates and levels at key locations in the system. This can be done quickly and with a reasonable expectation of accuracy.

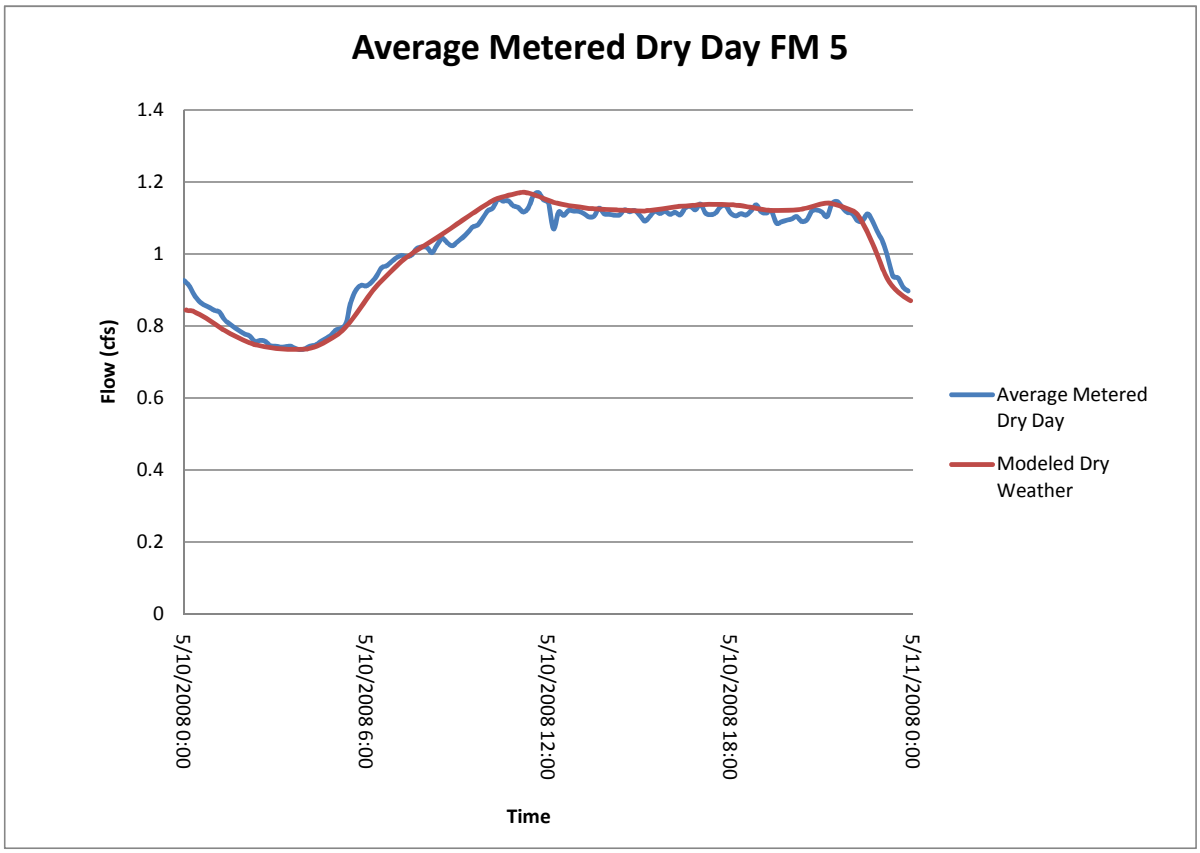
The dry weather calibration, wet weather calibration, and wet weather validation results indicate that the existing XP-SWMM model is a reasonable representation of the existing City of Aurora CSS and, therefore, can be used to develop a basic understanding of the response of the City of Aurora CSS to a variety of rainfall events. However, model results should always be viewed realistically and utilized in conjunction with proper engineering judgment.

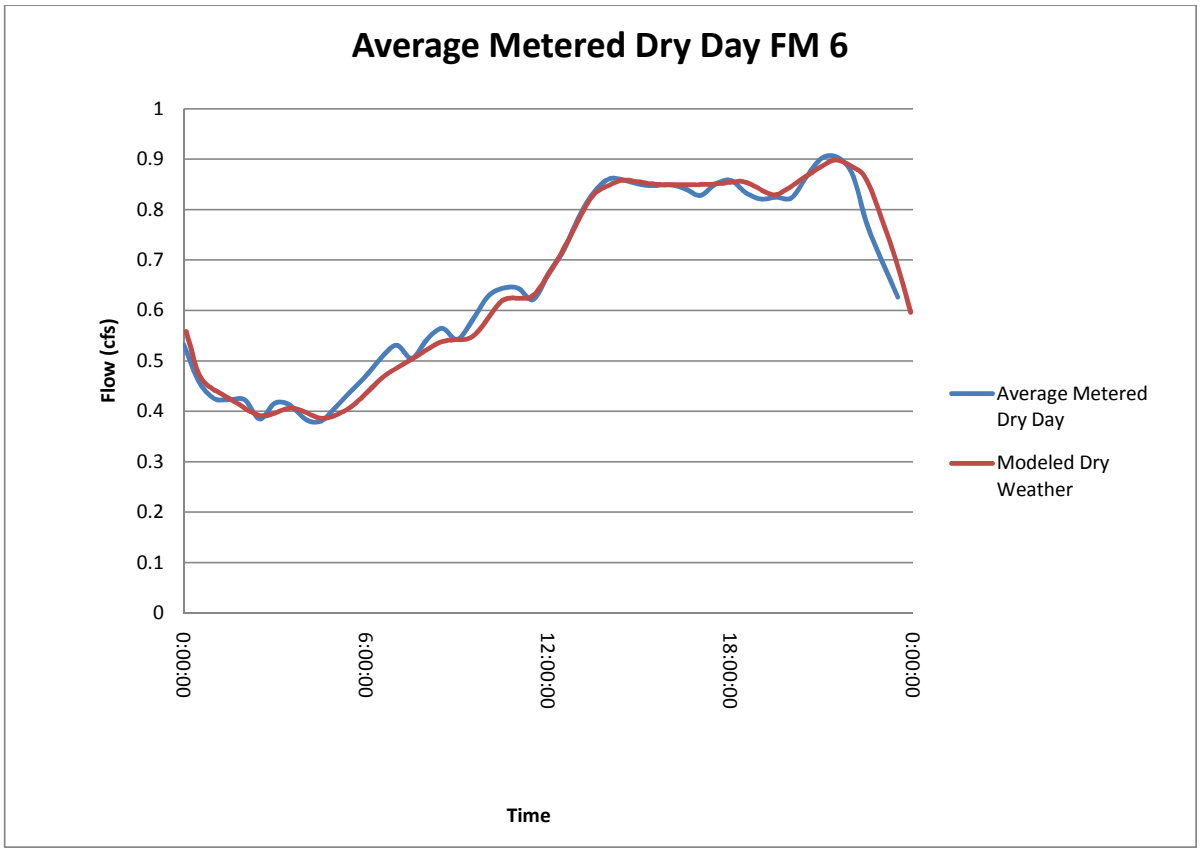
ATTACHMENT B-1
DRY WEATHER CALIBRATION GRAPHS

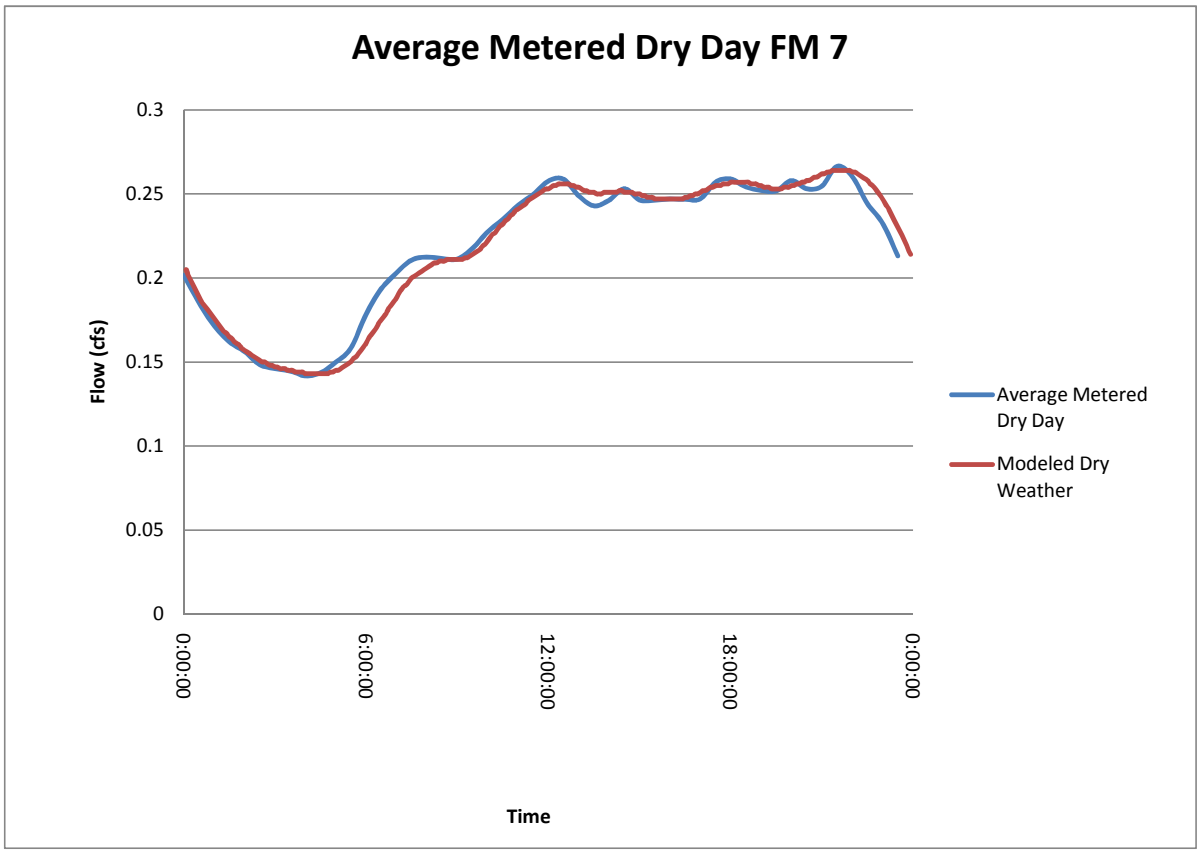

Average Metered Dry Day FM 1
Flow (cfs)
3
2.5
2
1.5
1
0.5
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

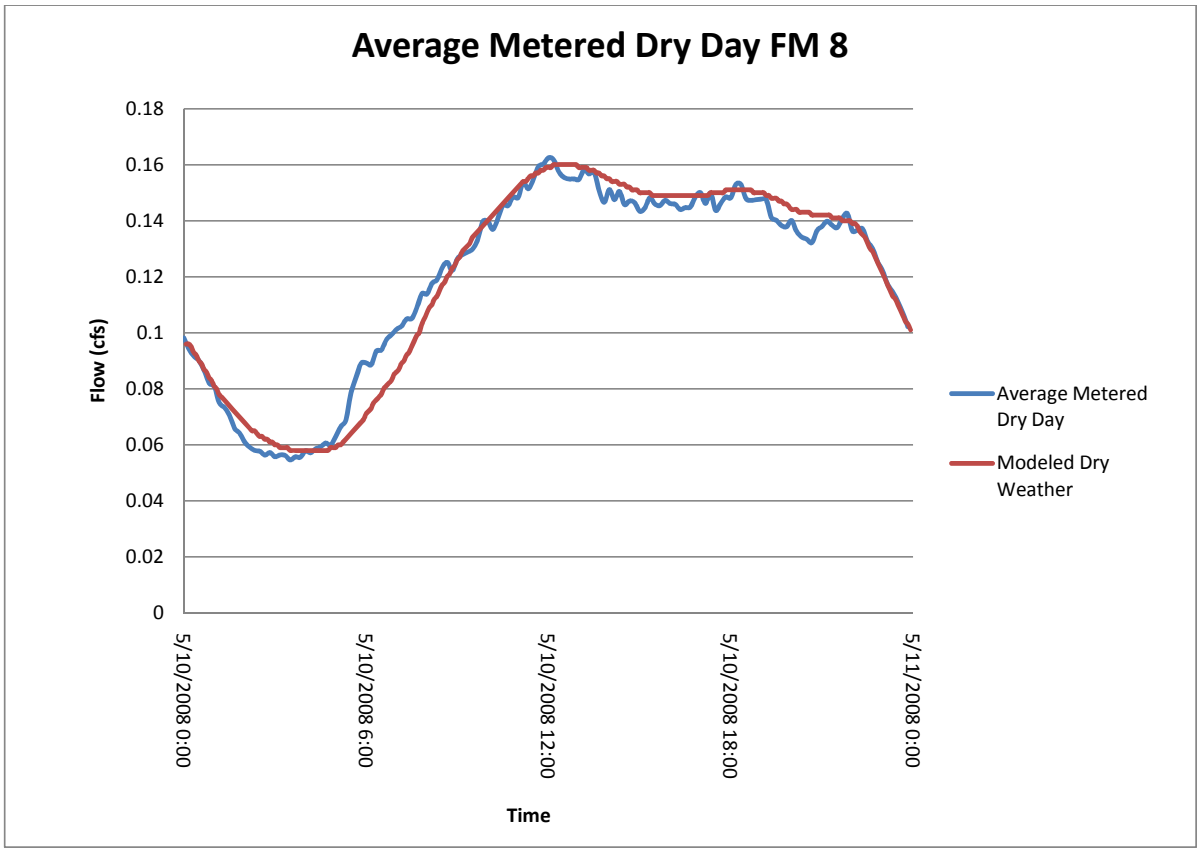

Average Metered Dry Day FM 2
Flow (cfs)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

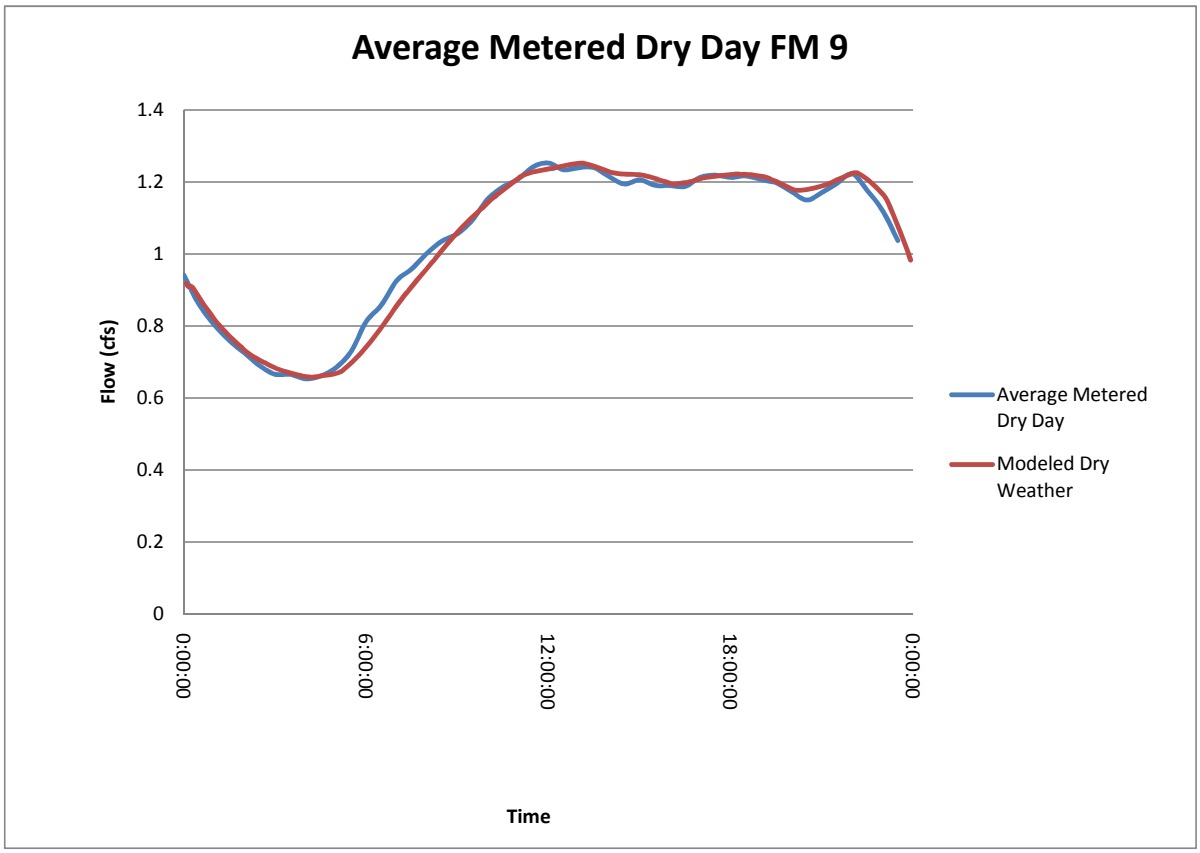

Average Metered Dry Day FM 4
Flow (cfs)
2.5
2
1.5
1
0.5
0
0:00:00
6:00:00
12:00:00
18:00:00
0:00:00
Time
Average Metered Dry Day
Modeled Dry Weather

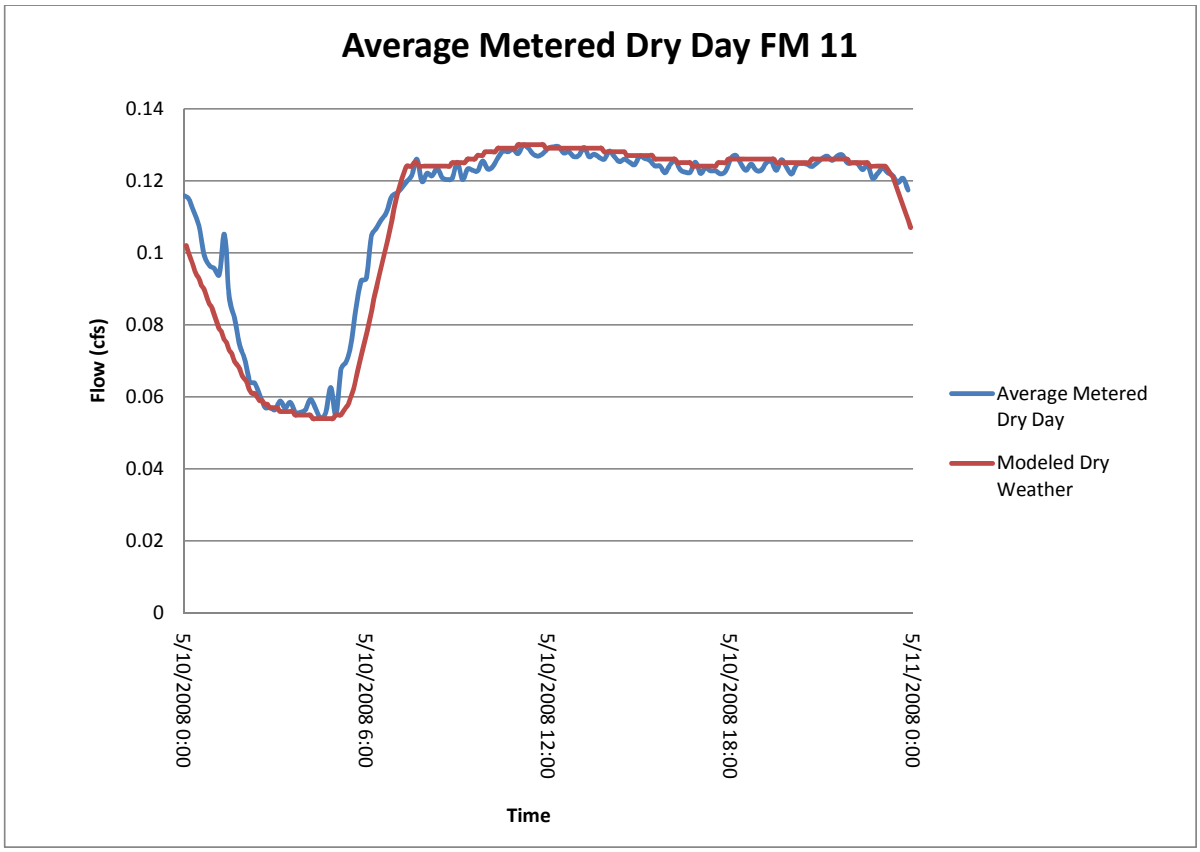

Average Metered Dry Day FM 5
Flow (cfs)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

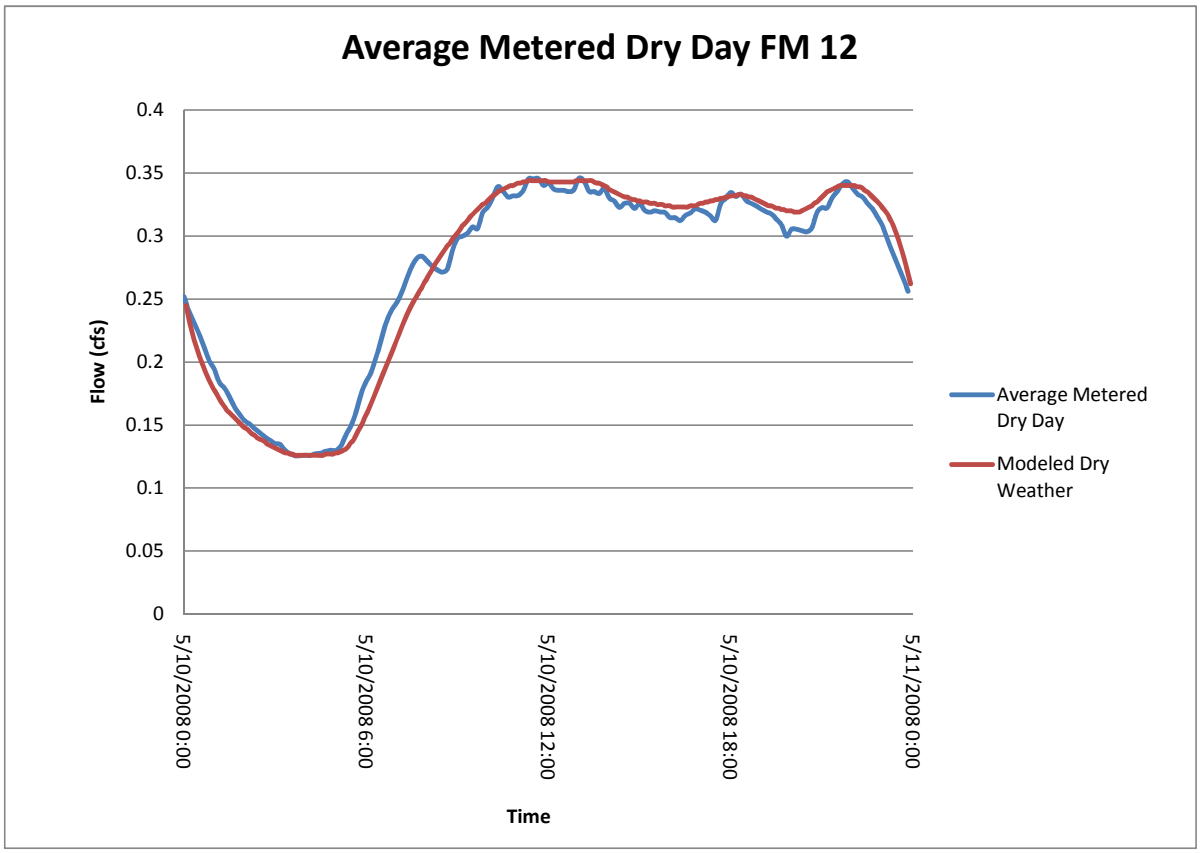

Average Metered Dry Day FM 6
Flow (cfs)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0:00:00
6:00:00
12:00:00
18:00:00
0:00:00
Time
Average Metered Dry Day
Modeled Dry Weather

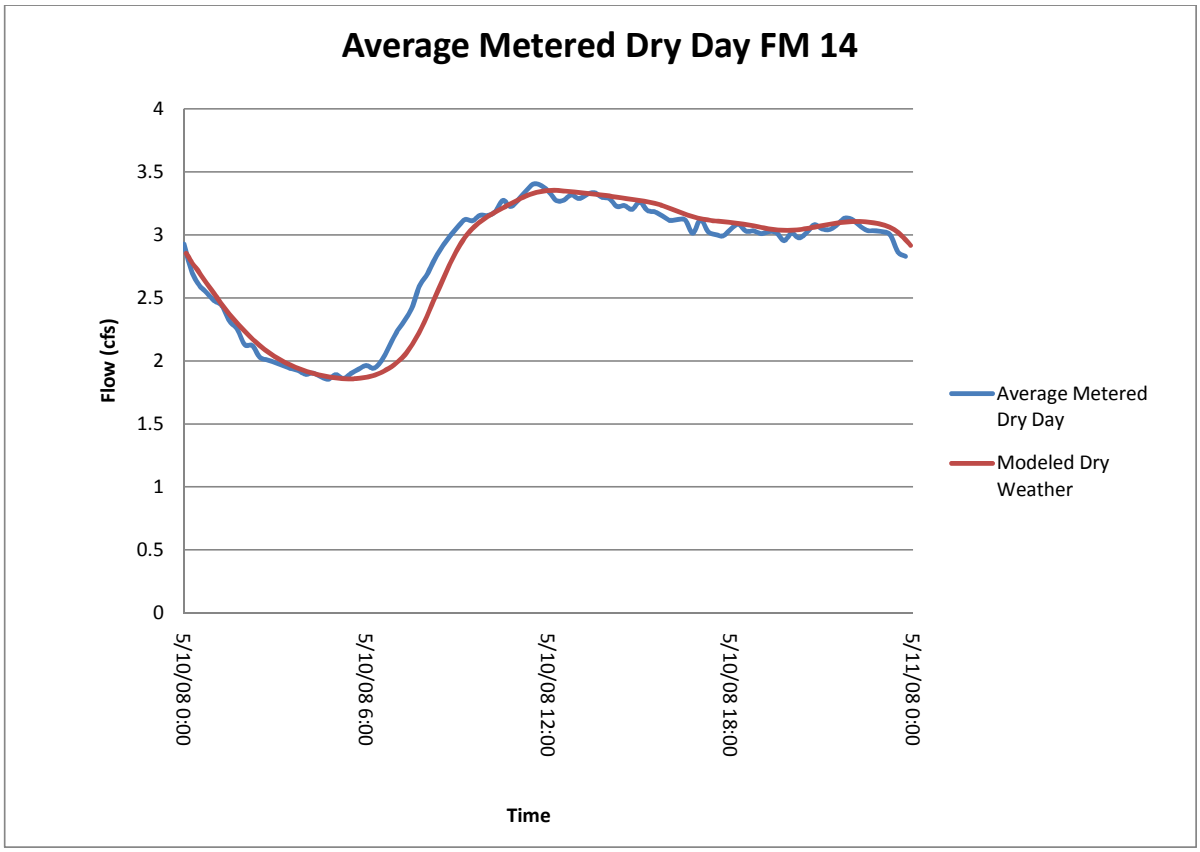

Average Metered Dry Day FM 7
Flow (cfs)
0.3
0.25
0.2
0.15
0.1
0.05
0
0:00:00
6:00:00
12:00:00
18:00:00
0:00:00
Time
Average Metered Dry Day
Modeled Dry Weather

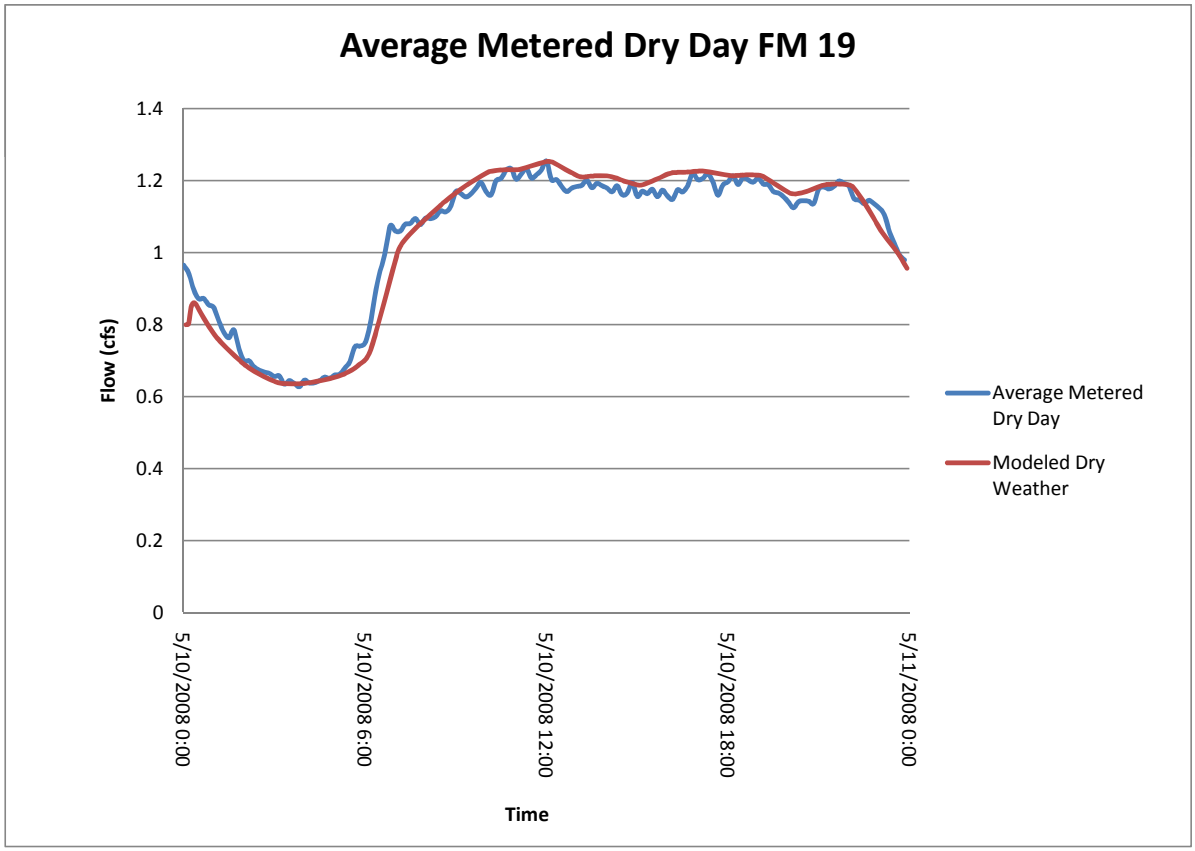

Average Metered Dry Day FM 8
Flow (cfs)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

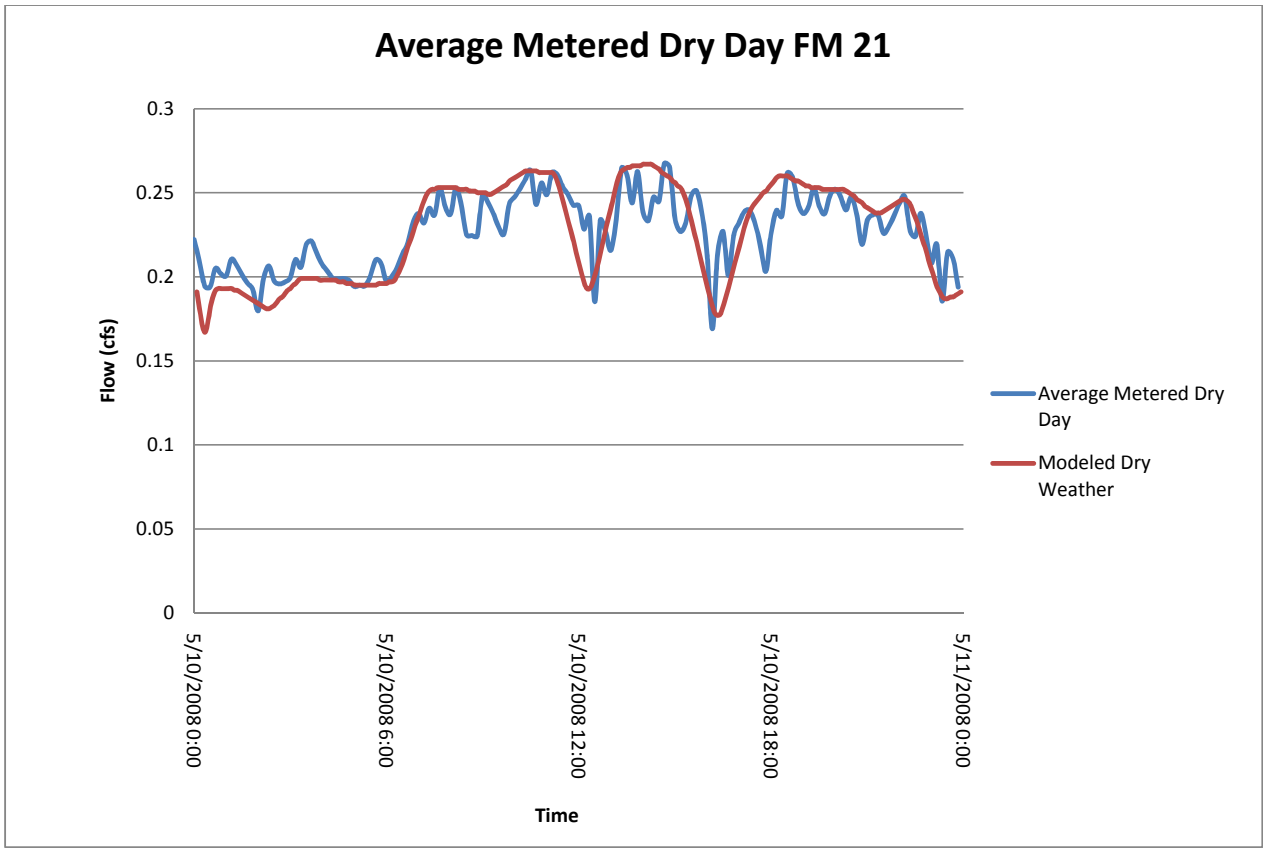

Average Metered Dry Day FM 9
Flow (cfs)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0:00:00
6:00:00
12:00:00
18:00:00
0:00:00
Time
Average Metered Dry Day
Modeled Dry Weather

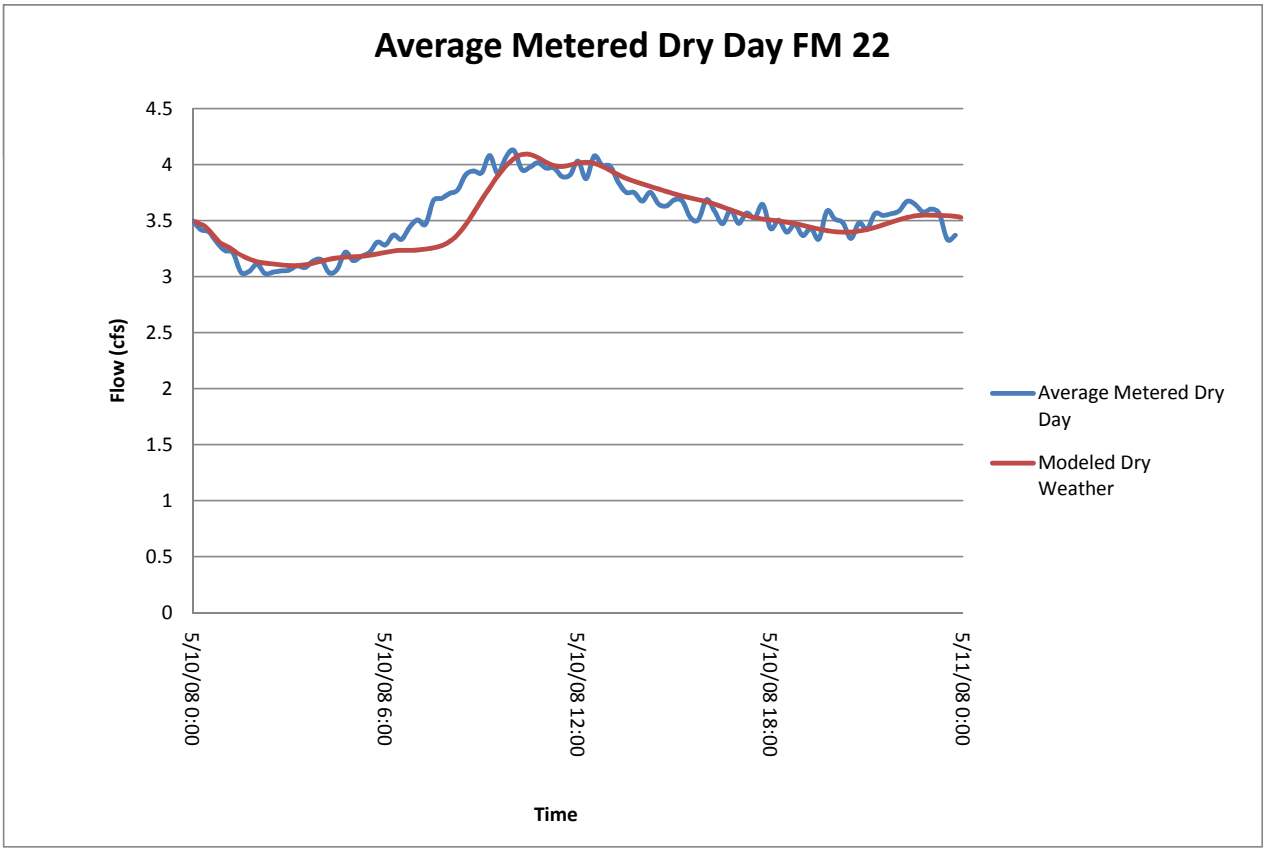

Average Metered Dry Day FM 11
Flow (cfs)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

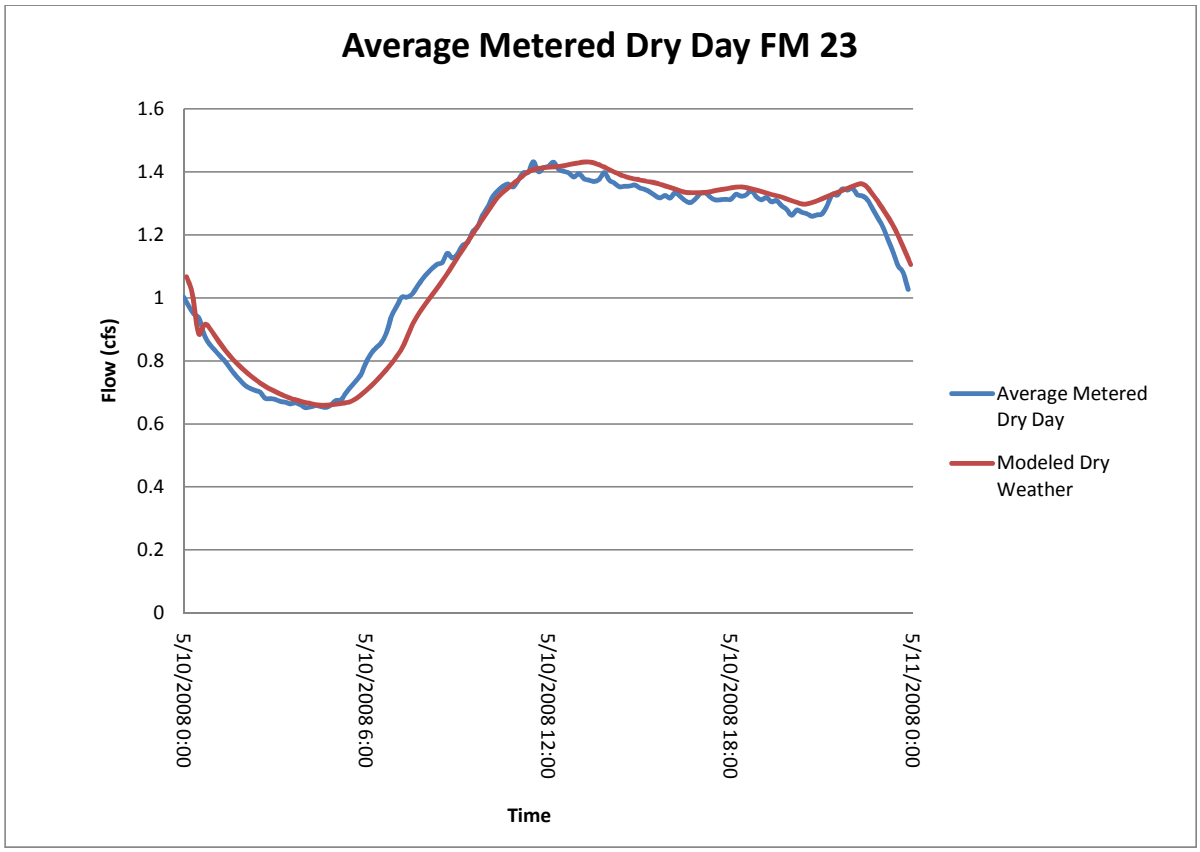

Average Metered Dry Day FM 12
Flow (cfs)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

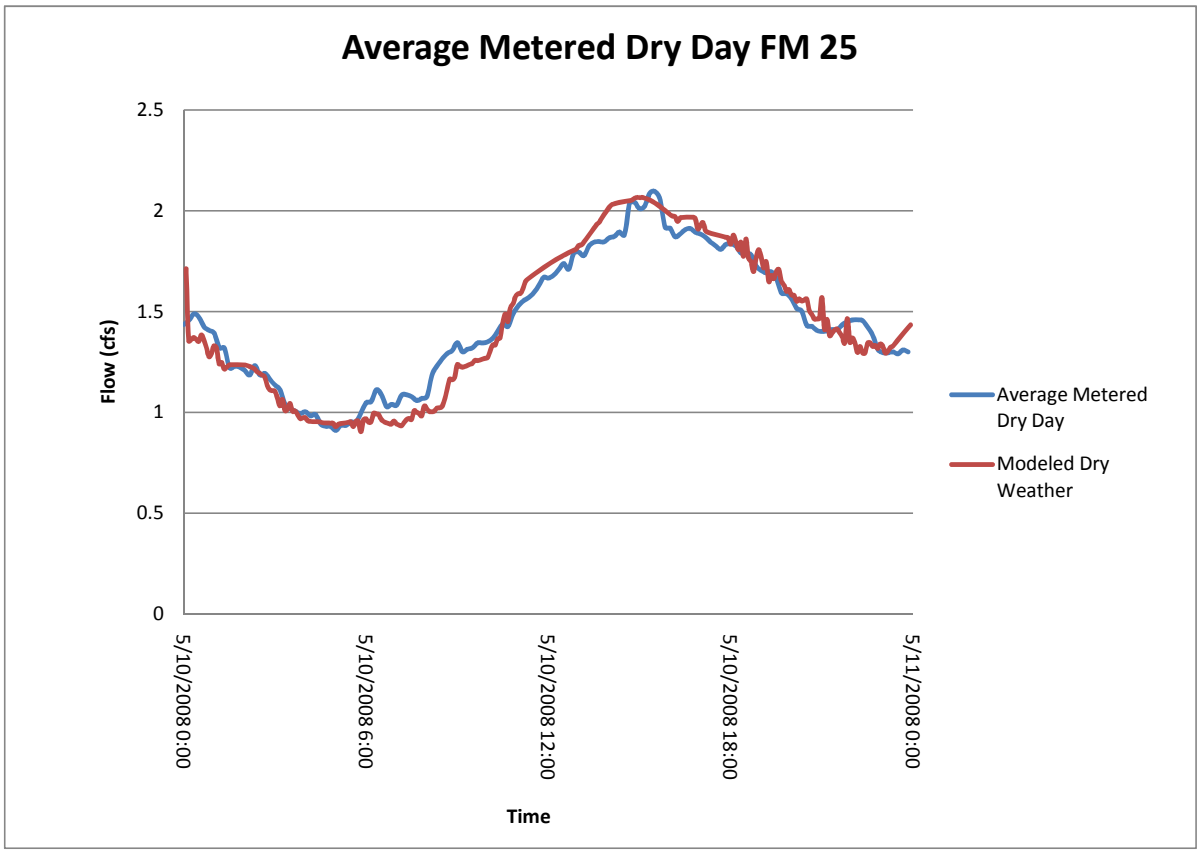

Average Metered Dry Day FM 14
Flow (cfs)
4
3.5
3
2.5
2
1.5
1
0.5
0
5/10/08 0:00
5/10/08 6:00
5/10/08 12:00
5/10/08 18:00
5/11/08 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

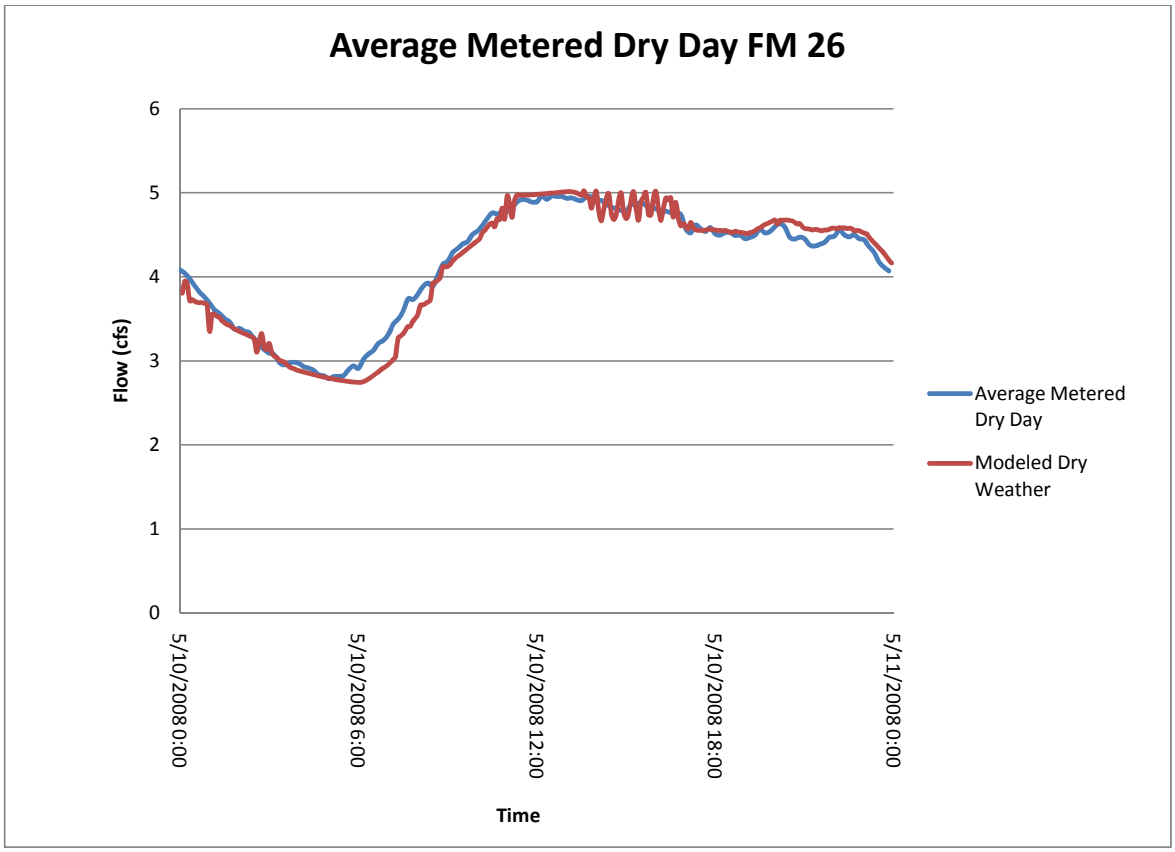

Average Metered Dry Day FM 19
Flow (cfs)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

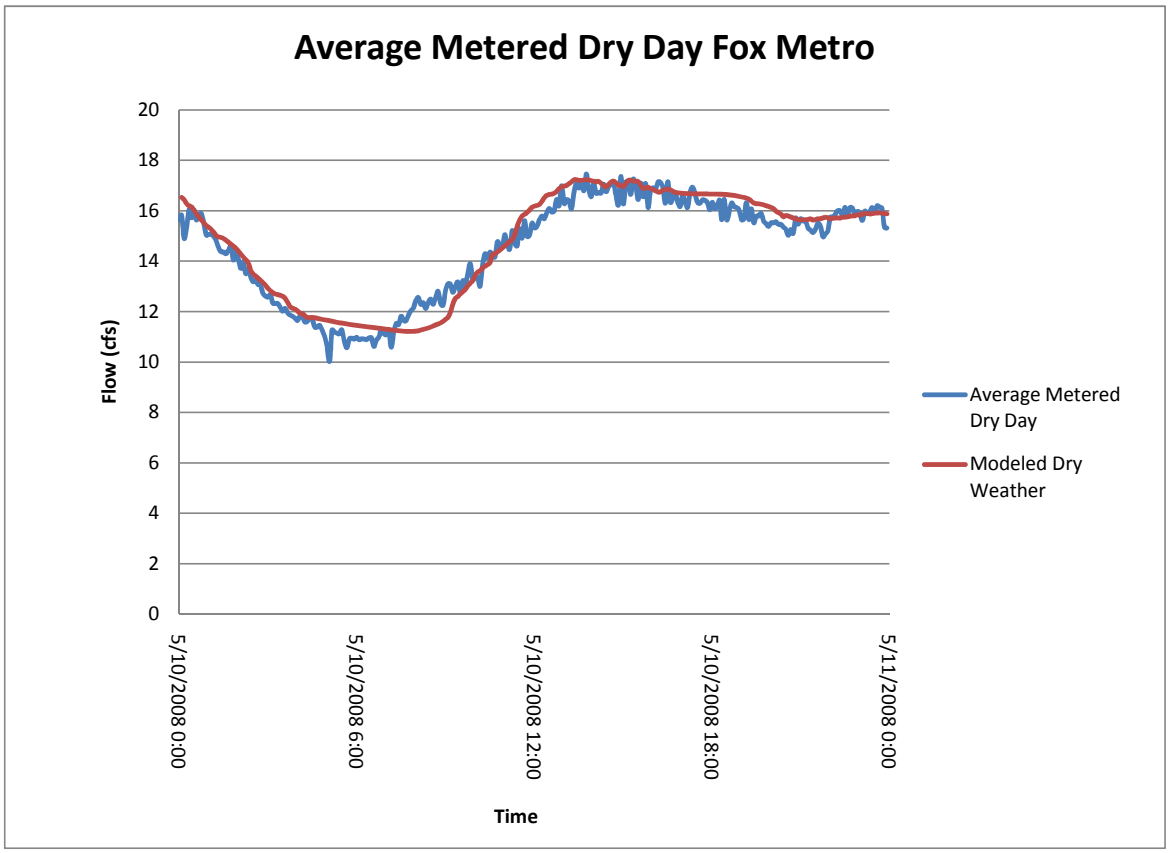

Average Metered Dry Day FM 21
Flow (cfs)
0.3
0.25
0.2
0.15
0.1
0.05
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather


Average Metered Dry Day FM 22
Flow (cfs)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
5/10/08 0:00
5/10/08 6:00
5/10/08 12:00
5/10/08 18:00
5/11/08 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

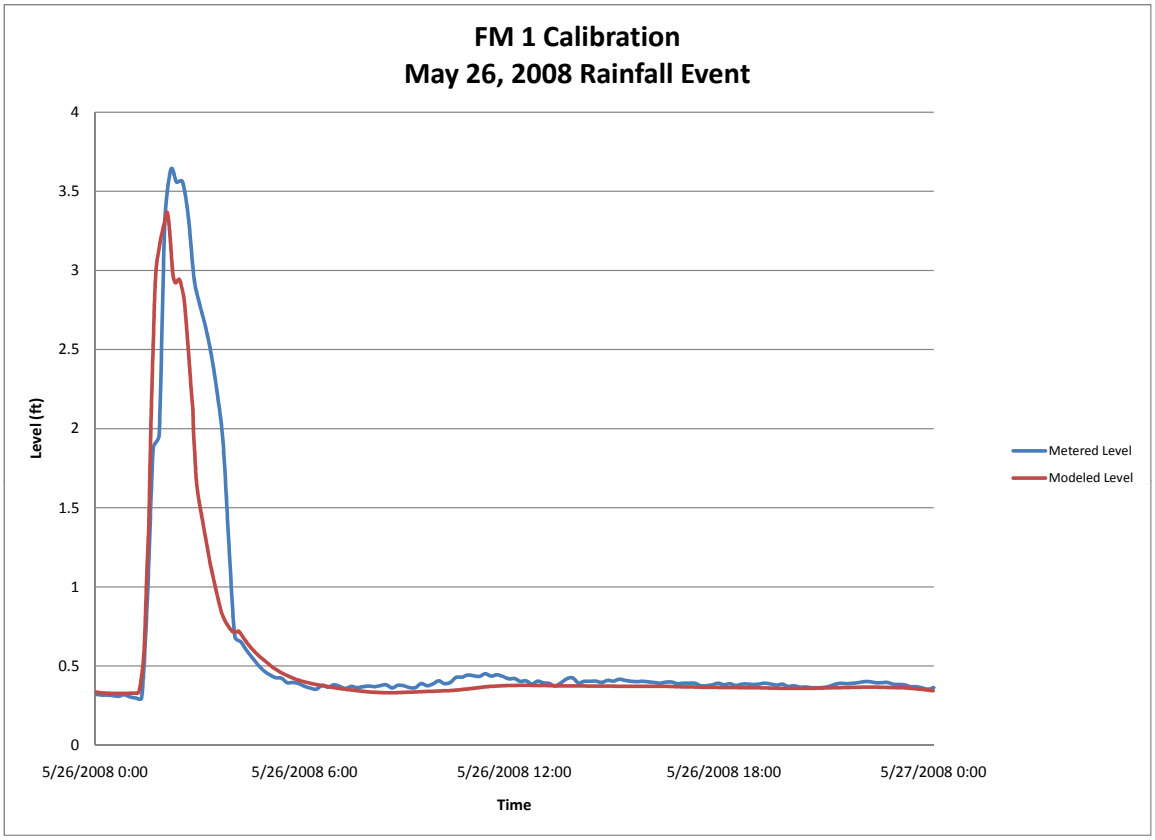

Average Metered Dry Day FM 23
Flow (cfs)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

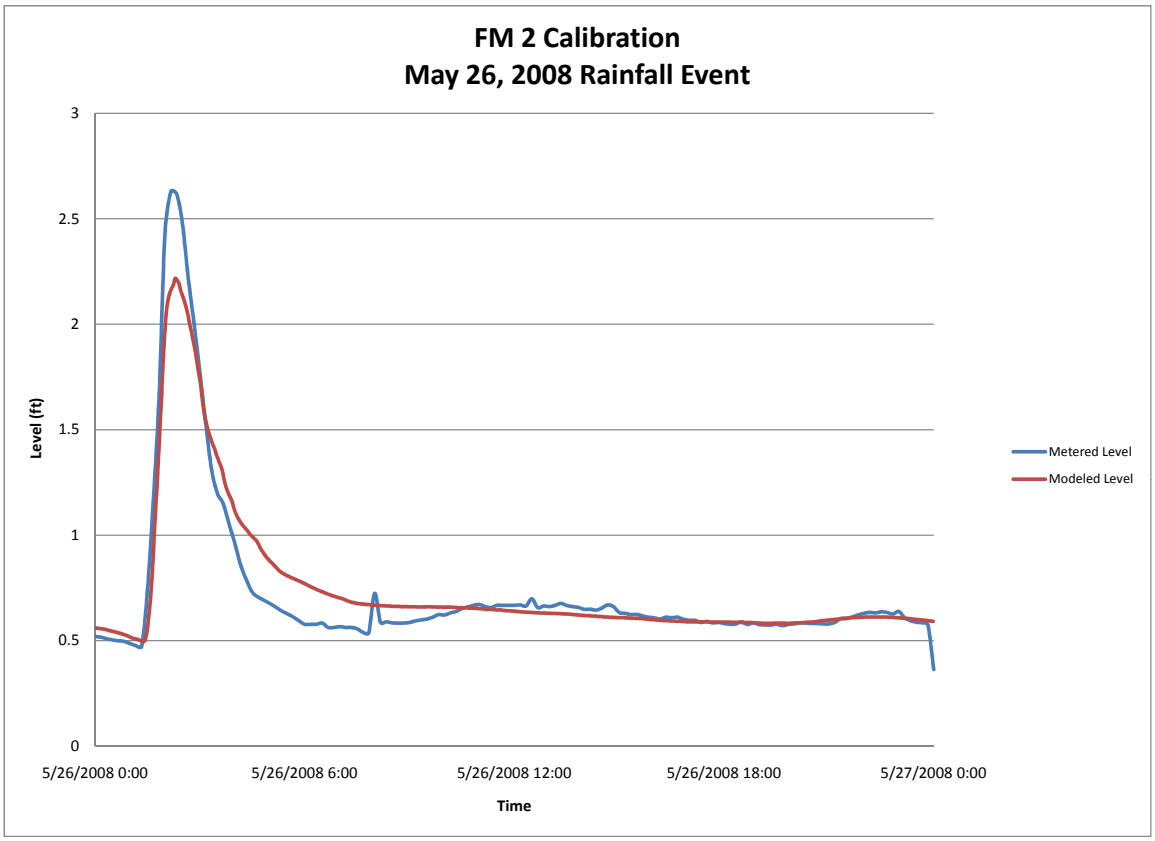

Average Metered Dry Day FM 25
Flow (cfs)
2.5
2
1.5
1
0.5
0
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

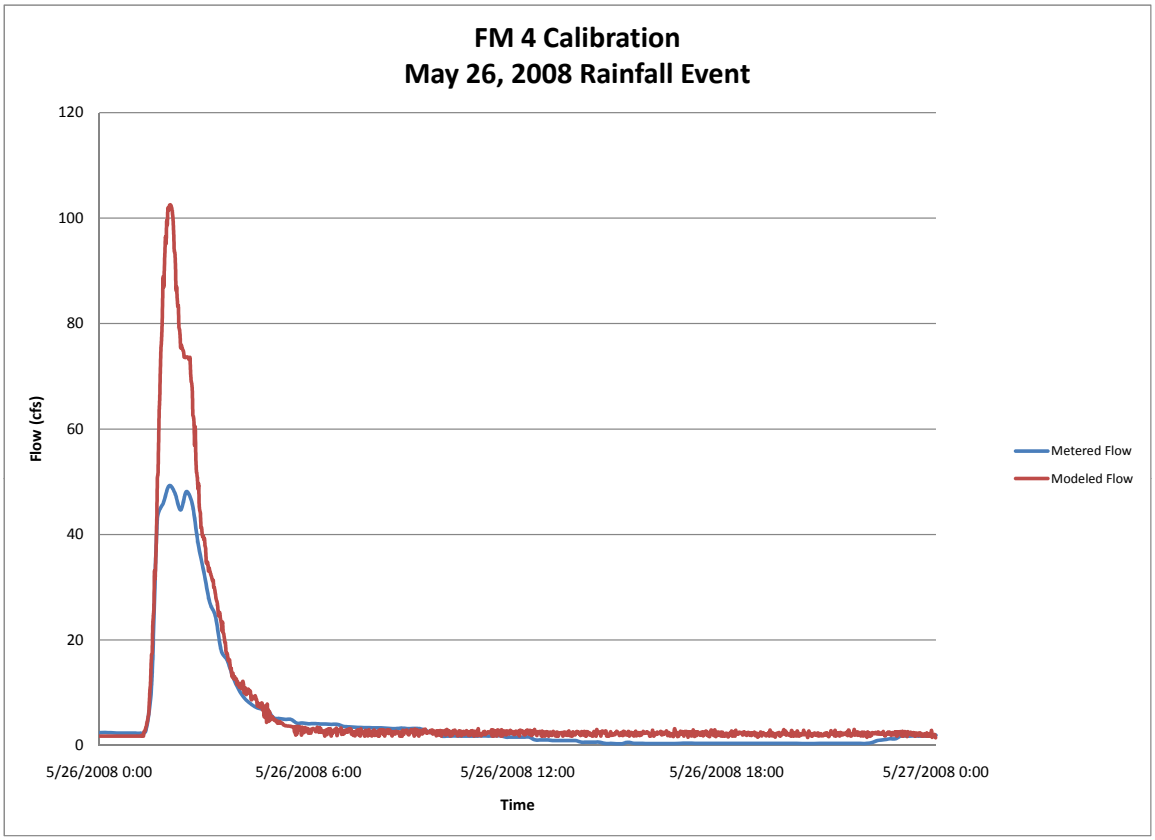

Average Metered Dry Day FM 26
Flow (cfs)
0
1
2
3
4
5
6
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

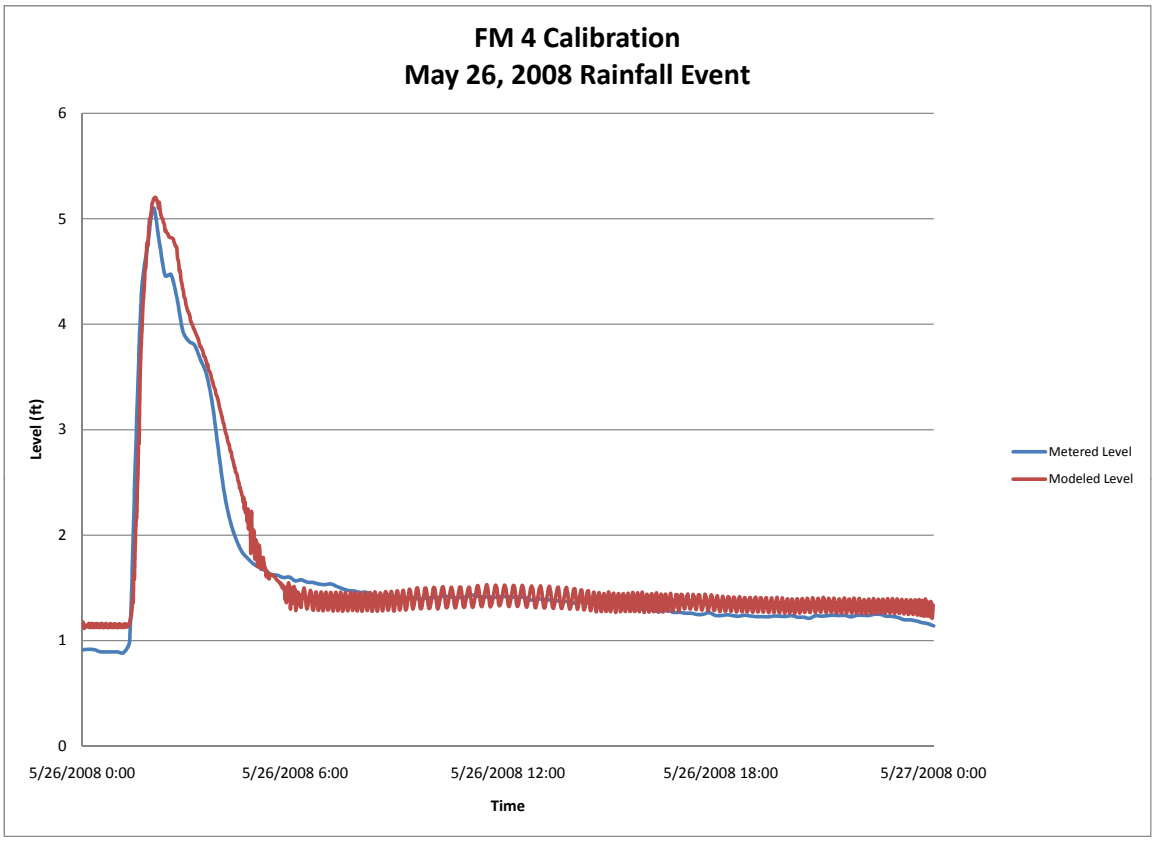

Average Metered Dry Day Fox Metro
Flow (cfs)
0
2
4
6
8
10
12
14
16
18
20
5/10/2008 0:00
5/10/2008 6:00
5/10/2008 12:00
5/10/2008 18:00
5/11/2008 0:00
Time
Average Metered Dry Day
Modeled Dry Weather

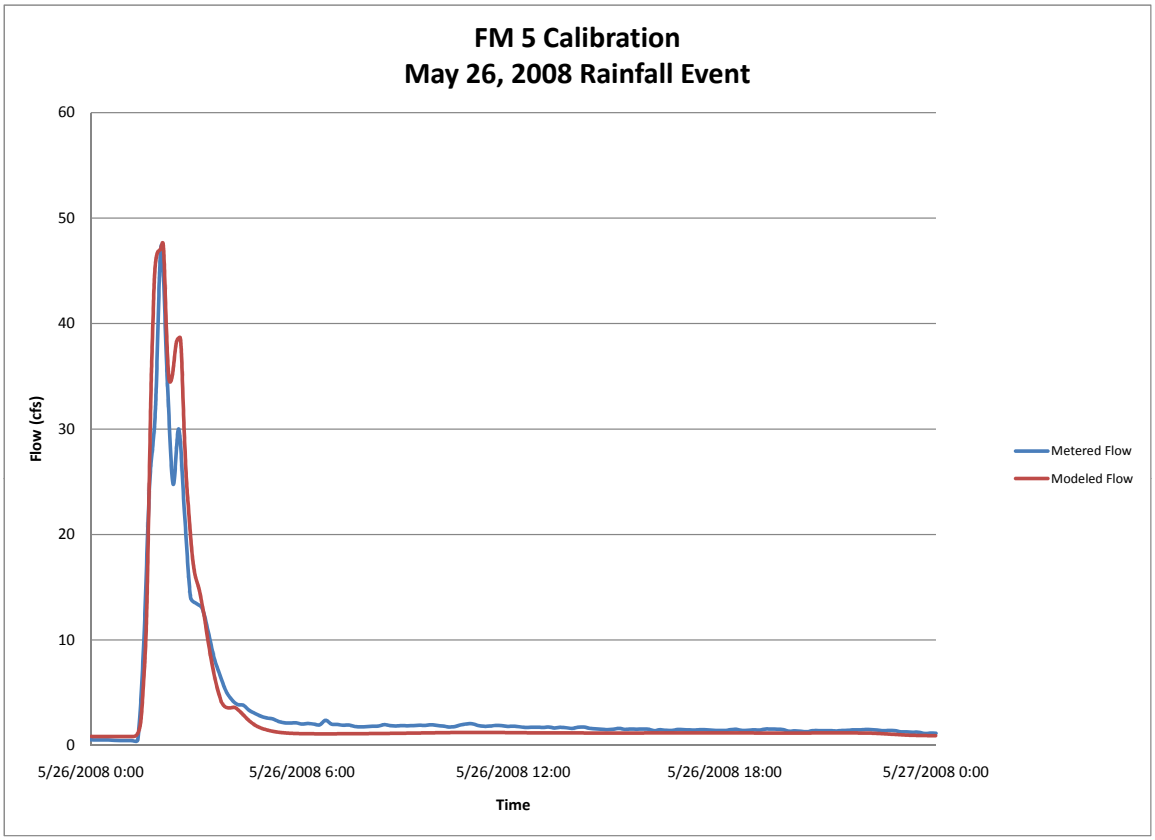
ATTACHMENT B-2
WET WEATHER CALIBRATION GRAPHS

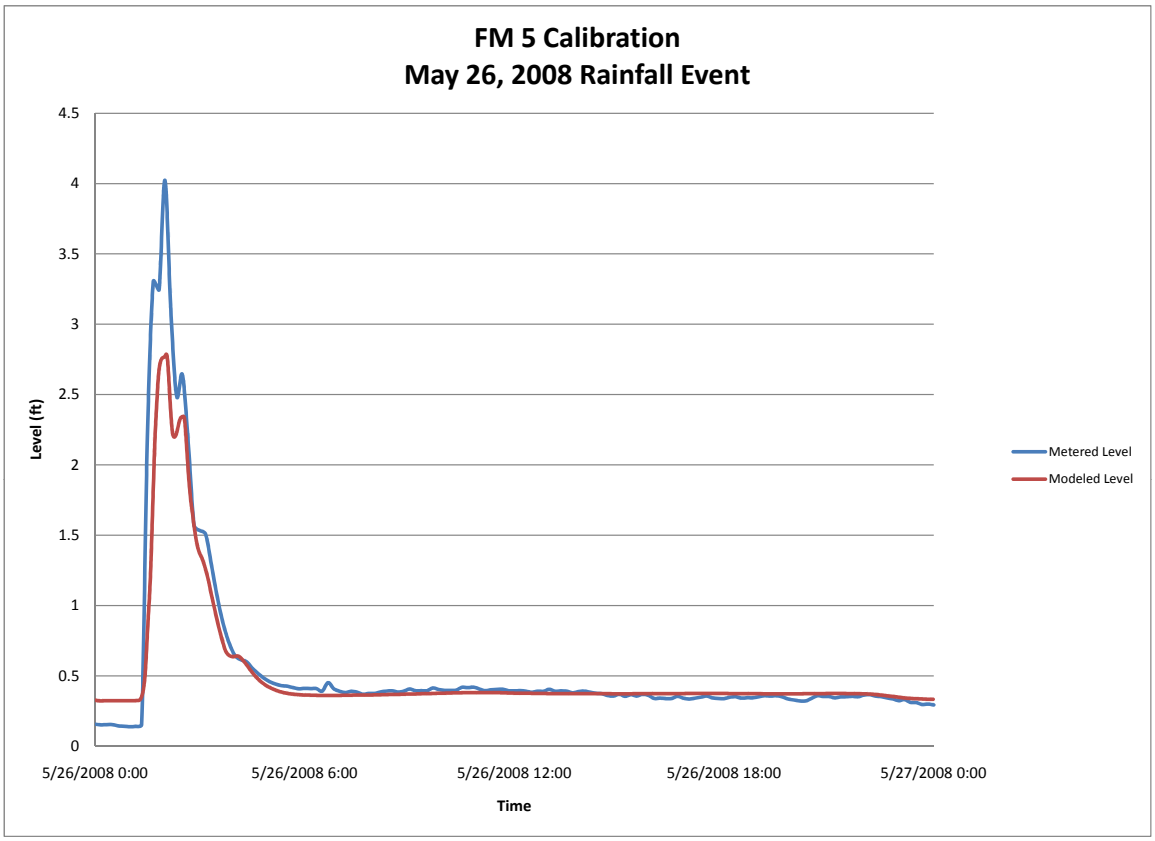

FM 1 Calibration
May 26, 2008 Rainfall Event
Level (ft)
4
3.5
3
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

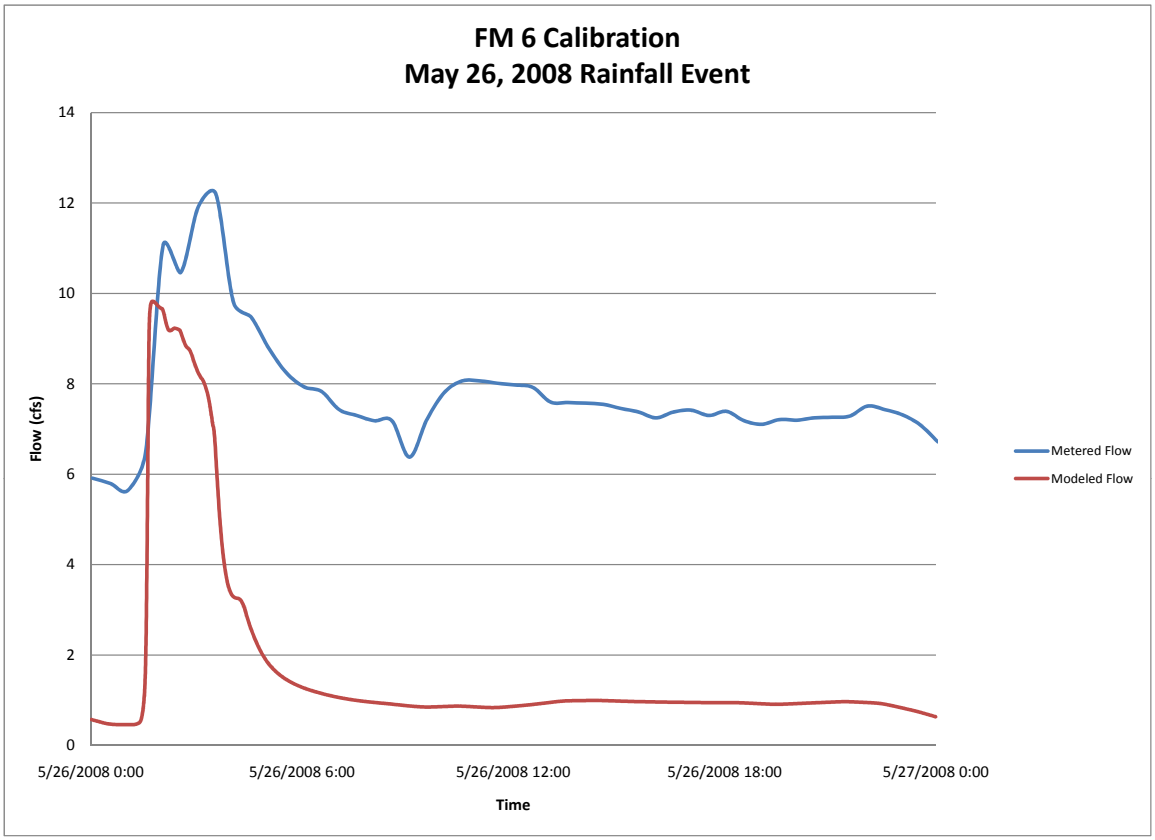

FM 2 Calibration
May 26, 2008 Rainfall Event
Level (ft)
3
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

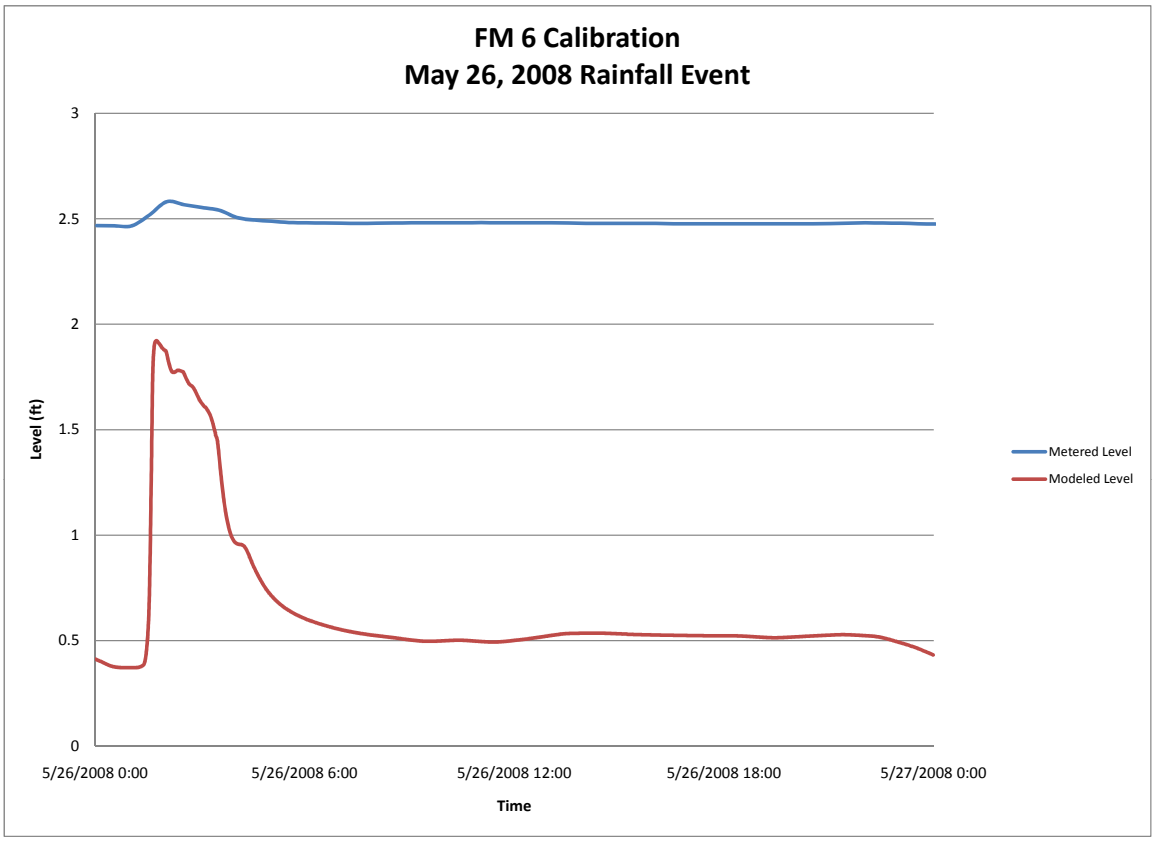

FM 4 Calibration
May 26, 2008 Rainfall Event
120
100
80
60
40
20
0
Flow (cfs)
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

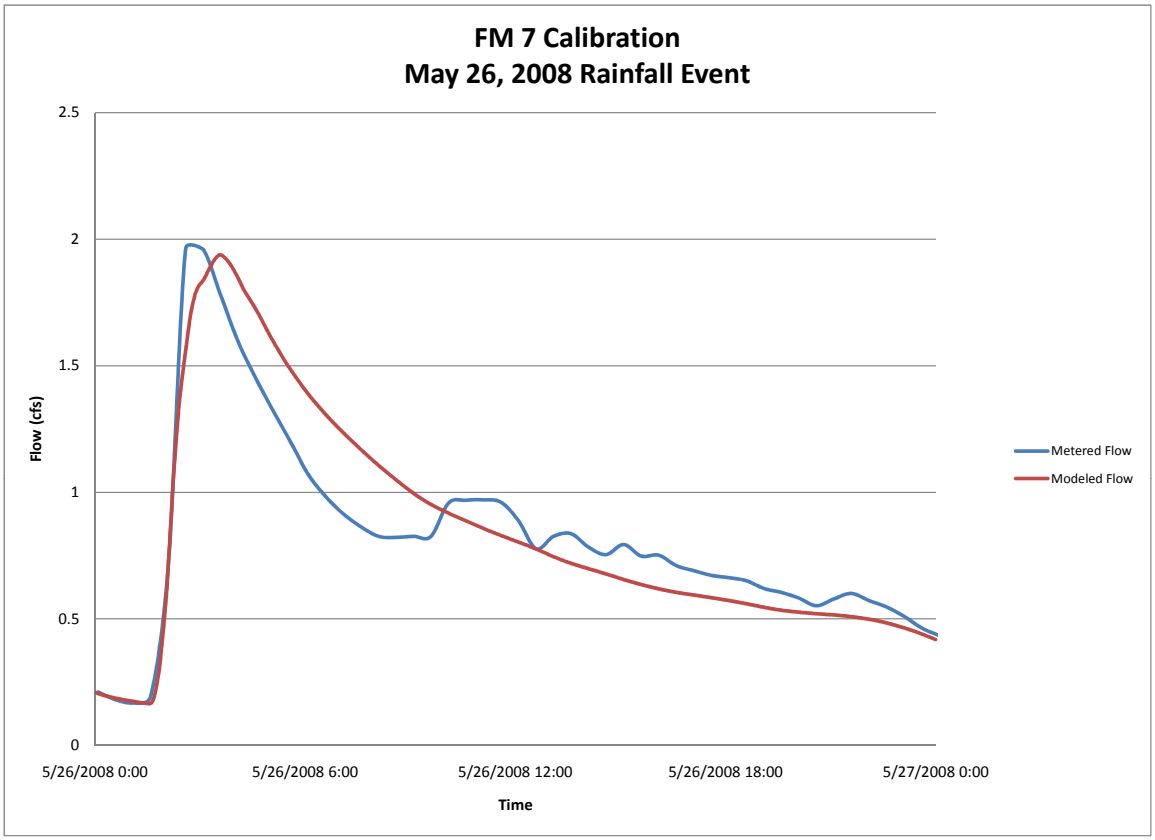

FM 4 Calibration
May 26, 2008 Rainfall Event
6
5
4
3
2
1
0
Level (ft)
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

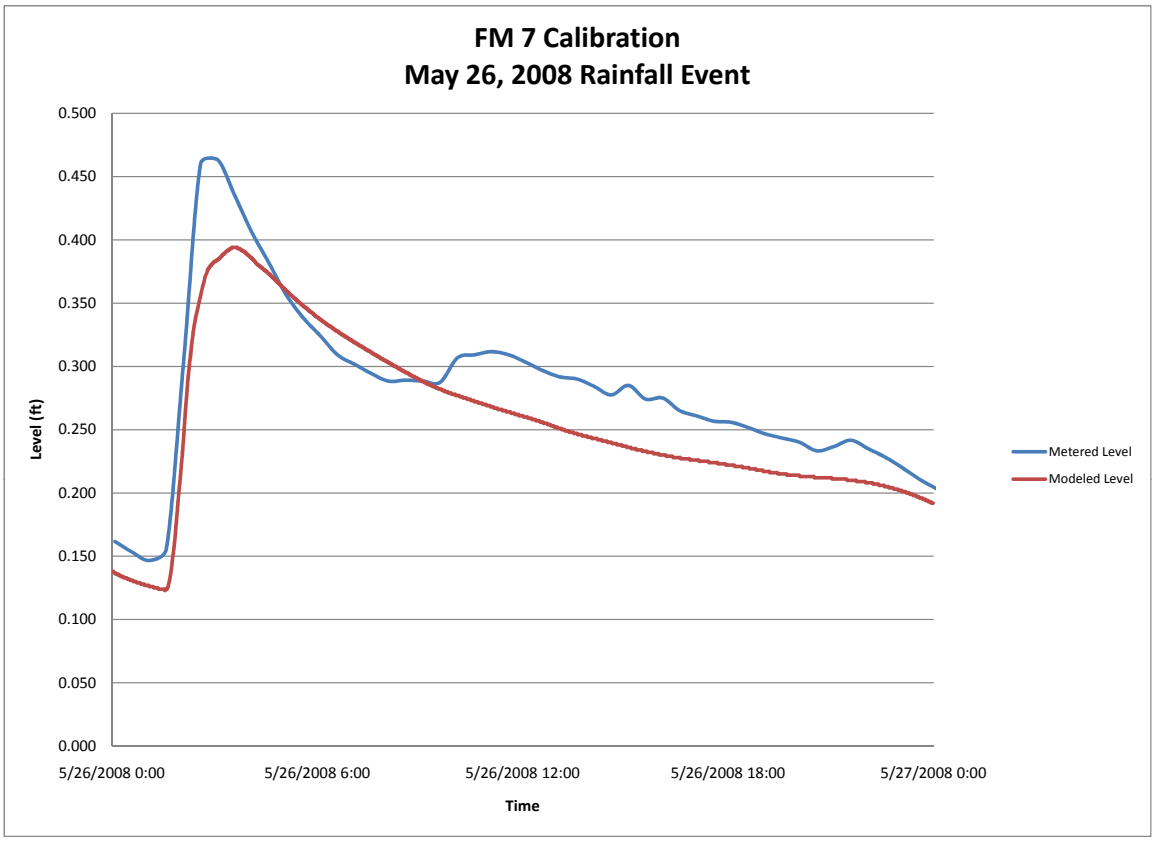

FM 5 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
60
50
40
30
20
10
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

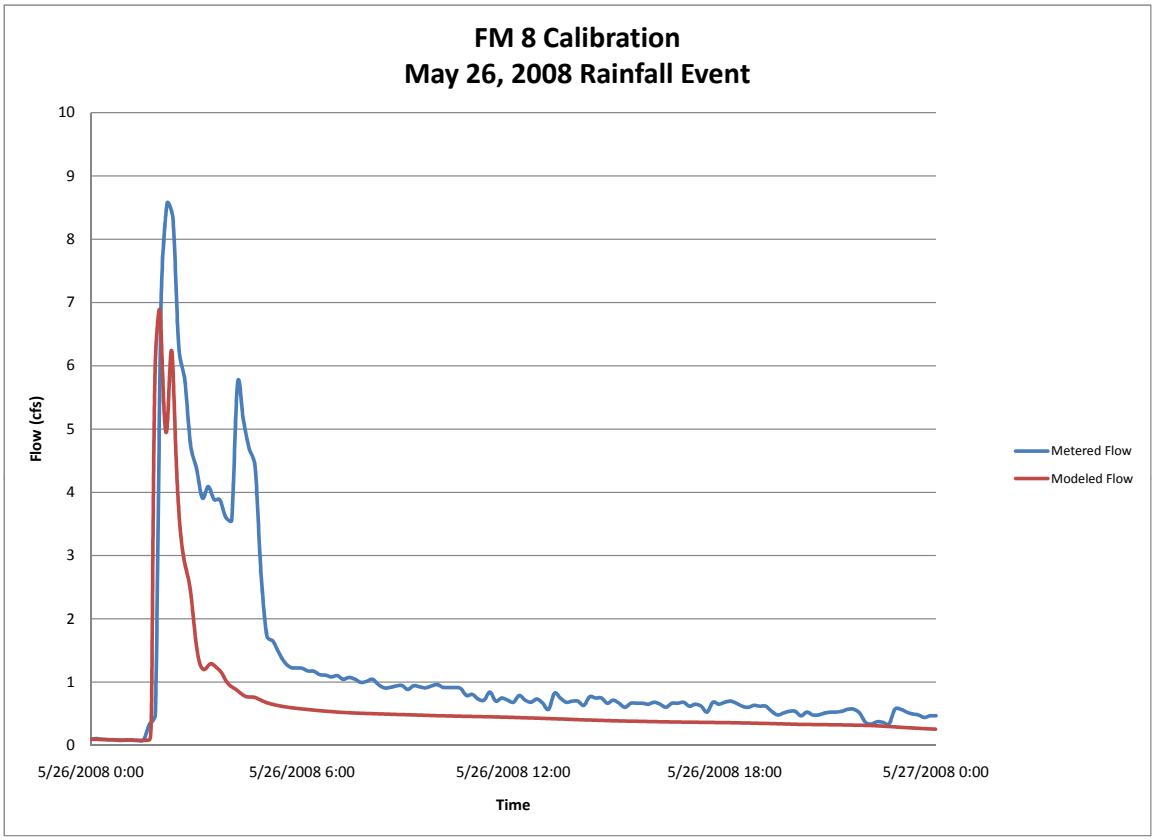

FM 5 Calibration
May 26, 2008 Rainfall Event
Level (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

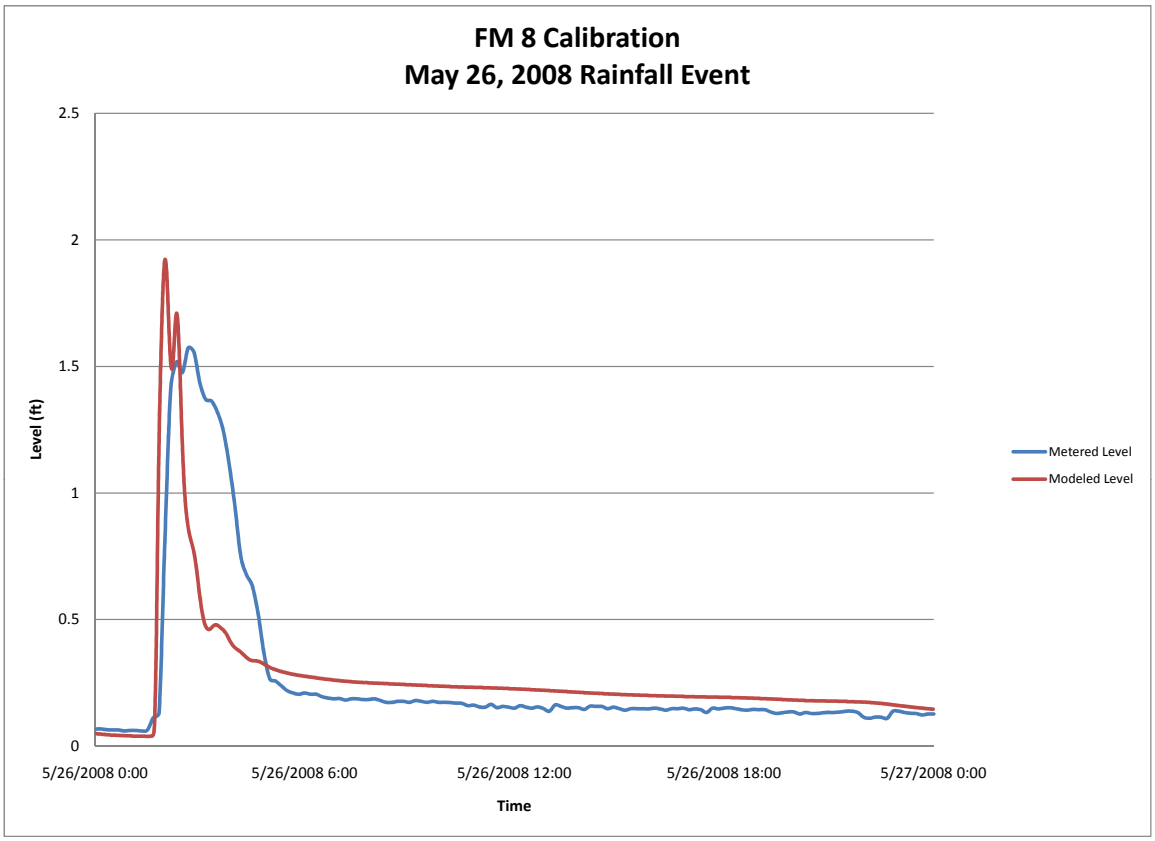

FM 6 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
14
12
10
8
6
4
2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

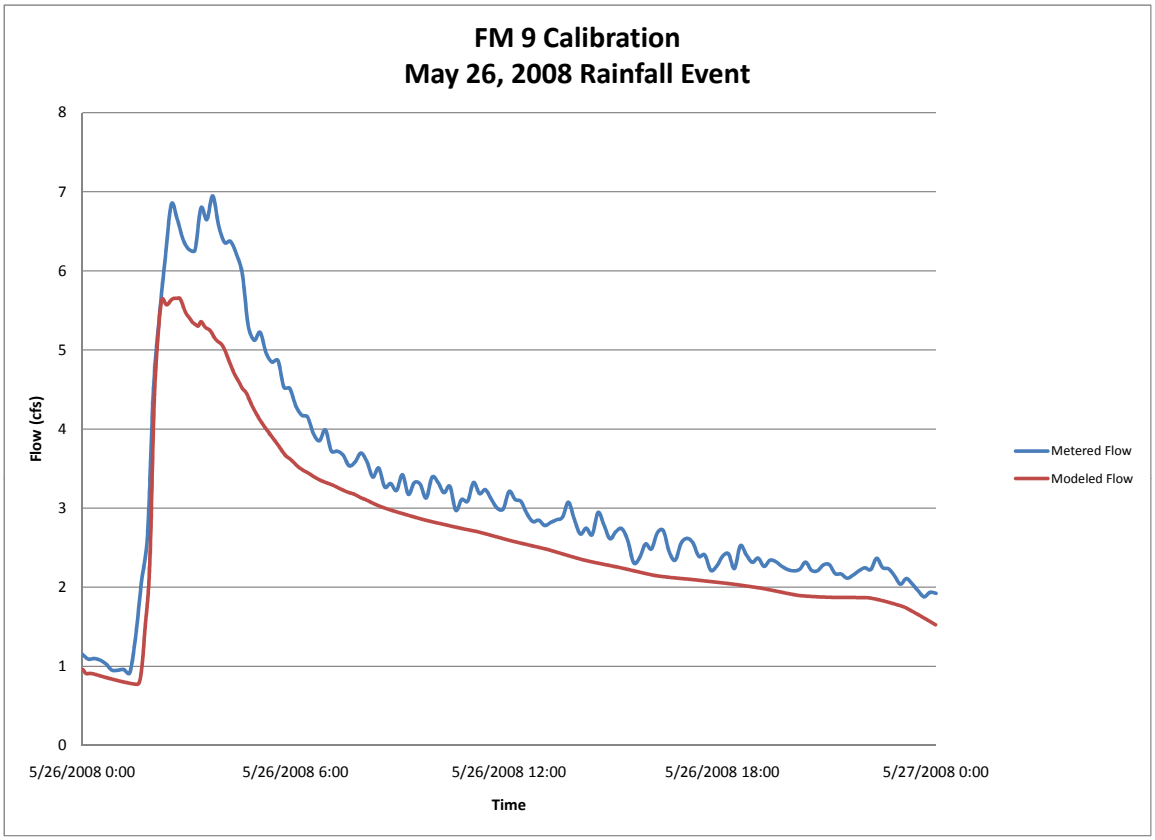

FM 6 Calibration
May 26, 2008 Rainfall Event
Level (ft)
3
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

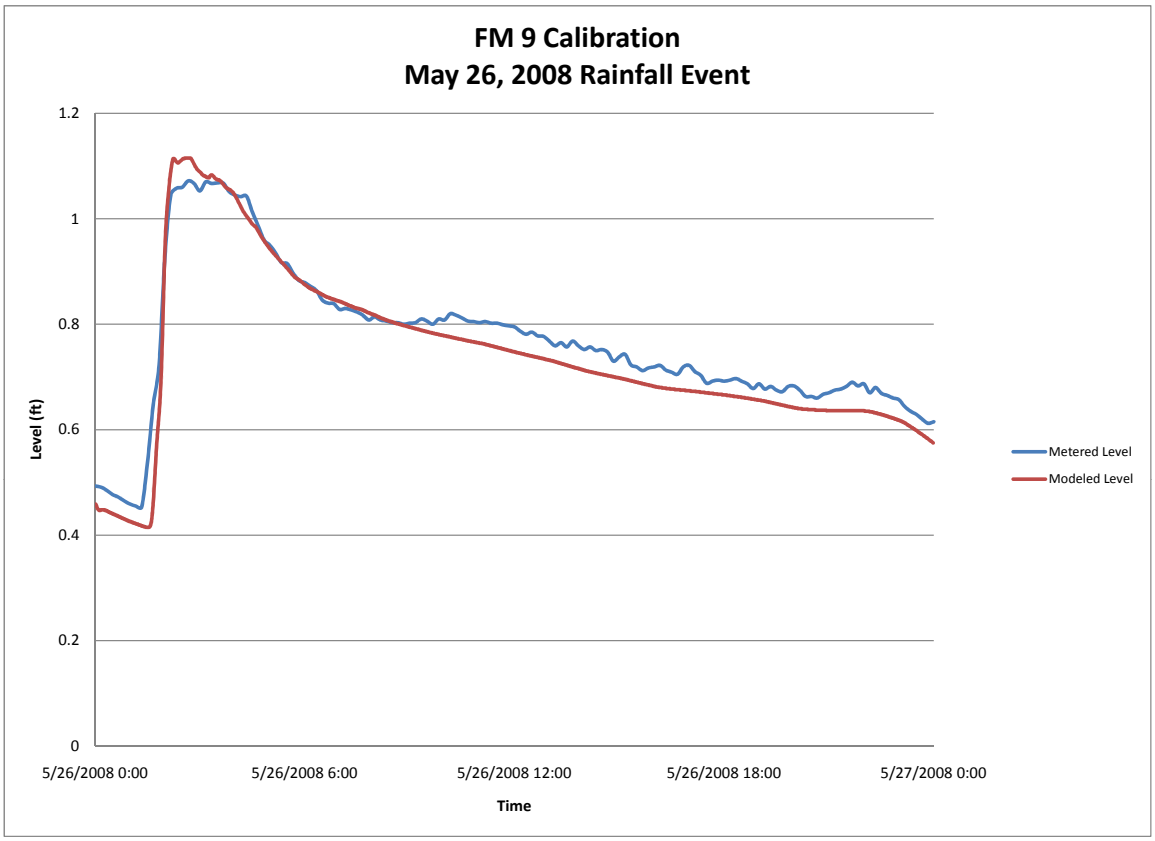

FM 7 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

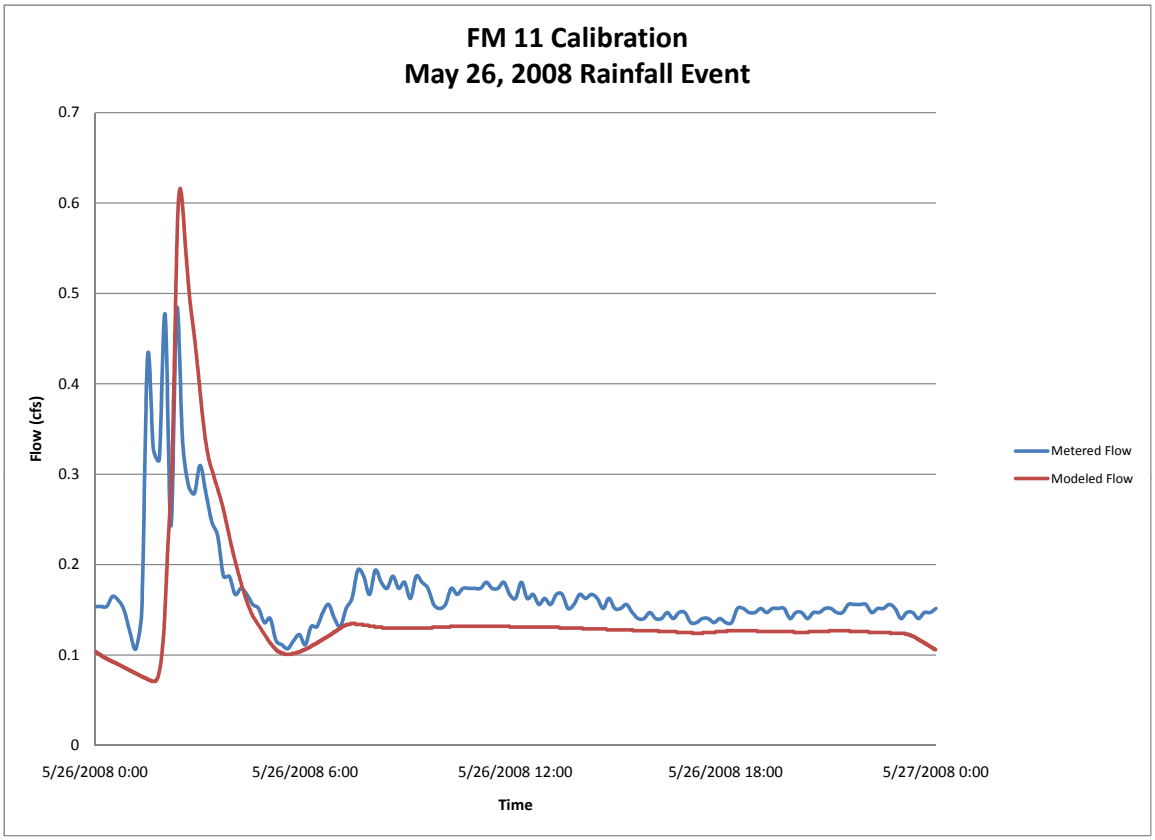

FM 7 Calibration
May 26, 2008 Rainfall Event
Level (ft)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

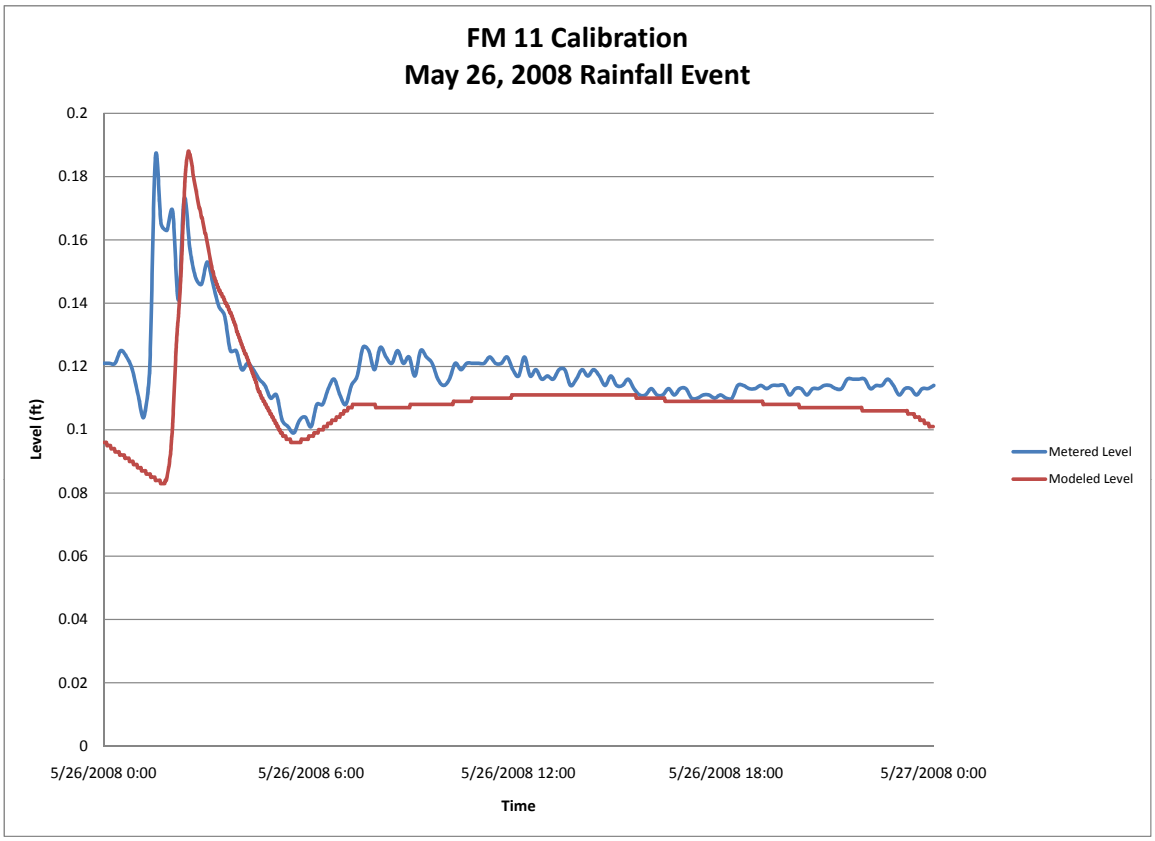

FM 8 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
10
9
8
7
6
5
4
3
2
1
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

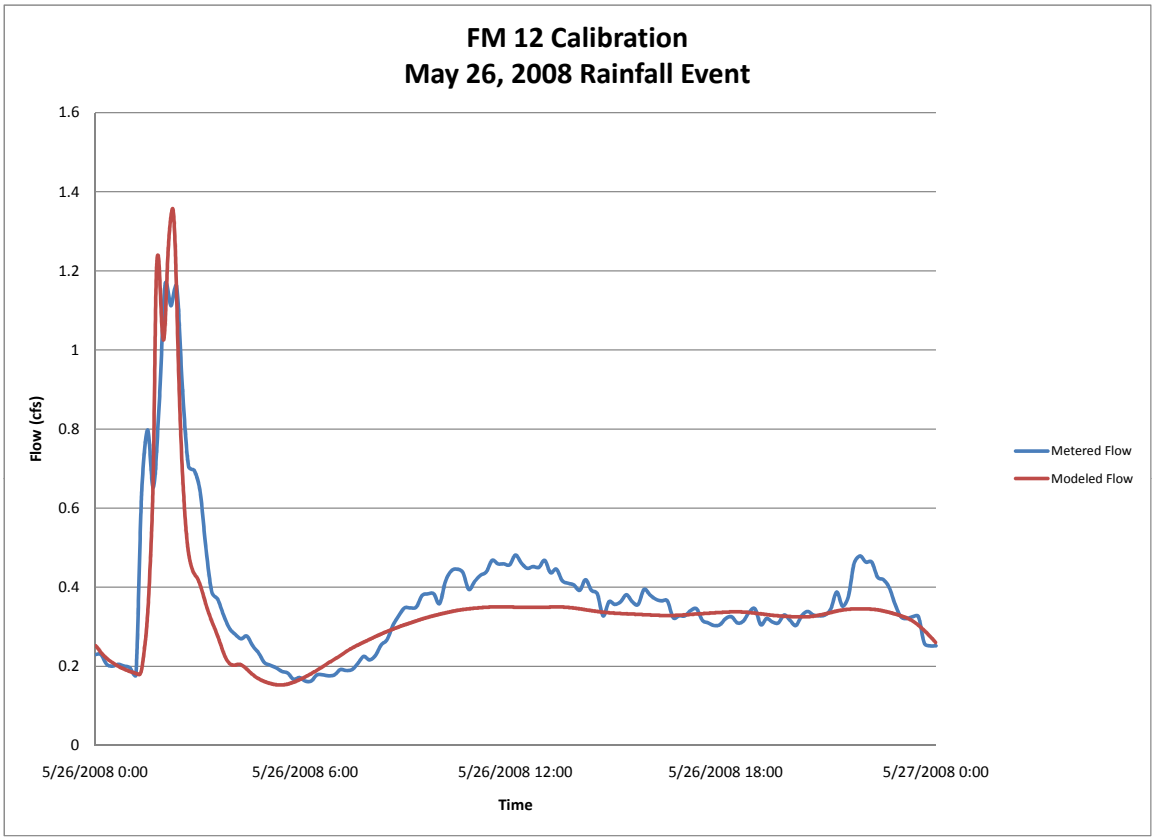

FM 8 Calibration
May 26, 2008 Rainfall Event
Level (ft)
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

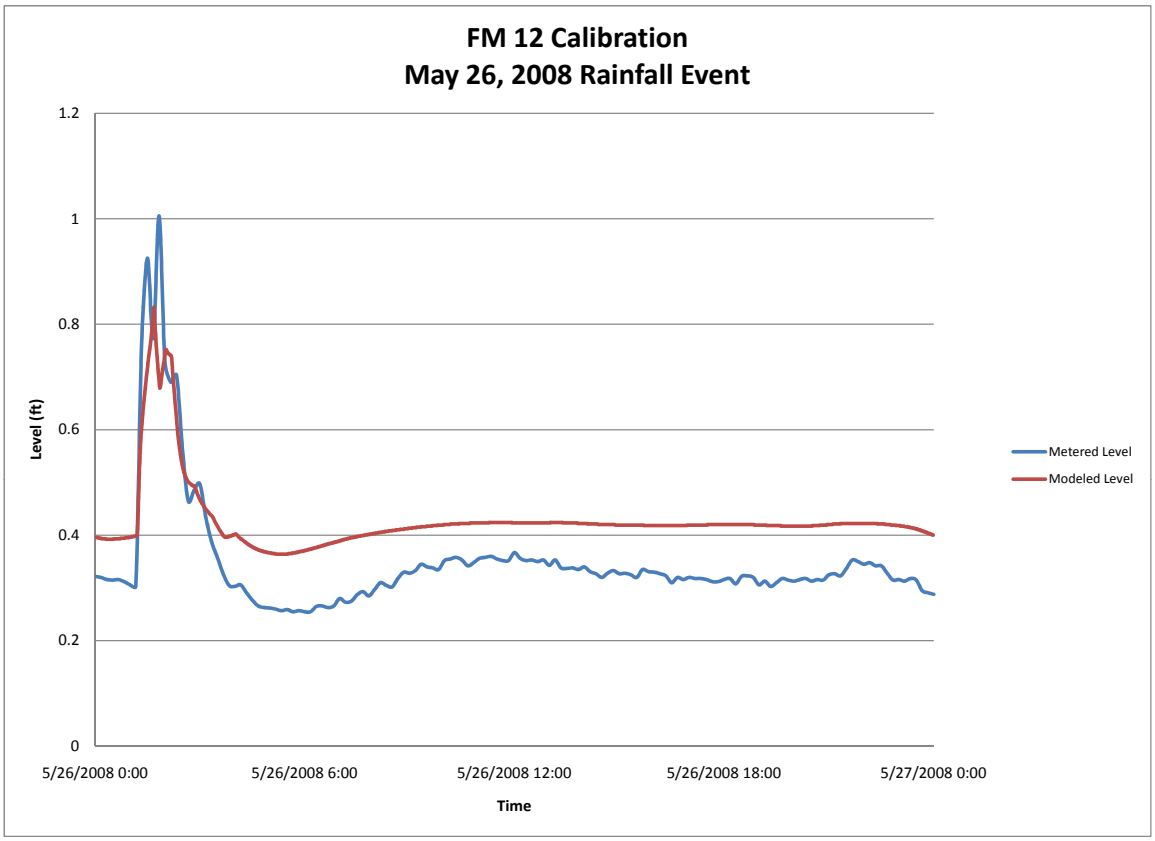

FM 9 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
8
7
6
5
4
3
2
1
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

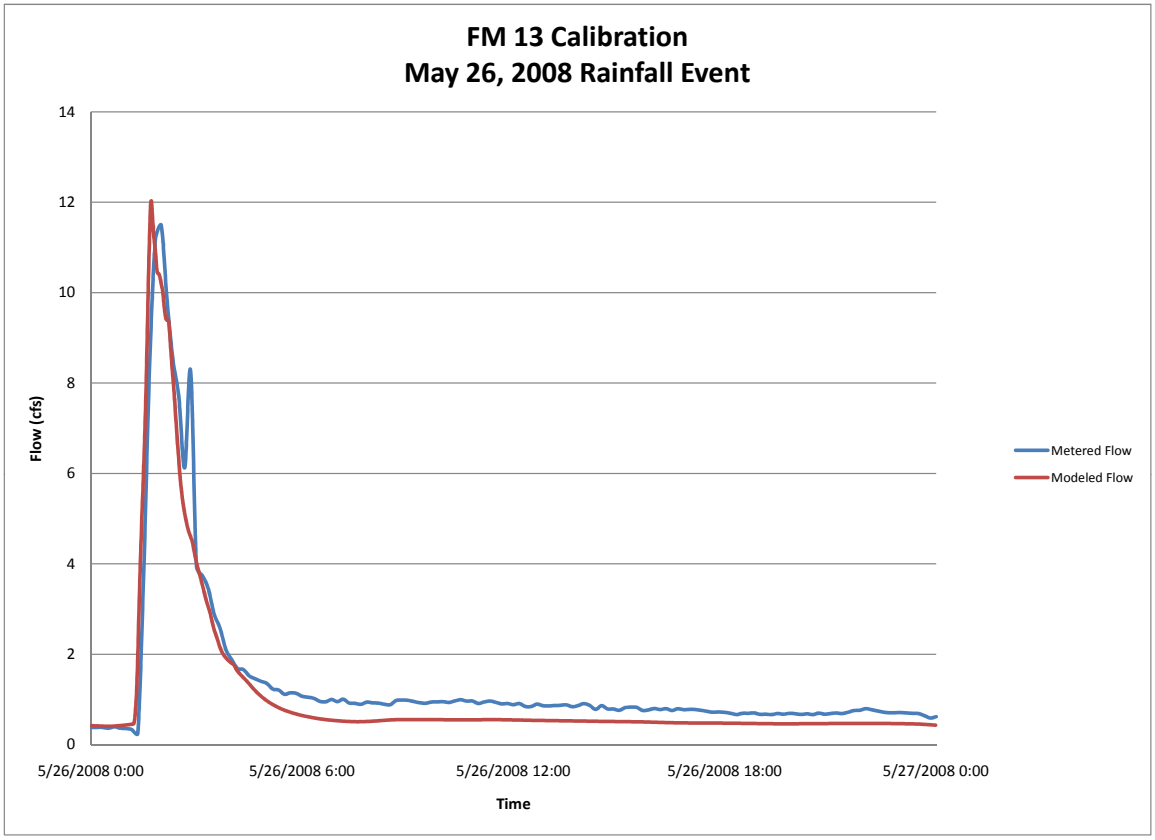

FM 9 Calibration
May 26, 2008 Rainfall Event
Level (ft)
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

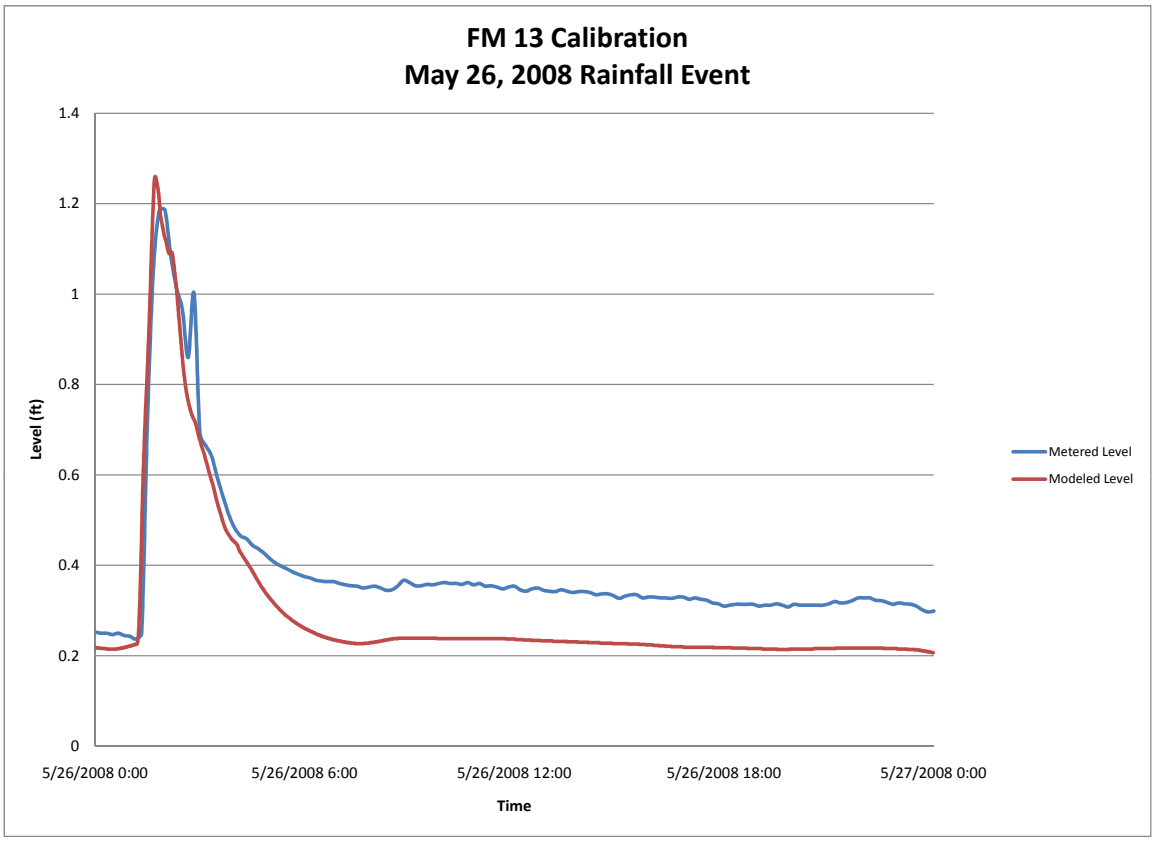

FM 11 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

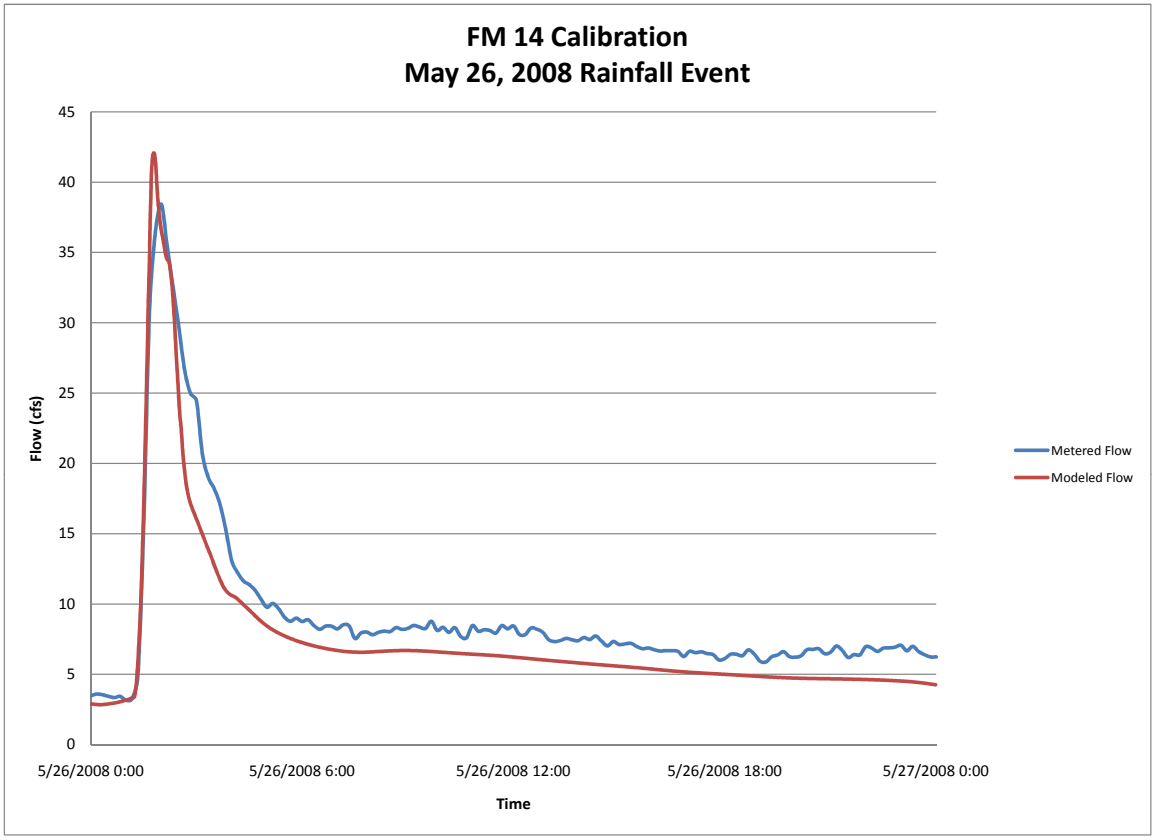

FM 11 Calibration
May 26, 2008 Rainfall Event
Level (ft)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

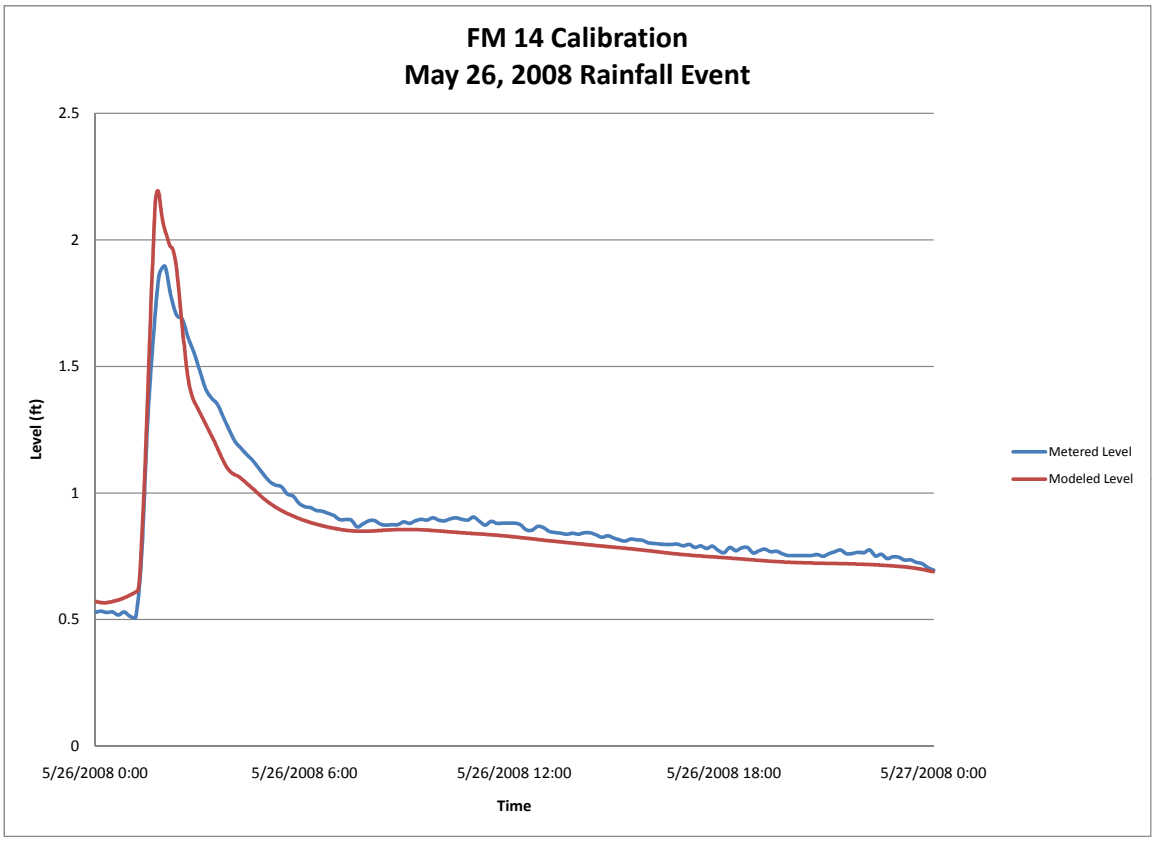

FM 12 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

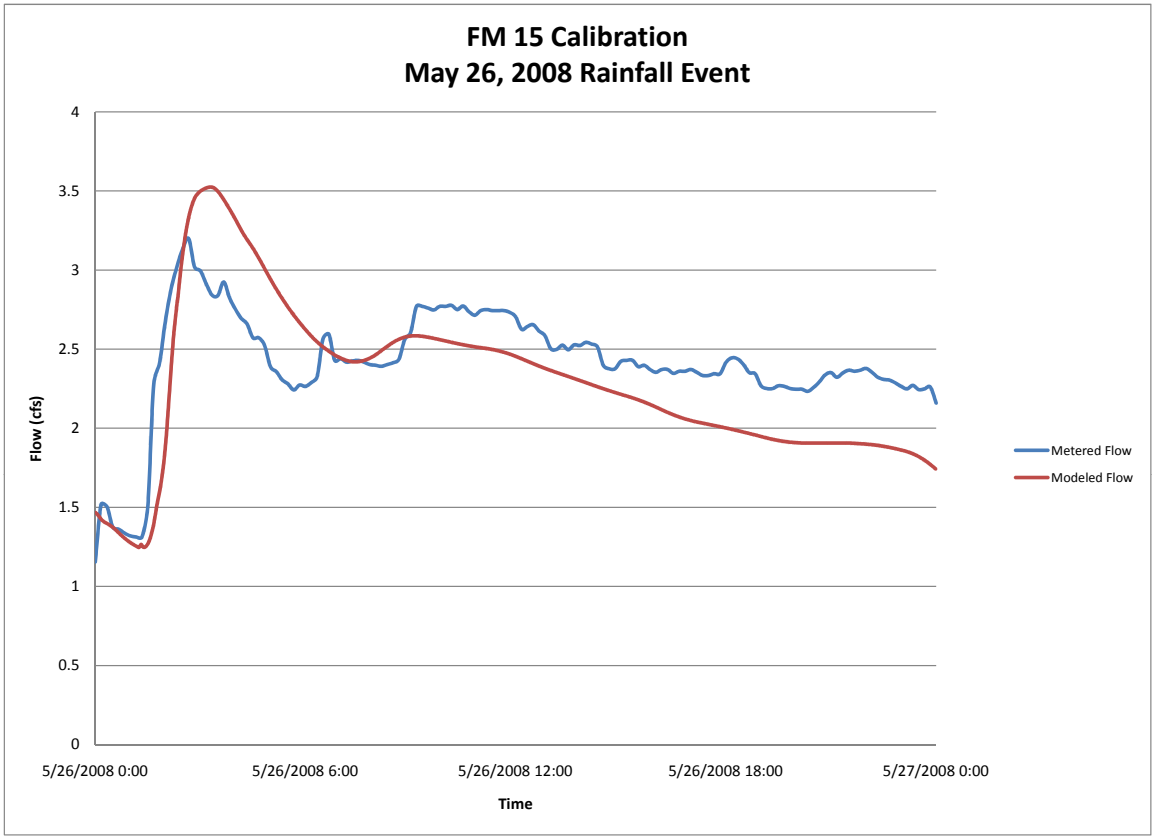

FM 12 Calibration
May 26, 2008 Rainfall Event
Level (ft)
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

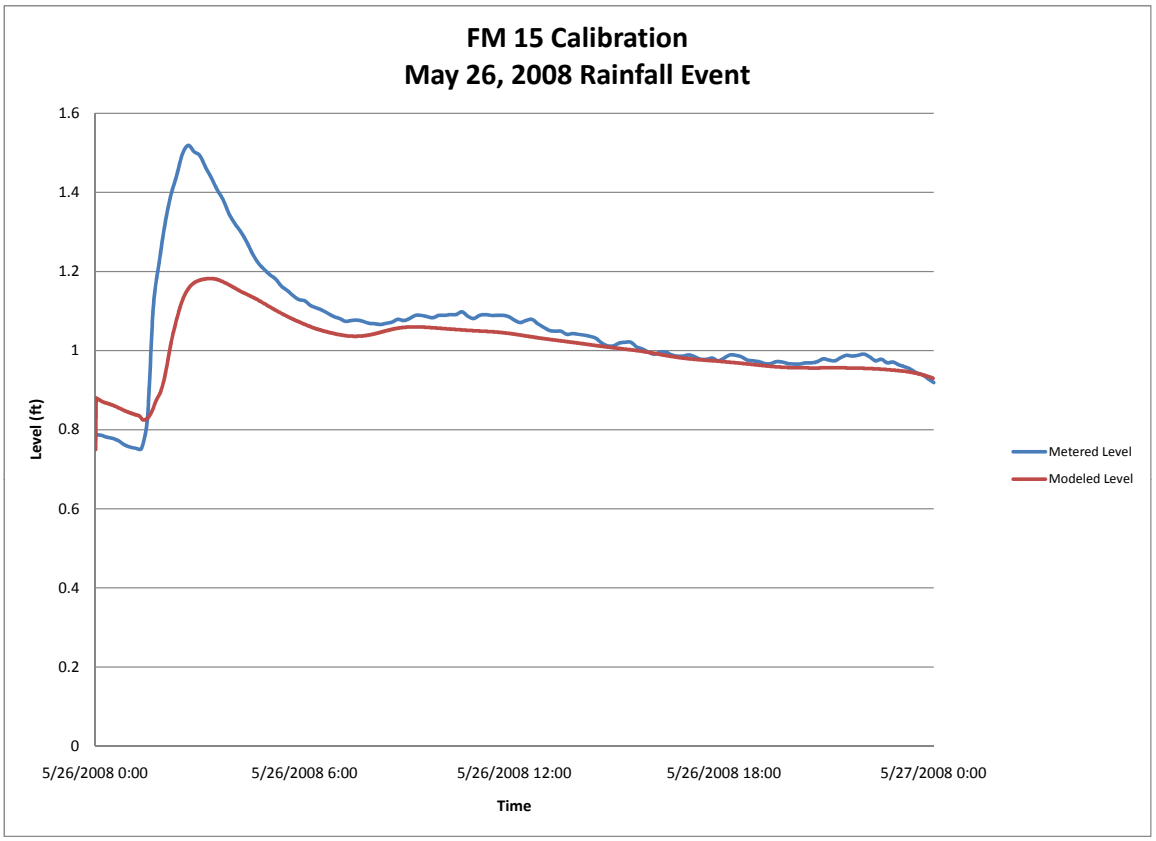

FM 13 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
14
12
10
8
6
4
2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

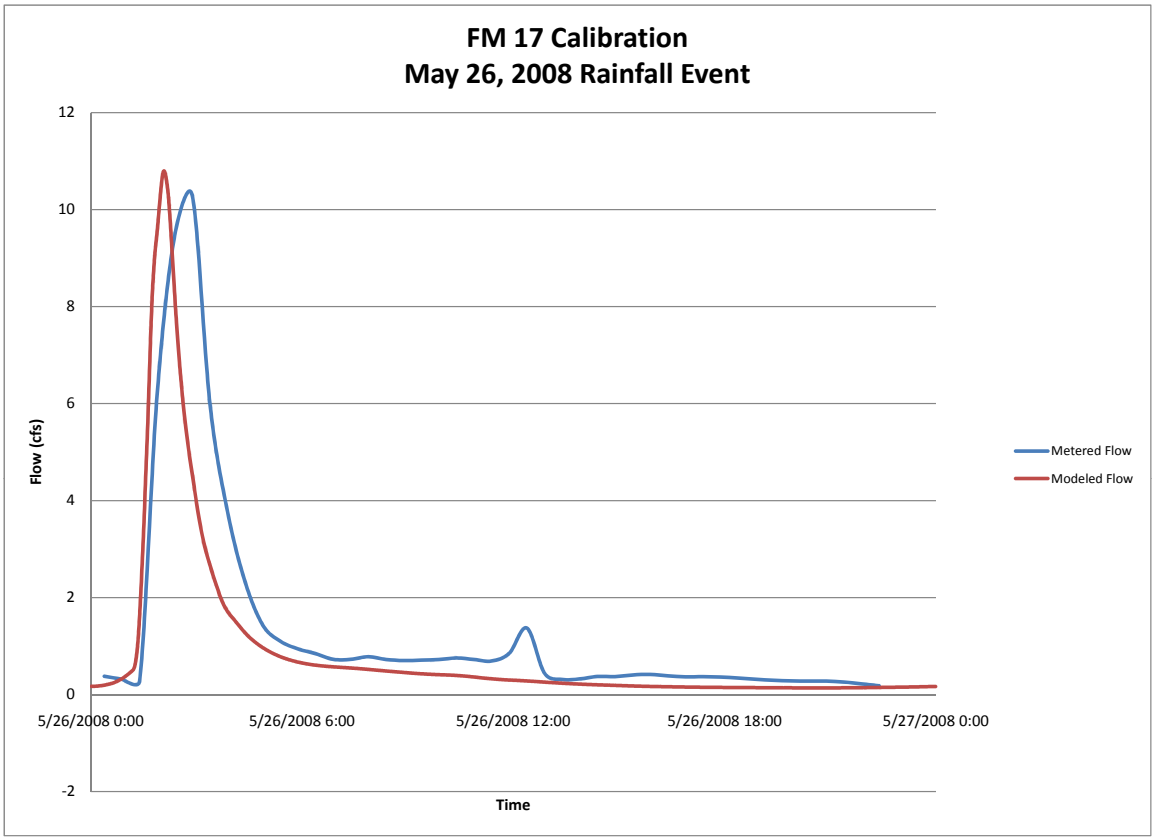

FM 13 Calibration
May 26, 2008 Rainfall Event
Level (ft)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

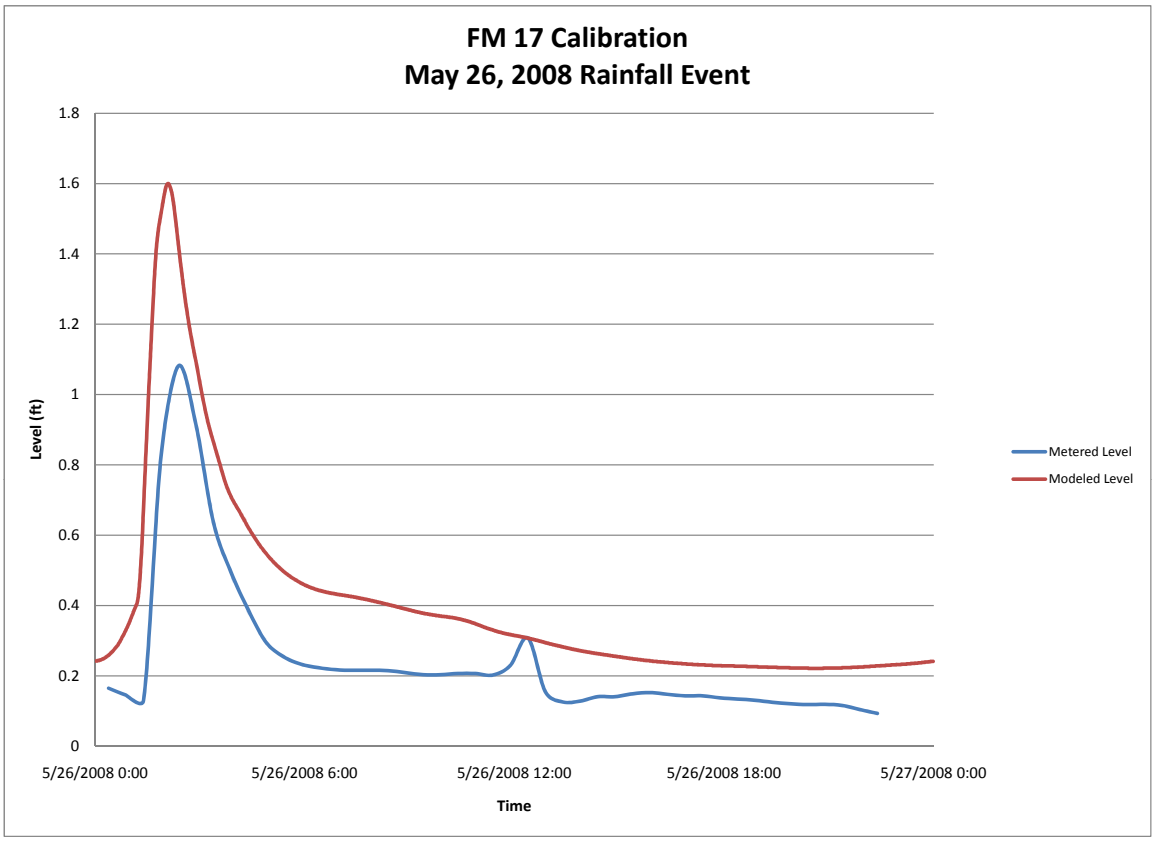

FM 14 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
45
40
35
30
25
20
15
10
5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

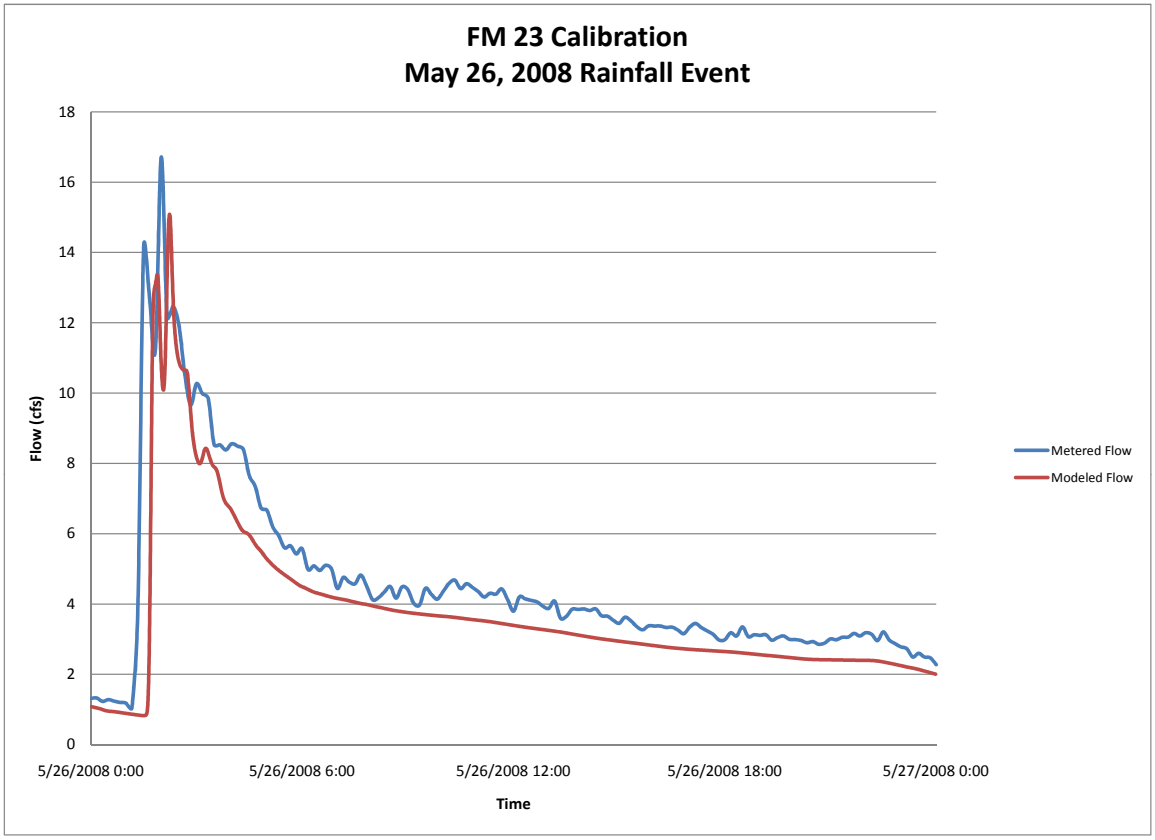

FM 14 Calibration
May 26, 2008 Rainfall Event
Level (ft)
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

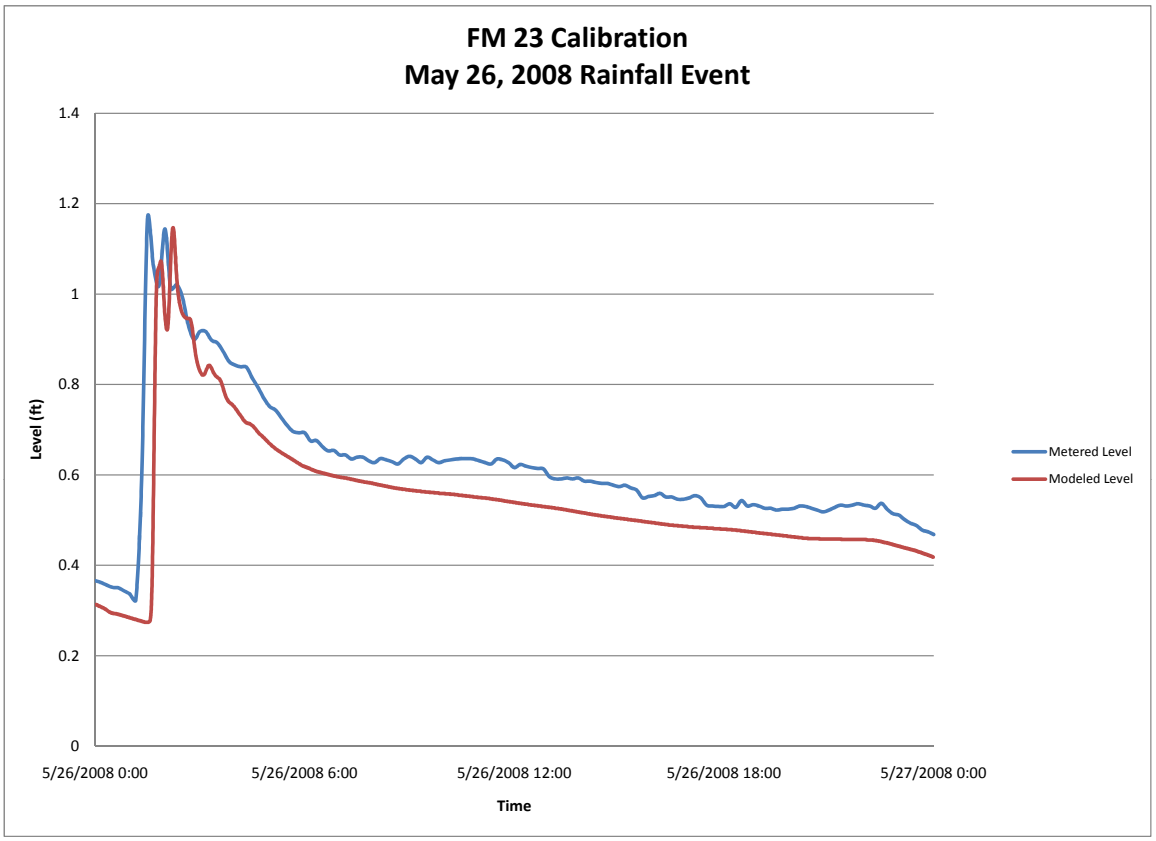

FM 15 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
4
3.5
3
2.5
2
1.5
1
0.5
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

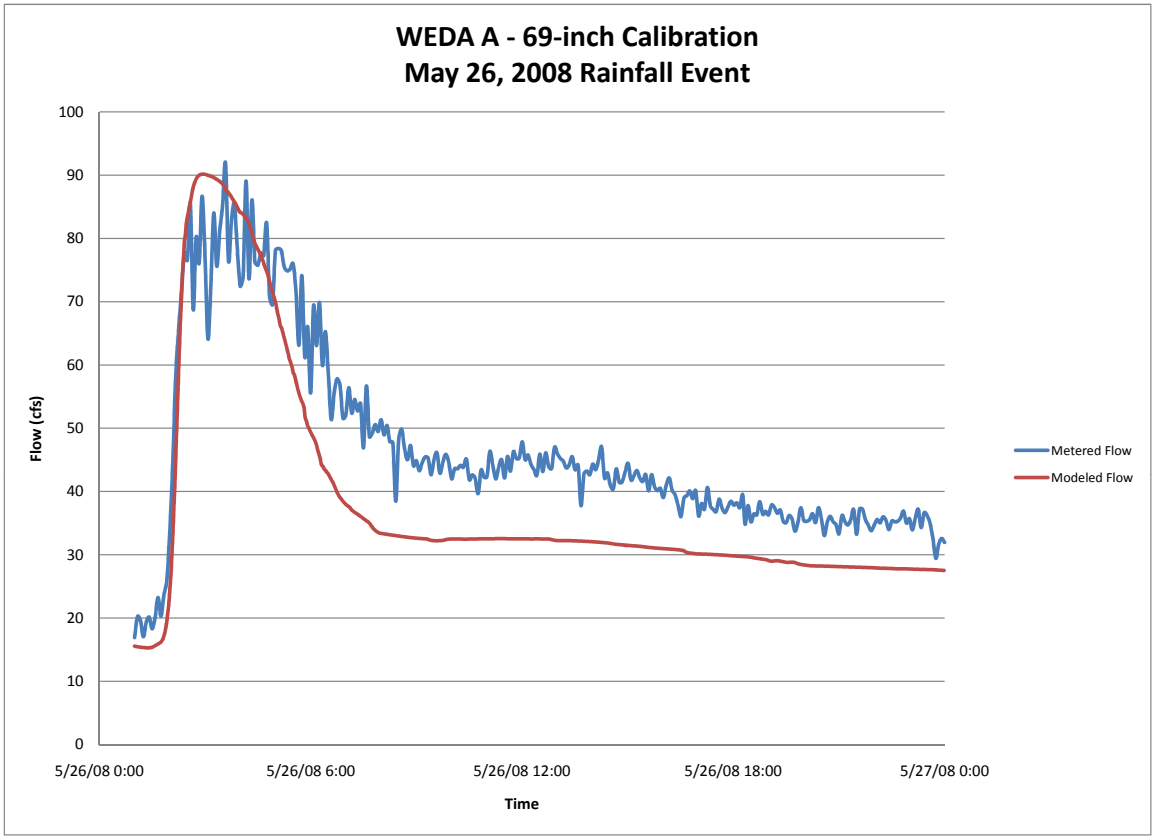

FM 15 Calibration
May 26, 2008 Rainfall Event
Level (ft)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

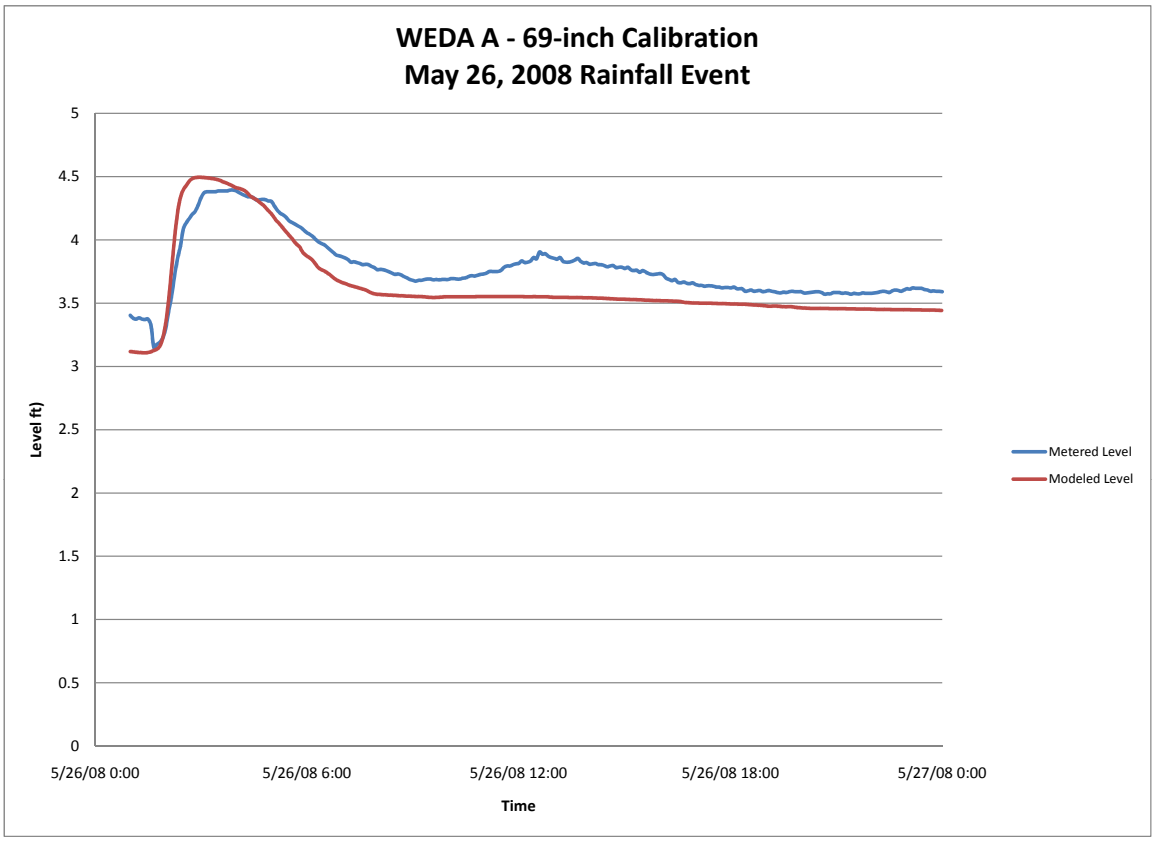

FM 17 Calibration
May 26, 2008 Rainfall Event
12
10
8
6
4
2
0
-2
Flow (cfs)
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

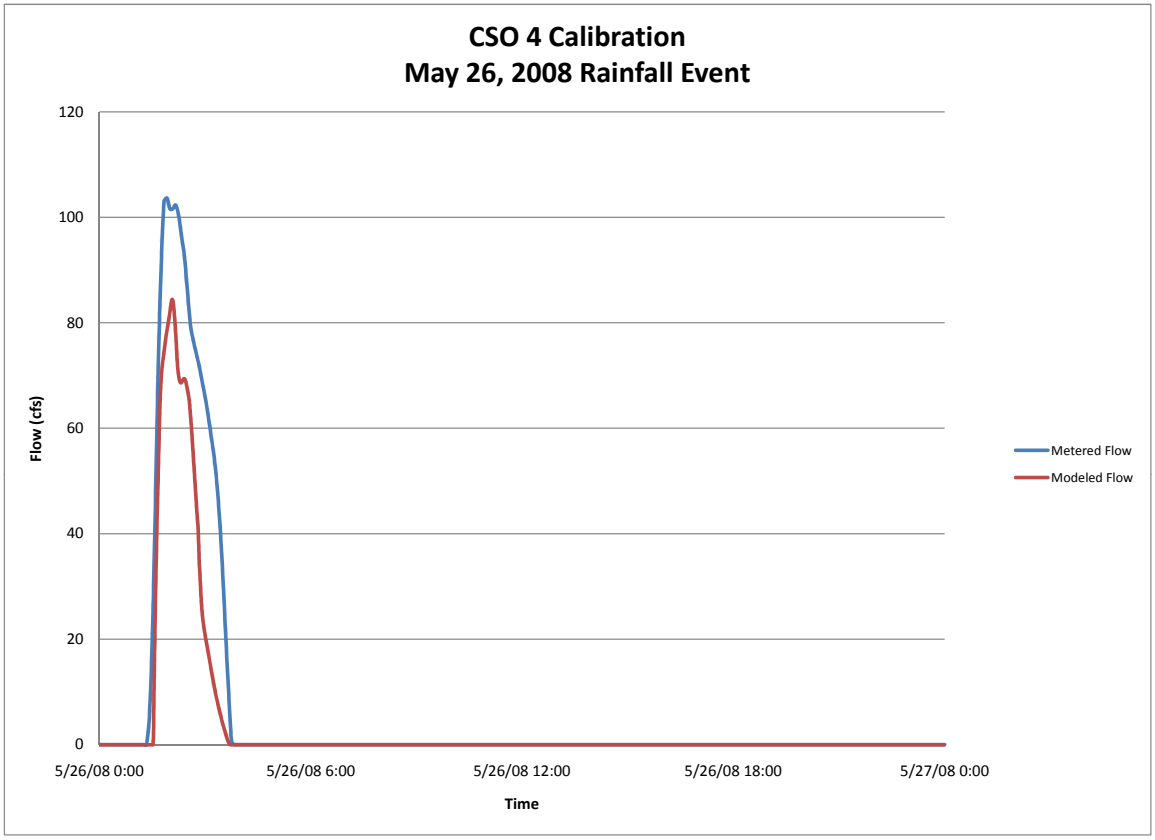

FM 17 Calibration
May 26, 2008 Rainfall Event
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Level (ft)
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

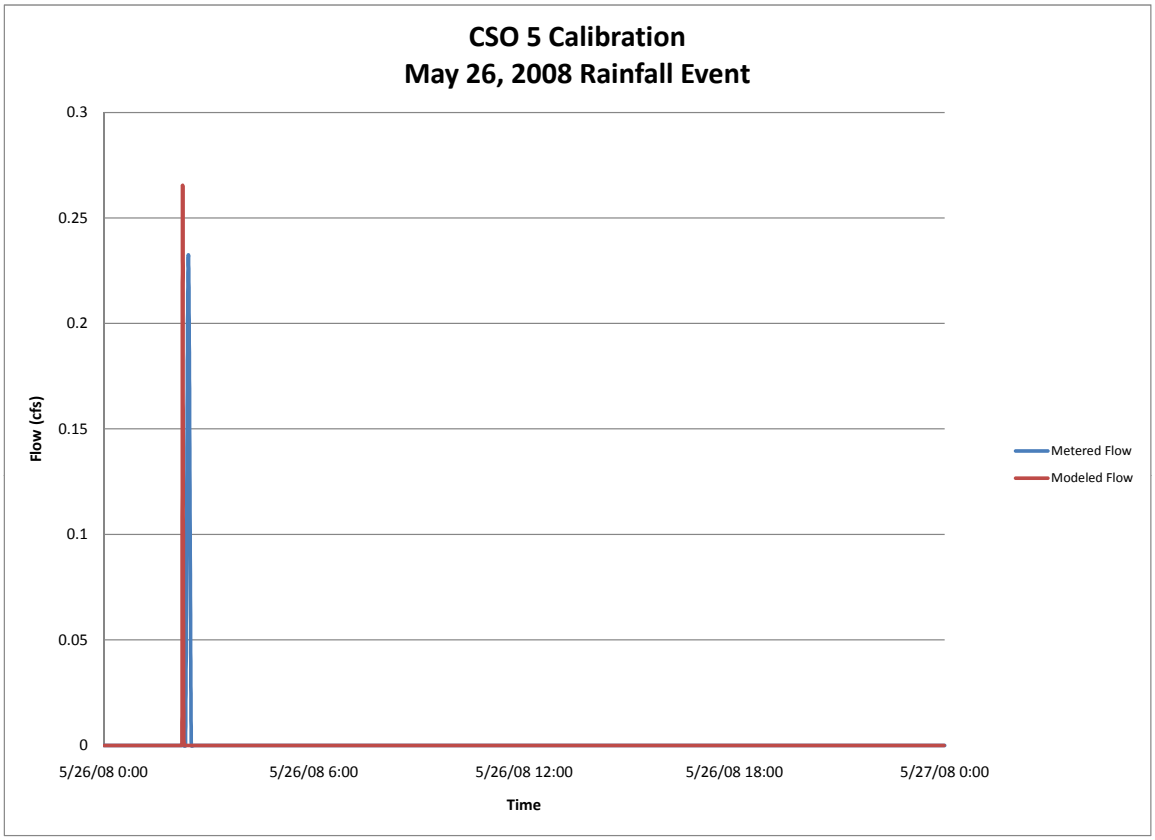

FM 23 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
18
16
14
12
10
8
6
4
2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Flow
Modeled Flow

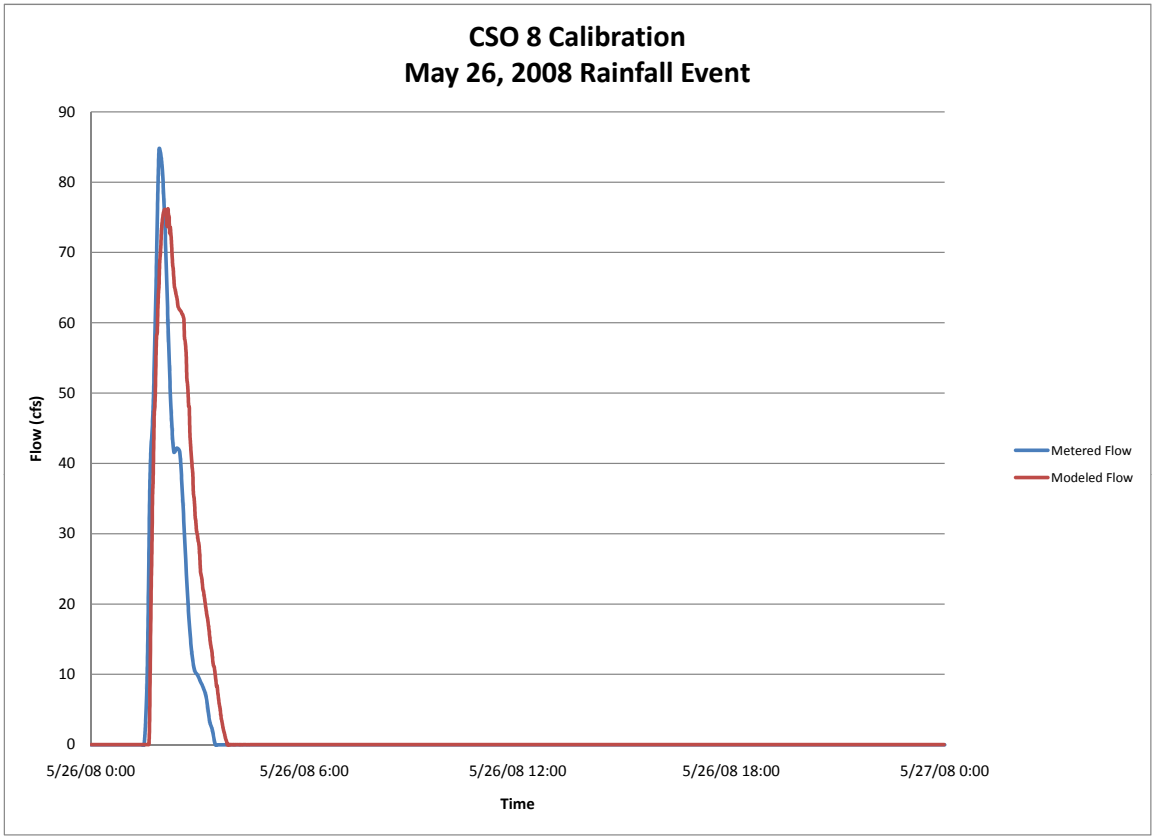

FM 23 Calibration
May 26, 2008 Rainfall Event
Level (ft)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
5/26/2008 0:00
5/26/2008 6:00
5/26/2008 12:00
5/26/2008 18:00
5/27/2008 0:00
Time
Metered Level
Modeled Level

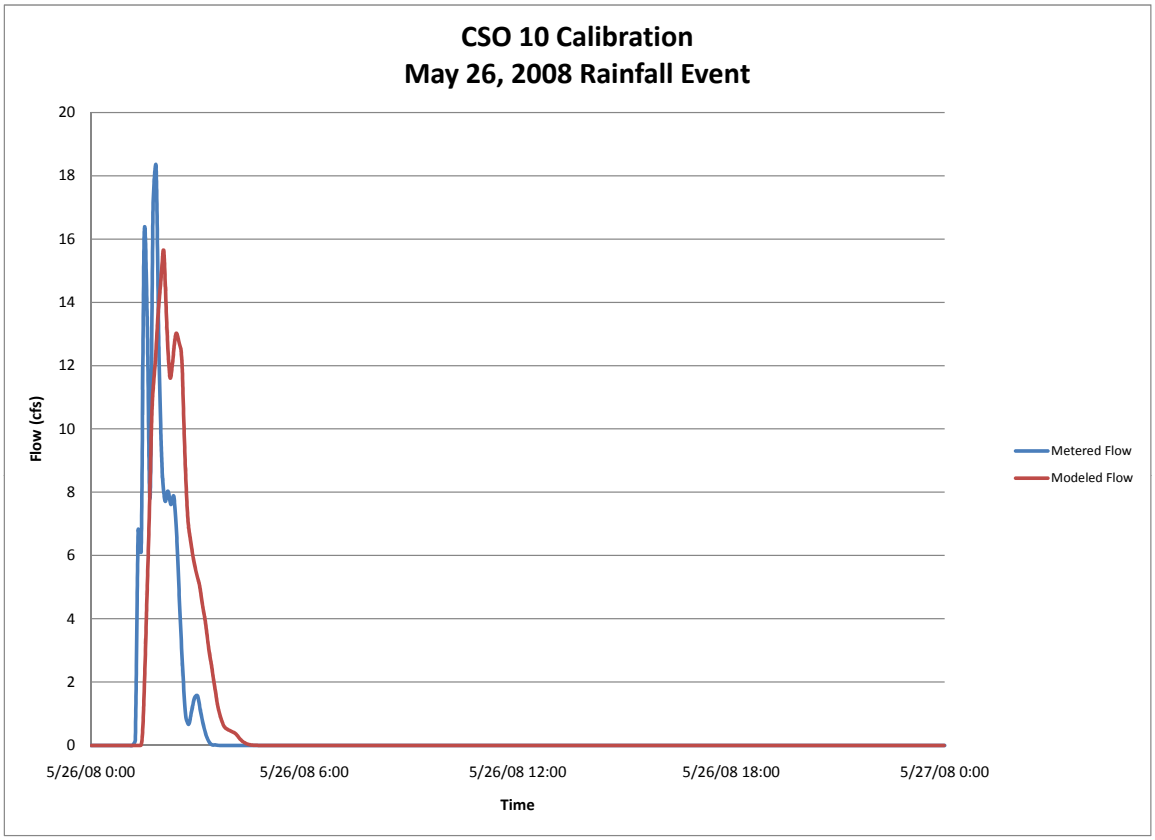

WEDA A - 69-inch Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
100
90
80
70
60
50
40
30
20
10
0
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Flow
Modeled Flow


WEDA A - 69-inch Calibration
May 26, 2008 Rainfall Event
Level (ft)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Level
Modeled Level

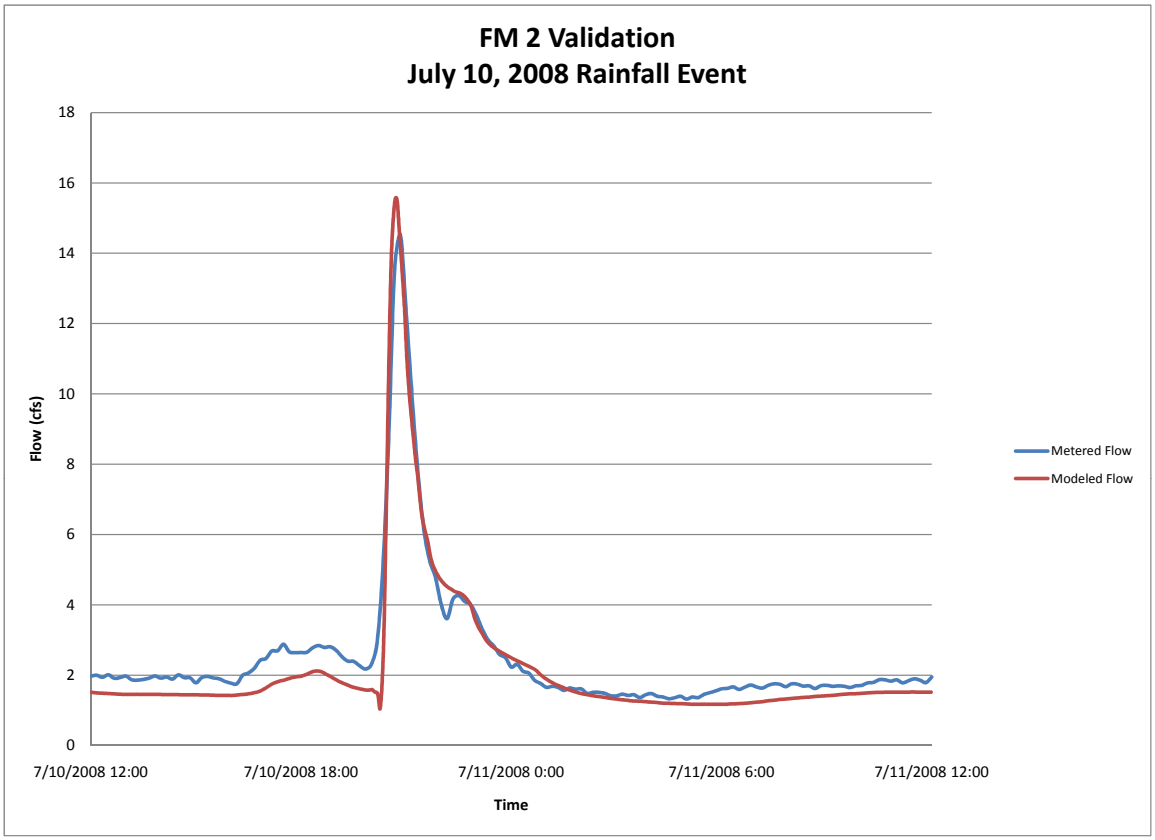

CSO 4 Calibration
May 26, 2008 Rainfall Event
120
100
80
60
40
20
0
Flow (cfs)
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Flow
Modeled Flow

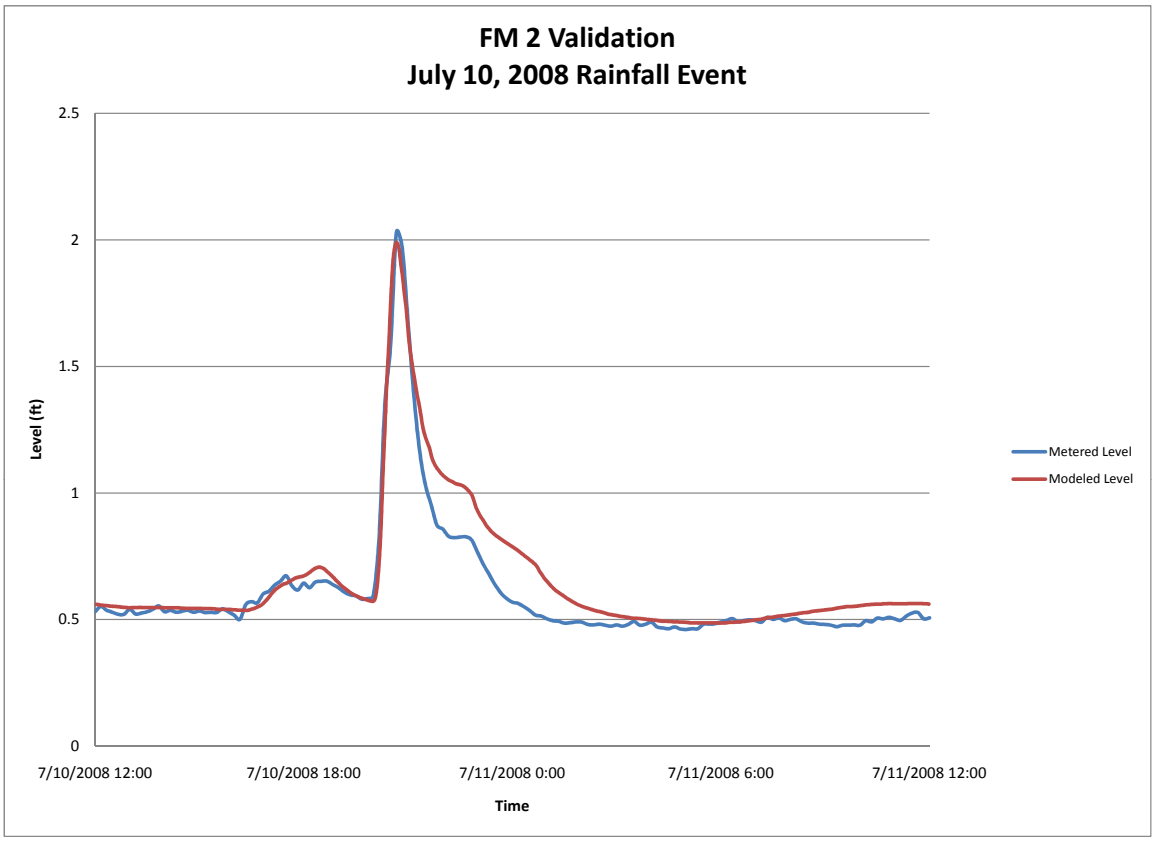

CSO 5 Calibration
May 26, 2008 Rainfall Event
0.3
0.25
0.2
0.15
0.1
0.05
0
Flow (cfs)
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Flow
Modeled Flow

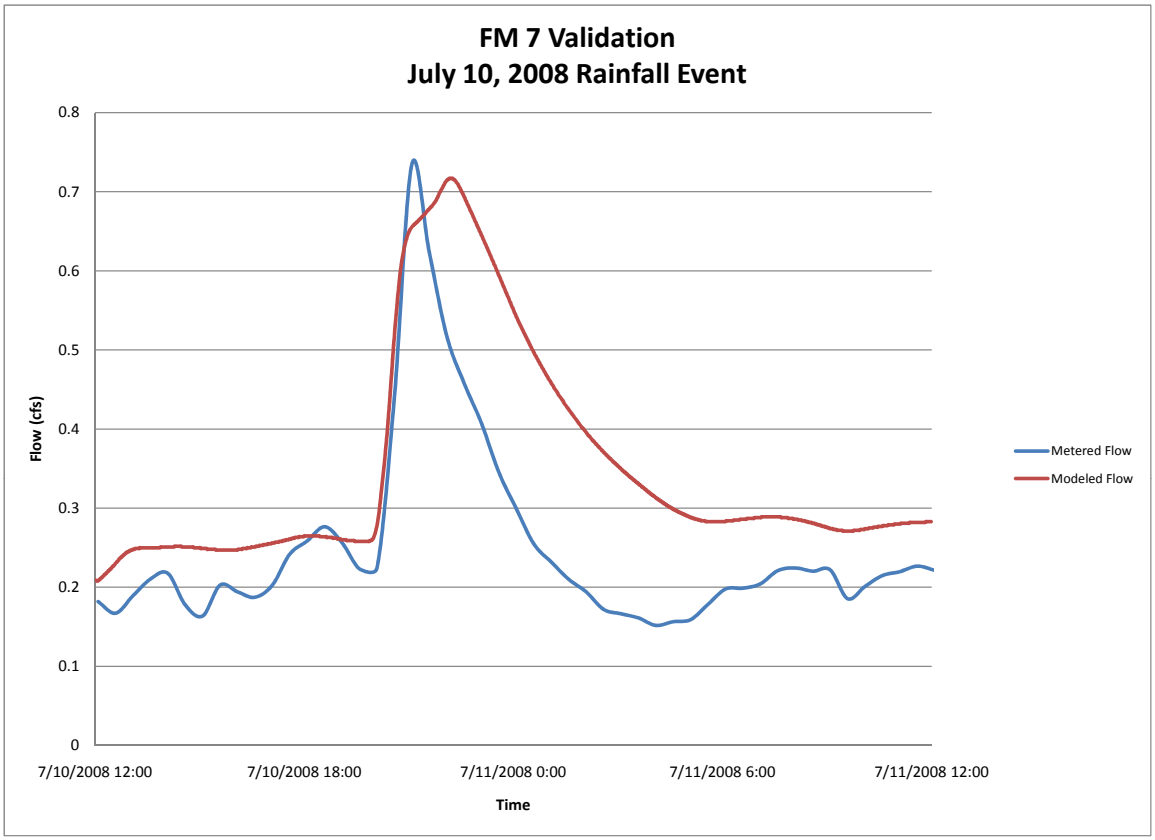

CSO 8 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
90
80
70
60
50
40
30
20
10
0
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Flow
Modeled Flow

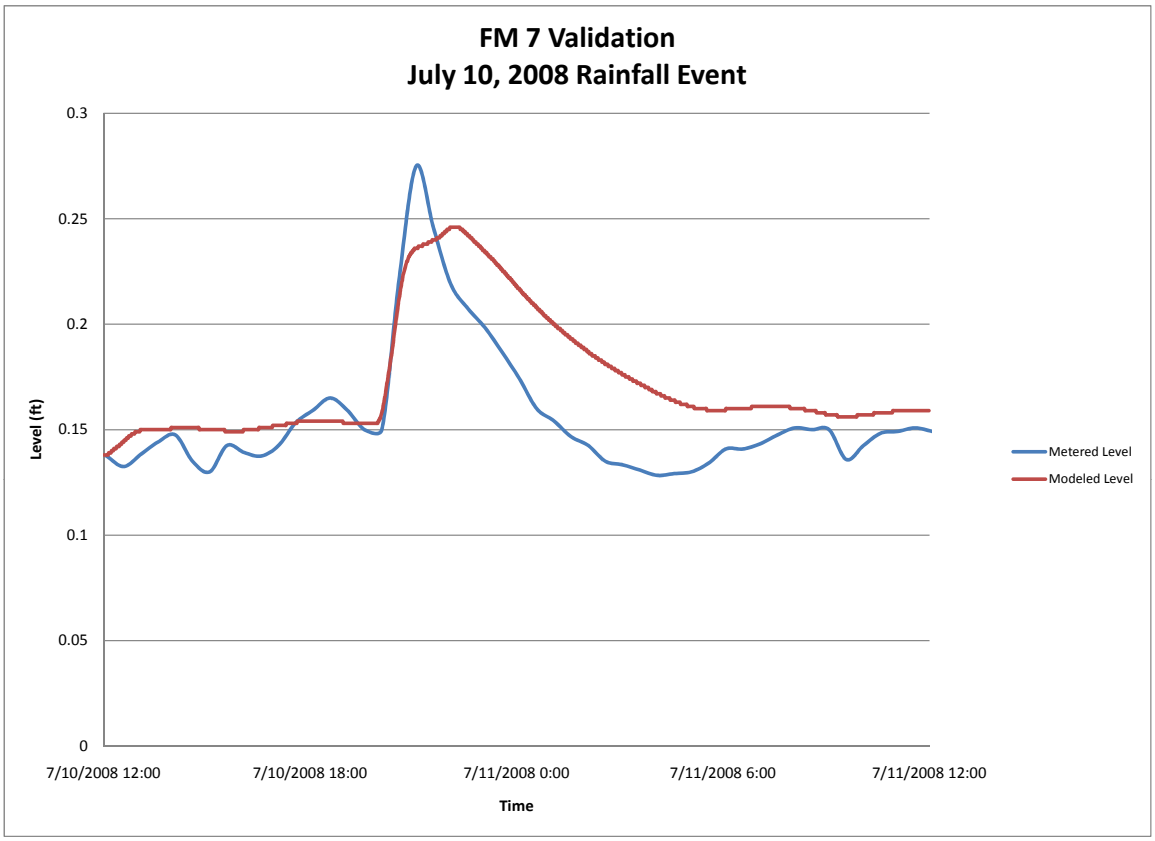

CSO 10 Calibration
May 26, 2008 Rainfall Event
Flow (cfs)
20
18
16
14
12
10
8
6
4
2
0
5/26/08 0:00
5/26/08 6:00
5/26/08 12:00
5/26/08 18:00
5/27/08 0:00
Time
Metered Flow
Modeled Flow

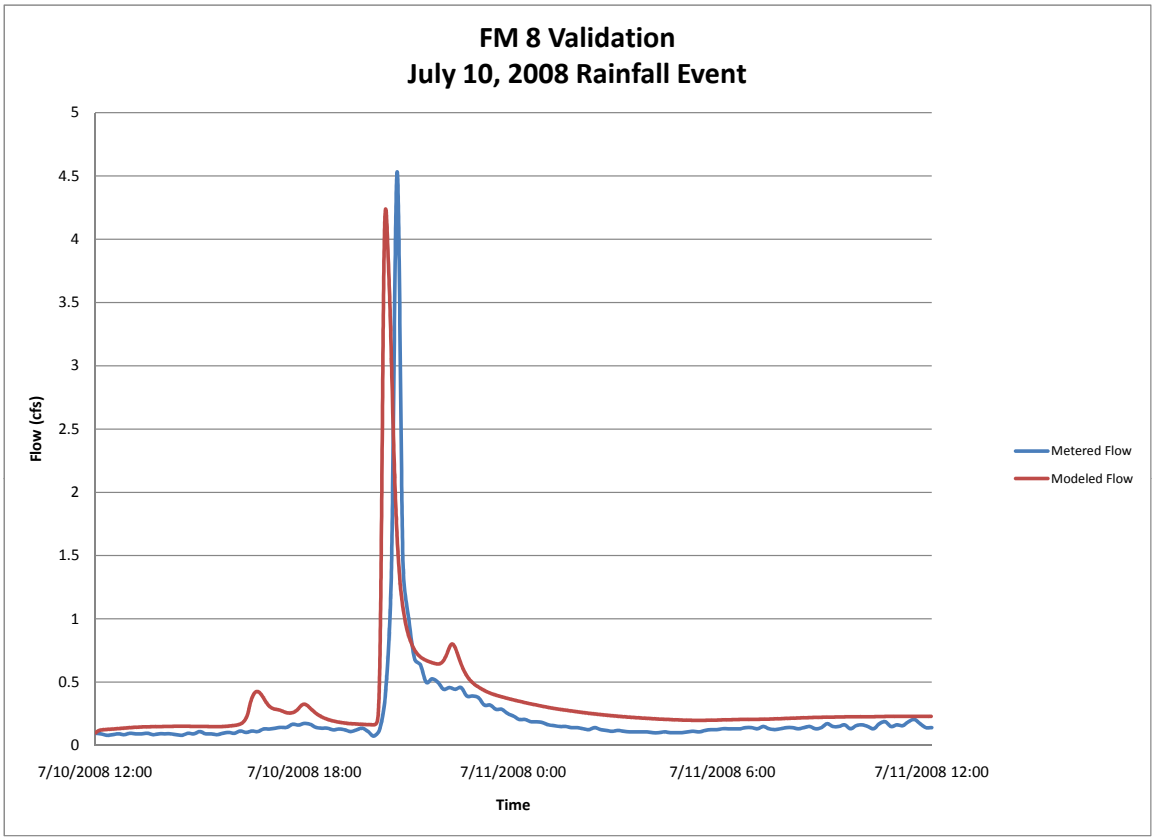
ATTACHMENT B-3
WET WEATHER VALIDATION GRAPHS

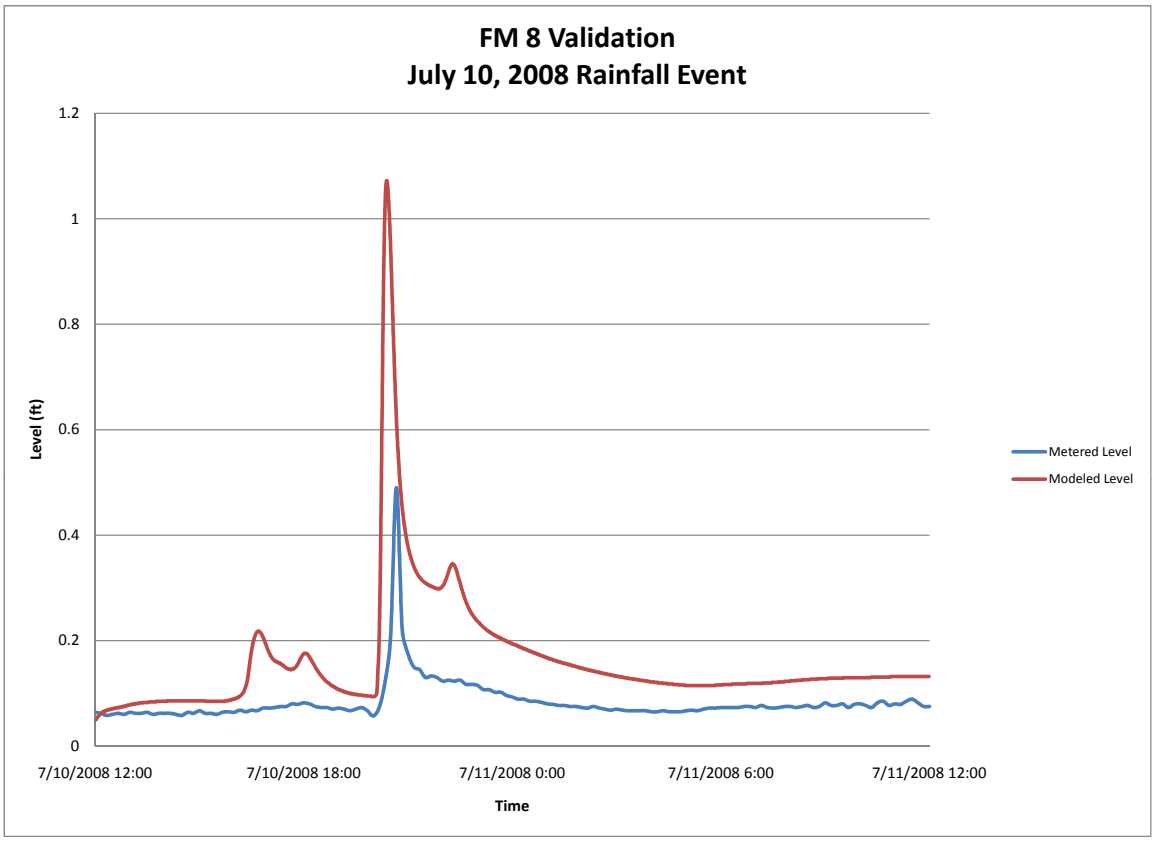

FM 2 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
18
16
14
12
10
8
6
4
2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

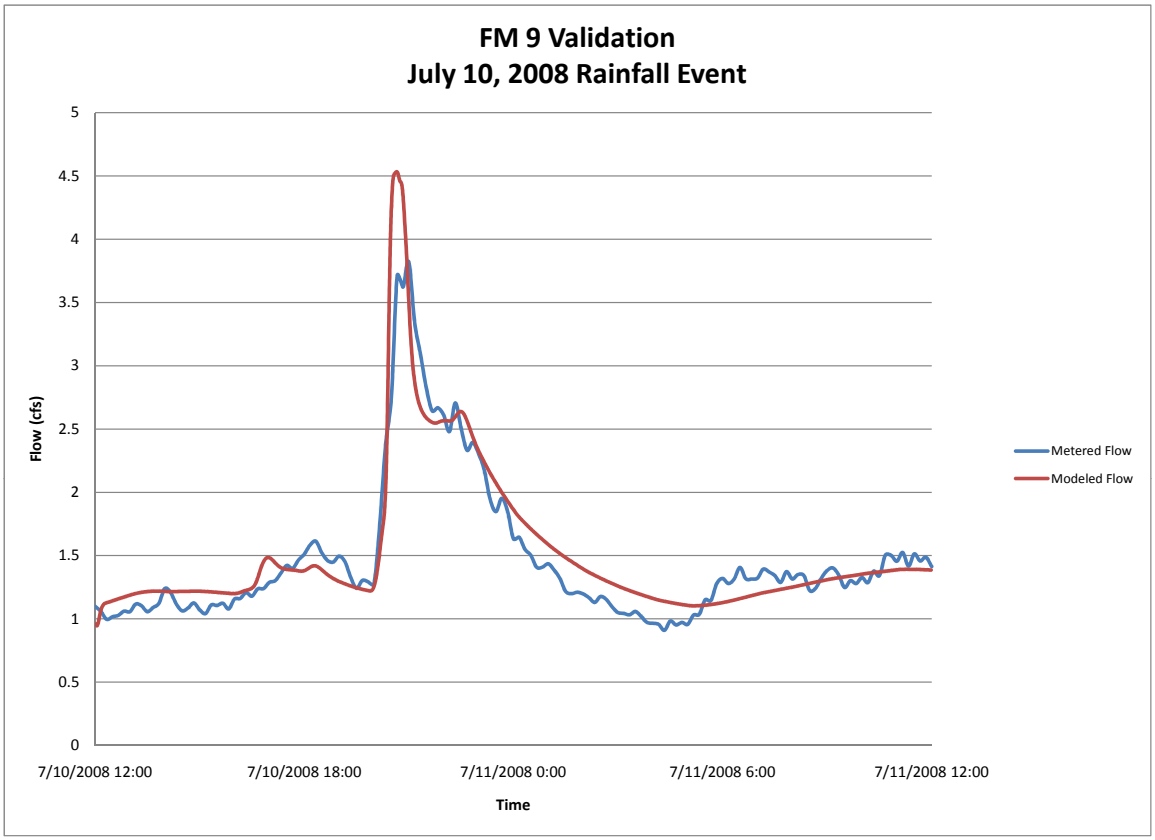

FM 2 Validation
July 10, 2008 Rainfall Event
Level (ft)
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

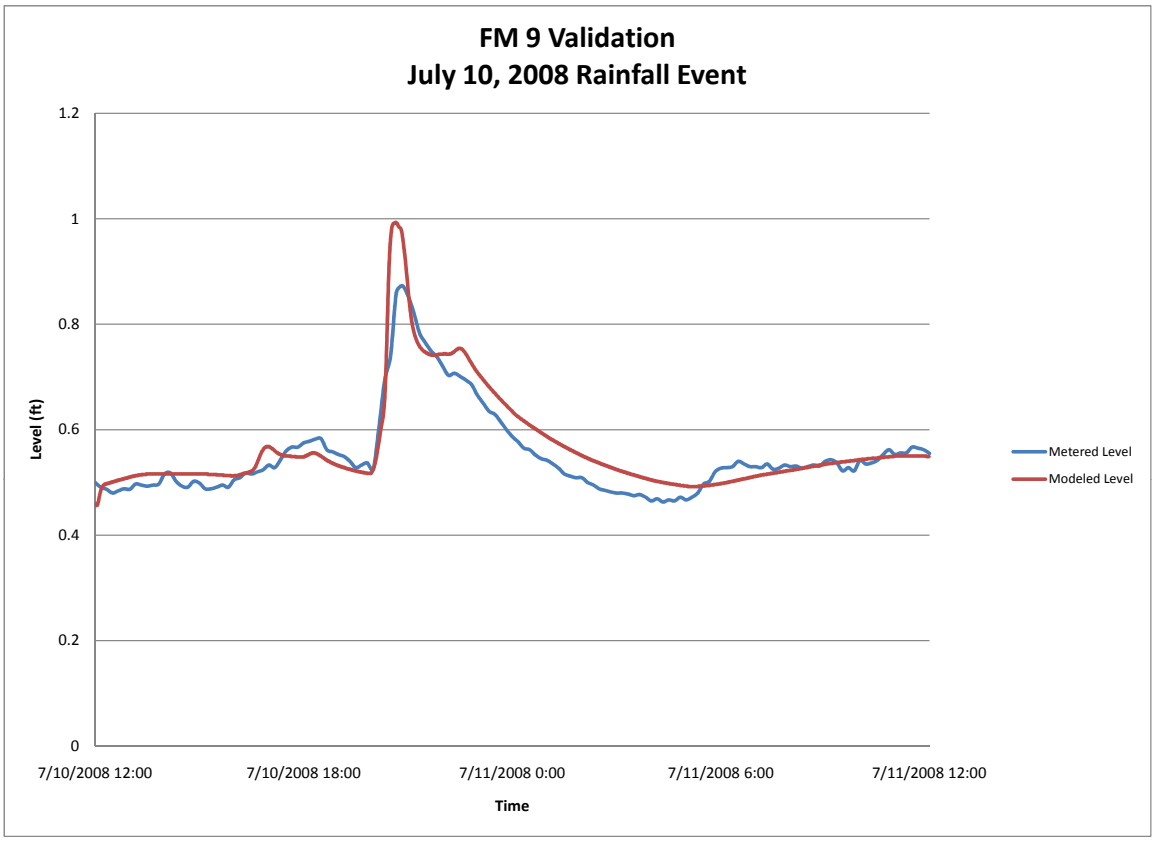

FM 7 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

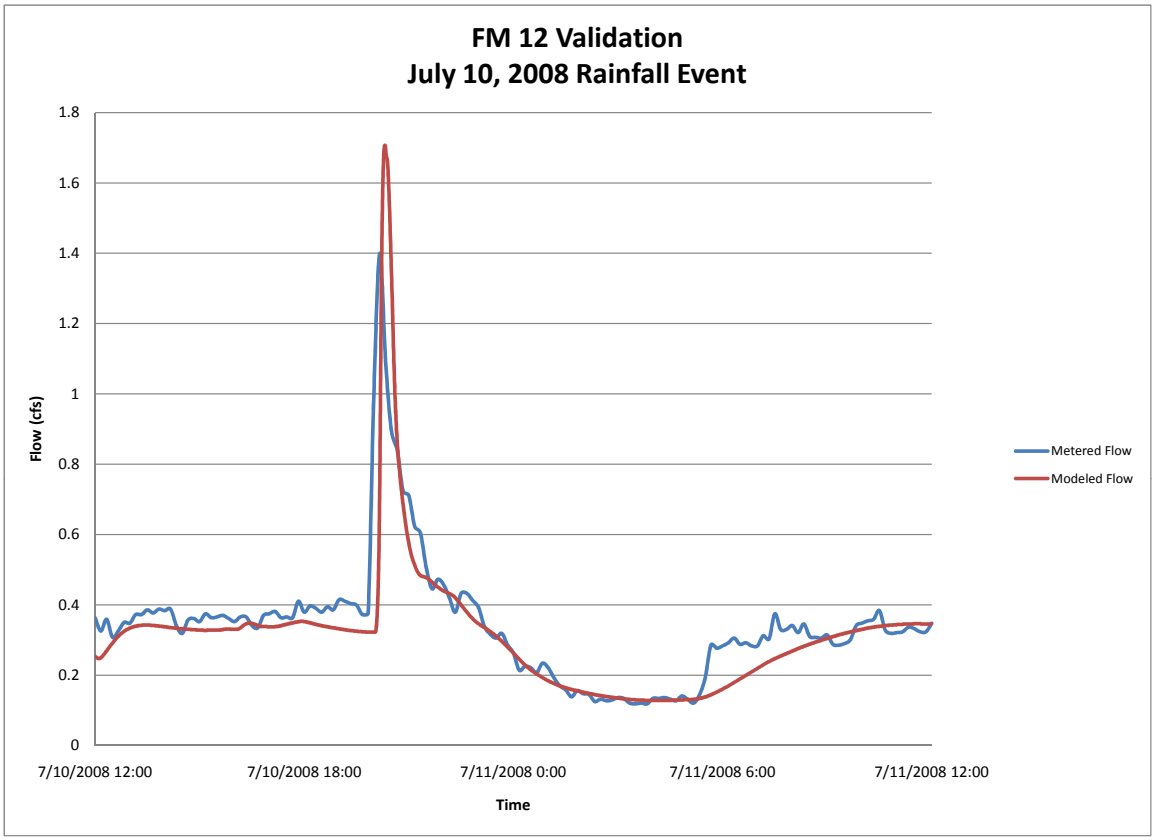

FM 7 Validation
July 10, 2008 Rainfall Event
Level (ft)
0.3
0.25
0.2
0.15
0.1
0.05
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

