

**US Army Corps  
of Engineers®  
Chicago District**

---

**LAKE MICHIGAN  
DIVERSION ACCOUNTING  
WATER YEAR 1997  
ANNUAL REPORT**





## **EXECUTIVE SUMMARY**

This document is the Water Year (WY) 1997 Annual Report of the Chicago District, U. S. Army Corps of Engineers activities in the monitoring and review of the accounting of Lake Michigan diversion flows through Chicago, Illinois as directed by 1980 amendment to the U. S. Supreme Court Decree. Additionally, this report serves to summarize the Corps' major accomplishments with respect to the mission as mandated by the Water Resources Development Act of 1986, PL99-662, Section 1142. This act gave the Corps complete responsibility for diversion accounting effective 1 October 1987. This report provides an overview and audit of flow measurements and accounting computed by the Corps of Engineers for WY 1996, 1 October 1995 through 30 September 1996.

The Lake Michigan Diversion Accounting Report for WY 1996 has been completed. The State of Illinois diverted 3,108 cfs during WY 1996. This diversion is 92 cfs less than the 3,200 cfs 40 year average diversion specified in the modified decree. The running average of the diversion for WY 1981 through WY 1996 is 3,418 cfs, or 218 cfs over the annual allocation. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation is now -3,493 cfs-years. The negative sign indicates a cumulative flow deficit. The maximum allowable cumulative flow deficit specified in the decree is 2,000 cfs-years.



**Table of Contents**

**EXECUTIVE SUMMARY..... I**

**INTRODUCTION..... 1**

**AUTHORITY FOR REPORT ..... 1**

**HISTORY OF THE DIVERSION ..... 1**

**SIGNIFICANT HYDROLOGIC EVENTS ..... 5**

**STATUS OF ACCOUNTING REPORTS..... 5**

**SOURCES OF DIVERSION..... 6**

**ACCOUNTING PROCEDURES ..... 7**

**DIVERSION COMPUTATION ..... 7**

**DIVERSION BUDGET CHECKS ..... 8**

**ACTIVITIES FOR FY 1997 ..... 9**

**ACTIVITIES FOR FY 1998 – FY2000..... 9**

**ACCOUNTING REPORTS..... 10**

**SUMMARY AND CONCLUSIONS ..... 10**

**SUMMARY..... 10**

**CONCLUSIONS..... 10**

**Table of Figures and Tables**

**FIGURE 1 DEVELOPMENT OF THE CHICAGO SANITARY AND SHIP CANAL SYSTEM..... 3**

**FIGURE 2 LOCATION PLAN - LAKE MICHIGAN DIVERSION AT CHICAGO..... 4**

**TABLE 1 WY 1996 MONTHLY AND ANNUAL PRECIPITATION (INCHES)..... 5**

**TABLE 2 STATUS OF THE STATE OF ILLINOIS DIVERSION ..... 6**

**List of Appendices**

**APPENDIX A: WY 1996 LAKE MICHIGAN DIVERSION ACCOUNTING REPORT**



## **INTRODUCTION**

The diversion of water from the Lake Michigan watershed is important to the Great Lake states and to the Canadian province of Ontario. The states and province that border the Great Lakes have concerns with diversions during periods of low lake levels and the long term effects of diversion. To insure these concerns are considered, the U.S. Army Corps of Engineers is responsible for the accounting of flow diverted from the Lake Michigan watershed.

The Water Year (WY) 1997 Annual Report on Lake Michigan Diversion Accounting presents activities by the Corps of Engineers in accounting for the diversion from Lake Michigan by the State of Illinois. The accounting of the diversion is performed according to the guidelines established in the 1980 modified U.S. Supreme Court Decree concerning the diversion.

Presented in this report is the history of the diversion and its accounting, the certification of WY 1996 diversion flows, a description of the sources of the diversion, a description of the accounting procedures, and a summary of all significant activities that occurred during WY 1997.

## **AUTHORITY FOR REPORT**

Under the provisions of the U.S. Supreme Court Decree in the Wisconsin, et al v. Illinois et al, 388 U.S. 426, 87 S.Ct. 1774 (1967) as modified by 449 U.S. 48, 101 S. CT. 557 (1980), the Corps of Engineers monitors the measurement and computation Lake Michigan diversion by the State of Illinois. The terms of the modified decree require the Corps of Engineers to prepare an annual report on the accounting of the Lake Michigan water diverted by the State of Illinois and actions taken by the involved agencies.

## **HISTORY OF THE DIVERSION**

Water has been diverted from Lake Michigan at Chicago into the Mississippi River Watershed since the completion of the Illinois and Michigan (I & M) Canal in 1848. At that time, the diversion averaged about 500 cubic feet per second (cfs). The I & M Canal was built primarily to serve transportation needs by providing a connecting watercourse between the Great Lakes and the Mississippi River system.

With the development of the Chicago metropolitan area, sewer and drainage improvements led to severe sanitation problems in the mid to late 1800's. The newly constructed sewers moved water and wastes into the Chicago River, which until 1900 drained to Lake Michigan. The water quality of Lake Michigan deteriorated and contaminated the city's primary water supply.

A second problem that occurred during this time period was an increase in the overbank flooding within the city. As more roads were built and buildings constructed, the sewer system was correspondingly expanded. The increase in impervious area

from the newly constructed roads and buildings increased the rate and volume of stormwater runoff and resulted in increased flooding.

As a solution to the sanitation and flooding problems, construction of the Chicago Sanitary and Ship Canal (CSSC) was undertaken. Construction of the CSSC allowed the flow direction of the Chicago River to be reversed (Figure 1). Construction of the Chicago Sanitary and Ship Canal was completed in 1900 by the MWRDGC. The CSSC followed the course of the older I & M Canal. The CSSC is much larger than the I & M canal and can handle the Chicago River flow, as well as increased shipping. In the 1930's, the Chicago River Controlling Works (CRCW) was constructed at the mouth of the Chicago River. The CRCW regulates the amount of Lake Michigan water allowed to pass into the river and restricts river flooding from entering Lake Michigan. The Lockport Lock and Dam controls the water level in the CSSC.

Between 1907 and 1910, the MWRDGC constructed a second canal called the North Shore Channel. It extended from Lake Michigan at Wilmette in a southerly direction 6.14 miles to the north branch of the Chicago River. The Wilmette Pumping Station, also known as the Wilmette Controlling Works, regulates the amount of Lake Michigan flow allowed down the channel through the use of one vertical lift gate.

Construction of a third canal, the Calumet Sag Channel, was completed in 1922. The canal connects Lake Michigan through the Grand Calumet River, to the CSSC. The Calumet Sag Channel was constructed to carry sewage from South Chicago, Illinois and East Chicago, Indiana. The Blue Island Lock and Dam controlled flow through the canal. The O'Brien Lock and Dam, which replaced the Blue Island Lock and Dam, was completed in 1967 and is located on the Calumet River. The O'Brien Lock and Dam regulates the flow of Lake Michigan waters down the Calumet Sag Channel. Figure 2 shows the affected watershed.

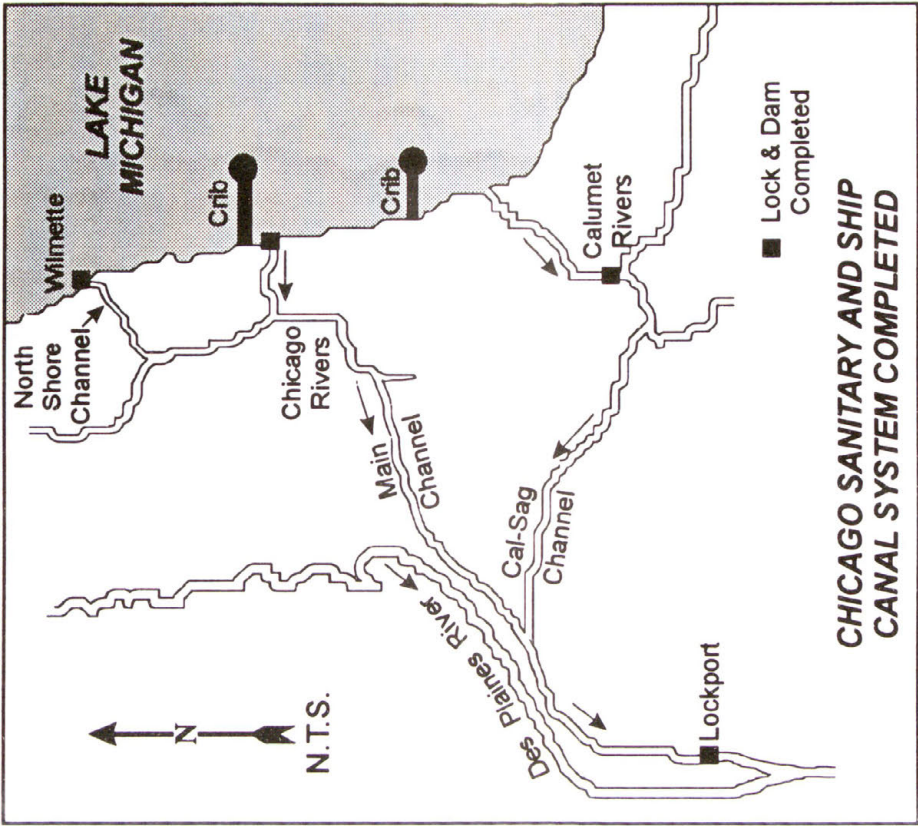
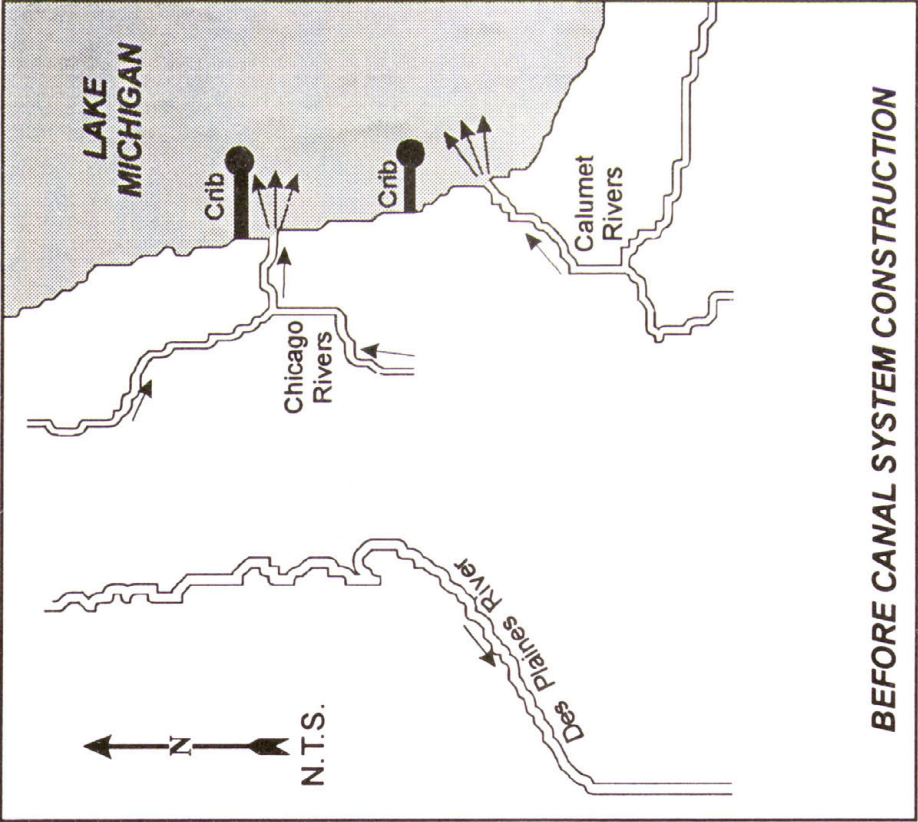