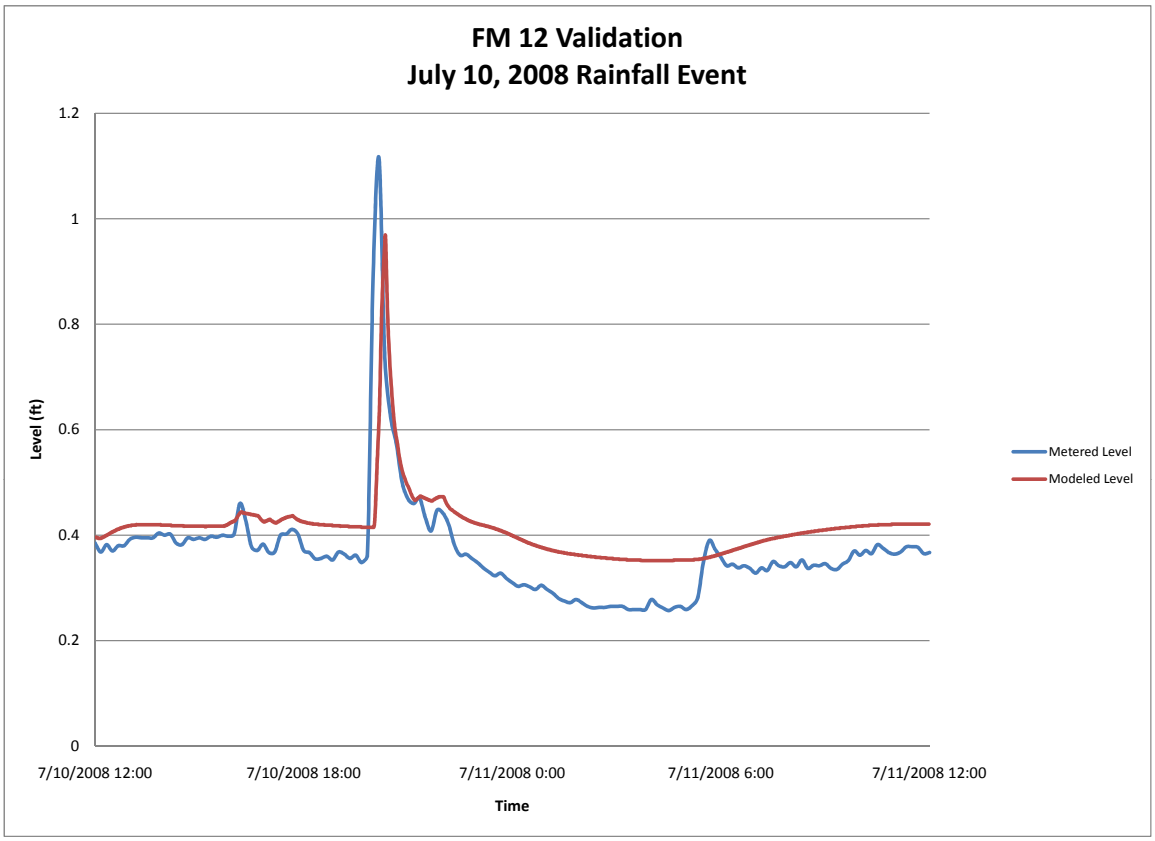

FM 8 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

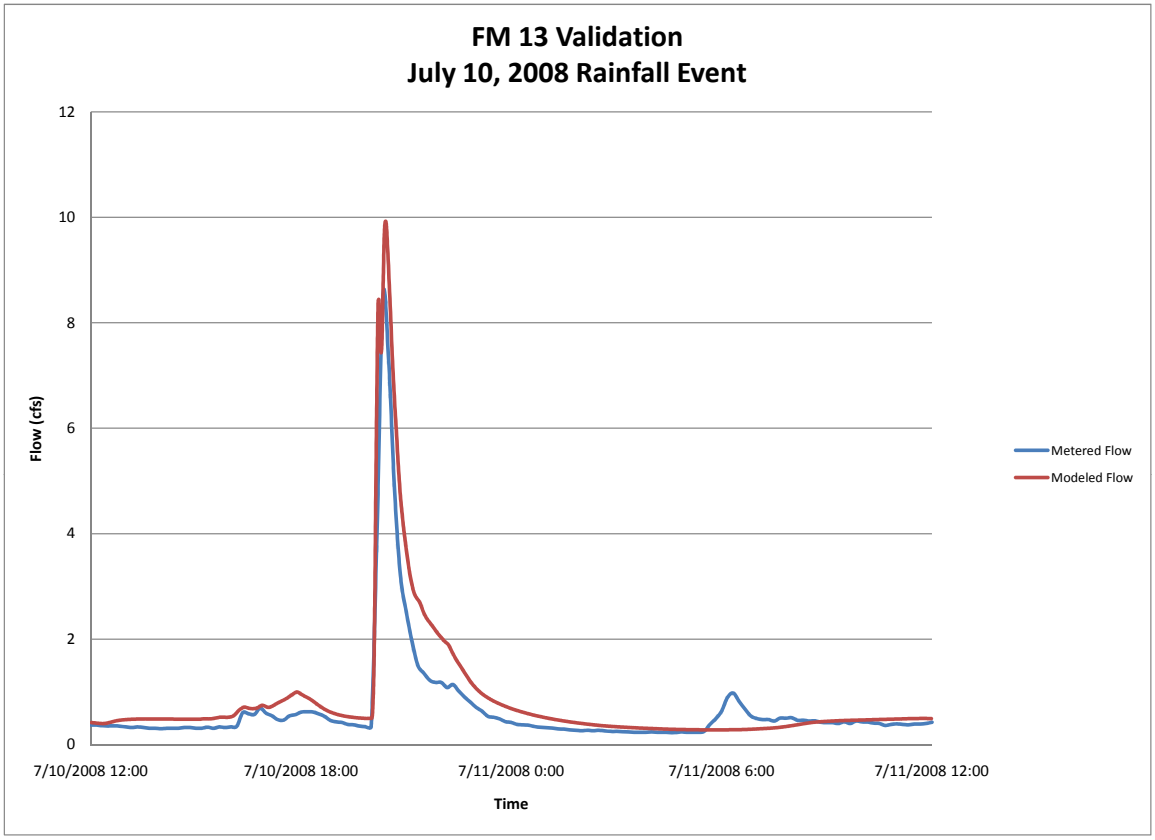

FM 8 Validation
July 10, 2008 Rainfall Event
Level (ft)
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

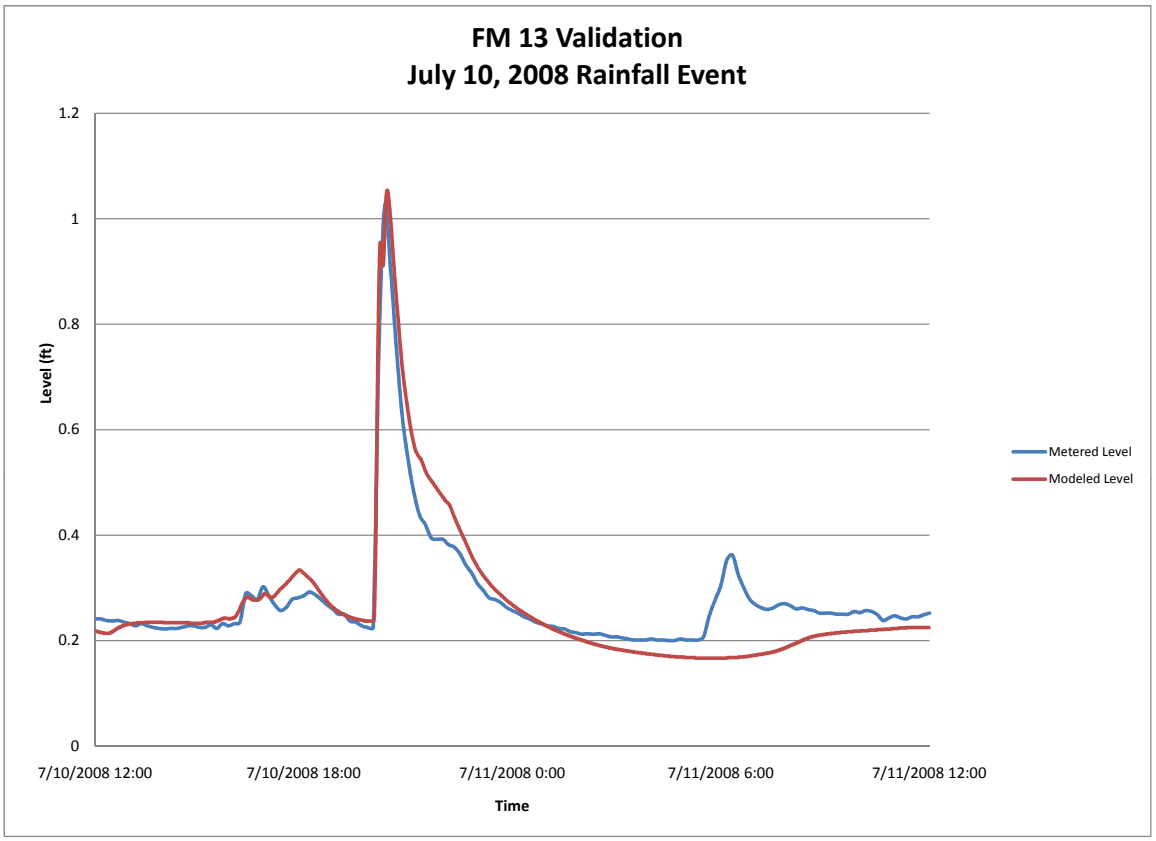

FM 9 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

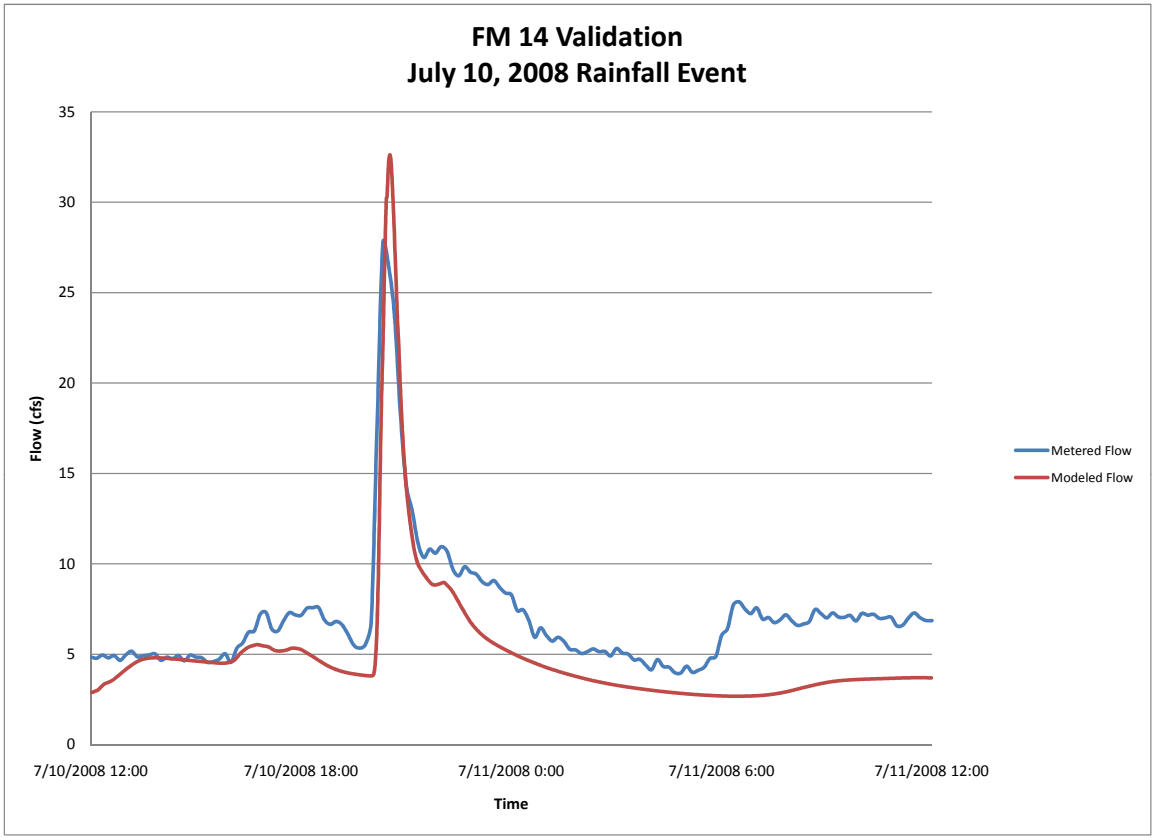

FM 9 Validation
July 10, 2008 Rainfall Event
Level (ft)
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

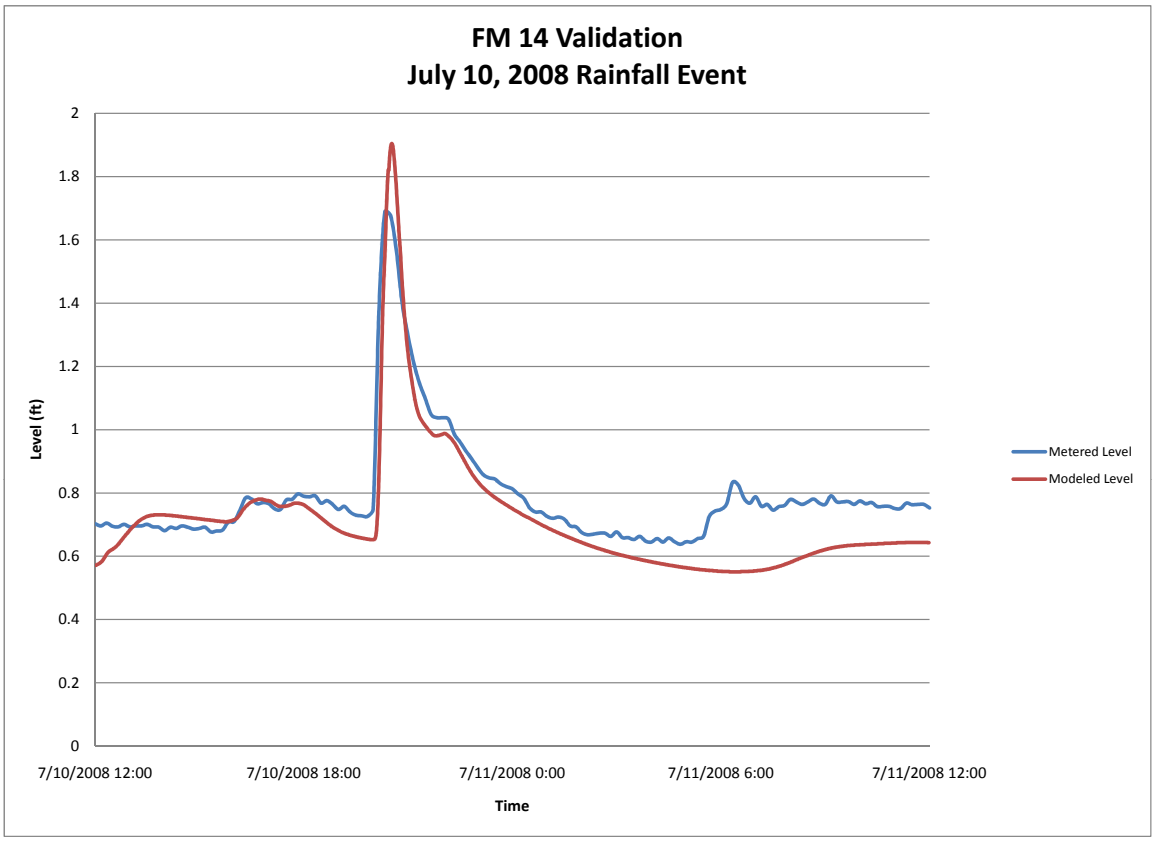

FM 12 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

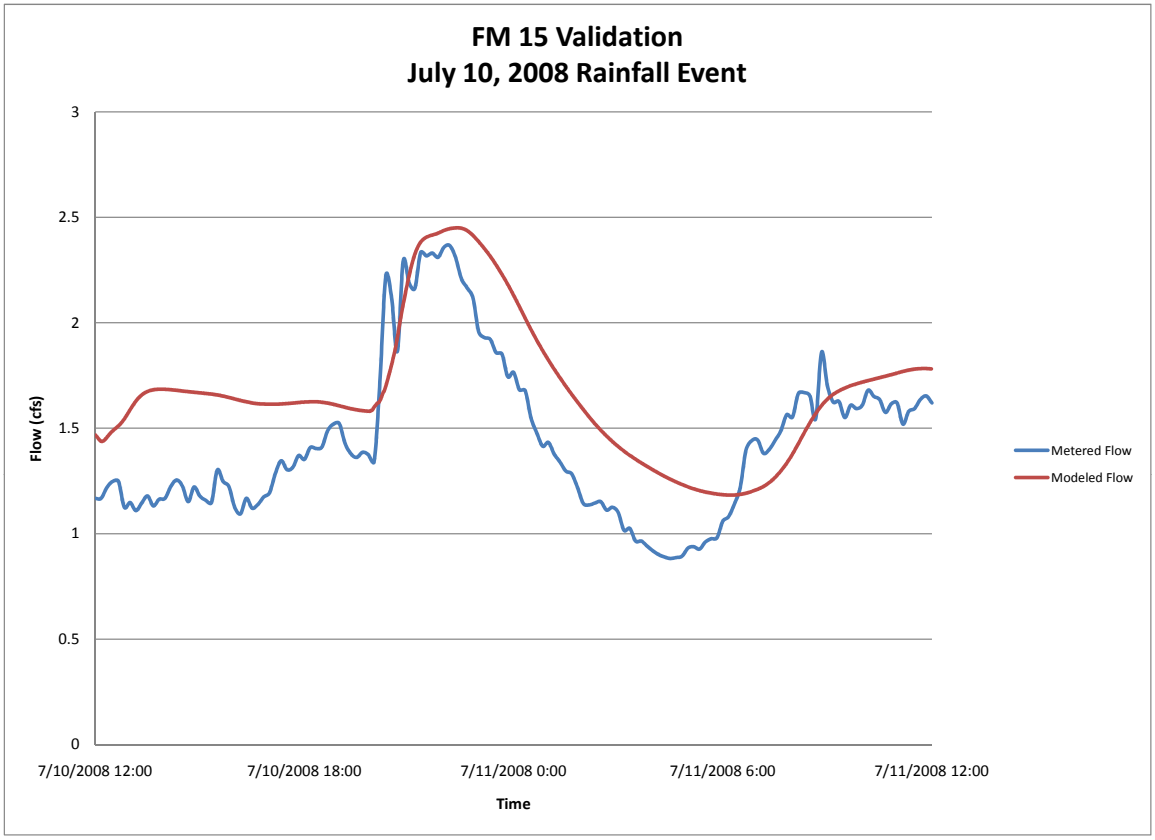

FM 12 Validation
July 10, 2008 Rainfall Event
Level (ft)
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

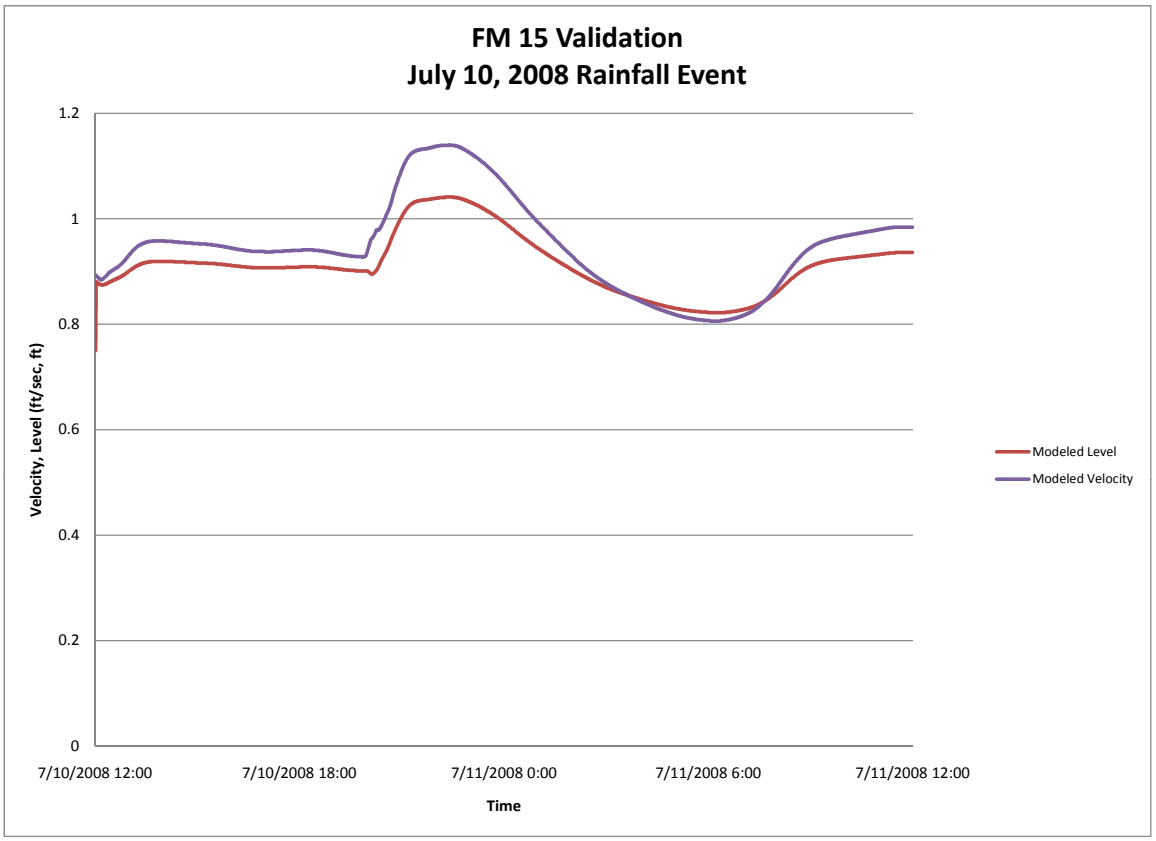

FM 13 Validation
July 10, 2008 Rainfall Event
12
10
8
6
4
2
0
Flow (cfs)
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

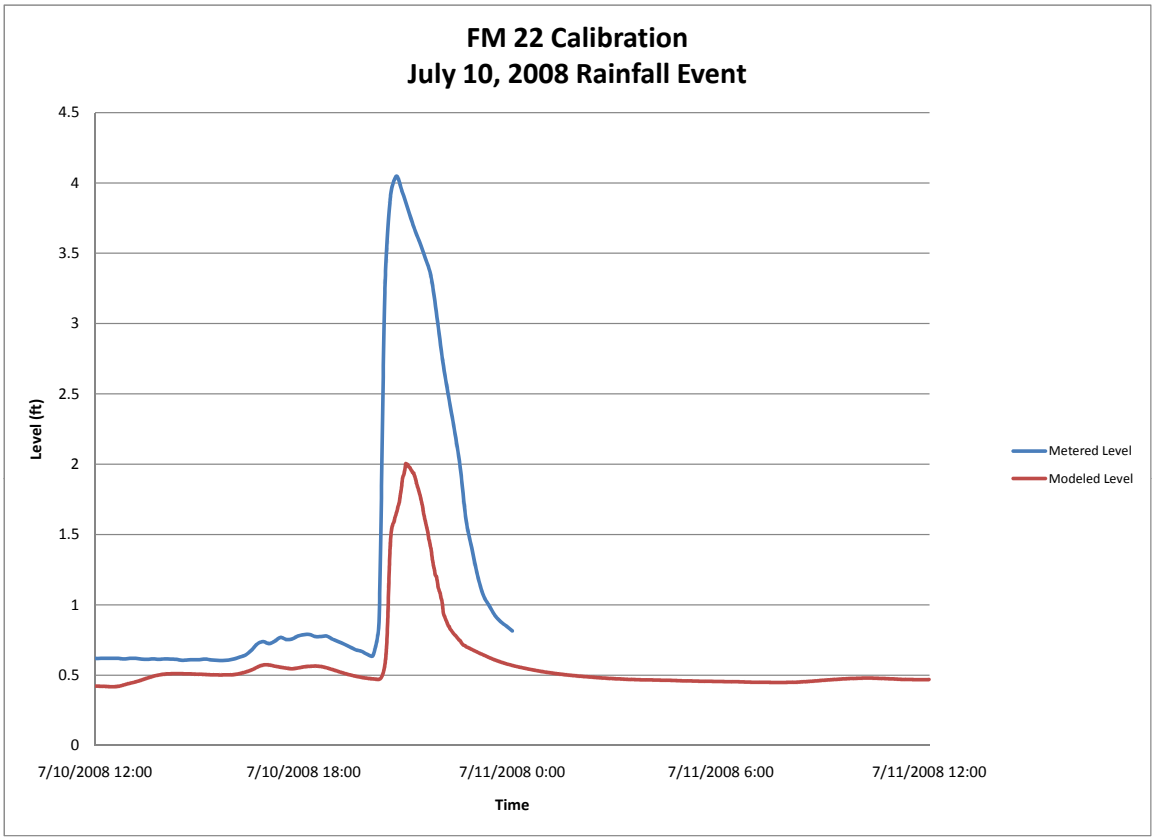

FM 13 Validation
July 10, 2008 Rainfall Event
1.2
1
0.8
0.6
0.4
0.2
0
Level (ft)
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

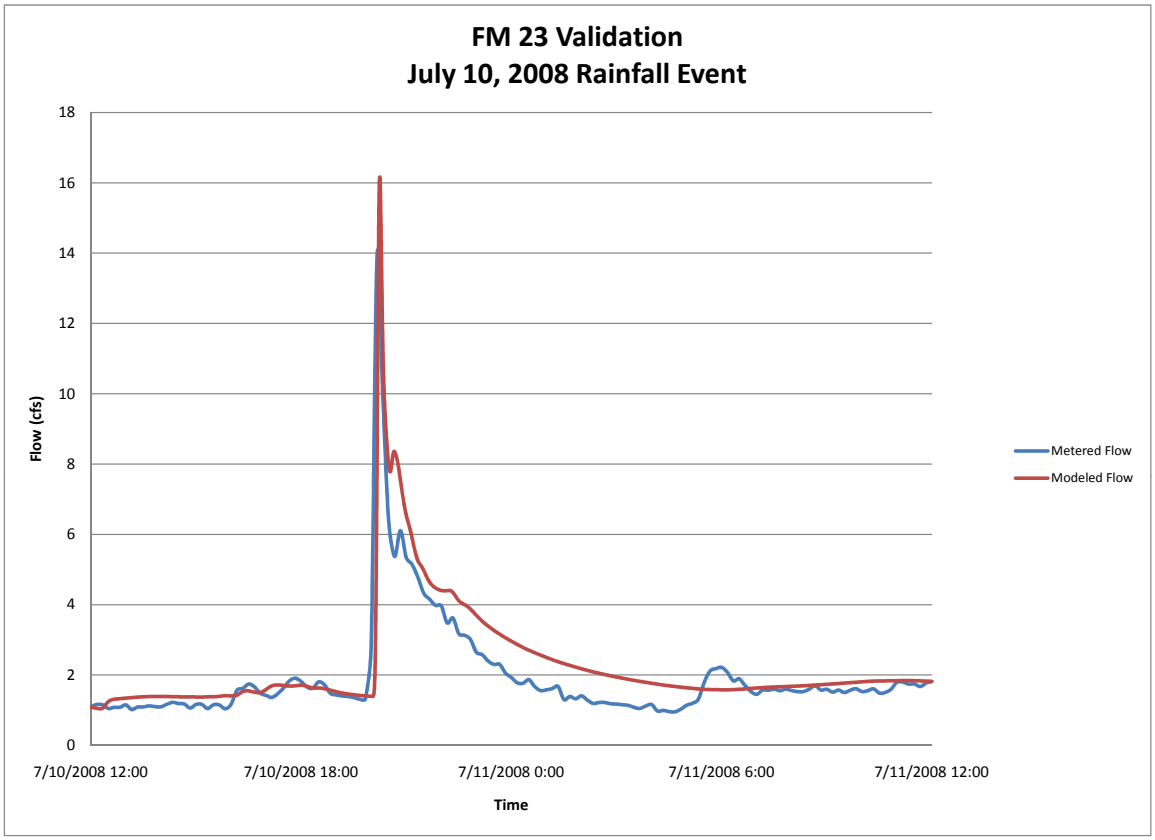

FM 14 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
35
30
25
20
15
10
5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

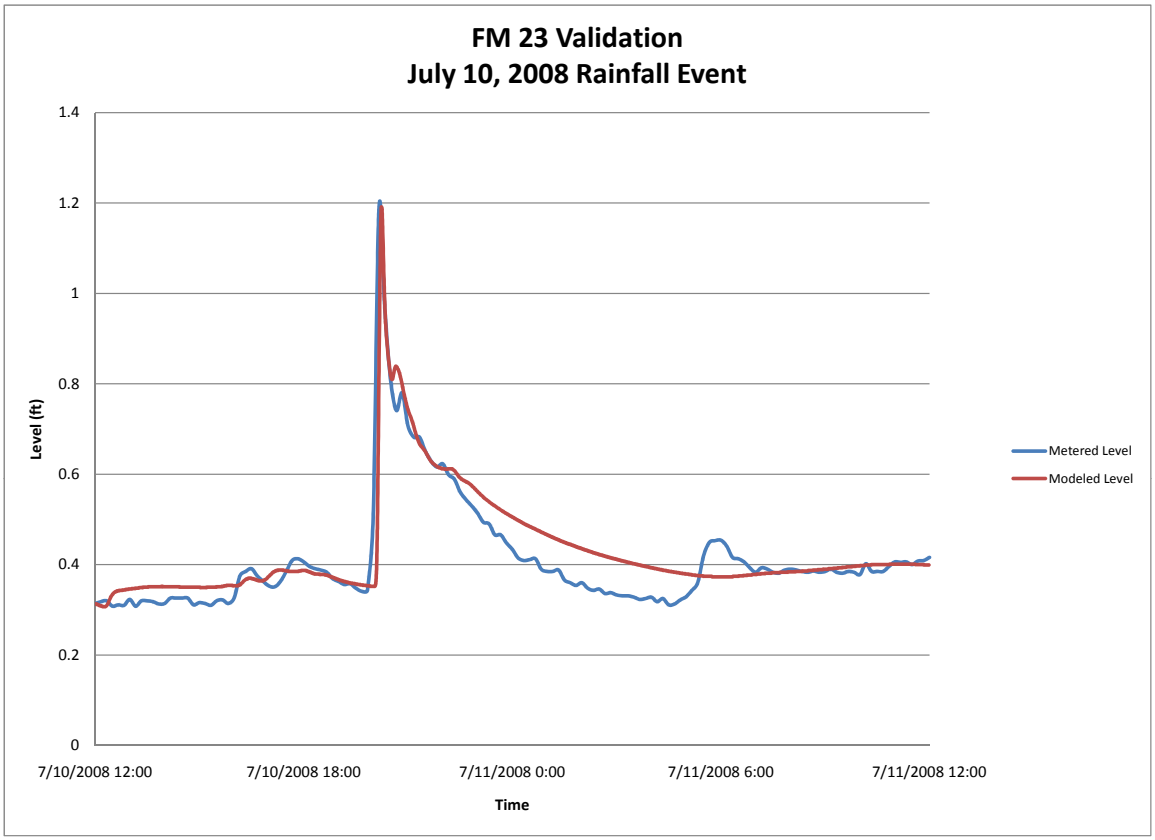

FM 14 Validation
July 10, 2008 Rainfall Event
Level (ft)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

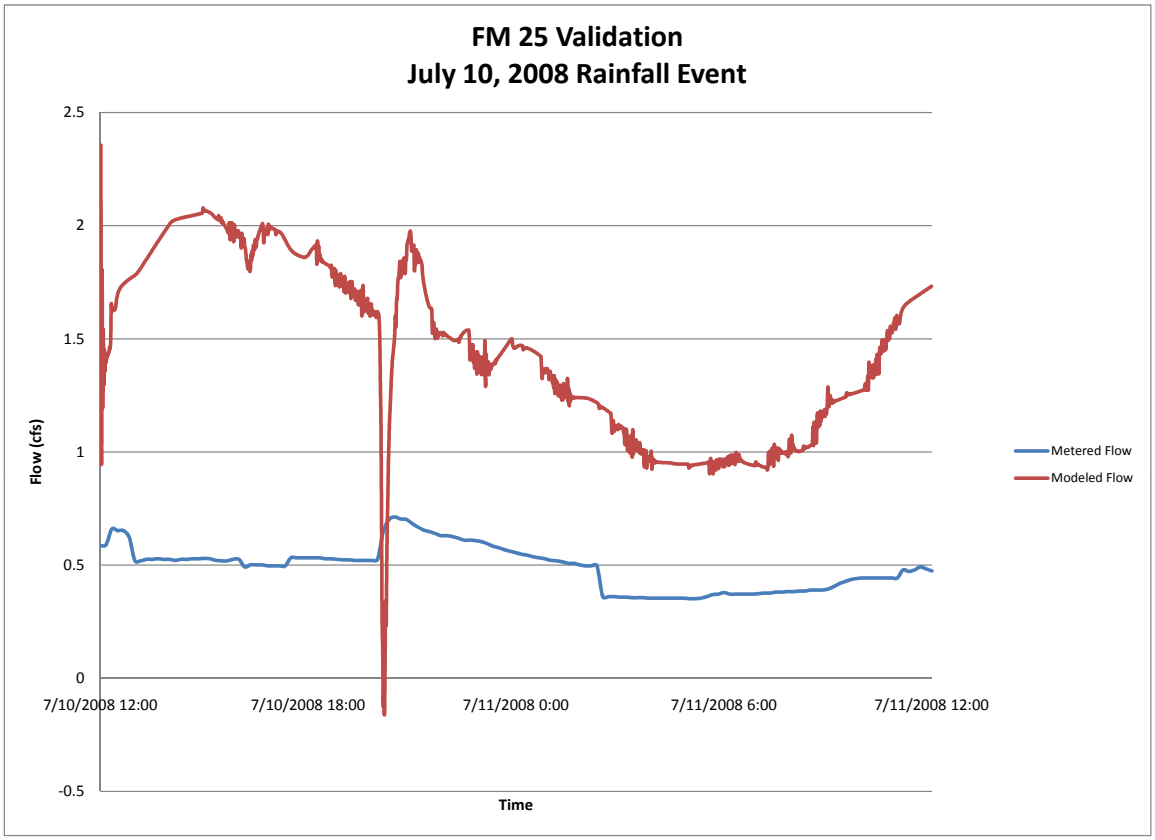

FM 15 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
3
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

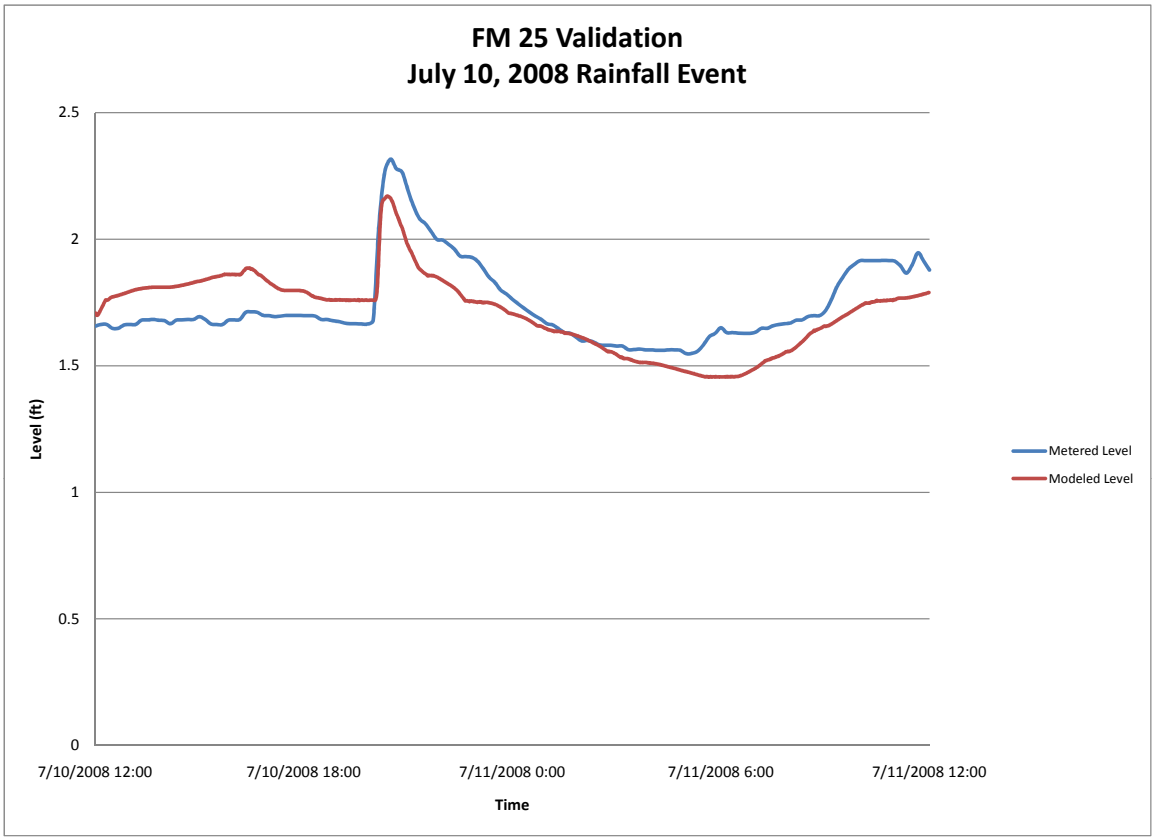

FM 15 Validation
July 10, 2008 Rainfall Event
Velocity, Level (ft/sec, ft)
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Modeled Level
Modeled Velocity

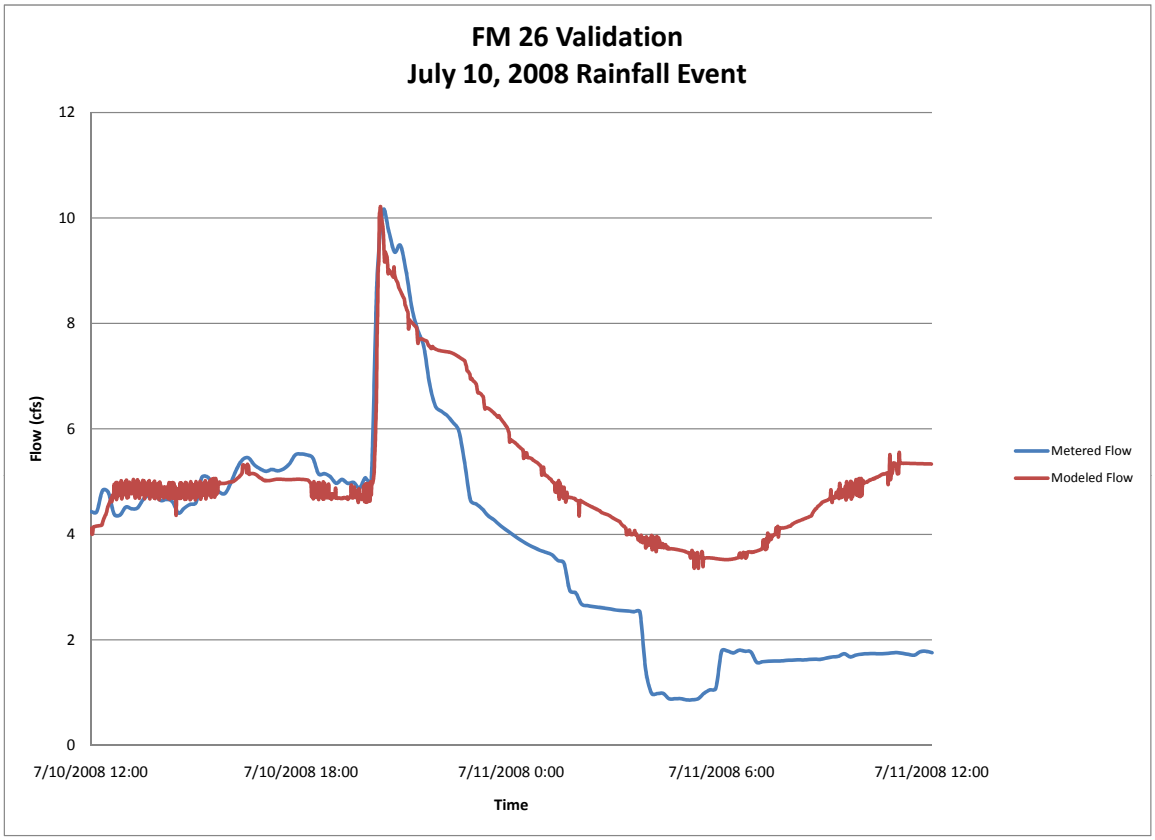

FM 22 Calibration
July 10, 2008 Rainfall Event
Level (ft)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

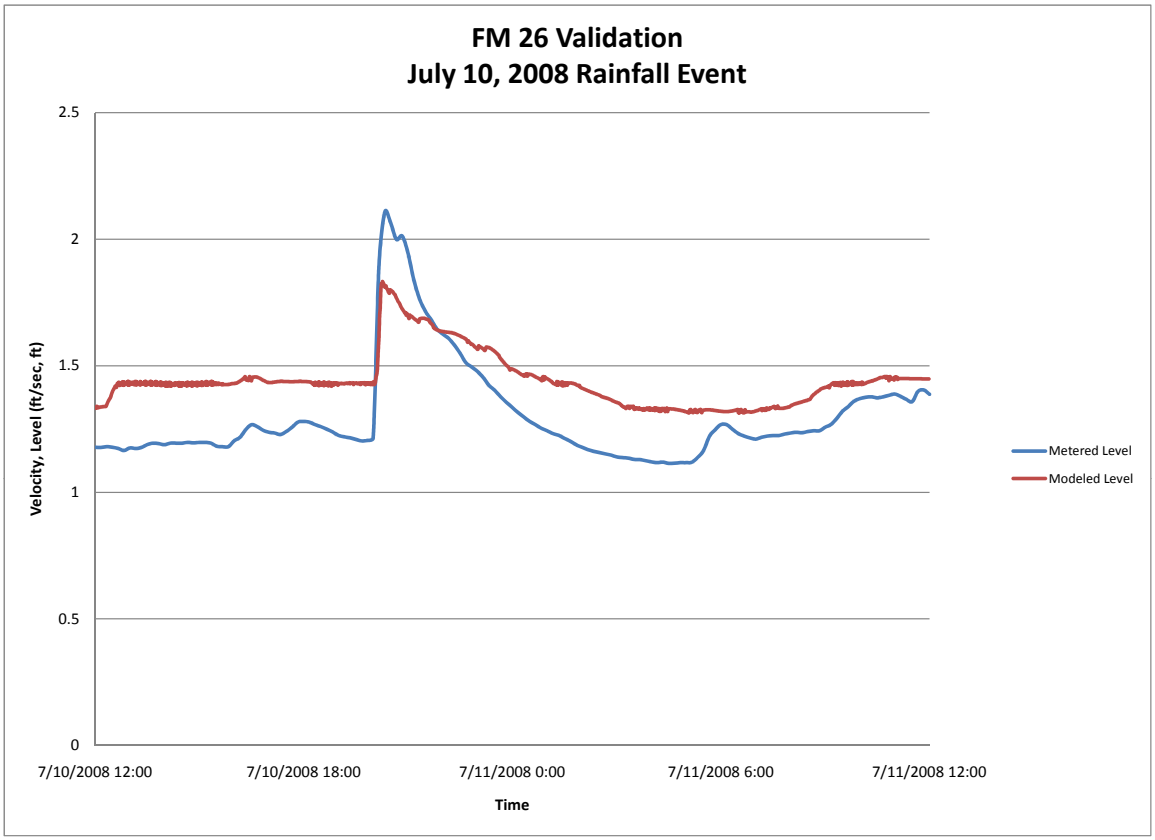

FM 23 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
18
16
14
12
10
8
6
4
2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

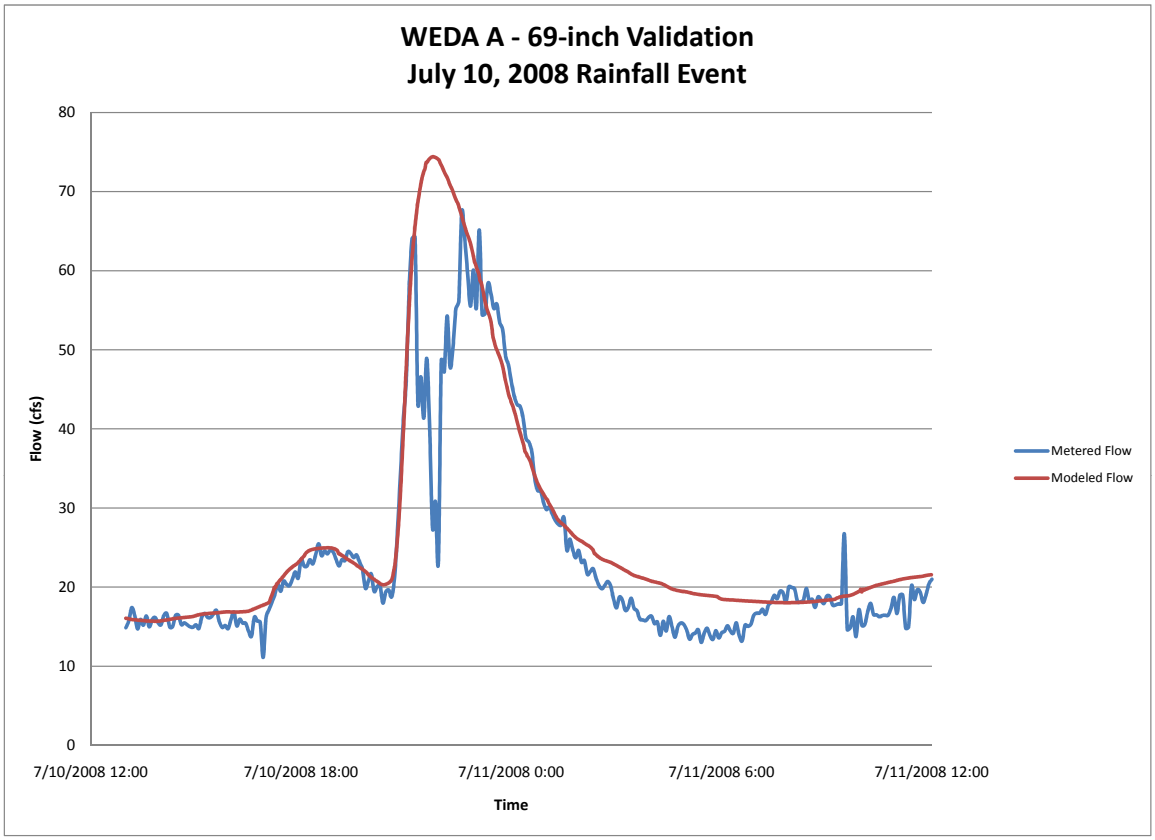

FM 23 Validation
July 10, 2008 Rainfall Event
Level (ft)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

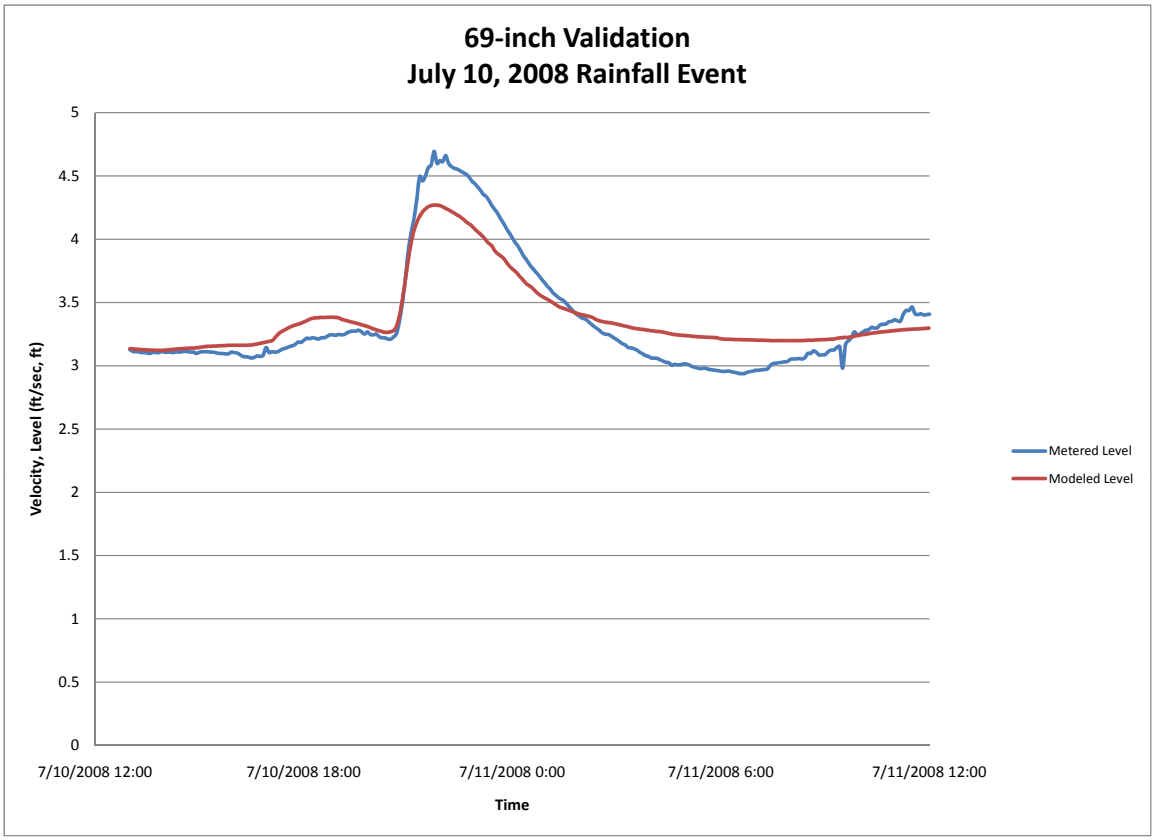

FM 25 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
2.5
2
1.5
1
0.5
0
-0.5
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

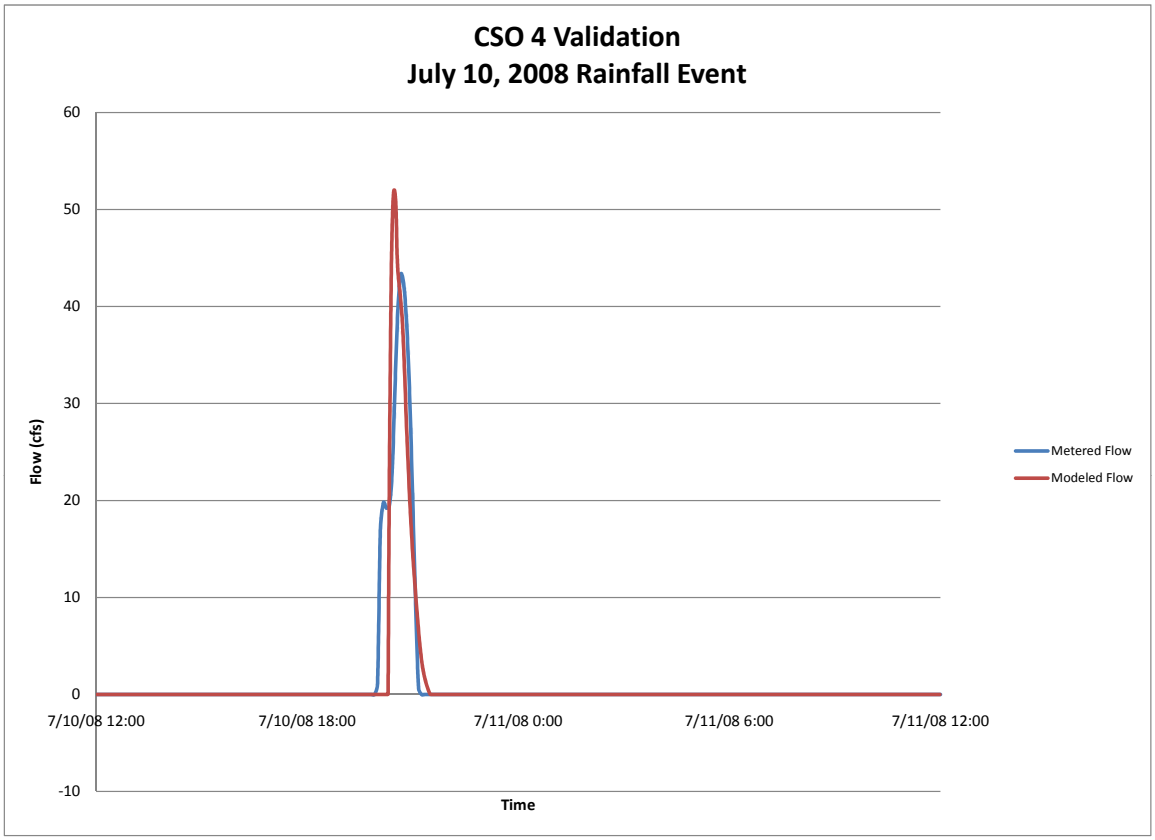

FM 25 Validation
July 10, 2008 Rainfall Event
2.5
2
1.5
1
0.5
0
Level (ft)
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level

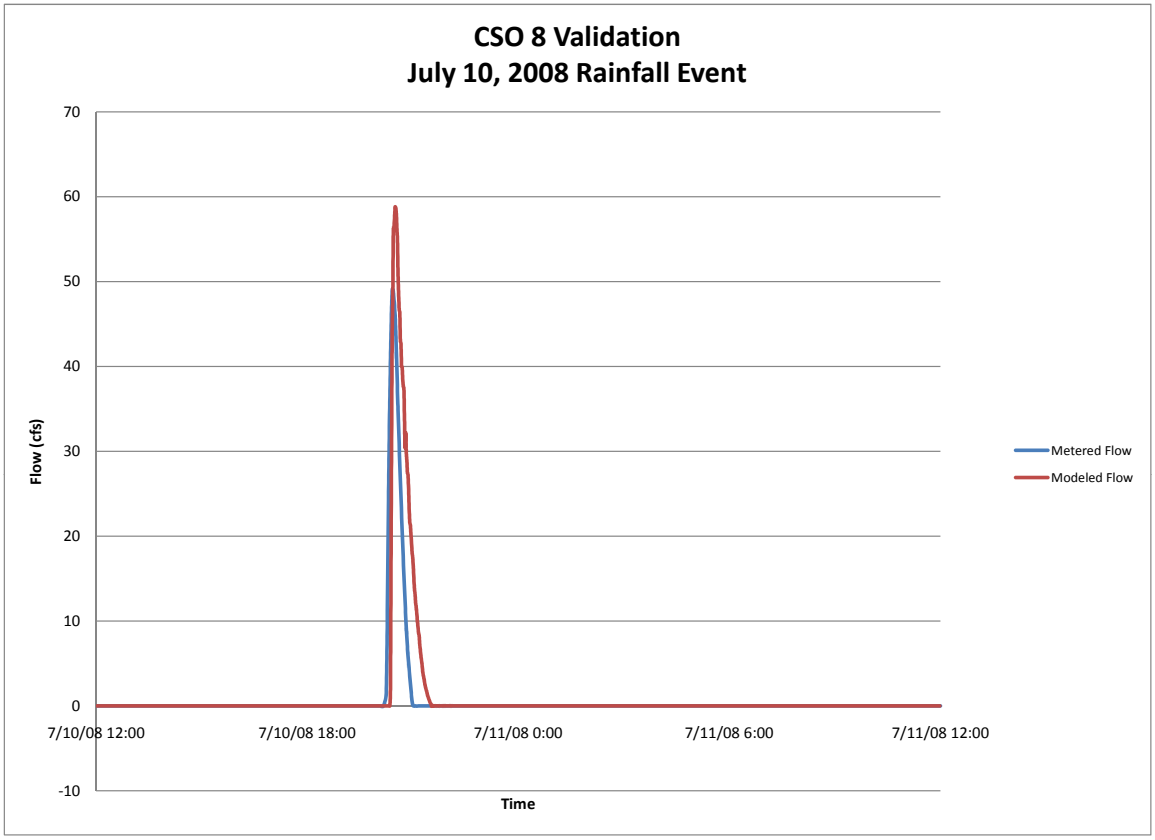

FM 26 Validation
July 10, 2008 Rainfall Event
12
10
8
6
4
2
0
Flow (cfs)
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow

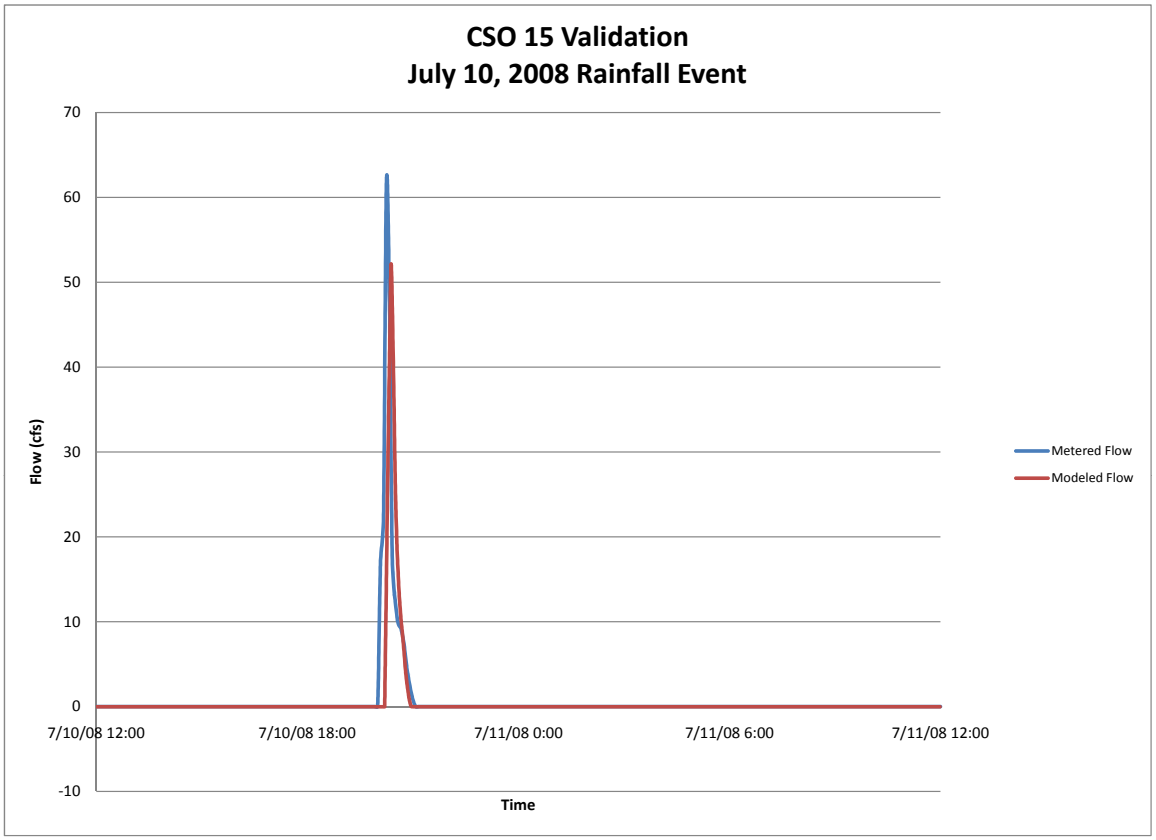

FM 26 Validation
July 10, 2008 Rainfall Event
Velocity, Level (ft/sec, ft)
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level


WEDA A - 69-inch Validation
July 10, 2008 Rainfall Event
Flow (cfs)
80
70
60
50
40
30
20
10
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Flow
Modeled Flow


69-inch Validation
July 10, 2008 Rainfall Event
Velocity, Level (ft/sec, ft)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
7/10/2008 12:00
7/10/2008 18:00
7/11/2008 0:00
7/11/2008 6:00
7/11/2008 12:00
Time
Metered Level
Modeled Level


CSO 4 Validation
July 10, 2008 Rainfall Event
Flow (cfs)
60
50
40
30
20
10
0
-10
7/10/08 12:00
7/10/08 18:00
7/11/08 0:00
7/11/08 6:00
7/11/08 12:00
Time
Metered Flow
Modeled Flow


CSO 8 Validation
July 10, 2008 Rainfall Event
70
60
50
40
30
20
10
0
-10
Flow (cfs)
7/10/08 12:00
7/10/08 18:00
7/11/08 0:00
7/11/08 6:00
7/11/08 12:00
Time
Metered Flow
Modeled Flow


CSO 15 Validation
July 10, 2008 Rainfall Event
70
60
50
40
30
20
10
0
-10
Flow (cfs)
7/10/08 12:00
7/10/08 18:00
7/11/08 0:00
7/11/08 6:00
7/11/08 12:00
Time
Metered Flow
Modeled Flow

APPENDIX C
FIRST FLUSH ANALYSIS

This section summarizes the results of the 2009 sewer water quality monitoring program to project first flush volumes that would be generated during the 1.2-in/hour 1-hour storm event as required by Illinois Code.

C.01 DEFINITION OF FIRST FLUSH

First flush is generally defined as the volume of combined stormwater in a combined sewer system (CSS) that has a higher concentration than typical wastewater because of settled solids in the sewer being resuspended in the high flows of the storm event. It is generally desirable to capture the first flush volume for treatment as it represents a possible impact on receiving water quality. Combined stormwater that follows the first flush is generally much lower in concentration and is less likely to cause water quality impacts.

Illinois Code Part 375.402 states that the first flush volume must be provided full treatment, unless an exception is granted. As described in Section 1.02 of this report, the City of Aurora and the Fox Metro Water Reclamation District (FMWRD) were granted an exception to this rule in July 1988, requiring that 57 percent of first flush be captured.

The design storm for first flush determination is a 1.2-in/hour intensity storm with a 60-minute duration which equates to approximately a 1-year 1-hour storm. The first flush begins when sewer flows begin to increase because of rainfall. The first flush ends when the concentrations of five-day biochemical oxygen demand (BOD or BOD_5), total suspended solids (TSS), and volatile suspended solids (VSS) drop below "background" dry weather concentrations or pre-event concentrations. The total volume of flow within the first flush period determines the amount of combined wastewater that represents the first flush volume. (See Figure A.03-2.)

C.02 BACKGROUND ON FIRST FLUSH ANALYSIS

In October 1983, the FMWRD (at the time known as the Aurora Sanitary District) published a report, titled *The Aurora Sanitary District Combined Sewer Overflow Study* (Walter E. Deuchler Associates, Inc.) that provided projections of first flush volumes based on computer simulations. The results of that analysis suggest that the first flush durations for the combined sewer overflow (CSO) basins ranged from 2 to 4 hours with an area-weighted average of about 2.7 hours. The analysis performed in this report will discuss the first flush durations as determined by the 2009 sewer water quality monitoring program and calculate first flush volumes based on XP-SWMM modeling results.

C.03 SEWER WATER QUALITY MONITORING PROGRAM

As discussed in Appendix A, during the months of May through September of 2009, two sequential samplers were installed at key points in the Aurora system. On the west side, Sampler 22 was installed at the FM 22 location just upstream of CSO 001 as shown on Figure A.03-3, which represents 2,301 acres of total watershed area and 731 acres of combined area. On the east side, Sampler 1 was located at the FM1 location on Hazel Ave (CSO 004 basin). The CSO 004 basin represents about 775 acres of total watershed and 381 acres of fully combined sewers (i.e., with street inlets connected to the combined sewer). The samplers were refrigerated sequential samplers programmed to collect samples every 15 minutes once activated and capable of collecting up to 24 samples. The samplers

were manually activated by field personnel when rain events were expected or had already begun. For longer-duration events, samples were retrieved by field personnel after six hours and the samplers were restocked with fresh bottles for continued sampling.

All samples were tested within required holding times for BOD, TSS, and VSS. The purpose of the first flush rule is to capture the sediment that settles in the bottom of the sewer during periods of low flow.

As shown on Table C.03-1, there were three successful wet weather sampling events for water quality (July 15, August 19-20, and September 20) in which one or both of the samplers was active. It was preferable to select rain events where there had been a considerable dry period preceding them. (Illinois Code 375.402 b suggests that a 10-day antecedent dry period is optimal.) However, with no control over weather patterns, field personnel take advantage of the wet weather events that occur, and these antecedent conditions are difficult to meet. Table C.03-1 suggests that the September 20 event meets this 10 dry days criteria while the July 15 and August 19 to 20 events saw rain in the preceding days.

Event	Total inches	Peak 1 hour intensity	Rainfall Time	Collection Time	Dry Days Preceeding	Samplers Collecting
July 15	0.22	0.21	4:15-5:30	4:30-16:15	5	22
August 19 to 20	0.71	0.61	16:15-18:30	16:45-4:30	2	1
September 20	0.88	0.36	16:15-20:45	15:15-21:00	>10	1 and 22
July 23 (Dry)	-	-		7:00-19:00	8	1 and 22

Table C.03-1 Sewer Water Quality Data Collection Events (2009)

In addition to collecting wet weather sewer WQ data, it is also necessary to establish a baseline; that is, what the sewer WQ is during dry periods. Baseline WQ data was collected on Thursday, July 23, between 7 A.M. and 7 P.M., after about 8 days without rain. (Although somewhat short of the ideal 10-day dry period, the 8-day period duration was considered adequate since there is uncertainty during a sampling program whether 10-day dry events will occur.) It is this baseline that helps establish the benchmark of when the first flush ends; when the WQ concentrations during a wet weather event drop below the baseline concentrations, the first flush is over, as shown in Figure A.03-2.

A. Baseline Sewer WQ Data

Figures C.03-1 through C.03-6 show the water quality data for the July 23 baseline WQ monitoring event. Sampler 1 at Hazel Ave., for the most part, shows expected characteristics. (See Figures C.03-1 through C.03-3.) The concentrations of BOD, TSS, and VSS are within a typical 50 mg/L to 300 mg/L range in concentration, with one outlier of about 500 mg/L. Concentrations are lowest at the beginning of the day and highest in the midday, which is consistent with the results for Strand's dry weather sampling program at Joliet. This phenomenon likely occurs because midday flow increases cause some degree of solids resuspension that does not occur during nighttime low flows. The average values of BOD, TSS, and VSS are shown in Table C.03-2; these average values appear reasonable and will be used to represent "background" conditions for evaluating first flush concentrations for wet weather WQ events at Sampler 1.

Figure C.03-1
Sampler 1 BOD Dry Weather
July 23, 2009

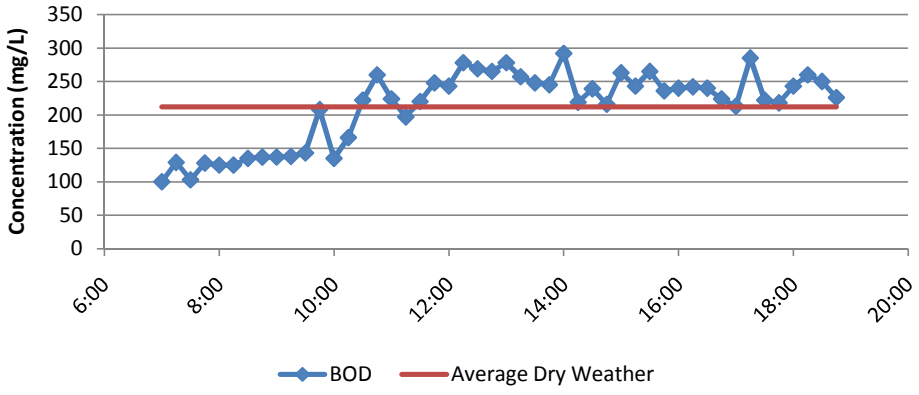


Figure C.03-2
Sampler 1 TSS Dry Weather
July 23, 2009

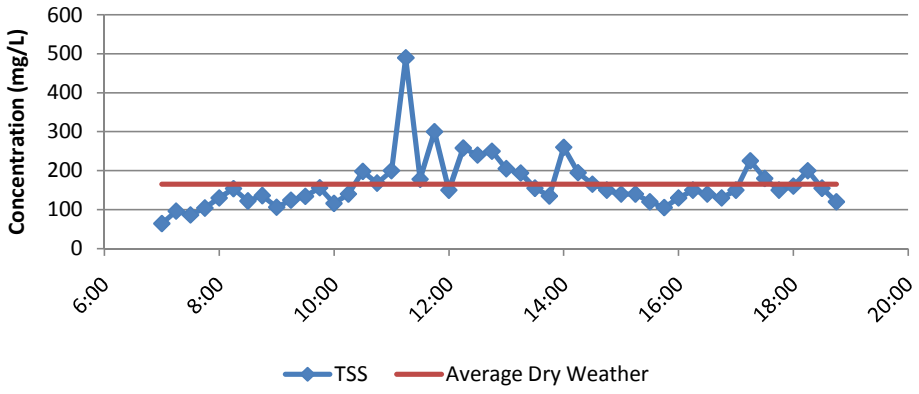


Figure C.03-3
Sampler 1 VSS Dry Weather
July 23, 2009

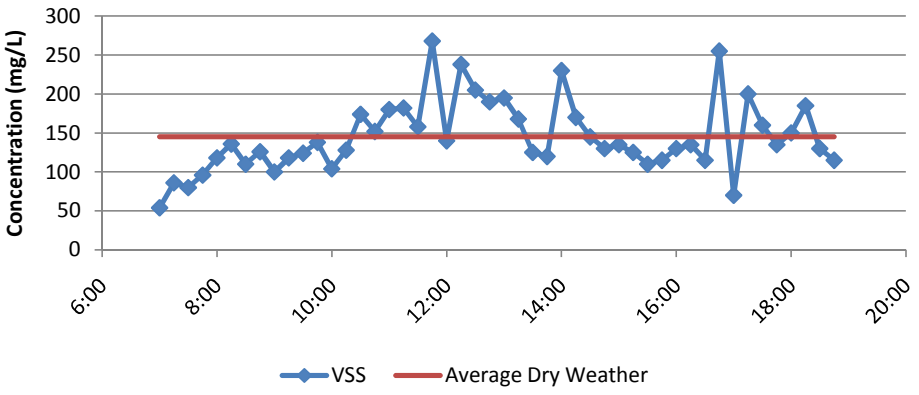


Figure C.03-4
Sampler 22 BOD Dry Weather
July 23, 2009

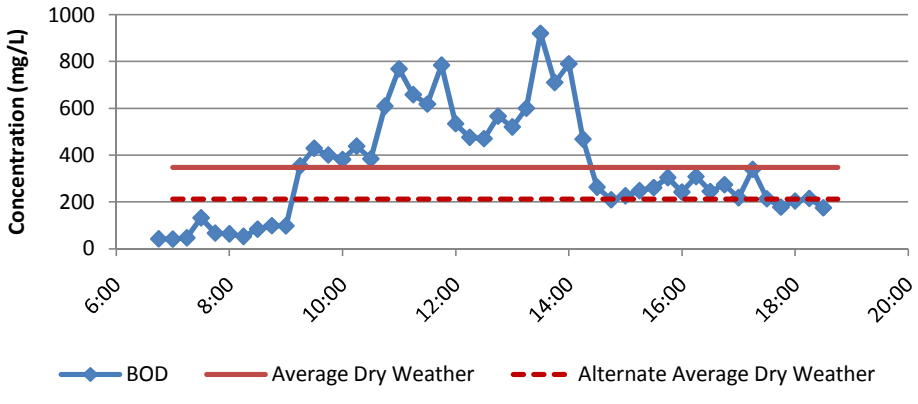


Figure C.03-5
Sampler 22 TSS Dry Weather
July 23, 2009

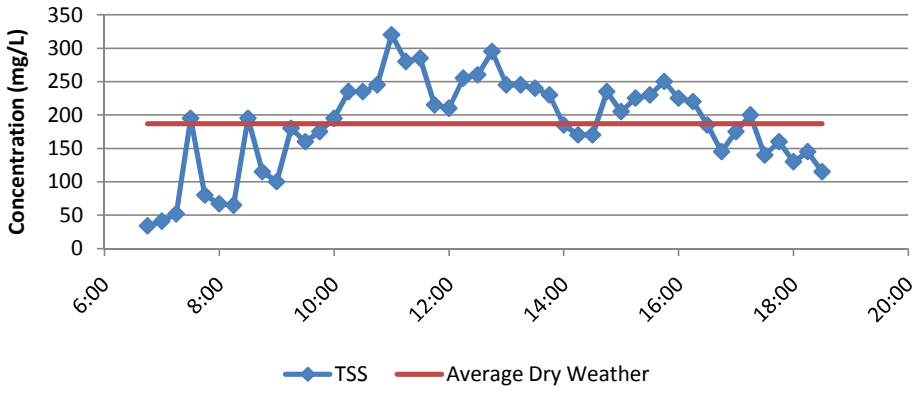
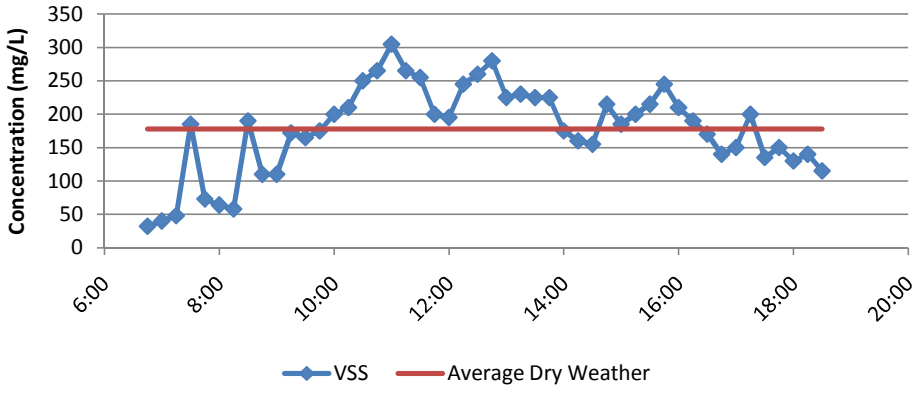


Figure C.03-6
Sampler 22 VSS Dry Weather
July 23, 2009



Parameter	Sampler 1 Hazel Ave. (CSO 004 basin)	Sampler 22 Rathbone Ave. (CSO 022 basin)
BOD (mg/L)	212	348* (212)
TSS (mg/L)	165	187
VSS (mg/L)	145	178

*Dataset reflects atypically high BOD values. Recommended BOD background data for analysis shown in parentheses.

Table C.03-2 Average Dry Weather Sewer Water Quality

Sampler 22 at Rathbone Ave. showed many expected characteristics, although with a noteworthy exception. (See Figures C.03-4 through C.03-6.) The data for VSS and TSS were generally in the 30 mg/L to 300 mg/L range, with the lowest values at the beginning and end of the sampling period and the highest values midday. The average values for TSS and VSS are shown in C.03-2. Sampler 22 showed some unexpected data for BOD, however. While concentrations and the beginning and end of the day were lower than midday values (as expected), the midday values in the 400 mg/L to 900 mg/L range were higher than expected. It appears likely that an industry was discharging a high strength waste during this period. This high midday concentration of BOD puts the average value for the day at about 348 mg/L, which is likely not representative of typical background conditions. Therefore, it is recommended that the first flush analysis apply the Sampler 1 BOD value of 212 mg/L as the background value, which will be conservative for identifying first flush duration.

B. Wet Weather Sewer Water Quality

Figures C.03-7 through C.03-22 at the end of this appendix show the wet weather WQ data relevant to this analysis

1. Hazel Ave. (CSO 004 Basin) Data (Sampler 1)

a. August 19-20 Event

Figure C.03-7 shows the rainfall and sewer response. Based on the sewer metering data, the flow began to increase around 17:00, which will be used as the beginning of the event.

Sampler 1 data for this event is shown in Figures C.03-8 through C.03-10. As shown on Figure C.03-8, the BOD data does not show a typical first flush pattern, and virtually all of the sample data is below the background value. This data does not appear to be useful for approximating first flush duration and will be disregarded.

Figure C.03-9 shows that the TSS data for this event follows a typical trend. Using the baseline value of 165 mg/L, it appears the first flush ends at 19:45, suggesting a 2.75-hour duration. (Note that the high concentration value at 22:30 appears to be an outlier caused by possible sample contamination and is disregarded.) Figure C.03-10 shows the VSS data for the event. Because the data hovers around the background

level for about two hours, the end of the first flush event is somewhat ambiguous; it appears to end between 19:45 and 21:00, suggesting a 2.75- to 4.0-hour first flush duration.

Because the TSS data appears to show the least ambiguous data for determining first flush, the duration value of 2.75 hours will be applied for the Hazel Ave. basin for this event. Based on the flow meter data, this suggests a basin first flush volume of 1.02 mil gal. Table C.03-3 summarizes this information.

First Flush Duration	Sampler 1		Sampler 22	
	August 19 to 20	September 20	July 15	September 20
BOD	-	2.25 h	1.25 h	1.25 h
TSS	2.75 h	2.75 h	1.75 h	2.75 h
VSS	2.75–4.0 h	2.75 h	1.75 h	2.5 h
Duration Applied	2.75 h	2.75 h	1.75 h	2.75 h
Total Inches	0.71	0.61	0.22	0.61
Peak Intensity (in/hr)	0.88	0.36	0.21	0.36
Event Volume	1.02 mil gal	0.33 mil gal	0.35 mil gal	0.37 mil gal
Typical Duration Applied	2.75 h		2.75 h	

Table C.03-3 Summary of First Flush Water Quality Sampling

b. September 20 Event

Figure C.03-11 shows the rainfall and sewer response and Figures C.03-12 through C.03-14 show the sampling data. The sewer metering data began to increase around 16:45, and the sampled concentrations began to increase around 16:30. Based on the earlier of these two, 16:30 will be used as the beginning of the event.

Figure C.03-12 shows the BOD data for this event shows a fairly typical trend, although with a dip midway in the event. The sewer concentrations appear to drop off around 18:45, suggesting a 2.25-hour duration event. Figures C.03-13 and C.03-14 showing the TSS and VSS data both exhibit a classic first flush curve, with the event ending around 19:15, suggesting a 2.75-hour first flush duration.

This 2.75-hour first flush duration will be applied for this event. Based on the flow meter data, this suggests a basin first flush volume for this event of 0.33 mil gal. Table C.03-3 summarizes this information.

Both events for the Hazel Ave. basin suggest a first flush duration of 2.75 hours. This is somewhat longer than the 2-hour first flush duration identified in the 1983 report for the CSO 004 basin, although within the 2- to 4-hour typical range for the basins in the CSS. However, the first flush volume appears to be impacted by the storm intensity they represent.

2. Rathbone Ave. (CSO 001 Basin) Data (Sampler 22)

   a. July 15 Event

   Figure C.03-15 shows the rainfall and sewer response and Figures C.03-16 through C.03-18 show the sampling data. The sewer metering data began to increase around 4:45, and the sampled concentrations began to increase around 4:30. Based on the earlier of these two, 4:30 will be used as the beginning of the event.

   Figure C.03-16 shows the BOD data for this event has a fairly typical trend. The sewer concentrations appear to drop off around 5:45, suggesting a 1.25-hour duration event. Figures C.03-17 and -18 showing the TSS and VSS data both show a classic first flush curve, with the event ending around 6:15, suggesting a 1.75-hour first flush duration.

   This 1.75-hour first flush duration will be applied for this event. Based on the flow meter data, this suggests a basin first flush volume for this event of 0.35 mil gal. Table C.03-3 summarizes this information.

   b. September 20 Event

   Figure C.03-19 shows the rainfall and sewer response and Figures C.03-20 through C.03-22 show the sampling data. The sewer metering data began to increase around 17:00 and the sampled concentrations began to increase around 16:45. Based on the earlier of these two, 16:45 will be used as the beginning of the event.

   Figure C.03-20 shows the BOD data for this event follows a typical trend. The sewer concentrations appear to drop below the alternate background value of 212 mg/L around 18:00, suggesting a 1.25-hour duration event.

   Figures C.03-21 and C.03-22 showing the TSS and VSS data include a classic first flush pattern, with the concentrations dropping below the background value around 19:15 to 19:30. The first flush durations for TSS and VSS are 2.75-hours and 2.5-hours, respectively.

   The 2.75-hour first flush duration is applied for this event. Based on the flow meter data, this suggests a basin first flush volume for this event of 0.37 mil gal. Table C.03-3 summarizes this information.

Because the September 20 event is somewhat larger than the July 15 event, the 2.75-hour first flush duration from that event will be assumed for this basin. This is somewhat longer than the 2-hour first flush duration for the CSO 001 basin identified in the 1983 report, although within the typical 2- to 4-hour range for first flush duration for all the basins.

C.04 PROJECTING FIRST FLUSH DURATIONS AND VOLUMES

A. Projecting First Flush Durations for all Basins

The next goal is to determine the first flush duration for the entire system. For straightforward calculation, it is desired to select a single systemwide first flush duration rather than applying a different first flush duration for each basin. The sampling program described in the previous section identified 2.75-hour first flush durations for both the Hazel Ave. and the Rathbone Ave. basins. These sampled basins represent just over half of the CSS both in terms of total acreage and combined acreage. This suggests that results in these two basins will largely dominate the overall results. As discussed in Section C.02, the 1983 report identified 2- to 4-hour first flush durations for individual basins, with an approximately 2.7-hour systemwide area-weighted average. This apparent consistency between the two data sets is logical, since first flush duration would remain dependent on overall basin characteristics. Based on this information, it appears that a first flush duration of 2.75 hours for the entire system is reasonable.

B. Projecting First Flush Overflow Volumes for all Basins

As discussed in Section C.01 above, first flush volume is defined as the volume generated during the first flush duration for a 1-hour 1.2-inch storm (approximately 1-year return frequency). Because the events for which water quality sampling information was obtained fall short of this standard in terms of both intensity and total rainfall, the total first flush volume was instead projected based on the XP-SWMM model results. The first flush storm was run through the model beginning around 10:20 A.M. to coincide with the peak dry weather flow period, and the hydrographs for all overflow points and key points within the model were collected for analysis.

Figure C.04-1 shows the locations within the model used to project the overflow and total system first flush volume. Attachment C.04-1 shows the flow rates in cfs projected by the model for the duration for each of the points of interest identified in Figure C.04-1 for the peak flow period from 10:00 through 15:30.

For two locations within the model, the results were adjusted prior to analysis. As discussed previously in this report, the model did not appear to simulate the behavior of the CSO 001 structure accurately, often underpredicting overflow volumes, especially for smaller storms. In addition, the model appears to predict flows in the 69-inch interceptor somewhat in excess of what Fox Metro indicates is its peak capacity. Therefore, for the purpose of conservatively projecting the capture, adjustments to these model projections have been applied, which are shown on Attachment C.04-1 as “CSO 001-Adj” and “69-inch Upstream of WWTP-Adj.”

Two factors are applied in the calculation of this adjustment. First, Fox Metro has indicated the capacity of the 69-inch interceptor is limited to a peak instantaneous flow of 59.1 mgd (91.4 cfs) and to a peak hourly flow of 50.5 mgd (78.2 cfs). However, the model predicts flows greater than this for the segment just upstream of the WWTP (Link 162), suggesting that overflows, in particular at CSO 001, may be underpredicted. Therefore, for periods where the model predicts flows above the peak hourly flow of 78.2 cfs, the flow in excess of 78.2 cfs is considered a “correction” to the CSO 001 overflow rate.

S:\MAD\1100-1199\1181\001\Data\GIS\Figures\Figure C.04-1 Model Locations 11x17.mxd



FIGURE C.04-1
1181.001

STRAND ASSOCIATES, INC. ENGINEERS

MODEL LOCATIONS FOR FIRST FLUSH DETERMINATION

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA
KANE COUNTY, ILLINOIS

Second, the model appears to overpredict the amount of flow that can pass from the 96-inch Rathbone trunk sewer into the 69-inch interceptor through the two 15-inch pipe orifices. This analysis assumed that the typical overflow condition limiting flow into the interceptor is about 16 cfs, as discussed in C.04.B.a. (Note to the reader: This analysis is somewhat detailed and is not necessary for the overall understanding of the first flush analysis.)

a. Projection of Typical Limiting Flow into 69-inch Interceptor

This analysis applied Toricelli's equation:

$Q = C_d A \sqrt{(2gh)}$

Where:

Q = flow (cfs)
C_d = orifice coefficient
A = area of orifices
g = gravity (32.2 ft/s^2)
h = head difference across the orifice

It was assumed that both the entrance and exit of the 15-inch pipes are submerged and that the pipes may be treated as curved entrance tubes (C_d=0.82). To determine a range of likely flow into the interceptor, a range of heads must be determined. To ascertain the maximum flow into the interceptor during overall periods of high flow, it was assumed that the water surface in the trunk sewer was at the level of the dam (about to overflow) and that the water surface in the interceptor is at the top of the 15-inch orifices (just submerged), yielding an h value of 2.25 feet. This maximum flow was determined to be about 24 cfs.

To estimate the minimum value of flow, it was assumed that the hydraulic grade in the interceptor was surcharged to the dam height and that the 96-inch was overflowing the dam at about 3 inches, yielding a minimum h value of 0.25 ft. This minimum flow was determined to be about 8 cfs. Therefore, analysis of the orifices suggests the flow into the 69-inch is likely in the range of 8 to 24 cfs, with most typical occurrences to be in the midrange between the two, at about 16 cfs.

To confirm this estimate of a typical flow rate into the interceptor, the Manning capacity of the interceptors upstream and downstream of the interceptors was calculated, assuming a full pipe. The upstream 54-inch interceptor has a capacity of approximately 49.1 cfs, applying the overall interceptor slope between CSO 005 and CSO 001. The downstream 69-inch interceptor has a capacity of approximately 64.5 cfs. The difference between the two values is 15.4 cfs, suggesting that the 16 cfs approximation is reasonable.

Based on this approximate limit of 16 cfs, where the model shows the peak flow into the interceptor to exceed this value, the flow in excess of the limit is considered a "correction" to the CSO 001 overflow rate. Then, to determine the "adjusted" CSO 001 flow, the maximum of these two corrections was added to the model-projected CSO 001 flow. To determine the "adjusted" 69-inch WWTP interceptor flow, the maximum of these two corrections was subtracted from the model-projected 69-inch WWTP interceptor flow.

Without this adjustment, the model suggests that 3.08 mil gal of overflow would occur at CSO 001, compared with the 4.93 mil gal of total flow in the CSO 001 basin, or about 62 percent. With the proposed adjustment, the total overflow is projected to be about 4.57 mil gal, or about 93 percent. (Note: A sensitivity analysis on the 16 cfs assumption showed only a small degree of sensitivity to this assumption. The adjusted overflow volume changed only about 5 percent when the limiting orifice flow was varied from 8 cfs to 24 cfs.)

Table C.04-1 shows the calculated volumes at each of these model locations from the beginning of when sewer flows began to increase for 2.75 hours (from 10:26 to 13:11).

C. Projecting First Flush Overflow Volume at the WWTP

To project the volume of overflow that would occur at the WWTP (shown as "Fox Metro CSO" on Table C.04-1) during the first flush event, flow and overflow information for a 1.2-inch 1-hour event was requested from Fox Metro's consulting engineer. In response to this request, a spreadsheet showing model results for a variety of storm intensities was provided. The model was calibrated on a May 11, 2002, rainfall event of approximately 4 hours of high intensity that was both preceded and followed by rainfall of lower intensity. From this data, the overflow volume for a range of events was projected by scaling the peak storm intensities to represent return frequencies of 3-month through 10-year storms, based on the 3-hour storm. This analysis for first flush is based on that information provided.

Attachment C.04-2 shows the rainfall patterns that were modeled, as provided by Fox Metro. Peak rainfall occurred during the period of 20:00 to 24:00. The data show that only the most intense event modeled (the "10-year" event) saw a 1-hour period with rainfall in the range of 1.2 inches per hour: the 1.27 inches that fell during the 20:00 hour. The total overflow that occurred from when the flows started to increase at about 20:00 through to 22:45 (2.75 hours) was about 3.4 mil gal. (Graphs for overflows provided by Fox Metro can be found at the end of this appendix.) However, this value likely overpredicts the first flush volume, since the 1.27 inches that fell for the first hour was followed by another 3 hours of intense rainfall of approximately 1.9 inches. Therefore, basing first flush overflow on this value would likely be excessively conservative, and it is useful to identify a "lower bound" value.

The "1-year" storm event showed 1.15 inches of rain over the 2-hour period of 20:00 to 22:00. This is close to the 1.2 inches of total rainfall, although the duration is longer than the 1 hour applied for first flush, suggesting this event may provide a lower bound on the first flush volume. The total overflow that occurred during the 2.75-hour period starting at 20:10 when flows began to increase was 2.2 mil gal. Therefore, the total WWTP overflow during the 2.75-hour first flush period is likely between 2.2 mil gal and 3.4 mil gal. For the purpose of this analysis, it will be assumed that the first flush overflow volume is in the midrange of these values, 2.8 mil gal.

The total first flush overflow volume systemwide is therefore estimated to be approximately 21.3 mil gal, as shown on Table C.04-1. Next, the total amount of first flush flow captured and eliminated must be determined.

Table C.04-1 Model-Projected First Flush Volumes

Model Location	Model Link Name		First Flush Volume (mil gal)
Overflow Volumes			
CSO 001-Adj	Link 675-Adj		4.57
CSO 002	Link 797		0.00
CSO 003A	Link 798		0.00
CSO 004	Link 673		6.09
CSO 005	Link 684		0.07
CSO 008	Link 691		3.36
CSO 010	Link 373		0.74
CSO 015	CSO 015 Weir		2.55
CSO 018	Link 692		0.00
CSO 021	Link 772		0.14
CSO 022	Link 808		0.14
CSO 023	Link 814		0.06
CSO 025	Link 339		0.46
CSO 027 (Bypass)	Pump 3		0.33
CSO 027 (Treated)	Link 820		0.00
Fox Metro CSO			2.80
		Total Overflow Volume (mil gal)	**21.31**
Captured/Eliminated Volumes			
CSO Plant Captured			
Total Flow to CSO Plant			
CSO Plant (North)	Link 780		0.84
CSO Plant (South)	Link 740		0.63
Flow Not Captured at CSO Plant			
CSO 027 (Bypass)	Pump 3		-0.33
CSO 027 (Treated)	Link 820		0.00
		Total CSO Plant Captured Volume (mil gal)	1.14
WWTP Captured			
69-inch Upstream of WWTP-Adj	Link 162-Adj		4.32
Fox Metro CSO			-2.80
		Total WWTP Captured Volume (mil gal)	1.52
Decombined Volume Captured			
Acres Decombined		3669	
Volume/Acre Decombined-1.2 in/hour (mil gal/ac)		0.015	
		Total Decombination Captured Volume (mil gal)	55.04
		Total Captured Volume (mil gal)	**60.36**
Total Volumes			
Total Overflow Volume (mil gal)			21.31
Total Captured Volume (mil gal)			60.36
		Total First Flush Volume (mil gal)	81.67
Percent Captured/Eliminated			**73.9%**

D. Estimating Wet Weather Flow Captured at CSO Plant

The CSO plant at 400 N. Broadway is served by two incoming combined sewers, indicated on Table C.04-1 as "CSO Plant (North)" and "CSO Plant (South)." When the flow to the CSO plant exceeds its capacity, the overflow is pumped to the river, "CSO 027 (Bypass)." The volume of CSO that enters the plant that goes completely through primary treatment and disinfection and is discharged, "CSO 027 (Treated)," does not count as "captured" for the first flush analysis, since first flush requires full treatment. However, the total amount stored at the CSO plant, which is returned to the gravity sewer at the end of the event to be treated at the Fox Metro WWTP, may be considered "captured." The total amount captured by the plant is the difference between the total flow to the plant and the total discharged as bypass or treated. The model suggests that this volume is approximately 1.1 mil gal, which is approximately equivalent to the volume of the clarifiers.

E. Estimating Total Flow Captured at the WWTP

The total flow captured at the WWTP is approximated as the total adjusted flow during the first flush duration in the 69-inch interceptor ("69-inch Upstream of WWTP-Adj.") less the total amount of projected overflow at the WWTP, as discussed above. (Note: It is assumed that all the plant CSO occurs from the combined portion of the system, and only the total combined flow from the 69-inch interceptor is included in this calculation.) The total wet weather CSS volume treated during the first flush period appears to be about 1.5 mil gal.

F. Estimating Wet Weather Flow Eliminated by Decombining

A significant amount of improvements to the CSS have been implemented through the decombining efforts that the City has undertaken, and it is appropriate that first flush capture credit be taken for the amount of potential CSO that has been eliminated through decombining. To project this, mapping of the CSS was reviewed to estimate the total acres that have been decombined. Mapping of the CSS shows approximately 7,145 acres within the CSS boundary. (Please refer to Figure 4.01-4.) A significant portion of this area has been effectively decombined in the last few decades with the installation of storm sewers. Of this 7,145 acres, it appears that approximately 4,919 acres are currently decombined, based on review of existing plan sets that show approximately 1,511 acres of decombined areas, plus another 3,408 acres known to have storm sewer based on AutoCAD mapping. Of the 3,408 acres having storm sewer, it is necessary to know how much was originally constructed as combined system. Based on discussion with City personnel, it appears the approximate 1,000 acres north of New Indian Trail on the northwest side were originally constructed with separate sewers as was the approximately 250-acre area bounded by W. Illinois Ave., New Indian Trail, N. Randall Rd., and N. Elmwood Dr. Based on this, it appears that approximately 3,669 acres have been intentionally decombined through the City's efforts.

To approximate the first flush volume that would typically be removed per acre through decombining, two first flush model runs (1.2 inches over 1 hour) were performed comparing CSO 015 before and after separation of 77.7 acres. (This comparison is shown in the right two columns of Attachment C.04-1.) Comparing the 2.55 mil gal of first flush overflow before separation to the 1.36 mil gal after separation, it appears that approximately 1.19 mil gal of first flush flow was removed from the system through separation, which is about 0.015 mil gal/acre. Applying the 0.015 mil gal/acre to the 3,669 acres that have been separated suggests that a total of 55 mil gal of first flush volume has been eliminated through the City's decombining efforts.

G. Summary

Based on these analyses, the total first flush volume captured/eliminated appears to be approximately 60.4 mil gal, and the total overflow volume appears to be about 21.3 mil gal, for a total first flush volume of 81.7 mil gal. Considering the captured volume relative to the total first flush volume suggests a percent capture/eliminated of about 74 percent. Therefore, the Aurora system exceeds the 57 percent first flush capture requirement stipulated in the exception.

Figure C.03-7
Flow Meter 1 August 19-20, 2009

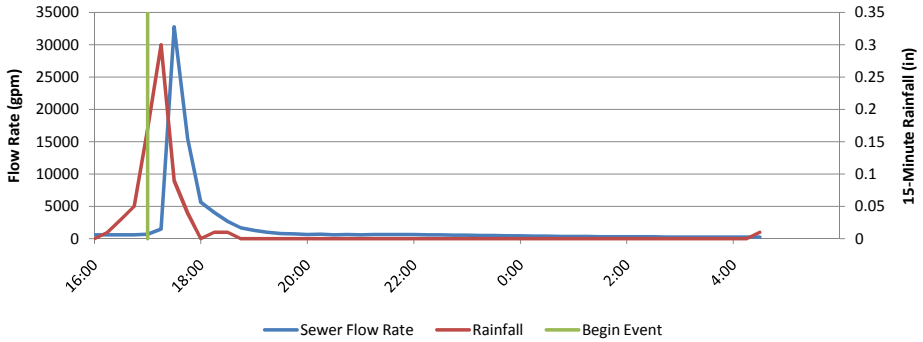


Figure C.03-8
Sampler 1 BOD August 19-20, 2009

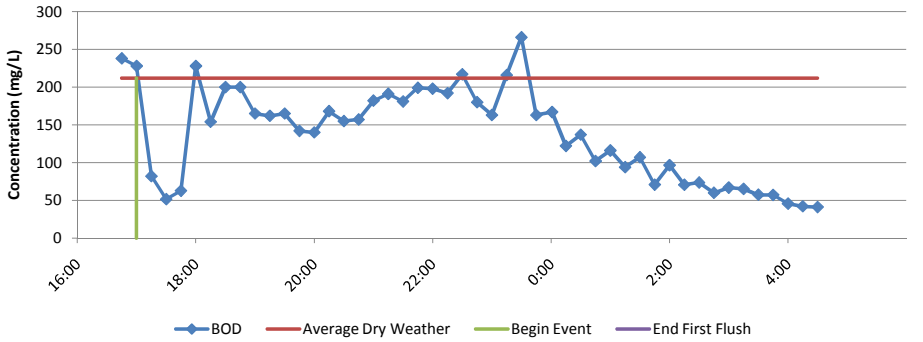


Figure C.03-9
Sampler 1 TSS August 19-20 2009

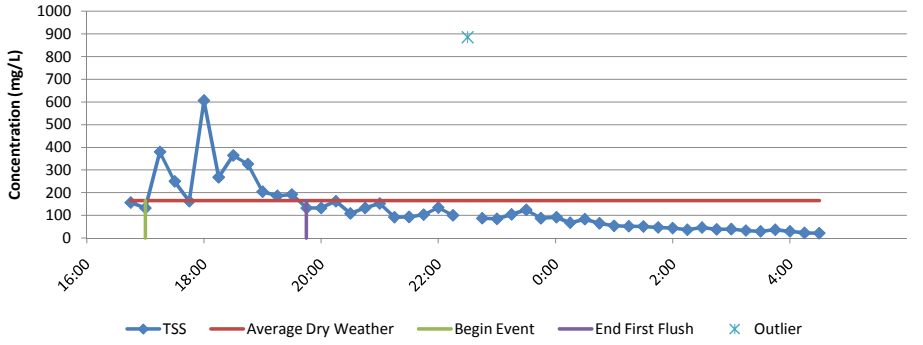


Figure C.03-10
Sampler 1 VSS August 19-20, 2009

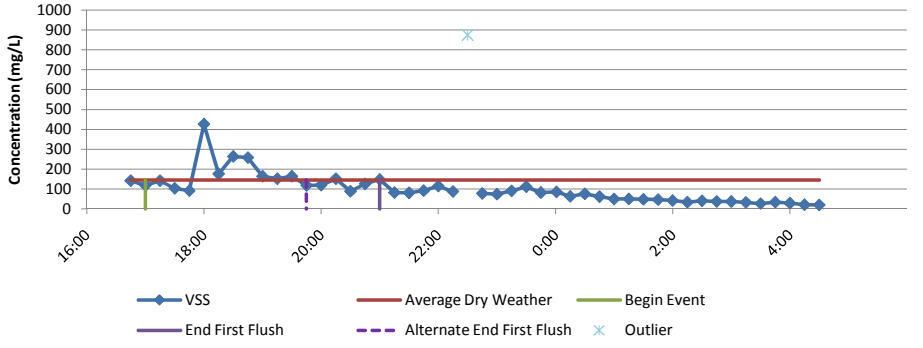


Figure C.03-11
Flow Meter 1 September 20, 2009

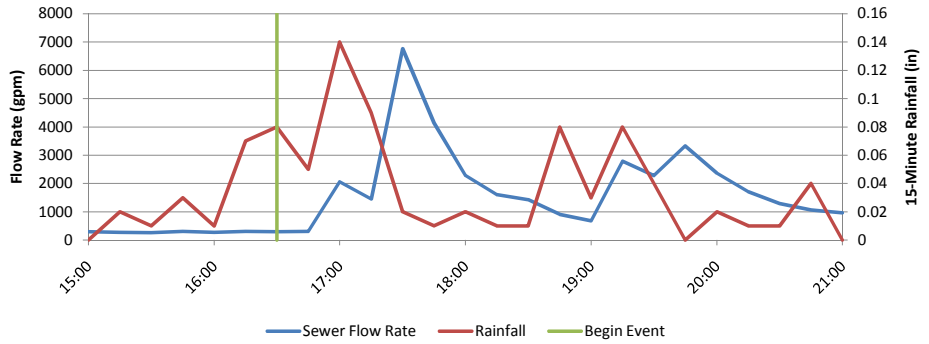


Figure C.03-12
Sampler 1 BOD September 20, 2009

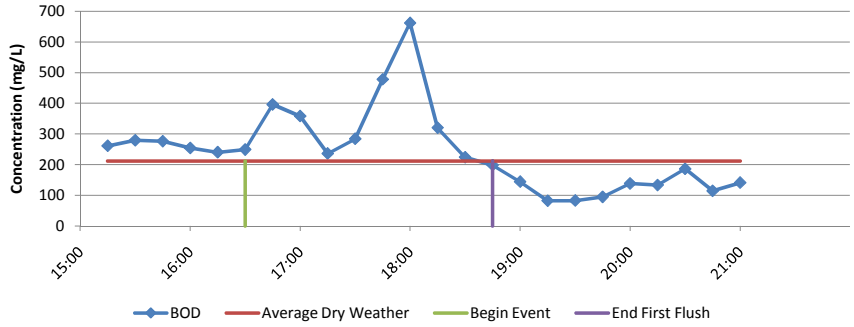


Figure C.03-13
Sampler 1 TSS September 20, 2009

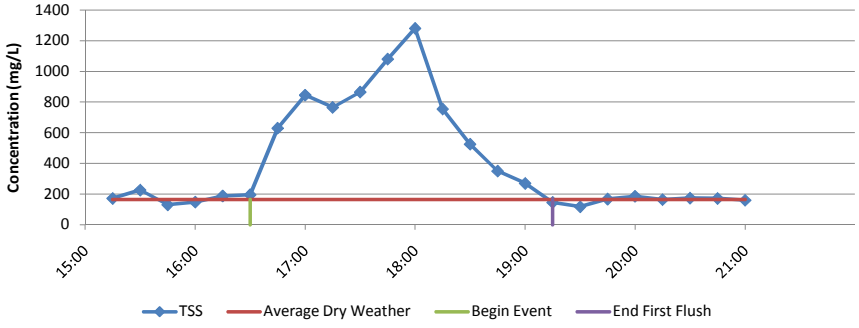


Figure C.03-14
Sampler 1 VSS September 20, 2009

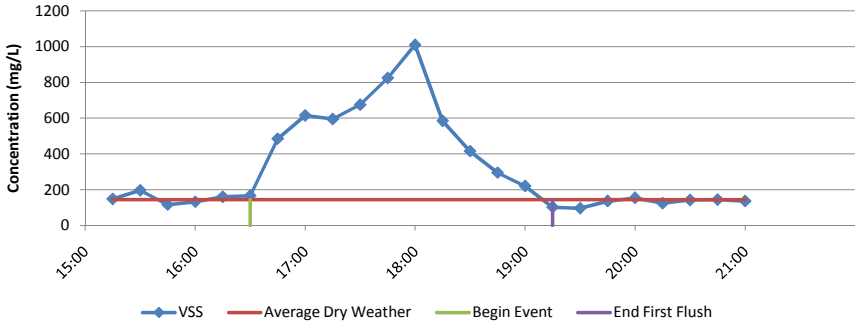


Figure C.03-15
Flow Meter 22 July 15, 2009

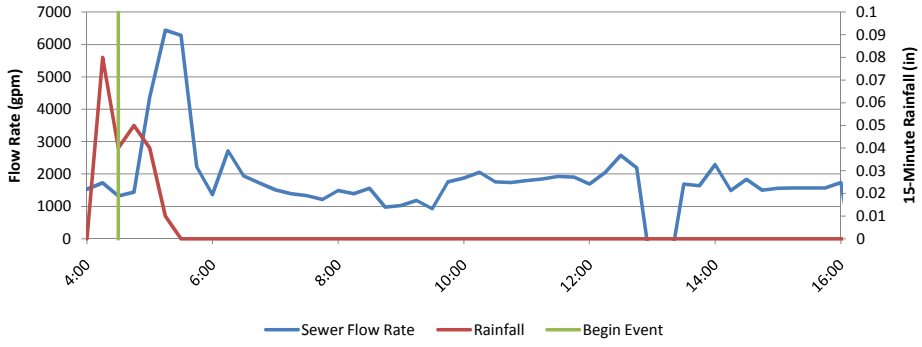


Figure C.03-16
Sampler 22 BOD July 15, 2009

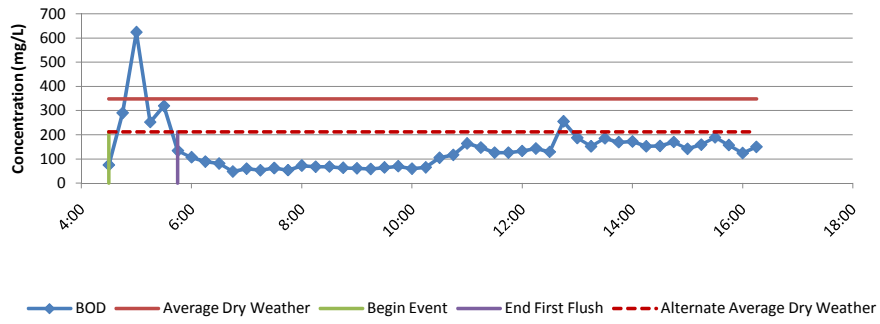


Figure C.03-17
Sampler 22 TSS July 15, 2009

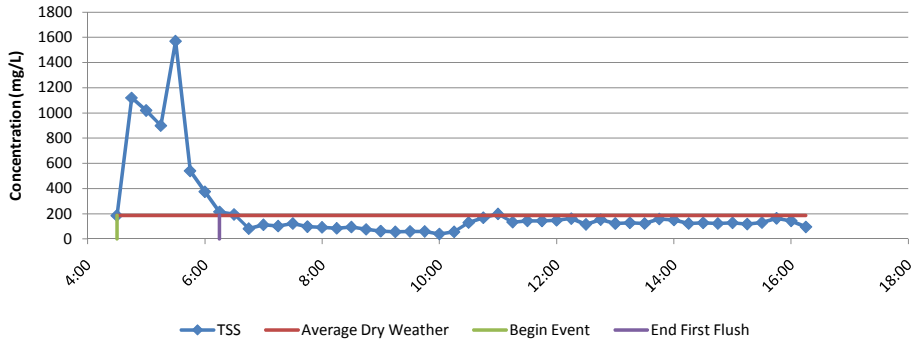


Figure C.03-18
Sampler 22 VSS July 15, 2009

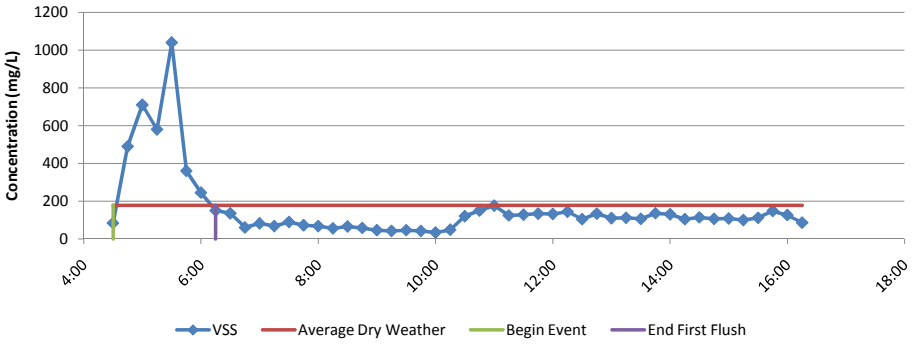


Figure C.03-19
Flow Meter 22 September 20, 2009

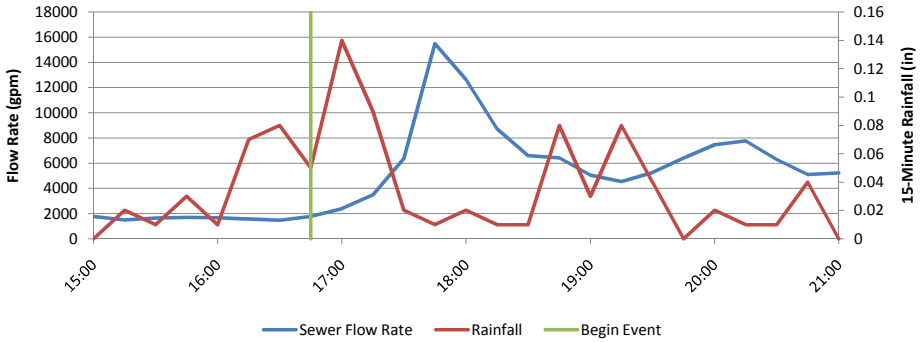


Figure C.03-20
Sampler 22 BOD September 20, 2009

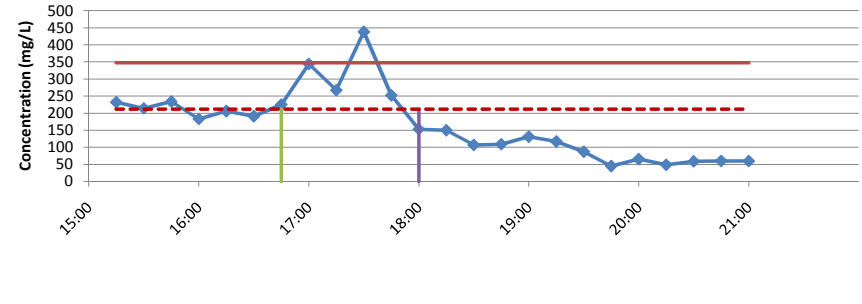


Figure C.03-21
Sampler 22 TSS September 20, 2009

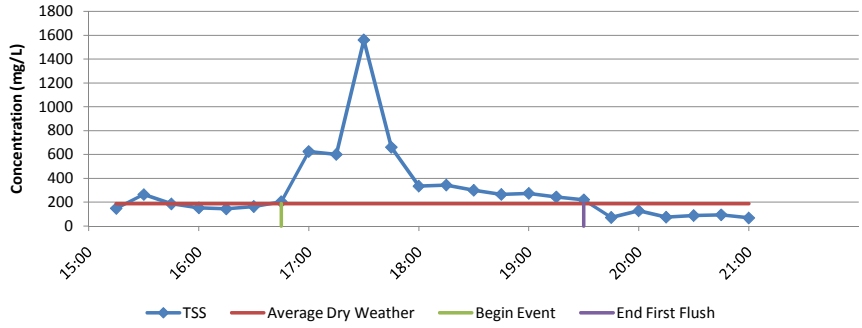
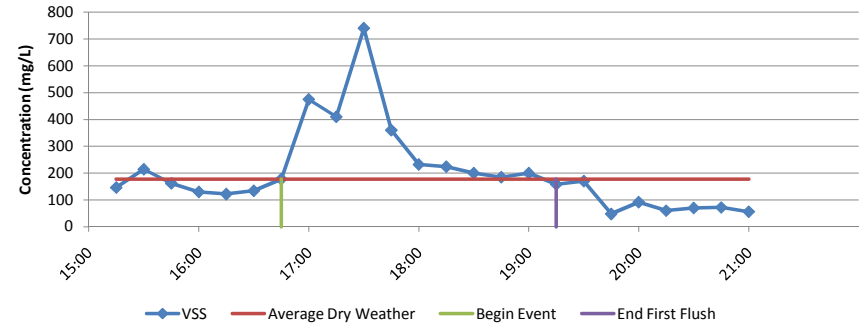


Figure C.03-22
Sampler 22 VSS September 20, 2009



Attachment C.04-1 First Flush Duration Flow (cfs) for Selected Model Locations

	Model Location	69-inch Upstream of WWTP	69-inch Upstream of WWTP-Adj	Basin 001	CSO 001	CSO 001-Adj	CSO 002	CSO 003A	CSO 004	CSO 005	CSO 008	CSO 010	CSO 015	CSO 018	CSO 021	CSO 022	CSO 023	CSO 025	CSO 027 (Treated)	CSO 027 (Bypass)	CSO Plant (North)	CSO Plant (South)		
	Model Link	Link 162	Link 162-Adj	FM 22	Link 675	Link 675-Adj	Link 797	Link 798	Link 673	Link 684	Link 691	Link 373	CSO 015 Weir	Link 692	Link 772	Link 808	Link 814	Link 339	Link 820	Pump 3	Link 780	Link 740	CSO 015 (Before)	CSO 015 (After)
	2.75 h Volume (mil gal)	5.81	4.32	4.93	3.08	4.57	0.00	0.00	6.09	0.07	3.36	0.74	2.55	0.00	0.14	0.14	0.06	0.46	0.00	0.33	0.84	0.63	2.55	1.36
	6/8/2009 10:00	13.032	13.032	3.436	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:01	13.06	13.06	3.44	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:02	13.089	13.089	3.444	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:03	13.117	13.117	3.447	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:04	13.146	13.146	3.451	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:05	13.177	13.177	3.454	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:06	13.208	13.208	3.457	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:07	13.242	13.242	3.46	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:08	13.281	13.281	3.464	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:09	13.323	13.323	3.467	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:10	13.367	13.367	3.47	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:11	13.412	13.412	3.473	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:12	13.456	13.456	3.476	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:13	13.498	13.498	3.479	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:14	13.552	13.552	3.481	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:15	13.595	13.595	3.484	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:16	13.631	13.631	3.487	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:17	13.66	13.66	3.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:18	13.683	13.683	3.492	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:19	13.694	13.694	3.495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:20	13.7	13.7	3.497	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:21	13.702	13.702	3.5	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:22	13.701	13.701	3.502	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:23	13.7	13.7	3.505	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:24	13.7	13.7	3.507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:25	13.71	13.71	3.509	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Begin	**6/8/2009 10:26**	13.729	13.729	3.512	0	0	0	-0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:27	13.747	13.747	3.514	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:28	13.765	13.765	3.516	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:29	13.783	13.783	3.518	0	0	0	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:30	13.8	13.8	3.521	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:31	13.819	13.819	3.524	0	0	0	0	0	0	0	0.29	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:32	13.838	13.838	3.535	0	0	0	0.001	0	5.733	0	4.124	0	0	0	0	0	0	0	0	0	0	0	0
	6/8/2009 10:33	13.86	13.86	3.574	0	0	0	0	0	7.536	0	8.663	31.053	0	0	0	0	0	0	0	0	0	31.053	17.349
	6/8/2009 10:34	13.885	13.885	3.67	0	0	0	-0.001	18.564	8.23	0	13.241	50.893	0	0	0	0	0	0	0	0	0	50.893	31.82
	6/8/2009 10:35	13.916	13.916	3.871	0	0	0	0	37.205	9.264	0	17.32	80.48	0	0	0	0	0	0	0	0	0	80.48	41.783
	6/8/2009 10:36	13.956	13.956	4.237	0	0	0	0	53.524	9.93	0	24.011	94.866	0	0	0	0	0	0	0	0	0	94.866	54.648
	6/8/2009 10:37	14.305	14.305	4.838	0	0	0	-0.001	70.704	9.851	1.156	29.444	105.374	0	0.004	0	0	0	0	0	0	0.001	105.374	73.029
	6/8/2009 10:38	14.456	14.456	5.758	0	0	0	0	90.826	9.819	23.818	30.701	114.579	0	0.349	0	0	0	0	0	0	5.824	114.579	78.805
	6/8/2009 10:39	14.676	14.676	7.145	0	0	0	0	108.8	9.808	53.822	31.261	120.212	0	1.564	0	0	0	0	0	0.005	26.839	120.212	81.88
	6/8/2009 10:40	14.974	14.974	9.209	0	0	0	0.001	125.589	9.803	75.201	31.615	124.242	0	3.102	0	0	0	0	0	5.246	35.769	124.242	84.45
	6/8/2009 10:41	15.331	15.331	11.787	0	0	0	0	139.495	9.802	97.848	32.013	126.147	0	4.583	0	0	0	0	0	21.317	43.972	126.147	87.57
	6/8/2009 10:42	15.732	15.732	15.213	0	0	0	0	149.615	9.029	116.529	32.067	127.119	0	5.839	0	0	0	0	0	22.604	49.925	127.119	88.684
	6/8/2009 10:43	16.216	12.168	20.048	0	4.048	0	0.001	155.221	6.985	144.696	31.824	127.535	0	6.91	0	0	0	0	10.026	21.393	52.572	127.535	89.285
	6/8/2009 10:44	16.834	5.977	26.857	0	10.857	0	0	158.545	5.755	162.747	31.736	126.907	0	7.672	0	0	0	0	16.144	13.057	56.161	126.907	89.678
	6/8/2009 10:45	17.54	-2.981	36.521	0	20.521	0	-0.001	160.452	4.013	172.214	31.528	126.101	0	8.006	0	0	0	0	17	15.549	52.266	126.101	88.986
	6/8/2009 10:46	18.292	-15.485	49.777	0	33.777	0	0	160.821	2.663	171.45	31.16	125.011	0	8.593	0	0	0.327	0	17	11.119	51.508	125.011	87.664
	6/8/2009 10:47	18.883	-32.05	66.933	0	50.933	0	0	159.821	1.791	168.099	30.877	123.524	0	9.007	2.537	0	3.231	0	17	10.436	46.724	123.524	86.856
	6/8/2009 10:48	19.937	-50.763	86.7	0	70.7	0	-0.001	158.439	0.903	166.271	30.565	121.026	0	9.276	15.09	0	7.234	0	17	14.2	41.828	121.026	83.338
	6/8/2009 10:49	20.844	-70.173	107.017	0	91.017	0	0	157.89	0.254	164.163	30.171	118.487	0	9.44	17.487	0.826	9.373	0	17	19.382	35.594	118.487	80.449
	6/8/2009 10:50	21.822	-88.076	125.898	0	109.898	0	0	157.004	0	161.55	29.846	116.189	0	9.538	23.279	2.789	11.484	0	17	21.688	31.565	116.189	77.608
	6/8/2009 10:51	22.914	-99.474	138.668	0.28	122.668	0	0.001	157.405	0	158.417	29.484	112.795	0	9.587	24.38	3.58	13.824	0	17	25.579	27.84	112.795	74.909
	6/8/2009 10:52	24.112	-87.099	157.041	29.83	141.041	0.643	0.682	158.813	0	154.481	29.037	112.316	0	9.601	27.994	3.954	16.23	0	17	32.663	20.822	112.316	72.625
	6/8/2009 10:53	25.542	-54.695	167.965	71.728	151.965	0.052	0.27	160.411	0	150.746	28.65	111.54	0	9.585	33.652	4.139	18.281	0	17	33.647	16.5	111.54	70.125
	6/8/2009 10:54	27.088	-40.324	176.145	92.733	160.145	0.007	-0.24	163.007	0	147.853	28.31	108.704	0	9.538	31.717	4.272	19.576	0	17	33.647	16.912	108.704	67.087
	6/8/2009 10:55	28.926	-28.007	181.714	108.781	165.714	0.003	-0.231	166.476	0	144.435	28.01	106.39	0	9.454	28.451	4.366	20.364	0	17	31.976	18.022	106.39	64.626
	6/8/2009 10:56	30.672	-9.01	184.507	128.825	168.507	0.001	-0.129	169.932	0	146.909	27.943	105.457	0	9.319	23.989	4.422	20.836	0	17	31.318	19.248	105.457	64.023
	6/8/2009 10:57	33.648	-5.185	189.325	134.492	173.325	0.001	0.025	171.999	0.522	149.148	27.604	105.199	0	9.138	21.024	4.448	21.133	0	17	30.474	19.764	105.199	61.827
	6/8/2009 10:58	36.437	-2.947	192.368	136.984	176.368	0.001	0.074	173.654	0.902	144.146	27.194	104.121	0	8.939	17.506	4.447	21.282	0	17	29.981	20.471	104.121	60.392
	6/8/2009 10:59	40.401	2.526	193.907	140.032	177.907	0	0.106	174.897	0.824	140.772	26.792	103.167	0	8.684	14.423	4.426	21.296	0	17	29.106	21.134	103.167	58.773
	6/8/2009 11:00	44.773	8.163	194.623	142.013	178.623	0	0.109	175.475	0.742	137.62	26.926	102.471	0	8.391	12.046	4.388	21.181	0	17	28.158	22.168	102.471	57.122
	6/8/2009 11:01	49.55	15.614	194.461	144.525	178.461	0	0.081	175.481	0.7	132.903	26.372	101.747	0	8.082	9.809	4.332	20.983	0	17	27.272	22.999	101.747	55.577
	6/8/2009 11:02	55.122	21.85	193.7	144.428	177.7	0	0.04	175.102	0.702	129.295	26.336	99.339	0	7.855	7.316	4.26	20.728	0	17	26.505	23.858	99.339	54.216
	6/8/2009 11:03	61.022	29.609	192.278	144.865	176.278	0	0.001	174.569	0.727	126.464	25.902	98.087	0	7.769	4.35	4.171	20.377	0	17	25.867	24.485	98.087	52.974
	6/8/2009 11:04	66.249	37.107	190.337	145.195	174.337	0	-0.033	174.063	0.765	122.699	25.537	97.279	0	7.433	1.693	4.069	19.919	0	17	25.445	24.966	97.279	51.852
	6/8/2009 11:05	71.69	45.893	187.668	145.871	171.668	0	-0.064	173.416	0.808	117.969	25.607	96.165	0	7.055	1.738	3.955	19.435	0	17	25.026	25.28	96.165	50.822
	6/8/2009 11:06	76.715	53.753	184.456	145.494	168.456	0	-0.069	172.648	0.852	116.617	25.491	95.183	0	6.679	0.578	3.839	18.899	0	17	24.768	25.511	95.183	49.909
	6/8/2009 11:07	80.073	60.898	181.307	146.132	165.307	0	-0.054	171.791	0.903	113.151	25.142	94.028	0	6.32	0.036	3.725	18.38	0	17	24.635	25.499	94.028	49.071
	6/8/2009 11:08	84.526	68.084	178.357	145.915	162.357	0	-0.036	170.879	0.951	110.03	24.885	92.255	0	5.997	0	3.607	17.898	0	17	25.049	24.516	92.255	48.379
	6/8/2009 11:09	87.281	72.908	175.179	144.806	159.179	0	-0.012	169.894	0.987	106.559	24.66	85.89	0	5.696	0	3.488	17.445	0	17	25.961	23.879	85.89	47.717
	6/8/2009 11:10	90.445	78.16	171.729	143.698	155.983	0	0	168.681	1.011	103.63	24.478	83.334	0	5.423	0	3.395	17.038	0	17	26.686	23.122	83.334	47.02
	6/8/2009 11:11	92.997	78.16	168.227	142.653	157.49	0	0.012	167.096	1.026	100.661	24.314	80.967	0	5.169	0	3.303	16.651	0	17	27.295	22.506	80.967	46.234
	6/8/2009 11:12	96.102	78.16	164.777	141.283	159.225	0	0.02	165.442	1.02	96.742	24.156	77.582	0	4.932	0	3.216	16.295	0	17	27.87	21.894	77.582	45.523
	6/8/2009 11:13	98.11	78.16	161.293	139.907	159.857	0	0.03	163.627	1.017	94.473	23.858	75.087	0	4.704	0	3.134	15.959	0	17	28.249	21.47	75.087	44.741
	6/8/2009 11:14	99.877	78.16	157.934	138.09	159.807	0	0.034	161.508	1.016	92.224	23.508	72.917	0	4.471	0	3.057	15.624	0	17	28.724	20.968	72.917	43.823
	6/8/2009 11:15	99.937	78.16	154.619	135.954	157.731	0	0.034	158.611	1.012	89.76	23.143	70.466	0	4.232	0	2.976	15.314	0	17	29.213	20.355	70.466	40.431
	6/8/2009 11:16	99.763	78.16	151.255	133.649	155.252	0	0.03	155.653	1.002	87.822	22.864	68.145	0	3.987	0	2.88	15.028	0	17	29.592	19.857	68.145	33.541
	6/8/2009 11:17	100.081	78.16	147.894	131.331	153.252	0	0.026	153.639	0.986	84.216	22.63	65.91	0	3.747	0	2.782	14.755	0	17	30.042	19.199	65.91	26.564
	6/8/2009 11:18	101.113	78.16	144.626	128.973	151.926	0	0.018	151.431	0.964	82.127	22.435	63.756	0	3.514	0	2.677	14.495	0	17	30.678	18.383	63.756	22.184
	6/8/2009 11:19	102.139	78.16	141.484	126.365	150.344	0	0.009	149.319	0.939	80.187	22.216	62.087	0	3.295	0	2.563	14.233	0	17	31.177	17.712	62.087	19.935
	6/8/2009 11:20	102.942	78.16	138.394	123.647	148.429	0	0.001	147.271	0.91	77.332	21.901	60.608	0	3.09	0	2.443	13.986	0	17	32.968	15.337	60.608	18.502
	6/8/2009 11:21	103.49	78.16	135.323	120.952	146.282	0	0	145.246	0.879	74.802	21.785	59.199	0	2.895	0	2.318	13.823	0	17	33.362	14.901	59.199	17.271
	6/8/2009 11:22	103.811	78.16	132.324	118.287	143.938	0	-0.008	143.311	0.847	72.675	21.643	57.884	0	2.705	0	2.194	13.683	0	17	34.233	14.162	57.884	16.081
	6/8/2009 11:23	103.942	78.16	129.364	115.32	141.102	0	-0.014	141.548	0.812	71.154	21.413	56.763	0	2.521	0	2.072	13.39	0	15.56	32.607	13.259	56.763	14.98
	6/8/2009 11:24	103.955	78.16	126.385	112.578	138.373	0	-0.018	139.797	0.791	68.32	21.22	55.626	0	2.343	0	1.95	13.232	0	13.566	30.698	12.615	55.626	14.153
	6/8/2009 11:25	103.912	78.16	123.401	109.744	135.496	0	-0.02	138.146	0.761	66.422	21.11	54.626	0	2.174	0	1.829	13.092	0	11.638	28.297	12.035	54.626	13.326

Attachment C.04-1 First Flush Duration Flow (cfs) for Selected Model Locations

Model Location	69-inch Upstream of WWTP	69-inch Upstream of WWTP-Adj	Basin 001	CSO 001	CSO 001-Adj	CSO 002	CSO 003A	CSO 004	CSO 005	CSO 008	CSO 010	CSO 015	CSO 018	CSO 021	CSO 022	CSO 023	CSO 025	CSO 027 (Treated)	CSO 027 (Bypass)	CSO Plant (North)	CSO Plant (South)		
Model Link	Link 162	Link 162-Adj	FM 22	Link 675	Link 675-Adj	Link 797	Link 798	Link 673	Link 684	Link 691	Link 373	CSO 015 Weir	Link 692	Link 772	Link 808	Link 814	Link 339	Link 820	Pump 3	Link 780	Link 740	CSO 015 (Before)	CSO 015 (After)
2.75 h Volume (mil gal)	5.81	4.32	4.93	3.08	4.57	0.00	0.00	6.09	0.07	3.36	0.74	2.55	0.00	0.14	0.14	0.06	0.46	0.00	0.33	0.84	0.63	2.55	1.36
6/8/2009 11:26	103.842	78.16	120.402	106.92	132.602	0	-0.02	136.656	0.723	64.661	21.119	53.932	0	2.016	0	1.715	12.701	0	9.685	25.913	11.592	53.932	12.734
6/8/2009 11:27	103.758	78.16	117.42	104.06	129.658	0	-0.019	135.24	0.681	63.164	21.133	53.577	0	1.873	0	1.602	12.253	0	7.671	23.093	11.29	53.577	12.472
6/8/2009 11:28	103.672	78.16	114.495	101.28	126.792	0	-0.016	133.495	0.613	62.11	19.058	53.412	0	1.754	0	1.495	11.727	0	5.848	20.286	10.927	53.412	12.359
6/8/2009 11:29	103.589	78.16	111.645	98.325	123.754	0	-0.012	131.052	0.555	61.977	16.013	52.687	0	1.648	0	1.402	11.25	0	3.675	16.791	10.846	52.687	12.224
6/8/2009 11:30	103.506	78.16	108.873	95.463	120.809	0	-0.009	128.653	0.507	61.466	13.243	51.521	0	1.547	0	1.327	10.879	0	1.637	15.341	10.667	51.521	11.906
6/8/2009 11:31	103.415	78.16	106.114	92.572	117.827	0	-0.006	126.172	0.458	59.373	11.907	50.078	0	1.441	0	1.265	10.603	0	0.004	14.712	10.51	50.078	11.128
6/8/2009 11:32	103.305	78.16	103.397	89.773	114.918	0	-0.002	123.687	0.408	57.822	10.822	48.645	0	1.325	0	1.197	10.392	0	0	15.277	10.217	48.645	10.171
6/8/2009 11:33	103.17	78.16	100.734	87.069	112.079	0	0	121.229	0.361	56.067	9.948	47.544	0	1.205	0	1.128	10.217	0	0	14.222	9.683	47.544	9.104
6/8/2009 11:34	103.012	78.16	98.11	84.31	109.162	0	0	118.627	0.313	54.193	9.215	46.186	0	1.082	0	1.051	10.047	0	0	12.516	9.055	46.186	7.987
6/8/2009 11:35	102.835	78.16	95.516	81.535	106.21	0	0.002	115.489	0.263	52.84	8.585	44.761	0	0.956	0	0.961	9.857	0	0	12.295	8.335	44.761	7.014
6/8/2009 11:36	102.647	78.16	93.047	78.885	103.372	0	0.004	112.231	0.21	51.641	8.027	43.479	0	0.83	0	0.861	9.659	0	0	12.044	7.61	43.479	6.108
6/8/2009 11:37	102.453	78.16	90.621	76.309	100.602	0	0.005	109.078	0.157	50.509	7.53	42.424	0	0.709	0	0.753	9.437	0	0	11.737	6.895	42.424	5.269
6/8/2009 11:38	102.256	78.16	88.189	73.54	97.636	0	0.006	106.271	0.106	50.216	7.072	41.007	0	0.595	0	0.641	9.21	0	0	11.4	6.253	41.007	4.525
6/8/2009 11:39	102.06	78.16	85.749	71.108	95.008	0	0.007	103.686	0.057	47.144	6.655	30.836	0	0.481	0	0.531	8.978	0	0	11.079	5.565	30.836	3.922
6/8/2009 11:40	101.865	78.16	83.323	68.62	92.325	0	0.008	101.486	0.016	46.099	6.263	16.707	0	0.38	0	0.417	8.798	0	0	10.784	4.949	16.707	3.327
6/8/2009 11:41	101.673	78.16	80.915	66.208	89.721	0	0.009	99.474	0	43.78	5.887	9.915	0	0.297	0	0.306	8.754	0	0	10.512	4.3	9.915	2.753
6/8/2009 11:42	101.484	78.16	78.52	63.681	87.005	0	0.009	97.484	0	42.692	5.51	7.456	0	0.228	0	0.208	8.518	0	0	10.247	3.714	7.456	2.202
6/8/2009 11:43	101.307	78.16	76.233	61.5	84.647	0	0.009	95.513	0	41.387	5.168	6.145	0	0.171	0	0.122	8.184	0	0	9.995	3.15	6.145	1.744
6/8/2009 11:44	101.148	78.16	74.084	59.219	82.207	0	0.009	93.594	0	40.496	4.855	5.205	0	0.135	0	0.024	7.855	0	0	9.747	2.652	5.205	1.326
6/8/2009 11:45	101.005	78.16	72.015	56.989	79.834	0	0.009	91.718	0	39.685	4.568	4.432	0	0.106	0	0.01	7.558	0	0	9.494	2.21	4.432	0.952
6/8/2009 11:46	100.844	78.16	70.217	54.336	77.02	0	0.008	89.914	0	39.301	4.304	3.738	0	0.083	0	0.006	7.282	0	0	9.241	1.81	3.738	0.615
6/8/2009 11:47	100.538	78.16	68.517	51.396	73.774	0	0.008	88.14	0	38.161	4.057	3.122	0	0.067	0	0.004	7.026	0	0	8.994	1.445	3.122	0.334
6/8/2009 11:48	100.039	78.16	66.394	49.391	71.27	0	0.007	86.425	0	36.168	3.808	2.573	0	0.055	0	0.002	6.783	0	0	8.753	1.149	2.573	0.094
6/8/2009 11:49	99.405	78.16	64.818	46.391	67.636	0	0.007	84.734	0	35.243	3.568	2.056	0	0.044	0	0.002	6.556	0	0	8.521	0.904	2.056	0
6/8/2009 11:50	98.78	78.16	63.01	43.34	63.96	0	0.006	83.127	0	34.212	3.349	1.562	0	0.037	0	0.001	6.345	0	0	8.301	0.71	1.562	0
6/8/2009 11:51	98.479	78.16	60.696	41.611	61.93	0	0.005	81.518	0	32.674	3.151	1.125	0	0.03	0	0.001	6.15	0	0	8.089	0.572	1.125	0
6/8/2009 11:52	98.339	78.16	59.348	39.385	59.564	0	0.004	79.944	0	32.295	2.966	0.744	0	0.026	0	0.001	5.976	0	0	7.886	0.473	0.744	0
6/8/2009 11:53	98.264	78.16	57.347	37.85	57.954	0	0.003	78.451	0	31.446	2.79	0.391	0	0.022	0	0.001	5.832	0	0	7.69	0.403	0.391	0
6/8/2009 11:54	98.219	78.16	55.774	36.385	56.444	0	0.002	77.029	0	30.79	2.623	0.104	0	0.019	0	0.001	5.707	0	0	7.505	0.351	0.104	0
6/8/2009 11:55	98.318	78.16	54.662	32.832	52.99	0	0.001	75.61	0	30.122	2.471	0	0	0.016	0	0.001	5.593	0	0	7.33	0.308	0	0
6/8/2009 11:56	98.686	78.16	52.745	31.503	52.029	0	0.001	74.199	0	29.409	2.33	0	0	0.014	0	0	5.478	0	0	7.159	0.275	0	0
6/8/2009 11:57	98.609	78.16	50.618	31.278	51.727	0	0.001	72.821	0	28.641	2.198	0	0	0.012	0	0	5.347	0	0	7.002	0.247	0	0
6/8/2009 11:58	98.32	78.16	49.032	30.026	50.186	0	0.001	71.454	0	27.838	2.077	0	0	0.011	0	0	5.199	0	0	6.857	0.223	0	0
6/8/2009 11:59	97.946	78.16	47.706	27.55	47.336	0	0.001	70.113	0	27.504	1.961	0	0	0.01	0	0	5.047	0	0	6.723	0.202	0	0
6/8/2009 12:00	97.548	78.16	46.998	25.51	44.898	0	0	68.773	0	26.441	1.85	0	0	0.009	0	0	4.885	0	0	6.597	0.184	0	0
6/8/2009 12:01	97.087	78.16	44.4	25.159	44.086	0	0	67.478	0	24.674	1.742	0	0	0.008	0	0	4.723	0	0	6.474	0.169	0	0
6/8/2009 12:02	96.414	78.16	43.054	26.411	44.665	0	0	66.216	0	23.524	1.629	0	0	0.007	0	0	4.581	0	0	6.353	0.156	0	0
6/8/2009 12:03	95.943	78.16	42.439	23.642	41.425	0	0	65.074	0	22.657	1.501	0	0	0.006	0	0	4.44	0	0	6.237	0.144	0	0
6/8/2009 12:04	95.577	78.16	41.267	21.057	38.474	0	-0.001	63.971	0	21.067	1.384	0	0	0.006	0	0	4.278	0	0	6.128	0.134	0	0
6/8/2009 12:05	95.256	78.16	39.513	19.277	36.373	0	-0.001	62.956	0	20.493	1.287	0	0	0.005	0	0	4.1	0	0	6.018	0.124	0	0
6/8/2009 12:06	94.957	78.16	39.3	17.941	34.738	0	-0.002	61.918	0	19.551	1.199	0	0	0.005	0	0	3.916	0	0	5.908	0.116	0	0
6/8/2009 12:07	94.688	78.16	37.375	17.402	33.93	0	-0.002	60.97	0	18.939	1.119	0	0	0.004	0	0	3.743	0	0	5.799	0.108	0	0
6/8/2009 12:08	94.447	78.16	36.818	15.506	31.793	0	-0.002	60.019	0	18.367	1.047	0	0	0.004	0	0	3.592	0	0	5.697	0.101	0	0
6/8/2009 12:09	94.233	78.16	34.75	16.159	32.232	0	-0.002	59.083	0	17.412	0.98	0	0	0.004	0	0	3.45	0	0	5.596	0.094	0	0
6/8/2009 12:10	94.044	78.16	34.325	15.569	31.453	0	-0.002	58.191	0	17.234	0.917	0	0	0.003	0	0	3.311	0	0	5.499	0.088	0	0
6/8/2009 12:11	93.767	78.16	33.894	13.1	28.707	0	-0.002	57.312	0	17.043	0.858	0	0	0.003	0	0	3.176	0	0	5.407	0.083	0	0
6/8/2009 12:12	93.697	78.16	33.216	11.911	27.448	0	-0.003	56.475	0	15.928	0.803	0	0	0.003	0	0	3.047	0	0	5.317	0.079	0	0
6/8/2009 12:13	93.6	78.16	32.028	11.786	27.226	0	-0.003	55.643	0	15.52	0.754	0	0	0.003	0	0	2.927	0	0	5.229	0.074	0	0
6/8/2009 12:14	93.492	78.16	32.081	10.616	25.948	0	-0.003	54.859	0	14.251	0.705	0	0	0.002	0	0	2.811	0	0	5.143	0.07	0	0
6/8/2009 12:15	93.376	78.16	32.178	7.935	23.151	0	-0.003	54.086	0	13.534	0.659	0	0	0.002	0	0	2.697	0	0	5.058	0.066	0	0
6/8/2009 12:16	93.247	78.16	30.919	7.176	22.263	0	-0.003	53.233	0	13.171	0.615	0	0	0.002	0	0	2.563	0	0	4.975	0.063	0	0
6/8/2009 12:17	93.11	78.16	30.23	7.357	22.307	0	-0.003	52.42	0	12.336	0.574	0	0	0.002	0	0	2.428	0	0	4.892	0.059	0	0
6/8/2009 12:18	92.967	78.16	29.726	6.52	21.327	0	-0.004	51.562	0	11.583	0.536	0	0	0.002	0	0	2.306	0	0	4.813	0.056	0	0
6/8/2009 12:19	92.824	78.16	29.582	5.777	20.441	0	-0.004	50.677	0	11.057	0.501	0	0	0.002	0	0	2.2	0	0	4.736	0.053	0	0
6/8/2009 12:20	92.7	78.16	29.342	5.204	19.744	0	-0.004	49.813	0	10.161	0.468	0	0	0.002	0	0	2.106	0	0	4.662	0.05	0	0
6/8/2009 12:21	92.613	78.16	28.183	4.769	19.222	0	-0.004	48.833	0	9.059	0.437	0	0	0.001	0	0	2.022	0	0	4.589	0.048	0	0
6/8/2009 12:22	92.56	78.16	27.794	4.1	18.5	0	-0.004	48.018	0	8.356	0.407	0	0	0.001	0	0	1.943	0	0	4.52	0.046	0	0
6/8/2009 12:23	92.523	78.16	27.439	3.291	17.654	0	-0.004	47.227	0	7.334	0.38	0	0	0.001	0	0	1.869	0	0	4.453	0.043	0	0
6/8/2009 12:24	92.485	78.16	27.077	2.697	17.022	0	-0.004	46.362	0	5.935	0.354	0	0	0.001	0	0	1.799	0	0	4.388	0.041	0	0
6/8/2009 12:25	92.436	78.16	26.644	2.236	16.512	0	-0.004	45.477	0	5.011	0.329	0	0	0.001	0	0	1.731	0	0	4.326	0.04	0	0
6/8/2009 12:26	92.375	78.16	25.885	2.007	16.222	0	-0.004	44.598	0	3.997	0.305	0	0	0.001	0	0	1.664	0	0	4.265	0.038	0	0
6/8/2009 12:27	92.304	78.16	25.312	1.724	15.868	0	-0.004	43.741	0	3.129	0.284	0	0	0.001	0	0	1.598	0	0	4.206	0.036	0	0
6/8/2009 12:28	92.228	78.16	24.621	1.424	15.492	0	-0.004	42.891	0	2.363	0.264	0	0	0.001	0	0	1.532	0	0	4.15	0.035	0	0
6/8/2009 12:29	92.149	78.16	24.112	1.092	15.081	0	-0.004	41.986	0	1.708	0.245	0	0	0.001	0	0	1.468	0	0	4.099	0.033	0	0
6/8/2009 12:30	92.067	78.16	23.887	0.73	14.637	0	-0.004	41.159	0	1.314	0.227	0	0	0.001	0	0	1.405	0	0	4.05	0.032	0	0
6/8/2009 12:31	91.982	78.16	23.78	0.404	14.226	0	-0.004	40.398	0	0.805	0.21	0	0	0.001	0	0	1.345	0	0	4.005	0.03	0	0
6/8/2009 12:32	91.893	78.16	24.015	0.208	13.941	0	-0.004	39.505	0	0.529	0.194	0	0	0.001	0	0	1.285	0	0	3.962	0.029	0	0
6/8/2009 12:33	91.802	78.16	23.597	0.108	13.75	0	-0.004	38.583	0	0.055	0.179	0	0	0.001	0	0	1.227	0	0	3.919	0.028	0	0
6/8/2009 12:34	91.708	78.16	23.607	0.062	13.61	0	-0.004	37.626	0	-0.018	0.165	0	0	0.001	0	0	1.171	0	0	3.877	0.027	0	0
6/8/2009 12:35	91.6	78.16	22.661	0.039	13.479	0	-0.004	36.554	0	0.002	0.152	0	0	0.001	0	0	1.117	0	0	3.837	0.026	0	0
6/8/2009 12:36	91.496	78.16	23.025	0.026	13.362	0	-0.004	35.401	0	0.01	0.14	0	0	0.001	0	0	1.065	0	0	3.799	0.025	0	0
6/8/2009 12:37	91.397	78.16	23.03	0.018	13.255	0	-0.004	34.263	0	-0.014	0.129	0	0	0.001	0	0	1.018	0	0	3.763	0.024	0	0
6/8/2009 12:38	91.3	78.16	23.431	0.013	13.153	0	-0.004	33.138	0	0.015	0.119	0	0	0.001	0	0	0.973	0	0	3.727	0.023	0	0
6/8/2009 12:39	91.203	78.16	22.434	0.01	13.053	0	-0.004	32.051	0	-0.016	0.11	0	0	0	0	0	0.931	0	0	3.69	0.022	0	0
6/8/2009 12:40	91.105	78.16	22.135	0.007	12.952	0	-0.004	31.08	0	0.012	0.102	0	0	0	0	0	0.89	0	0	3.65	0.021	0	0
6/8/2009 12:41	91.004	78.16	21.987	0.005	12.849	0	-0.004	30.156	0	-0.01	0.093	0	0	0	0	0	0.852	0	0	3.607	0.021	0	0
6/8/2009 12:42	90.899	78.16	22.212	0.004	12.743	0	-0.004	29.306	0	0.006	0.086	0	0	0	0	0	0.815	0	0	3.563	0.02	0	0
6/8/2009 12:43	90.79	78.16	21.606	0.003	12.633	0	-0.004	28.456	0	-0.001	0.079	0	0	0	0	0	0.779	0	0	3.522	0.019	0	0
6/8/2009 12:44	90.675	78.16	21.076	0.002	12.517	0	-0.004	27.371	0	0	0.073	0	0	0	0	0	0.744	0	0	3.485	0.018	0	0
6/8/2009 12:45	90.553	78.16	21.424	0.002	12.395	0	-0.003	25.924	0	0.003	0.067	0	0	0	0	0	0.709	0	0	3.453	0.018	0	0
6/8/2009 12:46	90.332	78.16	21.232	0.001	12.173	0	-0.003	24.225	0	-0.005	0.061	0	0	0	0	0	0.676	0	0	3.426	0.017	0	0
6/8/2009 12:47	90.129	78.16	20.71	0.001	11.97	0	-0.003	22.501	0	0.006	0.055	0	0	0	0	0	0.643	0	0	3.403	0.017	0	0
6/8/2009 12:48	89.984	78.16	20.601	0.001	11.825	0	-0.003	20.847	0	-0.007	0.05	0	0	0	0	0	0.611	0	0	3.382	0.016	0	0
6/8/2009 12:49	89.867	78.16	20.471	0.001	11.708	0	-0.003	19.327	0	0.006	0.045	0	0	0	0	0	0.581	0	0	3.362	0.016	0	0
6/8/2009 12:50	89.755	78.16	20.022	0	11.595	0	-0.003	18.016	0	-0.005	0.041	0	0	0	0	0	0.553	0	0	3.344	0.015	0	0
6/8/2009 12:51	89.628	78.16	19.932	0	11.468	0	-0.003	16.804	0	0.004	0.037	0	0	0	0	0	0.527	0	0	3.327	0.015	0	0

Attachment C.04-1 First Flush Duration Flow (cfs) for Selected Model Locations

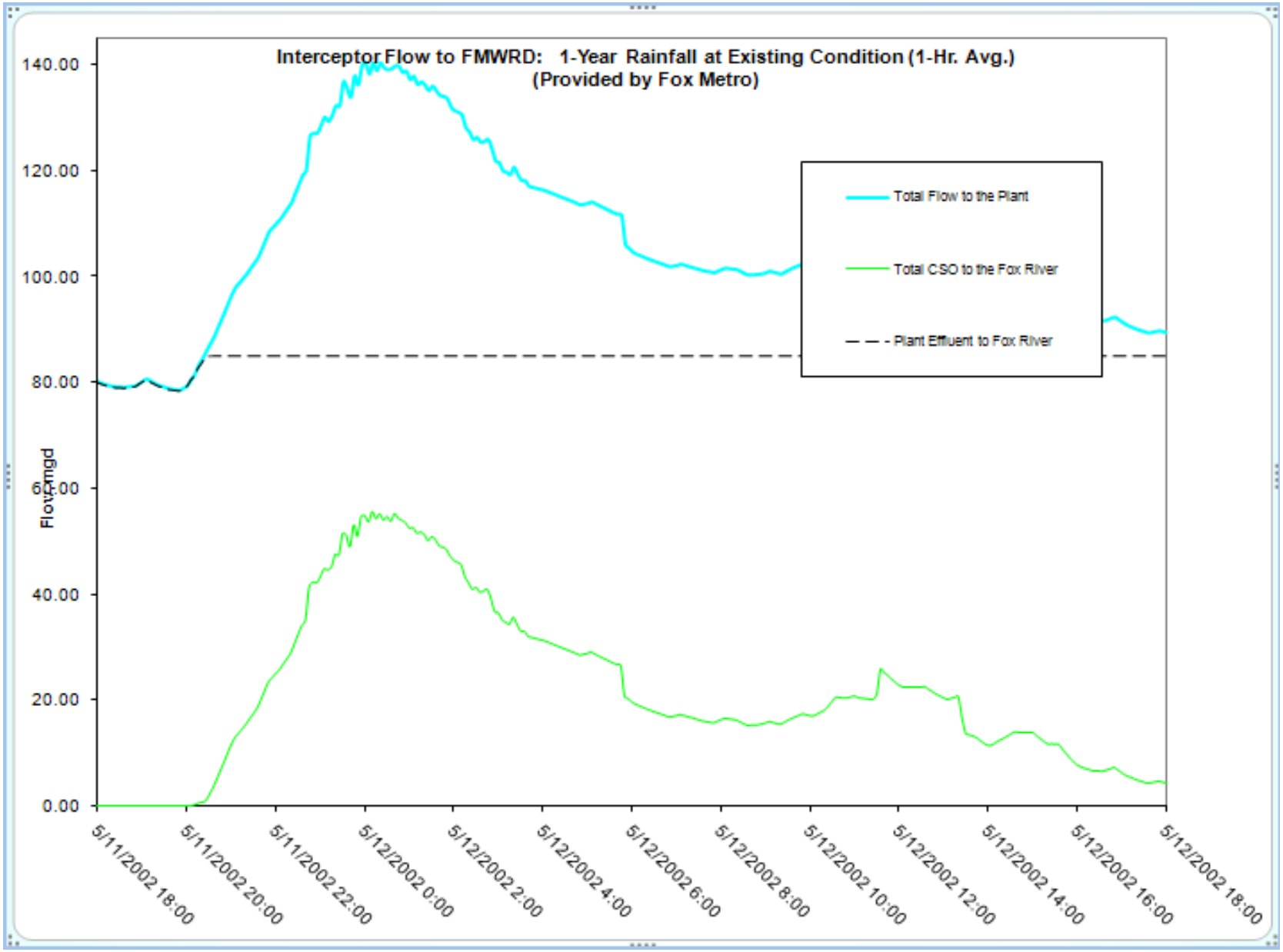
	Model Location	69-inch Upstream of WWTP	69-inch Upstream of WWTP-Adj	Basin 001	CSO 001	CSO 001-Adj	CSO 002	CSO 003A	CSO 004	CSO 005	CSO 008	CSO 010	CSO 015	CSO 018	CSO 021	CSO 022	CSO 023	CSO 025	CSO 027 (Treated)	CSO 027 (Bypass)	CSO Plant (North)	CSO Plant (South)		
	Model Link	Link 162	Link 162-Adj	FM 22	Link 675	Link 675-Adj	Link 797	Link 798	Link 673	Link 684	Link 691	Link 373	CSO 015 Weir	Link 692	Link 772	Link 808	Link 814	Link 339	Link 820	Pump 3	Link 780	Link 740	CSO 015 (Before)	CSO 015 (After)
	2.75 h Volume (mil gal)	5.81	4.32	4.93	3.08	4.57	0.00	0.00	6.09	0.07	3.36	0.74	2.55	0.00	0.14	0.14	0.06	0.46	0.00	0.33	0.84	0.63	2.55	1.36
	6/8/2009 12:52	89.482	78.16	19.7	0	11.322	0	-0.003	15.653	0	-0.002	0.033	0	0	0	0	0	0.502	0	0	3.31	0.014	0	0
	6/8/2009 12:53	89.321	78.16	19.433	0	11.161	0	-0.003	14.55	0	0.001	0.03	0	0	0	0	0	0.479	0	0	3.292	0.014	0	0
	6/8/2009 12:54	89.153	78.16	19.242	0	10.993	0	-0.003	13.509	0	0	0.027	0	0	0	0	0	0.456	0	0	3.272	0.013	0	0
	6/8/2009 12:55	88.982	78.16	19.139	0	10.822	0	-0.003	12.542	0	-0.001	0.025	0	0	0	0	0	0.434	0	0	3.251	0.013	0	0
	6/8/2009 12:56	88.809	78.16	18.72	0	10.649	0	-0.003	11.647	0	0.003	0.022	0	0	0	0	0	0.413	0	0	3.229	0.012	0	0
	6/8/2009 12:57	88.634	78.16	18.752	0	10.474	0	-0.003	10.818	0	-0.003	0.02	0	0	0	0	0	0.392	0	0	3.207	0.012	0	0
	6/8/2009 12:58	88.457	78.16	18.433	0	10.297	0	-0.003	10.053	0	0.004	0.017	0	0	0	0	0	0.371	0	0	3.186	0.012	0	0
	6/8/2009 12:59	88.276	78.16	18.366	0	10.116	0	-0.003	9.345	0	-0.004	0.015	0	0	0	0	0	0.353	0	0	3.166	0.011	0	0
	6/8/2009 13:00	88.091	78.16	18.155	0	9.931	0	-0.003	8.699	0	0.004	0.013	0	0	0	0	0	0.335	0	0	3.148	0.011	0	0
	6/8/2009 13:01	87.903	78.16	18.133	0	9.743	0	-0.003	7.989	0	-0.004	0.011	0	0	0	0	0	0.317	0	0	3.133	0.011	0	0
	6/8/2009 13:02	87.59	78.16	17.858	0	9.43	0	-0.003	5.695	0	0.003	0.01	0	0	0	0	0	0.301	0	0	3.12	0.01	0	0
	6/8/2009 13:03	87.381	78.16	17.814	0	9.221	0	-0.003	3.565	0	-0.002	0.008	0	0	0	0	0	0.284	0	0	3.107	0.01	0	0
	6/8/2009 13:04	87.208	78.16	17.658	0	9.048	0	-0.003	1.458	0	0.001	0.007	0	0	0	0	0	0.266	0	0	3.093	0.01	0	0
	6/8/2009 13:05	87.054	78.16	17.599	0	8.894	0	-0.003	0.088	0	0	0.006	0	0	0	0	0	0.248	0	0	3.077	0.01	0	0
	6/8/2009 13:06	86.907	78.16	17.505	0	8.747	0	-0.003	0.002	0	0	0.005	0	0	0	0	0	0.231	0	0	3.061	0.009	0	0
	6/8/2009 13:07	86.755	78.16	17.481	0	8.595	0	-0.003	0	0	0.001	0.004	0	0	0	0	0	0.215	0	0	3.044	0.009	0	0
	6/8/2009 13:08	86.59	78.16	17.329	0	8.43	0	-0.003	0	0	-0.001	0.003	0	0	0	0	0	0.199	0	0	3.025	0.009	0	0
	6/8/2009 13:09	86.413	78.16	17.295	0	8.253	0	-0.003	0	0	0.002	0.003	0	0	0	0	0	0.185	0	0	3.004	0.009	0	0
	6/8/2009 13:10	86.226	78.16	17.184	0	8.066	0	-0.003	0	0	-0.003	0.002	0	0	0	0	0	0.171	0	0	2.981	0.008	0	0
End	**6/8/2009 13:11**	86.033	78.16	17.122	0	7.873	0	-0.003	0	0	0.003	0.002	0	0	0	0	0	0.157	0	0	2.957	0.008	0	0
	6/8/2009 13:12	85.833	78.16	17.04	0	7.673	0	-0.003	0	0	-0.003	0.001	0	0	0	0	0	0.143	0	0	2.932	0.008	0	0
	6/8/2009 13:13	85.628	78.16	16.908	0	7.468	0	-0.003	0	0	0.002	0.001	0	0	0	0	0	0.13	0	0	2.907	0.008	0	0
	6/8/2009 13:14	85.412	78.16	18.336	0	7.252	0	-0.003	0	0	-0.002	0.001	0	0	0	0	0	0.116	0	0	2.885	0.008	0	0
	6/8/2009 13:15	85.136	78.16	16.579	0	6.976	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.103	0	0	2.867	0.007	0	0
	6/8/2009 13:16	84.826	78.16	16.256	0	6.666	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.091	0	0	2.853	0.007	0	0
	6/8/2009 13:17	84.521	78.16	16.772	0	6.361	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.08	0	0	2.841	0.007	0	0
	6/8/2009 13:18	84.232	78.16	16.723	0	6.072	0	-0.003	0	0	0	0	0	0	0	0	0	0.069	0	0	2.828	0.007	0	0
	6/8/2009 13:19	83.971	78.16	16.264	0	5.811	0	-0.003	0	0	0	0	0	0	0	0	0	0.059	0	0	2.815	0.007	0	0
	6/8/2009 13:20	83.887	78.16	15.706	0	5.727	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.052	0	0	2.801	0.006	0	0
	6/8/2009 13:21	83.928	78.16	16.397	0	5.768	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.045	0	0	2.787	0.006	0	0
	6/8/2009 13:22	83.992	78.16	16.015	0	5.832	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.04	0	0	2.773	0.006	0	0
	6/8/2009 13:23	84.004	78.16	15.971	0	5.844	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.035	0	0	2.759	0.006	0	0
	6/8/2009 13:24	83.933	78.16	16.012	0	5.773	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.031	0	0	2.745	0.006	0	0
	6/8/2009 13:25	83.787	78.16	15.736	0	5.627	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.028	0	0	2.731	0.006	0	0
	6/8/2009 13:26	83.581	78.16	15.5	0	5.421	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.025	0	0	2.716	0.006	0	0
	6/8/2009 13:27	83.246	78.16	15.36	0	5.086	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.023	0	0	2.702	0.005	0	0
	6/8/2009 13:28	82.803	78.16	15.065	0	4.643	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.021	0	0	2.687	0.005	0	0
	6/8/2009 13:29	82.35	78.16	15.348	0	4.19	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.019	0	0	2.673	0.005	0	0
	6/8/2009 13:30	81.913	78.16	14.598	0	3.753	0	-0.003	0	0	0	0	0	0	0	0	0	0.018	0	0	2.659	0.005	0	0
	6/8/2009 13:31	81.485	78.16	14.71	0	3.325	0	-0.003	0	0	0	0	0	0	0	0	0	0.016	0	0	2.645	0.005	0	0
	6/8/2009 13:32	81.083	78.16	14.868	0	2.923	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.015	0	0	2.63	0.005	0	0
	6/8/2009 13:33	80.037	78.16	14.391	0	1.877	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.014	0	0	2.616	0.005	0	0
	6/8/2009 13:34	79.786	78.16	14.405	0	1.626	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.013	0	0	2.602	0.005	0	0
	6/8/2009 13:35	79.498	78.16	14.056	0	1.338	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.012	0	0	2.587	0.004	0	0
	6/8/2009 13:36	79.288	78.16	14.28	0	1.128	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.011	0	0	2.573	0.004	0	0
	6/8/2009 13:37	79.107	78.16	14.282	0	0.947	0	-0.003	0	0	0.002	0	0	0	0	0	0	0.011	0	0	2.558	0.004	0	0
	6/8/2009 13:38	78.922	78.16	14.042	0	0.762	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.01	0	0	2.544	0.004	0	0
	6/8/2009 13:39	78.71	78.16	13.971	0	0.55	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.01	0	0	2.529	0.004	0	0
	6/8/2009 13:40	78.366	78.16	13.903	0	0.206	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.009	0	0	2.514	0.004	0	0
	6/8/2009 13:41	77.778	77.778	13.737	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.008	0	0	2.498	0.004	0	0
	6/8/2009 13:42	77.271	77.271	13.671	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.008	0	0	2.481	0.004	0	0
	6/8/2009 13:43	76.868	76.868	13.737	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.008	0	0	2.462	0.004	0	0
	6/8/2009 13:44	76.552	76.552	13.615	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.007	0	0	2.438	0.004	0	0
	6/8/2009 13:45	76.285	76.285	13.599	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.007	0	0	2.412	0.004	0	0
	6/8/2009 13:46	76.023	76.023	13.462	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.007	0	0	2.385	0.004	0	0
	6/8/2009 13:47	75.728	75.728	13.422	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.006	0	0	2.358	0.003	0	0
	6/8/2009 13:48	75.387	75.387	13.413	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.006	0	0	2.334	0.003	0	0
	6/8/2009 13:49	75.014	75.014	13.355	0	0	0	-0.003	0	0	-0.002	0	0	0	0	0	0	0.006	0	0	2.311	0.003	0	0
	6/8/2009 13:50	74.616	74.616	13.304	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.005	0	0	2.289	0.003	0	0
	6/8/2009 13:51	74.088	74.088	13.293	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.005	0	0	2.268	0.003	0	0
	6/8/2009 13:52	73.33	73.33	13.198	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.005	0	0	2.247	0.003	0	0
	6/8/2009 13:53	72.767	72.767	13.184	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.005	0	0	2.227	0.003	0	0
	6/8/2009 13:54	72.264	72.264	13.136	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.005	0	0	2.207	0.003	0	0
	6/8/2009 13:55	71.809	71.809	13.093	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.004	0	0	2.189	0.003	0	0
	6/8/2009 13:56	71.395	71.395	13.058	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.004	0	0	2.17	0.003	0	0
	6/8/2009 13:57	70.943	70.943	13.003	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.004	0	0	2.151	0.003	0	0
	6/8/2009 13:58	70.435	70.435	12.973	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.004	0	0	2.131	0.003	0	0
	6/8/2009 13:59	69.943	69.943	12.91	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.004	0	0	2.111	0.003	0	0
	6/8/2009 14:00	69.515	69.515	12.892	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.004	0	0	2.092	0.003	0	0
	6/8/2009 14:01	69.127	69.127	12.837	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.004	0	0	2.076	0.003	0	0
	6/8/2009 14:02	68.685	68.685	12.811	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.003	0	0	2.063	0.003	0	0
	6/8/2009 14:03	68.179	68.179	12.775	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.003	0	0	2.054	0.002	0	0
	6/8/2009 14:04	67.692	67.692	12.73	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.003	0	0	2.048	0.002	0	0
	6/8/2009 14:05	67.255	67.255	12.691	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.003	0	0	2.045	0.002	0	0
	6/8/2009 14:06	66.864	66.864	12.649	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.003	0	0	2.043	0.002	0	0
	6/8/2009 14:07	66.511	66.511	12.612	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.003	0	0	2.04	0.002	0	0
	6/8/2009 14:08	65.446	65.446	12.576	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.003	0	0	2.036	0.002	0	0
	6/8/2009 14:09	65.355	65.355	12.538	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.003	0	0	2.029	0.002	0	0
	6/8/2009 14:10	65.23	65.23	12.502	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.003	0	0	2.019	0.002	0	0
	6/8/2009 14:11	65.062	65.062	12.466	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.003	0	0	2.007	0.002	0	0
	6/8/2009 14:12	64.87	64.87	12.431	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.993	0.002	0	0
	6/8/2009 14:13	64.473	64.473	12.396	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.977	0.002	0	0
	6/8/2009 14:14	64.228	64.228	12.363	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.96	0.002	0	0
	6/8/2009 14:15	64.024	64.024	12.329	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.941	0.002	0	0
	6/8/2009 14:16	63.825	63.825	12.295	0	0	0	-0.003	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.922	0.002	0	0
	6/8/2009 14:17	63.49	63.49	12.263	0	0	0	-0.003	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.902	0.002	0	0

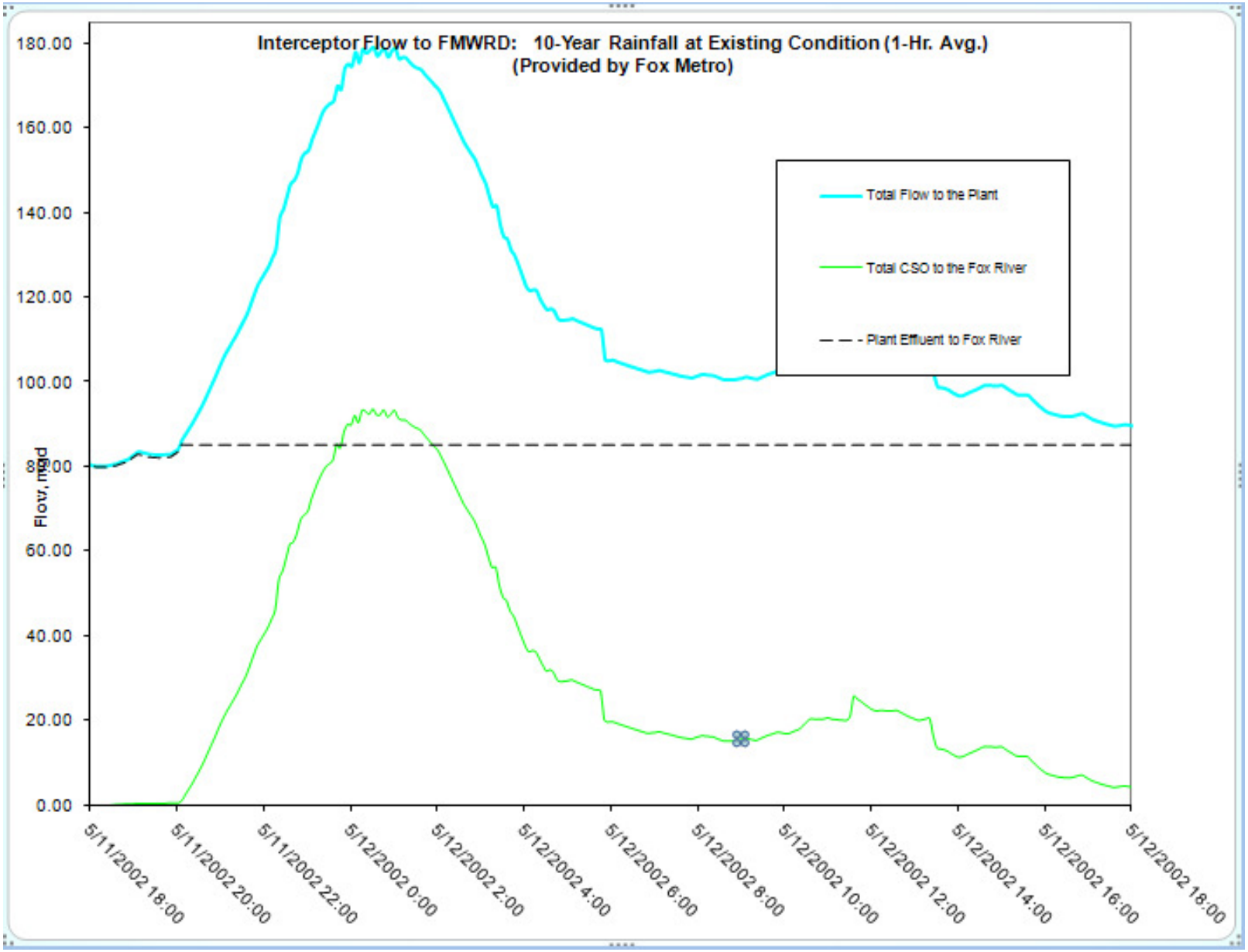
Attachment C.04-1 First Flush Duration Flow (cfs) for Selected Model Locations

Model Location	69-inch Upstream of WWTP	69-inch Upstream of WWTP-Adj	Basin 001	CSO 001	CSO 001-Adj	CSO 002	CSO 003A	CSO 004	CSO 005	CSO 008	CSO 010	CSO 015	CSO 018	CSO 021	CSO 022	CSO 023	CSO 025	CSO 027 (Treated)	CSO 027 (Bypass)	CSO Plant (North)	CSO Plant (South)		
Model Link	Link 162	Link 162-Adj	FM 22	Link 675	Link 675-Adj	Link 797	Link 798	Link 673	Link 684	Link 691	Link 373	CSO 015 Weir	Link 692	Link 772	Link 808	Link 814	Link 339	Link 820	Pump 3	Link 780	Link 740	CSO 015 (Before)	CSO 015 (After)
2.75 h Volume (mil gal)	5.81	4.32	4.93	3.08	4.57	0.00	0.00	6.09	0.07	3.36	0.74	2.55	0.00	0.14	0.14	0.06	0.46	0.00	0.33	0.84	0.63	2.55	1.36
6/8/2009 14:18	63.097	63.097	12.23	0	0	0	-0.003	0	0	0	0	0	0	0	0	0	0.002	0	0	1.882	0.002	0	0
6/8/2009 14:19	62.644	62.644	12.197	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.002	0	0	1.862	0.002	0	0
6/8/2009 14:20	62.169	62.169	12.165	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.002	0	0	1.842	0.002	0	0
6/8/2009 14:21	61.709	61.709	12.131	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.002	0	0	1.821	0.002	0	0
6/8/2009 14:22	61.292	61.292	12.101	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.801	0.002	0	0
6/8/2009 14:23	60.929	60.929	12.069	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.78	0.002	0	0
6/8/2009 14:24	60.543	60.543	12.038	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.761	0.002	0	0
6/8/2009 14:25	60.212	60.212	12.007	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.741	0.002	0	0
6/8/2009 14:26	59.941	59.941	11.976	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.722	0.002	0	0
6/8/2009 14:27	59.695	59.695	11.945	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.703	0.002	0	0
6/8/2009 14:28	59.459	59.459	11.914	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.002	0	0	1.685	0.002	0	0
6/8/2009 14:29	59.221	59.221	11.884	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.002	0	0	1.667	0.001	0	0
6/8/2009 14:30	58.143	58.143	11.854	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.002	0	0	1.65	0.001	0	0
6/8/2009 14:31	58.076	58.076	11.825	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.002	0	0	1.634	0.001	0	0
6/8/2009 14:32	57.978	57.978	11.796	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.618	0.001	0	0
6/8/2009 14:33	57.788	57.788	11.767	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.603	0.001	0	0
6/8/2009 14:34	57.504	57.504	11.738	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.589	0.001	0	0
6/8/2009 14:35	57.157	57.157	11.71	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.576	0.001	0	0
6/8/2009 14:36	56.732	56.732	11.682	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.565	0.001	0	0
6/8/2009 14:37	56.296	56.296	11.654	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.556	0.001	0	0
6/8/2009 14:38	55.903	55.903	11.627	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.548	0.001	0	0
6/8/2009 14:39	55.567	55.567	11.6	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.54	0.001	0	0
6/8/2009 14:40	55.288	55.288	11.573	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.534	0.001	0	0
6/8/2009 14:41	55.057	55.057	11.547	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.528	0.001	0	0
6/8/2009 14:42	54.865	54.865	11.521	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.522	0.001	0	0
6/8/2009 14:43	54.704	54.704	11.495	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.516	0.001	0	0
6/8/2009 14:44	54.563	54.563	11.468	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.51	0.001	0	0
6/8/2009 14:45	54.432	54.432	11.442	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.503	0.001	0	0
6/8/2009 14:46	54.3	54.3	11.416	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.494	0.001	0	0
6/8/2009 14:47	54.154	54.154	11.39	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.485	0.001	0	0
6/8/2009 14:48	53.987	53.987	11.364	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.474	0.001	0	0
6/8/2009 14:49	53.796	53.796	11.338	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.463	0.001	0	0
6/8/2009 14:50	53.583	53.583	11.312	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.45	0.001	0	0
6/8/2009 14:51	53.356	53.356	11.287	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.437	0.001	0	0
6/8/2009 14:52	53.123	53.123	11.262	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.423	0.001	0	0
6/8/2009 14:53	52.891	52.891	11.238	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.41	0.001	0	0
6/8/2009 14:54	52.245	52.245	11.214	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.396	0.001	0	0
6/8/2009 14:55	51.957	51.957	11.19	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.382	0.001	0	0
6/8/2009 14:56	50.691	50.691	11.166	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.369	0.001	0	0
6/8/2009 14:57	50.614	50.614	11.143	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.356	0.001	0	0
6/8/2009 14:58	50.465	50.465	11.12	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.344	0.001	0	0
6/8/2009 14:59	50.302	50.302	11.097	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.331	0.001	0	0
6/8/2009 15:00	50.148	50.148	11.074	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.319	0.001	0	0
6/8/2009 15:01	50.015	50.015	11.052	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.308	0.001	0	0
6/8/2009 15:02	49.895	49.895	11.029	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.296	0.001	0	0
6/8/2009 15:03	49.783	49.783	11.007	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.285	0.001	0	0
6/8/2009 15:04	49.678	49.678	10.985	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.274	0.001	0	0
6/8/2009 15:05	49.58	49.58	10.963	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.263	0.001	0	0
6/8/2009 15:06	49.489	49.489	10.941	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.253	0.001	0	0
6/8/2009 15:07	49.375	49.375	10.919	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.243	0.001	0	0
6/8/2009 15:08	49.257	49.257	10.897	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.233	0.001	0	0
6/8/2009 15:09	49.139	49.139	10.875	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.224	0.001	0	0
6/8/2009 15:10	49.018	49.018	10.853	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.215	0.001	0	0
6/8/2009 15:11	48.891	48.891	10.832	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.207	0.001	0	0
6/8/2009 15:12	48.756	48.756	10.81	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.198	0.001	0	0
6/8/2009 15:13	48.612	48.612	10.789	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.19	0.001	0	0
6/8/2009 15:14	48.461	48.461	10.767	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.182	0.001	0	0
6/8/2009 15:15	48.309	48.309	10.747	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.174	0.001	0	0
6/8/2009 15:16	48.16	48.16	10.726	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.167	0.001	0	0
6/8/2009 15:17	48.013	48.013	10.706	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.16	0.001	0	0
6/8/2009 15:18	47.865	47.865	10.685	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.153	0.001	0	0
6/8/2009 15:19	47.711	47.711	10.666	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.146	0.001	0	0
6/8/2009 15:20	47.55	47.55	10.646	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.139	0.001	0	0
6/8/2009 15:21	47.388	47.388	10.627	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.132	0.001	0	0
6/8/2009 15:22	47.232	47.232	10.608	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.125	0.001	0	0
6/8/2009 15:23	47.081	47.081	10.588	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.118	0.001	0	0
6/8/2009 15:24	46.936	46.936	10.569	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.111	0.001	0	0
6/8/2009 15:25	46.798	46.798	10.55	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.103	0.001	0	0
6/8/2009 15:26	46.671	46.671	10.531	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.096	0.001	0	0
6/8/2009 15:27	46.553	46.553	10.512	0	0	0	-0.002	0	0	0	0	0	0	0	0	0	0.001	0	0	1.088	0.001	0	0
6/8/2009 15:28	46.426	46.426	10.492	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.081	0.001	0	0
6/8/2009 15:29	46.235	46.235	10.473	0	0	0	-0.002	0	0	0.001	0	0	0	0	0	0	0.001	0	0	1.073	0	0	0
6/8/2009 15:30	45.989	45.989	10.454	0	0	0	-0.002	0	0	-0.001	0	0	0	0	0	0	0.001	0	0	1.065	0	0	0

Attachment C.04-2 Rainfall Applied for Projection of WWTP Flows (Provided by Fox Metro)

	RAW 2002 Rainfall	3-month Scaled	1-year Scaled	2-year Scaled	5-year Scaled	10-year Scaled
5/11/02 0:00						
5/11/02 1:00						
5/11/02 2:00						
5/11/02 3:00						
5/11/02 4:00						
5/11/02 5:00						
5/11/02 6:00						
5/11/02 7:00						
5/11/02 8:00						
5/11/02 9:00	0.06	0.06	0.06	0.06	0.06	0.06
5/11/02 10:00	0.14	0.14	0.14	0.14	0.14	0.14
5/11/02 11:00	0.260	0.260	0.26	0.26	0.26	0.26
5/11/02 12:00	0.390	0.390	0.39	0.39	0.39	0.39
5/11/02 13:00	0.110	0.110	0.11	0.11	0.11	0.11
5/11/02 14:00	0.320	0.320	0.32	0.32	0.32	0.32
5/11/02 15:00	0.010	0.010	0.01	0.01	0.01	0.01
5/11/02 16:00	0.010	0.010	0.01	0.01	0.01	0.01
5/11/02 17:00						
5/11/02 18:00						
5/11/02 19:00	0.030	0.030	0.03	0.03	0.03	0.03
5/11/02 20:00	0.580	0.428	0.672	0.776	1.044	1.268
5/11/02 21:00	0.410	0.296	0.479	0.557	0.758	0.926
5/11/02 22:00	0.260	0.184	0.306	0.358	0.492	0.604
5/11/02 23:00	0.230	0.192	0.253	0.279	0.346	0.402
5/12/02 0:00	0.030	0.030	0.03	0.03	0.03	0.03
5/12/02 1:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 2:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 3:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 4:00						
5/12/02 5:00						
5/12/02 6:00						
5/12/02 7:00						
5/12/02 8:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 9:00	0.030	0.030	0.03	0.03	0.03	0.03
5/12/02 10:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 11:00						
5/12/02 12:00						
5/12/02 13:00						
5/12/02 14:00						
5/12/02 15:00						
5/12/02 16:00						
5/12/02 17:00						
5/12/02 18:00						
5/12/02 19:00						
5/12/02 20:00						
5/12/02 21:00	0.010	0.010	0.01	0.01	0.01	0.01
5/12/02 22:00						
5/12/02 23:00						


Interceptor Flow to FMWRD: 1-Year Rainfall at Existing Condition (1-Hr. Avg.)
(Provided by Fox Metro)
Total Flow to the Plant
Total CSO to the Fox River
Plant Effluent to Fox River
Flow, mgd
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
5/11/2002 18:00
5/11/2002 20:00
5/11/2002 22:00
5/12/2002 0:00
5/12/2002 2:00
5/12/2002 4:00
5/12/2002 6:00
5/12/2002 8:00
5/12/2002 10:00
5/12/2002 12:00
5/12/2002 14:00
5/12/2002 16:00
5/12/2002 18:00


Interceptor Flow to FMWRD: 10-Year Rainfall at Existing Condition (1-Hr. Avg.)
(Provided by Fox Metro)
Flow, mgd
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Total Flow to the Plant
Total CSO to the Fox River
Plant Effluent to Fox River
5/11/2002 18:00
5/11/2002 20:00
5/11/2002 22:00
5/12/2002 0:00
5/12/2002 2:00
5/12/2002 4:00
5/12/2002 6:00
5/12/2002 8:00
5/12/2002 10:00
5/12/2002 12:00
5/12/2002 14:00
5/12/2002 16:00
5/12/2002 18:00

APPENDIX D
ALTERNATIVES EVALUATION

D.1 INTRODUCTION

Evaluation of alternatives for combined sewer overflow (CSO) control requires identifying reasonable CSO abatement options in individual CSO basins and across the entire system. The process of evaluating CSO abatement alternatives includes identifying systemwide alternatives (combinations of those options that work well together), identifying the level of CSO control each alternative would achieve, and projecting monetary costs for those alternatives. This appendix provides a summary of the approach used to identify basin and systemwide options, systemwide CSO abatement alternatives, CSO level of control, and monetary costs. Monetary costs contained herein and in subsequent appendices are based on 4th Quarter 2009 dollars.

D.2 MONETARY COST ANALYSES

Projecting costs for CSO control projects is a very important aspect of long-term control planning, since cost very often dictates alternatives selection and the level of control attainable, and cost strongly influences the degree of public resistance to or acceptance of the LTCP.

A. Capital Cost Projections

Construction costs for proposed projects are determined based on unit costs, equipment prices, and typical factors. Structure costs are projected using unit costs for items like excavation, fill, and concrete. New equipment costs are obtained from equipment manufacturers or from recent past projects. Costs for items such as piping, electrical, instrumentation and controls, HVAC, and odor control are based on typical percentages of structure and equipment costs. Construction costs include an additional 8 percent for contractor mobilization and overhead [Contractor General Conditions (GCs)]. Capital costs are projected by applying a 30 percent factor to construction costs to include a contingency allowance and a 20 percent factor for technical, legal, and administrative services and costs. Additional costs such as land acquisition are included as separate line items.

B. Operation, Maintenance, And Replacement (O,M&R) Cost Projections

For each CSO control option evaluated, the impact on annual O,M&R costs are projected. This includes a projection of increased labor, energy, maintenance, and other costs associated with the option. It is assumed, for example, that each new wet weather pumping station will require an additional 6 to 8 personnel hours per week of operational maintenance, which will include regular inspection, required attention during storm events, and potential postevent needs. A labor rate of $47.87 per hour was applied for a typical City of Aurora utility employee, which includes salary, benefits, and overhead. Per year operational maintenance supplies are estimated at 1 percent of raw equipment costs. It is also assumed that yearly O&M costs for new gravity sewer and force mains will be about $0.50 a foot. Power costs are based on recent billing to the City of Aurora at energy costs of $0.085/kWh and typical demand charges.

C. Life-Cycle Costs

Monetary costs for CSO abatement alternatives are compared on the basis of present value costs. This method considers initial capital costs, future capital costs, annual O,M&R costs, and future salvage value (residual value at end of the life cycle) to determine a “Present Value.” The present value can be

considered that sum of money required at the project outset to build and operate the systems associated with an option for the period of the life cycle, assuming it could be sold for its residual (salvage) value at the end.

Life-cycle costs are determined for a 20-year period using a 4th Quarter 2009 discount rate of 4.375 percent. The discount rate is the "time value of money" factor that is used to determine the present value of future sums. The 4.375 percent discount rate can be thought of as the "lost opportunity" cost of capital less the long-term rate of inflation. For example, if the long-term rate of inflation is 3 percent, the 4.375 percent discount rate suggests that capital can currently earn about 7.375 percent per year. Present value computations determined on this basis utilize current costs for all cash flows, since future inflation is accounted for in the discount rate.

For determining salvage value, linear depreciation is assumed over the expected life of structures and equipment. Sewers and sewer structures are assigned a life of 50 years; structures and associated piping systems, 40 years; mechanical and electrical equipment, 20 years; and instrumentation, HVAC, and odor control, 10 years. Land values are assumed permanent.

D.3 CSO MANAGEMENT COMPONENTS

Proper management of CSOs requires that the City of Aurora have the ability to either eliminate or collect, convey, store, and eventually treat all flows in the CSS to an acceptable level of control. This section examines basin-specific and major systemwide improvements to the sewer system to achieve various levels of CSO control. Improvements considered include storage units, sewer separation, green infrastructure, conveyance facilities (pumping stations, force mains, and gravity interceptors), and CSO treatment facilities. Each of these components, and in particular their specific siting issues and cost development, is described in more detail in appendices that follow this appendix. Figure D.3-1 shows the universe of proposed options that are considered in this appendix.

A. Overflow Storage

One alternative to achieving desired CSO control is to capture and store overflow volumes for later conveyance and treatment following a storm event. This requires the ability to convey the CSO into the storage tanks and then back out of the tanks for conveyance to the wastewater treatment plant (WWTP); this almost always requires pumping during fill or discharge, or possibly both. For achievement of a return-frequency (RF) level of control, storage units need to be designed based on the largest (critical) volume produced from short-, medium-, or long-duration events and be able to be cleaned after use.

Storage can either be local, near the point of CSO discharge, or be provided at a few key locations in the system. While this section presents the storage-related options evaluated, Appendix I discusses storage locations, volumes, and costs in greater detail.

1. Local Storage

Storing all overflows at or near their point of discharge is one option for consideration. The City of Aurora currently has 16 permitted CSOs in the system, suggesting that many separate storage facilities would have to be constructed if this method were used. Use of a single storage facility to serve clusters of CSOs could reduce this number somewhat.

There are some inherent problems with providing local storage at multiple overflow points. First, because localized storage cannot take advantage of an economy of scale, the capital costs for local storage will be higher than for centralized storage. Second, each tank will require cleaning after a storm, as well as routine maintenance, putting additional burden on the City of Aurora personnel during periods that are already taxing resources. Third, some CSOs (particularly CSOs 008 and 015) are in the most densely developed parts of the city, and the volumes of CSO requiring storage are so great as to render storage at those locations impractical. Finally, the City of Aurora places a high value on the aesthetics of riverfront property and is very intentional on how that property is used. CSO storage will not be an attractive use except where green space can be provided over the top. These monetary and nonmonetary factors suggest that storage of the CSO at every location is not a practical way to manage CSOs in the City of Aurora.

However, local storage may be a suitable alternative at some of the more peripheral CSOs where the volumes are smaller, especially if land for underground storage is already publicly owned. City of Aurora personnel identified two publicly owned areas that may be suitable for storage, provided that it would not hinder these areas' current use as public parks. The first area is within McCullough Park, south of CSO 023 (W. Illinois St.). This park is owned by the Fox Valley Park District, and its potential use for CSO control would require a cooperative effort between the Park District and the City. The second area that may be available for use is in the park adjacent to the police station at River St. and West Park Ave., near CSO 021. The completion of the new Police Station located on East Indian Trail will make this property available for use in the very near future. The original covenant for the property, which was given to the City of Aurora by a local benefactor, requires that it be maintained for public use. Constructing underground CSO storage with park-like green space on top is considered consistent with this covenant. Based on these criteria, it appears that local storage for CSO 023 (W. Illinois St.) and CSO 021 (West Park Ave.) may be viable. These local storage options are shown on Figure D.3-1 as St023 and St021, respectively.

In addition, where space is available, storage of some or all of the flow may be a viable alternative for larger CSOs, in combination with other basin options. Because of the large volume at CSO 001 (Rathbone Ave.), it is advantageous to provide underground storage on the trunk sewer upstream of the CSO, especially if flow into storage can be by gravity, thereby eliminating the need for pumping the high rates of flow. This option is shown on Figure D.3-1 as St001 and could be pursued at a selection of parcels within the blue shaded area.

Table D.3-1 lists locations and CSOs for which local storage may be a practical solution and will be considered. The required storage volumes and areas are discussed in further detail in Appendix I.

CSO	Figure Notation	Location
001-Rathbone	St001	Rathbone Ave.
021-W. Park Ave.	St021	Police Station Site
023-W. Illinois St.	St023	McCullough Park

Table D.3-1 Local CSO Storage Locations Evaluated

2. Remote Storage

A second storage option, one that could increase the feasibility and economy of scale for storage, would be to provide storage at one or two selected locations around the city. (This option of centrally located points of storage is referred to as "remote" storage, meaning that the sites are remote from both the point of overflow and the WWTP.) This requires new conveyance systems from the CSOs to the points of storage. While experience with other CSO communities suggests that bulk storage of large quantities of CSO is rarely cost-effective, when applied in combination with treatment, storage can become very cost-effective. Storage of conveyed CSOs at St001 and near the Fox Metro WWTP will be considered in this evaluation.

B. Remote Treatment

Another option for wastewater management is to locate wet weather treatment facilities (WWTFs), such as the 21.8 mgd CSO plant located at 400 North Broadway, at key locations around the city to provide treatment of wastewater during storm events. Although it is not practical to have local treatment at each of the CSO locations, having one or two remote treatment locations around the city may be practical and manageable. As with remote storage locations, conveyance facilities will need to be upgraded to deliver the required wastewater flow to the remote treatment locations. Outfall sewers from these facilities will also be necessary.

WWTFs will be designed for brief, intense storms, such as the 1-hour storm. Pumping, screening, solids separation, and disinfection will be designed for the peak projected flow rate unless equalization storage can be provided such that lower treatment rates would be adequate to handle equalized flow. (Please see Appendix F for a detailed discussion of WWTF design considerations.)

1. Treatment Option A: Enclosed Rectangular Clarification and Chlorine Disinfection

Appendix F identifies clarification with chlorine disinfection as the most practical treatment option for this LTCP. One alternative for implementing clarification and chlorine disinfection is to use rectangular clarifier tanks with common wall construction in an enclosed structure. Clarification will be designed for a settling rate of 1,800 gpd/sf, and chlorine contact will be provided at about 15 minutes of contact time at peak flow. Odors can also be contained and treated using an odor control system.[1] The CSO treatment facility at 400 North Broadway, owned by the City of Aurora and operated by the Fox Metro Water Reclamation District (FMWRD), is designed on this principle. Because of the relative operational success and public acceptance of this facility, this layout is considered a good option for treatment.

2. Treatment Option B: Enclosed Rectangular Clarification with Enhanced Settling and Chlorine Disinfection.

This option is similar to Option A in layout, but it is equipped with inclined plate settling to achieve a settling rate of as high as about 5,300 gpd/sf, or approximately three times the current

[1] City staff have noted that operating the odor control system at 400 N. Broadway has never been necessary. However, as noted in Appendix F, costs for odor control have been included.

design settling rate of 1,800 gpd/sf. This option is particularly attractive since the CSO plant designed on Option A principles can be upgraded to Option B. Therefore, upgrading the CSO plant in this fashion is considered a viable alternative and, based on the discussion in Appendix F, it will be assumed that the currently 21.8 mgd plant would be able to treat 50 mgd.[2] This treatment option would likely require piloting prior to being permitted by IEPA.

3. Treatment Option C: Treatment at Fox Metro WWTP

Based on conversations with FMWRD personnel, treating additional wet weather flow requires acquisition of additional property north of the existing WWTP, shown as Area A00 on Figure D.3-1. The most practical way to provide full treatment of wet weather flows is to provide a large amount of storage to retain those wet weather flows, to be bled back into the plant as capacity became available. Alternatively, additional wet weather treatment can be provided, similar to Option A above. For simplicity in this evaluation, it is assumed that costs for additional wet weather treatment at Fox Metro are similar to new wet weather treatment located within the Aurora system. It is assumed that providing storage near the plant will be about 10 percent lower in cost than in-city sites, since aesthetic concerns are less of an issue and open or aboveground tanks may be an option.

The next step requires identification of potential locations for treatment. It is preferable that these locations be relatively close to the main interceptors and CSOs and also to a point of discharge on the Fox River. The site should be above the 100-year floodplain but should be relatively flat. Aerial photographs were reviewed with the City of Aurora staff, and several potential sites were identified as shown on Figure D.3-1 as blue shaded areas.

1. Area 00–Near WWTP

This approximately 17-acre site is located just north of the Fox Metro WWTP. This site is by far the largest of the sites available for CSO control. However, this site is reported to have environmental contamination. In addition, since this site is nearly 2 miles south of CSO 001, CSO conveyance to this site is anticipated to be more costly than to the other sites.

2. Area A01–Powell Street

This site, named for the platted street that runs through the parcel, is located somewhat near CSO 001 (Rathbone Ave.) on the east side of the railroad tracks. The site is currently owned by the Rockford Diocese. City personnel indicate elevations around this site suggest stormwater control and wetland mitigation are additional factors for consideration if this site is selected.

3. Area A02–Rathbone Avenue

Area A02 designates a collection of potential sites just west of CSO 001. Owners of these properties include the Fox Valley Park District and several businesses and private individuals.

[2] This upgrade requires that one of the four existing clarifiers be converted to a chlorine contact tank; thus the increase in capacity of the plant is less than the three-fold increase of the settling rate.

The proximity of this area to the City's largest CSO and the potential for limiting exposure to residences make it a very attractive location.