FIGURE 1 DEVELOPMENT OF THE CHICAGO SANITARY AND SHIP CANAL SYSTEM

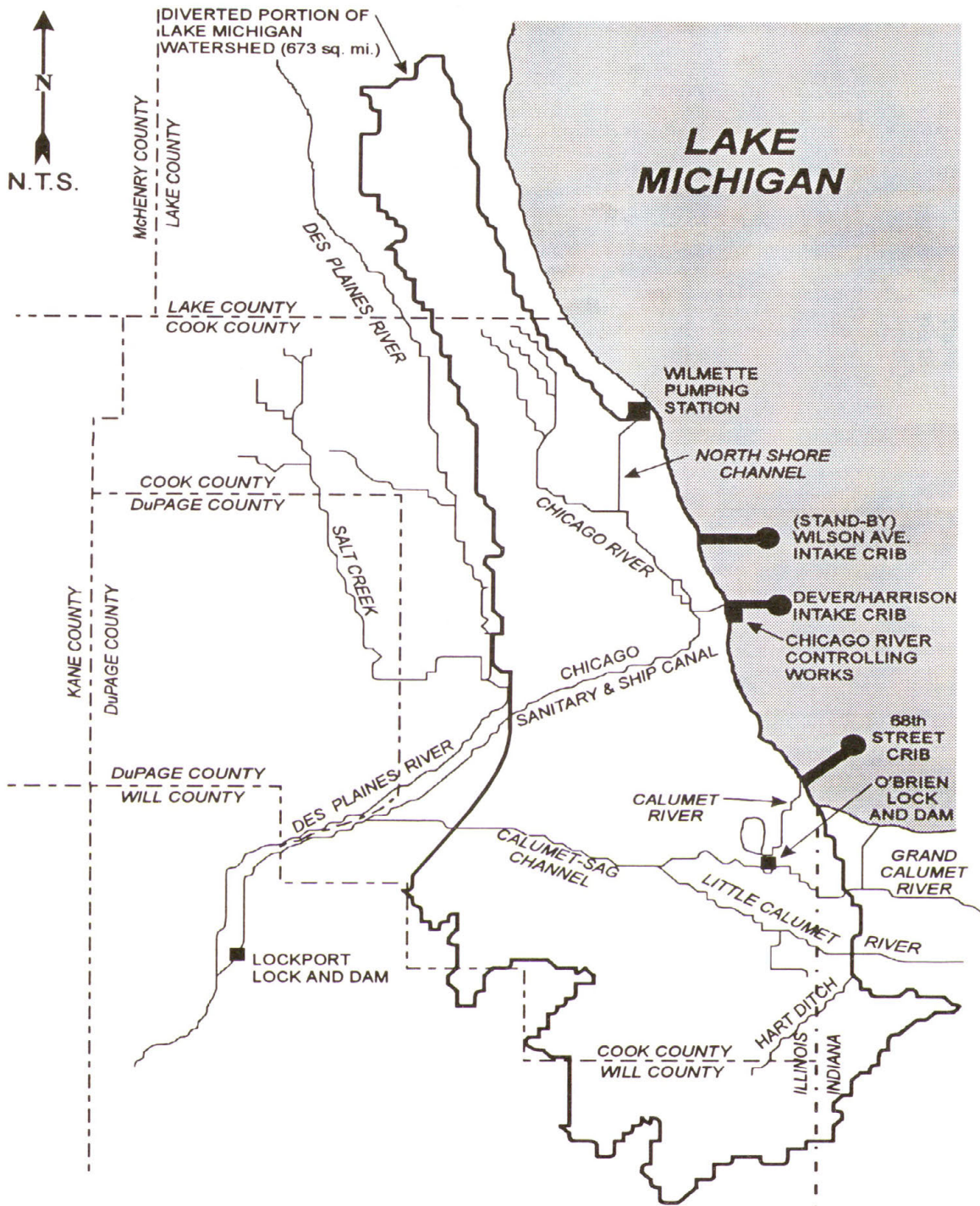


FIGURE 2 LOCATION PLAN - LAKE MICHIGAN DIVERSION AT CHICAGO

## **SIGNIFICANT HYDROLOGIC EVENTS**

During WY 1997, a total of 31.01 inches of precipitation fell at the National Weather Service (NWS) O'Hare Weather Station. This recorded precipitation for WY 1997 is 13% less than the long term (1951-1990) average of 35.82 inches. The recorded monthly rainfall data during WY 1997, and the deviation from long term annual and monthly average precipitation, are tabulated in Table 1.

TABLE 1 WY 1997 MONTHLY AND ANNUAL PRECIPITATION (INCHES)  
National Weather Service, O'Hare Weather Station

<u>Month</u>	<u>1951 - 1990 Average</u>		<u>Deviation</u>	<u>Percent of Average</u>
	<u>Precipitation</u>	<u>Precipitation</u>		
Oct-96	2.32	2.41	-0.09	96%
Nov-96	1.48	2.92	-1.44	51%
Dec-96	1.21	2.47	-1.26	49%
Jan-97	1.38	1.53	-0.15	90%
Feb-97	5.56	1.36	4.20	409%
Mar-97	1.57	2.69	-1.12	58%
Apr-97	1.76	3.64	-1.88	48%
May-97	2.69	3.32	-0.63	81%
Jun-97	3.81	3.78	0.03	101%
Jul-97	3.04	3.66	-0.62	83%
Aug-97	4.50	4.22	0.28	107%
Sep-97	1.69	3.82	-2.13	44%
Annual	31.01	35.82	-4.81	87%

## **STATUS OF ACCOUNTING REPORTS**

Lake Michigan diversion flow data is summarized in accounting reports prepared on an annual basis as flows are certified. Since implementation of the modified Supreme Court Decree of 1 December 1980 and before this report, the Corps of Engineers has certified diversion flows for WY 1981 through WY 1995. The WY 1996 Lake Michigan Diversion Accounting Report is certified and included as appendix A of this Water Year 1997 Annual Report. The State of Illinois diverted 3,108 cfs during WY 1996. This diversion is 92 cfs less than the 3,200 cfs 40 year average diversion specified in the 1980 modified decree. Table 2 shows the accounting year, the certified flows, the running average flows, and the cumulative deviation from the allowable diversion of 3,200 cfs.

The running average diversion for the period WY 1981 through WY 1996 is 3,418 cfs, 218 cfs greater than the 3,200 cfs 40 year average diversion specified by the modified decree. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation, the sum of the differences between the annual average flows and 3,200 cfs, is -3,493 cfs-years. The negative cumulative deviation indicates a cumulative flow deficit. The decree specifies a maximum allowable deficit of 2,000 cfs- years over the first 39 years of the 40 year averaging period.

Data collection and preparation, diversion computation, and report writing for the WY 1996 accounting report was performed by the Corps. Data collection and preparation for this report began in Fiscal Year (FY) 1997. Certification of the WY 1997 accounting report is scheduled for FY 2000.

TABLE 2 STATUS OF THE STATE OF ILLINOIS DIVERSION  
Under the 1980 modified U.S. Supreme Court Decree

<u>Accounting Year</u>	<u>Certified Flow (cfs)</u>	<u>Running Average (cfs)</u>	<u>Cumulative Deviation (cfs)</u>
1981	3,106	3,106	94
1982	3,087	3,097	207
1983	3,613	3,269	-206
1984	3,432	3,310	-438
1985	3,472	3,342	-710
1986	3,751	3,410	-1,261
1987	3,774	3,462	-1,835
1988	3,376	3,451	-2,011
1989	3,378	3,443	-2,189
1990	3,531	3,452	-2,520
1991	3,555	3,461	-2,875
1992	3,409	3,457	-3,084
1993	3,841	3,487	-3,725
1994	3,064	3,456	-3,589
1995	3,197	3,439	-3,586
1996	3,108	3,418	-3,493

## **SOURCES OF DIVERSION**

The Lake Michigan diversion consists of three primary components. These components are domestic pumpage from Lake Michigan used for water supply and not returned to Lake Michigan, stormwater runoff from the diverted Lake Michigan watershed, and direct diversions through the three lakefront control structures.

Domestic pumpage from Lake Michigan is used for water supply and its effluent is discharged to the canals by various Water Reclamation Plants (WRP's). Currently, the WRP's that divert domestic pumpage from the lake either discharge to the canal system or to the Des Plaines River and its tributaries. In the future as more communities convert to Lake Michigan water supply, water supply effluent may also be discharged to the Fox River. The Fox River is approximately 35 miles west of downtown Chicago.

Stormwater runoff that previously drained to Lake Michigan through the Chicago River and the Calumet River now drains to the Chicago Sanitary and Ship Canal (CSSC) and the Calumet Sag Channel, respectively. The Calumet Sag Channel drains to the CSSC, and the CSSC ultimately drains into the Illinois River and the Mississippi River. The drainage area of the diverted Lake Michigan watershed is approximately 673 square miles.

Direct diversion locations are at the Chicago River Controlling Works (CRCW), the O'Brien Lock and Dam, and the Wilmette Controlling Works. These controlling structures are located downtown, at the south end, and at the north end of the Chicago area, respectively.

The direct diversion consists of four components; lockage, discretionary flow, navigation makeup flow, and leakage. The lockage component is the flow used in locking vessels to and from the lake. The purpose of the discretionary diversion is to dilute effluent from sewage discharges. When large storms are forecast, the canal is drawn down before the storm to prevent flooding. If the runoff is not enough to refill the canal, navigation makeup water is passed. The leakage component is water estimated to pass, in an uncontrolled way, through or around the lakefront structures.

## **ACCOUNTING PROCEDURES**

Diversion accounting uses both measured and estimated flows. A series of hydrologic and hydraulic computer models use various meteorological data to simulate flows not measured. These simulated flows as well as measured flows are used to compute the diversion. Along with the diversion calculation, a number of water budgets verify simulated flows and estimate the reliability of the computed diversion.

## **DIVERSION COMPUTATION**

An acoustic velocity meter (AVM) was installed and has been operating at Romeoville (five miles upstream of the Lockport Powerhouse and three miles upstream of the Lockport Controlling Works) since 12 June 1984. The AVM directly measures total flow through the canal above both the Powerhouse and the Controlling Works. The overwhelming majority of the Lake Michigan diversion and some non-Lake Michigan flows pass through the AVM. The diversion accounting procedure uses the flow measured at Romeoville and deducts flows not accountable in the diversion.

Diversion flows which bypass Lockport are added to yield the net computed diversion of water from Lake Michigan. This procedure represents the accounting technique as required by the modified Supreme Court Decree.

The flow measured at Romeoville was approximately 102% of the annual diversion during WY 1996. Approximately 92% of the diverted water was measured by the AVM during WY 1996. This portion of the diversion measured at the AVM is being reduced due to the influx of western suburbs using Lake Michigan water as their primary domestic water supply source. Most of these new users of Lake Michigan water do not discharge their sewage effluent to the canal system. As more communities are added, more water will be discharged outside the canal system, further lowering the percentage measured by the AVM.

Deductions from the Romeoville AVM flow include runoff from 217 square miles of the Des Plaines River watershed discharged to the canal, groundwater supply effluent and groundwater seepage into the Tunnel and Reservoir Plan (TARP) tunnels discharged to the canal, and Indiana water supply discharged to the canal through the Calumet River system and the Calumet Sag Channel (see figure 2 for locations). The computer models of the Des Plaines watershed area estimate the runoff deduction. The groundwater pumpage deductions are obtained directly from pumping records. The Indiana water supply is computed from pumping records and a calculation to determine the portion of the water supply draining west to the Calumet Sag Channel.

The additions for diversion flow that do not flow through Romeoville are primarily Lake Michigan water supply pumpage effluent treated and released to the Des Plaines River or its tributaries. This flow is obtained directly through pumping records of the communities involved and accounts for approximately 8% of the diversion in WY 1996. As more communities convert to Lake Michigan water supply, the percentage will increase.

## **DIVERSION BUDGET CHECKS**

Water budgets verify those flows not measured. Most of the budgets compare simulated flows to recorded flows and these comparisons indicate the accuracy of the diversion accounting. The four primary budgets are the budgets for the three major Water Reclamation Plants (WRP's) that serve the area involved in diversion accounting and the canal balance budget for the CSSC. The Upper Des Plaines pump station budget will also become a significant budget after measurement problems are resolved. The remaining budgets estimate runoff from stream gaged areas in the Lake Michigan watershed or are budgets of non-simulated flows such as water supply pumpage. The budgets were discussed in detail in the WY 1996 accounting report.

## **ACTIVITIES FOR FY 1997**

The activities for FY 1997 centered on the WY 1995 diversion accounting modeling and initiating the data collection and input activities for the WY 1996 analysis. In addition, work began on the changes to the TNET files for the Calumet tunnel. Christopher Burke Engineering, Ltd. was hired by the Corps to review the model to ensure consistency with the as-built plans for the Calumet tunnel system and its dropshafts. They were also tasked with updating the TNET model to account for the new Calumet tunnel legs that went on-line during WY 1996. In-house, the Corps began the change over from computing solar radiation data using O'Hare meteorologic data to using the measured solar radiation data collected at Argonne National Labs. This change was necessary due to a change in how O'Hare collected and reported its cloud cover that occurred in February 1996. The changes to the TNET modeling and solar radiation are detailed in the WY 1996 accounting report attached herein. The efforts relating to the changes to the Calumet modeling and the computation of the solar radiation were carried over into FY 1998 and FY 1999 and were a primary reason for the delay in the release of the WY 1996 accounting report.

In addition to the activities listed above, ongoing work related to the potential switch to lakefront accounting continued. This work included:

- The USGS work with the lakefront gages at the Chicago River Controlling Works and O'Brien Lock and Dam.
- Ongoing mediation activities related to the Great Lakes Mediation Committee that was initiated in December 1995 including technical support and detailed analyses of long-term runoff and consumptive use values.
- The U.S. Water Conservation Laboratory detailed QA/QC analysis of three pumping stations.

## **ACTIVITIES FOR FY 1998 – FY2000**

The efforts in FY 1998 focused on completing the WY 1995 accounting report, initiating the data input for the WY 1996 accounting report, and contracting efforts related to establishing the Fourth Technical Committee. In addition the lakefront activities listed above for FY 1997 continued in FY 1998.

The activities in FY 1999 focused on completing the WY 1996 accounting report, coordination of activities related to the Fourth Technical Committee, and ongoing mediation activities related to the Great Lakes Mediation Committee. In addition the lakefront activities listed above for FY 1997 continued in FY 1999. A contract was initiated for work on a detailed QA/QC of ten primary water supply diverters in Chicago and five in the northern Chicago suburbs. The Corps also completed a hydraulic analysis of various alternatives for Navigation Makeup Reduction.

The efforts in FY 2000 will include initiation and completion of the WY 1997 accounting report. Lakefront accounting for WY 1997 will also be initiated in FY 2000. Corps activities continue in support of the Great Lakes Mediation Committee including

technical support. The previously completed studies on long-term runoff and consumptive use provided the technical basis of an agreement between the states to potentially move the accounting process to the lakefront. The long-term runoff and consumptive use studies have been released in draft form and will be finalized in FY 2000 and be included in a final format with the Water Year 1999 Annual Report (release scheduled for early FY 2001). The Fourth Technical Committee will provide its final report to the Corps during FY 2000 which will be included in the WY 1998 Annual Report. In addition, activities related to the potential move to lakefront accounting have continued in FY 1998 through FY 1999 and will continue through FY 2000. Finally, the Corps and the State of Illinois are negotiating the agreement to execute a one-year demonstration study to look at the impacts of a change to the existing Navigation Makeup operations in an effort to reduce this component of diversion. The physical study is slated for FY 2001 and will potentially lead to a change in the Code of Federal Regulations.

## **ACCOUNTING REPORTS**

The accounting report for WY 1995 was completed in FY 1998 and distributed at the beginning of FY 1999. The accounting report for WY 1996 was completed in FY 2000 and the accounting report for WY 1997 will be completed in FY 2000. Thereafter, additional accounting reports are expected to be completed in the second fiscal year following the end of the water year for which the diversion is computed.

## **SUMMARY AND CONCLUSIONS**

### **SUMMARY**

The Lake Michigan Diversion Accounting procedure continues to evolve and improve. Further improvements are being implemented. A comprehensive diversion accounting manual is being completed during FY 2000 to include all the improvements. This manual will be included in the WY 1998 Annual Report. Progress continues to be made on the Lakefront Accounting activities.

### **CONCLUSIONS**

The Lake Michigan Diversion Accounting Report for WY 1996 has been completed as required by the Supreme Court Decree. The State of Illinois diverted 3,108 cfs during WY 1996. These flows are 92 cfs less than the 3,200 cfs limit specified in the decree. The running average of the diversion for WY 1981 through WY 1996 is 3,418 cfs, or 218 cfs over the annual allocation. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation is now -3,493 cfs-years. The negative sign indicates a cumulative flow deficit. The maximum allowable cumulative flow deficit specified in the decree is 2,000 cfs-years.

**APPENDIX A**  
**LAKE MICHIGAN DIVERSION ACCOUNTING**  
**WATER YEAR 1996 REPORT**



## **EXECUTIVE SUMMARY**

This document is the Water Year (WY) 1997 Annual Report of the Chicago District, U. S. Army Corps of Engineers activities in the monitoring and review of the accounting of Lake Michigan diversion flows through Chicago, Illinois as directed by 1980 amendment to the U. S. Supreme Court Decree. Additionally, this report serves to summarize the Corps' major accomplishments with respect to the mission as mandated by the Water Resources Development Act of 1986, PL99-662, Section 1142. This act gave the Corps complete responsibility for diversion accounting effective 1 October 1987. This report provides an overview and audit of flow measurements and accounting computed by the Corps of Engineers for WY 1996, 1 October 1995 through 30 September 1996.