4. Area A10–Hurds Island

The Burlington Northern Santa Fe (BNSF) Railroad bisects Hurds Island, the largest island in the Fox River within the Aurora city limits. The northwest side of the island is a park, and the southeast side of the island, owned by the railroad, is currently not used and remains a wooded lot. In some respects, this location is ideal for CSO control: the site is relatively large and is midway between the largest and most active CSOs. In other respects, it is somewhat disadvantageous. First, the site is reported to have some environmental contamination because of cinders. Second, the topography of the site may require a significant amount of earthwork. Next, presently, access to the southern portion of the island requires passage under a railroad bridge, and this may not be accessible during high river levels, unless an at-grade railroad crossing is also constructed. Fourth, this site is overlooked by a dozen or more riverfront parcels that have the potential to become high value properties in the future. Next, the Fox Valley Park District has plans for the construction of a footbridge from near CSO 005 to Hurds Island, increasing public exposure to the site. Finally, in 2000 the City Council expressed an explicit preference against using Hurds Island for CSO management. For the purpose of the alternatives analysis, Hurds Island will be included so that any potential cost savings may be demonstrated before site selection is made.

5. Area A27–400 North Broadway CSO Plant

Because of the possibility of expanding the existing 21.8 mgd CSO plant to treat 50 mgd with the addition of inclined plate settling, sending additional flow to the CSO plant was considered a viable option.

6. Area A28–456 North Broadway (CSO Plant Expansion)

When the CSO plant was designed in the 1990s, it was planned for potential expansion to the south. In the meantime, however, significant riverfront planning has occurred, and the area immediately south of the CSO facility is planned as public amphitheatre. However, expansion of the facility to the north appears possible and could triple the footprint of the building, for a capacity of about 65 mgd. If both physical expansion and enhanced settling are applied, the capacity of the expanded CSO plant would be about 150 mgd. This site is currently owned by Garbe Iron Works but has been a tentative part of the City's long-term plan for its riverfront park.

7. Area A04–Hazel Avenue

One additional location was identified by the City as having potential value for CSO treatment. Like Hurds Island, Area A04, shown with a star just north of CSO 004, has the advantage of being close to two main CSOs, CSO 001 (Rathbone Ave.) and CSO 004 (Hazel Ave.), as well as close to the river for an outfall. Although there appear to be several inactive businesses, suggesting parcels may be available for sale, there are also active businesses on the nearby properties.

C. Gravity System Conveyance

When feasible and economical, conveying wastewater flows by gravity is preferable to conveyance by pumping station and force main, because of cost savings and ease of operation. Gravity flow works effectively without power or control and is self-regulating. Because of the very high flow rates involved in CSO control, however, conveyance by gravity is often impractical as the primary systemwide approach, particularly where open corridors are limited. Large flow rates can require multiple large diameter gravity sewers, and routing these sewers quickly becomes impractical, owing to the requirement for continuous downslope grading.

Because of this overall constraint, systemwide conveyance by a wet weather pumping station (WWPS)/Force Main (FM) network will be assumed as a starting point. However, in specific areas where conveyance may be achieved by gravity more cost-effectively or more practically, it will be included as an option.

Several locations in the system where gravity conveyance is considered viable are shown on Figure D.3-1 with the "G" notation. These locations and the feasibility of gravity conveyance are discussed in greater detail in Appendix J.

1. Because local storage is planned to be underground, it was assumed that gravity sewers could convey combined wastewater to storage without a pumping station. Therefore, gravity segments G01, G21, and G23 will convey flows to St001, St021, and St023.

2. When the CSO plant was constructed in the 1990s, a new 36- to 48-inch sewer parallel to the existing interceptor was constructed between CSO 002 (E. Illinois Ave.) and CSO 022 (Superior St.) to convey peak flows to the CSO plant. The long-term intent of this sewer was also to serve CSO 023 (W. Illinois Ave.) and CSO 021 (West Park Ave). Therefore, gravity conveyance for these CSOs via siphons G26 and G20, respectively, is considered a viable alternative.

3. Currently, a significant portion of flow to the CSO plant comes from the CSO 008 basin, via a diversion structure at Lincoln Ave. and Superior St., shown at the location designated G22 on Figure D.3-1. Proposed improvements indicated as G22 and G28 will allow additional flow to be offloaded from the CSO 008 basin to the CSO plant.

4. During 2000, City of Aurora and FMWRD were considering eliminating CSO 008 (E. Benton St.), CSO 015 (W. Benton St.), and CSO 018 (W. Galena Blvd.) by constructing a siphon and gravity sewers to a proposed new pumping station on the triangular parcel of land encompassed by North Ave., the railroad, and the river, just northeast of Hurds Island. This new location will be permitted as CSO 028 if constructed and will be referred to in this report as North Ave. (East).[3] Especially because of the constraint for locating a pumping station at either CSO 008 or CSO 015, this layout for gravity conveyance will be considered a viable alternative. This alternative is shown as G13, G14, and G15 on Figure D.3-1.

5. Because of their proximity, within about 600 feet on either side of the river, CSO 001 and CSO 004 may have the potential to be served by a single pumping station (rather than

[3] Because Aurora already has a North Ave. PS, this proposed PS will be referred to as the North Ave. (East) PS.

two pumping stations) if a siphon or small tunnel is constructed, denoted G04 on Figure D.3-1.

6. In addition, it may be possible to serve CSO 005 (3rd St.) and CSO 010 (1st St.) with gravity siphons and a single pumping station located near CSO 005 or possibly on Hurds Island.

7. Finally, capacity analysis in the CSO 025 (Dearborn St. and Trask St.) basin showed that CSOs can be substantially relieved by upsizing sewer segments on Trask St., Dearborn Ave., and N. Ohio St. (denoted G24, G25, and G27).

These gravity options will be considered in the analysis to determine the most cost-effective alternatives.

D. Pressure System Conveyance

Appendices G and H discuss FM and WWPS considerations in detail, but general information about the pressure conveyance options and their evaluation is provided here.

In a WWPS/FM network, multiple pumping stations are designed to collect CSO and discharge it into a system of pressure sewers. The pumping stations operate in parallel, so flow only needs to be pumped once. Force main systems, if properly designed, are not subject to overflows. Additionally, force mains do not have to be buried as deeply, in general, and are smaller in diameter than gravity sewers of the same hydraulic capacity because they convey flow at a much higher velocity, typically 5 to 10 fps or higher as compared with 2 to 5 fps for gravity sewer under design peak flow. This can make force mains less costly to construct than gravity sewers for the same amount of flow. Therefore, one or two pressure conveyance networks may be a cost-effective abatement strategy for some of the City of Aurora's CSOs.

Any point of entry to the force main network requires a pumping station. All pumping stations must be able to overcome the pressure in the force main to operate. The most upstream pump stations will generally have the highest head required condition. The complexity with pressure systems is largely related to the proper selection of pumps that will meet all the potential operating conditions and the control of pumping rates to prevent system surges.

Figure D.3-1 shows proposed WWPS location options. WWPSs were considered viable options at most of the active CSOs.[4] These WWPS locations are denoted by the CSOs they are adjacent to, e.g., PS001 designates a WWPS at CSO 001.

The two active CSOs that have not been evaluated for individual WWPSs include CSO 018 (W. Galena Blvd.) and CSO 025 (Dearborn Ave. and Trask St.). Because CSO 018 serves as a second outfall for the CSO 015 basin (rather than being its own basin), the approach will be to address both CSOs with one set of basin improvements. CSO 025 was not considered to require WWPS conveyance because capacity analysis early in the LTCP process showed that a short segment of moderately sized sewer

[4] WWPSs were considered an option at most CSOs that have been active over the past several years. However, the final cost-effective alternative may not have a WWPS or any improvements at all, for that matter, in basins that overflow infrequently. For completeness of the evaluation, however, all location options were included.

will address this CSO, which is far less costly than including it in the pumping station/force main network. (See Appendix J for further discussion.)

In addition to potential WWPSs at most CSO basins, options of WWPSs at "multibasin" locations where proposed gravity sewers converge are also included. These locations are denoted on Figure D.3-1 as PS9XX, where "9" indicates the WWPS serves more than one basin.[5]

WWPS Location	WWPS Figure Notation	Serves CSO Basin(s)
W. Illinois St.	PS023	023
E. Illinois St.	PS002	002
Pierce St.	PS003A	003A
CSO Plant	PS027	027
Superior St.	PS022	022
West Park Ave.	PS021	021
W. Benton St.	PS015	015
E. Benton St.	PS008	008
North Ave. (East)	PS928	008, 015, 018
1st Ave.	PS010	010
3rd Ave.	PS005	005
3rd Ave.	PS905	005, 010
Hazel Ave.	PS004	004
Hazel Ave.	PS904	001, 004
Rathbone Ave.	PS001	001
Rathbone Ave.	PS901	001, 004

Table D.3-3 WWPS Location Options

Alternative potential force main routes (shown in Figure D.3-1) were identified through discussion with the City of Aurora staff. The objectives in force main route selection are to minimize impact on residents and potential for conflict with existing utilities. Clearly, the routes have to be constructible considering topographic constraints, the proximity of utilities, and surface improvements. The denotation (e.g., "P01") shown on Figure D.3-1 for each of the force main segments is used in the alternatives analysis to identify flows, sizes, and costs associated with each.

For projecting design sizing and alternatives cost, it is assumed force mains will have 5 to 6 fps design velocity. Pumping stations are sized based on the peak flow for a 1-hour storm projected from SWMM™ modeling for a selected level of control (e.g., 3-month or 1-year return frequency). Projected total dynamic head (TDH) was based on the total dyanamic head loss in individual force mains with an allowance for static head resulting from elevation differences between the WWPS low-water level and the discharge.

F. Sewer Separation

Another method considered for managing combined wastewater flow for CSO control is to minimize introduction of stormwater to the system by separating sanitary and storm sewers in selected basins, thus reducing system flows.

[5] Note that these denotations help serve the alternatives analysis discussed later in this section and are not intended to dictate the name selected by the City of Aurora.

Over the past few decades, the City of Aurora has made a concerted effort toward decombining much of the CSS (see Figure 4.01-1), largely in an effort to alleviate street flooding and basement backups and also to provide additional sewer capacity for redevelopment. While much improvement has occurred, City personnel suspect that many basement backups still occur but go unreported because of language issues, concern for property resale with a record of backups, or residents' acceptance of the problem. Therefore, the City remains interested in pursuing separation in the following CSO basins: 001, 002, 003A, 004, 005, 008, and 010. The option of basin separation is denoted on Figure D.3-1, for example, as "Sp001" for the CSO 001 basin.

Implementing sewer separation tends to be costly since it means construction of an additional sewer network in an already built-up area. While it is necessary and cost-effective to reduce flooding and basement backups, it is not always cost-effective for CSO control. For long-term planning purposes, it is useful to know whether permanent separation is cost-effective relative to simply conveying and treating the combined flow.[6] Although developing a detailed cost opinion of sewer separation in a basin requires considerable field work and detailed predesign, a simple cost relationship can be developed to approximate sewer separation costs per acre in densely developed areas. Sewer separation and the methodology of cost projection are discussed in Appendix E.

G. Green Infrastructure

The City administration and the Citizens Advisory Committee have expressed interest in pursuing green infrastructure throughout the city. Green infrastructure includes facilities of constructed "natural-like" features that use the infiltration capacity of the soil to treat stormwater and reduce the volume that flows to the combined sewer system. (Please see Section 5 for additional information on Aurora's current green infrastructure program and Appendix K for a discussion of green infrastructure alternatives.)

D.4 DESIGN TOOL AND SPREADSHEET ANALYSES METHOD

Now that the CSO abatement options have been described, the means by which the alternatives were evaluated will be described. Evaluation of and calculations of volumes were performed using both spreadsheet analyses and Strand Associates' Design Tool (or "Tool"), a software program written in the Python programming language that was developed specifically based on Aurora's CSOs and abatement options. The purpose of this section is to describe the assumptions made for this analysis within both the spreadsheets and the software.

A. Introduction to the Design Tool

The Tool is useful for analysis of options and flows because it contains a great deal of information that would be otherwise cumbersome to manage and use. The Tool includes:

1. SWMM™ model basin and CSO flow rates, volumes, and hydrographs for 1-hour, 6-hour, 1-day, 3-day, and 10-day storm events (return frequencies: <2-month, 2-month,

[6] For basins where the City is compelled to perform separation to alleviate basement backups irrespective of CSO control, it will be most beneficial for the City to include that separation as part of the LTCP, since it directly impacts sizing of CSO controls.

3-month, 6-month, 1-year, and 5-year). Table D.4-1 shows the applied rainfalls for these model runs. The peak flow rates and volumes for the relevant points within the model are provided in Attachments D.4-1 and D.4-2 at the end of this appendix.

	Return Frequency						
Duration	**<2-month**	**2-month**	**3-month**	**6-month**	**1-year**	**2-year**	**5-year**
10-day	1.56	2.02	2.48	3.3	4.12	4.95	6.04
3-day	1.23	1.53	1.83	2.34	2.93	3.55	4.44
1-day	1.15	1.38	1.61	2.03	2.51	3.04	3.80
6-hour	0.85	1.03	1.21	1.52	1.88	2.28	2.85
1-hour	0.54	0.65	0.76	0.96	1.18	1.43	1.79

Table D.4-1 Total Rainfalls for Northeast Illinois Applied for Model Runs (from *Rainfall Frequency Atlas of the Midwest*)

2. Generalized cost functions for capital projects including:

    a. Pumping stations (based on mgd and TDH).
    b. Force mains (based on diameter, length, and construction conditions).
    c. Gravity sewers (based on diameter, length, and construction conditions).
    d. Remote treatment facilities (based on peak flow).
    e. Storage units (based on total volume).
    f. Sewer separation.

3. Proposed upgrade options as shown in Figure D.3-1.

The Tool is programmed to accept user-input of the following factors:

a. Alternative levels of CSO control (e.g., 3-month, 1-year, 5-year) at each individual basin.[7]
b. Types of control (e.g., WWPS, storage) to be considered at each basin.
c. Locations at which conveyed flow is to be evaluated for treatment.

For each alternative, the Tool determines design sizing required for all improvements to manage flows captured by the selected level of control. Then by applying size requirements to cost functions for all selected individual improvement options, systemwide costs can be determined for every alternative, including capital costs, O,M&R, and present value. (Development of cost functions is detailed in Appendices E through J.)

Finally, using the model hydrographs for each of the CSOs, the Tool assists in determining the degree of CSO volume control (or “benefit”) achieved.

[7] Although model runs for additional storm frequencies were conducted, the 3-month, 1-year, and 5-year levels of control were selected for alternatives analysis based on the discussion in Section 5.01.

B. Flow Projection Methodology

The Tool and spreadsheet analyses calculate design flows in pumping stations, force mains, and gravity sewers based on "peak flow accounting." As discussed above, the Tool and spreadsheets contain tabularized information on the peak flows determined by the SWMM model for all basins and CSOs for a range for design storm return frequencies and durations. Once the "design standard" for each basin is selected, the peak CSO flow rate is applied for the selected standard to determine the basin flow rate to be abated. Within basins, pumping stations, and gravity sewers required are sized based on the peak 1-hour flow. Storage sizing is based on the maximum CSO volume between the 1-hour, 1-day, and 10-day storms. Moving downstream within the FM network, peak flow rates in the selected WWPSs are added together. This generates conservative projections of peak flow at downstream locations.

Force mains are sized based on peak flow at 5 to 6 fps. Headloss in each pipe segment is calculated and the TDH for each WWPS is determined by summing the pipe head losses between each WWPS and treatment, plus an estimated static head difference between the discharge at treatment or storage and the low water level at the WWPS. (See Appendix G for discussion of the head loss calculation in pipes.) Peak flow at the WWTF is based on the sum of the peak WWPSs flows.

C. Cost Functions

Once the Tool and spreadsheet determine the design sizing of each element, capital cost, O,M&R, and present value cost for each element are determined based on "cost functions" for each kind of improvement. These cost functions allow cost for a series of improvements to be determined automatically without the need to perform specific cost evaluation of every component for each alternative evaluated.

For facilities that experience an economy of scale, it is not uncommon to see costs given a power function, such as:

$$\text{Cost} = \text{Constant} \times \text{Capacity}^{M}$$

The M-factor is usually between 0.5 to 1.0, with the lower M-factor suggesting a strong economy of scale and an M-factor of 1.0 representing a linear cost function. Power functions often apply to facilities like pumping stations, treatment facilities, and equipment. Although somewhat counterintuitive, very large systems may lose their economy of scale and show linear cost functions because of maximum available sizes for some processes and equipment.

The present value cost functions used in this analysis are provided in the individual appendices:

1. Sewer Separation. See Appendix E.
2. Treatment. See Appendix F.
3. Force Mains. See Appendix G.
4. Wet Weather Pump Stations. See Appendix H.
5. Storage. See Appendix I.
6. Gravity Sewers. See Appendix J.

These costs include construction, legal and technical services, contingencies, O,M&R, and 20-year salvage value, all in 4th Quarter 2009 dollars.

D.5 ALTERNATIVES SCREENING METHODOLOGY

With the significant number of CSO management options available, it was necessary to develop a methodology whereby the options could be systematically evaluated to screen out costly or impractical alternatives. This was performed in a hierarchical fashion, with the broadest questions considered first and more specific questions considered in subsequent analysis levels.

At the outset of this analysis, it is uncertain what level of control will be implemented for the LTCP. However, selection of the most cost-effective alternative must be based on a selected level of control. For the purpose of this analysis, varying levels of control were considered for most alternatives. Selection of the most cost-effective alternative was based on assuming that CSOs in the sensitive areas will be controlled to a 3-month to 1-year level of control. It was assumed that CSOs in nonsensitive areas will be controlled to up to a maximum 3-month level of control,[8] but that not all nonsensitive CSOs will be required for control if the 85 percent criterion is met.

This section first identifies a suite of projects that represent a "most rigorous standard" of control, that is, potential (to be determined) sensitive area CSOs to a 1-year level of control and nonsensitive area CSOs to a 3-month level of control. Then, this suite of projects is evaluated to determine the costs associated with lower levels of control, including the 3-month level of control for sensitive areas.

Once this suite of most rigorous standard projects is identified, Section D.6 determines the percent capture for this level of control. Finally, Section D.7 analyzes the projects to determine how cost savings may be accomplished for the LTCP without significantly compromising the overall level of CSO control achieved.

The following narrative explains the sequential screening approach used, comparing the present value cost of each alternative. The sizing of improvements is determined based on model projected flows and volumes for the varying levels of control provided in Attachments D.4-1 and -2. Costs are determined based on the cost function methodology described in Section D.4.

A. Systemwide Evaluation

Evaluation 1: ***How does providing wet weather treatment or storage at the Fox Metro WWTP for all CSOs compare with treatment or storage at the in-city locations proposed?***

For Evaluation 1, it is assumed each basin will be served by a WWPS set to a 3-month standard, except for CSOs 001, 022, and 023, which will be set to a 1-year standard. Table D.5-1 shows the costs for conveyance to the proposed blue-shaded areas shown on Figure D.3-1 and storage or primary treatment and disinfection. This analysis shows the present value cost for conveying all flow to the WWTP (Area A00) is about 80 percent higher than conveyance to Area A04 at Hazel Ave., which

[8] In some locations (for example, gravity siphons), a higher level of control is selected where the costs to do so are not substantially higher or practical considerations suggest the higher level of control is warranted.

TABLE D.5-1 EVALUATION 1: CONVEYANCE AND STORAGE OR TREATMENT TO THE PROPOSED LOCATIONS

	Fox Metro WWTP	Aurora In-City Locations				
	A00	A01	A02	A04	A10	A28
	Near WWTP	Powell St.	Rathbone	Hazel	Hurds Island	456 N. Broadway
Total Conveyance						
Capital Cost	$ 184,010,000	$ 115,530,000	$ 105,760,000	$ 98,590,000	$ 109,420,000	$ 169,360,000
Present Value	$ 180,670,000	$ 116,050,000	$ 106,720,000	$ 100,190,000	$ 110,800,000	$ 167,360,000
Wet Weather Treatment						
Capital Cost	$ 173,170,000	$ 170,420,000	$ 172,059,000	$ 171,170,000	$ 173,170,000	$ 171,670,000
Present Value	$ 183,180,000	$ 180,730,000	$ 182,270,000	$ 181,180,000	$ 183,180,000	$ 181,680,000
Storage						
Capital Cost	$ 69,900,000	$ 74,590,000	$ 76,229,000	$ 75,340,000	$ 77,340,000	$ 75,840,000
Present Value	$ 67,090,000	$ 71,810,000	$ 73,350,000	$ 72,260,000	$ 74,260,000	$ 72,760,000
TOTALS						
Conveyance and Treatment						
Capital Cost	$ 357,180,000	$ 285,950,000	$ 277,819,000	$ 269,760,000	$ 282,590,000	$ 341,030,000
Present Value	$ 363,850,000	$ 296,780,000	$ 288,990,000	$ 281,370,000	$ 293,980,000	$ 349,040,000
Conveyance and Storage*						
Capital Cost	$ 253,910,000	*$ 190,120,000*	*$ 181,989,000*	*$ 173,930,000*	*$ 186,760,000*	*$ 245,200,000*
Present Value	$ 247,760,000	*$ 187,860,000*	*$ 180,070,000*	*$ 172,450,000*	*$ 185,060,000*	*$ 240,120,000*

*Note: Costs do not include additional O,M&R cost for treatment of stored flow at WWTP.
Costs shown in italics represent projects that do not appear feasible due to space constraints.

has the lowest cost of the in-city sites. This suggests the strategy of conveying all flow to the WWTP is not cost-effective relative to CSO management at one of the in-city sites. In addition, none of the in-city sites appear large enough to accommodate the entire storage requirement. From this analysis, it appears the present value costs for citywide conveyance of all flow to a single practicable location for storage or treatment exceed $240 million. As will be seen in the remainder of this section, this alternatives analysis shows that an approximately equal degree of CSO reduction can be achieved for substantially lower cost.

Review of these alternatives results suggests that a significant portion of this cost is due to the long conveyance distances between CSO generation and a single point of treatment. However, the locations of the CSOs relative to the proposed treatment locations suggest a natural north-south division. On the north side, CSOs 002, 003A, 021, 022, 023, 025, and 027 are close to the existing CSO plant and Area A28. On the south side, CSOs 001, 004, 005, 008, 010, 015, and 018 are relatively close to the proposed treatment areas A01, A02, A04, and A10. Therefore, the remainder of this evaluation will treat these two areas as independent.

B. North Side Evaluation

1. CSO 021 (West Park Ave.) and CSO 023 (W. Illinois Ave.)

As discussed previously, the north side CSOs on the east bank of the river (002, 003A, and 022) are treated at the CSO plant at 400 N. Broadway. According to its designers, the CSO plant and the relief sewer serving it are intended to also serve northwest side CSOs 021 and 023. Evaluation of the gravity sewers performed in Appendix J shows that both of these CSOs can be served by gravity siphons, connecting to the relief sewer for treatment at the CSO plant. Where CSOs are able to be served by gravity sewers, pumping station and force mains are typically not cost-effective. However, both of these basins also have storage as a viable alternative. Therefore, Evaluation 2 compares storage and gravity conveyance.

Evaluation 2: Is storage or gravity conveyance more cost-effective at CSO 023 (W. Illinois St.) and at CSO 021 (West Park Ave.)?

For Evaluation 2, the costs were evaluated for the 5-year, 1-year, and 3-month levels of control for both storage and gravity conveyance. Table D.5-2 shows that siphons are the lower cost option in terms of present value. Therefore, if capital improvements at these CSOs are pursued, siphons are assumed as the preferred option. For the remaining evaluations, where assumptions are made about the levels of control at upstream CSOs, the following assumptions will be made. For CSO 023 under the most rigorous standard of control, a 5-year level of control is assumed, since the cost for a 1-year level of control is not significantly lower. It will be assumed that these siphon flows in excess of dry weather capacity would be conveyed to the CSO plant for treatment. In the case of CSO 021, it is assumed if any major capital project is pursued here, a 3-month level of control would be applied, because the cost to achieve the 1-year or 5-year level of control is significantly higher. Table D.5-2 shows the costs associated with this selected alternative in bold.

TABLE D.5-2 EVALUATION 2: CSOs 021 AND 023 STORAGE VERSUS SIPHON CONVEYANCE

	CSO 023			CSO 021		
	5-year	1-year	3-month	5-year	1-year	3-month
Storage						
Capital Cost	$ 6,947,000	$ 3,827,000	$ -	$ 6,343,000	$ 5,001,000	$ 2,852,000
Present Value	$ 7,511,000	$ 4,201,000	$ -	$ 7,001,000	$ 5,731,000	$ 3,031,000
Gravity Siphon						
Capital Cost	**$ 4,672,000**	$ 4,464,000	$ -	$ 4,350,000	$ 3,840,000	**$ 2,337,000**
Present Value	**$ 3,565,000**	$ 3,405,000	$ -	$ 3,320,000	$ 2,930,000	**$ 1,780,000**

TABLE D.5-3 EVALUATION 3: CSO 025 GRAVITY SEWER COSTS

	CSO 025		
	5-year	1-year	3-month
Gravity Sewers			
Capital Cost	$ 3,177,000	**$ 1,690,000**	$ 1,138,000
Present Value	$ 2,430,000	**$ 1,290,000**	$ 870,000

TABLE D.5-4 EVALUATION 4: MAXIMIZING TREATMENT AT CSO PLANT AND CSO 022 IMPROVEMENTS

	9-month to 1-year	3-month
Plant Capacity Enhancement (to 50 mgd)		
Capital Cost	$ 9,852,000	$ 9,068,000
Present Value	$ 9,930,000	$ 9,340,000
Plant Capacity Expansion (to 50 mgd)		
Capital Cost	$ 26,154,000	$ 25,370,000
Present Value	$ 28,500,000	$ 27,910,000
Plant Capacity Expansion to Level of Control		
Capital Cost	**$ 37,424,000**	$ 14,860,000
Present Value	**$ 40,710,000**	$ 16,480,000

2. CSO 025 (Dearborn Ave. and Trask St.)

Evaluation 3: What is the cost associated with addressing CSO 025?

As discussed in Appendix J, abatement of overflows from CSO 025 can be achieved relatively easily with replacement of several segments of gravity sewer. Table D.5-3 shows the costs to abate this CSO to the 5-year, 1-year, and 3-month levels of control. Because of the relatively low cost and the City's desire to abate this CSO that discharges to a small water body, it will be assumed these improvements will be pursued to the 1-year level of control. Table D.5-3 shows the costs associated with this selected alternative in bold. It is assumed that this additional flow, if in excess of the dry weather capacity of the sewers at the CSO 003A control structure, will be conveyed to the CSO plant.

3. CSO 022 (Superior St.) and CSO 027 (CSO Plant)

Evaluation 4: How can flow to the CSO plant be maximized?

In addition to the above improvements that will result in increased flow to the CSO plant, an additional improvement has been identified that has the potential to increase the flow further. As discussed in Appendix J, the diversion structure at Superior St. and Lincoln Ave. controls the flow to a 48-inch bypass sewer that flows to CSO 022 and the CSO plant. The model suggests that the dry weather flow in the Superior St. subbasin remains below about 2 cfs. During wet weather, as much as 15 cfs flows in the dry weather sewer, according to the model, while the remainder enters the bypass. This 15 cfs flows southward to CSO 008 basin; because of the prevalence of overflows at CSO 008, this 15 cfs contributes to overflow volume at that location. To get more flow to the CSO plant, the CSO 022 diversion structure at Superior St. can be modified to allow a maximum of about 2 cfs in the dry weather sewer. It is assumed that adding a baffle wall with an orifice within the existing diversion structure may be adequate to direct more flow to the bypass and ultimately to the CSO plant.

To determine whether the existing CSO plant would have the capacity to handle the additional flow from CSOs 021, 022, 023, and 025, the model hydrographs for each of the existing and proposed CSO plant inputs from the 1-hour storm events were totaled (for both 3-month and 1-year events), taking into account the time of travel, to estimate the flow available for treatment. Figure D.5-1 shows the projected 1-year and 3-month hydrographs to the CSO plant, relative to the existing 21.8 mgd capacity and the proposed 50 mgd enhanced capacity. Based on this analysis, it appears the existing 21.8 mgd CSO plant would produce about 0.05 million gallons (mil gal) and 1.1 mil gal of overflow during a 3-month and a 1-year event, respectively, if the additional flow is conveyed to the facility as discussed above. If the existing plant capacity is increased from 21.8 mgd to 50 mgd with enhanced treatment, the CSO plant would overflow 0.18 mil gal during the 1-year event only.

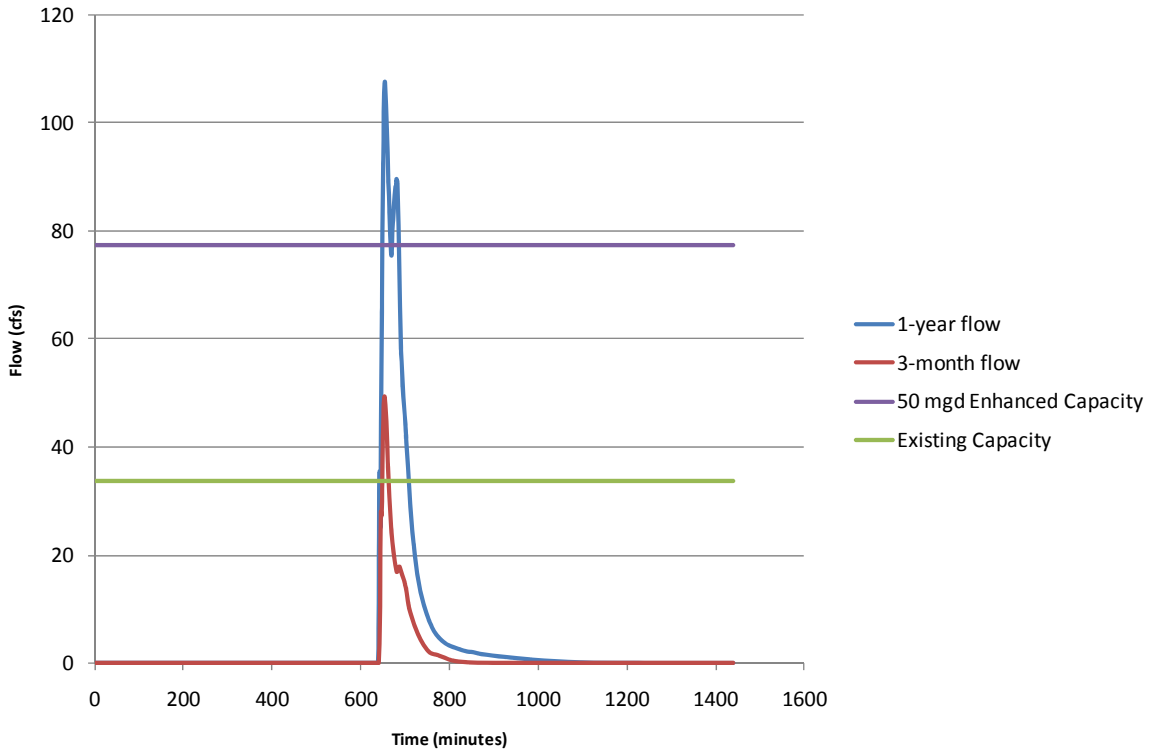


Figure D.5-1 Projected 1-Hour Flow to CSO Plant with Proposed North Side Improvements at Superior St. and CSOs 021, 022, 023, and 025

Reviewing the hydrograph analysis for the 36-inch to 48-inch relief sewer from CSO 022 to the CSO plant (G28 on Figure D.3-1) suggests that, in the 1-year scenario, this would need to be upgraded to 54 inches.

It is understood that enhancing the capacity of the CSO plant with inclined plate settling would likely require pilot testing to demonstrate to IEPA that the treatment plant would achieve a quality effluent under the increased surface area loading of the clarifiers. Even with such a demonstration, it is possible that this approach would not be acceptable to IEPA and that expansion of treatment footprint would be required.

Table D.5-4 compares the cost for plant enhancement versus plant expansion, including the costs for G22 and G28 improvements. It is assumed that if the plant is enhanced, it will be enhanced to its full 50 mgd (77 cfs) capacity potential. If the plant is expanded, it will be expanded to the size needed for the level of control. However, for direct comparison of the relative costs of enhancement versus expansion, an additional scenario of expansion to the 50 mgd level is included.

Comparing the enhancement versus expansion to either 50 mgd or the selected level of control, it is significantly less costly to enhance the capacity of the existing plant versus expanding the footprint, for the 1-year level of control. To be conservative, for the purpose of this LTCP, it will be assumed that IEPA may not approve the proposed treatment enhancement and that an

expansion of the footprint of the CSO plant would be required. However, because of the potential cost savings, it is recommended that the possibility of applying the lower cost enhanced treatment be pursued with pilot testing and discussions with IEPA.

The 1-year level of control is considered appropriate for the CSO plant under the most rigorous standard since CSOs 022 and 023 have been identified by IEPA as candidates to be a sensitive areas. Therefore, these improvements to the CSO plant are included in the suite of alternatives identified for the most rigorous level of control. Table D.5-4 shows the costs associated with this selected alternative in bold.

C. Downtown CSOs: 008 (E. Benton St.), 015 (W. Benton St.), and 018 (W. Galena Blvd.)

Evaluation 5: What is the most cost-effective way to manage the downtown CSOs?

Aurora has three active CSOs located in the downtown area. This evaluation compares conveyance by gravity sewers (two alternatives) with conveyance by pumping station and force main (one alternative).

In 2000, it was proposed to relocate these CSOs with large diameter gravity conveyance to a new pumping station and overflow at North Ave. (East), as shown in Figure D.3-1.[9] If the relocation option is pursued, the gravity sewers and siphons would need to be designed for a high level of control, and a 5-year level of control was selected for this purpose. The North Ave. (East) PS was intended in the original plan to serve as a dry weather pumping station with screening and grit removal from the wet weather flows prior to discharge as CSO. The evaluation performed here assumes that the North Ave. (East) PS would have two separate sets of pumps, one set to serve dry weather flows and a second set to provide wet weather conveyance. Sizing of the wet weather portion of the North Ave. (East) PS was evaluated at 3-month, 1-year, and 5-year levels of control.

More recently, it has been proposed to construct a new 66-inch east side Fox Metro Interceptor at the same invert elevations as the existing 54-inch interceptor in order to do without the proposed dry weather pumping station. However, this project would increase the capacity to serve the CSO 008 basin but would not replace the siphons serving the CSO 015 basin. As mentioned above, gravity relocation of these CSOs requires a high level of control. However, one alternative is to size the gravity conveyance for the same level of control as the proposed pumping station. In this way, CSOs 008 and 015 would still overflow at their existing locations. Because it appears a dry weather pumping station may be necessary to accommodate new siphon from CSO 015, for the purpose of this cost evaluation for control of the downtown CSOs, a dry weather pumping station is included in these costs for the most rigorous standard of control.

[9] Since the time of the study, improvements to the 015/018 basin have reduced CSO 018 occurrences dramatically, and the model shows that overflows at this location are not expected to occur at the 1-year level. Therefore, it is intended that any improvements at CSO 015 will be sized to abate CSO 018 as well and that specific improvements at CSO 018 will not be required.

TABLE D.5-5 EVALUATION 5: CSOs 008, 015, AND 018 COSTS

	5-year	1-year	3-month
Gravity Relocation			
Capital Cost	$ 45,395,000	$ 37,115,000	$ 35,275,000
Present Value	$ 52,375,000	$ 40,155,000	$ 37,425,000
Gravity Conveyance to Selected Level of Control			
Capital Cost	$ 45,395,000	$ 35,915,000	**$ 29,453,000**
Present Value	$ 52,375,000	$ 39,240,000	**$ 32,895,000**
Pumping Station Conveyance			
Capital Cost	$ 47,021,000	$ 39,014,000	$ 26,904,000
Present Value	$ 54,955,000	$ 45,270,000	$ 30,070,000

TABLE D.5-6 EVALUATION 6: CSO 001 STORAGE VERSUS CONVEYANCE AND TREATMENT

	5-year	1-year	3-month
Storage Via Gravity			
Capital Cost	$ 108,086,000	**$ 86,169,000**	$ 67,601,000
Present Value	$ 105,000,000	**$ 84,470,000**	$ 67,100,000
Pumping Station Conveyance w/ Treatment			
Capital Cost	$ 189,568,000	$ 102,770,000	$ 56,974,000
Present Value	$ 200,846,000	$ 109,016,000	$ 61,216,000
Storage Via Gravity w/ Treatment			
Capital Cost	$ 82,498,000	**$ 59,611,000**	$ 45,615,000
Present Value	$ 81,447,000	**$ 59,907,000**	$ 46,637,000

As an alternative to CSO relocation by gravity, pump station and force main conveyance of the CSOs from their existing locations was evaluated at the 3-month, 1-year, and 5-year levels of control.

Table D.5-5 shows the cost for the three alternatives considered, gravity relocation to a 5-year level of control, gravity conveyance to a selected level of control (allowing CSOs at their existing locations), and pumping station conveyance. Table D.5-5 shows that abating to the 5-year and 1-year levels of control somewhat favors gravity relocation or gravity conveyance over pumping station conveyance. However, in the 3-month level of control, individual pumping stations at CSO 008 and CSO 015 are significantly lower in present value cost as compared to gravity relocation and somewhat lower than gravity conveyance. Because neither of these locations is considered to be sensitive, this LTCP is likely to target no higher than the 3-month level of control for these CSOs, suggesting that individual pumping stations may be the most cost-effective alternative.

However, it should be noted that these three alternatives are not precisely comparable in terms of their potential social value. First, the gravity relocation option completely removes these CSOs from the downtown area to North Ave. (East) where there would be significantly less opportunity for visual impact. This matter was discussed with City personnel and the CAC at its November 18, 2009, meeting to determine the level of social value of this alternative. City personnel noted there have been no complaints about the presence of these CSOs. CSO 015 is not readily visible because of its location under the Benton St. bridge abutment and its partial submergence. Like CSO 015, CSO 018 is within the Galena Blvd. bridge abutment and is not obtrusive. The 72-inch CSO 008 is within a headwall, and although visible, it has not attracted negative attention from the public. City personnel commented during the November CAC meeting that it appears none of these CSOs would interfere with future construction of a river walk. Based on these comments, the CAC did not feel relocation of these CSOs to be of high value. Therefore, the gravity relocation option is not considered a high priority.

However, City personnel have indicated that locating WWPSs for CSOs 008 and 015 would be difficult. First, the area around CSO 015 is very developed and any proposed WWPS location would need to be located farther away from the CSO than would be optimal. Second, proposed development in the area south and west of CSO 008 would make a WWPS in this area an unattractive alternative. Therefore, gravity conveyance to the 3-month level of control is selected for the downtown CSOs and is shown in bold on Table D.5-5.

D. South Side CSOs

With the north side CSOs managed through conveyance to and treatment at the existing CSO plant, only the CSOs south of 018 are candidates for conveyance to one of the proposed in-city treatment locations (Areas A01, A02, A04, or A10, shown on Figure D.3-1). Because of the potential sensitive designation of CSO 001 and its high projected flow rates, cost-effective management of this CSO is considered key to identifying an affordable LTCP and is pursued in Evaluation 6. Evaluation 7 considers the overall cost-effectiveness of the treatment locations for the south side CSOs in light of those results.

Evaluation 6: Is storage a viable option for management of CSO 001 flows?

CSO 001 is a significant contributor to the overall volume and occurrences of CSOs in the system. Therefore, identifying the most cost-effective means of addressing CSO 001 is an important goal.

As discussed in Appendix B on modeling, the challenges associated with metering and modeling of the unusual structure of the CSO 001 overflow meant that predicting CSO rates and volumes was not fully satisfactory. It appeared the model overpredicted the amount of CSO 001 basin flow that could enter the 69-inch interceptor through the orifices, as high as about 50 cfs at times. Because of CSO 001's location at the downstream end of the collection system, during intense rainfall events, the 69-inch interceptor is already flowing full, and the flow rate into the interceptor is likely significantly more limited. Analysis of the orifices in the CSO 001 structure performed in Appendix C suggest the flow rate into the interceptor from the 96-inch trunk sewer is likely limited to approximately 16 cfs, possibly less if there is surcharging in the interceptor.

In addition, the model representation of the peak capacity of the 69-inch interceptor exceeds the value that Fox Metro has provided Aurora as the limitation to the amount of flow it can accept. According to Fox Metro's assessment, the 69-inch interceptor at the WWTP is limited to a peak instantaneous flow of 59.1 mgd (91.4 cfs) and 50.5 mgd (78.2 cfs) peak hourly flow (PHF). Therefore, for this LTCP, a conservative approach to the sizing and cost evaluation of improvements at CSO 001 relative to model representation of CSO 001 and the 69-inch interceptor appears warranted.

Reviewing the model's ability to predict flow in the 96-inch trunk sewer upstream of CSO 001, the model appears well-calibrated, based on the overall consistency between the calibrated model and the modeling events. Peak model-projected flow rates in the 96-inch trunk sewer are about 195 cfs and 86 cfs for the 1-year 1-hour and 3-month 1-hour storms, respectively. Comparing this to the approximately 16 cfs capacity of the orifices, this means that, during peak system flows, the vast majority of flow in the trunk sewer would be discharged as CSO.

Because of these factors and the desire for a conservative representation of sizing, the peak model flows in the 96-inch trunk sewer for the design condition will be used to represent the CSO peak flow for sizing of improvements for this LTCP cost evaluation. While this is a conservative approach for sizing improvements, this approach would offer Aurora the flexibility to "download" all flow from the trunk sewer, which may result in some relief of upstream CSOs.[10]

The "first cut" alternative for managing this CSO would be to construct a WWPS at or near the CSO and convey the pumped flow to treatment along with flow from the other CSOs, for example, at Area A02. In this case, the WWPS, force main, and fully sized treatment capacity represent a large cost. However, because Area A02 is adjacent to the interceptor, it may be possible to directly download the trunk sewer via a control structure and convey this flow to underground storage at that location. Table D.5-6 compares the costs of managing CSO 001 flow for these two alternatives. For sizing of the storage tank, it is assumed that all the flow for each given recurrence interval storm would be downloaded from the trunk sewer during rain events causing overflows for up to 10 days.

[10] During the design phase, it is recommended that this conservative approach be reviewed in light of additional overflow metering data obtained after this LTCP.

The comparison of the storage versus treatment options shows that, for all levels of control, storage offers a very significant cost advantage. There are a few additional advantages to storage that should be considered. The ability to store all the flow the CSO 001 basin generates during a long-duration event means that, after the rain event, the stored flow will be discharged to the gravity sewer for full treatment at the Fox Metro WWTP. Second, if the proposed CSO treatment for the other CSOs is located with storage at A02, the volume from the conveyed CSOs can also be stored for full treatment. Finally, downloading all the flow from this CSO during CSO events provides additional 69-inch interceptor capacity for the other basins, potentially allowing smaller design sizing for those basins.

Additional cost savings may be realized by combining storage and treatment so that storage may provide buffering capacity for peak flow rates, and treatment capacity can allow storage to be sized smaller, taking into account the ability of treatment to manage a significant volume over long-duration storms. The costs for a combination of storage and treatment at Area A02, also shown on Table D.5-6, indicate a significant savings above storage alone.

Based on these significant advantages and because the present value costs are significantly lower at all levels of control, it is assumed storage will be provided at A02, possibly in combination with wet weather treatment capacity. These alternatives are shown in bold on Table D.5-6.

Evaluation 7: What is the most cost-effective location for treatment for the remaining south side CSOs?

Assuming that storage or storage/treatment is used to manage CSO 001, the remaining CSOs to be evaluated for treatment include CSOs 004, 005, 008, 010, and 015. Based on the results of Evaluation 5, it is assumed that CSOs 008 and 015 will be served by gravity conveyance to a new dry weather/wet weather PS located at North Ave. (East) and that recent improvements to the CSO 015 basin have rendered CSO 018 occurrence infrequent enough that it does not require separate conveyance. Based on a review of the elevations of CSOs 005 and 010 discussed in Appendix J, it is assumed both of these will be served by a single pumping station near CSO 005. Areas A01 (Powell St.), A02 (Rathbone Ave.), A04 (Hazel Ave.), and A10 (Hurds Island) were all considered for providing primary clarification and disinfection treatment similar to that provided at 400 N. Broadway. None of these CSOs is considered sensitive, and the baseline assumption for the most rigorous standard of control will be control to the 3-month level, with CSO 001 assumed at the 1-year level.

One important advantage of providing treatment at Area A02 is that the proposed CSO 001 storage at that location has the potential to provide equilization capacity for peak flows. That is, without storage, the peak treatment rate will have to be equal to the peak conveyance rate. However, with storage assumed at that location, the peak flows can be discharged to the storage and the flows will only need to be treated if the storage tank is approaching capacity that could be operated this way and additional rainfall is expected. Alternative means of operating the system may be desired. For example, operators may elect to begin treatment early in the storm to maximize the overall capacity of the system. In addition, Fox Metro's consulting engineer has expressed concern the dilute nature of the stored CSO may affect the effectiveness of biological nutrient removal at the WWTP. Fox Metro's LTCP also relies on storage at remote sites for its other customers for subsequent treatment. These factors may influence the choice to treat at the CSO facility rather than discharging to the WWTP. These are

important considerations that must be made for future operation of the system. However, the design sizing of the system as discussed in this LTCP provides for a significant degree of operational flexibility.

For this cost analysis, note that under all alternatives that involve treatment at A01, A04, or A10, storage is provided at Rathbone Ave. for CSO 001 flows.

For the alternative in which treatment is provided at Area A02 along with storage, it is assumed that all flow from the CSO 001 basin and the other CSOs conveyed by the WWPS/FM network will be discharged to the storage tank. Under this case, for cost comparison the storage tank is sized for the total 1-day CSO 001 basin volume for the 1-year event plus the maximum CSO volume generated by the 3-month critical duration event from the other CSOs conveyed to A02. (Under the most rigorous standard of control, these other CSOs include 004, 005, 008, 010, and 015.) Screening and vortex grit removal are provided for all peak flows, assuming all flow is discharged to the storage tank.

The next consideration is to develop an assumed design sizing for the treatment associated with storage. Taking into account a variety of hydrographs for varying storm intensities and durations would allow an “optimization” of the treatment capacity. A preliminary optimization analysis performed for this LTCP suggested treatment rates as low as approximately one-quarter of the storage tank per day (that is, treatment of a full storage tank over the course of four days) would be adequate. However, it is anticipated that storage of wastewater over this length of time would promote odors and anaerobic conditions that could be problematic for treatment.

A more typical way to look at the sizing of treatment would be in terms of the amount of time required to treat the contents of a full storage tank. While Illinois does not have a code requirement regarding the maximum dewatering time for storage, experience with other states suggest that 48 hours to 72 hours is typical. For example, the Indiana Department of Environmental Management CSO Treatment Facility Guidance indicates that treatment of stored volume should occur within 48 hours of the end of the rainfall event, and the Michigan Department of Environmental Quality has a similar requirement. It is anticipated that IEPA would likely require a dewatering time of no more than 48 hours so that storage would be available for a follow-up storm and to prevent anaerobic conditions from occurring. This design criterion is expected to be negotiated with IEPA as part of the final LTCP. For the purpose of cost evaluation, it is conservatively assumed that a dewatering time of 48 hours would be required. A transfer pumping station of the same capacity as treatment is provided to withdraw combined wastewater from storage for treatment.

One additional factor has been considered in this analysis. Because 85 percent capture may not necessarily require management of all the CSOs, four scenarios have been evaluated: (1) management of all south side CSOs, (2) management of all south side CSOs except 005 and 010, (3) management of CSOs 001, 004, and 008, and (4) management of only CSOs 001 and 004. This matter will be discussed later in the alternatives analysis.

Table D.5-7a summarizes the costs for treatment at the four proposed treatment locations for four scenarios. For all four scenarios, Area A02 at Rathbone Ave. provides a very substantial cost savings relative to the other sites. In addition, the potential to leave some CSOs without conveyance or treatment, if an acceptable level of capture can be achieved without them, offers a significant opportunity to reduce overall project cost. In particular, being able to leave CSOs 005 and 010 as-is

TABLE D.5-7a EVALUATION 7: CONVEYANCE AND STORAGE/TREATMENT OF REMAINING SOUTH SIDE CSOs FOR VARYING LEVELS OF CAPTURE

	CSOs Managed			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	All South Side CSOs	CSOs 001, 004, 008, and 015/018	CSOs 001, 004, and 008	CSOs 001, 004
Area A01 - Powell St.				
Capital Cost	$ 241,846,000	$ 223,599,000	$ 188,250,000	$ 140,806,000
Present Value	$ 244,564,000	$ 226,005,000	$ 188,945,000	$ 141,661,000
Area A02 - Rathbone Ave.				
Capital Cost	**$ 135,366,000**	$ 125,149,000	$ 106,927,000	$ 84,301,000
Present Value	**$ 138,795,000**	$ 128,386,000	$ 109,036,000	$ 86,702,000
Area A04 - Hazel Ave.				
Capital Cost	$ 225,705,000	$ 208,606,000	$ 174,392,000	$ 130,612,000
Present Value	$ 232,410,000	$ 215,061,000	$ 178,831,000	$ 134,342,000
Area A10 - Hurds Island				
Capital Cost	$ 229,449,000	$ 212,811,000	$ 179,831,000	$ 139,744,000
Present Value	$ 235,923,000	$ 218,924,000	$ 183,664,000	$ 141,950,000

TABLE D.5-7b EVALUATION 7: INCREMENTAL COST ANALYSIS FOR MANAGEMENT OF SOUTH SIDE CSOs AT A02

	Capital Cost	Present Value
CSO 001	$ 59,611,000	$ 59,907,000
CSO 004	$ 24,690,000	$ 26,795,000
CSO 008	$ 22,626,000	$ 22,334,000
CSO 015	$ 18,222,000	$ 19,350,000
CSOs 005 and 010	$ 10,217,000	$ 10,409,000

offers about 8 percent cost savings, without significantly affecting the percent capture. Table D.5-7b shows the incremental costs for managing each of the CSOs, assuming the "order of preference" shown. These results will be useful when evaluating the costs for various control goals.

For the purpose of this LTCP, it is assumed that treatment and storage will be provided at one of the sites within the A02 area.

E. Evaluation of Separation

Evaluation 8: What degree of sewer separation/decombination is appropriate for the LTCP?

The next method considered for managing combined wastewater flow for CSO control is to minimize introduction of stormwater to the system by separating sanitary and storm sewers in selected basins, thus reducing system flows.

Over the past few decades, the City of Aurora has made a concerted effort toward decombining much of the CSS, largely in an effort to alleviate street flooding and basement backups and also to provide additional sewer capacity for redevelopment. While much improvement has occurred, City personnel suspect that many basement backups still occur but go unreported because of language issues, concern for property resale with a record of backups, or residents' acceptance of the problem. Therefore, the City remains interested in pursuing separation in the following CSO basins: 001, 002, 003A, 004, 005, 008, 010, 015, and 022. The option of basin separation is denoted on Figure D.3-1, for example, as "Sp001" for the CSO 001 basin.

Implementing sewer separation tends to be costly since it means construction of an additional sewer network in an already built-up area. While it is necessary and cost-effective to reduce flooding and basement backups, it is not always cost-effective for CSO control. For long-term planning purposes, it is useful to know whether permanent separation is cost-effective relative to simply conveying and treating the combined flow.[11] Although developing a detailed cost opinion of sewer separation in a basin requires considerable field work and detailed predesign, a simple cost relationship can be developed to approximate sewer separation costs per acre in densely developed areas. As developed in Appendix E, sewer separation cost projections of $80,000 capital cost per acre and $60,000 present value cost per acre are assumed.

Projecting the potential cost-effectiveness of future sewer separation strictly for CSO control has proven to be one of the more challenging components of this LTCP. This is because projecting the effectiveness of separation to reduce combined wastewater flow rate and volume depends significantly on the inflow removal rates applied, which may vary over a factor of 2 to 3. The hydraulic model may be applied to estimate removals. However, since the model is calibrated on one state of separation, its prediction of flow reduction for further separation is uncertain. The cost-effectiveness of separation is often dependent on whether separation eliminates the occurrences of CSO to an acceptable level of control so that no other CSO control measures are required. Again, it is difficult to project whether or not this is practically achievable without pilot separation projects.

[11] For basins where the City is compelled to perform separation to alleviate basement backups irrespective of CSO control, it will be most beneficial for the City to include that separation as part of the LTCP, since it directly impacts sizing of CSO controls.

In previous LTCPs, sewer separation has typically been shown to be the least cost-effective approach to systemwide CSO control as compared to storage and treatment alternatives. As such, the decision to implement sewer separation will usually be based on other factors beside CSO control, such as basement backup mitigation, alleviation of street flooding, and storm sewer capacity for redevelopment. However, where separation is pursued to improve these conditions, it is clear that CSO benefit will be realized; therefore, separation is considered part of the City's CSO LTCP.

Of the four motivations for pursuing separation, prevention of basement backups is primary. Currently, the City has limited basement backup historical data. The hydraulic model as it presently exists is somewhat helpful in predicting basement backups. However, the model only represents combined sewers that are 18 inches in diameter and larger, and the model was calibrated on lower intensity rainfall events, so its ability to represent system behavior for extreme events, such as 1-year to 5-year storms for which basement backup control is desired, is uncertain. Additionally, using the model requires assuming basement depths relative to the sewer, which adds to the uncertainty of the modeled results.

Furthermore, while we are certain that some of the properties within the combined sewer system will redevelop, it is impossible to anticipate the full extent of redevelopment that might take place within the combined system over the 20-year planning horizon. Also, the effectiveness on CSO control will vary from basin to basin because of ground water conditions.

In light of the above issues it is proposed that the sewer separation component of the LTCP include as much flexibility as possible through the following program, as articulated by City staff.

1. Develop and implement a basement backup survey program to obtain additional data. Include the basement backup survey in the "Early Action Projects" section of the LTCP implementation schedule.

2. Include a capital cost placeholder in the LTCP to account for future sewer separation costs. Since the exact extent of future sewer separation is not presently known, costs will be estimated based on several assumptions listed below with the understanding that additional data will be obtained while the sewer separation program proceeds. Consequently, it is likely that how the sewer separation efforts are allocated will be adjusted as the program proceeds. To develop the placeholder for separation costs, the following were applied as to the extent of future separation projects:

    a. Assume 20 percent sewer separation of the remaining combined acreage in areas tributary to CSOs 005 (Third St.), 008 (East Benton St.), 010 (First St.), and 022 (Superior St.), and 10 percent in CSO 001 (Rathbone Ave.). This level was estimated to be the amount of sewer separation needed to gain an understanding of the site-specific hydrological attributes of the subject basins.

    b. Assume 50 percent sewer separation of the remaining combined acreage in the area tributary to CSO 004 (Hazel Ave.). The hydraulic model and staff experience suggests that this basin is very vulnerable to basement backups. Consequently, a greater level of sewer separation is being proposed for this area.

c. Assume 100 percent of the remaining street inlets in the area tributary to CSO 015 (West Benton St.) will be removed via sewer separation. Extensive sewer separation has been performed in this basin. Currently, two additional sewer separation projects are underway. Those projects are being funded through the ARRA program and the Illinois State Revolving Loan program. The current projects will be complete by July 2010. After the current projects are completed, there will be 19 roadway intersections still connected to the combined system. It is anticipated that this basin will respond very favorably to sewer separation considering the subsurface conditions that have been encountered so far. Furthermore, CSO 015's location relatively far away from proposed storage and treatment locations and its relatively high density of development constrains opportunities for cost-effective CSO conveyance.

3. Perform additional pre- and postconstruction flow monitoring in conjunction with the sewer separation. Utilize the flow monitoring data to optimize future sewer separation efforts.

4. Adjust sewer separation plans as needed to be as responsive as practical to redevelopment needs throughout the combined system.

Table D.5-8 shows the projected capital and present value costs for the recommended degree of sewer separation.

F. Green Infrastructure

The City administration and the Citizens Advisory Committee have expressed interest in pursuing green infrastructure throughout the city. Green infrastructure includes facilities of constructed "natural-like" features that use the infiltration capacity of the soil to treat stormwater and reduce the volume that flows to the combined sewer system. (Please see Section 5 for additional information on Aurora's current green infrastructure program, and see Appendix K for a description of types of green infrastructure controls.)

For the purpose of evaluating the cost and benefit of green infrastructure, several assumptions have been made. First, it is assumed that for strategically located green infrastructure projects that would abate stormwater flow from impervious areas, the amount of peak flow removal per acre is approximately comparable to that achieved by sewer separation. Second, based on their recent projects, City personnel indicate a capital cost of about $80,000 per acre of area managed through green infrastructure. Based on discussions in Appendix K, yearly O,M&R costs are approximated at 2 percent of capital costs. Assuming that approximately 75 percent of green infrastructure improvement components (such as pavements and piping) have a 40-year service life, the present value of green infrastructure is about $90,000 per acre. On a capital cost basis, green infrastructure is about the same as sewer separation but approximately 50 percent higher in terms of present value cost.

Based on these assumptions, green infrastructure does not strictly appear to be a cost-effective approach for CSO control on a systemwide basis. However, improvement of the Fox River water

TABLE D.5-8 DECOMBINATION PILOT PROGRAM

Basin	Remaining Areas to be Decombined (ac)	Percent Decombination Program Recommended	Recommended Pilot Decombining Project (ac)	Capital Cost	PV Cost
CSO 001	730.8	10	73	$5,840,000	$4,380,000
CSO 002	19.5	0	0	$0	$0
CSO 003A (excluding CSO 025 Basin)	101.5	0	0	$0	$0
CSO 004	381	50	191	$15,280,000	$11,460,000
CSO 005/010	113.8	20	23	$1,840,000	$1,380,000
CSO 008 (excluding CSO 022 Basin)	274.6	20	55	$4,400,000	$3,300,000
CSO 015	98.7	100	99	$7,920,000	$5,940,000
CSO 022	167.4	20	33	$2,640,000	$1,980,000
CSO 025	36	0	0	$0	$0
Total Decombining Projects	1923.3		474	$37,920,000	$28,440,000
Evaluation Study of Decombination Impacts and Future Decombination Projects				$1,500,000	$1,500,000
Total Decombining Pilot Project				$39,420,000	$29,940,000

quality, which is consistent with the intent of the National CSO Control Policy, is a primary motivation for the City's interest in pursuing green infrastructure.

Therefore, based on the guidance and encouragement of City of Aurora's administration and the expressed interest of the CAC, the implementation of green solutions to solve infrastructure deficiencies and improve the water quality of the Fox River is being considered as a viable part of the City's CSO Long Term Control Plan. While it is unlikely that large volumes of stormwater will be removed from the combined system through green infrastructure, preliminary investigations suggest that green infrastructure can be an effective tool for managing wet weather at some locations throughout the City's combined system.

The success of green infrastructure for CSO control will be largely dependent on site-specific conditions such as soil types, groundwater, and available space. There are some locations within the City's combined sewer system that are known to have soils that are very favorable for green infrastructure. (In particular, areas denoted as Soil Type B shown on Figure 4.03-2 would be most suitable for green infrastructure.) However, since underground conditions in Aurora tend to vary dramatically in relatively short distances, it is difficult to predict the overall benefits that might be gained from green infrastructure improvements prior to engaging in detailed analysis and design. Consequently very broad assumptions must be made at this point in order to estimate the extent and associated cost of the green infrastructure component of the LTCP.

Based on the City's and the CAC's interest in green infrastructure, a preliminary placeholder for green infrastructure is assumed. This preliminary placeholder of 5 percent of project costs[12] is applied. It is anticipated that the green infrastructure would be utilized in the following ways:

1. Include green infrastructure, for example bioswales and porous pavements, at CSO improvement sites such as storage/treatment facilities and pump stations.

2. Combine green infrastructure with sewer separation projects to provide increased capacity in the new storm sewer system and to mitigate the degradation of the Fox River because of pollutants commonly found in stormwater.

3. Use green infrastructure in lieu of conventional storm sewers to remove storm inlets from the combined system.

It is proposed that the green infrastructure portion of the LTCP be developed by starting with smaller projects and developing a detailed plan based on the results of a pilot program. The pilot program would include detailed soils analysis, site-specific hydrological analysis, and pre- and postconstruction monitoring.

[12] The basis of "project costs" for the 5 percent is based on the major conveyance, storage and treatment projects indicated as "Recommended Projects from Cost-Effective Analysis-Subtotal," which appears on Table D.5-9.

G. Preliminary Summary of Results

Based on the cost-effective evaluation performed here, the preliminary determination of most cost-effective projects for the most rigorous level of control is shown in Table D.5-9 along with their costs. (The CSOs are listed in geographical order from north to south rather than in numerical order, since some projects are grouped together for neighboring CSOs.)

Note that this cost evaluation considered only those projects and costs that vary between alternatives. Added at the bottom of Table D.5-9 are six additional anticipated LTCP program costs that are not anticipated to affect the overall comparison of alternatives. First, as described in Appendix J, the City of Aurora is interested in automating its metering of CSOs, plus several CSO structures require modification and installation of check valves. Next, as discussed in F above, proposed green infrastructure costs represent 5 percent of "Recommended Projects from Cost-Effective Analysis" in Table D.5-9. Third, the sewer separation program shown in Table D.5-8 is included in the Additional recommended programs. Finally, preliminary projected costs for a Use Attainability Analysis and Stormwater Utility development are included. The total cost for these projects appears in the "Additional Recommended Programs" portion of Table D.5-9.

This suggests the cost to achieve the most rigorous level of control (1-year return frequency for the potentially sensitive areas and a minimum of 3-month return frequency for the remaining CSOs) is approximately $231 million in present value costs. This will be referred to as Control Alternative 1, which is shown in Figures D.5-2 and -3.

D.6 CSO CONTROL FOR 85 PERCENT CAPTURE

Table D.5-9 listed the alternatives for each CSO as the most cost-effective to abate CSOs to the most rigorous level of control. The next step is to identify what subset of these projects is necessary to meet the National CSO Control Policy. Within the presumptive approach of the 1994 National CSO Control Policy, communities are allowed to target one of the following:

1. No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year.

2. The elimination or capture for treatment of no less than 85 percent by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis.

3. The elimination or removal of no less than the mass of pollutants identified as causing water quality impairment as determined by the sewer system characterization, monitoring, and modeling effort.

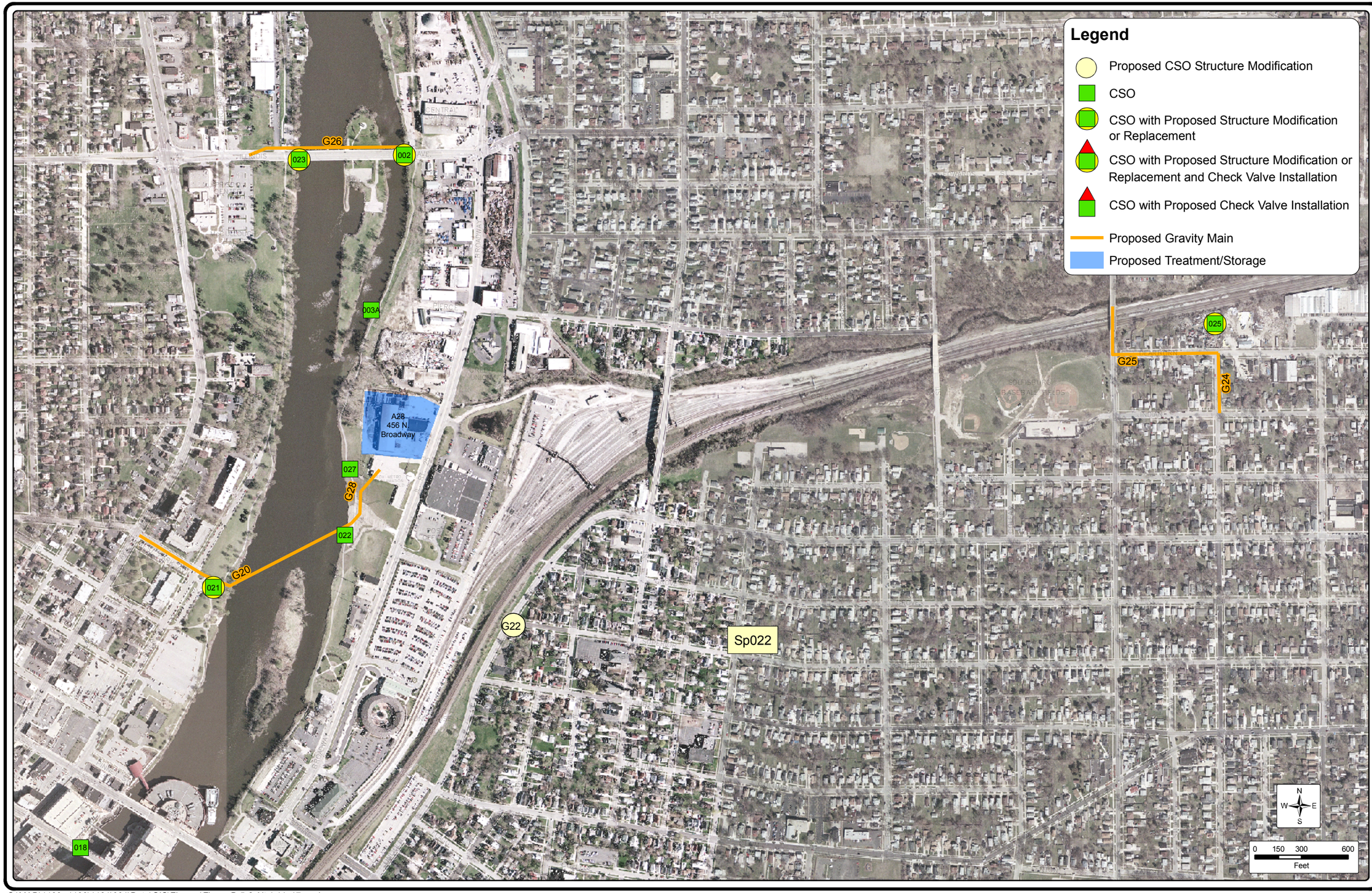
Treatment as defined above shall include:

1. Primary clarification.
2. Solids and floatables disposal.
3. Disinfection of effluent and removal of disinfection chemicals.

TABLE D.5-9 CONTROL ALTERNATIVE 1: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
1-YEAR LEVEL OF CONTROL FOR SENSITIVE AREAS AND MINIMUM 3-MONTH FOR OTHER CSOs

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.	Replacement siphon for all basin flow to CSO002 Area	5-year	$ 4,672,000	$ 3,565,000
002	E. Illinois St.		-	$ -	$ -
003A	Pierce St.		-	$ -	$ -
027	CSO Plant	Upgrade CSO Plant	1-year	$ 37,424,000	$ 40,710,000
022	Superior St.	Modified diversion chamber and reinforced relief sewer	1-year		
021	West Park Ave.	New siphon CSO to CSO022 Area	3-month	$ 2,337,000	$ 1,780,000
018	W. Galena Blvd.		-	$ 18,222,000	$ 19,350,000
015	W. Benton St.	WWPS/FM to Area A02	3-month		
008	E. Benton St.	WWPS/FM to Area A02	3-month	$ 22,626,000	$ 22,334,000
010	1st St.	WWPS/FM to Area A02	3-month	$ 10,217,000	$ 10,409,000
005	3rd St.	WWPS/FM to Area A02	3-month		
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 24,690,000	$ 26,795,000
001	Rathbone Ave.	Storage/Treatment at Area A02	1-year	$ 59,611,000	$ 59,907,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 181,489,000**	**$ 186,140,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 9,074,000	$ 8,823,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 55,194,000**	**$ 44,573,000**
			Recommended CSO Control Program	**$ 236,683,000**	**$ 230,713,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected



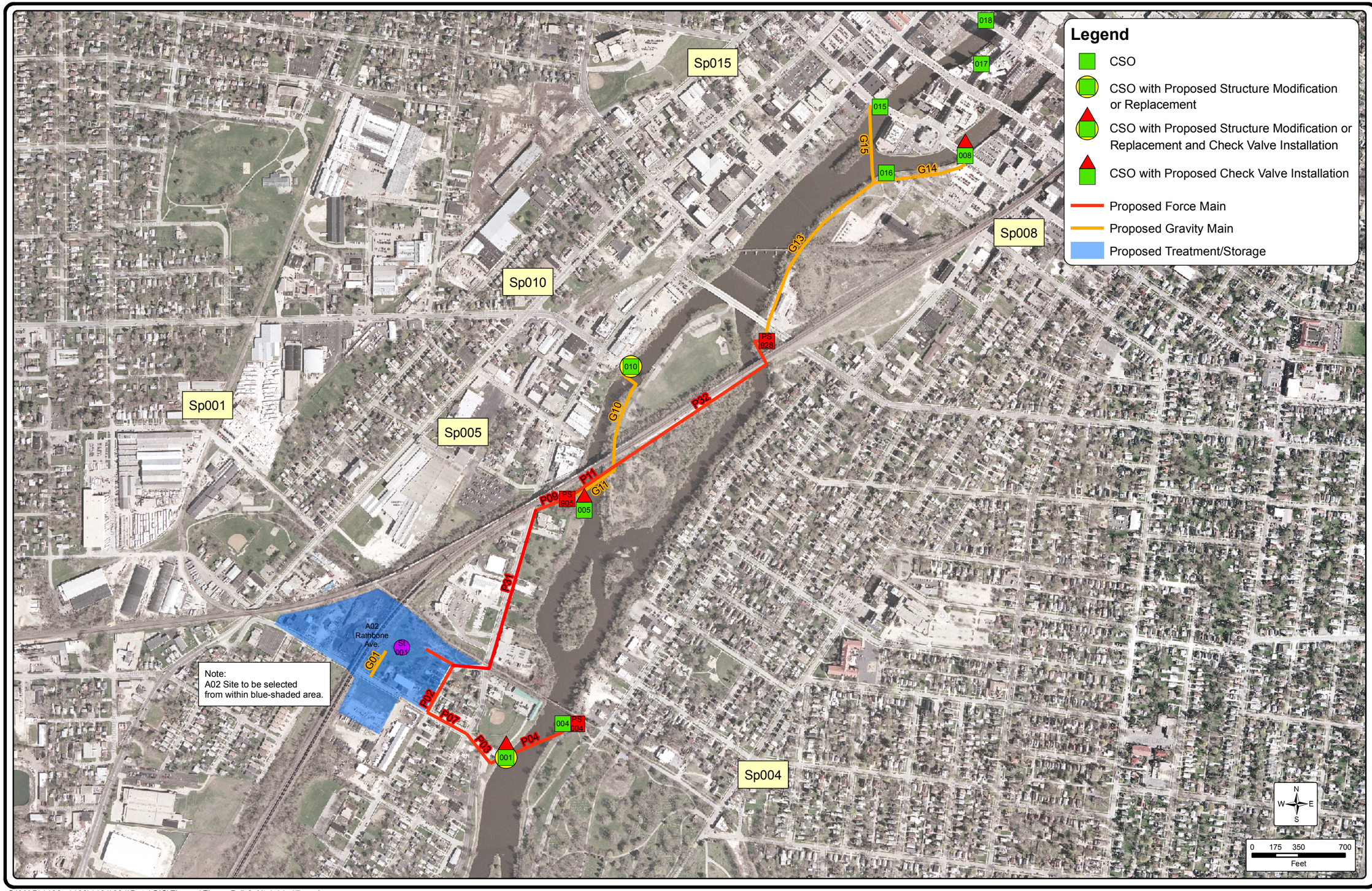
CONTROL ALTERNATIVE 1
NORTH SIDE IMPROVEMENTS

COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.®
ENGINEERS

FIGURE D.5-2
1181.006

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COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

CONTROL ALTERNATIVE 1
SOUTH SIDE IMPROVEMENTS

STRAND ASSOCIATES, INC.®
ENGINEERS

FIGURE D.5-3
1181.006

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While the selection of the level of control for each CSO used to identify design flows in the previous section stipulates the number of occurrences per year, determining the level of capture/elimination in a typical year is somewhat more involved. The purpose of this section is to identify the percent capture/elimination that would be achieved by the projects listed in Table D.5-9.

A. Defining Wet Weather Capture/Elimination

The percentage of capture/elimination within the CSS may be defined as follows:

$$\%_{capt/elim} = \frac{V_{capt/elim}}{V_{tot}} = \frac{V_{WWTP} + V_{CSO\ Plant} + V_{decombined}}{V_{WWTP} + V_{CSO\ Plant} + V_{decombined} + V_{CSO-preimprovement}}$$

Where:

$\%_{capt/elim}$ = percent capture/elimination
$V_{capt/elim}$ = total wet weather volume captured or eliminated
V_{tot} = total wet weather volume
V_{WWTP} = total volume conveyed to the wastewater treatment plant during wet weather
$V_{CSO\ Plant}$ = total volume conveyed to the CSO plant during wet weather
$V_{decombined}$ = total volume that has been eliminated in the CSS through decombining
$V_{CSO-preimprovement}$ = total volume of CSO prior to improvement

Another way to evaluate percent capture for a proposed suite of improvements is:

$$\%_{capt/elim} = \frac{V_{capt/elim}}{V_{tot}} = 1 - \frac{V_{CSO-postimprovement}}{V_{WWTP} + V_{CSO\ Plant} + V_{decombined} + V_{CSO-preimprovement}}$$

Where:

$V_{CSO-postimprovement}$ = total volume of CSO with proposed improvements

Therefore, the goal of this section is to estimate each of these values for a typical year.

As mentioned, determining this value is somewhat challenging, suggesting that performing the calculation using several different approaches is warranted. This will be performed in three ways. First, a full year of storm events for 1959 was run through the model. Second, from the series of design storm and model runs for which results are provided in Attachments D.4-1 and D.4-2, a collection of storms was selected to represent a typical year. Third, the average of the 2005-2008 overflow data collected by the City was treated as representative of a typical year. Based on each of these three methods, the percent capture was evaluated.

B. Year 1959 Simulation

The first method applied was to run a full year of storm events through the SWMM model. The year 1959 was recommended by the Illinois State Water Survey (ISWS) as representing a typical year. The total amount of rainfall during that year was 34.7 inches, which is close to the 35.1-inch average for 1901 to 2008. The actual rainstorms experienced during that year were somewhat more intense than would be projected based solely on the *Rainfall Frequency Atlas of the Midwest* (Bulletin 71). Table D.6-1 shows the majority of larger storm events in order of their return frequency as determined by Bulletin 71. This table shows there were three events in the 1- to 3-year return frequency range, whereas one event would be more typical. This table also shows there were nine events equal to or more significant than a 2-month storm, whereas six events would be expected. Therefore, this simulation would represent a conservative projection of total overflow volume, since it is the larger events that contribute most to overflow. Overflow volume is simply the sum of the total flow exiting each of the CSOs (except for CSO 001, discussed below) over the simulated year 1959.

To represent the total flow volume to the WWTP during wet weather (V_{WWTP}) for each storm, the area under the hydrograph representing a point in the system on the 69-inch interceptor just downstream of CSO 001 for the wet weather duration was calculated. (Wet weather duration was assumed to be the longest of (a) the entire rain event, (b) the period during which system overflows were occurring, or (c) the period of time from the beginning of the storm period until the flow in the 69-inch interceptor subsides to about 2.5 times DAF, or about 35.5 cfs (23 mgd). To represent the total flow volume to the CSO Plant ($V_{CSO\ Plant}$), the flow in the two relief sewers flowing to the plant was totaled. For projecting the preimprovement flow from all the CSOs ($V_{CSO-pre\ improvement}$), the overflow volume as calculated by the model was applied, with the exception of CSO 001, as discussed below.

To project CSO 001 flows, a somewhat modified approach was necessary. As discussed previously, modeling the hydraulics of this overflow to match the calibration data for the range of calibration events proved difficult to accomplish, as calibrating to the larger events meant that smaller events were significantly underpredicted. Therefore, a surrogate for CSO 001 flow was developed. First, it was assumed that, under typical conditions, the 15-inch openings in the interceptor would limit the flow from the CSO 001 basin into the 69-inch interceptor to a maximum of about 16 cfs.[13] Second, it was assumed that any flow projected for the 69-inch pipe exceeding 78.2 cfs (about 50.5 mgd) would occur as overflow. This value is based on Fox Metro's engineer's determination of the peak hourly flow capacity in the 69-inch interceptor.[14]

Next, it is necessary to project the amount of flow that has been eliminated through the City's decombining efforts ($V_{decombined}$), which was discussed in Section 4 and Appendix C, to determine how much the total volume can be considered "eliminated" from the CSS. Mapping of the CSS shows approximately 7,145 acres within the CSS boundary (see Figure 4.01-1). However, a significant portion of this area has been effectively decombined in the last few decades with the installation of storm sewers. Of this 7,145 acres, it appears that approximately 4,919 acres are currently decombined, based on review of existing plan sets that show approximately 1,511 acres of decombined areas, plus

[13] See Section C.04.B.a for how this value was projected.

[14] Based on these assumptions, for CSO 001 the 6-hour and 24-hour events represented the critical duration (for volume generation) for the 3-month and 1-year storms, respectively. However, where the 24-hour storm was the critical duration, the volume generated by the 6-hour storm was within about 12 percent.

TABLE D.6-1 SUMMARY OF LARGEST STORM EVENTS OF 1959

Begin	End	Peak Intensity	Total Rainfall	Return Frequency	Duration Basis
8/16/09 11:05	8/16/09 17:30	1.59	1.59	3 year	1 hour
4/27/09 17:05	4/28/09 14:45	0.89	3.72	>2 year	2-24 hour
2/10/09 19:05	2/11/09 0:15	1.16	1.16	1 year	1 hour
6/10/09 12:05	6/11/09 8:00	1.07	1.93	9 month	1 hour
1/30/09 1:05	1/30/09 5:30	1.00	1.00	9 month	1 hour
9/21/09 13:05	9/21/09 17:40	0.88	0.90	4 month	1 hour
12/27/09 23:05	12/28/09 3:05	0.83	0.83	4 month	1 hour
5/11/09 6:05	5/11/09 10:05	0.70	0.70	3 month	1 hour
8/3/09 2:05	8/3/09 14:20	0.46	1.15	2 month	8 hour
3/30/09 21:05	4/1/09 17:05	0.47	1.00	<2 month	
9/26/09 17:05	9/26/09 22:40	0.42	0.70	<2 month	
10/4/09 7:05	10/6/09 16:50	0.42	3.25	<2 month	
3/5/09 15:05	3/6/09 4:00	0.36	0.70	<2 month	
4/17/09 19:05	4/17/09 22:20	0.36	0.36	<2 month	
5/30/09 11:05	5/30/09 15:50	0.30	0.36	<2 month	
11/24/09 11:05	11/24/09 14:35	0.30	0.34	<2 month	
3/14/09 18:05	3/15/09 7:00	0.27	0.86	<2 month	
10/23/09 5:05	10/25/09 3:05	0.26	1.13	<2 month	
3/25/09 14:05	3/27/09 6:00	0.25	1.13	<2 month	
7/22/09 15:05	7/23/09 15:00	0.23	1.17	<2 month	
9/28/09 12:05	9/28/09 21:35	0.21	0.54	<2 month	
5/18/09 20:05	5/19/09 11:10	0.20	0.79	<2 month	
11/3/09 22:05	11/5/09 13:00	0.19	1.51	<2 month	
6/29/09 18:05	7/1/09 2:00	0.13	0.82	<2 month	
12/11/09 4:05	12/12/09 4:05	0.12	0.72	<2 month	

another 3,408 acres known to have storm sewer based on AutoCAD mapping. Of the 3,408 acres having storm sewer, it is necessary to know how much was originally constructed as combined system. Based on discussion with City personnel, it appears that the approximately 1,000 acres north of New Indian Trail on the northwest side was originally constructed with separate sewers as was the 250-acre area bounded by W. Illinois Ave., New Indian Trail, N. Randall Rd., and N. Elmwood Dr. Based on this, it appears that approximately 3,669 acres have been intentionally decombined through the City's efforts. For the purpose of projecting the inflow reduction, two assumptions were made. First, it was assumed the total rainfall which fell on impervious surfaces that were disconnected from the combined system and reconnected to the new storm sewers through decombination (estimated at about 15 percent). Second, a conservative portion of the rainfall onto pervious areas (estimated at 5 percent) was considered eliminated.

Table D.6-2 shows the total overflow volumes for each of the CSOs, based on the year 1959 simulation. Based on this method, it appears that Aurora already achieves greater than 85 percent capture.

C. Typical Year Collection

The second approach is to develop a "typical year collection" of storms from the modeled design storms. Two principles were used to create a collection of typical year storms from the model runs to identify a conservative projection of CSO capture. First, a review of the model data showed the largest (critical) volume of overflow occurs for the 1-hour or 6-hour storms.[15] In addition, the shorter duration storms generate the highest peak overflow rates and would require larger-sized conveyance improvements to capture. Therefore, a conservative assumption was made that shorter, more intense storms that cause the greater overflow should be selected to be a part of the typical year collection versus longer duration storms that develop less overflow, as predicted by the model. As discussed above, the model was run at a variety of durations, including 1-hour, 6-hour, 1-day, 3-day, and 10-day. It was assumed the 1-hour and 6-hour model runs represented the behavior of the system for the conservative shorter-duration events. Therefore, the typical year collection of events emphasized 1-hour and 6-hour duration storms.

Second, the selected return frequencies were based on the relative cumulative recurrence of the various events. For example, in a 1-year period, for a particular duration storm, it would be expected that one storm approximately equal to the 1-year return frequency would occur. During a typical year, for a particular duration, it would be expected that two storms equal to or greater than the 6-month return frequency would occur; however, since the 1-year storm selected counts as "equal to or greater than" the 6-month storm, one additional 6-month storm is included, in addition to the 1-year storm. This process is repeated for the smaller duration storms. In this way, the selected collection of storms generated 38.5 inches of rainfall, which is a conservative estimate of the 35.1 inches of average rainfall for Aurora, identified by the Illinois State Water Survey, based on data since 1901.

To project the typical year parameters above, the model results for volumes and hydrographs at the representative locations were applied for each storm in the typical year collection. Modifications to the CSO 001 overflow rate, calculations of total flow to the WWTP, and determination of wet weather flow eliminated by decombining applied the same methods as described for the year 1959 analysis.

[15] An exception to this is CSO 001, which will be discussed later.

TABLE D.6-2 WET WEATHER VOLUMES FOR 1959

			Volume (mil gal) Captured Level of Control	
	Volume (mil gal)	Percent of CSO Volume	3-month	1 year
CSO 001	52.9	26.6%	35.8	48.9
CSO 002	0.1	0.1%	0.0	0.0
CSO 003A	0.4	0.2%	0.0	0.0
CSO 004	51.6	25.9%	41.8	51.1
CSO 005	0.7	0.4%	0.3	0.7
CSO 008	52.7	26.5%	42.6	52.4
CSO 010	9.5	4.8%	8.3	9.5
CSO 015	19.9	10.0%	15.6	19.5
CSO 018	0.1	0.1%	0.0	0.0
CSO 021	1.2	0.6%	0.4	1.1
CSO 022	2.7	1.4%	0.0	2.3
CSO 023	1.2	0.6%	0.0	1.2
CSO 025	3.2	1.6%	2.1	3.2
CSO 027	2.8	1.4%	1.3	2.5
Total CSO Volume	199.0		148.2	192.4
Total Flow to WWTP	600.3			
Total Flow to CSO Plant	19.5			
Total Flow Decombined	691.4			
Total Flow Captured	1311.2			
Total Wet Weather Flow	1510.2			
Current Percent Capture	86.8%			
Volume Capture of CSO Required to Achieve 85 percent	-27.5			

Based on this method, Table D.6-3 shows the total projected yearly CSO occurring from each overflow along with the total captured flow. This collection of modeled storms suggests an annual CSO generation of about 265 mil gal and suggests that an additional 36 mil gal of overflow during that year would need to be abated to achieve 85 percent capture.

D. CSO Historical Records

The third approach was to analyze the CSO records for 2005-2008 in a similar fashion in which the average over this period was taken to represent a typical year.[16] Table D.6-4 shows the average CSO volumes for the 2005 to 2008 period. For simplicity of the calculation, values for total wet weather flow captured ($V_{capt/elim}$) from the year 1959 are applied for this analysis. This analysis suggests that approximately an additional 52 mil gal of capture would be required to meet the 85 percent criterion.

E. Comparison of Projected Three Methods' Overflow Volumes

Comparing Tables D.6-2, -3, and -4, the most significant difference between the 2005-2008 evaluation relative to the other two is the significantly higher amount of overflow at CSO 015. This is because the model reflects the conditions in the CSO 015 basin after the significant improvements recently implemented. (Improvements include the construction of the new North Ave. PS that diverts up to 7 mgd of flow from the CSS, decombination projects within the basin, and especially reconstruction of the overflow itself.) To adjust for this in the calculation, the year 1959 volume of CSO 015 is used as a surrogate value for the historical data. With this adjustment, the total amount of CSO projected from the historical record is about 292 mil gal versus 199 mil gal for the year 1959 and 165 mil gal for the typical year collection.

Comparing the "adjusted" percentages of overflow for all three methods (year 1959 simulation, typical year collection, and CSO historical records) shows many similarities. All methods agree that the north side CSOs constitute approximately 4 to 6 percent of the total overflow volume, of which CSO 025 represents the largest volume. In addition, CSOs 005 and 010 represent a small portion of the total overflow, about 2 to 6 percent.

All three methods agree that CSOs 001, 004, and 008 represent the very large majority (approximately 85 percent) of the yearly overflow, although there is noteworthy disagreement between the methods regarding the relative contribution of each. Whereas the typical year collection projects that CSO 004 is the largest contributor of the three and the year 1959 analysis suggests all three are roughly equal, the 2005-2008 CSO data suggest that CSO 001 is the largest.

F. Determination of the Projected CSO Captured

For all three methods, the projected amount of CSO that would be captured by the proposed improvements was evaluated. Any flows or volumes above the 3-month and 1-year design capacities of each potential improvement (e.g., WWPSs or storage) were projected to be overflow. Then, the difference between the projected year CSO volume and postimprovement CSO volume was considered

[16] The average rainfall during the 2005-2008 period is 36.1 inches, slightly above the 35.1-inch typical year identified by the Illinois State Water Survey.

TABLE D.6-3 WET WEATHER VOLUMES FOR TYPICAL YEAR COLLECTION

			Volume (mil gal) Captured Level of Control	
	Volume (mil gal)	Percent of CSO Volume	3-month	1 year
CSO 001	67.0	25.3%	67.0	67.0
CSO 002	0.0	0.0%	0.0	0.0
CSO 003A	0.0	0.0%	0.0	0.0
CSO 004	95.6	36.1%	80.0	95.6
CSO 005	0.4	0.2%	0.2	0.4
CSO 008	57.3	21.6%	53.7	57.3
CSO 010	17.0	6.4%	16.2	17.0
CSO 015	16.3	6.2%	15.1	16.3
CSO 018	0.0	0.0%	0.0	0.0
CSO 021	0.8	0.3%	0.4	0.8
CSO 022	0.4	0.2%	0.0	0.4
CSO 023	0.2	0.1%	0.0	0.2
CSO 025	8.6	3.2%	6.0	8.6
CSO 027	1.4	0.5%	0.0	1.4
Total CSO Volume	265.0		238.7	265.0
Total Flow to WWTP	466.1			
Total Flow to CSO Plant	28.5			
Total Flow Decombined	767.5			
Total Flow Captured	1262.2			
Total Wet Weather Flow	1527.2			
Current Percent Capture	82.6%			
Volume Capture of CSO Required to Achieve 85 percent	35.9			

TABLE D.6-4 WET WEATHER VOLUMES FOR 2005-2008

	Average 2005-2008	CSO 015 Adjusted		Volume (mil gal) Captured Level of Control	
	Volume (mil gal)	Volume (mil gal)	Percent of CSO Volume	3-month	1 year
CSO 001	142.1	142.1	48.6%	83.9	108.3
CSO 002	0.0	0.0	0.0%	0.0	0.0
CSO 003A	0.2	0.2	0.1%	0.1	0.2
CSO 004	45.6	45.6	15.6%	44.9	45.6
CSO 005	3.4	3.4	1.2%	0.9	3.0
CSO 008	63.3	63.3	21.6%	34.4	56.3
CSO 010	2.5	2.5	0.8%	2.5	2.5
CSO 015*	141.9	19.9	6.8%	12.9	16.7
CSO 018	0.1	0.1	0.0%	0.0	0.1
CSO 021	0.0	0.0	0.0%	0.0	0.0
CSO 022	1.4	1.4	0.5%	0.9	1.2
CSO 023	0.0	0.0	0.0%	0.0	0.0
CSO 025	14.0	14.0	4.8%	9.1	11.8
CSO 027	0.0	0.0	0.0%	0.0	0.0
Total CSO Volume	414.5	292.5		189.5	245.6

Total Flow to WWTP	600.3
Total Flow to CSO Plant	19.5
Total Flow Decombined	691.4
Total Flow Captured	1311.2
Total Wet Weather Flow	1603.7
Current Percent Capture	81.8%
Volume Capture of CSO Required to Achieve 85 percent	51.9

to be captured. Therefore, the potential amount of average CSO reduction for all three methods could be determined for the proposed improvements designed to any combination of the 3-month and 1-year levels of control. For the simulation-based methods (year 1959 and typical year collection), it was relatively straightforward to make these determinations from the model-generated hydrographs. For the CSO data-based model, the 5-minute CSO data was analyzed for flow and volume. Because this was a relatively cumbersome process, this method was only applied to the data for CSOs 001, 004, 005, 008, and 010, which account for about 87 percent of the overflow volume.

The remaining CSOs constitute just 13 percent of the overflow volume, so the total percent capture calculation will not depend heavily on these CSOs. To approximate the amount of CSO that would be removed from the smaller north side CSOs and further removed from CSO 015 and 018 with proposed improvements, the percent removals determined for the south side CSOs were applied, 65 percent for the 3-month level of control and 84 percent for the 1-year level of control.

D.7 VARYING LEVELS OF CONTROL

A. Costs for Varying Levels of Control

Section D.5 evaluated the most cost-effective strategy for achieving a 3-month level of control at all CSOs, plus a 1-year level of control for CSOs 001, 022, and 023–in other words, Control Alternative 1, the most rigorous standard of control. The purpose of this section is to identify the potential for cost savings for the City's LTCP by targeting slightly lower levels of control that still meet the National CSO Control Policy. To this end, seven additional Control Alternatives are evaluated. Table D.7-1 describes the additional Control Alternatives evaluated to assists in identifying costs for a range of percent capture values from approximately 85 percent to approaching 100 percent.

Control Alt	Target Level of Control	Level of Control (return frequency)			
		Proposed Sensitive Area CSOs (001, 022, 023)	Nonsensitive CSOs		
			Captured to minimum 3-month level	Not captured	Not requiring capture
1	1-year for sensitive, 3-month for nonsensitive	1 year	004, 005, 008, 010, 015, 021, 025, 027		002, 003A, 016, 017, 018
2	1-year for sensitive, ~95 percent capture	1 year	004, 008, 025, 027	005, 010, 015, 021	002, 003A, 016, 017, 018
3	1-year for sensitive, ~90 percent capture	1 year	004, 025, 027	005, 008, 010, 015, 021	002, 003A, 016, 017, 018
4	1-year for sensitive, ~85 percent capture	1 year	025, 027	004, 005, 008, 010, 015, 021	002, 003A, 016, 017, 018
5	3-month for sensitive and nonsensitive	3 month	004, 005, 008, 010, 015, 021, 025, 027		002, 003A, 016, 017, 018
6	3-month for sensitive, ~93 percent capture	3 month	004, 008, 025	005, 010, 015, 021	002, 003A, 016, 017, 018, 027
7	3-month for sensitive, ~90 percent capture	3 month	004, 025	005, 008, 010, 015, 021	002, 003A, 016, 017, 018, 027
8	3-month for sensitive, ~85 percent capture	3 month	025	004, 005, 008, 010, 015, 021	002, 003A, 016, 017, 018, 027

Table D.7-1 Description of Control Alternatives

Tables D.7-2 through D.7-8 show the projects required for Control Alternatives 2 through 8, including costs for improving the CSO structures and installation of permanent metering, the green infrastructure program, and the sewer decombining program discussed in Section D.5. For convenience in this discussion, Table D.5-9 showing Control Alternative 1 is also included. At the end of this appendix, Figures D.7-1 through D.7-14 illustrate each of the Control Alternatives' design configurations for Control Alternatives 2 through 8. (Note that Figures D.5-2 and D.5-3 show Control Alternative 1. Tables D.7-9 to D.7-16 show the detailed design criteria for all control alternatives.)

To achieve Control Alternative 2, several of the proposed projects in Control Alternative 1 can be removed, including the proposed improvements to CSOs 005, 010, 015, and 021, as shown in Table D.7-2. Note that the proposed CSO 025 improvement could also be removed, since it does not contribute significantly to percent capture. However, because this frequently occurring CSO can be controlled for relatively low cost, it is considered a desirable project to pursue and will be included in all control alternatives.

Control Alternative 3 is similar to Control Alternative 2, except the projects associated with CSO 008 for conveyance to storage and treatment are removed (see Table D.7-3). Control Alternative 4 is similar to Control Alternative 3, except the WWPS/FM project at CSO 004 for conveyance to storage and treatment is removed (see Table D.7-4), and storage/treatment is provided for CSO 001 only.

To achieve Control Alternative 5, which applies a 3-month level of control for the potential sensitive area CSOs, three projects are modified from Control Alternative 1, as shown in Table D.7-5. First, because both the model and the CSO records show that CSO 023 only overflows about 1 to 2 times per year, control to the 3-month level does not require any project at this location. Second, for CSO 022, the proposed size increase for the relief sewer to the CSO plant would not be required at the 3-month level of control, and the capacity of the CSO plant expansion can be reduced. Finally, the size of the storage and treatment at CSO 001 can be reduced to the 3-month level. Note the improvements at the CSO plant are maintained in this alternative for the following reason. The model shows that, during the 3-month, 1-hour event, the current capacity of the CSO plant is slightly exceeded for a short period of time, generating a small amount of overflow, less than 3,000 gallons. Given the approximate nature of the model projections, it suggests the CSO plant's current capacity is likely relatively close to the 3-month, 1-hour design standard. With the additional flow contribution from CSOs 025 and 021 but particularly from the Superior St. diversion, that overflow volume would be larger, suggesting that a capacity increase would be required to meet the 3-month target.

For Control Alternative 6, the projects at CSO 005, 010, 015, and 021 can be removed from Control Alternative 5, as shown in Table D.7-6, since they do not significantly increase the percent capture. Also, the Superior St. diversion and CSO plant expansion are removed from this alternative, since the model suggests the plant is about adequately sized for the 3-month flow. (Note that the hydrograph analysis discussed in D.5 showed that the potential contribution to the CSO plant flow from improvements at CSO 025 would lag behind flow sources that appear to cause brief exceedance of CSO plant capacity. Also, note that without the Superior St diversion, the CSO 008 control costs are somewhat higher than in Control Alternative 2.)

Control Alternative 7 is similar to Control Alternative 6, except the projects associated with CSO 008 for conveyance to storage and treatment is removed (see Table D.7-7). Control Alternative 8 is similar to

TABLE D.5-9 CONTROL ALTERNATIVE 1: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
1-YEAR LEVEL OF CONTROL FOR SENSITIVE AREAS AND MINIMUM 3-MONTH FOR OTHER CSOs

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.	Replacement siphon for all basin flow to CSO002 Area	5-year	$ 4,672,000	$ 3,565,000
002	E. Illinois St.		-	$ -	$ -
003A	Pierce St.		-	$ -	$ -
027	CSO Plant	Upgrade CSO Plant	1-year	$ 37,424,000	$ 40,710,000
022	Superior St.	Modified diversion chamber and reinforced relief sewer	1-year		
021	West Park Ave.	New siphon CSO to CSO022 Area	3-month	$ 2,337,000	$ 1,780,000
018	W. Galena Blvd.		-	$ 18,222,000	$ 19,350,000
015	W. Benton St.	WWPS/FM to Area A02	3-month		
008	E. Benton St.	WWPS/FM to Area A02	3-month	$ 22,626,000	$ 22,334,000
010	1st St.	WWPS/FM to Area A02	3-month	$ 10,217,000	$ 10,409,000
005	3rd St.	WWPS/FM to Area A02	3-month		
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 24,690,000	$ 26,795,000
001	Rathbone Ave.	Storage/Treatment at Area A02	1-year	$ 59,611,000	$ 59,907,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 181,489,000**	**$ 186,140,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 9,074,000	$ 8,823,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 55,194,000**	**$ 44,573,000**
			Recommended CSO Control Program	**$ 236,683,000**	**$ 230,713,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-2 CONTROL ALTERNATIVE 2: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
1-YEAR LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSOs 004, 008, AND 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.	Replacement siphon for all basin flow to CSO002 Area	5-year	$ 4,672,000	$ 3,565,000
002	E. Illinois St.		-	$ -	$ -
003A	Pierce St.		-	$ -	$ -
027	CSO Plant	Upgrade CSO Plant	1-year	$ 37,424,000	$ 40,710,000
022	Superior St.	Modified diversion chamber and reinforced relief sewer	1-year		
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.	WWPS/FM to Area A02	3-month	$ 22,626,000	$ 22,334,000
010	1st St.				
005	3rd St.				
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 24,690,000	$ 26,795,000
001	Rathbone Ave.	Storage/Treatment at Area A02	1-year	$ 59,611,000	$ 59,907,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 150,713,000**	**$ 154,601,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 7,536,000	$ 7,328,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 53,656,000**	**$ 43,078,000**
			Recommended CSO Control Program	**$ 204,369,000**	**$ 197,679,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-3 CONTROL ALTERNATIVE 3: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
1-YEAR LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSOs 004 AND 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.	Replacement siphon for all basin flow to CSO002 Area	5-year	$ 4,672,000	$ 3,565,000
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant	Upgrade CSO Plant	1-year		
022	Superior St.	Modified diversion chamber and reinforced relief sewer	1-year	$ 37,424,000	$ 40,710,000
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.				
010	1st St.				
005	3rd St.				
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 24,690,000	$ 26,795,000
001	Rathbone Ave.	Storage/Treatment at Area A02	1-year	$ 59,611,000	$ 59,907,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 128,087,000**	**$ 132,267,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 6,404,000	$ 6,227,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 52,524,000**	**$ 41,977,000**
			Recommended CSO Control Program	**$ 180,611,000**	**$ 174,244,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-4 CONTROL ALTERNATIVE 4: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
1-YEAR LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSO 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.	Replacement siphon for all basin flow to CSO002 Area	5-year	$ 4,672,000	$ 3,565,000
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant	Upgrade CSO Plant	1-year		
022	Superior St.	Modified diversion chamber and reinforced relief sewer	1-year	$ 37,424,000	$ 40,710,000
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.				
010	1st St.				
005	3rd St.				
004	Hazel Ave.				
001	Rathbone Ave.	Storage/Treatment at Area A02	1-year	$ 59,611,000	$ 59,907,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 103,397,000**	**$ 105,472,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 5,170,000	$ 5,027,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 51,290,000**	**$ 40,777,000**
			Recommended CSO Control Program	**$ 154,687,000**	**$ 146,249,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-5 CONTROL ALTERNATIVE 5: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
3-MONTH LEVEL OF CONTROL FOR SENSITIVE AREAS AND MINIMUM 3-MONTH FOR OTHER CSOs

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.				
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant	Upgrade CSO Plant	3-month	$ 14,860,000	$ 16,480,000
022	Superior St.	Modified diversion chamber	3-month		
021	West Park Ave.	New siphon CSO to CSO022 Area	3-month	$ 2,337,000	$ 1,780,000
018	W. Galena Blvd.			$ 18,203,000	$ 19,300,000
015	W. Benton St.	WWPS/FM to Area A02	3-month		
008	E. Benton St.	WWPS/FM to Area A02	3-month	$ 25,436,000	$ 25,054,000
010	1st St.	WWPS/FM to Area A02	3-month	$ 10,432,000	$ 10,579,000
005	3rd St.	WWPS/FM to Area A02	3-month		
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 23,368,000	$ 25,895,000
001	Rathbone Ave.	Storage/Treatment at Area A02	3-month	$ 45,615,000	$ 46,637,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 141,941,000**	**$ 147,015,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 7,097,000	$ 6,901,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 53,217,000**	**$ 42,651,000**
			Recommended CSO Control Program	**$ 195,158,000**	**$ 189,666,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-6 CONTROL ALTERNATIVE 6: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
3-MONTH LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSOs 004, 008, AND 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.				
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant				
022	Superior St.				
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.	WWPS/FM to Area A02	3-month	$ 25,436,000	$ 25,054,000
010	1st St.				
005	3rd St.				
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 23,368,000	$ 25,895,000
001	Rathbone Ave.	Storage/Treatment at Area A02	3-month	$ 45,615,000	$ 46,637,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 96,109,000**	**$ 98,876,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 4,805,000	$ 4,672,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 50,925,000**	**$ 40,422,000**
			Recommended CSO Control Program	**$ 147,034,000**	**$ 139,298,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-7 CONTROL ALTERNATIVE 7: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
3-MONTH LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSOs 004 AND 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.				
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant				
022	Superior St.				
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.				
010	1st St.				
005	3rd St.				
004	Hazel Ave.	WWPS/FM to Area A02	3-month	$ 23,368,000	$ 25,895,000
001	Rathbone Ave.	Storage/Treatment at Area A02	3-month	$ 45,615,000	$ 46,637,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 70,673,000**	**$ 73,822,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 3,534,000	$ 3,436,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 49,654,000**	**$ 39,186,000**
			Recommended CSO Control Program	**$ 120,327,000**	**$ 113,008,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

TABLE D.7-8 CONTROL ALTERNATIVE 8: SUMMARY OF COST-EFFECTIVE CSO ABATEMENT OPTIONS
3-MONTH LEVEL OF CONTROL FOR SENSITIVE AREAS PLUS CAPTURE OF CSO 025

Recommended Projects from Cost-Effective Analysis					
CSO Number	CSO Name	Improvement Description	Level of Control*	Capital Cost	Present Value
025	Dearborn and Trask	New gravity sewers	1-year	$ 1,690,000	$ 1,290,000
023	W. Illinois St.				
002	E. Illinois St.				
003A	Pierce St.				
027	CSO Plant				
022	Superior St.				
021	West Park Ave.				
018	W. Galena Blvd.				
015	W. Benton St.				
008	E. Benton St.				
010	1st St.				
005	3rd St.				
004	Hazel Ave.				
001	Rathbone Ave.	Storage/Treatment at Area A02	3-month	$ 45,615,000	$ 46,637,000
		Recommended Projects from Cost-Effective Analysis - Subtotal		**$ 47,305,000**	**$ 47,927,000**
Additional Recommended Programs					
		Permanent Overflow Metering		$ 1,000,000	$ 590,000
		CSO Modifications and Check Valves		$ 5,000,000	$ 4,520,000
		Green Infrastructure Program		$ 2,365,000	$ 2,300,000
		Sewer Decombination Program		$ 39,420,000	$ 29,940,000
		Use Attainability Analysis		$ 200,000	$ 200,000
		Stormwater Utility		$ 500,000	$ 500,000
		Additional Recommended Programs - Subtotal		**$ 48,485,000**	**$ 38,050,000**
			Recommended CSO Control Program	**$ 95,790,000**	**$ 85,977,000**

*Note: Where practical considerations dictate a higher level of control than 3 month, that level of control is selected

Control Alternative 7, except the WWPS/FM project at CSO 004 for conveyance to storage and treatment is removed (see Table D.7-8) and storage/treatment is provided for CSO 001 only.

Comparing the total costs for the Control Alternatives suggests that a significant degree of cost savings can be achieved with removal of selected projects. It is useful then to compare these costs relative to the level of capture achieved by each alternative. Table D.7-17 compares the approximate percent typical year capture of each of the Control Alternatives, based on the three methods described in Section D.6.

This data is plotted in a "knee of the curve" fashion on Figures D.7-15, D.7-16, and D.7-17. Based on the knee of the curve data and the preceding tables, several conclusions can be reached. First, it appears that Control Alternative 7 is the lowest cost alternative that meets the 85 percent capture standard under all methods. Second, comparing Control Alternatives 1 and 5, the difference in present value cost to achieve a 1-year level of control versus a 3-month level of control at CSOs 001, 022, and 023 is about $39 million (excluding the Additional Recommended Programs). Next, achieving a 3-month level of control at all nonsensitive CSOs (Control Alternatives 1 and 5) is well to the left of the knee of the curve, suggesting that these control alternatives may not be cost-effective for Aurora. Finally, Control Alternative 6 appears to represent the knee of the curve.

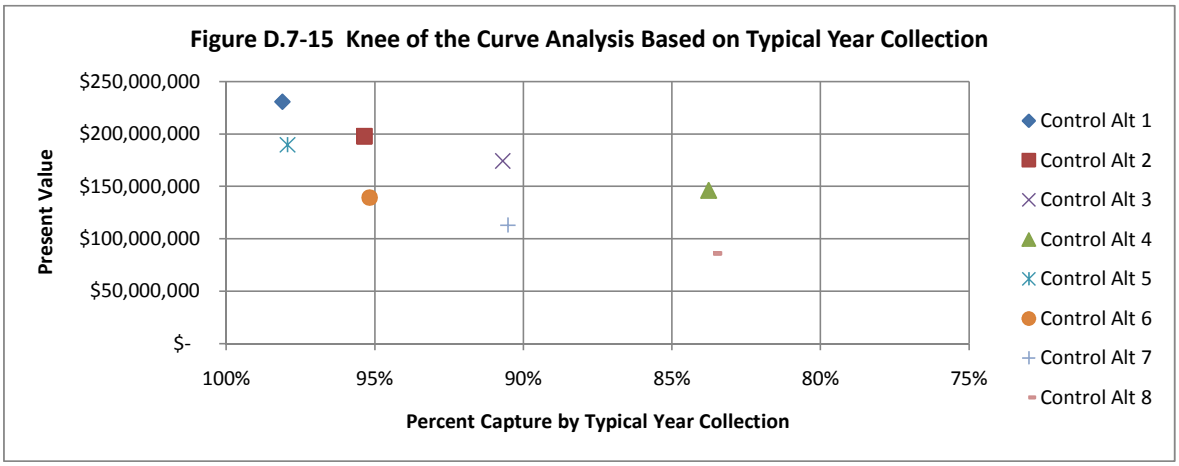
Based on this analysis, it appears that Control Alternative 7 would meet the National CSO Control Policy requirements. It represents a relatively compact project that minimizes construction through lengthy corridors. Also, as shown in Section 7, Control Alternative 7 results in a percent of MHI of approximately 2 percent. Therefore, Control Alternative 7 is selected as the recommended alternative. Section 5 discusses Control Alternative 7 in greater detail.

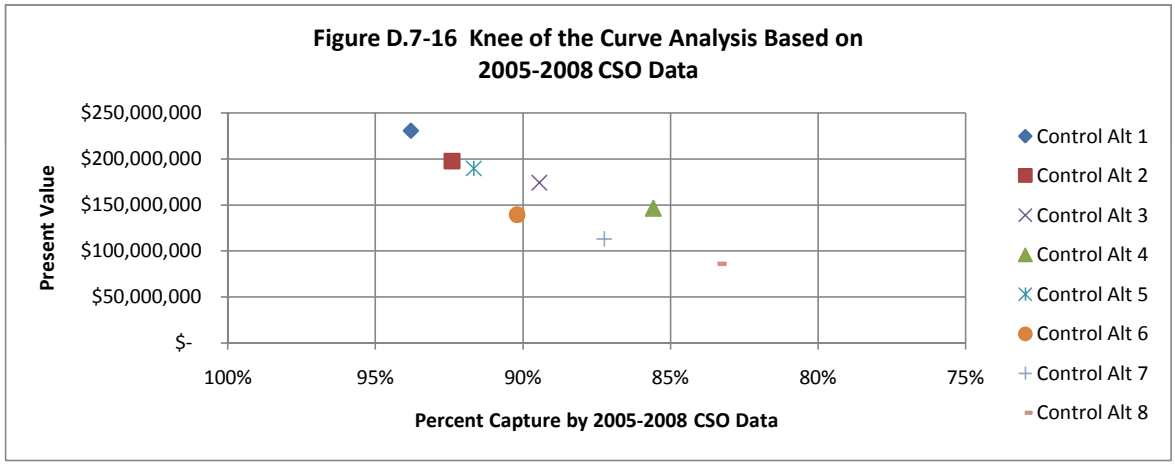
B. Number of Events for Varying Levels of Control

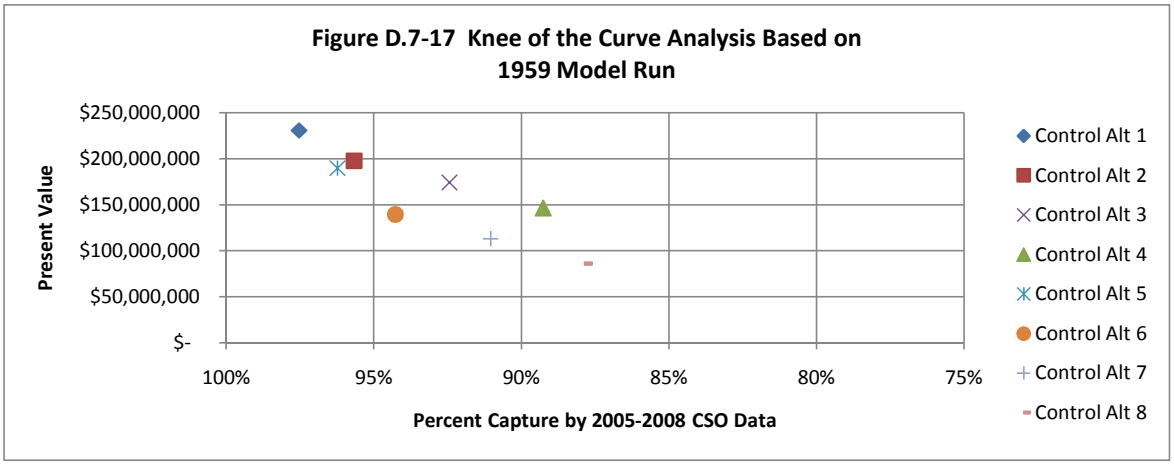
Although this LTCP applies the percent capture criterion for determining the knee of the curve and therefore an acceptable level control, it is worthwhile to identify the anticipated number of remaining events for each Control Alternative. Table D.7-18 shows this information based on the design storms applied and sensitivity analyses performed through SWMM modeling.

TABLE D.7-17 COST VS. PERCENT CAPTURE

Control Alternative	Capital Cost	Present Value	Percent Capture by 1959 Model Run	Percent Capture by Typical Year Collection	Percent Capture by 2005-2008 Historical Data	Average
Control Alt 1	$ 236,683,000	$ 230,713,000	97.5%	98.1%	93.8%	96.5%
Control Alt 2	$ 204,369,000	$ 197,679,000	95.7%	95.3%	92.4%	94.5%
Control Alt 3	$ 180,611,000	$ 174,244,000	92.4%	90.7%	89.4%	90.9%
Control Alt 4	$ 154,687,000	$ 146,249,000	89.3%	83.8%	85.6%	86.2%
Control Alt 5	$ 195,158,000	$ 189,666,000	96.2%	97.9%	91.7%	95.3%
Control Alt 6	$ 147,034,000	$ 139,298,000	94.3%	95.2%	90.2%	93.2%
Control Alt 7	$ 120,327,000	$ 113,008,000	91.0%	90.5%	87.2%	89.6%
Control Alt 8	$ 95,790,000	$ 85,977,000	87.9%	83.6%	83.4%	84.9%





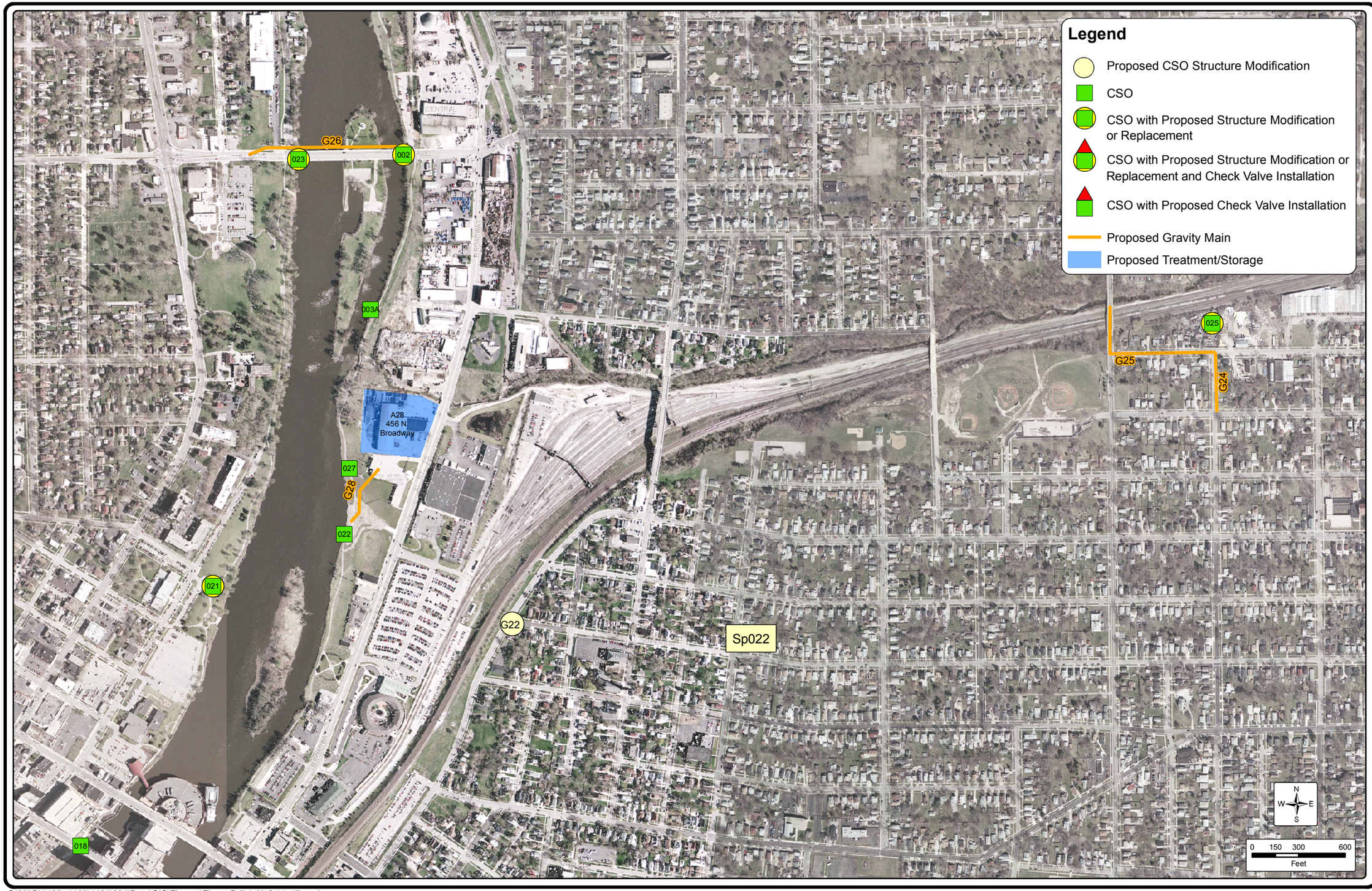


	Control Alternative							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
001	≤1	≤1	≤1	≤1	≤4	≤4	≤4	≤4
002	1	1	1	1	1	1	1	1
003A	1	1	1	1	1	1	1	1
004	≤4	≤4	≤4	*≥12*	≤4	≤4	≤4	*≥12*
005	≤4	6	6	6	≤4	6	6	6
008	≤4	≤4	*≥12*	*≥12*	≤4	≤4	*≥12*	*≥12*
010	≤4	*≥12*	*≥12*	*≥12*	≤4	*≥12*	*≥12*	*≥12*
015	≤4	*≥12*	*≥12*	*≥12*	≤4	*≥12*	*≥12*	*≥12*
018	≤1	≤1	≤1	≤1	≤1	≤1	≤1	≤1
021	≤4	6	6	6	≤4	6	6	6
022	≤1	≤1	≤1	≤1	2	2	2	2
023	≤1	≤1	≤1	≤1	2	2	2	2
025	≤1	≤1	≤1	≤1	≤1	≤1	≤1	≤1
027	≤1	≤1	≤1	≤1	≤4	6	6	6

1 Projections do not include potential further CSO reduction due to preliminary planned separation projects but do include the current separation projects in the CSO 008 and 015 basins. Projections do include weir raising for CSOs 010 and 021.
2 For CSOs shown in italics model projections suggest that no CSO would occur at intensities less than about 0.35-0.4 in/hr.

Table D.7-18 Projected Number of CSOs in a Typical Year for Varying Levels of Control

For the recommended Control Alternative 7, the model projections suggest that CSOs 008, 010, and 015 would continue to overflow on at least a monthly basis. However, as noted in the footnote to the table, anticipated reductions in CSO occurrences because of preliminary planned separation are not taken into account. The CSO 015 basin is intended to be a target for significant further separation. In addition, CSO records suggest that, although CSO 010 occurs relatively frequently, it is one of the smaller volume CSOs, as shown in Table D.6-3. These issues, in combination with the high percent capture and 2 percent of MHI status achieved by Control Alternative 7, suggest that it is the appropriate recommended alternative.



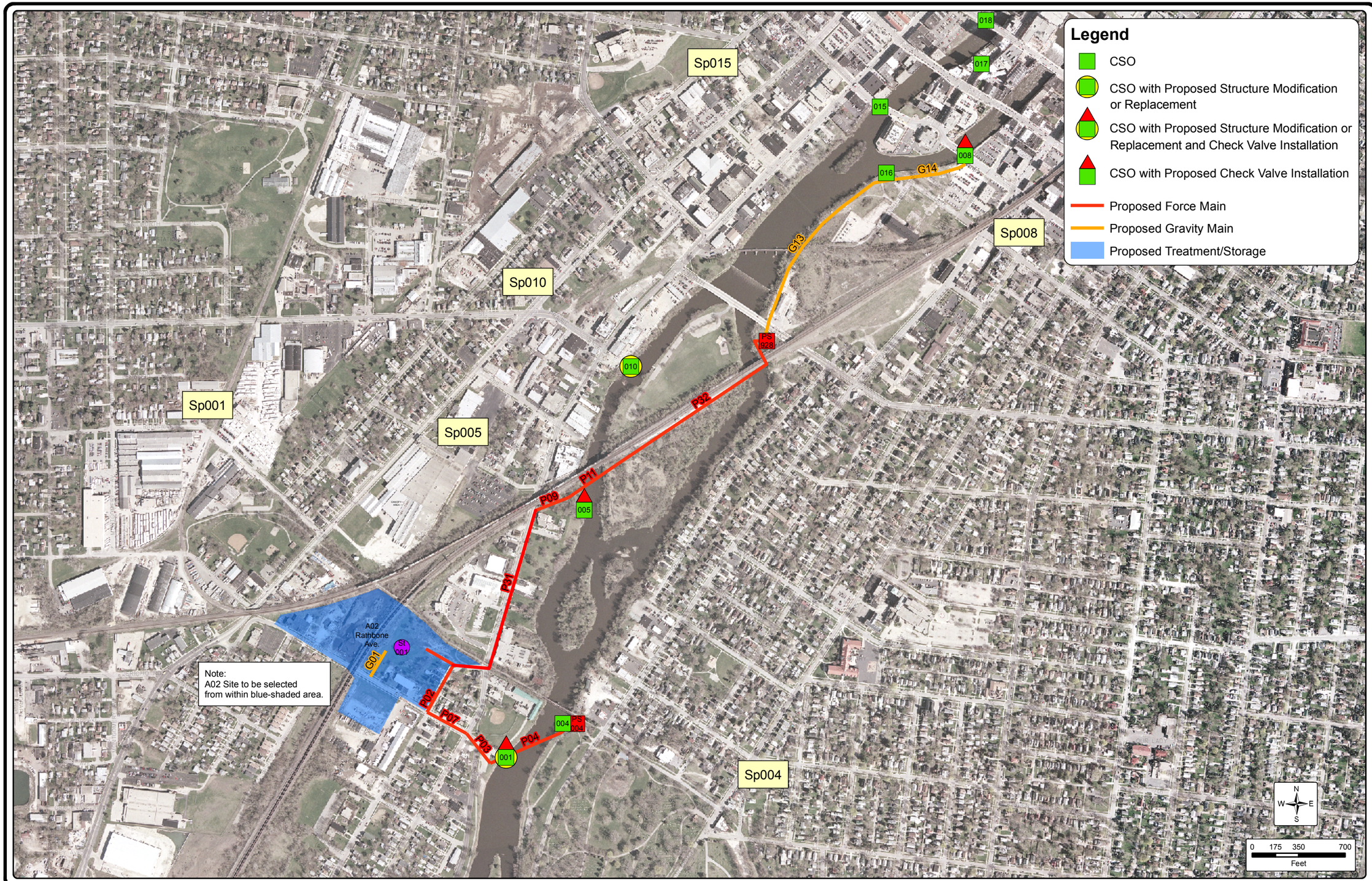
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FIGURE D.7-1
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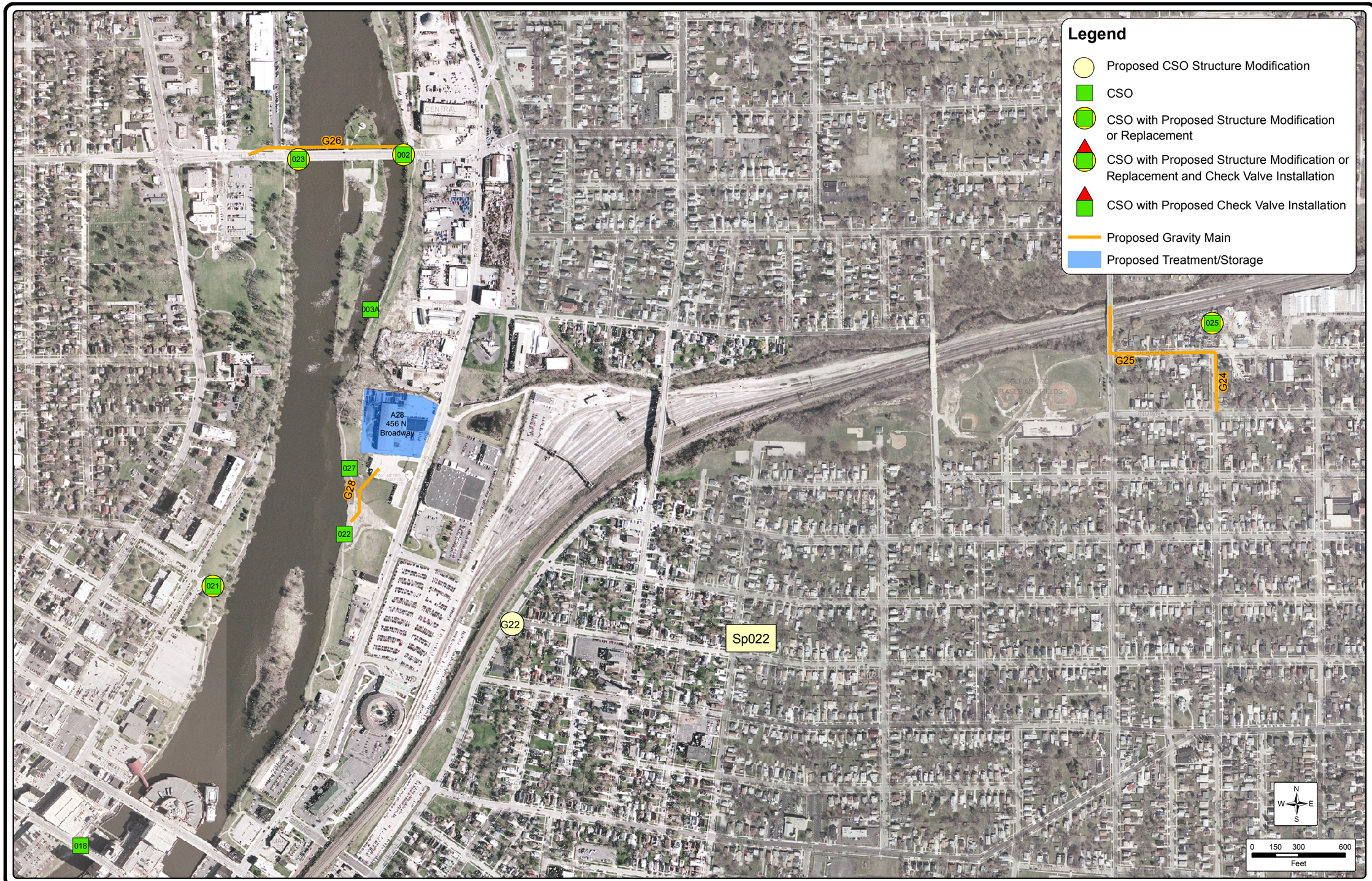
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FIGURE D.7-2
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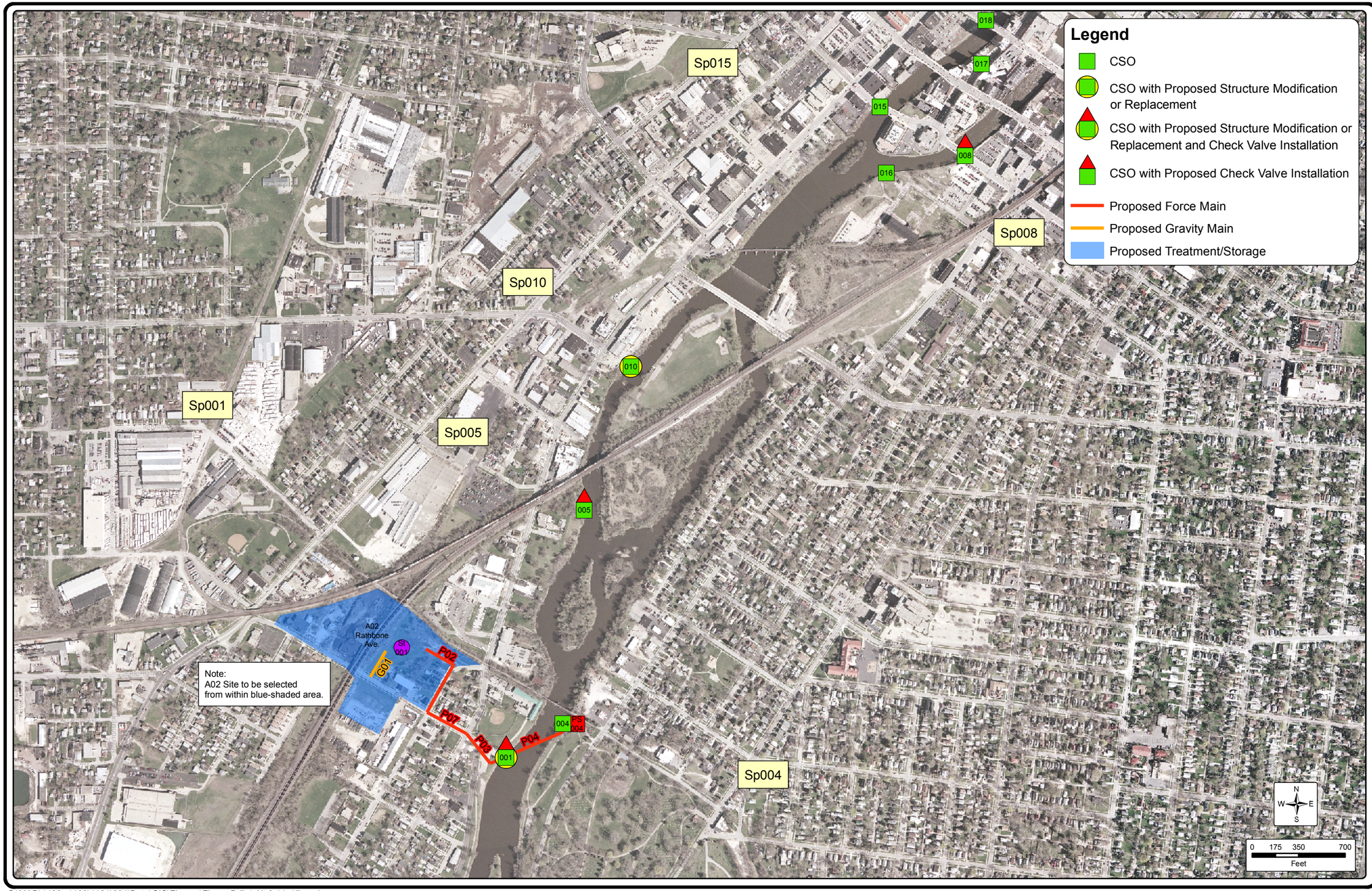
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FIGURE D.7-3
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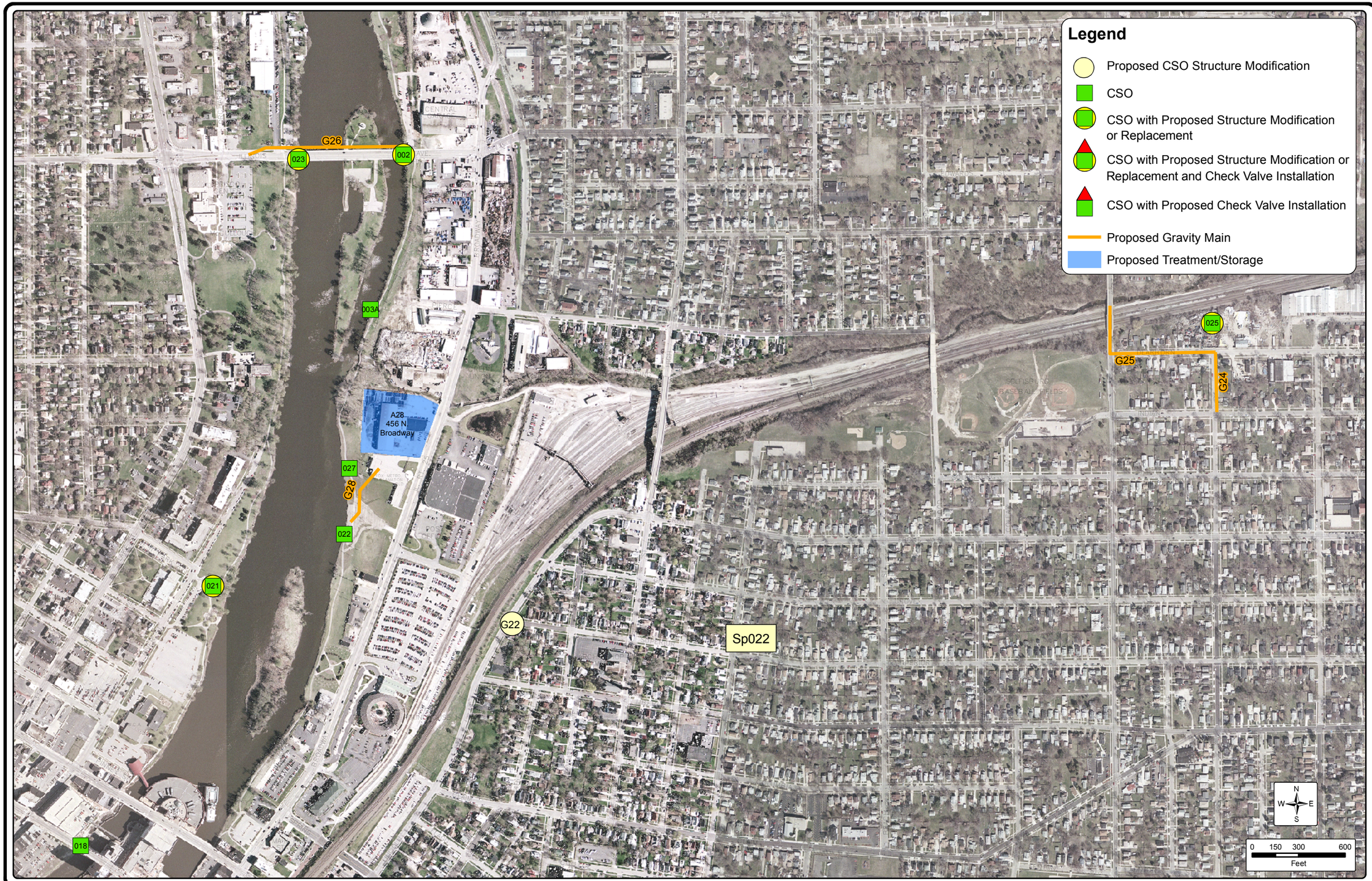
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SOUTH SIDE IMPROVEMENTS

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FIGURE D.7-4
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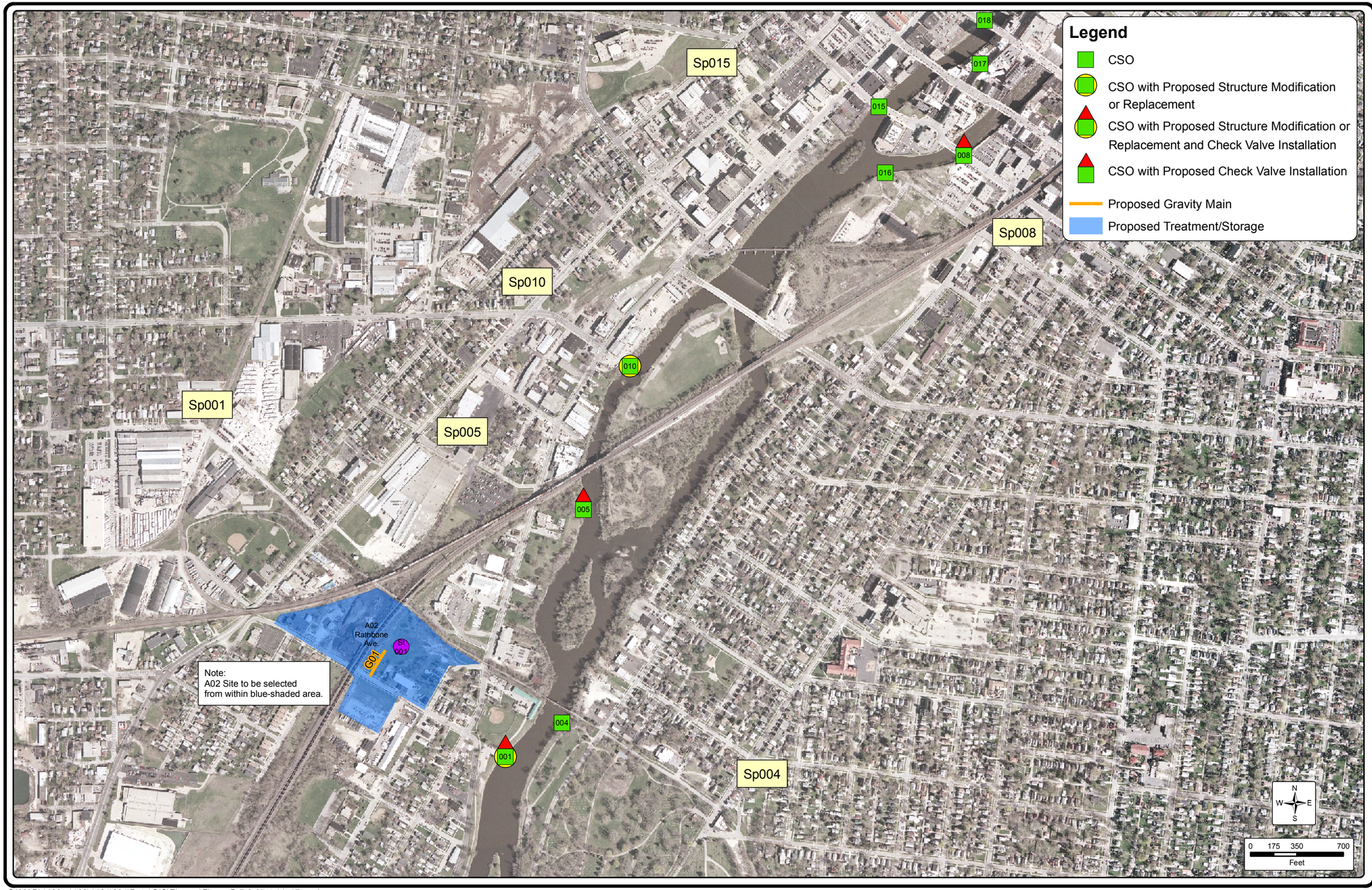
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FIGURE D.7-5
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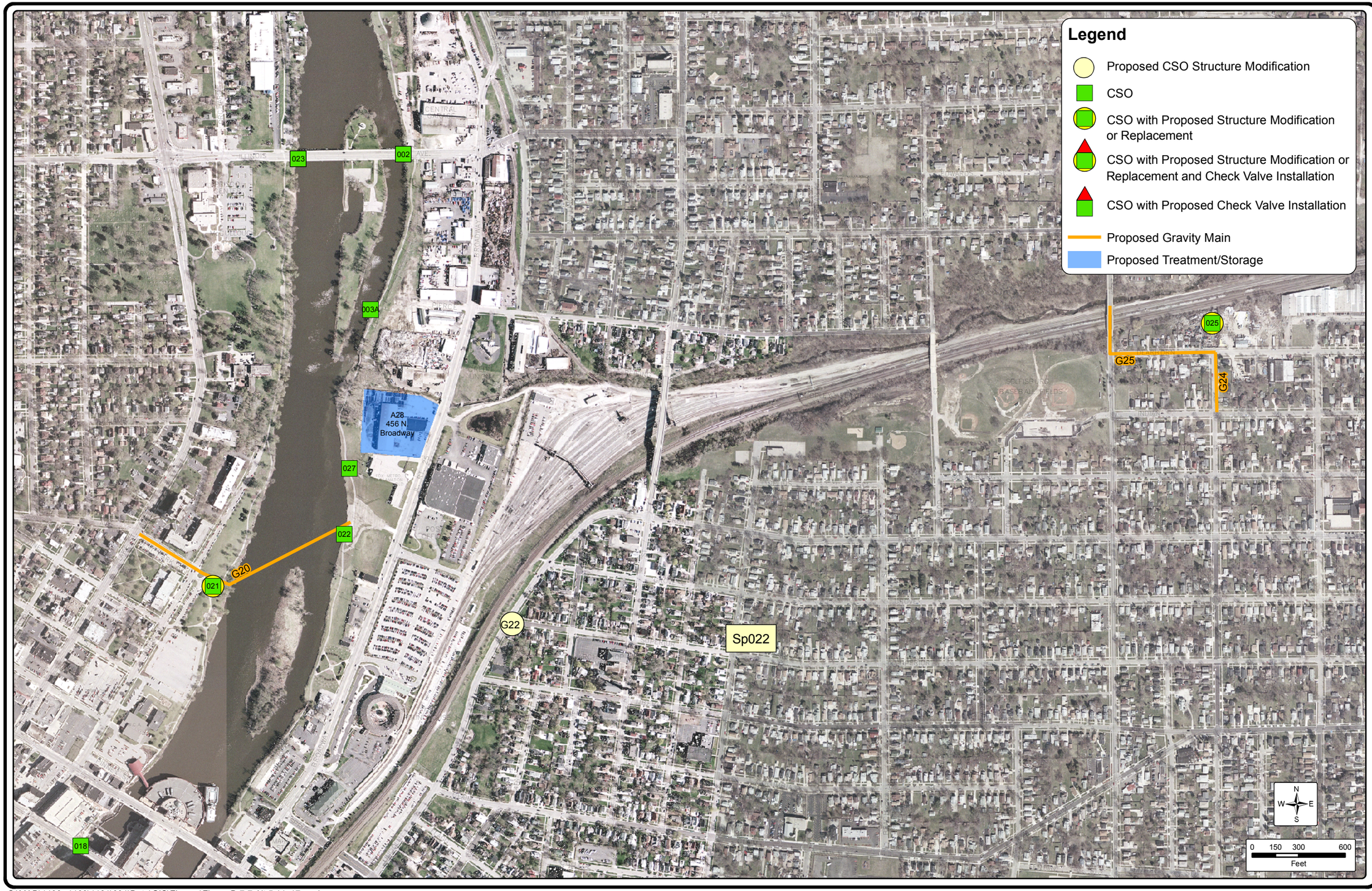
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FIGURE D.7-6
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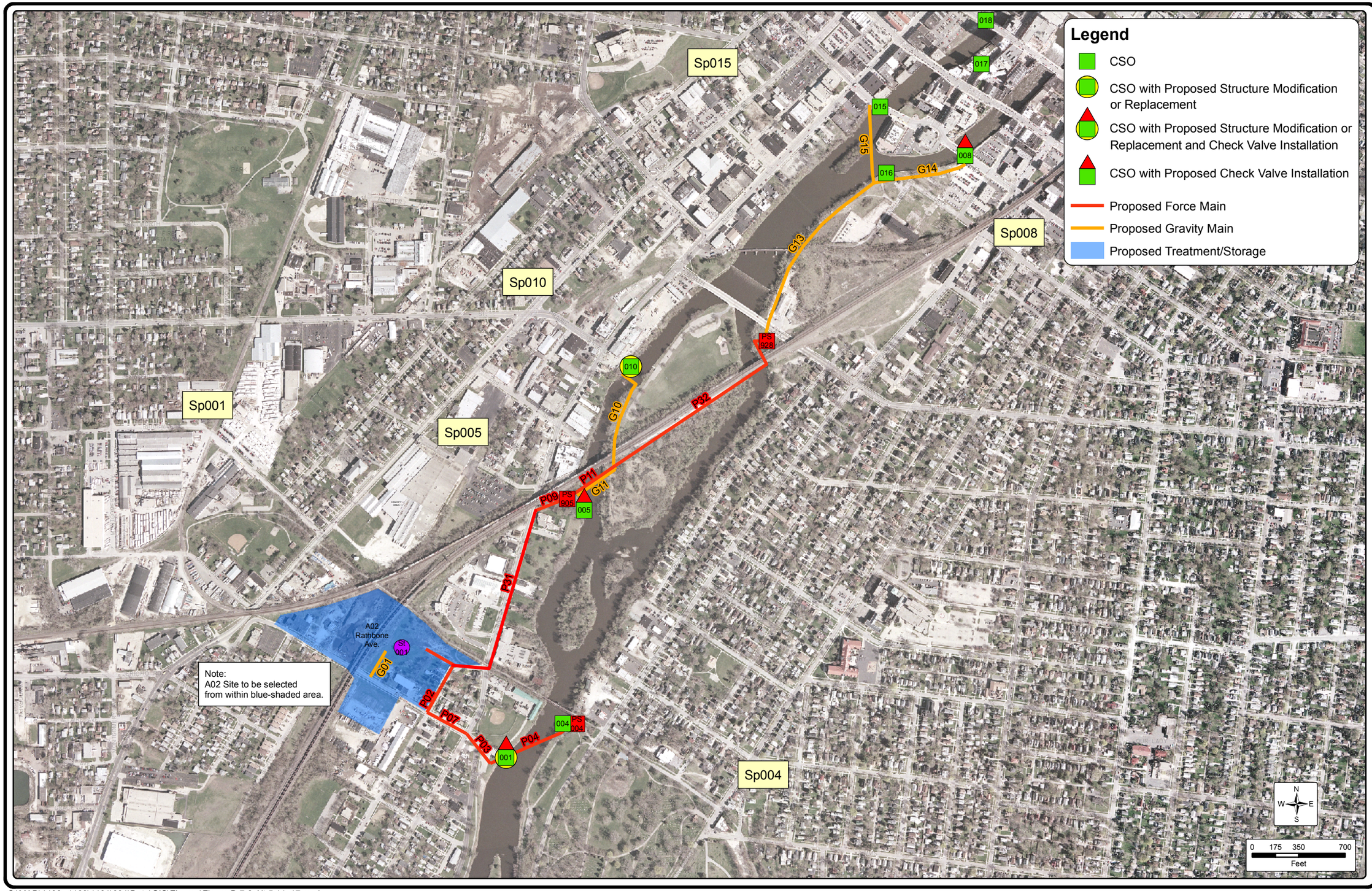
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NORTH SIDE IMPROVEMENTS

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FIGURE D.7-7
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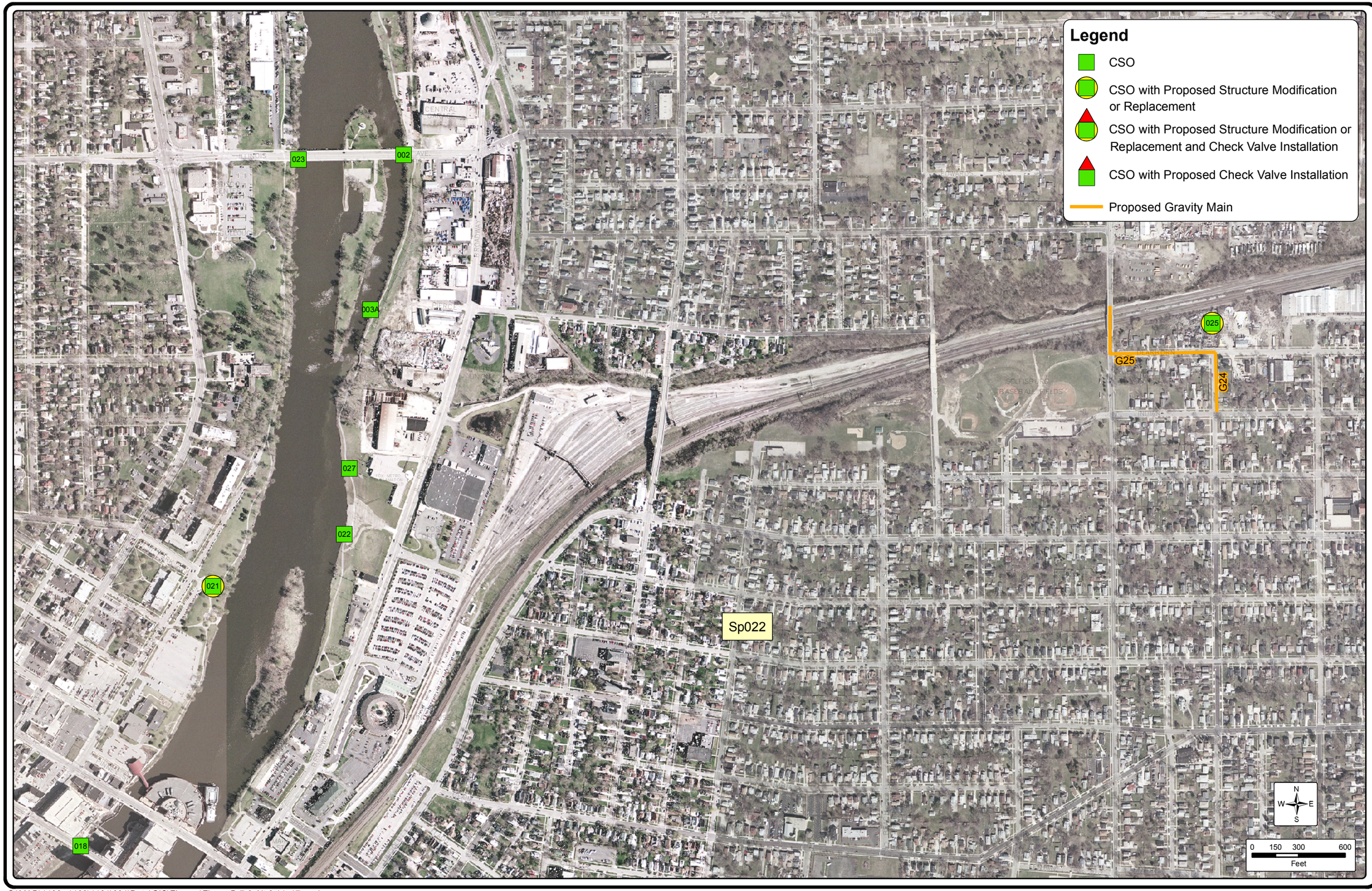
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FIGURE D.7-8
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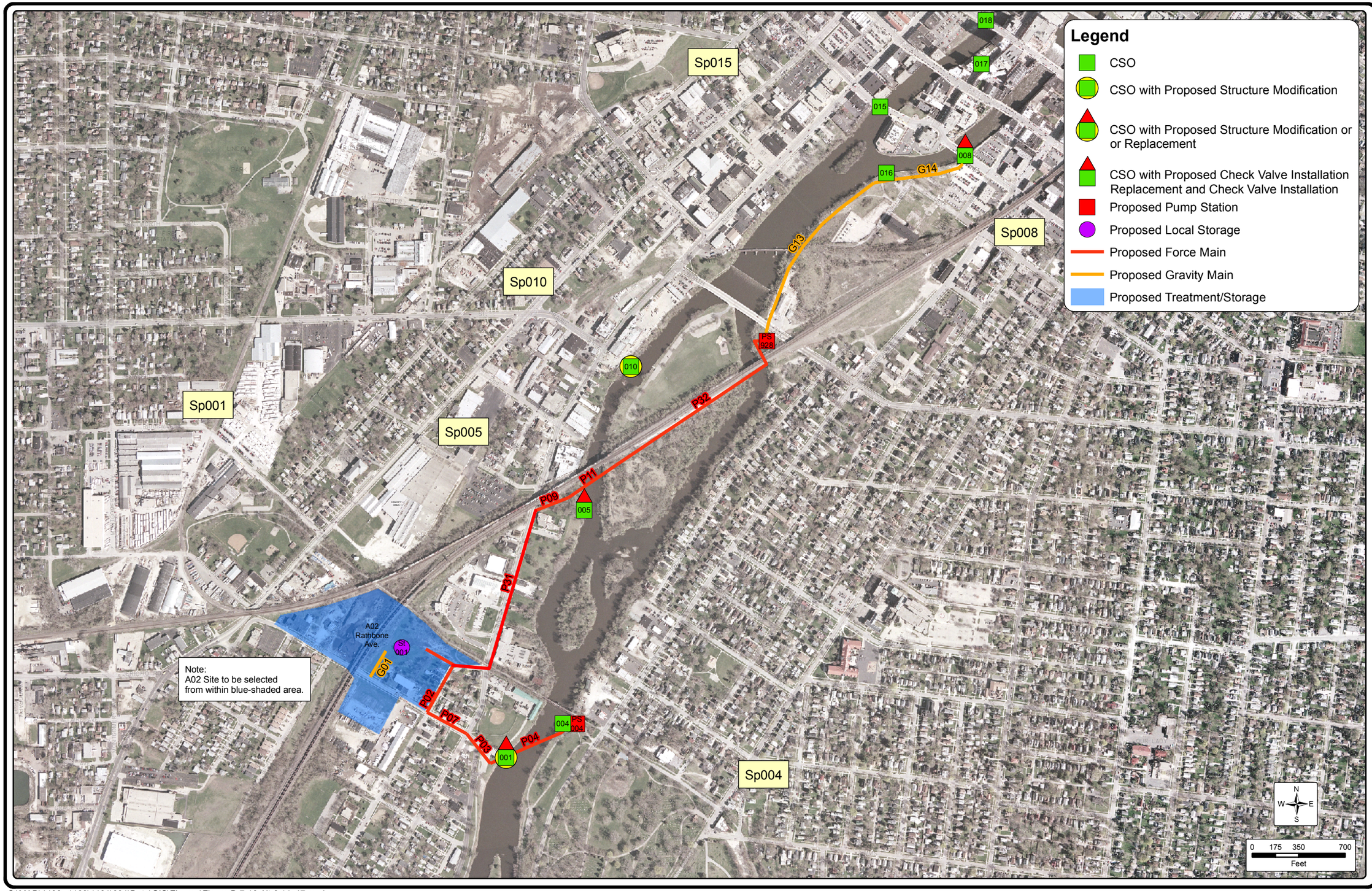
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NORTH SIDE IMPROVEMENTS

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FIGURE D.7-9
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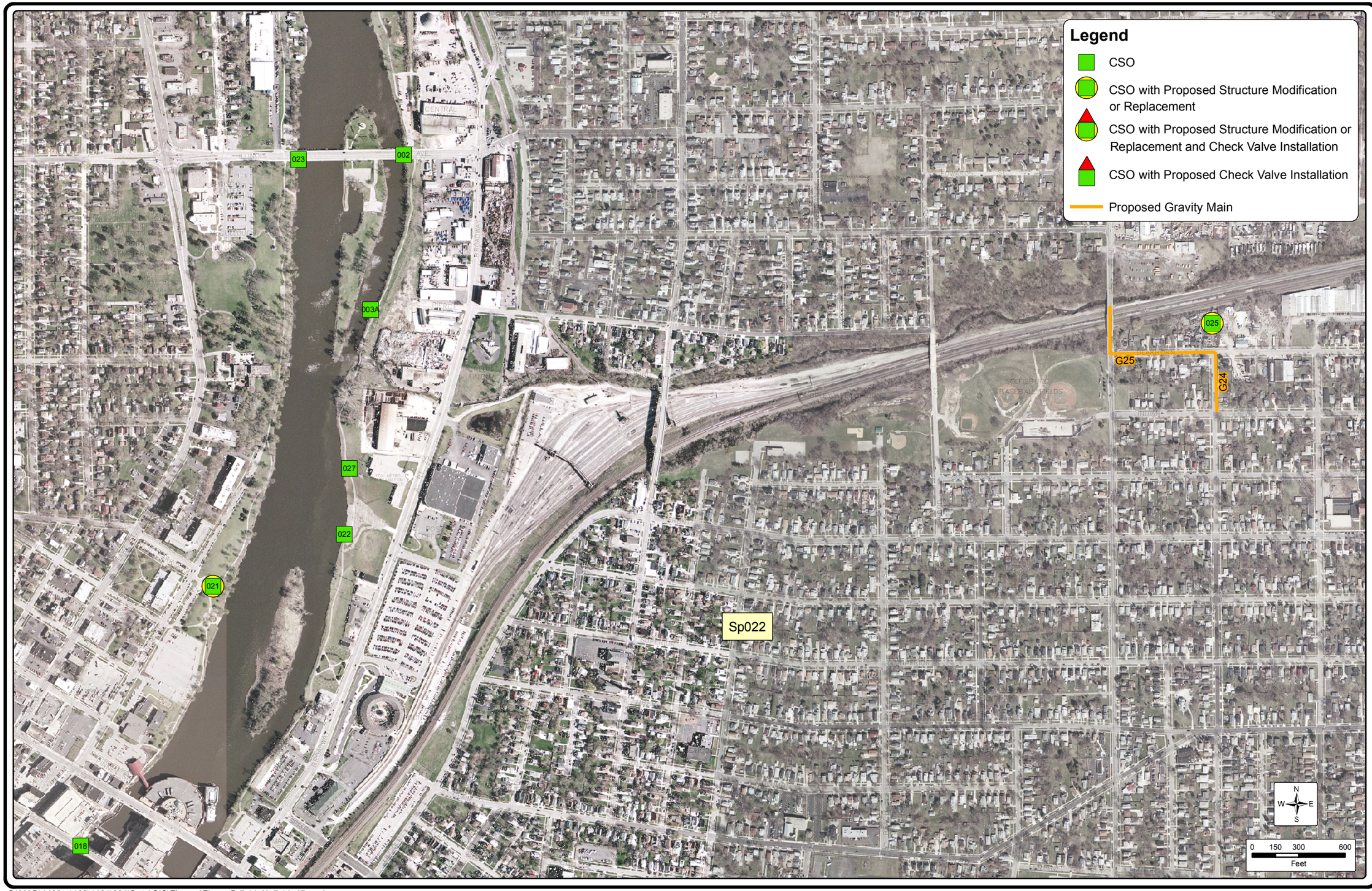
CONTROL ALTERNATIVE 6
SOUTH SIDE IMPROVEMENTS

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FIGURE D.7-10
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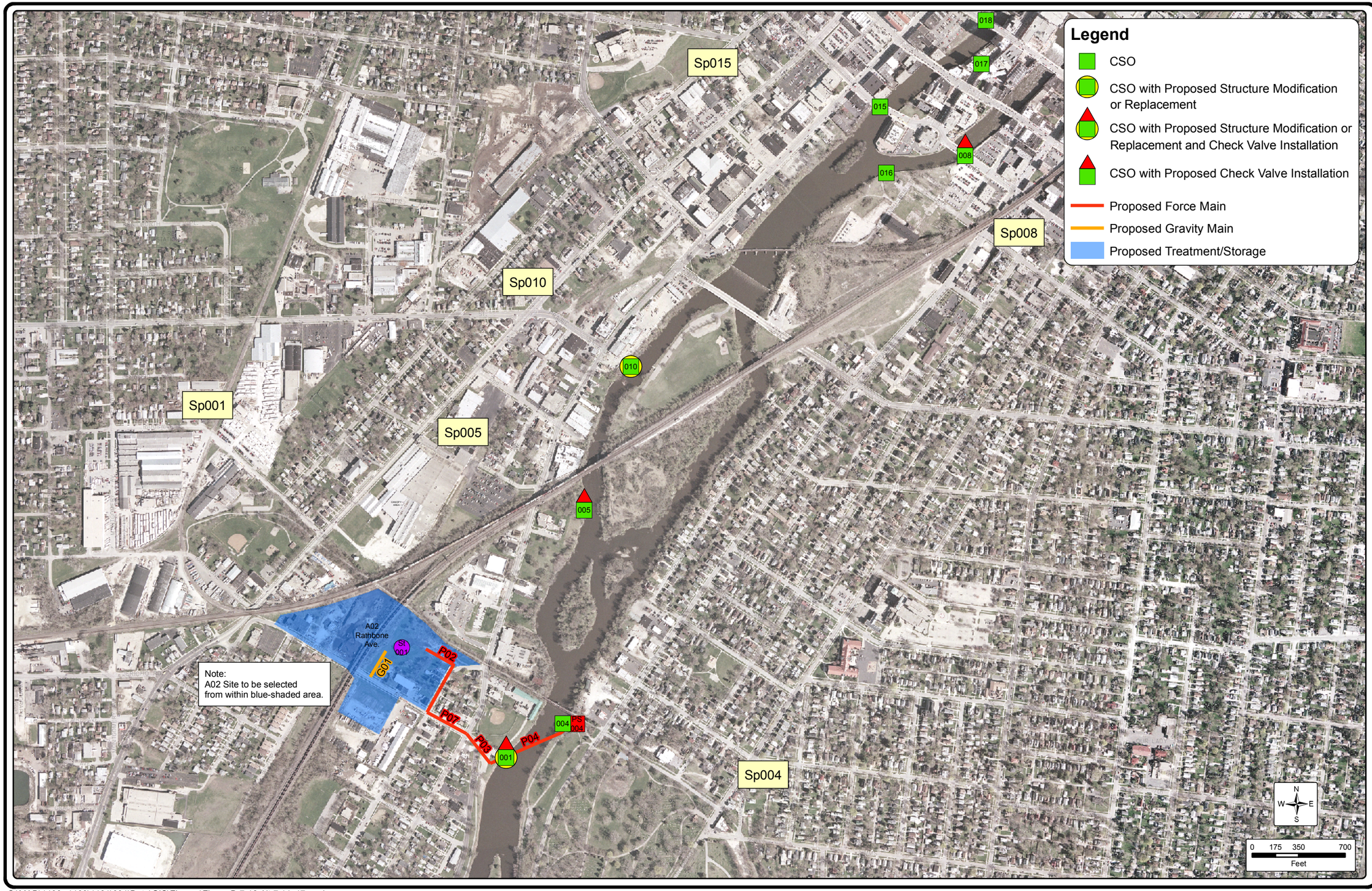
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CONTROL ALTERNATIVE 7
NORTH SIDE IMPROVEMENTS

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FIGURE D.7-11
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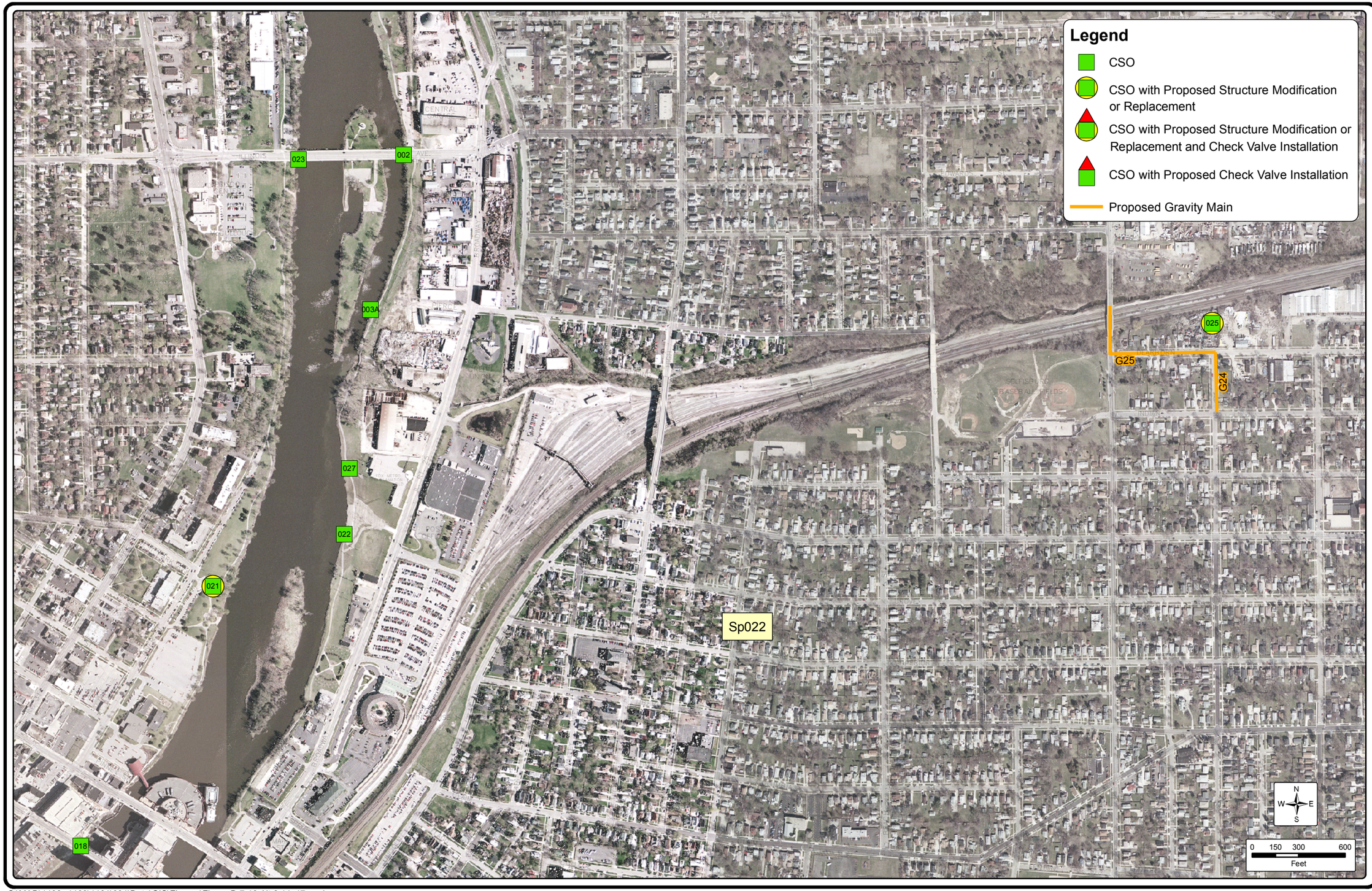
COMBINED SEWER OVERFLOW LONG TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

CONTROL ALTERNATIVE 7
SOUTH SIDE IMPROVEMENTS

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FIGURE D.7-12
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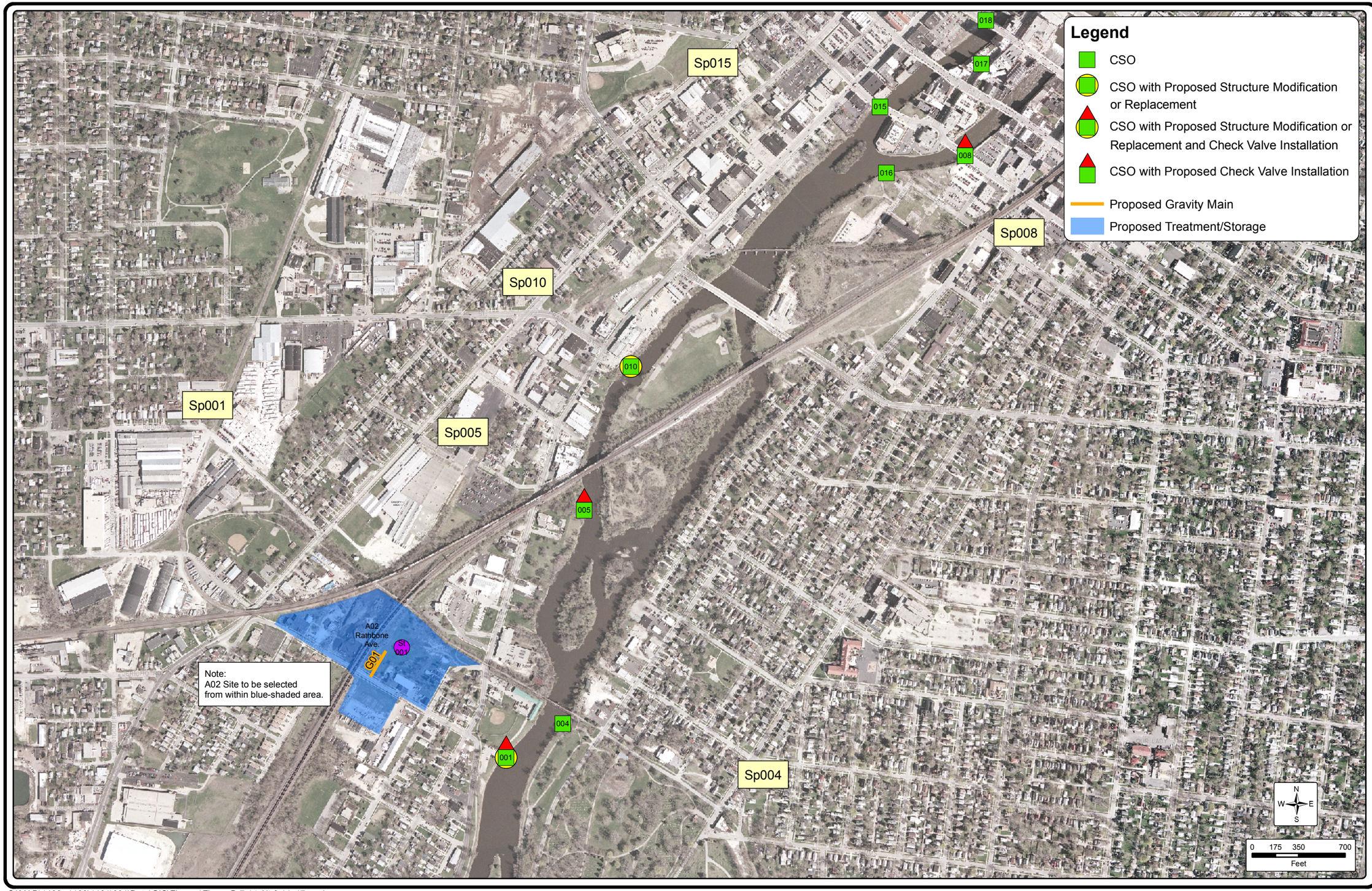
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FIGURE D.7-13
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CONTROL ALTERNATIVE 8
SOUTH SIDE IMPROVEMENTS

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FIGURE D.7-14
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TABLE D.7-9 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 1

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure										$ 250,000	$ -	$ 189,000
	Gravity Sewer	G26	2	24	1000						$ 4,322,000	$ 1,000	$ 3,300,000
CSO 002													
	Overflow Structure Modification										$ 100,000	$ -	$ 76,000
CSO 003A													
CSO 027													
	Land Purchase										$ 1,000,000	$ -	$ 600,000
	CSO Plant Expansion							47.8			$ 35,620,000	$ 1,480,000	$ 39,490,000
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave										$ 20,000	$ 1,000	$ 30,000
	Gravity Sewer	G28	1	54	700						$ 784,000	$ -	$ 590,000
CSO 021													
	Gravity Sewer	G20	1	15	800						$ 2,337,000	$ -	$ 1,780,000
CSO 015													
	Gravity Sewer	G15	2	42	750						$ 4,308,000	$ 400	$ 3,270,000
CSO 008													
	Gravity Sewer	G14	1	54	650						$ 728,000	$ 300	$ 560,000
	Gravity Sewer	G13	1	72	1700						$ 4,321,000	$ 900	$ 3,410,000
	Dry Weather/Wet Weather PS	PS928				28.7 / 75.6	25 / 55				$ 18,200,000	$ 440,000	$ 23,230,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P32	1	60	1500						$ 4,528,000	$ 800	$ 3,535,000
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon	2	27	200						$ 894,000	$ 100	$ 680,000
	Gravity Sewer	G10 - On land	1	36	1300						$ 1,305,000	$ 700	$ 1,000,000
	Gravity Sewer	G11	2	27	200						$ 894,000	$ 100	$ 680,000
CSO 005													
	Wet Weather PS	PS905				13.7	48				$ 5,360,000	$ 100,000	$ 6,480,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P09	1	66	1800						$ 4,727,000	$ 900	$ 3,590,000
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	78	200						$ 405,000	$ 100	$ 310,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							285.5			$ 14,610,000	$ 260,000	$ 16,820,000
	Storage								20.12	35	$ 34,710,000	$ 150,000	$ 33,660,000
	Transfer Pumping Station					10.1	40				$ 4,940,000	$ 80,000	$ 5,810,000
	Treatment							10.1			$ 10,000,000	$ 150,000	$ 11,370,000
	Outfall Gravity Sewer	D02	2	78	1600						$ 7,957,000	$ 800	$ 6,040,000
Subtotal											**$ 181,489,000**	**$ 2,893,700**	**$ 186,140,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 9,074,000	$ 90,700	$ 8,823,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 55,194,000**	**$ 68,500**	**$ 44,573,000**
Totals											**$ 236,683,000**	**$ 2,962,200**	**$ 230,713,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-10 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 2

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure										$ 250,000	$ -	$ 189,000
	Gravity Sewer	G26	2	24	1000						$ 4,322,000	$ 1,000	$ 3,300,000
CSO 002													
	Overflow Structure Modification										$ 100,000	$ -	$ 76,000
CSO 003A													
CSO 027													
	Land Purchase										$ 1,000,000	$ -	$ 600,000
	CSO Plant Expansion							47.8			$ 35,620,000	$ 1,480,000	$ 39,490,000
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave										$ 20,000	$ 1,000	$ 30,000
	Gravity Sewer	G28	1	54	700						$ 784,000	$ -	$ 590,000
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14	1	54	650						$ 728,000	$ 300	$ 560,000
	Gravity Sewer	G13	1	72	1700						$ 3,801,000	$ 900	$ 2,890,000
	Dry Weather/Wet Weather PS	PS928				0 / 43.9	0 / 55				$ 8,120,000	$ 200,000	$ 10,480,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P32	1	48	1500						$ 3,404,000	$ 800	$ 2,675,000
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09	1	48	1800						$ 3,313,000	$ 900	$ 2,520,000
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	78	200						$ 405,000	$ 100	$ 310,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							240			$ 13,780,000	$ 250,000	$ 15,950,000
	Storage								19.13	35	$ 33,570,000	$ 150,000	$ 32,560,000
	Transfer Pumping Station					9.6	40				$ 4,900,000	$ 80,000	$ 5,770,000
	Treatment							9.6			$ 9,720,000	$ 150,000	$ 11,080,000
	Outfall Gravity Sewer	D02	2	78	1600						$ 7,957,000	$ 800	$ 6,040,000
Subtotal											**$ 150,713,000**	**$ 2,542,400**	**$ 154,601,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 7,536,000	$ 75,400	$ 7,328,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 53,656,000**	**$ 53,200**	**$ 43,078,000**
Totals											**$ 204,369,000**	**$ 2,595,600**	**$ 197,679,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-11 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 3

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure										$ 250,000	$ -	$ 189,000
	Gravity Sewer	G26	2	24	1000						$ 4,322,000	$ 1,000	$ 3,300,000
CSO 002													
	Overflow Structure Modification										$ 100,000	$ -	$ 76,000
CSO 003A													
CSO 027													
	Land Purchase										$ 1,000,000	$ -	$ 600,000
	CSO Plant Expansion							47.8			$ 35,620,000	$ 1,480,000	$ 39,490,000
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave										$ 20,000	$ 1,000	$ 30,000
	Gravity Sewer	G28	1	54	700						$ 784,000	$ -	$ 590,000
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14											
	Gravity Sewer	G13											
	Dry Weather/Wet Weather PS	PS928											
	Land Purchase												
	Force Main	P32											
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09											
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	78	200						$ 405,000	$ 100	$ 310,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							196.1			$ 12,710,000	$ 230,000	$ 14,800,000
	Storage								17.92	35	$ 31,980,000	$ 140,000	$ 31,020,000
	Transfer Pumping Station					9	40				$ 4,850,000	$ 80,000	$ 5,720,000
	Treatment							9			$ 9,420,000	$ 150,000	$ 10,760,000
	Outfall Gravity Sewer	D02	2	78	1600						$ 7,957,000	$ 800	$ 6,040,000
Subtotal											**$ 128,087,000**	**$ 2,309,500**	**$ 132,267,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 6,404,000	$ 64,000	$ 6,227,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 52,524,000**	**$ 41,800**	**$ 41,977,000**
Totals											**$ 180,611,000**	**$ 2,351,300**	**$ 174,244,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-12 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 4

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure										$ 250,000	$ -	$ 189,000
	Gravity Sewer	G26	2	24	1000						$ 4,322,000	$ 1,000	$ 3,300,000
CSO 002													
	Overflow Structure Modification										$ 100,000	$ -	$ 76,000
CSO 003A													
CSO 027													
	Land Purchase										$ 1,000,000	$ -	$ 600,000
	CSO Plant Expansion							47.8			$ 35,620,000	$ 1,480,000	$ 39,490,000
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave										$ 20,000	$ 1,000	$ 30,000
	Gravity Sewer	G28	1	54	700						$ 784,000	$ -	$ 590,000
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14											
	Gravity Sewer	G13											
	Dry Weather/Wet Weather PS	PS928											
	Land Purchase												
	Force Main	P32											
CSO 004													
	Wet Weather PS	PS004											
	Land Purchase												
	Force Main	P04											
	Force Main	P03/07/02											
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09											
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	78	200						$ 405,000	$ 100	$ 310,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							134			$ 7,150,000	$ 130,000	$ 8,260,000
	Storage								15.60	35	$ 28,300,000	$ 130,000	$ 27,460,000
	Transfer Pumping Station					7.8	40				$ 4,760,000	$ 80,000	$ 5,630,000
	Treatment							7.8			$ 8,800,000	$ 140,000	$ 10,110,000
	Outfall Gravity Sewer	D02	2	78	1600						$ 7,957,000	$ 800	$ 6,040,000
Subtotal											**$ 103,397,000**	**$ 1,968,600**	**$ 105,472,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 5,170,000	$ 51,700	$ 5,027,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 51,290,000**	**$ 29,500**	**$ 40,777,000**
Totals											**$ 154,687,000**	**$ 1,998,100**	**$ 146,249,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-13 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 5

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure												
	Gravity Sewer	G26											
CSO 002													
	Overflow Structure Modification												
CSO 003A													
CSO 027													
	Land Purchase										$ 1,000,000	$ -	$ 600,000
	CSO Plant Expansion							10.1			$ 13,840,000	$ 1,210,000	$ 15,850,000
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave										$ 20,000	$ 1,000	$ 30,000
	Gravity Sewer	G28											
CSO 021													
	Gravity Sewer	G20	1	15	800						$ 2,337,000	$ -	$ 1,780,000
CSO 015													
	Gravity Sewer	G15	2	42	750						$ 4,308,000	$ 400	$ 3,270,000
CSO 008													
	Gravity Sewer	G14	1	60	650						$ 878,000	$ 300	$ 670,000
	Gravity Sewer	G13	1	78	1700						$ 4,847,000	$ 900	$ 3,815,000
	Dry Weather/Wet Weather PS	PS928				28.7 / 83.4	25 / 55				$ 18,750,000	$ 460,000	$ 24,000,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P32	1	66	1500						$ 4,909,000	$ 800	$ 3,830,000
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon	2	27	200						$ 894,000	$ 100	$ 680,000
	Gravity Sewer	G10 - On land	1	36	1300						$ 1,305,000	$ 700	$ 1,000,000
	Gravity Sewer	G11	2	27	200						$ 894,000	$ 100	$ 680,000
CSO 005													
	Wet Weather PS	PS905				13.7	48				$ 5,360,000	$ 100,000	$ 6,480,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P09	1	72	1800						$ 5,216,000	$ 900	$ 3,960,000
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	60	200						$ 270,000	$ 100	$ 210,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							214.7			$ 12,930,000	$ 240,000	$ 15,020,000
	Storage								15.20	35	$ 28,020,000	$ 130,000	$ 27,190,000
	Transfer Pumping Station					7.6	40				$ 4,740,000	$ 80,000	$ 5,610,000
	Treatment							7.6			$ 8,700,000	$ 140,000	$ 10,000,000
	Outfall Gravity Sewer	D02	1	72	1600						$ 3,554,000	$ 800	$ 2,700,000
Subtotal											**$ 141,941,000**	**$ 2,592,700**	**$ 147,015,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 7,097,000	$ 71,000	$ 6,901,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 53,217,000**	**$ 48,800**	**$ 42,651,000**
Totals											**$ 195,158,000**	**$ 2,641,500**	**$ 189,666,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D-7.14 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 6

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure												
	Gravity Sewer	G26											
CSO 002													
	Overflow Structure Modification												
CSO 003A													
CSO 027													
	Land Purchase												
	CSO Plant Expansion												
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave												
	Gravity Sewer	G28											
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14	1	60	650						$ 878,000	$ 300	$ 670,000
	Gravity Sewer	G13	1	78	1700						$ 4,302,000	$ 900	$ 3,270,000
	Dry Weather/Wet Weather PS	PS928				0 / 51.6	0 / 55				$ 8,760,000	$ 230,000	$ 11,500,000
	Land Purchase										$ 250,000	$ -	$ 149,000
	Force Main	P32	1	54	1500						$ 4,041,000	$ 800	$ 3,165,000
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09	1	54	1800						$ 3,935,000	$ 900	$ 2,990,000
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	60	200						$ 270,000	$ 100	$ 210,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							169.2			$ 12,140,000	$ 230,000	$ 14,180,000
	Storage								14.21	35	$ 26,190,000	$ 120,000	$ 25,420,000
	Transfer Pumping Station					7.1	40				$ 4,700,000	$ 80,000	$ 5,570,000
	Treatment							7.1			$ 8,420,000	$ 140,000	$ 9,710,000
	Outfall Gravity Sewer	D02	1	72	1600						$ 3,554,000	$ 800	$ 2,700,000
Subtotal											**$ 96,109,000**	**$ 1,030,400**	**$ 98,876,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 4,805,000	$ 48,100	$ 4,672,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 50,925,000**	**$ 25,900**	**$ 40,422,000**
Totals											**$ 147,034,000**	**$ 1,056,300**	**$ 139,298,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-15 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 7

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure												
	Gravity Sewer	G26											
CSO 002													
	Overflow Structure Modification												
CSO 003A													
CSO 027													
	Land Purchase												
	CSO Plant Expansion												
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave												
	Gravity Sewer	G28											
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14											
	Gravity Sewer	G13											
	Dry Weather/Wet Weather PS	PS928											
	Land Purchase												
	Force Main	P32											
CSO 004													
	Wet Weather PS	PS004				62.1	45				$ 8,980,000	$ 220,000	$ 11,580,000
	Land Purchase										$ 25,000	$ -	$ 15,000
	Force Main	P04	1	60	600						$ 2,883,000	$ 300	$ 2,190,000
	Force Main	P03/07/02	1	60	1200						$ 2,852,000	$ 600	$ 2,170,000
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09											
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	60	200						$ 270,000	$ 100	$ 210,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							117.6			$ 10,910,000	$ 210,000	$ 12,870,000
	Storage								13.00	35	$ 24,500,000	$ 110,000	$ 23,790,000
	Transfer Pumping Station					6.5	40				$ 4,650,000	$ 80,000	$ 5,520,000
	Treatment							6.5			$ 8,120,000	$ 130,000	$ 9,390,000
	Outfall Gravity Sewer	D02	1	72	1600						$ 3,554,000	$ 800	$ 2,700,000
Subtotal											**$ 70,673,000**	**$ 757,500**	**$ 73,822,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 3,534,000	$ 35,300	$ 3,436,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 49,654,000**	**$ 13,100**	**$ 39,186,000**
Totals											**$ 120,327,000**	**$ 770,600**	**$ 113,008,000**

*Negative O,M&R Cost relative to current expenditure

TABLE D.7-16 PROJECT DESIGN CRITERIA AND COSTS - CONTROL ALTERNATIVE 8

CSO Location	Improvement Type	Figure Designation	Gravity Sewers/Force Mains Number	Size (in)	Length	Pumping Station Capacity (mgd)	TDH (ft)	Treatment Capacity (mgd)	Storage Volume (mil gal)	SWD (ft)	Capital Cost	Yearly O,M&R Cost	Present Value
CSO 025													
	Gravity Sewer	G24	1	27	400						$ 251,000	$ 200	$ 190,000
	Gravity Sewer	G25	1	36 + 24	1050						$ 1,439,000	$ 500	$ 1,100,000
CSO 023													
	New CSO 023 Diversion Structure												
	Gravity Sewer	G26											
CSO 002													
	Overflow Structure Modification												
CSO 003A													
CSO 027													
	Land Purchase												
	CSO Plant Expansion												
CSO 022													
	Diversion Structure at Superior St and Lincoln Ave												
	Gravity Sewer	G28											
CSO 021													
	Gravity Sewer	G20											
CSO 015													
	Gravity Sewer	G15											
CSO 008													
	Gravity Sewer	G14											
	Gravity Sewer	G13											
	Dry Weather/Wet Weather PS	PS928											
	Land Purchase												
	Force Main	P32											
CSO 004													
	Wet Weather PS	PS004											
	Land Purchase												
	Force Main	P04											
	Force Main	P03/07/02											
CSO 010													
	Gravity Sewer	G10 - Siphon											
	Gravity Sewer	G10 - On land											
	Gravity Sewer	G11											
CSO 005													
	Wet Weather PS	PS905											
	Land Purchase												
	Force Main	P09											
CSO 001 / Area A02													
	Land Purchase										$ 500,000	$ -	$ 298,000
	Special Waste Removal										$ 1,389,000	$ -	$ 1,389,000
	Gravity Sewer	G01	1	60	200						$ 270,000	$ 100	$ 210,000
	Diversion Structure										$ 350,000	$ 5,000	$ 410,000
	Screening and Vortex Grit Removal							55.5			$ 5,360,000	$ 100,000	$ 6,330,000
	Storage								10.68	35	$ 21,010,000	$ 100,000	$ 20,410,000
	Transfer Pumping Station					5.4	40				$ 4,550,000	$ 70,000	$ 5,290,000
	Treatment							5.4			$ 7,500,000	$ 130,000	$ 8,740,000
	Outfall Gravity Sewer	D02	2	54	1600						$ 4,686,000	$ 800	$ 3,560,000
Subtotal											**$ 47,305,000**	**$ 406,600**	**$ 47,927,000**
Additional Recommended Programs													
Permanent Overflow Metering*											$ 1,000,000	$ (32,200)	$ 590,000
CSO Modifications and Check Valves											$ 5,000,000	$ 10,000	$ 4,520,000
Green Infrastructure Program											$ 2,365,000	$ 23,700	$ 2,300,000
Sewer Separation for Elimination of Basement Backups											$ 39,420,000		$ 29,940,000
Use Attainability Analysis											$ 200,000		$ 200,000
Stormwater Utility											$ 500,000		$ 500,000
Subtotal - Additional Recommended Programs											**$ 48,485,000**	**$ 1,500**	**$ 38,050,000**
Totals											**$ 95,790,000**	**$ 408,100**	**$ 85,977,000**

*Negative O,M&R Cost relative to current expenditure

ATTACHMENT D.4-1
MODEL-PROJECTED FLOW RATES

ATTACHMENT D.4-1 MODEL-PROJECTED FLOW RATES (cfs)
1 Hour Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	23.4	7.5	5	1	0.4	0.3	0.4
CSO002Basin	21.2	19.3	13.5	8.7	6.5	5.3	2
CSO002toTnC	23.2	16.1	10.1	5.5	3.6	2.5	0.2
CSO03ABasin	55.7	30.4	24.5	18.6	15.4	12.2	2.8
CSO03AtoTnC	58.3	26	20.2	14.2	11	7.9	0.2
CSO022SprBa	102.8	67.5	51.5	35.5	27.8	21.1	1.5
CSO022DryWe	15.5	14.9	14.5	14.1	13.7	13.1	1.5
CSO022WetWe	98.1	57.4	41.2	25.2	17.6	11.2	0
CSO022toTnC	70.8	56.2	43.8	25.2	17.6	11.2	0
CSOplantnorth	44.7	34.2	27.6	19	14	9.8	0.4
CSOplanttreated	1.2	0	0	0	0	0	0
CSO021Basin	25	13.1	8.3	4.1	2.1	1	0.7
CSO018Basin	-4.7	-2.3	-0.7	0	0	0	0
CSO015Basin	120.6	104.5	89.3	64.9	49.7	36.5	2.6
CSO008Basin	-265.4	-210.3	-155.4	-108.5	-82.7	-57.7	-18.7
CSO010Basin	41.1	37.2	33.8	23.4	17	11.3	0.6
CSO005Basin	15.4	15.4	11.4	5.9	2.2	0.3	0.2
CSO001Basin	366.8	194.7	130.8	85.8	62.5	44.7	7.6
CSO001LknPk	319.7	182.2	127.9	85.9	64.6	44.6	7.6
CSO004Basin	288	195	150.7	118.8	100.5	78.1	5
ToWWTP	143.5	108	95.7	90	87	80.7	38.6
CSO023Outfl	20.4	4.5	0.4	0	0	0	0
CSO002Outfl	16	0.7	0	0	0	0	0
CSO025Outfl	41.7	21.3	12	4.6	1.4	0	0
CSO03AOutfl	24	1.2	0	0	0	0	0
CSO022Outfl	80.4	33.7	0	0	0	0	0
CSO027Outfl	17	17	17	1.6	0	0	0
CSO021Outfl	21	9.6	5.5	1.7	0.2	0	0
CSO018Outfl	3	0	0	0	0	0	0
CSO015Outfl	106.4	89.9	74.3	50.7	35.9	22.6	0
CSO008Outfl	243.3	173.2	121.8	76.2	51.5	27.6	0
CSO010Outfl	35.9	32.2	29	19.3	13.2	7.9	0
CSO005Outfl	12.5	9.9	6.1	1.9	0	0	0
CSO001Outfl	364.3	146.3	81.5	32.6	7.8	0	0
CSO004Outfl	267.9	175.5	128.9	96.1	78.1	56.4	0

ATTACHMENT D.4-1 MODEL-PROJECTED FLOW RATES (cfs)
6 Hour Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	14.5	4.4	0.8	0.4	0.3	0.2	0.4
CSO002Basin	12.4	5.6	3	2.2	2	1.5	2
CSO002toTnC	11.4	2.8	0.6	0	0	0	0.2
CSO03ABasin	37.7	16.4	12.9	10.2	8.2	4.2	2.8
CSO03AtoTnC	33.1	12.1	8.5	5.8	3.9	0.2	0.2
CSO022SprBa	57.8	23.4	16.2	12.6	10.6	6.6	1.5
CSO022DryWe	9.8	9.2	9.3	9.3	9	6.6	1.5
CSO022WetWe	47.9	14.2	7.3	3.8	1.9	0	0
CSO022toTnC	36.8	14.2	7.3	3.8	1.9	0	0
CSOplantnorth	38.2	14.6	8.9	5.8	3.9	0.2	0.4
CSOplanttreated	33.2	0	0	0	0	0	0
CSO021Basin	12.3	4.1	1.7	0.7	0.6	0.3	0.7
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	68.9	34.8	22.3	14	11.5	7.3	2.6
CSO008Basin	-163.3	-99.4	-70.9	-51.2	-44.3	-28.5	-18.7
CSO010Basin	34.1	25.6	19.5	14.2	11	4.2	0.6
CSO005Basin	7.9	3.2	1.3	-0.4	-0.3	0.1	0.2
CSO001Basin	233.5	85.9	51.3	34.8	29.6	18	7.6
CSO001LknPk	203.4	79.5	49.2	32.9	27.4	17.2	7.6
CSO004Basin	228.2	124.3	83.1	54.9	42.2	25	5
ToWWTP	121.1	101.6	94.3	89.1	85.7	72.1	38.6
CSO023Outfl	11.6	0	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	30.8	15.7	10	5	2.3	0	0
CSO03AOutfl	3.7	0	0	0	0	0	0
CSO022Outfl	34.8	0	0	0	0	0	0
CSO027Outfl	17	0	0	0	0	0	0
CSO021Outfl	9.1	1.8	0.1	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	57.7	24.7	12.5	4.3	1.8	0	0
CSO008Outfl	144.5	79	49.5	26.5	19.7	2.3	0
CSO010Outfl	29.3	21.4	15.7	10.6	7.6	1.5	0
CSO005Outfl	6.1	1.3	0	0	0	0	0
CSO001Outfl	233.5	71.2	26.6	7.5	0	0	0
CSO004Outfl	208.6	106.3	65.8	37.3	24.3	6.9	0

ATTACHMENT D.4-1 MODEL-PROJECTED FLOW RATES (cfs)
1 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	0.5	0.4	0.4	0.3	0.3	0.3	0.4
CSO002Basin	2.2	1.8	1.5	1.5	1.3	1.2	2
CSO002toTnC	0	0	0	0	0	0	0.2
CSO03ABasin	16.6	11.2	10.2	7.8	7.3	5.6	2.8
CSO03AtoTnC	12.1	6.9	5.9	3.7	3.1	1.6	0.2
CSO022SprBa	11.9	7.9	7.7	5.1	5.4	4.6	1.5
CSO022DryWe	9.3	7.8	7.7	5.1	5.4	4.6	1.5
CSO022WetWe	3.2	0	0	0	0	0	0
CSO022toTnC	3.2	0	0	0	0	0	0
CSOplantnorth	12.1	6.9	5.9	3.7	3.1	1.6	0.4
CSOplanttreated	8.5	0	0	0	0	0	0
CSO021Basin	0.9	0.7	0.7	0.5	0.5	0.5	0.7
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	12.1	8.3	7.9	5.7	5.7	4.9	2.6
CSO008Basin	-59.3	-36.7	-35.2	-25.4	-26.2	-25	-18.7
CSO010Basin	14.1	8.7	8.1	4.8	4.8	3.7	0.6
CSO005Basin	0.2	0.1	0.1	0.1	0.1	0.1	0.2
CSO001Basin	48.2	30.1	27.2	18.9	18.4	15.3	7.6
CSO001LknPk	46.2	29.1	26.4	18.4	17.7	14.8	7.6
CSO004Basin	48.7	30.8	30.2	19.9	20.9	17.6	5
ToWWTP	102.6	94.9	93	81.7	79.4	71.2	38.6
CSO023Outfl	0	0	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	11.1	4.7	3.9	0.4	0.2	0	0
CSO03AOutfl	0	0	0	0	0	0	0
CSO022Outfl	0	0	0	0	0	0	0
CSO027Outfl	0	0	0	0	0	0	0
CSO021Outfl	0	0	0	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	3.4	0	0	0	0	0	0
CSO008Outfl	36.8	14.8	12.8	0	0.4	0	0
CSO010Outfl	10.6	5.4	4.8	2	2	1.1	0
CSO005Outfl	0	0	0	0	0	0	0
CSO001Outfl	31.6	5.7	1.3	0	0	0	0
CSO004Outfl	32.8	15.5	14.7	3.1	3.9	0.2	0

ATTACHMENT D.4-1 MODEL-PROJECTED FLOW RATES (cfs)
3 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	0.4	0.3	0.3	0.3	0.3	0.2	0.4
CSO002Basin	1.7	1.4	1.3	1.3	1.2	1.2	2
CSO002toTnC	0	0	0	0	0	0	0.2
CSO03ABasin	12.6	9	7.2	5.6	4.7	3.8	2.8
CSO03AtoTnC	8	4.6	3	1.4	0.6	0	0.2
CSO022SprBa	7.2	4.9	4	3.3	2.8	2.4	1.5
CSO022DryWe	7.2	4.9	4	3.3	2.8	2.4	1.5
CSO022WetWe	0	0	0	0	0	0	0
CSO022toTnC	0	0	0	0	0	0	0
CSOplantnorth	8	4.6	3	1.4	0.6	0	0.4
CSOplanttreated	5.4	0	0	0	0	0	0
CSO021Basin	0.7	0.5	0.5	0.5	0.4	0.4	0.7
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	7.2	5.1	4.3	3.6	3.2	2.8	2.6
CSO008Basin	-32.7	-25.2	-25.1	-24.7	-23.5	-20	-18.7
CSO010Basin	7.2	4.2	3	1.9	1.3	0.7	0.6
CSO005Basin	0.2	0.1	0.1	0.1	0.1	0.1	0.2
CSO001Basin	34	22.5	16.8	13.3	11.3	9.4	7.6
CSO001LknPk	31.8	20.7	16.4	13	11.1	9.2	7.6
CSO004Basin	28.1	19	15.5	12.4	10.7	8.9	5
ToWWTP	99.9	87.9	76.1	64.4	53.6	47.7	38.6
CSO023Outfl	0	0	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	4.8	0.9	0	0	0	0	0
CSO03AOutfl	0	0	0	0	0	0	0
CSO022Outfl	0	0	0	0	0	0	0
CSO027Outfl	0	0	0	0	0	0	0
CSO021Outfl	0	0	0	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	0	0	0	0	0	0	0
CSO008Outfl	10.6	0	0	0	0	0	0
CSO010Outfl	4.1	1.5	0.7	0.2	0	0	0
CSO005Outfl	0	0	0	0	0	0	0
CSO001Outfl	14.5	0	0	0	0	0	0
CSO004Outfl	13.1	3.1	0	0	0	0	0

ATTACHMENT D.4-1 MODEL-PROJECTED FLOW RATES (cfs)
10 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	0.3	0.2		0.2	0.2	0.2	0.4
CSO002Basin	1.3	1.2		1.1	1.1	1.1	2
CSO002toTnC	0	0		0	0	0	0.2
CSO03ABasin	8.1	5.6		3.5	2.9	2.4	2.8
CSO03AtoTnC	3.9	1.6		0	0	0	0.2
CSO022SprBa	3.3	2.4		1.6	1.5	1.3	1.5
CSO022DryWe	3.3	2.4		1.7	1.5	1.3	1.5
CSO022WetWe	0	0		0	0	0	0
CSO022toTnC	0	0		0	0	0	0
CSOplantnorth	3.9	1.6		0	0	0	0.4
CSOplanttreated	1.6	0		0	0	0	0
CSO021Basin	0.5	0.4		0.4	0.4	0.4	0.7
CSO018Basin	0	0		0	0	0	0
CSO015Basin	3.6	2.8		2.2	2	1.8	2.6
CSO008Basin	-25	-21.9		-16.3	-11.6	-11.5	-18.7
CSO010Basin	2	0.9		0.5	0.5	0.4	0.6
CSO005Basin	0.1	0.1		0.1	0.1	0.1	0.2
CSO001Basin	17.8	12.6		8.3	7.1	6	7.6
CSO001LknPk	17.4	12.4		8.2	7	5.9	7.6
CSO004Basin	12.9	9.4		6.3	5.5	4.6	5
ToWWTP	76.5	58.9		38.9	33.4	28.1	38.6
CSO023Outfl	0	0		0	0	0	0
CSO002Outfl	0	0		0	0	0	0
CSO025Outfl	0	0		0	0	0	0
CSO03AOutfl	0	0		0	0	0	0
CSO022Outfl	0	0		0	0	0	0
CSO027Outfl	0	0		0	0	0	0
CSO021Outfl	0	0		0	0	0	0
CSO018Outfl	0	0		0	0	0	0
CSO015Outfl	0	0		0	0	0	0
CSO008Outfl	0	0		0	0	0	0
CSO010Outfl	0.2	0		0	0	0	0
CSO005Outfl	0	0		0	0	0	0
CSO001Outfl	0	0		0	0	0	0
CSO004Outfl	0	0		0	0	0	0

ATTACHMENT D.4-2
MODEL-PROJECTED FLOW VOLUMES

ATTACHMENT D.4-2 MODEL-PROJECTED FLOW VOLUMES (cf)
1 Hour Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	97945	34786	21539	15637	14473	13971	33166
CSO002Basin	130155	97250	86592	78725	75970	74371	171884
CSO002toTnC	65579	25481	13392	5239	3088	1987	20277
CSO03ABasin	547128	321970	266881	221962	198545	171623	239930
CSO03AtoTnC	312372	105701	65268	38312	27175	14377	13055
CSO022SprBa	437634	219530	165054	129951	115725	103028	129268
CSO022DryWe	132536	117161	109004	102305	98146	93412	131319
CSO022WetWe	306648	103385	56944	28462	18302	10245	0
CSO022toTnC	108974	84067	56867	28404	18252	10207	0
CSOplantnorth	314674	131813	79013	43770	30463	16519	32558
CSOplanttreated	14306	0	0	0	0	0	0
CSO021Basin	95836	53387	40362	30944	27477	25511	58150
CSO018Basin	-1243	-8	1	0	0	0	0
CSO015Basin	514984	328068	263039	207189	179290	154590	223514
CSO008Basin	-1747084	-1228016	-1045737	-888245	-816179	-747411	-1192884
CSO010Basin	256571	151653	116540	86334	70112	54375	48772
CSO005Basin	31664	22407	16320	10836	8552	7704	18716
CSO001Basin	2224114	1109685	840256	658233	575480	502786	650866
CSO001LknPk	2047297	1059185	814549	640364	559941	489322	652683
CSO004Basin	2217942	1176606	861444	625729	521821	433249	425807
ToWWTP	3757561	2923757	2651570	2411546	2278519	2118849	3059824
CSO023Outfl	64930	8478	165	0	0	0	0
CSO002Outfl	23320	42	0	0	0	0	0
CSO025Outfl	159810	61932	33401	11368	2126	0	0
CSO03AOutfl	41047	64	0	0	0	0	0
CSO022Outfl	197657	19191	0	0	0	0	0
CSO027Outfl	99341	44475	19374	373	0	0	0
CSO021Outfl	56753	19052	8587	1854	181	0	0
CSO018Outfl	1272	0	0	0	0	0	0
CSO015Outfl	357647	182429	122062	70424	45060	23877	0
CSO008Outfl	872991	449282	292526	161362	103664	57081	0
CSO010Outfl	192507	98739	67663	41528	27889	15413	0
CSO005Outfl	24853	9080	3492	327	0	0	0
CSO001Outfl	1453310	410731	182613	52140	7579	0	0
CSO004Outfl	1745468	813960	527670	309810	214184	132279	0

ATTACHMENT D.4-2 MODEL-PROJECTED FLOW VOLUMES (cf)
6 Hour Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	109886	27842	18067	16324	15673	14300	33166
CSO002Basin	138627	97878	86771	81919	79813	75364	171884
CSO002toTnC	53004	9760	1227	0	0	0	20277
CSO03ABasin	880632	526778	433188	354891	308336	202842	239930
CSO03AtoTnC	515233	194966	120736	66264	38909	341	13055
CSO022SprBa	583075	278428	216508	178876	157946	114042	129268
CSO022DryWe	248197	204422	186294	167660	154260	115001	131319
CSO022WetWe	335837	74825	31134	12143	4562	0	0
CSO022toTnC	213368	74808	31128	12137	4570	0	0
CSOplantnorth	563704	205126	122251	66453	39032	348	32558
CSOplanttreated	316419	0	0	0	0	0	0
CSO021Basin	97461	45051	33095	28899	27869	25753	58150
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	597543	342534	262336	213036	193140	153420	223514
CSO008Basin	-2359329	-1599750	-1340139	-1149757	-1060927	-827142	-1192884
CSO010Basin	386089	230809	177315	132053	106266	54135	48772
CSO005Basin	40905	16397	9979	7963	7890	7740	18716
CSO001Basin	3005520	1436389	1101270	885787	777619	560516	650866
CSO001LknPk	2799638	1391115	1074075	863854	758533	547450	652683
CSO004Basin	2701425	1321690	944066	714360	615468	436692	425807
ToWWTP	6044427	4738000	4222503	3724288	3413599	2619004	3059824
CSO023Outfl	61972	1	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	294566	120248	66203	27245	9637	0	0
CSO03AOutfl	5286	0	0	0	0	0	0
CSO022Outfl	122442	0	0	0	0	0	0
CSO027Outfl	145552	0	0	0	0	0	0
CSO021Outfl	43454	5144	104	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	331669	111316	46598	13027	4327	0	0
CSO008Outfl	1212077	515513	292071	147579	90431	3366	0
CSO010Outfl	284117	145765	99481	61643	41259	6157	0
CSO005Outfl	30923	2459	0	0	0	0	0
CSO001Outfl	1897267	365909	102490	15894	0	0	0
CSO004Outfl	2050401	752490	410196	215373	138283	23669	0

ATTACHMENT D.4-2 MODEL-PROJECTED FLOW VOLUMES (cf)
1 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	38677	34002	32124	30744	29815	29000	33166
CSO002Basin	179435	164351	158678	153834	151106	148427	171884
CSO002toTnC	0	0	0	0	0	0	20277
CSO03ABasin	1221452	866556	541293	596121	408787	354474	239930
CSO03AtoTnC	547603	274868	165486	100024	64747	25827	13055
CSO022SprBa	529760	377196	309256	271094	236161	210515	129268
CSO022DryWe	497200	378954	310981	272897	237937	212292	131319
CSO022WetWe	34402	0	0	0	0	0	0
CSO022toTnC	34400	0	0	0	0	0	0
CSOplantnorth	547770	275000	165467	100112	64813	25868	32558
CSOplanttreated	257296	0	0	0	0	0	0
CSO021Basin	70431	61041	56123	54971	52650	51440	58150
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	569179	432098	378349	336996	311036	287268	223514
CSO008Basin	-3110898	-2384551	-1911286	-1896335	-1618696	-1513127	-1192884
CSO010Basin	439741	262261	195618	147562	123742	99586	48772
CSO005Basin	16444	15937	15749	15586	15496	15408	18716
CSO001Basin	2931453	2035566	1416773	1428425	1084563	972626	650866
CSO001LknPk	2869387	1993913	1381990	1401083	1060090	951832	652683
CSO004Basin	2058300	1440827	1177169	1018500	883960	781009	425807
ToWWTP	10873885	8729448	5994191	6611340	4925847	4486435	3059824
CSO023Outfl	0	0	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	290157	86216	46325	2425	436	0	0
CSO03AOutfl	0	0	0	0	0	0	0
CSO022Outfl	0	0	0	0	0	0	0
CSO027Outfl	0	0	0	0	0	0	0
CSO021Outfl	0	0	0	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	35905	0	0	0	0	0	0
CSO008Outfl	686451	185266	102676	0	384	0	0
CSO010Outfl	236038	100510	62520	27794	19971	9267	0
CSO005Outfl	0	0	0	0	0	0	0
CSO001Outfl	719672	55565	2637	0	0	0	0
CSO004Outfl	712132	262511	162376	26174	20740	112	0

ATTACHMENT D.4-2 MODEL-PROJECTED FLOW VOLUMES (cf)
3 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	66480	61076	58969	57151	56084	55019	33166
CSO002Basin	320704	303092	296212	290268	286772	283276	171884
CSO002toTnC	0	0	0	0	0	0	20277
CSO03ABasin	1331860	973926	818056	688196	615654	546422	239930
CSO03AtoTnC	405021	196102	110697	44389	12578	0	13055
CSO022SprBa	670588	496463	428806	370598	336527	302643	129268
CSO022DryWe	674095	500015	432367	374162	340096	306216	131319
CSO022WetWe	0	0	0	0	0	0	0
CSO022toTnC	0	0	0	0	0	0	0
CSOplantnorth	404841	196027	110660	44411	12580	0	32558
CSOplanttreated	81185	0	0	0	0	0	0
CSO021Basin	117043	107790	104327	101413	99738	98095	58150
CSO018Basin	0	0	0	0	0	0	0
CSO015Basin	790390	632406	570868	517783	486646	455543	223514
CSO008Basin	-4173495	-3427650	-3126773	-2842051	-2682222	-2474107	-1192884
CSO010Basin	387485	230088	179292	140224	121190	104838	48772
CSO005Basin	31617	31024	30796	30598	30482	30365	18716
CSO001Basin	3360145	2442097	2096691	1806563	1640955	1480441	650866
CSO001LknPk	3289384	2395686	2059788	1777922	1617209	1461647	652683
CSO004Basin	2532299	1836759	1566434	1333381	1196866	1061078	425807
ToWWTP	14023931	11070007	9676482	8432657	7714229	6950581	3059824
CSO023Outfl	0	0	0	0	0	0	0
CSO002Outfl	0	0	0	0	0	0	0
CSO025Outfl	140278	13668	0	0	0	0	0
CSO03AOutfl	0	0	0	0	0	0	0
CSO022Outfl	0	0	0	0	0	0	0
CSO027Outfl	0	0	0	0	0	0	0
CSO021Outfl	0	0	0	0	0	0	0
CSO018Outfl	0	0	0	0	0	0	0
CSO015Outfl	0	0	0	0	0	0	0
CSO008Outfl	191858	0	0	0	0	0	0
CSO010Outfl	103698	27784	10434	1648	71	0	0
CSO005Outfl	0	0	0	0	0	0	0
CSO001Outfl	268048	0	0	0	0	0	0
CSO004Outfl	290004	36390	0	0	0	0	0

ATTACHMENT D.4-2 MODEL-PROJECTED FLOW VOLUMES (cf)
10 Day Events

Link	5yr	1yr	6Mo	3Mo	2Mo	Small	2.5x
CSO023Basin	162526	155566		149631	148125	146779	33166
CSO002Basin	808202	785764		766627	761885	757397	171884
CSO002toTnC	0	0		0	0	0	20277
CSO03ABasin	2824844	2096816		1508141	1336638	1229413	239930
CSO03AtoTnC	406299	86847		0	0	0	13055
CSO022SprBa	1159101	931636		737851	687761	644151	129268
CSO022DryWe	1168953	941490		747706	697618	654007	131319
CSO022WetWe	0	0		0	0	0	0
CSO022toTnC	0	0		0	0	0	0
CSOplantnorth	406287	86832		0	0	0	32558
CSOplanttreated	58833	0		0	0	0	0
CSO021Basin	300651	281909		268034	264565	262262	58150
CSO018Basin	0	0		0	0	0	0
CSO015Basin	1532287	1323598		1147662	1103890	1063812	223514
CSO008Basin	-9034190	-7746689		-6468104	-6138026	-5856279	-1192884
CSO010Basin	434957	314443		259912	247200	235888	48772
CSO005Basin	84473	83728		83093	82936	82787	18716
CSO001Basin	6391553	5011538		3854470	3523821	3289232	650866
CSO001LknPk	6305627	4957177		3827002	3502608	3274440	652683
CSO004Basin	4163889	3261254		2491469	2295222	2119683	425807
ToWWTP	28780339	23033081		18053813	16727871	15636315	3059824
CSO023Outfl	0	0		0	0	0	0
CSO002Outfl	0	0		0	0	0	0
CSO025Outfl	24	0		0	0	0	0
CSO03AOutfl	2	2		2	2	2	0
CSO022Outfl	0	0		0	0	0	0
CSO027Outfl	0	0		0	0	0	0
CSO021Outfl	0	0		0	0	0	0
CSO018Outfl	0	0		0	0	0	0
CSO015Outfl	0	0		0	0	0	0
CSO008Outfl	0	0		0	0	0	0
CSO010Outfl	7992	0		0	0	0	0
CSO005Outfl	0	0		0	0	0	0
CSO001Outfl	0	0		0	0	0	0
CSO004Outfl	0	0		0	0	0	0

APPENDIX E
SEWER SEPARATION

E.1 INTRODUCTION

Combined sewers are designed to receive sanitary sewer discharges as well as stormwater flows from roof downspouts, area drains, curb inlets, sump pumps, foundation drains, and similar sources, shown conceptually in Figure E.1-1A. To reduce combined sewer system (CSS) flows, utilities may perform "sewer separation" or "decombination." Sewer separation provides a sanitary sewer to convey sanitary flows downstream to wastewater treatment plant (WWTP) facilities; decombination provides a separate storm sewer to convey stormwater flows for discharge to area waterways. (For convenience in this report, the term "sewer separation" may be applied to either strict separation *or* decombination.) The purpose of this appendix is to provide background information on methods used for combined sewer separation, typical costs for separation, and how sewer separation is evaluated in the screening of alternatives as part of the City of Aurora Combined Sewer Overflow (CSO) Long-Term Control Plan (LTCP).