The Lake Michigan Diversion Accounting Report for WY 1996 has been completed. The State of Illinois diverted 3,108 cfs during WY 1996. This diversion is 92 cfs less than the 3,200 cfs 40 year average diversion specified in the modified decree. The running average of the diversion for WY 1981 through WY 1996 is 3,418 cfs, or 218 cfs over the annual allocation. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation is now -3,493 cfs-years. The negative sign indicates a cumulative flow deficit. The maximum allowable cumulative flow deficit specified in the decree is 2,000 cfs-years.



## Table of Contents

<b>EXECUTIVE SUMMARY.....</b>	<b>I</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>AUTHORITY FOR REPORT .....</b>	<b>1</b>
<b>HISTORY OF THE DIVERSION .....</b>	<b>1</b>
<b>SIGNIFICANT HYDROLOGIC EVENTS .....</b>	<b>5</b>
<b>STATUS OF ACCOUNTING REPORTS.....</b>	<b>5</b>
<b>SOURCES OF DIVERSION.....</b>	<b>6</b>
<b>ACCOUNTING PROCEDURES .....</b>	<b>7</b>
<b>DIVERSION COMPUTATION .....</b>	<b>7</b>
<b>DIVERSION BUDGET CHECKS .....</b>	<b>8</b>
<b>ACTIVITIES FOR FY 1997 .....</b>	<b>9</b>
<b>ACTIVITIES FOR FY 1998 – FY2000.....</b>	<b>9</b>
<b>ACCOUNTING REPORTS.....</b>	<b>10</b>
<b>SUMMARY AND CONCLUSIONS .....</b>	<b>10</b>
<b>SUMMARY.....</b>	<b>10</b>
<b>CONCLUSIONS.....</b>	<b>10</b>

## Table of Figures and Tables

<b>FIGURE 1 DEVELOPMENT OF THE CHICAGO SANITARY AND SHIP CANAL SYSTEM.....</b>	<b>3</b>
<b>FIGURE 2 LOCATION PLAN - LAKE MICHIGAN DIVERSION AT CHICAGO.....</b>	<b>4</b>
<b>TABLE 1 WY 1996 MONTHLY AND ANNUAL PRECIPITATION (INCHES).....</b>	<b>5</b>
<b>TABLE 2 STATUS OF THE STATE OF ILLINOIS DIVERSION .....</b>	<b>6</b>

## List of Appendices

<b>APPENDIX A: WY 1996 LAKE MICHIGAN DIVERSION ACCOUNTING REPORT</b>
--



## **INTRODUCTION**

The diversion of water from the Lake Michigan watershed is important to the Great Lake states and to the Canadian province of Ontario. The states and province that border the Great Lakes have concerns with diversions during periods of low lake levels and the long term effects of diversion. To insure these concerns are considered, the U.S. Army Corps of Engineers is responsible for the accounting of flow diverted from the Lake Michigan watershed.

The Water Year (WY) 1997 Annual Report on Lake Michigan Diversion Accounting presents activities by the Corps of Engineers in accounting for the diversion from Lake Michigan by the State of Illinois. The accounting of the diversion is performed according to the guidelines established in the 1980 modified U.S. Supreme Court Decree concerning the diversion.

Presented in this report is the history of the diversion and its accounting, the certification of WY 1996 diversion flows, a description of the sources of the diversion, a description of the accounting procedures, and a summary of all significant activities that occurred during WY 1997.

## **AUTHORITY FOR REPORT**

Under the provisions of the U.S. Supreme Court Decree in the Wisconsin, et al v. Illinois et al, 388 U.S. 426, 87 S.Ct. 1774 (1967) as modified by 449 U.S. 48, 101 S. CT. 557 (1980), the Corps of Engineers monitors the measurement and computation Lake Michigan diversion by the State of Illinois. The terms of the modified decree require the Corps of Engineers to prepare an annual report on the accounting of the Lake Michigan water diverted by the State of Illinois and actions taken by the involved agencies.

## **HISTORY OF THE DIVERSION**

Water has been diverted from Lake Michigan at Chicago into the Mississippi River Watershed since the completion of the Illinois and Michigan (I & M) Canal in 1848. At that time, the diversion averaged about 500 cubic feet per second (cfs). The I & M Canal was built primarily to serve transportation needs by providing a connecting watercourse between the Great Lakes and the Mississippi River system.

With the development of the Chicago metropolitan area, sewer and drainage improvements led to severe sanitation problems in the mid to late 1800's. The newly constructed sewers moved water and wastes into the Chicago River, which until 1900 drained to Lake Michigan. The water quality of Lake Michigan deteriorated and contaminated the city's primary water supply.

A second problem that occurred during this time period was an increase in the overbank flooding within the city. As more roads were built and buildings constructed, the sewer system was correspondingly expanded. The increase in impervious area

from the newly constructed roads and buildings increased the rate and volume of stormwater runoff and resulted in increased flooding.

As a solution to the sanitation and flooding problems, construction of the Chicago Sanitary and Ship Canal (CSSC) was undertaken. Construction of the CSSC allowed the flow direction of the Chicago River to be reversed (Figure 1). Construction of the Chicago Sanitary and Ship Canal was completed in 1900 by the MWRDGC. The CSSC followed the course of the older I & M Canal. The CSSC is much larger than the I & M canal and can handle the Chicago River flow, as well as increased shipping. In the 1930's, the Chicago River Controlling Works (CRCW) was constructed at the mouth of the Chicago River. The CRCW regulates the amount of Lake Michigan water allowed to pass into the river and restricts river flooding from entering Lake Michigan. The Lockport Lock and Dam controls the water level in the CSSC.

Between 1907 and 1910, the MWRDGC constructed a second canal called the North Shore Channel. It extended from Lake Michigan at Wilmette in a southerly direction 6.14 miles to the north branch of the Chicago River. The Wilmette Pumping Station, also known as the Wilmette Controlling Works, regulates the amount of Lake Michigan flow allowed down the channel through the use of one vertical lift gate.

Construction of a third canal, the Calumet Sag Channel, was completed in 1922. The canal connects Lake Michigan through the Grand Calumet River, to the CSSC. The Calumet Sag Channel was constructed to carry sewage from South Chicago, Illinois and East Chicago, Indiana. The Blue Island Lock and Dam controlled flow through the canal. The O'Brien Lock and Dam, which replaced the Blue Island Lock and Dam, was completed in 1967 and is located on the Calumet River. The O'Brien Lock and Dam regulates the flow of Lake Michigan waters down the Calumet Sag Channel. Figure 2 shows the affected watershed.

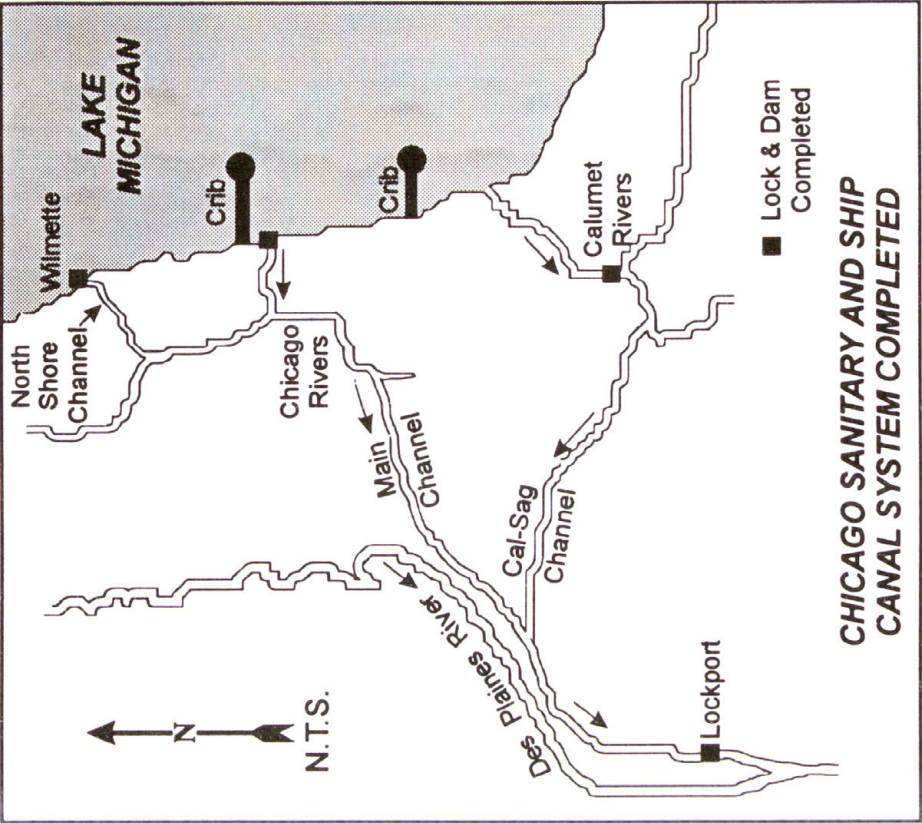
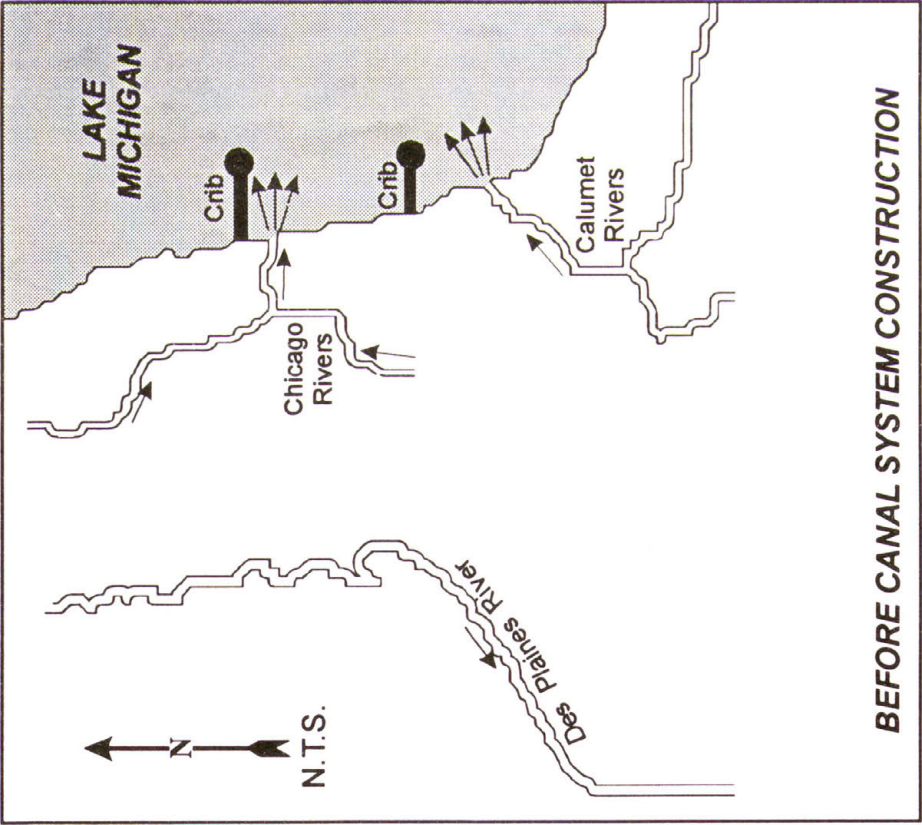


FIGURE 1 DEVELOPMENT OF THE CHICAGO SANITARY AND SHIP CANAL SYSTEM

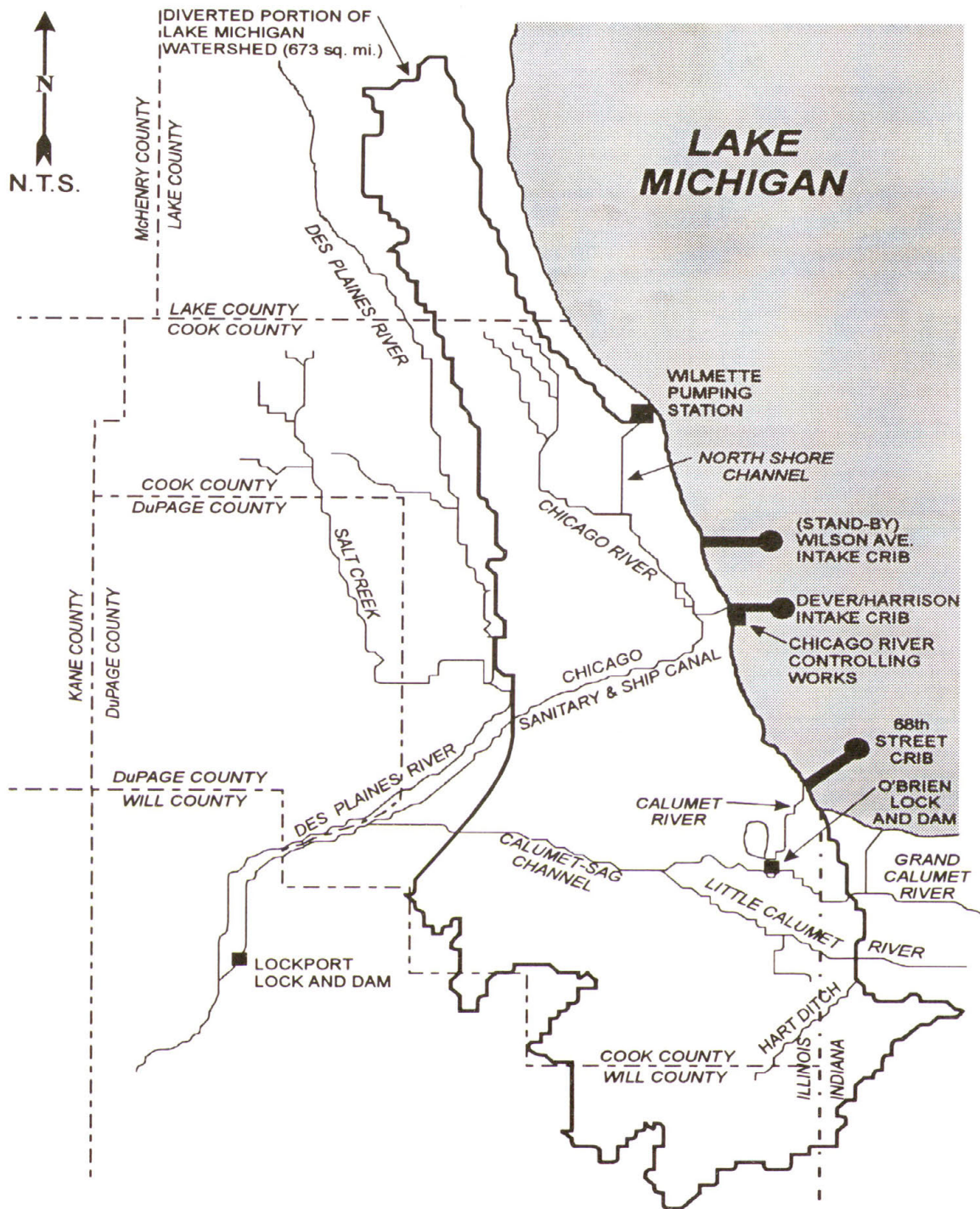


FIGURE 2 LOCATION PLAN - LAKE MICHIGAN DIVERSION AT CHICAGO

## **SIGNIFICANT HYDROLOGIC EVENTS**

During WY 1997, a total of 31.01 inches of precipitation fell at the National Weather Service (NWS) O'Hare Weather Station. This recorded precipitation for WY 1997 is 13% less than the long term (1951-1990) average of 35.82 inches. The recorded monthly rainfall data during WY 1997, and the deviation from long term annual and monthly average precipitation, are tabulated in Table 1.

TABLE 1 WY 1997 MONTHLY AND ANNUAL PRECIPITATION (INCHES)  
National Weather Service, O'Hare Weather Station

<u>Month</u>	<u>1951 - 1990 Average</u>		<u>Deviation</u>	<u>Percent of Average</u>
	<u>Precipitation</u>	<u>Precipitation</u>		
Oct-96	2.32	2.41	-0.09	96%
Nov-96	1.48	2.92	-1.44	51%
Dec-96	1.21	2.47	-1.26	49%
Jan-97	1.38	1.53	-0.15	90%
Feb-97	5.56	1.36	4.20	409%
Mar-97	1.57	2.69	-1.12	58%
Apr-97	1.76	3.64	-1.88	48%
May-97	2.69	3.32	-0.63	81%
Jun-97	3.81	3.78	0.03	101%
Jul-97	3.04	3.66	-0.62	83%
Aug-97	4.50	4.22	0.28	107%
Sep-97	1.69	3.82	-2.13	44%
Annual	31.01	35.82	-4.81	87%

## **STATUS OF ACCOUNTING REPORTS**

Lake Michigan diversion flow data is summarized in accounting reports prepared on an annual basis as flows are certified. Since implementation of the modified Supreme Court Decree of 1 December 1980 and before this report, the Corps of Engineers has certified diversion flows for WY 1981 through WY 1995. The WY 1996 Lake Michigan Diversion Accounting Report is certified and included as appendix A of this Water Year 1997 Annual Report. The State of Illinois diverted 3,108 cfs during WY 1996. This diversion is 92 cfs less than the 3,200 cfs 40 year average diversion specified in the 1980 modified decree. Table 2 shows the accounting year, the certified flows, the running average flows, and the cumulative deviation from the allowable diversion of 3,200 cfs.

The running average diversion for the period WY 1981 through WY 1996 is 3,418 cfs, 218 cfs greater than the 3,200 cfs 40 year average diversion specified by the modified decree. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation, the sum of the differences between the annual average flows and 3,200 cfs, is -3,493 cfs-years. The negative cumulative deviation indicates a cumulative flow deficit. The decree specifies a maximum allowable deficit of 2,000 cfs- years over the first 39 years of the 40 year averaging period.

Data collection and preparation, diversion computation, and report writing for the WY 1996 accounting report was performed by the Corps. Data collection and preparation for this report began in Fiscal Year (FY) 1997. Certification of the WY 1997 accounting report is scheduled for FY 2000.

TABLE 2 STATUS OF THE STATE OF ILLINOIS DIVERSION  
Under the 1980 modified U.S. Supreme Court Decree

<u>Accounting Year</u>	<u>Certified Flow (cfs)</u>	<u>Running Average (cfs)</u>	<u>Cumulative Deviation (cfs)</u>
1981	3,106	3,106	94
1982	3,087	3,097	207
1983	3,613	3,269	-206
1984	3,432	3,310	-438
1985	3,472	3,342	-710
1986	3,751	3,410	-1,261
1987	3,774	3,462	-1,835
1988	3,376	3,451	-2,011
1989	3,378	3,443	-2,189
1990	3,531	3,452	-2,520
1991	3,555	3,461	-2,875
1992	3,409	3,457	-3,084
1993	3,841	3,487	-3,725
1994	3,064	3,456	-3,589
1995	3,197	3,439	-3,586
1996	3,108	3,418	-3,493

### SOURCES OF DIVERSION

The Lake Michigan diversion consists of three primary components. These components are domestic pumpage from Lake Michigan used for water supply and not returned to Lake Michigan, stormwater runoff from the diverted Lake Michigan watershed, and direct diversions through the three lakefront control structures.

Domestic pumpage from Lake Michigan is used for water supply and its effluent is discharged to the canals by various Water Reclamation Plants (WRP's). Currently, the WRP's that divert domestic pumpage from the lake either discharge to the canal system or to the Des Plaines River and its tributaries. In the future as more communities convert to Lake Michigan water supply, water supply effluent may also be discharged to the Fox River. The Fox River is approximately 35 miles west of downtown Chicago.