E.2 METHODS OF SEWER SEPARATION

Varying approaches can be taken in the separation of combined sewers, and the most appropriate method is not only community-specific but also specific to the characteristics of the sewer catchment or sewershed being evaluated. In cases where the combined sewer infrastructure is old, with many sanitary and stormwater connections throughout the area served, the most practical approach may be construction of a new sanitary sewer for collection of sanitary flows. Although this typically requires construction of a deeper sewer (to service building basements), the sewer can be of smaller diameter because storm inflow from catch basins are excluded. It avoids the often high rates of infiltration/inflow (I/I) that would remain if the combined sewer were converted for sanitary service. This method is shown in Figure E.1-1B.

This is not always the case, however, and there are alternative means of sewer separation. If the existing combined sewer is in good condition, has low leakage rates and/or if stormwater connections are relatively few, it may be more cost-effective to add relatively shallow storm sewer, leaving the combined sewer to serve the flows from building laterals. This is similar to the approach the City of Aurora has applied in its "decombining" efforts to remove stormwater from the combined system over the past few decades. (Note that in reference to the City's decombining efforts, the text of this report employs the term "separation" to indicate "decombination" projects. Because alleviation of street flooding and basement backups and provision of capacity for redevelopment have been the focus of its decombining efforts, the City of Aurora has sought to remove as much storm flow as could be readily accomplished, but without attempting to remove all stormwater contribution. To this end, Aurora has compelled property owners to disconnect roof drains and has typically installed new storm sewer and reconnected the storm inlets to it. In this approach, foundation drains and any existing infiltration because of open joints or cracks remain. Figure E.1-1C illustrates this approach.

While not as effective in removing all stormwater in a system, decombination (as strictly defined) has been successful in significant reduction of excess stormwater causing short-term flooding and basement backups. For example, in the last 10 years, the City of Aurora performed decombination/separation in many basins, including 004, 008, 015, 021, 022, and 023. Since that time, the City of Aurora personnel have noted a significant decrease in the number of phone calls

Figure E.1-1A
Combined Sewer System – Wet Weather

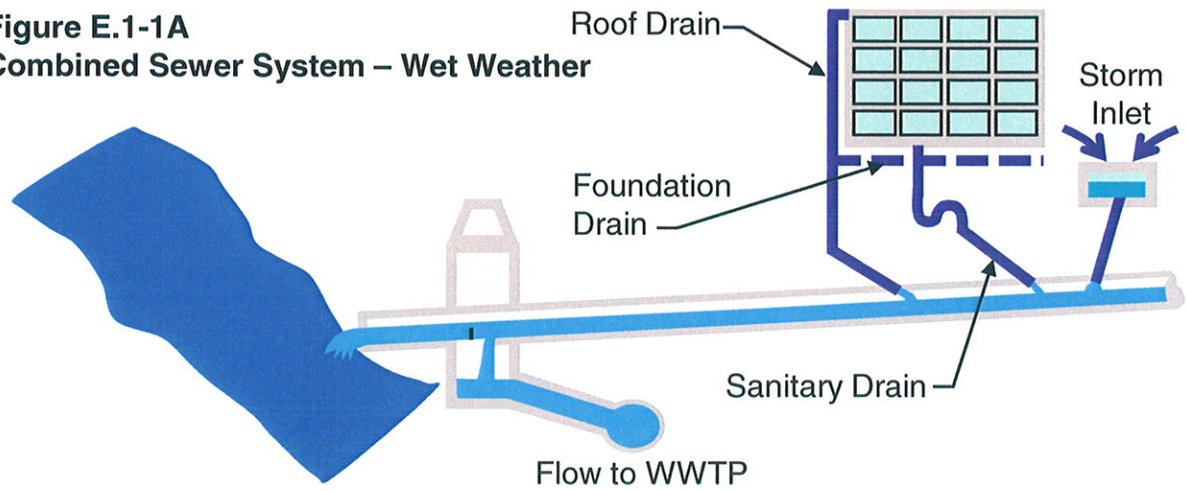


Figure E.1-1B
Combined Sewer Separation Method

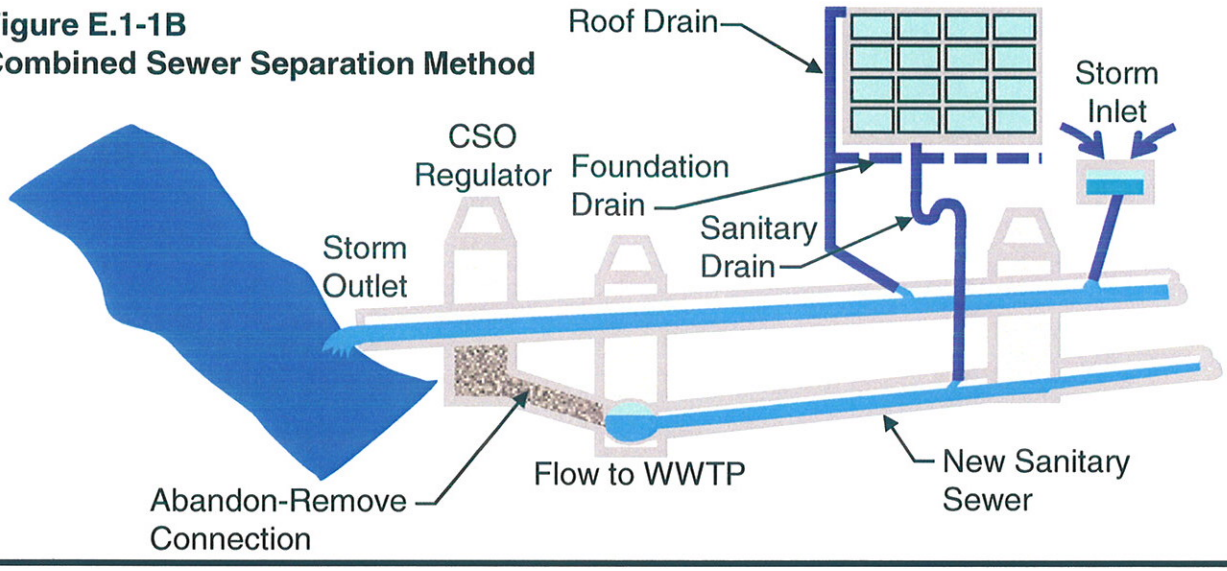
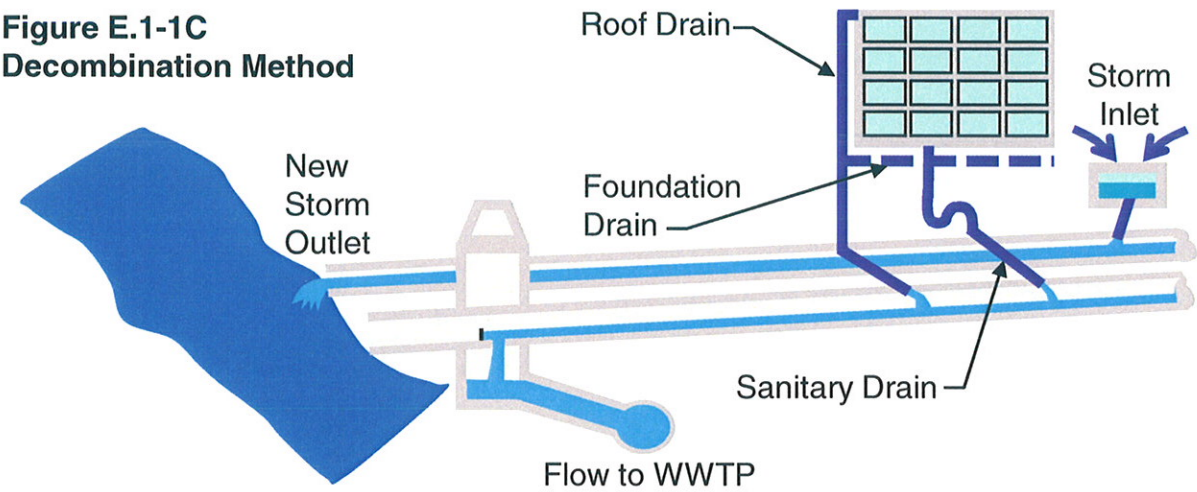


Figure E.1-1C
Decombination Method



Combined Sewer System
Combined Sewer Overflow Long-Term Control Plan
City of Aurora, Illinois

STRAND ASSOCIATES, INC.® ENGINEERS

Figure E.1-1A, B, C
1-181-001

regarding basement backups during heavy rainfalls. For this analysis, it is assumed this will continue to be the City of Aurora's approach to sewer separation.

E.3 MONETARY COST OF SEWER SEPARATION

To project the cost of potential future sewer separation projects, it is useful to compare a city's experience with its own sewer separation projects to typical costs across the nation. To project future costs for the City's decombining projects, the report Sewer De-Combining of Basins 5, 6, and 13, RJN Group (March 2007) was reviewed. The Engineer's Opinion of Probable Construction Costs for the Galena St., Spring St., Superior St., Spruce St., and Gale St. subbasins were compared with the approximate combined acreage within each subbasin. Based on this review, per acre construction costs appear to be approximately $40,000 to $60,000 (1st Qtr 2007 Dollars), with an average of about $47,000 per acre. Inflating to 4th Qtr 2009 and applying 20 percent for technical and legal services and 30 percent for contingency suggests a per acre capital cost of approximately $80,000 per acre.

A review of reported sewer separation projects across the country was performed to evaluate whether the City of Aurora's costs are consistent with the other communities. A sampling of monetary cost experience from these sewer separation projects is provided as follows:[1]

1. Rouge River Sewer Separation Projects (Wayne County, Michigan)–Six separation projects were completed in 1998. The areas ranged in size from 86 acres to 1,180 acres. A total of 41 miles of new sewer was installed. The "grant eligible construction cost" totaled $34.7 million, for an average cost of about $160/linear feet (LF) of new sewer (about $200/LF in current dollars). Costs per acre separated were reported to be $15,800/ac ($21,000/ac in current dollars).

2. The City of Indianapolis, Indiana, has developed a projection of capital cost of $6.2 billion to separate 35,400 acres or $175,000/ac. This is almost an order of magnitude higher than the Rouge River costs.

3. Harbor Brook, New York, completed a separation project in a commercial area reported to be densely developed. Year 2001 construction costs were reported to be $610/LF of sewer ($745/LF in current dollars).

4. St. Paul, Minnesota's $331 million sewer separation project, completed in 1996, constructed 200 miles of new sewer. In today's dollars, the cost would be about $460/LF of sewer.

5. South Boston, Massachusetts' CSO LTCP includes separation of 300 acres at a projected cost of $54 million in today's dollars or about $180,000/ac.

[1] These projects were not identified as to the type of separation performed.

6. Portsmouth, New Hampshire, conducted two sewer separation projects at a total cost of $1.8 million in today's dollars. For about 3,500 linear feet of construction, this cost is about $515/LF.

7. Jeffersonville, Indiana, completed a separation project (Graham Street area) in 2002. The project separated an area 18 acres in size and cost $1.5 million. About 2,500 feet of new sewer was constructed. In current dollars, total cost would be about $104,000/ac or about $745/LF. These costs include engineering costs.

8. Syracuse, New York. The West Street sewer separation project was completed in 2000 at a construction cost of $606/LF. In current dollars, the construction cost would be about $745/LF. This construction occurred in a densely developed commercial area.

9. Onondaga County, New York. For planning conducted in 2001, Onondaga County used unit costs (construction only) for sewer separation of $490/LF in residential areas and $610/LF in commercial areas. (The residential unit cost was developed from the average of actual construction costs for separation in ten residential areas where unit costs ranged from about $270/LF to about $580/LF.) In current dollars, these unit construction costs would be about $620/LF (residential) and $780/LF (commercial).

The unit cost for separation projects is high compared to values typically used for new construction in developing areas. This is due to a number of factors including:

1. Location and identification of utilities, services, laterals, and so on.
2. Protection of underground and surface improvements during construction.
3. The need to work in congested areas.
4. Street restoration, restoration of walks and landscaping, and similar items.
5. Testing (if necessary) of services and laterals.
6. Replacement or lining of services and laterals found to be in poor condition.

This sampling of LF costs from other communities and a midrange residential parcel depth for Aurora of 175 feet suggests planning level sewer separation costs in the range of about $100,000 to $120,000 per acre with a typical value of $110,000 per acre.[2] This average value is somewhat higher than the $80,000 per acre identified within Aurora. However, because decombination is generally somewhat simpler construction than sewer separation, this appears reasonable. Based on this analysis, $80,000 per acre will be applied to project the capital cost of decombination projects. Assuming a 50-year life for this construction, yearly maintenance of sewers at $0.50/ft/year, the present value of decombining is projected to be approximately $60,000 per acre.

[2] These "planning level" costs apply a factor of 20 percent for technical services and 30 percent for contingency to the per foot values identified as construction costs.

E.4 AURORA'S EXISTING SEWER DECOMBINING PLAN

A plan was prepared to specifically study and recommend decombining of the sanitary and storm sewers in areas 5, 6, and 13, as well as rehabilitation plans for the remaining decombined sewer. Basins 5, 6, and 13 include the downtown business area (including Stolp Island) and areas immediately east and west of the downtown area. Further descriptions of the decombination projects are provided in Section 4 of this report. The City of Aurora has started construction on approximately $4.5 million of additional sewer decombination projects expected to be completed in 2010. These projects include decombination in basins served by CSOs 008 and 015.

E.5 REDUCING BASEMENT BACKUPS AND ANALYSIS OF SEWER SEPARATION COSTS

City of Aurora staff has indicated that, while formerly problematic surface flooding has been greatly reduced, basement backups remain a concern in several basins. Therefore, continued efforts to decombine sewers remain a priority.

Existing records regarding locations of basement backups are not considered representative of the magnitude of the overall problem for several reasons.

1. The basement backup records database is maintained by City water and sewer staff. According to personnel, the location entered into the GIS database labeled as basement backups does not represent the location of the residences affected but rather the location of the identified problem. Also, the database does not differentiate between a wet weather-related basement backup and a grease-, root-, or collapsed sewer-caused backup.

2. Many of Aurora's residents are foreign-born, and there is a concern among City staff that this population may not report basement backups because of language barriers or cultural issues.

3. Residents may be hesitant to complain, since it would create a public record of problems on their property, thereby harming potential resale values.

4. Long-time residents may be complacent about the problem, accepting it as a part of home ownership, and neglect to report it.

Without reliable comprehensive data on basement backup occurrences, City staff identified target basins for potential separation projects based on general knowledge about basin characteristics. As shown on Figure D.3-1 with the "St" designation, nine CSO basins were selected to target potential future decombining efforts, including basins served by CSOs 001, 002, 003A, 004, 005, 008, 010, 015, and 022. Appendix Section D.5.E discusses the recommended approach for continued sewer separation projects as part of the LTCP.

APPENDIX F
WET WEATHER FLOW TREATMENT

F.1 INTRODUCTION

This section reviews the technologies for combined sewer overflow (CSO) treatment and identifies alternatives for wet weather treatment facilities (WWTFs) that meet City of Aurora's need for treatment. The method for development of the WWTF costs applied in the spreadsheet analyses and Tool is explained.

F.2 GOALS AND APPROACHES OF CSO TREATMENT

A. Goals

A city's primary motivation in treating wastewater is to provide environmental protection by compliance with state and national laws and regulations requiring secondary treatment of all sanitary wastewater. Secondary treatment requirements typically include biochemical oxygen demand (BOD) and total suspended solids (TSS) limits [often 30 milligrams per liter (mg/L) each], fecal coliform limits (for Illinois, 400 colonies/100 mL, daily maximum), and 85 percent removal of BOD and TSS from the influent. Secondary treatment requirements are "categorical standards" applicable even for discharges to water bodies with very large assimilative or dilutional capacity. More stringent requirements may be applied to small streams, if necessary, to maintain water quality and use attainment. When constructed for CSO control, WWTFs are not subject to categorical standards under the Clean Water Act (CWA) but would have treatment objectives consistent with the National CSO Control Policy: (1) to assist in meeting "presumptive" control levels, if that is the intent of the Long-Term Control Plan (LTCP), or (2) to assist in compliance with water quality standards applicable to designated uses of receiving waters. As discussed earlier in this report, bacteria (fecal coliform and *E. coli*) are the primary water quality parameters of specific concern relative to Aurora's CSOs. Consequently, WWTFs constructed as part of long-term CSO controls in Aurora would have the primary goal of CSO disinfection. A primary purpose for the removal of BOD and TSS in the WWTF is that it significantly improves the efficiency of disinfection. The equivalent of primary treatment and disinfection are requirements of the Illinois rules. Other goals of WWTF operation would be to remove solids and floatables present in the wet weather flow, as necessary, to satisfy that water quality narrative standard.

B. Design Challenges

CSO treatment facilities have challenges that are not typical of wastewater treatment plants (WWTPs) that receive continual flow. They must be able to (1) start up quickly and automatically after long periods of being idle; (2) operate for some length of time in the absence of personnel; (3) treat widely ranging flow volumes and water qualities; and (4) be easily maintained following an event. Available land area for WWTFs is often limited in CSO communities.

For a WWTF, postevent maintenance should be relatively straightforward. In the discussion of treatment technologies that follows, several evaluation criteria were used in addition to the monetary evaluation. These include, in order of importance:

1. Reliability and ease of operation–The system must start up and operate reliably with minimal operator attention.

2. Industry experience–Processes with multiple successful installations present the least risk and the greatest likelihood for satisfactory performance.

3. Simplicity of process–Staff typically prefer simple processes that will likely require less maintenance. In general, processes with fewer mechanical units were preferred.

4. Safety and ease of cleanup and maintenance–At the end of each event, the WWTF will require cleanup including discharging and flushing wastewater tanks and emptying trash screened from wastewater. Regular maintenance would include replacement of used chemical, necessary equipment lubrication, and verification of readiness for next event. Processes for which cleanup and maintenance are straightforward were preferred.

F.3 WWTF TREATMENT TECHNOLOGIES

The three basic WWTF operations being considered are coarse solids removal, clarification, and disinfection. This section discusses equipment and processes that are currently being used for this purpose.

A. Preliminary Treatment

Preliminary treatment includes screening of wastewater and removal of grit. This section discusses alternatives screening and briefly discusses grit removal.

Screening includes removal of plastics, rags, and other floatables found in wastewater. Screening is generally employed as a first step in the treatment process and reduces maintenance and operating problems in downstream equipment. Conventional screening is considered that greater than 1/4 inch (6 mm), fine screening is 1/4 inch or less, and very fine screening is less than 1/16 inch (1.5 mm). Screening can occur either at the WWTF or at the location of the overflow that is then transferred to the WWTF. The recommended screening alternative considers screening at the WWTF.

1. Bar Screens

   a. Climber-Type (Infilco Degremont-Climber or Vulcan Industries-Mensch)

      Climber or Mensch screens employ a rake arm that clears the mat of screenings accumulated on the bars periodically and have the benefit of being installed with no bearings or other moving parts permanently in the wastewater. The climber screen has a minimum bar spacing of 1/4 inch but is quite robust.

FIGURE F.3-1

MENSCH BAR SCREEN, RACINE, WISCONSIN



FIGURE F.3-2

MENSCH BAR SCREEN OPERATIONAL SEQUENCE (FROM VULCAN INDUSTRIES)

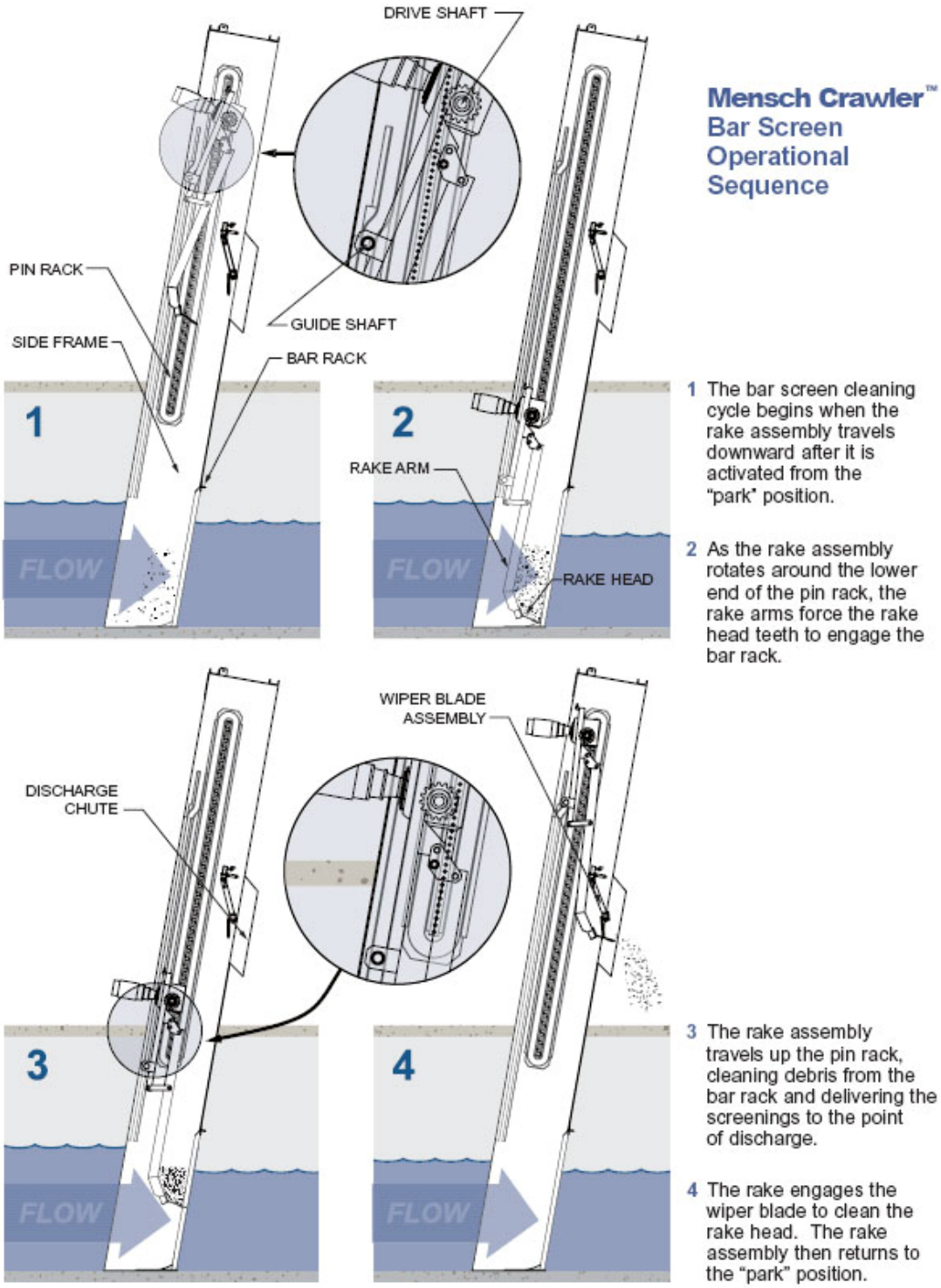
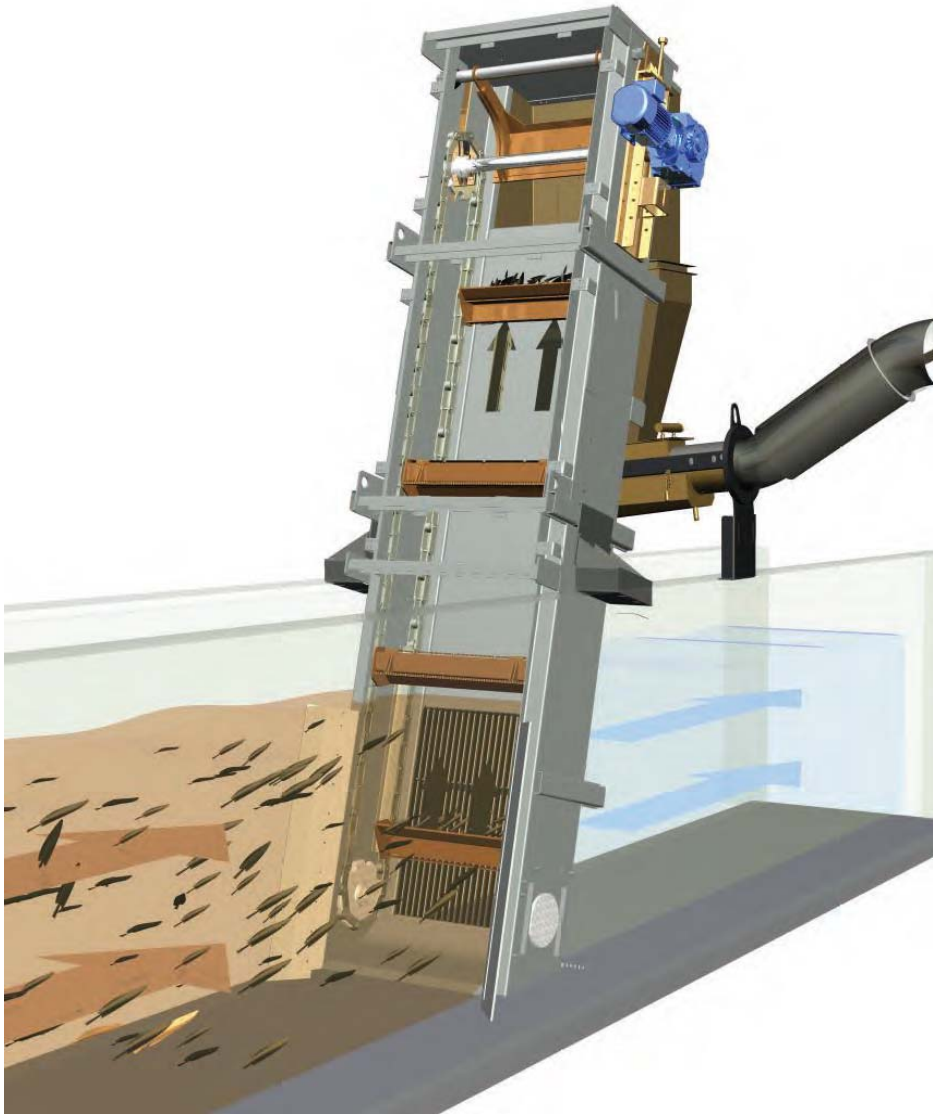


FIGURE F.3-3

MAHR BAR SCREEN (FROM HEADWORKS)



Note multiple rakes and chain system

b. Front Raked, Front Return Bar Screen (Headworks-Mahr)

Mahr bar screens use multiple rake bar teeth that positively engage with the screenfield bars. The rakes travel in a continuous circuit from the bottom of the channel up the bar rack and past the debris plate. Minimum bar spacing can be as fine as 3/16 inch and still providing the robustness required for the application. The shape of the bars, together with more rapid cleaning, may reduce the "blinding factor" in final design. The Mahr bar screen requires less than 8 feet of overhead clearance, regardless of the channel depth.

For either of these bar screens, the depth of the screen is an important factor in the design and cost of the system. Screens can be installed to depths of 40 feet or greater, which significantly adds to the cost. In addition to the need for screening at the WWTF, screening is also considered necessary for locations where storage is provided for CSO. Underground storage from gravity sewers is anticipated; in this application screening would be somewhat deep.

While flow through the screen at widely varying rates would need to be addressed, this screening technology appears to be among the most accepted methods of treatment and would be applicable in conjunction with other methods of solids separation.

For mechanically cleaned screens, the screenings would be collected, washed, compacted, mechanically bagged, and discharged into a dumpster for ultimate disposal to the landfill. Design of the WWTF and screening building would facilitate screenings pickup at the end of an event or series of events.

Because operation of bar screens at low flows is not optimal, it is envisioned that the WWTF could be equipped with multiple bar screens in separate channels. Automatic gates would control which channels receive flow. Because the majority of events will see low-to-moderate flows, it may be cost-effective to design one or two channels with mechanically operated screens having a narrow opening, while an additional two or three channels are equipped with screens having a coarser bar spacing and greater hydraulic capacity. In this way a high degree of screening effectiveness would occur under the most common events, while the large range of flows could be handled with fewer units.

The final design consideration is that the climber-type screen requires approximately twice the vertical space above the channel than the Mahr bar screen and would also require a sky light or roof hatch for required screen maintenance or replacement. Therefore, the Mahr bar screen has been selected for cost evaluation.

2. Drum Screens (not selected)

Rotating drum screens have been used for screening peak wet weather flow and providing fine screening to about 0.01 to 0.1 inches. In larger applications, wastewater enters at one end of the drum, and screened water flows out the base of the drum. The drum rotates at about 6 to 8 rpm, and screenings are collected in the interior and are scraped horizontally toward the end. A spray system cleans the screen from both the inside and outside. Solids are conveyed away from the screen, compacted, bagged, and ultimately landfilled.

The screen is constructed of wedge wire from bars with triangular cross sections that run parallel to the axis of the screen. The triangle shape of the bar is intended to reduce screen clogging. Because this screen has bearings, mechanical parts, and moving surfaces that are below the water level, there would be potential for maintenance issues that are not seen in screens that have no submerged mechanical parts.

Drum screens have an advantage over climber-type and step-type screens in that they can be constructed with much smaller screen openings. At WWTPs, drum screens have been successfully used in lieu of primary settling because they can screen for very fine solids. At WWTFs where a high overflow rate in settling can fail to meet desired results, the manufacturer has indicated that drum screens have the potential to make settling tanks unnecessary.

However, there are distinct disadvantages of the drum screens that make its application in the City of Aurora unfavorable. First, the largest available unit has a maximum capacity ranging from about 5 to 15 mgd, depending on the influent quality and the level of desired screening. Therefore, they are not a good option where a high flow rate is desired. Second, the complexity of the screens and their fine aperture suggests a potential for operational and maintenance issues beyond what would be anticipated with bar screens. These fine screens would also likely require some coarser screening upstream to prevent damage to the drum screen. Finally, it is anticipated that approval of fine drum screens in lieu of primary clarification would be difficult to obtain. Therefore, drum screens are not selected for this application.

3. CSO Screens (not selected)

The screens described above are appropriate for enclosed WWTF locations where additional treatment such as clarification and disinfection will be provided. This subsection discusses alternative screening technologies that are intended for location within the collection system. This approach may be used to screen CSO either prior to overflow or prior to pumping to the WWTF.

a. Ro-MAG® Screens (not selected)

Some communities have utilized a relatively new type of horizontally mounted high capacity screen that is installed on top of an overflow weir in a sanitary manhole. Once the water level increases to the top of the weir where it would overflow, it is screened and discharged to the overflow sewer. Screenings are removed from the screen with a comb-like system that operates from behind the face of the screen. Screenings are thereby cleaned off the screen and fall back into the normal flow sewer and are sent to the WWTP, thus eliminating the need to separately lift, compact, and dispose of screenings. Screening as fine as 4 mm (0.16 inches) can be achieved. This technology would be applicable where all screening took place at the point of overflow in advance of pumping to offline treatment. However, since this approach would require equipment to be installed at many remote locations, this type of screen was not deemed appropriate.



Figure F.3-4 ROMAG® CSO screen (from ROMAG AG)

b. Huber RoK1® (not selected)

Another type of remotely installed screen available for overflow treatment is the Huber RoK1®, a weir-mounted screen that resembles a screw conveyor. Similar to the Ro-MAG® system, water flows over the top of a weir through the perforated trough. A screw then conveys the solids to one end, where they are discharged. Simultaneously, the perforated trough is cleaned with the wear brush secured to the

periphery of the rotating screw. Like the Ro-MAG® screen, it would be used at the point of overflow and discharge screening back into the flow stream for treatment at the WWTP. This design appears rugged, although the layout suggests that high flows may be able to overtop the screen if it is not operating properly. Also, there are bearings and moving parts at or below the water level, suggesting that long-term maintenance of mechanical parts may be an issue. Similar to the Ro-MAG® screen, a decentralized screening approach applying the Huber RoK1® is not believed appropriate for Aurora.



Figure F.3-5 RoK1® Storm Screen installed upstream of the CSO (from Huber)

c. Continuous Deflective Separation™ (not selected)

Another method of solids separation combines the vortex and screening concepts into one process by using the velocity of the incoming water to create vortex flow through a cylindrical screen. Screened material moves into a sump below the screen and is pumped off and deposited back into the sewer. The Continuous Deflective Separation™ (CDS™) vortex flow unit is intended to manage large flow volumes in a self-cleaning fashion. Underflow is accomplished by an intermittently operating grinder-type pump. Instrumentation monitors the incoming flow, and the underflow pump engages when the control logic indicates the solids content in the sump reaches about 2 percent. The manufacturer indicates that systems can be designed for underflow rates of 1 to 2 percent, significantly less than a standard vortex unit. During the pump-down, a washer system activates to clean the screen.

This system is reported by the manufacturer to achieve separation of solids down to 0.04 inches (1 mm). With the vortex-type flow, heavier grit-type solids should also be removed, although it is reported that the screen impedes the hydraulically optimal vortex flow that is central to effective treatment. This type of screen has seen limited installation in the United States for CSOs. Operational experience at one facility suggests that potential maintenance problems can be significant. The two primary problems with the in-place systems have been clogging of the screens and the underflow pumps. While this kind of system may hold promise for CSO treatment, it has not been proven in enough applications to be recommended for Aurora.

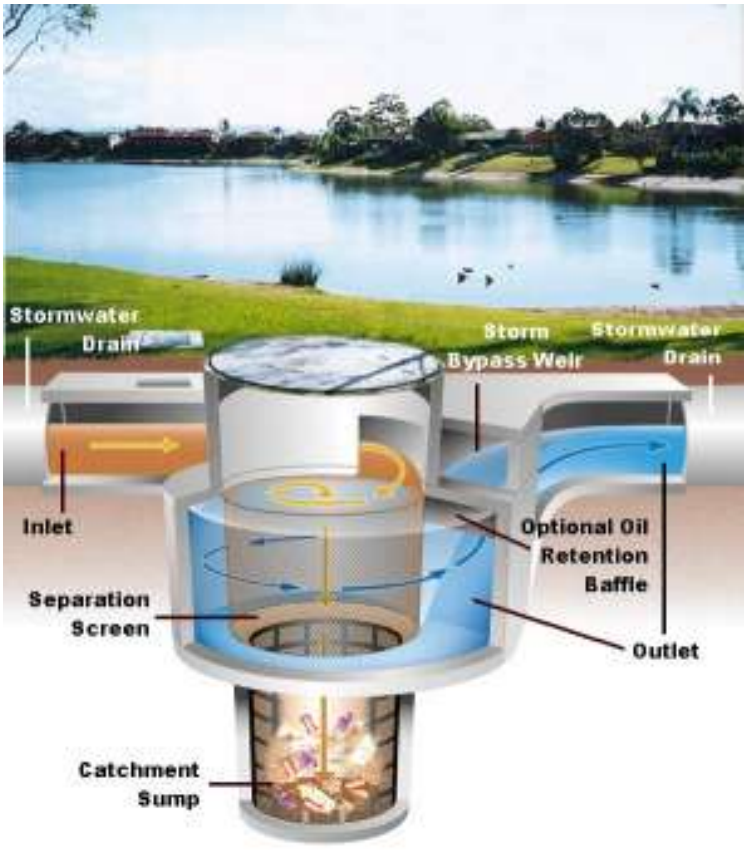


Figure F.3-6 Continuous Deflection Separation (from CDS Technologies)

4. Vortex Grit Traps

In addition to screening for the removal of floatables, vortex (or swirl) grit traps are commonly used at WWTPs to remove the small, heavier solids. Screened CSO flow enters the grit chamber to provide the velocity to create circular movement in the chamber. Heavier solids move toward the center and are intermittently pumped from the bottom of the trap to a grit classifier. The grit classifier further separates the inorganic from the

organic fraction, washes and dries the grit for ultimate disposal in a dumpster. It is assumed that the WWTF will include vortex grit removal instead of the aerated grit system at the existing CSO plant at 400 N. Broadway.

B. Clarification

Separation of solids may be one of the more challenging aspects of CSO treatment. Removal of suspended solids is necessary to achieve effective disinfection. Because particulates are difficult to penetrate with disinfection agents, pathogens can be difficult to inactivate without adequate TSS removal prior to disinfection. Ultraviolet (UV) disinfection, if selected, would only be effective with an adequate ultraviolet transmittance (UVT), and an effective clarification process is critical to achieve adequate UVTs. Since bacteria often represent the primary cause of water body impairment, adequate TSS removal to facilitate disinfection is critical.

Since WWTFs must operate intermittently and start up quickly, secondary biological treatment typical at conventional WWTPs is not recommended. There are three general categories of processes that achieve similar process goals, (1) Conventional Sedimentation, (2) Enhanced Primary Sedimentation and (3) Chemically Assisted High Rate Clarification.

1. Conventional Sedimentation

CSOs contain suspended particles that are heavier than water that settle by gravity under quiescent conditions. Conventional sedimentation tanks are primarily sized based on surface overflow rate, also known as surface loading rate, which can be calculated mathematically as flow rate divided by the surface area of the tank. Typical depths for primary clarifiers are 8 to 12 feet. In Illinois, there is precedence to size excess flow primary clarifiers at 1,800 gallons per day per square foot (gpd/sf) of tank area. The obvious advantages of these basins include their simplicity of start-up and operation.

As is the case for Aurora's CSO plant, smaller storms may not completely fill the clarifiers, and their water quality benefit comes from the storage that they provide. Therefore, in addition to the peak overflow rate, the amount of storage provided can be an important aspect of design. While metering programs and system modeling can project approximate peak flow *rates* for certain return periods of storms, projection of total *volume* is much more difficult to predict. Because of the uncertainty associated with the actual flows that will be seen at a WWTF, it is recommended that a modular approach to storage/clarification be used. In this fashion, the clarification portion of a WWTF would ideally be designed and laid out assuming potential required increase in tankage. Because of the high cost and large footprint of large capacity tanks, the WWTF initially may be built with somewhat less storage/clarification capacity than is projected to be required for the most extreme events with additional units added as necessary.

A combination of storage and clarification settling appears to be a good potential option if there is available property. The simplicity of operation and cleanup make it attractive for owners and operators, especially where integrated cleaning systems are included, such as tipping buckets. Because of the long-time application of clarification in wastewater

treatment, it probably enjoys the best chance for meeting with regulatory approval, although it may not be able to achieve the kind of effluent quality that chemically assisted high rate clarification can. The kind of tankage that would be required for storage could be retrofit with clarifier mechanisms in the future or be used for some other kind of process, including addition of inclined plate settlers and/or chemically assisted settling, if necessary. The two primary disadvantages with conventional sedimentation are that a relatively large area located outside of the floodplain would be required and that construction of large tank volume would involve high monetary cost.

For cost analyses contained in this report, new treatment facilities will be assumed to have 12-foot-deep primary clarifiers with 1,800 gpd/sf surface overflow rates. Tipping buckets were also assumed to facilitate cleanup.

2. Enhanced Primary Sedimentation (not selected)

Conventional primary sedimentation can be enhanced by chemical coagulation and with the addition of plate settlers.

a. Chemical coagulation: Chemical coagulation of wastewater prior to sedimentation promotes flocculation of finely divided solids into more readily settleable flocs, thereby increasing clarifier performance efficiency. Advantages of coagulation include greater removal efficiencies, the ability to use higher overflow rates, and more consistent performance. Disadvantages of coagulation include chemical feed equipment and chemical costs, additional operator attention, and an increased mass of sludge generated. Historically, iron and aluminum salts have been the chemical coagulants used for wastewater treatment. Coagulant selection should be based on performance, reliability, and cost. Bench-scale and/or pilot scale testing may be warranted. Based on past experience, we believe that overflow rates of 2,000 gpd/sf could be achieved with chemical coagulation.

b. Inclined plate settlers: Inclined plate settlers are clarification devices designed to increase the capacity of conventional clarifiers. Surface area for settling is provided by arrays of metal or plastic plates, commonly installed at an angle of 55 to 60 degrees. Accumulating solids settle, agglomerate and flow down the sloped plate surfaces while clear water is conducted upward.

Because a falling particle now travels a shorter distance to reach a resting place, production of clear water and flow through the basin are greatly accelerated. Each plate provides an effective settling area equal to that of its horizontal projection, and it will produce an upflow identical to the area of basin floor covered by this projection. By using a large number of settling plates, a basin can be made to contain an effective settling area five to ten times that of its own surface area, and its productivity will increase proportionally.

While the use of plate settlers has been widely accepted throughout the United States, it is possible that IEPA would require a pilot system to be installed to demonstrate performance. One manufacturer's pilot system requires about 100 gallons per minute of flow. Piloting would need to be performed during wet weather events and is not part of the scope of an LTCP.

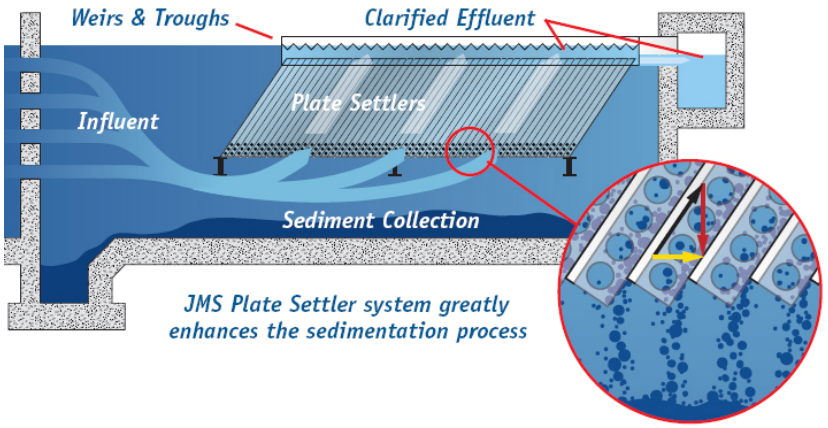
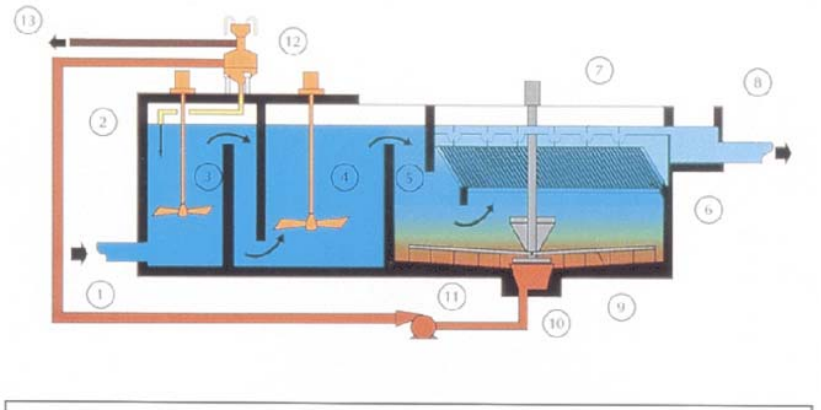


Figure F.3-7 Typical inclined plate settler cross section (from JMS)

3. Chemically Assisted High Rate Clarification (not selected)

One method of achieving high rate solids removal in a relatively limited space that has been attracting national attention is chemically assisted high rate clarification, known commercially as Actiflo®, DensaDeg®, and other trade names. Actiflo®, shown in Figure F.3-8, introduces chemical coagulant, polymer, and fine sand ("ballast") to the wastewater in the "flash mixing zone." The wastewater then flows to a gentle mixing zone where large sand-ballasted flocs form. The flocculated wastewater then flows to a settling zone equipped with lamella (flat, diagonally oriented plates) to enhance the settling rate. DensaDeg® uses the same concept using solids from the wastewater stream instead of sand. In both cases, the ballasted floc settles to the bottom of a settling tank. Solids are drawn off the bottom of the settling tank and are sent to a hydroclone that separates the wastewater solids and the denser solids. Wastewater solids are returned to the sewer and the denser solids are reused. Because of the ballast and/or large particle size, floc settles significantly faster than normal wastewater floc, and solids clarification can be achieved in about one-tenth the area required for moderate rate primary settling.



1 - Raw water inlet
2 - Injection of microsand
3 - Flash mixing zone (coagulation)
4 - Gentle mixing zone (flocculation)
5 - Inlet to settling zone
6 - Lamella modules
7 - Collecting troughs or pipes
8 - Treated water outlet
9 - Sludge scraper and trough
10 - Sludge and sand outlet sump
11 - Recycling pump
12 - Hydrocyclones for microsand recovery
13 - Sludge outlet

Figure F.3-8 ACTIFLO Process

High rate clarification would appear to have good potential for CSO treatment in that it could likely achieve better TSS removals than any of the other processes and within a relatively small footprint. The process is, however, operationally much more complex than conventional sedimentation and enhanced primary sedimentation. Evaluations of this process performed for other LTCPs have shown that WWTFs designed around high rate clarification are approximately 60 to 80 percent more costly on a per mgd basis. Therefore, this process is only cost-effective in locations where space constraints mean that no other choice is available. Because Aurora has several relatively large potential sites for treatment, high rate clarification is not considered a cost-effective alternative and will be discarded from consideration.

C. Disinfection

Disinfection at a WWTF is required when pathogens represent an impairment to the water body and wet weather water quality variances cannot be obtained. There are several options for disinfection, and there is a widely varying degree of field experience between the disinfection methods. While adequate disinfection is a particularly important aspect of peak flow treatment, it appears that most WWTFs experience little difficulty meeting their fecal coliform limits, in general.

1. Chemical Disinfection

A few important parameters apply to all applications of chemical disinfection, including contact time, dosing, mixing, and chlorine residual. Inactivation of pathogens is primarily a function of disinfectant concentration and contact time.

Adequate contact time must be identified in the design of chemical disinfection. For the existing WWTF systems reviewed, design contact time at peak flow varied from 5 to 30 minutes as compared with typical WWTP peak flow contact time of 30 minutes to 1 hour. Applying a 5-minute contact time appears somewhat experimental at this stage, and there would be a greater potential for short-circuiting the tank with such a small volume. Illinois Code requires 15-minute contact time following primary clarification, and this will be assumed for cost projection.

Typical dosing rates of primary clarified CSO wastewater appear to be about 20 to 25 mg/L with 15-minute contact times at peak flow, and Illinois Code requires a minimum of 20 mg/L. Because of the variability in flow, required chlorine feed rates would vary dramatically. This is due not only to the high flow volume that must be dosed but also because, at lower flow rates, longer contact times allow for adequate disinfection at lower doses, such as 5 to 10 mg/L. Proper dosing, especially at low flow rates, is reported to be an operational difficulty at existing facilities. It will be important to design a control system that measures flow accurately and doses based both on flow and perhaps on expected contact time. Such a control system might include oxygen reduction potential (ORP) measurement within the tanks and chlorine residual analyzers on the tank discharge. This instrumentation would allow the control logic to adjust chlorine delivery rate to match conditions. Ideally, a proper dosing system would be accurately adjustable over about two orders of magnitude range.

Proper mixing of disinfectant with the wastewater at the contact tank inlet is especially vital where contact times are short. After dose and contact time, mixing has been identified as the most important factor in achieving adequate disinfection. While mixing can be achieved in a turbulent zone, such as at a splitter box, dedicated mixing equipment in a small dosing chamber upstream of the contact tank is recommended. High-speed submersible induction mixers have been shown to achieve adequate mixing and have a high overall reliability.

Because dose rates are high and contact times short, there typically remains a considerable chlorine residual, which may be toxic to fish and aquatic life in the receiving stream. Dechlorination to eliminate a significant chlorine residual is required prior to discharge. Sodium or magnesium bisulfite are commonly applied dechlorination chemicals.

One difficulty experienced with chlorine contact tanks at WWTFs with clarification settling is that solids accumulation occurs, requiring not only postevent cleaning but also increasing chlorine demand in the tank during operation. Tipping buckets for the chlorine contact tanks have been included in the costs to aid in postevent cleanup.

a. Disinfection with Liquid Chlorine (NaOCl)

By far, the most common method of disinfecting overflows is the application of liquid chlorine. Liquid chlorine (sodium hypochlorite) is relatively safe and simple to store and dose, and its common application at WWTPs and existing WWTFs gives it an advantage over other disinfection methods that are less proven. The 400 North Broadway CSO treatment facility utilizes sodium hypochlorite for disinfection, making it an attractive alternative for a new WWTF for Aurora.

A couple of important issues exist with the application of liquid chlorine. First, liquid chlorine is known to have a limited shelf life, especially at higher concentrations. Most communities that were surveyed for this review indicated this is a problem. A degradation study performed for a pilot facility on the Detroit River on batches and on fill and draw operations that would be typical of a WWTF showed that, in practice, the degradation resulting from shelf life would not represent a significant problem. Based on batch tests, the degradation appeared to be a reduction from about 11 percent to about 9.5 percent available chlorine after 150 days.

Other factors that influence chlorine's degradation rate would have to be taken into account when designing chemical storage at WWTFs. Temperature can have a significant effect on the degradation of chlorine. According to *The Handbook of Chlorination* (1986), an increase of $10^{O}F$ may double the degradation rate of chlorine. Also significant is exposure to light. Sunlight can be expected to decrease the half life of chlorine solutions by 3 to 6 times. One other factor that substantially contributes to the degradation of chlorine is the presence of heavy metal cations such as iron, copper, nickel, and cobalt.

Because CSOs have been common in Aurora, it is expected that WWTFs would operate with relatively high frequency, allowing for a continuous turnover of stock. This suggests that shelf life may not be an important concern for WWTFs in the system.

Liquid chlorine is typically available in 5 to 15 percent solutions. The required chemical storage for a large WWTF can be significant. For example, a 100 mgd facility designed to dose at 20 mg/L would require the ability to feed about 700 pounds chlorine an hour, requiring significant chemical pumping capability. Assuming that a 1-hour storm would result in flows to the plant at the peak flow rate for 2 hours, this would require 1,400 pounds available chlorine on-site. A longer, lower intensity storm might require even more. Assuming a three-day storm at a modest influent rate of 10 mgd, 5,000 pounds available chlorine would be required on-site. A storm with a high initial intensity that continued for several days could require 6,000 pounds or more. Clearly, the immediate availability of liquid chlorine to replenish the used chlorine would also be a factor in determining chemical storage sizing.

b. Gaseous Chlorine (not selected)

Gaseous chlorine has also been a common and effective means of achieving disinfection at WWTPs. Gaseous chlorine does not experience the same kinds of degradation problems that liquid chlorine does. However, safety has been a significant concern at WWTPs that employ gaseous chlorine. Facilities that keep more than 2,500 pounds of gaseous chlorine on-site are required by the CWA to have a risk management plan for the public; OSHA requires risk management plans for employees at facilities that store more than 1,500 pounds. Building and safety codes require specialized scrubbing systems to mitigate an accidental catastrophic loss of chlorine. As this WWTF would likely require storage far in excess of this

2,500-pound threshold, and because the proposed treatment sites would generally be unattended, gaseous chlorine is not recommended as a means of disinfection.

c. Calcium Hypochlorite (not selected)

In addition to gaseous and liquid forms, chlorine is also available in solid form. Solid calcium hypochlorite (CaOCl) has some advantages over other kinds of chlorine disinfectants. Calcium hypochlorite comes in granular, tabular, or “briquette” form, usually in 7-pound pails or 400- or 2,000-pound sacks, and has a much higher percentage of available chlorine than does liquid-based chlorine as sodium hypochlorite, usually 65 percent. Clearly, 400- to 2,000-pound sacks would require a large crane-type system for managing the product. Because it can be stored compactly, it may be appropriate for applications where space is highly limited. Second, the product has a reported 1-year shelf life and does not degrade as readily as liquid chlorine. In a situation where the facility would be idle for very long periods of time, calcium hypochlorite may be a viable alternative.

There are some distinct disadvantages to solid chlorine, which perhaps suggest why its application at WWTPs and WWTFs is not common. First, solids handling, feed, and dosing do not appear to be as convenient, accurate, or reliable as liquid or gas systems. The feed mechanisms appear to have potential for plugging and require nearly continual operator attention for hopper reloading. Accurate regulation of dosing rate is difficult. The material itself is hazardous and corrosive, particularly when exposed to moisture. Based on discussions with one manufacturer, existing installations have generally been designed for lower doses. In a facility where high moisture levels would be expected and that would need to operate reliably in the absence of an operator, solid chlorine does not appear to be a viable alternative for disinfection.

2. UV Disinfection (not selected)

An alternative to chemical disinfection that has been applied successfully at WWTPs is UV disinfection. Clarified wastewater is sent through a channel in which closely spaced UV lamps are suspended. Pathogens are inactivated because of damage in their DNA, leaving them unable to reproduce.

The capital and operation cost of UV systems is highly dependent on the quality of the wastewater to be treated. In particular, the expected UVT dictates UV system design and cost. Where high transmittance can be achieved (>85 percent), UV can be cost-effective. However, costs increase dramatically with decreasing UVT, and primary clarification typically achieves UVTs well below 85 percent, typically closer to 50 percent. Review of UV disinfection for previous LTCPs showed that it would only be cost-effective to use UV disinfection where space was at a high premium. Therefore, UV disinfection will be discarded from consideration.

F.4 WWTF TREATMENT ALTERNATIVES

A. Treatment Alternatives

Based on the technologies reviewed, the best alternatives for treatment appear to be as follows:

1. Coarse solids removal: Mechanical bar screens and vortex grit removal.
2. Clarification: Conventional-storage settling with or without inclined plate settling.
3. Disinfection: Liquid chlorine disinfection

These process selections suggest two viable WWTF treatment train alternatives:

1. Treatment Option A

    a. Screening and vortex grit removal.
    b. Conventional sedimentation.
    c. Conventional chlorine disinfection and dechlorination.

2. Treatment Option B

    a. Screening and vortex grit removal.
    b. Sedimentation with inclined plate settling.
    c. Conventional chlorine disinfection and dechlorination.

Because Treatment Option B calls for surface overflow rates in excess of the 1,800 gpd/sd identified in the code, it is expected that approval would require pilot testing. Even with a successful pilot test, it is not certain that this option would garner approval by IEPA. Therefore, this LTCP assumes that new facilities would be designed around Treatment Option A. However, because Treatment Option B may be a cost-effective alternative for increasing the capacity of the existing 400 N. Broadway CSO plant, costs for upgrading the CSO plant with inclined plate settling are also evaluated.

B. Additional Features

In addition to the treatment processes, a WWTF would require some additional features that would enhance operation of the facility. These are generally common to all alternatives that were evaluated including:

1. Enclosure of treatment within an attractive brick and block structure.
2. Flow splitting/control structures.
3. Drawdown pumping station to remove remaining wastewater from treatment tanks at the end of the storm and route it to the FMWRD WWTP.
4. Tipping buckets for postevent cleanup.
5. Odor control.[1]
6. Supervisory control and data acquisition (SCADA) system.
7. Site work, including access driveways, fencing, landscaping.

[1] City staff have noted that operating the odor control system at 400 N. Broadway has never been necessary. However, costs for odor control have been included.

C. Treatment Option A Cost Projection

The capital, operation and maintenance (O&M), salvage, and present value costs of Treatment Option A, over a range of treatment capacities, were evaluated based on:

1. Manufacturer equipment quotes, including a factor for installation.
2. Unit costs for items such as excavation and concrete.
3. Typical factors for electrical, instrumentation and controls, piping, HVAC, and sitework costs.
4. Contractor's General Conditions (GCs) of 8 percent.
5. A 30 percent factor for contingencies.
6. A 20 percent factor for legal and technical services.
7. Land acquisition.
8. Operation, Maintenance and Replacement
9. Power.
10. Labor.
11. Supplies.
12. Equipment replacement.
13. 20-year Salvage.
14. A projected Engineering News Record (ENR) construction cost index (CCI) of 8,559 for 4th Quarter (November) 2009.
15. Current USEPA recommended discount rate for facilities planning of 4.375 percent.

Table F.4-1 shows the costs for several sizes of WWTFs, based on the assumptions stated above. From these costs, cost functions for use in the spreadsheet and Tool analyses were determined as follows:

Capital Cost	=	$4.7 million + $530,000 x mgd
O,M&R	=	$100,000 + $5,500 x mgd
Present Value	=	$5.7 million + $560,000 x mgd

(It should be noted that these cost functions do not include land acquisition, special preparation of the sites, construction of replacement parking facilities, or long effluent discharge pipes. Such costs relevant for each individual site are included separately in the Appendix D-Alternatives Analysis.)

D. Costs for Upgrading Existing CSO Plant

Upgrade of the existing City of Aurora CSO facility at 400 N. Broadway is considered a viable alternative as Treatment Alternative B. As mentioned earlier, upgrades at 400 N. Broadway could occur by increasing capacity within the existing footprint using plate settlers. Investigation of the existing unit design criteria revealed the existing facility could be upgraded to 50 mgd flow rate within the existing footprint. Required improvements are based on the following. Existing bar screening and grit removal appear to be sized for approximately 50 mgd.

1. Upgrade existing influent pumps to 3 at 25 mgd.

2. Install plate settlers in three of the existing storage/clarification tanks (plate settler 0.5 gpm/sf).[2]

3. Convert one existing storage/clarification tank to a chlorine contact tank to maintain 15-minute contact time.

4. Construct miscellaneous structural modifications associated with conversion to the chlorine contact tank.

Note that pilot-scale testing of the plate settlers may be required to obtain IEPA approval for CSO treatment. Table F.4-2 presents the costs associated with upgrading of 400 North Broadway to 50 mgd.

Description	Capital Cost
Pumps/VFDs	$ 1,154,000
Plate settlers	$ 3,821,000
Misc Structural/Control Modifications	$ 750,000
Subtotal	$ 5,725,000
Contractors GCs (8%)	$ 460,000
Contingencies (30%)	$ 1,718,000
Legal and Technical Services (20%)	$ 1,145,000
Total Opinion of Probable Capital Costs	**$ 9,048,000**

Table F.4-2 Capital Cost For Upgrade of CSO Plant to 50 mgd

[2] This settling rate equates to 720 gpd/sq ft and applies to each of the lamella rather than to the overall tank surface area.

TABLE F.4-1 TREATMENT OPTION A: COST FUNCTION ANALYSIS

CAPITAL COSTS

Design Criteria Capacity (MGD)	**10**	**25**	**50**	**75**	**100**
Structure	**$ 2,745,900**	**$ 4,461,600**	**$ 7,340,500**	**$ 11,310,900**	**$ 16,721,800**
Equipment Installed	**$ 1,504,000**	**$ 2,148,000**	**$ 3,177,000**	**$ 4,257,000**	**$ 5,188,000**
Subtotal	**$ 4,249,900**	**$ 6,609,600**	**$ 10,517,500**	**$ 15,567,900**	**$ 21,909,800**
Site Work	$ 212,495	$ 330,480	$ 525,875	$ 778,395	$ 1,095,490
Divisions 5-10	$ 849,980	$ 1,321,920	$ 2,103,500	$ 3,113,580	$ 4,381,960
Mechanical	$ 212,495	$ 330,480	$ 525,875	$ 778,395	$ 1,095,490
Piping and Valves	$ 764,982	$ 1,189,728	$ 1,893,150	$ 2,802,222	$ 3,943,764
Electrical	$ 637,485	$ 991,440	$ 1,577,625	$ 2,335,185	$ 3,286,470
Instrumentation and Controls	$ 424,990	$ 660,960	$ 1,051,750	$ 1,556,790	$ 2,190,980
Total Construction	**$ 7,352,000**	**$ 11,435,000**	**$ 18,195,000**	**$ 26,932,000**	**$ 37,904,000**
Contractor's GCs	$ 588,000	$ 915,000	$ 1,456,000	$ 2,155,000	$ 3,032,000
Engineering, Architecture, and Legal	$ 1,470,000	$ 2,287,000	$ 3,639,000	$ 5,386,000	$ 7,581,000
Contingencies	$ 2,206,000	$ 3,431,000	$ 5,459,000	$ 8,080,000	$ 11,371,000
Land (included separately)	$ -	$ -	$ -	$ -	$ -
Total Capital Cost	**$ 11,616,000**	**$ 18,068,000**	**$ 28,749,000**	**$ 42,553,000**	**$ 59,888,000**
O,M&R					
Labor Cost	$ 49,800	$ 49,800	$ 49,800	$ 49,800	$ 49,800
O&M Supplies	$ 22,300	$ 31,800	$ 47,100	$ 63,100	$ 76,900
Chemical Costs	$15,000	$37,500	$75,000	$112,500	$150,000
Power Costs					
Yearly Power	$ 1,466	$ 2,384	$ 3,914	$ 5,444	$ 6,974
Replacement	$ 73,965	$ 116,591	$ 186,389	$ 274,997	$ 383,512
Yearly O,M&R	$ 163,000	$ 238,000	$ 362,000	$ 506,000	$ 667,000
20-Year O,M&R	**$ 2,098,000**	**$ 3,063,000**	**$ 4,658,000**	**$ 6,511,000**	**$ 8,583,000**
SALVAGE	**$ 770,000**	**$ 1,244,000**	**$ 2,039,000**	**$ 3,126,000**	**$ 4,594,000**
PRESENT VALUE	**$ 12,944,000**	**$ 19,887,000**	**$ 31,368,000**	**$ 45,938,000**	**$ 63,877,000**

APPENDIX G
FORCE MAINS

G.1 INTRODUCTION

Appendix D discussed briefly how force mains (FMs) are sized for various alternatives. The purpose of this appendix is to provide a more detailed discussion on FM conveyance options, identify potential routes, and show how cost projection is performed.

G.2 POTENTIAL FORCE MAIN LOCATIONS AND CONSTRUCTION CONDITIONS

Figure D.3-1 shows the general locations of all potential FM routes in red. These routes were identified and refined with the input of City of Aurora personnel.

A. Construction Conditions

The costs for construction of FMs depend to a large extent on the conditions of construction, that is, whether the pipe is located in an open area or in a street, or includes a river crossing. For convenience of developing costs for construction of FMs, several categories of construction conditions are identified, as described below.

1. Open Go

Construction that is in relatively open areas that do not have traffic or utility conflicts and have minimal restoration requirements is categorized as Open Go. This is the least costly construction condition.

2. Open Go Steep

This condition is applied for construction in open but topographically difficult areas (such as along the river bank or up a steep hill).

3. Parking Lot

Construction in relatively open parking lots requires pavement restoration and minor traffic control but has few utility conflicts.

4. Minor Street

This construction condition is applied in lightly traveled residential streets with some utilities and minor traffic control but fewer construction constraints than would be encountered in major streets.

5. Major Street with Few Utilities

Construction that is along streets that have few utilities will require sheeting, diversion of traffic, and substantial restoration but will be lower in cost than streets with a complex array of utilities.

6. Major Streets with Utilities

Construction in major streets that have many utilities will require sheeting, traffic diversion, restoration, and also relocation of utilities.

7. Bore/Jack

Where FMs must cross highways or railroads, costs for boring and jacking are applied.

8. River–Open Cut

Discussions with City personnel suggest that river crossings in Aurora are typically installed by open cutting in the river bottom. Based on these discussions, it is assumed for development of costs that approximately 4 feet of sediment overlays bedrock, so installations of pipes larger than 12 inches will require rock excavation.

For the purpose of alternatives analysis and conservative cost projections, it is assumed the maximum practical size pipe for installation is 84 inches. However, it is understood that, under final design, larger diameter sewers may be practical.

B. General Route Locations

Preliminary sewer location and anticipated construction conditions are described below. Note that segments of FM are identified by “from” and “to” intersection points such as wet weather pumping stations (WWPSs), which are described in more detail in Appendix H. Note that this describes the “universe” of potential FM routes, although the various alternatives may only require selected segments of these FMs. Please refer to Figure D.3-1.

1. North Side (CSOs 002, 003A, 021, 022, 023, and 027)

All potential north-south FM routes north of Stolp Island are planned to be constructed immediately parallel to the river bank. Much of this construction will be within Fox Valley Park District property and property planned as part of the City’s riverfront park and will require mitigation of construction impacts to respect this area’s use. The construction cost of these segments is based on the Parking Lot construction type, since construction of the new sewer may impact existing paths and lighting facilities.

The two river crossing segments (P20 and P26) apply the River–Open Cut construction condition.

2. Downtown (CSOs 015 and 018)

Because several buildings exist immediately adjacent to the river bank in this area, potential FM construction in the downtown area between Pinney/New York Ave. and Benton St. will require FM location in city streets. The majority of those FM segments have

been designated as Major Street with Utilities, with the exception of Pinney St., which is categorized as Minor Street. Construction of a potential river crossing from CSO 015 has been categorized as River–Open Cut.

3. Southeast Area (between CSOs 008 and 004)

The developer Sho-Deen is in the process of designing a mixed use development on the former industrial site between CSO 008 and the proposed new CSO 028 (PS 928 on Figure D.3-1). This plan will likely require relocating the existing FMWRD interceptor and will likely impact the routing of any proposed CSO-related sewer in this area. For the purpose of cost identification in the LTCP, a route at the periphery of the site has been selected, although this should not be construed as a route recommendation. Between CSO 008 and the proposed PS 928, the Open Go construction condition has been mostly applied, except for one segment of Parking Lot.

In addition to these costs, for segment P13, two additional costs have been assumed. First, based on reported environmental issues at this site, costs for special waste disposal have been added, assuming up to 15 feet of excavation depth may require disposal. Second, it is assumed that bedrock is relatively shallow and would require removal.

Between PS 928 and Hurds Island, crossing under the railroad applied the Bore/Jack construction condition and crossing the river applied River–Open Cut. All construction on the southeast half of Hurds Island applies to the Open Go Steep construction condition plus special waste disposal for known contamination up to 15 feet of excavation depth.

Construction between Hurds Island and CSO 004 applies a River–Open Cut crossing, Minor Street along Rosewood Ave., Parking Lot behind the businesses on Broadway and under the pedestrian walkway, and Open Go Steep to CSO 004.

4. Southwest Area (CSOs 001, 005, and 010)

This area of Aurora is more actively industrial than the other areas considered. Because of constraints between CSO 010 (1st St./Prairie St.) and CSO 005 (3rd St.), FM construction from CSO 010 is planned to cross the river (River–Open Cut) and then follow the west bank of Hurds Island (Open Go) and pass under the railroad via Bore/Jack construction. Construction from CSO 005 to join with this FM will apply a River–Open Cut crossing and Open Go Steep. Construction from CSO 005 to the south will parallel the railroad for a short segment (Open Go Steep) and then be constructed within a corridor parallel to River St. While a portion of this segment could be constructed in the open space on the east side of River St., the Major Street with Utilities construction condition has been applied, for conservatism. Special waste disposal has been assumed in the portion of P10 and P11 southeast of the railroad tracks.

Construction between CSO 001 and Areas A01 and A02 has been categorized as Minor Street within street rights-of-way and Open Go within the areas themselves.

5. Between CSO 001 and Fox Metro WWTP

Construction between CSO 001 and the proposed area A00 is anticipated to parallel the river in a combination of Open Go and Minor Street-type areas. The existence of the 69-inch interceptor between CSO 001 and the Fox Metro WWTP along the river bank will place constraints on the location of this route. It is assumed for cost purposes that a new FM would have both Open Go and Minor Street construction conditions in roughly equal proportions.

For the purpose of projecting costs, a route from Area A00 to the WWTP was identified (see Figure D.3-1), which consists primarily of Open Go with one Bore/Jack railroad crossing. It is understood that an actual FM route from CSO 001 to the WWTP will not likely cross Area A00 as shown; however, as this option appears an unlikely alternative for CSO control, further refinement of this route is not considered necessary at this time.

G.3 FORCE MAIN COST FUNCTIONS

Construction cost for FM installation primarily depends on FM length, diameter, and construction conditions. Table G.3-1 shows projected per foot construction costs for a range of FM sizes and construction conditions. These per foot costs are based on recent Illinois projects and obtaining material and installation costs from contractors specializing in sewer construction. Ductile iron pipe pricing is used for land and river construction conditions up to 60 inches and welded steel pipe pricing is applied for larger pipe. The cost of fittings, which can be substantial for large diameter force mains, is included in the per foot cost, based on an assumption of one elbow fitting every 500 feet. Capital, O,M&R, and present value costs are determined as described in Appendix D.1.

G.5 FORCE MAIN SIZING AND TOTAL PROJECT COST DETERMINATION

Based on the Alternative selected, the Tool and spreadsheet determine the total peak flow in every segment of FM. Each segment is sized based on a design peak flow velocity of 6 feet per second (fps) for all FMs larger than 12 inches and 5 fps for FMs 12 inches and smaller.

The Tool and spreadsheet analyses then determine the projected cost for each segment of FM, from the size and construction condition, multiplying that per foot cost by the FM segment length. For routes where size constraint required the installation of two or more pipes, the cost was calculated assuming no cost savings for parallel mains constructed on land. For river crossing construction, a 35 percent cost savings on any additional parallel pipe was assumed. The analysis determined total capital, O,M&R, and present value costs for the FMs for each alternative based on the assumptions described in Appendix D.

Table G.3-1 UNIT COSTS FOR FORCE MAIN CONSTRUCTION

	Construction Condition							
	1	2	3	4	5	6	7	8
Pipe Size	Open Go	Open Go Steep	Parking Lot	Minor Street	Major Street with Few Utilities	Major Street with Utilities	Bore/Jack	River - Open Cut
12	$ 182	$ 191	$ 254	$ 271	$ 337	$ 345	$ 766	$ 1,519
14	$ 194	$ 204	$ 270	$ 287	$ 353	$ 362	$ 786	$ 1,539
16	$ 201	$ 211	$ 280	$ 297	$ 363	$ 372	$ 830	$ 1,566
18	$ 214	$ 224	$ 296	$ 314	$ 380	$ 388	$ 904	$ 1,590
20	$ 226	$ 238	$ 310	$ 329	$ 395	$ 403	$ 1,044	$ 1,617
24	$ 245	$ 258	$ 336	$ 355	$ 421	$ 430	$ 1,069	$ 1,672
30	$ 258	$ 271	$ 378	$ 399	$ 465	$ 494	$ 1,300	$ 1,759
36	$ 303	$ 318	$ 448	$ 495	$ 562	$ 597	$ 1,641	$ 1,863
42	$ 667	$ 700	$ 830	$ 879	$ 946	$ 983	$ 2,290	$ 2,149
48	$ 866	$ 909	$ 1,044	$ 1,094	$ 1,160	$ 1,201	$ 2,952	$ 2,420
54	$ 1,060	$ 1,113	$ 1,255	$ 1,307	$ 1,373	$ 1,417	$ 3,745	$ 2,700
60	$ 1,206	$ 1,266	$ 1,414	$ 1,467	$ 1,533	$ 1,580	$ 4,268	$ 2,966
66	$ 1,297	$ 1,362	$ 1,521	$ 1,576	$ 1,642	$ 1,695	$ 4,781	$ 3,228
72	$ 1,450	$ 1,522	$ 1,688	$ 1,743	$ 1,810	$ 1,865	$ 4,844	$ 3,486
78	$ 1,530	$ 1,606	$ 1,781	$ 1,838	$ 1,904	$ 1,963	$ 5,766	$ 3,719
84	$ 1,681	$ 1,765	$ 1,945	$ 2,003	$ 2,070	$ 2,131	$ 5,827	$ 3,984

G.6 SYSTEM TOTAL DYNAMIC HEAD

An important design factor for pumping stations is the total dynamic head (TDH), which is determined in part by FM flows, pipe sizes, and pipe friction. TDH is the pressure that the pumps must operate against to convey flow into the FM. TDH, expressed in feet of water, includes "static head" plus "dynamic head." Static head is simply the elevation difference between the wet well low-water level in the pumping station and the elevation of the point where the wastewater is discharged to a condition at atmospheric pressure (or the controlling high point in the FM). Dynamic head is the pressure required to overcome the friction of the pipes. For a given pipe diameter, dynamic head loss increases exponentially as flow rate increases, as governed by the equation:

$$HL = 0.2083 \times (100 / C)^{1.852} \times Q^{1.852} / D^{4.87}$$

where:

HL = head loss per 100 feet of pipe (feet)
C = friction factor; ranges from 100 for older, rougher pipe to 140 for newer, smoother pipe.
Q = flow rate in the pipe (gpm)
D = pipe diameter (inches)

The large exponent on D indicates that changes in pipe diameter strongly affect dynamic head loss. Selection of FM diameter can have a significant impact on design requirements for the pumping stations. While allowing higher flow velocities decreases pipe cost, it does increase the cost of the pumping stations because of the higher TDH requirements. Projections of dynamic head loss in each pipe segment are calculated so that TDH at each pumping station can be applied for cost evaluation. Since operating TDH will range from the static head condition at very low flow rates to the design TDH at design flow rates, a choice of smaller pipes and therefore higher design velocity means a much wider range in operating head required, which is disadvantageous for optimum pump selection.

APPENDIX H
WET WEATHER PUMPING STATIONS

H.1 INTRODUCTION

This appendix discusses the wet weather pumping stations (WWPSs) that are integral to several options being considered for control of combined sewer overflows (CSOs) in the City of Aurora combined sanitary system (CSS). Topics include potential WWPS locations and their sizing, their design considerations, development of cost functions used in the screening and evaluation of alternatives, the determination of design total dynamic head (TDH) for each station, and methods for projecting WWPS costs.

H.2 WWPS LOCATIONS

Figure D.3-1 shows locations of all potential WWPSs considered in development of CSO control alternatives. Most of the potential WWPS locations are associated directly with a CSO and are intended to serve the CSO/basin for which they are named. There are a few exceptions to this: because CSO 018 is within the CSO 015 Basin, improvements at CSO 015 take into consideration overflows at CSO 018. Pumping Station (PS) 928 [North Ave. (East)] is intended to serve Basins 015, 018, and 008, eliminating the need for pumping stations at these locations. This location was proposed in a previous engineering report[1] and permitting a new outfall at this location has been discussed with the Illinois Environmental Protection Agency (IEPA). If constructed, this plan will eliminate CSOs 008, 015, and 018. In addition, because of their proximity, PSs at 001 and 004 may be sized to accept flow from both basins. (In the alternatives analysis, these PSs are referred to as PS901 and PS904, where the “9” indicates a PS that serves multiple basins.)

Most of the potential WWPS locations appear to have adequate space for a WWPS. However, siting PSs at downtown locations 008 and especially 015 may be problematic. The locations shown for PS 008 and 015 should be considered somewhat general, and, if constructed, a more detailed review of siting would need to be performed.

It should be noted that many of these potential WWPSs are included at the outset for completeness of the alternatives analysis and may not be anticipated for the final LTCP. This is because many of these locations either overflow infrequently or can be served by gravity sewer, storage, separation, or even regulator weir modifications. In a sense, the WWPS network may be viewed as a “starting point” in the alternatives analysis.

H.3 WWPS DESIGN CONSIDERATIONS

There are a number of important design considerations for pumping stations that affect their cost, operation, physical size, maintenance, and appearance. This section discusses these considerations in detail and presents the basis for the cost evaluation.

The WWPS network is intended to operate with the WWPSs in parallel as opposed to operating in series. Parallel operation means that networked WWPSs pump into a common force main and that no flow, once it has entered the network, is “double pumped.” This means that upstream pumping stations may have to pump against much higher heads; it also means that the head condition at

[1] “Proposed Relocation of 3 CSO Outfalls at One Location” WEDA, letter dated September 8, 2000.

each pumping station can vary considerably, depending on which other pump stations are in operation.

A. Flow Capacity

Flow capacity is the most important factor in determining the cost and physical size of pumping stations. As discussed in Appendix D, the design requirement is dictated by the peak flow to the WWPS during the 1-hour design storm. While pumping stations are "rated" for a particular peak flow at a particular TDH, the actual flow from the station can vary substantially depending on the level in the wet well and the pressure in the force main downstream. This contributes to the complexity of pumping station design and is discussed in the Pump Selection section below.

B. Total Dynamic Head (TDH)

As discussed in Appendix G-Force Mains, TDH is a measure of the pressure against which pumps in a pumping station must operate, as calculated based on the wet well and discharge elevations, flow rate, pipe diameter, and pipe friction. While the flow capacity for the pumping station is determined entirely by the basin flows, determination of the TDH depends on the relative elevations between the wet well low-water level and discharge (or other controlling) point and also depends on the selected alternative for the downstream condition (flow velocity and pipe friction factors). The alternatives analysis includes calculations of the TDH at each pumping station, based on the equations provided in Appendix G, assuming all the pumping stations are operating at design capacity simultaneously. Therefore, design WWPS TDHs for the alternative selected as the best overall option cannot be determined until all the other design alternatives (such as force main sizes and lengths) are determined.

C. Pump Station Layout

Large pumping stations come in two general configurations: submersible and wet well/dry well. In both configurations, wastewater flows from the gravity sewer into the wet well from which the wastewater is pumped.

In submersible pumping stations, the pumps sit directly within the station's wet well. Pump motors are immersed in the wastewater. The motors must be explosion-proof and waterproof. A vault houses the discharge piping, shut-off valves, and surge relief valves. A separate room houses the electrical controls and odor control system, where required. This configuration has relatively low cost because the structure is less complex, less piping is required, and the footprint is smaller, but maintenance is more difficult because pumps must be removed from the wet well for service. Each pump is designed with a vertical railing for pump removal and some type of hoist at the top of the wet well.

In wet well/dry well pumping stations, the pumps and motors are located in a room (the dry well) that is fully accessible to maintenance personnel. Suction piping draws from the adjacent wet well. Wet well/dry well configurations require a substantially larger "at depth" footprint than submersible pumping stations, making them generally more expensive to construct. Better access to equipment, however, provides operation and maintenance advantages. Both submersible and wet well/dry well stations employ centrifugal nonclog pumps.

Coarse screening (3-inch bar spacing) is recommended to prevent large items from damaging the pumps. Coarse screening could be accomplished with a bar rack or a screening basket on the wet well influent. The bar rack would required manual raking. The screening basket would be coupled with a rail system hoist to allow cleaning.

Based on the City of Aurora's emphasis on riverfront aesthetics, personnel preference for convenience of operation and maintenance, and the desire to conservatively predict overall CSO control costs, a wet well/dry well configuration with an attractive brick and block exterior has been applied for planning level projection of costs.

D. WWPS Influent Configuration

WWPSs designed for CSO control may apply to either of two concepts: (1) direct capture of CSOs, or (2) interceptor relief. In "direct capture," the CSO outfall is reconstructed to direct wastewater that cannot enter the interceptor to the WWPS influent. Any WWPS influent that exceeds pumping capacity exits the CSO outfall to the river. In "interceptor relief," the WWPSs are intended to capture all CSO and some or all flow from the trunk sewer. This configuration allows an upstream WWPS to provide potentially significant interceptor relief to downstream locations. Interceptor relief could be designed using mechanical or inflatable gate structures that activate (open) upon signal from the Supervisory Control and Data Acquisition (SCADA) system. In a modified configuration, a signal from SCADA adjusts the WWPS's low-water level (LWL) shutoff to draw down the interceptor only if required.

Generally speaking, the direct capture method has been assumed for the systemwide alternatives analysis; WWPSs have been sized based on projected peak CSO rates during 1-hour design storms. Since maximizing flow to the wastewater treatment plant (WWTP) via the interceptors is a high priority with the National CSO Control Policy, this is a reasonable approach.

However, having the ability to actively control system flows during large events offers operational advantage for preventing overflows. Therefore, cost functions include an allowance for gate structures to control diversion from the trunk sewer. It is recommended that options for achieving interceptor relief be evaluated during the design phase.

E. Pump Selection

1. Number of Pumps

WWPSs will typically be designed with multiple pumps (typically three to six), sized to provide "firm" capacity for the peak flow requirement, with the largest pump out of service. Smaller pumping stations can be designed with fewer pumps (two to three) while larger pumping stations that will see the greatest range of flow can be designed with four or more pumps. The availability of pumps that provide the required TDH/flow characteristics is also an important factor in determining number of pumps; very large pumps that are rarely ordered have a relatively high premium. On the other hand, a larger number of pumps increase the cost and footprint of the pumping station, but it also decreases the pumping

capacity that must be “discounted” in determining firm capacity. For the purpose of this analysis, it is assumed that each of the multiple pumps will be identically sized.

For projects where there is uncertainty and/or likelihood of future flow increase, additional wet well/dry well space should be provided for the addition of future pumps. For the purposes of general cost evaluation and facility sizing, it is assumed that the WWPS may require future capacity increases. To this end, WWPS layouts and cost functions consider the potential need to add one or two additional pumps, replace impellers, or upsize pumps.

2. Pump Curves

Because of the intended design of a parallel force main network and the variability of possible downstream conditions, the selection of pumps that will operate under the range of conditions is critical. Individual pumps are rated for a particular flow rate at a particular head condition, but they have a considerable potential for variability of output, depending on the level in the wet well and the pressure in the force main downstream. This phenomenon is described graphically by the typical downsloping pump curve, shown in Figure H.3-1. Because of this phenomenon, two identical pumps that each operate alone at 3,000 gpm will operate together at a flow less than 6,000 gpm. Two pumps running create a higher head in the discharge force main because of the greater friction losses, thereby reducing their output.

There are two other conditions that make pump operation and selection complex. First, all pumps have a maximum “shut-off” head beyond which they cannot operate, as shown on the left of the pump curve in Figure H.3-1. Therefore, running one or more high-head pumps in a pump station may mean that a low-head pump cannot be operated. In this case, a station may not be able to take advantage of its full “on paper” pumping capacity unless the pumps are well matched. Although not anticipated to be an issue for the City of Aurora, since gravity sewers provide the large majority of conveyance, this is an issue in CSO communites where existing PSs must be expanded to provide CSO control.

Second, pumps can also experience “run out,” when the pressure that the pump is working against is relatively low, and the pump operates at the far right end of its curve. Downstream facilities may receive more flow under these conditions than intended under design conditions. Motors must be sized to not overload under run out conditions.

As shown on the curve, operating near either the shut-off or run out conditions dramatically affects pump efficiency. Pump curves that are “steep” between shut-off and run out can provide relatively steady output for a wide range of head conditions and would be advantageous for this application, whereas flat pump curves are much more likely to be limited by their head capacity and would not be well-suited.

Pumping complexity is magnified for a citywide pressure system with interconnected force mains. If, for example, proposed WWPSs at North Ave. (East) (PS 928) and at Rathbone Ave. (PS 001) were connected to a common force main, the operation or nonoperation of one station affects the output of the other. If PS 928 were not designed with high enough

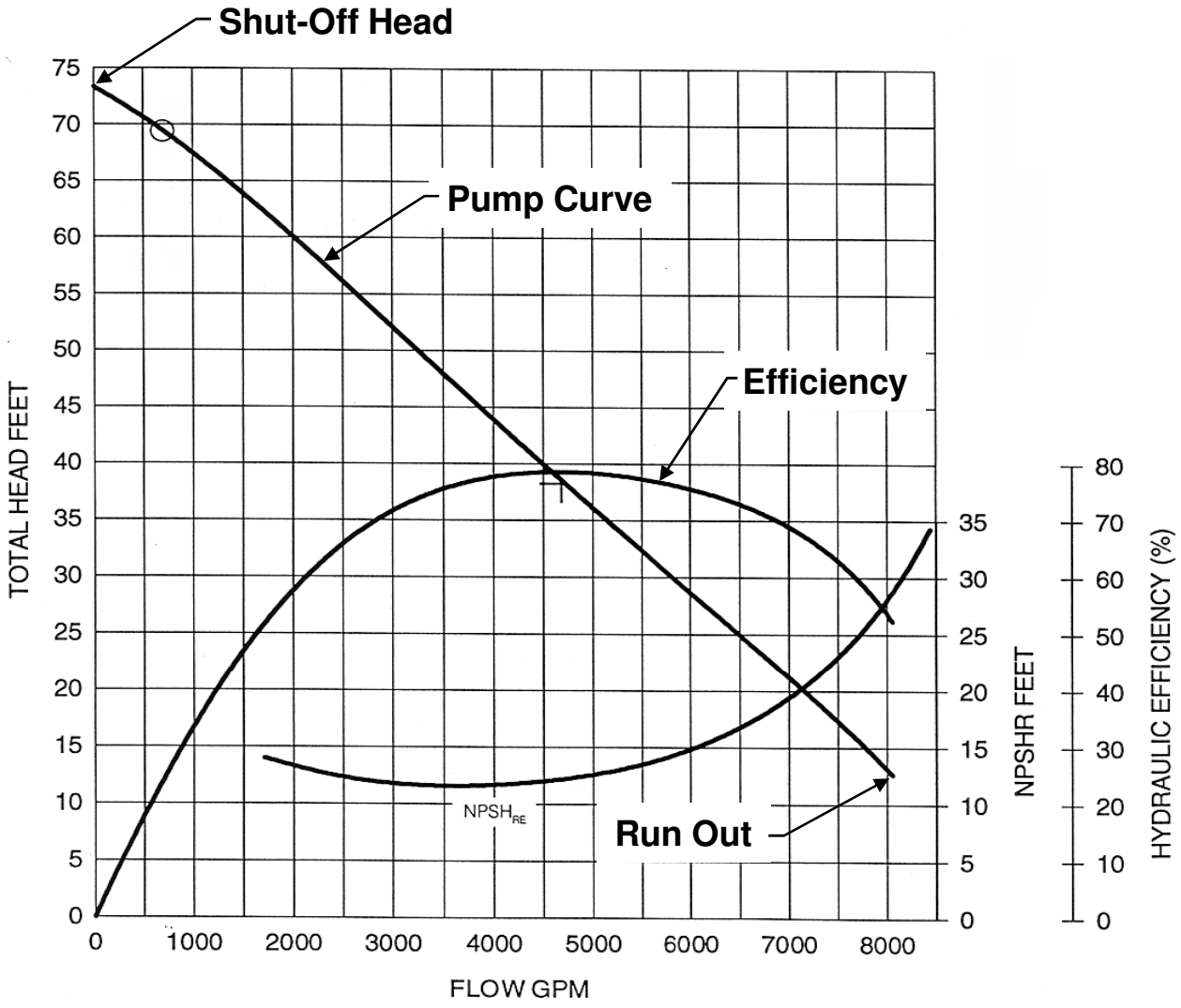


Figure used with permission of Flygt

Typical Pump Curve
Combined Sewer Overflow Long-Term Control Plan
City of Aurora, Illinois

STRAND ASSOCIATES, INC.® ENGINEERS

Figure H.3-1
1-181-001

overall head capability, for example, it is possible the operation of the PS 001 would prevent PS 928 from operating at its intended capacity. Calculations of systemwide cost must therefore take into account the way these PSs would interact.

The downward moderately steeply sloping pump curve shape also offers an advantage for CSO control. As previously mentioned, WWPSs are sized assuming all are simultaneously operating at their peak capacity. Because rainfall is rarely uniformly distributed in short intense events, some basins may "see" increases in flows much sooner than others. In a parallel system when fewer WWPSs are operating, the head condition will be lower and those that are operating will convey higher than rated flows. On Figure H.3-1, a reduction in TDH (y-axis) from 50 to 45 feet (10 percent) allows a flow increase from 3,250 to 3,800 (17 percent). In effect, then, WWPSs provide a somewhat higher level of control than the rated capacity under typical operating conditions.

If possible, pumps will be selected that allow for replacement of impellers (and possibly motors) for future increases in pumping station capacity. While selection of actual pumps to meet the requirements of each pumping station is beyond the scope of this LTCP, it will be important during the design phase to select these pumps carefully. Such an evaluation must also include provision for system protection from pressure surges by means of surge relief valves or other suitable systems.

3. Pump Type and Drives

For wet well/dry well stations, centrifugal pumps are the most common type of pump where large volumes of low percent solids content wastewater must be conveyed over long distances. Variable frequency drives (VFDs) allow these pumps to be operated at lower flow rates by turning down the speed of the motor. VFDs are very useful for wet weather applications where flows occur over a wide range and where head conditions must be controlled. Where pumps are designed only for the high flow condition, lower flows cause the pumps to turn on and off in a relatively short operation cycle, causing frequent changes to head conditions for other pumping stations, pressure surges, and potential damage from water hammer, and motor overheating from many starts. VFDs can increase pump cost by 50 percent or more, so it may be a cost-effective option to add VFDs to only two to three pumps in larger pumping stations with four or five pumps. This can be accomplished without greatly sacrificing operational flexibility since controllers can be designed to optimize pump use. For the purpose of the cost analysis, however, it will be assumed that all pumps will be equipped with VFDs since it gives all the pumps the ability to operate at lower head conditions that may prevail during less intense storms.

F. Controls

Successful optimization of the treatment capacity at the WWTP and the potential wet weather treatment facility (WWTF) will depend on centralized control of the system. Each pumping station will be monitored and controlled by SCADA operations at the plant via telemetry. In addition, specialized controls will be designed to optimize pump operations and will be necessary to signal pumping stations "interceptor relief" mode.

G. Redundant Power Sources and Generators

In combined sewer systems served by pumping stations, there exists a reliance on electrical power. To minimize the impact of localized power outages on the sewer system (and therefore on water quality), facilities are often designed with redundant power feeds from separate substations or with backup emergency generators.

While using redundant power feeds is a viable option to be considered during design, electric generators were assumed for development of costs, because of the large electrical demands from the WWPSs being considered. Cost functions for WWPSs include an electrical generator, automatic switchgear and, if necessary, paralleling gear to allow two generators to simultaneously operate.

H.4 WWPS COST FUNCTIONS

Because of the variety of scenarios evaluated in the Tool, development of a generalized cost function for WWPSs based on design flow and TDH is an essential step in alternatives evaluation. For this purpose, general cost evaluations are performed for a range of WWPS flow capacities and TDH taking into account structure purpose, costs, requirement, and so on as shown in Table H.4-1. A regression analysis was then performed to determine “best-fit” cost functions:

WWPS Capital Cost =	$4.1 M + $12,200 x mgd $^{0.9}$ x TDH $^{0.6}$
WWPS O,M&R Cost =	$55,000 + $150 x mgd $^{0.9}$ x TDH $^{0.87}$
WWPS Salvage Value =	$150,000+ $940 x mgd $^{0.9}$ x TDH $^{0.2}$
WWPS Present Value =	WWPS Capital Cost + WWPS O,M&R Cost x 20-year Cost Recovery Factor - WWPS Salvage Value

Table H.4-1 - WET WEATHER PUMPING STATION COST EVALUATION

Firm Capacity (mgd)	**7.2**	**30.3**	**86.5**	**144**	**180**
Total Dynamic Head (ft)	**20**	**20**	**20**	**20**	**20**
Capital Cost					
Pumps	**$ 74,200**	**$ 246,900**	**$ 641,600**	**$ 1,236,000**	**$ 1,483,200**
Pump Installation (35%)	**$ 26,000**	**$ 86,400**	**$ 224,600**	**$ 432,600**	**$ 519,100**
Pump Crane System	**$ 43,000**	**$ 48,000**	**$ 58,000**	**$ 70,000**	**$ 70,000**
VFDs total	**$ 55,600**	**$ 103,000**	**$ 170,000**	**$ 309,000**	**$ 370,800**
VFD installation (35%)	**$ 19,500**	**$ 36,100**	**$ 59,500**	**$ 108,200**	**$ 129,800**
Excavation, sheeting, dewatering	**$ 334,200**	**$ 402,800**	**$ 506,800**	**$ 564,500**	**$ 600,200**
Concrete	**$ 747,400**	**$ 955,400**	**$ 1,296,700**	**$ 1,484,200**	**$ 1,608,100**
Diversion Structure/CSO Modification	**$ 60,000**	**$ 100,000**	**$ 180,000**	**$ 270,000**	**$ 320,000**
Coarse Static Screening	**$ 10,000**	**$ 20,000**	**$ 30,000**	**$ 40,000**	**$ 50,000**
Control Building	**$ 182,000**	**$ 230,000**	**$ 303,000**	**$ 344,000**	**$ 370,000**
Subtotal	**$ 1,551,900**	**$ 2,228,600**	**$ 3,470,200**	**$ 4,858,500**	**$ 5,521,200**
Piping and Valves	$ 232,800	$ 334,300	$ 520,500	$ 728,800	$ 828,200
Division 5-10	$ 124,200	$ 178,300	$ 277,600	$ 388,700	$ 441,700
Electrical	$ 232,800	$ 334,300	$ 520,500	$ 728,800	$ 828,200
Backup Power	$ 28,000	$ 99,000	$ 287,000	$ 475,000	$ 593,000
Instrumentation & Controls	$ 124,200	$ 178,300	$ 277,600	$ 388,700	$ 441,700
HVAC	$ 77,600	$ 111,400	$ 173,500	$ 242,900	$ 276,100
Odor Control Required?	Yes	Yes	Yes	Yes	Yes
Odor Control	$ 57,000	$ 104,000	$ 145,000	$ 150,000	$ 150,000
Site Work	$ 77,600	$ 111,400	$ 173,500	$ 242,900	$ 276,100
Aesthetics	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Subtotal	**$ 2,556,100**	**$ 3,729,600**	**$ 5,895,400**	**$ 8,254,300**	**$ 9,406,200**
Contractor's GCs	$ 204,500	$ 298,400	$ 471,600	$ 660,300	$ 752,500
Engineering, Architecture, and Legal	$ 511,200	$ 745,900	$ 1,179,100	$ 1,650,900	$ 1,881,200
Contingencies	$ 766,800	$ 1,118,900	$ 1,768,600	$ 2,476,300	$ 2,821,900
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 4,040,000**	**$ 5,890,000**	**$ 9,310,000**	**$ 13,040,000**	**$ 14,860,000**
O,M&R					
Yearly Power Costs	$ 5,400	$ 17,500	$ 48,000	$ 79,200	$ 96,100
Maintenance supplies	$ 1,300	$ 3,500	$ 8,100	$ 15,500	$ 18,500
Yearly Labor Cost	$ 14,900	$ 15,900	$ 17,900	$ 18,900	$ 19,900
Replacement	$ 43,100	$ 71,400	$ 122,100	$ 189,000	$ 218,500
Total Annual O,M&R	$ 64,700	$ 108,300	$ 196,100	$ 302,600	$ 353,000
O,M&R Present Value	**$ 830,000**	**$ 1,390,000**	**$ 2,520,000**	**$ 3,890,000**	**$ 4,540,000**
Salvage Value					
20-Year Salvage Value	$ 369,800	$ 476,000	$ 652,200	$ 777,900	$ 849,800
Present Value Salvage	**$ 150,000**	**$ 190,000**	**$ 260,000**	**$ 310,000**	**$ 340,000**
Total Present Value	**$ 4,720,000**	**$ 7,090,000**	**$ 11,570,000**	**$ 16,620,000**	**$ 19,060,000**

Table H.4-1 - WET WEATHER PUMPING STATION COST EVALUATION

Firm Capacity (mgd)	**7.2**	**30.3**	**86.5**	**144**	**180**
Total Dynamic Head (ft)	**45**	**45**	**45**	**45**	**45**
Capital Cost					
Pumps	**$ 152,400**	**$ 355,300**	**$ 694,500**	**$ 1,053,200**	**$ 1,263,800**
Pump Installation (35%)	**$ 53,300**	**$ 124,400**	**$ 243,100**	**$ 368,600**	**$ 442,300**
Pump Crane System	**$ 43,000**	**$ 48,000**	**$ 58,000**	**$ 70,000**	**$ 70,000**
VFDs total	**$ 77,300**	**$ 136,000**	**$ 309,000**	**$ 386,300**	**$ 772,500**
VFD installation (35%)	**$ 27,100**	**$ 47,600**	**$ 108,200**	**$ 135,200**	**$ 270,400**
Excavation, sheeting, dewatering	**$ 334,200**	**$ 402,800**	**$ 506,800**	**$ 564,500**	**$ 600,200**
Concrete	**$ 747,400**	**$ 955,400**	**$ 1,296,700**	**$ 1,484,200**	**$ 1,608,100**
Diversion Structure/CSO Modification	**$ 60,000**	**$ 100,000**	**$ 180,000**	**$ 270,000**	**$ 320,000**
Coarse Static Screening	**$ 10,000**	**$ 20,000**	**$ 30,000**	**$ 40,000**	**$ 50,000**
Control Building	**$ 182,000**	**$ 230,000**	**$ 303,000**	**$ 344,000**	**$ 370,000**
Subtotal	**$ 1,686,700**	**$ 2,419,500**	**$ 3,729,300**	**$ 4,716,000**	**$ 5,767,300**
Piping and Valves	$ 253,000	$ 362,900	$ 559,400	$ 707,400	$ 865,100
Division 5-10	$ 134,900	$ 193,600	$ 298,300	$ 377,300	$ 461,400
Electrical	$ 253,000	$ 362,900	$ 559,400	$ 707,400	$ 865,100
Backup Power	$ 55,000	$ 224,000	$ 629,000	$ 1,049,000	$ 1,311,000
Instrumentation & Controls	$ 134,900	$ 193,600	$ 298,300	$ 377,300	$ 461,400
HVAC	$ 84,300	$ 121,000	$ 186,500	$ 235,800	$ 288,400
Odor Control Required?	Yes	Yes	Yes	Yes	Yes
Odor Control	$ 57,000	$ 104,000	$ 145,000	$ 150,000	$ 150,000
Site Work	$ 84,300	$ 121,000	$ 186,500	$ 235,800	$ 288,400
Aesthetics	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Subtotal	**$ 2,793,100**	**$ 4,152,500**	**$ 6,641,700**	**$ 8,606,000**	**$ 10,508,100**
Contractor's GCs	$ 223,400	$ 332,200	$ 531,300	$ 688,500	$ 840,600
Engineering, Architecture, and Legal	$ 558,600	$ 830,500	$ 1,328,300	$ 1,721,200	$ 2,101,600
Contingencies	$ 837,900	$ 1,245,800	$ 1,992,500	$ 2,581,800	$ 3,152,400
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 4,410,000**	**$ 6,560,000**	**$ 10,490,000**	**$ 13,600,000**	**$ 16,600,000**
O,M&R					
Yearly Power Costs	$ 10,700	$ 39,200	$ 105,000	$ 175,000	$ 212,300
Maintenance supplies	$ 2,300	$ 4,900	$ 10,000	$ 14,400	$ 20,400
Yearly Labor Cost	$ 14,900	$ 15,900	$ 17,900	$ 18,900	$ 19,900
Replacement	$ 51,400	$ 83,300	$ 141,400	$ 183,900	$ 246,900
Total Annual O,M&R	$ 79,300	$ 143,300	$ 274,300	$ 392,200	$ 499,500
O,M&R Present Value	**$ 1,020,000**	**$ 1,840,000**	**$ 3,530,000**	**$ 5,050,000**	**$ 6,430,000**
Salvage Value					
20-Year Salvage Value	$ 375,200	$ 483,700	$ 662,700	$ 772,100	$ 859,800
Present Value Salvage	**$ 150,000**	**$ 200,000**	**$ 270,000**	**$ 310,000**	**$ 350,000**
Total Present Value	**$ 5,280,000**	**$ 8,200,000**	**$ 13,750,000**	**$ 18,340,000**	**$ 22,680,000**

Table H.4-1 - WET WEATHER PUMPING STATION COST EVALUATION

Firm Capacity (mgd)	**7.2**	**30.3**	**86.5**	**144**	**180**
Total Dynamic Head (ft)	**75**	**75**	**75**	**75**	**75**
Capital Cost					
Pumps	**$ 184,500**	**$ 361,000**	**$ 814,700**	**$ 1,596,500**	**$ 1,915,800**
Pump Installation (35%)	**$ 64,600**	**$ 126,400**	**$ 285,100**	**$ 558,800**	**$ 670,500**
Pump Crane System	**$ 43,000**	**$ 48,000**	**$ 58,000**	**$ 70,000**	**$ 70,000**
VFDs total	**$ 86,500**	**$ 218,400**	**$ 515,000**	**$ 643,800**	**$ 1,223,600**
VFD installation (35%)	**$ 30,300**	**$ 76,400**	**$ 180,300**	**$ 225,300**	**$ 428,300**
Excavation, sheeting, dewatering	**$ 334,200**	**$ 402,800**	**$ 506,800**	**$ 564,500**	**$ 600,200**
Concrete	**$ 747,400**	**$ 955,400**	**$ 1,296,700**	**$ 1,484,200**	**$ 1,608,100**
Diversion Structure/CSO Modification	**$ 60,000**	**$ 100,000**	**$ 180,000**	**$ 270,000**	**$ 320,000**
Coarse Static Screening	**$ 10,000**	**$ 20,000**	**$ 30,000**	**$ 40,000**	**$ 50,000**
Control Building	**$ 182,000**	**$ 230,000**	**$ 303,000**	**$ 344,000**	**$ 370,000**
Subtotal	**$ 1,742,500**	**$ 2,538,400**	**$ 4,169,600**	**$ 5,797,100**	**$ 7,256,500**
Piping and Valves	$ 261,400	$ 380,800	$ 625,400	$ 869,600	$ 1,088,500
Division 5-10	$ 139,400	$ 203,100	$ 333,600	$ 463,800	$ 580,500
Electrical	$ 261,400	$ 380,800	$ 625,400	$ 869,600	$ 1,088,500
Backup Power	$ 82,000	$ 373,000	$ 900,000	$ 1,744,000	$ 2,200,000
Instrumentation & Controls	$ 139,400	$ 203,100	$ 333,600	$ 463,800	$ 580,500
HVAC	$ 87,100	$ 126,900	$ 208,500	$ 289,900	$ 362,800
Odor Control Required?	Yes	Yes	Yes	Yes	Yes
Odor Control	$ 57,000	$ 104,000	$ 145,000	$ 150,000	$ 150,000
Site Work	$ 87,100	$ 126,900	$ 208,500	$ 289,900	$ 362,800
Aesthetics	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Subtotal	**$ 2,907,300**	**$ 4,487,000**	**$ 7,599,600**	**$ 10,987,700**	**$ 13,720,100**
Contractor's GCs	$ 232,600	$ 359,000	$ 608,000	$ 879,000	$ 1,097,600
Engineering, Architecture, and Legal	$ 581,500	$ 897,400	$ 1,519,900	$ 2,197,500	$ 2,744,000
Contingencies	$ 872,200	$ 1,346,100	$ 2,279,900	$ 3,296,300	$ 4,116,000
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 4,590,000**	**$ 7,090,000**	**$ 12,010,000**	**$ 17,360,000**	**$ 21,680,000**
O,M&R					
Yearly Power Costs	$ 17,000	$ 65,300	$ 175,000	$ 290,900	$ 352,800
Maintenance supplies	$ 2,700	$ 5,800	$ 13,300	$ 22,400	$ 31,400
Yearly Labor Cost	$ 14,900	$ 15,900	$ 17,900	$ 18,900	$ 19,900
Replacement	$ 55,000	$ 92,800	$ 173,400	$ 253,300	$ 345,800
Total Annual O,M&R	$ 89,600	$ 179,800	$ 379,600	$ 585,500	$ 749,900
O,M&R Present Value	**$ 1,150,000**	**$ 2,310,000**	**$ 4,880,000**	**$ 7,530,000**	**$ 9,650,000**
Salvage Value					
20-Year Salvage Value	$ 377,500	$ 488,600	$ 680,500	$ 815,900	$ 920,100
Present Value Salvage	**$ 150,000**	**$ 200,000**	**$ 280,000**	**$ 330,000**	**$ 370,000**
Total Present Value	**$ 5,590,000**	**$ 9,200,000**	**$ 16,610,000**	**$ 24,560,000**	**$ 30,960,000**

Table H.4-1 - WET WEATHER PUMPING STATION COST EVALUATION

Firm Capacity (mgd)	**7.2**	**30.3**	**86.5**	**144**	**180**
Total Dynamic Head (ft)	**140**	**140**	**140**	**140**	**140**
Capital Cost					
Pumps	**$ 196,200**	**$ 488,200**	**$ 1,305,500**	**$ 2,060,000**	**$ 2,472,000**
Pump Installation (35%)	**$ 68,700**	**$ 170,900**	**$ 456,900**	**$ 721,000**	**$ 865,200**
Pump Crane System	**$ 43,000**	**$ 48,000**	**$ 58,000**	**$ 70,000**	**$ 70,000**
VFDs total	**$ 117,400**	**$ 515,000**	**$ 1,148,500**	**$ 1,900,400**	**$ 2,280,400**
VFD installation (35%)	**$ 41,100**	**$ 180,300**	**$ 402,000**	**$ 665,100**	**$ 798,100**
Excavation, sheeting, dewatering	**$ 334,200**	**$ 402,800**	**$ 506,800**	**$ 564,500**	**$ 600,200**
Concrete	**$ 747,400**	**$ 955,400**	**$ 1,296,700**	**$ 1,484,200**	**$ 1,608,100**
Diversion Structure/CSO Modification	**$ 60,000**	**$ 100,000**	**$ 180,000**	**$ 270,000**	**$ 320,000**
Coarse Static Screening	**$ 10,000**	**$ 20,000**	**$ 30,000**	**$ 40,000**	**$ 50,000**
Control Building	**$ 182,000**	**$ 230,000**	**$ 303,000**	**$ 344,000**	**$ 370,000**
Subtotal	**$ 1,800,000**	**$ 3,110,600**	**$ 5,687,400**	**$ 8,119,200**	**$ 9,434,000**
Piping and Valves	$ 270,000	$ 466,600	$ 853,100	$ 1,217,900	$ 1,415,100
Division 5-10	$ 144,000	$ 248,800	$ 455,000	$ 649,500	$ 754,700
Electrical	$ 270,000	$ 466,600	$ 853,100	$ 1,217,900	$ 1,415,100
Backup Power	$ 166,000	$ 687,000	$ 1,965,000	$ 2,795,000	$ 3,300,000
Instrumentation & Controls	$ 144,000	$ 248,800	$ 455,000	$ 649,500	$ 754,700
HVAC	$ 90,000	$ 155,500	$ 284,400	$ 406,000	$ 471,700
Odor Control Required?	Yes	Yes	Yes	Yes	Yes
Odor Control	$ 57,000	$ 104,000	$ 145,000	$ 150,000	$ 150,000
Site Work	$ 90,000	$ 155,500	$ 284,400	$ 406,000	$ 471,700
Aesthetics	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Subtotal	**$ 3,081,000**	**$ 5,693,400**	**$ 11,032,400**	**$ 15,661,000**	**$ 18,217,000**
Contractor's GCs	$ 246,500	$ 455,500	$ 882,600	$ 1,252,900	$ 1,457,400
Engineering, Architecture, and Legal	$ 616,200	$ 1,138,700	$ 2,206,500	$ 3,132,200	$ 3,643,400
Contingencies	$ 924,300	$ 1,708,000	$ 3,309,700	$ 4,698,300	$ 5,465,100
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 4,870,000**	**$ 9,000,000**	**$ 17,430,000**	**$ 24,740,000**	**$ 28,780,000**
O,M&R					
Yearly Power Costs	$ 31,800	$ 120,200	$ 327,600	$ 542,900	$ 658,700
Maintenance supplies	$ 3,100	$ 10,000	$ 24,500	$ 39,600	$ 47,500
Yearly Labor Cost	$ 14,900	$ 15,900	$ 17,900	$ 18,900	$ 19,900
Replacement	$ 59,200	$ 135,400	$ 280,700	$ 427,900	$ 505,100
Total Annual O,M&R	$ 109,000	$ 281,500	$ 650,700	$ 1,029,300	$ 1,231,200
O,M&R Present Value	**$ 1,400,000**	**$ 3,620,000**	**$ 8,370,000**	**$ 13,250,000**	**$ 15,840,000**
Salvage Value					
20-Year Salvage Value	$ 379,800	$ 511,700	$ 741,900	$ 909,900	$ 1,008,200
Present Value Salvage	**$ 150,000**	**$ 210,000**	**$ 300,000**	**$ 370,000**	**$ 410,000**
Total Present Value	**$ 6,120,000**	**$ 12,410,000**	**$ 25,500,000**	**$ 37,620,000**	**$ 44,210,000**

Table H.4-1 - WET WEATHER PUMPING STATION COST EVALUATION

Firm Capacity (mgd)	**7.2**	**30.3**	**86.5**	**144**	**180**
Total Dynamic Head (ft)	**200**	**200**	**200**	**200**	**200**
Capital Cost					
Pumps	**$ 270,400**	**$ 488,200**	**$ 1,305,500**	**$ 2,575,000**	**$ 3,090,000**
Pump Installation (35%)	**$ 94,600**	**$ 170,900**	**$ 456,900**	**$ 901,300**	**$ 1,081,500**
Pump Crane System	**$ 43,000**	**$ 48,000**	**$ 58,000**	**$ 70,000**	**$ 70,000**
VFDs total	**$ 231,800**	**$ 515,000**	**$ 1,627,400**	**$ 2,719,200**	**$ 3,263,000**
VFD installation (35%)	**$ 81,100**	**$ 180,300**	**$ 569,600**	**$ 951,700**	**$ 1,142,100**
Excavation, sheeting, dewatering	**$ 334,200**	**$ 402,800**	**$ 506,800**	**$ 564,500**	**$ 600,200**
Concrete	**$ 747,400**	**$ 955,400**	**$ 1,296,700**	**$ 1,484,200**	**$ 1,608,100**
Diversion Structure/CSO Modification	**$ 60,000**	**$ 100,000**	**$ 180,000**	**$ 270,000**	**$ 320,000**
Coarse Static Screening	**$ 10,000**	**$ 20,000**	**$ 30,000**	**$ 40,000**	**$ 50,000**
Control Building	**$ 182,000**	**$ 230,000**	**$ 303,000**	**$ 344,000**	**$ 370,000**
Subtotal	**$ 2,054,500**	**$ 3,110,600**	**$ 6,333,900**	**$ 9,919,900**	**$ 11,594,900**
Piping and Valves	$ 308,200	$ 466,600	$ 950,100	$ 1,488,000	$ 1,739,200
Division 5-10	$ 164,400	$ 248,800	$ 506,700	$ 793,600	$ 927,600
Electrical	$ 308,200	$ 466,600	$ 950,100	$ 1,488,000	$ 1,739,200
Backup Power	$ 232,000	$ 985,000	$ 2,531,000	$ 3,592,000	$ 4,255,000
Instrumentation & Controls	$ 164,400	$ 248,800	$ 506,700	$ 793,600	$ 927,600
HVAC	$ 102,700	$ 155,500	$ 316,700	$ 496,000	$ 579,700
Odor Control Required?	Yes	Yes	Yes	Yes	Yes
Odor Control	$ 57,000	$ 104,000	$ 145,000	$ 150,000	$ 150,000
Site Work	$ 102,700	$ 155,500	$ 316,700	$ 496,000	$ 579,700
Aesthetics	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Subtotal	**$ 3,544,100**	**$ 5,991,400**	**$ 12,606,900**	**$ 19,267,100**	**$ 22,542,900**
Contractor's GCs	$ 283,500	$ 479,300	$ 1,008,600	$ 1,541,400	$ 1,803,400
Engineering, Architecture, and Legal	$ 708,800	$ 1,198,300	$ 2,521,400	$ 3,853,400	$ 4,508,600
Contingencies	$ 1,063,200	$ 1,797,400	$ 3,782,100	$ 5,780,100	$ 6,762,900
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 5,600,000**	**$ 9,470,000**	**$ 19,920,000**	**$ 30,440,000**	**$ 35,620,000**
O,M&R					
Yearly Power Costs	$ 44,500	$ 172,300	$ 465,500	$ 776,500	$ 942,000
Maintenance supplies	$ 5,000	$ 10,000	$ 29,300	$ 52,900	$ 63,500
Yearly Labor Cost	$ 14,900	$ 15,900	$ 17,900	$ 18,900	$ 19,900
Replacement	$ 77,500	$ 135,400	$ 334,100	$ 557,700	$ 660,800
Total Annual O,M&R	$ 141,900	$ 333,600	$ 846,800	$ 1,406,000	$ 1,686,200
O,M&R Present Value	**$ 1,830,000**	**$ 4,290,000**	**$ 10,900,000**	**$ 18,090,000**	**$ 21,700,000**
Salvage Value					
20-Year Salvage Value	$ 390,100	$ 511,700	$ 768,100	$ 982,800	$ 1,095,700
Present Value Salvage	**$ 160,000**	**$ 210,000**	**$ 310,000**	**$ 400,000**	**$ 440,000**
Total Present Value	**$ 7,270,000**	**$ 13,550,000**	**$ 30,510,000**	**$ 48,130,000**	**$ 56,880,000**

APPENDIX I
STORAGE

I.1 INTRODUCTION

Appendix D Alternatives Analysis discusses the options of providing "local storage" at combined sewer overflows (CSOs) or of providing "remote storage" to store flows from several CSOs. Appendix D concluded that applying local storage as the primary form of CSO abatement was not practical for Aurora because of volume requirements, land availability, and aesthetics. Three storage locations near CSOs 001, 021, and 023 are evaluated and it appears storage is not as cost-effective as other alternatives within basins served by CSOs 021 and 023, but that storage has a significant potential to reduce cost at the CSO 001 basin, especially if combined with wet weather treatment.

The purpose of this appendix is to show the locations considered for storage, describe design considerations assumed, develop cost functions, and show how design sizing is determined. Most of the alternatives evaluations regarding storage can be found in Appendix D.

I.2 PROPOSED STORAGE LOCATIONS

Figure D.3-1 shows the general locations of potential storage facilities considered in the alternatives analysis, with basic site information in Table I.2-1. (Please see Appendix D.3.A for a discussion on how these locations are identified.)

CSO Basin	Storage Designation	Location	Maximum Footprint (ft)	Max Volume (mil gal), 20 ft SWD	Max Volume (mil gal), 35 ft SWD
CSO 001	St 001	Area A02 - Rathbone	400 x 450	26.9	47.1
CSO 021	St 021	Police Station Site	150 x 200	4.5	7.9
CSO 023	St 023	McCullough Park	250 x 250	9.4	16.3

Table I.2-1 Potential Storage Area Information

For the screening process, potential sites for storage are determined from aerial photographs and discussions with City of Aurora personnel.

I.3 DESIGN CONSIDERATIONS

Storage facilities can be constructed above ground or below ground. Tanks constructed below ground can be circular wire-wound concrete or rectangular cast-in-place, with a side water depth (SWD) of 20 feet up to about 35 feet. Alternately, some larger communities have constructed deep large diameter tunnels for CSO storage and this appears to be a possible alternative for Aurora. An advantage to underground storage is that flow into the facility can possibly be accomplished by gravity, if the influent gravity sewer is shallow enough. Once the system recovers from the storm event, the wastewater is pumped from the underground storage into the gravity sewers for conveyance to the WWTP.

Aboveground facilities will generally be steel or concrete wire-wound cylindrical tanks, which are generally available in height increments of 8 feet, such as 24 feet. CSO would need to be pumped into the tank, requiring a larger WWPS designed for peak flow rates. While discharge from storage back to the gravity system could be by gravity, there will need to be a practical means to control

that flow, and another low head pumping station may be necessary. Construction of aboveground storage can be somewhat less costly than underground storage; however, there can be a negative visual impact.

Because of the level of importance the City of Aurora places on aesthetics, particularly at riverfront areas, only belowground storage will be considered in the LTCP.

I.4 COSTS

To project cost functions for underground local storage, costs are developed for a range of sizes, as shown in Table I.4-1. These cost projections assume:

1. 20-foot SWD for smaller storage tanks, up to 35-foot SWD for larger tanks.
2. 7 feet of freeboard.
3. Sizes ranging from 25 feet by 25 feet to 500 feet by 500 feet.
4. Concrete Structure with:
   a. 2-foot-thick walls and base slab.
   b. 2-foot columns on 25-foot centers.
   c. 1-foot-thick top slab with 8 feet of cover.
5. Submersible in-tank low-head discharge pumping station with two to three pumps, sized to empty the tank in a minimum of one day, with a maximum discharge pumping rate of 25 mgd.
6. Tipping bucket facilities for cleaning.
7. Odor control.
8. Possible rock excavation below 15 feet, for which a “rock contingency” has been added to the capital cost.

Based on the range of sizes (0.1 to 64 mil gal) analyzed, underground storage costs were determined to be as shown in Table I.4-2. The spreadsheet and Tool analyses applied lookup functions based on the costs determined in Table I.4-1.

	<0.4 mil gal	0.4 - 4 mil gal	4 - 30 mil gal	>30 mil gal
Capital Cost	>$5/gal	$2.50-$5/gal	$1.50-$2.50/gal	$1.50/gal
Yearly O,M&R	$0.04-$0.2/gal	$0.01-$0.04/gal	$0.007-$0.01/gal	$0.005-$0.007/gal
Present Value	>$5/gal	$2.50-$5/gal	$1.50-$2.50/gal	$1.50/gal

Table I.4-2 Storage Costs

In addition to these costs, it is also assumed that all flow into storage facilities will be screened with mechanical bar screens. These cost functions are developed based on discussions of screening in Appendix F. Table I.4-3 shows costs developed for a range of screening capacities. From this, the following cost functions were derived for screening:

TABLE I.4-1 STORAGE COST FUNCTION ANALYSIS

CAPITAL COSTS

Design Criteria									
Volume (MG)	**0.092**	**0.4**	**1.8**	**4.3**	**8.2**	**13.7**	**21.1**	**30.5**	**64.1**
Volume (cf)	**13,000**	**55,000**	**240,000**	**585,000**	**1,120,000**	**1,875,000**	**2,880,000**	**4,165,000**	**8,750,000**
Excavation, Dewatering, and Fill	**$ 200,000**	**$ 360,000**	**$ 770,000**	**$ 1,320,000**	**$ 2,010,000**	**$ 2,860,000**	**$ 3,880,000**	**$ 5,100,000**	**$ 8,800,000**
Concrete	**$ 130,000**	**$ 366,000**	**$ 1,164,000**	**$ 2,417,000**	**$ 4,139,000**	**$ 6,343,000**	**$ 9,045,000**	**$ 12,257,000**	**$ 24,306,000**
Discharge Pumps	**$ 61,000**	**$ 73,000**	**$ 130,000**	**$ 304,000**	**$ 507,000**	**$ 737,000**	**$ 993,000**	**$ 1,138,000**	**$ 1,126,000**
Odor Control and Cleaning Facilities	**$ 60,000**	**$ 148,000**	**$ 392,000**	**$ 728,000**	**$ 1,143,000**	**$ 1,630,000**	**$ 2,190,000**	**$ 2,820,000**	**$ 4,952,000**
Site Work	**$ 114,000**	**$ 122,000**	**$ 142,000**	**$ 169,000**	**$ 202,000**	**$ 241,000**	**$ 287,000**	**$ 339,000**	**$ 521,000**
Electrical	**$ 23,000**	**$ 33,000**	**$ 68,000**	**$ 143,000**	**$ 235,000**	**$ 344,000**	**$ 471,000**	**$ 580,000**	**$ 820,000**
Instrumentation and Controls	**$ 23,000**	**$ 33,000**	**$ 68,000**	**$ 143,000**	**$ 235,000**	**$ 344,000**	**$ 471,000**	**$ 580,000**	**$ 820,000**
Total Construction	**$ 611,000**	**$ 1,135,000**	**$ 2,734,000**	**$ 5,224,000**	**$ 8,471,000**	**$ 12,499,000**	**$ 17,337,000**	**$ 22,814,000**	**$ 41,345,000**
Contractor's GCs	$ 49,000	$ 91,000	$ 219,000	$ 418,000	$ 678,000	$ 1,000,000	$ 1,387,000	$ 1,825,000	$ 3,308,000
Engineering, Architecture, and Legal	$ 122,000	$ 227,000	$ 547,000	$ 1,045,000	$ 1,694,000	$ 2,500,000	$ 3,467,000	$ 4,563,000	$ 8,269,000
Contingencies	$ 183,000	$ 341,000	$ 820,000	$ 1,567,000	$ 2,541,000	$ 3,750,000	$ 5,201,000	$ 6,844,000	$ 12,404,000
Rock Contingency	$ 71,000	$ 228,000	$ 824,000	$ 1,867,000	$ 3,431,000	$ 5,587,000	$ 8,410,000	$ 11,972,000	$ 24,659,000
Land (included separately)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost	**$ 1,036,000**	**$ 2,022,000**	**$ 5,144,000**	**$ 10,121,000**	**$ 16,815,000**	**$ 25,336,000**	**$ 35,802,000**	**$ 48,018,000**	**$ 89,985,000**
Capital Cost per Gallon	$ 11.31	$ 5.02	$ 2.92	$ 2.36	$ 2.05	$ 1.84	$ 1.70	$ 1.57	$ 1.40
O,M&R									
Labor Cost	$ 10,000	$ 10,000	$ 11,000	$ 12,900	$ 15,900	$ 19,900	$ 25,900	$ 32,900	$ 57,800
Power Costs									
Yearly Power	$ 199	$ 391	$ 1,228	$ 2,874	$ 5,578	$ 9,628	$ 15,338	$ 21,075	$ 33,311
Replacement	$ 4,836	$ 7,890	$ 17,688	$ 35,250	$ 57,456	$ 84,497	$ 116,566	$ 148,888	$ 241,276
Yearly O,M&R	$ 15,000	$ 18,000	$ 30,000	$ 51,000	$ 79,000	$ 114,000	$ 158,000	$ 203,000	$ 332,000
20-Year O,M&R	**$ 193,000**	**$ 232,000**	**$ 386,000**	**$ 656,000**	**$ 1,017,000**	**$ 1,467,000**	**$ 2,033,000**	**$ 2,612,000**	**$ 4,272,000**
SALVAGE	**$ 70,000**	**$ 167,000**	**$ 460,000**	**$ 896,000**	**$ 1,479,000**	**$ 2,218,000**	**$ 3,120,000**	**$ 4,192,000**	**$ 8,000,000**
PRESENT VALUE	**$ 1,159,000**	**$ 2,087,000**	**$ 5,070,000**	**$ 9,881,000**	**$ 16,353,000**	**$ 24,585,000**	**$ 34,715,000**	**$ 46,438,000**	**$ 86,257,000**
Present Value Cost per Gallon	$ 12.65	$ 5.18	$ 2.88	$ 2.30	$ 1.99	$ 1.79	$ 1.64	$ 1.52	$ 1.34

TABLE I.4-3 - SCREENING FOR STORAGE COSTS

Facility Capacity (mgd)	5	10	25	50	100
Capital Costs					
Equipment & Installation	**$ 625,860**	**$ 625,860**	**$ 655,020**	**$ 713,205**	**$ 834,840**
Excavation, sheeting, dewatering	**$ 49,100**	**$ 60,800**	**$ 82,700**	**$ 107,900**	**$ 132,500**
Concrete and Masonry (Div 3,4)	**$ 254,900**	**$ 390,800**	**$ 660,500**	**$ 986,900**	**$ 1,317,300**
Subtotal	**$ 929,860**	**$ 1,077,460**	**$ 1,398,220**	**$ 1,808,005**	**$ 2,284,640**
Piping and Valves	$ 46,500	$ 53,900	$ 69,900	$ 90,400	$ 114,200
Electrical	$ 139,500	$ 161,600	$ 209,700	$ 271,200	$ 342,700
Instrumentation & Controls	$ 74,400	$ 86,200	$ 111,900	$ 144,600	$ 182,800
HVAC	$ 46,500	$ 53,900	$ 69,900	$ 90,400	$ 114,200
Odor Control	$ 46,500	$ 53,900	$ 69,900	$ 90,400	$ 114,200
Site Work	$ 46,500	$ 53,900	$ 69,900	$ 90,400	$ 114,200
Div 5-10	$ 139,500	$ 161,600	$ 209,700	$ 271,200	$ 342,700
Subtotal	**$ 1,469,300**	**$ 1,702,500**	**$ 2,209,100**	**$ 2,856,600**	**$ 3,609,600**
Contractor's GCs	$ 117,500	$ 136,200	$ 176,700	$ 228,500	$ 288,800
Engineering, Architecture, and Legal	$ 293,900	$ 340,500	$ 441,800	$ 571,300	$ 721,900
Contingencies	$ 440,800	$ 510,800	$ 662,700	$ 857,000	$ 1,082,900
Land (included separately)	$ -	$ -	$ -	$ -	$ -
TOTAL Capital Cost	**$ 2,320,000**	**$ 2,690,000**	**$ 3,490,000**	**$ 4,510,000**	**$ 5,700,000**
Cost per mgd	$ 464,000	$ 269,000	$ 139,600	$ 90,200	$ 57,000
O,M&R					
Maintenance supplies	$ 4,600	$ 4,600	$ 4,900	$ 5,300	$ 6,200
Yearly Labor Cost	$ 19,900	$ 20,900	$ 20,900	$ 22,900	$ 24,900
Replacement	$ 30,400	$ 35,300	$ 45,900	$ 59,200	$ 74,900
Total Annual O,M&R	$ 54,900	$ 60,800	$ 71,700	$ 87,400	$ 106,000
O,M&R Present Value	**$ 710,000**	**$ 780,000**	**$ 920,000**	**$ 1,120,000**	**$ 1,360,000**
Salvage Value					
Present Value Salvage	**$ 100,000**	**$ 140,000**	**$ 210,000**	**$ 310,000**	**$ 410,000**
Total Present Value	**$ 2,930,000**	**$ 3,330,000**	**$ 4,200,000**	**$ 5,320,000**	**$ 6,650,000**

Screening Capital Cost = $1.24 M x mgd $^{0.33}$
Screening O,M&R Cost = $33,900 x mgd $^{0.24}$
Screening Present Value = $1.63 M x mgd $^{0.30}$

I.5 PROJECTING LOCAL STORAGE VOLUMES

Determining the volume of CSO storage to provide at a particular location is somewhat more complex than sizing a WWPS, which is based on peak flows. This is because, while longer duration storms would have the largest flow volume, the largest (critical) CSO volume may occur in short, medium, or long duration storms. The purpose of this section is to show how local storage volumes are projected for evaluation in the alternatives analysis.

A. CSO 021 (W. Park Ave.) and CSO 023 (W. Illinois Street) Storage

The purpose of storage at CSOs 021 and 023 is to capture and store the overflow from these locations until there is enough system capacity to discharge the combined wastewater back to the interceptor for full treatment. The two criteria that dictate storage volume at these locations are the level of control (e.g., 3-month, 1-year, 5-year) and the critical controlling volume, as determined by evaluating a range of storm durations (e.g., 1-hour, 6-hour, 1-day, 3-day, and 10-day). Table I.5-1 shows the model-projected total CSO volumes projected for both CSOs at all combinations of level of control and duration. The controlling volume for each level of control is dictated by the storm duration generating the largest CSO volume.

	CSO Volume (mil gal)					
	St 021–CSO 021–W. Park Ave. Level of Control			St 023–CSO 023–W. Illinois St. Level of Control		
Duration	**5-year**	**1-year**	**3-month**	**5-year**	**1-year**	**3-month**
CSO Volume						
1-hour	0.42	0.14	0.0	0.49	0.06	0.0
6-hour	0.33	0.04	0.0	0.46	0.0	0.0
1-day	0.0	0.0	0.0	0.0	0.0	0.0
3-day	0.0	0.0	0.0	0.0	0.0	0.0
10-day	0.0	0.0	0.0	0.0	0.0	0.0
Controlling Volume	0.42	0.14	0.0	0.49	0.06	0.0

Table I.5-1 Volumes for CSOs 021 and 023

Based on the land areas available shown in Table I.2-1, it appears that both sites would have adequate capacity for all levels of control. Costs for storage relative to other control options are developed in Appendix D.

B. CSO 001 (Rathbone Ave.) Storage

As discussed in Appendix D, the area designated on Figure D.3-1 as A02-Rathbone and St 001 shows significant potential to reduce CSO control costs if used for storage of all flow in the 96-inch

Rathbone Ave. trunk sewer during CSO events. Looking at the area on Rathbone Ave. just east of the railroad crossing, the ground elevation is approximately 632 feet mean sea level (MSL). The sewer invert at this point is at about 619.5 feet MSL, suggesting that gravity flow from the trunk sewer is practical for storage at this location, in particular if an automated control structure may be used to control off-loading the trunk sewer.

Table I.5-2 shows the model-projected volumes for the trunk sewer upstream of CSO 001.[1] Comparing these volumes to the volume of storage available, it appears the 5-year volume would "max out" the site, whereas the 1-year and 3-month event volumes will fit on the site. Because of the possibility of sensitive designation for CSO 001, it appears possible that a 1-year level of control volume may be required. Costs for storage at CSO 001 compared to other alternatives can be found in Appendix D.

Duration	Rathbone Ave. Trunk Sewer Volume (mil gal)		
	5-year	1-year	3-month
Total Volume			
1-hour storm (1 day total)	16.6	8.3	4.9
6-hour storm (1 day total)	22.5	10.7	6.6
1-day storm (2 day total)	21.9	15.2	10.7
3-day (4 day total)	25.1	18.2	13.5
10-day storm (11 day total)	47.8	37.5	28.8
Controlling Volume	47.8	37.5	28.8

Table I.5-2 Volumes for CSO 001

[1] Note that the extra day for the 1-day to 10-day storms is applied within the model to represent system recovery at the end of a storm.

APPENDIX J
GRAVITY SEWERS

J.1 INTRODUCTION

This appendix describes the method by which gravity sewer capacities within the City of Aurora combined sewer system (CSS) were evaluated during the alternatives analysis. This appendix describes how gravity projects necessary for various options were identified and evaluated and how their monetary costs were projected for the long-term control plan (LTCP). Finally, this appendix includes discussions of overflow structures where their modification may help reduce occurrences of CSOs or improve the accuracy of metering overflow events.

J.2 GRAVITY SEWER CAPACITY

The flow capacity of gravity sewers is typically determined by the application of Manning's equation:

$$Q = vA = (1.49/n)AR^{(2/3)}\sqrt{S}$$

where

Q = flow capacity in cubic feet per second
v = flow velocity in feet per second
A = cross-sectional area of the pipe in square feet
n = Manning roughness coefficient (0.013 for smoother, newer pipe; up to 0.017 for older or rougher pipe)
S = slope, as a decimal fraction, feet per feet

The hydraulic radius, R, is given by

$$R = A/P$$

where

R = hydraulic radius in feet
P = wetted perimeter (circumference, if full) of the pipe in feet

For a circular full pipe (diameter = D), the hydraulic radius is

$$R = A/P = (\pi D^2/4)/(\pi D) = D/4$$

For the overall alternatives evaluation contained within the Tool and spreadsheet analyses, some simplifying assumptions were made. First, segments were sized based on the peak 1-hour flow rate for the selected standard of control. Second, where enough information on endpoint elevations of proposed gravity sewers was available, hydraulic grades were calculated, as discussed in this section. Sewers were then sized based on Manning's equation. It was assumed that river crossings would be siphons, possibly employing multiple pipes, to keep sewer velocities higher. In this case, the Tool and spreadsheet select two same-sized sewers for the purpose of cost development; however, it is understood that final design may likely adjust these sizes for operational considerations. Third, where elevation information was not available, sewers were sized based on maintaining flow velocities in the range of 3 to 4 feet per second (fps), according to

the following reasoning. It was assumed that most CSO controls would be required to manage relatively high flows. Any gravity sewers constructed for this purpose would likely be large diameter. The minimum slope (to generate 2 fps) for large diameter sewers (greater than 36 inches) is very shallow (less than about 0.04 percent). At a slope of just 0.16 percent, velocities would double. Therefore, flow velocities of 3 to 4 fps are applied to peak flow rates for preliminary sizing and costing of gravity sewers. These sizes may be refined once final alternatives are selected.

J.3 GRAVITY SEWER COST PROJECTION

As with force mains (FMs), the cost of gravity sewers is driven by pipe diameter and material, depth, and construction conditions. Construction conditions take into account location, land rights, terrain, whether pavement restoration and/or traffic management would be required, the potential need for tunneling or boring and jacking, and possible utility conflicts. For the purpose of screening, each of the pipe segments was assigned one of nine construction conditions described for force mains in Appendix G:

1. Open Go
2. Open Go Steep
3. Parking Lot
4. Minor Street
5. Major Street with Few Utilities
6. Major Street with Utilities
7. Bore/Jack
8. River–Open Cut

Figure D.3-1 shows in yellow corridors where gravity sewers have been deemed feasible, based on projected flows, resulting hydraulic grades, and elevations. The purpose of this section is to discuss these potential projects and provide design criteria.

Table J.3-1 shows the per foot construction costs applied for this LTCP, which include an allowance for manholes. These costs assumed PVC pipe for smaller diameter and centrifugally-cast fiberglass reinforced polymer mortar (CCFRPM) pipe[1] for larger diameter sewers, and recent pipe prices were obtained from suppliers. Costs for pipe installation were based on unit prices for excavation, bedding, backfill and restoration and compared with recent Illinois projects. For more specialized construction conditions such as trenchless construction and open cut river crossings, per foot costs were developed through discussions with contractors specializing in these kinds of construction. As with FM costs, total gravity sewer costs are developed on per foot costs based on construction conditions and size, number of pipes, and total gravity sewer length.

[1] Hobas, for example, is a brand of CCFRPM pipe.

Table J.3-1 UNIT COSTS FOR GRAVITY CONSTRUCTION

	Construction Condition							
	1	2	3	4	5	6	7	8
Pipe Size	Open Go	Open Go Steep	Parking Lot	Minor Street	Major Street with Few Utilities	Major Street with Utilities	Bore/Jack	River - Open Cut
12	$ 124	$ 131	$ 249	$ 265	$ 331	$ 340	$ 956	$ 1,519
15	$ 150	$ 157	$ 285	$ 302	$ 368	$ 377	$ 988	$ 1,539
18	$ 169	$ 177	$ 311	$ 329	$ 395	$ 403	$ 1,020	$ 1,566
21	$ 184	$ 193	$ 333	$ 351	$ 417	$ 426	$ 1,020	$ 1,590
24	$ 191	$ 200	$ 345	$ 364	$ 431	$ 439	$ 1,109	$ 1,617
27	$ 201	$ 211	$ 368	$ 388	$ 454	$ 462	$ 1,321	$ 1,672
30	$ 207	$ 218	$ 401	$ 422	$ 488	$ 517	$ 1,388	$ 1,759
36	$ 409	$ 429	$ 635	$ 683	$ 749	$ 784	$ 1,778	$ 1,863
42	$ 500	$ 524	$ 751	$ 800	$ 866	$ 904	$ 2,040	$ 2,149
48	$ 595	$ 625	$ 932	$ 982	$ 1,048	$ 1,089	$ 2,359	$ 2,420
54	$ 691	$ 726	$ 1,066	$ 1,117	$ 1,184	$ 1,228	$ 2,741	$ 2,700
60	$ 834	$ 876	$ 1,242	$ 1,295	$ 1,362	$ 1,408	$ 3,060	$ 2,966
66	$ 1,033	$ 1,085	$ 1,480	$ 1,534	$ 1,601	$ 1,653	$ 3,219	$ 3,228
72	$ 1,104	$ 1,159	$ 1,583	$ 1,638	$ 1,705	$ 1,760	$ 3,379	$ 3,486
78	$ 1,250	$ 1,312	$ 1,763	$ 1,820	$ 1,887	$ 1,945	$ 3,602	$ 3,719
84	$ 1,345	$ 1,413	$ 1,891	$ 1,950	$ 2,016	$ 2,078	$ 3,953	$ 3,984

J.4 DISCUSSION OF PROPOSED GRAVITY SEWERS

This section discusses the sizing requirements for several segments of proposed new gravity sewers, based on modeling data for peak flows during 1-hour events for recurrence intervals of 5 years, 1 year, and 3 months.

A. CSO 025–Dearborn Ave. and Trask St. (G24, G25, and G27)

This subsection discusses three potential sewer replacement projects considered for the CSO 025 basin, shown on Figure D.3-1 as G24, G25, and G27.

CSO 025 is unique among Aurora's CSOs in that it does not discharge to the Fox River but rather to Indian Creek, a Fox River Tributary, and is relatively remote. Analysis of the configuration and sizing of gravity sewers and projected peak flows shows that relatively minor modifications to the gravity system would allow for a significant reduction in CSO occurrence; therefore, the option types being considered for other CSO basins were not considered necessary for CSO 025. The purpose of this subsection is to describe the configuration of CSO 025, discuss the flow rates that must be addressed, and describe the proposed CSO 025 abatement projects for determination of costs in Appendix D.

The main contribution to combined sewer flow is from the area bounded by Dearborn Ave., Farnsworth Ave., New York Ave., and Ohio St. The two main trunk sewers (both 30 to 42 inches in diameter) serving this area run from south to north along Farnsworth Ave. and Trask St. As shown in Figure J.4-1, the Dearborn Ave. regulator structure is near the corner of Farnsworth Ave. and Dearborn Ave. The 36-inch Farnsworth Ave. combined sewer discharges to two parallel 12-inch combined sewers, which convey flows west on Dearborn Ave. Gate valves exist on each of the parallel 12-inch sewers immediately downstream from the regulator structure. The intended purpose for the gate valves is to regulate the flow in each of the 12-inch sewers to avoid basement backups. Whatever flow exceeds the two 12-inch sewers' capacity overflows to a parallel 36- to 48-inch storm sewer.

The Indian Ave. regulator structure that serves the Trask St. sewer is at the corner of Trask St. and Indian Ave. The forward flow from the 42-inch sewer enters a 12-inch decombined sewer and any flow that exceeds its capacity is discharged through a 12-inch overflow to a 42-inch storm sewer. (This 42-inch sewer also collects storm drainage on Trask St. between Indian St. and Dearborn Ave.)

The storm sewers flow to the CSO 025 overflow structure at the corner of Dearborn Ave. and Trask St., from which it is discharged into Indian Creek. The Trask St. 12-inch decombined sewer along with the 12-inch combined sewers from Farnsworth Ave. join at the Trask St. regulator at the corner of Dearborn Ave. and Trask St. Forward flow enters into an 18-inch combined sewer that follows Dearborn Ave. and Ohio St., then crosses the railroad and joins the 30-inch sewer along Indian Creek. Flow in excess of the 18-inch capacity overflows from the Trask St. structure to the CSO 025 overflow structure. Thus, a combination of stormwater and combined sewage enters the CSO 025 structure for discharge to Indian Creek.

CONFIGURATION OF CSO 025
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.®
ENGINEERS

FIGURE J.4-1
1-181-001

Table J.4-1 shows model-projected combined sewage flow rates in the various segments of the CSO 025 basin.

Segment	Model Link	1-Hour Storm Peak Flows (cfs)		
		5-year	1-year	3-month
Farnsworth Ave. Basin				
Farnsworth Ave Combined Sewer[1]	FM7	5.3	2.8	1.5
Dearborn Ave Regulator Overflow[2]	Dearborn Ave. Reg.	2.1	0.0	0.0
12-inch Combined Sewer	Link 321	1.7	1.7	1.4
12-inch Combined Sewer	Link 331	1.7	1.3	0
Trask St. Combined Sewer				
Trask St. Combined Sewer	FM8	52.1	24.7	8.0
Indian Ave. Regulator Overflow [2, 3]	Link 337	30.8	16.1	1.1
12-inch Combined Sewer	Link 707	11.7	8.5	6.8
Trask St. (at Dearborn Ave.) Regulator				
Influent from Farnsworth Ave. and Trask St.	Link 321 Link 331 Link 707	15.1	11.5	8.3
Overflow to CSO 025	CSO 025	10.9	6.2	3.9
18-Inch Combined Sewer	Link 804	4.0	3.7	3.6
Total Overflow[1]	**Link 339**	**41.7**	**21.3**	**4.6**
18-Inch Combined Sewer	Link 804	4.0	3.7	3.6
Total Basin Flow		**45.7**	**25.0**	**8.2**

[1] The total peak overflow rate will be less than the sum of the peak overflow rates of the contributing sewers when their peaks do not coincide.
[2] Stormwater flows from the separated basins have not been included in these flow rates.
[3] Model representation of this link may overpredict flows through 12-inch overflow orifice. However, this does not appear to affect final design sizing.

Table J.4-1 Peak CSO 025 Flows

Based on the invert elevations at the CSO 025 overflow structure [~676 ft mean sea level (MSL)] and the 30-inch Indian Creek Interceptor (664 ft MSL), it appears additional flow from this basin can be conveyed to the Indian Creek interceptor with an increase in the 18-inch pipe size between the Trask St. regulator structure and the Indian Creek Interceptor. However, the configuration complexity of the overflow suggests that capturing this CSO without capturing stormwater from the separated basins requires additional consideration where the overflows occur.

As discussed above, overflows occur at these separate points in this basin:

1. Dearborn Ave. and Farnsworth Ave.
2. Trask St. and Indian Ave.
3. Dearborn Ave. and Trask St.

Based on the model results, it appears that an increase in capacity from the Indian Ave. regulator structure would be required for CSO control to the 3-month or 1-year level but that the two 12-inch combined sewers from the Dearborn Ave. regulator structure are adequately sized. To verify this, results from flow metering during 2008 and 2009 were reviewed.

During the flow monitoring program in 2008, FM 7 and FM 8 were installed just upstream of the Dearborn Ave. regulator structure and the Indian Ave. regulator structure, respectively. In addition, a flow meter was installed on top of the weir in the Dearborn regulator structure in July, 2008. Water surface elevations obtained from flow metering were compared to overflow structure elevations to determine when overflows occurred at both locations. The meter installed on the weir in the Dearborn regulator structure registered only one overflow, which was during the September 12 to 14 event. This event was approximately a 40-year recurrence interval storm with a peak 1-hour recurrence interval equaling a 1-year storm. Overflow at the Indian Ave. regulator structure was more active, overflowing on May 26 and August 4. The May 26 event was a 3-month recurrence interval storm with a peak hourly recurrence interval of four months, while the August 4 event was a 3-month recurrence interval storm with a peak hourly recurrence interval of three months. (During the period of the September 12-14 event, the meter in the Trask St. subbasin was not operating properly, but it is assumed overflow likely occurred.)

Additional flow metering was conducted in spring and summer 2009. The flow meters were installed in the same locations from the 2008 flow monitoring program. Based on the collected data, it was determined that overflows occurred at only the Indian Ave. regulator structure on August 16 and August 17. The August 16 event was a 3-month recurrence interval storm with a peak 1-hour recurrence interval of 3 months, and the August 17 event was a 9-month 1-hour recurrence interval storm.

This metering information is consistent with the model results, suggesting that the 12-inch sewer serving the Trask St. basin is undersized to prevent CSOs during moderate intensity 3-month events, but that the two 12-inch combined sewers serving the Farnsworth Ave. portion of the basin are adequately sized up to about a 1 year storm.

Table J.4-2 shows the replacement combined sewer size that would be required to handle each of these overflows based on a Mannings analysis of the sewer capacities, without surcharging.

					Estimated Mannings-Based Gravity Sewer Size Required			
Figure D.3-1 Designation	**Segment**	**Length (ft)**	**Slope (%)**	**Based on**	**5-year (in)**	**1-year (in)**	**3-month (in)**	**Existing Size (in)**
G27	Dearborn Ave., Farnsworth Ave to Trask St.	1,938	Varies Min 0.14 Avg. 0.35	FM7	1@12 1@18	-	-	2 @ 12
G24	Indian Ave. Regulator to Trask St. Regulator	364	1.75	FM8	36	**27**	18	12
G25	Trask St. Regulator to Indian Creek Interceptor	684	0.18 to 0.34	Total Basin Flow	42 to 48	**36**	24	18
		155	2.6 to 6.6		30	**24**	15	12 to 18

Table J.4-2 CSO 025 Basin Replacement Sewer Size Requirements Based on Mannings Equation

Based on this, projects are recommended for segments G24 and G25, as shown on Table J.4-2 in bold. Fox Metro's consulting engineer reported that an upgrade of the 18-inch sewer (G25) from the Trask St. diversion structure to the 30-inch Fox Metro sewer along Indian Creek had been planned for when the 30-inch sewer was originally designed and constructed. For the cost analyses performed in this LTCP, a new trunk sewer will be assumed for segment G25, 24 to 36 inches in size, based on the sewer grade available. For segment G24, a 27-inch sewer will be assumed. These improvements are anticipated to abate CSOs to the 1-year level of control. Both modeling and Mannings analysis confirm adequate capacity in the Indian Creek Interceptor to convey the increased flows.

B. CSOs North of Stolp Island

Six gravity sewer segments serving three different purposes are included in the CSO abatement options in this area:

1. Gravity flow to/from storage (G21 and G23)

Storage of CSO at 021 and 023 is being considered among the abatement options, as shown on Figure D.3-1 as St021 and St023. Because underground storage is considered to be the only aesthetically implementable means of storage in parklike areas, gravity flow into the reservoirs has been assumed. For the purpose of this evaluation, it is assumed that a "take-off" point upstream of the CSO discharge would be used, in order to take advantage of as much elevation as possible. In addition, for returning stored CSO to the WWTP, there would be a submersible lift station within the storage tank discharging to a gravity sewer (not shown on Figure D.3-1).

Table J.4-3 shows the assumptions applied within the Tool and spreadsheet analyses for gravity sewers to and from storage at St021 and St023.

Storage Area	Gravity Segment	Length (ft)	Construction Condition
St 021 W. Park Ave. at Police Station Site	G21	300	Open Go
St 023 W. Illinois Ave. at McCullough Park	G23	700	Open Go

Table J.4-3 Design Assumptions for Gravity Segments to Storage

2. Siphons from CSO 021 (G20) and CSO 023 (G26)

According to its designers and validated through review of design criteria, the CSO treatment plant at 400 N. Broadway and the 36- to 48-inch relief interceptor that flows to it from both the north and the south were intended also to serve CSO 021 (W. Park Ave.) and CSO 023 (W. Illinois St.). Therefore, conveying these CSOs by gravity siphons across the river appears to be a good option. The following paragraphs provide the model-projected flows and identify hydraulic grades available based on known elevations within the sewer system. This information was used for hydraulic analysis to project required sizes for proposed improvements.

Table J.4-4 shows the projected model peak flow rates for varying levels of control for CSOs 021 and 023.

Basin	Location	Model	Model-Projected Peak Flow Rates (cfs)		
			5-year	1-year	3-month
021 W. Park Ave	Basin	Link 608	25.0	13.1	4.1
	Overflow	Link 772	21.0	9.6	1.7
023 W. Illinois St.	Basin	Link 588	23.4	7.5	1.0
	Overflow	Link 814	20.4	4.5	0.0

Table J.4-4 Peak Flow Rates for CSOs 021 and 023 Basins and Overflows

a. CSO 021 (W. Park Ave.) to Relief Sewer near CSO 022 (Superior St.)–G20

Approximate elevations at CSO 021 and CSO 022 are as shown in Table J.4-5.

	IE (ft MSL)	Diameter (in)	Crown EL (ft MSL)
CSO 021	642	24	644
CSO 022	629	48	633
Relief Sewer to CSO Plant	623	36	626

Table J.4-5 Elevations for Potential CSO 021 Siphon G20

Based on these elevations, an approximate grade of 0.35 to 0.4 percent could be achieved in segment G20,[2] assuming:

(1) Up to 1,400 feet of pipe between the regulator and the 36-inch relief sewer.
(2) Siphon discharge above the crown of CSO 022 discharge.
(3) Approximately 1 foot of entrance and exit losses in siphon structures.

Table J.4-6 shows the siphon sizes as determined by the spreadsheet analysis used for cost projection for various levels of control and design assumptions. The values shown in bold were assumed for the alternatives analysis in Appendix D.

	5-year (in)	1-year (in)	3-month (in)
n = 0.017			
One Siphon	36	27	**15**
Two Siphons	**2 @ 27**	**2 @ 21**	

Table J.4-6 Projected Requirements for CSO 021 Siphon G20

[2] All hydraulic grades identified in this appendix are for planning and cost projection purposes and should be reviewed prior to final design.

CSO 021 contributes a relatively small CSO volume to the total discharged by all Aurora CSOs. In addition, the configuration of the overflow (discussed in section J.5) suggests opportunities to reduce its occurrence with relatively minor adjustments to the overflow weirs. Therefore, while a siphon remains an option for CSO 021, it is assumed that this may not be a high priority project. However, a proposal to upgrade the canoe/kayak chute 1,500 feet downstream of CSO 021 to accommodate tubing, may impact whether this CSO is deemed a higher priority in the future.

b. CSO 023 (W. Illinois St.) to Relief Sewer near CSO 002 (E. Illinois St.)–G26

Approximate elevations at CSOs 023 and 002 are shown in Table J.4-7.

	IE (ft MSL)	Diameter (in)	Crown EL (ft MSL)
350 foot U/S of CSO 023	645.2	27	647.7
CSO 023	633.6	27	634.8
CSO 002	631.6	24	633.6
Dry weather sewer U/S of CSO 002	631.2	24	633.2
Relief Sewer to CSO Plant	628.9	36	631.9

Table J.4-7 Elevations for Potential CSO 023 Siphon G26

Based on the elevations between CSO 023 and the crown of CSO 002, there would be relatively little hydraulic head in the proposed siphon. However, assuming that an entirely new diversion structure could be constructed about 350 feet upstream (west) of the current CSO 023 location, a significant amount of hydraulic head would be gained, approximately 12 feet. If this were pursued, it may be advantageous to allow all CSO 023 basin flows in the new siphon, thereby removing that flow from the 12-inch/15-inch siphon structure north of Illinois St. This would require that the new discharge structure to be connected in the dry weather sewer upstream of CSO 002 and that modifications be made to the CSO structure to account for the increased flow. In addition, dry weather connections north of W. Illinois St. would need to be directed to the Illinois St. PS.

Assuming a new siphon structure can be constructed upstream of the existing location, a hydraulic grade of approximately 0.7 percent can be achieved, assuming:

(1) Up to 1,100 feet of pipe between the new regulator and the CSO 002 structure.

(2) Siphon discharge at or upstream of the dry weather sewer, upstream of CSO 002.

(3) Approximately 1 foot of entrance and exit losses in siphon structures.

Table J.4-8 shows the required siphon sizes for various levels of control and design assumption applied in the cost analysis.

	5-year (in)	1-year (in)	3 month
n = 0.017			Not required to prevent overflow.
One Siphon	30	21	
Two Siphons	**2@24**	**2@15**	

Table J.4-8 Projected Requirements for CSO 023 Siphon G26

Based on the possible designation of CSO 023 as sensitive, it is considered possible that control of this basin will be required to the 1-year level.

3. Superior St. Diversion (G22 and G28)

Under the current system configuration, peak flows in the northern portion of the CSO 008 basin may be diverted to the existing CSO plant via the CSO 022 regulator at Superior St. and Lincoln Ave. (see Figure J.4-2). This overflow runs west toward the river where it is intercepted by the 36-inch relief sewer, just upstream of the CSO 022 outfall. Table J.4-9 shows the model projected 1-hour flows for this regulator structure for various levels of control.

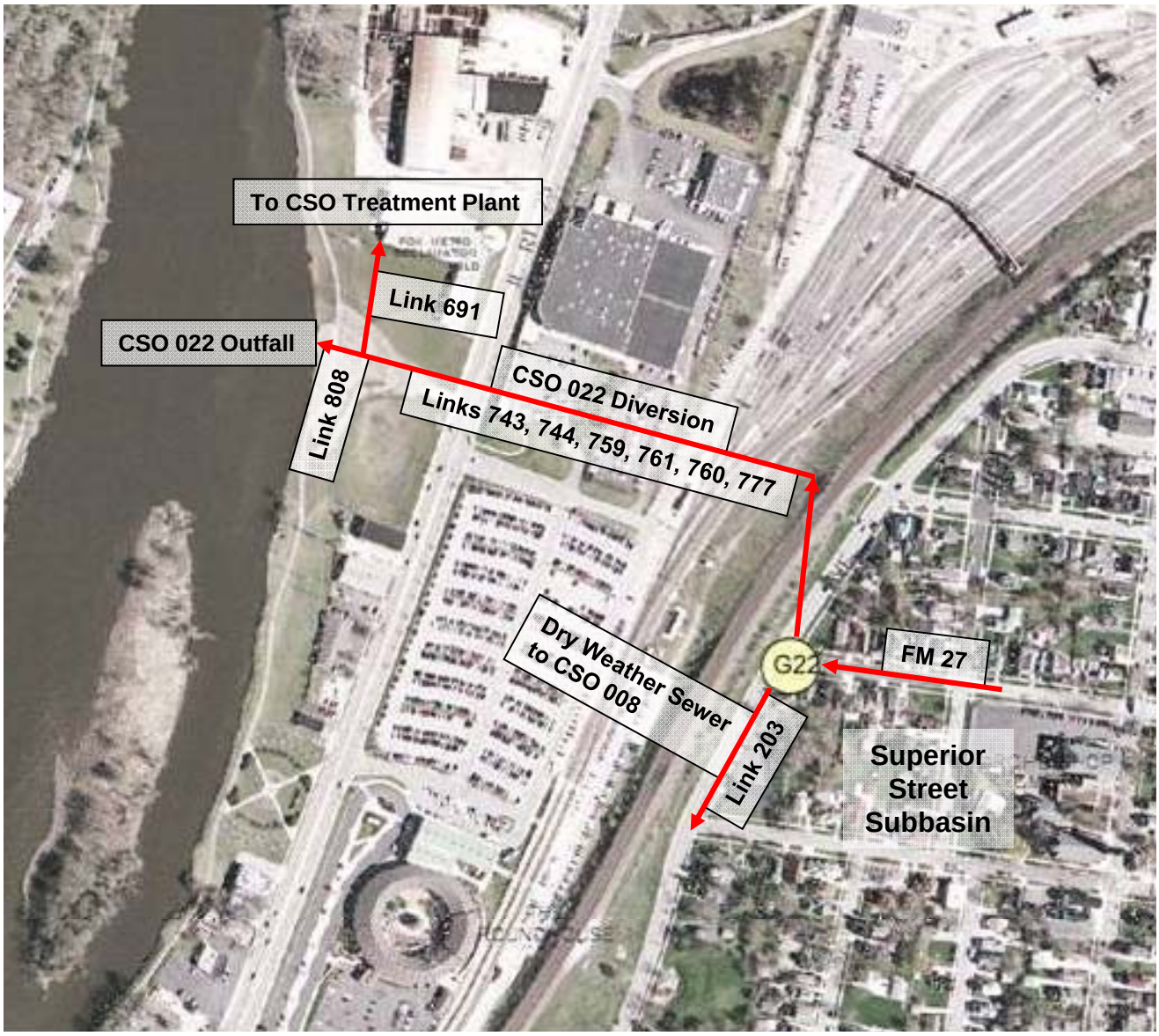
Segment	Model Link	Peak Flows (cfs)		
		5-year	1-year	3-month
Superior St. Subbasin	FM27	102.8	67.5	35.5
Dry Weather Sewer	Link 203	15.5	14.9	14.1
CSO 022 Diversion	Link 744	98.1	57.4	25.2
36-inch Relief Sewer to CSO Treatment Plant	Link 740	70.8	56.2	25.2
CSO 022 Outfall	Link 808	80.4	33.7	0
CSO 008 Basin	Link 131	265.4	210.3	108.5
CSO 008 Outfall	Link 691	243.3	173.2	76.2

Table J.4-9 Peak Model Projected Flows for CSO 022 Area, 1-Hour Storm

One option to convey additional flow to the existing CSO plant is to provide for diversion for some portion of the 14 to 16 cubic feet per second (cfs) in the dry weather sewer (Link 203) during wet weather events by modifying the diversion structure to restrict flows in the dry weather sewer to a greater degree and upgrading downstream sewers if required.

This scheme could deliver up to an additional 15 cfs to the CSO plant (10 mgd) thereby relieving CSO 008 of this peak flow. This represents a relatively small percentage of CSO 008 flow (6 to 18 percent), so this option should be seen as a minor potential system modification. (As discussed in Appendix D, it is assumed for this cost analysis that about 2 cfs would remain in the dry weather sewer[3] and that the remaining approximately 13 cfs could be diverted to the CSO plant.) However, because this additional diversion is relatively easy to accomplish, versus pumping and conveying that flow at CSO 008, this is seen by the City as an advantageous approach.

[3] The model suggests the typical peak dry weather flow is about 1.5 cfs.



SUPERIOR STREET SUBBASIN TO CSO 022
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.4-2
1-181-001

To determine the capacity of the existing system to deliver the additional flow, segments of existing bypass sewer from Superior St. down to the CSO plant were reviewed, as shown in Table J.4-10.

Model Link	Length (ft)	Diameter	Slope (%)	Mannings Capacity (cfs) n = 0.017
Link 777	382	4	0.50	78
Link 760	192	4	0.57	83
Link 761	441	4	1.7	144
Link 759	62	5	0.80	178
Link 744	29	4	1.25	123
Link 743	172	4	1.7	144

Table J.4-10 Capacity of the CSO 022 (Superior St.) Diversion

From the Mannings-based capacities of the sewer, compared to the subbasin flows, it appears that the existing sewer has adequate capacity to handle the 1-year flows.

Based on a review of the 36- to 48-inch relief sewer capacity shown in Table J.4-11, it appears the Manning capacity of this sewer (G28) is adequately sized for the 3-month flow but not the 1-year and 5-year flows. Because the sizing of this sewer depends also on additional flows from CSO 021, this sewer will be discussed further in Appendix D.

Model Link	Length (ft)	Diameter	Slope (%)	Mannings Capacity (cfs) n = 0.017
Link 740+741	240	3	0.25	26
Link 779	130	4	0.26	56

Table J.4-11 Capacity of the CSO 022 (Superior St.) Relief Sewer to CSO Plant

C. Downtown, CSO 008 (E. Benton St.) and CSO 015 (W. Benton St.)

One important option for CSO control in Aurora is the proposed relocation of CSOs 008, 015, and 018 from downtown to the North Ave. (East) area. This was proposed in 2000 when the River City Development was being considered for the area south of Benton St. Because this development was anticipated to include a river walk that would increase public exposure to the river in this area, the relocation of CSOs to the North St. (East) area was considered desirable. This plan included upsized siphons and gravity sewers, plus a dry weather PS at North Ave. (East). This LTCP evaluated this alternative in Appendix D. The purpose of this subsection is to determine hydraulic grades that would be available for use in the spreadsheet analysis.

Since that time, the plans for development have changed, and construction of high rise apartment dwellings is being considered. This plan has altered the concept for CSOs 008, 015, and 018 somewhat. When and if this development occurs, Fox Metro plans on replacing the existing 54-inch

interceptor between CSO 008 and North Ave. with a 66-inch interceptor, matching the existing pipe inverts,[4] and rerouting the sewer along planned street rights-of-way. This plan would not include any upgrade to the existing siphons from the CSO 015 basin on a dry weather PS. In this alternative, CSOs would still overflow at their current locations. Therefore, Appendix D has also evaluated this alternative, but the gravity sewer was sized to limit CSO 008 to four occurrences per year. Flows from the CSO 015 basin would be limited to the capacity of the existing siphons, shown in Table J.4-12. Figure D.3-1 shows gravity segments G13, G14, and G15 that are proposed to convey flow from these CSOs. [5]

Table J.4-12 shows the model-projected overflow rates for CSO 008 and CSOs 015 and 018, along with the maximum capacity of the existing trunk sewers identified by WEDA in its report. The proposed design flows identified in the year 2000 report are significantly lower than the 1-year and 5-year peak model-projected basin flows. The historical overflow data show CSOs well in excess of the year 2000 proposed capacities. CSO 008 has experienced peak flows as high as 275 mgd during January 2008 and CSO 015 above 80 mgd on numerous occasions. While it is beyond the scope of this analysis to identify the source of this discrepancy, for the purpose of cost projection, the model-projected flows for the 5-year condition will be applied for determining pipe sizes and costs; this selection was made because the desire to relocate the CSOs would require design around an extreme event. However, if this gravity relocation is pursued, it is recommended that the design peak flows be reviewed.

	Model	Model-Projected Peak Flows for 1-Hour Storms (cfs)			Year 2000 Proposed Design Flows
		5-year	1-year	3-month	
CSO 015/018*					
Basin Flow	Link 634	120.6	104.5	64.9	65.2
Overflow	CSO 15 Weir Link 772	109.4	89.9	50.7	
Existing Siphons	H-brook 12 and 24	18.2	16.8	15.8	
CSO 008					
Basin Flow	Link 131	265.4	210.3	108.5	147.0
Overflow	Link 691	243.3	173.2	76.2	
Total					
Basin Flow		**386.0**	**314.8**	**173.4**	**212.2**
Overflow		**352.7**	**263.1**	**126.9**	

* Because CSOs 015 and 018 are closely related, it is intended that proposed improvements for CSO 015 would also address CSO 018. Therefore, their model-projected overflow rates are added together and treated as though they occur at CSO 015

Table J.4-12 Model-Projected Peak Flows for 1-Hour Storms for CSOs 008 and 015

[4] Preliminary plans developed by WEDA show this sewer to have a slope of 0.12 percent, which is assumed for this analysis.

[5] The original Letter Report *Proposed Relocation of 3 CSO Outfalls at One Location* dated September, 8, 2000, (WEDA) also proposed replacing the existing gravity sewer on River St. between CSO 018 and CSO 015; however, recent basin modifications suggest that this sewer replacement may not be necessary, and it is not included in these improvements.

Table J.4-13 shows CSO elevations that will be useful for determining design criteria.

	Model	IE (ft MSL)	Diameter (in)	Crown (ft MSL)
CSO 015				
Upstream	Link 634	623.3	42	626.8
Overflow	CSO 15 Weir	623.25	42	626.75
CSO 008				
Upstream	Link 131	621.13	72	627.3
Overflow	Link 691	621.4	72	627.4

Table J.4-13 CSOs 008 and 015 Elevations

1. Siphon from CSO 015 (G15)

The hydraulic grade in segment G15 from CSO 015 is projected to be about 0.4 percent based on the following assumptions:

a. 750 feet of pipe (about 25 percent greater than actual distance shown on Figure D.3-1 for routing/location flexibility).
b. Invert elevation of receiving sewer at about 611 ft MSL.
c. Maximum receiving sewer size of 78 inches.
d. Downstream siphon invert elevation of 617.5 ft MSL.
e. Approximately 1 foot of entrance and exit losses.

Table J.4-14 shows the Mannings equation-determined sizes of the G15 siphon for the 5-year recurrence interval level of control variety of conditions.

2. Gravity Sewer from CSO 008 (G14)

The hydraulic grade in segment G14 from CSO 008 is projected to be about 0.5 percent based on the following assumptions:

a. 650 feet of pipe.
b. G14 downstream invert elevation of 614 ft MSL, maximum.

Table J.4-1 shows the Mannings equation-determined sizes of the G14 sewer based on the 5-year basin flow rate, less approximately 13 cfs of flow diversion that was described for CSO 022 above.

3. Gravity Sewer from G14/G15 to PS 928 (G13)

The G15 siphon crossing dictated a relatively deep sewer for G13, and therefore a relatively shallow grade of 0.25 percent is assumed. Table J.4-14 shows the Mannings equation-determined sizes of the G13 sewer.

	Gravity Relocation 5-year Basin Flows	Gravity Conveyance 3-month Basin Flows	Year 2000 Design Criteria
G15 from CSO 015–Two Siphons	2 @ 48 inches	2 @ 42 inches	
G15 from CSO 015–Three Siphons	3 @ 42 inches	3 @ 36 inches	3 @ 27 inches
G14 from CSO 008	78 inches	54 inches	66 inches @ 0.26 to 0.29%
G13 to PS 928	2 @ 78 inches	72 inches	84 inches @ 0.15%

Table J.4-14 Sizes for Gravity Segments from CSOs 008 and 015 (G13, G14, and G15)

The sizes shown in Table J.4-14 were determined from the spreadsheet analysis, based hydraulic grades determined above. As indicated earlier, these sizes are used for projecting and comparing costs and should be reviewed in final design.

D. Hurds Island Area, CSO 005 (3rd St.) and CSO 010 (1st St.) (G10 and G11)

CSOs 005 and 010 serve relatively small basins in Aurora's system, so although CSO 010, in particular, has historically overflowed fairly frequently, these CSOs represent a significantly smaller volume than CSOs 001, 004, and 008. In addition, these CSOs are difficult to access, and the potential for public exposure to them has been minimal.[6] Therefore, improvements to these basins may be a lower priority than some of the others. For completeness, however, these basins are evaluated in this section to be served by gravity sewers.

Table J.4-15 shows the projected model CSO peak flow for 1-hour storms under various levels of control.

	Peak CSO Flow Rate for 1-Hour Storm (cfs)		
	5-year	1-year	3-month
CSO 005	12.5	9.9	1.9
CSO 010	35.9	32.2	19.3
Total	**48.4**	**42.1**	**21.2**

Table J.4-15 Peak Flow Rates for CSOs 005 and 010

Table J.4-16 shows the approximate elevations of CSOs 005 and 010 and indicates that CSO 010 is significantly higher in elevation, suggesting that gravity flow from CSO 010 to a pumping station at or near CSO 005 (PS 905) may be feasible.

[6] A proposed pedestrian footbridge near the corridor as shown for P11 on Figure D.3-1 may increase public exposure to CSO 005.

Segment	Model Link	IE (ft)	Diameter (in)	Crown EL (ft MSL)
CSO 005				
Upstream	Link 787	617.5	20	619.2
Outfall	Link 684	617.4	20	619.1
CSO 010				
Upstream	Link 371	626.1	27	628.3
Outfall	Link 372	626.0	27	628.2

Table J.4-16 CSO 005 and 010 Elevations

Assuming a WWPS located at CSO 005, a hydraulic grade of 0.30 percent in segments G10 and G11 was assumed based on the following:

a. 1,400 feet of pipe.
b. Invert elevation of receiving sewer at about 617.4 ft MSL.
c. Downstream siphon invert elevation of about 619 ft MSL.
d. Approximately 2 feet of entrance and exit losses, given two siphons required.

Table J.4-17 shows the resulting sizing, based on these assumptions.

	5-year	1-year	3-month
G10–Siphon			
One Siphon	42 inches	42 inches	36 inches
Two Siphons	2 @ 36 inches	2 @ 30 inches	**2 @ 27 inches**
G10–Gravity Sewer	42 inches	42 inches	**36 inches**
G11–Siphon			
One Siphon	42 inches	42	36 inches
Two Siphons	2 @ 36 inches	2 @ 30 inches	**2 @ 27 inches**

Table J.4-17 Projected Siphon and Gravity Sewer Requirements for CSO 010

J.5 CSO OVERFLOW STRUCTURE MODIFICATION RECOMMENDATIONS

During this LTCP process, a few of the regulator structures and their overflow monitoring schemes were identified as requiring modification. The purpose of this section is to discuss those CSOs and to provide preliminary recommendations. Drawings of all the overflows are provided at the end of this Appendix as J.5-1 through J.5-14. The majority of these improvements are constant between alternatives evaluated in Appendix D. Those that are constant are not included in the Appendix D evaluation and will be included in the final costs developed in Section 5. Those costs that are dependent on the alternatives are included in Appendix D.

A. River Backflow Prevention

Table 4.01-1 compared the control structure overflow elevations with various river flood elevations as stated in the Flood Insurance Study prepared by the Federal Emergency Management Agency, August 2009 (Appendix Q). In general, those overflows with control structure elevations less than

the 10-year flood recurrence elevation are recommended to be equipped with river backflow prevention devises, such as rubber check valve, also known as duckbill valves. Those locations with a control elevation less than the 10-year flood recurrence elevation are CSOs 001, 003A, 005, 008, and 017.