Stormwater runoff that previously drained to Lake Michigan through the Chicago River and the Calumet River now drains to the Chicago Sanitary and Ship Canal (CSSC) and the Calumet Sag Channel, respectively. The Calumet Sag Channel drains to the CSSC, and the CSSC ultimately drains into the Illinois River and the Mississippi River. The drainage area of the diverted Lake Michigan watershed is approximately 673 square miles.

Direct diversion locations are at the Chicago River Controlling Works (CRCW), the O'Brien Lock and Dam, and the Wilmette Controlling Works. These controlling structures are located downtown, at the south end, and at the north end of the Chicago area, respectively.

The direct diversion consists of four components; lockage, discretionary flow, navigation makeup flow, and leakage. The lockage component is the flow used in locking vessels to and from the lake. The purpose of the discretionary diversion is to dilute effluent from sewage discharges. When large storms are forecast, the canal is drawn down before the storm to prevent flooding. If the runoff is not enough to refill the canal, navigation makeup water is passed. The leakage component is water estimated to pass, in an uncontrolled way, through or around the lakefront structures.

## **ACCOUNTING PROCEDURES**

Diversion accounting uses both measured and estimated flows. A series of hydrologic and hydraulic computer models use various meteorological data to simulate flows not measured. These simulated flows as well as measured flows are used to compute the diversion. Along with the diversion calculation, a number of water budgets verify simulated flows and estimate the reliability of the computed diversion.

## **DIVERSION COMPUTATION**

An acoustic velocity meter (AVM) was installed and has been operating at Romeoville (five miles upstream of the Lockport Powerhouse and three miles upstream of the Lockport Controlling Works) since 12 June 1984. The AVM directly measures total flow through the canal above both the Powerhouse and the Controlling Works. The overwhelming majority of the Lake Michigan diversion and some non-Lake Michigan flows pass through the AVM. The diversion accounting procedure uses the flow measured at Romeoville and deducts flows not accountable in the diversion.

Diversion flows which bypass Lockport are added to yield the net computed diversion of water from Lake Michigan. This procedure represents the accounting technique as required by the modified Supreme Court Decree.

The flow measured at Romeoville was approximately 102% of the annual diversion during WY 1996. Approximately 92% of the diverted water was measured by the AVM during WY 1996. This portion of the diversion measured at the AVM is being reduced due to the influx of western suburbs using Lake Michigan water as their primary domestic water supply source. Most of these new users of Lake Michigan water do not discharge their sewage effluent to the canal system. As more communities are added, more water will be discharged outside the canal system, further lowering the percentage measured by the AVM.

Deductions from the Romeoville AVM flow include runoff from 217 square miles of the Des Plaines River watershed discharged to the canal, groundwater supply effluent and groundwater seepage into the Tunnel and Reservoir Plan (TARP) tunnels discharged to the canal, and Indiana water supply discharged to the canal through the Calumet River system and the Calumet Sag Channel (see figure 2 for locations). The computer models of the Des Plaines watershed area estimate the runoff deduction. The groundwater pumpage deductions are obtained directly from pumping records. The Indiana water supply is computed from pumping records and a calculation to determine the portion of the water supply draining west to the Calumet Sag Channel.

The additions for diversion flow that do not flow through Romeoville are primarily Lake Michigan water supply pumpage effluent treated and released to the Des Plaines River or its tributaries. This flow is obtained directly through pumping records of the communities involved and accounts for approximately 8% of the diversion in WY 1996. As more communities convert to Lake Michigan water supply, the percentage will increase.

## **DIVERSION BUDGET CHECKS**

Water budgets verify those flows not measured. Most of the budgets compare simulated flows to recorded flows and these comparisons indicate the accuracy of the diversion accounting. The four primary budgets are the budgets for the three major Water Reclamation Plants (WRP's) that serve the area involved in diversion accounting and the canal balance budget for the CSSC. The Upper Des Plaines pump station budget will also become a significant budget after measurement problems are resolved. The remaining budgets estimate runoff from stream gaged areas in the Lake Michigan watershed or are budgets of non-simulated flows such as water supply pumpage. The budgets were discussed in detail in the WY 1996 accounting report.

## **ACTIVITIES FOR FY 1997**

The activities for FY 1997 centered on the WY 1995 diversion accounting modeling and initiating the data collection and input activities for the WY 1996 analysis. In addition, work began on the changes to the TNET files for the Calumet tunnel. Christopher Burke Engineering, Ltd. was hired by the Corps to review the model to ensure consistency with the as-built plans for the Calumet tunnel system and its dropshafts. They were also tasked with updating the TNET model to account for the new Calumet tunnel legs that went on-line during WY 1996. In-house, the Corps began the change over from computing solar radiation data using O'Hare meteorologic data to using the measured solar radiation data collected at Argonne National Labs. This change was necessary due to a change in how O'Hare collected and reported its cloud cover that occurred in February 1996. The changes to the TNET modeling and solar radiation are detailed in the WY 1996 accounting report attached herein. The efforts relating to the changes to the Calumet modeling and the computation of the solar radiation were carried over into FY 1998 and FY 1999 and were a primary reason for the delay in the release of the WY 1996 accounting report.

In addition to the activities listed above, ongoing work related to the potential switch to lakefront accounting continued. This work included:

- The USGS work with the lakefront gages at the Chicago River Controlling Works and O'Brien Lock and Dam.
- Ongoing mediation activities related to the Great Lakes Mediation Committee that was initiated in December 1995 including technical support and detailed analyses of long-term runoff and consumptive use values.
- The U.S. Water Conservation Laboratory detailed QA/QC analysis of three pumping stations.

## **ACTIVITIES FOR FY 1998 – FY2000**

The efforts in FY 1998 focused on completing the WY 1995 accounting report, initiating the data input for the WY 1996 accounting report, and contracting efforts related to establishing the Fourth Technical Committee. In addition the lakefront activities listed above for FY 1997 continued in FY 1998.

The activities in FY 1999 focused on completing the WY 1996 accounting report, coordination of activities related to the Fourth Technical Committee, and ongoing mediation activities related to the Great Lakes Mediation Committee. In addition the lakefront activities listed above for FY 1997 continued in FY 1999. A contract was initiated for work on a detailed QA/QC of ten primary water supply diverters in Chicago and five in the northern Chicago suburbs. The Corps also completed a hydraulic analysis of various alternatives for Navigation Makeup Reduction.

The efforts in FY 2000 will include initiation and completion of the WY 1997 accounting report. Lakefront accounting for WY 1997 will also be initiated in FY 2000. Corps activities continue in support of the Great Lakes Mediation Committee including

technical support. The previously completed studies on long-term runoff and consumptive use provided the technical basis of an agreement between the states to potentially move the accounting process to the lakefront. The long-term runoff and consumptive use studies have been released in draft form and will be finalized in FY 2000 and be included in a final format with the Water Year 1999 Annual Report (release scheduled for early FY 2001). The Fourth Technical Committee will provide its final report to the Corps during FY 2000 which will be included in the WY 1998 Annual Report. In addition, activities related to the potential move to lakefront accounting have continued in FY 1998 through FY 1999 and will continue through FY 2000. Finally, the Corps and the State of Illinois are negotiating the agreement to execute a one-year demonstration study to look at the impacts of a change to the existing Navigation Makeup operations in an effort to reduce this component of diversion. The physical study is slated for FY 2001 and will potentially lead to a change in the Code of Federal Regulations.

## **ACCOUNTING REPORTS**

The accounting report for WY 1995 was completed in FY 1998 and distributed at the beginning of FY 1999. The accounting report for WY 1996 was completed in FY 2000 and the accounting report for WY 1997 will be completed in FY 2000. Thereafter, additional accounting reports are expected to be completed in the second fiscal year following the end of the water year for which the diversion is computed.

## **SUMMARY AND CONCLUSIONS**

### **SUMMARY**

The Lake Michigan Diversion Accounting procedure continues to evolve and improve. Further improvements are being implemented. A comprehensive diversion accounting manual is being completed during FY 2000 to include all the improvements. This manual will be included in the WY 1998 Annual Report. Progress continues to be made on the Lakefront Accounting activities.

### **CONCLUSIONS**

The Lake Michigan Diversion Accounting Report for WY 1996 has been completed as required by the Supreme Court Decree. The State of Illinois diverted 3,108 cfs during WY 1996. These flows are 92 cfs less than the 3,200 cfs limit specified in the decree. The running average of the diversion for WY 1981 through WY 1996 is 3,418 cfs, or 218 cfs over the annual allocation. Also, the annual average diversion has exceeded the 3,680 cfs annual limit three times, once more than the maximum number of times allowed in the decree. Additionally, the absolute annual maximum of 3,840 cfs has been exceeded during the WY93 accounting period. The cumulative deviation is now -3,493 cfs-years. The negative sign indicates a cumulative flow deficit. The maximum allowable cumulative flow deficit specified in the decree is 2,000 cfs-years.

**APPENDIX A**  
**LAKE MICHIGAN DIVERSION ACCOUNTING**  
**WATER YEAR 1996 REPORT**



## **Executive Summary**

In compliance with the 1967 U.S. Supreme Court decree as modified in 1980 (hereinafter, the Decree), the WY96 diversion was computed using the best current engineering practice and scientific knowledge.

Given the complexity of the hydrologic cycle in the heavily urbanized Chicago metropolitan area, and given the number of human and other factors that cannot be adequately represented in numerical modeling procedures, the results of the simulations which compute diversion flows worked exceptionally well.

The WY96 diversion accountable to the State of Illinois is 3,108 cubic feet per second (cfs). This flow is 92 cfs less than the 3,200 cfs average specified by the Decree. The 40 year running average, rounded to the nearest cfs, beginning with WY81 is 3,418 cfs and the cumulative deviation from the 3,200 cfs average is -3,493 cfs-years. The negative cumulative deviation indicates a water allocation deficit and the maximum deficit allowed by the Decree is 2,000 cfs-years.