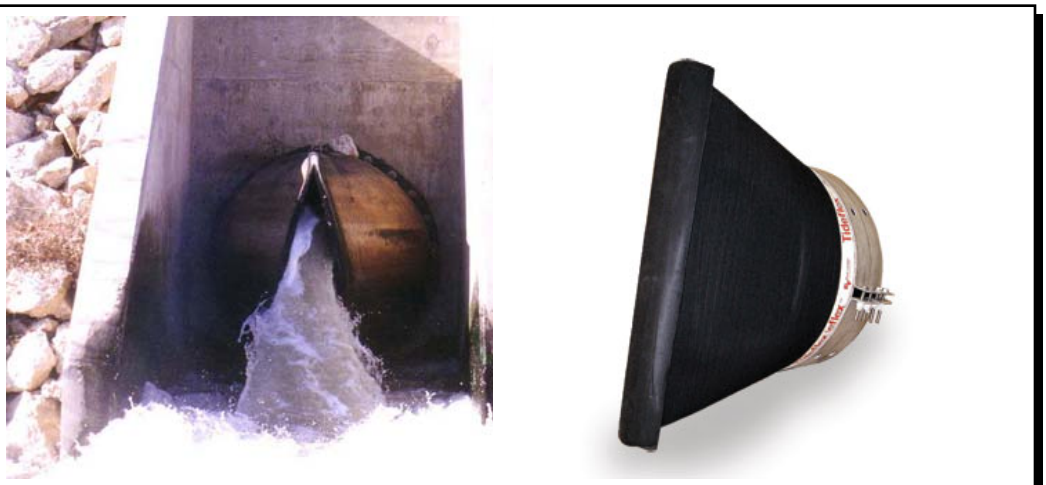


Figure J.5-15 River Backflow Prevention Device

B. CSO 001–Rathbone Ave.

The existing Rathbone Ave CSO has an irregular concrete structure approximately 27 feet long and 16 feet wide (see Figure J.5-1). A 96-inch-diameter combined sewer enters the structure and a combined sewer intersects the structure at a 67 degree angle. As shown in Figure J.5-1, this combined sewer is 54 inches upstream of the structure and 69 inches within and downstream of the structure and becomes the 69-inch interceptor sent to the WWTP. The 69-inch sewer acts as a dam and there are two approximately 15-inch-diameter openings in the 69-inch sewer that allow water to enter (and possibly “throttle” water from exiting the sewer when the hydraulic grade line of the interceptor is greater than that in the structure). When the water surface in the structure exceeds the height of the dam atop the 69-inch pipe, it overflows into a 96-inch combined sewer pipe and then to the river. Depending on the final recommendation of alternatives, this structure could be modified to have both the 96-inch and the 69-inch combine in a chamber that would be separated from the river with an adjustable weir overflow. The minimum overflow elevation would be set higher than the 10-year flood recurrence elevation, and higher if possible. This modification would provide more accurate overflow measurement. The potential for flooding of upstream structures served by the 96-inch combined sewer (and 69-inch combined sewer, depending on hydraulic grade line), the significance of additional hydraulic losses in this structure, and the potential for grit accumulation (either positive to reduce grit accumulation in the 69-inch interceptor or negative because of additional maintenance and odors) would need to be assessed during design.

C. CSOs 002 and 023–E. and W. Illinois Ave.

Section J.4.B discussed the possibility of installing a gravity siphon (G26) structure to serve the CSO 023 basin (rather than just the overflow). The proposed design sizing of this siphon depends on constructing a new structure upstream of the existing CSO 023 diversion structure to gain additional elevation. On the downstream end, that siphon would need to be connected to a 30-inch combined sewer upstream of CSO 002 (see Figure J.5-2), thereby increasing the amount of flow to that regulator. If that improvement were constructed, it is recommended that the configuration of the CSO 002 overflow be reevaluated, in particular the size of the 24-inch gravity connection between the two structures, since overflows to the relief sewer would see higher flow rates with this additional input. Note that neither of these improvements is required if the G26 siphon is not constructed.

D. CSO 005–Third St.

This CSO consists of a manhole with a 20-inch combined sewer entering and an 8-inch combined sewer flowing into the 54-inch-diameter Fox Metro Interceptor (see Figure J.5-5). A dam is located in the structure so that when the water surface exceeds a certain elevation, it will overflow into a 20-inch combined sewer overflow that goes to the river. The model shows that this overflow occurs because of flow exiting the 54-inch interceptor, rather than due to flows in the CSO 005 basin. Therefore increasing the 8-inch connection may exacerbate CSO flows rather than alleviating them. One option would be complete separation of CSO 005 basin and elimination of the CSO 005 overflow. This would be dependent on other modifications made in the system and the hydraulic grade line in the 54-inch interceptor.

E. CSO 010–First St.

This CSO consists of a manhole that is fed by a 27-inch combined sewer and a 12-inch combined sewer (see Figure J.5-7). A 16-inch combined sewer exits this structure and is routed to the WWTP. The 27-inch overflow pipe is approximately 0.3 feet higher than the invert of the manhole and drawings mention a dam that no longer appears to be in place. The 16-inch combined sewer is therefore not flowing full with this configuration as described. A hydraulic analysis using the SWMM model was performed to assess whether a weir constructed in this structure may reduce overflows. Although it would be very desirable if overflow occurrences at this CSO can be controlled to an acceptable level with a simple structure modification, this analysis suggested that, even with the highest practical weir elevation, overflows still occur even during a 2-month 1-hour storm because of limited hydraulic capacity downstream. In this configuration it appears that no overflows would occur at intensities below about 0.4 inches/hour or about 60 percent of the 2-month storm. Therefore, for the purpose of overall cost projections described in Appendix D and Section 5, it will be assumed that the existing configuration cannot be modified to reduce overflows to the 3-month level and that capital improvements may be required.

F. CSO 021–West Park Ave.

Figure J.5-10 shows the configuration and Figure J.5-16 shows a picture of the CSO 021 overflow structure. Based on this drawing, it appears that very little depth is required in the influent sewers

to cause overflows to the 27-inch sewer. Because CSO 021 is being considered for either gravity siphons or storage improvements a SWMM hydraulic analysis was performed on the upstream trunk sewers to assess whether a weir can be constructed in this or a new structure could be built to minimize or eliminate overflows. As with CSO 010, it is the downstream gravity sewer that appears to cause overflows. However, raising this weir would appear to have the potential to reduce overflow occurrences to a 2-month storm.



Figure J.5-16 Photograph of CSO 021 (15-inch to WWTP on right, 27-Inch overflow forward)

Although it would be very desirable if overflow occurrences at this CSO can be controlled to an acceptable level with a simple structure modification, for the purpose of overall cost projections described in Appendix D and Section 5, it will be assumed that the existing configuration cannot be modified and that the capital improvements may be required.

G. CSO 025–Dearborn Ave. and Trask St.

The configuration of the Dearborn Ave. and Trask St. area near CSO 025 was described in Section J.4.A above. Figure J.4-1 shows the configuration of the CSO 025 area, and Figure J.5-14 shows the configuration of the overflow structure just upstream of CSO 025. As indicated above, there are three locations from which flow can exit the CSS to the CSO 025 overflow structure and only one of these overflow locations has been metered regularly. Additionally, the location of the meter on the 18-inch overflow from the Trask St. regulator structure suggests that it may be influenced by stormwater flows from the 42-inch and 48-inch stormwater inputs.

In order to more accurately account for CSO flows, we recommend that a permanent CSO remote metering and monitoring system be included for the Dearborn Ave., Indian Ave., and Trask St. regulator structures. (See discussion below describing permanent overflow metering.) Currently, these overflows are permitted as a single overflow. We recommend discussion with IEPA to determine if they wish to maintain a single CSO that would include the summation of the future three overflow meters, or reclassify as individual overflows.

Evaluating the site-specific complexity that may be required for the CSO structure modifications and backflow prevention installations is somewhat beyond the scope of this LTCP. Therefore, a conservative cost projection of $5 million will be assumed for these improvements.

H. Permanent Overflow Metering

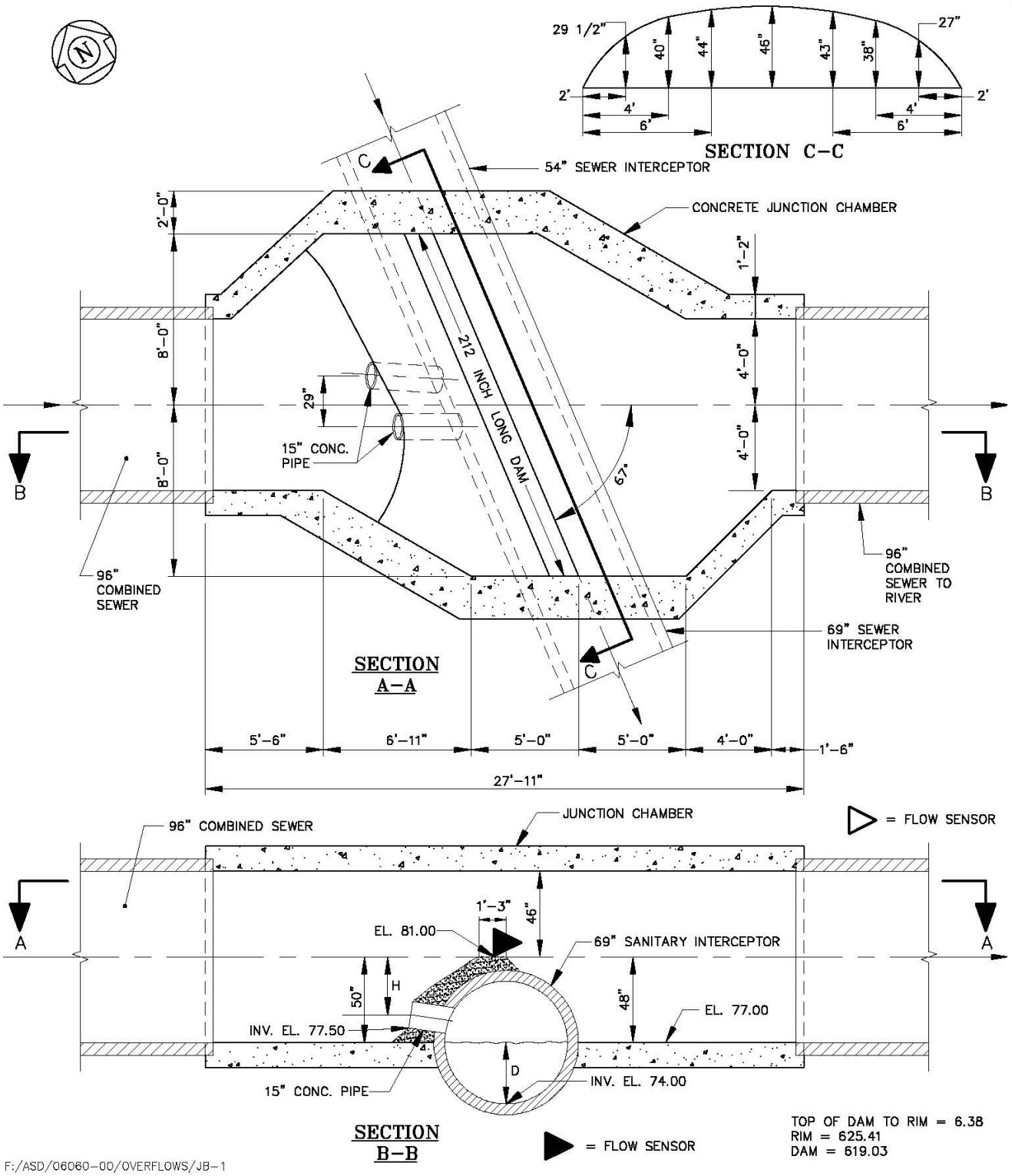
The City of Aurora currently contracts to have overflow meters maintained and the data downloaded. It is recommended that permanent overflow meters be installed for all CSO locations to provide “real-time” monitoring of the overflows and to minimize dry weather overflows that may occur because of debris interfering with normal operation of the overflow. Most of the overflows have a weir or other type of “primary” device, so that if water level is known, flow can be calculated (this is how overflow volumes are currently calculated). The overflows would be fitted with a level sensing device such as an ultrasonic level sensor and transmitter or a submersible pressure sensor. The level sensor would be connected to a programmable logic controller (PLC) and a digital radio located outside, but near the overflow structure in a secure enclosure. The PLC would communicate and temporarily store level data from the overflow and would “report” this data to a master radio. The master radio would be connected to a personal computer with software installed to allow storage and analysis of the data. The system could be designed to also collect and store rain gauge data. With rain fall and overflow detection known, the system could be configured with an overflow alarm and dialer so that if an overflow is detected it would alarm on a designated person’s personal computer. If the alarm was not acknowledged within a operator-adjustable period of time, the system would dial the programmed number(s) until the alarm was acknowledged.

Construction costs for this type of system would be approximately $30,000 per CSO location (includes level instrumentation, PLC, radio, enclosure, new utility, new pole, installation). Cost for the office system would be approximately $75,000 for software, computers, dialer, and enclosure. Table J.5-1 shows that the projected costs for such a system is approximately $1 million.

Item	Cost
Instrumentation and installation (18 locations)	$540,000
Office System	$75,000
Subtotal	$615,000
Contractor's GCs (8%)	$49,200
Subtotal	$664,200
Engineering and Contingency (50%)	$332,100
Total	$996,300

Table J.5-1 Permanent Overflow Metering Costs

Based on the City of Aurora's current contract of $84,000 per year to manage the overflow data collection and compilation and the current discount rate, the payback period on this installation would be approximately 20 years.

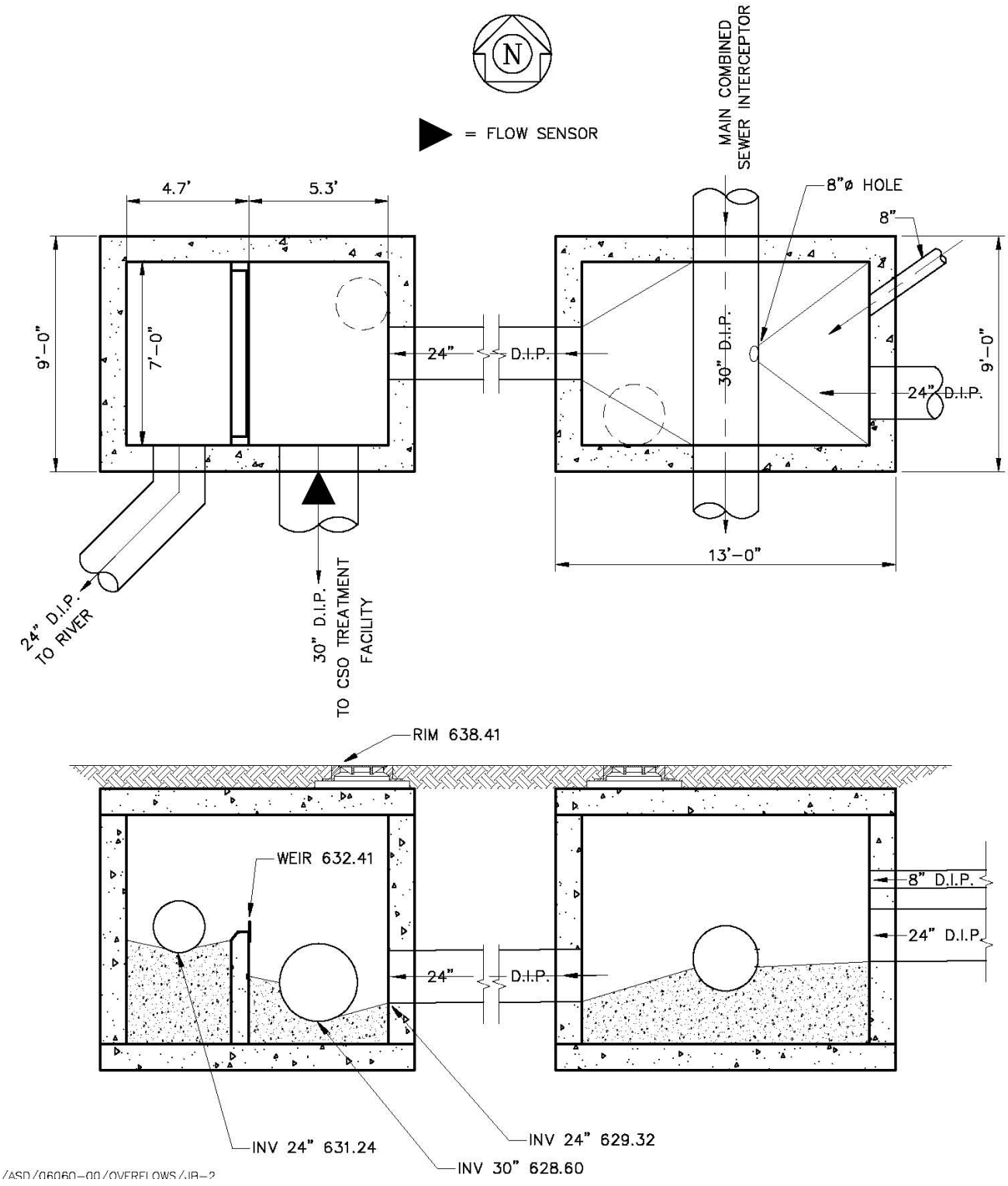


From Walter E. Deuchler Associates, Inc.

CSO 001 – RATHBONE AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-1
1-181-001



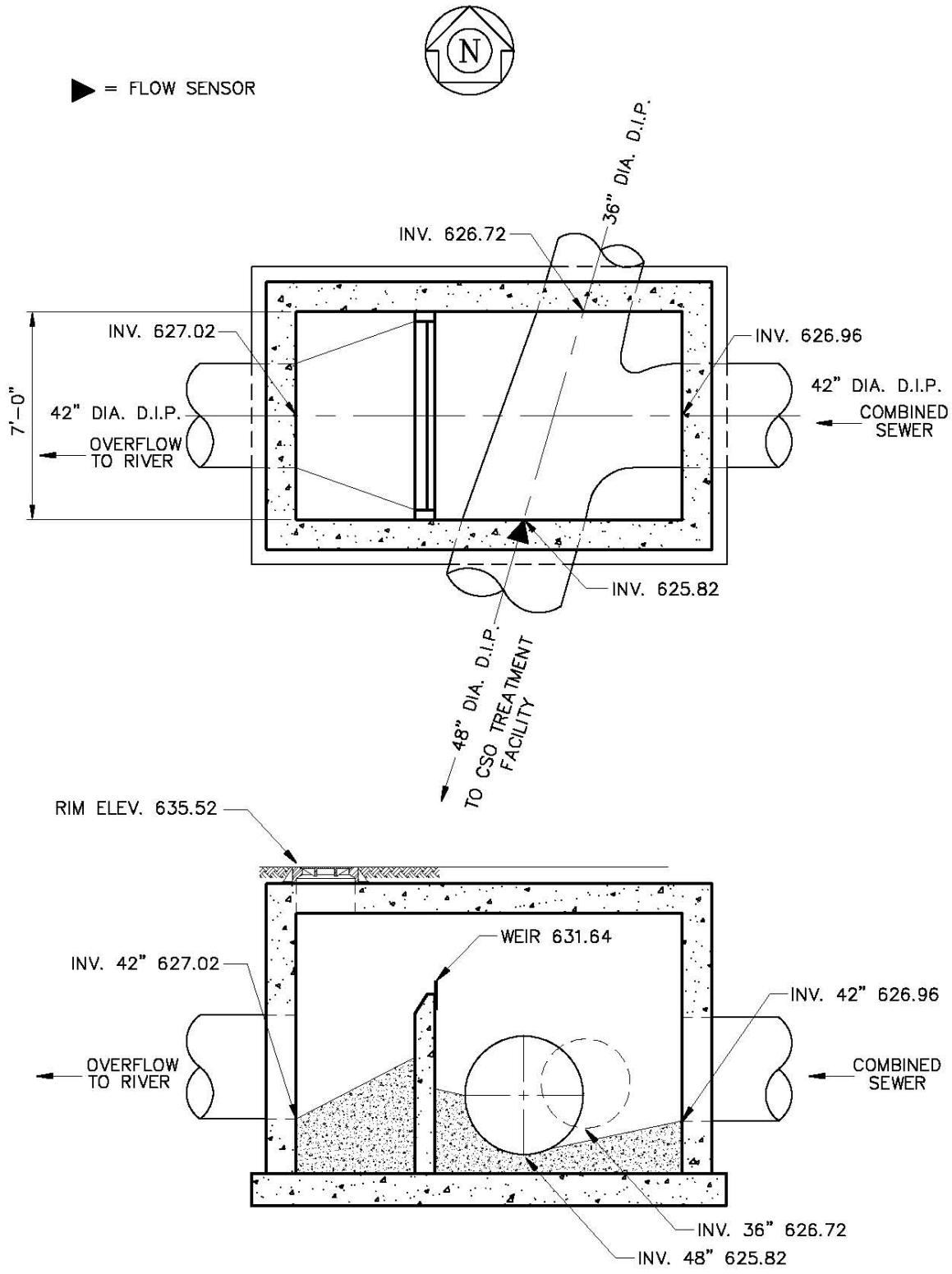
/ASD/06060-00/OVERFLOWS/JB-2

From Walter E. Deuchler Associates, Inc.

CSO 002 – EAST ILLINOIS AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-2
1-181-001

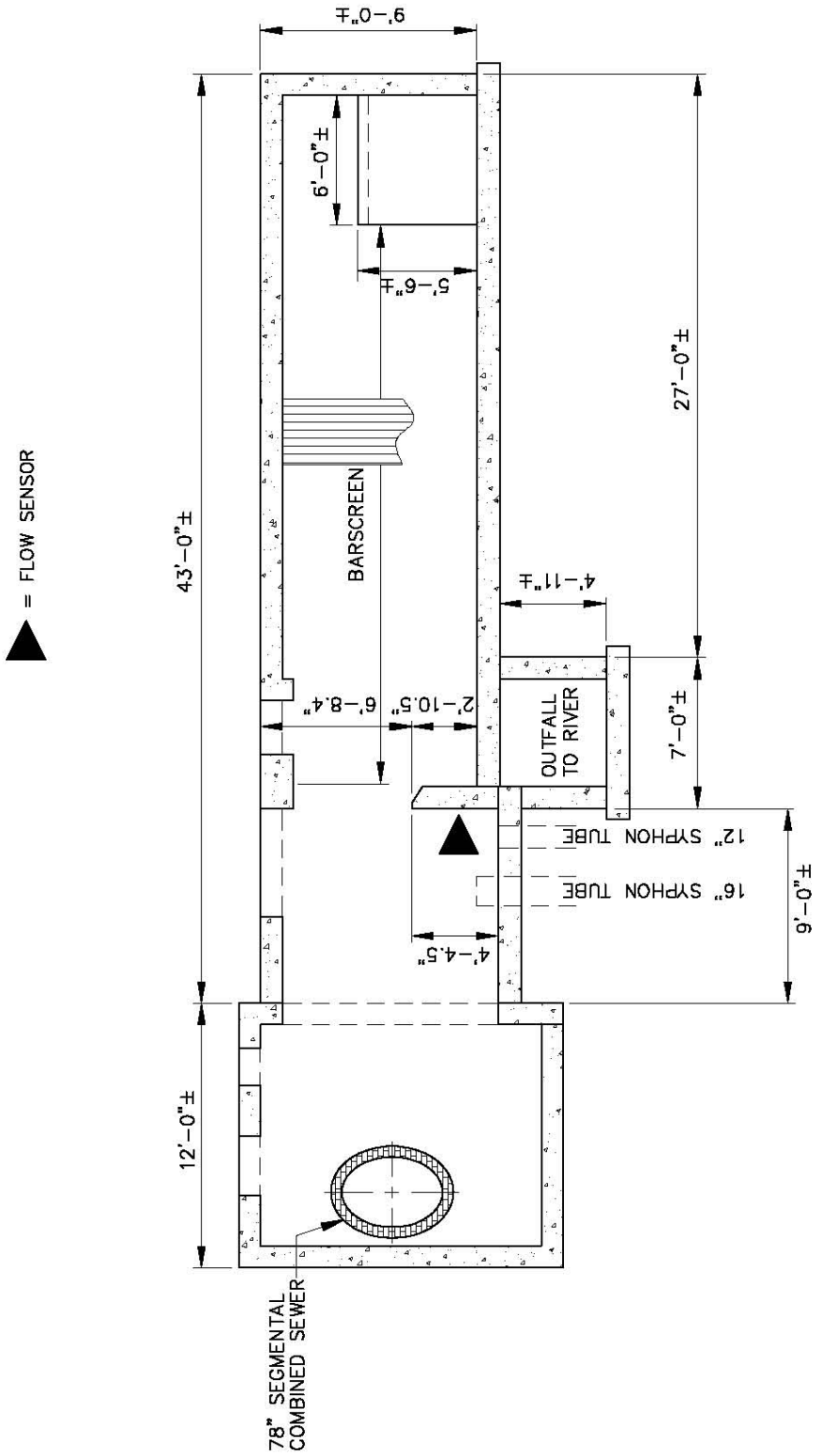


From Walter E. Deuchler Associates, Inc.

CSO 003 – PIERCE STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-3
1-181-001

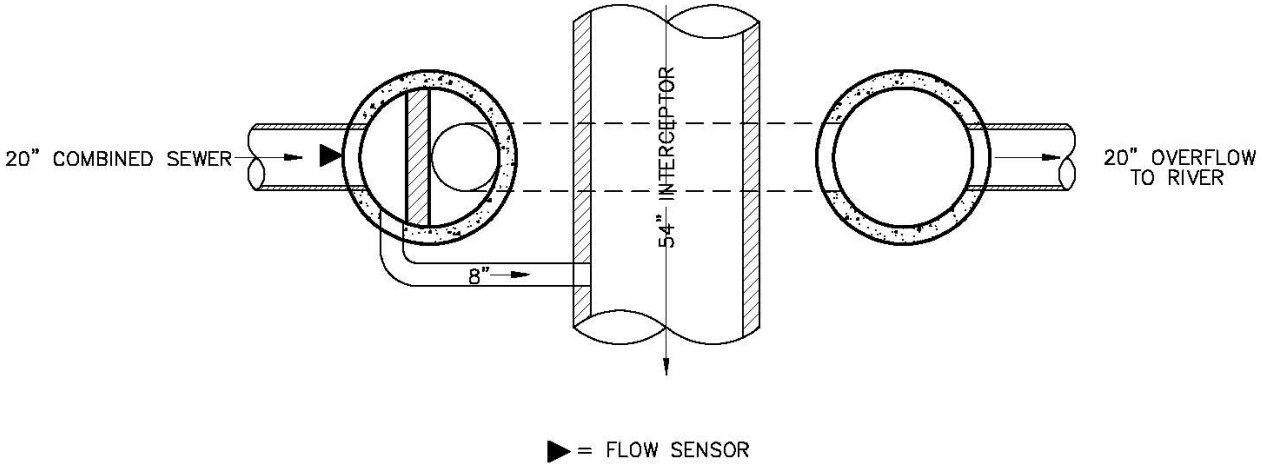


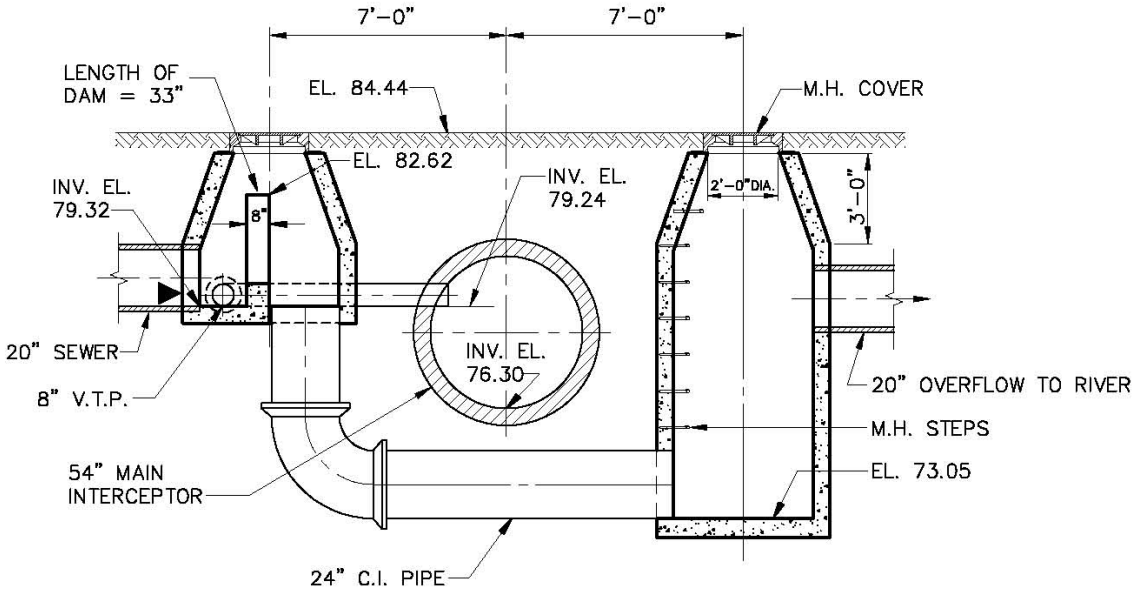
From Walter E. Deuchler Associates, Inc.

CSO 004 – HAZEL AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-4
1-181-001



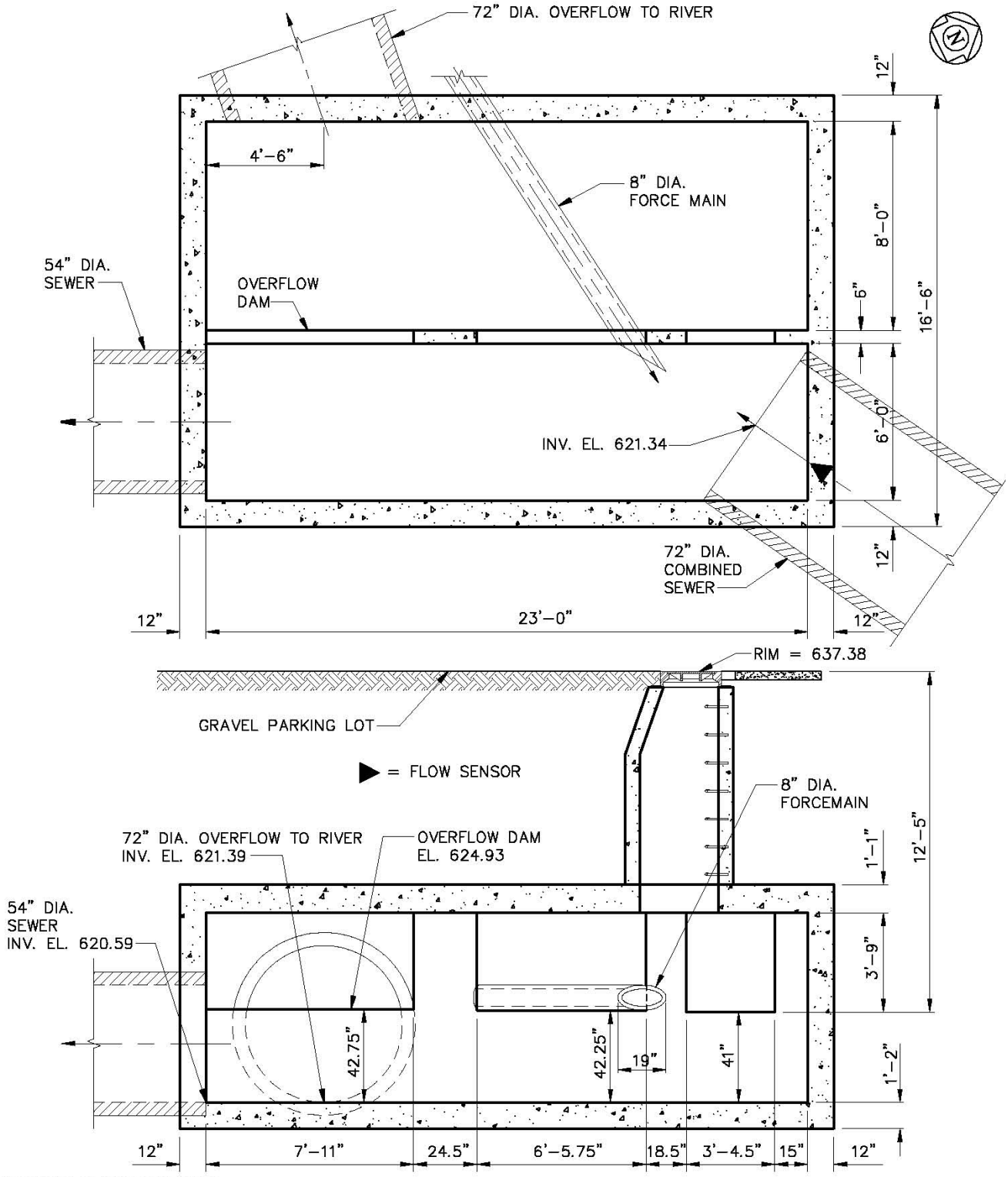


From Walter E. Deuchler Associates, Inc.

CSO 005 – THIRD STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-5
1-181-001

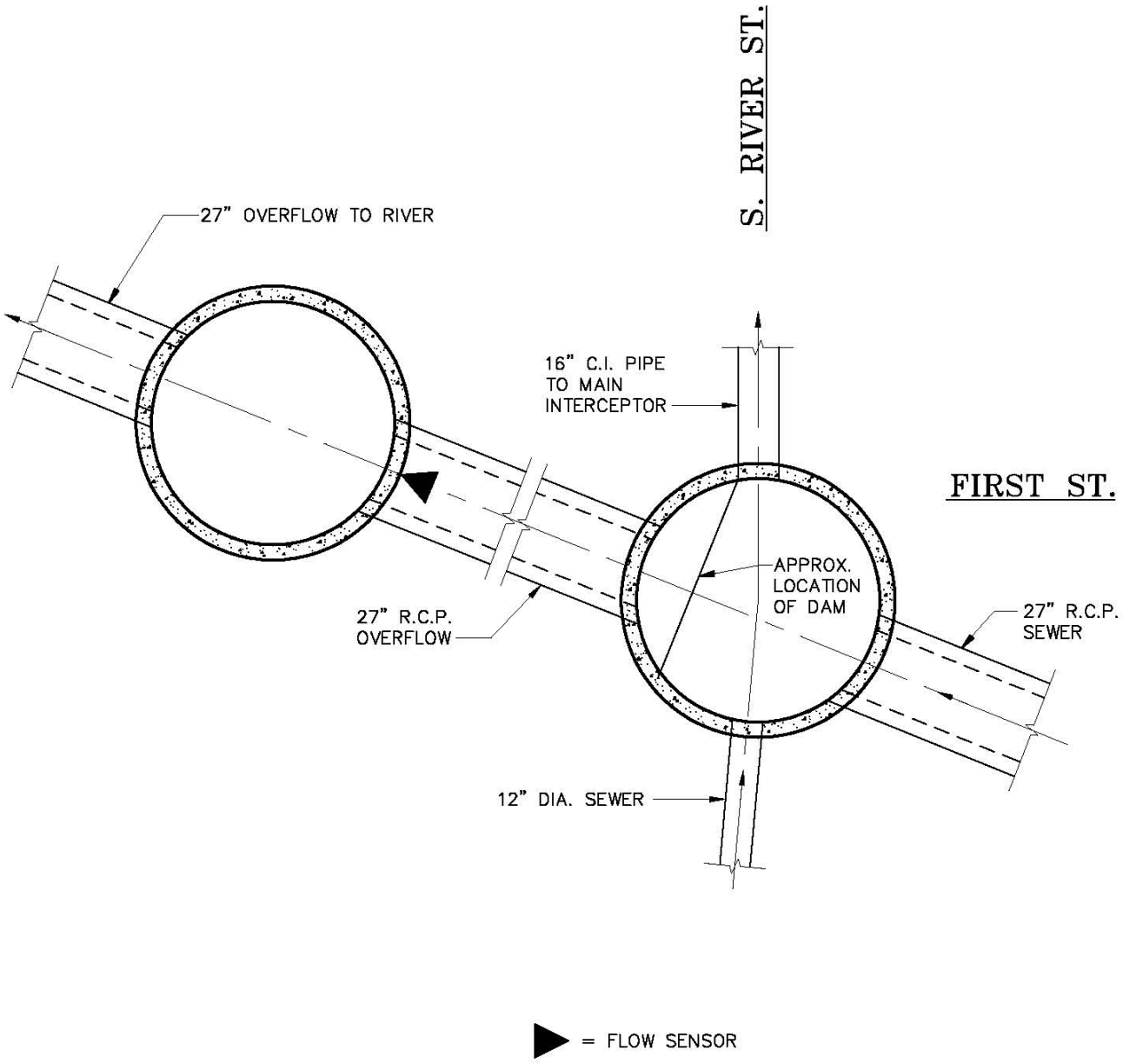


From Walter E. Deuchler Associates, Inc.

CSO 008 – EAST BENTON STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-6
1-181-001

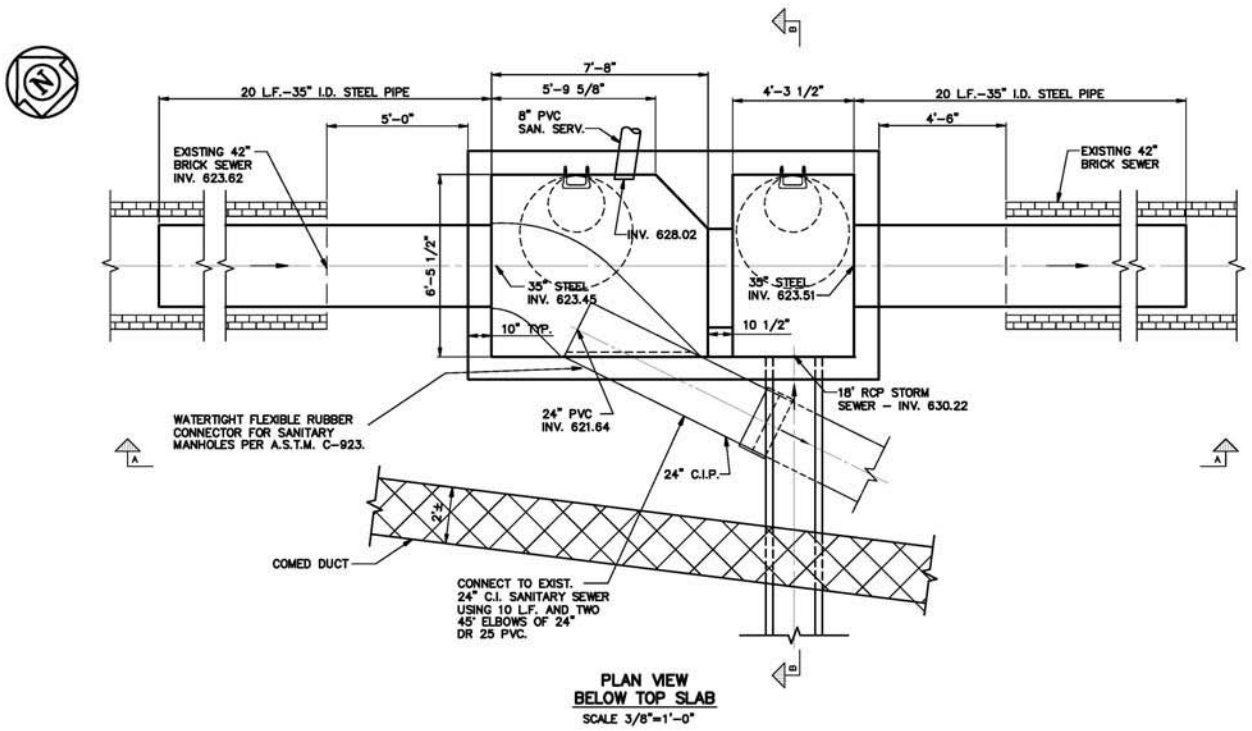


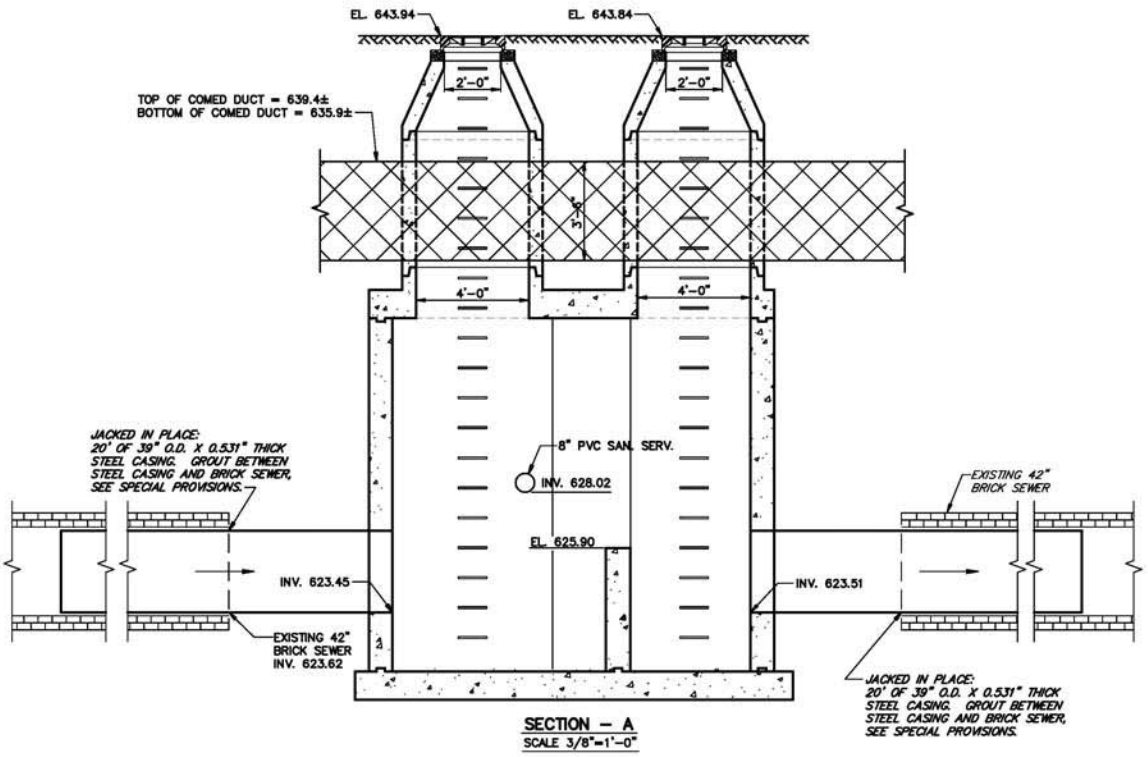
From Walter E. Deuchler Associates, Inc.

CSO 010 – FIRST STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-7
1-181-001



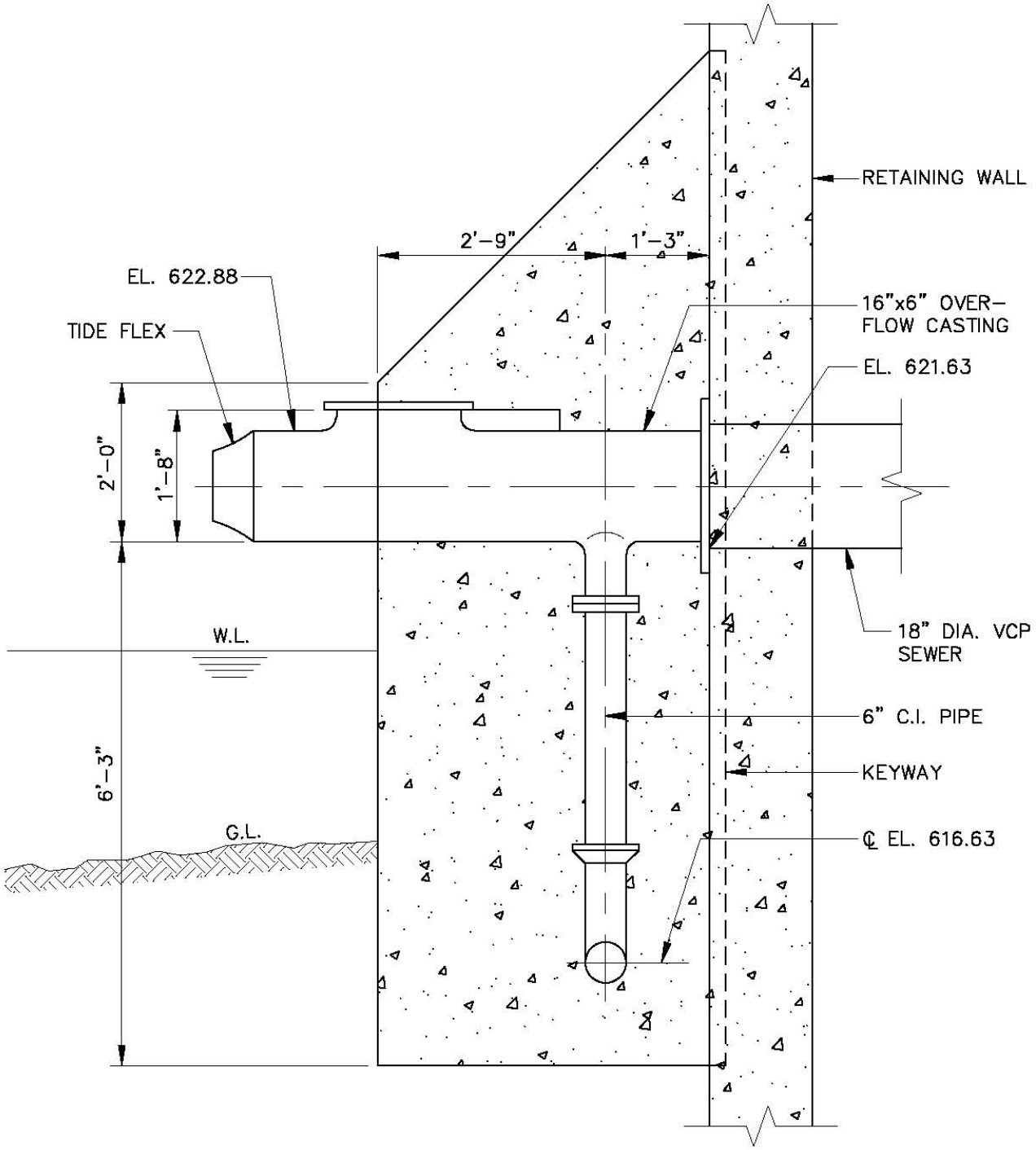


From Walter E. Deuchler Associates, Inc.

CSO 015 – WEST BENTON STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-8
1-181-001

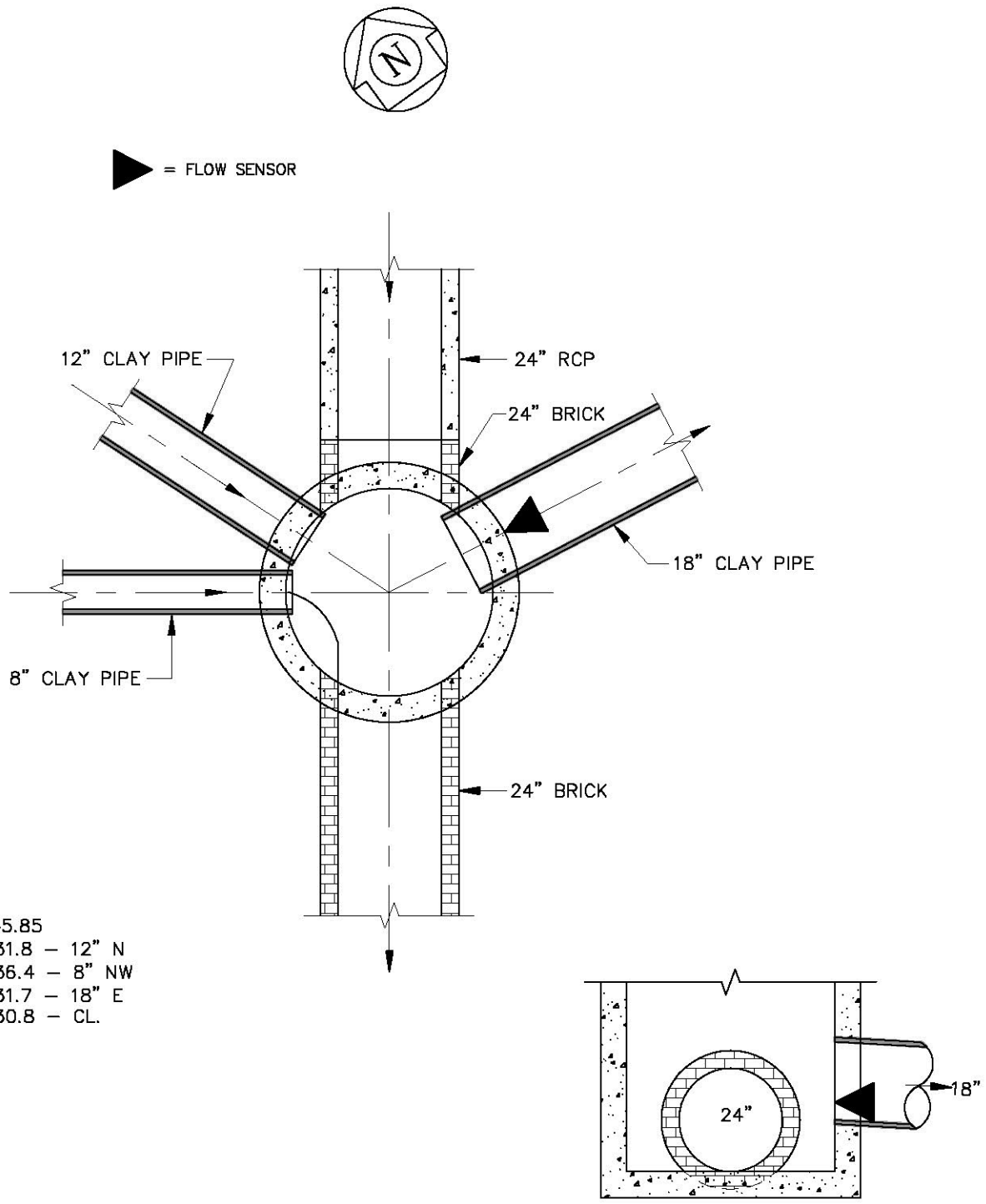


From Walter E. Deuchler Associates, Inc.

CSO 017 – STOLP AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-9
1-181-001



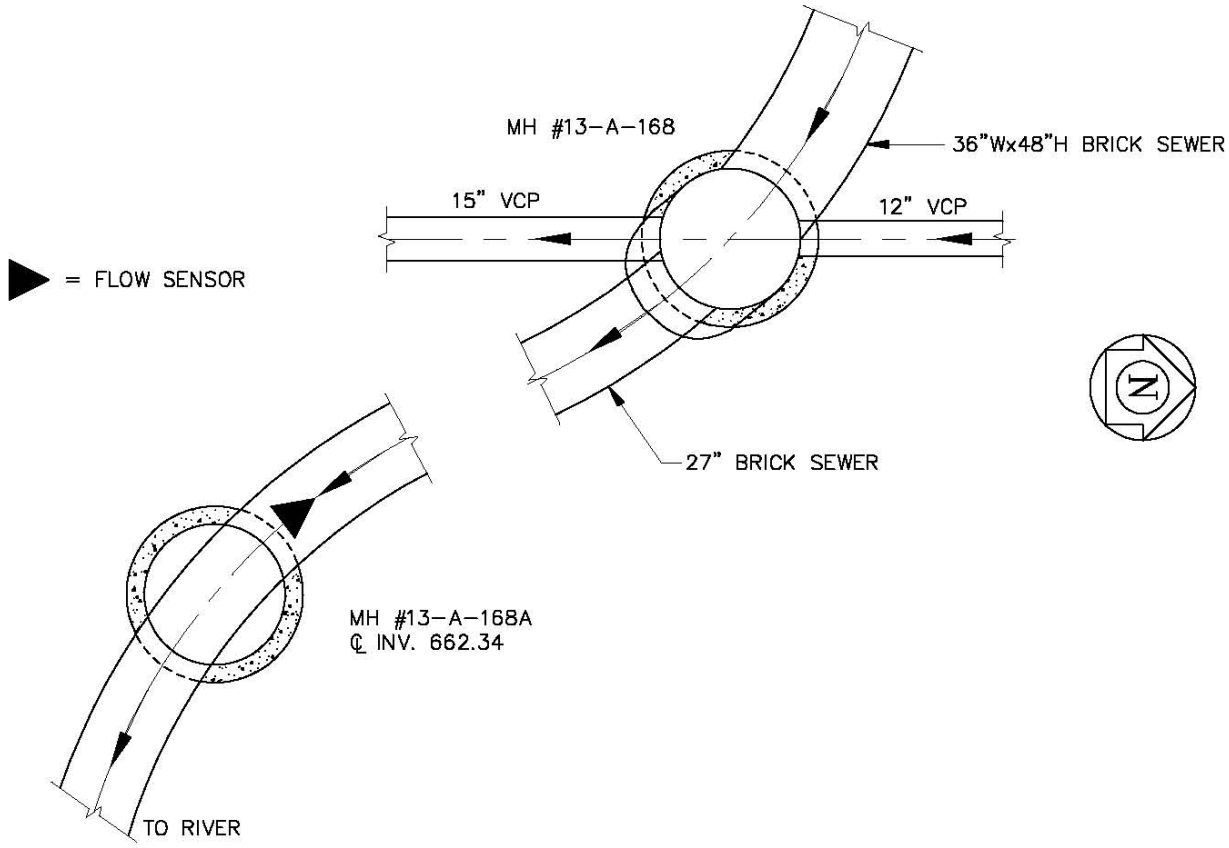
From Walter E. Deuchler Associates, Inc.

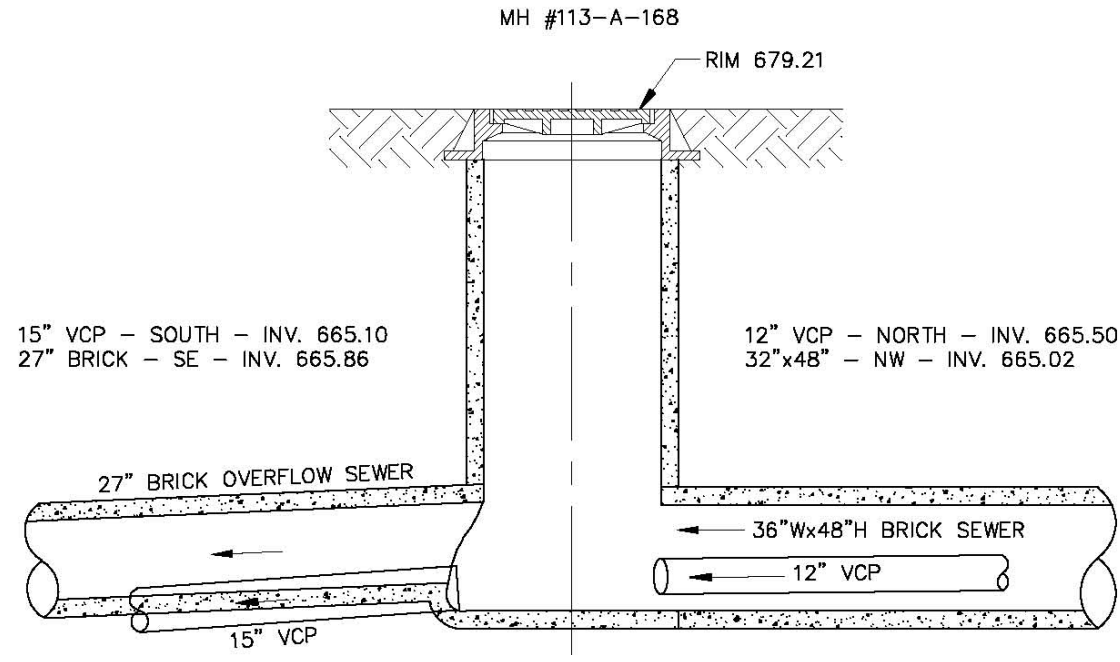
CSO 018 – GALENA BLVD
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-10
1-181-001

LOCATION – CL. LAKE ST. AT WEST PARK AVE./ELM ST.



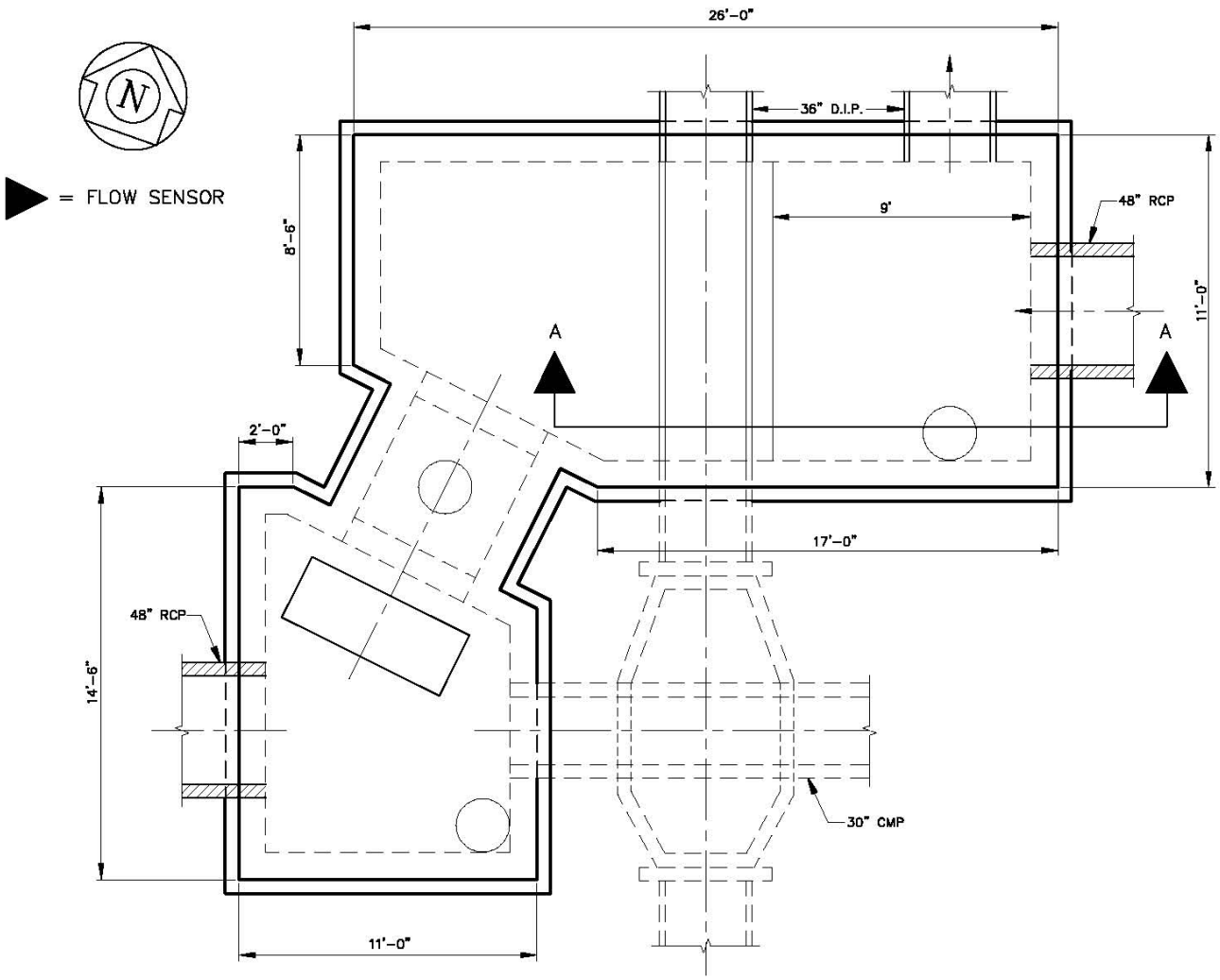


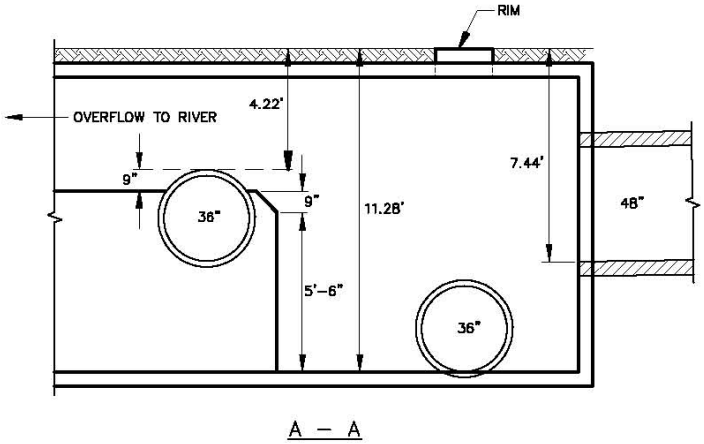
From Walter E. Deuchler Associates, Inc.

CSO 021 – WEST PARK AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-11
1-181-001





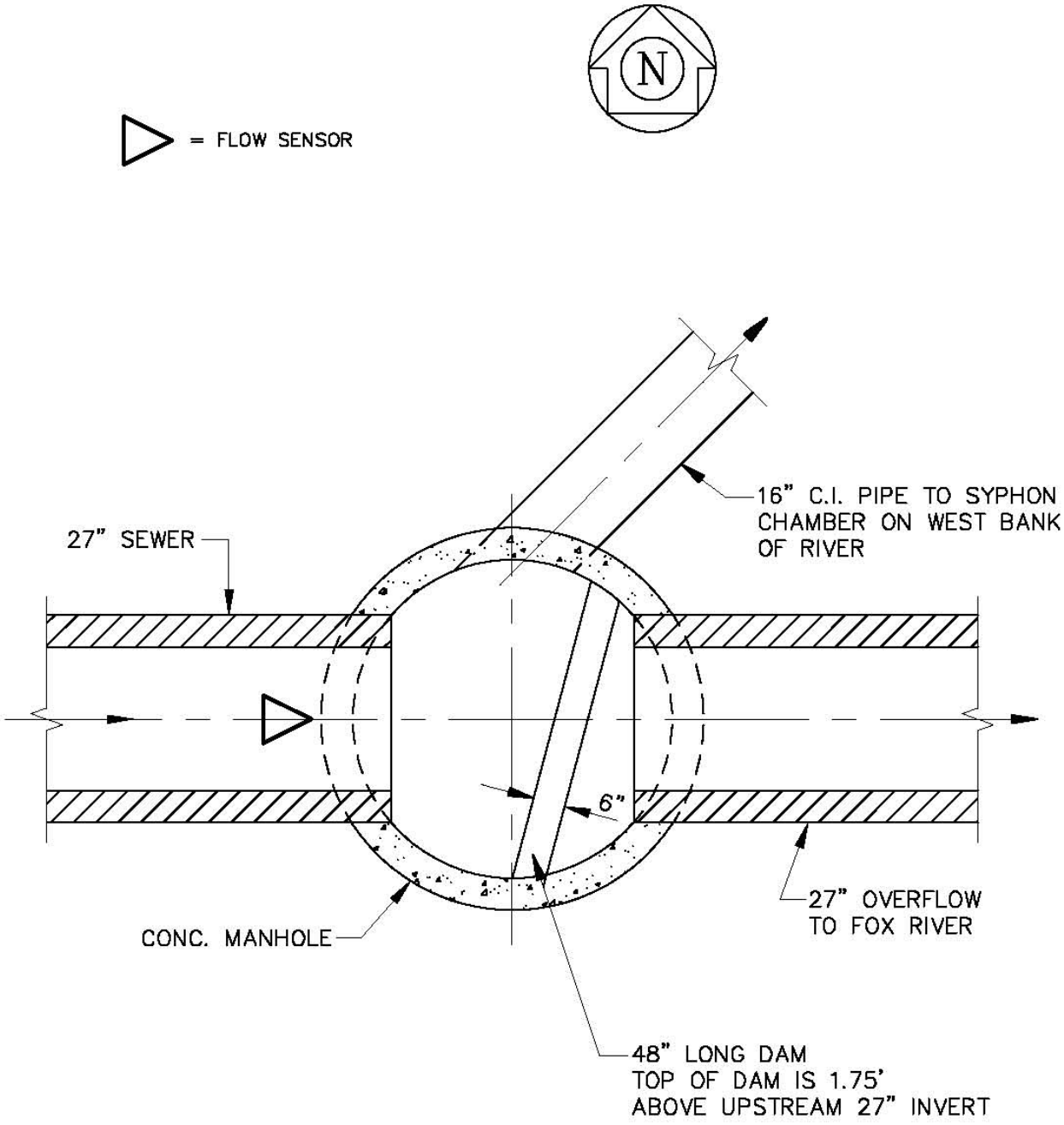
A – A

From Walter E. Deuchler Associates, Inc.

CSO 022 – SUPERIOR STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-12
1-181-001

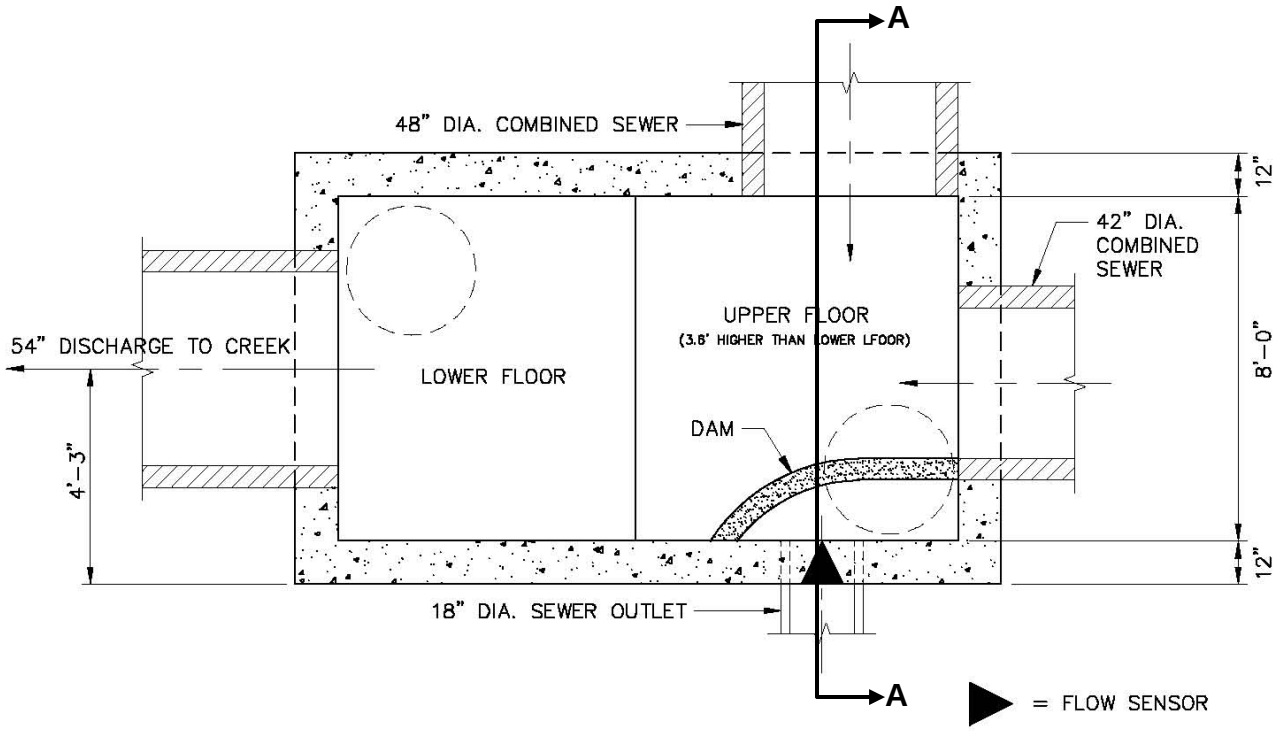


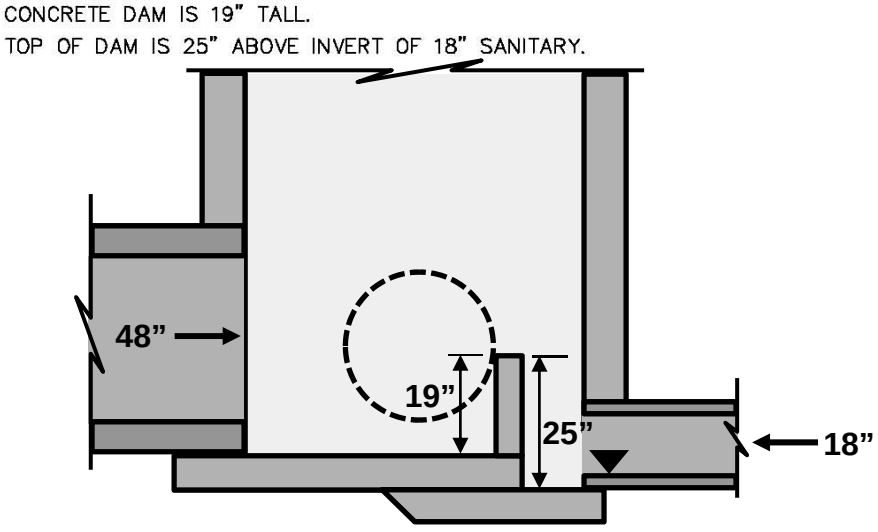
From Walter E. Deuchler Associates, Inc.

CSO 023 – WEST ILLINOIS AVENUE
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-13
1-181-001





SECTION A-A
Not to Scale

From Walter E. Deuchler Associates, Inc.

CSO 025 – DEARBORN AVENUE & TRASK STREET
COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN
CITY OF AURORA, ILLINOIS

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE J.5-14
1-181-001

APPENDIX K
GREEN INFRASTRUCTURE

K.1 WHAT IS GREEN INFRASTRUCTURE?

According to the United States Environmental Protection Agency (USEPA), green infrastructure is characterized as those techniques that utilize natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse, and reduce stormwater runoff using plants, soils, and microbes. Combined sewer overflow (CSO) communities have begun to use green infrastructure techniques to reduce the stormwater runoff within their combined sewer area, thereby reducing CSO frequency, duration, and volume, utilizing environmentally sensitive techniques compared to more traditional engineering solutions or "gray" solutions that are typically employed in CSO control programs.

At the national level, the Natural Resources Defense Council (NRDC) released a report titled *Rooftops to Rivers* (June 2006) that identified green infrastructure as a viable strategy for reducing the impacts of CSO discharges on the water quality of our nation's waterways. This report provides case studies from numerous communities that have successfully incorporated green infrastructure strategies into their CSO reduction programs.

On March 5, 2007, Benjamin Grumbles, the Assistant Administrator of Water for USEPA released a memorandum to all the USEPA Regional Administrators regarding "Using Green Infrastructure to Protect Water Quality in Stormwater, CSO, Nonpoint Source and other water programs."

In this memorandum, Mr. Grumbles stated:

> "Green infrastructure can be both a cost effective and environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions."

Mr. Grumbles went on to say:

> "I strongly support the use of green infrastructure approaches described in the NRDC report…"

CSOs occur when too much stormwater runoff enters the combined system and the sewer system capacity is exceeded resulting in discharges directly to local receiving streams. The root cause of the excessive stormwater runoff is impervious surfaces. As landscapes are developed and natural vegetation is replaced with pavements and rooftops, the rate and volume of stormwater runoff that occurs during precipitation events dramatically increases. Green infrastructure techniques use existing natural systems and the replacement of impervious surfaces with vegetated surfaces to both minimize runoff and to convey redirected runoff from the combined sewer system (CSS) to existing natural systems. Either of these approaches should assist in reducing CSOs.

Many green infrastructure techniques rely on infiltration as the primary mechanism to achieve runoff volume reductions. Soils and geology are important components in determining if and where stormwater runoff can be infiltrated into the subsurface. Soil permeability plays a major role in the design configuration and the functionality of certain green control techniques. High permeability rates can reduce the footprint and/or profile of a proposed green component resulting in very cost-effective designs. Understanding local soil characteristics is very important in the selection and success of different types of green infrastructure techniques.

Figure 4.02-4 shows the hydrologic soils group for the area within the CSS. Soil types A and B have good infiltration characteristics and are well-suited for green infrastructure, while groups C and D may be less ideal. The soils map shows that type C soils predominate in the area east of High Street.

Type B soils predominate west of High Street, with significant areas of combination type B/D soils, especially in the northwestern portion of the CSS. It is recommended that a green infrastructure program implemented by Aurora be planned to emphasize projects within the type B soil areas.

The following sections provide a brief description of several green infrastructure techniques and information regarding applications, advantages and disadvantages, and cost and benefit data. The green infrastructure techniques presented include:

1. Green roofs.
2. Vegetated swales.
3. Bioretention techniques.
4. Porous pavement.
5. Cisterns and rain barrels.

A. Green Roofs

Vegetated roofs, or green roofs, are vegetated areas that are designed as part of a roofing system consisting of thin layers topped by soil and low-lying, drought tolerant vegetation. Vegetated roofs improve rainwater absorption and reduce energy usage and pollutant discharge, while acting like giant sponges, soaking up the rain and reducing annual runoff volumes. They have been installed in many cities throughout the United States. They are great for high density urban settings. These systems can be utilized on commercial, industrial, or residential roofs. Data from monitored vegetated roof systems indicate a significant reduction in annual runoff from these systems when compared to more traditional metal or asphalt roofs.



Figure K.1-1 Green Roof–The Calhoun School, New York City

Two primary types of vegetated roofs include extensive and intensive systems. Extensive systems are simply constructed, typically do not allow public access, and require less maintenance. In contrast, intensive systems are similar to gardens. They are more costly and require added maintenance. Both systems work to control the quantity and quality of stormwater runoff.

Even though vegetated roofs require more maintenance than a traditional roof system, they offer several advantages in addition to capturing and reducing stormwater runoff:

1. Improves water quality by removing pollutants.
2. Adds insulation, reducing energy costs.
3. Protects the underlying roofing system.
4. Extends roof life.
5. Creates a unique wildlife habitat.
6. Improves air quality.

Vegetated roofs have been installed in several cities around the country. With the installation of a green roof, it is important to consider the added cost of maintenance. Extensive green roofs are less expensive to install and maintain than intensive green roofs. The costs of a vegetated roof will increase based on the complexity of the garden and the vegetation throughout. According to the Low Impact Development Center, vegetated roofs are estimated to average between $15 to $20 per square foot. Although initial capital and maintenance costs exist, green roofs provide savings because of increased insulation and longevity of the roof. In addition, a vegetated roof can reduce stormwater runoff by 45 percent to 60 percent depending on the slope of the roof and the vegetation complexity.

B. Vegetated Swales

Vegetated swales, which are also referred to as vegetated open channels, biofiltration swales, or water quality swales, are designed to treat the water quality volume for a designated drainage area. Although vegetated swales are designed primarily for stormwater quality improvements, they can be supplemented with additional structural controls to allow for water quantity control as well to allow for infiltration and evapotranspiration.

Two variations in the designs of vegetated swales include dry swales and wet swales. Dry swales are vegetated channels equipped with an underdrain system that allows for the swale to remain dry most of the time. The primary form of stormwater quality treatment in dry swales is filtration. Wet swales, which are also called wetland channels, are vegetated channels that have wetland conditions and often retain water for a period of time. The primary form of stormwater quality treatment in wet swales is through sediment accumulation and biological removal processes.



Source: www.georgiastormwater.com

Figure K.1-2 Dry Swale



Source: www.georgiastormwater.com

Figure K.1-3 Wet Swale

Typical applications of vegetated swales are along rural highways, small parking areas, and within residential and commercial developments. Although vegetated swales are generally not used in extremely high density urban areas because they tend to require a large amount of space, they do provide an alternative to traditional curb and gutter conveyance systems.

Even though vegetated swales require more maintenance than a traditional curb and gutter system, they offer several advantages such as the following:

1. High pollutant removal rates.
2. Lower cost than curb and gutter systems.
3. Runoff velocity reduction.

As with most green infrastructure controls, the cost of the swale will vary widely depending on the local site conditions and the design criteria. Factors to consider include the drainage area to the swale, local soil conditions, size and depth of the swale, and planting selections. According to the Wisconsin Regional Planning Commission, the cost of vegetated swales can vary between $12.75 and $75 per linear foot, depending on the swale depth and bottom width. However, vegetated swales can reduce stormwater runoff by approximately 40 to 60 percent depending on the local soil conditions.

C. Bioretention Techniques

Bioretention systems, which are also known as rain gardens, are shallow basins designed to treat runoff through engineered soil and proper vegetation. These best management practices are applicable to a variety of projects including both residential and commercial developments.

Although their primary purpose is water quality treatment, bioretention systems can be designed for water quantity control and have a variety of applications. They can control the runoff from residential lots, parking lots, highway and road drainage areas, and within large landscaped pervious areas such as golf courses. Utilizing landscaped areas, whether through street planters, rain gardens or parking lot medians, bioretention areas provide an opportunity to treat and reduce stormwater runoff through infiltration and evapotranspiration.



Figure K.1-4 Street Planter–Portland, Oregon

Although bioretention facilities will require a significant amount of landscaping and therefore additional maintenance, they do have a wide variety of advantages:

1. High pollutant removal rates.
2. Good for small drainage areas and impervious surfaces.
3. Retrofit suitability.
4. Aesthetically pleasing.
5. Easily incorporated into a variety of areas.

Because of the wide variety of bioretention techniques and the materials needed for the different types of facilities, the cost is highly site-specific. The extent of the bioretention facility, whether it requires a street planter, utilizes an existing median, or creates a rain garden within an already pervious area, will determine the design components and cost of the green feature. On average, the cost of a bioretention facility can range from $10 to $40 per cubic foot depending on local soil conditions and the need for structural controls, underdrains, and specific vegetation. However, bioretention facilities can reduce stormwater runoff by approximately 40 to 80 percent depending on the type of facility and the local soil conditions.

D. Porous Pavement

There are several types of porous pavement including concrete, asphalt, paving stones, and grass pavers that allow for the capture and infiltration of stormwater runoff. The primary design variations include asphalt and concrete porous pavements. These involve a layer of asphalt or concrete placed over a permeable layer of gravel and crushed stone with about a 40 percent void space for stormwater storage and recharge. The porous asphalt layer is a mixture of stone aggregate, asphalt cement, and fine aggregates. Next, the porous concrete layer is a mixture of Portland cement, coarse aggregate, and water. Paving stones include blocks made of stone, brick, or concrete placed on a sand base with sand filled joints. Lastly, grass pavers are concrete paved systems with open cells that have turf planted in them.



Figure K.1-5 Porous Asphalt–Sanitation District No. 1 of Northern Kentucky



Figure K.1-6 Porous Concrete–Sanitation District No. 1 of Northern Kentucky

Porous pavements can be designed for many different situations including parking lots, walkways, driveways, and patios. Because of their low load-bearing capacity, they are best suited for pedestrian-only areas as well as low volume, low speed zones. Furthermore, porous pavements are not suitable in areas with high sediment loads because of clogging can occur in these conditions.

There are several advantages and disadvantages with porous pavement. Advantages consist of groundwater recharge, reduction in stormwater runoff volume, pollutant filtration, and less cracking from freezing and thawing. However, some disadvantages to porous pavements include clogging from sand and fine sediments, frost in cold climates, potential groundwater contamination, and inability to treat pollutants from vehicles.

The design, installation, and cost of porous pavement is often very site-specific. The design and cost of porous pavement often depends on the material, the infiltration capacity of the surrounding soils, the inlets and piping, and size of the area. Based on information from available demonstration projects and research, porous pavement can range in cost from $2 to $14 per square foot depending on the design. In addition, maintenance costs can be approximately 1 to 2 percent of construction costs for activities such as removing debris, sweeping, and high pressure washing. However, porous pavements can remove approximately 45 to 75 percent of the stormwater runoff directed to the porous area depending on the soil conditions and presence of an underdrain to discharge excess stormwater.

E. Cisterns and Rain Barrels

Cisterns and rain barrels provide an easy way to collect and store stormwater runoff for later use. Cisterns are often a lot larger than rain barrels and provide either aboveground or underground storage for collecting stormwater runoff from large roof surfaces. This water is then used for landscaping or other nonpotable uses. Cisterns are most often used for large industrial or commercial properties. Rain barrels, more often used on residential properties, provide an effective way to educate the general public about the storage and reuse of rainwater and how this helps a community deal with CSO activity.



Figure K.1-7 Cistern–Sanitation District No. 1 of Northern Kentucky

Cisterns and rain barrels collect stormwater runoff by disconnecting roof downspouts and directing them to the installed storage device. The rainwater is then stored for use by the owner. The rain barrel or cistern system should be designed in such a manner that when the storage device is full, an overflow path is directed to a rain garden or bioretention area whenever possible. By utilizing rain barrels and cisterns within a combined sewer area, a significant portion of impervious area can be removed from directly connecting to the combined system.

There are several advantages to using cisterns and rain barrels for collecting stormwater runoff including the following:

1. Little space required providing a good opportunity for urban areas.
2. Alternative source for irrigation and other nonpotable water needs providing a cost savings.
3. Reduction in peak rates and runoff.
4. Educational opportunities.

Although cisterns and rain barrels provide a community some great opportunities for storing and reusing stormwater runoff, there are also some disadvantages to this type of green infrastructure control. Cisterns and rain barrels can only provide a certain amount of storage for any storm event, and this is entirely dependent on whether or not the owner drains the device after each rain event. In addition, rain barrels and cisterns to not provide any pollutant removal benefits and there are often user concerns about attracting mosquitoes if they are not properly sealed.

The cost of rain barrels and cisterns is highly dependent on the type of system installed. A typical residential rain barrel can range in cost from $60 to $125 for a 55-gallon barrel. However, cisterns are much larger and often require pumps and other more complex features, significantly impacting the cost of the structure. According to the Water Environment Research Federation, a value of $1.45 per gallon can be used for estimating the cost of a cistern based on storage capacity. Rain barrels and cisterns can remove approximately 10 to 40 percent of the stormwater runoff directed to the facility depending on the storage capacity.

K.2 CONCLUSION

Green infrastructure techniques can be very successful at reducing or delaying stormwater runoff from entering a traditional piped system. This is especially beneficial in CSO areas where the reduction or delaying of stormwater runoff from entering the combined system can impact CSOs. There are several factors to consider when selecting a green infrastructure technology. The success of green controls is often site-specific and can depend highly on local conditions such as soils and geology. In addition to providing a stormwater or sewer overflow benefit, green infrastructure techniques achieve multiple objectives and therefore provide multiple benefits including improvement in air and water quality, increased green space and wildlife habitat, and community beautification.

APPENDIX L
REGULATORY DOCUMENTS

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 – (217) 782-3397
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601 – (312) 814-6026

ROD R. BLAGOJEVICH, GOVERNOR DOUGLAS P. SCOTT, DIRECTOR

217/782-0610

RECEIVED
FEB 27 2007
CITY OF AURORA
ENGINEERING DEPT.

February 9, 2007

City of Aurora
44 East Downer Plaza
Aurora, Illinois 60507

Re: City of Aurora Combined Sewer Overflows
NPDES Permit No. IL0048518
Final Permit

Dear Mr. Haurykiewicz:

Attached is the final NPDES Permit for your discharge. The Permit as issued covers discharge limitations, monitoring, and reporting requirements. Failure to meet any portion of the Permit could result in civil and/or criminal penalties. The Illinois Environmental Protection Agency is ready and willing to assist you in interpreting any of the conditions of the Permit as they relate specifically to your discharge.

The Agency has begun a program allowing the submittal of electronic Discharge Monitoring Reports (eDMRs) instead of paper Discharge Monitoring Reports (DMRs). If you are interested in eDMRs, more information can be found on the Agency website, http://epa.state.il.us/water/edmr/index.html. If your facility is not registered in the eDMR program, a supply of preprinted paper DMR Forms for your facility will be sent to you prior to the initiation of DMR reporting under the reissued permit. Additional information and instructions will accompany the preprinted DMRs upon their arrival.

The attached Permit is effective as of the date indicated on the first page of the Permit. Until the effective date of any re-issued Permit, the limitations and conditions of the previously-issued Permit remain in full effect. You have the right to appeal any condition of the Permit to the Illinois Pollution Control Board within a 35 day period following the issuance date.

Should you have questions concerning the Permit, please contact Ralph Hahn at the telephone number indicated above.

Sincerely,

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:DJS:RJH:06022301.dlk

Attachment: Final Permit

cc: Walter Deuchler Associates, Inc.
Fox Metro WRD
Records
Compliance Assurance Section
Des Plaines Region
NIPC

NPDES Permit No. IL0048518

Illinois Environmental Protection Agency

Division of Water Pollution Control

1021 North Grand Avenue East

Post Office Box 19276

Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Reissued (NPDES) Permit

Expiration Date: March 31, 2012

Issue Date: February 9, 2007
Effective Date: April 1, 2007

Name and Address of Permittee:

City of Aurora
44 East Downer Place
Aurora, Illinois 60507

Facility Name and Address:

City of Aurora
CSO's along the Fox River and Indian Creek
Aurora, Illinois
(Kane County)

Receiving Waters: The Fox River and Indian Creek

In compliance with the provisions of the Illinois Environmental Protection Act, Title 35 of the Ill. Adm. Code, Subtitle C, Chapter I, and the Clean Water Act (CWA), the above-named Permittee is hereby authorized to discharge at the above location to the above-named receiving stream in accordance with the standard conditions and attachments herein.

Permittee is not authorized to discharge after the above expiration date. In order to receive authorization to discharge beyond the expiration date, the Permittee shall submit the proper application as required by the Illinois Environmental Protection Agency (IEPA) not later than 180 days prior to the expiration date.

Alan Keller

Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAK:RJH:06022301.dlk

NPDES Permit No. IL0048518

Effluent Limitations, Monitoring, and Reporting

FINAL

Discharge Number(s) and Name(s): 027 Treated CSO Outfall

These flow facilities shall not be utilized until the main treatment facility is receiving its maximum practical flow.

From the effective date of this Permit until the expiration date, the effluent of the above discharge(s) shall be monitored and limited at all times as follows:

Parameter		CONCENTRATION LIMITS mg/L Monthly Average	Sample Frequency	Sample Type
Total Flow (MG)	See Below		Continuous When Discharging	*IRT
BOD_5		Report	Daily When Discharging	Grab
Suspended Solids		Report	Daily When Discharging	Grab
Fecal Coliform	Daily Maximum Shall Not Exceed 400 per 100 mL		Daily When Discharging	Grab
pH	Shall be in the range of 6 to 9 Standard Units		Daily When Discharging	Grab
Chlorine Residual		0.75	Daily When Discharging	Grab

Total flow in million gallons shall be reported on the Discharge Monitoring Report (DMR) in the quantity maximum column.

Report the number of days of discharge in the comments section of the DMR.

Fecal Coliform shall be reported on the DMR as daily maximum.

Chlorine Residual shall be reported on the DMR as a monthly average concentration.

pH shall be reported on the DMR as a minimum and a maximum.

BOD_5 and Suspended Solids shall be reported on the DMR as a monthly average concentration.

*Indicating, Recording, Totalizing.

NPDES Permit No. IL0048518

Special Conditions

SPECIAL CONDITION 1. This Permit may be modified to include different final effluent limitations or requirements which are consistent with applicable laws, regulations, or judicial orders. The IEPA will public notice the permit modification.

SPECIAL CONDITION 2. The use or operation of the treatment facilities discharging through outfall 027 shall be by or under the supervision of a Certified Class 3 operator.

SPECIAL CONDITION 3. The IEPA may request in writing submittal of operational information in a specified form and at a required frequency at any time during the effective period of this Permit.

SPECIAL CONDITION 4. The effluent, alone or in combination with other sources, shall not cause a violation of any applicable water quality standard outlined in 35 Ill. Adm. Code 302.

SPECIAL CONDITION 5. During January of each year the Permittee shall submit annual fiscal data regarding sewerage system operations to the Illinois Environmental Protection Agency/Division of Water Pollution Control/Compliance Assurance Section. The Permittee may use any fiscal year period provided the period ends within twelve (12) months of the submission date.

Submission shall be on forms provided by IEPA titled "Fiscal Report Form For NPDES Permittees".

SPECIAL CONDITION 6.

AUTHORIZATION OF
COMBINED SEWER AND TREATMENT PLANT DISCHARGES

The IEPA has determined that at least a portion of the collection system consists of combined sewers. References to the collection system and the sewer system refer only to those parts of the system which are owned and operated by the Permittee unless otherwise indicated. The Permittee is authorized to discharge from the overflow(s)/bypass(es) listed below provided the diversion structure is located on a combined sewer and the following terms and conditions are met:

Discharge Number	Location	Receiving Water
004	Hazel	Fox River
001	Rathbone	Fox River
005	Third	Fox River
010	First	Fox River
A16	Clark	Fox River
015*	West Benton	Fox River
018*	West Galena	Fox River
021	West Park (formerly Elm)	Fox River
022	Superior	Fox River
023	West Illinois	Fox River
002	East Illinois	Fox River
025	Dearborn - Trask	Indian Creek
017	Stolp	Fox River
008*	Benton	Fox River
A03	Pierce	Fox River
028*	North Avenue	Fox River

*Upon completion of construction, North Avenue overflow 028 will replace overflows 008, 015 and 018.

Treatment Requirements

1. All combined sewer overflows and, if applicable, treatment plant bypasses, shall be given sufficient treatment to prevent pollution and the violation of applicable water quality standards and to the extent required by the federal Clean Water Act, including any amendments made by the Wet Weather Water Quality Act of 2000.

NPDES Permit No. IL0048518

Special Conditions

2. All dry weather flows, and storm flows, to the extent required by PCB 85-224 and dated July 13, 1988, shall be conveyed to the Fox Metro Water Reclamation District (FMWRD) Sewage Treatment Plant for treatment. The terms and conditions of this Board Order are hereby incorporated by reference as if fully set forth herein.

3. All CSO discharges authorized by this Permit shall be treated, in whole or in part, to the extent necessary to prevent accumulations of sludge deposits, floating debris and solids in accordance with 35 Ill. Adm. Code 302.203 and to prevent depression of oxygen levels below the applicable water quality standards.

4. Overflows during dry weather are prohibited. Dry weather overflows shall be reported to the IEPA pursuant to Standard Condition 12(e) of this Permit (24 hour notice).

5. The collection system shall be operated to optimize transport of wastewater flows and to minimize CSO discharges and the treatment system, if applicable, shall be operated to maximize treatment of wastewater flows.

Nine Minimum Controls

6. The Permittee shall comply with the nine minimum controls contained in the National CSO Control Policy published in the Federal Register on April 19, 1994. The nine minimum controls are:

   a. Proper operation and maintenance programs for the sewer system and the CSOs (Compliance with this Item shall be met through the requirements imposed by Paragraph 8 of this Special Condition);

   b. Maximum use of the collection system for storage (Compliance with this Item shall be met through the requirements imposed by Paragraphs 2, 5, and 8 of this Special Condition);

   c. Review and modification of pretreatment requirements to assure CSO impacts are minimized (Compliance with this Item shall be met through the requirements imposed by Paragraph 9 of this Special Condition);

   d. Maximization of flow to the POTW for treatment (Compliance with this Item shall be met through the requirements imposed by Paragraphs 2, 5, and 8 of this Special Condition);

   e. Prohibition of CSOs during dry weather (Compliance with this Item shall be met through the requirements imposed by Paragraph 4 of this Special Condition);

   f. Control of solids and floatable materials in CSOs (Compliance with this Item shall be met through the requirements imposed by Paragraphs 3 and 8 of this Special Condition);

   g. Pollution prevention programs which focus on source control activities (Compliance with this Item shall be met through the requirements imposed by Paragraph 6 of this Special Condition, See Below);

   h. Public notification to ensure that citizens receive adequate information regarding CSO occurrences and CSO impacts (Compliance with this Item shall be met through the requirements imposed by Paragraph 12 of this Special Condition); and,

   i. Monitoring to characterize impacts and efficiency of CSO controls (Compliance with this Item shall be met through the requirements imposed by Paragraphs 10 and 11 of this Special Condition).

A pollution prevention plan (PPP) shall be developed by the Permittee unless one has already been prepared for this collection system. Any previously prepared PPP shall be reviewed, and revised if necessary, by the Permittee to address the items contained in Chapter 8 of the U.S. EPA guidance document, Combined Sewer Overflows, Guidance For Nine Minimum Controls, and any items contained in previously sent review documents from the IEPA concerning the PPP. Combined Sewer Overflows, Guidance For Nine Minimum Controls is available online at http://www.epa.gov/npdes/pubs/owm0030.pdf. The PPP (or revised PPP) shall be presented to the general public at a public information meeting conducted by the Permittee within nine (9) months of the effective date of this Permit. The Permittee shall submit documentation that the pollution prevention plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted to the IEPA within twelve (12) months of the effective date of this Permit and shall include a summary of all significant issues raised

by the public, the Permittee's response to each issue, and two (2) copies of the "CSO Pollution Prevention Plan Certification" one (1) with original signatures. This certification form is available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-pol-prev.pdf. Following the public meeting, the Permittee shall implement the pollution prevention plan within one (1) year and shall maintain a current pollution prevention plan, updated to reflect system modifications, on file at the sewage treatment works or other acceptable location and made available to the public. The pollution prevention plan shall be submitted to the IEPA upon written request. The Permittee may coordinate the development/review of the PPP and the public meeting with the FMWRD.

Sensitive Area Considerations

7. Pursuant to Section II.C.3 of the federal CSO Control Policy of 1994, sensitive areas are any water likely to be impacted by a CSO discharge which meet one or more of the following criteria: (1) designated as an Outstanding National Resource Water; (2) found to contain shellfish beds; (3) found to contain threatened or endangered aquatic species or their habitat; (4) used for primary contact recreation; or, (5) within the protection area for a drinking water intake structure.

   The IEPA has noted on the Public Notice/Fact Sheet for this Permit that some or all of the City's CSOs may discharge into sensitive areas and that the past determination on this issue is no longer valid. Unless the IEPA specifically notifies the Permittee in writing that none of the CSOs authorized in this Permit discharge into sensitive areas, the Permittee shall provide information sufficient for the IEPA to make a determination pursuant to Section II.C.3 of the federal CSO Control Policy of 1994. Failure to provide information sufficient for the IEPA to make this determination in the long-term control plan could result in a determination that some or all of the CSOs discharge into a sensitive area. Should the IEPA conclude that any of the CSOs listed in this Special Condition discharge to a sensitive area, the Permittee shall adress these CSOs through the long-term control plan and either relocate, control, or treat discharges from these outfalls. If none of these options are possible, the Permittee shall submit adequate justification as to why these options are not possible. Such justification shall be in accordance with Section II.C.3 of the National CSO Control Policy and shall be updated every five (5) years and submitted with the NPDES renewal application as required by the federal CSO Control Policy of 1994.

Operational and Maintenance Plans

8. The IEPA reviewed and accepted a CSO operational and maintenance plan "CSO O&M plan" on April 21, 1997 prepared for this sewerage system. The Permittee shall review and revise, if needed, the CSO O&M plan to reflect system changes.

   The CSO O&M plan shall be presented to the general public at a public information meeting conducted by the Permittee within nine (9) months of the effective date of this Permit. The Permittee shall submit documentation that the CSO O&M plan complies with the requirements of this Permit and that the public information meeting was held. Such documentation shall be submitted to the IEPA within twelve (12) months of the effective date of this Permit and shall include a summary of all significant issues raised by the public, the Permittee's response to each issue, and two (2) copies of the "CSO Operational Plan Checklist and Certification", one (1) with original signatures. Copies of the "CSO Operational Plan Checklist and Certification" are available online at http://www.epa.state.il.us/water/permits/waste-water/forms/cso-checklist.pdf. Following the public meeting, the Permittee shall implement the CSO O&M plan within one (1) year and shall maintain a current CSO O&M plan, updated to reflect system modifications, on file at the sewage treatment works or other acceptable location and made available to the public. The CSO O&M plan shall be submitted to the IEPA upon written request. The Permittee may coordinate the review of the CSO O&M and the public meeting with the FMWRD.

   The objectives of the CSO O&M plan are to reduce the total loading of pollutants and floatables entering the receiving stream and to ensure that the Permittee ultimately achieves compliance with water quality standards. These plans, tailored to the local governments's collection and waste treatment systems, shall include mechanisms and specific procedures where applicable to ensure:

   a. Collection system inspection on a scheduled basis;

   b. Sewer, catch basin, and regulator cleaning and maintenance on a scheduled basis;

   c. Inspections are made and preventive maintenance is performed on all pump/lift stations;

d. Collection system replacement, where necessary;

e. Detection and elimination of illegal connections;

f. Detection, prevention, and elimination of dry weather overflows;

g. The collection system is operated to maximize storage capacity and the combined sewer portions of the collection system are operated to delay storm entry into the system; and,

h. The treatment and collection systems are operated to maximize treatment.

Sewer Use Ordinances

9. The Permittee, within six (6) months of the effective date of this Permit, shall review and where necessary, modify its existing sewer use ordinance to ensure it contains provisions addressing the conditions below. If no ordinance exists, such ordinance shall be developed and implemented within six (6) months from the effective date of this Permit. Upon completion of the review of the sewer use ordinance(s), the Permittee shall submit two (2) copies of a completed "Certification of Sewer Use Ordinance Review", one (1) with original signatures. Copies of this certification form can be obtained online at http://www.epa.state.il.us/water/permits/waste-water/forms/sewer-use.pdf. The Permittee shall submit copies of the sewer use ordinance(s) to the IEPA upon written request. Sewer use ordinances are to contain specific provisions to:

   a. prohibit introduction of new inflow sources to the sanitary sewer system;

   b. require that new construction tributary to the combined sewer system be designed to minimize and/or delay inflow contribution to the combined sewer system;

   c. require that inflow sources on the combined sewer system be connected to a storm sewer, within a reasonable period of time, if a storm sewer becomes available;

   d. provide that any new building domestic waste connection shall be distinct from the building inflow connection, to facilitate disconnection if a storm sewer becomes available;

   e. assure that CSO impacts from non-domestic sources are minimized by determining which non-domestic discharges, if any, are tributary to CSOs and reviewing, and, if necessary, modifying the sewer use ordinance to control pollutants in these discharges; and,

   f. assure that the owners of all publicly owned systems with combined sewers tributary to the Permittee's collection system have procedures in place adequate to ensure that the objectives, mechanisms, and specific procedures given in Paragraph 8 of this Special Condition are achieved.

The Permittee shall enforce the applicable sewer use ordinances.

Long-Term Control Planning and Compliance with Water Quality Standards

10. a. Pursuant to Section 301 of the federal Clean Water Act, 33 U.S.C. § 1311 and 40 CFR § 122.4, discharges from the CSOs, including the outfalls listed in this Special Condition and any other outfall listed as a "Treated Combined Sewage Outfall", shall not cause or contribute to violations of applicable water quality standards or cause use impairment in the receiving waters. In addition, discharges from CSOs shall comply with all applicable parts of 35 Ill. Adm. Code 306.305(a), (b), (c), and (d).

   b. The Permittee shall develop a Long-Term CSO Control Plan (LTCP) for assuring that the discharges from the CSOs (treated or untreated) authorized in this Permit comply with Paragraph 10.a above and all applicable standards, including water quality standards. Two (2) copies of the LTCP shall be submitted to the IEPA within thirty-six (36) months of the effective date of this Permit. The LTCP shall contain all applicable elements of Paragraph 10.c below including a schedule for implementation and provisions for re-evaluating compliance with applicable standards and regulations after implementation. The LTCP shall be:

1. Consistent with Section II.C.4.a.i of the Policy; or,
2. Consistent with either Section II.C.4.a.ii, Section II.C.4.a.iii, or Section II.C.4.b of the Policy and be accompanied by data sufficient to demonstrate that the LTCP, when completely implemented, will be sufficient to meet water quality standards.

c. Pursuant to the Policy, the required components of the LTCP include the following:

1. Characterization, monitoring, and modeling of the Combined Sewer System (CSS);
2. Consideration of Sensitive Areas;
3. Evaluation of alternatives;
4. Cost/Performance considerations;
5. Revised CSO Operational Plan;
6. Maximizing treatment at the treatment plant;
7. Implementation schedule;
8. Post-Construction compliance monitoring program; and
9. Public participation.

The Permittee shall coordinate the development of the LTCP with the FMWRD. Following submittal of the LTCP, the Permittee shall respond to any initial IEPA review letter in writing within ninety (90) days of the date of such a review letter, and within thirty (30) days of any subsequent review letter(s), if any. Implementation of the LTCP shall be as indicated by IEPA in writing or other enforceable mechanism.

d. The IEPA recognizes the Fox River Study Group is currently working on funding mechanisms to gather data and to develop and calibrate a model to determine appropriate limitations and permit requirements for dischargers to the Fox River. The implementation schedule for the LTCP shall give priority to controlling, treating, or eliminating CSOs which discharge into areas where primary contact activities occur and to other areas that may be considered sensitive pursuant to Section II.C.3 of the federal CSO Control Policy. The LTCP implementation schedule may also allow the Permittee to verify by appropriate methods, including use of the FRSG-developed model after it is calibrated, and to ensure that the selected CSO control alternatives are adequate to meet water quality standards and to protect the designated uses in the receiving waters. The length of the implementation schedule shall also be based upon financial considerations pursuant to Section II.C.8 of the federal CSO Control Policy and on the USEPA guidance document, *Combined Sewer Overflows--Guidance for Financial Capability Assessment and Schedule Development*. This document is available online at http://www.epa.gov/npdes/pubs/csocf.pdf. Other guidance documents can be found at http://cfpub.epa.gov/npdes/cso/guidedocs.cfm.

Monitoring, Reporting and Notification Requirements

11. The Permittee shall monitor the frequency of discharge (number of discharges per month) and estimate the duration (in hours) of each discharge from each outfall listed in this Special Condition. Estimates of storm duration and total rainfall shall be provided for each storm event.

    For frequency reporting, all discharges from the same storm, or occurring within 24 hours, shall be reported as one. The date that a discharge commences shall be recorded for each outfall. Reports shall be in the form specified by the IEPA and on forms provided by the IEPA. These forms shall be submitted to the IEPA monthly with the DMRs and covering the same reporting period as the DMRs. Parameters (other than flow frequency), if required in this Permit, shall be sampled and reported as indicated in the transmittal letter for such report forms.

12. A public notification program in accordance with Section II.B.8 of the federal CSO Control Policy of 1994 shall be developed employing a process that actively informs the affected public. The program shall include at a minimum public notification of CSO occurrences and CSO impacts, with consideration given to including mass media and/or Internet notification. The Permittee shall also consider posting signs in waters likely to be impacted by CSO discharges at the point of discharge and at points where these waters are used for primary contact recreation. Provisions shall be made to include modifications of the program when necessary and notification to any additional member of the affected public. The program shall be presented to the general public at a public information meeting conducted by the Permittee. The Permittee shall conduct the public information meeting within nine (9) months of the effective date of this Permit. The Permittee shall submit documentation that the public information meeting was held, shall submit a summary of all significant issues raised by the public and the Permittee's response to each issue and

shall identify any modifications to the program as a result of the public information meeting. The Permittee shall submit the public information meeting documentation to the IEPA and implement the public notification program within twelve (12) months of the effective date of this Permit. The Permittee shall submit copies of the public notification program to the IEPA upon written request. The Permittee may coordinate the development of the public notification plan and the public meeting with the FMWRD.

13. If any of the CSO discharge points listed in this Special Condition are eliminated, or if additional CSO discharge points, not listed in this Special Condition, are discovered, the Permittee shall notify the IEPA in writing within one (1) month of the respective outfall elimination or discovery. Such notification shall be in the form of a request for the appropriate modification of this NPDES Permit.

Summary of Compliance Dates in this CSO Special Condition

14. The following summarizes the dates that submittals contained in this Special Condition are due at the IEPA (unless otherwise indicated):

Submission of CSO Monitoring Data (Paragraph 11)	15th of every month
Elimination of a CSO or Discovery of Additional CSO Locations (Paragraph 13)	1 month from discovery or elimination
Control (or Justification for No Control) of CSOs to Sensitive Areas (Paragraph 7)	3 months from IEPA notification
Certification of Sewer Use Ordinance Review (Paragraph 9)	6 months from the effective date of this Permit
Conduct Pollution Prevention, OMP, and PN Public Information Meeting (Paragraphs, 6, 8 and 12) **No Submittal Due with this Milestone**	9 months from the effective date of this Permit
Submit Pollution Prevention Certification, OMP Certification, and PN Information Meeting Summary (Paragraphs, 6, 8 and 12)	12 months from the effective date of this Permit
Submit CSO Long-Term Control Plan (Paragraph 10)	36 months from the effective date of this Permit

All submittals listed in this Special Condition can be mailed to the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Attention: CSO Coordinator, Compliance Assurance Section

All submittals hand carried shall be delivered to 1021 North Grand Avenue East.

Reopening and Modifying this Permit

15. The IEPA may initiate a modification for this Permit at any time to include requirements and compliance dates which have been submitted in writing by the Permittee and approved by the IEPA, or other requirements and dates which are necessary to carry out the provisions of the Illinois Environmental Protection Act, the Clean Water Act, or regulations promulgated under those Acts. Public Notice of such modifications and opportunity for public hearing shall be provided.

NPDES Permit No. IL0048518

Special Conditions

SPECIAL CONDITION 7. This Permit may be modified to include alternative or additional final effluent limitations or other requirements pursuant to an approved Total Maximum Daily Load (TMDL) Study or upon completion of an alternate Fox River Water Quality Study.

SPECIAL CONDITION 8. The Permittee shall record monitoring results on Discharge Monitoring Report (DMR) Forms using one such form for each outfall each month.

In the event that an outfall does not discharge during a monthly reporting period, the DMR Form shall be submitted with no discharge indicated.

The Permittee may choose to submit electronic DMRs (eDMRs) instead of mailing paper DMRs to the IEPA. More information, including registration information for the eDMR program, can be obtained on the IEPA website, http://www.epa.state.il.us/water/edmr/index.html.

The completed Discharge Monitoring Report forms shall be submitted to IEPA no later than the 15th day of the following month, unless otherwise specified by the permitting authority.

Permittees not using eDMRs shall mail Discharge Monitoring Reports with an original signature to the IEPA at the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 North Grand Avenue East
Post Office Box 19276
Springfield, Illinois 62794-9276

Attention: Compliance Assurance Section, Mail Code # 19

SPECIAL CONDITION 9. Upon completion of construction for Discharge Number 028, the Permittee shall submit notification to the IEPA in writing at the above address within thirty (30) days of the completion of construction. Such notification letter shall also request that this Permit be modified to remove the authorization to discharge from Discharge Numbers 008, 015, and 018. Unless this Permit is modified to include other items at the time, Public Notification will not be given unless so requested in writing.

ATTACHMENT H

Standard Conditions

Definitions

Act means the Illinois Environmental Protection Act, Ch. 111 1/2 Ill. Rev. Stat., Sec 1001-1052 as Amended.

Agency means the Illinois Environmental Protection Agency.

Board means the Illinois Pollution Control Board.

Clean Water Act (formerly referred to as the Federal Water Pollution Control Act) means Pub. L. 92-500, as amended. 33 U.S.C. 1251 et seq.

NPDES (National Pollutant Discharge Elimination System) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318 and 405 of the Clean Water Act.

USEPA means the United States Environmental Protection Agency.

Daily Discharge means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurements, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

Maximum Daily Discharge Limitation (daily maximum) means the highest allowable daily discharge.

Average Monthly Discharge Limitation (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

Average Weekly Discharge Limitation (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Aliquot means a sample of specified volume used to make up a total composite sample.

Grab Sample means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

24 Hour Composite Sample means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

8 Hour Composite Sample means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

Flow Proportional Composite Sample means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

(1) Duty to comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

(2) Duty to reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.

(3) Need to halt or reduce activity not a defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

(4) Duty to mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

(5) Proper operation and maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.

(6) Permit actions. This permit may be modified, revoked and reissued, or terminated for cause by the Agency pursuant to 40 CFR 122.62. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

(7) Property rights. This permit does not convey any property rights of any sort, or any exclusive privilege.

(8) Duty to provide information. The permittee shall furnish to the Agency within a reasonable time, any information which the Agency may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also furnish to the Agency, upon request, copies of records required to be kept by this permit.

(9) Inspection and entry. The permittee shall allow an authorized representative of the Agency, upon the presentation of credentials and other documents as may be required by law, to:

(a) Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

(c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

(d) Sample or monitor at reasonable times, for the purpose of assuring permit compliance, or as otherwise authorized by the Act, any substances or parameters at any location.

(10) Monitoring and records.

(a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

(b) The permittee shall retain records of all monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of this permit, measurement, report or application. This period may be extended by request of the Agency at any time.

(c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;

(2) The individual(s) who performed the sampling or measurements;

(3) The date(s) analyses were performed;

(4) The individual(s) who performed the analyses;

(5) The analytical techniques or methods used; and

(6) The results of such analyses.

(d) Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. Where no test procedure under 40 CFR Part 136 has been approved, the permittee must submit to the Agency a test method for approval. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to ensure accuracy of measurements.

(11) Signatory requirement. All applications, reports or information submitted to the Agency shall be signed and certified.

(a) Application. All permit applications shall be signed as follows:

(1) For a corporation: by a principal executive officer of at least the level of vice president or a person or position having overall responsibility for environmental matters for the corporation;

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

(b) Reports. All reports required by permits, or other information requested by the Agency shall be signed by a person described in paragraph (a) or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described in paragraph (a); and

(2) The authorization specifies either an individual or a position responsible for the overall operation of the facility, from which the discharge originates, such as a plant manager, superintendent or person of equivalent responsibility; and

(3) The written authorization is submitted to the Agency.

(c) **Changes of Authorization.** If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.

(12) **Reporting requirements.**

(a) **Planned changes.** The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility.

(b) **Anticipated noncompliance.** The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

(c) **Compliance schedules.** Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

(d) **Monitoring reports.** Monitoring results shall be reported at the intervals specified elsewhere in this permit.

(1) Monitoring results must be reported on a Discharge Monitoring Report (DMR).

(2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.

(3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.

(e) **Twenty-four hour reporting.** The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24 hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit;

(2) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit to be reported within 24 hours;

The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

(f) **Other noncompliance.** The permittee shall report all instances of noncompliance not reported under paragraphs (12)(c), (d), or (e), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12)(e).

(g) **Other information.** Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.

(13) **Transfer of permits.** A permit may be automatically transferred to a new permittee if:

(a) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;

(b) The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage and liability between the current and new permittees; and

(c) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.

(14) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:

(a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:

(1) One hundred micrograms per liter (100 ug/l);

(2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/l) for antimony;

(3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or

(4) The level established by the Agency in this permit.

(b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the NPDES permit application.

(15) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Agency of the following:

(a) Any new introduction of pollutants into that POTW from an indirect discharger which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants; and

(b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

(c) For purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

(16) If the permit is issued to a publicly owned or publicly regulated treatment works, the permittee shall require any industrial user of such treatment works to comply with federal requirements concerning:

(1) User charges pursuant to Section 204(b) of the Clean Water Act, and applicable regulations appearing in 40 CFR 35;

(2) Toxic pollutant effluent standards and pretreatment standards pursuant to Section 307 of the Clean Water Act; and

(3) Inspection, monitoring and entry pursuant to Section 308 of the Clean Water Act.

(17) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) and (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked, and reissued to conform to that effluent standard or limitation.

(18) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. Code 309.154 is hereby incorporated by reference as a condition of this permit.

(19) The permittee shall not make any false statement, representation or certification in any application, record, report, plan or other document submitted to the Agency or the USEPA, or required to be maintained under this permit.

(20) The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing Sections 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less than $2,500, nor more than $25,000 per day of violation, or by imprisonment for not more than one year, or both.

(21) The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

(22) The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit shall, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

(23) Collected screening, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes (or runoff from the wastes) into waters of the State. The proper authorization for such disposal shall be obtained from the Agency and is incorporated as part hereof by reference.

(24) In case of conflict between these standard conditions and any other condition(s) included in this permit, the other condition(s) shall govern.

(25) The permittee shall comply with, in addition to the requirements of the permit, all applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and all applicable orders of the Board.

(26) The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit is held invalid, the remaining provisions of this permit shall continue in full force and effect.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 – (217) 782-3397
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601 – (312) 814-6026

ROD R. BLAGOJEVICH, GOVERNOR DOUGLAS P. SCOTT, DIRECTOR

RECEIVED
APR 17 2008
CITY OF AURORA
PUBLIC WORKS OFFICE

April 11, 2008

Mr. Kenneth Schroth, Director of Public Works
City of Aurora
44-East Downer Place
Aurora, Il 60507

Re: Long Term Control Plan (LTCP)
NPDES# IL0048518

Dear Mr. Schroth:

The purpose of this letter is to bring your attention to special condition 14 – Authorization of Combined Sewer and Treatment Plant Discharge of your NPDES Permit.

Special Condition 14.10 of your NPDES Permit identifies required components of the LTCP, which include the following:

1. *Characterization, monitoring, and modeling of the Combined Sewer System (CSS);*
2. *Consideration of Sensitive Areas;*
3. *Evaluation of alternatives;*
4. *Cost/Performance considerations;*
5. *Revised CSO Operational Plan;*
6. *Maximizing treatment at the treatment plant;*
7. *Implementation schedule;*
8. *Post-Construction compliance monitoring program; and*
9. *Public participation*

Special Condition 14.14 of your NPDES Permit provides a summary of compliance dates as follows:

✓ *Submission of CSO Monitoring Data*	*15th of every month*
Elimination of a CSO or Discovery of Additional CSO Locations	*1 month from discovery or elimination*
Control (or Justification for No Control) of CSOs to Sensitive Areas	*3 months from IEPA notification*

✓ *Certification of Sewer Use Ordinance Review (Paragraph 9)*	*6 months from the effective date of the Permit*
Conduct Pollution Prevention, OMP, and PN Public Information Meeting	*9 months from the effective date of the Permit*
Submit Pollution Prevention Certification, OMP Certification, and PN Information Meeting Summary	*12 months from the effective date of the Permit*
Submit CSO Long-Term Control Plan	*36 months from the effective date of the Permit*

We realize that LTCP is not due until 2010; however, early coordination and planning will make the review/approval process easier. In order to reach this goal mutually, we ask that you develop a *Plan of Study* (POS) and submit the POS to the Agency at your earliest convenience. If a *Plan of Study* has already been developed, we urge you to submit the current stage of the plan. Please submit written response within 30 days of the receipt of this letter.

If you need to discuss the plan and would like to arrange a meeting, please contact Mr. George Lambert at 217/785-1896.

Sincerely,

Michael S. Garretson, Manager
Compliance Assurance Section
Bureau of Water

4

City of Aurora

Engineering Division • 44 E. Downer Place • Aurora, Illinois 60507-2067 • (630) 844-3620
FAX (630) 892-0322

Kenneth Schroth, P.E.
Director of Public Works
City Engineer

September 26, 2007

Mr. Alan Keller, P.E.
Manager, Permit Section
Division of Water Pollution Control
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276

Re: Sewer Use Ordinance Review
City of Aurora NPDES Permit No. IL0048518

Dear Mr. Keller,

Attached please find one (2) original copies of the Certification of Sewer Use Ordinance per the requirements of the above referenced NPDES Permit.

Please feel free to contact the undersigned at 630-906-7442 if you have any questions.

Sincerely,

L. Eric Schoeny, P.E.
Drainage and Underground Coordinator
City of Aurora

CC: Ralph Hahn, IEPA w/attachments
Tom Muth, Fox Metro WRD w/attachments
Philippe Moreau, WEDA w/attachments

printed on recycled paper

CERTIFICATION OF SEWER USE ORDINANCE REVIEW

I attest that I have reviewed the applicable sewer use ordinance(s) for the City of Aurora *and find that said ordinance(s) contain(s) requirements for the following items in the identified sections (mark N/A for any requirement that is not contained in your NPDES permit):*

1. prohibit introduction of new inflow sources to the sanitary sewer system;
   Ordinance Number 002-32 ; Section 48-133
2. require that new construction tributary to the combined sewer system be designed to minimize and/or delay inflow contribution to the combined sewer system;
   Ordinance Number 002-32 ; Section 48-103
3. require that inflow sources on the combined sewer system be connected to a storm sewer, within a reasonable period of time, if a storm sewer becomes available;
   Ordinance Number 002-32 ; Section 48-103
4. provide that any new building domestic waste connection be distinct from the building inflow connection, to facilitate disconnection if a storm sewer becomes available;
   Ordinance Number 002-32 ; Section 48-103
5. assure that CSO impacts from non-domestic sources are minimized by determining which non-domestic discharges, if any, are tributary to CSO's and reviewing, and, if necessary, modifying the sewer use ordinance to control pollutants in these discharges; and,
   Ordinance Number 002-32 ; Section 48-135, 136, 137
6. assure that the owners of all combined sewers tributary to the Permittee's collection system have procedures in place to ensure that the objectives, mechanisms, and specific procedures for operation and maintenance as described in the Permit.
   Ordinance Number 002-32 ; Section 48-139, 140, 141

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein; and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete.

Kenneth Schroth, P.E.	Director of Public Works
Name (typed or printed)	Title
Kenneth Schroth	9-20-07
Signature	Date

I attest that above individual is a duly authorized representative of the City of Aurora *and has authority to sign this certification.*

Thomas Weisner	Mayor
Ranking Elected Official (typed or printed)	Title
Thomas Weisner	9/24/07
Signature	Date

IL 532-2785
WPC 729 2/2004

Information required by this form must be provided to comply with 415 ILCS 5/39 (1994). Failure to so provide may result in penalties of up to $10,000 and/or maximum imprisonment of between 6 months and 5 years. This form has been approved by the Forms Management Center.

CITY OF AURORA, ILLINOIS
ORDINANCE NO. 002-32
DATE OF PASSAGE April 9, 2002

AN ORDINANCE AMENDING CHAPTER 48 OF THE AURORA CODE OF ORDINANCES ENTITLED "UTILITIES"

WHEREAS, the City of Aurora ("City) has a population of more than 25,000 persons and is, therefore, a home rule unit under subsection (a) of Section 6 of Article VII of the Illinois Constitution of 1970; and

WHEREAS, subject to said Section, a home rule unit may exercise any power and perform any function pertaining to its government and affairs for the protection of the public health, safety, morals and welfare; and

WHEREAS, in furtherance of its home rule powers, it is necessary and desirable for the City of Aurora to amend it's ordinances regarding parking regulations for commercial vehicles, trailers, and truck tractors in residence districts.

NOW, THEREFORE, BE IT ORDAINED by the City Council of the City of Aurora, Illinois, as follows:

Section One: That Chapter 48 of the Aurora Code of Ordinances is amended as follows:

Sec. 48-103. Special provisions for sewer construction within the combined sewer system

(a) New residential, commercial or industrial building construction in areas served by combined sewers or areas whose stormwater drainage or sanitary sewage or both are tributary to areas served by combined sewers are subject to the following additional sewer construction specifications:

(1) Connections to combined sewers shall be designed in such a way as to minimize and/or delay inflow contribution to the combined sewer system. This may be accomplished by constructing storage facilities or alternative drainage systems.

(2) New building construction shall be designed in such a way that the building sanitary sewage and/or industrial waste collection is distinct from the building and site stormwater runoff conveyance system, in order to facilitate its disconnection of the stormwater conveyance system from the combined sewer should a storm sewer become available. The storm sewer system may be rejoined in the public right-of-way to the combined sewer if no sewer is available.

(b) In the event a storm sewer is constructed in close proximity to a parcel of property that currently discharges inflow into a combined sewer, the property owner shall reroute this inflow connection to the newly constructed storm sewer. Said connection shall be completed within twelve months after completion of the new storm sewer.

(c) A general description of the geographic areas of the city served by combined sewer systems shall be on file with the city engineer.

Section Two: That this ordinance shall be in full force and effect, and shall be controlling, upon its passage and approval.

Section Three: That all ordinances or parts of ordinances thereof in conflict herewith are hereby repealed to the extent of any such conflict.

Section Four: That any section or provision of this ordinance that is construed to be invalid or void shall not effect the remaining sections or provisions which shall remain in full force and effect thereafter.

PASSED by the City Council of the City of Aurora, Illinois, on April 9, 2002.

AYES 10 NAYES 0

APPROVED AND SIGNED by the Mayor of the City of Aurora, Illinois, on April 9, 2002.

ATTEST:

Cheryl M Vonhoff
City Clerk

Mayor

City of Aurora
Law Department
44 East Downer Place
Aurora, IL 60507
(630) 844-4731

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(c) A general description of the geographic areas of the city served by combined sewer systems shall be on file with the city engineer.

(Ord. No. Ord. No. 002-32, § 1, 4-9-02)

Sec. 48-133. When stormwater must be excluded.

All sewers connected directly or indirectly with any sewer without the intervention of a spillway or other diversion arrangement for stormwater shall be constructed so as to be impervious to groundwater infiltration and so as to exclude stormwater therefrom and shall be used to carry only such sewage as is authorized by the terms of this article to be discharged into the sewage system. No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof runoff, subsurface drainage, uncontaminated cooling water or unpolluted industrial process waters to any sanitary sewer. All new sewer construction shall provide two (2) separate and distinct sewer systems, one (1) for the collection of stormwater and the other for the collection of sanitary wastes. The above requirements and prohibitions of this section shall include, but not be limited to, the following special provisions.

(1) *Downspouts.* All downspouts or roof drains shall discharge onto the ground or be connected to storm sewers. No downspouts or roof drains shall be connected to the sanitary sewers.

(2) *Footing drains.* No footing drains or drainage tile shall be connected to the sanitary sewers.

(3) *Sump pumps.* Sump pumps installed to receive and discharge groundwaters or other stormwaters shall be connected to the storm sewer or discharge onto the ground. Sump pumps installed to receive and discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of stormwater or the discharge of sewage.

(4) *Window well and areaway drains.* No window well or areaway drain shall be connected to the sanitary sewer.

(Code 1969, § 47-96)

Sec. 48-135. Pretreatment required.

No sewage, solid wastes or industrial wastes prohibited by this article or required to be treated or purified before being discharged into the sewers or sewerage system or such portion of Fox River or any other watercourse within the boundaries of the city, shall be deposited or discharged either directly or indirectly into the same until and unless treated and purified in such manner as is required by the terms of this article or any other ordinance.

(Code 1969, § 47-98)

Sec. 48-136. Responsibility for pretreatment.

The persons or parties operating any and all factories, industries, garages and other plants or places of business and other places producing or in which are produced or may exist or in or from which it is proposed to discharge any industrial wastes or other wastes, the discharge of which into Fox River or any other watercourse within the boundaries of the city or into the sewers or sewerage system is prohibited by the terms of this article or any other ordinance, shall adopt, install, erect and thereafter continuously and efficiently maintain and operate any and all such methods, processes, apparatus, machinery, equipment and appurtenances as are necessary to treat, remove and dispose of such solid wastes and industrial wastes and to prevent the discharge thereof into Fox River or any other watercourse within the boundaries of the city or into the sewers or sewerage system.

(Code 1969, § 47-99)

Sec. 48-137. Efficiency of pretreatment facilities.

The apparatus, machinery, equipment and appurtenances required by the terms of this article to be installed and operated by the persons or parties operating any factory, industry, garage, plant, place of business or other place for the purposes in this article, shall be so constructed, reconstructed, repaired and efficiently maintained and all outlets, drains, sewers and other apparatus or appurtenance changed, repaired or rebuilt and thereafter continuously maintained and operated, as to efficiently dispose of and prevent, except as may be otherwise by this article permitted, the discharge or deposit into Fox River or any other watercourse within the boundaries of the city or into any sewer or the sewerage system of any of the solid wastes, industrial wastes or other wastes prohibited by the terms of this article.

(Code 1969, § 47-100)

Sec. 48-139. Right of entry for inspections.

For the purpose of making the inspections herein provided for and for carrying out and enforcing the terms and provisions of this article, the city by its duly authorized engineers, chemists, inspectors, investigators, accountants, attorneys and agents, at any and all reasonable times, shall have access to and the right to inspect the plants, places of business, offices, dwellings and premises of any and all persons subject to the terms of this article and shall have access and the right to inspect the outlets, sewers, drains and other instrumentalities of any factory, industry, garage or other place of business or dwelling for the purpose of ascertaining whether any waste, industrial waste or other liquids or solids prohibited by or coming under or subject to the terms of this article are produced by any such person and for the purpose of determining whether the same are being discharged, deposited or are finding their way either directly or indirectly into Fox River or any other watercourse within the boundaries of the city, or into any sewer or the sewerage system, or for any other purpose necessary or proper for the carrying out and enforcing of the terms and provisions of this article.

(Code 1969, § 47-102)

Sec. 48-140. Tests, analyses, measurements; examination of records.

The representatives of the city shall be permitted to measure the flow to, from or in any and all outlets, sewers and drains or any part or parts thereof and to take samples from the whole or any part of such flow or discharge at any reasonable time, and shall have access to and may examine and inspect any and all records, books, documents and papers covering or relating or pertinent to the determination of the nature, character, extent and volume of any such wastes or industrial wastes and the methods of the treatment, disposal or discharge thereof, and shall be permitted to make and take copies and notes with reference thereto.

(Code 1969, § 47-103)

Sec. 48-141. Notice; correction of violations; penalties.

(a) If the public works director shall determine that any factory, industry, garage, place of business or other place or the occupant and/or owner of any building, dwelling or other place is not complying with the terms and provisions of this article, then the director or other authorized representative of the city shall serve or cause to be served upon any such person not so complying, a notice in writing stating and setting forth wherein or in what regard such person or party is failing to comply with the terms and provisions of this article and further notifying such person that within one (1) year, or in the case of violations of section 48-133, paragraph (1) sixty (60) days, from the receipt of such notice, or immediately in the case of random inspections of new construction under this article, he shall either cease to discharge such waste, industrial waste or other liquids or solids prohibited by this article or in lieu thereof, if applicable, that such person shall within one (1) year, or in the case of violations of section 48-133, paragraph (1) sixty (60) days, adopt and install such method or methods, process or processes, instrumentalities or apparatus for the treatment of its sewage, industrial wastes and other wastes. From and after the expiration of such applicable period such person shall thereafter continuously and efficiently carry out, operate and maintain such method or methods, process or processes, instrumentalities or apparatus and shall thereafter

continuously treat its sewage, industrial wastes and other wastes in such manner that the sewage or effluent discharged from the premises shall be of such character and quality as is permitted by the terms and provisions of this article; provided, however, that if compliance with the terms of this article by such person or party does not require the adoption or installation of any additional methods, equipment, apparatus or instrumentalities, any such person or party shall forthwith from and after the receipt by him or it of such notice thereafter continuously comply with the terms and provisions of this article. In the case of new construction, compliance with this article must be verified by reinspection at the owner's expense prior to receipt of a certificate of occupancy under the zoning ordinance and building code; provided, however, that in the event of a new construction violation within an ongoing development or subdivision, all other current new construction therein shall thereupon be inspected under this article at the developer's expense. If any person or party receiving notice under this section shall produce satisfactory evidence to the city council that he cannot comply with the terms of such notice and the terms and provisions of this article within the applicable period, then the city council, in its discretion, may grant to such person or party such extension of time as the city council shall deem necessary or proper.

(b) Additionally, the city council may grant any person or party not in compliance with this article, as it pertains to sanitary and/or stormwater runoff, a variation from the terms and provisions thereof. An application for variance shall be in writing and shall set forth the basis for the variation request. An application for variance may be made at any time, provided, however, that no application will be accepted more than thirty (30) days after a notice of violation has been served. The application shall be acted upon by the city council after first holding a public hearing before the planning and development committee of the council. The hearing shall be held not less than fourteen (14) days after receipt of an application for variance. For all applications, public notice shall be mailed by the applicant. Such notices shall be mailed after a public hearing date has been scheduled by the chairman of the planning and development committee. The notices shall be mailed to the district manager of the Fox Metro Water Reclamation District as well as to all owners of record within two hundred fifty (250) feet in each direction of the location of the property in question. The owners of record within the two-hundred-fifty-foot requirement shall be determined by consulting the tax assessor's rolls of the township or county in which the property is located, provided the number of feet occupied by all public roads, streets, alleys and other public ways shall be excluded in computing the two-hundred-fifty-foot requirement. The notice shall be in writing and shall contain the following information:

(1) Common address of the property;

(2) Requested action;

(3) Date, time and place of hearing;

(4) Reference to engineering department of the city for further information;

(5) Telephone number of engineering department.

The notice shall be mailed not more than twenty-one (21) days, nor less than seven (7) days in advance of such hearing. The notice shall be sent by first class mail, properly addressed as shown on the assessor's rolls and with sufficient postage affixed thereto. Proof of mailing certificates, as provided by the U.S. Postal Service, shall be submitted to the chairman of the

planning and development committee at least three (3) days prior to the hearing date and shall be made part of the hearing record. A copy of the notice is to be sent to the city engineer. The applicant shall also file a sworn affidavit containing a complete list of the owners of record required to be served, the method of service, and names and addresses of the persons so served with copies of the notice.

(c) The following, while neither controlling nor fully measuring the city council's discretion, are deemed indicative of the criteria which may cause a variation request to be granted:

(1) The effect of the water runoff in question upon the overall runoff being introduced into the sewer system and, in particular, the effect of the runoff upon downstream users;

(2) The cost of repairs, as evidenced by no less than two (2) written contractor's estimates, in relation to the assessed value of the property in question;

(3) Previous city approval, either explicit or implicit, with regard to sanitary and/or stormwater runoff; and

(4) The length of time the applicant or his predecessors has relied upon the aforesaid city approval.

(d) The penalties for violations under this article shall be as provided in subsection 117.4 of section 12-17, as now or hereafter amended; and violating persons shall be subject to all other remedies or actions authorized by the building code as now or hereafter amended.

(Code 1969, § 47-104; Ord. No. 087-5630, § 1, 3-3-87; Ord. No. O02-94, § 22, 9-10-02)

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ILLINOIS POLLUTION CONTROL BOARD
July 13, 1988

IN THE MATTER OF:	)	
	)	
JOINT PETITION OF THE AURORA SANITARY DISTRICT, THE CITY OF AURORA, AND THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY FOR EXCEPTION TO THE COMBINED SEWER OVERFLOW (CSO) REGULATIONS	)	PCB 85-224

OPINION AND ORDER OF THE BOARD (by R.C. Flemal):

This matter comes before the Board on a December 31, 1985 joint petition filed by the Aurora Sanitary District ("ASD") and the City of Aurora ("City") (hereinafter collectively referred to as "Aurora") and the Illinois Environmental Protection Agency ("Agency") for exception to 35 Ill. Adm. Code 306.305 (a) and (b) to relieve Aurora from the requirement to construct and operate certain combined sewer overflow ("CSO") transport and treatment facilities.

Hearing was held at the Aurora City Hall on March 6, 1986. On June 6, 1986 Petitioners filed a Proposed Order ("Proposed Order"). On June 20, 1986 the petition was remanded to the Petitioners by Board Order. On March 27, 1987 Petitioners filed an Amended Joint Petition ("Amended Pet."). On July 1, 1988 Petitioners filed a Second Amended Joint Petition ("2nd Amended Pet."). No additional hearing has been held.

For the reasons described below, the Board finds that Petitioners have made the showings requisite for granting the relief requested. The relief will accordingly be granted, subject to conditions as stipulated to by Petitioners and consistent with the Board's rules and regulations.

CSO REGULATIONS

The Board's CSO regulations are contained in 35 Ill. Adm. Code Subtitle C, Chapter I, Part 306. They were amended in R81-17, 51 PCB 383, March 24, 1983. Sections pertinent to the instant matter are Sections 306.305 and 306.361(a). Section 306.305 provides as follows:

> All combined sewer overflows and treatment plant bypasses shall be given sufficient treatment to prevent pollution, or the violation of applicable water standards unless an exception has been granted by the Board pursuant to Subpart D.

EXHIBIT A

Sufficient treatment shall consist of the following:

a) All dry weather flows, and the first flush of storm flows as determined by the Agency, shall meet the applicable effluent standards; and

b) Additional flows, as determined by the Agency but not less than ten times average dry weather flow for the design year, shall receive a minimum of primary treatment and disinfection with adequate retention time; and

c) Flows in excess of those described in subsection (b) shall be treated, in whole or in part, to the extent necessary to prevent accumulations of sludge deposits, floating debris and solids in accordance with 35 Ill. Adm. Code 302.203, and to prevent depression of oxygen levels; or

d) Compliance with a treatment program authorized by the Board in an exception granted pursuant to Subpart D.

Subpart D allows the discharger to file a petition for an exception either singly, or jointly with the Agency as Aurora has done. A joint petition may seek an exception based on minimal discharge impact as provided in Section 306.361(a):

> An exception justification based upon minimal discharge impact shall include, as a minimum, an evaluation of receiving stream ratios, known stream uses, accessibility to stream and side land use activities (residential, commercial, agricultural, industrial, recreational), frequency and extent of overflow events, inspections of unnatural bottom deposits, odors, unnatural floating material or color, stream morphology and results of limited stream chemical analyses.

Pursuant to 306.361(a) Aurora and the Agency assert that overflows from its combined storm and sanitary sewer system have minimal impact on the water quality of, and do not restrict the use of, the Fox River and Indian Creek (the receiving streams).

SUPPORT DOCUMENTS

Petitioners have presented several documents in support of their petition. Included among these is a two-volume combined sewer overflow study undertaken by Walter E. Deuchler Associates, Inc. This document was attached to the Petition and Amended Petition as Attachment A; it was also admitted as hearing exhibit

Among other matters, the study contains analysis of impact of the existing CSOs on the Fox River and the reduction of flow and pollutant loads that can be expected from implementation of several CSO options.

In response to concerns as expressed by the Board in its June 20, 1986 Order, Petitioners commissioned and submitted a study: "An Assessment of Indian Creek Bottom Sediments in the Vicinity of Combined Sewer Overflow 25 in Aurora, Illinois", Illinois State Water Survey Contract Report 412, January 1987. This report is Appendix G to the Amended Petition of March 27, 1987.

On January 28, 1988 Aurora completed a study, as an amendment to its Municipal Compliance Plan, which provides an update on relief sewer projects undertaken as part of the overall CSO program. This report was submitted to the Board along with the 2nd Amended Pet as Exhibit I.

BACKGROUND

The ASD provides wastewater treatment for Aurora, North Aurora, Montgomery, Boulder Hill, and part of Oswego. Its facility plan area encompasses portions of DuPage, Kane, Kendall, and Will Counties. The population currently served by the ASD is approximately 120,000, with a projected population for the year 2003 of 193,000 (R. at 12).

The ASD's only treatment plant is located west of the Fox River and south of Montgomery, Illinois. The plant provides preliminary treatment, primary clarification, biological oxidation and nitrification, tertiary sand filtration, and chlorine disinfection. It has a design average flow capacity of 32 mgd, with a design maximum flow capacity of 68 mgd (R. at 12). Discharge is to the Fox River.

The City of Aurora has both combined and separate sanitary sewer systems, while the remainder of the service area has separate sanitary and storm sewers. The City's combined sewers serve approximately 4,360 acres (6.9 sq. mi.) of the approximately 50 square miles served by the ASD (R. at 52, 89). No new combined sewers have been constructed since 1937 pursuant to a city ordinance (R. at 52).

The system has fourteen CSO overflow points (Amended Pet. at 3). Thirteen are located within the City and one is located at the ASD plant. All of the discharges are directly to the Fox River, with the exception of one City point which discharges to Indian Creek. The overflows occur primarily at diversion structures which serve to limit wet weather flow to the treatment plant. Four of the City overflow points are considered major by

the Petitioners because they collectively receive flow from more than two thirds of the land areas within the City served by combined sewers. These four points, plus the ADS treatment plant overflow, account for 79% of the total overflow volume. The remaining nine City overflow points are considered minor by the Petitioners in that they collectively receive flow from less than 1/3 of the acreage served by the combined sewers and account for only 21% of overflows (Id. at 3-4). The major City overflow points are numbered 1, 4, 8, and 25; 1, 4, and 8 are located at the Fox River at Rathbone Avenue, Hazel Avenue, and Benton Street, respectively; CSO 25 is tributary to Indian Creek.

CONTROL AND IMPACT-REDUCTION OPTIONS

Aurora has investigated options by which it might moot the need for the relief requested, or, in the alternative, minimize the impact of its CSOs. Six options were considered, including: (1) complete elimination of all combined sewers, (2) construction of facilities necessary to achieve compliance under Section 306.305, and (3) four options - identified in the record as Alternatives A, B, C, and D - which provide for progressively greater reduction in the impact of existing CSOs.

Elimination of all existing combined sewers is estimated to cost at least $160 million[1] (Amended Pet. at 14).

Full compliance with Section 306.305 could be achieved by providing the necessary treatment to combined sewer discharges. The required facilities would include large storage basins at four locations and several relief sewers to assure hydraulic capacity for all first flush flow. Additionally, three treatment facilities with a combined capacity of 51 mgd would be required at the ASD plant to provide treatment for flows up to 10 x average dry weather flow. The total cost of these facilities is approximately $99 million (Amended Pet. at 14).

Petitioners contend that neither the complete CSO elimination option nor the 306.305 compliance option is cost effective (Amended Pet. at 4), and, moreover, that neither would materially improve the water quality or enhance any beneficial uses of the Fox River (R. at 15). Accordingly, Petitioners have turned to the options which would at least reduce CSO impact.

Petitioners have opted to pursue and present to the Board Alternative D, which provides the greatest impact reduction among the four alternatives. Alternative D is designed to assure:

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[1] Control option cost figures cited herein are in 1986 dollars.

1) Complete treatment of peak dry weather flow;

2) Complete treatment of up to 2.5 x average dry weather flow;

3) Complete treatment of 57% of first flush; and

4) Complete or primary treatment of 65% of flows in excess of 2.5 x average dry weather flow.

Amended Pet. at 5

Alternative D would conservatively[2] also cause a 58.9% reduction in CSO flows and a reduction in pollutant loads ranging from 50.1% for suspended solids to 77.5% for phosphate (Id. at 6).

At $22.25 million, Alternative D is the most costly of the four impact-reduction options (Amended Pet. at 13-18). Among the activities to be undertaken are sewer separations, addition and replacement of sewer pipes, modification of siphon and weir structures, re-routing of combined sewer flows, implementation of inflow/infiltration reduction strategies, and elimination of one CSO. Aurora has stipulated to carrying out these improvements, and Petitioners request (Proposed Order at 1-2) that they be listed in the Board's Order.

Aurora additionally stipulates to a schedule for completion of the improvements (Amended Pet., Appen. G, as modified in 2nd Amended Pet.), and Petitioners request that this schedule also be incorporated into the Board's Order. However, the Board notes that both the internal and final completion dates for all but two of the many individual projects within the program are now past. Presumably, therefore, all but two of the projects are now complete. For this reason the Board will condition the grant of relief only upon the agreed-upon final dates.

DOCUMENTATION OF MINIMAL IMPACT

Section 306.361(a) requires that Petitioners seeking a CSO exception on the basis of minimal discharge impact, as is the case here, make a number of showings. Pursuant thereto, Petitioners provide the following information and observations:

---

[2] Calculation of CSO impacts under Alternative D was made prior to certain additional improvements made to the Alternative D program at the Agency's suggestion. The precise impact of these additional improvements has not been determined, and is therefore not reflected in the Alternative D impact figures (Amended Pet. at 5, 7).

Receiving Stream Ratios

The average discharge of the Fox River at Aurora is approximately 1,810 cubic feet per second ("cfs"). The average CSO flow rate from all City and ASD overflow points is 3.9 cfs, or 0.20% of the average river discharge. Petitioners also contend that pollution loading of the CSOs is small relative to the load of the Fox River. In support thereof, Petitioners present the following data:

	Total Load (tons/yr)	CSO CONTRIBUTION Prior to Alt. D (tons/yr)	Percent	After Alt. D (Percent)
BOD	26,800	350	1.30	.40
Ammonia-Nitrogen	530	16	3.02	.79
Nitrate-Nitrogen	3,550	2.1	.06	.02
Phosphate	710	1.9	.27	.06

From these data Petitioners concluded that "[i]t is thus apparent that the extremely low ratios of CSO flow and pollutant loads to Fox River flow and pollutant loads assure that the City and ASD CSOs have no significant impact on Fox River water quality" (Amended Pet. at 7).

Indian Creek is an intermittent stream with a ten-year, seven-day low flow of zero (Amended Pet. at 7).

Known Stream Uses

Petitioners report that a 1981 Northeastern Illinois Planning Commission study listed the following uses for the Fox River in Kane County:

(i) fishing;
(ii) canoeing;
(iii) other types of pleasure boating;
(iv) picnicking, fishing, hiking, etc., in public parks along the shore;
(v) agricultural drainage;
(vi) "urban drainage" from commercial and residential land along the river;
(vii) receiving effluents from several wastewater treatment plants and overflow diversion structures.

Petitioners additionally point out that the Fox River in the CSO study area is abutted for the most part by commercial and residential properties (Amended Pet. at 8). They also note that "Indian Creek is basically an urban drainage channel" for its lower 3 to 4 miles, although in its upper reaches it receives runoff from farmlands (Id.).

Accessibility to Stream Side Land Use Activities

Regarding accessibility to stream-side land, Petitioners note:

> The combined sewer portion of the ASD service area consists almost exclusively of residential and commercial establishments. Agricultural land and open space account for but a small fraction of acreage abutting the river in the ASD service area. Some light manufacturing plants and warehouses abut the river in the southwest portion of the combined sewer area. (Appendix A at p. 2-5). Exhibit 4 to the CSO study details the riparian land use in the CSO area. Generally, the river is not readily accessible to the general public, with the exception of boaters who use two designated "boat access areas" in the City of Aurora.
>
> Indian Creek is, for the most part, within the Burlington Northern Railroad right of way and the activities along the stretch both immediately upstream and downstream of OVF. No. 25 can be characterized as industrial.

Amended Pet. at 8-9.

Frequency and Extent of Overflow Events

The CSO study (Ex. 1) estimates that 1,187 overflow events per year, with a total yearly flow of 914 million gallons, occurred prior to implementation of Alternative D. Of these, 663 events and 568 million gallons were attributable to the major overflow points 1, 4, 8, and 25. Full implementation of Alternative D is expected to reduce yearly overflow events to 658 and total overflow volume to 375 million gallons, reductions of 44.5% and 59.0%, respectively (Amended Pet. at 9; see also footnote 2).

Inspections of Outfalls (Bottom Deposits, Odors, etc.)

Regarding inspections of unnatural bottom deposits, Petitioners note:

> In June, 1983, the Fox River was examined for sludge deposits, sewer-related odors, sediment in quiet portions of the river, and sewer-related impact on vegetation. The purpose of the inspections was to determine if CSOs significantly contributed to sludge deposits or adverse environmental impacts.

The CSO study details inspection locations, methods and results. (Appendix A at pp. 3-5 to 3-11). To summarize, approximately 30 locations in the river, including points upstream and downstream of all CSO points, were examined for sediment depth, color, texture and odor. At the same time depth of water, the size of the stream-bed area examined, and the amount and nature of floating debris, if any, were noted. The inspections revealed that, with the exception of the shoreline areas, most of the river bottom is rock or gravel with no sludge deposits. However, some sludge deposits were noted in low velocity areas -- i.e., near shorelines and downstream of islands. Sewage-related odors were detectable at a few small and localized areas near CSO outfalls. Although a relatively large area of sludge deposits was noted upstream of all CSO points, no comparable deposits were found downstream of the overflow points. The study concludes that there is no correlation between the overflow points and sludge deposits in the Fox River in the Aurora CSO areas. (Appendix A at p. 3-11).

In addition to inspecting the river, the contractor reviewed a 1978 NIPC study of sediment oxygen demand in the Fox River. The study showed varying sediment oxygen demands at five different locations in the river. However, no relation between sediment oxygen demand and CSOs could be detected. In fact, of the five sampling points, the highest sediment oxygen demand was found upstream of all of the overflow points. (Appendix A at pp. 2-5 to 2-8).

The Agency survey (Appendix D at p. 4) shows black septic sludge at the site of overflow No. 25. Further investigations reveal that the most severe incidence of bottom deposits is limited to 500 or 600 feet downstream of the overflow.

As noted above, sewage-related odors were detected in localized areas near a few CSO outfalls. (Appendix A at 3-11). Odors are moderate to severe near Overflow No. 25, but they can be detected for some distance downstream (±500 ft.) and intermittently throughout Indian Creek.

No unnatural colors were noted in the course of the river inspection. Floating debris was found in several locations, but all floating materials noted were unrelated to sewer overflows -- the specific items noted were tree branches, drums, tires, cardboard boxes and pipes. (Appendix A at pp. 3-6 to 3-10).

Rags, tissue paper, etc. were observed in brush and log jams immediately below OVF No. 25 up to a distance of approximately 200 feet downstream.

Amended Pet. at 9-11

Pursuant to concerns raised at hearing and to the Board's Order of June 20, 1986 Petitioners have caused further investigation of CSO impacts on Indian Creek. In particular, a study was undertaken by the Illinois State Water Survey and reached the following conclusions (Amended. Pet., Appendix G at 9-10):

a) Indian Creek below overflow 25 exhibits some benthic sediment degradation. However, this degradation is relatively minor and is in line with that of other streams receiving intermittent combined sewage overflows or a steady flow of well-treated effluent.

b) Benthos and phytoplankton productivity is low both upstream and downstream of the outfall.

c) The stream supports lush and extensive periphyton growth. Sediment oxygen demand is contributed by bottom-dwelling diatoms, iron bacteria respiration, and ammonia oxidation. The latter accounts for almost two-thirds of the sediment oxygen demand in the outfall area, but none of the sediment oxygen demand at a station above the outfall.

d) Gross visual and aesthetic pollution due to discharges from overflow 25 was not evident.

e) A reduction in the frequency and quantity of the CSO probably would enhance downstream conditions.

Petitioners further note that the sediment oxygen demands of Indian Creek are comparable to those of the Fox River (Amended Pet. at 10), and that the impacts of overflow 25 appear to be localized to the first 600 feet downstream of the outfall (Id.).

Stream Morphology

The condition of the Fox River through Aurora has been described in a Northeastern Illinois Planning Commission 1981 stream use inventory as "natural" with scarce aquatic vegetation and "fair to good" aesthetic appeal (Amended Pet. at 11). The streamside vegetation was noted to be "mature forest/brush" (Id.). Petitioners further note that the river is locally free

of log jams and other accumulations of vegetative debris and that the river substrate is rock or gravel; some channelization has occurred in the highly-developed areas (Id. at 11-12).

Indian Creek has a relatively steep gradient and flows in a series of riffles and pools (Amended Pet. at 12).

Stream Chemical Analyses

Aurora undertook a sampling of CSO water quality and instream water quality during two storm events in 1981 (See Ex. 1 at 3-1 to 3-4 and Appendix B; Exhibit 10; Exhibit 11). From these data Petitioners conclude that "there appears to be little if any correlation between the combined sewer overflows and Fox River water quality during and after rainfalls" (Amended Pet. at 13). No chemical analyses were conducted on Indian Creek because the Petitioners "assumed that during the time overflow is active, the creek would reflect basically degraded conditions" (Id.).

CONCLUSION

The Board determines that Petitioners have shown pursuant to 35 Ill. Adm. Code 306.361(a) that exception to 35 Ill. Adm. Code 306.305(a), as it relates to first flush of storm flows, and to 35 Ill. Adm. Code 306.305(b) would produce minimal impact on the receiving stream. Accordingly, the Board will grant the exception. The Board further will accept the conditions as agreed to by Petitioners in their June 6, 1986 Proposed Order as modified in the Amended Petition of March 27, 1987 and Second Amended Petition of July 1, 1988.

ORDER

Aurora Sanitary District and the City of Aurora are hereby granted an exception from combined sewer overflow regulations 35 Ill. Adm. Code 306.305 (a) as it relates to first flush storm flows, and to 35 Ill. Adm. Code 306.305 (b), subject to the following conditions:

1. The City and District shall implement the following system improvements:

   a. Provide an additional 15" diameter connecting pipe at overflow No. 1 located at Rathbone Avenue.

   b. Modify the existing west siphon chamber at Hurd's Island to facilitate maintenance, and provide a manhole at the bend in the interceptor just north of the railroad bridge.

c. Remove siphon over Western United Gas and Electric Co. discharge tunnels and replace it with a 54" diameter connecting pipe.

d. Re-route Basins 8 and 33 to the wastewater treatment plant through the Washington Interceptor.

e. Implement and maintain programmed maintenance on critical areas comprised of overflows 1, 4 and all the siphons.

f. Sewer separation upstream of overflow numbers 4, 8, 22 and 25 to reduce runoff into the combined system. Additionally implement inflow-infiltration reduction strategies in basins 24, 25, 26, 28, 29, 30 and 36.

g. Eliminate overflow number 6 diverting all flows from tributary sub-basins into the Hazel Avenue Interceptor.

h. Raise weirs 6" on overflows 5, 22, and 23 to eliminate bypassing during small storms.

i. Perform sewer separation in a 60 acre tract associated with the Transportation center project.

2. Improvements identified in paragraph 1 above shall be completed by July 31, 1988, with the exception of:

a. 30-inch storm sewer along Plum Street in basins 24 and 25, which shall be completed by November 1, 1988.

b. Removing of storm inlets along Lake Street in Basin 29, which shall be completed by November 1, 1988.

3. The Aurora Sanitary District Treatment facility shall be operated in accordance with the following provisions:

a. All flows received at the treatment plant must be screened and metered.

b. All flows up to 74 million gallons per day ("MGD") must receive a minimum of primary clarification prior to and during any occurrence of bypassing.

c. All flows up to 68 MGD must receive full treatment prior to and during any occurrence of bypassing ahead of or following primary treatment units.

4. Aurora Sanitary District and the City of Aurora shall conduct performance evaluation and reporting of the improvements specified in this Order in accordance with the Plan of Study appended to and which is hereby made a part of this Order.

5. This grant of exception does not preclude the Agency from exercising its authority to require as a permit condition a CSO monitoring program sufficient to assess compliance with this exception and any other Board regulations and other controls, if needed, for compliance, including compliance with water quality standards.

6. This grant of exception is not to be construed as affecting the enforceability of any provisions of this exception, other Board regulations, or the Environmental Protection Act.

IT IS SO ORDERED.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, hereby certify that the above Opinion and Order was adopted on the 13th day of July, 1988, by a vote of 7-0.

Dorothy M. Gunn

Dorothy M. Gunn, Clerk
Illinois Pollution Control Board

JUN. 25 19

ILLINOIS POLLUTION CONTROL BOARD
June 21, 1990

IN THE MATTER OF:	)	
	)	
JOINT PETITION OF THE AURORA SANITARY DISTRICT, THE CITY OF AURORA, AND THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY FOR EXCEPTION TO THE COMBINED SEWER OVERFLOW (CSO) REGULATIONS	)	PCB 85-224 (CSO Exception)

ORDER OF THE BOARD (by R.C. Flemal):

This matter comes before the Board on a Motion for Modification of a Board Order filed June 14, 1990 by Aurora Sanitary District ("ASD"), the City of Aurora, and the Illinois Environmental Protection Agency.

The Board's final Order in this matter, in which the Board granted the CSO exception, was entered on July 13, 1988. Conditions attached to the grant of exception include certain construction and operational requirements imposed on the ASD as found at Condition (paragraph) #3 of the July 13 Order. Among other matters, Condition #3 does not specify a date certain upon which these requirements are to be in effect.

Subsequent to entry of the July 13 Board Order, the ASD obtained a State of Illinois Loan to enable it to carry out the requirements of Condition #3. A condition of the loan is that Condition #3 be modified to reflect a completion date of July 1, 1992. Petitioners accordingly now request that the Board so modify Condition #3.

Petitioners' motion is granted. Condition #3 of the Board's Order in this matter of July 13, 1988 is hereby amended to read as follows:

3. The Aurora Sanitary District Treatment facility shall be operated in accordance with the following provisions, effective July 1, 1992:

   a. All flows received at the treatment plant must be screened and metered.

   b. All flows up to 74 million gallons per day ("MGD") must receive a minimum of primary clarification prior to and during any occurrence of bypassing.

   c. All flows up to 68 MGD must receive full treatment prior to and during any occurrence of bypassing ahead of or following primary treatment units.

EXHIBIT A-1

IT IS SO ORDERED.

Board Member J.D. Dumelle concurred.

I, Dorothy M. Gunn, Clerk of the Illinois Pollution Control Board, hereby certify that the above Order was adopted on the 21st day of June, 1990, by a vote of 7-0.

Dorothy M. Gunn

Dorothy M. Gunn, Clerk
Illinois Pollution Control Board

APPENDIX M
PUBLIC INVOLVEMENT INFORMATION

City of Aurora CSO LTCP
Citizen's Advisory Committee Roster

Name	Phone Number	E-mail Address	Representing
Ray Anderson	630-892-4158	N/A	Citizen
Fran Caffee	630-859-1687	Fran.caffee@gmail.com	Sierra Club
Linda Cole	630-897-9373	MCCLAC3739@aol.com.	Sierra Club/Citizen
John Curley	630-878-1852	jcurley@aurora-il.org	City of Aurora Community Development
Bill Donnell	630-897-0516	bdonnell@fvpd.net	Fox Valley Park District
Roscoe Green	630-801-7000	roscoe.greene@pngaming.com	Hollywood Casino
Bart Jones	608-251-2129	bart.jones@strand.com	Strand Associates, Inc.
Pete Kerl	630-301-5027	Pkerl@sd129.org	West Aurora School District #129
Bruce Kleinfieldt	630-898-8308	N/A	Citizen
Manny Maysonet	630-859-3977	mmaysonet@aurora-il.org	City of Aurora
Chuck Nelson	630-844-3612	cnelson@aurora-il.org	Mayor's Office
Mike Ott	815-744-4200	michael.ott@strand.com	Strand Associates, Inc.
Whitey Peters	630-844-3619	wpeters@aurora-il.org	Alderman
Amy Roth	630-264-3049	aroth@aurora-il.org	City of Aurora
Rich Santiago	630-779-8050	R.Santiago@sd131.org	East Aurora School District #131
Eric Schoeny	630-844-3620	eschoeny@aurora-il.org	City of Aurora Engineering
Ken Schroth	630-844-3621	kschroth@aurora-il.org	City of Aurora Public Works
Arlene Shoemaker	630-232-5930	ahshoe@aol.com	Kane County Board
Scott Stearns	608-251-4843	scott.stearns@strand.com	Strand Associates, Inc.
Steve Stephens	630-906-9900	sstephens@ccim.net	Stephens Commercial Real Estate
Brandon Wright	630-301-7925	bwright@aurora-il.org	City of Aurora

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 1---AGENDA

January 21, 2009

1. Introductions of CAC Membership	All	10:00 AM to 11:15 AM
2. BREAK		11:15 AM to 11:30 AM
3. High Level of Overview of LTCP Development	Jones	11:30 AM to 11:45 AM
4. Describe CAC Roles and Responsibilities	Jones	11:45 AM to 11:55 AM
5. What are Combined and Separate Sewers and How do they Operate?	Jones	11:55 AM to 12:15 PM
6. LUNCH		12:15 PM to 1:00 PM
7. What is the Regulatory History Driving CSO Abatement Programs?	Jones	1:00 PM to 1:15 PM
8. What Has Aurora Done Respecting CSO Abatement Over the Past 20-Years	Schoeny	1:15 PM to 1:50 PM
9. General Housekeeping Protocols, Meeting Schedules, Q & A	Stearns	1:50 PM to 1:55 PM
10. Matters Arising/ Adjourn	Stearns	1:55 PM to 2:00 PM

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 1—Sign In Sheet

January 21, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Barton Jones	Strand Assoc., Inc	608.251.4843	bart.jones@strand.com
Mike Ott	Strand Assoc. Inc	815-744-4200	Mchael.ott@Strand.com
Scott Stearns	Strand Associates	608. 251-4843	scott.stearns@strand.com
Brandon Wright	City of Aurora	630-301-7925	bwright@aurora-il.org
Manny Maysonet	City of Aurora	630. 859-3977	mmaysonet@aurora-il.org
Tim Roth	COA	630-264-3049	troth@aurora-il.org
BILL DONNELL	FVPD	630.897.0516	bdonnell@fvpd.net
Linda A Cole	Sierra Club Citizen	630-897-8373	Mccac3239@AOL.com
Fran Caffee	Sierra Club.	630-859-1687	Fran.caffee@gmail.com
BRUCE KLEINFIELDT	CITIZEN	630 898 8308	
Kay C. Anderson	Citizen	630 892 4158	
PETE KERL	W. Aurora School Dist 129	630-301-5027	pkerl@sd129.org
R. Santiago	E Aurora School Dist 131	630-844-8050	R.Santiago@SD131.org
Chuck Nelson	Mayor's Office	630-844-3612	cnelson@aurora-il.org
Steve Stephens	Stephens Comm. R.E.	630-906-9900	ssstephens@comcast.net
Ken Schroth	COA - Engineering	630-844-3621	Kschroth@aurora-il.org
ERIC SCHOENY	COA - ENGINEERING	630-844-3620	ESCHOENY@AURORA-IL.ORG
JOHN CURREY	COA - COMM DEV.	630 878. 1852	jcurry@aurora-il.org

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, IL
January 21, 2009, 10 A.M.

Location: Phillip's Park Zoo Visitor Center

Purpose: Citizen Advisory Committee (CAC) Meeting No. 1 was focused on getting to know the CAC members and the regulatory framework of the combined sewer overflow (CSO) LTCP.

Attendees:

Name/Title	Representing
Brandon Wright	City of Aurora
Manny Maysonet	City of Aurora
Amy Roth	City of Aurora
Bill Donnell	Fox Valley Park District
Linda Cole	Sierra Club, Aurora Citizens
Fran Caffee	Sierra Club
Bruce Kleinfieldt	Aurora Citizens
Ray Anderson	Aurora Citizens
Pete Kerl	West Aurora School District No. 129
Rich Santiago	East Aurora School District No. 131
Chuck Nelson	Mayor's Office
Steve Stephens	Stephens Commercial Real Estate
Ken Schroth	City of Aurora Public Works
Eric Schoeny	City of Aurora Engineering
John Curley	City of Aurora Community Development
Bart Jones	Strand Associates, Inc.
Mike Ott	Strand Associates, Inc.
Scott Stearns	Strand Associates, Inc.

Discussion Items:

1. Introductions

   a. Bart Jones began by introducing the CAC and thanking everyone for joining. He explained the purpose of this committee will be to develop the best LTCP regarding the City's values, local economics, and environmental benefit. He said these meetings are informal and any questions are encouraged. The binders are for each member to keep and are encouraged to bring with them for each meeting.

   b. Bart Jones
      (1) Principal and senior project engineer with Strand.
      (2) Involved in wastewater since 1974.
      (3) Graduated from Georgia Tech.
      (4) Has worked in eight different United States Environmental Protection Agency (USEPA) Regions throughout his career.
      (5) Primary job is to be an educator for the committee.

   c. Eric Schoeny
      (1) With the City of Aurora Engineering Division since 2002.
      (2) Has worked on stormwater-related issues for the City since 1991.
      (3) Grew up in Boulder Hill just outside of Aurora.
      (4) Special interest in this project is to ensure the citizen's money is well spent.
      (5) Special interest regarding the Fox River because he grew up recreating on the river.

d. Ken Schroth
   (1) City Engineer and Public Works Director for three years.
   (2) Development Coordinator for five years.
   (3) Primary interest is the continued development of the City, especially downtown.

e. Steve Stephens
   (1) Commercial property broker and owner of Stephens Commercial Real Estate.
   (2) Lived in Aurora since 1983.
   (3) Special interest in the potential for businesses to be able to develop downtown where growth is currently hindered because of sewer capacity problems.

f. Chuck Nelson
   (1) Represents the Mayor's Office.
   (2) Former Alderman and long time operator at Fox River Metropolitan Water Reclamation District.
   (3) Special interest is to make Aurora a better place to live.

g. Rich Santiago
   (1) With the East Aurora School District No. 131 since March 2008.
   (2) New to Aurora, came from a large school district in Chicago.
   (3) Worked for Chicago Diocese.
   (4) Served as a water treatment plant operator.

h. Pete Kerl
   (1) With West Aurora School District No. 129 for three years.
   (2) Has an interest in the City as whole with 13 schools throughout the west side.
   (3) Freeman Elementary and West High suffered from basement backups during heavy rains.

i. Ray Anderson
   (1) Teaching in Aurora since 1961.
   (2) Moved to West Downer in the 1970s and has lived there since.
   (3) Previously a board member.
   (4) Excited about the downtown development potential.

j. Bruce Kleinfieldt
   (1) Lifelong resident of Aurora
   (2) Active member of the 7th Ward Committee

k. Fran Caffee
   (1) Chair of the Valley of the Fox Sierra Club Group.
   (2) Lived on West Downer since the 1960s.
   (3) Main interest is water quality and overall Fox River health.
   (4) Monitor of the Fox River since 1995, leading to the development of the Fox River Study Group. It allows for groups with different interests, such as farmers and wastewater treatment operators, to meet in the same arena concerning river health.

l. Linda Cole
   (1) Main interest is the overall quality of life in Aurora.
   (2) Resident for 50 years.
   (3) Member of the Sierra Club, a trustee for the Fox Valley Park District, and a former member of the planning commission.
   (4) Worked at Mercy Center for 30 years as a nurse.

m. Bill Donnell
   (1) Lived in Aurora for 25 years.
   (2) Director of Park Operations and Natural Resources with the Fox Valley Park District.
   (3) The Park District has been trying to create river access for the last 100 years.
   (4) Part of the City of Aurora Planning Commission.
   (5) Part of the 1996 Fox Ecosystem and C-2000 programs to help clean up the Fox River.

n. Amy Roth
   (1) Public Information Director for the City of Aurora.
   (2) Lived in Aurora for 22 years.
   (3) Her job will be to inform the citizens of Aurora simply and efficiently of all the decisions made by the group.

o. Manny Maysonet
   (1) Member of the Development Committee.
   (2) Lifelong Aurora resident.

p. Brandon Wright
   (1) Worked in the finance department for the City of Aurora for 1 1/2 years.
   (2) Interest in the group is to assure that the City of Aurora spends its dollars responsibly.

q. Scott Stearns
   (1) Technical project manager for this project.
   (2) Worked for Strand for 15 years.
   (3) Received his undergraduate and graduate degrees at the University of Iowa.
   (4) Responsible to present information to the group from a technical standpoint and to try and develop creative technical solutions.
   (5) Has been responsible for numerous LTCPs and has worked in several other states and USEPA Regions.

r. Michael Ott
   (1) Graduated from Bradley University in May 2008.
   (2) Project engineer developing the hydraulic model for the LTCP and to assist Scott in alternative development.
   (3) Grew up in Sugar Grove and lived for a short time in Aurora.

2. <u>Project Description</u> (Bart Jones–Strand)

   a. The goal is to develop a long term control plan that adheres to both U.S. and Illinois EPA regulations in order to control the 11 square miles of combined sewer in Aurora.
   b. The boundaries of the combined sewer system are Illinois Avenue Bridge to the north and the Montgomery Dam to the south.
   c. Fifteen permitted CSOs on the Fox River and Indian Creek discharge a mixture of raw sewage and rain water to the receiving streams.

3. <u>Describe the CAC Roles and Responsibilities</u> (Bart Jones–Strand)

   a. The CAC was developed to provide input on a plan to reduce the impacts of CSOs while meeting regulation requirements.
   b. The key is to balance social values, economics, and environmental benefits.
   c. The CAC is also developed to create public support for the project.

4. What are Combined Sewers and Separate Sewers (Bart Jones–Strand)

   a. Combined Sewers
      (1) One pipe conveys both storm water and sewage to a structure that houses a weir or dam. If the flows are low enough, they are diverted to an interceptor and go to the wastewater treatment plant.
      (2) During heavy rains, flows get too high, the interceptor becomes full and untreated sewage and rain water go over the weir and into the receiving stream.
   b. Sanitary sewers consist of two pipes, one for sewage to the wastewater treatment plant and the other for storm water to the river.

5. Regulatory History (Bart Jones–Strand)

   a. National CSO Control Strategy, April 10, 1989
      (1) Voluntary
      (2) Three objectives:
         (a) Ensure CSO's only occur during wet weather.
         (b) Bring all wet weather CSO discharges in to compliance with the Clean Water Act.
         (c) Minimize impacts of CSOs on water quality, aquatic biota, and human health.
   b. National CSO Control Policy
      (1) Mandatory
      (2) Four objectives:
         (a) Provide clear levels of control.
         (b) Provide sufficient flexibility to municipalities for cost-effective solutions.
         (c) Allow a phased approach for implementation.
         (d) Review and revise site specific CSO impacts.

6. History of Combined Sewer Improvements (Eric Schoeny–City of Aurora)

   a. Background information–built in late 1800s; treatment plant built in 1929; in 1983 there were over 1,100 overflow events in Aurora.
   b. Since 1988, around $171 million 2008 dollars have been spent.
      (1) System improvements.
      (2) Fox River Metropolitan Water Reclamation District wet weather improvements.
      (3) CSO Facility.
      (4) Overflow number 4 screening.
      (5) Indian Creek Interceptor.
      (6) East Bank Interceptor.
      (7) Drainage Improvements.
   c. In 2007, there were only 221 overflow events.

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7. Recent and Upcoming Projects (Ken Schroth–City of Aurora)

   a. COA/Fox Metro Sewer Expansion.
      (1) Illinois Avenue pump station.
      (2) North Avenue pump station.
      (3) River Street improvements.
   b. North Avenue Storm Sewer.
   c. Basins 5, 6, and 13.
      (1) Sewer inspections.
      (2) Spring Street Subbasin.
      (3) Basin 13 improvements.
   d. Much of the work in the downtown area is needed to serve the existing residential areas on both the east and west sides of the City, as well as the downtown area itself.

8. General Housekeeping and Scheduling

   a. Meeting days
      (1) Steven Stephens has conflicts on Tuesdays.
      (2) Bill Donnell has a conflict with the third Wednesday of every month.
      (3) Meetings will continue to be held on Wednesdays, but not the third Wednesday of the month.
   b. Requests from the group:
      (1) An overall 11-inch x 17-inch map with all of the overflows identified and labeled.
      (2) A glossary of terms and acronyms.
      (3) A CAC roster.
      (4) An overall calendar.
      (5) A paper copy of the PowerPoint presentation with one slide per page.
   c. Next meeting will be 10 A.M. on Wednesday, February 25, 2009, at the City of Aurora Potable Water Treatment Plant, 1111 Aurora Avenue (AKA IL Rt 25 and Broadway). The meeting will include field visits to some of the CSO sites. CAC member are encouraged to dress accordingly.

Prepared by Michael Ott and respectfully submitted to all in attendance.

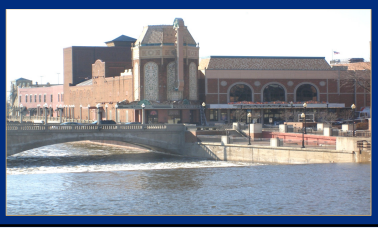
Enclosures: Agenda for January 21, 2009, CAC meeting
PowerPoint presentation from January 21, 2009, CAC meeting

c/enc: All Participants

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City of Aurora's Development of the CSO LTCP

Citizen's Advisory Committee (CAC) Meeting 1 January 21, 2009



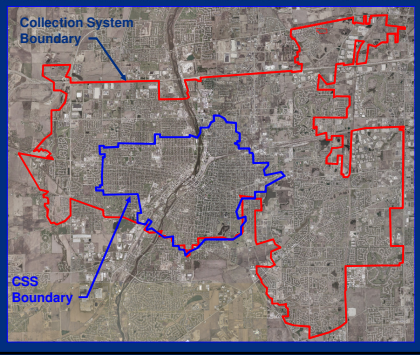
Overview of CAC Meeting 1

1. Introductions of CAC Membership
2. Generally Describe the Project
3. Describe CAC Roles and Responsibilities
4. What Are Combined and Separate Sewer Systems?
5. What is the Regulatory History Driving Combined Sewer Overflow (CSO) Abatement Programs?
6. What has Aurora Done Regarding CSO Abatement Over the Past 20-Years?

CAC Member Introductions

- Name
- Where do you live
- A little about your Aurora history
  - How long have you lived in Aurora
  - What stakeholder group do you represent
- Do you have a special interest in Aurora's CSO abatement program; if so, please describe it

The Project: The City Limits of Aurora Comprise Approximately 45 Sq. Miles. Approximately 24% of this Area (11 sq. miles) are Served by Combined Sewers



The Project:

- 15 Permitted CSOs Discharge into Fox River
- 1 Permitted CSO Discharges into Indian Creek



The Project:

LTCP Must Integrate 2 Regulatory Program Requirements

IEPA

The Project:

LTCP Must Balance Competing Interests



The Project:

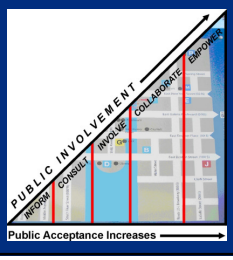
Coordination / Cooperation with FMWRD Essential for Mutual Success



- Maximize Treatment
- Maximize Conveyance

The Project:

Public Participation in Developing and Implementing LTCP is critical to Success



- Bill Inserts
- News Releases
- City Website
- CAC

CAC Participation:
Strand Will Facilitate / Lead CAC Meetings

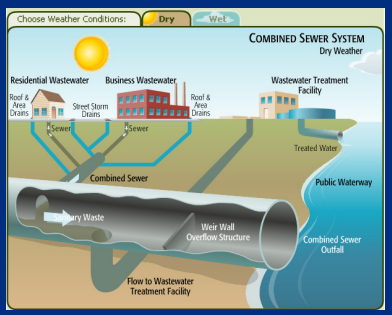


1. Put into context the regulatory framework underpinning the issues at hand
2. Explain the external forces acting upon the issues at hand
3. Explain, in lay terms, the technical considerations surrounding the issues at hand
4. Explain, in summary fashion, the financial implications associated with the issues at hand

CAC Roles and Responsibilities

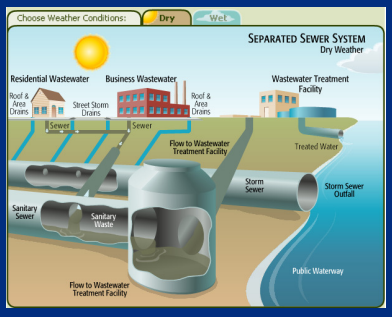
- Provide Guidance to LTCP Development
  - ID Issues (Sensitive Areas, Define Aurora's Social Values)
- Balance Water Quality Benefits and Social Values Against Economic Costs
  - Alternatives to Address Priorities
- Provide Dialogue Between Various Constituencies and CAC (Inform – Feedback Loop)
- Advocate Approval of Recommended LTCP to Representative Constituencies

What are Combined Sewer Systems and How Do they Operate?



Courtesy of SD #1 of Northern Kentucky

What are Separate Sewer Systems and How Do they Operate?



Courtesy of SD #1 of Northern Kentucky

Regulatory History Driving CSO Abatement:

National Combined Sewer Overflow Control Strategy, April 10, 1989 (54 *Federal Register* 37370) Set Forth Three Objectives:

1. Ensure that if CSO's occur, they are only a result of wet weather
2. Bring all wet weather CSO discharges into compliance with technology-based and water quality-based requirements of the Clean Water Act (CWA)
3. Minimize the impacts of CSOs on water quality, aquatic biota, and human health

Regulatory History Driving CSO Abatement:

National Combined Sewer Overflow Control Policy, April 19, 1994 (59 *Federal Register* 18688) Contains Four Key Principles:

1. Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives
2. Provide sufficient flexibility to municipalities to determine the most cost-effective means of meeting CWA objectives and requirements
3. Allow a phased approach for implementation of CSO controls considering a communities financial capacity
4. Review and revise as appropriate, Water Quality Standards (WQS) and implementing procedures that reflect site-specific wet weather impacts of CSOs

Regulatory History Driving CSO Abatement:

National Combined Sewer Overflow Control Policy Contains Explicit Expectations

- Aurora must implement the Nine Minimum Controls (NMCs) which are designed to reduce CSOs and their effects on water quality in the Fox River and Indian Creek – NLT Jan. 1, 1997
- Aurora must develop CSO LTCP to control CSOs – To be submitted to IEPA by April, 2010
- Aurora must give CSO abatement priority to discharges into environmentally sensitive areas
- IEPA should consider the financial capability of Aurora when reviewing CSO LTCP

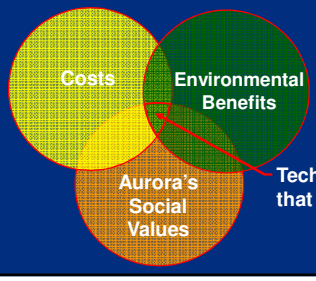
Regulatory History Driving CSO Abatement:

Aurora Has Implemented the NMCs !!

1. Proper operation and maintenance
2. Maximize use of collection system for storage
3. Review and modify the industrial pretreatment program
4. Maximize flow to the wastewater treatment plant for optimal treatment before discharge
5. Eliminate dry weather CSOs
6. Control solids and floatables from CSOs
7. Design pollution prevention program
8. Develop a public notification program
9. Monitor CSO discharges and report volume and duration

Regulatory History Driving CSO Abatement:

CAC Will Assist Aurora to develop a LTCP that Will Satisfy 3 Constraints and Meet Regulatory Requirements



What has Aurora Done Regarding CSO Abatement Over the Past 20-Years

?

City of Aurora

A City Second to None
AURORA
City of Lights
Mayor Thomas J. Weisner

History of Combined Sewer Improvements

History of Combined Sewers

- Combined Sewers built in Aurora in the late 1800's through the early 1900's were constructed of clay or brick



History of Combined Sewers

- The Aurora Sanitary District was formed in the late 1920's to treat sanitary sewage prior to discharging into the Fox River

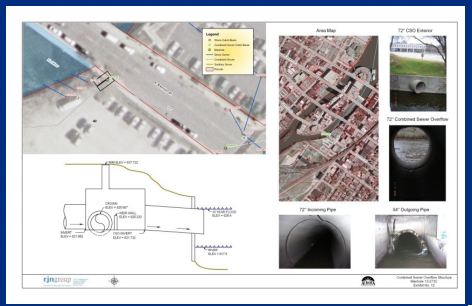


We are not alone

- Currently there are 772 CSO communities nation wide. There are approximately 100 CSO communities in Illinois.



How a CSO Works

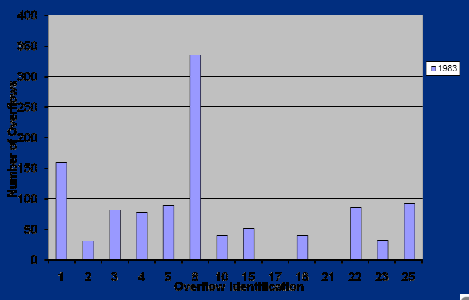


East Benton CSO Exhibit

Problems Associated with Combined Sewers

- Sewage backs up in basements and overflows into the Fox River and Indian Creek during rain events.

Historical Wet Weather Efforts Overflow Events in 1983



Historical Wet Weather Efforts

- 1988 The IL State Water Pollution Control Board accepted a petition that was filed jointly by the City of Aurora, Fox Metro WRD, and the IL EPA.
  - The Water Pollution Control Board action established the amount of combined storm and sanitary sewage that is required to be treated prior to being discharged into the Fox River.
  - A list of improvements was established that would presumably meet the agreed upon standards.

Historical Wet Weather Efforts

- The improvements included up-grades to both the combined sewer system and to Fox Metro's treatment plant.
  - Combined Sewer System Improvements $ 12.7 M-1988 ($ 26.9 M 2008)
    - 11 unique system improvements identified including sewer enlargement, flow re-routing, sewer separation, overflow weir raising, reduction of storm water inflow and infiltration, and the elimination of overflow No. 6.
  - FMWRD Treatment Facility $10.8 M-1988 ($22.8 M 2008)
    - All flows must be screened and metered
    - All flows up to 74 mgd must receive primary clarification prior to and during any bypassing.
    - All flows up to 68 mgd must receive full treatment.

Historical Wet Weather Efforts

- In 1991 a detailed inspection by the IEPA of the combined sewer overflows indicated the need for additional improvements.
- Hazel Bar Screen Structure $415K 1998 ($600K 2008)
- CSO Treatment Facility $ 12M-1997 ($17.6M-2008) – Treated CSO 27
- Indian Creek Interceptor $2.1 M-1996 ($3.2M-2008)
- East Bank Interceptor $1.5 M-1998 ($2.2M-2008)

Historical Wet Weather Efforts

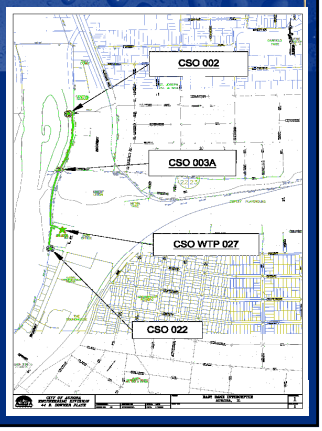
Develop screening, primary clarification and disinfection for OVFs 2 (E. Illinois), 3 (Pierce), 22 (Superior) and 25 (Dearborne/Trask)

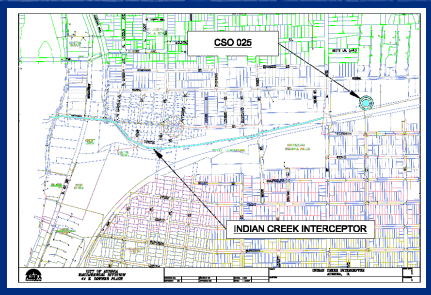


- Functional in 1999
- 21.8 mgd capacity for 'full primary treatment'
- 45.8 mgd screening and grit removal
- USEPA Training Facility
- $17.6M-2008

East Bank Interceptor

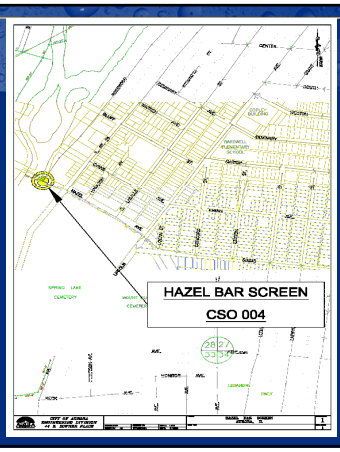
The sewer improvements transport flows from CSO's 2, 3A, and 22 to the CSO Treatment Plant.





Indian Creek Interceptor Improvements

Hazel Bar Screen



Historical Wet Weather Efforts

Aurora Has Implemented Many Separate Drainage Improvement Projects Totaling Well over $98 M-2008



The City of Aurora also completed a multitude of sewer separation projects.

Ashland Avenue Storm Sewer	Trask & Bonner Storm Sewer
Oakhurst Lake and Outfall	Lincoln Park (Downer Phases 2 & 3) Storm Sewer
Plum Street Storm Sewer	Illinois & View Storm Sewer
George Avenue Storm Sewer	Riddle Highlands Storm Sewer
Basin 7 SSA	Western/Westlawn/Marsellaise/Kensington Storm Sewer
Rosewood	Near West Side Sewer Improvements Project
SE Sewer Separation	Valley Avenue Storm Sewer
5th Ave Reconstruction	Ingleside Storm Sewer Kenilworth to Marsellaise
Gates St. Storm Sewer	Area 3 A West Illinois Sanitary and Storm
E. Galena Storm Sewer	Sewer Improvements Construction
SSA #10	Area 2 Phase 1 Sanitary and Storm
Near Northeast Phases I-IV	Sewer Improvements Construction
New Haven	Area 2 Phase 2 Sanitary and Storm
Lancaster S.S.	Sewer Improvements Construction
Liberty Coolidge Phase I	Area 3B West Park Storm and Sanitary
Liberty Coolidge Phase II	Sewer Improvements Construction
SSA #7	Preliminary Engineering Basins 5,6 & 13
George Avenue Storm Sewer Phase I	North Ave Storm Sewer Phase 1 (Area 2 Phase 3)
George Avenue Storm Sewer Phase II	North Ave Storm Sewer Phase 2
SSA #5	Basins 5 & 6 Sewer Separation
E. New York St. Reconstruction	Basin 13 Sewer Separation
Hill Ave	Downtown Sewer Expansion

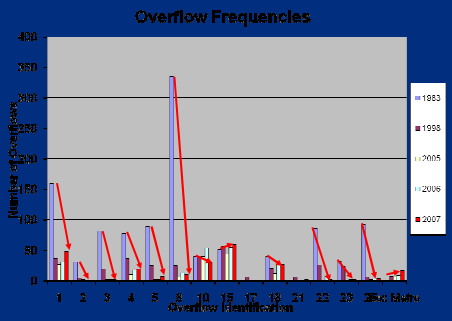
Benefits of Sewer Separation

- Decreases the number of basement backups
- Improves Street Drainage – reduces flooding
- Provides capacity in the storm sewer system for redevelopment
- Reduction in the amount of raw sewage entering the Fox River

Total Investment To Date In Reducing Wet Weather CSOs

Description	Dollars (2008)
System Improvements	$ 26,900,000
FMWRD Wet Weather Improvements	$ 22,800,000
CSO Facility	$ 17,600,000
Screening at OVF No. 4	$ 600,000
Indian Creek Interceptor	$ 3,200,000
East Bank Interceptor	$ 2,200,000
Drainage Improvements	$ 98,000,000
TOTAL	$171,300,000

Improvements Completed so Far Have Significantly Reduced CSO Frequency



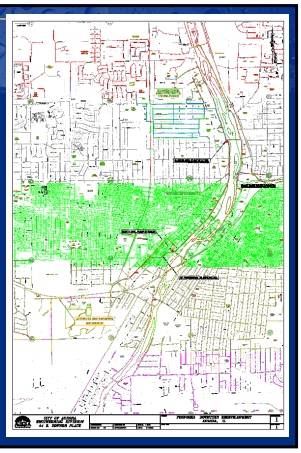
Overflow	1983 # of Overflows	2007 # of Overflows
1	159	48
2	30	0
3	81	1
4	77	19
5	89	7
8	335	10
10	39	29
15	51	59
17		0
18	39	26
21		1
22	85	1
23	31	1
25	92	3
Fox Metro		16
Totals	1108	221

Recent and Upcoming Projects

- Partnership with Fox Metro Water Reclamation District to relieve the overburdened, combined sewer system.
- The work that has taken place in the River Street area is needed to serve approximately 450 acres on the City's West side.
- Approximately $13.5M in Sanitary Sewer improvements that will be owned and operated by Fox Metro.
- Approximately $7M in Water Main, Storm Sewer, and Sanitary Sewer that will be owned by the City of Aurora.

COA/Fox Metro Sewer Expansion Project

- IL Ave Pump Station
- IL Ave Pump Station Forcemain
- River St Utilities Contract II
- River St Utilities Contract I
- North Ave Pump Station
- North Ave Pump Station Forcemain
- Jericho Rd Sanitary Sewer Replacement



North Avenue Storm Sewer Exhibit



Recent and Upcoming Projects

- In 2005, The Engineering Division of the Public Works Department was directed by the current Administration & City Council to complete the largest comprehensive sewer system plan established to date.
- The area encompasses 1220 acres (almost two square miles)

Recent and Upcoming Projects

- The area is referred to as Basins 5, 6, & 13



Recent and Upcoming Projects

- Approximately $ 1.4 million has been spent in preliminary engineering and inspection of the existing system

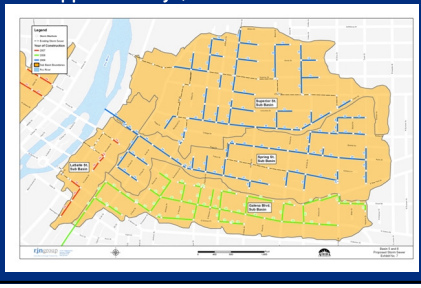






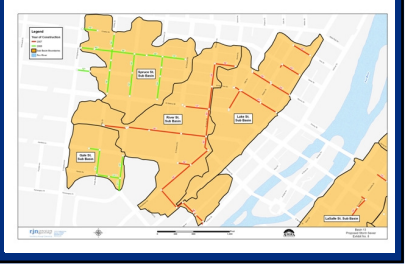
2008 – 2009 Construction

- Spring Street Sub-Basin
  - Approximately $ 4.8 Million



2008 – 2009 Construction

- Basin 13
  - Approximately $ 3.8 Million



Questions ?

A City second to none
AURORA
City of Lights
Mayor Thomas J. Weisner

Engineering Division of the Public Works Department
for the
City of Aurora

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 2—Sign In Sheet

February 2, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Barton Jones	Strand Assoc., Inc.	608.251.4843	bart.jones@strand.com
Scott Stevens	"	"	Scott.Stevens@Strand.com
Mike Ott	Strand Assoc Inc	815.744.4200	mike.ott@strand.com
Whitney Peters	City of Aurora	630-710-0355	jsp1925@comcast.net
Linda A Cole	Public	630-897-8373	MCCLAC3739@AOL.com
Bruce Kleinfeldt	Public	630-898-8308	
Rich Santiago	Dist 131	630-779-8050	RSantiago@D131.org
Brandon Wright	COA	630-301-7925	bwright@aurora-il.org
Pete Kerl	D.S.D. 129 West	630-301-5027	PKerl@sd129.org
Eric Schoeny	COA	630-844-3620	eschoeny@aurora-il.org
Bill Dunnell	FVPD	630-851-7516	bdunnell@fvpd.net
Amy Roth	COA	630.264.3049	aroth@aurora-il.org
Steve Stephens	Stephens Comm. Real Estate	630-906-9900	sstephens@ccim.net
Manny Maysonet	COA	630.897.5500	mmaysonet@aurora-il.org
Julia Shanahan	Kane County Bd	630-896-7709	ashahan@aol.com
Chuck Nelson	COA Mayor's Office	630 844-3612	cnelson@aurora-il.org
Ken Schroth	COA Public Works	630-844-3621	Kschroth@aurora-il.org

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, IL
February 25, 2009, 10 A.M.

Location: Aurora's Potable Water Treatment Plant

Purpose: Citizen Advisory Committee (CAC) Meeting No. 2, a tour of the combined sewer overflows (CSOs), and the CSO Treatment Plant.

Attendees:

Name/Title	Representing
Brandon Wright	City of Aurora
Manny Maysonet	City of Aurora
Amy Roth	City of Aurora
Bill Donnell	Fox Valley Park District
Linda Cole	Sierra Club, Aurora Citizens
Arlene Shumaker	Kane County Board
Bruce Kleinfieldt	Aurora Citizens
Pete Kerl	West Aurora School District No. 129
Rich Santiago	East Aurora School District No. 131
Chuck Nelson	Mayor's Office
Steve Stephens	Stephens Commercial Real Estate
Ken Schroth	City of Aurora Public Works
Eric Schoeny	City of Aurora Engineering
Whitey Peters	Alderman
Bart Jones	Strand Associates, Inc.
Mike Ott	Strand Associates, Inc.
Scott Stearns	Strand Associates, Inc.

Discussion Items:

1. Corrections or Clarifications to previous Meeting Minutes

   a. Bill Donell corrected the statement "The Park District has been trying to create river access for the last 100 years." The Park District has existed for about 60 years.

2. Introduction

   a. Bart Jones introduced the CAC and thanked everyone for coming.
   b. He reviewed the safety procedures and tips for the ensuing field trip.

3. Meeting Overview (Scott Stearns–Strand)

   a. Reviewed the CSOs and its function in Aurora.
   b. Talked about sensitive areas and Illinois Environmental Protection Agency's (IEPA) definitions of sensitive areas.
   c. Explained the purpose of this meeting for the CAC members to develop their own opinions regarding the CSOs. Whether or not CSOs discharge into sensitive areas will be discussed at the next meeting.

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4. CSO Tours (Eric Schoeny–City of Aurora)

   a. Two vans transported the CAC members to each of the overflow locations.
   b. A brief description, history, and other information was provided at each location.

5. Lunch

6. CSO Treatment Plant Tour

7. Next Meeting

   The next meeting will be held at the Roots Street Community Center, 501 College Avenue, Room 200, Aurora, Illinois on April 15, 2009, at 10 A.M.

Prepared by Michael Ott and respectfully submitted to all in attendance.