**Table Of Contents**

**Executive Summary.....i**

**Introduction.....1**

**Authority for Report .....1**

**History of the Diversion .....2**

**Background of Lake Michigan Diversion Accounting.....3**

**Diversion Accounting Procedures .....10**

**WY96 Revisions to Diversion Accounting Procedures .....14**

**Accounting Results .....16**

**Discussions of Results .....18**

**Columns .....18**

Column 1: Chicago Sanitary and Ship Canal (CSSC) at Romeoville, USGS  
AVM Gage Record .....18

Column 2: Diversions from the CSSC Above the Gage .....18

Column 3: Total Flow Through the CSSC .....18

Column 4: Groundwater Discharged to the CSSC And Adjoining Channels .....19

Column 5: Water Supply Pumpage from Indiana Reaching the CSSC .....20

Column 6: Runoff from the Des Plaines River Watershed Reaching the CSSC .....21

Column 7: Lake Michigan Pumpage by Federal Facilities Which Discharge to  
the CSSC.....22

Column 8: Total Deductions from the CSSC Romeoville Gage Record .....22

Column 9: Lake Michigan Pumpage Not Discharged to the CSSC .....22

Column 10: Total Diversion .....24

Column 11 Through Column 13: Lake Michigan Diversion Components .....24

**Budgets .....27**

Budget 1 and Budget 2: Water Supply Pumpage.....27

*Budget 1: Diverted Lake Michigan Water Supply* .....27

*Budget 2: Groundwater Diverted to the CSSC* .....27

Budgets 3 Through Budget 6: Stream Gaging Stations .....28

Budgets 7 Through Budget 13: MWRDGC Water Reclamation Facilities.....29

*Budget 7: Northside Water Reclamation Facility* .....29

<i>Budget 8: Upper Des Plaines Pump Station.....</i>	<i>29</i>
<i>Budget 9: Mainstream and Des Plaines TARP Pumping Stations.....</i>	<i>33</i>
<i>Budget 10: Stickney Water Reclamation Facility.....</i>	<i>35</i>
<i>Budget 11: Calumet TARP Pumping Station.....</i>	<i>38</i>
<i>Budget 12: Calumet Water Reclamation Facility.....</i>	<i>40</i>
<i>Budget 13: Lemont Water Reclamation Facility .....</i>	<i>40</i>
<i>Aggregated Results of Four MWRDGC Water Reclamation Facilities .....</i>	<i>40</i>
<b>Budget 14: CSSC System Balance .....</b>	<b>43</b>
<b>Areas for Improvement .....</b>	<b>46</b>
Impervious Model Estimates .....	46
Tunnel and Reservoir Plan Models.....	46
MWRDGC Upper Des Plaines Pump Station.....	47
Assessment of Impact of Using Direct Solar Radiation Versus Cloud Cover.....	47
O'Hare and Egan Basin Flow Transfer .....	48
<b>Summary .....</b>	<b>49</b>
<b>References.....</b>	<b>50</b>
<b>Appendix A - Summary of Daily Diversion Flows.....</b>	<b>A-1</b>

**List of Tables**

Table 1 - Description of the Diversion Accounting Columns..... 12

Table 2 - Description of the Diversion Accounting Computational Budgets..... 13

Table 3 - Status of the State of Illinois' Diversion from Lake Michigan under the 1980  
Modified Supreme Court Decree ..... 16

Table 4 - Lake Michigan Diversion Accounting - WY1996 Summary of Diversion Flows... 17

Table 5 - Breakdown of the Diversion by the State of Illinois Based on Columns 11 Through  
13..... 25

Table 6 - Stream Gage Flow Separation ..... 28

Table 7 - WY 1996 Summary of Simulation Statistics ..... 30

Table 8 - WY1996 Summary of Flow Components for the CSSC System Balance..... 45

**List of Figures**

Figure 1 Development of the Chicago Sanitary and Ship Canal System..... 4

Figure 2 Location Plan - Lake Michigan Diversion at Chicago..... 5

Figure 3 Component Breakdown of Illinois' Diversion Based Upon Columns 11 thru 13.. 26

Figure 4 Budget 7 - Simulation of the MWRDGC Northside Water Reclamation Facility.. 31

Figure 5 Budget 8 - Simulation of the MWRDGC Upper Des Plaines Pump Station ..... 32

Figure 6 Map of Mainstream, Des Plaines and Calumet TARP ..... 34

Figure 7 Budget 9 - Simulation of the MWRDGC Mainstream and Des Plaines TARP  
Pumping Station ..... 36

Figure 8 Budget 10 - Simulation of the MWRDGC Stickney Water Reclamation Facility.. 37

Figure 9 Budget 11 - Simulation of the MWRDGC Calumet TARP Pumping Station..... 39

Figure 10 Budget 12 – Simulation of the MWRDGC Calumet Water Reclamation Facility41

Figure 11 Budget 13 – Simulation of the MWRDGC Lemont Water Reclamation Facility 42

Figure 12 Budget 14 – CSSC System Balance ..... 44



## **Introduction**

The diversion of water from the Lake Michigan watershed is of major importance to the Great Lakes states and to the Canadian province of Ontario. The states and province that border the Great Lakes have concerns with both diversions during periods of low lake levels, as well as the long term effects of diversion. To insure that the concerns of these interested parties are considered, the U. S. Army Corps of Engineers has been given the responsibility for the accounting of flow that is diverted from the Lake Michigan watershed.

The Corps of Engineers, Chicago District, is responsible for monitoring the measurements and the computation of the diversion of Lake Michigan water by the State of Illinois. Prior to the WY83 report, the calculations were made for the Illinois Department of Natural Resources - Office of Water Resources (IDNR-OWR), formerly known as the Illinois Department of Transportation - Division of Water Resources (IDOT-DWR), by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), formerly known as the Metropolitan Sanitary District of Greater Chicago (MSDGC). The computations for Water Year 1983 (WY83), WY84 and WY85 (1 October 1982 through 30 September 1985) were performed by the Northeastern Illinois Planning Commission (NIPC) for IDNR-OWR. The Corps reviewed, modified, and updated the WY84 and WY85 diversion accounting performed by NIPC. The computations for WY86 were performed jointly by NIPC (under contract to the Corps of Engineers) and the Corps of Engineers. Computations since then have been performed solely by the Corps of Engineers, with the exception of WY91 and WY92, which were performed jointly with Christopher B. Burke Engineering, LTD. This report represents the final Lake Michigan diversion accounting for WY96.

## **Authority for Report**

Under the provisions of the U.S. Supreme Court Decree in the Wisconsin, et. al. v. Illinois et. al., 388 U.S. 426, 87 S.Ct. 1774 (1967) as modified in 449 U.S. 48, 101 S.Ct. 557 (1980), the Chicago District of the Corps of Engineers is responsible for monitoring the measurement and computation of diversion of Lake Michigan water by the State of Illinois. The Water Resources Development Act of 1986 (Section 1142 of PL 99-662) gave the Corps total responsibility for the computation of diversion flows as formerly done by the State of Illinois. The Corps' new mission became effective on October 1, 1987.

## **History of the Diversion**

Water has been diverted from Lake Michigan at Chicago into the Mississippi River Watershed since the completion of the Illinois and Michigan (I & M) Canal in 1848. At that time, the diversion averaged about 500 cubic feet per second (cfs). The I & M Canal was built primarily to serve transportation needs by providing a connecting watercourse between the Great Lakes and the Mississippi River system.

With the development of the Chicago metropolitan area, sewer and drainage improvements led to severe sanitation problems in the mid to late 1800's. The newly constructed sewers moved water and wastes into the Chicago River, which until 1900 drained to Lake Michigan. The water quality of Lake Michigan deteriorated and contaminated the city's primary water supply.

A second problem that occurred during this time period was an increase in the overbank flooding within the city. As more roads were built and buildings constructed, the sewer system was correspondingly expanded. The increase in impervious area from the newly constructed roads and buildings increased the rate and volume of stormwater runoff and resulted in increased flooding.

As a solution to the sanitation and flooding problems, construction of the Chicago Sanitary and Ship Canal (CSSC) was undertaken. Construction of the CSSC allowed the flow direction of the Chicago River to be reversed (Figure 1). Construction of the Chicago Sanitary and Ship Canal was completed in 1900 by the MWRDGC. The CSSC followed the course of the older I & M Canal. The CSSC is much larger than the I & M canal and can handle the Chicago River flow, as well as increased shipping. In the 1930's, the Chicago River Controlling Works (CRCW) was constructed at the mouth of the Chicago River. The CRCW regulates the amount of Lake Michigan water allowed to pass into the river and restricts river flooding from entering Lake Michigan. The water levels in the CSSC are controlled by the Lockport Lock and Dam.

Between 1907 and 1910, the MWRDGC constructed a second canal called the North Shore Channel. It extended from Lake Michigan at Wilmette in a southerly direction 6.14 miles to the north branch of the Chicago River. The Wilmette Pumping Station, also known as the Wilmette Controlling Works, regulates the amount of Lake Michigan flow allowed down the channel through the use of one vertical lift gate.

Construction of a third canal, the Calumet Sag Channel, was completed in 1922. The canal connects Lake Michigan through the Grand Calumet River, to the CSSC. The Calumet Sag Channel was constructed to carry sewage from South

Chicago, Illinois and East Chicago, Indiana. Flow through the canal was controlled by the Blue Island Lock and Dam. The O'Brien Lock and Dam, which replaced the Blue Island Lock and Dam, was completed in 1967 and is located on the Calumet River. The O'Brien Lock and Dam regulates the flow of Lake Michigan waters down the Calumet Sag Channel. Figure 2 shows the affected watershed.