Enclosures: Agenda for January 21, 2009, CAC meeting

c/enc: All Participants

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City of Aurora CSO LTCP Development
Citizens Advisory Committee Document

February 25, 2009

GLOSSARY of TERMS:

"Affected Public", includes the residential and business rate payers and users of the Aurora sewer system, persons who reside in municipalities that are downstream from Aurora's CSOs that may possibly be affected by Aurora's CSOs, persons who use and enjoy these waters, user organizations (such as fishing clubs, conservation groups, etc.), and residents and businesses that will be affected by any construction activity associated with CSO abatement implementation.

"Best Management Practices (BMPs)", means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States". BMPs also include treatment requirements, operating procedures and practices, and other non-structural practices that minimize pollution.

"Combined Sewage", refers to a combination of wastewater (including domestic, commercial, or industrial wastewater) and stormwater transported in a combined sewer.

"Combined Sewer", is a sewer designed to convey domestic, commercial, and industrial wastewater and stormwater in the same pipe.

"Combined Sewer Operational Plan", means a plan that contains the nine minimum BMPs applicable to, and requirements for operation and maintenance of, a combined sewer system.

"Combined Sewer Overflow (CSO)", means the portion of flow from a combined sewer system (CSS) that discharges into a water body from one or more overflow points when the hydraulic capacity of the system, or part of the system, is exceeded as a result of a wet weather event.

"Control Alternative", means any of the following measures, or any combination of the following measures, for the control of wet weather flows in a combined sewer system:

1. Source controls and Green Infrastructure
2. Collection system controls and sewer separations
3. Storage technology, and
4. Treatment technologies

"Criteria", are elements of state water quality standards, expressed as pollutant constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular designated use. When criteria are met, water quality will protect the designated use."

"Designated Uses", are those uses specified in water quality standards for each water body or segment whether or not they are being attained.

"Existing Use", means a use actually attained in the water body on or after November 28, 1975, whether or not it is included in the water quality standards.

"Financial Capability Assessment (FCA)", is a structured, robust analysis which involves calculation of a number of generalized benchmarks that relate the total cost of implementing the LTCP control alternative to the overall economic and social impact to the residents of the CSO community. Benchmark metrics include, but are not limited to, the following:

(i) median household income (MHI)
(ii) current unemployment rate and trend
(iii) overall net debt per capita
(iv) bond rating(s)
(v) property tax revenue as a percent of full market property value
(vi) property tax revenue collection rate

"First Flush", means the transport of solids, and other pollutants, in a combined sewer system that:

1. Have settled in pipes during periods between wet weather events; and
2. Have washed off impermeable surfaces such as streets and parking lots during the beginning of a wet weather event.

"Full Body Contact Recreation", means swimming and other activities that potentially involve total body immersion in a water body.

Hydraulic Model", means a technically acceptable method for assessing the hydraulic response of a combined sewer system to a specific rainfall/runoff event, by quantifying the total volume of discharge and/or peak rate of discharge from one or more CSO discharge locations that result from control alternatives ranging from "doing nothing" to complete CSO elimination.

"Infiltration", means water other than wastewater that enters a wastewater system and building sewers from the ground through such means as defective pipes, pipe joints, connections, and manholes. (Infiltration does not include inflow.)

"Infiltration and Inflow (I/I)", means the total quantity of water from both infiltration and inflow.

"Inflow", means water other than wastewater that enters a wastewater system and building sewers from sources such as roof leaders, cellar drains, yard drains, area drains, foundation drains, drains from springs and swampy areas, manhole covers, cross connections between storm drains and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters and drainage. (Inflow does not include infiltration.)

"Interceptor Sewer", means a sewer without building sewer connections that is used to convey flows from main and trunk sewers to the wastewater treatment facility.

"Knee of the Curve", is the point where incremental change in the cost of the control alternatve per change in performance of the control alternative changes most rapidly.

"Long Term Control Plan", means a plan that:

1. is consistent with the federal CSO Control Policy (59 FR 18688);

2. is developed in accordance with the recommendations set forth in CSO Guidance for LTCP (EPA 832 B 95 002);
3. describes changes and improvements to be made to a combined sewer system or to a wastewater treatment facility for purposes of meeting the requirements of the CWA and state law;
4. is developed with public participation using a process that is designed to promote active involvement by the affected public, through opportunities to provide information, opinions, and comments, in the decision making process, to select CSO control alternatives;
5. is submitted to the Illinois Environmental Protection Agency and the United States Environmental Protection Agency for approval; and
6. considers the site-specific nature of combined sewer overflow discharges and does the following:
   (A) uses characterization, monitoring, and modeling of the combines sewer system to determine:
      (i) the response of the combined sewer system to various precipitation events,
      (ii) the characteristics of the overflows from the combined sewer system, and
      (iii) the water quality impacts that result from overflows from the combined sewer system;
   (B) considers the impact of combined sewer overflows on sensitive areas and gives highest priority to controlling overflows in those areas;
   (C) contains an evaluation of a reasonable range of control alternatives, taking into account expected and projected future growth;
   (D) contains cost and performance analyses of the control alternatives evaluated;
   (E) maximizes treatment of wet weather flows at the wastewater treatment facility;
   (F) contains a practicable implementation schedule for the selected control alternative;
   (G) contains a post-construction compliance monitoring program adequate to ascertain:
      (i) The effectiveness of the selected control alternative'
      (ii) The extent to which water quality standards have been attained.

"National Pollutant Discharge Elimination System (NPDES)", means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements under Sections 307, 402, 318, and 405 of the CWA. The term includes "approved program."

"Peak Flow", means the maximum flow that occurs over a specific length of time (e.g. daily, hourly, instantaneous).

"Point Source", means any discernible, confined, and discreet conveyance, including but not limited to: any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, concentrated animal feeding operation, landfill leachate collection system, etc. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

"Sensitive Areas", means waters impacted by CSO discharges which must be given highest priority for CSO discharge elimination, relocation, or control. Sensitive areas include:
   (i) habitat for threatened or endangered aquatic species,
   (ii) primary contact recreational areas such as beaches and swimming areas,
   (iii) drinking water source waters, and
   (iv) outstanding state or national resource waters

"Stormwater", means runoff, snow melt runoff, and surface runoff and drainage.

"Total Maximum Daily Load", is a calculation of the maximum amount od any specific pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount of pollutant's sources, as described in 40 CFR 130.2 (g)-(i).

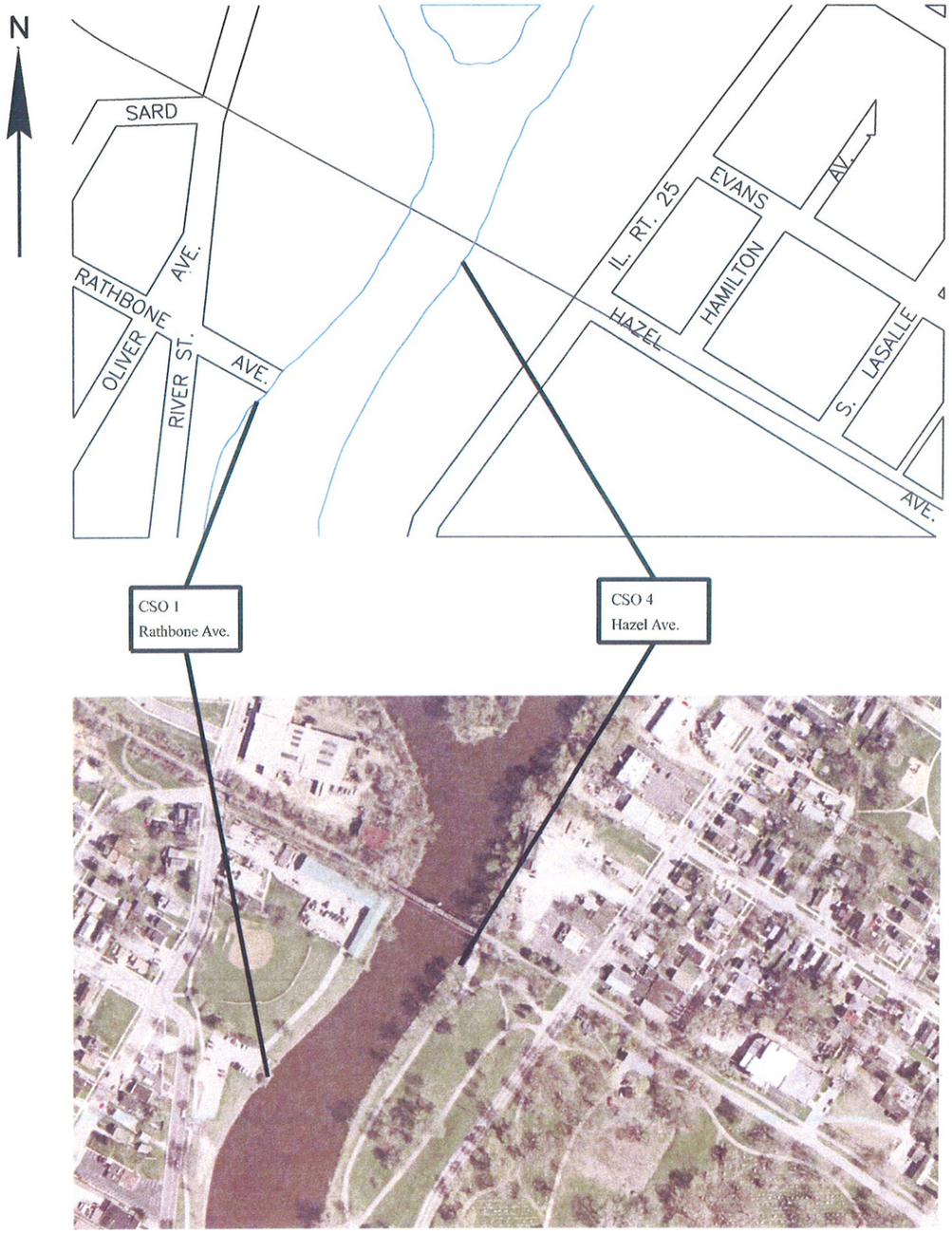
"Use Attainability Analysis (UAA)", is a structured scientific assessment of the factors affecting the attainment of a designated use. It includes assessments of physical, chemical, biological, and economic factors as described in Section 131.10(g) of the CWA.

"Variance", is a discharger specific, short-term modification to the applicable water quality standard. A legal permit for the discharger may be based upon a variance.

"Water Quality Model", means a technically acceptable method for assessing the real-time and spatial impacts to the quality of the receiving water body resulting from both point source and non-point source external inputs of pollutants.

Water Quality Standards" are the provisions of federal and state law which consist of a designated use or uses for the water body, water quality criteria to protect the most sensitive uses for the water body, and an antidegradation policy and implementation procedures to protect water quality. Water quality standards are established to protect the public health or welfare, enhance the quality of the water, and to serve the purposes of the CWA.

"Wet Weather Event", means stormwater runoff, snowmelt runoff, or ice melt runoff entering a combined sewer system.



Upstream



Downstream

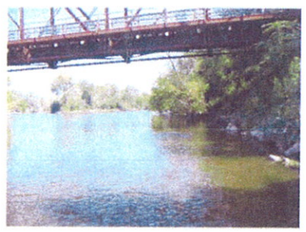


Across the River



CSO 1 Rathbone Avenue

Upstream



Downstream



Across the River



CSO 4 Hazel Avenue

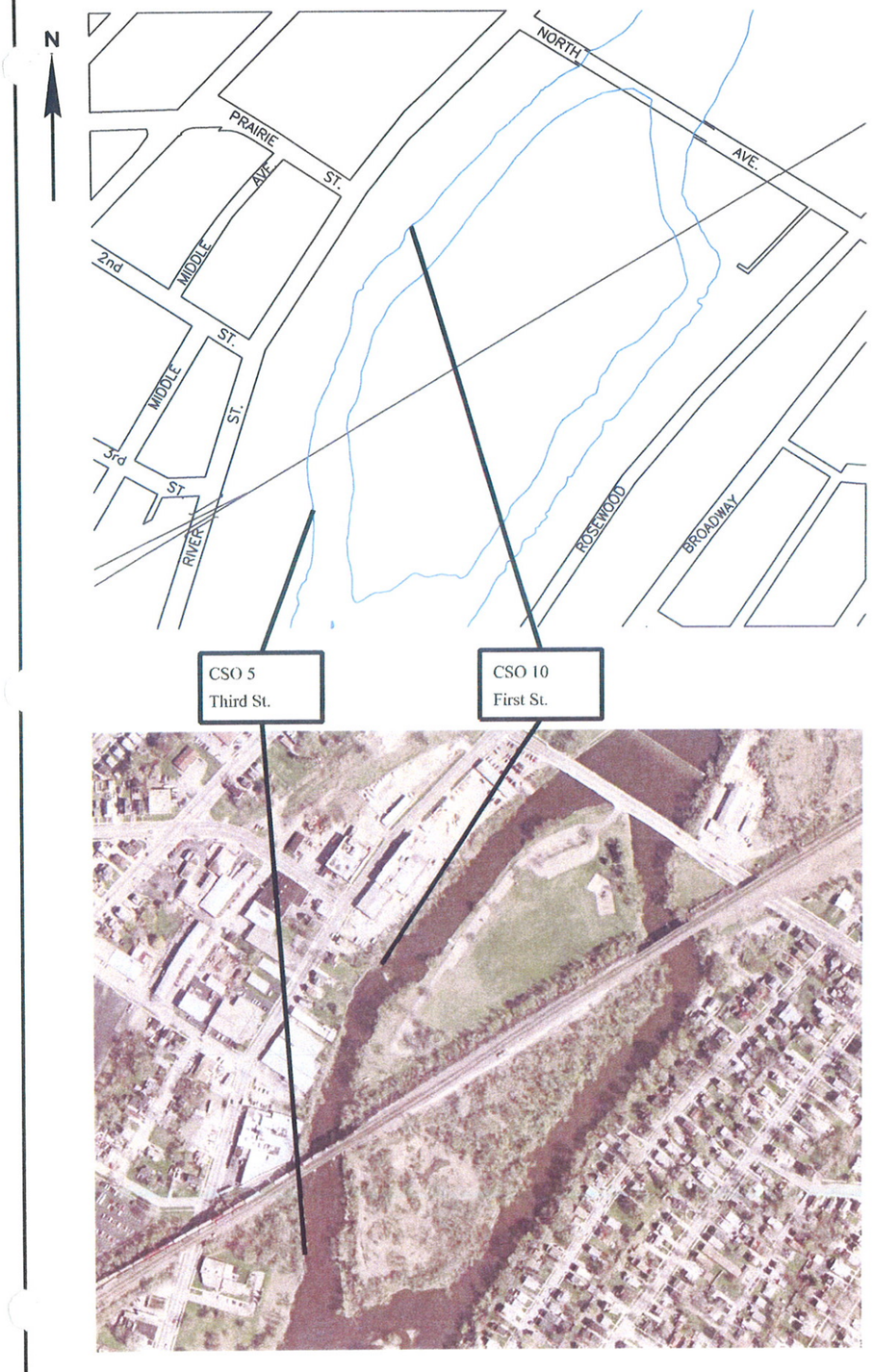
CSO 1 and CSO 4 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ASSOCIATES, INC. ENGINEERS

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Upstream



Downstream



Across the River



CSO 10 First Street

Upstream



Downstream



Across the River



CSO 5 Third Street

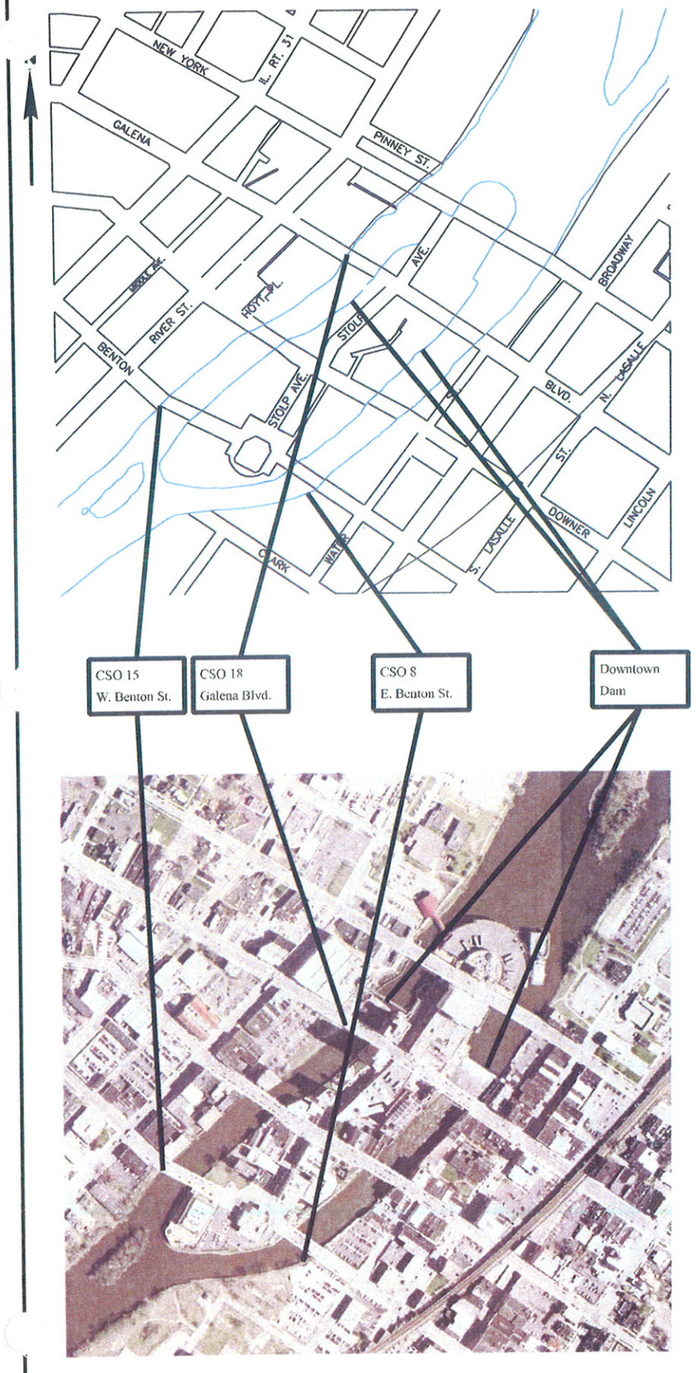
CSO 5 and CSO 10 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ASSOCIATES, INC. ENGINEERS

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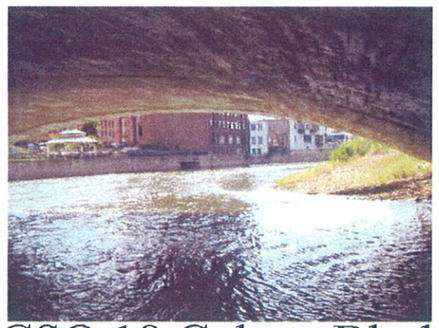
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Upstream



Downstream



Across the River



CSO 18 Galena Blvd.

Upstream



Downstream



Across the River



CSO 15 West Benton Street

Upstream



Downstream



Across the River



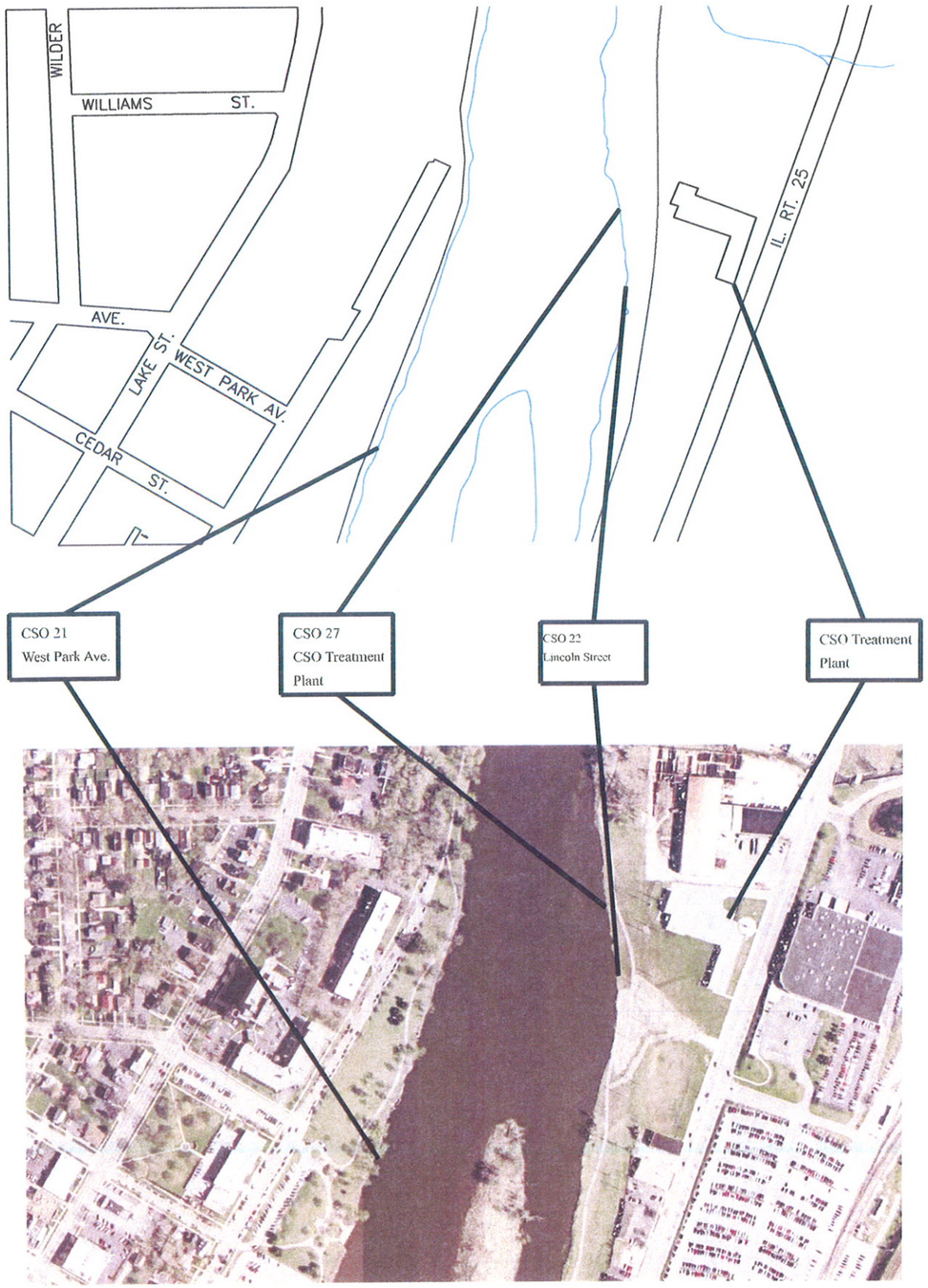
CSO 8 East Benton Street

CSO 8, CSO 15, and CSO 18 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ASSOCIATES, INC. ENGINEERS

FIGURE NO.
JOB /



Upstream



Downstream



Across the River



CSO 27 Wet Weather Treatment Plant

Upstream



Downstream



Across the River



CSO 22 Superior Street

Upstream



Downstream



Overflow Pipe



CSO 21 West Park Ave.

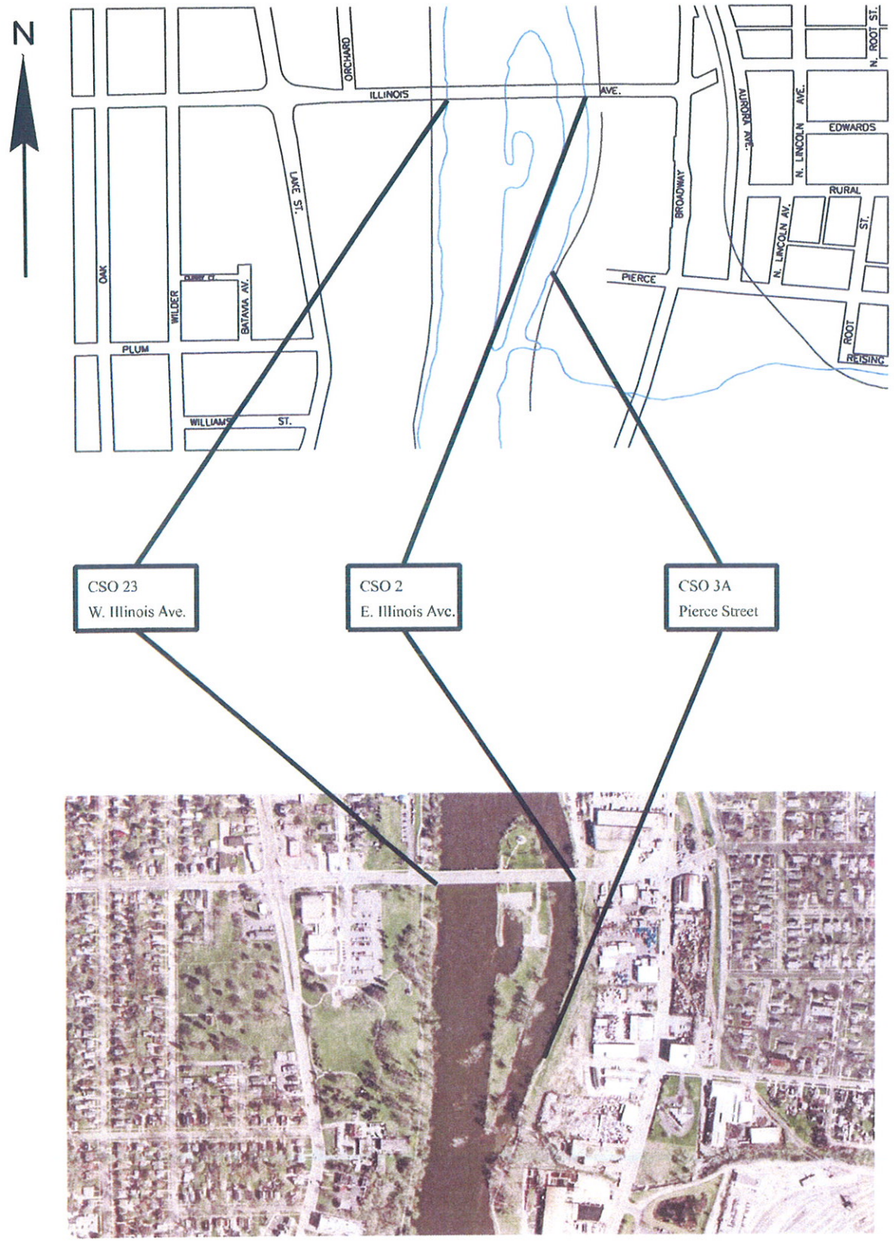
CSO 21, CSO 22, and CSO 27 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ASSOCIATES, INC. ENGINEERS

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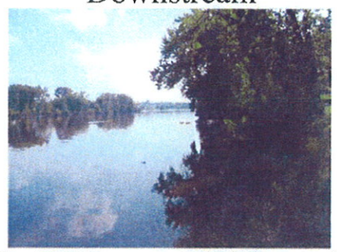
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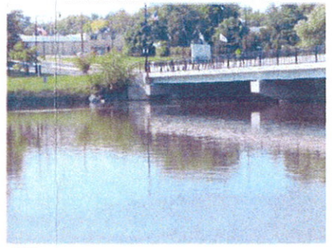
Upstream



Downstream



Across the River



CSO 23 West Illinois Street

Upstream



Downstream



Across the River

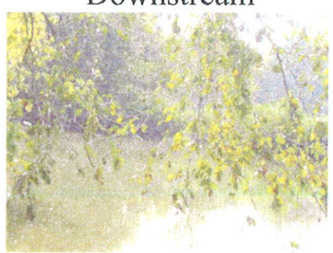


CSO 2 East Illinois Street

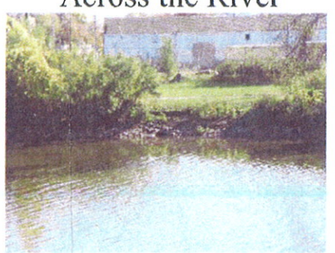
Upstream



Downstream



Across the River



CSO 3A Pierce Street

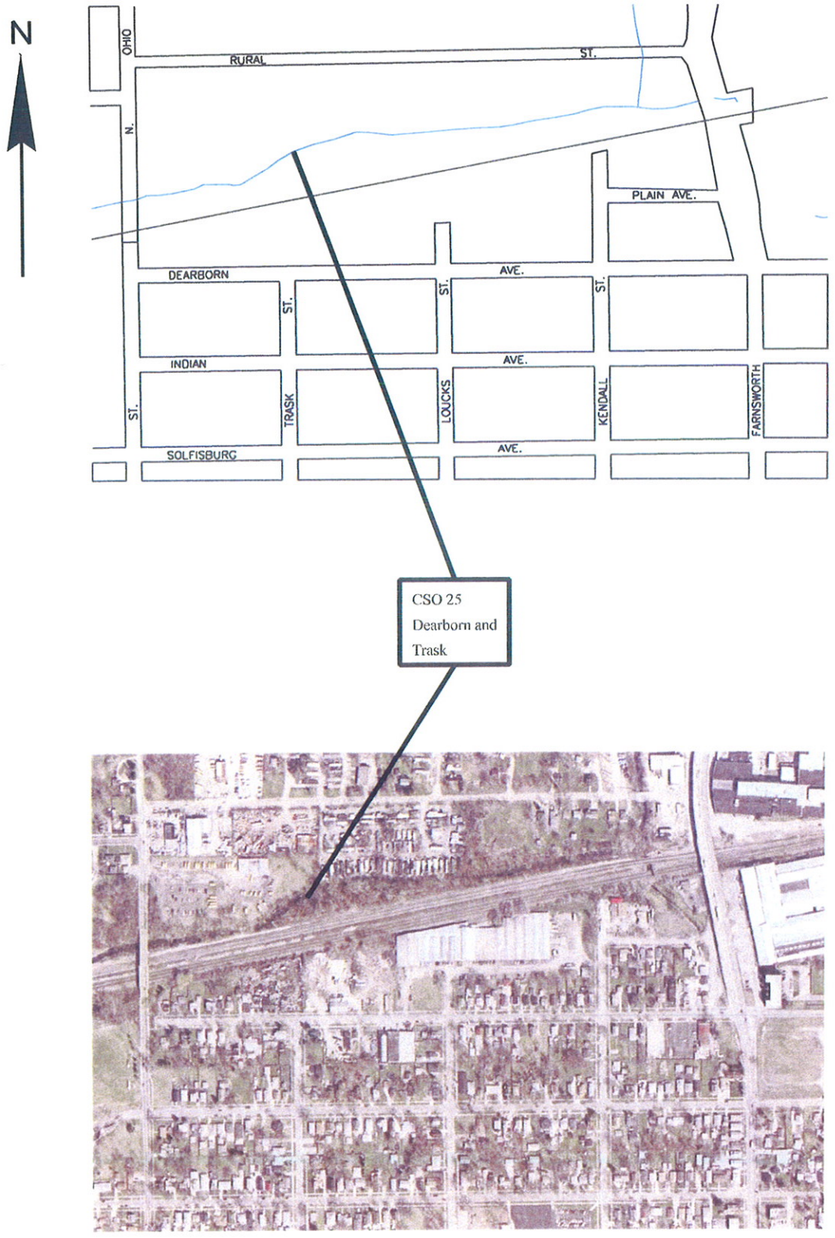
CSO 2, CSO 3A, and CSO 23 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ASSOCIATES, INC. ENGINEERS

FIGURE NO.
JOB #

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Upstream



Downstream



Outfall Pipe



CSO 25 Dearborn and Trask

CSO 25 Characteristics

City of Aurora CAC
Aurora LTCP

STRAND ENGINEERS

FIGURE NO.
JOB #

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 3---AGENDA

April 15, 2009

(1) Introductions of CAC Attendees	10:00 AM to 10:05 AM
(2) Approval of Minutes from CAC Meetings 1 & 2	10:05 AM to 10:10 AM
(3) Overview of Water Quality Standards and How WQS Relate to CSO Abatement	10:10 AM to 10:30 AM
(4) CSO Discharge Location Site-specific Determination Respecting "Sensitive Areas"	10:30 AM to Noon
(5) Lunch	Noon to 12:45 PM
(6) CSO Discharge Location Site-specific Determination Respecting "Sensitive Areas"---Continued	12:45 PM to 2:00 PM

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 3—Sign In Sheet

April 15, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Barton Jones	Strand Assoc. Inc.	608.251.4843	bart.jones@strand.com
Mike Ott	Strand Associates	815-744-4200	Mike.Ott@strandcom
Ken Schroth	COA - Public Works	844-3621	Kschroth@aurora-il.org
BRUCE KLEINFIGHT	CITIZEN Comm.	(630) 898-8308	
Scott Stearns	STRAND	608.251 4843	Scott.Stearns@strand.com
ERIC SCHROEDY	COA	630-844-3626	ESCHROEDY@AURORA-IL.ORG
Linda A Cole	Public SIERRA Club	630-897-8373	MCCLAC3739@aol.com
Chuck Nelson	City of Aurora		cnelson@aurora-il.org.
Fran Caffee	Sierra Club	630-859-1687	fran.caffee@gmail.com
Brandon Wright	COA - Finance	630-301-7925	bwright@aurora-il.org
Pete Kerl	S.D.#. 129	630-301-5027	PKerl@sd129.org
Steve Stephens	Commercial Real Estate	630-906-9900	ssstephens@ccim.net.
Manny Maysonet	COA - Econ. Development	630.897-5500	mmaysonet@aurora-il.org
Ray C. Anderson	Citizen	630 892 4158	
Whitney Peters	City of Aurora	630-844-3619	
Amy Roth	COA	630-264-3049	aroth@aurrra-il.org
* Tom Muth	FPWRD	630.892.4378	tmuth@foxmetro.dst.il.us

* Added by mistake

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, Illinois
April 15, 2009, 10 A.M.

Location: The Root Street Community Center at 501 College Avenue, Room 200

Purpose: Citizen Advisory Committee (CAC) Meeting No. 3, primer respecting Water Quality Standards (WQS) and how they relate to combined sewer overflow (CSO) abatement; sensitive area determinations and social values

Attendees:

Name/Title	Representing
Brandon Wright	City of Aurora
Manny Maysonet	City of Aurora
Amy Roth	City of Aurora
Fran Caffee	Sierra Club
Linda Cole	Sierra Club, Aurora Citizen
Bruce Kleinfieldt	Aurora Citizen
Pete Kerl	West Aurora School District No. 129
Chuck Nelson	Mayor's Office
Steve Stephens	Stephens Commercial Real Estate
Ken Schroth	City of Aurora Public Works
Eric Schoeny	City of Aurora Engineering
Whitey Peters	Alderman
Ray Anderson	Aurora Citizen
Bart Jones	Strand Associates, Inc.
Mike Ott	Strand Associates, Inc.
Scott Stearns	Strand Associates, Inc.

Discussion Items:

1. Introductions (Scott Stearns)

2. Corrections or Clarifications to previous Meeting Minutes

   a. Linda Cole is a current member of the planning commission.
   b. Bruce Kleinfeldt is an active member of the 2nd Ward Committee.
   c. Meeting minutes from Meeting 1 were approved pending the above changes motioned by Steve Stephens and seconded by Linda Cole. Meeting 1 minutes were approved by unanimous vote.
   d. Meeting minutes from Meeting 2 were unanimously approved after a motion by Steve Stephens, a second by Linda Cole.

3. Overview of WQS and How WQS Relate to CSO Abatement (Bart Jones)

   a. Bart Jones discussed the history of the Clean Water Act and its enforcement.
   b. He defined a sensitive area as one that contains one or more of the following criteria: is an aquatic habitat for endangered or threatened species, contains shellfish beds, is used for primary contact recreation, is a public drinking source, or is an outstanding national or state resource water.

4. CSO Discharge Location Site-Specific Determination Respecting "Sensitive Areas" (Scott Stearns–Strand)

   a. Reviewed Issue Paper No. 1.
   b. Reviewed each CSO site location and the physical attributes of the respective receiving stream.

5. Lunch

6. CSO Discharge Location Site-Specific Determination Respecting "Sensitive Areas" Continued (Scott Stearns–Strand)

   a. The floor was opened for discussion.
   b. Eric Schoeny of the City of Aurora reminded the group that on average a storm sewer system will overflow approximately 200 to 300 times a year from as many as 60 sources throughout the city compared to the 17 Aurora CSO locations that overflow a fraction of that amount of time, meaning the CSOs are a very small fraction of overflow activity in the City of Aurora. Additionally, historic data suggests the water quality in urban storm sewer runoff is just as poor as a CSO. He continued on saying that if the dollars are going to be spent, he would prefer to see them spent on the entire system through green infrastructure rather than having to spend extra money on a CSO discharging into a sensitive area.
   c. Ray Anderson commented that CSO 1 and 4 are areas where a lot of boating and fishing occur and that CSO 2, 3, 22, and 27 are in areas that are heavily walked and will be near a new planned urbanization park on the river front.
   d. Steve Stephens commented that to make things easier, the group should narrow down where people are even able to swim.
   e. Fran Caffee asked that even though right now there are no endangered species or shellfish, if things improve and they move into the area, is there a procedure to revisit the sensitive area discussion. Bart Jones told the group that during permit renewal the issue is reevaluated.
   f. A discussion and vote for each CSO location was conducted; the results are as follows:

   CSO 1 Rathbone: Linda Cole commented, there is a boat launch, some jet-skiing, and lots of fishing, but she has never seen anyone swimming there. Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-2 No-10**

   CSO 4 Hazel: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-1 No-11**

   CSO 5 Third St.: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

   CSO 10 First St.: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

   CSO 8 East Benton: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 15 West Benton: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 18 Galena: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 21 West Park: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 22 Superior: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 27 CSO Treatment Plant: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 3A Pierce: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-0 No-12**

CSO 2 East Illinois: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-2 No-9** (Linda Cole was on the fence and could not decide)

CSO 23 West Illinois: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-2 No-9** (Linda Cole was on the fence and could not decide)

CSO 25 Dearborn and Trask: Result of the vote in response to the question, "Does this CSO discharge into a sensitive area?": **Yes-1 No-11**

7. Next Meeting

There will be no Fox Metro Plant tour next meeting. The next meeting will be held at the City of Aurora Visitor's Center at Phillips Park Zoo, 1,000 Ray Moses Drive, Aurora, IL 60505, on May 13, 2009, at 10 A.M.

Prepared by Michael Ott and respectfully submitted to all in CAC members in attendance.

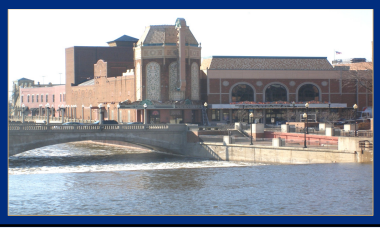
Enclosures

c/enc: All CAC members on the roster

STRAND ASSOCIATES, INC.® ENGINEERS

City of Aurora's Development of the CSO LTCP

Citizen's Advisory Committee (CAC) Meeting 3
April 15, 2009



How Environmental Regulations are Promulgated



Be it known by the Senate and the House of Representative of the United States of America in Congress Assembled

federal register

Code of Regulations

The Clean Water Act (CWA)

". . . It is the national goal that, whenever attainable, water quality which provides for the protection and propagation of fish, shellfish, and wildlife and further provides for recreation in and on the water be achieved."



CWA Operates via "Command and Control" Theory

CWA

NPDES Permits

Command | Control

1. "THOU SHALL"
2. "THOU SHALL NOT"

1. Civil Penalties
2. Criminal Penalties



Water Quality Standards (WQS) have 3 Components

1. Designated Uses
2. Water Quality Criteria (WQC) to Support the Uses
3. Antidegradation Policy

2 General Types of Designated Uses



1. Domestic Water Supply
2. Industrial Water Supply
3. Fish / Aquatic Life
4. Recreation
5. Irrigation
6. Livestock / Wildlife Watering
7. Navigation

1. Outstanding
2. Remarkable
3. Excellent
4. Good

2 General Types of Water Quality Criteria

"Numeric"

1. Protects Most Sensitive Species
2. Measured In-Stream

"Narrative" Free from substances that:

1. Settle to form putrescent deposits
2. are unsightly or deleterious
3. produce color, oil sheen, or odor
4. are acutely toxic to aquatic life or humans
5. will cause or contribute to growth of aquatic plants and algae that becomes a nuisance

3 Tiers in Antidegradation Policy

Tier III – Protects National / State Outstanding Resource Water

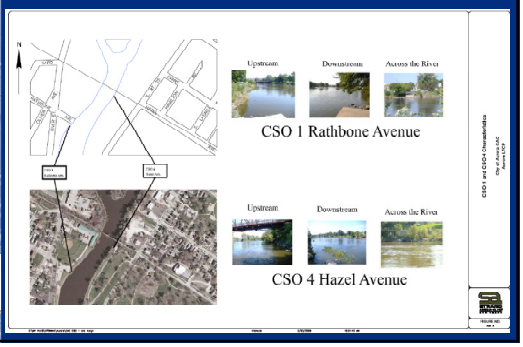
Tier II – Protects WQC in water better than "Fishable / Swimmable"

Tier I – Maintains and Protects "Existing" Uses

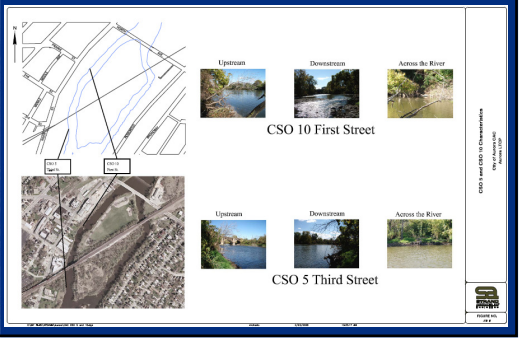
WQS Affecting the Fox River in Aurora

- **Designated Use – General Purpose**
  1. Primary Recreational Contact
  2. Secondary Recreational Contact
  3. Fishing
- **Criteria – Must Support Most Restrictive Use**
  1. Fecal Coliform Bacteria
- **IMPAIRED – 40% of time in dry weather**
  100% of time in and immediately after wet weather
  CSOs Contribute, but not the only source

CSO 1 and CSO 4 Characteristics



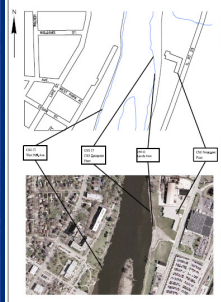
CSO 5 and CSO 10 Characteristics



CSO 5, CSO 15 and CSO 18 Characteristics



CSO 21, CSO 22 and CSO 27 Characteristics





CSO 27 Wet Weather Treatment Plant

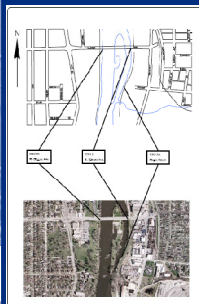


CSO 22 Superior Street



CSO 21 West Park Ave.

CSO 2, CSO 3A and CSO 23 Characteristics





CSO 23 West Illinois Street

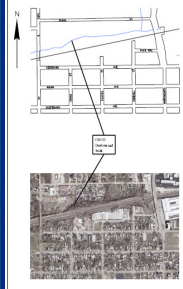


CSO 2 East Illinois Street



CSO 3A Pierce Street

CSO 25 Characteristics





CSO 25 Dearborn and Trask

ISSUE PAPER NO. 1

ISSUE TO BE RESOLVED: Given that USEPA's National Combined Sewer Overflow (CSO) Control Policy and IEPA's requirements for CSO LTCPs dictate elimination, relocation, or control of CSO discharges into "sensitive areas" as being the highest priority in the development of control alternatives in the LTCP, do sensitive areas exist along Indian Creek and the Fox River within the boundaries of the combined sewer system?

REGULATORY FRAMEWORK UNDERPINNING THE ISSUE:

Historically, the control of CSOs has proven to be extremely complex. This complexity stems partly from the difficulty in quantifying CSO impacts on receiving water quality and the site-specific variability in the volume, frequency, and characteristics of CSOs. Additionally, the financial impacts upon communities with CSOs can be significant. There are approximately 772 remaining CSO communities nationally, down from 1132, with about 100 of them in the state of Illinois.

To address these challenges, USEPA issued a National CSO Control Strategy on August 10, 1989 (54 *Federal Register* 37370). This strategy reaffirmed that CSOs are point source discharges subject to NPDES permit requirements within the context of the Clean Water Act (CWA). The CSO Strategy set forth three objectives:

1. Ensure that if CSOs occur, they are only as a result of wet weather;
2. Bring all wet weather CSO discharge points into compliance with the technology-based and water quality-based requirements of the CWA; and
3. Minimize the impacts of CSOs upon water quality, aquatic biota, and human health.

Although the CSO strategy was successful in focusing increased attention on CSOs, it fell short in resolving many fundamental issues. In 1991, USEPA initiated a process to accelerate implementation of the Strategy. The process included negotiations with the regulated community, state regulatory agencies, and environmental groups. The initiative resulted in the development of the CSO Control Policy which was published on April 19, 1994 (59 *Federal Register* 18688). The CSO Control Policy contains provisions for developing appropriate, site-specific NPDES permit requirements for all combined sewer systems (CSS) that overflow due to a wet weather event. It also announced an enforcement initiative that required the immediate elimination of overflows that occur during dry weather and ensured that CWA requirements are complied with as soon as possible. The CSO Control Policy contains four key principles to ensure that CSO controls are cost-effective and meet the requirements of the CWA. The four key principles are:

1. Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives;
2. Provide sufficient flexibility to municipalities, especially those that are financially disadvantaged, to consider site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives;
3. Allow a phased approach for implementation of CSO controls considering the community's financial capability; and

4. Review and revise, as appropriate, Water Quality Standards (WQS) and their implementing procedures when developing CSO LTCPs to reflect site-specific wet weather impacts of CSOs.

Within the framework of the CSO LTCPs, receiving waters that are determined by the local community (Aurora's CAC) to be "sensitive areas" become the focus of special attention. USEPA's and IEPA's definition of a sensitive area include:

(i) Aquatic habitat for endangered or threatened species;
(ii) Shellfish beds;
(iii) Primary contact recreational areas;
(iv) Public drinking water source waters;
(v) Outstanding national or state resource waters.

USEPA and IEPA CSO Control Policy states the LTCP should:

- Prohibit new or significantly increased CSO volumes into sensitive areas;
- Control, eliminate, or relocate CSOs that discharge into sensitive areas whenever physically possible and economically achievable. Where elimination or relocation of CSOs is not physically possible and economically achievable, provide the level of CSO treatment for the remaining CSOs deemed necessary to meet WQS for full protection of existing and designated uses; and
- Where elimination or relocation of CSOs is not physically possible or economically achievable, for each subsequent NPDES permit term, require reassessment based on new or improved techniques to eliminate or relocate, or on changed circumstances that influence economic feasibility.

BACKGROUND and HISTORY OF PAST SENSITIVE AREA DETERMINATIONS:

The City of Aurora retained Walter E. Deuchler Associates, Inc. (WEDA) to conduct engineering studies to assess whether the city's CSOs discharge into sensitive areas. In April 1997 WEDA submitted a report to IEPA that concluded CSOs, 003, 005, 008, 010, 015, 016A, 017, 018, and 025 DID NOT discharge into sensitive areas. IEPA requested additional information for CSOs 002, 004, 022, 001, 021, and 023.

In January 1998 WEDA submitted the additional information to IEPA (stream depth, depth of sediment, accessibility, and other factors) for these six CSOs. WEDA concluded that CSOs 002, 004, 021, and 022 DID NOT discharge into sensitive areas. Data on CSOs 001 and 023 were inconclusive and WEDA requested an extension of time to further study these two CSO discharges.

In October 2000 WEDA submitted the CSO 001 and 023 sensitive area study to IEPA which was based upon: (1) intermittent observance of uses between the hours of 9 AM and 4:45 PM during the months of July and August in 1998; (2) dye testing; and (3) bacterial testing. 35 people entered the water in the vicinity of CSO 001 during this two-month period for purposes of swimming, wading and boating. 41 people entered the water in the vicinity of CSO 023 during the same period for purposes of swimming, wading, boating, skiing, jet-skiing, and fishing. Most uses occurred on weekends. Dye tests indicated the CSO discharge plumes dissipated within 500 feet at both locations. Bacteria sampling demonstrated that bacteria levels were less than human health risk levels during the first 12 to 24 hours from the event onset, but human health

exposure limits were exceeded for the next 48-hours. Because the uses were intermittent and very infrequent, and because the discharge plumes dissipated within 500 feet from the CSO and hugged the bank upon which the CSO was located, and because many other sources for bacteria contamination exist in the Fox River (outside of CSO discharges), WEDA concluded these two CSOs did not discharge into sensitive areas.

During the reissuance of NPDES Permit number IL0048518 to the City of Aurora in 2006, the Fact Sheet attached to the draft NPDES permit contained the following paragraph"

> *"On march 23, 1999, January 22, 2001 and June 5, 2001, IEPA determined that the CSO discharge locations (outfalls) do not discharge into sensitive areas. These determinations were based upon information submitted to IEPA* (the WEDA Reports) *that indicated the immediate vicinity of the CSO discharge locations (outfalls) are not areas of the Fox River and Indian creek where whole body contact is likely to occur. Since that time, IEPA has expanded the definition of a sensitive area to be consistent with the federal CSO Control Policy of 1994."*

[Note to CAC members---when the sensitive area determinations were made by WEDA that resulted in IEPA's finding that no sensitive areas existed within Aurora's combined sewer system, the only criterion that IEPA required for the analysis was primary contact recreation.]

When IEPA reissued NPDES Permit number IL0048518 to the city in January of 2008, the permit contained the following language within the Special Conditions of the permit:

> *"IEPA has noted that some or all of the City's CSOs may discharge into sensitive areas and that the previous determination on this issue is no longer valid. Unless IEPA specifically notifies the City of Aurora in writing that none of the CSOs authorized in this permit discharge into sensitive areas, the city shall provide information sufficient for IEPA to make a determination respecting sensitive areas pursuant to Section II.C.3 of the 1994 CSO Control Policy. Failure to provide information sufficient for IEPA to make this determination in the LTCP could result in a determination that some or all of the CSOs discharge into a sensitive area.*

STRAND'S ANALYSIS TO-DATE RESPECTING SENSITIVE AREAS:

(i) **Aquatic habitat for endangered or threatened species:**

Strand has contacted the U.S. Fish and Wildlife Service (USFWS) to ascertain if there may be any federally listed threatened or endangered aquatic species within the Lower Fox River (HUC 07120007) from the North Aurora Dam, river mile 51.5, downstream to the Montgomery Dam, river mile 46.2. USFWS reported no federally listed aquatic species reside within this reach of the Fox River. We also contacted the Illinois Department of Natural Resources (IDNR) to inquire about endangered or threatened aquatic species within the study area. IDNR has determined that the River Redhorse (*Moxostoma* carinatum) does not exist within the study area but records indicate the fish exists both above and below the study area. Therefore, Aurora's CSOs do not discharge into a sensitive area based upon this criterion.

Shellfish beds:

Strand contacted the Illinois Natural History Survey (INHS) to ascertain if there are any shellfish beds within the study area. The last survey performed by INHS was conducted in 2003 within the study area and no live shellfish specimens were found. We also contacted IDNR respecting the presence/absence of shellfish within the study area. IDNR reported no records (< 1/meter^2) of state listed shellfish exist in the study area. Therefore, Aurora's CSOs do not discharge into a sensitive area based upon this criterion.

(ii) **Primary contact recreational areas:**

The CAC will be utilized to assist the City of Aurora in making these determinations.

(iii) **Public drinking water source water:**

The CAC meeting number 2 was held at the City of Aurora's water treatment plant which is located upstream of any of the city's CSO discharge locations. Therefore, Aurora's CSOs do not discharge into a sensitive area based upon this criterion.

(iv) **Outstanding National or State resource waters:**

The Fox River nor Indian Creek within the study area are not identified as either a national or state resource water by USEPA or IEPA. Therefore, Aurora's CSOs do not discharge into a sensitive area based upon this criterion.

POTENTIAL CONSEQUENCES OF A "SENSITIVE AREA" DETERMINATION:

A determination that any CSO that discharges into a sensitive area will require the LTCP control alternative to place the highest priority upon control, elimination, or relocation or any such CSO. Control, elimination or relocation of CSOs is very expensive. It is reported that a national average cost per CSO to control, eliminate or relocate the discharge is approximately $5,000,000 dollars per CSO. Of course, costs to address each CSO is a function of many variables including; volume and peak flow rates of the overflows, the distance that the CSO discharge has to be moved to avoid the sensitive areas, the selected method for CSO control, and local construction challenges.

Notwithstanding the engineering analyses surrounding the sensitive area issue, the CAC may make a positive sensitive area determination at any, or all, of the CSO discharge locations based upon the communities "social values".

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 4---AGENDA

May 13, 2009

(1) Introductions of CAC Attendees	10:00 AM to 10:05 AM
(2) Approval of Minutes from CAC Meetings 3; F. Caffee's email	10:05 AM to 10:10 AM
(3) Stormwater and CSO Abatement Interface Utilizing Green Infrastructure (GI); Social Values of GI	10:10 AM to Noon
(4) Lunch	Noon to 12:45 PM
(5) Principles of Stormwater Utility Formation and How Stormwater User Fees Can Support CSO Abatement	12:45 PM to 1:45 PM
(6) CAC Sentiment Respecting Stormwater User Fees to Partially Support the CSO Abatement Program ***	1:45 PM to 2:00 PM

*** [Note to CAC---This discussion will help inform city staff on potential Policy impact if current stormwater utility fee structure is revised.]

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 4—Sign In Sheet

May 13, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Barton Jones	Strand Assoc.	608.251.4843	bart.jones@strand.com
Margaret Guell	Strand Assoc	"	margaret.guell@strand.com
John Lyons	STRAND Assoc	513-861-5100	john.lyons@strand.com
Michael Ott	Strand Assoc	815-744-4200	michael.ott@strand.com
Fran Caffee	Sierra Club.	630-859-1687	fran.caffee@sierraclub.org
Scott Stearns	STRAND	608.251.4843	scott.stearns@strand.com
Linda A Cole	SIERRA CLUB CITIZEN	630-897-8373	MCCLAC3739CAOL.com
Tom Muth	FOX METRO WRD	630 301 6801	tmuth@foxmetro.dst.il.us
BILL DONNELL	FVPD	630-897-0386	bdonnell@fvpd.net
BRUCE KLEINFIELD	CITIZEN AURORA	630-898-8308	
Ray C. Anderson	Citizen Aurora	630 892 4158	
Roscoe Greene	Hollywood CASINO	630-801-7045	Roscoe.greene@PNGaming.com
Amy Roth	city of Aurora PIO	630.264.3049	aroth@aurora-il.org
JOHN CURLEY	COA Comm Dev	630-844-3627	jcurley@aurora-il.org
Ken Schroth	COA-Public Works	630-844-3621	Kschroth@aurora-il.org
Jay Patel	IEPA-FOS	847-294-4000	Jay.Patel@illinois.gov
Chuck Nelson	COA-Mayors Office	630-844-3612	cnelson@aurora-il.org
Steve Stephens	Stephens Commercial Real Estate	630-906-9900	sstephens@ccim.net.
Arlene Shoemaker	Kane County Bd #3	630-896-7709	ahshoe@aol.com
WHITEY PETERS	COA ALDERMAN WS	630-710-0355	
ERIC SCHOENY	COA ENGINEERING	630-844-3620	ESCHOENY@AURORA-IL.ORG

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, Illinois
May 13, 2009, 10 A.M.

Location: Philip's Park Visitor Center

Purpose: Citizen Advisory Committee (CAC) Meeting No. 4, discussing green infrastructure (GI) and the fundamental principles of Stormwater Utility Formation.

Attendees:

Name	Representing
Tom Muth	Fox Metro Water Reclamation District
Bill Donnell	Fox Valley Park District
Amy Roth	City of Aurora
John Curley	City of Aurora
Roscoe Green	Hollywood Casino
Fran Caffee	Sierra Club
Linda Cole	Sierra Club, Aurora Citizen
Bruce Kleinfieldt	Aurora Citizen
Jay Patel	IEPA
Chuck Nelson	Mayor's Office
Steve Stephens	Stephens Commercial Real Estate
Ken Schroth	City of Aurora Public Works
Eric Schoeny	City of Aurora Engineering
Whitey Peters	Alderman
Ray Anderson	Aurora Citizen
Arlene Shoemaker	Aurora Citizen
Bart Jones	Strand Associates, Inc.
Mike Ott	Strand Associates, Inc.
Scott Stearns	Strand Associates, Inc.
Margaret Guell	Strand Associates, Inc.
John Lyons	Strand Associates, Inc.

Discussion Items:

1. Introductions (Scott Stearns)

   a. A new member, Roscoe Green from the Hollywood Casino.
   b. Tom Muth from Fox Metro and Jay Patel from the IEPA were visitors.

2. Fran Caffee made a comment specifically for the minutes reminding the CAC that although CSO 25 was not determined to be a sensitive area, Indian Creek will be part of the River's Edge project for the city. She hopes that the CAC will do its best to preserve if not better Indian Creek throughout the LTCP process. Indian Creek's headwaters are at Fermi Lab in Batavia, which means much of Indian Creek flows originate from Aurora. She did not want to revisit the vote from the previous meeting concerning the sensitive areas but wanted to remind everyone of the social value linked to Indian Creek.

STRAND ASSOCIATES, INC.® ENGINEERS

3. Green Infrastructure (John Lyons)

   a. John Lyons discussed the various components of green infrastructure.
   b. He also presented various previous projects that Strand Associates has been involved with concerning green infrastructure.

4. Lunch

5. Corrections or Clarifications to previous Meeting Minutes

   a. Linda Cole clarified her view on the sensitive area vote. She believes that CSO 2 and CSO 23 by definition are not sensitive areas. She had hoped they were sensitive based on personal values.

   b. The meeting minutes were approved unanimously pending the changes by a motion from Steve Stephens and second by Roscoe Green.

6. Stormwater Utility Formation Fundamentals (Bart Jones)

7. Next Meeting

   It was discussed to move the next meeting up an hour to 9 A.M. until 1 P.M. The next meeting is scheduled for 9 A.M. on June 10 at Fox Metro Water Reclamation District in Oswego, Illinois (682 State Route 31).

Prepared by Michael Ott and respectfully submitted to all CAC members in attendance.

Enclosures

c/enc: All CAC members on the roster

STRAND ASSOCIATES, INC.® ENGINEERS

Green Infrastructure

Presented by:
John Lyons, P.E.

Strand Associates, Inc.
May 13, 2009

Agenda

1. Background
2. Regulatory Perspective
3. Green Infrastructure Components
4. Case Studies
   a. National Summary
   b. American Can
   c. Louisville
   d. Sanitation District No. 1
5. Summary
6. Discussion

What is Green Infrastructure?

"It traditionally has been thought of as the interconnected network of waterways, wildlife habitats, and other natural areas that maintain natural ecological processes."

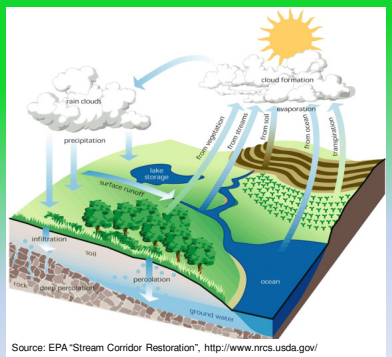
- Rooftops to Rivers

What is Green Infrastructure?

Green infrastructure techniques utilize natural systems, or engineered systems that mimic natural landscapes, to capture, cleanse and reduce stormwater runoff using plants, soils and microbes.

- U.S. EPA website

The Hydrologic Cycle

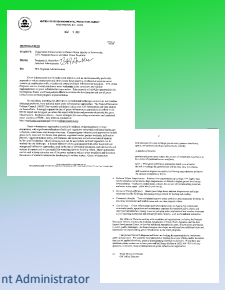


Source: EPA "Stream Corridor Restoration", http://www.nrcs.usda.gov/

Regulatory Perspective

U.S. Environmental Protection Agency

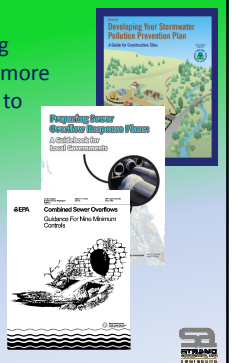
- **"Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions."**



– Ben Grumbles, Assistant Administrator
Memo to EPA Regional Administrators
March 5, 2007

Regulatory Perspective

- Green Infrastructure is now being considered as a tool to augment more traditional engineering solutions to address:
  - **combined sewer overflows**
  - **sanitary sewer overflows**
  - **stormwater discharges**
  - **other public infrastructure**



Regulatory Perspective

"Green infrastructure represents a new approach to stormwater management that is cost-effective, sustainable, and environmentally friendly."

– U.S. EPA



What is Green Infrastructure?

- *Regional Scale:*
  - **On the regional scale, green infrastructure consists of the interconnected network of open spaces and natural areas (such as forested areas, floodplains and wetlands) that improve water quality while providing recreational opportunities and wildlife habitat.**

- U.S.EPA

What is Green Infrastructure?

- *Local Scale:*
  - **On the local scale, green infrastructure consists of site-specific management practices (such as rain gardens, porous pavements, and green roofs) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls.**

- U.S. EPA

Green Infrastructure

- Example Components
  - Vegetated Roof
  - Trees
  - Rain Gardens
  - Vegetated Swales
  - Pocket Wetlands
  - Stormwater Pond
  - Infiltration Planters
  - Vegetated Filter Strips
  - Reforestation
  - Riparian Buffers
  - Porous Pavements
  - Dry Swale

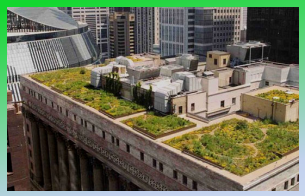
Vegetated Roofs



Dearborn, MI



New York City



Chicago City Hall

Green Streets



Portland, OR





Vancouver, BC

Green Streets





Green Highways



Wisconsin

Green Parking Lots





Fort Wright, KY

Green Parking Lots





Fort Wright, KY

Green Parking Lots





Fort Wright, KY

Rainwater Harvesting



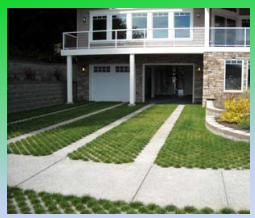


Fort Wright, KY

Residential Applications

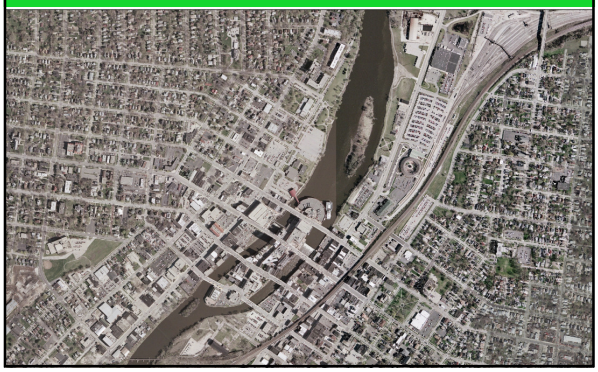


Downspout disconnection



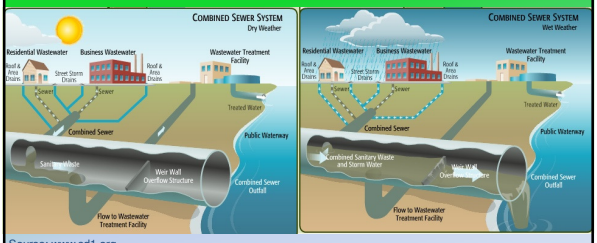
Grass pavers in driveway

How Can Green Infrastructure Be Used To Address CSOs?



Infrastructure Overview

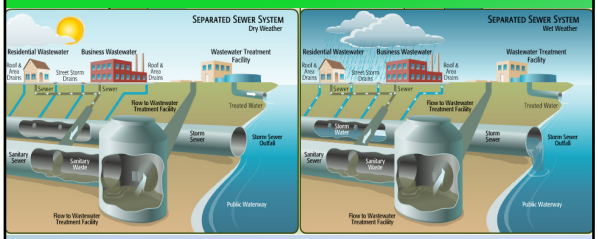
Combined Sewer Overflow



Source: www.sd1.org

Infrastructure Overview

Sanitary Sewer Overflow

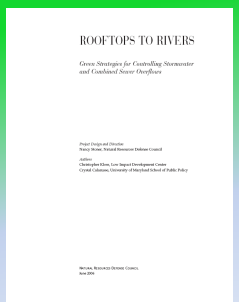


Source: www.sd1.org

Green Infrastructure Case Studies

"Reducing runoff with green infrastructure decreases the amount of pollution introduced into waterways and relieves the strain on stormwater and wastewater infrastructure."

- Rooftops to Rivers, Natural Resources Defense Council, June 2006



ROOFTOPS TO RIVERS

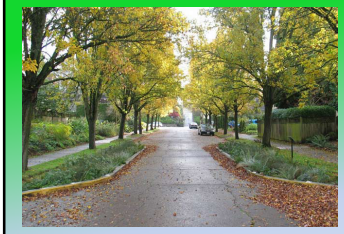
Green Strategies for Controlling Stormwater and Combined Sewer Overflows

Green Infrastructure Case Studies

	Chicago	Kansas City	Milwaukee	Pittsburgh	Portland	Seattle	Washington, D.C.
Green Roofs	☑		☑	☑	☑	☑	☑
Downspout Disconnect	☑	☑	☑	☑	☑	☑	☑
Rain Gardens and Swales	☑	☑	☑	☑	☑	☑	☑
Rain Barrel Program	☑	☑	☑	☑	☑	☑	☑
Green Streets	☑		☑	☑	☑	☑	☑
Permeable Pavement	☑		☑	☑			☑
Wetlands	☑		☑	☑			
Park Restoration		☑	☑	☑		☑	☑

Source: Rooftop to Rivers

Retrofit Opportunities





Retrofit Opportunities



Retrofit Opportunities



Retrofit Opportunities



American Can

Green Infrastructure Project









Green BMP Premium Costs

- Green roofs $320,000
- Pervious concrete $180,000
- Porous pavers $0.0
- Grass pavers $65,000
- Porous asphalt $15,000
- Biofiltration beds $40,000

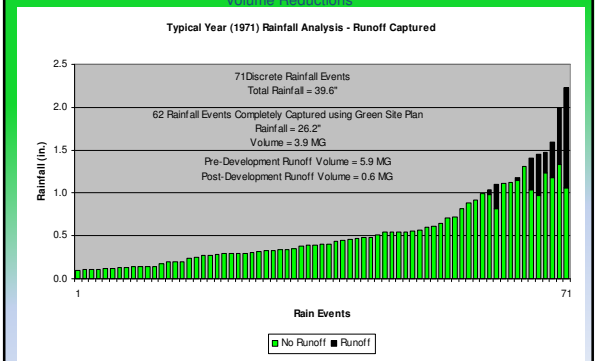
Total = $620,000

- Less traditional
  - underground storage $81,000
  - curb reduction $41,000
  - pipes/inlets $20,000
  - sewer separation $50,000

Green Premium (approximately) $428,000

Stormwater Runoff Analysis

Volume Reductions



American Can Cost Analysis

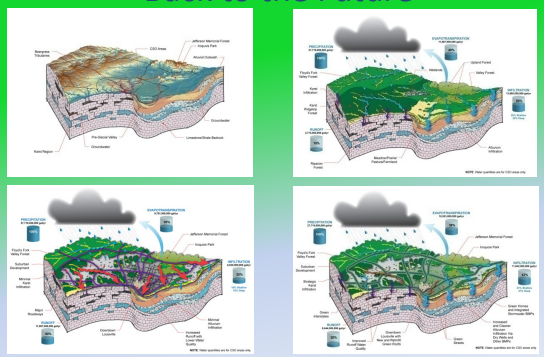
- Assume LTCP level of control = 2 overflows/year
- Consider the 3rd largest storm event in the typical year (1971) = 1.59"
- Existing runoff during this event = 236,000 gallons
- Post dev. runoff during this event = 61,000 gallons
- Size of gray solution reduced by 175,000 gallons
- Assume conventional storage @ $5/gallon

- **MSD savings = $875,000**
- **CSO reduction achieved at 50% of conventional costs**

Louisville: The Green City



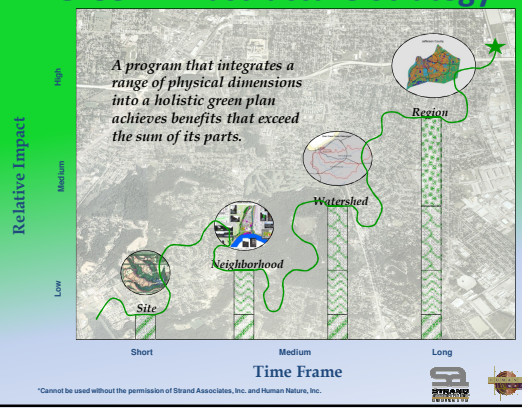
Green Infrastructure Vision
Back to the Future



Green Program Objectives

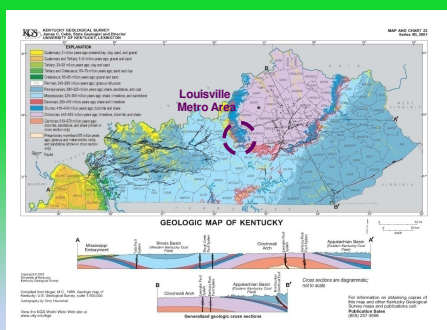
- **Augment traditional "gray" engineering solutions**
  - Comprehensive CSS evaluation drives site specific solutions
  - Focus on quantity (i.e reduce runoff)
- **Assist in achieving regulatory compliance**
  - Consent Decree
- **Cost effective**
  - Green commitments based on a "business case"
- **Provide supplemental benefits**
  - Habitat, air quality, urban beautification
  - Public amenities (i.e community connectivity)
  - Builds upon the current planning and priority initiatives

Green Infrastructure Strategy



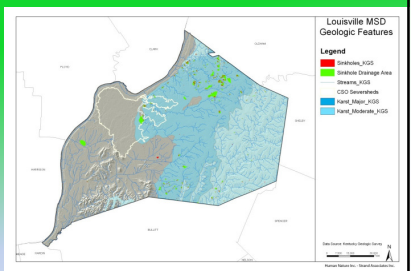
*Cannot be used without the permission of Strand Associates, Inc. and Human Nature, Inc.

State Geology



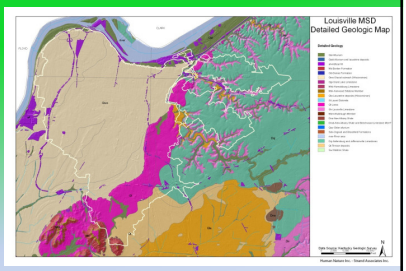
Metro/County Karst Geology

Karst geology in eastern sections of Metro Area contains limestone bedrock with sinkholes that may be considered for infiltration with supplemental biofiltration strategies included

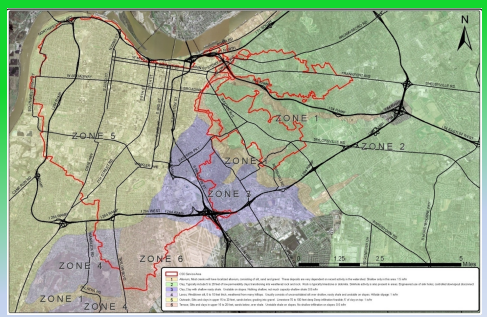


CSO Area Geology

Most of the CSO Area is bottomland alluvium, which is permeable and conducive to infiltration strategies in the west and central

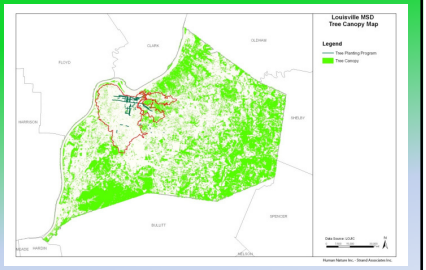


Metro/County Geology and Soils



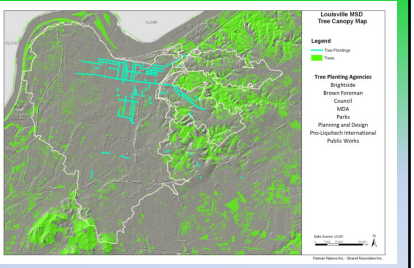
Metro/County Canopy Coverage

Approximately 40% of the Metro area is covered by tree canopy



CSO Area Canopy Coverage

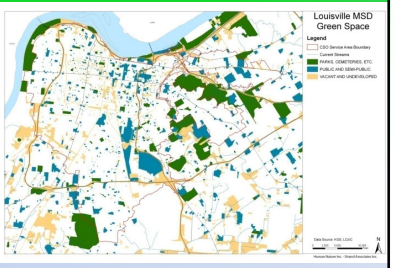
Approximately 11% of the CSO area is covered by tree canopy - including street trees



CSO Area Greenspace

Approximately 12% of the CSO area is public or semi-public green space (parks, schools, cemeteries, etc.)

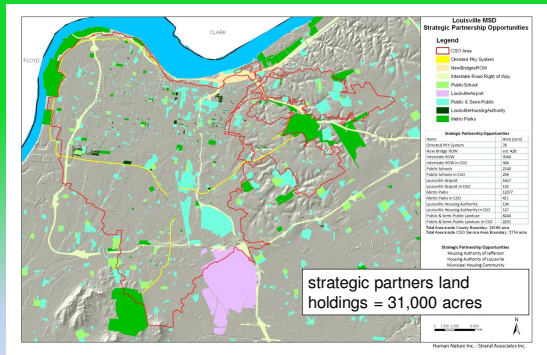
These stakeholders represent excellent opportunities for green infrastructure partners



Foster Strategic Partnerships

- Kentucky Transportation Cabinet
- Metro Government Leadership
- Metro Parks
- Public Works
- University of Louisville
- Jefferson County Public Schools
- Louisville Housing Authority
- Environmental Non-Profits
- Neighborhood Groups

Strategic Partners



Strategic Partnerships

METRO PUBLIC WORKS



Strategic Partnerships

JEFFERSON COUNTY PUBLIC SCHOOLS



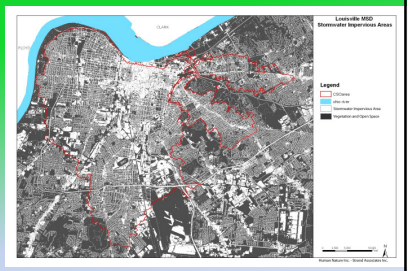
79 out of 91 rainfall events completely captured

78.5% reduction in post-development runoff

Impervious Area in CSS

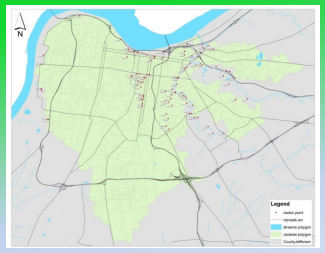
54% of the CSS area is comprised of impervious surfaces.

- Roads – 27%
- Single Family – 27%
- Industrial – 16%
- Commercial – 13%

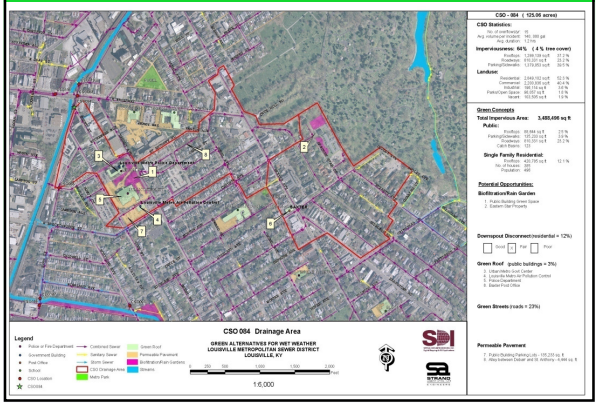


CSO Sewershed Evaluations

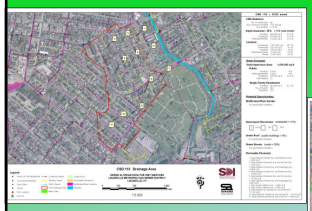
- Impervious area distribution
- Land use distribution
- Public green space
- Alleys and ROW
- Public parking lots and buildings
- Number of catch basins
- Residential properties



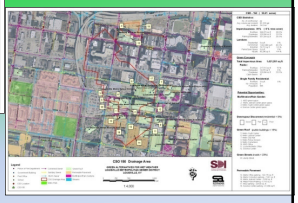
Sewershed Evaluations



Site Specific Strategies



95 % of Land Use = Com/Ind
- Impervious Area
  - Rooftops 39%
  - Parking Lots 39%

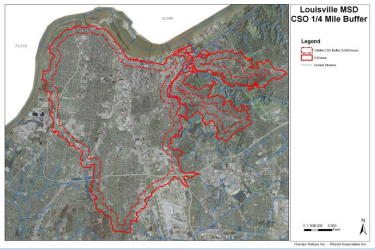


91% of Land Use = Residential
- Rooftops are 41% of the Impervious Area

Green Infrastructure and Natural Systems

CSO PERIMETER OFF-LOADING
¼ mile inside the perimeter of the CSS is approximately 8,000 acres

- The potential to separate and offload stormwater into natural systems exist
- A 25% target would represent 20 million gallons of stormwater removed from the CSO area.



Canopy Coverage

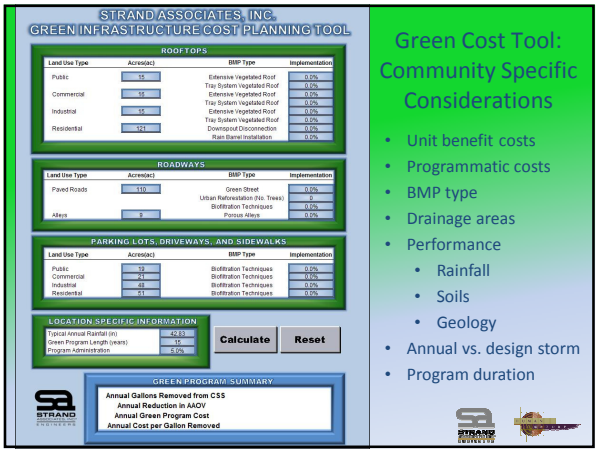
Recommended Tree Canopy Coverage and Benefits

CSO Area: Increase Tree Canopy by 15% leads to;

Additional Stormwater Reduction of 7,166,019 cubic feet (or over 53 million gallons)

As well as;

Carbon Stored 196,364 tons
Carbon Sequestered annually 1,528 tons per year
Air pollution removal 463,724 lbs removed per year



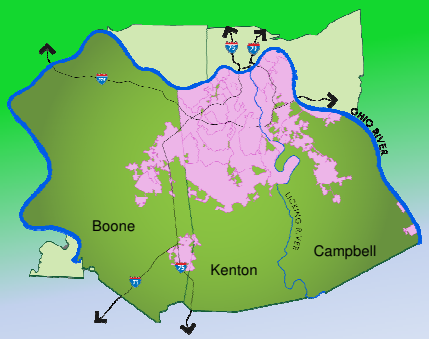
Green Cost Tool: Community Specific Considerations

- Unit benefit costs
- Programmatic costs
- BMP type
- Drainage areas
- Performance
  - Rainfall
  - Soils
  - Geology
- Annual vs. design storm
- Program duration

Green Infrastructure Program Generates Public Support for SD1

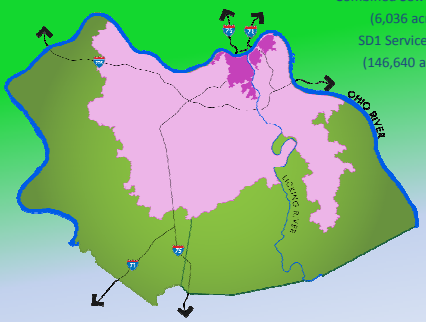
Context

3-county Region
(Population: 354,166)
36 cities



Context

Combined Sewer System
(6,036 acres)
SD1 Service Area
(146,640 acres)



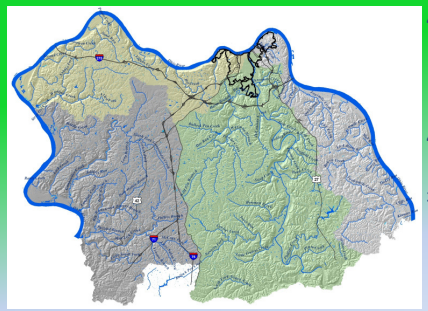
Primary Challenges

- Combined Sewer Overflows (CSOs)
  2 billion gallons annually
- Sanitary Sewer Overflows (SSOs)
  80 million gallons annually
- Stormwater Runoff (NSP+MS4)
  70 billion gallons annually
- Hydromodification
  209 miles of sewer infrastructure adjacent to rivers and streams

Vision + Goals

- **"Preserve, Enhance and Restore our region's natural systems to improve the water quality, public health and quality of life in Northern Kentucky. Increase infiltration and evapotranspiration, and reduce stormwater runoff to restore the appropriate water balance."**
- **Goals**
  - Reduce the volume of combined sewer overflows (CSOs)
  - Improve the quality of stormwater runoff entering the region's streams and rivers
  - Reduce stream erosion problems resulting from growth

Natural Systems: Hydrologic Network

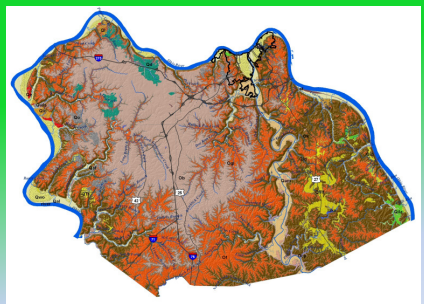


4 major basins
North Basin
East Basin
Central Basin
West Basin

460 miles of major streams

3,410 acres of lakes

Natural Systems: Geology

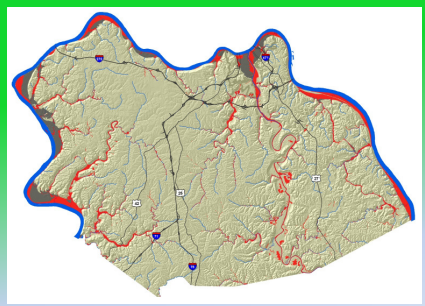


Limited opportunities for infiltration

Unstable geologic layer along steep hillsides
(Kope formation)

Buried ancestral river basins

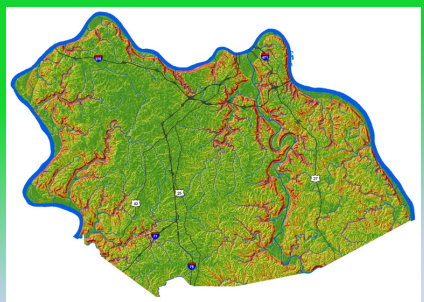
Natural Systems: Geology



Alluvium Deposits

Glacial Outwash

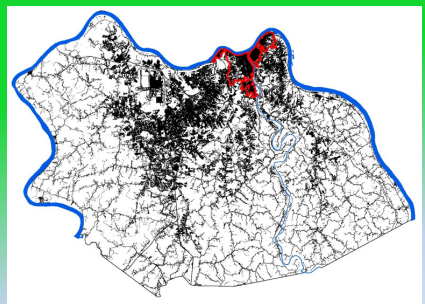
Natural Systems: Steep Slopes



36,975 acres with slopes over 20%

10% of land area

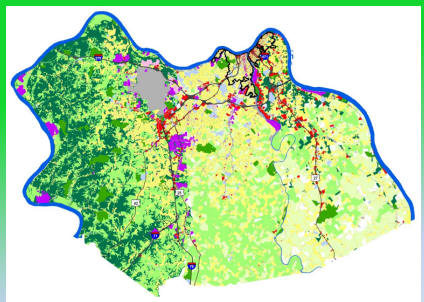
Built Systems: Imperviousness



23,850 acres of impervious surfaces

7% of land area

Built Systems: Existing Land Use



28% Agricultural

24% Residential

19% Woodlands

15% Undeveloped

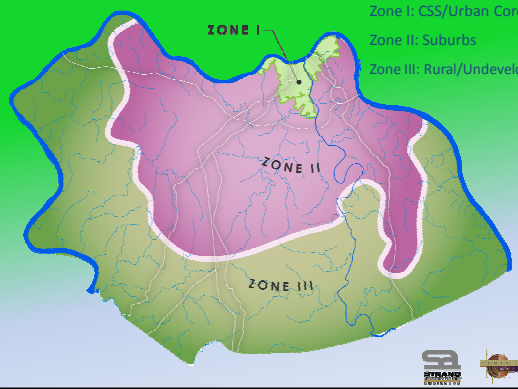
5% Transportation (includes airport)

2% Industrial

2% Commercial

5% Other

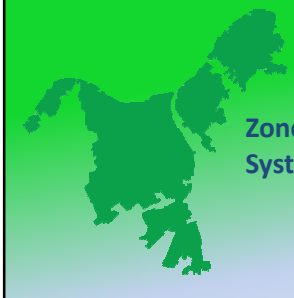
Strategic Framework



Zone I: CSS/Urban Core

Zone II: Suburbs

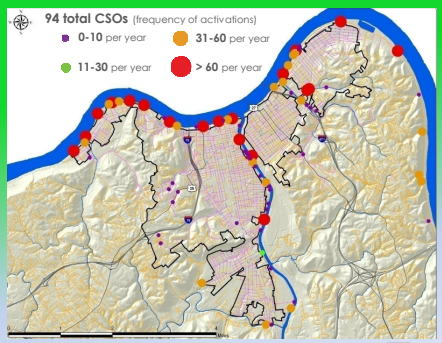
Zone III: Rural/Undeveloped



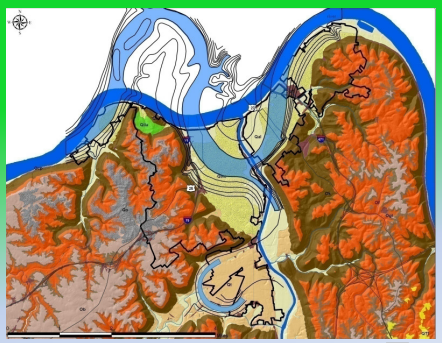
Zone I: Combined Sewer System

- GIS Inventory
- Challenges
- Green Solutions

Combined Sewer Overflows

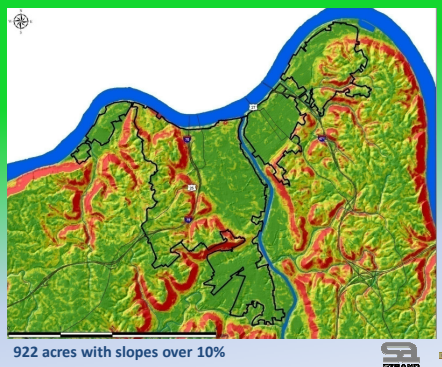


Natural Systems: Geology



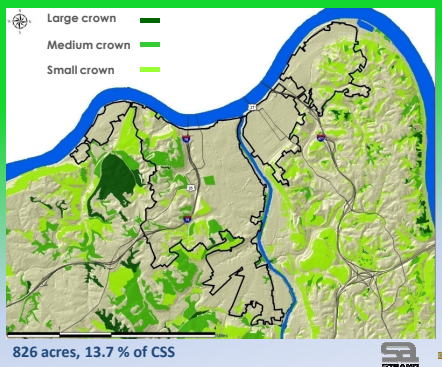
Deposits of glacial outwash and alluvium from ancestral river beds

Natural Systems: Steep Slopes



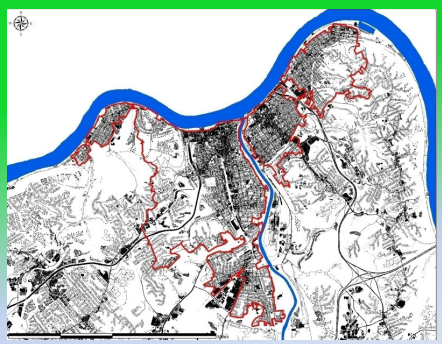
922 acres with slopes over 10%

Natural Systems: Tree Canopy Cover



826 acres, 13.7 % of CSS

Built Systems: Imperviousness



2,155 acres of impervious surfaces
36% of CSS land area

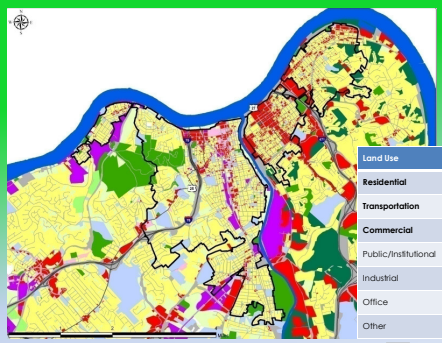
Impervious Surface Characteristics

Surface Type	Impervious Area (acres)	Percent of Impervious Area
Rooftops	1,010	46%
Roadways	758	36%
Parking, driveways and sidewalks	390	18%

Impervious surface by land use type evaluation

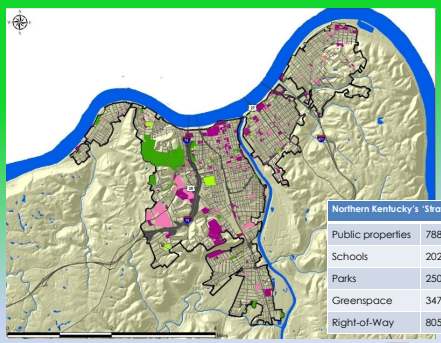
Land Use Classification	Impervious Area (acres)	Percent of Impervious Area
Residential	44%	24%
Public property (including roadways)	24%	69%
Commercial	18%	48%
Right-of-way (excluding pavement)	12%	0%
Industrial	1%	65%
Unknown	1%	99%

Built Systems: Land Use



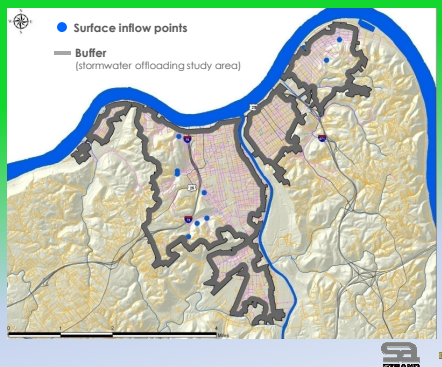
Land Use	Percentage
Residential	49.4%
Transportation	19.1%
Commercial	9.5%
Public/Institutional	6.5%
Industrial	2.2%
Office	1.3%
Other	11.9%

Built Systems: Strategic Land Uses



Northern Kentucky's Strategic Land Uses	
Public properties	788 acres
Schools	202 acres
Parks	250 acres
Greenspace	347 acres
Right-of-Way	805 acres

Stormwater Offloading/Separation



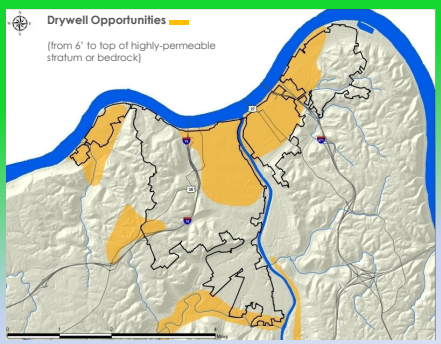
Stormwater Offloading/Separation



Stormwater Offloading/Separation



CSS : Green Infrastructure Solutions



CSS : Green Infrastructure Solutions

Reforestation

- Reforest physically-restricted development areas ('Hillside Greenbelt')
- Reforest road right-of-way
- Promote street trees in the urban core
- Reforest with "Strategic Partners"
- Use adaptive reforestation techniques
  (*e.g.*, terraced reforestation, bio-log enhancement of steep slopes)

14% Existing Canopy Cover: **Combined Sewer System**

15% Recommended Canopy Cover: **Central Business District**

25% Recommended Canopy Cover: **Urban Residential**

CSS : Green Infrastructure Solutions

Benefits from existing tree canopy

172 million
gallons of annual storage volume
(based on design storm)

$344 million
in annual stormwater benefits
(based on $2.00 / gallon)

Potential benefits of reforestation (1,430 acres)

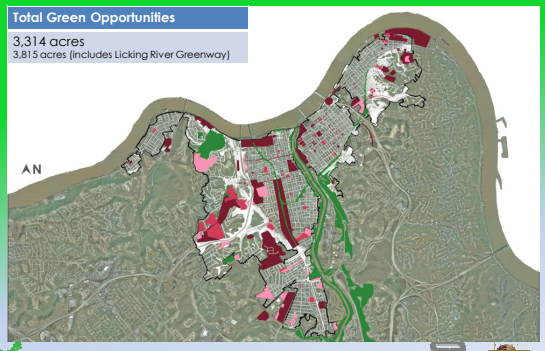
410 million
gallons of annual storage volume

$820 million
in total stormwater benefits
(based on $2.00 / gallon)

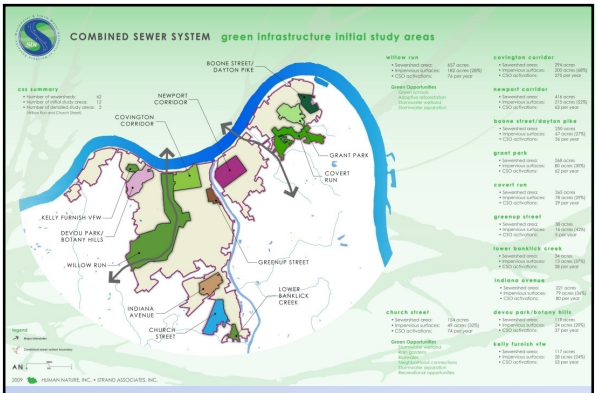
* Values based on CITYgreen analysis of existing and proposed land cover; annual benefits may not fully consider seasonal variations

CSS : Green Infrastructure Solutions

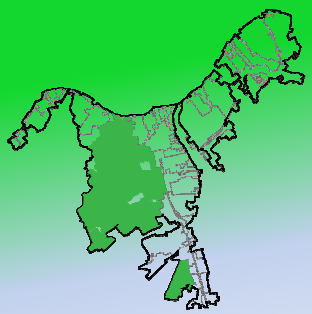
Total Green Opportunities
3,314 acres
3,815 acres (includes Licking River Greenway)



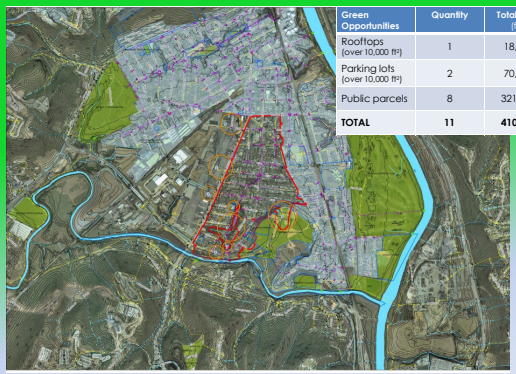
COMBINED SEWER SYSTEM green infrastructure initial study areas



CSS : Green Infrastructure Solutions prove cost-effective



- 3 basins studied



Green Opportunities	Quantity	Total Area (ft²)
Rooftops (over 10,000 ft²)	1	18,400
Parking lots (over 10,000 ft²)	2	70,300
Public parcels	8	321,900
TOTAL	**11**	**410,600**

Church Street Study Area

COMBINED SEWER SYSTEM church street study area



Estimated Benefits

Potential volume reduction of 1.5 million gallons
(1.23" storm event)

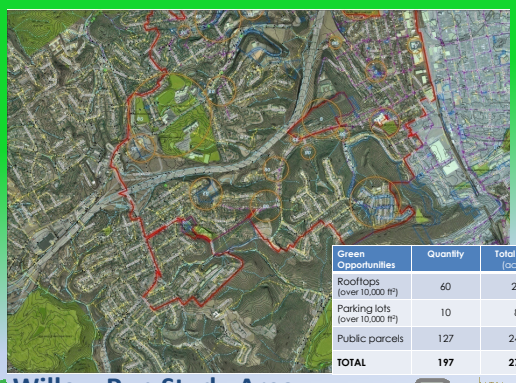
Adds over 2 miles of trails

Estimated Cost

$14 million
($6 million less than gray solution)



Willow Run Study Area



Green Opportunities	Quantity	Total Area (acres)
Rooftops (over 10,000 ft²)	60	28
Parking lots (over 10,000 ft²)	10	8
Public parcels	127	241
TOTAL	197	277

Willow Run Study Area

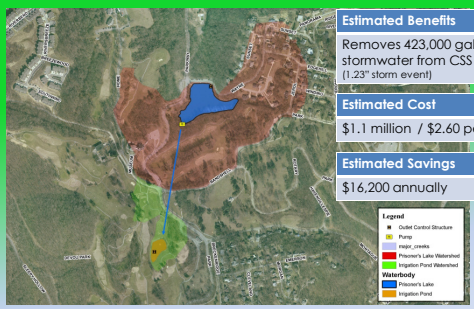
COMBINED SEWER SYSTEM willow run study area



COMBINED SEWER SYSTEM kentucky's 'green gateway' at goebel park



Prisoners Lake



Estimated Benefits

Removes 423,000 gallons of stormwater from CSS
(1.23" storm event)

Estimated Cost

$1.1 million / $2.60 per gallon

Estimated Savings

$16,200 annually

KYTC Basin Green Retrofit



Estimated Benefits

Removes 750,000 gallons of stormwater from CSS
(current annual flow = 25 MG)

Estimated Cost

$2.2 million / < $3 per gallon

St. Elizabeth Hospital Rain Garden



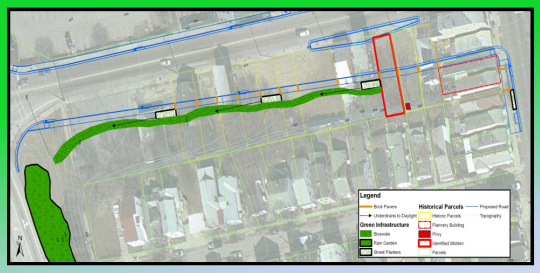
Estimated Benefits

Removes 115,000 gallons of stormwater from CSS
(in design storm)

Estimated Cost

$211,000 / $1.80 per gallon

12th Street Interpretive Park



Estimated Benefits

Removes 150,000 gallons of stormwater from CSS
(in design storm)

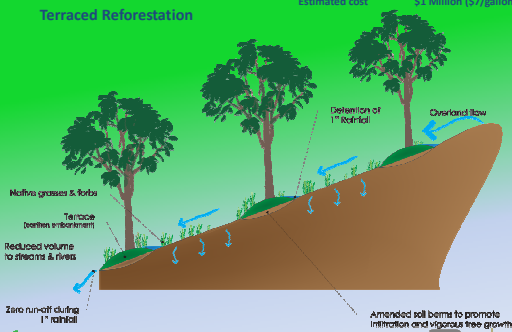
Estimated Cost

< $4 per gallon

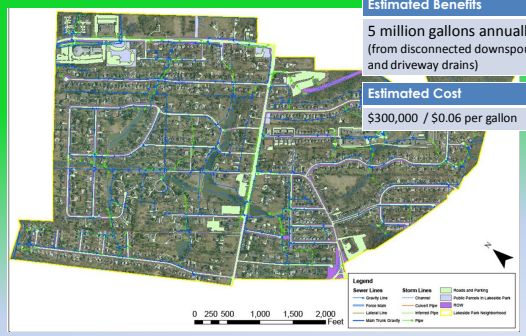
I-75 Reforestation

Drainage area	20 acres
Volume reduction	50,000 gallons (design storm)
Estimated cost	$1 Million ($7/gallon)

Terraced Reforestation



Lakeside Park



Estimated Benefits

5 million gallons annually
(from disconnected downspouts and driveway drains)

Estimated Cost

$300,000 / $0.06 per gallon

Green infrastructure program generates public support for SD1

Prisoner's Lake

- Removes 400,000 gallons from CSS in 3 month storm @ $3/gallon
- Reduces tax payer costs to irrigate golf course ($34,000 in 2008)

12th Street

- < $4/gallon to remove stormwater from CSS

Church Street

- Integrated gray/green solution saves SD1 $6M.
- Provides community amenities (walking trails), removes nuisance

Green infrastructure program generates public support for SD1

Lakeside Park

Removes 5 MG/year from private sources

Estimated cost for PSRP program = $0.06/gallon

KTC Basin Retrofit

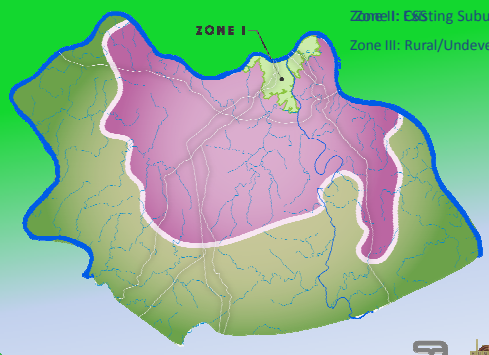
750,000 gallons of SW removed in 3 month design storm

Estimated cost = $2,200,000 (equivalent gray storage = $4,500,000)

I-75 Reforestation

$7/gallon

Strategic Framework



Zone II: Existing Suburbs

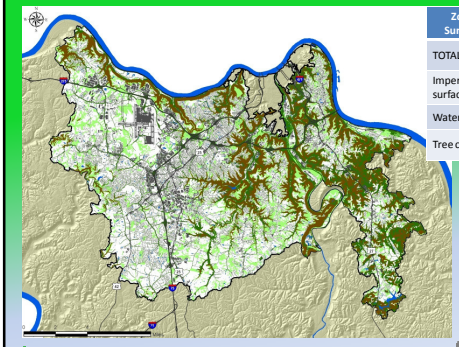
Zone III: Rural/Undeveloped



Zone II: Suburbs
Zone III: Future Growth

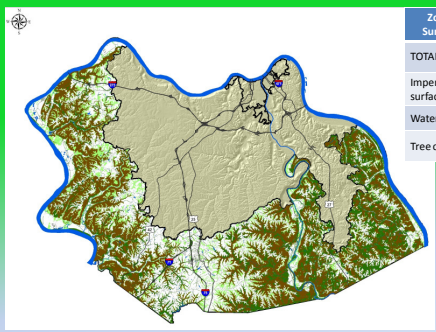
- Challenges
- Green Solutions

Zone II: Existing Suburbs



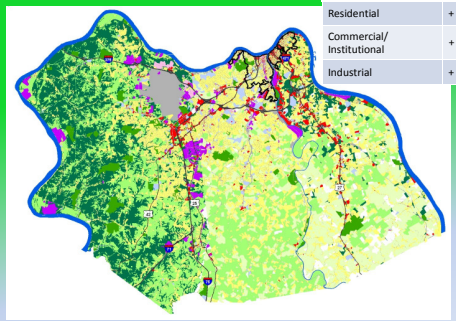
Zone II Summary	Area (percent)
TOTAL	146,640
Impervious surfaces	12%
Water	1%
Tree cover	30%

Zone III: Rural/Undeveloped



Zone III Summary	Area (percent)
TOTAL	214,513 acres
Impervious surfaces	2%
Water	5%
Tree cover	45%

Land Use



Future Land Use (2030)	Projected Increase in Impervious Surfaces
Residential	+ 1,347 acres
Commercial/ Institutional	+ 1,921 acres
Industrial	+ 2,276 acres

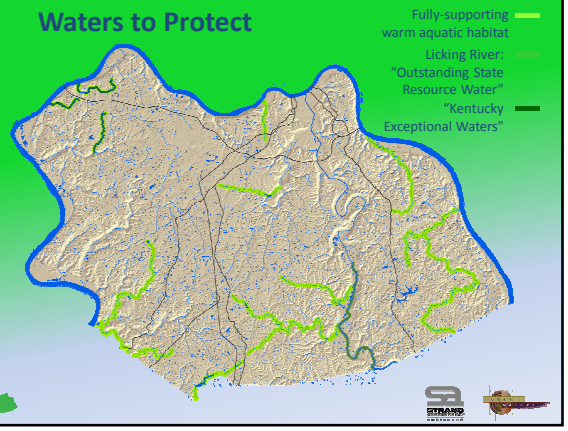
Zones II & III

- **Existing and Future Challenges**
  - Water Quality
    - Restore impaired streams
    - Conserve high-quality streams
  - Water Quantity
    - Flooding
    - Hydromodification (protection of sewer infrastructure)
  - Regulatory Issues
    - SSOs
    - Stormwater infrastructure
    - Inflow and infiltration (public and private sources)

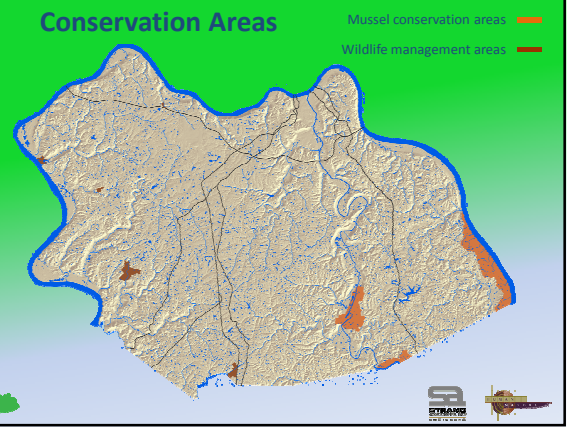
Zones II & III

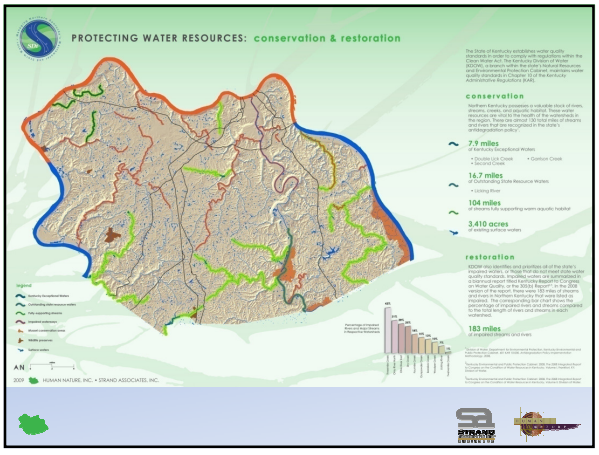
- **Green Infrastructure Goals**
  - Protect and restore water resources
    - Reduce pollutant loadings
    - Minimize hydromodification
    - Increase baseflows in streams
    - Establish and enhance stream buffers
  - Protect, enhance and connect forests
  - Promote transportation corridors as greenway connections
  - Facilitate regional planning and Smart Growth

Waters to Protect



Conservation Areas

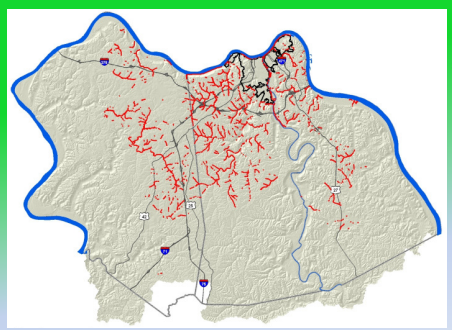




Protect and Restore Water Resources

- **Minimize Hydromodification Impacts**
  - Protect sewer and other public infrastructure adjacent to waterways
  - Enhance dry detention ponds (*i.e.*, increase infiltration, retain small storms, extend base flow in streams, enhance ecological benefits)
  - Enhance wet ponds and lakes (*i.e.*, vegetated filters, fore bays, extended drawdown, extend base flow in streams)
  - Regional detention

Infrastructure adjacent to streams

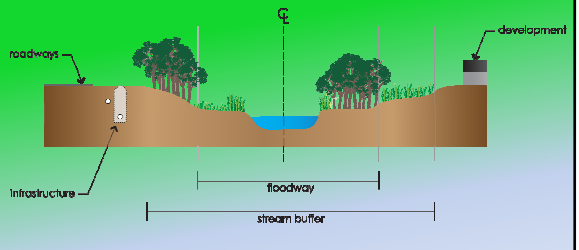


209 miles of sanitary infrastructure

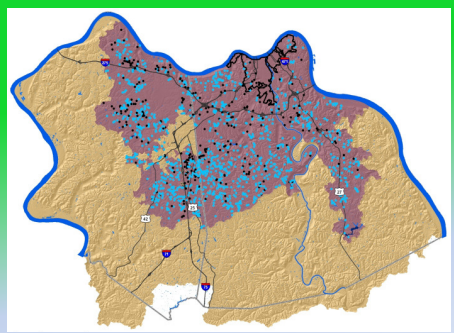




Recommended Stream Cross Section



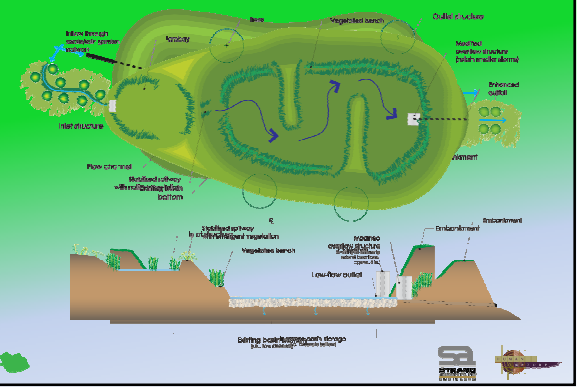
Existing detention/retention ponds



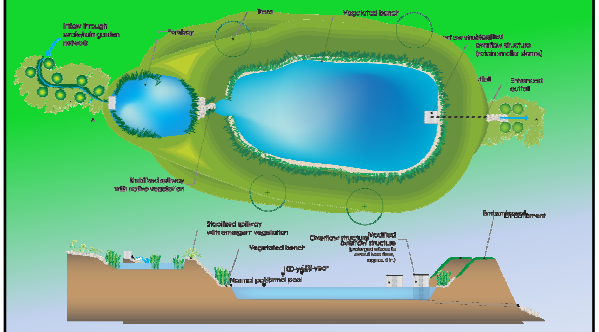
1,289 retention ponds

284 detention ponds

Retrofit existing detention (dry) ponds



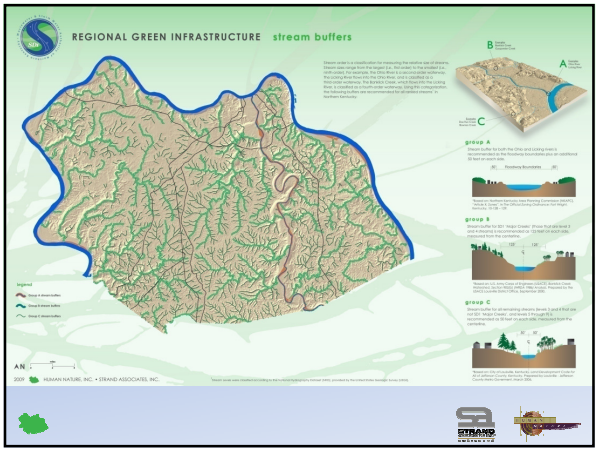
Retrofit existing retention (wet) ponds



Protect and Restore Water Resources

Stream Buffers

- Protect sewer and other public infrastructure adjacent to waterways
- Reduce sediment and erosion problems
- Improve water quality
- Increase infiltration
- Enhance ecological benefits
- Provide habitat



Reforestation Strategies

- Fill gaps in riparian forests
- Reforest road right-of-way
- Reforest steep hillsides ('Hillside Greenbelt')
  - Physically-restricted development areas
- Reforest with 'Strategic Partner' properties
  - Use adaptive reforestation techniques
  - Build on and expand existing community/urban reforestation programs

Enhance Riparian Forests

Benefits from existing tree canopy

579 million
gallons of storage volume
(based on design storm)

$154.7 million
in total stormwater benefits
(based on $2.00 / ft³)

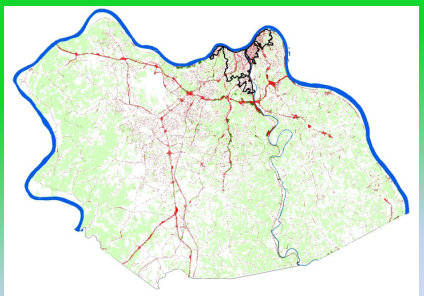
Potential benefits of reforestation (8,297 acres)

85.1 million
gallons of additional storage volume

$22.7 million
in total stormwater benefits
(based on $2.00 / ft³)

*Values based on CITYgreen analysis of land cover and 2-year, 24-hour rainfall of 2.75 inches

Reforest Right-of-Way



14,025 acres of right-of-way

84% without canopy cover

Reforest Right-of-Way

Benefits from existing tree canopy

66.8 million
gallons of storage volume
(based on design storm)

$17.9 million
in total stormwater benefits
(based on $2.00 / ft³)
@$2.00 / gallon = $133.6 million

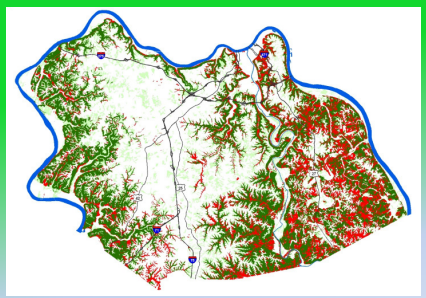
Potential benefits of reforestation (11,830 acres)

60.2 million
gallons of additional storage volume

$16.1 million
in total stormwater benefits
(based on $2.00 / ft³)
@$2.00 / gallon = $120.3 million

*Values based on CITYgreen analysis of land cover and 2-year, 24-hour rainfall of 2.75 inches

Reforest Steep Slopes



141,000 acres of landslide-prone areas

34% without canopy cover

Reforest Steep Slopes

Benefits from existing tree canopy

3.7 billion
gallons of storage volume
(based on design storm)

$994 million
in total stormwater benefits
(based on $2.00 / ft³)

Potential benefits of reforestation (48,404 acres)

398 million
gallons of additional storage volume

$106 million
in total stormwater benefits
(based on $2.00 / ft³)

*Values based on CITYgreen analysis of land cover and 2-year, 24-hour rainfall of 2.75 inches

Regional Reforestation

Benefits from existing tree canopy

18.2 billion
gallons of annual storage volume

$4.9 billion
in annual stormwater benefits
(based on $2.00 / ft³)

Potential benefits of reforestation (62,068 acres)

28.1 billion
gallons of annual storage volume

$7.5 billion
in annual stormwater benefits
(based on $2.00 / ft³)

* Values based on CITYgreen analysis of existing and proposed land cover; annual benefits may not fully consider seasonal variations

Low-Impact Development

– Reduce impacts of land use changes and future growth

- Low-Impact Development
  - Integrated on-street parking
  - Reduced right-of-way widths
  - Reduced pavement widths
  - Reduced parking space requirements
  - Enhanced detention ponds
  - Green streets
  - Porous pavements
  - Green roofs and disconnected downspouts
  - Conservation-based design principles

(*e.g.*, zoning and land use that protect and enhance natural systems)

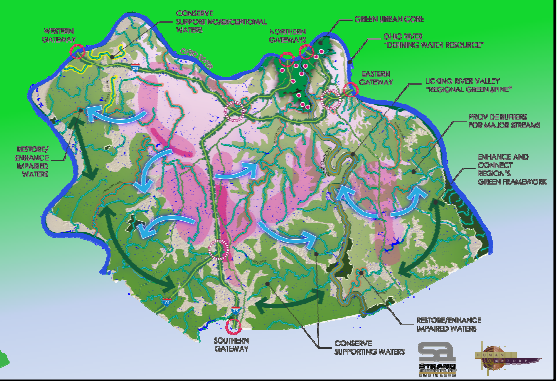
  - Connectivity of green components



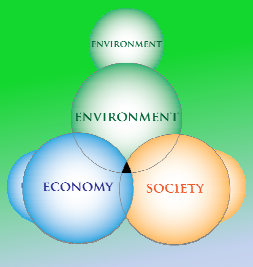
Seattle, WA



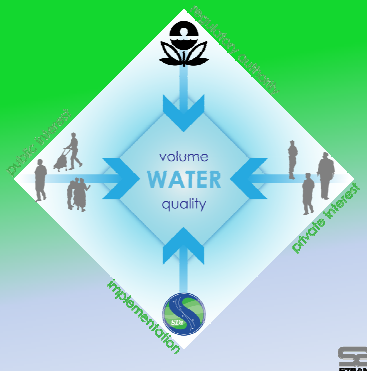
Regional Green Infrastructure



Triple Bottom Line



Implementation



Implementation

- Promote partnerships with public and institutional stakeholders
- Prioritize areas by highest benefit, public awareness and impact
- Promote understanding and education of water quality issues
- Green Grants Program (G2)



Implementation

- Identify green infrastructure strategies within focus areas
  - Leverage with other planned projects
- Pilot Demonstration Projects (implement, monitor, adjust)
  - Drywells
  - Retrofitting existing infrastructure
  - Natural systems enhancement
- Further evaluation of green opportunities
  - Zone I (CSS)
  - Zone II



Green Infrastructure Approaches

- Programs are site specific and must acknowledge:
  - Physical and Technical Limitations
  - Financial Constraints
  - Regulatory Issues
  - Political and Social Issues
  - Community Values

The Green Challenge…

- Site Specific
  - Soils, topography, rainfall, land use
- Project Scale
  - Regional, watershed, neighborhood, site
- Broad Range of Stakeholders
  - Public and private
  - Federal, State, County, Local
- Program Objectives
  - Green space, SW, CSO, SSO, Connectivity

Green in CSO control

- Augment traditional engineering solutions
  - site specific
  - throughout the watershed
  - quantity or quality
- Assist in achieving regulatory compliance
- Cost effective
  - cost sharing and grant opportunities
- Provide supplemental benefits
  - habitat
  - community connectivity
  - public amenities

Discussion

An Overview of Stormwater Utility Creation

"Why these things are tricky"

presented by

Barton G. Jones, P.E.
Strand Associates, Inc.

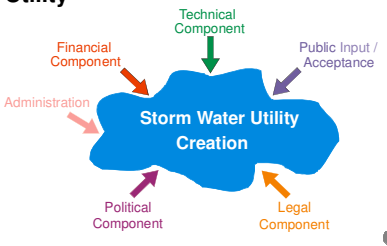
Stormwater Utilities Help Prevent the "HYDRO-ILLOGIC CYCLE"



"There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things."

Niccolo Machiavelli

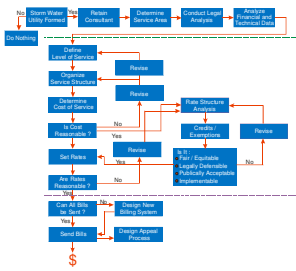
Forces Acting Upon A Stormwater Utility



Stormwater Utility Task Force

- Engineers
- Administrators/Finance
- Politicians
- Public
- Regulators
- Print/Electronic Media

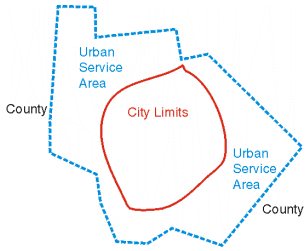
Stormwater Utility Creation Logic Diagram



Strategic Issues

- Definition of Service Area
- Statutory Organizational Options

What is the Appropriate Service Area?



Statutory Organizational Options

- Create New City Department
- Add New Division into Existing City Department
- Create MSD with Stormwater Authority
- Create New Stormwater Utility for Defined Service Area
- Create Water Conservation District
- Others

Institutional Organization Analysis

Criteria	Option 1	Option 2	Option 3	Option 4
Enabling Procedure				
Governance Structure and Supervision ● Number ● Terms ● Appointing Authority				
Funding Alternatives ● Rates/Fees ● Bonds ● Taxes				
Service Area				
Scope of Services				
Relationship to City Organization ● Autonomous ● Semi-autonomous ● Fully Integrated				
Flexibility to Change w/ Future Conditions				
Adequate Authority ● Administration ● Engineering & Planning ● Reg. & Enforcement ● Operations & Maint.				

For each of the Macro elements, the following Functional Activities should be applied:

Administration/Fiscal
Regulation & Enforcement
Engineering and Planning
Operation and Maintenance
Capital Improvement Projects

Quantity Element	Quality Element
Localized Stormwater Flooding	Federal/State Stormwater Quality Program CWA Section 402 (p)
Stormwater Conveyance Infrastructure	

Determine Viable Revenue Source(s)



- Revenue Sufficient
- Fair and Equitable
- Legally and Technically Defensible
- Publicly Acceptable
- Able to Implement

Conduct an Alternative Funding Analysis

- Property Taxes (City/County General Fund)
- Stormwater Service Charge (User Fee)
- Sewer Surcharge
- Water Surcharge
- Revenue Bonds
- General Obligation Bonds
- Impact Fees

Alternative Funding Analysis Continued

- In Lieu of Construction Fees
- Plan Review and Inspection Fees for New Development
- Special Inspection Fees
- Federal and State Funding

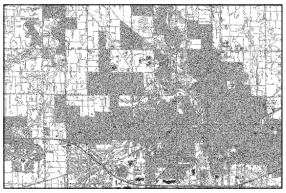
Analyze Existing Financial and Technical Data

- Adequacy
- Currency
- Maintenance

Analyze Existing Financial and Technical Data

- Property Ownership Records
- Tax Information
- Utility Billing Information and Capacity
- GIS/MIS Interfaces
- Aerial Photography
- Existing Budget Construction

Stormwater Master Planning Identifies:



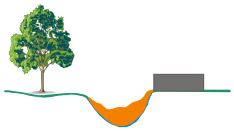
- Capital Improvement Projects/Costs
- Priorities

Institutional Source Controls



- No Littering Ordinance
- "Pooper Scooper" Ordinance
- Chemical Use Ordinance
- Recycling Programs
- Public Education Program
- Vacant Lot Cleanup Program
- Spill Prevention Ordinance and Programs

Non-Structural Source Controls



- Prevent Illicit Discharges
- Increased Street and Sidewalk Sweeping
- Clean Storm Drains
- Maintain Ponds, Detention Facilities, Channels, etc.

Pesticides, Herbicides, and Fertilizer Controls



- Ordinances
- Programs
- Permits
- Certifications
- Education
- Inspections

Construction Site Controls



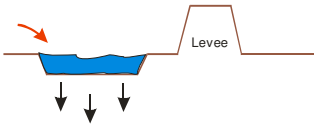
- Permits
- Waste Management Controls
- Inspection
- Education
- Straw Bales/Silt Fences
- Dust Control
- Pond
- Land Grading Controls
- Temporary Gravel Entrances
- Seeding/Mulching

Minor Structural Controls



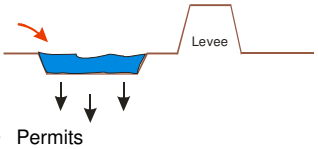
- Diversion Channel
- Grass Swales
- Improve Natural Channels to Reduce Erosion
- Plant Vegetation on Exposed Soils

Flood Plain Management and Planning



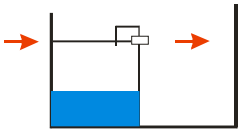
- FEMA Flood Insurance Program
- Flood Protection System
- Flood Fighting

Flood Plain Management and Planning



- Permits
- Existing Detention/Retention Retrofitting
- Existing Wetland Retrofitting
- Recharge Areas
- Porous Pavements

Flotables and Oil Removal



- Parking Lot Oil/Grease Separators
- Parking Lot and Rooftop Runoff Storage

How Will the Stormwater Service Fees be Calculated?



Technical Issues

- How to Create a Bill and to Whom Should it be Sent?
- What Data is Accurate and Available Respecting Property Ownership?
- Will a Geographic Information System (GIS) be Instituted

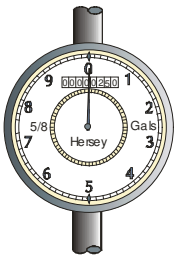
How to Create a Bill and to Whom Should it be Sent?

- What is residential and and non-residential property?
- Who is billed for a duplex, triplex, etc.?
- How are shopping malls/strip malls and office parks treated?
- Who is billed for apartments?
- How are high-rise condos treated?
- Will there be exemptions?
- Will there be credits; if so, how will they be calculated?

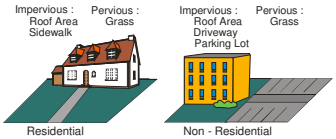
How to Create a Bill and to Whom Should it be Sent?

- How will public property be treated?
- Who pays for the water quality component?
- How will undeveloped property be treated?

Water and Sewer Service Fees Determined by Water Meter

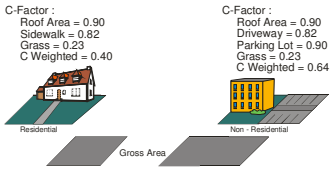


Generic Rate Methodology Impervious Area:



- Most Commonly Used
- High Degree of Technical Accuracy and Legal Defensibility
- Easily Understood by Public
- Does Not Charge Undeveloped Properties

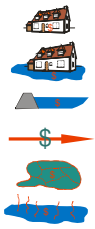
Generic Rate Methodology Gross Area and Intensity of Development:



- C-Factors are Subjectively Selected
- Technical Accuracy May Be Challenged
- More Difficult for Public to Understand
- Does Create a Charge for Undeveloped Properties

Generic Rate Methodology

Any Selected Rate Structure May Incorporate Modifying Factors



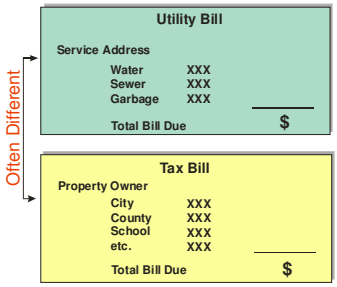
- Flat Rate Charges
- Floodplain Surcharges
- Credits
- Fixed Overhead Costs
- Drainage District Surcharges
- Water Quality Factors

Can a Stormwater Bill be Sent?

Is there a Collection Mechanism?

Stormwater Bill Appeal?

How to Create a Bill?



How Much Will it Cost to Create and Implement a Stormwater Utility?

Depends Upon:

- Internal Knowledge and Staff Resources
- Degree of Prior Stormwater Programs
- Institutional/Internal Organizational Structure
- Quantity of Current and Correct Data
- Size and Complexity of Service Area
- Degree of Public Knowledge and Support

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 5—Sign In Sheet

June 10, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Scott Stearns	SAI	608-251-4843	scott.stearns@strand.com
Michael Ott	SAI	815-744-4200	
Margaret Buell	SAI	608-251-4843	margaret.buell@strand.com
Ken Schroth	COA	630-844-3621	
ERIC SCHROW	COA	630-844-3620	
Brandon Wright	COA	630-301-7925	bwright@aurora-il.org
MANNY MAYSONET	COA	630-859-3977	Mmaysonet@aurora-il.org
BRUCE KLEINFELDT	AURORA CITIZEN	630 898-8308	
Ray C. Anderson	Citizen	630-892-4158	
BILL DONNELL	FVPD	630-897-0516	bdonnell@fvpd.org
LINDA A COLE	CITIZEN	630-897-8373	MCCIAC3739@AOL.COM
Fran Caffee	Sierra Club	630-859-1687	Fran.caffee@sierraclub.org
JAY PATEL	IEPA/BOS	847-294-4000	Jay.Patel@illinois.gov
Philippe MORENO	Deuchler	6308974651	pmoreau@deuchler.com
Timothy Hummer	Fox Metro	630 301 6809	thummer@foxmetro.dst.il.us
Sue Glavan	Fox Metro	630 301 6809	
AMY ROTH	COA	630.264.3049	aroth@aurora-il.org
Chuck Mebane	COA	630-844-3612	cmebane@aurora-il.org
WHITNEY PETERS	COA - WQS	844-3619	

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, Illinois
Meeting No. 5
June 10, 2009, 10 A.M.

Location: Fox Metro Water Reclamation District

Purpose: Citizen Advisory Committee (CAC) Meeting No. 5, discussing last summer's flow metering results, hydraulic modeling construction, and model calibration and validation.

Attendees:

Name	Representing
Tom Muth	Fox Metro Water Reclamation District
Tim Morrall	Fox Metro Water Reclamation District
Sue Glavan	Fox Metro Water Reclamation District
Randy Hummer	Fox Metro Water Reclamation District
Amy Roth	City of Aurora
Manny Maysonet	City of Aurora
Brandon Wright	City of Aurora
Eric Schoeny	City of Aurora Engineering
Ken Schroth	City of Aurora Public Works
Philippe Morau	Walter E. Deuchler and Associates
Bob Bauer	Walter E. Deuchler and Associates
Fran Caffee	Sierra Club
Jay Patel	Illinois Environmental Protection Agency
Steve Stephens	Stephens Commercial Real Estate
Bill Donnell	Fox Valley Park District
Linda A. Cole	Aurora Citizen
Ray Anderson	Aurora Citizen
Bruce Kleinfieldt	Aurora Citizen
Michael Ott	Strand Associates, Inc.
Margaret Guell	Strand Associates, Inc.
Scott Stearns	Strand Associates, Inc.

Discussion Items:

1. Introductions (Scott Stearns)

2. Fox Metro Water Reclamation District presentation (Tom Muth)

   a. Tom introduced Bob Bauer and Philippe Moreau from Walter E. Deuchler and Associates.

b. Tim Morrall gave a PowerPoint presentation highlighting the different buildings and processes of the wastewater treatment plant.

c. Sue Glavan showed a microscope projection of a sample from the activated sludge tank and explained the significance of the different organisms.

3. Fox Metro Water Reclamation District Wastewater Treatment plant tour (Tim Morrall)

4. Lunch

5. Metering, modeling, and water quality sampling results and discussion (Margaret Guell, Scott Stearns, and Michael Ott)

6. Meeting minutes approval (Scott Stearns)

a. Steve Stephens moved to approve last meeting's minutes.
b. Eric Schoeny seconded.

7. Next Meeting

Next meeting day and location are to be announced.

Prepared by Michael Ott and respectfully submitted to all CAC members in attendance.

c: All CAC members on the roster

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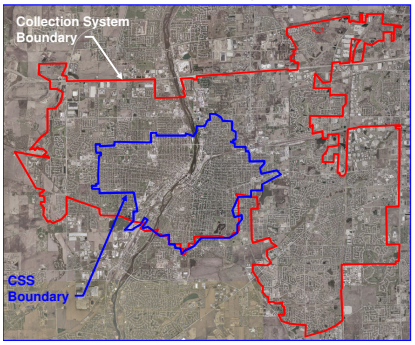
Metering, Modeling, and WQ Sampling in the City of Aurora's Combined Sewer System (CSS)

June 10, 2009

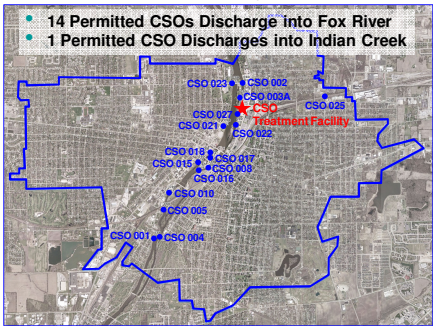


City of Aurora, Illinois

City of Aurora Wastewater Conveyance System



City of Aurora Combined Sewer System (CSS)

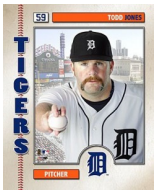


What is a Model?

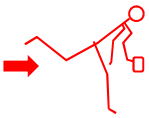
- A model is a simple representation of a complex system used to predict how that system would behave.

What is a Model?

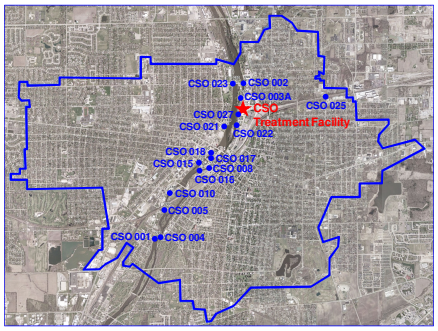
- A model is a simple representation of a complex system used to predict how that system would behave.



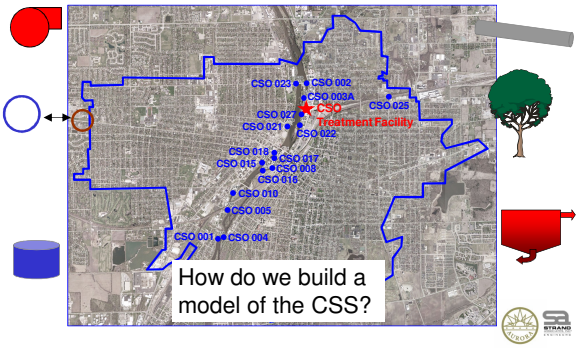




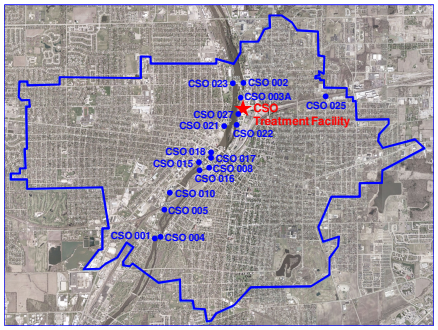
Why do we need a model of the CSS?



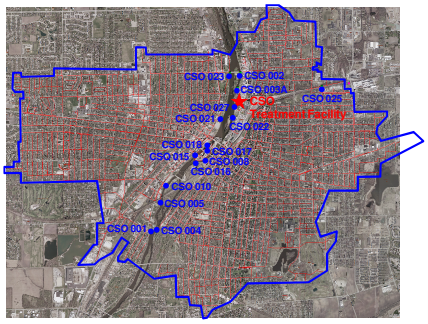
We have to construct improvements and a computer model helps us size them.



Step 1: Take stock of what you have



Step 1: Take Stock of What We Have



Step 2: Then Simplify It…

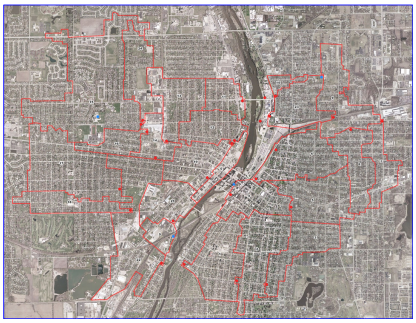


- Create a skeleton of the system
  - Model pipe sizes >= 18 inches
  - Eliminates significant percentage of pipes
- Break the system into manageable parts
  - Basins and subbasins
- "Cluster" Stormwater and Sanitary Inputs

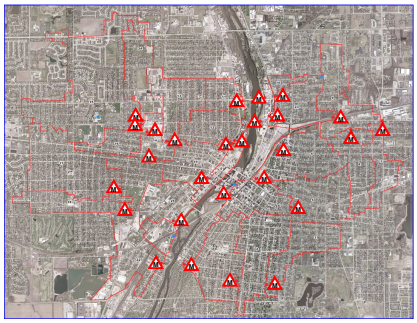
Simplifying the System…



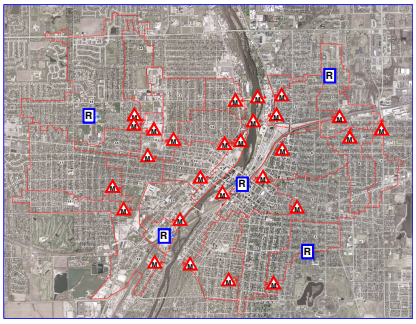
Breaking the System into Basins



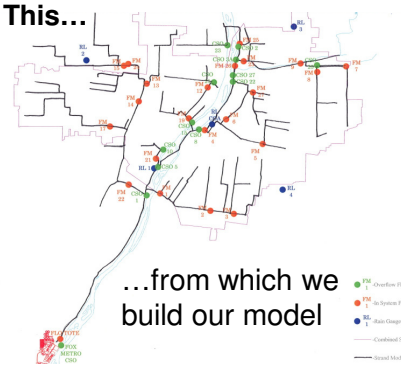
Put a Flow Meter on the Downstream End of Each Basin



Locate Gauges to Measure Rain

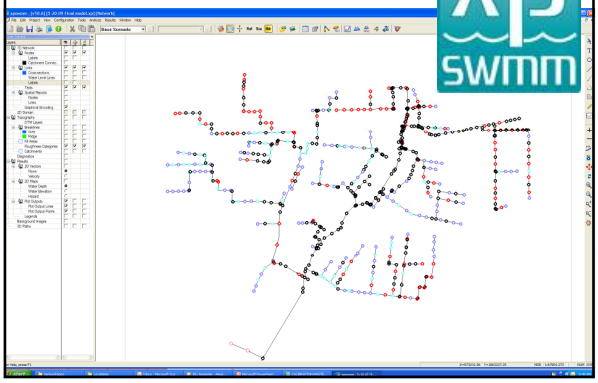


After Simplifying, We End Up With This…

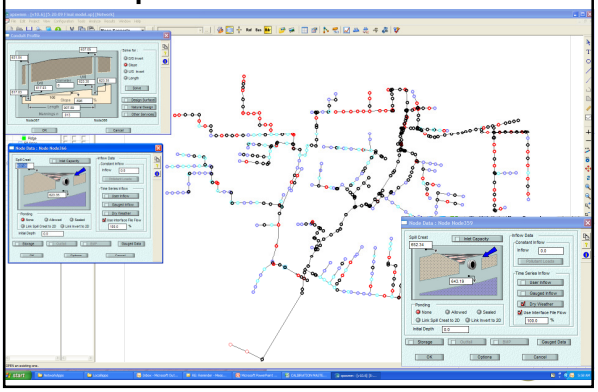


…from which we build our model

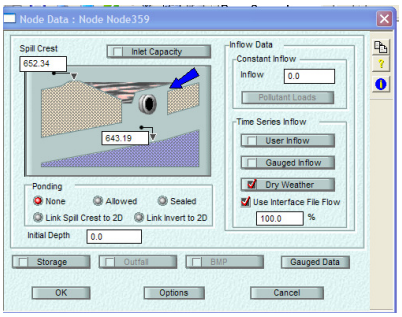
Computer Model Interface



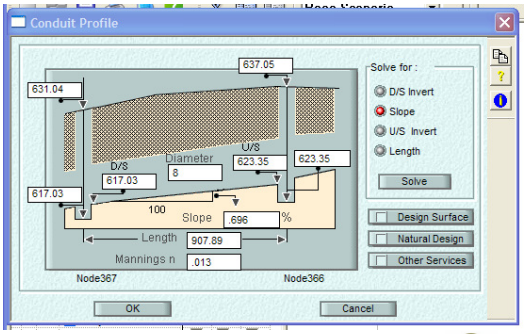
Computer Model Interface



Computer Model Interface

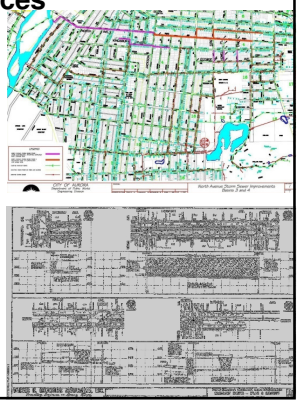


Computer Model Interface

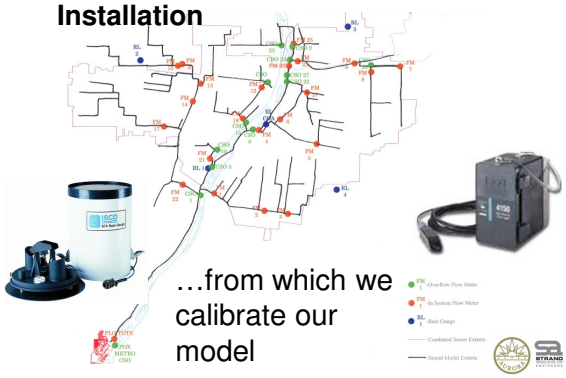


Information Sources

- AutoCAD mapping of CSS
- Topographic mapping
- Record Drawings
- Field Verification



Flow Meter and Rain Gauge Installation



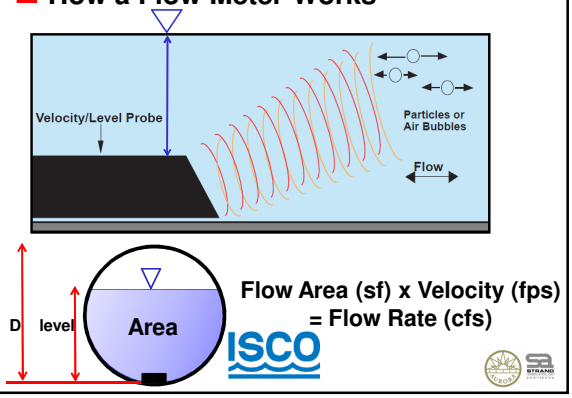
…from which we calibrate our model

Rain Gauge Installation





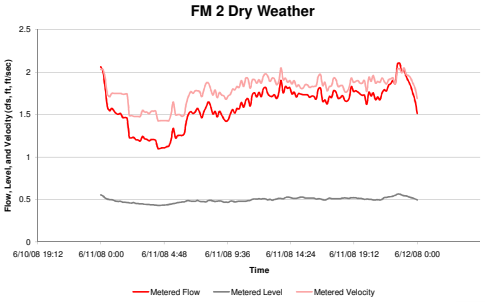
How a Flow Meter Works



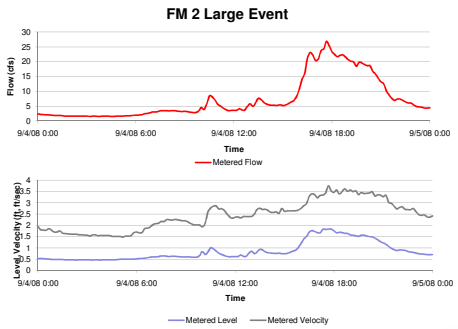
Flow Meter Installation



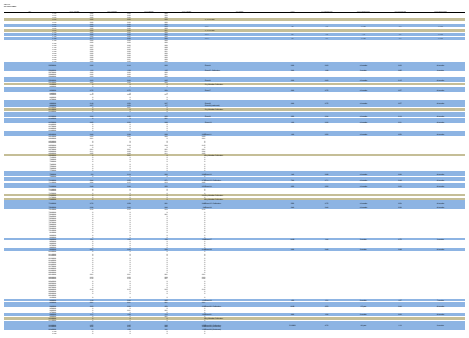
Flow Meter Data - Dry Weather



Flow Meter Data – Wet Weather



Picking Calibration Events from Rain Gauge Data

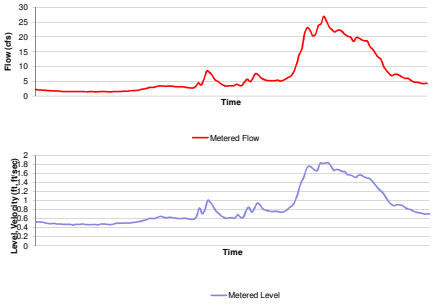


Picking Calibration Events from Rain Gauge Data

TABLE A-20-1
DAILY RAINFALL SUMMARY

DATE	SAI-RL1 SOUTHWEST	SAI-RL2 NORTHWEST	SAI-RL3 NORTHEAST	SAI-RL4 SOUTHEAST	Event Designation	Duration	Cumulative Rainfall (inches)	Approximate Recurrence Interval	Peak 1-Hour Rainfall (inches)	Approximate Recurrence Interval
5/25/2008	0.20	0.16	0.23		Event 4	0:30	0.23	<2 months	0.23	<2 months
5/26/2008	1.03	1.08	1.05		Event 5 - Calibration	3:00	1.08	3 months	0.85	4 months
5/27/2008	0.00	0.00	0.00							
6/7/2008	0	0	0							
6/8/2008	0.18	0.56	0.27		Event 8	2:00	0.75	<2 months	0.57	<2 months
6/9/2008	0.57	0.53	0.7		Event 8 (continued)					
6/10/2008	0	0.01	0							
6/11/2008	0	0	0		Dry Weather Calibration					
6/12/2008	0	0	0							
6/13/2008	0.29	0.35	0.33		Event 9	3:50	0.34	<2 months	0.19	<2 months
6/14/2008	0	0	0.01							
6/15/2008	0.25	0.33	0.28		Event 10	1:00	0.32	<2 months	0.31	<2 months
7/16/2008	0	0	0	0.01	Dry Weather Calibration					
7/17/2008	0	0	0	0						
7/18/2008	0	0	0	0	Dry Weather Calibration					
7/19/2008	0.72	0.58	0.81	0.68	Event 15 - Calibration	5:50	0.75	<2 months	0.54	<2 months
7/20/2008	0.36	0.42	0.46	0.4	Event 16	2:40	0.46	<2 months	0.36	<2 months
7/21/2008	0.14	0.15	0.14	0.14						
9/1/2008	0	0	0	0						
9/2/2008	1.19	0.26	0.65	1.31	Event 19	1:50	1.31	9 months	1.07	7 months
9/3/2008	0.01	0.01	0.01	0.01						
9/4/2008	2.23	2.32	2.54	2.39	Event 20 - Calibration	16:30	2.53	1.5 year	0.42	<2 months
9/5/2008	0	0	0	0						
9/6/2008	0	0.01	0.01	0						
9/11/2008	0	0	0	0						
9/12/2008	0.55	0.45	0.49	0.59	Event 22 - Calibration	51:08:00	6.72	40 year	1.19	9 months
9/13/2008	4.04	4.33	4.82	3.58	Event 22 (Continued)					
9/14/2008	1.3	1.29	1.41	1.32	Event 22 (Continued)					

Flow Meters Don't Always Collect Good Data

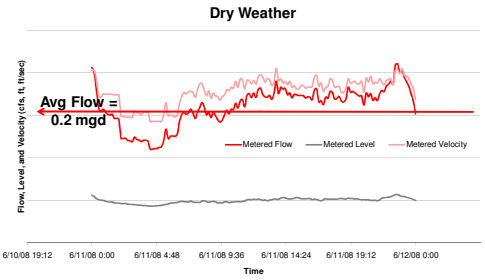


Select Calibration Events

TABLE A-3-1
DAILY RAINFALL SUMMARY

DATE	SAI-RL1 SOUTHWEST	SAI-RL2 NORTHWEST	SAI-RL3 NORTHEAST	SAI-RL4 SOUTHEAST	Event Designation	Duration	Cumulative Rainfall (inches)	Approximate Recurrence Interval	Peak 1-Hour Rainfall (inches)	Approximate Recurrence Interval
5/25/2008	0.20	0.16	0.23		Event 4	0:30	0.23	<2 months	0.23	<2 months
5/26/2008	1.03	1.08	1.05		Event 5 - Calibration	3:00	1.08	3 months	0.85	4 months
5/27/2008	0.00	0.00	0.00							
6/7/2008	0	0	0							
6/8/2008	0.18	0.56	0.27		Event 8	2:00	0.75	<2 months	0.57	<2 months
6/9/2008	0.57	0.53	0.7		Event 8 (continued)					
6/10/2008	0	0.01	0							
6/11/2008	0	0	0		Dry Weather Calibration					
6/12/2008	0	0	0							
6/13/2008	0.29	0.35	0.33		Event 9	3:50	0.34	<2 months	0.19	<2 months
6/14/2008	0	0	0.01							
6/15/2008	0.25	0.33	0.28		Event 10	1:00	0.32	<2 months	0.31	<2 months
7/16/2008	0	0	0	0.01	Dry Weather Calibration					
7/17/2008	0	0	0	0						
7/18/2008	0	0	0	0	Dry Weather Calibration					
7/19/2008	0.72	0.58	0.81	0.68	Event 15 - Calibration	5:50	0.75	<2 months	0.54	<2 months
7/20/2008	0.36	0.42	0.46	0.4	Event 16	2:40	0.46	<2 months	0.36	<2 months
7/21/2008	0.14	0.15	0.14	0.14						
9/1/2008	0	0	0	0						
9/2/2008	1.19	0.26	0.65	1.31	Event 19	1:50	1.31	9 months	1.07	7 months
9/3/2008	0.01	0.01	0.01	0.01						
9/4/2008	2.23	2.32	2.54	2.39	Event 20 - Calibration	16:30	2.53	1.5 year	0.42	<2 months
9/5/2008	0	0	0	0						
9/6/2008	0	0.01	0.01	0						
9/11/2008	0	0	0	0						
9/12/2008	0.55	0.45	0.49	0.59	Event 22 - Calibration	51:08:00	6.72	40 year	1.19	9 months
9/13/2008	4.04	4.33	4.82	3.58	Event 22 (Continued)					
9/14/2008	1.3	1.29	1.41	1.32	Event 22 (Continued)					

Dry Weather Calibration - Example



Estimated Basin Population = 200,000 gal/day / 100 gcd = 2,000 persons

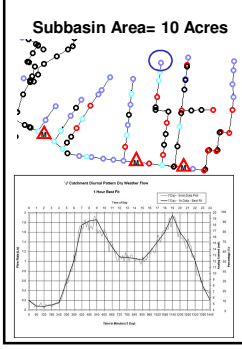
Dry Weather Calibration is Performed Basin by Basin

Total Basin 2 Area = 260 Acres

Population Density = 2,000 persons / 260 ac = 7.7persons per ac



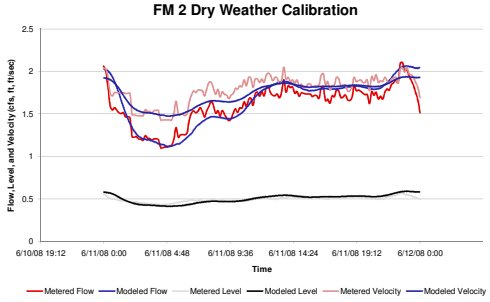
Allocate Over All Sanitary Inputs And Add "Diurnal" Flow Pattern



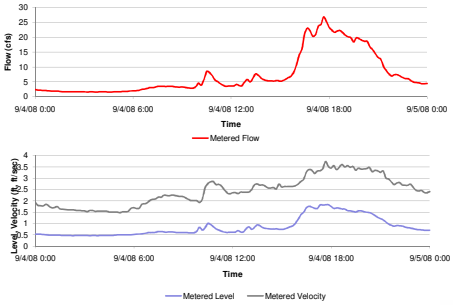


Calibration Parameter

Model Calibration – Dry Weather



Wet Weather Calibration



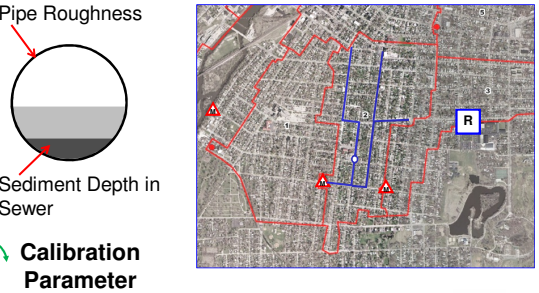
Characterize Each Wet Weather Weather Subbasin

- Subbasin Area
- Percent Impervious Surface
- Depression Storage
- Infiltration Characteristics
- Ground Roughness
- Ground Slope
- **Calibration Parameter**

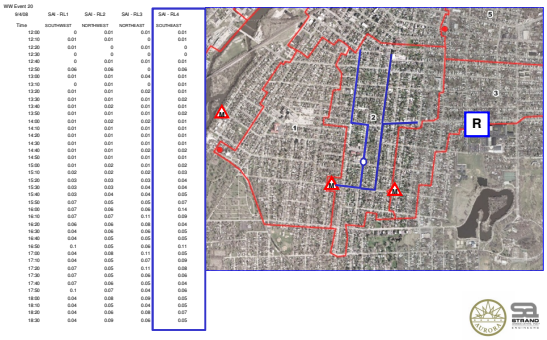


Two More Factors Can Be Adjusted For Wet Weather Calibration

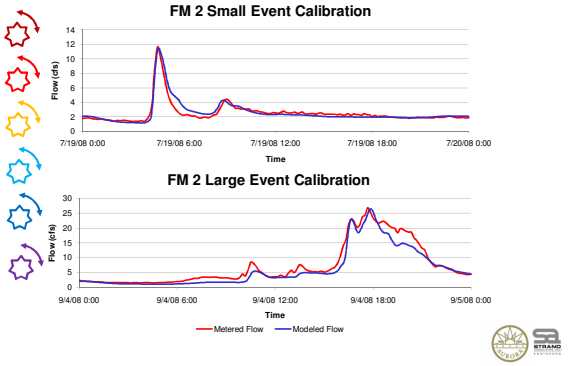
- Pipe Roughness
- Sediment Depth in Sewer
- **Calibration Parameter**



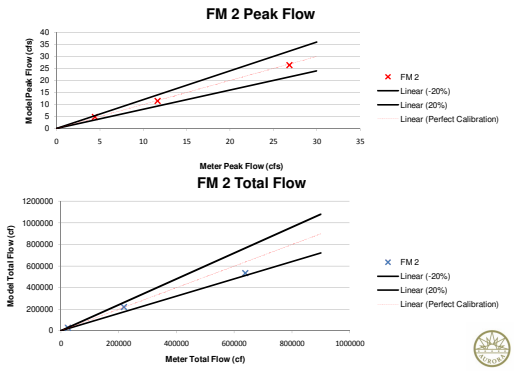
Develop Rainfall Input File Based on Nearest Rain Gauge



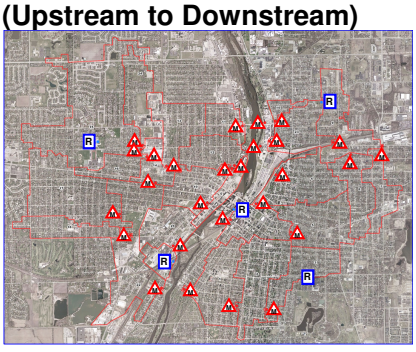
Model Calibration – Wet Weather



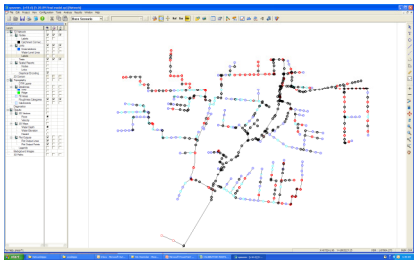
Model Calibration – Wet Weather



Repeat for Each Basin (Upstream to Downstream)



Now It's Time to Validate the Model



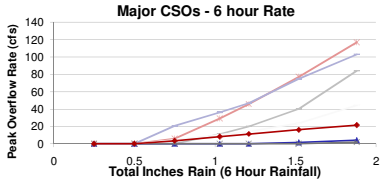
Does the model make sense with other data that wasn't used in calibration?

How the Model Was Validated

1. Compared Model Results with 2005-2008 CSO Frequency
2. Compared April 2009 CSO Occurrence with Month-long Model Run

Validation 1: 2005-2008 CSO Frequency

- Ran the model for seven different rainfall intensities to determine what size event would "trigger" each CSO

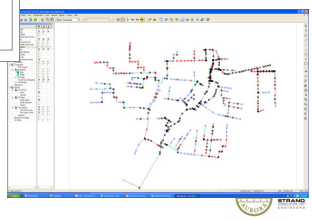


- Compare with Yearly CSO Occurrences

Validation 2: April 2009



- Modeled one month of 7 rainfall events caused overflows
- Plot metered vs modeled overflow rate and volume for each event



Validation 2: Example Results

Figure B.05-9
CSO 015 - Peak Flow

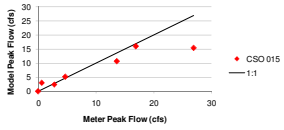
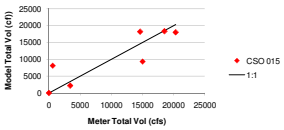
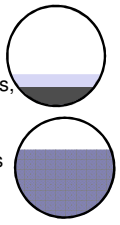


Figure B.05-10
CSO 015 - Total Volume

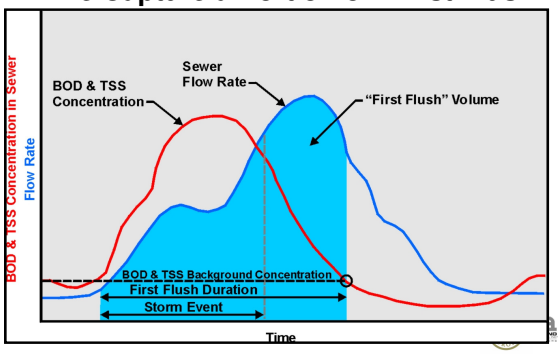


Illinois Code/Aurora Permit Require We Capture "First Flush"

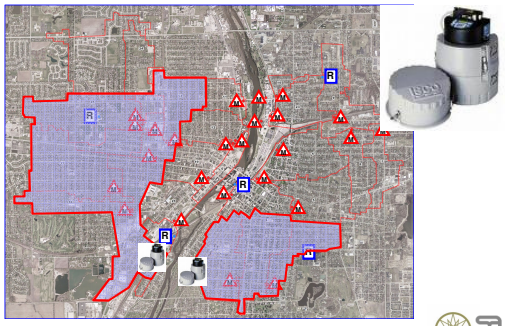


- During low flow, sediment accumulates in base of sewer.
- During high flow, the sediment resuspends, increasing wastewater concentration until sediment is completely "flushed."
- Goal of "First Flush" regs is to capture this high concentration wastewater for later treatment.
- 1.2 inch 1 hour storm is Illinois' First Flush standard event.

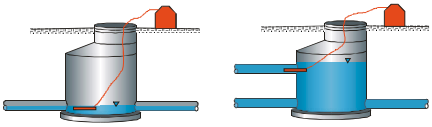
Illinois Code/Aurora Permit Require We Capture a Portion of "First Flush"



Samplers Are Placed at Key Points in CSS and Activated When Storm is Predicted



Water Quality Sampling (WQ)



Sampling during dry weather establishes "baseline condition"

Sampling during wet weather helps establish first flush duration and volume

Water Quality Sampling (WQ)

- An initial round of sampling performed during Summer 2008.
- Results were not "robust" enough to perform first flush calculation.
- Two samplers installed for Summer 2009.
- Anticipate first flush analysis will be complete in fall.

Questions and Answers

AGENDA
City of Aurora CSO LTCP Development
Citizen's Advisory Committee Meeting 6
Root Street Community Center
November 18, 2009

1.	Introductions of CAC members and guests (all)	9:00 AM to 9:10 AM
2.	Update of activities since last CAC meeting (SWS)	9:10 AM to 10:00 AM
3.	Summary of preliminary alternatives (MAG)	10:00 AM to 11:30 PM
4.	Lunch	11:30 PM to 12:30 PM
5.	Financial capability assessment (BGJ)	12:30 PM to 12:45 PM
6.	Next steps and anticipated schedule (SWS)	12:45 PM to 1:00 PM
7.	Matters arising (all)	
8.	Adjorn	

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 6—Sign In Sheet

November 18, 2009

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Barton Jones	Strand Assoc.	608.251.4843	bart.jones@strand.com
Scott Stearns	Strand Assoc	"	scott.stearns@strand.com
BRUCE KLEINFIELDT	AURORA CITIZEN	630 898-8308	—
Amy Roth	COA	630 878 0446	aroth@aurora-il.org
HERMAN BENEKE	COA - BP	630 906 4069	hbeneke@aurora-il.org
Kay C. Anderson	Citizen	630 892 4159	
Steve Stephens	Stephens Pam R &	630-906-9900	ssstephens@comcast.net
Dan Caffee	Sierra Club	630 859-1687	dan.caffee@sierraclub.org
BILL DONNELL	FVPD	630.897.0516	bdonnell@fvpd.net
Chuck Nelson	COA	630-844-3612	cnelson@aurora-il.org
Mike Ott	Strand	615-744-4206	michael.ott@strand.com
Ken Schroth	Public Works	630-844-3621	Kschroth@aurora-il.org
ERIC SCHEERY	ENGINEERING	630-844-3620	ESCHEERY@AURORA-IL.ORG
Margaret Guell	Strand	608-251-4843	margaret.guell@strand.com
WHITEY PETERS	C.O.A. ALD. 5	710-0355	peters3615@ATT.NET

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, Illinois
Meeting No. 6
November 18, 2009, 9 A.M.

Location: Root Street Community Center

Purpose: Citizen Advisory Committee (CAC) Meeting No. 6 updating the CAC on LTCP activities performed since previous meeting and discussing the preliminary alternative options, the financial capability assessment, and the anticipated schedule.

Attendees:

Name	Representing
Amy Roth	City of Aurora
Herman Beneke	City of Aurora
Chuck Nelson	City of Aurora
Eric Schoeny	City of Aurora Engineering
Ken Schroth	City of Aurora Public Works
Whitey Peters	City of Aurora Alderman
Ray Anderson	Aurora Citizen
Bruce Kleinfieldt	Aurora Citizen
Steve Stephens	Stephens Commercial Real Estate
Fran Caffee	Sierra Club
Bill Donnell	Fox Valley Park District
Barton Jones	Strand Associates, Inc.®
Michael Ott	Strand Associates, Inc.®
Margaret Guell	Strand Associates, Inc.®
Scott Stearns	Strand Associates, Inc.®

Discussion Items:

1. Introductions (Scott Stearns)

2. Update of activities since last CAC meeting (Scott Stearns)

   a. Continued to collect flow metering data and update the XP-SWMM Model.

   b. Met with IEPA on September 8, 2009, regarding metering and modeling, first flush analysis, sensitive areas, and financial capabilities.

   c. Developed overall alternatives analysis tools.

3. Sensitive Areas Discussion (Bart Jones)

   a. In the April 15, 2009, meeting, CAC reviewed potentially sensitive areas based on definition of primary contact recreation and determined that none of the CSOs discharged to sensitive areas.

   b. Despite this recommendation, IEPA has proposed that CSOs 001, 022, and 023 be considered sensitive.

   c. Potential sensitive areas impact level of control and implementation priority.

4. Discussion of Alternatives (Margaret Guell)

   a. Development of CSO abatement options.

   b. How CSO control is defined.

   c. Development of design criteria and costs.

   d. Specific alternatives analysis and conclusions:
      (1) Gravity conveyance of CSOs 012, 023, and 025 is most cost-effective.
      (2) Expansion of 400 N. Broadway CSO plant is cost-effective for reduction of north side CSOs.
      (3) Benton Street CSOs: Comparison of gravity versus pumping station/force main conveyance.
      (4) Storage/treatment combination at Rathbone CSO offers cost savings.

5. Lunch

6. Financial Capability Assessment (Bart Jones)

   a. Threshold to reach Widespread Social and Economic Hardship about $253 M.

   b. Approximately 34,500 residents will experience future sewer service charges that demonstrate Hardship.

   c. Remainder of residents paying the same future sewer service charges will be considered to have a medium financial burden.

   d. Sewer rates will have to be increased about 220 percent over the next 20 years.

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7. Q/A (Scott Stearns)

An informal question and answer session followed the presentations and covered the following areas:

a. History of CSO control in Illinois.

b. Aurora has been proactive over the years in managing CSOs.

c. Past projects have shown that decombination projects are very effective in reducing basement backups. In addition, the value of decombination includes reduction of street flooding and providing capacity for redevelopment.

d. Specific aspects of the project may involve easements or property acquisition from Fox Valley Park District.

e. The upcoming communication process with Building, Grounds, and Infrastructure (BGI); Committee of the Whole; City Council; and the Public was discussed. A "Fact Sheet" was recommended, as was a discussion with the media.

f. The approved LTCP will represent a commitment by Aurora to a level of spending and an implementation schedule. This commitment will likely be manifest in a legally enforceable agreement between the City and the IEPA.

g. The LTCP is due to IEPA on April 1, 2010. The regulatory review process is anticipated to be lengthy. The program requires regular 5-year reviews of the LTCP.

h. The CSO control program is a nonoptional program. Should the City choose to ignore this requirement, IEPA would first issue a Notice of Violation (NOV), likely followed by enforcement action by a judge. If this occurs, the City would lose negotiating position for determining which projects to implement and their schedule.

i. The major portion of the stimulus funding program which offered up to 50 percent principal forgiveness is complete. (For the upcoming year of funding, the State Revolving Fund will be including 30 percent principal forgiveness for qualifying projects, although it is unknown how long this program will last.) Aurora did very well in securing stimulus funding during the last round of funding.

j. The LTCP is anticipated to result in sewer rate increases, although these would not be expected to occur immediately. Rates would increase over the course of the project implementation schedule at the time funds are required to finance new debt and pay for new operation and maintenance expenses.

k. Challenges to public approval for the program are anticipated. Recommendations included green infrastructure, which would provide more visible forms of improvements.

l. The approach CSOs 008, 015, and 018 (East and West Benton Street) were considered in some depth, including potential for their relocation. CSOs 015 and 018 are not visible based on their location, and CSO 008 is visible. However, the City receives no complaints about the CSOs, and the CAC did not indicate that relocating these CSOs was a high priority.

8. Meeting minutes approval (Scott Stearns)

a. Steve Stephens moved to approve last meeting's minutes.

b. Eric Schoeny seconded.

9. Next Meeting

Next meeting day and location are to be announced.

Prepared by Margaret Guell and respectfully submitted to all CAC members in attendance.

c: All CAC members on the roster

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CAC Meeting No. 6

November 18, 2009



City of Aurora, Illinois

LTCP Must Balance Competing Interests



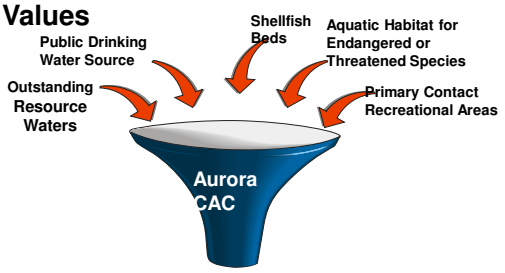
The Charge of CAC Members

- Provide Guidance to LTCP Development
  - ID Issues (Sensitive Areas, Define Aurora's Social Values)
- Balance Water Quality Benefits and Social Values Against Economic Costs
  - Alternatives to Address Priorities
- Provide Dialogue Between Various Constituencies and CAC (Inform – Feedback Loop)
- Advocate Approval of Recommended LTCP to Representative Constituencies

Update of Activities Since Last CAC Meeting

- Last CAC meeting held June 10, 2009 – "Metering, Modeling and WQ Sampling"
- Continued to collect flow metering data
- Continued to refine flow predictive model
- Met with IEPA September 8, 2009
  - Metering/Modeling
  - First flush
  - Sensitive areas
  - Financial capabilities
- Developed overall alternatives analysis tools

Sensitive Area Determinations Made by Local Residents Using Local Values



"YES or NO"
Determinations Made for Each Specific CSO Discharge Location

Aurora's CAC was Provided Background Information to Frame the Sensitive Area Issue

1. Water Quality Standards as they Relate to CSO Abatement – What Does "Fishable / Swimmable" Mean
2. Summary Report on Previous Sensitive Area Determinations Based Upon Primary Contact Recreation and IEPA's Subsequent Approvals
   - April 1997 Report
   - January 1998 Report
   - October 2000 Report
3. CAC Guided Tour of CSO Discharge Locations and CSO Treatment Facility

So, what is Primary Contact Recreation?

EPA's guidance document, Ambient Water Quality Criteria for Bacteria – 1986, establishes the numeric criteria for "bathing (full body contact) recreational waters" as 126 per 100 ml E. coli. This number was based on studies at public bathing beaches where people were "swimming". Another EPA guidance document, 1994 Water Quality Standards Handbook: 2nd Edition, describes "primary contact recreation" as "usually includes swimming, water skiing, skin diving, surfing, and other activities likely to result in immersion. "Secondary contact recreation" classification is to be protective when immersion is unlikely and the examples given are boating, wading and rowing. Still another EPA guidance document, May 2002 Draft Implementation Guidance for Ambient Water Quality Criteria for Bacteria, says: "Primary contact recreation uses are designated for water bodies where people engage or are likely to engage in activities that could result in ingestion of water or immersion. These activities logically include swimming, water skiing, kayaking or any other activity where contact and immersion in the water is likely." It appears that the definition of "primary contact recreation" has evolved over time from "full body contact" in 1986 to "contact and immersion" in 1994 to "immersion or ingestion of water" in 2002. In any case, the activities listed as constituting "primary contact recreation" include swimming, water skiing, skin diving, surfing, and kayaking as opposed to boating, wading and rowing which are "secondary contact recreation"

We Used Full-body Contact with Intentional Immersion

Site-Specific Sensitive Area Determinations were Made Upon:

1. Outstanding Resource Waters — Fact
2. Public Drinking Water Supply — Fact
3. Presence of Shellfish Beds — Fact
4. Presence of Aquatic Habitat for Endangered or Threatened Species — Fact
5. Primary Contact Recreation — Fact

Aurora's CAC Determined that None of the CSOs Discharge Into a Sensitive Area Based Upon Criteria Established in CSO Control Policy

1. Draft Findings Submitted to IEPA for Unofficial Reaction
2. IEPA Requested Further Consideration for CSO's 001, 022 and 023 Based Upon Current (and Future) Land Use and Known Recreational Use

IEPA's "Unofficial" Email Response

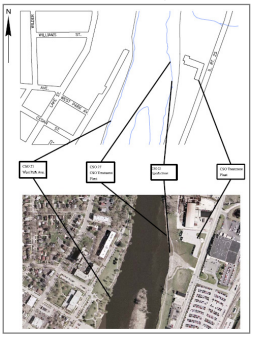
"Our understanding of the sensitivity analysis conducted so far is that Aurora has conducted this matter through the CAC. At this point the CAC and Aurora have determined that the CSOs are not discharging into any sensitive area. This conclusion has been arrived at, in part, from CAC's votes and WEDA's study in 2000. Aurora has not conducted any new study and/or produced new data.

Based on this same information, we believe CSOs 023, 022, and 001 may be potential concerns. CSO 023 is situated in a recreational area. A public park is located 50 feet downstream of the outfall. CSO 022 is located in an industrial area. We understand this site will be landscaped as a large public park at some time in the future. CSO 001 has both recreational and commercial activities in the vicinity of the discharge. A public park is located on both the sides of the river at this location.

The WEDA report indicated forty-one people entered the water in the vicinity of CSO 023 for purposes of swimming, wading, boating, skiing, jet-skiing, and fishing. Similar to CSO 001, most uses occurred on the weekends. We understand there were no recreational uses observed during and immediately after any wet weather event.

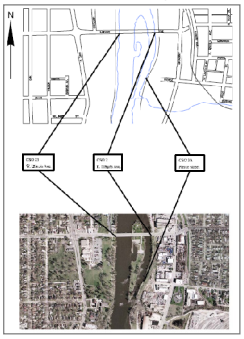
We ask that you consider changes in land use, notably the current recreational uses and the proposed park land development near these CSOs, and advise us as to the outcome of these factors to your analysis."

Why CAC Concluded CSO 022 Does Not Discharge Into a Sensitive Area



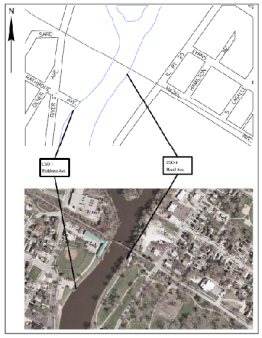
1. Proposed River Walk Park Does Not Enhance Ingress / Egress to River's Edge
2. Located Behind Existing CSO Treatment Facility
3. Location No Different than CSOs 002, 3A, 027 Just Upstream

Why CAC Concluded CSO 023 Does Not Discharge Into a Sensitive Area



1. No Primary Contact Recreation Ever Observed During Wet Weather Events
2. Infrequent "Secondary" Contact Recreation Observed in Dry Weather BUT No Recorded CSO Discharge in Dry Weather

Why CAC Concluded CSO 001 Does Not Discharge Into a Sensitive Area



1. Proximity of Montgomery Dam Downstream Minimizes Contact Recreational Use
2. No Primary Contact Recreation Ever Observed During Wet Weather Events
3. Infrequent "Secondary" Contact Recreation Observed in Dry Weather BUT No Recorded CSO Discharge in Dry Weather

Reasons to Affirm a Finding of No Sensitive Areas at CSOs 001, 022 and 023

1. Only Secondary Recreational Contact Observed At CSOs 001 and 023 During Dry Weather When Aurora's CSOs Are Not Discharging
2. Confirmation of "No Sensitive Areas" Made By Local Folks Who Have Observed Historical Uses.

Can Draft Sensitive Area Determination (LTCP-Section 3) be Revised in Any Manner which Would Allow IEPA to Conclude that CSOs in Question Do Not Discharge Into a Sensitive Area?

- CSO 022?
- CSO 023?
- CSO 001?

If There Exists Sensitive Areas:

1. Prohibit New or Significantly Increased CSO Volumes
2. Eliminate or Relocate CSOs that Discharge into Sensitive Areas whenever Physically Possible and Economically Achievable
   - Eliminate or relocate at what Level of Design Storm?
   - How Does One define "Economically Achievable"?
3. Give Priority in LTCP
   - Does this Mean First Priority in Implementation Schedule

IEPA's Sensitive Area Review Milestones

Date	Action
6/17/09	Sensitive Area Draft Section electronically sent to IEPA
7/06/09	Email to IEPA requesting status of review
7/17/09	IEPA's unofficial response received
8/24/09	Request meeting with IEPA to discuss specific concerns
9/08/09	Meeting with IEPA. Agency stated they would respond to questions within 3 weeks
10/30/09	Email to IEPA requesting status of Sensitive Area Decisions

Alternatives Discussion

Aurora's Metrics for Developing the FCA

Description	Value	Comments
Median Household Income	$70,422	2000 Census inflated to 2009 using BLS calculator
Population	182,638	Claritas 2009; official 2006 census was 164,681
COA Unemployment Rate	12.2%	(COA) 9.8 % National Average as of October 2009
Total Wastewater Accounts	48,167	FMWRD
Total Residential Accounts	45,187	COA
Average Wastewater/Stormwater Bill per month	$37.41	Wastewater Treatment Cost = $25.51 based upon 7,800 gallons per month (FMWRD). Wastewater conveyance costs = $8.45 based upon 7,8800 gallons per month (COA). Stormwater Costs is flat $3.45 per month (COA).
Bond Rating	AA +	COA Finance Dept.
Total Debt	$650,851,371	$9,431,891 2000 IEPA Loan; $58,554,951 Series 2006 Bonds; $171,575,000 General Obligation Bonds; $411, 289,529 Overlapping Debt. *** (COA 2009 Budget Documents pages 191, 192, and 204).
Full Market Property Value	$13,036,883,847	3 Times Equalized Assessed Value (COA)
Property Tax Collection rate	101.49%	Includes Back Taxes and Penalties (COA)
Property Tax Revenues	$77,684,000	COA 2009 Budget Document

Note: Overlapping Debt***	COA Share
School District 303	$9,646,450
School District 129	$62,438,483
School District 131	$90,559, 338
School District 200	$774
School District 204	$110,565, 585
School District 302	$3,720, 712
School District 308	$3,977, 897
Community College 502	$6,388, 804
Community College 516	$14,439, 252
DuPage County	$9,162, 856
Kane County	$9,890, 430
DuPage Forest Preserve	$9,983, 089
Kane County Forest Preserve	$32,095, 312
Batavia Library 1998 Bond	$30, 080
Batavia Library 1999 Bond	$23, 920
Batavia Park District	$477, 222
Fox Valley Park District	$47,730, 389
Naperville Park District	$197, 513
Warrenville Park District	$1, 383
Total Overlapping Debt	$411,289, 529

Aurora's Financial Capacity Assessment 2009 Baseline

Socio-Economic Indicators

Indicators	Strong	Mid-Range	Weak
Bond Rating	AA+		
Net Tax Funded Debt as Percent of Full Market Property Value		4.47%*	
Unemployment Rate			12.2%
Median Household Income (MHI)		$70,422	
Property Tax Revenue as Percent of Full Market Property Value	0.60%		
Property Tax Collection Rate	101.49%**		

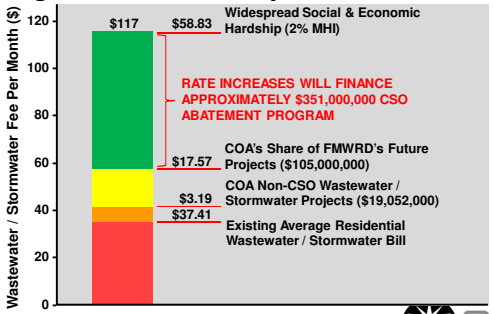
*** 5% Equal a Weak Rating**
**** Back Taxes Plus Penalties**

Aurora's Financial Capacity Assessment 2009 Baseline

Financial Capability Matrix

Socio-Economic Indicator Average Score	Residential Indicator (Cost per Household as Percent of MHI)		
	Low (< 1%)	Mid-Range (Between 1%-2%)	High (> 2%)
Weak – Below 1.5	Medium Burden	High Burden	High Burden
Midrange – Between 1.5 and 2.5	Low Burden	Medium Burden	High Burden
Strong – Above 2.5	Low Burden	Low Burden	Medium Burden

Aurora's Potential CSO Abatement Program Financial Impact



Aurora Faces Significant Financial Challenges as a Consequence of the Macro-economic Climate

- 2009 Budget Deficit of $5.6 Million
- 2010 Projected Budget Deficit of $19 Million
- State-shared Sales Tax Revenue Down 10.2%
- Home-rule Sales Tax Revenue Down 11.0%
- Revenue Streams Not Expected to Return to Historic Levels for a Few Years
- Demand for SRF Low Interest Loans for CSO Abatement Statewide Exceed Supply; Therefore Debt Financing Will Occur in Commercial Market at Much Higher rate

CSO Abatement Program Implementing Schedule Impact

- **Low Burden** — **Not to Exceed 5 Years**
- **Medium Burden** — **Not to Exceed 10 Years**
- **High Burden** — **15 to 20+ Years**

However, Because of the Macro-economic Factor Beyond Aurora's Control We Intend to Request an Implementing Schedule Outside the General Boundaries Established in USEPA Guidance

Next Steps and anticipated schedule:

Action	Anticipated Completion
Recommend LTCP Projects and Priority Implementing Schedule	December 15, 2009
Review with COA staff and FMWRD	January 10, 2010
Present to CAC	January 13, 2010
Present to BGI Committee	January 25, 2010
Public Hearing	March 15, 2010
Submit to IEPA	April 1, 2010
Receive comments from IEPA	TBA
Respond to IEPA comments	90 days after receipt
Negotiate scope/schedule with IEPA with possible USEPA	On-going

Aurora CSO Long-Term Control Plan
Discussion of Alternatives

CAC Meeting

November 18, 2009

Goals for Presentation

Cost vs. Benefit

- Show how "shopping list" of CSO abatement options was developed
- Explain how the CSO "Benefit" of each option is determined
- Show how the Design Criteria* for all of the options are chosen
- Show how costs are determined
- Describe the likely array of solutions

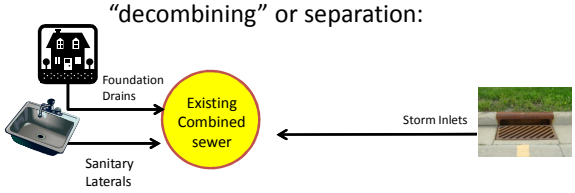
*Design Criteria = Engineer-speak for:
"How big do the improvements have to be?"

Develop "Shopping List" of CSO Abatement Options

- To abate CSOs, we can:
  - Eliminate inflow through "decombining"
  - Store overflows at CSOs
  - Convey overflows by
    - Gravity Sewers
    - Pumping Station/Force Main
  - Treat overflows

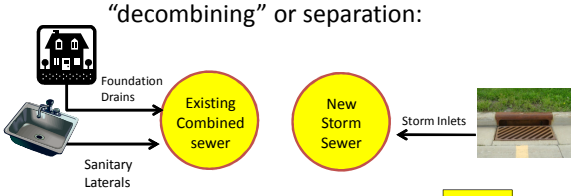
Develop "Shopping List" of CSO Abatement Options

- Eliminate inflow into CSS through "decombining" or separation:



Develop "Shopping List" of CSO Abatement Options

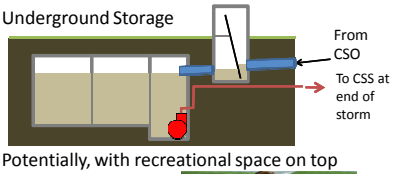
- Eliminate inflow into CSS through "decombining" or separation:



- Viable for CSO Basins: Sp004
  001 (Rathbone), 002 (East Illinois Ave),
  003A (Pierce St), 004 (Hazel Ave), 005 (First St)
  008 (East Benton St), 010 (Third St.)

Develop "Shopping List" of CSO Abatement Options

- Store CSO where its generated
  - Underground Storage

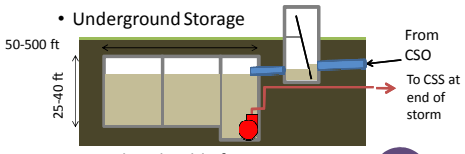


  - Potentially, with recreational space on top
    - Open green space
    - Soccer fields
    - Tennis or basketball courts



Develop "Shopping List" of CSO Abatement Options

- Store CSO where its generated
  - Underground Storage



  - Considered viable for
    - CSO 001 (Rathbone) at Sard Ave
    - CSO 021 (West Park Ave) at Current Police Station
    - CSO 023 (W. Illinois St) at McCullough Park

St 021

Develop "Shopping List" of CSO Abatement Options

G14

- Convey CSO
  - By Gravity Sewer
    - Requires adequate elevation
    - Appears practical for:
      - CSO 021 (West Park Ave)
      - CSO 023 (West Illinois St)
      - CSO 025 (Dearborn & Trask)

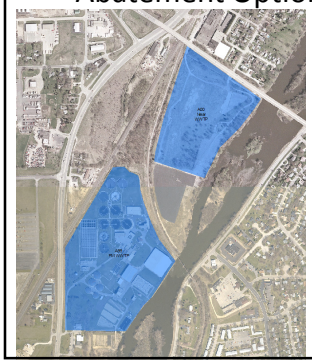


P14

PS 008

  - By Pumping Station/Force Main
    - Possibility for most CSOs

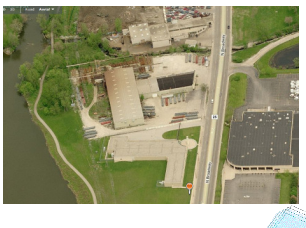
Develop "Shopping List" of CSO Abatement Options



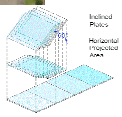
Treat flows conveyed by Gravity or PS/FM to:

- **Fox Metro WWTP**
- Existing CSO Plant at 400 N. Broadway
- A New Site

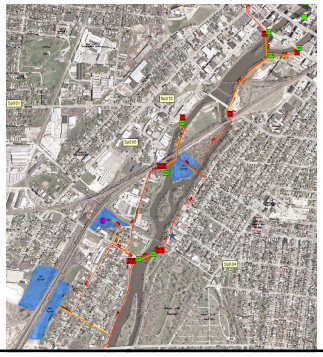
Develop "Shopping List" of CSO Abatement Options



- Existing CSO Plant 400 N. Broadway
  - Expansion – increasing footprint
  - Enhancement –
    - » 21.8 mgd -> 50 mgd
    - » Install inclined plate settling in existing clarifiers and increase disinfection



Develop "Shopping List" of CSO Abatement Options



- New Treatment Locations
  - Near Rathbone (2 sites)
  - Hurds Island

"Benefit" of Selected CSO Alternatives will be Evaluated Based on:

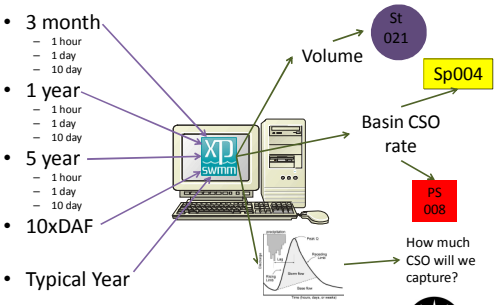
- EPA Requirements:
  - # CSOs per year remaining
    - **4 CSOs/year**
    - 3 month event: 1 hr, 1 day, 10 day

    OR
  - **Typical year capture/treatment (85%)**

    AND
  - Elimination of basement backups
- IEPA Requirements:
  - **First Flush capture**-storage (57 percent)
    - 1 year 1 hour storm
  - Reduction of CSOs to sensitive areas
    - Potentially 001 & 023
    - ~5 year event
      - 1 hr, 1 day, 10 day
  - 10xDry Weather Flow

XP-SWMM Model Helps Identify Design Sizes and Benefits

- 3 month
  - 1 hour
  - 1 day
  - 10 day
- 1 year
  - 1 hour
  - 1 day
  - 10 day
- 5 year
  - 1 hour
  - 1 day
  - 10 day
- 10xDAF
- Typical Year



Volume → St 021

Basin CSO rate → Sp004

How much CSO will we capture? → PS 008

System Hydrographs

How Cost Evaluation is Performed

- Construction Cost = Σ:
  - Structure (excavation, concrete, fill)
  - Equipment + installation (pumps, screens)
  - Electrical, HVAC, Sitework
- Capital Cost = Σ:
  - Construction Cost
  - Contractor GCs (8 percent)
  - Contingency & Engineering (50 percent)









How Cost Evaluation is Performed

- OM&R Cost = Σ:
  - Power
  - Operation Personnel
  - Maintenance
  - Replacement for items within 20 years (e.g., controls)



- Present Value
  - Discount Rate (4.6%) = Investment Yield – Inflation
  - Σ:
    - Capital Cost
    - 20 years of OM&R
    - - Salvage Value in 20 years
  - Engineers PV to determine "Cost Effectiveness"



Develop Cost Functions to ID Costs for Proposed Improvements (PV Cost)

- Pumping Stations: PS 008
  - Flow capacity and TDH
  - For large PS:
    $5.3 M + $114,000 mgd $^{0.9}$ TDH $^{0.65}$
- Underground Storage: St 021
  - Tank: $1-3/gal
  - Screening: $100-250K/mgd
- Force Mains/Gravity Sewers (cost per foot):
  - Size/Number
  - Construction Condition, e.g.:
    - Open Go
    - In-Street — P08
    - River Xing — G20
- Treatment
  - CSO Plant Enhancement
    - ~$10 Million ($350K/mgd)
  - New CSO Plant or Expansion (large fac.)
    - ~$13 Million +$500K/mgd

*Note: Cost functions may be further refined as LTCP is completed. Costs shown in this presentation are PRELIMINARY

What the Cost Effective Analysis Has Shown (Overall):



- Conveying to and Treating at Fox Metro WWTP is most costly alternative (by ~50 percent)

What the Cost Effective Analysis Has Shown (North Side):



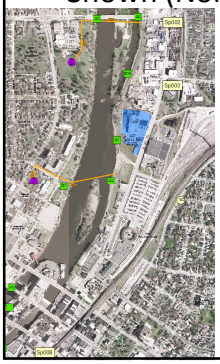
- PS/FMs not required for conveyance
- Storage does not appear cost effective
- Gravity siphon conveyance of CSOs 021 and 023 to CSO Plant appears cost effective.
  - This was part of original plan for CSO plant

What the Cost Effective Analysis Has Shown (North Side):



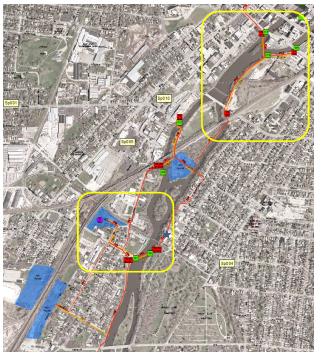
- CSO 025 can be readily abated to about 1 year with 1,500 feet of 24”-30” replacement gravity sewer.

What the Cost Effective Analysis Has Shown (North Side):



- About 10 mgd can be relieved from CSO 008 (East Benton St) with modified Diversion structure at Superior St and Lincoln Ave.
- All additional flow can be managed at “Enhanced” 50 mgd CSO plant up to 1 hour ~3 month storm.
- These improvements would alleviate approximately 1.9 MG of 2.2 MG of CSO in 1 yr 1 hr storm, with all overflow at CSO plant.

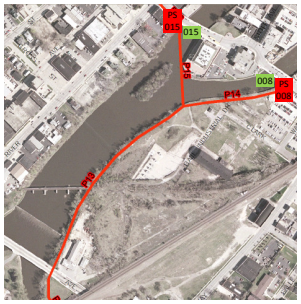
South Side Choices are also Promising



Benton Street
CSOs 015 and 008

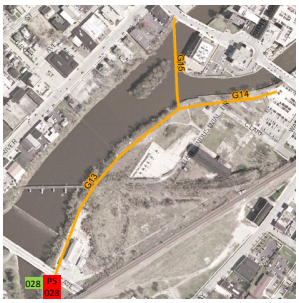
Rathbone Ave
CSO 001

Management of Benton St CSOs



- Alternative 1:
  - Individual PS at CSOs 015 and 008
  - Downtown CSOs remain
  - Can be designed to any selected level of control (3 month, 1 year, 5 year)
  - Note: Area around CSO 015 is densely developed and location of PS015 may prohibit alternative

Management of Benton St CSOs



- Alternative 2:
  - Relocating CSOs 015 and 008 to North Ave
  - One new PS and CSO
  - Selected level of control:
    - Gravity Sewers – 5 year
    - Pumping Station
      - 3 month
      - 1 year
      - 5 year

Management of Benton St CSOs

Level of Control			Present Value Cost	
Gravity Sewers	Pumping Station(s)	Force Mains	Alternative 1 – Two PSs	Alternative 2 – One PS
5 year	5 year	5 year	$63 M	$58 M
1 year	1 year	1 year	$48 M	$42 M
3 month	3 month	3 month	$30M	$26 M

Benton St CSOs - Conclusions

- For a particular level of control, one PS appears about 6-11 percent less costly than two

Management of Benton St CSOs

Level of Control			Present Value Cost	
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Benton St CSOs - Conclusions

- For a particular level of control, one PS appears about 6-11 percent less costly than two.
- Since we are "relocating" CSOs 015/008, 5 yr control required for the gravity sewers. But these Alts are not "apples to apples"

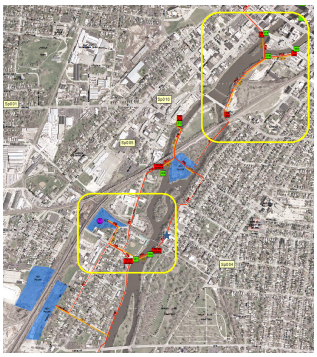
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Benton St CSOs - Conclusions

- For a particular level of control, one PS appears about 6-11 percent less costly than two.
- Since we are "relocating" CSOs 015/008, 5 yr control required for the gravity sewers. But these Alts are not "apples to apples"
- Therefore, the cost of "relocating" CSOs 015 and 008 is about $12 M, for about the same level of CSO control.

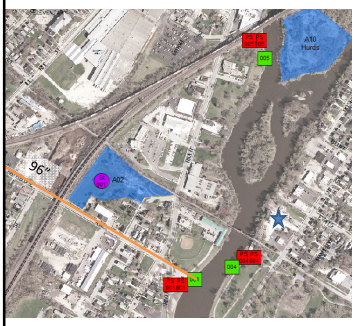
South Side Choices are also Promising



Benton Street
CSOs 015 and 008

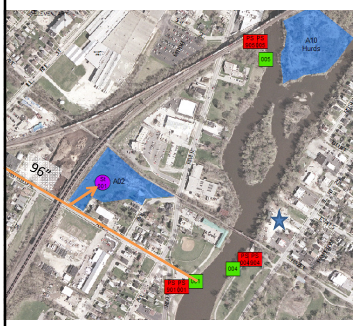
Rathbone Ave
CSO 001

Rathbone CSO Storage May Save $$



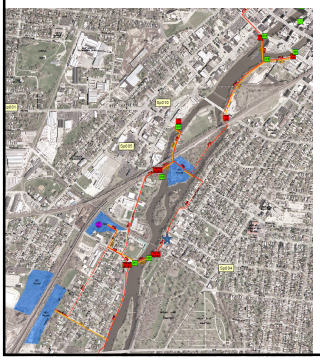
- 001 is Aurora's Largest CSO. 1 yr 1 hr storm:
  - Peak Overflow = 130 mgd
- Potential status as "Sensitive Area" may require control to a 5 yr storm:
  - Peak Overflow = 240 mgd
- PV Cost to Convey and Treat:
  - Total Cost: $80M - $120M

Rathbone CSO Storage May Save $$



- Can we grab and store flow from trunk sewer upstream of CSO?
- 5 year event:
  - Total Volume = 22 to 47 mil gal (1 to 10 day storm)
- PV Cost to Store
  - Total Cost: $45M - $65M
  - May save $35M +
- Allows Storage of *all* Basin Flows during storm events
- Significantly increases capture of "First Flush" volume.

Several Good Alternatives for Treatment Sites



- Hurds Island (A10)
  - In between proposed North Ave PS and CSO004 (Hazel)
  - When discussed in 2000, City Council was not in favor of using Hurds Island for CSO treatment.
- Powell St (A01)
  - Farthest site
  - Land available for sale
  - Potentially expandable across RR
- Rathbone (A02)
  - Farther from North Ave PS and CSO 004
  - Combining storage and treatment offers a significant cost savings

One Final Big Picture Concept



Recall that there are two ways to meet EPA's CSO Control Requirements:

1. Reducing all CSOs to 4/year
   - Do *some* improvement at all CSOs that overflow more than 4x/year
2. CSO Volume Capture : 85 percent of wet weather flow
   - Pick biggest volume CSOs where you can capture a *lot* of volume for less $/vol.
   - 100% Capture of CSO 001 may get us very far towards 85% rule.
   - Some frequent/low volume CSOs may remain (005, 010, 021)

Final Points and Thoughts

- Aurora has many good, cost effective options for abating CSOs,
  - additional options are being evaluated, including separation and green infrastructure.
- Control Goals dictate how we pick which CSOs to control.
- CSOs 001 and 023 controlled to 5 year level, if deemed sensitive
- CSO 025 controlled to 1 year level
- There is a cost/benefit choice in whether to relocate CSOs 008 and 015
- Level of Control of CSOs 004 and 028 to be selected based on control goals
- Low Volume CSOs 005 may 010 may remain.

Discussion/Feedback

City of Aurora CSO LTCP Development

Citizen's Advisory Committee Meeting 7—Sign In Sheet

January 13, 2010

NAME	REPRESENTING	PHONE NUMBER	EMAIL
Linda a Cole	Citizen/Sierra Club	630 897-8373	MCCLAC3739@AOL.com
Fran Caffee	Sierra Club	630-859-1689	Fran coffee@sierraclub.org
Bill Donnell	FVPD	630-897-8876	bdonnell@fvpd.net
Jay C. Anderson	Citizen	630 892 4158	
Steve Stephens	SCCRE	630-906-9900	ssstephens@cciim.net
Bruce Kleinfeldt	Citizen Aurora	630-898-8308	
Amy Roth	City of Aurora	630-844-4762	aroth@aurora-il.org
ERIC SCHOENY	CITY OF AURORA	630-844-3620	ESCHOENY@AURORA-IL.ORG
Ken Schroth	City of Aurora	630-844-3621	Kschroth@aurora-il.org
Pete Kerl	W. Aurora Dist 129 Schools	630-301-5027	PKerl@sd129.01
Chuck Nelson	COA	630-844-3612	CNelson@aurora-il.org
Scott Stearns	STRAND	608 251 4843	Scott.Stearns@Strand.com
Margaret Buell	Strand	608 251-4843	margaret.buell@strand.com
Brandon Wright	COA	630-844-3613	bwright@aurora-il.org

CITIZEN ADVISORY COMMITTEE MEETING MINUTES
Aurora Long Term Control Plan (LTCP)
City of Aurora, Illinois
Meeting No. 7
January 13, 2010, 9 A.M.

Location: Root Street Community Center

Purpose: Citizen Advisory Committee (CAC) Meeting No. 7 discussed Control Alternatives 1 through 8 and the selected Control Alternative 6, and requested CAC approval of the LTCP

Attendees:

Name	Representing
Amy Roth	City of Aurora
Chuck Nelson	City of Aurora
Brandon Wright	City of Aurora
Eric Schoeny	City of Aurora Engineering
Ken Schroth	City of Aurora Public Works
Pete Kerl	West Aurora School District 129
Ray Anderson	Aurora Citizen
Bruce Kleinfieldt	Aurora Citizen
Steve Stephens	Stephens Commercial Real Estate
Fran Caffee	Sierra Club
Linda Cole	Sierra Club, Aurora Citizen
Bill Donnell	Fox Valley Park District
Margaret Guell	Strand Associates, Inc.®
Scott Stearns	Strand Associates, Inc.®

Discussion Items:

1. Introduction and Background (Scott Stearns)

2. Discussion of Alternatives (Margaret Guell)

   a. Development of Control Alternative 1.
      i. Sensitive Area CSOs to 1 year level of control.
      ii. Remaining CSOs to 3 month level of control.

   b. Development of Control Alternatives 2 through 4 by winnowing out lowest "bang for the buck" projects

   c. Development of Control Alternative 5.

i. Sensitive Area CSOs to 3 month level of control
ii. Remaining CSOs to 3 month level of control.

d. Development of Control Alternatives 6 through 8 by winnowing out lowest "bang for the buck" projects.

e. Presentation of Knee of the Curve recommending Control Alternative 6.

3. Discussion and Q/A Items

a. Stearns: Recommended Control Alternative to be discussed with Fox Metro this afternoon.
b. Question: Is there any concern that people will begin to conserve water when rates are increased, thereby resulting in less revenue than required? Stearns: Yes, this does sometimes occur. If this happens, the rates would have to be further adjusted in order to generate adequate revenue.
c. Schoeny: If projects are implemented over the next 5 to 25 years, and bonds have a 20-year life, we would expect to see a peak debt service level at about year 25. After that, the early debt would start to be retired and debt service would decrease.
d. Question: Would we expect the $83/month sewer rates to be implemented right away? Schoeny/Schroth/Stearns: Note that the $83 represents all sewer-related costs that would be paid for by customers in the City of Aurora, but it doesn't represent a literal bill that a customer would receive. (The information is presented in this fashion because it is consistent with how regulators evaluate the information.) Not all of this would appear directly on the sewer bill residents receive from the city. Some would be on Fox Metro's bill and possibly also on a stormwater bill. The projects would be implemented over time, as would the rate increases.
e. Schoeny: The CSO control policy technically requires meeting water quality standards (WQS). However, even during dry weather, the Fox River does not always meet WQS. We're proposing projects that we feel are reasonable, but they may still push Aurora to 2 percent of MHI.
f. Question: Control Alternative 7 appears to meet 85 percent capture. Why not propose it instead of Control Alternative 6? Answer: Even though the control policy says 85 percent, regulators have been pushing to apply the 4 overflows per year criterion instead. Our attorneys have indicated that starting with a "bad faith" offer usually doesn't yield a positive result with the regulators. So, our intent of going with Control Alternative 6 is to show good faith in the negotiation. Plus, we'll be showing good faith with the proposed Early Action Projects (EAPs).

g. Question: What sort of punitive measures might be taken if Aurora doesn't comply? Stearns: CSOs are permitted by the National Pollutant Discharge Elimination System (NPDES). This requires elimination of all dry weather overflows (DWOs) and requires that all other CSOs be reported. The City can be fined $32,500 per day when reports are not submitted. Aurora's LTCP will be manifest in an "enforceable document" with some regulatory body. The most desirable would be an agreement with the IEPA for implementation of the plan. Alternatively, Aurora may have an agreement with the EPA. However, it is desirable to avoid a court-ordered plan, which may incorporate major fines or jail time. By being agreeable to the process up front, we are most likely to be able to enter into the agreement with the IEPA, which makes it easier to negotiate changes as conditions change over the next 20 years.

h. Stearns: There are a lot of cities across the country that are further along in their CSO programs. This is because EPA had focused on states that did not have as active CSO policies as Illinois did. Schoeny: Late in 2009, Aurora had a 3-day EPA inspection/audit, in which they emphasized the importance of the LTCP being submitted on time. This suggests that EPA will be taking particular interest in Aurora's LTCP. Based on Strand recommendation, we met with IEPA and EPA early in the process (December 2008) to gain EPA's confidence in Aurora's process.

i. Question: How does Fox River Study Group's (FRSG) cleanup plan mesh with the LTCP? Schoeny (on the board of the FRSG): The work of the FRSG is not technically a cleanup plan. The Fox River is targeted for TMDLs and the IEPA is helping to fund FRSG's study. Aurora's LTCP complements the improvements to the Rox River. The intent of the model that FRSG is developing of river WQ is to help determine the best bang for the buck to allocate funds to improve WQ.

j. Schroth: The LTCP does not require formal adoption by City Council at this time. We plan on presenting the plan to Council and submitting prior to the April 1 deadline. A formal public hearing is not required at this time.

4. <u>CAC Vote on Recommended Alternative</u>
   a. Linda Cole made a motion to vote for approval of the LTCP Control Alternative 6 with emphasis on the Green Infrastructure component of the program.
   b. Steve Stephens seconded the motion.
   c. All present were in favor of approving the LTCP, with none opposed.

5. <u>Approval of Meeting Minutes</u>
   a. Steve Stephens made a motion for approval of the minutes from the November 18, 2009, meeting.
   b. Fran Caffee seconded the motion.
   c. All present were in favor of approving the minutes.

Prepared by Margaret Guell and respectfully submitted to all CAC members in attendance.

c: All CAC members on the roster

STRAND ASSOCIATES, INC.®
ENGINEERS

Aurora CSO Long-Term Control Plan Presentation of Recommended Alternative

CAC Meeting

January 13, 2010

At Our November 18 Meeting

Cost vs. Benefit

- Showed how master list of all CSO abatement options was developed
- Explained how regulators will evaluate the degree of CSO Control achieved ("Benefit")
- Showed how the Design Criteria* for all of the options are chosen
- Showed how costs are determined
- Described a likely array of solutions

*Design Criteria = Engineer-speak for:
"How big do the improvements have to be?"

CSO Abatement Options Include:

- Eliminate inflow through "decombining"
- Store overflows at CSOs
- Convey overflows by
  - Gravity Sewers
  - Pumping Stations/Force Mains
- Treat overflows

Selected CSO Abatement Options are Based On:

- **Lowest Life Cycle Cost**
- Implementability
  - Is there available space?
  - Is option consistent with City's plans for other projects?
- Most Likely to Receive Regulatory Approval
  - Would this require a variance from a code requirement?

Regulators will Evaluate Degree of CSO Control Achieved Based on:

- EPA Requirements:
  - **# CSOs per year remaining**
    - **4 CSOs/year**
    - **3 month event**

    OR
  - Typical year capture/treatment (85%)

    AND
  - Elimination of basement backups
- IEPA Requirements:
  - First Flush capture-storage (57 percent)
    - 1 year 1 hour storm
  - **Reduction of CSOs to sensitive areas**
    - **Potentially 001, 022 & 023**
    - **Up to 1 year event**
  - 10xDry Weather Flow

The CSO Abatement Options were First Evaluated Based on:

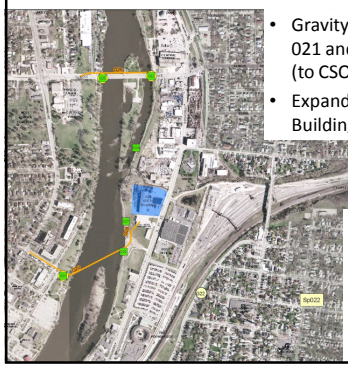
- **Reduction of CSOs to potentially sensitive areas (001, 022, 023)**
  - **1 year event**
- **Reduction of Nonsensitive CSOs to**
  - **3 month event**

Control Alternative 1:
"Most Rigorous Standard of Control"

Control Alternative 1 Includes All CSOs that Overflow During 3 Month Event

	Control Alternative			
CSO	1	2	3	4
001*	1 yr			
004	3 mo			
005	3 mo			
008	3 mo			
010	3 mo			
015	3 mo			
021	3 mo			
022*	1 yr			
023*	1 yr			
025	3 mo			

Control Alternative 1 - North Side:

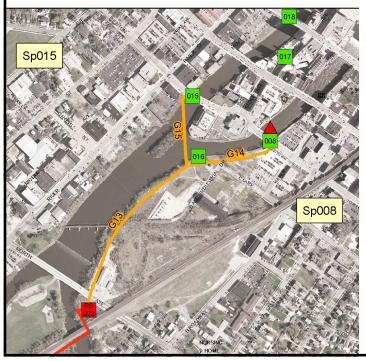


- Gravity siphon conveyance of CSOs 021 and 023 to east side (to CSO Plant).
- Expand Treatment at CSO Plant with Building Expansion to the North.



- Divert about 8 mgd from CSO 008 Basin to CSO Plant with Replacement Gravity Sewer
- New 24"-36" Gravity Sewers at CSO 025.

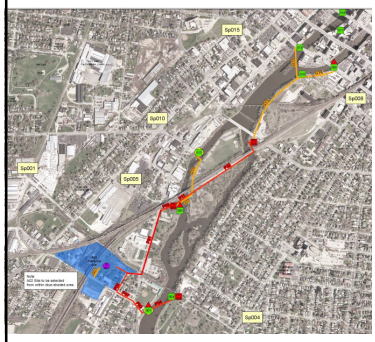
Control Alternative 1 - Benton St CSOs



- Gravity Conveyance of CSOs 008 and 015 to a New Pumping Station Near North Ave.

Note: Route shown is approximate. Actual route will depend on potential development.

Control Alternative 1 – South Side



- Conveyance of overflows from all South Side CSOs to near CSO 001.
- Screening and grit removal of all conveyed CSO.
- Storage up to 24 hour storm.
- Discharge of stored overflow to WWTP when 69-inch interceptor has capacity.
- Treatment of stored overflow when interceptor capacity lacking.

Control Alternative 1 – Additional Programs

- Permanent Metering System for All Overflows
  - Radio telemetry provides "real time" feedback of CSO occurrences.
- Modification of selected CSOs:
  - Raising overflow weirs (010, 021)
  - Check valves to prevent river intrusion (001, 005, 008)
  - Modification of CSO 001 to prevent blinding and DWOs
- Green Infrastructure Program
  - Additional 5 percent of Conveyance/Storage/Treatment Costs
- Sewer Decombination to Reduce Basement Backups
  - About 400 acres within CSO Basins 001, **004**, 005, 008, 010, 015, and 022
  - Pilot program to project CSO reduction
- Use Attainability Analysis (UAA)
- Stormwater Utility Development

Regulators will Evaluate Degree of CSO Control Achieved Based on:

- EPA Requirements:
  - **# CSOs per year remaining**
    - **4 CSOs/year**
    - **3 month event**

    OR
  - Typical year capture/treatment (85%)

    AND
  - Elimination of basement backups
- IEPA Requirements:
  - First Flush capture-storage (57 percent)
    - 1 year 1 hour storm
  - **Reduction of CSOs to sensitive areas**
    - **Potentially 001, 022 & 023**
    - **Up to 1 year event**
  - 10xDry Weather Flow

Regulators will Evaluate Degree of CSO Control Achieved Based on:

- EPA Requirements:
  - # CSOs per year remaining
    - 4 CSOs/year
    - 3 month event

    OR
  - **Typical year capture/treatment (85%)**

    AND
  - Elimination of basement backups
- IEPA Requirements:
  - First Flush capture-storage (57 percent)
    - 1 year 1 hour storm
  - Reduction of CSOs to sensitive areas
    - Potentially 001, 022 & 023
    - Up to 1 year event
  - 10xDry Weather Flow

How Does Control Alternative 1 Score Relative to 85 Percent Capture?

- **97 percent** >> 85 percent
- $237 Million (Capital Cost)

- How much can we save by controlling CSOs closer to 85 percent requirement
- Winnow out CSOs that offer the least "bang for the buck"
- Selection based on Present Value: Control Alternative 1: $233 Million*

Stepwise Reduction of CSO Control Costs

	Control Alternative			
CSO	1	2	3	4
001*	1 yr			
004	3 mo			
005	3 mo			
008	3 mo			
010	3 mo			
015	3 mo			
021	3 mo			
022*	1 yr			
023*	1 yr			
025	3 mo			
% Capture	97%			
Present Value	$233 M			

Stepwise Reduction of CSO Control Costs

	Control Alternative			
CSO	1	2	3	4
001*	1 yr	1 yr	1 yr	1 yr
004	3 mo	3 mo	3 mo	
005	3 mo			
008	3 mo	3 mo		
010	3 mo			
015	3 mo			
021	3 mo			
022*	1 yr	1 yr	1 yr	1 yr
023*	1 yr	1 yr	1 yr	1 yr
025	3 mo	3 mo	3 mo	3 mo
% Capture	97%	95%	92%	87%
Present Value	$233 M	$199 M	$176 M	$147 M

Any Other Options to Reduce Cost and Still Capture 85 Percent?

- What if possible sensitive area CSOs only required control to the 3-month level (rather than 1-year)
- Correspondence with IEPA suggests this is worth evaluating.

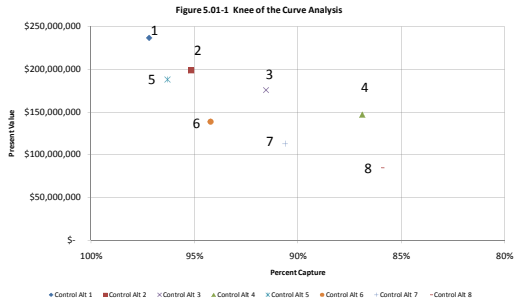
Stepwise Reduction of CSO Control Costs

	Control Alternative			
CSO	5	6	7	8
001*	3 mo			
004	3 mo			
005	3 mo			
008	3 mo			
010	3 mo			
015	3 mo			
021	3 mo			
022*	3 mo			
023*	3 mo			
025	3 mo			
% Capture	96%			
Present Value	$188 M			

Stepwise Reduction of CSO Control Costs

	Control Alternative			
CSO	5	6	7	8
001*	3 mo	3 mo	3 mo	3 mo
004	3 mo	3 mo	3 mo	
005	3 mo			
008	3 mo	3 mo		
010	3 mo			
015	3 mo			
021	3 mo			
022*	3 mo	3 mo	3 mo	3 mo
023*	3 mo	3 mo	3 mo	3 mo
025	3 mo	3 mo	3 mo	3 mo
% Capture	96%	94%	91%	86%
Present Value	$188 M	$139 M	$113 M	$85 M

Plotting These Values…

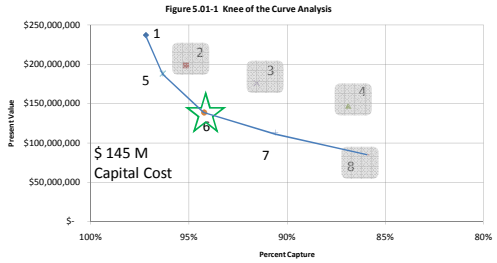


Which Do We Select as Our Recommended Alternative?

Considerations for Selecting Recommended Alternative

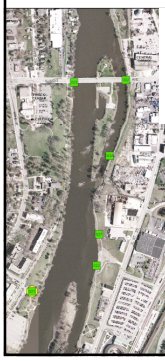
- > 85 Percent Capture
- Cost Effective for Volume Removal
- Where is the "Knee" of the Curve?

Selecting Recommended Alternative



- >85 percent
- Cost Effective for Volume Removal
- "Knee" of the Curve

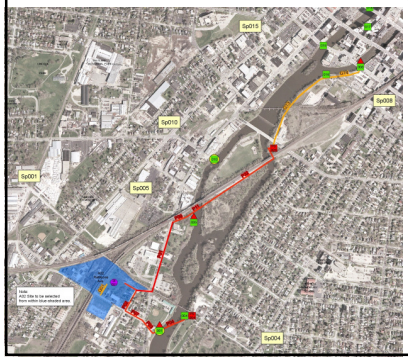
Control Alternative 6 - North Side:



- New 24"-36" Gravity Sewers at CSO 025
- Structure Modifications at 021 and 025
- Permanent Overflow Metering
- Decombining to alleviate Basement Backups (022)



Control Alternative 6 – South Side



- Conveyance of 001, 004, and 008 overflows to near CSO 001
- Screening and grit removal of all conveyed CSO
- Storage for 24 hour storm.
- Discharge to WWTP OR
- Treatment of storage
- Additional Programs:
  - Permanent CSO Metering
  - CSO Structures
  - Decombining
  - Etc.

Control Alternative 6 – 5% G.I. Allowance



Porous Pavements



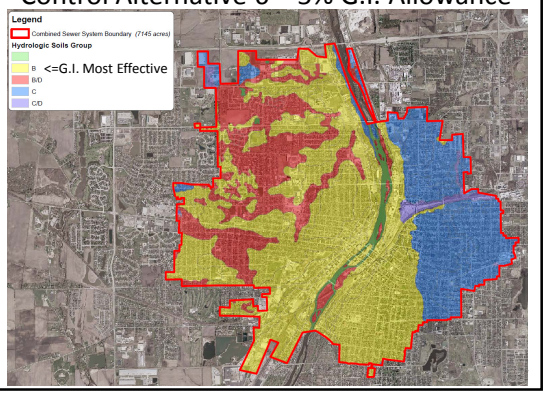
Street Planters



Dry Swales

- Water Quality Improvement
- Aesthetics
- "Visible" Portion of CSO Program

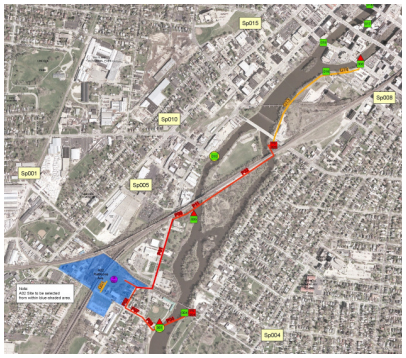
Control Alternative 6 – 5% G.I. Allowance



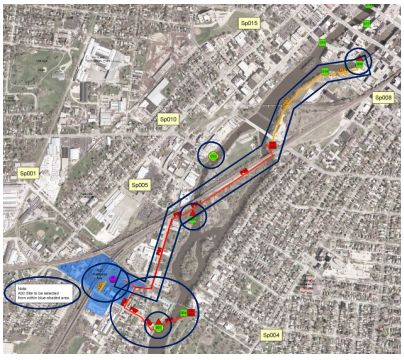
Implementation

- Group 1 - Early Action Projects (Could start anytime)
  - CSO Modifications and Telemetry
  - CSO 025 Gravity Improvements
  - Purchase Property for Storage Near 001
  - Decombination for Basement Backups
  - Initiate UAA
  - Develop Enhanced Stormwater Utility
- Group 2 (Dependent on LTCP Approval ~5 years)
  - Construct Screening and Storage Near 001.
- Group 3 (Dependent on LTCP Approval ~10 years)
  - PS for CSO 004
  - Treatment Near 001
- Group 4 (Dependent on LTCP Approval ~15 years)
  - CSO 008 Conveyance
- Group 5 (On-going)
  - Green Infrastructure

Implementation – South Side



Implementation – South Side



Overall Program Features

- Focuses $$ where CSO volumes are greatest.
- About 94 percent capture of total wet weather volume.
- Reduction of CSO Occurrences:

	2005-2008	Post-Gray "Infrastructure"
001	**26-48**	**4**
004	**10-20**	**4**
005	1-7	(same)
008	**5-16**	**4**
010	39-53	~20
015*	30-54	~20
018*	7-11	<1
025	1-7	<1

*Improvements already in place

Overall Program Features

- Includes Budget for Further Decombination Where Basement Backups Occur.
- Sets Aside an Allowance for G.I.
- Improves Real Time Response to CSOs.
- Results in Residential Customer Cost of $83/ Month (1.59% MHI)*

*Assumes $145M Aurora CSO, $41M Aurora CIP,
$150M Estimated FMWRD Improvements/future regulatory

Final Points and Thoughts

- Submittal of LTCP will begin a lengthy review and negotiation process with the IEPA (1-3 years).
- Key negotiations topics include level of control (total cost) and implementation schedule.
- While Control Alternative 6 and schedule is consistent with National CSO Control Policy, IEPA may want to add projects or shorten schedule to <20 years because rates<2% MHI.
- Negotiated LTCP will be incorporated into an "enforceable document" that commits Aurora to implement the program.

Discussion/Feedback

APPENDIX N
PUBLIC HEARING INFORMATION

PUBLIC MEETING

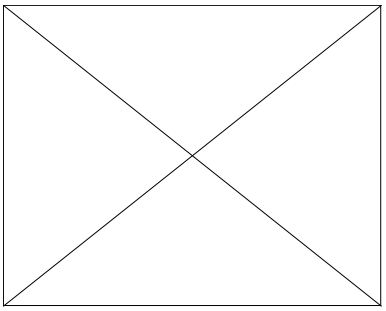
FEBRUARY 16, 2010

NAME	ADDRESS		ORGANIZATION
Scott Stearns	Madison, WI		Strand Associates
Bart Jones	Madison, WI		"
LEO PAWLOWSKI SR.	1861 CHURCH RD.	AURORA	N.E.N. Sierra club
LINDA A Cole	UNIT 3F 450 W. Downer Place	AURORA	Public
Fran Caffee	726 W Downer Pl	Aurora	AAC member
Chuck Nelson	235 LeGrande	Aurora	City Planner
ERIC SCHOONY	49 E. Downer	AURORA	CITY OF AURORA
Ken Schroth	44 E. Downer	Aurora	City of Aurora

Aurora CSO Long-Term Control Plan Presentation of Recommended Alternative

Public Meeting
February 16, 2010

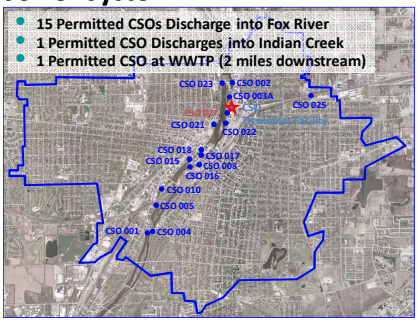
What are Combined Sewer Systems and How Do they Operate?



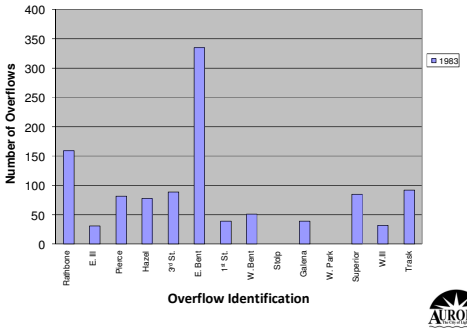
Courtesy of SD #1 of Northern Kentucky

City of Aurora and FMWRD Combined Sewer System

- 15 Permitted CSOs Discharge into Fox River
- 1 Permitted CSO Discharges into Indian Creek
- 1 Permitted CSO at WWTP (2 miles downstream)



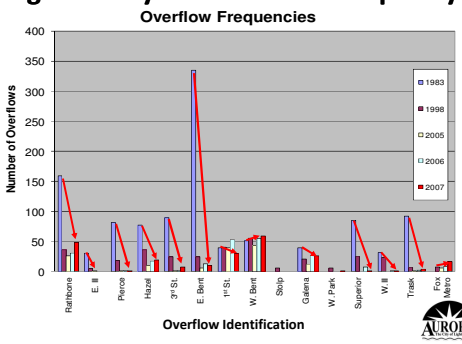
Historical Wet Weather Efforts Overflow Events in 1983



Significant Investment in Reducing Wet Weather CSOs

Description	Dollars (2008)
FMWRD Wet Weather Improvements	$ 22,800,000
CSO Facility	$ 17,600,000
Storm and Sanitary Improvement Projects	$168,400,000
TOTAL	$208,800,000

Improvements Completed so Far have Significantly Reduced CSO Frequency



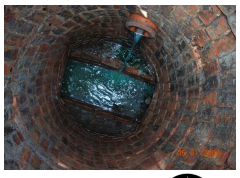
CSO Long Term Control Plan (LTCP)

2007 NPDES Permit Required Developing Complementary LTCP's for the City of Aurora and Fox Metro Water Reclamation District

Strand Associates, Inc (Engineering) and Barnes & Thornburg, LLP (Legal)

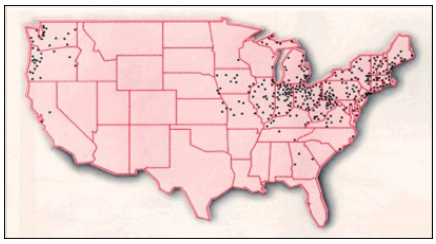
Plans are due to be submitted to the IEPA by April 1st 2010





You are not alone

- **Currently there are 772 CSO communities nation wide. There are approximately 100 CSO communities in Illinois.**



Regulatory Framework

- CSO control is not optional
- State bacteria standards are violated when CSOs discharge
- Clean Water Act requires NPDES permits that comply with state water quality standards
- Consequences of continued violations
  - State or federal enforcement actions
  - Enforcement orders for CSO control
  - Civil penalties
  - Criminal sanctions

Regulatory Framework

- EPA 1994 CSO Policy, incorporated into CWA
  - Dry weather overflows prohibited
  - Develop LTCP for wet weather overflow control
    - Sensitive areas receive special consideration
    - Reevaluate water quality standards through UAA process if necessary
    - Length of implementation period based on financial health and cost of project (%MHI)
  - Incorporate approved LTCP into NPDES permit to meet water quality standards

Permit History Driving CSO Abatement:

- ***Aurora*** **must implement the Nine Minimum Controls (NMCs) which are designed to reduce CSOs and their effects on water quality in the Fox River and Indian Creek – NLT Jan. 1, 1997**
- **Aurora must develop CSO LTCP to control CSOs – To be submitted to IEPA by April 2010**
- **Aurora must give CSO abatement priority to discharges into environmentally sensitive areas**
- **IEPA should consider the financial capability of Aurora when reviewing CSO LTCP**

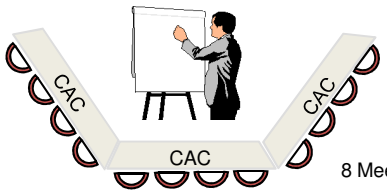
- 11

LTCP Includes the Following Components

- **Public Participation – Citizens Advisory Committee**
- **Sensitive Area Determinations**
- **Sewer System Characterization**
- **Recommended Plan**
- **Financial Capability Assessment**
- **Implementation Schedule**

- 12

Facilitated CAC Meetings



8 Meetings

CAC Members Will Include:

- Aldermen
- City Staff (Technical & Finance)
- NGO's
- FMWRD / WEDA
- General Public Representing Various Sections of Constituencies

Sensitive Area Determination Required in the LTCP

- **Area Sensitive if**
  - **Aquatic habitat for endangered or threatened species,**
  - **Shellfish beds,**
  - **Primary contact recreation,**
  - **Public drinking water source waters,**
  - **Outstanding national or state resource waters.**
- **IEPA asked us to reconsider 3 outfalls which may discharge to sensitive areas.**

- 14

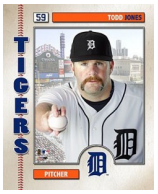
Sewer System Characterization

- **Sewer system characterization involved sewer system flow metering, rain gauging, and computer hydraulic model.**

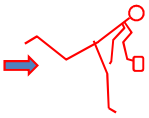
- 15

What is a Model?

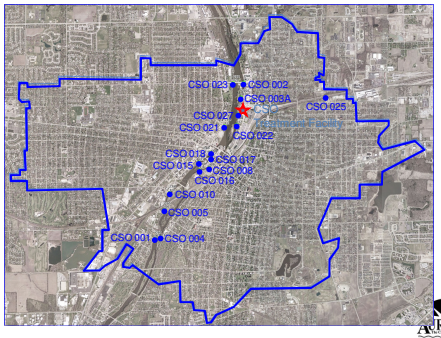
- A model is a simple representation of a complex system used to predict how that system would behave.



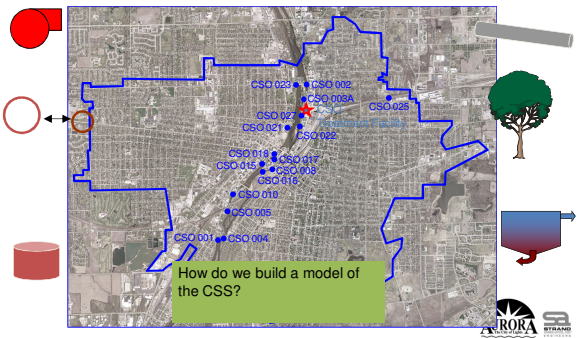




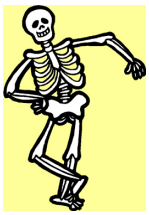
Why do we need a model of the CSS?



We have to construct improvements and a computer model helps us size them.

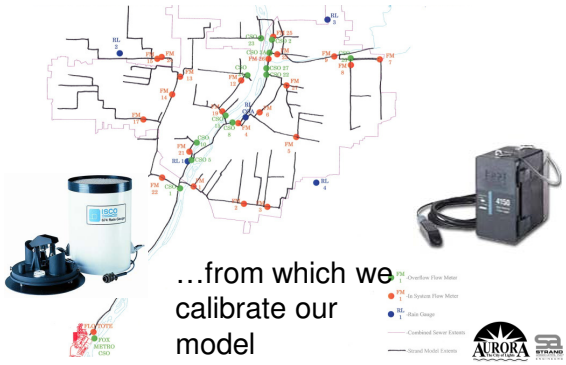


Understand what we have, Then Simplify It…



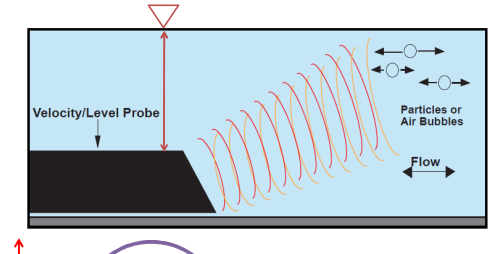
- Create a skeleton of the system
  - Model pipe sizes >= 18 inches
  - Eliminates significant percentage of pipes
- Break the system into manageable parts
  - Basins and subbasins
- "Cluster" Stormwater and Sanitary Inputs

Flow Meter and Rain Gauge Installation



…from which we calibrate our model

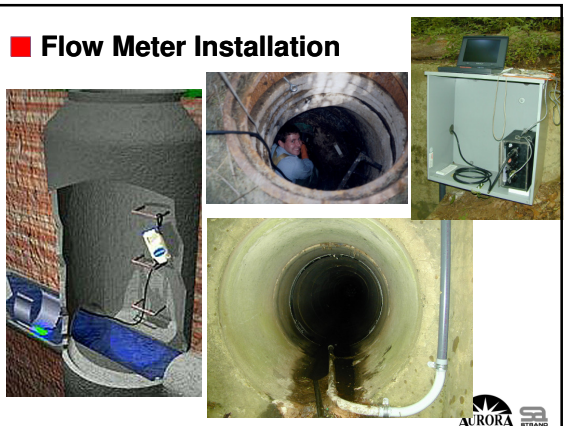
How a Flow Meter Works



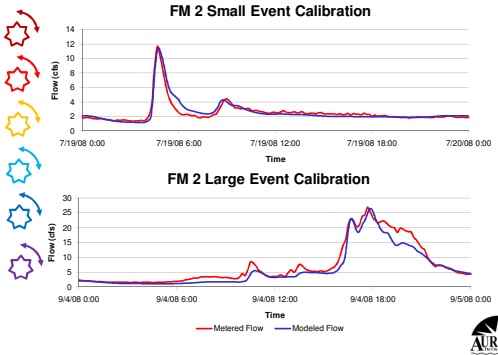
Flow Area (sf) x Velocity (fps) = Flow Rate (cfs)

ISCO

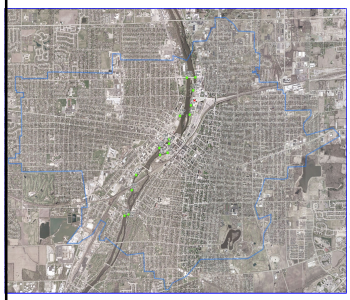
Flow Meter Installation



Model Calibration – Wet Weather



Hundreds of Alternatives Evaluated



- Larger Interceptors
- New pumping stations and forcemains
- New treatment factilities
- Storage
- Treatment

Privileged & Confidential

Recommend Control Alternative - North Side:



- New 24"-36" Gravity Sewers at CSO 025
- Structure Modifications at 021 and 025
- Permanent Overflow Metering
- Sewer Separation to alleviate Basement Backups

Recommended Control Alternative – South Side

- Conveyance of 001, 004, and 008 overflows to near CSO 001
- Screening and grit removal of all conveyed CSO
- Storage for 24 hour storm.
- Discharge to WWTP
- Additional Programs:
  - Permanent CSO Metering
  - CSO Structures
  - Sewer Separation

Recommended Control Alternative – 5% Green Infrastructure Allowance



Porous Pavements



Street Planters



Dry Swales

- Water Quality Improvement
- Aesthetics
- "Visible" Portion of CSO Program
- 319 Grants
- Stimulus Funds – McCarthy Park

Recommended Alternative

Group No.	Projects	Project Capital Costs
1	Early Action Projects	$8,890,000
2	CSO 001 Storage	$49,113,000
3	CSO 001 Treatment and CSO 004 PS/FM	$26,930,000
4	CSO 008 PS/FM	$21,219,000
5	Green Infrastructure	$4,973,000
6	Sewer Separation	$39,420,000
	Total	$150,545,000

Implementation

- Group 1 - Early Action Projects (Could start anytime)
  - CSO Modifications and Telemetry
  - CSO 025 Gravity Improvements
  - Separation for Basement Backups
  - Initiate UAA
  - Develop Enhanced Stormwater Utility
- Group 2 (Dependent on LTCP Approval ~5 years)
  - Construct Screening and Storage Near 001.
- Group 3 (Dependent on LTCP Approval ~10 years)
  - PS for CSO 004
  - Treatment Near 001
- Group 4 (Dependent on LTCP Approval ~15 years)
  - CSO 008 Conveyance
- Group 5 (On-going)
  - Green Infrastructure

Overall Program Features

- Includes Budget for Further Sewer Separation Where Basement Backups Occur.
- Sets Aside an Allowance for Green Infrastructure
- Improves Real Time Response to CSOs.

SUN-TIMES MEDIA
Certificates of Publication

CITY OF AURORA
2010 FEB 17 AM 8:45
PURCH. DEPT.

State of Illinois – County of ☐ Cook ☒ Kane ☐ Lake ☐ McHenry
☐ DuPage ☐ Will ☐ DeKalb ☐ Kendall ☐ Grundy

Sun-Times Media, does hereby certify it has published the attached advertisements in the following secular newspapers. All newspapers meet Illinois Compiled Statue requirements for publication of Notices per Chapter 715 ILCS 5/0.01 et seq. R.S. 1874, P728 Sec 1, EFF. July 1, 1874. Amended By Laws 1959, P1494, and EFF.July 17, 1959. Formerly Ill. Rev. Stat. 1991, CH100, RL.

Note: Legal Notice appeared in the following checked positions.

PUBLICATION DATE(S): 2-12-10

1 time

☒ **The Beacon News**
☐ **The Courier News**
☐ **The Herald News**
☐ **The Lake County News-Sun**
☐ **The Naperville Sun**
☐ **The SouthTownStar**
☐ **The Chicago Sun-Times**
☐ **Pioneer Press/The Doings**

The City of Aurora is in the process of completing a Combined Sewer Overflow Long Term Control Plan (CSO LTCP). The CSO LTCP is a requirement of the National Pollutant Discharge Elimination System permit that has been issued to the City of Aurora by the Illinois Environmental Protection Agency. The CSO LTCP will be presented to the public on February 16, 2010 at 7:30 p.m. at City Hall, 44 E. Downer Place Aurora IL, 60507, 5th floor, conference room A. Any questions should be directed to the attention of Eric Schoeny with the City of Aurora's Engineering Division at 630-844-3620.
988149 Pub: 2/12/2010

Weekly Papers

☐ **Batavia Sun**
☐ **Bolingbrook Sun**
☐ **Downers Grove Sun**
☐ **Fox Valley Villages Sun**
☐ **Geneva Sun**
☐ **Glen Ellyn Sun**
☐ **Homer Township/Lockport/Lemont Sun**
☐ **Lincoln Way Sun**
☐ **Lisle Sun**
☐ **Plainfield Sun**
☐ **St. Charles Sun**
☐ **Wheaton Sun**

IN WITNESS WHEREOF, the undersigned, being duly authorized, has caused this Certificate to be signed and its official seal affixed at Aurora, Illinois.

OFFICIAL SEAL
KIMERY S FRANZEN
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:10/16/12

By

John G. Bieschke
Legal Advertising Manager (Official Title)

Subscribed and sworn to before me this 15th Day of Feb A. D. 2010

By: _____ Notary Public

APPENDIX O
SENSITIVE AREA INFORMATION

APRIL 1997 SENSITIVE AREA ANALYSIS (54 PAGES)

WALTER E. DEUCHLER ASSOCIATES INC.
Consulting Engineers
230 WOODLAWN AVENUE • TELEPHONE (630) 897-4651 • FAX (630) 897-5696
AURORA, ILLINOIS 60506

April 8, 1997

Mr. Dean Studer
Illinois Environmental Protection Agency
Division of Water Pollution Control
1001 N. Grand Ave. East
Springfield, IL 62702

RE: City of Aurora NPDES Permit No. IL0048518
Phase I - Sensitive Area Determination
W.E.D.A. Job #111-94061-00

Dear Dean:

On behalf of the City of Aurora, we are pleased to transmit herewith two (2) copies of the report titled "Phase I Determination of Sensitive Areas Near CSO Discharge Points." This report has been prepared in accordance with Special Condition 1, Part 7 of the above referenced permit.

Should you have any questions regarding the enclosed information, please contact the undersigned.

Very truly yours,

WALTER E. DEUCHLER ASSOCIATES, INC.

Jodi Rose

Jodi Rose

JR/mw

Encl.

cc: Tom Muth, Fox Metro WRD, w/Encl.
Steve Andras, Fox Metro WRD, w/Encl.
Peter Haurykiewicz, City of Aurora, w/Encl.
Philippe Moreau, WEDA, w/Encl.

PHASE I
DETERMINATION OF SENSITIVE AREAS NEAR CSO DISCHARGE POINTS

CITY OF AURORA

March 1997

NPDES Permit No. IL 0048515

Prepared by:

Walter E. Deuchler Associates, Inc.
Aurora, Illinois

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- 3.3 LAND USE NEAR CSO OUTFALLS
- 3.4 USE ATTAINMENT OF THE FOX RIVER BASIN
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Exhibit A: Major Elements of CSO System

Exhibit B: Areas Tributary to OVF No. 1

Exhibit C: Areas Tributary to OVF No. 2

Exhibit D: Areas Tributary to OVF No. 3

Exhibit E: Areas Tributary to OVF No. 4

Exhibit F: Areas Tributary to OVF No. 5

Exhibit G: Areas Tributary to OVF No. 8

Exhibit H: Areas Tributary to OVF No. 10

Exhibit I: Areas Tributary to OVF No. 15

Exhibit J: Areas Tributary to OVF No. 16A

Exhibit K: Areas Tributary to OVF No. 17

Exhibit L: Areas Tributary to OVF No. 18

Exhibit M: Areas Tributary to OVF No. 21

Exhibit N: Areas Tributary to OVF No. 22

Exhibit O: Areas Tributary to OVF No. 23

Exhibit P: Areas Tributary to OVF No. 25

Exhibit Q: Degree of Use Attainment for the Fox River Basin: 1992-1993

Exhibit R: Degree of Use Attainment for the Fox River Basin: 1994-1995

PART 1

SUMMARY OF STUDY AND CONCLUSIONS

1.0 SUMMARY OF STUDY AND CONCLUSIONS

1.1 Purpose of Study

This report was prepared in accordance with requirements contained in the City of Aurora NPDES Permit No. IL0048518. The purpose of this study is to determine if any of the Combined Sewer Overflow (CSO) outfalls listed in the NPDES permit discharge to sensitive areas. In the 1994 CSO Control Policy Section II.C.3, the USEPA defines a sensitive area as a receiving stream which has any of the following designated uses:

1. Outstanding National Resource Waters, or
2. National Marine Sanctuaries, or
3. Waters with threatened or endangered species or their designated critical habitat, or
4. Primary contact recreation waters, or
5. Public drinking water intakes or their designated protection areas, or
6. Shellfish beds

All Aurora CSO outfalls discharge into the Fox River except for one which discharges into the Indian Creek. Based on the characteristics of these two waterbodies, only item (4) above is a designated use of these streams. For this reason, the primary factor in determining which CSO outfalls are located in sensitive areas is the recreational use of the receiving stream near the CSO outfall.

1.2 Summary of Study

In order to determine which CSO outfalls in the City of Aurora discharge to sensitive

areas, the following two characteristics were evaluated:

1. Recreational use of the receiving stream in the vicinity of the outfall
2. Land use in the vicinity of the outfall

Special Condition No. 1, Part 7 of the City's NPDES permit states that if a CSO location is found to discharge to a sensitive area, then additional CSO controls may be required to protect the area. In light of this condition, this report further evaluated any CSO outfalls located in sensitive areas in order to determine if additional CSO controls were necessary. This second evaluation considered the following characteristics:

1. Use attainment of the receiving stream as determined by the IEPA Illinois Water Quality Reports of 1992 and 1994
2. Size of the tributary area to the overflow
3. Annual discharge frequency and volume of the overflow
4. Near term control projects for the overflow.

1.3 Conclusions

Part 4 of this report discusses in detail each CSO in the City of Aurora and the sensitivity of its locale. The results of this analysis are summarized as follows:

1. Nine CSO outfalls do not discharge to sensitive areas for the following reasons:
    a) The outfall is located in a highly industrialized area, and/or
    b) There is no evidence of recreational activity such as fishing, swimming, sports activity, parks, trails, etc., in the vicinity of the outfall.

These CSO outfalls are: Overflow Nos. 3, 5, 8, 10, 15, 16A, 17, 18, and 25.

2. Three CSO outfalls discharge to sensitive areas, but "additional CSO controls" will not be required because these three CSOs will be subject to major improvements within the next two years. These major improvements include:

    a) Screening, primary treatment, disinfection and dechlorination of combined flows up to ten times the average dry weather flow.

    b) Reduction of overflow discharge frequency to 4 events per year.

    c) Full screening prior to discharge.

These CSO outfalls are Overflow Nos. 2, 4, and 22.

3. Finally, three CSO outfalls which discharge to sensitive areas may require, by definition, "additional CSO controls", but for which we do not recommend additional improvements for the following reasons:

    a) The IEPA Illinois Water Quality Reports of 1992 and 1994 concluded that the Fox River within the Aurora limits supports all designated uses such as fishing and swimming. One can therefore conclude that the CSO's do not impact the recreational uses of the river, thus additional CSO controls are not necessary.

    b) Two of the outfalls are considered minor overflows and a discharge limited volume of combined flows to the river.

    c) One of the outfalls is laid in the bedrock to the middle of the river for maximum dispersion of the combined flows.

These CSO outfalls are Overflow Nos. 1, 21, and 23.

PART 2

DESCRIPTION OF THE COMBINED SEWER SYSTEM

2.0 DESCRIPTION OF THE COMBINED SEWER SYSTEM

The Aurora Combined Sewer System (CSS) encompasses approximately 7,230 acres. There are 15 permitted overflow points within the limits of the City of Aurora CSS and one outside City limits. The CSS is served by the East and West Bank Interceptor which transports combined and separated wastewater flows to the Fox Metro wastewater treatment plant. All combined sewer overflows discharge into the Fox River, except for one which discharges into the Indian Creek tributary to the Fox River.

The City of Aurora owns and operates 14 of the CSOs. The Fox Metro Water Reclamation District owns two of the CSO diversion structures (Overflow No. 4 and the overflow located at the WWTP). The East and West Bank Interceptor located along the Fox River and the separated sanitary sewers with a diameter greater than 15 inches are owned and maintained by the Fox Metro WRD. All remaining sanitary and combined sewers are owned and maintained by the City of Aurora. A diagram of the CSS and tributary areas is included as Exhibit A.

Overall, the CSS can be described as being in fair condition. Due to the age of the system, some parts of the system admit large amounts of infiltration. In order to increase the capacity of the East and West Bank Interceptor, the City of Aurora and Fox Metro jointly administered massive I & I reduction programs in the 1980's and 1990's. These programs, which are still administered today, consist of ongoing I & I studies, sewer televising, flow monitoring, spot repairs, sewer rehabilitation or replacement, and sewer separation. A listing, description, and cost allocation of these I & I reduction programs can be provided to the Agency upon request.

PART 3

SYSTEM SURVEY

3.0 SYSTEM SURVEY

3.1 Background on CSO Outfalls and Tributary Areas

There are 15 permitted CSO discharge points within the limits of the City of Aurora. Table 1 lists these outfalls and the streams to which they discharge. Exhibits B through P delineate the area tributary to each separate outfall and the extent to which these areas are served by combined and/or separated sanitary sewers. The size of each tributary area is summarized in Table 2.

3.2 Recreational Use of Receiving Stream Near CSO Outfalls

As mentioned in Section 1.1, the main determining factor used to analyze the sensitivity of a CSO location was the recreational use of the receiving stream near the outfall. Assessing the recreational use of a stream was difficult since very little data is available on local use patterns. For this analysis, the recreational use of a stream was based on knowledge of local use of the streams and an assessment of factors which may influence these uses. Factors which may influence the recreational usage of a stream include:

1. Surrounding buildings and land use (i.e.: industrialized areas are not suited for recreational use)
2. Stream accessibility
3. Existing dangers such as dams, strong current, etc.

These factors, as well as consideration of areas known to support recreational activities, were considered when ascertaining recreational use trends near outfall locations.

3.3 Land Use Near CSO Outfalls

The land use in the vicinity of each overflow is summarized in Table 3. This information was collected from City of Aurora zoning maps and field inspections of the outfall locations. The land use was categorized as follows: residential, recreational, agricultural, commercial, and/or industrial. Sensitive areas were those located near recreational zones. Six of the 15 outfalls are located in the vicinity of recreational areas: Overflow Nos. 1, 2, 4, 21, 22 and 23.

3.4 Use Attainment of the Fox River Basin

Once every two years the IEPA conducts a comprehensive water quality study of all major waterbodies in the State of Illinois in order to report to the USEPA on the water quality and use attainment of the State's waterbodies. The water quality studies performed on rivers and streams consist of fishery surveys, habitat assessments, water and sediment analytical data, macroinvertebrate and aquatic life studies, bacteriological data, and statistics on the number of public advisories issued against fishing or swimming. Using this data, the IEPA makes a determination on the degree of use attainment of the rivers.

The results of the water quality studies are published by the IEPA in a report titled "Illinois Water Quality Report" (IWQR). The IWQR lists the following definitions of use attainment categories for summarizing the water quality:

1. Full Support - The water quality meets the needs of all designated uses protected by applicable water quality standards.
2. Full Threatened - Water quality is presently adequate to maintain designated uses, but if a declining trend continues, only partial support may be attained

in the future.

3. Partial Support/Minor Impairment - Water quality has been impaired, but only to a minor degree.

4. Partial Support/Moderate Impairment - Water quality conditions are impaired to a greater degree inhibiting the waterbody from meeting all the needs for that designated use.

5. Nonsupport - Water quality is severely impaired and not capable of supporting the designated use to any degree.

Data from two IWQRs are used in this report to demonstrate that the Aurora CSOs do not negatively impact the recreational use attainment of the Fox River:

1. 1992-1993 Illinois Water Quality Report, and

2. 1994-1995 Illinois Water Quality Report.

The IWQRs include a diagram delineating the use attainment ratings assigned to the various waterbodies in the Fox River basin. These diagrams have been duplicated and are included as Exhibits Q and R in this report. As shown on both diagrams, the Fox River from the State of Wisconsin to the Illinois River was rated as "Full Support" with an exception to minor impairments in a few locations. All of the locations where the Fox River suffered minor impairments were located upstream of the City of Aurora. The stretch of the Fox River through Aurora and downstream to the Illinois River was noted as fully supporting all designated uses. Based on this data, it can be concluded that the Aurora CSOs are not impacting the water quality of the Fox River to an extent which impairs use attainment.

It is worth noting that the "Indian Creek" delineated on the exhibits is located in

LaSalle County, with no relation to the Indian Creek (not shown on the exhibits) located in the southeastern part of Kane County.

3.5 Size of CSO Tributary Areas

The CSS and separated sewer areas tributary to the CSO outfalls encompass 7,230 acres, of which 3,430 acres are served by combined sewers and 3,800 are served by separated sewers (see Table 2). The largest drainage areas are tributary to Overflow Nos. 1 and 8 with 2,490 and 2,200 acres respectively.

The CSOs with the largest contributions from combined sewer areas are Overflow Nos. 1 and 4 with 1100 and 700 acres respectively. These two outfalls are therefore contributing the most combined sewer discharges to the Fox River.

3.6 Discharge Frequency and Volume

The discharge frequency and volume data used in this analysis was based on CSO monitoring and modeling performed in 1983 and 1990. A report prepared by this office in 1983 for Fox Metro WRD (which at the time was called The Aurora Sanitary District) titled "The Aurora Sanitary District Combined Sewer Overflow Study" summarized a study of CSO discharge frequency, volume, flows, and loadings at most CSO locations. The Hydrocomp computer model was used by the Northeastern Illinois Planning Commission (NIPC) to mathematically calculate annual pollutant loads to the Fox River and Indian Creek through CSO discharges. The model was also used to evaluate the effectiveness of alternative construction improvements to reduce these loads.The 1983 monitoring data and the model projection for the construction alternative selected (Alternative D) are summarized in Table 4.

Upon construction of the improvements in Alternative D, a performance monitoring analysis was performed on the four major overflows (Overflow Nos. 1, 4, 8 and 25) to verify that the construction improvements were successful in reducing pollutant loads as the computer model had projected. The results of the study revealed major decreases in overflows at three of the major overflow discharge points (Overflow Nos. 4, 8 and 25) as shown in Table 4. Overflow No. 1 was the only major overflow that did not meet the objectives of the computer model. The reason for not achieving the reduction in overflow volume and frequency can be attributed to the size of the combined sewer area tributary to Overflow No. 1. The size of the combined sewer area tributary to Overflow No. 1 used in the Hydrocomp model was 550 acres. In this report, we have concluded that the combined sewer areas tributary to Overflow No. 1 total 1,100 acres. This difference in acreage could explain the large discrepancy in the overflow results.

In any case, as previously stated, performance monitoring at three of the major overflows showed that the actual conditions were comparable to the model simulation. Based on this information, one can assume that the discharge frequencies and volumes for the remaining minor overflows are fairly consistent with the model predictions. Therefore, the 1983 model predictions and 1990 performance monitoring data can be used as the discharge frequency and volume data for this analysis until sufficient overflow data are compiled from the new Discharge Monitoring Reports.

3.7 Proposed CSO Controls

Special Condition 1, Part 7 of the City's NPDES permit states that if a CSO location discharges to a sensitive area, additional CSO controls may be required to protect the area. For

this reason, it is important to consider proposed CSO controls when identifying sensitive areas so that emphasis is placed on overflows which have not yet received controls instead of overflows for which controls have been planned.

Currently, the City and Fox Metro are undertaking two major CSO control projects. The first project is the construction of a 21.8 MGD CSO Treatment Facility and the second is the installation of a bar screen. Three overflow points listed in Table 3 as "recreational areas" will be improved by these CSO control projects as follows:

1. Overflow No. 2 - Ten times the average dry weather flow will be re-routed to the new CSO Treatment Facility for screening, primary treatment, disinfection and dechlorination.
2. Overflow No. 22 - Combined flows will be re-routed to the new CSO Treatment Facility for full screening prior to discharge. As a result, CSO discharges from this outfall will be reduced to 4 events per year.
3. Overflow No. 4 - The installation of a mechanical bar screen will provide screening up to 92 MGD peak combined flows prior to discharging to the river.

Finally, Overflow No. 3 will also benefit in the same magnitude as Overflow No. 2 even though it is not located in a recreational area.

PART 4

DISCUSSION OF OVERFLOW LOCATIONS

4.0 DISCUSSION OF OVERFLOW LOCATIONS

4.1 Overflow No. 1 (Rathbone)

Overflow No. 1, located at Rathbone Avenue and River Street, is one of the four major overflows in the Aurora CSS. The size of the tributary area is approximately 2,490 acres, of which 1,100 acres are served by combined sewers and 1,390 acres are served by separated sewers. This is the largest tributary area of all the overflows. At the overflow diversion structure, the 96 inch combined sewer discharges dry weather flow plus part of its wet weather flow into the 69 inch East and West Bank Interceptor via two 15 inch concrete pipes. Excess wet weather flows are discharged into the river via an outfall pipe laid in the bedrock of the river extending approximately 150 linear feet into the center of the Fox River. Overflow No. 1 is the most downstream overflow in the CSS.

In the vicinity of the outfall location there are recreational and commercial areas. A public park is located on both sides of the river at this location and a boat launch pad is located roughly 150 feet downstream of the outfall. Commercial enterprises are located on the west side of River Street, which is set back roughly 400 feet from the west bank of the river. These businesses include a restaurant, gas station, warehouse, and two furniture retail stores. Based on the recreational surroundings, one could conclude that this outfall is located in a sensitive area.

We feel that additional controls are not necessary at Overflow No. 1 based on data extracted from the 1992 and 1994 IWQRs. Exhibits Q and R, taken from the IWQRs, summarize the water quality and degree of use attainment throughout the Fox River basin.

As shown on both diagrams, the only stretches of the Fox River which were not rated as fully supporting the designated uses were areas located upstream of the Aurora CSS. The stretch of the Fox River which travels through the City of Aurora was rated as "Full Support" indicating that the water quality was very good and did not stifle use attainment in this area. Furthermore, the entire river downstream of the Aurora CSS was rated as fully supporting the designated uses. As mentioned in Section 3.4, these ratings are based on comprehensive water quality data, numerous aquatic life studies, and the number of fishing/swimming advisories issued. Clearly this comprehensive data demonstrates that the Aurora CSOs do not impact recreational use of the river. Therefore, it was concluded that additional controls are not necessary for Overflow No. 1.

4.2 Overflow No. 2 (E. Illinois)

Overflow No. 2 is located just south of the Illinois Avenue bridge on the east bank of the east branch of the Fox River. The size of the tributary area is only 40 acres, all of which are served by combined sewers. Dry and part of the wet weather flows are conveyed via an 8 inch cast iron pipe to the 30 inch East and West Bank Interceptor. Excess wet weather flows discharge into a 24 inch cast iron pipe to the river.

This outfall is surrounded primarily by public parks, although there are some industrial and commercial areas as well. The Fox Valley Park District (FVPD) bike trail meanders along the river side here and occasionally fisherman have been observed fishing from the banks.

This overflow can be considered a sensitive area since it is located in a recreational area. However, OVF No. 2 is a "minor" overflow with an annual discharge volume of only

2 MGD which accounts for less than 1% of the total CSS discharge volume (see Table 4). Furthermore, this overflow will be "controlled" in 1998-1999 by conveying ten times average dry weather flow to a new downstream CSO Treatment Facility. For these reasons, it was concluded that additional CSO controls are not necessary for Overflow No. 2.

4.3 Overflow No. 3 (Pierce St.)

This overflow is located at the dead-end of Pierce Street, with its outfall submerged and hidden behind heavy vegetation along the east bank of the river. The surroundings can be categorized as industrial and commercial. Next to the diversion structure are a scrap lumber yard, an automotive junkyard, and a retail outlet for used auto parts.

The tributary area for this overflow is estimated at 700 acres and includes the area tributary to Overflow No. 25 (See Exhibits D and P).

The discharge frequency at Overflow No. 3 will be reduced significantly following construction of the new CSO Treatment Facility and new CSO interceptors.

Based on the industrial surroundings of the outfall location it was concluded that the outfall of Overflow No. 3 is not located in a sensitive area.

4.4 Overflow No. 4 (Hazel Ave.)

Overflow No. 4 is one of the major overflows in the CSS. It is located on the east bank of the Fox River just south of the old railroad trestle across Hazel Avenue. This overflow has a tributary area of 810 acres, of which 700 acres are served by combined sewers. A 78 inch segmental combined sewer conveys the wastewater flows to the diversion structure. Dry and part of wet weather flows are transported through two siphon tubes under the Fox River to the East and West Bank Interceptor on the west side of the river. Excess

wet weather flows are discharged into the river through a 48 inch x 52.4 inch pipe. This structure is planned to be reconstructed in 1998 with a mechanical screen able to screen 92 MGD as discussed in Section 3.7.

Overflow No. 4 is located approximately 500 feet upstream of Overflow No. 1 on the opposite side of the river. The outfall itself is situated in a remote location, but a large public park is located roughly 100 feet downstream. Since this outfall is located just upstream of a public park, one could conclude that it is in a sensitive area.

As previously mentioned, the discharge of overflows at Overflow No. 4 will be controlled with the installation of an automated bar screen able to handle all combined flows. This CSO control will greatly reduce the amount of debris discharged into the Fox River. For this reason, it was concluded that additional CSO controls are not necessary for Overflow No. 4.

4.5 Overflow No. 5 (Third)

This overflow is located just south of the intersection of River Street and Third Street in a highly industrial section of Aurora. The tributary area is approximately 50 acres, of which 40 acres are served by combined sewers. The outfall is located on the west side of the river behind several industrial plants and warehouses, and is half submerged among heavy vegetation.

Due to the small size of the tributary area and the industrial surroundings of the outfall, it was concluded that the outfall of Overflow No. 5 is not located in a sensitive area.

4.6 Overflow No. 8 (E. Benton)

Overflow No. 8 is located on the east bank of the Fox River on the south side of Benton Street and is one of the four major overflows in the Aurora CSS. At this junction, dry and part of the wet weather flows from a 72 inch combined sewer are conveyed to the 54 inch East and West Bank Interceptor. Excess wet weather flows overflow a 23 foot long dam into the Fox River. The tributary area for Overflow No. 8 is the second largest of the CSS with 2,200 acres. As a result of numerous sewer separation projects, only 350 acres of this tributary area are presently served by combined sewers while the remaining areas are served by separated sewers.

This outfall is located in the downtown area which is highly commercial and industrial. Surrounding businesses include governmental offices, a municipal parking lot, an automotive service shop, and the Aurora Public Library. At this particular location, the banks of the Fox River consist of manmade retaining walls which extend 8 to 10 feet in height above the water surface. These tall walls as well as strong river current make it very difficult to access the river for recreational purposes.

Based on the above, it was concluded that the outfall of Overflow No. 8 is not located in a sensitive area.

4.7 Overflow No. 10 (First)

The diversion structure for Overflow No. 10 is located at the intersection of River Street and First Street, two blocks north of Overflow No. 5. The structure collects flows from two combined sewers, sized 12 inch and 27 inch. Dry and part of wet weather flows exit the structure through a 16 inch cast iron pipe to the main interceptor. Excess wet

weather flows are discharged to the river via a 27 inch outfall pipe.

The tributary area to Overflow No. 10 is approximately 130 acres. Similar to Overflow No. 5, this outfall is located on the west side of the river in a highly industrial area. Surrounding businesses include a natural gas production plant, electrical and furniture retail outlets, steel fabrication plant and a dry cleaning plant.

Based on the above, it was concluded that the outfall of Overflow No. 10 is not located in a sensitive area.

4.8 Overflow No. 15 (W. Benton)

Overflow No. 15 is located on West Benton Street. The diversion structure conveys dry and part of the wet weather flows from a 42 inch pipe into a 24 inch cast iron pipe which siphons flows across the Fox River to the East and West Bank Interceptor. Excess wet weather flows are bypassed over a dam into the river in the abutment wall of the West Benton Street bridge. The size of the tributary area is roughly 400 acres, which includes the tributary area of Overflow Nos. 18 and 21 (see Exhibits I, L, and M).

The outfall is located in the downtown area in highly industrial and commercial areas. Recreational use of the river at this location is virtually impossible due to inaccessibility. The banks of the river are very steep and are littered with broken bottles and other debris.

Based on the above, it was concluded that the outfall of Overflow No. 15 is not located in a sensitive area.

4.9 Overflow No. 16A (Clark)

This newly permitted overflow was the result of recent construction of the Clark Street pump station in downtown Aurora to replace the previous pump station on Stolp Island

(former Overflow No. 16). The new pump station is located at the corner of Clark Street and Industrial Drive in a former industrialized part of the City. This section of land can be categorized as "brownfield" because of old, vacant, dilapidated industrial buildings in the area. The riverfront is also in poor condition and is inaccessible. Recreational use of the river at this location is non-existent.

Based on the outfall surroundings, it was concluded that the outfall of Overflow No. 16A is not located in a sensitive area.

4.10 Overflow No. 17 (Stolp)

Overflow No. 17 is located in the west abutment wall of Stolp Island between Galena Boulevard and Downer Place. The diversion structure consists of an 18 inch combined sewer discharging into a 12 inch combined sewer via a 6 inch drop connection. When the overflow connection was originally constructed, a flap valve was installed on the overflow discharge pipe. This flap valve was found to be deficient and was replaced in 1996 with a rubber tide flex to prevent the backflow of river water into the sewer.

The tributary area for Overflow No. 17 is only 10 acres, the smallest tributary area of the CSS. This overflow is located in the downtown area surrounded by governmental, commercial, and apartment buildings. There are no public parks along the river in this area. High abutment walls on which buildings have been built, render the river inaccessible, minimizing recreational use of the stream.

Based on the above, it was concluded that the outfall of Overflow No. 17 is not located in a sensitive area.

4.11 Overflow No. 18 (W. Galena)

The diversion structure for Overflow No. 18 is located at the intersection of River Street and Galena Boulevard. The structure collects flows from three combined sewers, sized 24 inch, 12 inch and 8 inch. Excess wet weather flows discharge into an 18 inch outfall pipe. The outfall is located in the abutment wall of the West Galena bridge. Dry and part of the wet weather flows are conveyed southerly via a 24 inch pipe on River Street to Benton Street, then easterly to the diversion structure of Overflow No. 15.

The tributary area to this overflow is roughly 40 acres, all of which are served by combined sewers. The outfall is located in the commercialized downtown area. As with Overflow No. 17, primary contact recreational use of the river in the downtown area is restricted due to difficulties accessing the river.

Based on the above, it was concluded that the outfall of Overflow No. 18 is not located in a sensitive area.

4.12 Overflow No. 21 (Elm)

Overflow No. 21 is located at the intersection of Elm Street and River Street. The tributary area to this overflow is approximately 150 acres served only by combined sewers. At this junction, dry and part of the wet weather flows from a 27 inch combined sewer are conveyed via an 8 inch pipe to Overflow No. 18 on Galena Boulevard. Excess wet weather flows are diverted over a dam into the river.

The outfall for this overflow is submerged in the bank of the river. The surroundings include a large public park along the river's edge, the Aurora Police Department and apartment buildings. A gambling casino boat is docked roughly 1/4 mile downstream from

the outfall point.

For these reasons, one could conclude that this outfall is located in a sensitive area. However, since Overflow No. 21 is considered a "minor" overflow in the CSS and since the river fully supports all designated uses as reported in the 1992 and 1994 IWQRs, it was concluded that additional controls are not necessary for Overflow No. 21.

4.13 Overflow No. 22 (Superior)

The diversion structure for Overflow No. 22 is located inland roughly 1/4 mile east of the Fox River at the intersection of Superior Street and Lincoln Avenue. Dry and part of the wet weather flows are conveyed from a 48 inch combined sewer into a 24 inch pipe running southerly on Lincoln Avenue, eventually discharging into the 72 inch combined sewer at Overflow No. 8. Excess wet weather flows are diverted over a dam into a 48 inch outfall crossing the railroad tracks and Broadway Avenue into the Fox River. The outfall pipe extends 15 feet into the river under the water surface.

The tributary area to Overflow No. 22 is 250 acres, of which 200 acres are served by combined sewers. The outfall is located in an industrial area with an iron works warehouse and numerous automotive repair/recycling shops in the vicinity of the outfall. The property immediately east of the outfall location is the future site of a new CSO Treatment Facility. This site, a former junkyard, was jointly purchased in 1996 by the City and Fox Metro WRD and a massive environmental clean-up of the property was performed to make it suitable for the CSO Treatment Facility. After construction of the new facility, this site will be landscaped as a large public park. Based on the future plans for this site, one can conclude that this outfall will be located in a sensitive area.

As part of the construction of the CSO Treatment Facility most flows from Overflow No. 22 will be re-routed to the facility for full screening prior to discharge. As a result, overflows from this outfall will be reduced to 4 events per year prior to discharge. Since Overflow No. 22 will receive CSO controls in the near future, it was concluded that additional controls are not required.

4.14 Overflow No. 23 (W. Illinois)

Overflow No. 23 is located on the west bank of the west branch of the Fox River under the Illinois Avenue bridge. The tributary area is roughly 140 acres, all of which are served by combined sewers. A 27 inch combined sewer carries all flows to the overflow structure with the dry and part of the wet weather flows conveyed northerly into a 16 inch pipe, eventually crossing the river via two siphon tubes and making connection to the East and West Bank Interceptor. Excess wet weather flows are conveyed over a dam into a 27 inch outfall pipe located in the west wing wall of the Illinois Avenue bridge.

The outfall for Overflow No. 23 is situated in a recreational area. A public park is located 50 feet downstream of the outfall, and a public boat ramp is located on an island opposite the outfall. Based on the recreational surroundings, one can conclude that this outfall is located in a sensitive area.

However, the annual discharge volume from Overflow No. 23 accounts for only 3% of the total CSS annual discharge volume (see Table 4) classifying it as a minor overflow. Furthermore, the river fully supports all designated uses as reported in the 1992 and 1994 IWQRs. For these reasons it was concluded that additional controls are not necessary for Overflow No. 23.

4.15 Overflow No. 25 (Dearborn-Trask)

Overflow No. 25 is the only CSO in the Aurora CSS which does not discharge into the Fox River. Instead, this overflow discharges into Indian Creek, a small tributary of the Fox River (see Exhibits A and P). The diversion structure is located at the intersection of Dearborn Avenue and Trask Street, and its tributary area is approximately 370 acres. The entire combined area has been separated in the last few years. Nevertheless, excess wet weather overflows occasionally occur due to the City having left in place the old combined sewers as sanitary sewers and not having removed a multitude of illegal building footing drains. The construction in 1997 of a larger Indian Creek Interceptor along the Indian Creek will capture the flows from this basin and will greatly reduce overflow frequency.

The outfall pipe for Overflow No. 25 consists of a 52 inch pipe crossing, in a northerly direction, a junkyard and the Burlington Northern Railroad tracks, eventually discharging to the Indian Creek. The outfall is located in a run-down industrialized area of the City. The creek here flows in parallel with the railroad tracks and is surrounded by industrial buildings. Due to the industrial surroundings of the creek, this stream is seldom, if at all, used for recreation.

Based on the above, it was concluded that the outfall of Overflow No. 25 is not located in a sensitive area.

TABLES

TABLE 1

PERMITTED CSO OUTFALLS
(Within the City of Aurora Limits)

DISCHARGE NUMBER	DISCHARGE NAME	RECEIVING STREAM
1	Rathbone	Fox River
2	E. Illinois	Fox River
3	Pierce	Fox River
4	Hazel	Fox River
5	Third	Fox River
8	E. Benton	Fox River
10	First	Fox River
15	W. Benton	Fox River
16A	Clark	Fox River
17	Stolp	Fox River
18	W. Galena	Fox River
21	Elm	Fox River
22	Superior	Fox River
23	W. Illinois	Fox River
25	Trask-Dearborn	Indian Creek

TABLE 2

SIZE OF TRIBUTARY AREAS TO CSO OUTFALLS†

DISCHARGE NUMBER	DISCHARGE NAME	TOTAL AREA (Acres)	COMBINED SEWER AREAS (Acres)	SEPARATED SEWER AREAS (Acres)
1	Rathbone	2490	1100	1390
2	E. Illinois	40	40	0
3	Pierce	700	170	530
4	Hazel	810	700	110
5	Third	50	40	10
8	E. Benton	2200	350	1850
10	First	130	100	30
15	W. Benton	400	380	20
16A	Clark	20	20	0
17*	Stolp	10*	10*	0*
18*	W. Galena	40*	40*	0*
21*	Elm	150*	150*	0*
22	Superior	250	200	50
23	W. Illinois	140	140	0
25*	Trask-Dearborn	370*	0*	370*
	TOTAL	**7,230**	**3,430**	**3,800**

† Data presented in this table may differ from data presented in reports previously submitted to the IEPA for various reasons. Population growth and newly developed subdivisions have resulted in construction of sanitary sewers tributary to the combined sewers. Also, sewer separation projects have resulted in the decrease in the acreage served by combined sewers.

* These areas are included within other larger tributary areas. Subsequently, values designated with the asterisk were not included in the total summation because the value is already accounted for elsewhere.

TABLE 3

LAND USE IN VICINITY OF CSO OUTFALLS

DISCHARGE NUMBER	DISCHARGE NAME	LAND USE ZONES IN VICINITY OF OUTFALL (residential, commercial, industrial, recreational, agricultural)
1	Rathbone	recreational commercial
2	E. Illinois	recreational industrial commercial
3	Pierce	industrial commercial
4	Hazel	recreational industrial
5	Third	industrial
8	E. Benton	commercial industrial
10	First	industrial
15	W. Benton	commercial industrial
16A	Clark	commercial industrial
17	Stolp	commercial residential (multiple-family)
18	W. Galena	commercial industrial
21	Elm	recreational residential (multiple-family) commercial
22	Superior	industrial recreational
23	W. Illinois	recreational industrial
25	Trask-Dearborn	industrial

TABLE 4

SUMMARY OF AVAILABLE DATA ON ANNUAL CSO DISCHARGE FREQUENCY & VOLUME
(Data taken from 1983 Aurora Sanitary District CSO Study and 1990 CSO Performance Monitoring Report)

		1983 MONITORING DATA		COMPUTER MODEL PROJECTIONS WITH ALTERNATIVE D		1990 PERFORMANCE MONITORING OF MAJOR OVERFLOWS	
DISCHARGE NUMBER	DISCHARGE NAME	DISCHARGE VOLUME (MG)	DISCHARGE FREQUENCY (No. Of Events)	DISCHARGE VOLUME (MG)	DISCHARGE FREQUENCY (No. Of Events)	DISCHARGE VOLUME (MG)	DISCHARGE FREQUENCY (No. Of Events)
1	Rathbone	102	159	6	14	35	56
2	E. Illinois	2	30	2	30	†	†
3	Pierce	67	81	28	51	†	†
4	Hazel	73	77	63	74	38	52
5	Third	11	89	11	89	†	†
8	E. Benton	348	335	114	69	52	68
10	First	12	39	12	39	†	†
15	W. Benton	46	51	46	51	†	†
16A	Clark	*	*	*	*	†	†
17	Stolp	*	*	*	*	†	†
18	W. Galena	13	39	13	39	†	†
21	Elm	*	*	*	*	†	†
22	Superior	47	85	42	84	†	†
23	W. Illinois	11	31	11	31	†	†
25	Trask-Dearborn	45	92	15	44	13	54

* Data is unavailable because these overflows were not monitored during this study.

† Data is unavailable because the 1990 study only monitored the major overflows (Overflow Nos. 1, 4, 8 and 25).

EXHIBITS

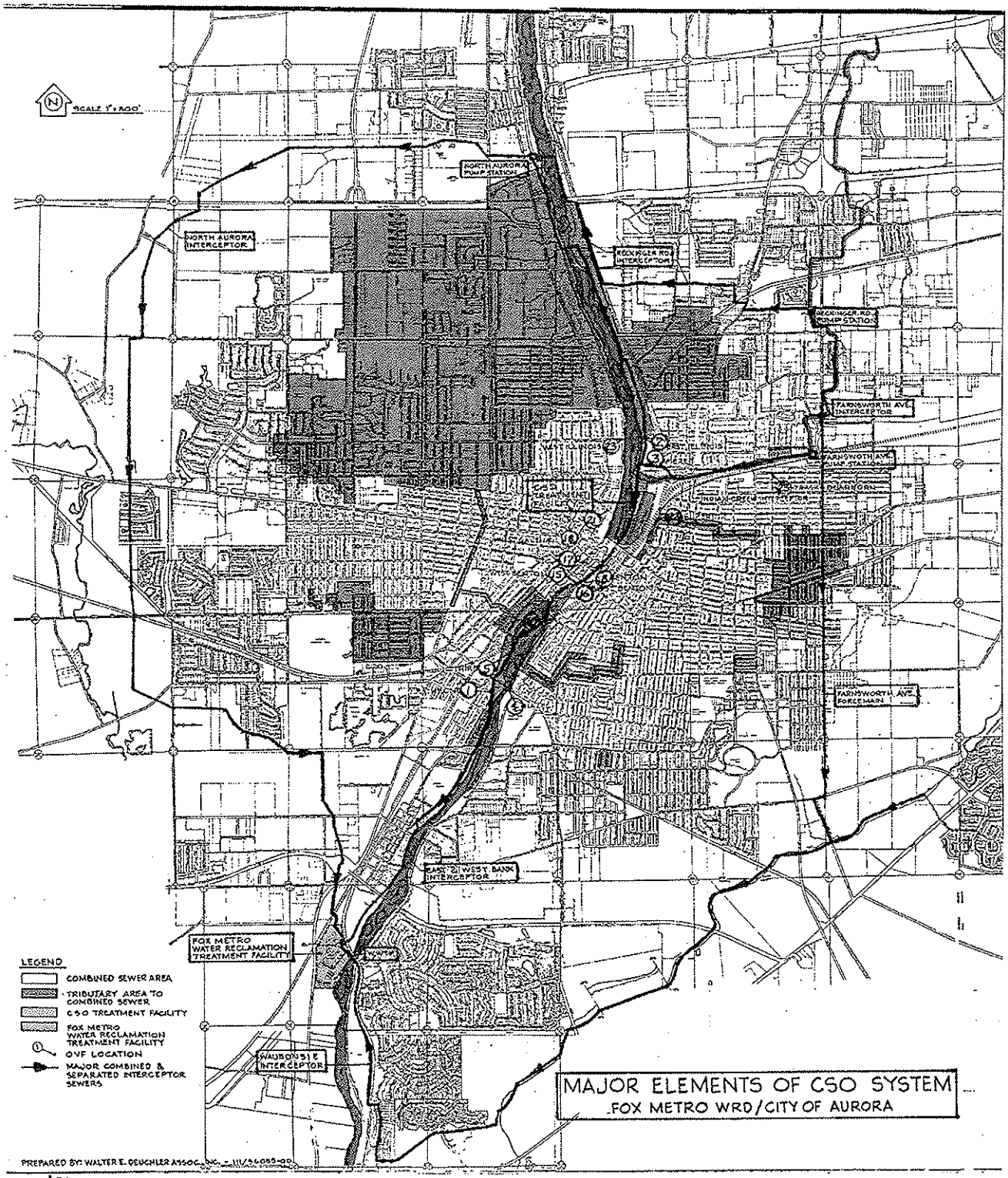
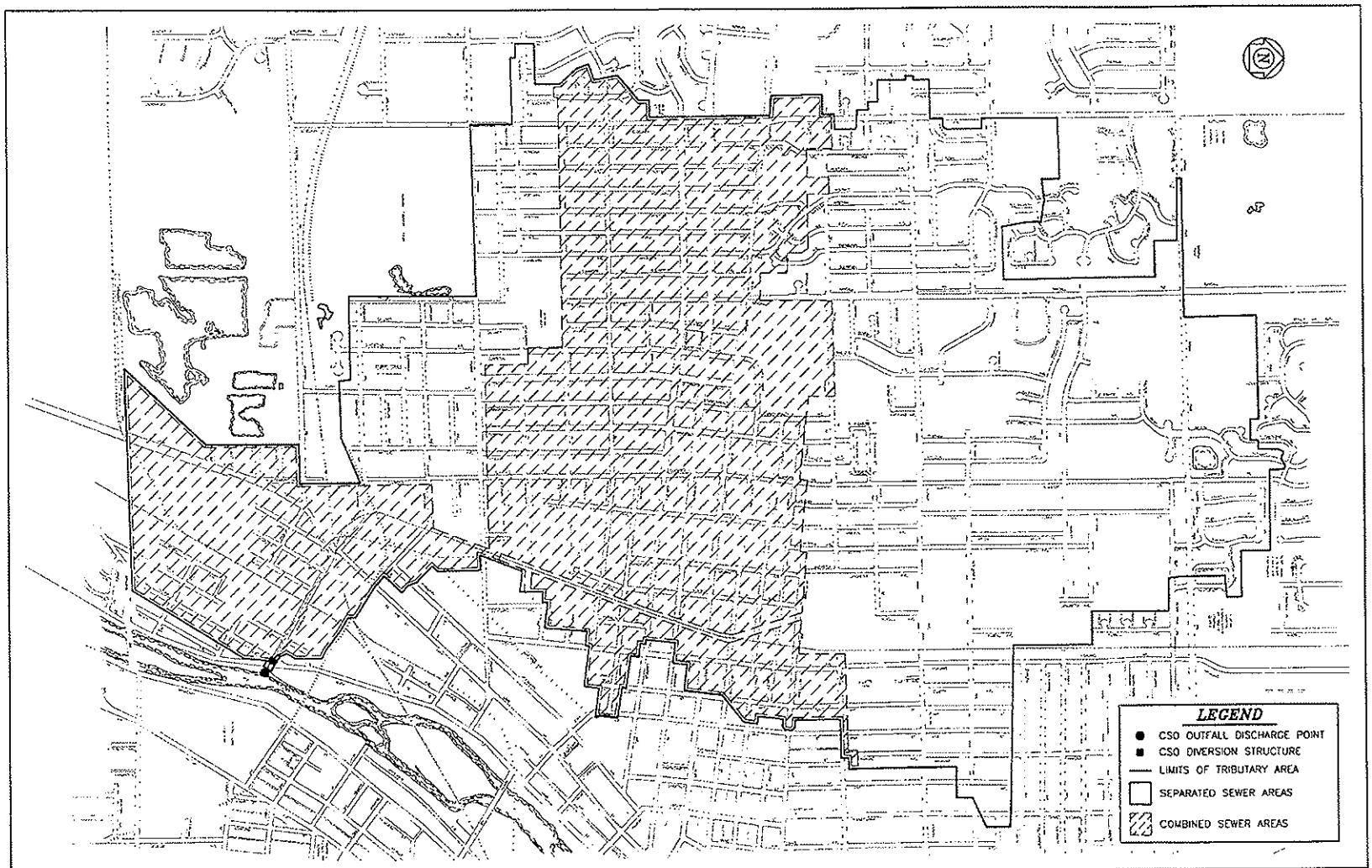

SCALE 1" = 800'
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NORTH AURORA INTERCEPTOR
ROCKINGER RD. INTERCEPTOR
ROCKINGER RD. PUMP STATION
FARNSWORTH AVE. INTERCEPTOR
FARNSWORTH AVE. PUMP STATION
FARNSWORTH AVE. FORCE MAIN
EAST SIDE INTERCEPTOR
EAST SIDE TREATMENT FACILITY
EAST & WEST BANK INTERCEPTOR
FOX METRO WATER RECLAMATION TREATMENT FACILITY
WAUBONSIE INTERCEPTOR
LEGEND
COMBINED SEWER AREA
TRIBUTARY AREA TO COMBINED SEWER
CSO TREATMENT FACILITY
FOX METRO WATER RECLAMATION TREATMENT FACILITY
OVF LOCATION
MAJOR COMBINED & SEPARATED INTERCEPTOR SEWERS
MAJOR ELEMENTS OF CSO SYSTEM
FOX METRO WRD / CITY OF AURORA
PREPARED BY: WALTER E. DEUCHLER ASSOC., INC. - III/96055-00

EXHIBIT A

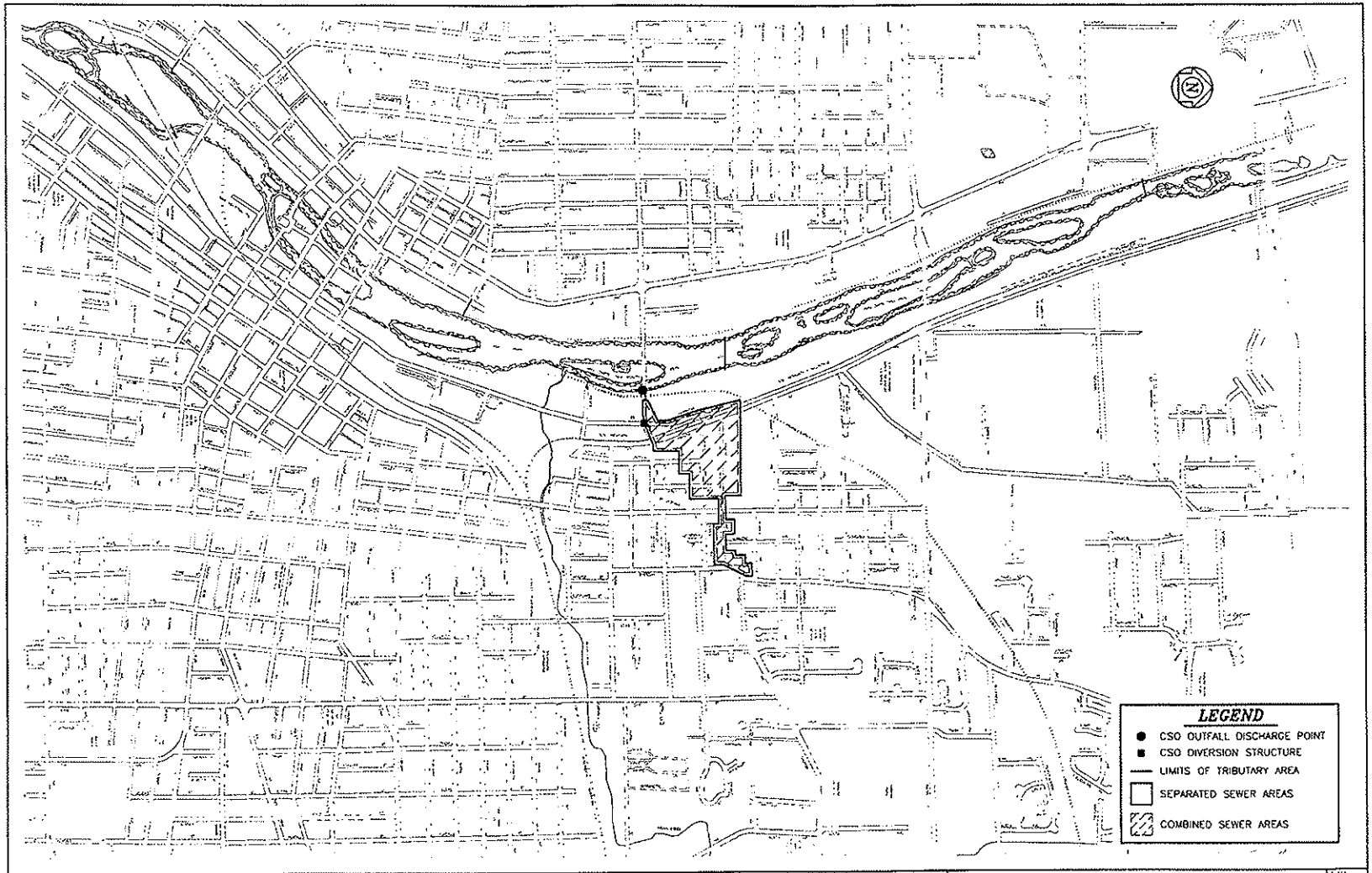


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EXHIBIT B
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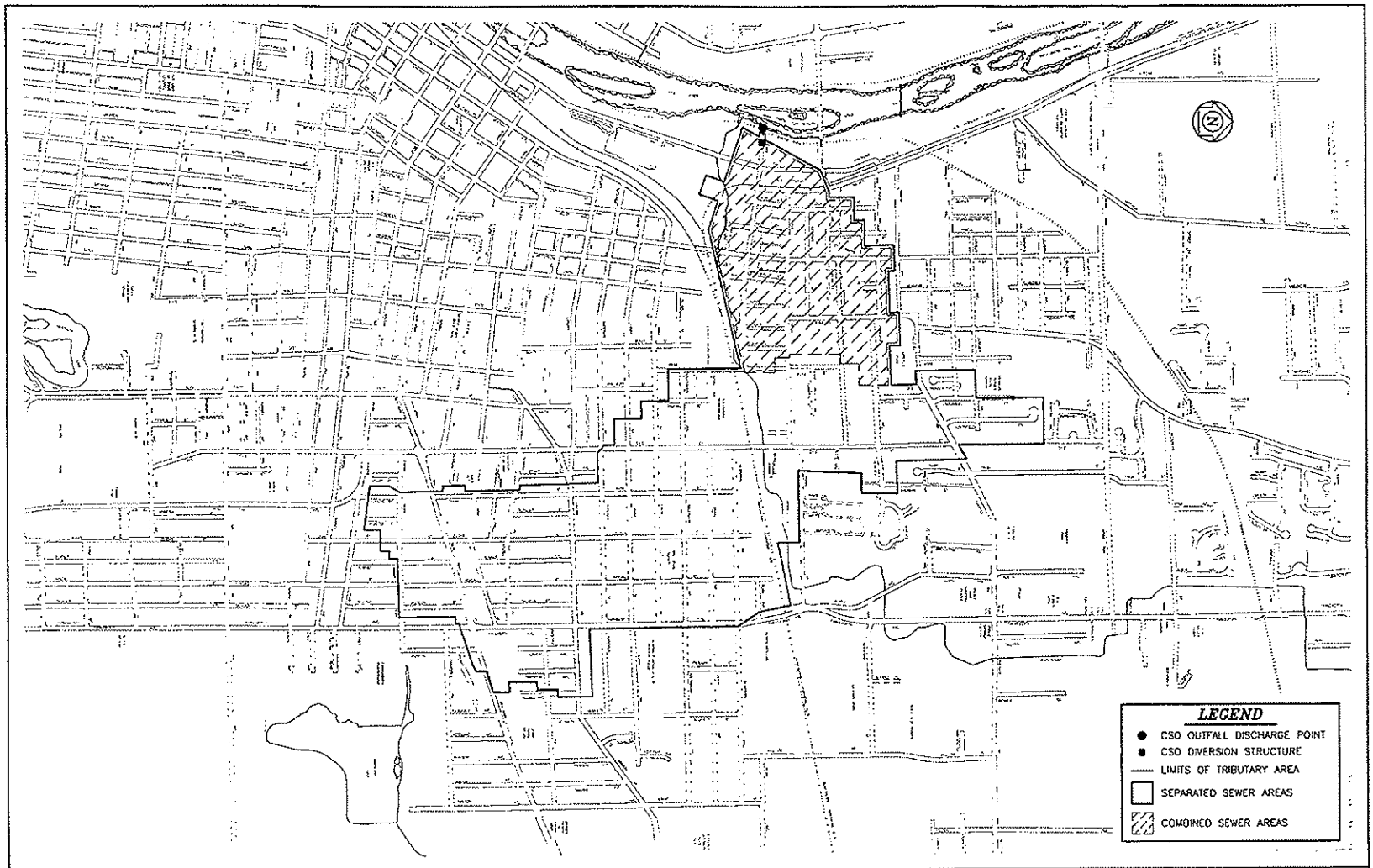
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EXHIBIT C
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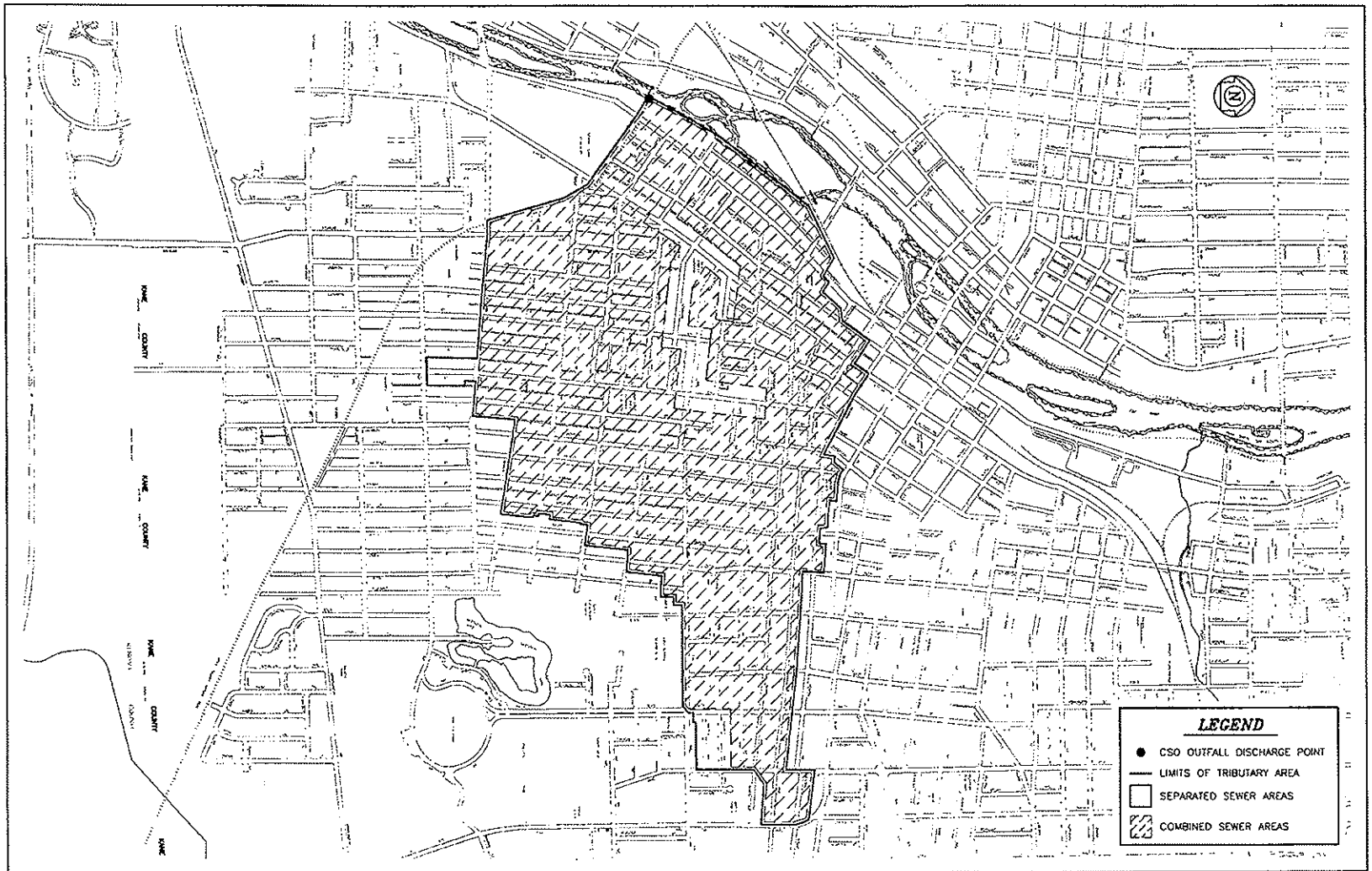


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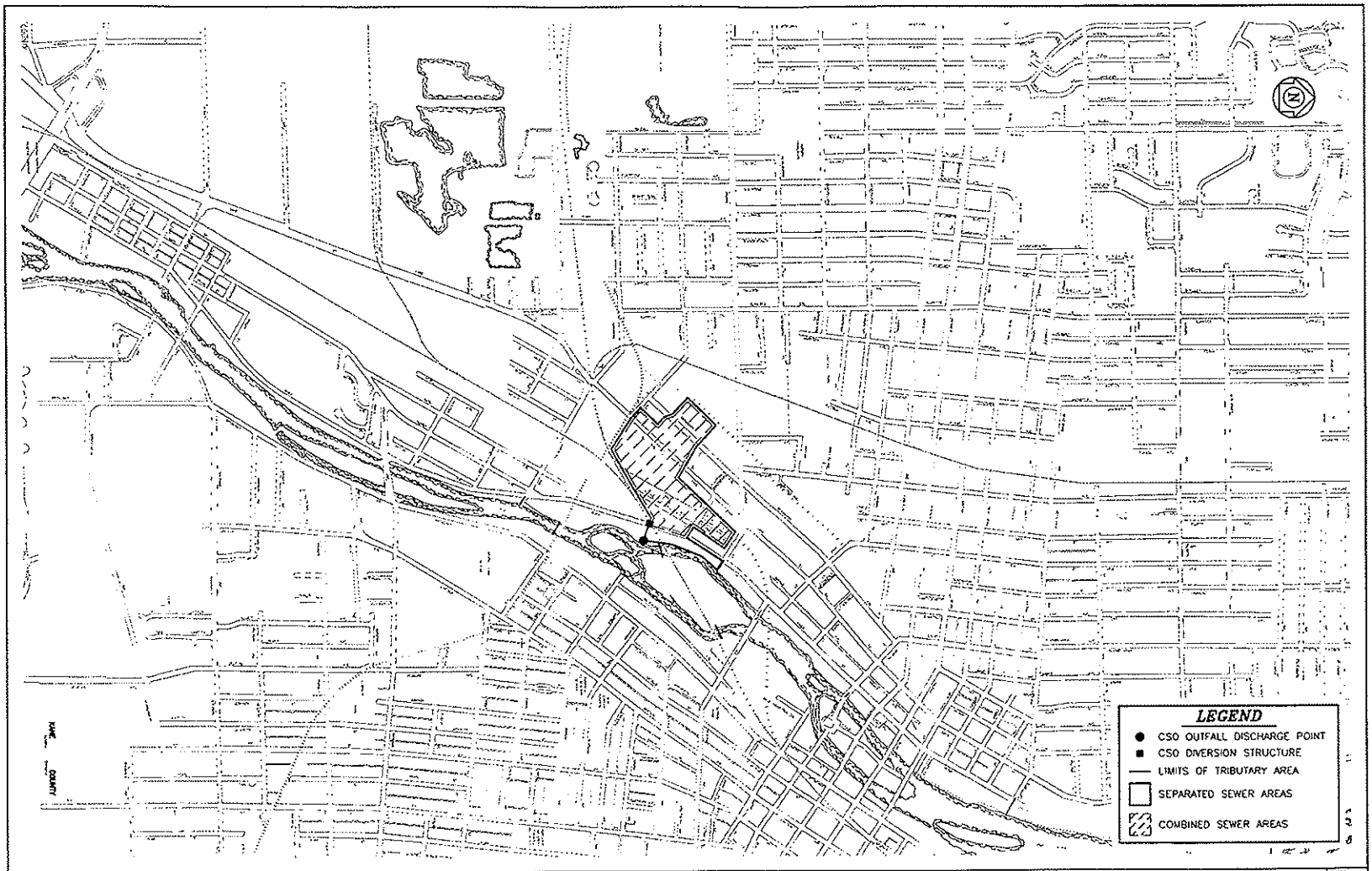
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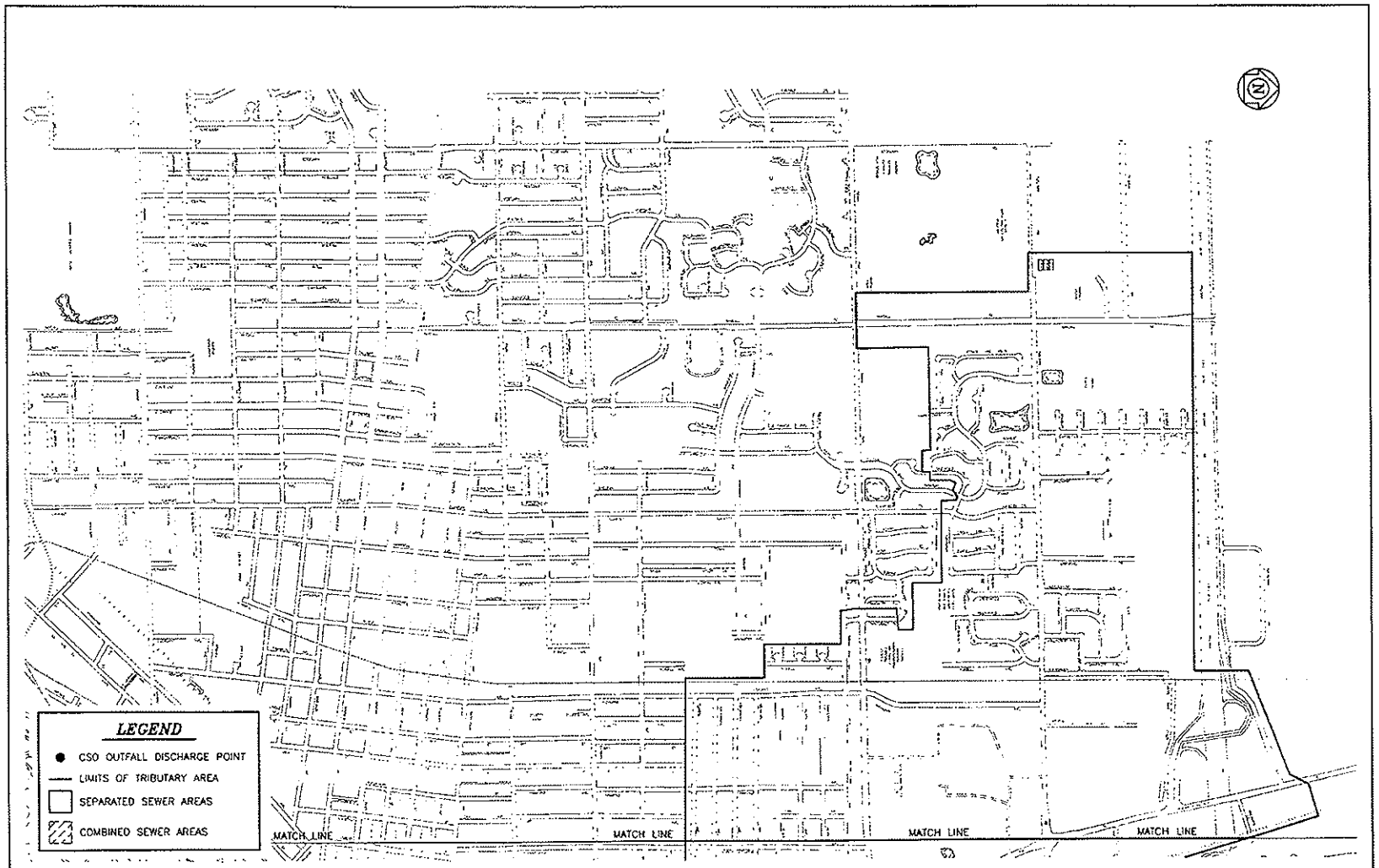


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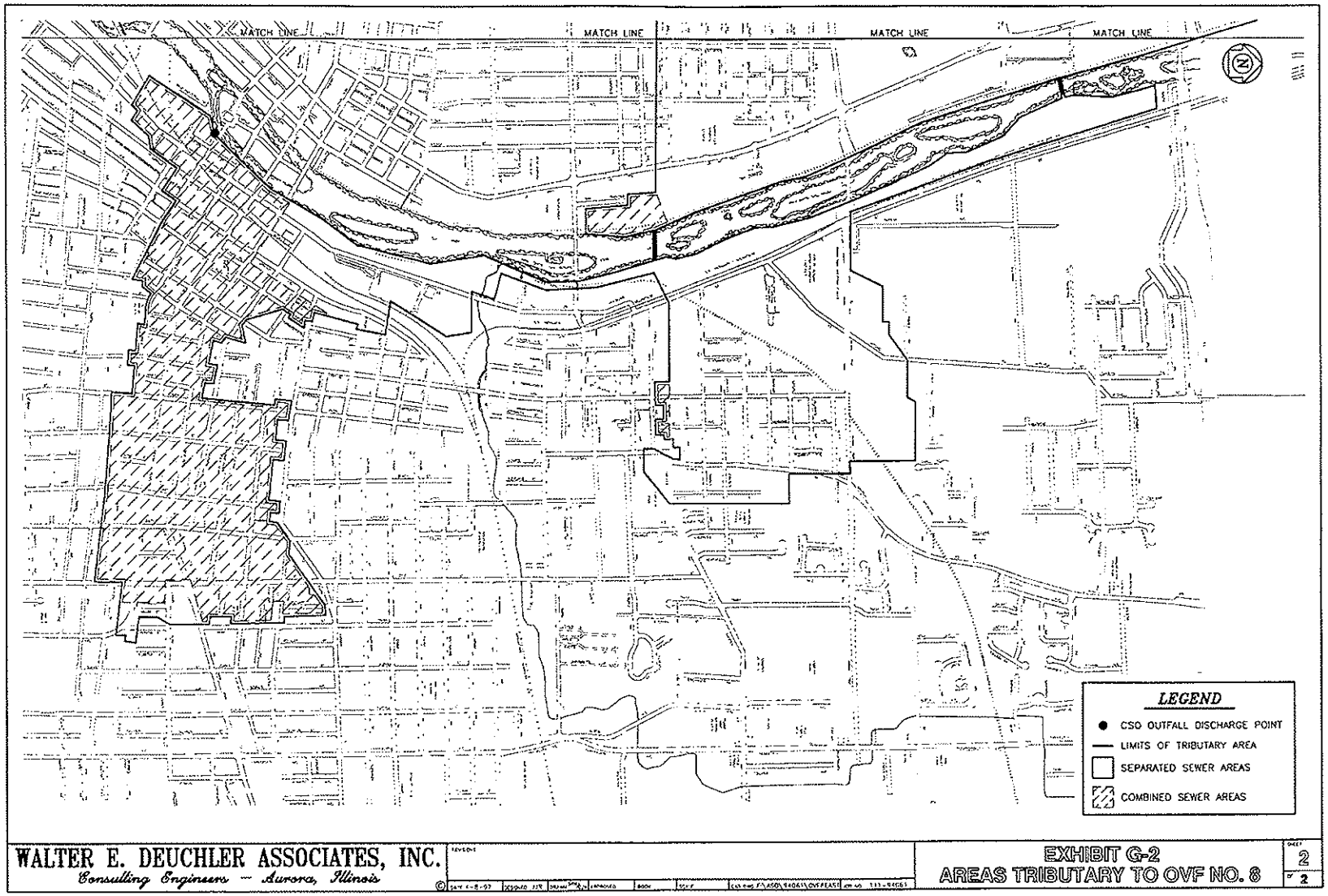
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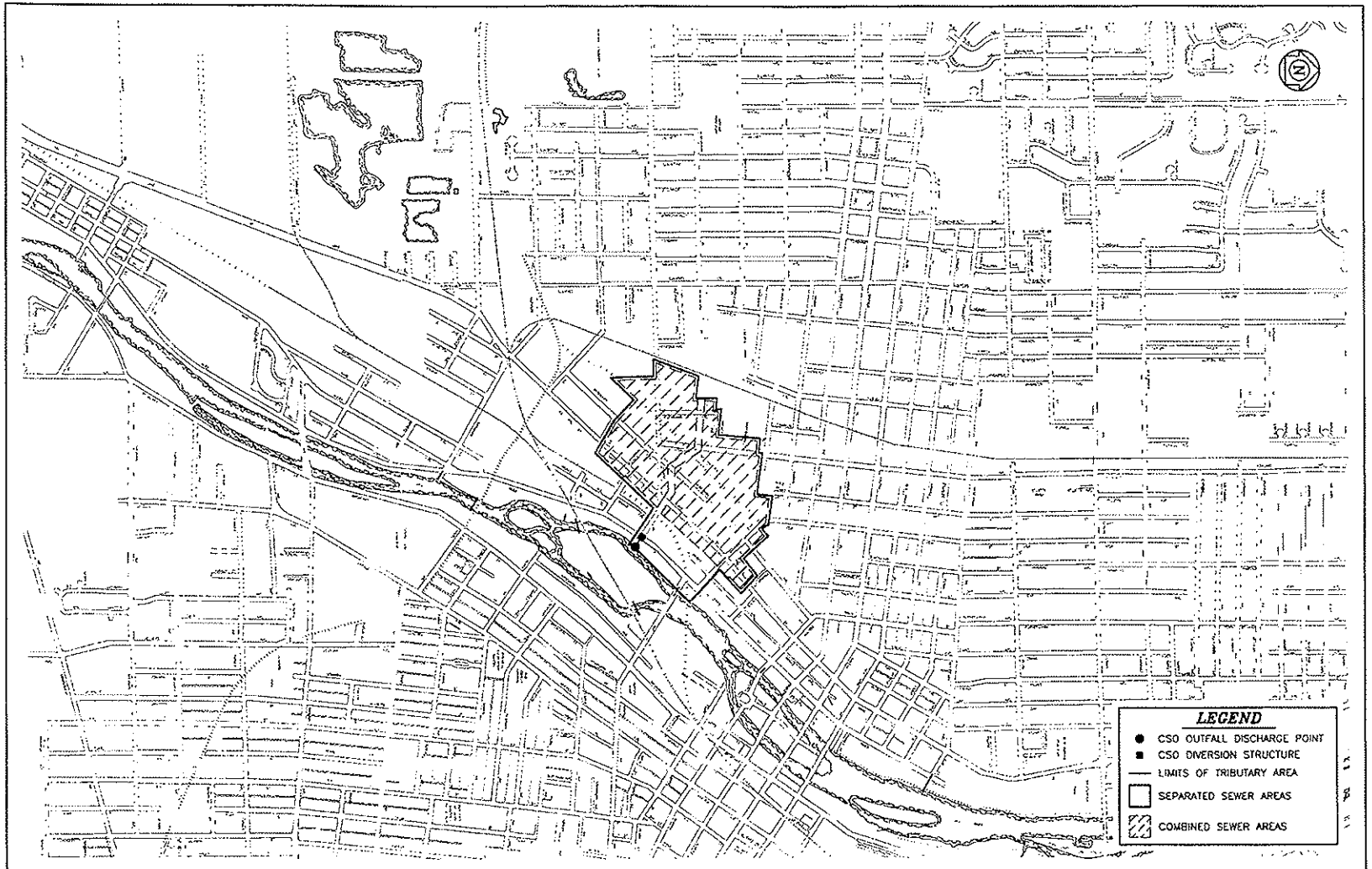


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EXHIBIT G-2
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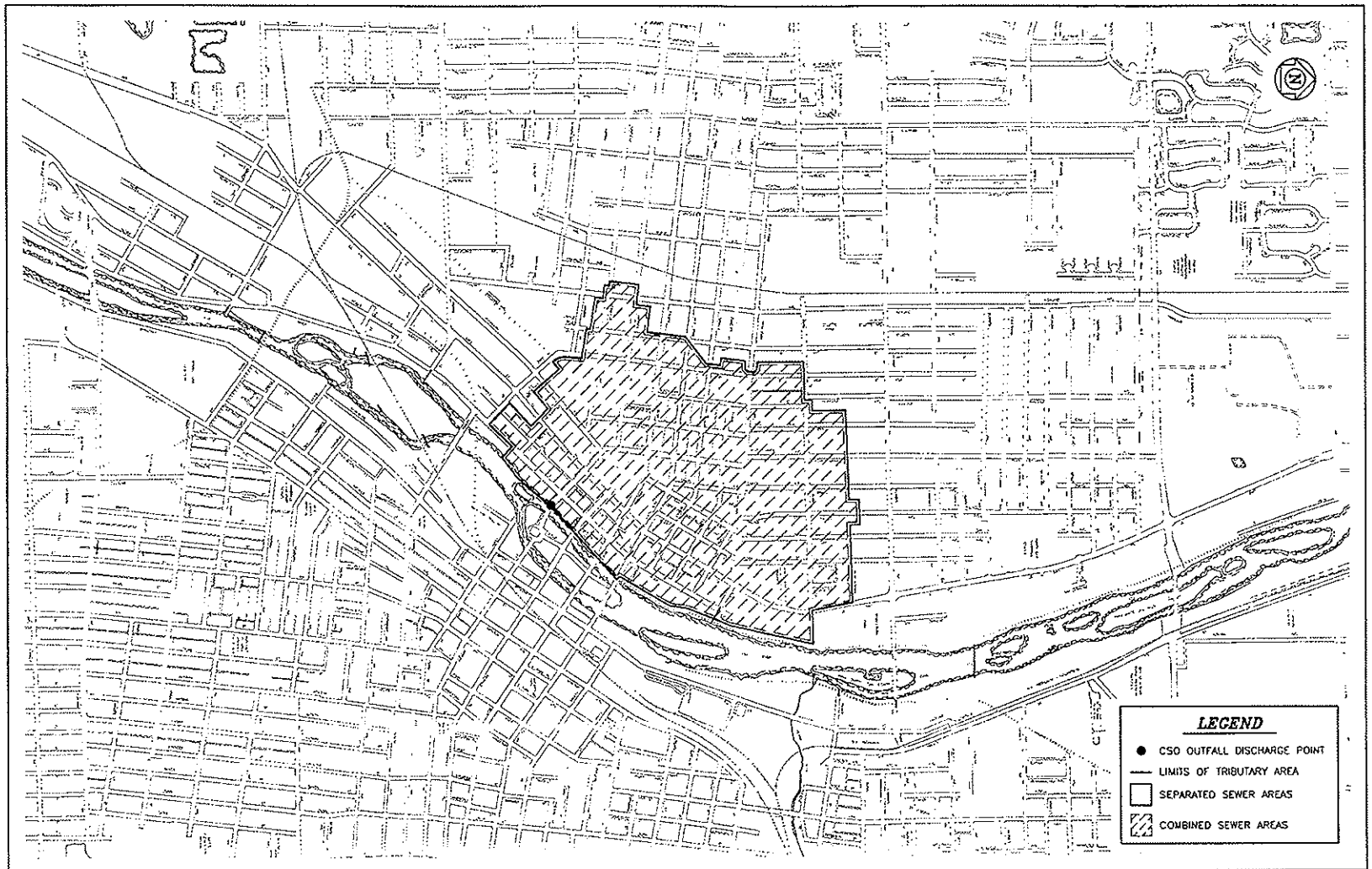
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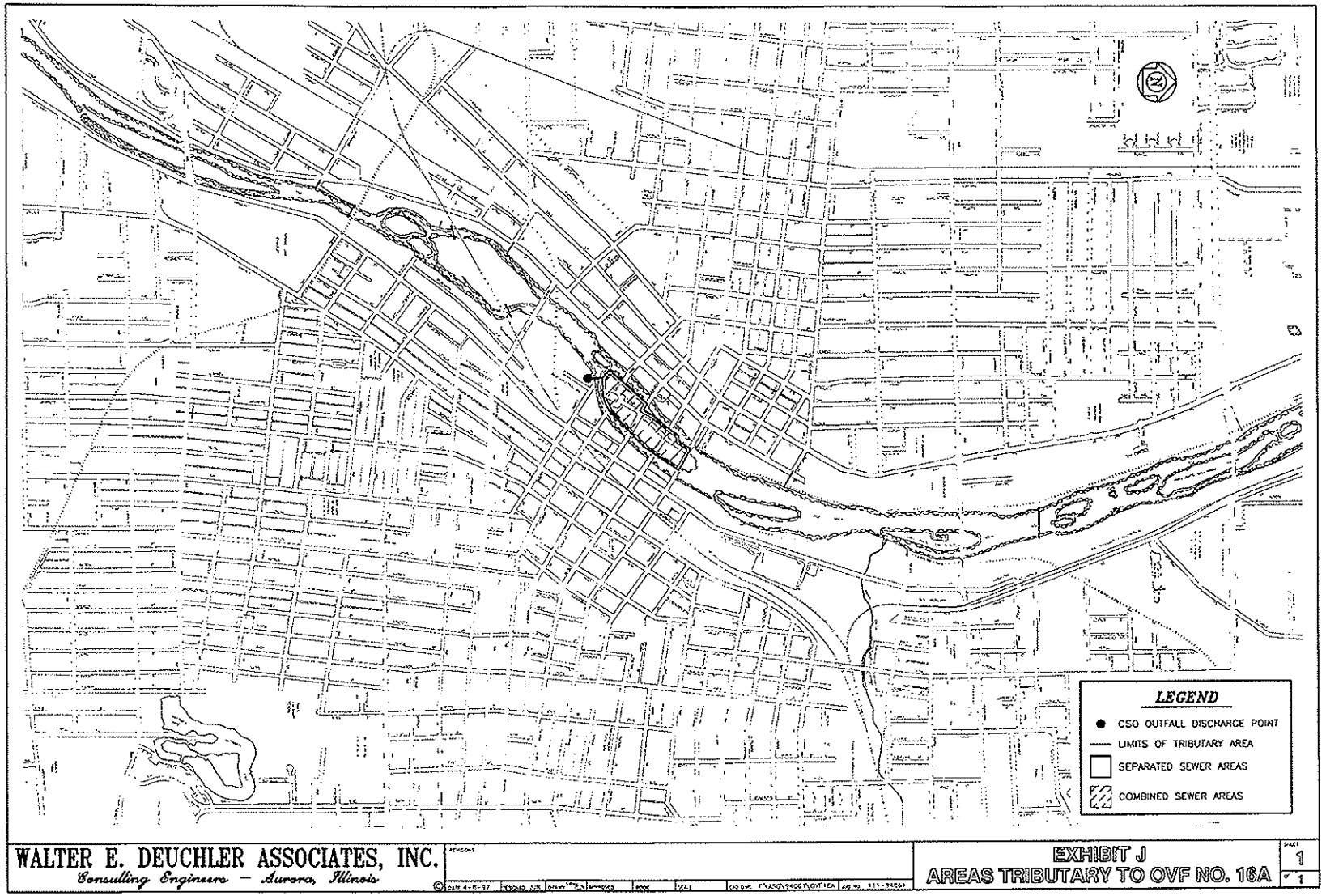
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EXHIBIT I
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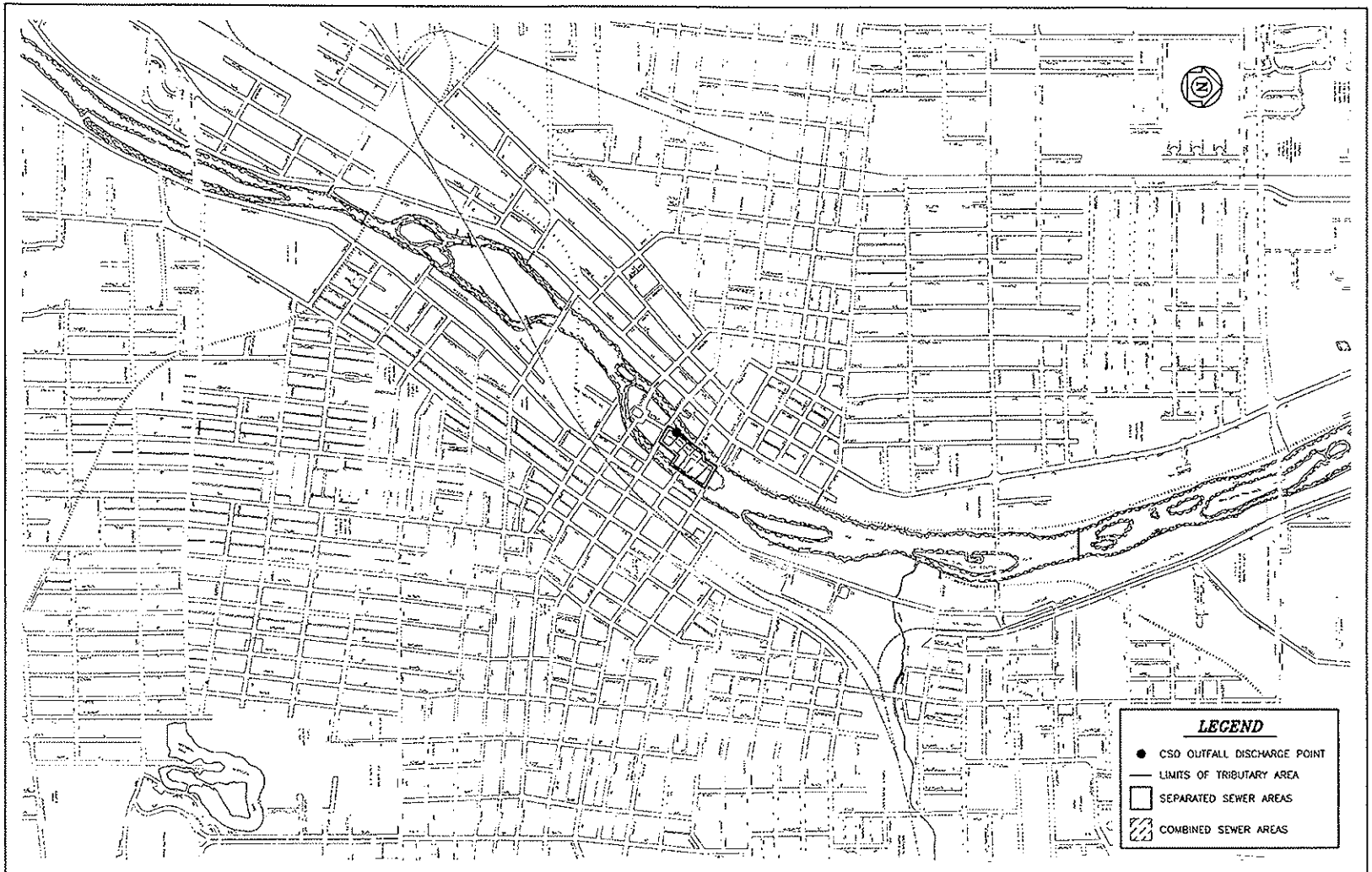


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EXHIBIT J
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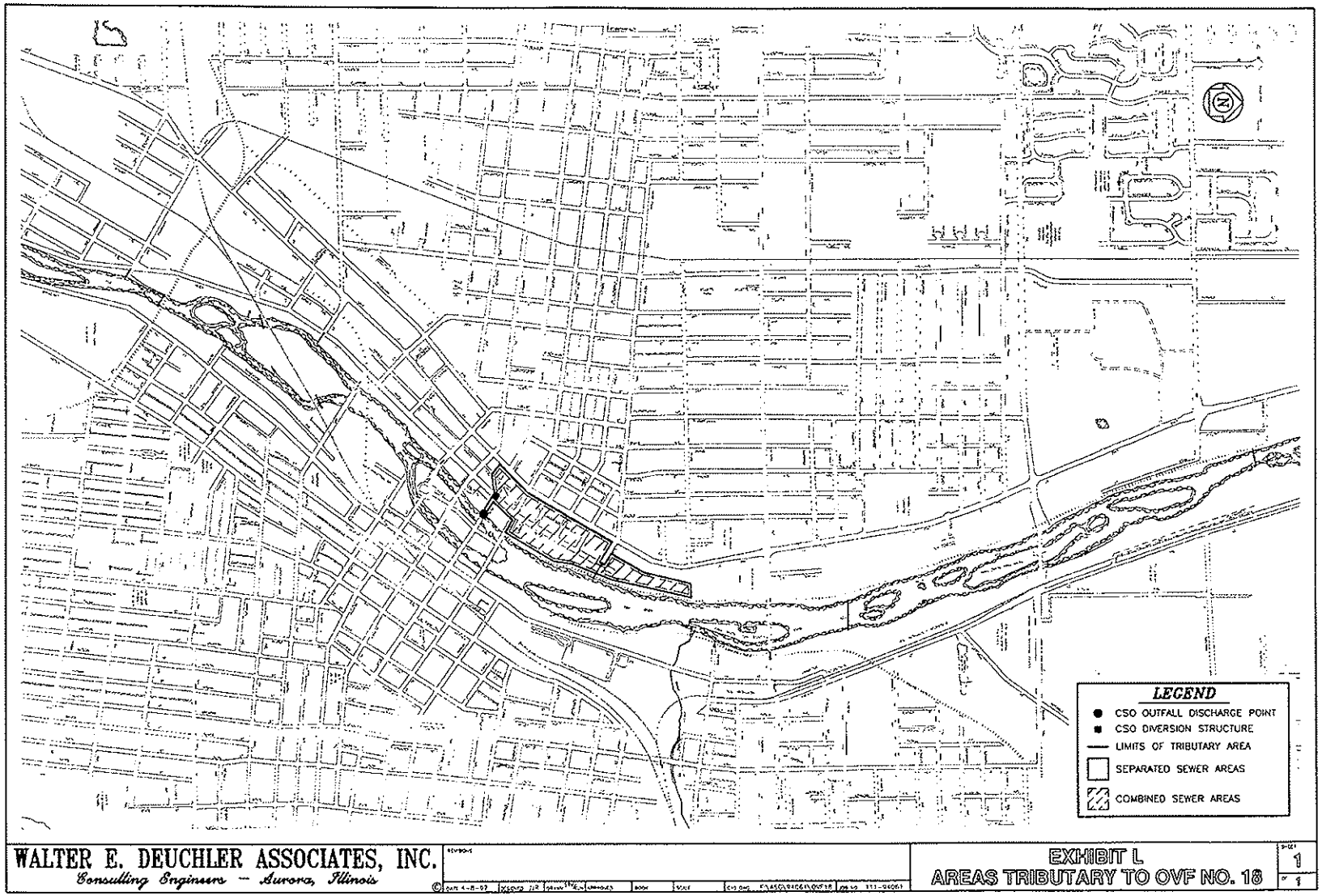


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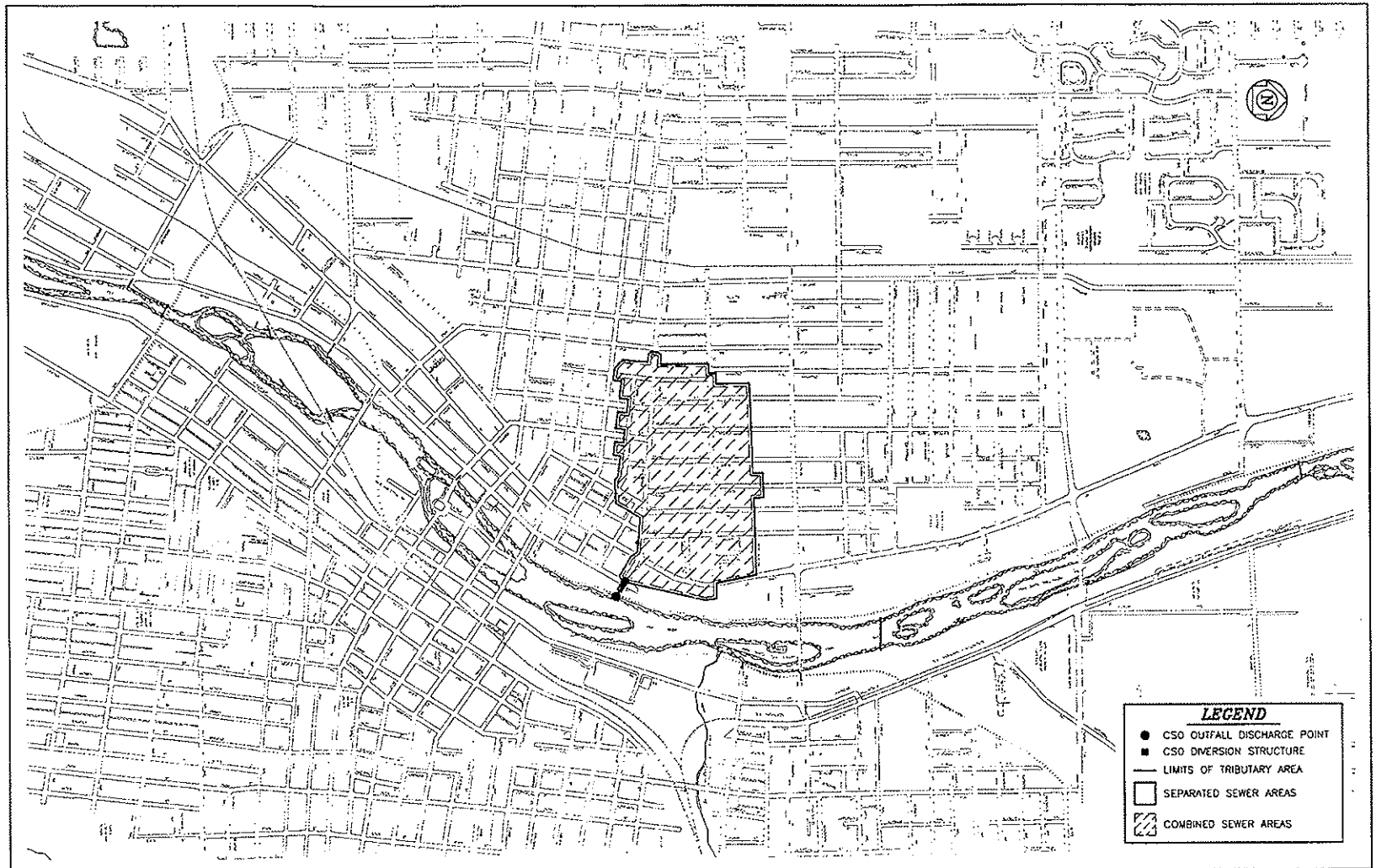
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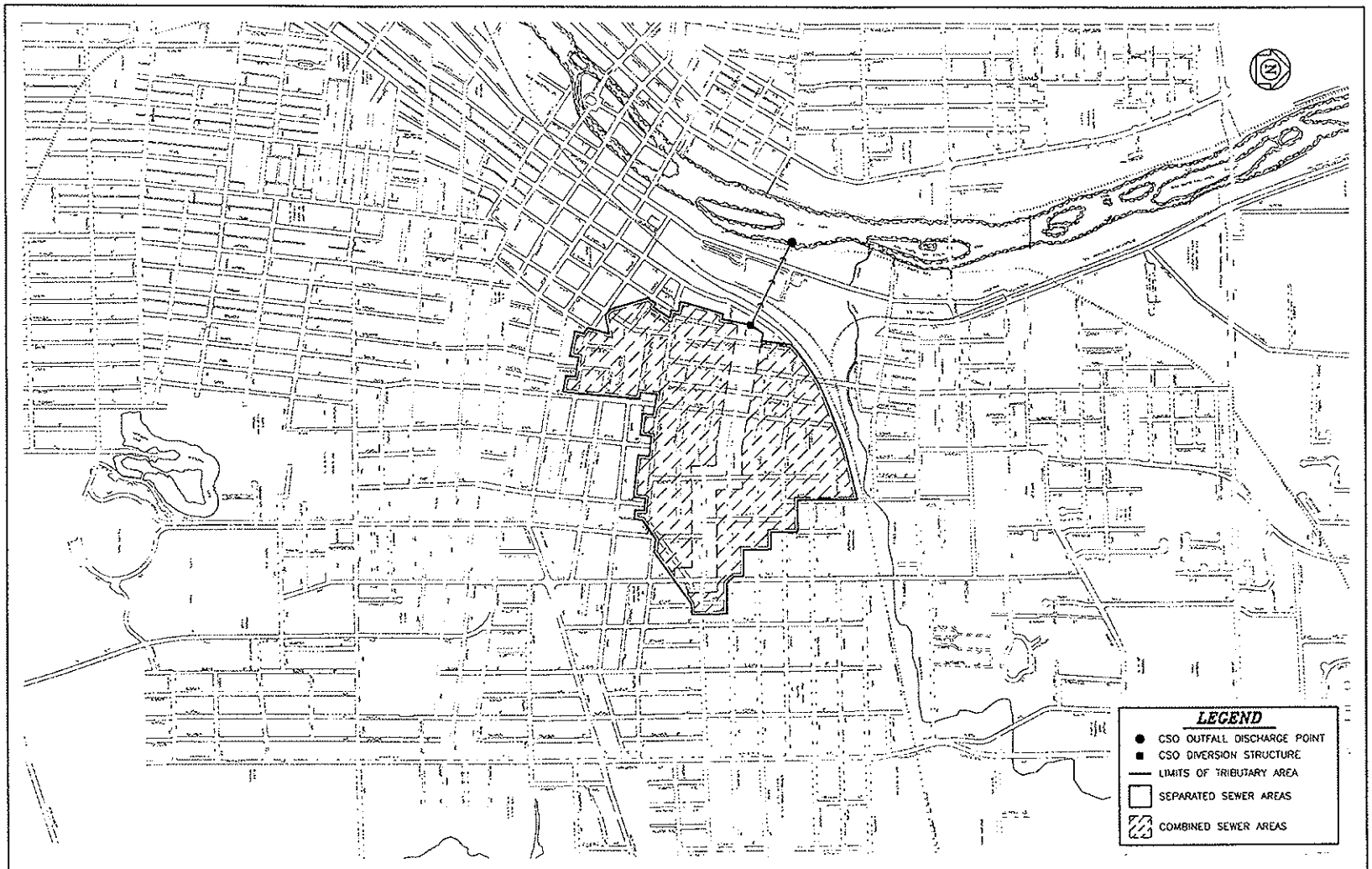
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EXHIBIT M
AREAS TRIBUTARY TO OVF NO. 21

SHEET 1 OF 1



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EXHIBIT N
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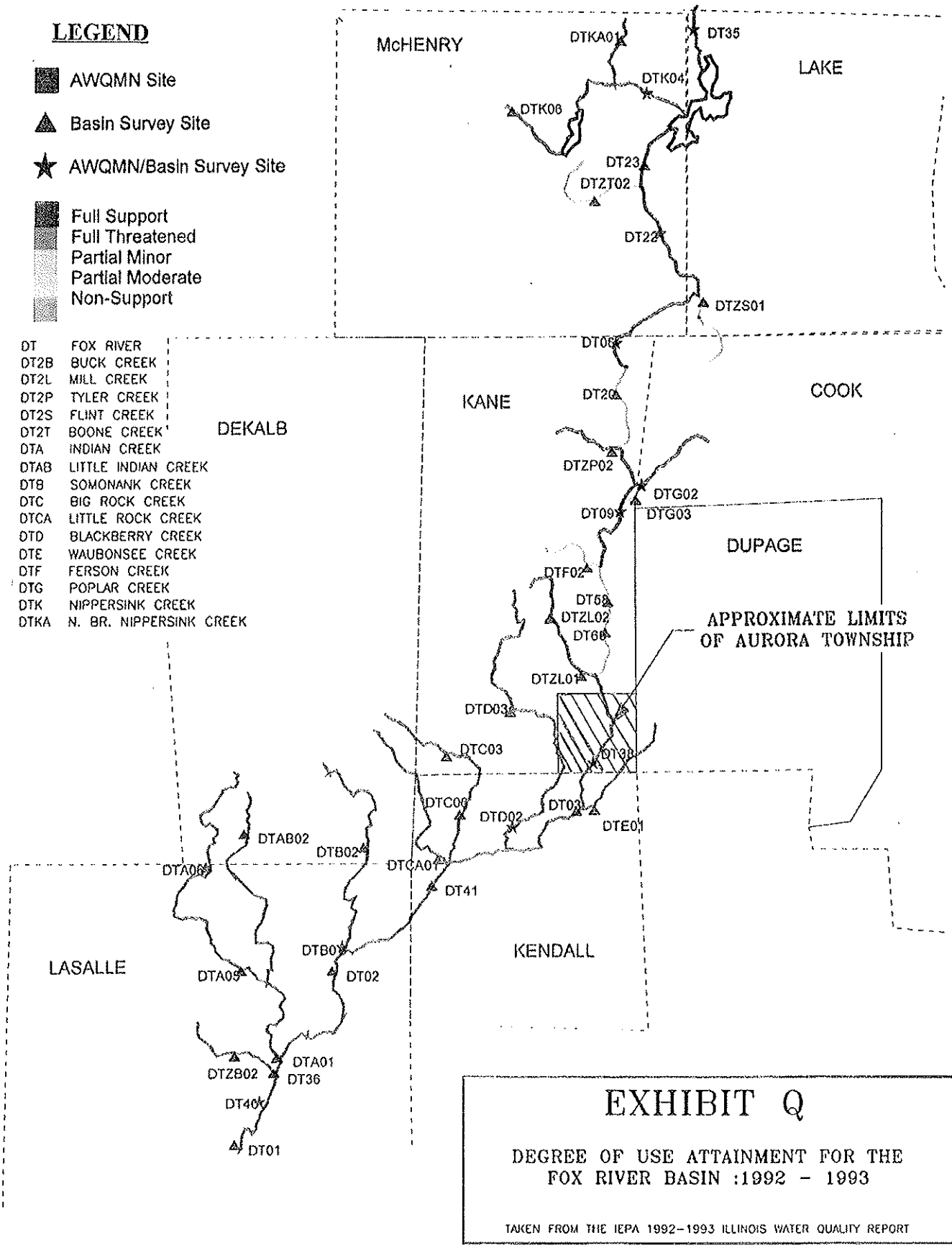


EXHIBIT Q

DEGREE OF USE ATTAINMENT FOR THE FOX RIVER BASIN :1992 - 1993

TAKEN FROM THE IEPA 1992-1993 ILLINOIS WATER QUALITY REPORT

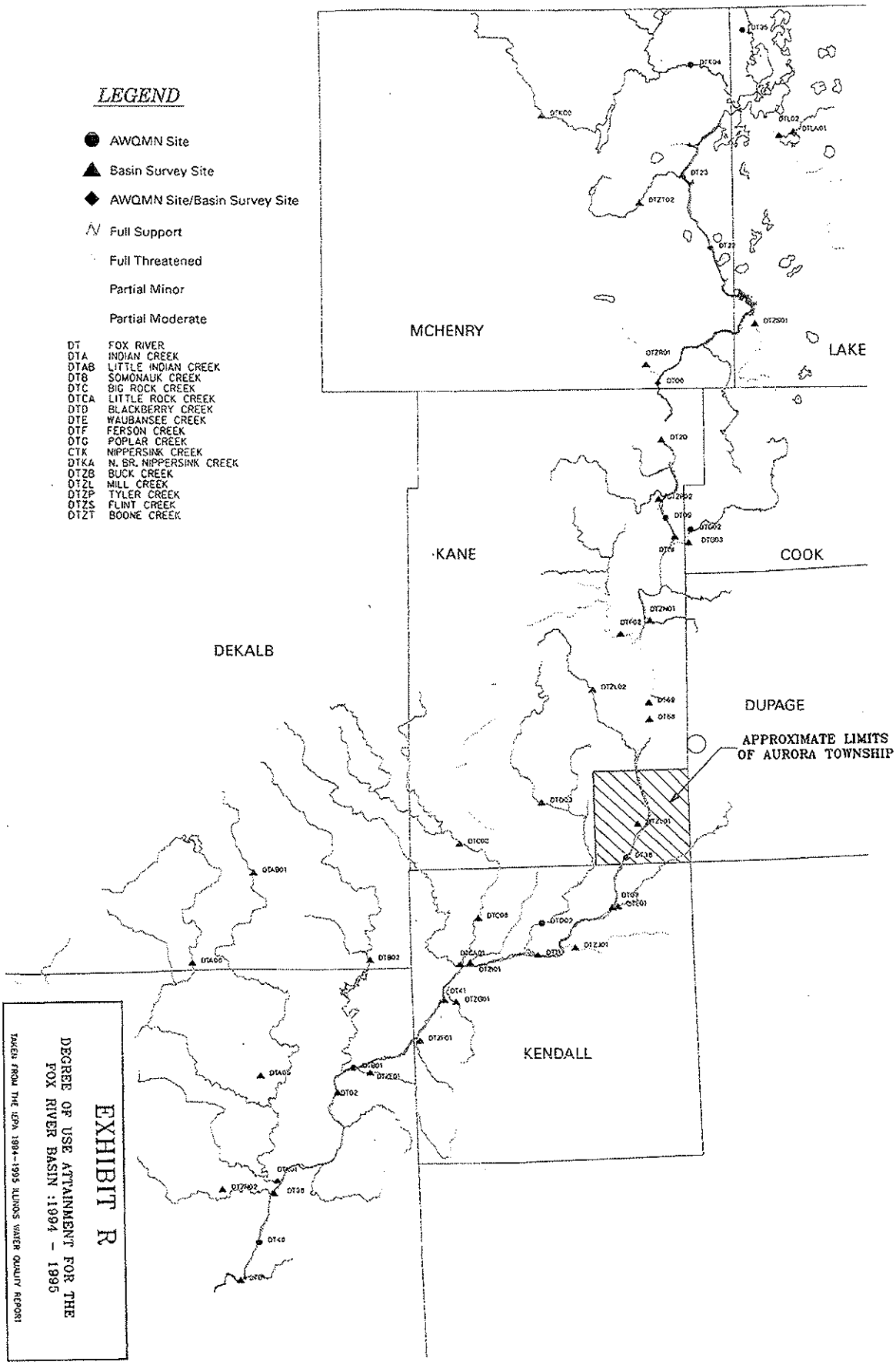


EXHIBIT R

DEGREE OF USE ATTAINMENT FOR THE FOX RIVER BASIN :1994 - 1995

TAKEN FROM THE IEPA 1994-1995 ILLINOIS WATER QUALITY REPORT

JANUARY 1998 SENSITIVE AREA ANALYSIS (26 PAGES)

WALTER E. DEUCHLER ASSOCIATES INC.
Consulting Engineers
230 WOODLAWN AVENUE • TELEPHONE (630) 897-4651 • FAX (630) 897-5696
AURORA, ILLINOIS 60506

January 2, 1998

Mr. Dean J. Studer, P.E.
Manager, Southern Municipal Unit
Permits Section
Illinois Environmental Protection Agency
Division of Water Pollution Control
1001 N. Grand Avenue East
Springfield, IL 62702

RE: Sensitive Areas Determination
NPDES Permit No. IL0048518 Special Condition 1, Paragraph 7
W.E.D.A. Job #111-94061-02

Dear Dean:

We are in receipt of your letter dated April 29, 1997, attached herein, requesting additional information on the sensitivity of CSOs in the City of Aurora pursuant to the City of Aurora Permit No. IL0048518 Special Condition 1, Paragraph 7.

As indicated in your letter, OVF Nos. 3A, 5, 8, 10, 15, 16A, 17, 18, and 25 are in compliance with the said condition. Your letter further states that additional information is required on conditions of the Fox River which may discourage primary contact recreational activities in the vicinity of the remaining CSO Nos. 1, 2, 4, 21, 22, and 23. In response to your request we have gathered data on the following characteristics of the river near each of these remaining outfalls:

1. Depth of the stream - The depth of the stream can affect recreational activities in two ways: Deep stream may discourage swimming activities whereas a shallow stream will restrict boating and water skiing activities.

2. Thickness of stream sediment - Stream sediment will discourage swimming and wading activities if the sediment layer is thick enough to entrap the lower part of a swimmer's leg. For this characteristic, it was determined that a sediment thickness of 6 inches or greater would be a hindrance to swimming and wading activities.

3. Stream accessibility - Public access structures such as boat ramps, beach fronts, or access ladders will encourage the recreational use of a stream. On the other hand, steep approach such as abrupt banks or retaining walls will limit recreational activities.

4. Miscellaneous-other site-specific factors affecting recreational usage were also identified where appropriate.

Based on the data collected, it was concluded that recreational activities are restricted near OVF Nos. 2, 4, 21, and 22 and thus these CSOs are not located in sensitive areas.

The data collected near OVF Nos. 1 and 23 was not conclusive. Solid data on recreational trends near these two outfalls is not available at the present time and it therefore cannot be reasonably concluded that these two outfalls are or are not located in sensitive areas.

For this reason, it is hereby requested that a time extension be granted so that reliable data can be collected on recreational trends near OVF Nos. 1 and 23. A proposed Plan of Action for OVF Nos. 1 and 23 is discussed in more detail later in this correspondence to provide the type and frequency of primary contact recreation taking place near these outfalls, and to assess the degree of sensitivity of these areas. The time extension is requested so that this study can be conducted during the summer of 1998 and the final report on OVF Nos. 1 and 23 be submitted to the Agency by November 1, 1998.

I. DATA COLLECTION & METHODOLOGIES

A. Stream Depth

Data on stream depth was collected utilizing field investigation and existing in-house topographic data. At locations upstream and downstream of each outfall, the depth of the stream was measured using a surveyor's rod. Measurements were made during November 1997, a time when the stream depth is likely to be near its maximum level. In addition, data from a Fox River sounding study was used to supplement the field data. The sounding was conducted in the main channel of the river, north of New York Street and south of Illinois Avenue (see Exhibit A). The sounding was performed in 1993 by Hydrographic Survey Company for the Hollywood Casino Aurora, Inc. Data collected on stream depth are shown on Exhibits B through E for OVF Nos. 2, 4, 21, and 22.

B. Sediment Thickness

Stream sediment thickness was also measured in the field at the same locations where depth measurements were taken. A surveyor's rod was used to measure the water depth to the surface of the sediment. The rod was then forced through the sediment surface until a hard bottom surface was encountered. The depth to the sediment surface was compared to the depth of the river bottom, and the difference was taken as the sediment thickness. Sediment thickness measurements are shown on Exhibits B and E for OVF Nos. 2 and 22.

C. Stream Accessibility

Stream accessibility was determined by considering the steepness of the river banks, presence of public access areas, or presence of retaining walls near the outfalls. Photographs were taken near OVF Nos. 2, 4, and 21 to demonstrate the limited accessibility near these outfalls. These photographs are included as Exhibits F, G, and H respectively.

D. **Site-Specific Factors**

Site-specific factors affecting the recreational use of the stream were identified for OVF Nos. 2, 21, and 22 as follows:

OVF Nos. 2 and 22 - There are numerous islands that exist throughout the river's course in the City of Aurora that divide the Fox River into the East and West Channels. The East Channel is typically more shallow and narrow than the West Channel, thus restricting certain recreational activities. OVF Nos. 2 and 22 are both located on the east bank of the East Channel, but OVF No. 22 is situated in the upstream part of an East Channel divergence point.

OVF No. 21 - The Hollywood Casino Boat dock is located 1/4 mile downstream of OVF No. 21 adjacent to New York Street. According to the casino boat's administration, the casino boats travel north to a turn around station which is located 600 feet upstream of OVF No. 21 (see Exhibit A). The two boats travel in staggered schedules such that one boat is out on the river at all times for 22 hours straight (from 6:00 A.M. until 4:00 A.M. the following day). The boats travel past OVF No. 21 numerous times per day except during inclement weather. The presence of this large watercraft prevents recreational activities in this vicinity.

II. DISCUSSION OF EACH OVERFLOW LOCATION

A. **OVF No. 2 (E. Illinois)**

The outfall for OVF No. 2 is located on the east bank of the East Channel immediately south of the Illinois Avenue Bridge. The East Channel is typically more narrow and more shallow than the West Channel. Recreational activities such as water skiing or jet skiing are severely limited in the East Channel due to the shallow depth and narrow channel width. Field investigations confirmed these shallow conditions. Measurements taken near the center of the channel in the vicinity of OVF No. 2 revealed a depth of less than 4 feet (see Exhibit B). This shallow depth continues at least 150 feet downstream of the outfall. Clearly, boating and skiing activities are restricted in this shallow area especially during dry weather conditions when the river level drops considerably.

Field investigations indicated that swimming activities would be limited near this outfall due to the presence of thick sediment. Within 25 feet of the river's edge, the sediment's thickness ranged from 4 to 16 inches. Within 50 feet of the edge, the sediment thickness was found to be as much as 22 inches thick. These measurements were consistent 150 feet downstream of the outfall. These conditions likely discourage the public from swimming or wading in this shallow channel.

Stream accessibility is also limited near this outfall. Public access points, such as boat ramps, do not exist along the East Channel near this outfall. Furthermore, the approach banks immediately downstream of the outfall are rather steep making it difficult to access

the river. Heavy vegetation along the shoreline as far as 300 feet downstream of the outfall restricts access to the river. Exhibit F contains photographs documenting the limited accessibility near OVF No. 2.

In summary, the stream's depth and width near OVF No. 2 discourage boating and skiing activities. Also, thick stream sediment and limited accessibility discourage swimming or wading near the outfall and up to 300 feet downstream. Given these conditions, it was concluded that OVF No. 2 is not located in a sensitive area.

B. **OVF No. 4 (Hazel)**

The outfall of OVF No. 4 is located on the east bank of the Fox River just south of the old railroad trestle at Hazel Avenue. At the outfall the width of the river is approximately 200 feet. One hundred feet downstream of the outfall, the width decreases to 180 feet. As shown on Exhibit C, the stream's depth 200 feet upstream of the outfall is only 2.5 feet deep. This depth decreases to 2.1 feet deep adjacent to the outfall. A boat ramp is located roughly 700 feet downstream of OVF No. 2 on the west bank (opposite side of the river). Shallow and narrow conditions of the river near OVF No. 4 discourage boaters from traveling upstream towards this outfall. Boats launched on the opposite side of the river typically continue farther downstream where the channel widens to at least 250 feet wide and roughly 8 feet deep.

Field investigations also indicated that swimming activities would be limited near this outfall. There are no public access points along the east bank near OVF No. 4. A public park is located in this area. However, steep approach banks and sharp drop-offs of the approach banks near the river's edge make it difficult for the public to enter the river from the shoreline. Exhibit G depicts the steepness of the river banks near this outfall and up to 400 feet downstream.

In summary, shallow and narrow channel conditions prevent boating and water skiing activities near this outfall. Also, restricted stream accessibility limits activities such as swimming and wading. Based on these observations, it was concluded that OVF No. 4 is not located in a sensitive area.

C. **OVF No. 21 (Elm)**

The outfall of OVF No. 21 is located on the west bank of the river, 150 feet upstream of the Police Boat Dock. Field investigation of stream depth near OVF No. 21 revealed that the river bottom severely drops off approximately 50 feet from the shore. As shown on Exhibit D, stream depth near the river's edge averages 3 feet deep, yet the depth of the stream only 50 feet from the shoreline averages 8.4 feet deep. This severe increase in depth discourages swimming and wading activities from the shoreline.

The Police Boat Dock located just downstream of the outfall consists of a large retaining

wall limiting access to the river there. Exhibit H documents this limited accessibility.

The most significant deterrent of recreational activities in this area are the Hollywood Casino Boats. The casino boats docking area is located 1/4 mile downstream of OVF No. 21 at the northern tip of Stolp Island (see Exhibit A). The boats (two) travel past OVF No. 21 to a turn around station located approximately 600 feet upstream of the outfall. The boats travel back and forth past this outfall several times per day and within 170 feet of the shoreline. Based on field observations, the constant traveling of these large watercrafts discourage recreationalists from swimming, boating or water skiing in this vicinity. Exhibit H contains a photograph of a casino boat, the boat dock, and their close proximity to OVF No. 21.

In summary, deep stream conditions near the shore discourage swimming and wading activities. The operation of two Hollywood Casino Boats restricts boating, water skiing, and swimming activities near this outfall as well. For these reasons, it was concluded that OVF No. 21 is not located in a sensitive area.

D. **OVF No. 22 (Superior)**

The outfall for OVF No. 22 is located on the east bank of the river, and the discharge pipe is extended roughly 25 feet into the stream. Stream depth measurements summarized on Exhibit E indicate that the stream is very shallow within 100 feet of the shore in the vicinity of OVF No. 22. The depth measurements ranged from 1.0 to 2.7 feet. These shallow depths prevent boating and water skiing within 200 feet of the shore in this area.

Field investigations also indicate that swimming activities would be limited near this outfall due to the presence of thick sediment. Near the shore, the sediment thickness ranged from 5 inches to 23 inches. Further away from the shore, the sediment thickness was found to be as much as 38 inches thick. These measurements were generally consistent 150 feet downstream of the outfall. Thick sediment conditions likely discourage the public from swimming or wading in this shallow area.

In summary, shallow stream depths restrict boating and water skiing activities, while thick sediments discourage shoreline swimming or wading activities. For these reasons, it was concluded that OVF No. 22 is not located in a sensitive area.

E. **OVF No. 1 (Rathbone) and OVF No. 23 (W. Illinois)**

OVF No. 1 is the most downstream CSO outfall in the Aurora system and is located at Rathbone Avenue. The outfall is located on the west bank of the river roughly 600 feet downstream and opposite to OVF No. 4. A large public park and boat dock are located within 200 feet of the outfall.

The outfall for OVF No. 23 is located in the west abutment wall of the Illinois Avenue Bridge. A large public park and a recent canoe boat ramp are located within 200 feet of this

outfall as well.

The stream data collected near these outfalls did not indicate major restrictions of primary contact recreation in the vicinity of the outfalls, and very little data is available on actual recreational trends in these areas. For this reason, it is requested that a time extension be granted so that more accurate data on recreational trends near these outfalls be collected during the summer of 1998.

It is therefore proposed that recreational trends near these two outfalls be determined by observing the daily activities that take place in these vicinities. An observer will record typical recreational activities, and frequency and use of the river, in the vicinity of these outfalls. In addition, green dye will be poured in the overflow structure during an overflow event to assess the extent of the CSO flow plume in the river and the potential impact on the shoreline. Should the dye water test be inconclusive, a computer model will simulate the test.

In conclusion, OVF Nos. 2, 4, 21 and 22 are not located in sensitive areas. It is requested that a time extension to November 1, 1998 be granted to more accurately evaluate whether or not OVF Nos. 1 and 23 are located in sensitive areas.

We trust the above addresses the requested information listed in your letter of April 29, 1997. Should you have any questions or need further information, please do not hesitate to call the undersigned.

Very truly yours,

WALTER E. DEUCHLER ASSOCIATES, INC.

Philippe F. Moreau, P.E.

PFM/mw

Encl.

cc: Tom Muth, Fox Metro WRD, w/Encl.
Steve Andras, Fox Metro WRD, w/Encl.
Peter Haurykiewicz, City of Aurora, w/Encl.
Jodi Rose, WEDA, w/Encl.

State of Illinois
ENVIRONMENTAL PROTECTION AGENCY

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

217/782-0610

April 29, 1997

Ms. Jodi Rose
Walter E. Deuchler Associates, Inc.
230 Woodlawn Avenue
Aurora, Illinois 60506-5194

Re: CSOs to Potentially Sensitive Areas--City of Aurora
NPDES Permit No. IL0048518 Special Condition 1, Paragraph 7

Dear Ms. Rose:

The Agency received a Phase I Report on April 10, 1997 prepared for the City of Aurora. Based on the information contained in the Phase I Report, the Agency has determined that CSOs 003, 005, 008, 010, 015, 016A, 017, 018, and 025, authorized in the City of Aurora's NPDES permit (IL0048518), do not discharge to sensitive areas. However, additional information is needed regarding CSOs 002, 004, 022, 001, 021 and 023 before the Agency can determine if these discharge into sensitive areas. Specially, the Agency is concerned with the recreational uses of the Fox River in the vicinity of these six CSOs.

Please provide the following information for the Fox River in the vicinity of CSOs 002, 004, 022, 001, 021 and 023:

> Whether the river is free of obstacles to primary contact activities, such as swimming or water skiing. Such obstacles may include barge docking, piers, high current waters, shallow waters coupled with near shore mixing conditions, or any other conditions that would render the area unsuitable for primary contact activities. Please keep in mind that elevated bacterial counts may persist for 48 to 72 hours after CSOs quit discharging.

If you have questions or concerns regarding this letter, please contact me at the phone number given above.

Sincerely,

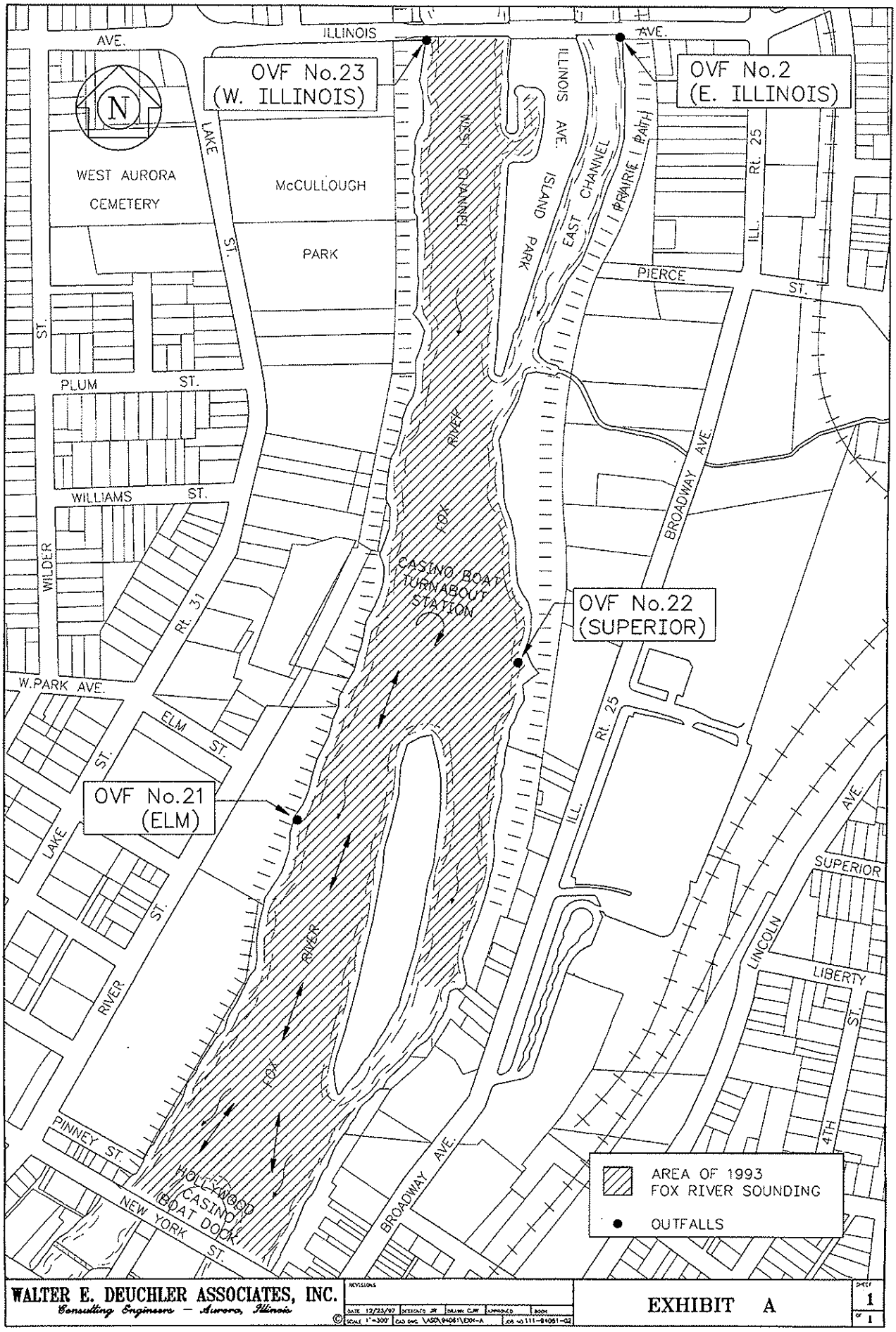
Dean J. Studer, P.E.
Manager, Southern Municipal Unit
Permits Section
Division of Water Pollution Control

DJS:ds

cc: Peter Haurykiewicz, City Engineer, City of Aurora
City Clerk, City of Aurora
Tom Muth, Fox Metro WRD
Phil Mcrean

Printed on Recycled Paper

EXHIBIT A



WALTER E. DEUCHLER ASSOCIATES, INC.
Consulting Engineers — Aurora, Illinois

REVISIONS

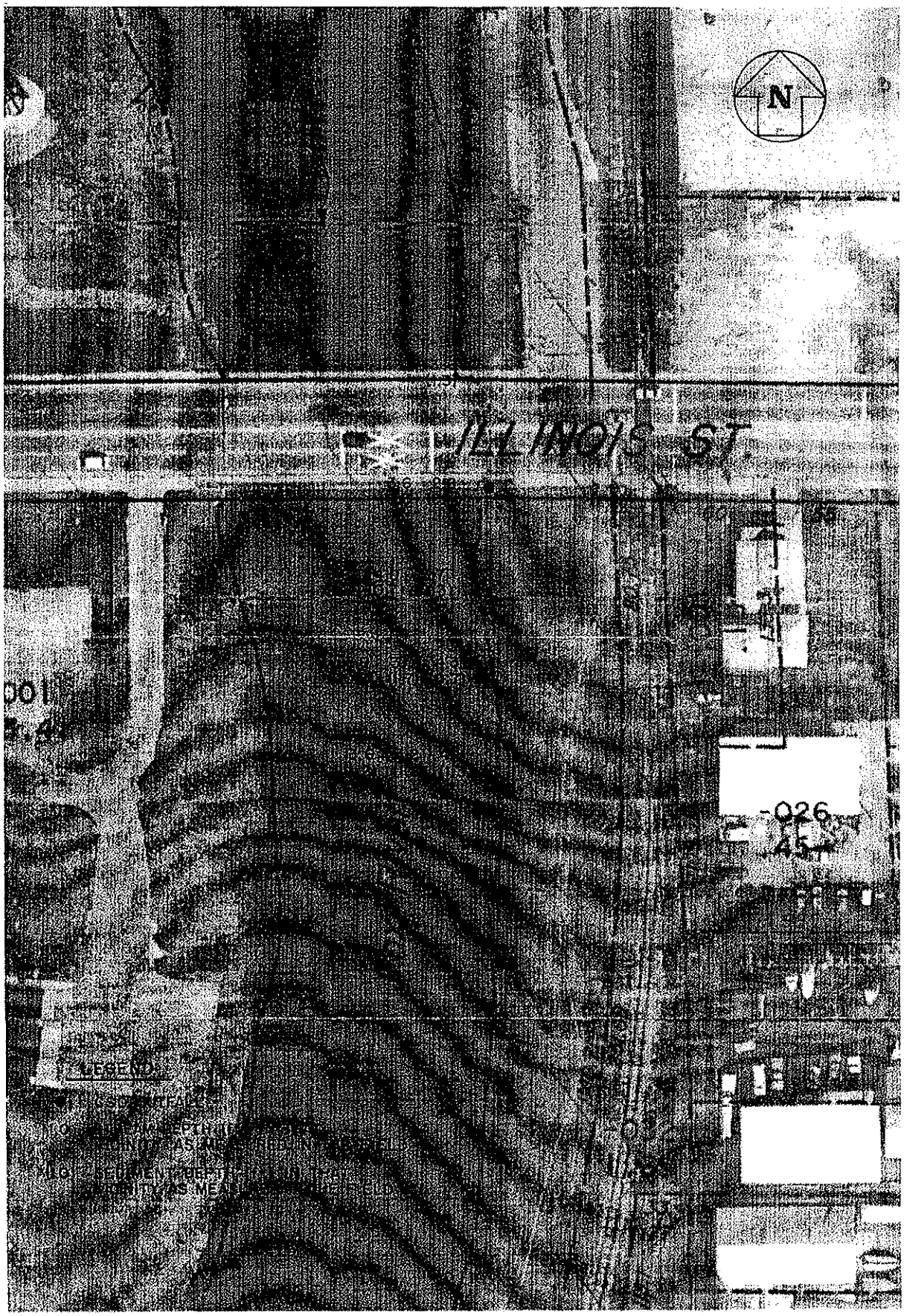
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EXHIBIT A

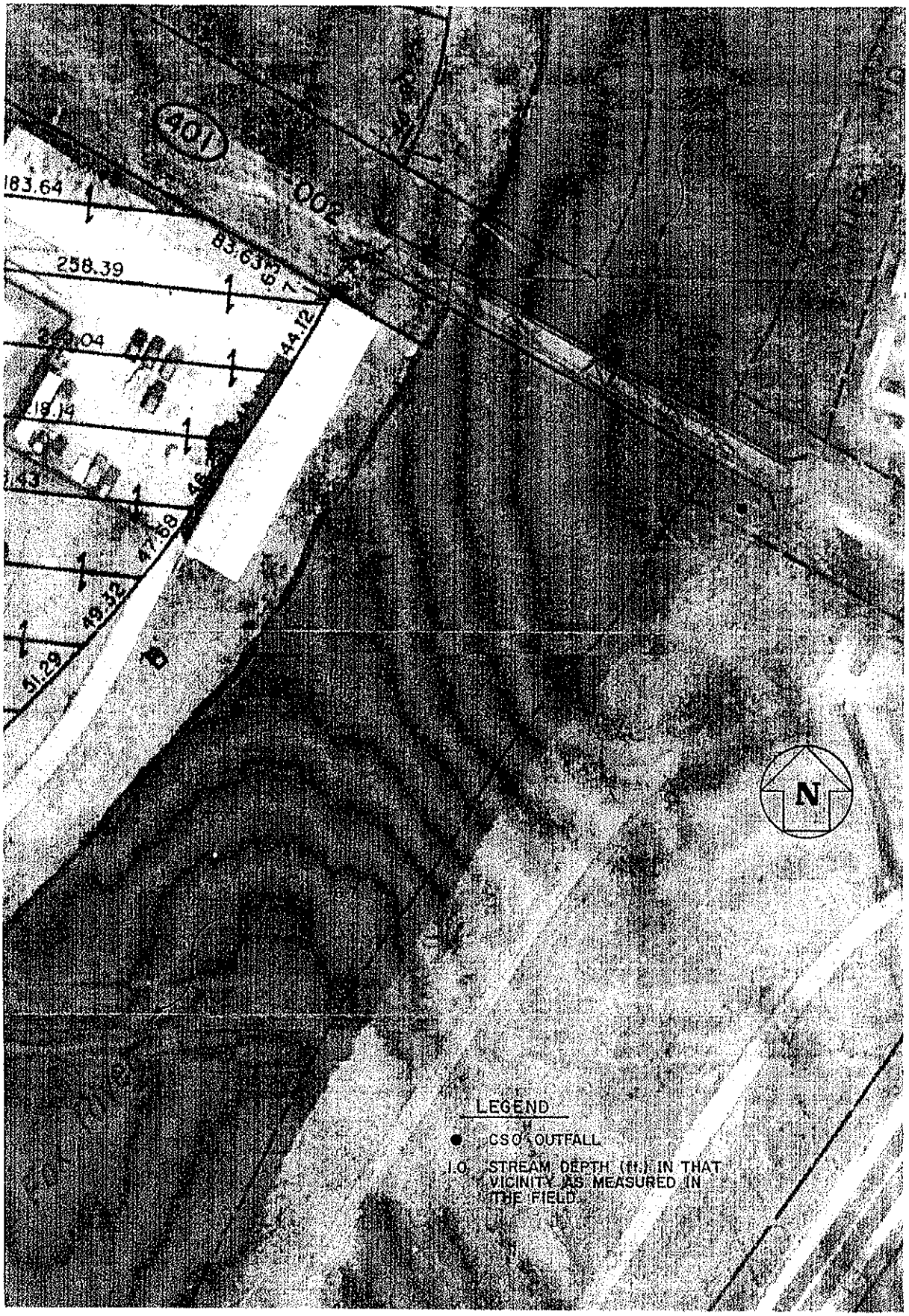
SHEET 1 OF 1

EXHIBIT B



WALTER E. DEUCHLER ASSOCIATES, INC. *Consulting Engineers – Aurora, Illinois*	REVISIONS	EXHIBIT B CSO No. 2 (East ILLINOIS) STREAM & SEDIMENT DEPTH	SHEET 1 OF 1
©	DATE 12/12/97 DESIGNED DRAWN C.W. APPROVED BOOK SCALE 1"=50' CAD DWG. \ASD\94061\EXH-B JOB NO 111-94061-02		

EXHIBIT C

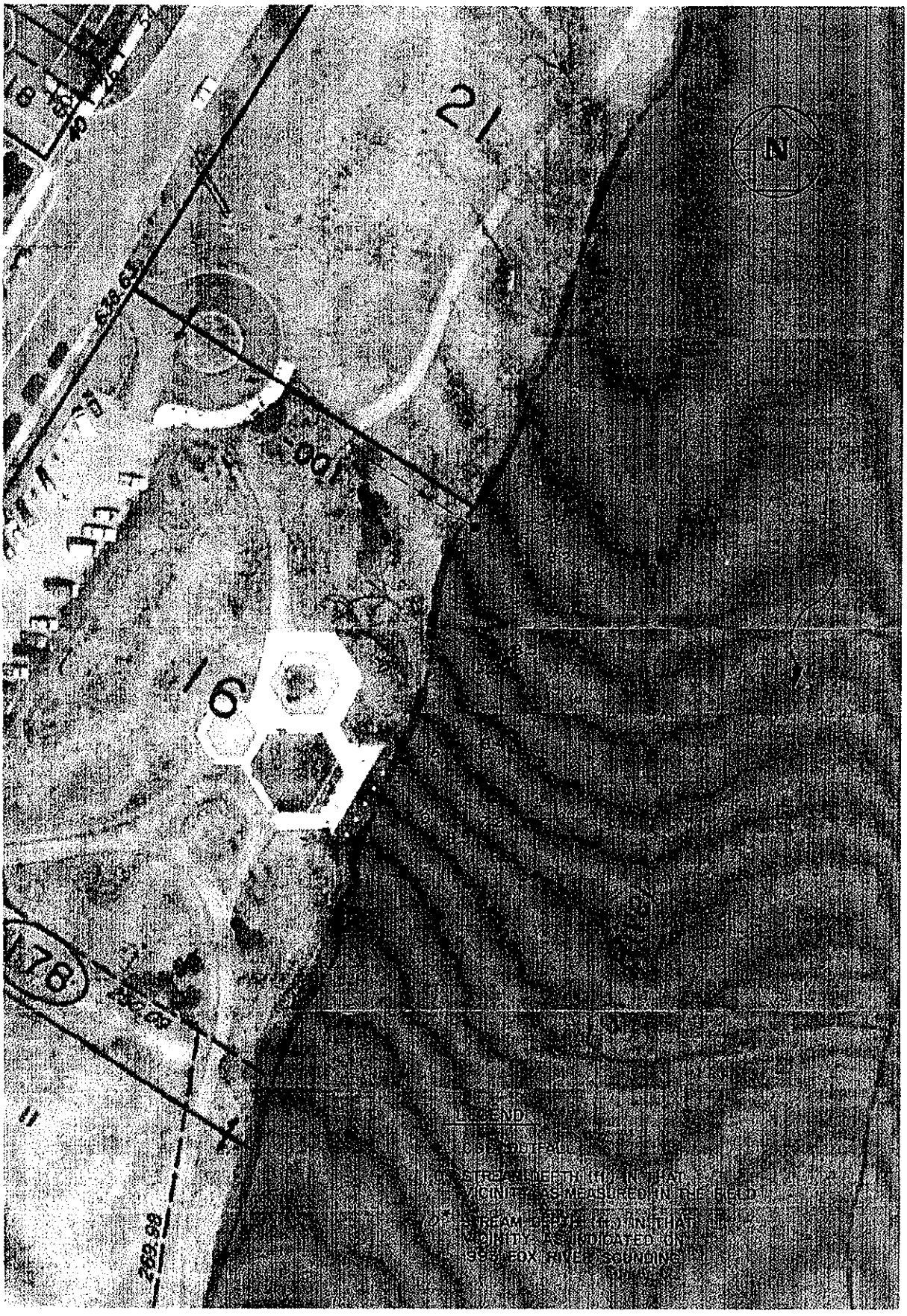


WALTER E. DEUCHLER ASSOCIATES, INC.
Consulting Engineers – Aurora, Illinois

EXHIBIT C
CSO No. 4 (HAZEL)
STREAM DEPTH

SHEET 1 OF 1

EXHIBIT D



WALTER E. DEUCHLER ASSOCIATES, INC.
Consulting Engineers — Aurora, Illinois

REVISIONS				
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EXHIBIT D
CSO No. 21 (ELM)
STREAM DEPTH

SHEET 1 OF 1

EXHIBIT E



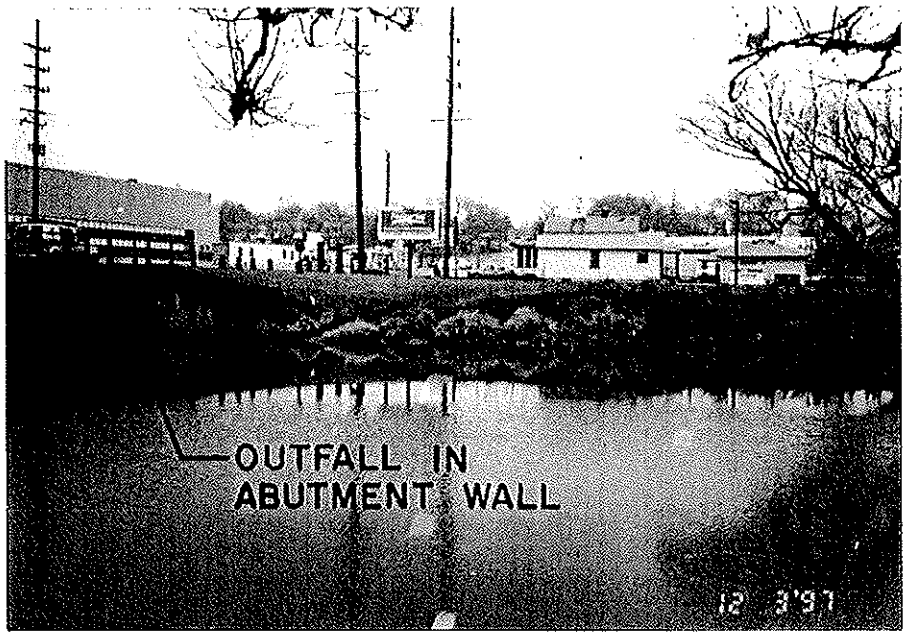
WALTER E. DEUCHLER ASSOCIATES, INC.
Consulting Engineers – Aurora, Illinois

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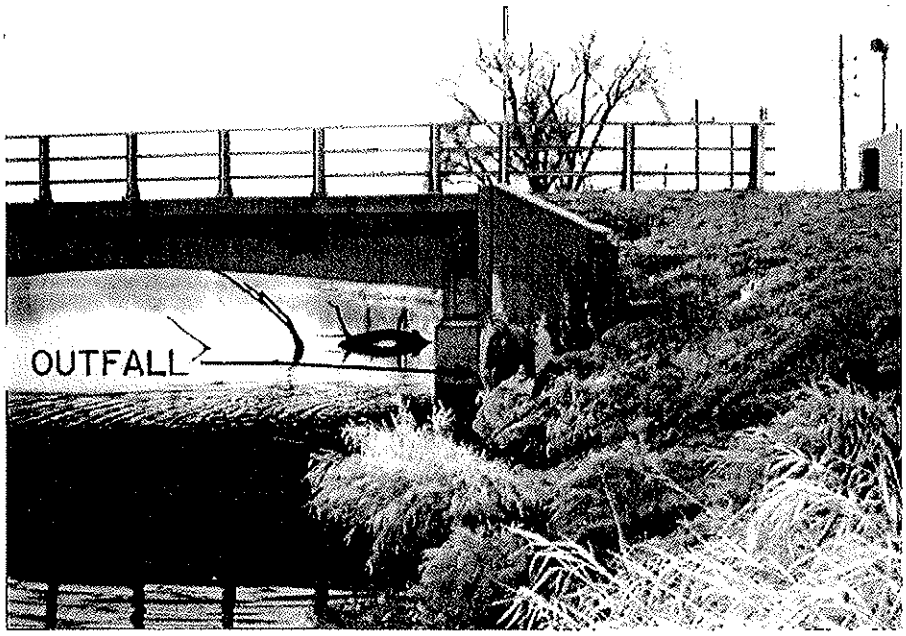
EXHIBIT E
CSO No. 22 (SUPERIOR)
STREAM & SEDIMENT DEPTH

SHEET 1 OF 1

EXHIBIT F

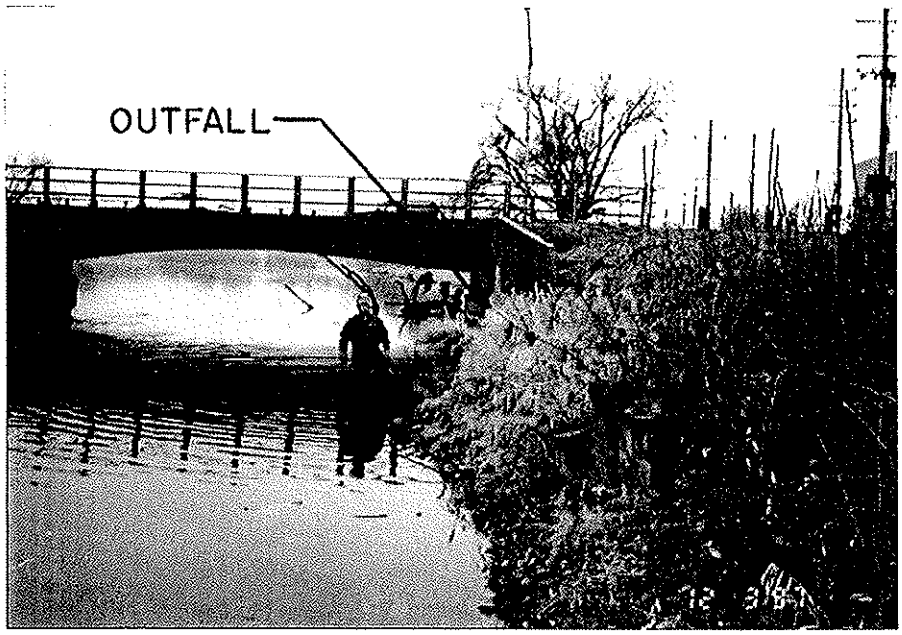


Looking east at the east bank of the East Channel immediately downstream of the Illinois Avenue Bridge.

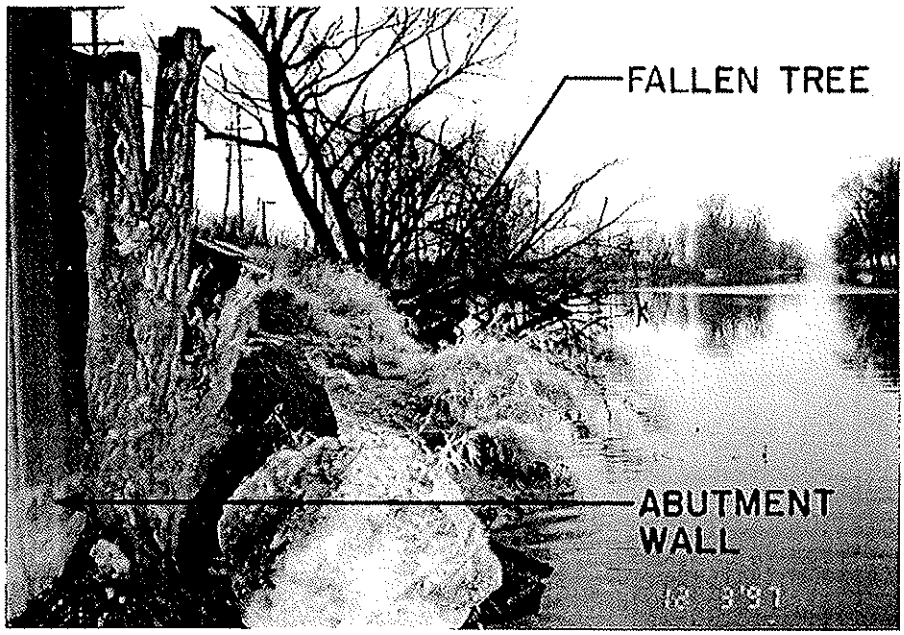


Standing on the east bank of the East Channel 50 feet downstream of the outfall looking north. Note steep approach banks and uneven shoreline adjacent to outfall.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT F OVF No. 2 (E. Illinois) Page 1 of 3



Standing 100 feet downstream of outfall looking north. Note heavy vegetation along river's edge rendering the river inaccessible here.

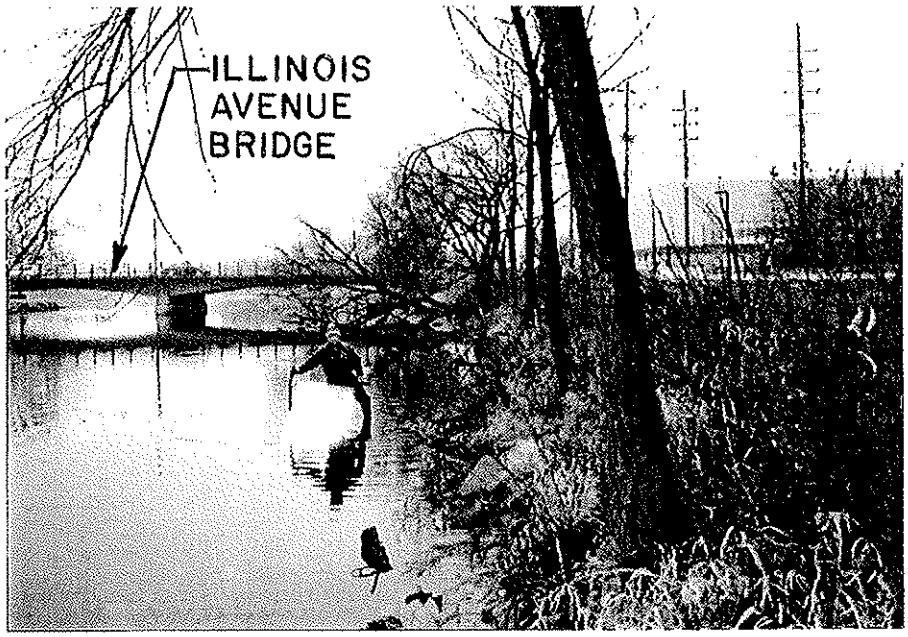


Standing next to the outfall looking south. The fallen tree marked in the picture is located roughly 200 feet downstream of the outfall. Note how the uneven shoreline and heavy vegetation cause it to be difficult to access the stream between zero and 200 feet downstream of the outfall.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT F OVF No. 2 (E. Illinois) Page 2 of 3



Standing 200 feet downstream of outfall looking north. Notice heavy vegetation along river's edge rendering the river inaccessible here.



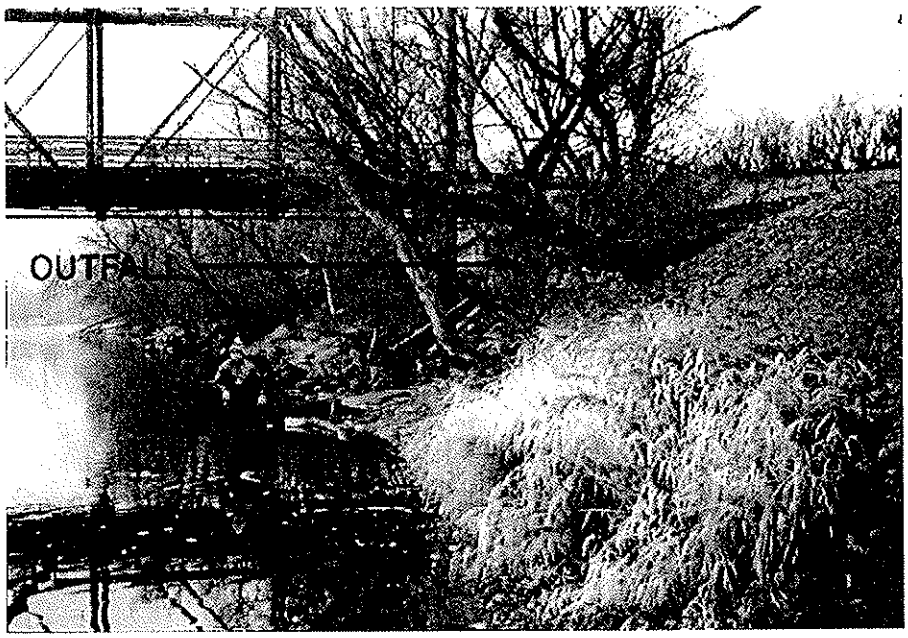
Standing 300 feet downstream of outfall looking north. Note heavy vegetation and inaccessible shoreline from 200 to 300 feet downstream of the outfall.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT F OVF No. 2 (E. Illinois) Page 3 of 3

EXHIBIT G

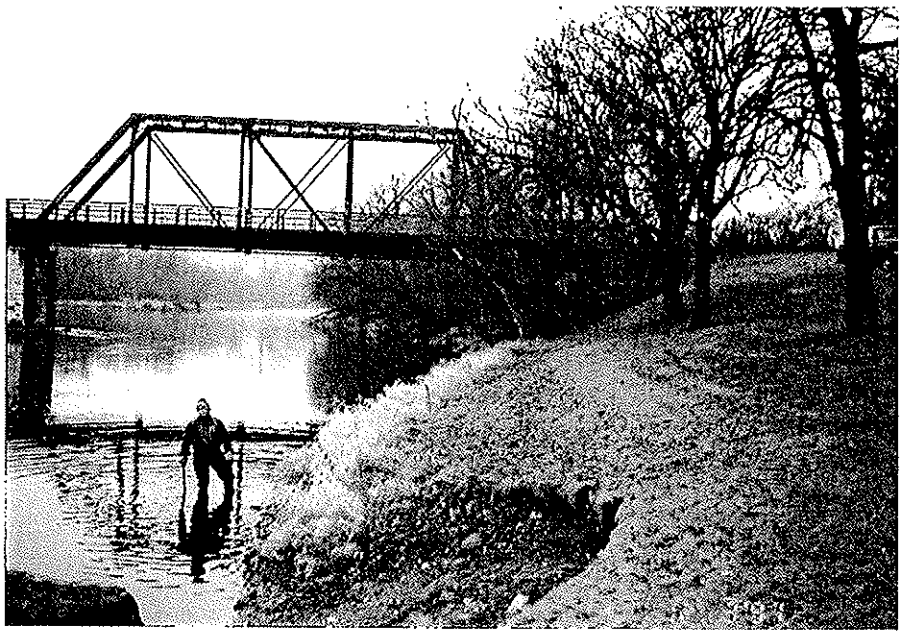


Standing on the east bank of the river, 50 feet downstream of the outfall, looking north. Note heavy vegetation and uneven shoreline upstream and downstream of the outfall causing it to be dangerous to access the river here.



Standing on the east bank, 100 feet downstream of the outfall, looking north. Note steep approach banks and sharp drop-off at river's edge.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT G OVF No. 4 (Hazel) Page 1 of 2



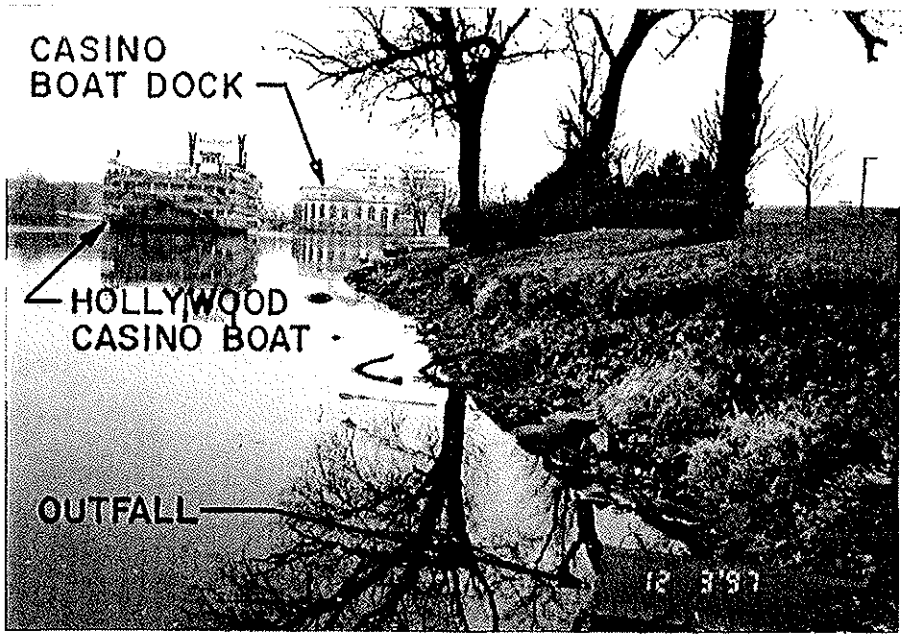
Standing 200 feet downstream of the outfall looking north. Note sharp drop-off of river's banks from 100 to 200 feet downstream of outfall. Sharp drop-offs cause it to be difficult to access the stream.



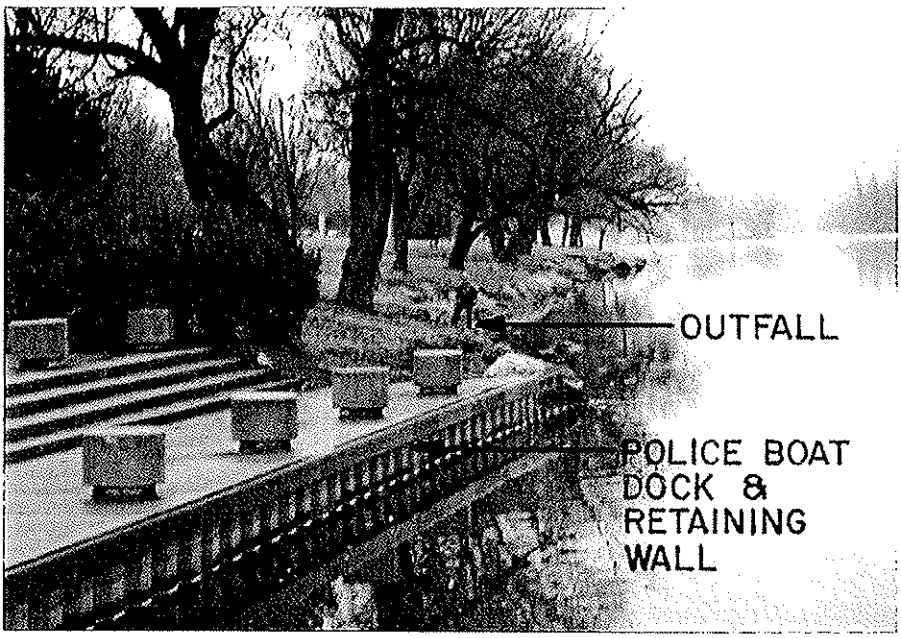
Standing 400 feet downstream of the outfall looking north. Note consistency of the shoreline's drop-off. These drop-offs and steep approach banks cause it to be difficult to access the river from zero to 400 feet downstream of the outfall.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT G OVF No. 4 (Hazel) Page 2 of 2

EXHIBIT H



Standing on the west bank of the river next to the outfall, looking south. During the summer, the casino boat travels north typically past the outfall for OVF No. 21. The presence of this large watercraft in the stream restricts recreational activities such as swimming and water skiing.



Standing 150 feet downstream of the outfall, looking north. Note retaining wall on the west bank which restricts access to the river in this area.

Walter E. Deuchler Associates, Inc. Consulting Engineers Aurora, Illinois	EXHIBIT H OVF No. 21 (Elm) Page 1 of 1

OCTOBER 2000 SENSITIVE AREA ANALYSIS (70 PAGES)

SENSITIVE RECEPTOR STUDY

OVF NOS. 1 AND 23

CITY OF AURORA

OCTOBER 30, 2000

WALTER E. DEUCHLER ASSOCIATES, INC.
CONSULTING ENGINEERS
230 WOODLAWN AVE.
AURORA, IL 60506

WALTER E. DEUCHLER ASSOCIATES INC.
Consulting Engineers
230 WOODLAWN AVENUE • TELEPHONE (630) 897-4651 • FAX (630) 897-5696
AURORA, ILLINOIS 60506

October 30, 2000

Mr. Dean J. Studer, P.E.
Manager, Southern Municipal Unit
Permits Section
Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 N. Grand Avenue East
Springfield, IL 62702

Re: City Of Aurora
NPDES Permit No. IL0048518 Special Condition 1, Paragraph 7
W.E.D.A. Job # 111-94061-02

Dear Mr Studer:

On behalf of the City of Aurora , Walter E. Deuchler Associates Inc. (WEDA) is pleased to submit two (2) copies of the "Sensitive Receptor Study" and two (2) copies of the "CSO Performance and Monitoring" report for your review.

The "Sensitive Receptor Study" outlines our analysis and discusses the outcomes of our sensitive receptor studies conducted during the summers of 1998, 1999 and 2000 at OVF No. 001 (Rathbone) and OVF No. 023.

The "CSO Performance and Monitoring" report details our field studies and monitoring of the CSO Facility and OVF Nos. 001 (Rathbone), 002 (East Illinois). 003 (Pierce), 004 (Hazel), 018 (W. Galena), 022 (Superior), and 025 (Dearborn-Trask).

Should you have any questions or need further information, please do not hesitate to call Philippe Moreau at 630/897-4651 or the undersigned.

Sincerely,
WALTER E. DEUCHLER ASSOCIATES, INC.

Amy A.L. Drucker
Project Manager

Encl.

cc: Tom Muth, Fox Metro WRD, w/1 copy
Peter Haurykiewicz, City of Aurora w/1 copy
Philippe Moreau, WEDA

PART 1.0

PURPOSE OF STUDY

SENSITIVE RECEPTOR STUDY
OVF NOS. 1 AND 23
CITY OF AURORA

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2.1.2 OVF No. 23 (W. Illinois)

2.2 RIVER DYE TESTING

2.3 BACTERIAL ANALYSIS

2.3.1 OVF No. 1 (Rathbone)
2.3.2 OVF No. 23 (W. Illinois)
2.3.3 Comparison of Data

3.0 CONCLUSIONS

4.0 EXHIBITS

EXHIBIT A - 2000 LABORATORY ANALYSIS OVF NO. 001

EXHIBIT B - 2000 LABORATORY ANALYSIS OVF NO. 023

EXHIBIT C - 1983 LABORATORY ANALYSIS AND SOP FOR UPSTREAM

1.0 PURPOSE OF STUDY

This report was prepared in accordance with requirements contained in the City of Aurora NPDES Permit No. IL0048518. The purpose of this study is to determine if Combined Sewer Overflows (CSOs) outfall Nos. 001 and 023 discharge to sensitive areas.

1.1 BACKGROUND

The Aurora Combined Sewer System (CSS) encompasses an area of approximately 7,230 acres in Aurora, Kane County, Illinois. There are 17 permitted overflow points discharging to the Fox River. The City of Aurora owns and operates 15 of the CSOs, while the Fox Metro Water Reclamation district owns the other two (2).

In the 1994 CSO Control Policy Section II.C.3., the USEPA defines a sensitive area as a receiving stream which has any of the following designated uses:

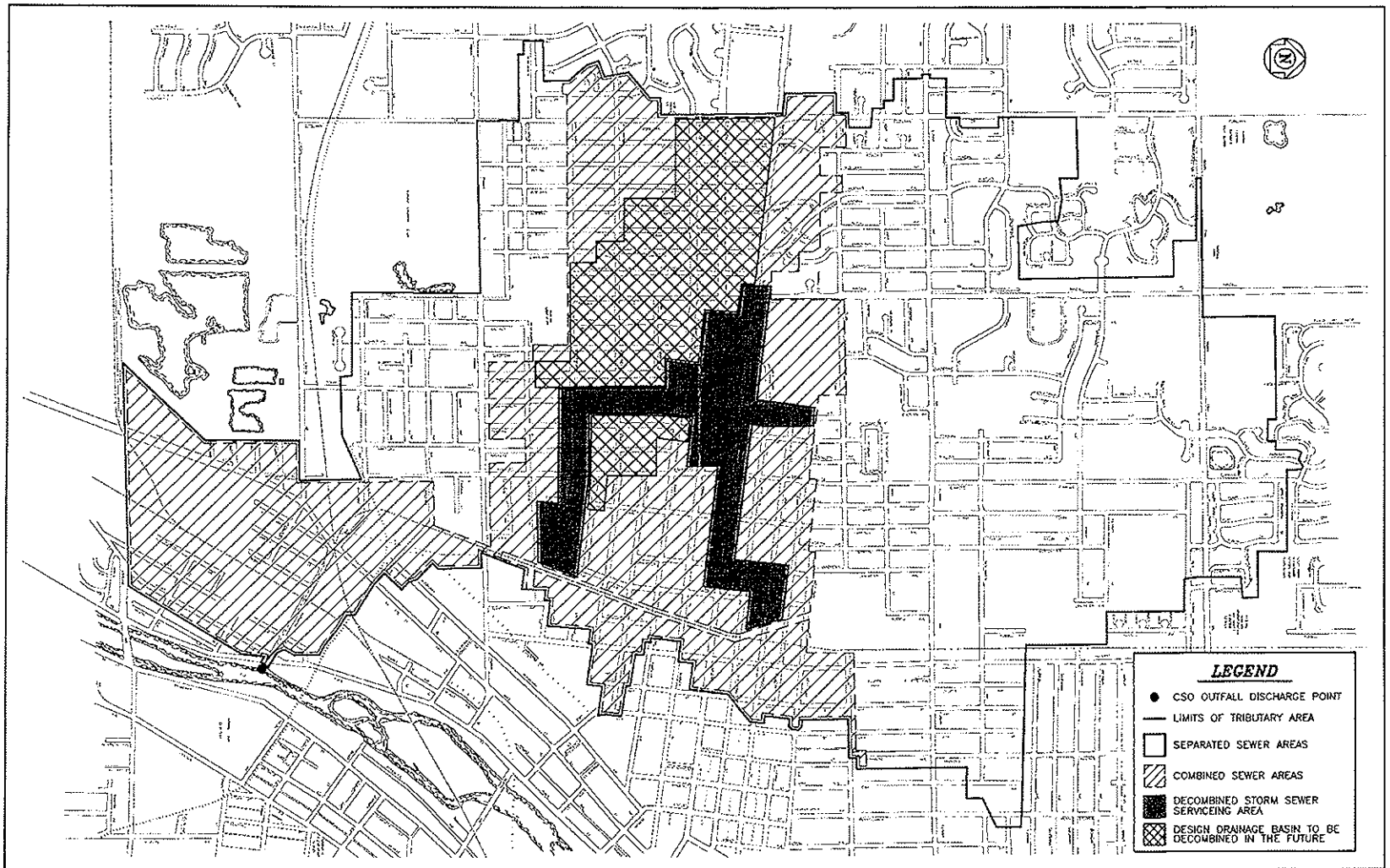
1. Outstanding National Resources Waters, or
2. National Marine Sanctuaries, or
3. Waters with threatened or endangered species or their designated critical habitat, or
4. Primary contact recreation waters, or
5. Public drinking water intakes or their designated protection areas, or
6. Shellfish beds.

The "Phase I Determination of Sensitive Areas Near CSO Discharge Points" dated March 1997, submitted by Walter E. Deuchler Associates, Inc. (WEDA) on behalf of the City of Aurora and the Fox Metro Water Reclamation District, indicated that CSOs 003, 005, 008, 010, 015, 016A, 017, 018 and 025 do not discharge to sensitive areas. This was agreed upon via correspondence from the IEPA dated April 29, 1997. At this time the IEPA indicated that further study was needed at the remaining six overflow locations which included: 001, 002, 004, 022, 021 and 023. The IEPA also stated ".... Please keep in mind that elevated bacterial counts may persist for 48 to 72 hours after CSOs quit discharging."

WEDA submitted a second correspondence detailing evidence that OVF Nos. 002, 004, 021, and 022 are not located in sensitive areas but that further information was needed regarding OVF Nos. 001 and 023. At that time WEDA proposed to track recreational trends near these two outfalls and dye the water in each overflow during an overflow event to assess the extent of the CSO flow plume in the river and the potential impact on the shoreline. This was agreed upon via IEPA correspondence dated January 12, 1998.

1.1.1 OVF No. 1 (Rathbone)

Overflow No. 1, located at Rathbone Avenue and River Street, is one (1) of the four (4) major overflows in the Aurora Combined Sewer System (CSS). The size of the tributary area is approximately 2,490 acres, of which 1,100 acres are served by combined sewers and 1,390 acres are served by separated sewers (see **Figure 1-1)** . This is the largest tributary area of all the overflows. At the overflow diversion structure, the 96 inch combined sewer discharges dry weather flow plus part of its' wet weather flow into the 69 inch East and West Bank Interceptor via two (2) 15 inch concrete pipes. Excess wet weather flows are discharged into the river via an outfall pipe laid in the bedrock of the river extending



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Consulting Engineers — Aurora, Illinois

FIGURE 1-1
AREAS TRIBUTARY TO OVF NO. 1

SHEET 1 OF 1

approximately 150 linear feet into the center of the Fox River. When the outfall pipe laid in the bedrock becomes clogged with sediment, overflows are discharged at a structure located on the shoreline. Overflow No. 1 is the most downstream overflow in the CSS, except for Fox Metro's wastewater treatment plant overflow in Montgomery.

In the vicinity of the outfall location there are recreational and commercial areas. A public park is located on both sides of the river and a boat launch area is located roughly 200 feet downstream of the outfall. Commercial enterprises are located on the west side of River Street, which is set back roughly 400 feet from the west bank of the river. These businesses include a restaurant, abandoned gas station, warehouse, and two furniture retail stores.

1.1.2 OVF No. 23 (W. Illinois)

Overflow No. 23 is located on the west bank of the west branch of the Fox River under the Illinois Avenue bridge. The tributary area is roughly 140 acres, all of which are currently served by combined sewers (see **Figure 1-2**). A recent sewer separation project for a portion of the tributary area will be complete by Spring 2001. Upon completion, approximately 50 acres will be separated and served with new storm sewers. A 27 inch combined sewer carries all combined flows to an overflow structure located 100 feet westerly of the Illinois Avenue bridge. The dry and part of the wet weather flows are conveyed northerly into a 16 inch pipe, eventually crossing the river via two (2) siphon tubes and making connection to the East and West Bank Interceptor. Excess wet weather flows are conveyed over a weir into a 27 inch outfall pipe located in the west wall of the Illinois Avenue bridge.

A public park is located 50 feet downstream of the outfall, and a public boat ramp is located on an island opposite the outfall. Overflow No. 23 is situated in a recreational area.

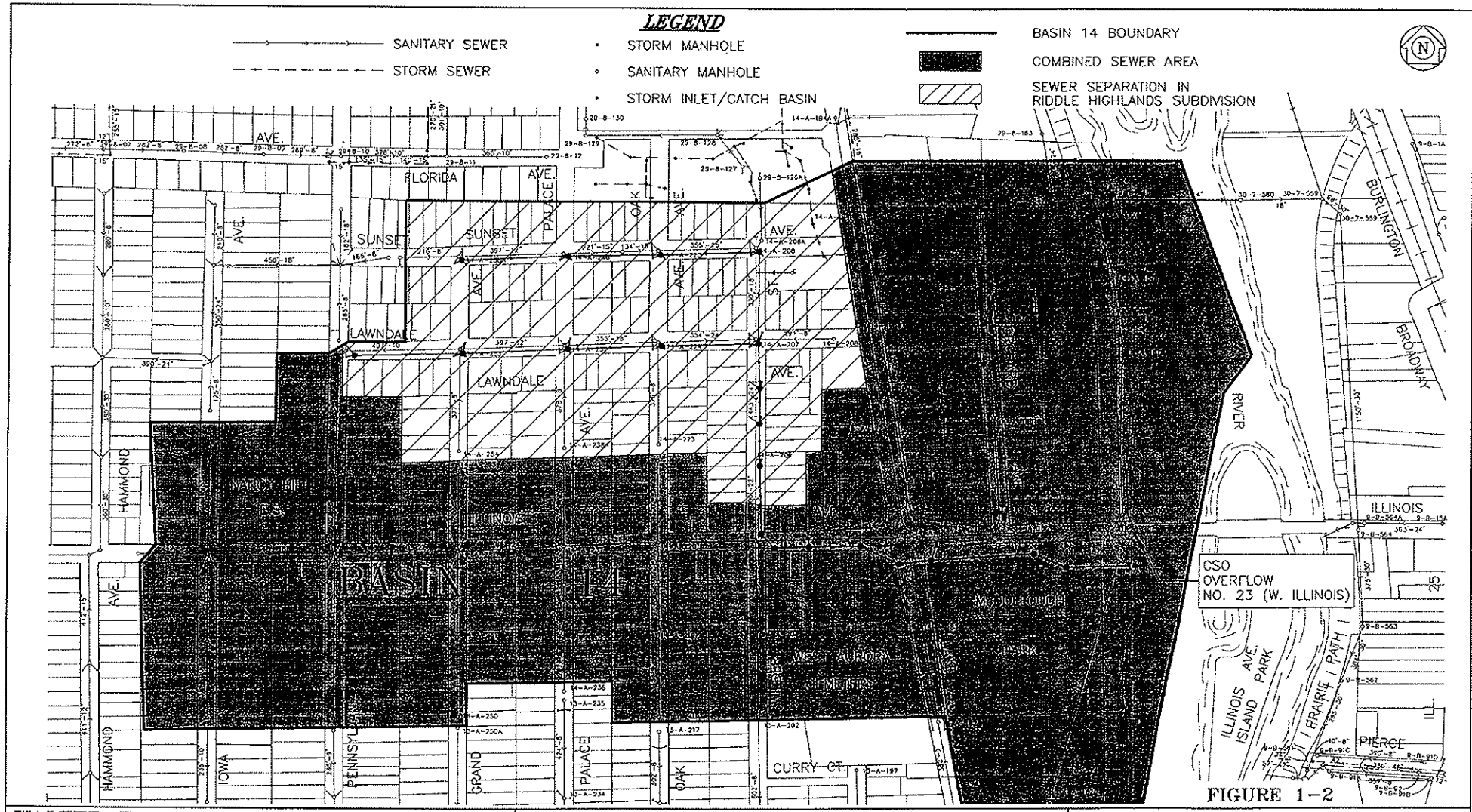


FIGURE 1-2

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RIDDLE HIGHLANDS SUBDIVISION COMBINED SEWER INVESTIGATION

AREAS TRIBUTARY TO OVF No. 23

PART 2.0

GENERAL STUDY

2.0 GENERAL STUDY

Special Condition No. 1, Part 7 of the City's NPDES permit states that if a CSO location is found to discharge to a sensitive area, then additional CSO controls may be required to protect the area. In light of this condition, this report further evaluated CSO OVF Nos. 001 and 023 in order to determine if additional CSO controls are necessary.

In order to determine if OVF Nos. 001 and 023 discharge to sensitive areas, three (3) characteristics were evaluated:

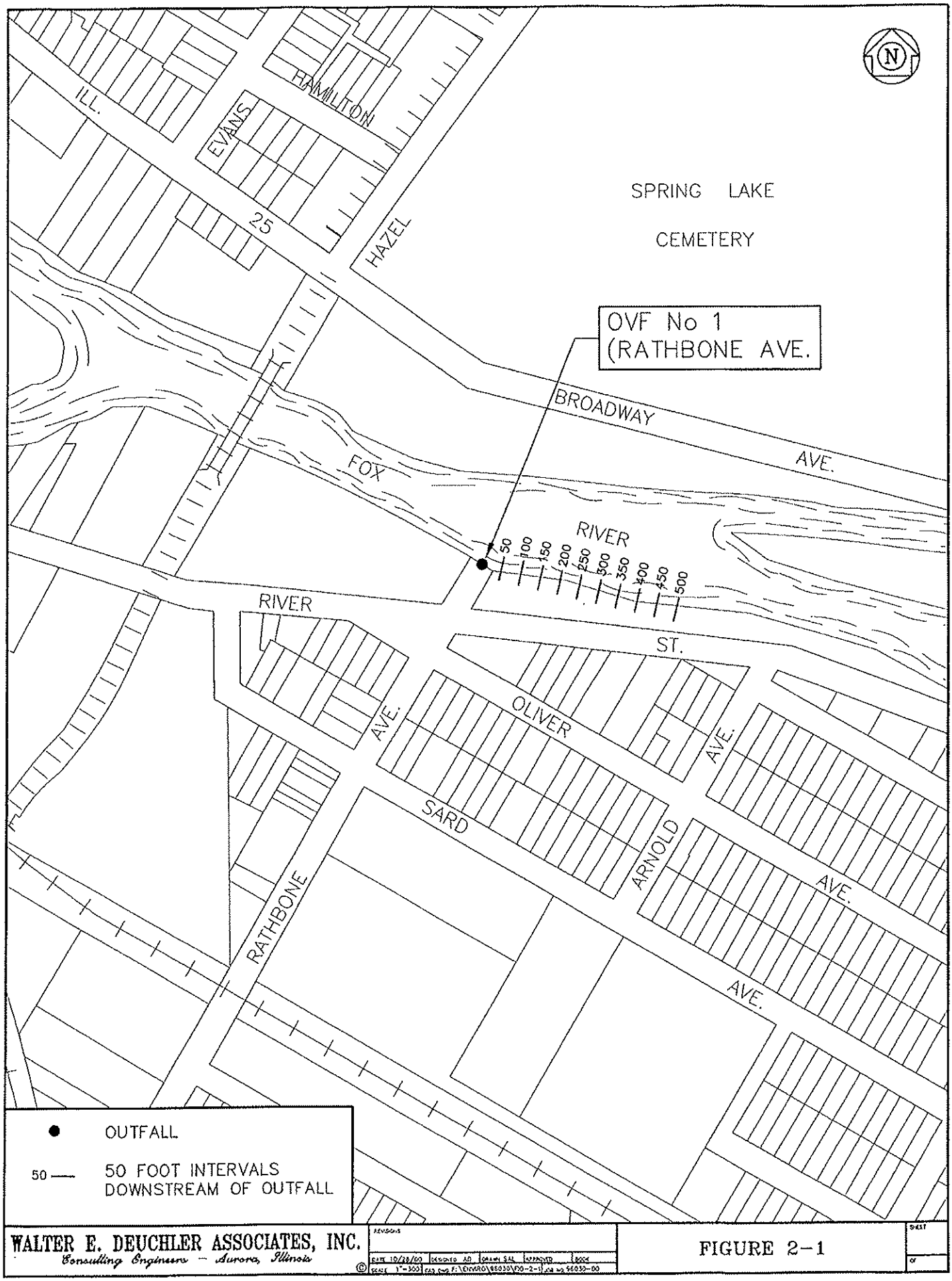
1. Recreational use of the receiving stream in the vicinity of the outfall,
2. Dye testing to evaluate plume characteristics, and
3. Bacterial analysis in the vicinity of the outfall.

2.1 RECREATIONAL USE TRENDS

The Fox River was studied in the vicinity of CSO OVF Nos. 001 and 023 to obtain data regarding the recreational uses of the river. The objective of the study was to characterize specific uses, locations and ages of river recreationalists.

2.1.1 OVF No. 1 (Rathbone)

The study area concentrated from the CSO structure located on the west bank of the river to a point 250 feet south of the CSO structure (**Figure 2-1**). Recreational activities at this location were observed during late July and early August, 1998. The river level was low and temperatures ranged between 75° and 95° F. with weather conditions ranging from drizzling and cloudy to sunny and humid. Data was collected during different time intervals between the hours of 9:00 A.M. and 4:45 P.M., on the weekends and during the week. Below is a summary of recreational activities recorded:



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Consulting Engineers — Aurora, Illinois

REVISIONS

DATE 10/28/00 | DESIGNED AD | DRAWN SAL | APPROVED | BOOK

SCALE 1"=300' | FILE NAME F:\DWGS\85030\FIG-2-1.DGN JOB NO 85030-00

SHEET

FIGURE 2-1

During the river study 35 people entered the river within the study area.

- 16 people entered the river for recreational activities including: swimming, wading and boating;
- 17 people utilized the river for fishing and maintained little or no contact with the river water;
- two (2) City water department workers utilized the river to test city water pumps;

The activities of the 16 individuals who utilized the river for recreational purposes, including swimming, wading and boating can be further characterized as follows:

- 14 of the river users entered the river from the west bank and 2 from the east bank;
- 10 of the river users appeared to be below the age of 10;
- 6 of the river users appeared to be between the ages of 20 and 55;
- Use of the river ranged from less than 50 feet south of the outfall to greater than 250 feet south of the outfall;
- None of the swimmers or waders ventured more than ten (10) feet from the shoreline, and none of the swimmers were fully submerged;
- Boaters exited and entered the river no greater than ten (10) feet from the shoreline;

The activities of the 17 individuals who utilized the river for fishing can be further characterized as follows:

- Only five (5) of the users entered the river from the west bank and 12 from the east bank;
- All five (5) of the users appeared to be between the ages of 20 and 55;

- Fishing locations ranged from off of the CSO structure itself to 250 feet south of the structure;
- None of the users who were fishing ventured greater than 2 feet off shore, with the majority never entering the water;

2.1.2 OVF No. 23 (W. Illinois)

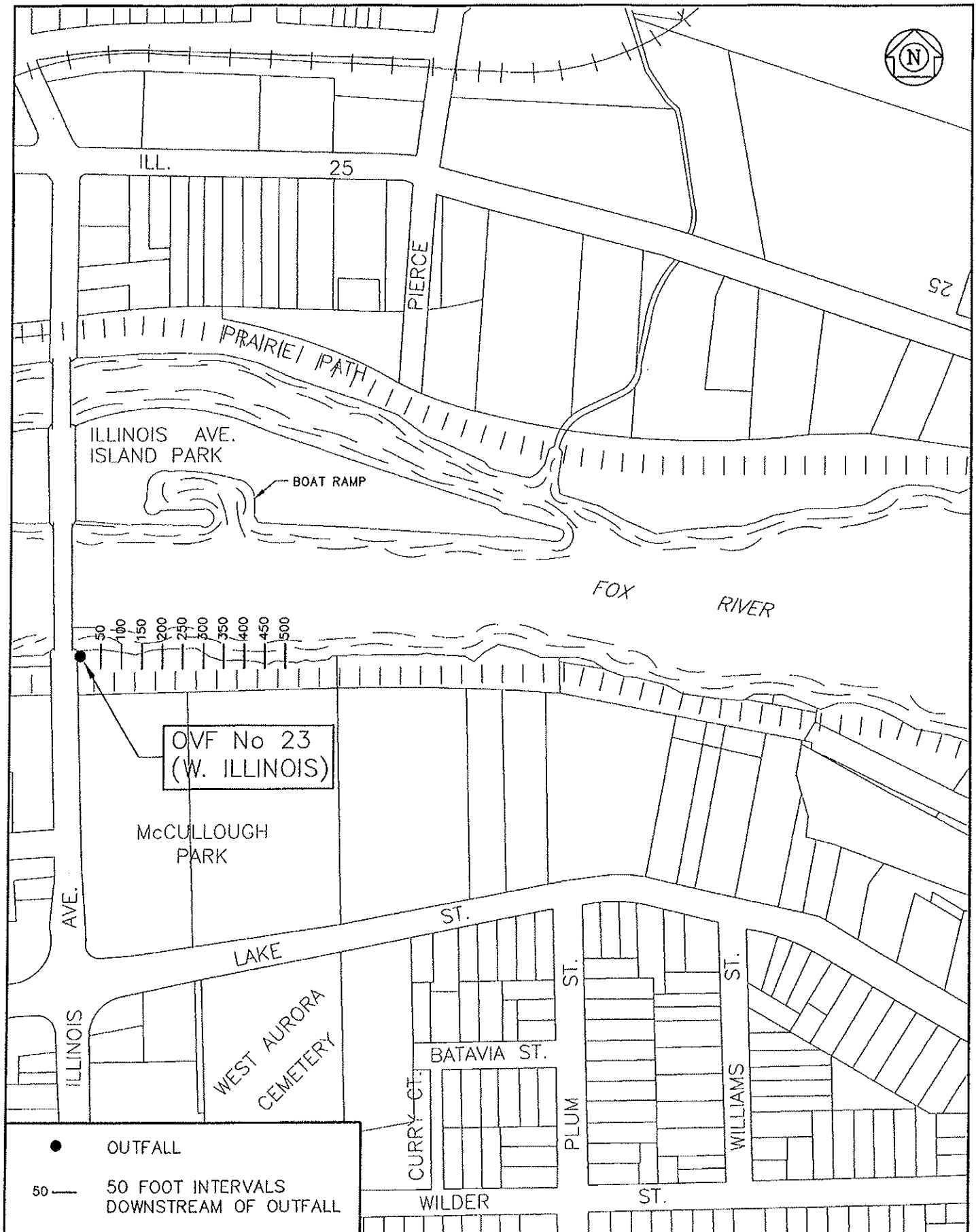
The study area concentrated from the CSO structure located under the bridge on the west bank of the west channel of the river to 250 feet south of the CSO overflow (**Figure 2-2**). The River at this location is bisected by an Island which offers numerous recreational activities to users. Recreational activities at this location were observed during late July and early August, 1998. The river level was low and temperatures ranged between 75° and 95° F. with weather conditions ranging from drizzling and cloudy to sunny and humid. Data was collected during different time intervals between the hours of 9:00 A.M. and 4:45 P.M., on the weekends and during the week. Below is a summary of recreational activities recorded:

During the river study 41 people entered the river within the study area.

- 39 people entered the river for recreational activities including: swimming, wading, boating, skiing, and jet skiing;
- 2 people utilized the river for fishing and maintained little or no contact with the river water;

The activities of the 39 individuals who utilized the river for recreational purposes, including swimming, wading, boating, skiing, and jet skiing are further characterized as follows:

- 30 of the river users entered the river from the west bank of the island and 9 from the west bank of the west channel;



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Consulting Engineers – Aurora, Illinois

FIGURE 2-2

- 17 of the river users appeared to be below the age of 10;
- 1 of the river users appeared to be between the ages of 10 and 20;
- 20 of the river users appeared to be between the ages of 20 and 55;
- 1 of the river users appeared to be above the age of 55;
- Use of the river ranged from less than 50 feet south of the outfall to greater than 250 feet south of the outfall;
- Recreational use included some wading from the west bank of the west channel, but did not include full primary contact. However, waders from the west bank of the island generally included full body submersion.

The activities of the two (2) individuals who utilized the river for fishing can be further characterized as follows:

- Both of the river users were fishing from the west bank of the west channel;
- Both of the users appeared to be between the ages of 20 and 55;
- Both locations were greater than 250 feet south of the outfall;
- Neither of the users who were fishing ventured greater than 2 feet off shore;

It is important to note that in both cases (OVF Nos. 001 and 023), the majority of river use occurred during the weekends and evenings when weather conditions were sunny and the temperature was above 80° F. and not during overflow events. Fishing still occurred during rain events, but no primary contact took place.

2.2 RIVER DYE TESTING

Dye testing was initiated to determine the flow or plume of the CSO discharge from each of the outfalls during a rain event. Dye testing took place on August 4, 1998 while the river was in a very low stage condition, during a rain event which caused both overflows to discharge. In both cases, green dye was injected during the overflow event, overflow into the outfall pipe discharging into the river.

At OVF No. 1 (Rathbone) the dye was observed to be exiting through the outfall structure located on the shoreline. The plume moved out towards the middle of the river and appeared to dissipate approximately 500 feet downstream of the outfall. At that time, the dyed discharge did not appear to affect either the west bank of the river or the east bank of the river. However, on August 5, 1998 it was noted during a follow-up inspection that some of the dye had been caught in a back current situation and had traveled along the west shoreline. It is believed that this may have been due to the very low stage of the river and may not be representative of normal river conditions.

At OVF No. 23 (W. Illinois) the dye was observed to be exiting through the outfall structure and migrating out approximately 25 feet from the west bank of the west channel. The dye appeared to move down stream, away from the shoreline and dissipated at the end of the Illinois Island Park. At that time the dyed discharge did not appear to affect the banks of the west channel.

2.3 BACTERIAL ANALYSIS

Following the recreational trend survey and dye testing analysis, the river water in the vicinity of each of the overflows was sampled following an overflow event to determine if bacteria lingered in the area. The overflow events lasted 1.0 hour at OVF No. 001 and 1.5 hours at OVF No.023. The following paragraphs describe those results and provide a comparison to background data obtained during a CSO study performed in 1983.

Bacterial sampling was conducted during an overflow event at each of the overflows, and at approximately three (3) hours, 21 hours and 47 hours later. Samples were collected in sterile 250 ml wide mouth glass bottles with screw caps. Grab samples were collected 50 feet, 100 feet, 150 feet, 200 feet, 250 feet and 300 feet downstream of the overflows and 15 feet away from the shoreline. Samples were collected 15 to 30 cm below the water surface with the bottleneck pointed upstream. Samples were immediately iced and taken to an IEPA certified laboratory (Enviro-Test/Perry Laboratories, Inc., Willowbrook, IL) within the six (6) hour holding time. Samples were analyzed for Fecal Coliform, E. Coli and Fecal Strep.

2.3.1 OVF No. 1 (Rathbone)

Laboratory analysis indicated that fecal strep was found to be less than 50 (MF) per 100 ml for all sampling times and locations. Likewise, E. Coli was also found to be less than 3 (MPN) per 100 ml for all sampling times and locations.

Laboratory analysis indicated that for all locations during the overflow event and three hours later fecal coliform were found to be less than 50 (MF) per 100 ml. During the sampling event conducted 21 hours after the overflow event, fecal coliform levels ranging from less than 10 (MF) per 100 ml at 50 feet downstream from the overflow were found with the highest count being found 150 feet downstream from the overflow at 620 (MF) per 100

ml.

During the sampling event conducted 47 hours after the overflow event, the highest bacterial count was found to be 460 (MF) per 100 ml at 50 feet downstream from the overflow and the next highest found 150 feet downstream from the overflow with a count of 360 (MF) per 100 ml. **Table 2-1** provides a summary of the laboratory analysis and copies of the laboratory reports can be found in **Exhibit A.**

It is believed that the fecal coliform counts found during the 21 hour and 47 hour sampling events can be attributed to overland run off from the surrounding parks or from upstream locations. Large populations of geese, ducks and some dog are commonly found using the open green space in this area. This would account for the lack of fecal coliform counts found during the first sampling events when bacteria from the overflows would normally be at their highest, and the high bacterial counts found after the overflow had already ceased.

TABLE 2-1

BACTERIAL ANALYSIS
CSO OVF No. 1 (Rathbone)

Date	Time (1) (Hours)	Distance from Overflow (ft.)	Fecal Coliform	E. Coli	Fecal Strep
9/20/2000	0:00	50	LT 50	LT 3	LT 50
	0:00	100	LT 50	LT 3	LT 50
	0:00	150	LT 50	LT 3	LT 50
	0:00	200	LT 50	LT 3	LT 50
	0:00	250	LT 50	LT 3	LT 50
	0:00	300	LT 50	LT 3	LT 50
9/20/2000	3:25	50	LT 50	LT 3	LT 50
	3:25	100	LT 50	LT 3	LT 50
	3:25	150	LT 50	LT 3	LT 50
	3:25	200	LT 50	LT 3	LT 50
	3:25	250	LT 50	LT 3	LT 50
	3:25	300	LT 50	LT 3	LT 50
9/21/2000	21:10	50	LT 10	LT 3	LT 50
	21:10	100	LT 10	LT 3	LT 50
	21:10	150	620	LT 3	LT 50
	21:10	200	450	LT 3	LT 50
	21:10	250	370	LT 3	LT 50
	21:10	300	400	LT 3	LT 50
9/22/2000	47:45:00	50	460	LT 3	LT 50
	47:45:00	100	220	LT 3	LT 50
	47:45:00	150	360	LT 3	LT 50
	47:45:00	200	160	LT 3	LT 50
	47:45:00	250	240	LT 3	LT 50
	47:45:00	300	180	LT 3	LT 50

NOTES:
- LT means "less than"
- All data are in bacterial densities per 100 ml
- (1) Time 0:00 is when overflow event begins.
- Overflow event ends at xx:xx

2.3.2 OVF No. 23 (W. Illinois)

Laboratory analysis indicated that fecal strep was found to be less than 50 (MF) per 100 ml for all sampling times and locations. Likewise, E. Coli was also found to be less than 3 (MPN) per 100 ml for all sampling times and locations.

Laboratory analysis indicated that for all locations during the overflow event and three (3) hours later fecal coliform were found to be less than 50 (MF) per 100 ml. During the sampling event conducted 21 hours after the overflow event, fecal coliform levels ranged from 400 (MF) per 100 ml at 50 feet downstream from the overflow to less than10 (MF) per 100 ml found 300 feet downstream of the overflow.

During the sampling event conducted 47 hours after the overflow event, the highest bacterial count was found to be 400 (MF) per 100 ml at 50 feet downstream from the overflow and the next highest was found 250 feet downstream from the overflow with a count of 340 (MF) per 100 ml. **Table 2-2** provides a summary of the laboratory analysis and copies of the laboratory reports can be found in **Exhibit B.**

As for OVF No. 001, it is believed that the fecal coliform counts found during the 21 hour and 47 hour sampling events can be attributed to overland run off from surrounding parks or upstream locations. Large populations of geese, ducks and some dogs are commonly using the open green space in this area. This would account for the lack of fecal coliform counts found during the first sampling events when bacteria from the overflows would normally be at their highest, and the high bacterial counts found after the overflow had already ceased.

TABLE 2-2

BACTERIAL ANALYSIS
CSO OVF NO. 23 (W. ILLINOIS)

Date	Time (1) (Hours)	Distance from Overflow (ft.)	Fecal Coliform	E. Coli	Fecal Strep
9/20/2000	0:00	50	LT 50	LT 3	LT 50
	0:00	100	LT 50	LT 3	LT 50
	0:00	150	LT 50	LT 3	LT 50
	0:00	200	LT 50	LT 3	LT 50
	0:00	250	LT 50	LT 3	LT 50
	0:00	300	LT 50	LT 3	LT 50
9/20/2000	3:25	50	LT 50	LT 3	LT 50
	3:25	100	LT 50	LT 3	LT 50
	3:25	150	LT 50	LT 3	LT 50
	3:25	200	LT 50	LT 3	LT 50
	3:25	250	LT 50	LT 3	LT 50
	3:25	300	LT 50	LT 3	LT 50
9/21/2000	20:45	50	400	LT 3	LT 50
	20:45	100	360	LT 3	LT 50
	20:45	150	320	LT 3	LT 50
	20:45	200	390	LT 3	LT 50
	20:45	250	270	LT 3	LT 50
	20:45	300	lt 10	LT 3	LT 50
9/22/2000	47:20:00	50	400	LT 3	LT 50
	47:20:00	100	180	LT 3	LT 50
	47:20:00	150	260	LT 3	LT 50
	47:20:00	200	320	LT 3	LT 50
	47:20:00	250	340	LT 3	LT 50
	47:20:00	300	220	LT 3	LT 50

NOTES:
- LT means "less than"
- All data are in bacterial densities per 100 ml
- (1) Time 0:00 is when overflow event begins.
- Overflow event ends at xx:xx

2.3.3 Comparison of Data

In 1981 and 1982 a comprehensive study of the combined sewer system was completed by WEDA on behalf of the City of Aurora and Fox Metro and was submitted to the IEPA in the form of a report titled, "Combined Sewer Overflow Study, 1983". This report was prepared in cooperation with the Northeastern Illinois Planning Commission (NIPC) to demonstrate control strategies necessary to maintain or improve the beneficial uses of the receiving streams (Fox River and Indian Creek). As a result of that investigation, the Illinois Pollution Control Board (IPCB) exempted Fox Metro from CSO regulations 35 IAC 306.305(a) as it related to sufficient treatment of first flush flows, and 306.305(b) which would have required treatment/disinfection of 10 times average dry weather flow. The exception was granted on the basis that compliance with the standards "would produce minimal impact on the receiving stream", and under the condition that the City and Fox Metro perform CSO improvements listed under Alternative D in the PCB Order.

During the 1983 study, in-stream fecal coliform counts were taken from the Fox River off of the Indian Trial Road Bridge which is located one (1) mile up stream from all of the overflows and off of the Oswego Bridge and Yorkville Bridge, which are both located several miles downstream of all the overflows in the City of Aurora. The data obtained indicated fecal coliform counts of 1,600, 2,400, and 2,000 per 100 ml up stream from all of the overflows (Indian Trail Bridge). Down stream fecal coliform counts of 6,000, 2,200 and 2,000 were found at the Oswego Bridge and fecal coliform counts of 2,000, 2,800 and 3,000 were found off of the Yorkville Bridge. **Table 2-3** provides a summary of the Laboratory data, and copies of the laboratory reports and a copy of the standard operating procedure utilized for collecting the samples in 1983 can be found in **Exhibit C.**

TABLE 2-3

BACKGROUND FECAL COLIFORM STUDY

Indian Trail Bridge (Upstream)	Oswego Bridge (Downstream)	Yorkville Bridge (Downstream)
1,600	6,000	2,000
2,400	2,200	2,800
2,000	2,000	3,000

The overall conclusion of the 1983 "Combined Sewer Overflow Study" indicated that the amount of pollutants discharged by the existing combined sewer overflow diversion structures is very small in comparison to the total pollutant loads in the river from upstream sources. It is currently believed that this holds true in this case as well. It appears, based on historical studies, that the bacterial counts from upstream are greater than those found shortly after the overflow events in 2000.

More recently, the IEPA recognized that up stream locations of the Fox River have water quality limited segments. According to the IEPA "Clean Water Act Section 303(d) List: Illinois' submittal for 1998" waterbody segments DT22, DT09 and DT69, all located north of the City of Aurora, are included in the list. Therefore, it is believed that historical data and current data prove that the conclusion cannot be drawn that the CSOs are creating an unsafe environment for primary contact recreational use of the Fox River.

Additionally, it can be pointed out that according to the USEPA *Ambient Water Quality Criteria for Bacteria, 1986*, Escherichia coli is considered to have a higher degree of association with outbreaks of certain diseases than fecal coliforms and therefore has been recommended as the basis for bacterial water quality standards. The standards are defined as a concentration of the indicator above which the health risk from waterborne disease is unacceptably high. The recommended bacterial density of E. Coli for full body contact recreational waters is 126 per 100ml. The bacterial data obtained from both of the overflows meets and exceeds this recommended standard during and after an overflow event.

PART 3.0

CONCLUSIONS

3.0 CONCLUSIONS

Based on the recreational trend analysis in Section 2.1 and the dye and bacterial testing conducted and reported in Sections 2.2 and 2.3, the following conclusions can be made regarding OVF No 001 (Rathbone) and OVF No. 23 (West Illinois):

- Recreationalists are not utilizing the river for primary contact during wet weather conditions when overflows are occurring.
- During warm and sunny weather conditions, recreationalists are not swimming near the shoreline. They are either fishing and wading without making full body contact, or they are boating and traveling down the river or are jet skiing a significant distance from the shoreline.
- Dye testing indicates that during an overflow event, CSO discharges travel down stream and dissipates away from the shoreline.
- Bacterial sampling indicates that during an overflow event, E. Coli, Fecal Strep and Fecal Coliform are below health risk levels. It is believed that Fecal Coliform that is found in the vicinity of the overflows 21 and 47 hours after an overflow can be attributed to overland run off from surrounding parks and up stream sources. Large populations of geese, ducks and some dogs are commonly using the open green spaces along the River.

- Although it has been determined that recreationalists do not tend to have full body contact in the vicinity of the overflows it is possible that full body contact could occur along the shoreline 21 and 47 hours after overflow events. They could therefore, potentially be exposed to elevated fecal coliform levels, not likely to come from CSO overflows, but from contaminated overland runoffs.

To conclude, based upon the results of this sensitive receptor study, we do not recommend that CSO OVF No. 001 and 023 be subject to additional CSO controls.

PART 4.0

EXHIBITS

EXHIBIT A

2000 Laboratory Analysis OVF No. 001

Enviro-Test/Perry Laboratories, Inc.
Chicago Dairy & Food Laboratories
7780 QUINCY STREET · WILLOW BROOK, IL 60521 · (630) 734-9530 · FAX (630) 734-9534

IEPA 100186 **CERTIFIED LABORATORY REPORT** IDPH 17134

Deuchler Environmental

230 Woodlawn Ave
Aurora, IL 60506

October 16, 2000
Received: 09-20-00
Completed:10-03-00

Lab No.	Sample Identification		
T4267	CS023 5A	09-20-00	1200
T4268	CS023 6A	09-20-00	1200
T4269	CS01 1A	09-20-00	1230
T4270	CS01 2A	09-20-00	1230

Test Parameter	T4267	T4268	T4269	T4270
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

LT means Less Than

All results are total and in ppm(mg/l) unless otherwise noted; 1ppm = 1000ppb.
Approved for the examination of water, dairy, chemical, microbiological and container testing by the ILDPH and ILEPA.

certify that I am familiar with the information contained in this report and that to the best of my knowledge and belief such information is true, complete and accurate.

G.P. Lenos
Laboratory Director

Enviro-Test/Perry Laboratories, Inc.
Chicago Dairy & Food Laboratories
7780 QUINCY STREET · WILLOW BROOK, IL 60521 · (630) 734-9530 · FAX (630) 734-9534

IEPA 100186 **CERTIFIED LABORATORY REPORT** IDPH 17134

Deuchler Environmental

230 Woodlawn Ave
Aurora, IL 60506

October 16, 2000
Received: 09-20-00
Completed:10-03-00

Lab No.	Sample Identification		
T4271	CS01 3A	09-20-00	1230
T4272	CS01 4A	09-20-00	1230
T4273	CS01 5A	09-20-00	1230
T4274	CS01 6A	09-20-00	1230

Test Parameter	T4271	T4272	T4273	T4274
Coliform:Fecal (MF) per 100ml	LT 50	50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

LT means Less Than

All results are total and in ppm(mg/l) unless otherwise noted; 1ppm = 1000ppb.
Approved for the examination of water, dairy, chemical, microbiological and container testing by the ILDPH and ILEPA.

ertify that I am familiar with the information contained in this report
and that to the best of my knowledge and belief such information
is true, complete and accurate.

G.P. Lenos
Laboratory Director

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IEPA 100186 **CERTIFIED LABORATORY REPORT** IDPH 17134

Deuchler Environmental

230 Woodlawn Ave
Aurora, IL 60506

October 16, 2000
Received: 09-20-00
Completed:10-03-00

Lab No.	Sample Identification		
T4263	CS023 1A	09-20-00	1200
T4264	CS023 2A	09-20-00	1200
T4265	CS023 3A	09-20-00	1200
T4266	CS023 4A	09-20-00	1200

Test Parameter	T4263	T4264	T4265	T4266
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

LT means Less Than

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Laboratory Director

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Chicago Dairy & Food Laboratories
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IEPA 100186 **CERTIFIED LABORATORY REPORT** IDPH 17134

Deuchler Environmental

230 Woodlawn Ave
Aurora, IL 60506

October 16, 2000
Received: 09-20-00
Completed:10-03-00

Lab No.	Sample Identification		
T4275	CS023 1B	09-20-00	1450
T4276	CS023 2A	09-20-00	1450
T4277	CS023 3B	09-20-00	1450
T4278	CS023 4B	09-20-00	1450

Test Parameter	T4275	T4276	T4277	T4278
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4279	CS023 5B	09-20-00	
T4280	CS023 6B	09-20-00	1450
T4281	CS01 1B	09-20-00	1525
T4282	CS01 2B	09-20-00	1525

Test Parameter	T4279	T4280	T4281	T4282
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4283	CS01 3B	09-20-00	1525
T4284	CS01 4B	09-20-00	1525
T4285	CS01 5B	09-20-00	1525
T4286	CS01 6B	09-20-00	1525

Test Parameter	T4283	T4284	T4285	T4286
Coliform:Fecal (MF) per 100ml	LT 50	100	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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October 16, 2000
Received: 09-21-00
Completed:10-02-00

Lab No.	Sample Identification		
T4311	CS023 1C	09-21-00	0845
T4312	CS023 2C	09-20-00	0845
T4313	CS023 3C	09-20-00	
T4314	CS023 4C	09-20-00	0845

Test Parameter	T4311	T4312	T4313	T4314
Coliform:Fecal (MF) per 100ml	400	360	320	390
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	4
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4315	CS023 5C	09-21-00	0845
T4316	CS023 6C	09-21-00	0845
T4317	CS01 1C	09-21-00	0910
T4318	CS01 2C	09-21-00	0910

Test Parameter	T4315	T4316	T4317	T4318
Coliform:Fecal (MF) per 100ml	270	LT 10	LT 10	LT 10
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4319	CS01 3C	09-21-00	0910
T4320	CS01 4C	09-21-00	0910
T4321	CS01 5C	09-21-00	0910
T4322	CS01 6C	09-21-00	0910

Test Parameter	T4319	T4320	T4321	T4322
Coliform:Fecal (MF) per 100ml	620	450	370	400
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4327	CS023 1D	09-22-00	1120
T4328	CS023 2D	09-22-00	1120
T4329	CS023 3D	09-22-00	1120
T4330	CS023 4D	09-22-00	1120

Test Parameter	T4327	T4328	T4329	T4330
Coliform:Fecal (MF) per 100ml	400	180	260	320
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4331	CS023 5D	09-22-00	1120
T4332	CS023 6D	09-22-00	1120
T4333	CS01 1D	09-22-00	1145
T4334	CS01 2D	09-22-00	1145

Test Parameter	T4331	T4332	T4333	T4334
Coliform:Fecal (MF) per 100ml	340	220	460	220
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4335	CS01 3D	09-22-00	1145
T4336	CS01 4D	09-22-00	1145
T4337	CS01 5D	09-22-00	1145
T4338	CS01 6D	09-22-00	1145

Test Parameter	T4335	T4336	T4337	T4338
Coliform:Fecal (MF) per 100ml	360	160	240	180
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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EXHIBIT B

2000 Laboratory Analysis OVF No. 23

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Lab No.	Sample Identification		
T4267	CS023 5A	09-20-00	1200
T4268	CS023 6A	09-20-00	1200
T4269	CS01 1A	09-20-00	1230
T4270	CS01 2A	09-20-00	1230

Test Parameter	T4267	T4268	T4269	T4270
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4271	CS01 3A	09-20-00	1230
T4272	CS01 4A	09-20-00	1230
T4273	CS01 5A	09-20-00	1230
T4274	CS01 6A	09-20-00	1230

Test Parameter	T4271	T4272	T4273	T4274
Coliform:Fecal (MF) per 100ml	LT 50	50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4263	CS023 1A	09-20-00	1200
T4264	CS023 2A	09-20-00	1200
T4265	CS023 3A	09-20-00	1200
T4266	CS023 4A	09-20-00	1200

Test Parameter	T4263	T4264	T4265	T4266
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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T4275	CS023 1B	09-20-00	1450
T4276	CS023 2A	09-20-00	1450
T4277	CS023 3B	09-20-00	1450
T4278	CS023 4B	09-20-00	1450

Test Parameter	T4275	T4276	T4277	T4278
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4279	CS023 5B	09-20-00	
T4280	CS023 6B	09-20-00	1450
T4281	CS01 1B	09-20-00	1525
T4282	CS01 2B	09-20-00	1525

Test Parameter	T4279	T4280	T4281	T4282
Coliform:Fecal (MF) per 100ml	LT 50	LT 50	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4283	CS01 3B	09-20-00	1525
T4284	CS01 4B	09-20-00	1525
T4285	CS01 5B	09-20-00	1525
T4286	CS01 6B	09-20-00	1525

Test Parameter	T4283	T4284	T4285	T4286
Coliform:Fecal (MF) per 100ml	LT 50	100	LT 50	LT 50
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4311	CS023 1C	09-21-00	0845
T4312	CS023 2C	09-20-00	0845
T4313	CS023 3C	09-20-00	
T4314	CS023 4C	09-20-00	0845

Test Parameter	T4311	T4312	T4313	T4314
Coliform:Fecal (MF) per 100ml	400	360	320	390
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	4
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4315	CS023 5C	09-21-00	0845
T4316	CS023 6C	09-21-00	0845
T4317	CS01 1C	09-21-00	0910
T4318	CS01 2C	09-21-00	0910

Test Parameter	T4315	T4316	T4317	T4318
Coliform:Fecal (MF) per 100ml	270	LT 10	LT 10	LT 10
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4319	CS01 3C	09-21-00	0910
T4320	CS01 4C	09-21-00	0910
T4321	CS01 5C	09-21-00	0910
T4322	CS01 6C	09-21-00	0910

Test Parameter	T4319	T4320	T4321	T4322
Coliform:Fecal (MF) per 100ml	620	450	370	400
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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Lab No.	Sample Identification		
T4327	CS023 1D	09-22-00	1120
T4328	CS023 2D	09-22-00	1120
T4329	CS023 3D	09-22-00	1120
T4330	CS023 4D	09-22-00	1120

Test Parameter	T4327	T4328	T4329	T4330
Coliform:Fecal (MF) per 100ml	400	180	260	320
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

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October 16, 2000
Received: 09-22-00
Completed:10-02-00

Lab No.	Sample Identification		
T4331	CS023 5D	09-22-00	1120
T4332	CS023 6D	09-22-00	1120
T4333	CS01 1D	09-22-00	1145
T4334	CS01 2D	09-22-00	1145

Test Parameter	T4331	T4332	T4333	T4334
Coliform:Fecal (MF) per 100ml	340	220	460	220
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

LT means Less Than

All results are total and in ppm(mg/l) unless otherwise noted; 1ppm = 1000ppb. Approved for the examination of water, dairy, chemical, microbiological and container testing by the ILDPH and ILEPA.

I certify that I am familiar with the information contained in this report and that to the best of my knowledge and belief such information is true, complete and accurate.

G.P. Lenos
Laboratory Director

Enviro-Test/Perry Laboratories, Inc.
Chicago Dairy & Food Laboratories
7780 QUINCY STREET • WILLOW BROOK, IL 60521 • (630) 734-9530 • FAX (630) 734-9534

IEPA 100186 **CERTIFIED LABORATORY REPORT** IDPH 17134

Deuchler Environmental

230 Woodlawn Ave
Aurora, IL 60506

October 16, 2000
Received: 09-22-00
Completed:10-02-00

Lab No.	Sample Identification		
T4335	CS01 3D	09-22-00	1145
T4336	CS01 4D	09-22-00	1145
T4337	CS01 5D	09-22-00	1145
T4338	CS01 6D	09-22-00	1145

Test Parameter	T4335	T4336	T4337	T4338
Coliform:Fecal (MF) per 100ml	360	160	240	180
E. Coliform, MPN per 100ml	LT 3	LT 3	LT 3	LT 3
Fecal Strep (MF) per 100ml	LT 50	LT 50	LT 50	LT 50

LT means Less Than

All results are total and in ppm(mg/l) unless otherwise noted; 1ppm = 1000ppb. Approved for the examination of water, dairy, chemical, microbiological and container testing by the ILDPH and ILEPA.

I certify that I am familiar with the information contained in this report and that to the best of my knowledge and belief such information is true, complete and accurate.

G.P. Lenos
Laboratory Director

EXHIBIT C

1983 Laboratory Analysis
and SOP for Up Stream

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

ıгRo No.	Sample Description	BOD_5	Nitrate	Nitrite as N	Ammonia	Suspended Solids	pH
799E	Indian Trail #1	68	0.91	.015	1.1	40	7.9
6800E	Indian Trail #2	50	0.91	.010	1.1	68	8.0
801E	Indian Trail #3	28	0.91	.018	0.7	78	8.0
6802E	Indian Trail #4	28	0.69	.017	3.9	44	8.0
803E	Indian Trail #5	28	0.62	.018	1.1	46	8.1
6901E	Indian Trail #6	16	0.91	.010	0.9	52	7.4
902E	Indian Trail #7	15	0.91	.009	1.1	63	7.3
903E	Indian Trail #8	14	1.0	.010	1.2	59	7.5
904E	Indian Trail #9	14	0.62	.016	1.4	47	7.4
905E	Indian Trail #10	14	0.92	.010	1.5	59	7.1
6906E	Indian Trail #11	11	0.60	.010	1.6	93	7.6
907E	Indian Trail #12	11	0.58	.012	1.0	65	7.6
6879E	Indian Trail #13	100	1.0	.011	.8	86	6.7
880E	Indian Trail #14	30	0.96	.016	1.2	86	7.9
6881E	Indian Trail #15	14	1.0	.016	.8	45	7.5
882E	Indian Trail #16	15	0.94	.016	1.0	53	7.5
946E	Indian Trail #17	18	0.77	.013	1.0	70	7.7

sults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

Approved by
TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

.o No.	Sample Description	BOD_{20}	Total Phosphorus	Soluble Phosphorus	COD	Oil & Grease
,6799E	Indian Trail #1					
00E	Indian Trail #2					
,6801E	Indian Trail #3	136	0.58			24
,02E	Indian Trail #4					
,0003E	Indian Trail #5				48	
,001E	Indian Trail #6	57	0.31	0.31		50
,02E	Indian Trail #7					
,6903E	Indian Trail #8					
,04E	Indian Trail #9	54	0.25	0.25		23
,6905E	Indian Trail #10				56	
,06E	Indian Trail #11					
,6907E	Indian Trail #12	45	0.40			19
79E	Indian Trail #13					
,0080E	Indian Trail #14					
,0081E	Indian Trail #15					
82E	Indian Trail #16					
,6946E	Indian Trail #17					

tesults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

pproved by
TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

ırRo No.	Sample Description	Fecal Coliform per 100 ml	Arsenic	Cyanide	Mercury, ppB	Chlorophyll A, mg/m^3 *
799E	Indian Trail #1					
66800E	Indian Trail #2					
801E	Indian Trail #3					
66802E	Indian Trail #4	1600				
803E	Indian Trail #5					46.4
66901E	Indian Trail #6					
902E	Indian Trail #7		.008	<0.003	1.75	
66903E	Indian Trail #8	2400				
66904E	Indian Trail #9					
905E	Indian Trail #10					41.6
66906E	Indian Trail #11					
907E	Indian Trail #12	2000				
66879E	Indian Trail #13					
880E	Indian Trail #14					
66881E	Indian Trail #15					
882E	Indian Trail #16					
66946E	Indian Trail #17					

sults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

Approved by
TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

ırRo No.	Sample Description	Lead	Cadmium	Iron	Total Chrome	Hex Chrome	Tri Chrome	Silver
799E	Indian Trail #1							
6800E	Indian Trail #2							
801E	Indian Trail #3							
6802E	Indian Trail #4	<0.08						
803E	Indian Trail #5							
6901E	Indian Trail #6							
6902E	Indian Trail #7		<0.05	0.55	<0.1	<0.1	<0.1	<0.05
903E	Indian Trail #8	<0.08						
6904E	Indian Trail #9							
905E	Indian Trail #10							
6906E	Indian Trail #11							
907E	Indian Trail #12	<0.08						
6879E	Indian Trail #13							
380E	Indian Trail #14							
6381E	Indian Trail #15							
6882E	Indian Trail #16							
946E	Indian Trail #17							

sults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

proved by
TERESE M. LACIAK
Laboratory Manager

Sept 28, 1981 Train Event

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	BOD_5	Nitrate	Nitrite as N	Ammonia	Suspended Solids	pH
66908E	Oswego Bridge #1	13	0.55	.040	.9	55	7.3
66909E	Oswego Bridge #2	17	0.58	.048	1.0	51	7.4
66910E	Oswego Bridge #3	18	0.60	.057	1.2	47	7.5
66911E	Oswego Bridge #4	3	0.70	.053	.8	51	7.5
66912E	Oswego Bridge #5	20	0.83	.037	1.2	40	7.4
66913E	Oswego Bridge #6	15	0.83	.033	.9	39	7.5
66914E	Oswego Bridge #7	17	0.92	.053	1.2	49	7.6
66915E	Oswego Bridge #8	15	0.77	.036	1.1	31	7.5
66916E	Oswego Bridge #9	13	0.70	.044	1.1	46	7.5
66917E	Oswego Bridge #10	20	0.65	.009	1.0	58	7.5
66883E	Oswego Bridge #11	17	1.04	.021	.7	62	7.3
66884E	Oswego Bridge #12	23	0.73	.016	1.7	69	7.3
66885E	Oswego Bridge #13	20	0.70	.024	1.2	67	7.3
66886E	Oswego Bridge #14	17	0.53	.009	.9	59	7.4
66944E	Oswego Bridge #15	13	0.46	.012	1.0	59	7.7
66945E	Oswego Bridge #16	6	0.75	.009	.9	57	7.7

Results expressed in mg/l unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

Approved by

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

:Ro No.	Sample Description	BOD_{20}	Total Phosphorus	Soluble Phosphorus	COD	Oil & Grease	Chlorophyll mg/m^3 *
66908E	Oswego Bridge #1						
5909E	Oswego Bridge #2						
66910E	Oswego Bridge #3	47	0.48			54	
5911E	Oswego Bridge #4						
66912E	Oswego Bridge #5				108		65.4
5913E	Oswego Bridge #6	46	0.43	0.30		11	
5914E	Oswego Bridge #7						
66915E	Oswego Bridge #8						
5916E	Oswego Bridge #9	47	0.45	0.32		13	
66917E	Oswego Bridge #10				68		58.3
5883E	Oswego Bridge #11						
66884E	Oswego Bridge #12	47	0.35			22	
5885E	Oswego Bridge #13						
66886E	Oswego Bridge #14						
5944E	Oswego Bridge #15						
5945E	Oswego Bridge #16						
* ug/l							

Results expressed in mg/l unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

Approved by

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	Fecal Coliform per 100 mls	Arsenic	Cyanide	Mercury, ppB
56908E	Oswego Bridge #1				
909E	Oswego Bridge #2				
66910E	Oswego Bridge #3				
66911E	Oswego Bridge #4	6000			
912E	Oswego Bridge #5				
66913E	Oswego Bridge #6				
914E	Oswego Bridge #7		.024	0.018	1.3
66915E	Oswego Bridge #8	2200			
916E	Oswego Bridge #9				
66917E	Oswego Bridge #10				
883E	Oswego Bridge #11				
66884E	Oswego Bridge #12	2000			
66885E	Oswego Bridge #13				
886E	Oswego Bridge #14				
66944E	Oswego Bridge #15				
945E	Oswego Bridge #16				

sults expressed in mg/l unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

proved by

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

~Ro No.	Sample Description	Lead	Cadmium	Iron	Total Chrome	Hex Chrome	Tri Chrome	Silver
66908E	Oswego Bridge #1							
66909E	Oswego Bridge #2							
66910E	Oswego Bridge #3							
66911E	Oswego Bridge #4	<0.08						
66912E	Oswego Bridge #5							
66913E	Oswego Bridge #6							
66914E	Oswego Bridge #7		<0.05	0.5	<0.1	<0.1	<0.1	<0.05
66915E	Oswego Bridge #8	<0.08						
66916E	Oswego Bridge #9							
66917E	Oswego Bridge #10							
66883E	Oswego Bridge #11							
66884E	Oswego Bridge #12	<0.08						
66885E	Oswego Bridge #13							
66886E	Oswego Bridge #14							
66944E	Oswego Bridge #15							
66945E	Oswego Bridge #16							

esults expressed in mg/1 unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

Approved by Terese M. Laciak

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	BOD_5	Nitrate	Nitrite as N	Ammonia	Suspended Solids	pH
56891E	Yorkville Bridge #1	15	1.08	.066	1.4	42	7.2
392E	Yorkville Bridge #2	12	0.77	.066	1.4	39	7.3
56893E	Yorkville Bridge #3	4	0.83	.068	0.9	37	7.4
56894E	Yorkville Bridge #4	22	0.62	.017	0.6	46	7.5
395E	Yorkville Bridge #5	14	0.70	.049	1.4	42	7.1
56896E	Yorkville Bridge #6	20	0.37	.044	1.0	85	7.1
397E	Yorkville Bridge #7	17	0.62	.012	1.4	65	7.3
56898E	Yorkville Bridge #8	12	1.08	.021	1.4	41	7.3
399E	Yorkville Bridge #9	15	0.55	.056	0.8	37	7.1
56900E	Yorkville Bridge #10	15	0.96	.015	0.9	37	7.3
387E	Yorkville Bridge #11	23	0.95	.066	1.2	64	7.1
56888E	Yorkville Bridge #12	9	0.89	.058	1.1	57	7.5
56889E	Yorkville Bridge #13	20	1.0	.055	1.0	54	7.4
390E	Yorkville Bridge #14	21	1.08	.114	1.3	45	7.1
56942E	Yorkville Bridge #15	13	0.70	.024	1.3	39	7.7
943E	Yorkville Bridge #16	17	0.77	.009	1.0	55	7.7

sults expressed in mg/l unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

Approved by Terese M. Laciak

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	BOD_{20}	Total Phosphorus	Soluble Phosphorus	COD	Oil & Grease	Chlorophyll mg/m^3 *
66891E	Yorkville Bridge #1						
6892E	Yorkville Bridge #2						
66893E	Yorkville Bridge #3	54	0.40			10	
6894E	Yorkville Bridge #4						
66895E	Yorkville Bridge #5				56		50.5
6896E	Yorkville Bridge #6	65	0.68	0.36		46	
66897E	Yorkville Bridge #7						
6898E	Yorkville Bridge #8						
6899E	Yorkville Bridge #9	55	0.32	0.32		29	
66900E	Yorkville Bridge #10				60		51.4
6887E	Yorkville Bridge #11						
66888E	Yorkville Bridge #12	52	0.38			13	
6889E	Yorkville Bridge #13						
66890E	Yorkville Bridge #14						
6942E	Yorkville Bridge #15						
66943E	Yorkville Bridge #16						

* ug/l

Results expressed in mg/l unless otherwise indicated

Alice G. Roketa

ALICE G. ROKETA, Manager
Environmental Division

Approved by

TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	Fecal Coliform per 100 mls	Arsenic	Cyanide	Mercury, ppB
66891E	Yorkville Bridge #1				
892E	Yorkville Bridge #2				
66893E	Yorkville Bridge #3				
894E	Yorkville Bridge #4	2000			
895E	Yorkville Bridge #5				
66896E	Yorkville Bridge #6				
897E	Yorkville Bridge #7		.020	<0.003	2.6
66898E	Yorkville Bridge #8	2800			
899E	Yorkville Bridge #9				
66900E	Yorkville Bridge #10				
887E	Yorkville Bridge #11				
66888E	Yorkville Bridge #12	3000			
889E	Yorkville Bridge #13				
890E	Yorkville Bridge #14				
66942E	Yorkville Bridge #15				
943E	Yorkville Bridge #16				

sults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

proved by
TERESE M. LACIAK
Laboratory Manager

WALTER E. DEUCHLER ASSOC., INC.

ANALYSES

Ro No.	Sample Description	Lead	Cadmium	Iron	Total Chrome	Hex Chrome	Tri Chrome	Silver
66891E	Yorkville Bridge #1							
892E	Yorkville Bridge #2							
66893E	Yorkville Bridge #3							
66894E	Yorkville Bridge #4	<0.08						
895E	Yorkville Bridge #5							
66896E	Yorkville Bridge #6							
897E	Yorkville Bridge #7		<0.05	0.55	<0.1	<0.1	<0.1	<0.05
66898E	Yorkville Bridge #8	<0.08						
899E	Yorkville Bridge #9							
66900E	Yorkville Bridge #10							
887E	Yorkville Bridge #11							
66888E	Yorkville Bridge #12	<0.08						
66889E	Yorkville Bridge #13							
66890E	Yorkville Bridge #14							
66942E	Yorkville Bridge #15							
943E	Yorkville Bridge #16							

sults expressed in mg/l unless otherwise indicated

ALICE G. ROKETA, Manager
Environmental Division

Approved by:
TERESE M. LACIAK
Laboratory Manager

SAMPLING PROCEDURE

RIVER SITES

I. SAMPLING SEQUENCE.

1. NOTE TIME and Sampling Bottle Number. Use Kemmerer to obtain one sample (at each of the 4 green markers on the bridge) and carefully pour in the 5 gallon bucket.

2. Use D.O. meter to record the Temperature and Dissolved Oxygen readings.

3. Mix samples by vigorously shaking the bucket so as to obtain a uniform mixture.

4. Pour sample into the 1/2 gallon plastic container. Close lid of the container and place it in the cooler.

II. SAMPLING FREQUENCY.

First 8 hours - 1 hour (1 team)

Next 16 hours - 2 hours (2 teams)

Next 24 hours - 8 hours (1 team)

III. SAFETY PRECAUTIONS.

a. Park car in a safe place from bridge traffic

b. Watch for hazardous traffic conditions.

c. Tie end of rope to bridge railing before dropping the Kemmerer into the river.

NOTE: IF KEMMERER malfunctions, use the sampling jar as a backup to obtain samples.

CAC MEETINGS REGARDING SENSITIVE AREAS

See Appendix M, CAC Meetings 3 and 4

USFWS CORRESPONDENCE REGARDING
THREATENED AND ENDANGERED AQUATIC SPECIES OR HABITAT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chicago Ecological Services Field Office
1250 South Grove Avenue, Suite 103
Barrington, Illinois 60010
Phone: (847) 381-2253 Fax: (847) 381-2285

IN REPLY REFER TO:
FWS/AES-CIFO/

October 3, 2008

Mr. Michael Ott
Strand Associates, Inc.
1170 South Houbolt Road
Joliet, Illinois 60431

Dear Mr. Ott:

This responds to your e-mailed letter dated September 23, 2008 requesting information on endangered or threatened species for the proposed long term control plan for the City of Aurora's combined sewer system. You have requested a review of the lower Fox River which is located at T38N, R8E, Sections 9, 10, 15, 21, 22, 28, 32, and 33 in the City of Aurora, Kane County, Illinois as depicted on the map you enclosed.

Based on the information provided in your submittal and a review of our records, we do not believe that any federally endangered or threatened species occur in the vicinity of the site. This conclusion is based on the best available information, including information in your submittal, the scientific and technical literature, and our own files. Newer information based on updated surveys, changes in the abundance and distribution of listed species, changed habitat conditions, or other factors could change the conclusion. This could become more likely if projects experience significant delays in implementation. Feel free to contact us if you need more current information or assistance regarding the potential presence of federally listed species.

These comments only address federally listed species. Please contact the Illinois Department of Natural Resources for information on State-listed species. Also, we may have the opportunity to review the project for a broader range of fish and wildlife impacts if it requires a Section 404 permit. We are willing to work with you in advance of formal submittal if it would help streamline the approval process.

RECEIVED
OCT 9 2008
STRAND ASSOCIATES, INC.®
JOLIET, IL

If you have any questions, please contact Ms. Cathy Pollack at 847/381-2253 ext. 20, or Ms. Karla Kramer at 847/381-2253 ext. 12.

Sincerely,

John D. Rogner

John D. Rogner
Field Supervisor

From: Ott, Michael G.
Sent: Tuesday, September 23, 2008 8:36 AM
To: 'john_rogner@fws.gov'
Subject: Endangered Species Consultation

Attachments: CSO Figure.pdf

Dear Mr. Rogner,

My name is Michael Ott, I am a wastewater engineer for a consulting engineering company by the name of Strand Associates, Inc. I am working in the Joliet, Illinois office. Recently we have been asked to assist the City of Aurora develop a long term control plan for their combined sewer system. I assume that you are aware of what a combined sewer system, however, in case you are not aware, basically a combined sewer system means that all of the rain water and sewage from throughout the city all end up in the same sewer. The way Aurora's system is set up is that all of the combined sewers all eventually flow into a main interceptor that leads to a waste water treatment plant. However, during rain events there are about 15 locations throughout the city in which, the system reaches its full capacity and has to overflow emergency flows of untreated wastewater into the Fox River. Long story short, we are helping the city to develop a plan of action, which would result in far fewer overflow situations throughout a typical year. The reason I am contacting you is that part of the planning process involves a sensitive area analysis of the Fox River for the Illinois Environmental Protection Agency where these overflows occur. A sensitive area is determined by five criteria, two of which are, the presence of shellfish beds or threatened/endangered aquatic species or habitat. I am writing to you because I was doing research on the Midwest Region of the U.S. Fish and Wildlife Service website and found the endangered species consultation process. As a result here is my formal request of an endangered species consultation.

If you need to contact me again my name is Michael Ott. I work for Strand Associates, Inc. located at 1170 South Houbolt Road Joliet, IL 60431. You can reach me by phone here in the office at 815-744-4200 extension 3319 or by email at michael.ott@strand.com.

This project is a long term control plan aimed at limiting Aurora, Illinois's combined sewer overflow events to less than 4-6 per year. The city is mostly residential with some small areas of commercial businesses. As part of the project I am conducting a sensitive areas investigation in this part of the Fox River.

The information that I was provided by the City of Aurora and the Project Manager is as follows: The approximate center of the project can be found at section 22, Township 38 North, Range 8 E, in Kane County, IL. Approximate coordinates are 41 degrees 45 minutes and 27 seconds latitude and 88 degrees 18 minutes and 54.21 seconds longitude. The body of water we are requesting an endangered/threatened species consultation is the Lower Fox River, HUC 07120007 from River Mile 51.5 (Sections 9 and 10, T38N, R8E 41 degrees 48 minutes 25.85 seconds N 88 degrees 19 minutes 27.87 seconds W) to River Mile 46.2 (Sections 32 and 33, T38N, R8E 41 degrees 44 minutes 01.39 seconds N 88 degrees 20 minutes 02.13 seconds W).

I have attached a map locating all of the combined sewer overflows. Any construction should be within

the city and away from the river, however any construction to be completed will be within the northern most and southern most overflows, i.e.. south of CSO 2 and CSO 23 and north of CSO 1 and CSO 4.

As of right now I do not believe we are going to be requesting any Army Corps permits.

The plant life to be affected within this project is limited to the Fox River habitat which we are requesting a consultation on.

Finally, I do not have access and/or have not been presented with any soil data for the city.

I hope this is everything that you will be needing in order to conduct all of your research. If you have any questions whatsoever or if I have left out important information feel free to e-mail me or give me a call at the provided address and phone number.

Thank you very much for your time and I look forward to hearing back from you.

Michael G. Ott, E.I.T.
Stand Associates, Inc.
1170 S. Houbolt Road
Joliet, IL 60431
815-744-4200 ext. 3319

SEPTEMBER 8, 2009, IEPA MEETING
SIGN-IN SHEET, MINUTES, AND PRESENTATION MATERIALS

Jones, Bart

From: Jones, Bart
Sent: Friday, October 30, 2009 9:06 AM
To: Yurdin, Bruce
Subject: Aurora LTCP

Greetings Bruce. At our Sept. 8 meeting, the CSOs 001, 022, and 023 were discussed in greater detail. We are working to complete the draft LTCP within next 30 days. We understood IEPA would take our additional points into consideration and get back to us regarding whether a sensitive area exists at any of these 3 location. Can you share IEPA's current thinking on this issue so we can write the draft LTCP with that knowledge. It may eliminate the need to revise the LTCP later.

With respect to a sensitive area finding, we posed a question regarding the "Eliminate or Relocate CSOs that discharge into sensitive areas whenever physically possible and economically achievable" notion. The infrastructure required to eliminate or relocate nay CSO discharge is a function of the intensity, duration and frequency of wet weather events. As such, we need a design storm IEPA believes to be reasonable. Can you share IEPA's current thinking on this. We are now refining the technical alternatives and of course this is critical information. The results of selecting a design storm for this purpose has direct consequences to the costs and thus the FCA.

Many thanks. Bart

Barton G. Jones, P.E.
Strand Associates, Inc.
608.251.4843, Ext. 1030

ATTENDANCE RECORD

Date SEPT 8, 2009

Subject AURORA / FOX METRO LTCP UPDATE

NAME	AFFILIATION	TELEPHONE
Scott Stearns	Strand	608 251 4843
Bart Jones	Strand	608 251.4843
Erika Powers	Barnes & Thornburg	312-338-5904
Ken Schroth	COA - Public Works	630-844-3621
Eric Schoeny	COA - Public Works	630-844-3620
Sanjoy Sofat	IEPA	217-782-1696
Amy Dragovich	IEPA Bow Permits	217/782-0610
Al Keller	IEPA Permit Section	217 782-0610
Tom Muth	FOX METRO WRD	630 301 6901
Philippe Morcau	Walter E. Deuchler Assoc.	630 897 4651
Bruce Yurdin	Illinois EPA	217-782-3362

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Attorney-Client Communication
Attorney Work Product

9/8/09 Aurora-IEPA Meeting Notes

Participants

- City of Aurora: Ken Schroth, Eric Schoeny, Bart Jones, Scott Stearns, Erika Powers
- Fox Metro: Tom Muth, Philippe Moreau
- IEPA: Bruce Yurdin, Al Keller, Sanjay Sofat, Amy Dragovich, Jay Patel (by phone)

Presentation

- Hard copies of slides provided to the agency
- Scott presented slides concerning metering and modeling and first flush
- Bart presented slides concerning sensitive areas and financial capability

Discussion

- Metering and modeling
  - **City Action Item:** Bruce Yurdin asked Scott to provide information concerning whether the 7 April 2009 wet weather events were representative of the typical event range.
- First flush
  - **Agency Action Item:** IEPA will respond in 2-3 weeks concerning whether the City can end its first flush monitoring program.
  - Al Keller indicated that IEPA would look back at the conditions of the PCB exception (57% first flush capture instead of 100%) to determine whether it would still be applicable from a federal standpoint. If all federal conditions are met, the exception may still be valid. The City will be required to demonstrate that it can meet water quality standards, either with or without a UAA.
  - Bart indicated that the City would make plans to comply with alternative standards, but may need assistance from the agency to establish an appropriate alternative.
- Sensitive areas
  - Jay Patel indicated that the WEDA 1997 study was old. Additional, more recent data might be required to avoid a sensitive area determination. Bart explained that additional studies were not conducted because not much has changed since the 1997 study, except perhaps higher flows due to increased urbanization. Jay indicated that there was a perception that the City is discharging to recreational areas.
  - Bruce Yurdin indicated that the primary contact definition used by the City (intentional immersion) may not be consistent with the agency definition. The agency has not used full body contact as the sole determinant of primary contact recreation, but has looked at jet skiing and wading. Both of those were observed at 001 and 023.
  - Sanjay Sofat indicated that IEPA is currently in litigation concerning its definition of sensitive areas, and will be making a decision shortly consistent with the definition that arises from that litigation.
  - Bart emphasized that in light of the April 2010 permit deadline for submitting the LTCP, the City needs to know very soon whether it needs to address sensitive area issues. A draft for City approval will need to be provided by December 2009.
  - Bruce asked if there was any additional information the City could share concerning why 2

members of the CAC voted to consider 001 and 023 sensitive. All CAC members agreed that 022 was not sensitive; not sure why 2 thought 001 and 023 should be.

- **Agency Action Item:** IEPA will respond in 2-3 weeks concerning whether CSOs 001, 022, and 023 will be considered sensitive areas.
- In response to slide requesting information on definition of "eliminate," Sanjay responded that it meant "close the door."
- Bruce asked what a shift to higher priority would mean for CSO 023—appeared to be looking to the City to determine how to prioritize any sensitive discharges. Bart explained the need for additional guidance concerning how to prioritize, particularly concerning CSO 23, which involves the highest cost per gallon to eliminate. Al Keller indicated that cost effectiveness is not considered in determining whether a discharge can be eliminated or relocated—only affordability. He did not rule out consideration of cost-effectiveness in prioritizing. Sanjay asked the City to tell the agency the earliest it can be done, assuming it is determined to be sensitive.
- Bart indicated that CSO 001 has the largest flow, so a sensitive area determination would make a big difference. 001 will be difficult to relocate due to its location, so may not be physically possible. Al Keller stated that if elimination or relocation is not possible, can consider treatment to meet water quality standards—primary plus disinfection, with disinfection being most important for bacteria removal.
- Sanjay indicated that "economically achievable" for sensitive areas looked at the same factors as the EPA LTCP financial capability analysis.
- **Joint Action Item:** IEPA and the City should schedule a conference call to discuss implications once a sensitive area determination is made.

- Financial capability
  - Ken described the projected City budget deficit, and the first round of City layoffs that occurred September 3.
  - Agency indicated that other factors could be considered in extending the LTCP implementation schedule, but that it is up to the City to make the case to IEPA and USEPA. Sanjay also indicated that if the financial assumptions change, the implementation schedule should be allowed to change. Bruce indicated that one community asked for 52 years, but did not get approved. Belleville got 18 years.

- USEPA Inspection
  - Bruce indicated that IEPA had no indication of how involved USEPA would be on the Aurora LTCP.
  - Jay Patel stated that USEPA was conducting 5 SSO inspections in the area before September 30, and that the agency may ask about the LTCP development and sensitive areas issues.

Jones, Bart

From: Jones, Bart
Sent: Friday, September 04, 2009 9:10 AM
To: 'Yurdin, Bruce'
Subject: RE: Status meeting on Tuesday, Sept. 8

Bruce, we plan on starting at 1 PM and believe the meeting shouldn't last longer than 2 hours. We wish to share with IEPA the: (1) hydraulic model construction, calibration and validation results; (2) methodology for determining IEPA's first flush volume since we didn't have a 1.2" per hour storm event in our sample universe; (3) sensitive area rationale at 001, 022, and 023; and (4) baseline FCA matrix and impacts of existing and near term macro-economy upon Aurora's financial status. See you Tuesday.

Barton G. Jones, P.E.
Strand Associates, Inc.
608.251.4843, Ext. 1030

From: Yurdin, Bruce [mailto:Bruce.Yurdin@Illinois.gov]
Sent: Friday, September 04, 2009 8:58 AM
To: Jones, Bart
Cc: Stearns, Scott; Schoeny, Eric; Schroth, Kenneth
Subject: RE: Status meeting on Tuesday, Sept. 8

We are set here and can provide a projector and laptop. At the moment I think we will have 5 staff at the meeting—Al Keller, Amy Dragovich, Jay Patel, Sanjay Sofat and me.

When would you like to meet on the 8th?
bjy

From: Jones, Bart [mailto:Bart.Jones@strand.com]
Sent: Friday, September 04, 2009 8:15 AM
To: Yurdin, Bruce
Cc: Stearns, Scott; Schoeny, Eric; Schroth, Kenneth
Subject: Status meeting on Tuesday, Sept. 8

Greetings Bruce. We have prepared a Power Point presentation for the Tuesday meeting. The Aurora team will have six attendees. Can you provide an approx. number of IEPA staff that will attend so we may prepare the appropriate number of handouts? Will IEPA be able to provide a computer and LCD projector or should we plan to bring them? Bart

Barton G. Jones, P.E.
Strand Associates, Inc.
608.251.4843, Ext. 1030

Jones, Bart

From: Jones, Bart
Sent: Tuesday, August 25, 2009 5:58 PM
To: 'Yurdin, Bruce'
Cc: Stearns, Scott; Schoeny, Eric; Schroth, Kenneth; Fredric Andes; Keller, Al; Patel, Jay; Dragovich, Amy
Subject: RE: Aurora's LTCP---Sensitive Areas and First Flush determinations

Bruce, thanks for the quick response. We'll meet you and staff at 1:00 PM on September 8 in the Springfield office. Bart

Barton G. Jones, P.E.
Strand Associates, Inc.

From: Yurdin, Bruce [mailto:Bruce.Yurdin@Illinois.gov]
Sent: Tuesday, August 25, 2009 3:16 PM
To: Jones, Bart
Cc: Stearns, Scott; Schoeny, Eric; Schroth, Kenneth; Fredric Andes; Keller, Al; Patel, Jay; Dragovich, Amy
Subject: RE: Aurora's LTCP---Sensitive Areas and First Flush determinations

I suggest we meet on September 8th. Illinois EPA staff will hold the date until we can lock in a time. Please let me know what time works best for those traveling and we'll accommodate.
bjy

From: Jones, Bart [mailto:Bart.Jones@strand.com]
Sent: Monday, August 24, 2009 10:30 AM
To: Yurdin, Bruce
Cc: Stearns, Scott; Schoeny, Eric; Schroth, Kenneth; Fredric Andes
Subject: Aurora's LTCP---Sensitive Areas and First Flush determinations

Greetings Bruce. As you know, the sensitive area determinations and first flush determinations impinge upon the technical solutions for the CSO abatement program. I believe I wasn't very articulate when drafting the section respecting our sensitive area determinations and want to more fully explain the rationale we utilized. We also want to gain a better understanding of IEPA's concerns at CSOs 001, 022, and 023 so the revised Section of the LTCP will be acceptable to IEPA, and hopefully USEPA. We are also concerned about the first flush determination as our sampling efforts to date haven't resulted in the capture of data for any storms approaching the 1.2 inch per hour event. Given the importance of these issues, would it be possible for us to meet (1-2 hours maximum) to discuss how best to move forward?

We can meet on any of the following dates, in priority order:

(1) September 2, any time
(2) September 8, any time
(3) September 4, meeting must conclude by noon, and
(4) August 28, meeting must conclude by noon

If any of these dates are convenient with you and your staff, just let me know the preferred date and time and we'll come to Springfield. Best personal regards. Bart

Barton G. Jones, P.E.
Strand Associates, Inc.
608.251.4843, Ext. 1030

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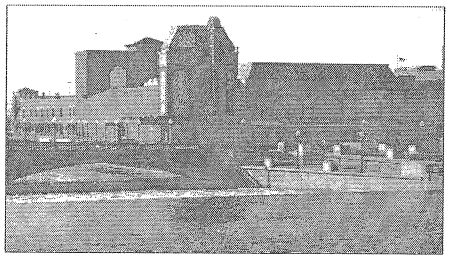
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IEPA Update

September 8, 2009

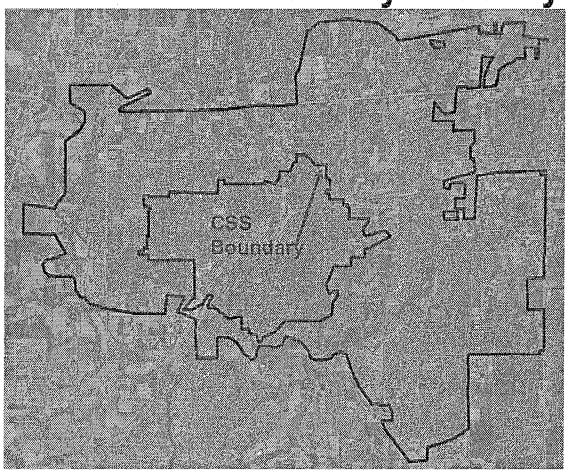


City of Aurora, Illinois

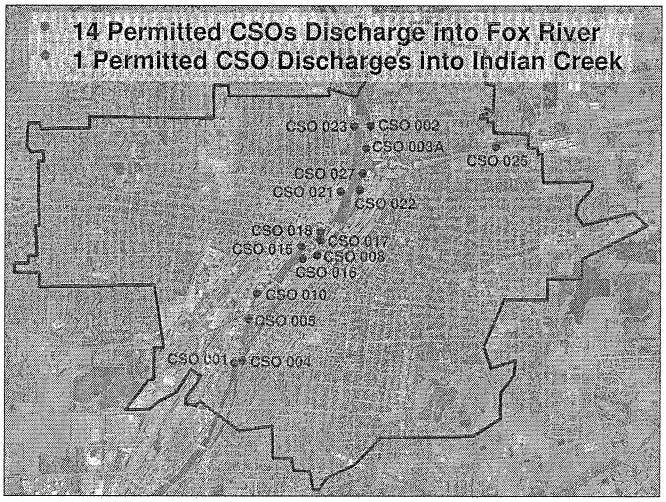
Presentation Outline

- Update on metering and modeling
- Update on first flush sampling/results
- Sensitive area discussion
- Financial Capability Assessment
  2009 Baseline discussion

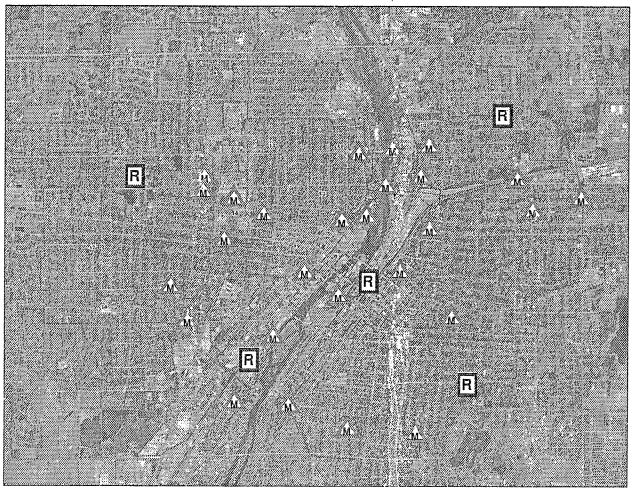
City of Aurora
Wastewater Conveyance System



City of Aurora Combined Sewer System (CSS)



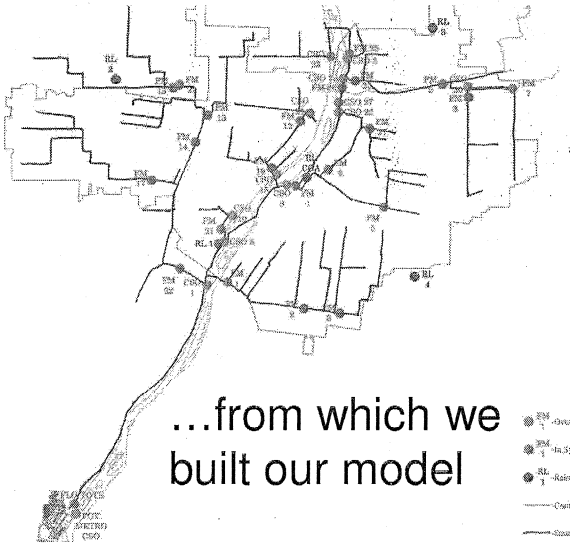
Flow Meter and Rain Gauge Locations



M 26 Flow Meters

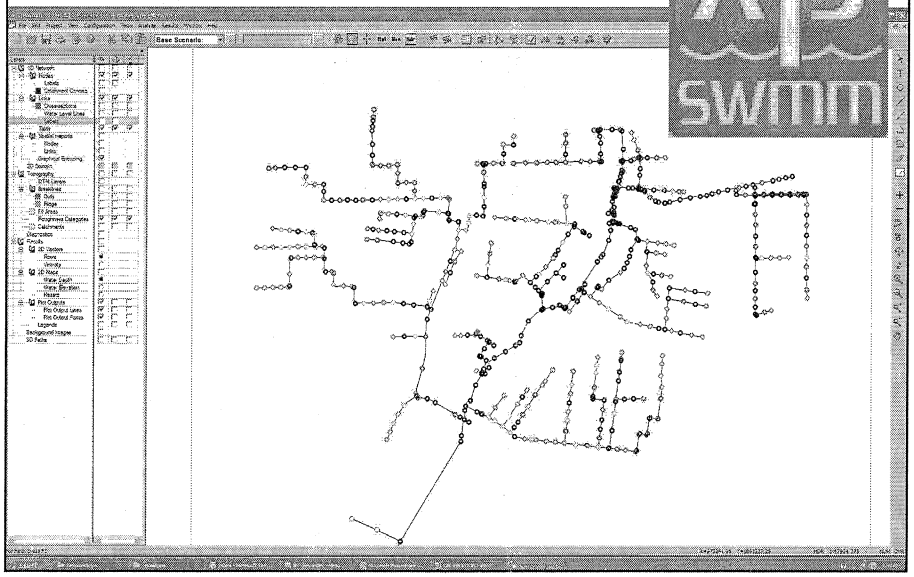
R 5 Rain Gauges

Skeleton of the System

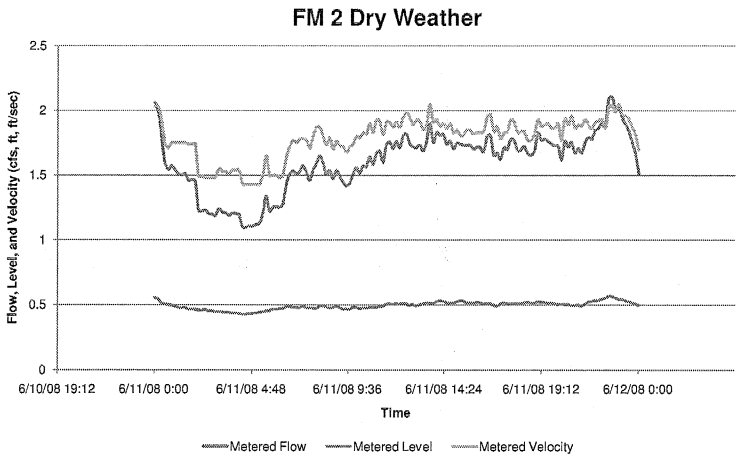


…from which we built our model

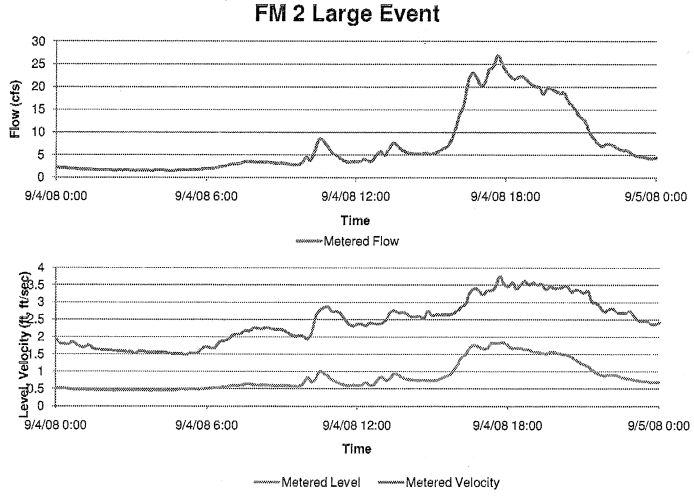
Computer Model Interface



Flow Meter Data - Dry Weather



Flow Meter Data – Wet Weather

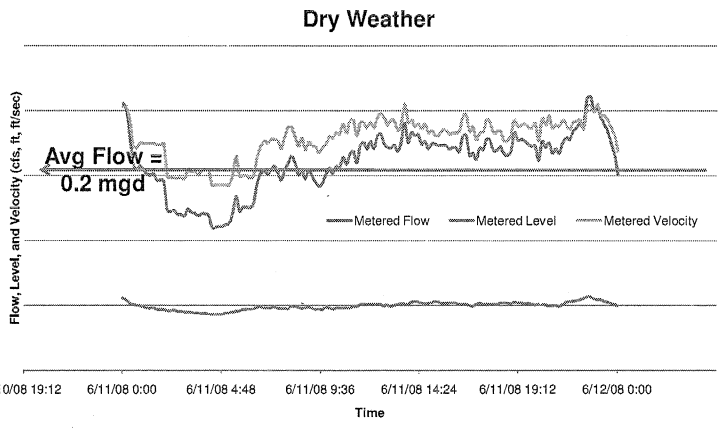


Select Calibration Events

TABLE A.04-1
DAILY RAINFALL SUMMARY

DATE	SAI-RL1 SOUTHWEST	SAI-RL2 NORTHWEST	SAI-RL3 NORTHEAST	SAI-RL4 SOUTHEAST	Event Designation	Duration	Cumulative Rainfall (inches)	Approximate Recurrence Interval	Peak 1-Hour Rainfall (inches)	Approximate Recurrence Interval
5/25/2008	0.20	0.16	0.23		Event 4	0:30	0.23	<2 months	0.23	<2 months
5/26/2008	1.03	1.08	1.05		Event 5 - Calibration	3:00	1.08	3 months	0.85	4 months
5/27/2008	0.00	0.00	0.00							
6/7/2008	0	0	0							
6/8/2008	0.18	0.56	0.27		Event 6	2:00	0.75	<2 months	0.57	<2 months
6/9/2008	0.57	0.53	0.7		Event 6 (continued)					
6/10/2008	0	0.01	0							
6/11/2008	0	0	0		Dry Weather Calibration					
6/12/2008	0	0	0							
6/13/2008	0.29	0.35	0.33		Event 9	3:50	0.34	<2 months	0.19	<2 months
6/14/2008	0	0	0.01							
6/15/2008	0.25	0.33	0.28		Event 10	1:00	0.32	<2 months	0.31	<2 months
7/16/2008	0	0	0	0.01	Dry Weather Calibration					
7/17/2008	0	0	0	0						
7/18/2008	0	0	0	0	Dry Weather Calibration					
7/19/2008	0.72	0.58	0.81	0.68	Event 15 - Calibration	5:50	0.75	<2 months	0.54	<2 months
7/20/2008	0.36	0.42	0.46	0.4	Event 16	2:40	0.46	<2 months	0.36	<2 months
7/21/2008	0.14	0.15	0.14	0.14						
9/1/2008	0	0	0	0						
9/2/2008	1.19	0.26	0.65	1.31	Event 19	1:50	1.31	9 months	1.07	7 months
9/3/2008	0.01	0.01	0.01	0.01						
9/4/2008	2.23	2.32	2.54	2.39	Event 20 - Calibration	16:30	2.53	1.5 year	0.42	<2 months
9/5/2008	0	0	0	0						
9/6/2008	0	0.01	0.01	0						
9/11/2008	0	0	0	0						
9/12/2008	0.55	0.45	0.49	0.59	Event 22 - Calibration	51:09:00	6.72	40 year	1.19	9 months
9/13/2008	4.04	4.33	4.82	3.58	Event 22 (Continued)					
9/14/2008	1.3	1.29	1.41	1.32	Event 22 (Continued)					

Dry Weather Calibration - Example



Estimated Basin Population = 200,000 gal/day / 100 gcd = 2,000 persons

Dry Weather Calibration Performed Basin by Basin

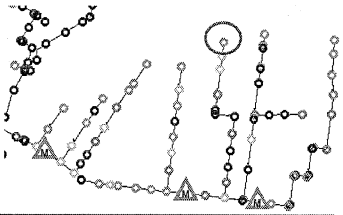
Total Basin 2 Area = 260 Acres

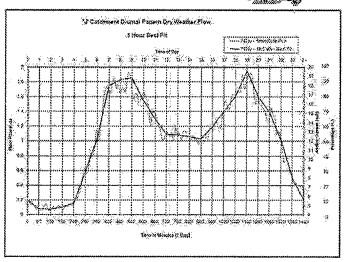
Population Density = 2,000 persons / 260 ac = 7.7persons per ac



Allocate Over All Sanitary Inputs And Add "Diurnal" Flow Pattern

Subbasin Area= 10 Acres

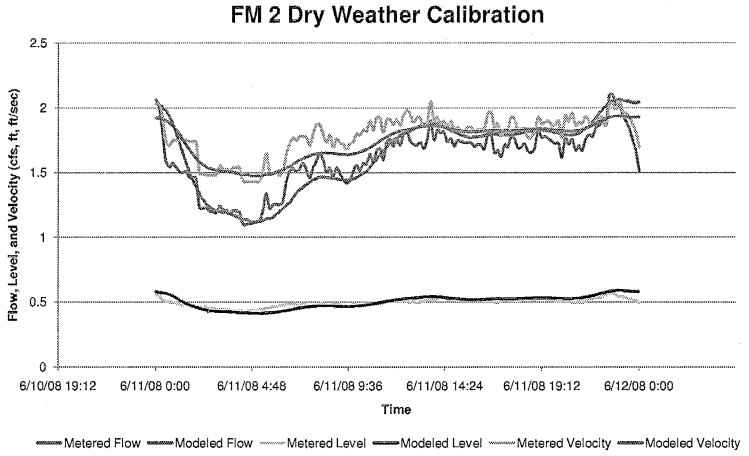






Calibration Parameter

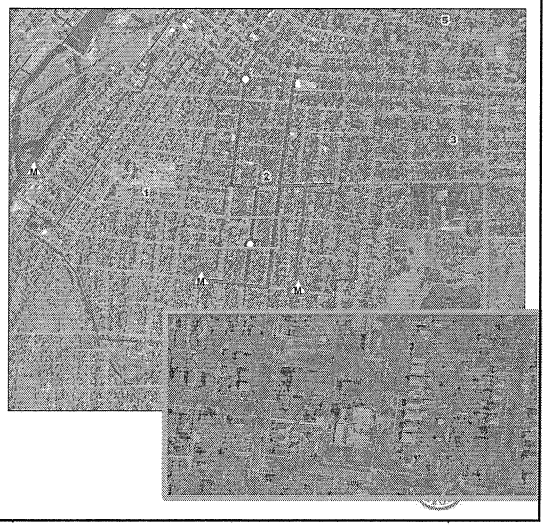
Model Calibration – Dry Weather



Characterize Each Wet Weather Weather Subbasin

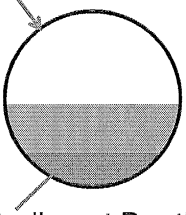
- Subbasin Area
- Percent Impervious Surface
- Depression Storage
- Infiltration Characteristics
- Ground Roughness
- Ground Slope

Calibration Parameter

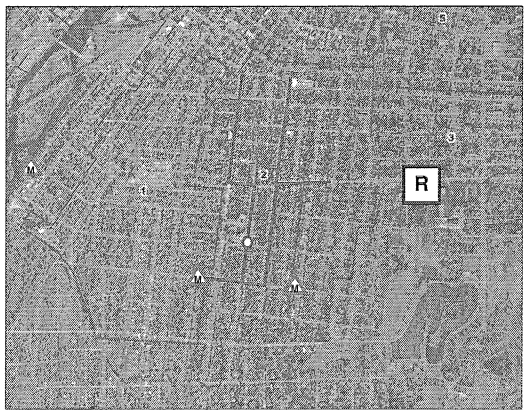


Two More Factors Can Be Adjusted For Calibration

- Pipe Roughness



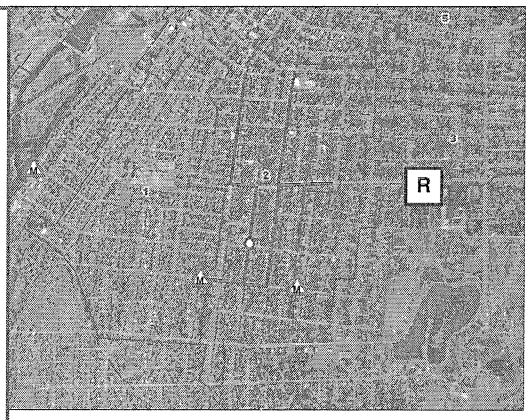
- Sediment Depth in Sewer
- **Calibration Parameter**



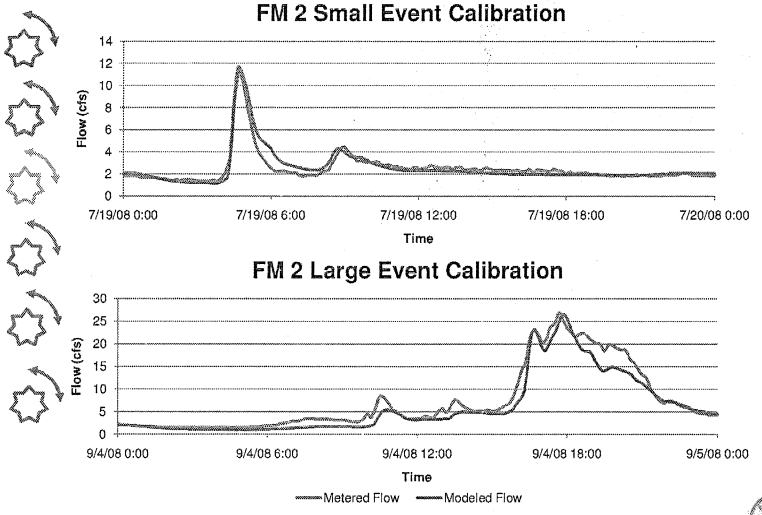
Develop Rainfall Input File Based on Nearest Rain Gauge

WW Event 20
9/4/08

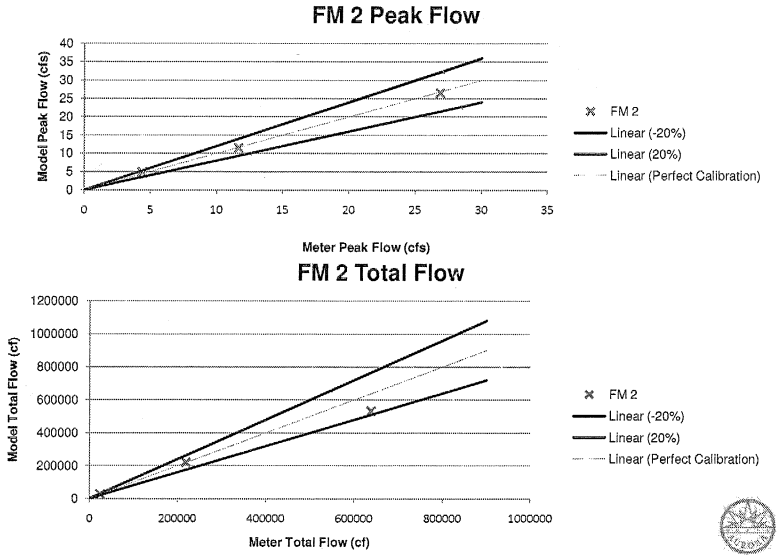
Time	SAI - RL1 SOUTHWEST	SAI - RL2 NORTHWEST	SAI - RL3 NORTHEAST	SAI - RL4 SOUTHEAST
12:00	0	0.01	0.01	0.01
12:10	0.01	0.01	0	0.01
12:20	0.01	0	0.01	0
12:30	0	0	0	0
12:40	0	0.01	0.01	0.01
12:50	0.06	0.06	0	0.06
13:00	0.01	0.01	0.04	0.01
13:10	0	0.01	0	0.01
13:20	0.01	0.01	0.02	0.01
13:30	0.01	0.01	0.01	0.02
13:40	0.01	0.02	0.01	0.01
13:50	0.01	0.01	0.01	0.02
14:00	0.01	0.02	0.02	0.01
14:10	0.01	0.01	0.01	0.01
14:20	0.01	0.01	0.01	0.01
14:30	0.01	0.01	0.01	0.01
14:40	0.01	0.01	0.02	0.02
14:50	0.01	0.01	0.01	0.01
15:00	0.01	0.02	0.01	0.02
15:10	0.02	0.02	0.02	0.03
15:20	0.03	0.03	0.03	0.04
15:30	0.03	0.03	0.04	0.04
15:40	0.03	0.04	0.04	0.05
15:50	0.07	0.05	0.05	0.07
16:00	0.07	0.06	0.06	0.14
16:10	0.07	0.07	0.11	0.09
16:20	0.06	0.06	0.08	0.04
16:30	0.04	0.06	0.06	0.05
16:40	0.04	0.05	0.05	0.05
16:50	0.1	0.05	0.06	0.11
17:00	0.04	0.08	0.11	0.05
17:10	0.04	0.05	0.07	0.09
17:20	0.07	0.05	0.11	0.09
17:30	0.07	0.05	0.06	0.06
17:40	0.07	0.06	0.05	0.04
17:50	0.1	0.07	0.04	0.06
18:00	0.04	0.08	0.09	0.05
18:10	0.04	0.05	0.04	0.05
18:20	0.04	0.06	0.08	0.07
18:30	0.04	0.09	0.06	0.05



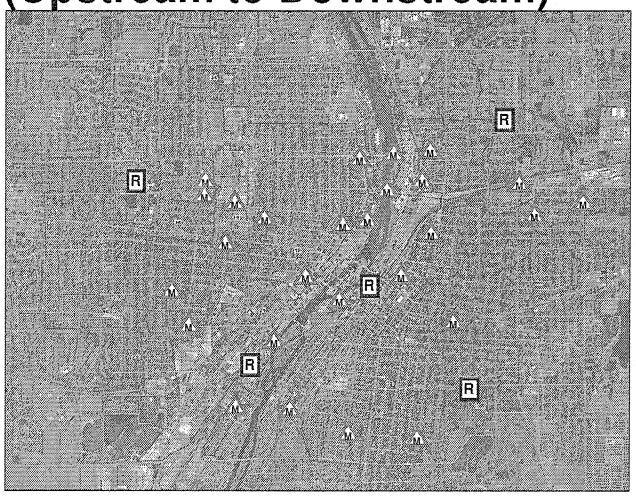
Model Calibration – Wet Weather



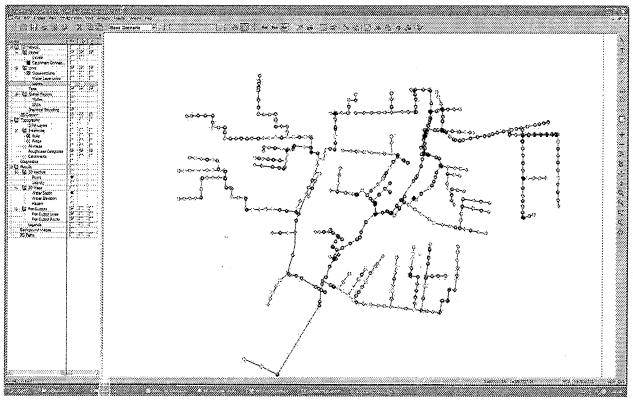
Model Calibration – Wet Weather



Repeat for Each Basin (Upstream to Downstream)



Model Validation Critical to Confidence



Does the model make sense with other data that wasn't used in calibration?

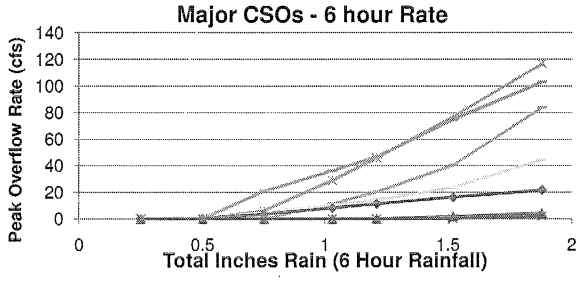
How the Model Was Validated

1. Compared Model Results with 2005-2008 CSO Frequency

2. Compared April 2009 CSO Occurrence with Month-long Model Run

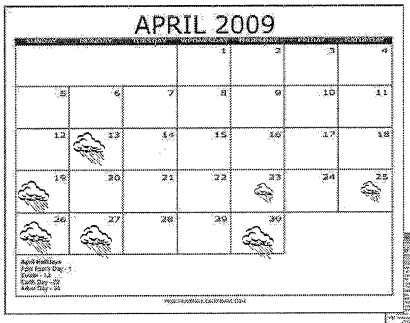
Validation 1: 2005-2008 CSO Frequency

- Ran the model for seven different rainfall intensities to determine what size event would "trigger" each CSO

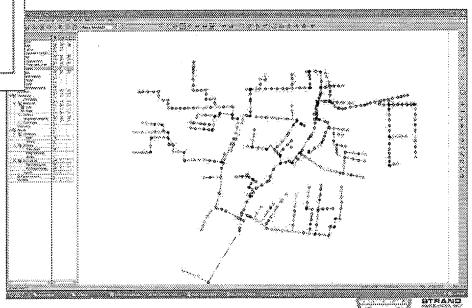


- Compare with Yearly CSO Occurrences

Validation 2: April 2009



- Modeled one month of 7 rainfall events caused overflows



- Plot metered vs modeled overflow rate and volume for each event

Validation 2: Results

Figure B.05-9
CSO 015 - Peak Flow

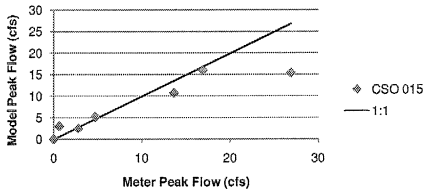
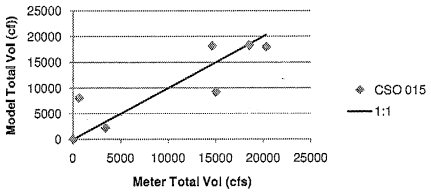
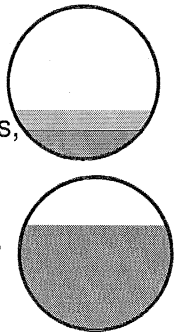


Figure B.05-10
CSO 015 - Total Volume

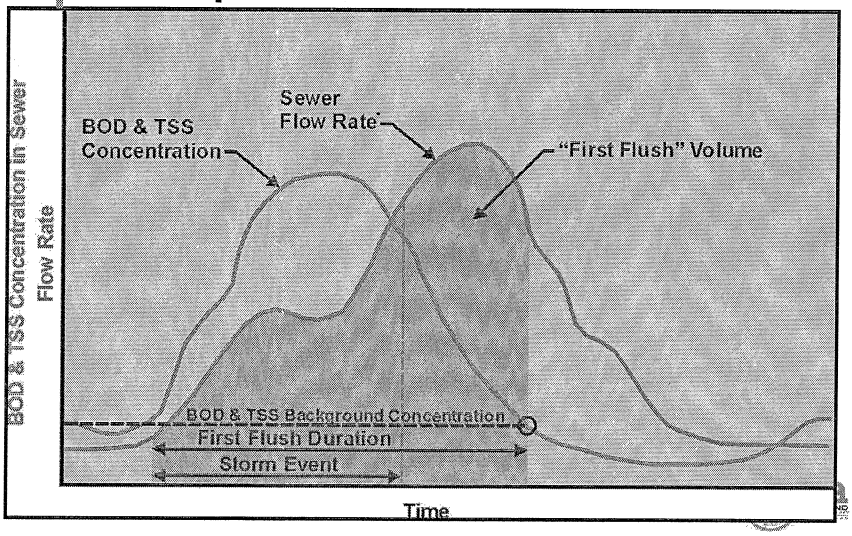


Illinois Code/Aurora Permit Require We Capture "First Flush"

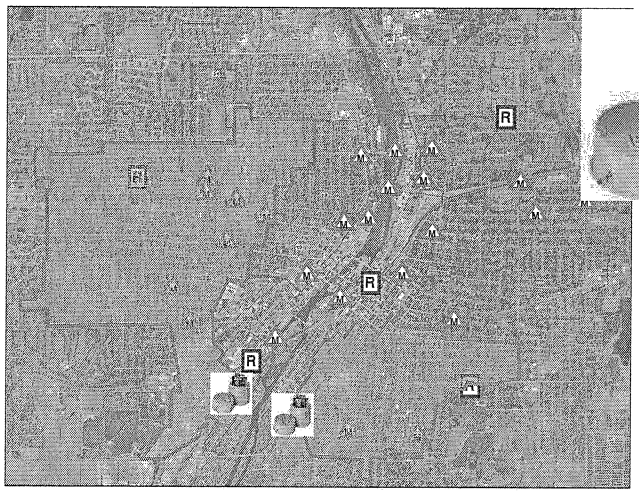
- During low flow, sediment accumulates in base of sewer.
- During high flow, the sediment resuspends, increasing wastewater concentration until sediment is completely "flushed."
- Goal of "First Flush" regs is to capture this high concentration wastewater for later treatment.
- 1.2 inch 1 hour storm is Illinois' First Flush standard event.



Illinois Code/Aurora Permit Require We Capture a Portion of "First Flush"

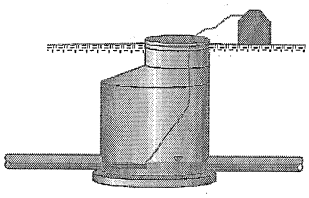


Samplers Are Placed at Key Points in CSS and Activated When Storm is Predicted

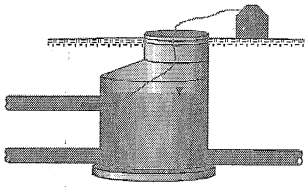




Water Quality Sampling (WQ)



Sampling during dry weather establishes "baseline condition"

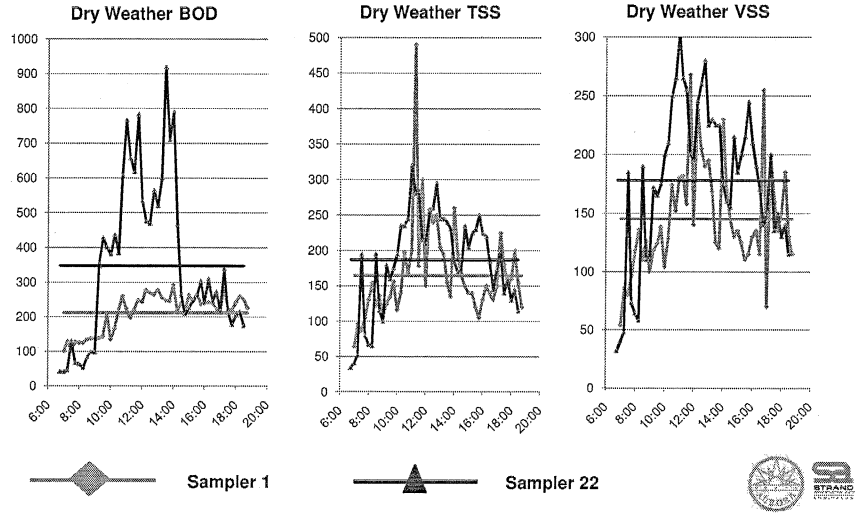


Sampling during wet weather helps establish first flush duration and volume

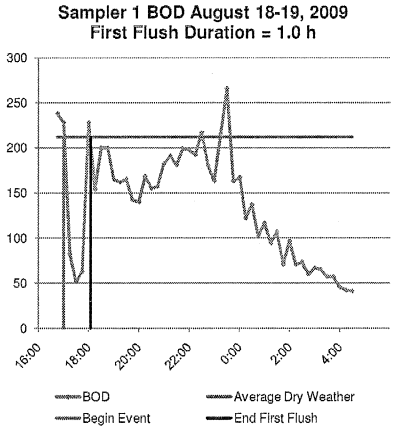
Water Quality Sampling (WQ)

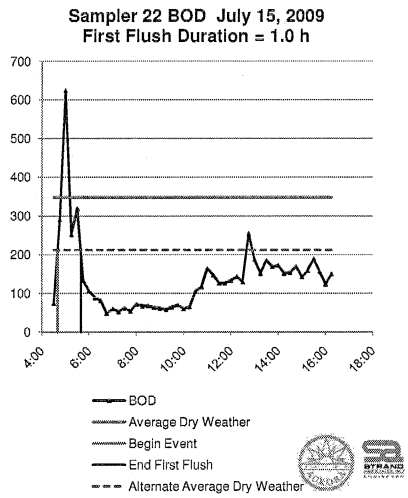
- An initial round of sampling performed during Summer 2008.
- Results were not "robust" enough to perform first flush calculation.
- Two samplers installed for Summer 2009.
  - One dry weather sampling event (7/23/2009)
  - Two wet weather sampling events
    - 7/15/2009
    - 8/18/2009

Dry Weather Water Quality Sampling establishes the "baseline" condition

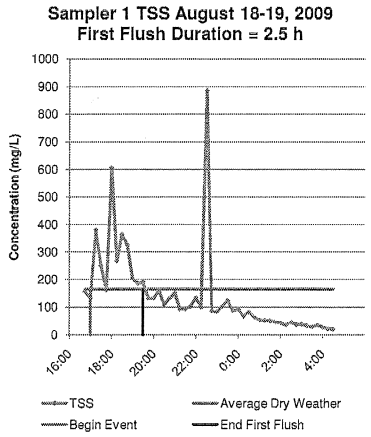


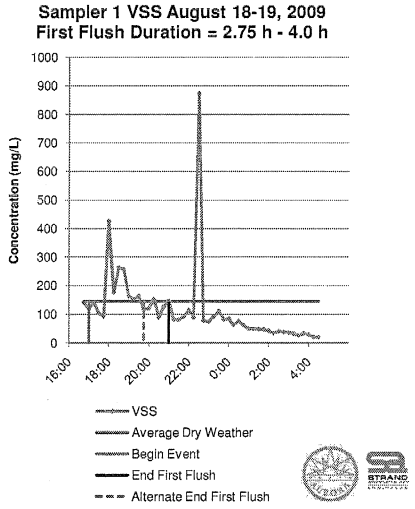
Data Suggest BOD May Not Offer Value for Determining First Flush



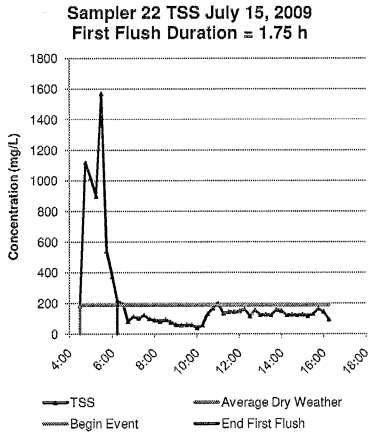


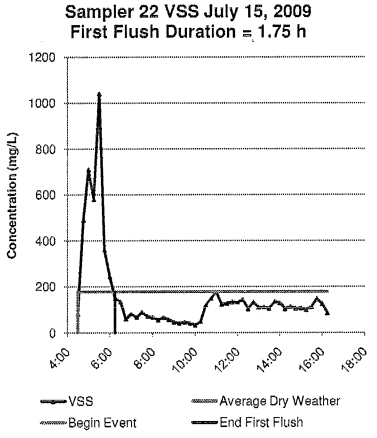
Data for TSS and VSS appear good for determining First Flush Duration





Data for TSS and VSS appear good for determining First Flush Duration



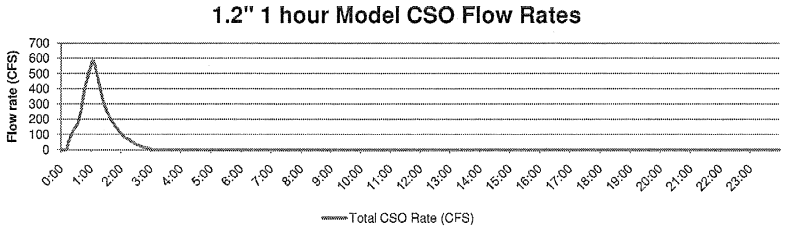


Conclusions

- First Flush Durations appear robust:
  - 2.5 hours for Sampler 1 (CSO 004 Basin)
  - 1.75 hours for Sampler 22 (CSO 001 Basin).
- Agree with WEDA's (1983) First Flush Durations
  - 2 hours: CSO Basins **001**, **004**, 010, 018
  - 3 hours: CSO Basins 002, 005, **015**, 023, 025
  - 4 hours: CSO Basins 003, **008**, 022
- First Flush Duration appears to be about 2 hours, possibly longer.
- How does length of time affect First Flush Volume?

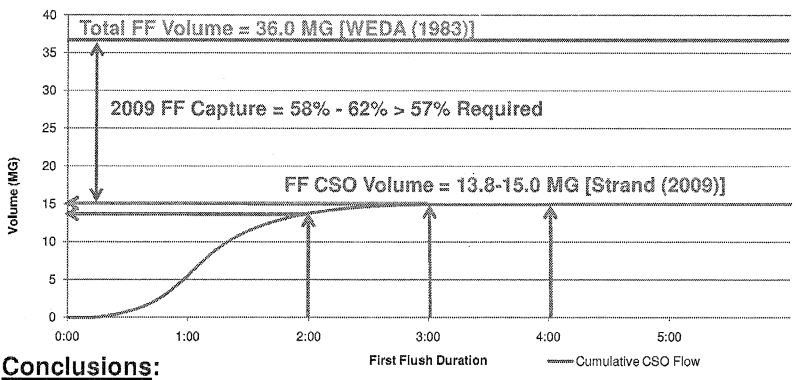
Determining First Flush Volume from Duration

- Water Quality sampling events were relatively intense but short of the 1.2" benchmark.
- To Determine Volume, we ran calibrated XPSWMM model for a 1.2" 1-hour uniformly distributed storm.



- Based on the Model results, how does Duration affect First Flush Volume?

How Does the Choice of Duration Affect First Flush?



Conclusions:

- **Aurora meets 57% capture requirement.**
- **Selection of FF duration (2 – 4 h) does not significantly impact CSO FF Volume.**

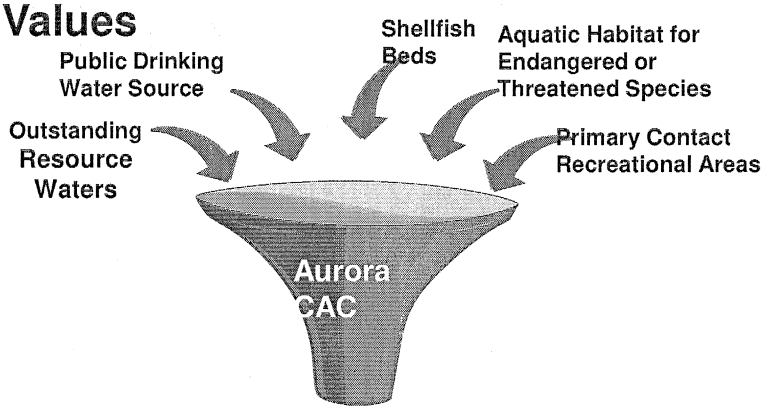
Strand and Aurora are Satisfied with First Flush Analysis

- Determination of FF CSO volume is not strongly dependent on FF Durations > 2 h.
- FF Duration is consistent with 1983 system evaluation.
- FF CSO Volume has decreased 25%:
  - 19 MG (1983) down to 13.8 – 15.0 MG (2009)

LTCP Analysis Assumes Exception Valid

- Included in most recent permit
- Preliminary alternative analysis shows 100% FF capture costs of $300M
- LTCP recommended projects will only increase FF Capture
- USEPA LTCP requirements in-place to meet WQ

Sensitive Area Determinations Made by Local Residents Using Local Values



"YES or NO"
Determinations Made for Each Specific CSO Discharge Location

Aurora's CAC was Provided Background Information to Frame the Sensitive Area Issue

1. Water Quality Standards as they Relate to CSO Abatement – What Does "Fishable / Swimmable" Mean

2. Summary Report on Previous Sensitive Area Determinations Based Upon Primary Contact Recreation and IEPA's Subsequent Approvals
   - April 1997 Report
   - January 1998 Report
   - October 2000 Report

3. CAC Guided Tour of CSO Discharge Locations and CSO Treatment Facility

So, what is Primary Contact Recreation?

EPA's guidance document, Ambient Water Quality Criteria for Bacteria – 1986, establishes the numeric criteria for "bathing (full body contact) recreational waters" as 126 per 100 ml E. coli. This number was based on studies at public bathing beaches where people were "swimming". Another EPA guidance document, 1994 Water Quality Standards Handbook: 2nd Edition, describes "primary contact recreation" as "usually includes swimming, water skiing, skin diving, surfing, and other activities likely to result in immersion. "Secondary contact recreation" classification is to be protective when immersion is unlikely and the examples given are boating, wading and rowing. Still another EPA guidance document, May 2002 Draft Implementation Guidance for Ambient Water Quality Criteria for Bacteria, says: "Primary contact recreation uses are designated for water bodies where people engage or are likely to engage in activities that could result in ingestion of water or immersion. These activities logically include swimming, water skiing, kayaking or any other activity where contact and immersion in the water is likely." It appears that the definition of "primary contact recreation" has evolved over time from "full body contact" in 1986 to "contact and immersion" in 1994 to "immersion or ingestion of water" in 2002. In any case, the activities listed as constituting "primary contact recreation" include swimming, water skiing, skin diving, surfing, and kayaking as opposed to boating, wading and rowing which are "secondary contact recreation"



Site-Specific Sensitive Area Determinations were Made Upon:

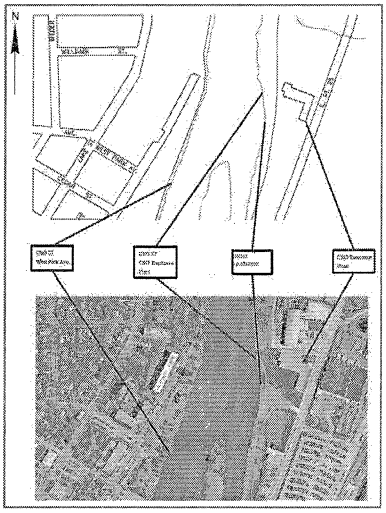
1. Outstanding Resource Waters Fact
2. Public Drinking Water Supply Fact
3. Presence of Shellfish Beds Fact
4. Presence of Aquatic Habitat for Endangered or Threatened Species Fact
5. Primary Contact Recreation Fact

Aurora's CAC Determined that None of the CSOs Discharge Into a Sensitive Area Based Upon Criteria Established in CSO Control Policy

1. Draft Findings Submitted to IEPA for Unofficial Reaction

2. IEPA Requested Further Consideration for CSO's 001, 022 and 023 Based Upon Current (and Future) Land Use and Known Recreational Use

Why CAC Concluded CSO 022 Does Not Discharge Into a Sensitive Area

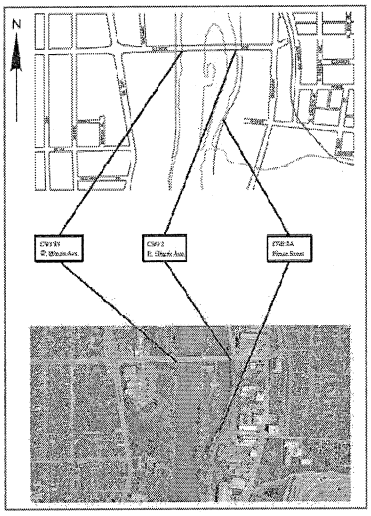


1. Proposed River Walk Park Does Not Enhance Ingress / Egress to River's Edge

2. Located Behind Existing CSO Treatment Facility

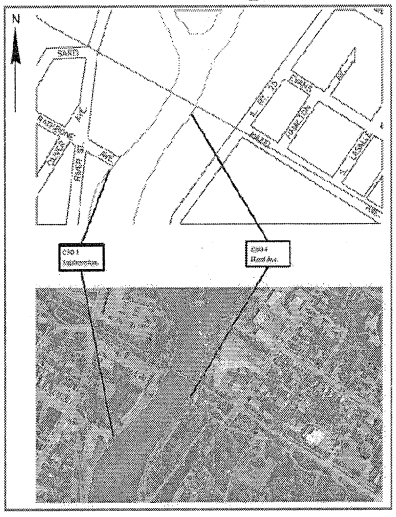
3. Location No Different than CSOs 002, 3A, 027 Just Upstream

Why CAC Concluded CSO 023 Does Not Discharge Into a Sensitive Area



1. No Primary Contact Recreation Ever Observed During Wet Weather Events
2. Infrequent "Secondary" Contact Recreation Observed in Dry Weather BUT No Recorded CSO Discharge in Dry Weather

Why CAC Concluded CSO 001 Does Not Discharge Into a Sensitive Area



1. Proximity of Montgomery Dam Downstream Minimizes Contact Recreational Use
2. No Primary Contact Recreation Ever Observed During Wet Weather Events
3. Infrequent "Secondary" Contact Recreation Observed in Dry Weather BUT No Recorded CSO Discharge in Dry Weather

Reasons to Affirm a Finding of No Sensitive Areas at CSOs 001, 022 and 023

1. Only Secondary Recreational Contact Observed At CSOs 001 and 023 During Dry Weather When Aurora's CSOs Are Not Discharging

2. Confirmation of "No Sensitive Areas" Made By Local Folks Who Have Observed Historical Uses.

Can Draft Sensitive Area Determination (LTCP-Section 3) be Revised in Any Manner which Would Allow IEPA to Conclude that CSOs in Question Do Not Discharge Into a Sensitive Area?

- CSO 022?
- CSO 023?
- CSO 001?

If There Exists Sensitive Areas:

1. Prohibit New or Significantly Increased CSO Volumes

2. Eliminate or Relocate CSOs that Discharge into Sensitive Areas whenever Physically Possible and Economically Achievable
   - Eliminate or relocate at what Level of Design Storm?
   - How Does One define "Economically Achievable"?

3. Give Priority in LTCP
   - Does this Mean First Priority in Implementation Schedule

Aurora's Financial Capacity Assessment 2009 Baseline

Socio-Economic Indicators

Indicators	Strong	Mid-Range	Weak
Bond Rating	AA+		
Total Debt as Percent of Full Market Property Value		4.56%*	
Unemployment Rate			12.2%
Median Household Income (MHI)		$70,422	
Property Tax Revenue as Percent of Full Market Property Value			5.98%
Property Tax Collection Rate	101.49%**		

* 5% Equal a Weak Rating
** Back Taxes Plus Penalties

Aurora's Financial Capacity Assessment 2009 Baseline

Financial Capability Matrix

Socio-Economic Indicator Average Score	Residential Indicator (Cost per Household as Percent of MHI)		
	Low (< 1%)	Mid-Range (Between 1%-2%)	High (> 2%)
Weak – Below 1.5	Medium Burden	High Burden	High Burden
Midrange – Between 1.5 and 2.5	Low Burden	Medium Burden	High Burden
Strong – Above 2.5	Low Burden	Low Burden	Medium Burden

Aurora Faces Significant Financial Challenges as a Consequence of the Macro-economic Climate

- 2009 Budget Deficit of $5.6 Million
- 2010 Projected Budget Deficit of $19 Million
- State-shared Sales Tax Revenue Down 10.2%
- Home-rule Sales Tax Revenue Down 11.0%
- Revenue Streams Not Expected to Return to Historic Levels for a Few Years
- Demand for SRF Low Interest Loans for CSO Abatement Statewide Exceed Supply; Therefore Debt Financing Will Occur in Commercial Market at Much Higher rate

CSO Abatement Program Implementing Schedule Impact

- Low Burden — Not to Exceed 5 Years
- Medium Burden — Not to Exceed 10 Years
- High Burden — 15 to 20+ Years

However, Because of the Macro-economic Factor Beyond Aurora's Control We Intend to Request an Implementing Schedule Outside the General Boundaries Established in USEPA Guidance



Questions and Answers



APPENDIX Q
FEMA MAPS FOR FOX RIVER

FLOOD INSURANCE STUDY

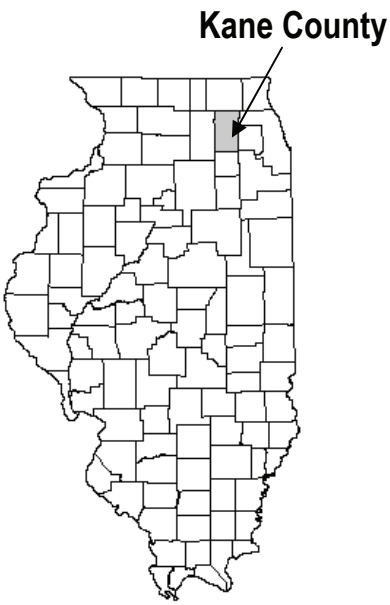


KANE COUNTY, ILLINOIS
AND INCORPORATED AREAS

Volume 1 of 3

COMMUNITY NAME	COMMUNITY NUMBER
ALGONQUIN, VILLAGE OF	170474
AURORA, CITY OF	170320
BARRINGTON HILLS, VILLAGE OF	170058
BARTLETT, VILLAGE OF	170059
BATAVIA, CITY OF	170321
BIG ROCK, VILLAGE OF	171081
* BURLINGTON, VILLAGE OF	171077
CAMPTON HILLS, VILLAGE OF	171396
CARPENTERSVILLE, VILLAGE OF	170322
EAST DUNDEE, VILLAGE OF	170323
ELBURN, VILLAGE OF	171026
ELGIN, CITY OF	170087
GENEVA, CITY OF	170325
GILBERTS, VILLAGE OF	170326
HAMPSHIRE, VILLAGE OF	170327
* HOFFMAN ESTATES, VILLAGE OF	170107
HUNTLEY, VILLAGE OF	170480
KANE COUNTY (UNINCORPORATED AREAS)	170896
* KANEVILLE, VILLAGE OF	171396
LILY LAKE, VILLAGE OF	171023
MAPLE PARK, VILLAGE OF	171018
MONTGOMERY, VILLAGE OF	170328
NORTH AURORA, VILLAGE OF	170329
PINGREE GROVE, VILLAGE OF	171078
SLEEPY HOLLOW, VILLAGE OF	170331
SOUTH ELGIN, VILLAGE OF	170332
ST. CHARLES, CITY OF	170330
SUGAR GROVE, VILLAGE OF	170333
VIRGIL, VILLAGE OF	171024
WAYNE, VILLAGE OF	170865
WEST DUNDEE, VILLAGE OF	170335

* NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED IN KANE COUNTY



Revised August 3, 2009

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER

17089CV001C

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the Community Map Repository. It is advisable to contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the Community Map Repository to obtain the most current FIS components.

Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zone
Al through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: December 20, 2002

Revised FIS Report Dates: November 16, 2006
August 3, 2009

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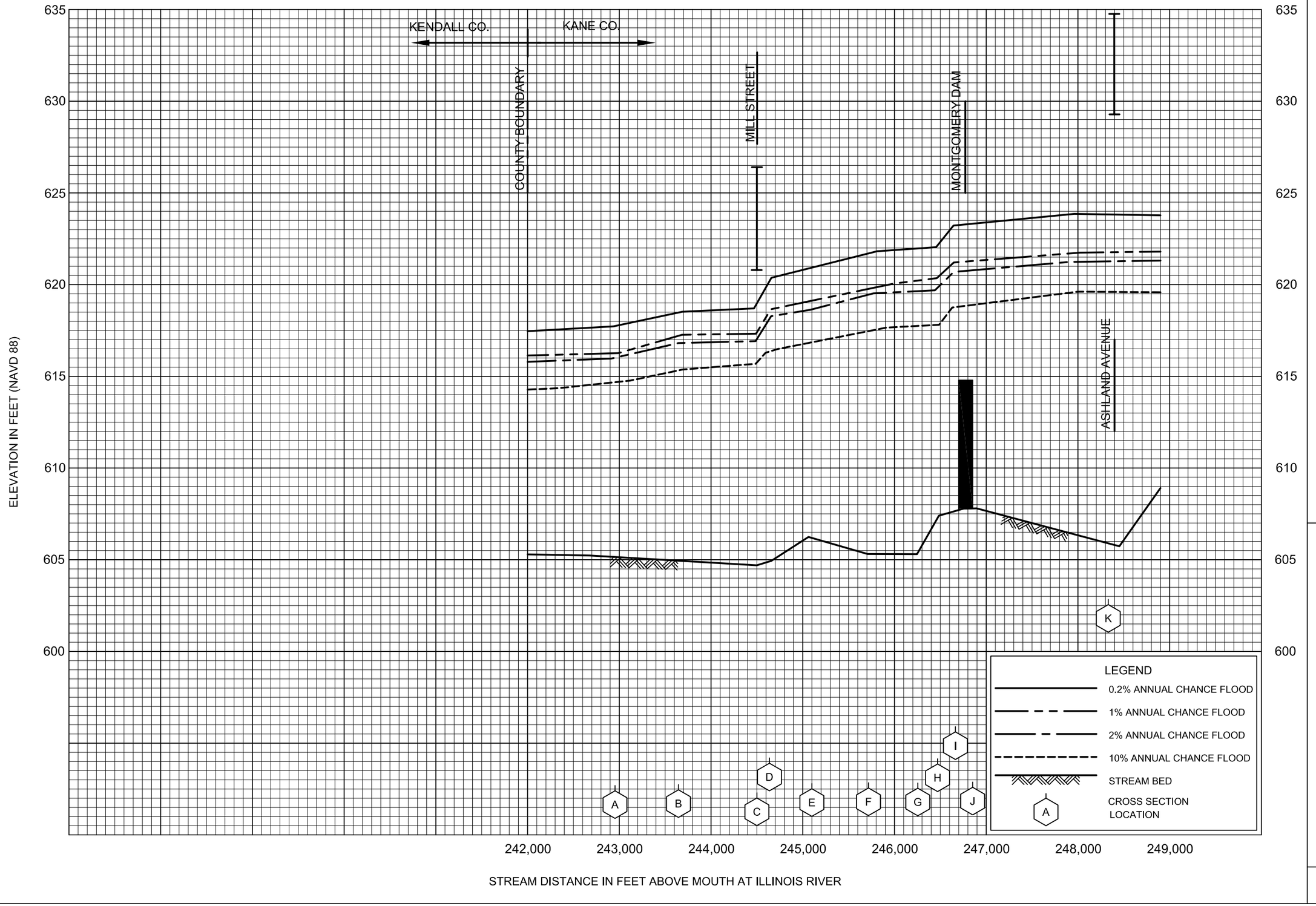
Exhibit 1 – Flood Profiles	Panel
7th Avenue Creek	01P-02P
7th Avenue Creek Tributary	03P
Anderson Road Run	04P
Anderson Road Run North Branch	05P
Aurora Chain of Lakes	06P-07P
Aurora Chain of Lakes Cherry Hills Diversion	08P
Blackberry Creek	09P-13P
Bowes Creek	14P-18P
Bowes Creek South	19P
Brewster Creek	20P
Carpenter Creek	21P
Eakin Creek	22P
East Run	23P-24P
East Run North Branch	25P
East Run North Loop	26P
Elburn Run	27P-29P
Ferson Creek	30P-39P
Fitchie Creek	40P-44P
Four Winds Way Creek	45P-46P
Fox River	47P-65P
Fox River East Channel	66P
Fox River Tributary	67P
Fox River Tributary East Branch	68P
Geneva Creek	69P-70P
Hampshire Creek	71P-74P
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Hampshire Creek Tributary No. 1	77P
Hampshire Creek Tributary No. 2	78P-80P
Hampshire Creek Tributary No. 3	81P
Hampshire Creek Tributary No. 4	82P-84P
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Jelkes Creek	89P-92P
Jericho Lake Diversion	93P
Lake Run	94P-97P

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Lake Run North of I-88 Overflow East Branch	101P
Lake Run South I-88 Diversion	102P
Lord's Park Tributary	103P
Mahoney Creek	104P-107P
McKee Road Tributary	108P-110P
Mill Creek	111P-119P
Mill Creek Tributary No. 2	120P
North Arm Brewster Creek	121P
Norton Creek	122-125P
Norton Creek Tributary	126P
Otter Creek	127P-131P
Otter Creek West	132P-134P
Pingree Creek	135P-137P
Poplar Creek	138P
Prestbury Branch	139P
Route 38 Branch	140P
Sandy Creek	141P-144P
Seavey Road Run	145P-146P
Seavey Road Run Green Road Branch	147P
Seavey Road Run Main Street Branch	148P
Selmarten Creek	149P
Sleepy Creek	150P-152P
South Tributary	153P
State Street Creek	154P-155P
State Street Creek Tributary	156P
Stony Creek	157P-161P
Sugar Grove Branch	162P-164P
Sugar Grove Branch East	165P
Sugar Grove Branch North	166P
Tollway Tributary	167P
Tyler Creek	168P-173P
Tyler Creek Unnamed Tributary	174P-175P
Union Ditch No. 2	176P
Waubonsee Creek	177P

Exhibit 2 – Flood Insurance Rate Map Index and Flood Insurance Rate Map



FLOOD PROFILES

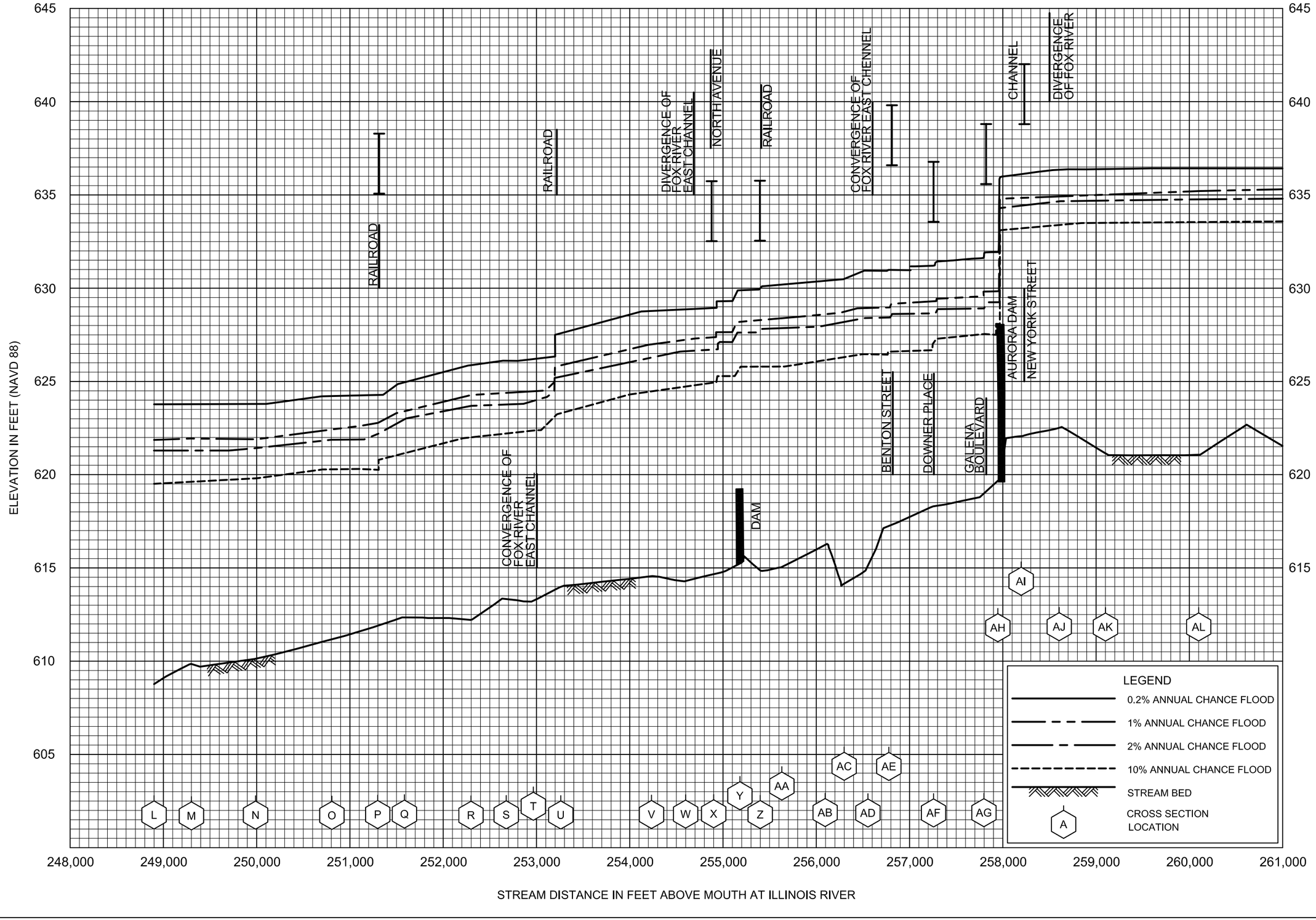
FOX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KANE COUNTY, IL

AND INCORPORATED AREAS

47P



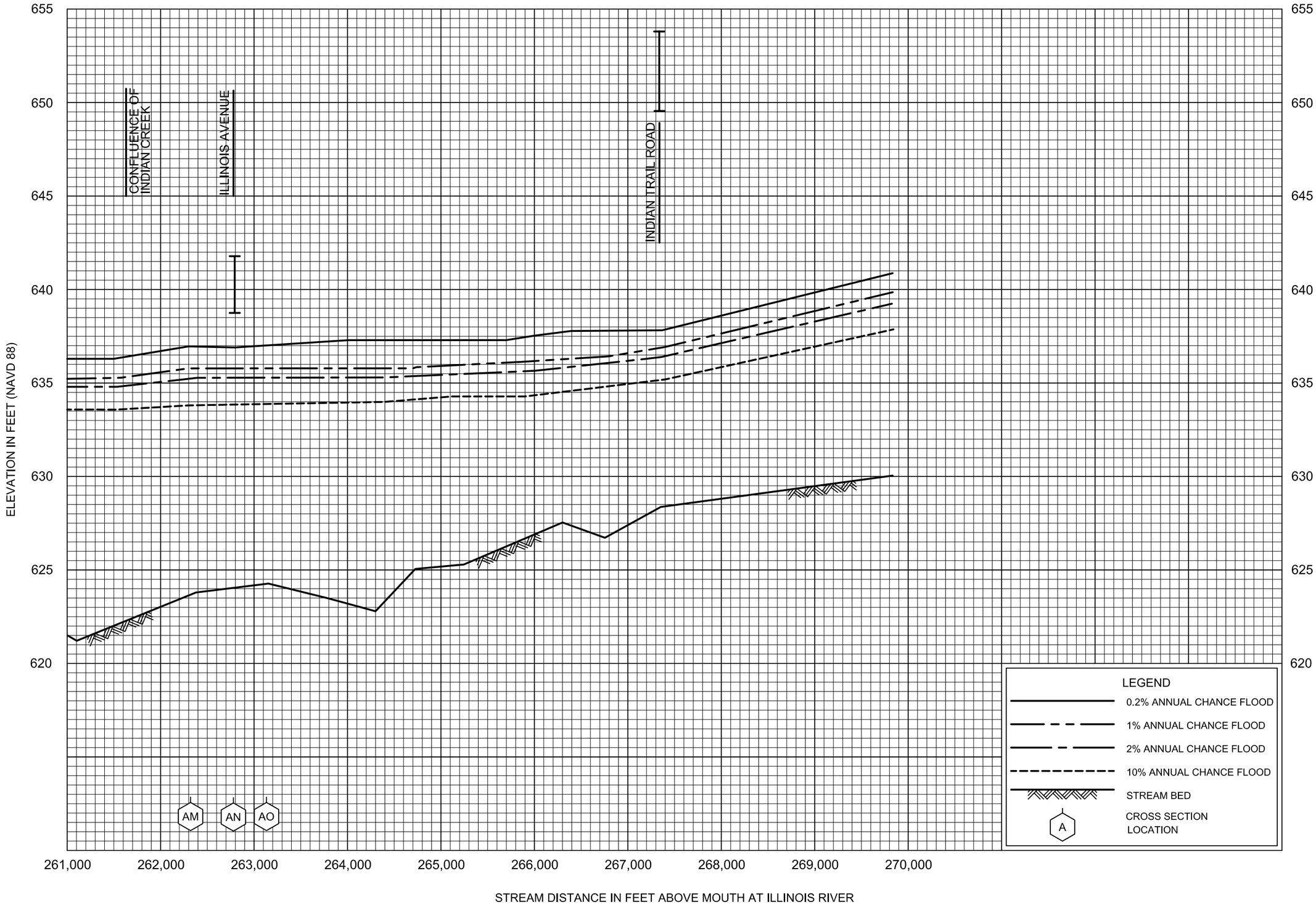
FLOOD PROFILES

FOX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

KANE COUNTY, IL

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FLOOD PROFILES

FOX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

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FLOOD PROFILES

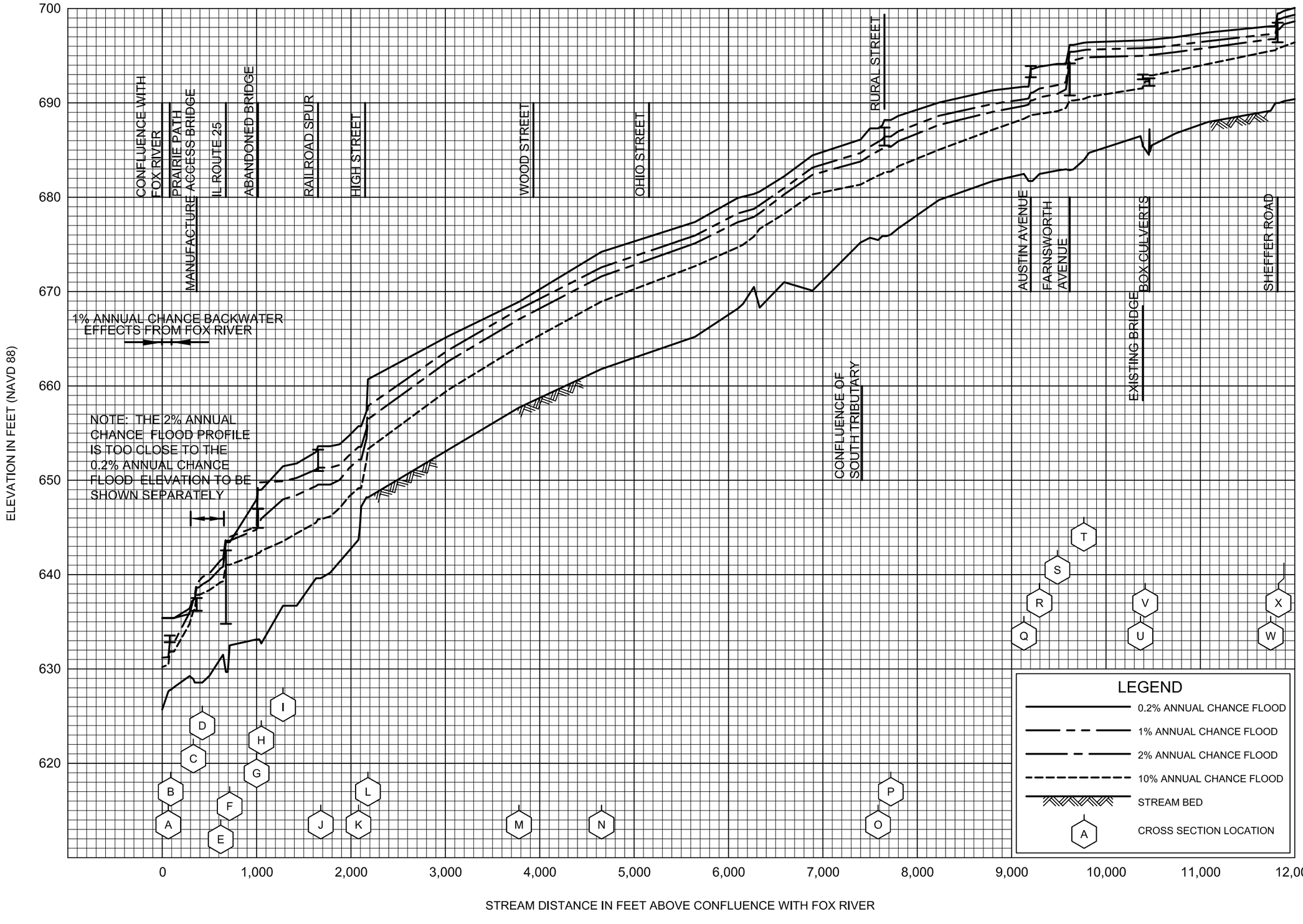
FOX RIVER EAST CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

KANE COUNTY, IL

AND INCORPORATED AREAS

66P



FLOOD PROFILES

INDIAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

KANE COUNTY, IL

AND INCORPORATED AREAS

85P

NOTES TO USERS

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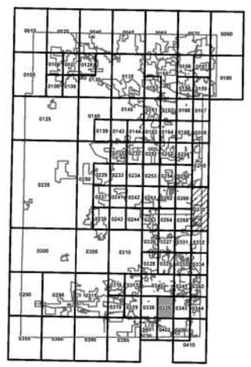
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PANEL INDEX





LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL. 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 — 23	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4989000mN	1000-meter Universal Transverse Mercator grid values, zone 16
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DX5510$_X$	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
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EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 20, 2002

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

November 16, 2006 -

August 3, 2009 - to reflect updated topographic information, to incorporate previously issued Letters of Map Revision, to change Base Flood Elevations, to add Special Flood Hazard Areas and Base FloodElevations, and to change zone designations.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0339H

FIRM
FLOOD INSURANCE RATE MAP
KANE COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 339 OF 410

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AURORA, CITY OF	170320	0339	H
KANE COUNTY	170896	0339	H

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
17089C0339H
MAP REVISED
AUGUST 3, 2009

Federal Emergency Management Agency

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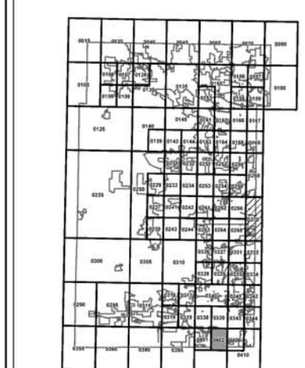
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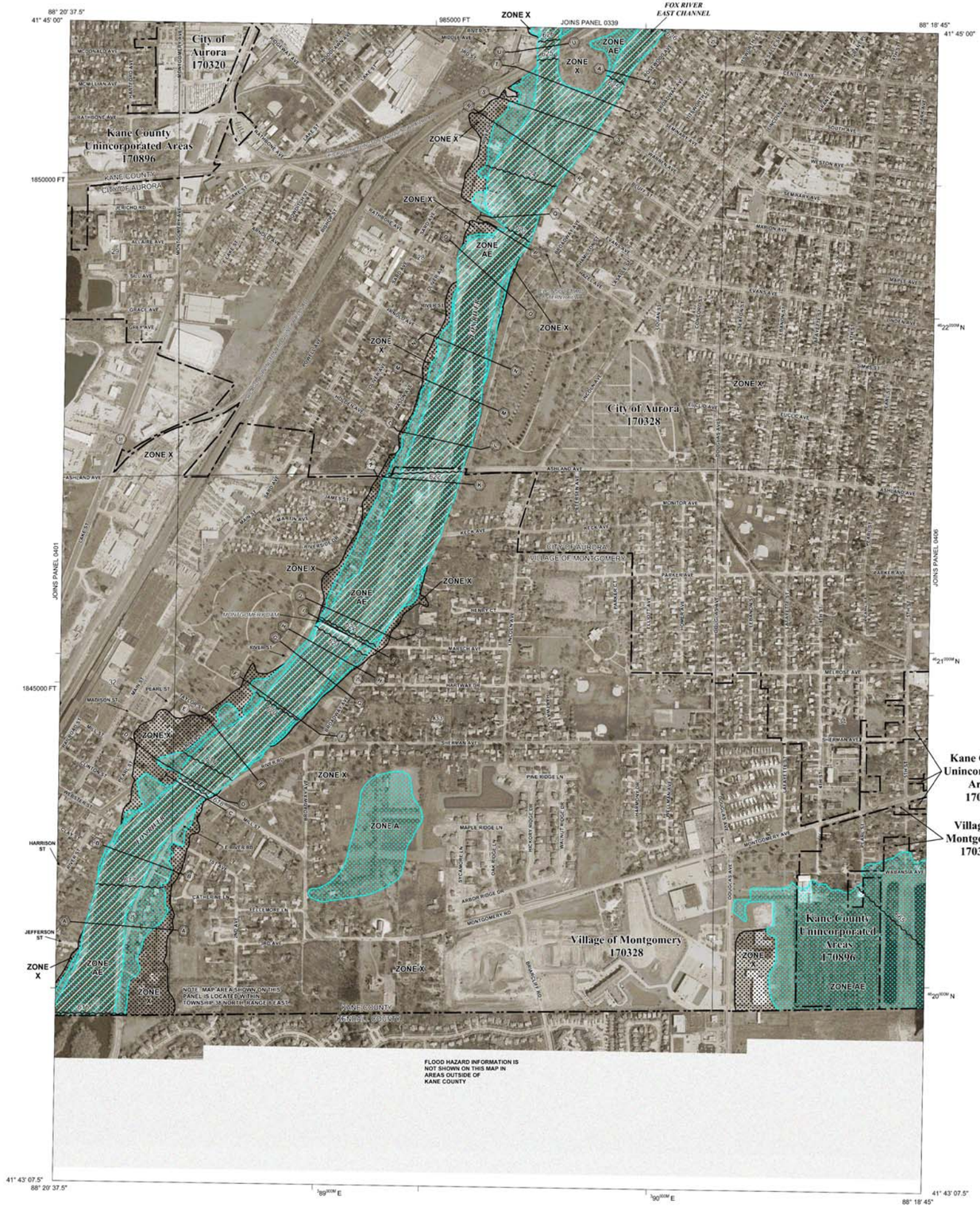
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PANEL INDEX



Panel Not Printed



LEGEND

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DECEMBER 20, 2002

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0402H

FIRM
FLOOD INSURANCE RATE MAP
KANE COUNTY, ILLINOIS
AND INCORPORATED AREAS

PANEL 402 OF 410

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AURORA, CITY OF	170320	0402	H
KANE COUNTY	170896	0402	H
MONTGOMERY, VILLAGE OF	170328	0402	H

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MAP NUMBER
17089C0402H

MAP REVISED
AUGUST 3, 2009

Federal Emergency Management Agency

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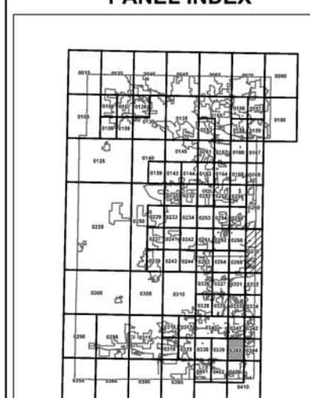
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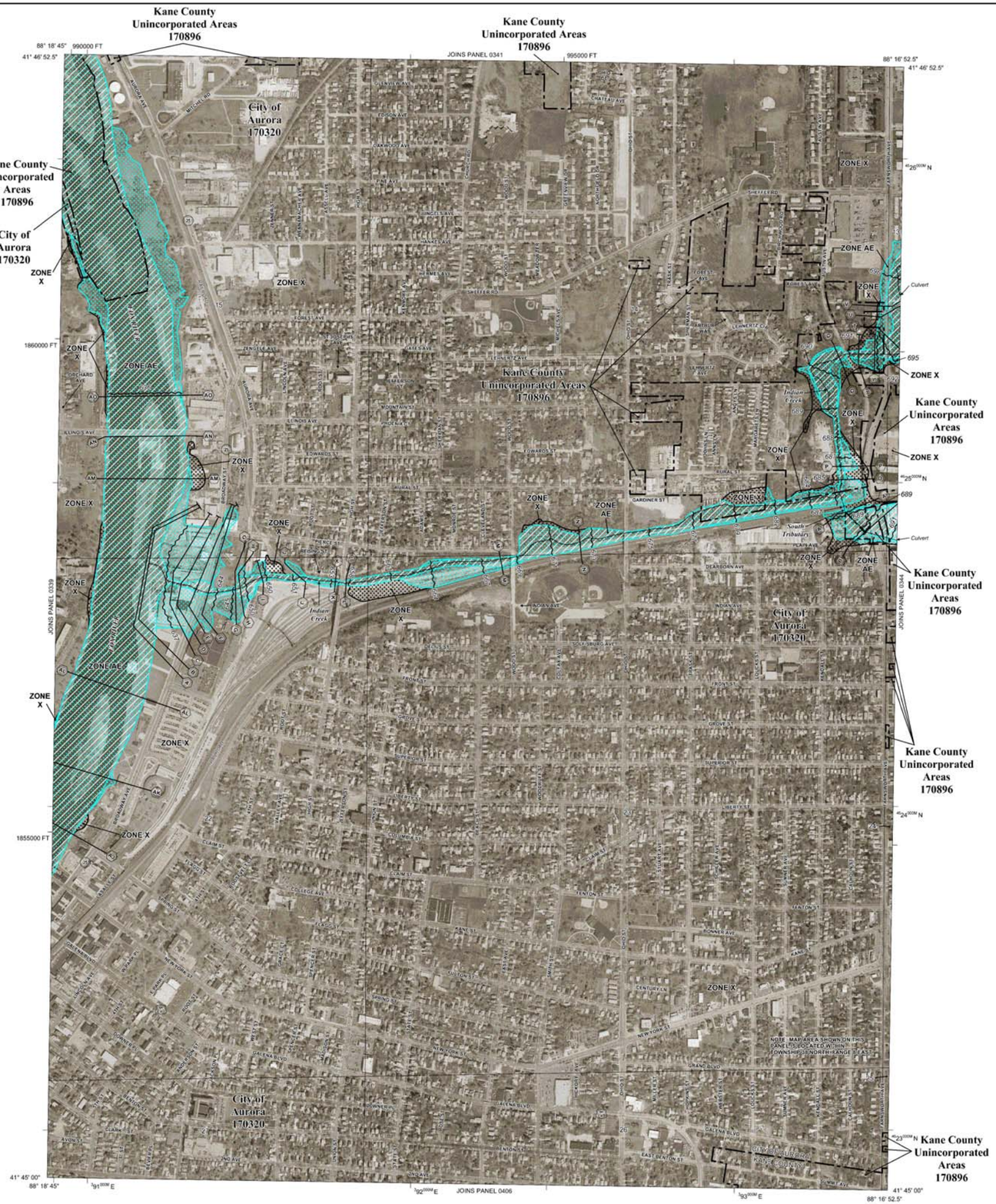
Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital version of this map. The FEMA Map Service Center may also be reached by fax at 1-800-358-9620 and its website at www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov/business/nfip/.

PANEL INDEX



Panel Not Printed



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL. 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- 45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4489000 M N — 1000-meter Universal Transverse Mercator grid values, zone 16
- 1565000 FT — 5000-foot grid tick: Illinois State Plane East Coordinate System, 3776 zone (FIPSZONE 1201) Transverse Mercator
- DX5510 X — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 20, 2002

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

November 16, 2006 -

August 3, 2009 - to reflect updated topographic information, to incorporate previously issued Letters of Map Revision, to change Base Flood Elevations, to add Special Flood Hazard Areas and Base Flood Elevations, and to change zone designations.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0343H

FIRM

FLOOD INSURANCE RATE MAP

KANE COUNTY, ILLINOIS AND INCORPORATED AREAS

PANEL 343 OF 410

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AURORA, CITY OF	170320	0343	H
KANE COUNTY	170896	0343	H

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.

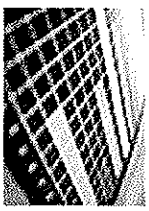
MAP NUMBER
17089C0343H

MAP REVISED
AUGUST 3, 2009

Federal Emergency Management Agency

APPENDIX R
SUPPORT DOCUMENTS FOR FCA

U.S. Census Bureau
American FactFinder



Aurora city, Illinois
Selected Economic Characteristics: 2006-2008
Data Set: **2006-2008 American Community Survey 3-Year Estimates**
Survey: **American Community Survey**

NOTE. Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology.

Selected Economic Characteristics	Estimate	Margin of Error	Percent	Margin of Error
EMPLOYMENT STATUS				
Population 16 years and over	**125,756**	**+/-3,085**	**125,756**	**(X)**
In labor force	95,186	+/-2,597	75.7%	+/-0.9
Civilian labor force	95,125	+/-2,611	75.6%	+/-0.9
Employed	89,366	+/-2,563	71.1%	+/-1.1
Unemployed	5,759	+/-666	4.6%	+/-0.5
Armed Forces	61	+/-73	0.0%	+/-0.1
Not in labor force	30,570	+/-1,418	24.3%	+/-0.9
Civilian labor force	**95,125**	**+/-2,611**	**95,125**	**(X)**
Percent Unemployed	6.1%	+/-0.7	(X)	(X)
Females 16 years and over	**62,948**	**+/-1,572**	**62,948**	**(X)**
In labor force	42,304	+/-1,469	67.2%	+/-1.6
Civilian labor force	42,291	+/-1,468	67.2%	+/-1.6
Employed	39,515	+/-1,483	62.8%	+/-1.7
Own children under 6 years	**19,282**	**+/-1,441**	**19,282**	**(X)**
All parents in family in labor force	11,945	+/-1,190	61.9%	+/-4.3
Own children 6 to 17 years	**32,869**	**+/-1,752**	**32,869**	**(X)**
All parents in family in labor force	23,323	+/-1,824	71.0%	+/-3.5
COMMUTING TO WORK				
Workers 16 years and over	**86,085**	**+/-2,655**	**86,085**	**(X)**
Car, truck, or van -- drove alone	65,503	+/-2,324	76.1%	+/-1.9
Car, truck, or van -- carpooled	10,154	+/-1,448	11.8%	+/-1.5
Public transportation (excluding taxicab)	4,772	+/-692	5.5%	+/-0.8
Walked	1,032	+/-406	1.2%	+/-0.5
Other means	1,637	+/-417	1.9%	+/-0.5
Worked at home	2,987	+/-540	3.5%	+/-0.6
Mean travel time to work (minutes)	29.6	+/-0.8	(X)	(X)
OCCUPATION				
Civilian employed population 16 years and over	**89,366**	**+/-2,563**	**89,366**	**(X)**
Management, professional, and related occupations	30,410	+/-1,422	34.0%	+/-1.7
Service occupations	12,219	+/-1,242	13.7%	+/-1.2
Sales and office occupations	22,988	+/-1,562	25.7%	+/-1.6
Farming, fishing, and forestry occupations	118	+/-106	0.1%	+/-0.1
Construction, extraction, maintenance and repair occupations	6,259	+/-904	7.0%	+/-1.0
Production, transportation, and material moving occupations	17,372	+/-1,561	19.4%	+/-1.6
INDUSTRY				
Civilian employed population 16 years and over	**89,366**	**+/-2,563**	**89,366**	**(X)**

Selected Economic Characteristics	Estimate	Margin of Error	Percent	Margin of Error
Agriculture, forestry, fishing and hunting, and mining	124	+/-88	0.1%	+/-0.1
Construction	5,348	+/-807	6.0%	+/-0.9
Manufacturing	15,694	+/-1,430	17.6%	+/-1.4
Wholesale trade	4,247	+/-722	4.8%	+/-0.8
Retail trade	10,872	+/-1,208	12.2%	+/-1.3
Transportation and warehousing, and utilities	4,663	+/-654	5.2%	+/-0.7
Information	1,950	+/-393	2.2%	+/-0.4
Finance and insurance, and real estate and rental and leasing	7,651	+/-1,033	8.6%	+/-1.2
Professional, scientific, and management, and administrative and waste management services	12,256	+/-1,328	13.7%	+/-1.4
Educational services, and health care and social assistance	14,817	+/-1,220	16.6%	+/-1.3
Arts, entertainment, and recreation, and accommodation, and food services	6,725	+/-991	7.5%	+/-1.0
Other services, except public administration	3,533	+/-836	4.0%	+/-0.9
Public administration	1,486	+/-398	1.7%	+/-0.4
CLASS OF WORKER				
Civilian employed population 16 years and over	**89,366**	**+/-2,563**	**89,366**	**(X)**
Private wage and salary workers	78,746	+/-2,458	88.1%	+/-1.0
Government workers	7,126	+/-734	8.0%	+/-0.8
Self-employed workers in own not incorporated business	3,484	+/-622	3.9%	+/-0.7
Unpaid family workers	10	+/-17	0.0%	+/-0.1
INCOME AND BENEFITS (IN 2008 INFLATION-ADJUSTED DOLLARS)				
Total households	**58,187**	**+/-888**	**58,187**	**(X)**
Less than $10,000	2,737	+/-452	4.7%	+/-0.8
$10,000 to $14,999	1,889	+/-316	3.2%	+/-0.5
$15,000 to $24,999	4,218	+/-680	7.2%	+/-1.1
$25,000 to $34,999	5,371	+/-697	9.2%	+/-1.2
$35,000 to $49,999	8,512	+/-887	14.6%	+/-1.5
$50,000 to $74,999	11,638	+/-881	20.0%	+/-1.5
$75,000 to $99,999	9,170	+/-798	15.8%	+/-1.4
$100,000 to $149,999	8,863	+/-740	15.2%	+/-1.2
$150,000 to $199,999	3,279	+/-500	5.6%	+/-0.9
$200,000 or more	2,510	+/-359	4.3%	+/-0.6
Median household income (dollars)	62,360	+/-1,940	(X)	(X)
Mean household income (dollars)	77,941	+/-2,227	(X)	(X)
With earnings	52,862	+/-952	90.8%	+/-0.8
Mean earnings (dollars)	78,783	+/-2,403	(X)	(X)
With Social Security	8,303	+/-731	14.3%	+/-1.2
Mean Social Security income (dollars)	14,871	+/-957	(X)	(X)
With retirement income	5,384	+/-480	9.3%	+/-0.8
Mean retirement income (dollars)	18,699	+/-2,029	(X)	(X)
With Supplemental Security Income	966	+/-313	1.7%	+/-0.5
Mean Supplemental Security Income (dollars)	7,820	+/-932	(X)	(X)
With cash public assistance income	728	+/-237	1.3%	+/-0.4
Mean cash public assistance income (dollars)	3,541	+/-1,154	(X)	(X)
With Food Stamp benefits in the past 12 months	4,428	+/-611	7.6%	+/-1.0
Families	**42,103**	**+/-1,114**	**42,103**	**(X)**
Less than $10,000	1,857	+/-368	4.4%	+/-0.9
$10,000 to $14,999	832	+/-314	2.0%	+/-0.7
$15,000 to $24,999	2,664	+/-521	6.3%	+/-1.2
$25,000 to $34,999	3,740	+/-664	8.9%	+/-1.6
$35,000 to $49,999	5,563	+/-766	13.2%	+/-1.8
$50,000 to $74,999	7,769	+/-847	18.5%	+/-1.9
$75,000 to $99,999	6,994	+/-720	16.6%	+/-1.6
$100,000 to $149,999	7,334	+/-574	17.4%	+/-1.4
$150,000 to $199,999	3,068	+/-496	7.3%	+/-1.2
$200,000 or more	2,282	+/-349	5.4%	+/-0.8
Median family income (dollars)	69,504	+/-3,417	(X)	(X)
Mean family income (dollars)	85,587	+/-2,939	(X)	(X)
Per capita income (dollars)	26,674	+/-802	(X)	(X)
Nonfamily households	**16,084**	**+/-963**	**16,084**	**(X)**
Median nonfamily income (dollars)	45,565	+/-3,960	(X)	(X)
Mean nonfamily income (dollars)	53,589	+/-3,707	(X)	(X)
Median earnings for workers (dollars)	32,024	+/-806	(X)	(X)

Selected Economic Characteristics	Estimate	Margin of Error	Percent	Margin of Error
	47,262	+/-1,935	(X)	(X)
Median earnings for female full-time, year-round workers (dollars)	36,658	+/-2,396	(X)	(X)
PERCENTAGE OF FAMILIES AND PEOPLE WHOSE INCOME IN THE PAST 12 MONTHS IS BELOW THE POVERTY LEVEL				
All families	9.1%	+/-1.4	(X)	(X)
With related children under 18 years	13.2%	+/-2.0	(X)	(X)
With related children under 5 years only	10.4%	+/-4.0	(X)	(X)
Married couple families	4.0%	+/-1.0	(X)	(X)
With related children under 18 years	6.0%	+/-1.5	(X)	(X)
With related children under 5 years only	2.9%	+/-2.4	(X)	(X)
Families with female householder, no husband present	30.4%	+/-5.4	(X)	(X)
With related children under 18 years	36.1%	+/-6.3	(X)	(X)
With related children under 5 years only	49.8%	+/-20.9	(X)	(X)
All people	11.3%	+/-1.6	(X)	(X)
Under 18 years	17.8%	+/-2.9	(X)	(X)
Related children under 18 years	17.6%	+/-3.0	(X)	(X)
Related children under 5 years	21.2%	+/-4.3	(X)	(X)
Related children 5 to 17 years	15.9%	+/-3.1	(X)	(X)
18 years and over	8.3%	+/-1.2	(X)	(X)
18 to 64 years	8.1%	+/-1.2	(X)	(X)
65 years and over	10.8%	+/-4.1	(X)	(X)
People in families	10.5%	+/-1.7	(X)	(X)
Unrelated individuals 15 years and over	15.9%	+/-3.1	(X)	(X)

Source: U.S. Census Bureau, 2006-2008 American Community Survey

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

Notes:
·Employment and unemployment estimates may vary from the official labor force data released by the Bureau of Labor Statistics because of differences in survey design and data collection. For guidance on differences in employment and unemployment estimates from different sources go to Labor Force Guidance.
·Workers include members of the Armed Forces and civilians who were at work last week.
·Occupation codes are 4-digit codes and are based on Standard Occupational Classification 2000.
·Industry codes are 4-digit codes and are based on the North American Industry Classification System 2002 and 2007. The 2006 and 2007 ACS data are coded using NAICS 2002 while the 2008 ACS data use NAICS 2007 codes. Categories that differ between 2002 and 2007 NAICS are aggregated so that the 3 years of data are consistent in display and reflect the NAICS 2007 codes. The Industry categories adhere to the guidelines issued in Clarification Memorandum No. 2, "NAICS Alternate Aggregation Structure for Use By U.S. Statistical Agencies," issued by the Office of Management and Budget.
·While the 2008 American Community Survey (ACS) data generally reflect the November 2007 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities. The 2008 Puerto Rico Community Survey (PRCS) data generally reflect the November 2007 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in PRCS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.
·Estimates of urban and rural population, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2000 data. Boundaries for urban areas have not been updated since Census 2000. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

Explanation of Symbols:
1. An '**' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
4. An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
5. An '***' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available. Selected earnings and income data are not available for certain geographic areas due to problems with group quarters data collection and imputation. See the ACS User Notes for details.

City of Aurora, Illinois		
General Headroom Necessary to Reach WSEH based upon EPA 832-B-97-004		
Nov. 6, 2009; Revised Nov. 13; Revised Dec. 8; Revised March 2, 2010		
BGJ		
Description	**Monthly Service Charge**	**Comments**
Wastewater Treatment	$25.51	Based upon 7,800 gallons per month (FMWRD) at $3.27/1000 gallons
Wastewater Collection & Conveyance	$8.45	Based upon 7,800 gallons per month at $0.81/100 cubic feet (COA)
Stormwater	$3.45	100% of fee applied to CSO abatement. Flat fee per month. (COA)
SubTotal Existing Service Charge per month for Residential Customer	**$37.41**	**2% of MHI = $104.36per month = WSEH.** Existing wastewater/stormwater service charge = 0.72% MHI
Add Aurora's prorata cost of future WWTP projects based upon growth, routine O&M, and anticipated regulatory mandates	$39.97	Convert 2009-2029 costs (estimated at $238,700,000 by FMWRD) to COA service fees necessary to eliminate debt using 6.5% intrest rate and 20-year bond repayment schedule; 45,187 residential customers = 0.77% MHI.
Add cost of known COA Wastewater/Stormwater Projects outside LTCP based upon growth, routine O&M and anticipated regulatory mandates	$6.86	Convert costs ($40,978,000 from 2009 to 2029) to service fees necessary to eliminate debt using 6.5% intrest rate and 20-year bond repayment schedule; 45,187 residential customers = 0.13% MHI
Total LTCP Baseline Wastewater Service Charge	**$84.24**	Existing service fees + future non-CSO Abatement Program costs = 1.61% MHI
Monthly Service Charge Available to Fund LTCP Before WSEH Reached	$20.12	$104.36 - $84.24
Total Project Dollars Available for LTCP Before Reaching WSEH	**$120,153,600**	$20.12 Monthly Service Charge Available x 12 months/year x 45,187 residential customers divided by $90,800. $90,800 is the annual debt service to leverage $1,000,000 at 6.5% for 20 years.

City of Aurora LTCP										
Future Wastewater Related Costs										
8 Dec. 2009										
Project No.	**Project Name**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014-2019**	**2020-2029**	**Total Project Costs**	**CSO/Wastewater Pro Rata Share**
A038	Waubonsee IGA		$152,000						$ 152,000	$152,000
B010	BGI Committee Projects		$200,000	$200,000	$200,000	$200,000	$1,000,000	$2,000,000	$ 3,800,000	$950,000
B032	Elmwood/Rathbone Storm Sewers				$150,000	$2,000,000	$2,250,000		$ 4,400,000	$4,400,000
GB032	Prairie St./N. Ave Improvements					$370,000	$1,200,000		$ 1,570,000	$261,225
GB034	Sheffer Rd - Church to Farnsworth					$500,000	$2,500,000		$ 3,000,000	$956,250
GB037	Fransworth Ave. - E. New York to 5th						$3,870,000		$ 3,870,000	$1,620,000
A022	Expanded Down Town Sewer	$115,000							$ 115,000	$115,000
B016	Stormwater Study Zone #2	$900,000							$ 900,000	$900,000
B020	Basin 12				$175,000	$2,625,000	$3,000,000		$ 5,800,000	$5,800,000
B021	Basin 24				$75,000	$1,175,000	$1,000,000		$ 2,250,000	$2,250,000
B034	Basin 4					$200,000	$1,600,000		$ 1,800,000	$1,800,000
B036	Green Infrastructure	$220,000	$300,000						$ 520,000	$520,000
B037	Storm Sewer Extensions in CSS		$200,000	$200,000	$200,000	$200,000	$1,000,000	$2,000,000	$ 3,800,000	$3,800,000
B038	NPDES Phase II Compliance		$15,000	$15,000	$15,000	$15,000	$75,000	$1,000,000	$ 1,135,000	$1,120,000
B040	Sewer Separation Basin 13; Phase 2		$444,300						$ 444,300	$444,300
B041	Sewer Separation Basin 13; Phase 3		$2,297,500						$ 2,297,500	$2,297,500
B042	Sewer Separation Basin 6		$1,891,800						$ 1,891,800	$1,891,800
IB018	Sanitary Sewer Evaluation and Repair		$100,000	$200,000	$200,000	$200,000	$1,000,000	$10,000,000	$ 11,700,000	$11,700,000
	Total Future Project Costs								**$ 49,445,600**	**$40,978,075**
Notes to Support Future Residential Fee Impact:										
1. Assume interest rate at 6.5 % for a bond life of 20 years										
2. At that rate, debt reduction of $90,800 per year for each $1 Million of debt										
3. Number of Residential Wastewater Accounts = 45,187										
$40.978 x $90,800 = $3,720,802 per year for debt service = $310,067 per month/45,187 residential accounts = **$6.86 per month per residential wastewater account**										

City of Aurora, Illinois		
Metrics for Use in Developing the FCA		
11/2/2009; Revised Dec. 8, 2009; Revised March 2, 2010		
BGJ		
Description	**Value**	**Comments**
Median Household Income	$62,613	2008 Census Bureau Estimated MHI inflated to 2009 using BLS calculator
Population	182,638	Claritas 2009; official 2006 census was 164,681
COA Unemployment Rate	12.2%	(COA) 9.8 % National Average as of October 2009
Total Wastewater Accounts	48,167	FMWRD
Total Residential Accounts	45,187	COA
Average Wastewater/Stormwater Bill per month	$37.41	Wastewater Treatment Cost = $25.51 based upon 7,800 gallons per month (FMWRD). Wastewater conveyance costs = $8.45 based upon 7,800 gallons per month (COA). Stormwater Costs is flat $3.45 per month (COA).
Bond Rating	AA +	COA Finance Dept.
Total Debt	$661,515,335	Series 2004A Bonds $11,186,259; Series 2004B Bonds $6,571,955; IEPA 2001 Loan $2,057,212; Series 2006 Bond $4, 089,588; Series 2006 Downtown Separation Bond $34,361,274; Series 2006 Expanded Downtown Separation Bond $17, 031,007; IEPA ARRA 2010 Loan $3,353,511; $171,575,000 General Obligation Bonds; $411, 289,529 Overlapping Debt. *** (COA 2009 Budget Documents pages 191, 192, and 204).
Full Market Property Value	$13,036,883,847	3 Times Equalized Assessed Value (COA)
Property Tax Collection rate	101.49%	Includes Back Taxes and Penalties (COA)
Property Tax Revenues	$77,684,000	COA 2009 Budget Document
Note: Overlapping Debt* **	**COA Share**	
School District 101	$9,646,650	
School District 129	$62,418,483	
School District 131	$90,559,338	
School District 200	$774	
School District 204	$110,565,585	
School District 302	$3,720,712	
School District 308	$3,977,697	
Community College 502	$6,388,804	
Community College 516	$14,419,152	
DuPage County	$9,162,816	
Kane County	$9,890,430	
DuPage Forest Preserve	$9,983,689	
Kane County Forest Preserve	$32,095,312	
Batavia Library 1998 Bond	$30,080	
Batavia Library 1999 Bond	$23,500	
Batavia Park District	$477,222	
Fox Valley Park District	$47,730,389	
Naperville Park District	$197,513	
Warrenville Park District	$1,383	
Total Overlapping Debt	$411,289,529	

City of Aurora Current Debt Load Repaid by Wastewater/Stormwater Fees
Based upon Data Provided by Finance Director on Feb. 1, 2010
2 Feb. 2010

YEAR	SERIES 2004A	SERIES 2004B	IEPA LOAN 2001	SERIES 2006 STORMWATER	SERIES 2006 DOWNTOWN SEPARATION	SERIES 2006 EXPANDED DOWNTOWN SEPARATION	IEPA ARRA LOAN 2010	TOTALS
2010	$744,056	$741,075	$178,888	$242,338	$1,235,594	$609,081	$159,691	$3,910,723
2011	$740,569	$734,725	$178,888	$242,450	$1,230,794	$611,881	$159,691	$3,898,998
2012	$740,694	$731,688	$178,888	$242,350	$1,235,594	$614,281	$159,691	$3,903,186
2013	$743,294	$731,737	$178,888	$241,725	$1,239,594	$616,281	$159,691	$3,911,210
2014	$744,194	$731,087	$178,888	$240,875	1,242,794	$617,881	$159,691	$3,915,410
2015	$745,194	$724,737	$178,888	$239,800	$1,245,194	$619,081	$159,691	$3,912,585
2016	$740,394	$722,081	$178,888	$238,500	$1,246,794	$619,881	$159,691	$3,906,229
2017	$744,994	$732,894	$178,888	$241,975	$1,247,594	$620,281	$159,691	$3,926,317
2018	$743,594	$721,931	$178,888	$240,000	$1,257,594	$620,281	$159,691	$3,921,979
2019	$746,394		$178,888	$237,800	$1,260,731	$624,556	$159,691	$3,208,060
2020	$748,194		$178,888	$240,375	$1,262,144	$627,869	$159,691	$3,217,161
2021	$748,238		$89,444	$237,500	$1,267,494	$625,544	$159,691	$3,127,911
2022	$751,462			$239,400	$1,265,044	$627,044	$159,691	$3,042,641
2023	$752,588			$240,850	$1,271,469	$627,869	$159,691	$3,052,467
2024	$752,400			$241,350	$1,266,319	$628,019	$159,691	$3,047,779
2025				$241,375	$1,270,044	$627,494	$159,691	$2,298,604
2026				$240,925	$1,277,194	$631,294	$159,691	$2,309,104
2027					$1,272,544	$634,194	$159,691	$2,066,429
2028					$1,281,544	$631,194	$159,691	$2,072,429
2029					$1,288,519	$637,519	$159,691	$2,085,729
2030					$1,293,469	$642,719	$159,691	$2,095,879
2031					$1,301,394	$641,794		$1,943,188
2032					$1,307,069	$649,969		$1,957,038
2033					$1,314,200	$651,150		$1,965,350
2034					$1,322,425	$655,500		$1,977,925
2035					$1,327,800	$658,425		$1,986,225
2036					$1,330,325	$659,925		$1,990,250
TOTALS	$11,186,259	$6,571,955	$2,057,212	$4,089,588	$34,361,274	$17,031,007	$3,353,511	$78,650,806