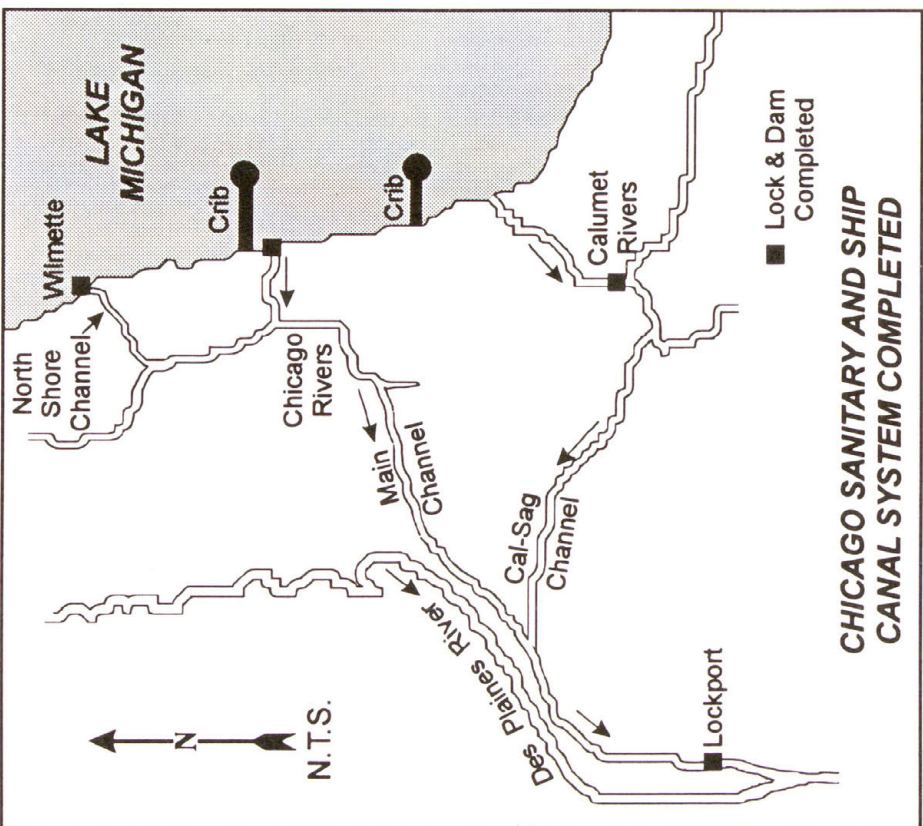
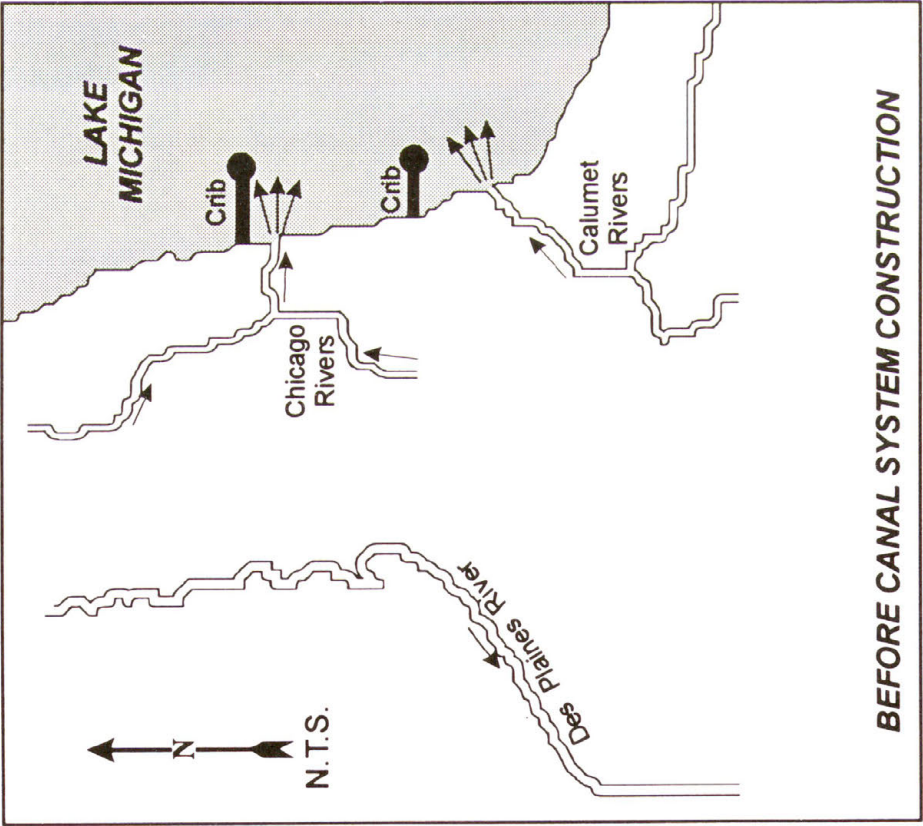
## **Background of Lake Michigan Diversion Accounting**

The Decree specifies several limitations on the diversion of Lake Michigan water by the State of Illinois. The Lake Michigan diversion accountable to Illinois is limited to 3,200 cubic feet per second (cfs) over a forty (40) year averaging period. During the forty (40) year period, the average diversion in any annual accounting period may not exceed 3,680 cfs, except in two accounting periods due to extreme hydrologic conditions in which the average diversion may not exceed 3,840 cfs. During the first thirty nine (39) year period, the maximum allowable cumulative difference between the calculated diversion and 3,200 cfs is 2,000 cfs-years. These limits apply to the forty year period beginning with WY81.

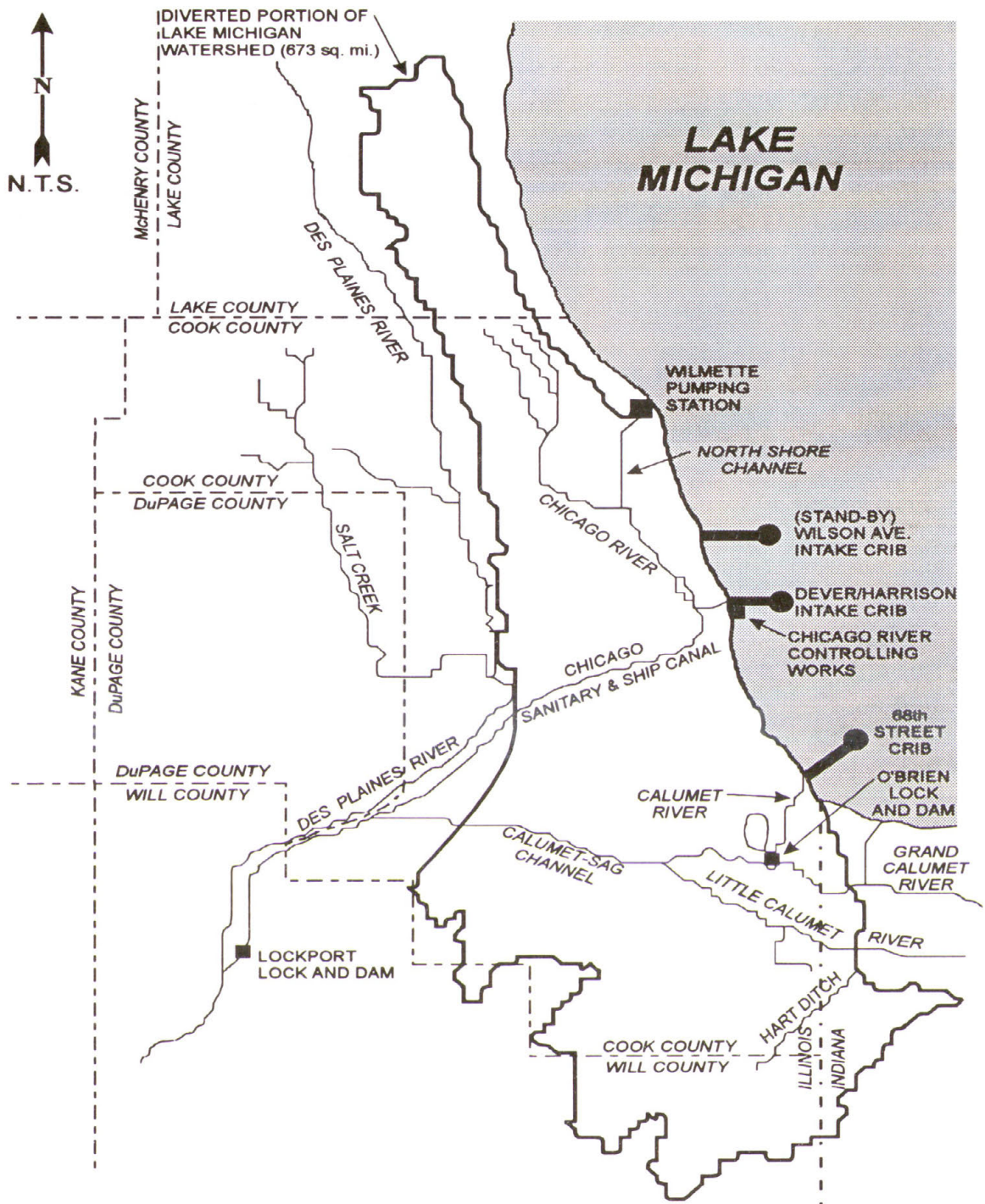
Also required by the Decree, a three (3) member technical committee is convened every five (5) years to evaluate the diversion accounting program to ensure that the accounting is accomplished using the best current engineering practice and scientific knowledge.

Prior to the 1983 accounting report, diversion accounting was done by the MWRDGC in the form of monthly hydraulic reports. As required by the Decree, the diversion was calculated by deducting non-diversion flows from the Lockport record measured by MWRDGC and adding those diversion flows not discharging to the CSSC. All of the deductible flows could not be measured, therefore MWRDGC used flow records from gaged areas to obtain typical flow values. To estimate the unmeasured deductible flows, the measured flow values were extrapolated to the areas from which the deductible flows originated.

While the diversion accounting was still being performed by MWRDGC the first technical committee was convened. The committee was primarily concerned with the rating of the various components at the Lockport facility, the primary diversion measurement location (Espey et. al., 1981). In response to the Committee's concerns, the Corps' Waterways Experiment Station (WES) revised the ratings of the two sets of Lockport sluice gates (Hart and McGee, 1985).



**Figure 1** Development of the Chicago Sanitary and Ship Canal System



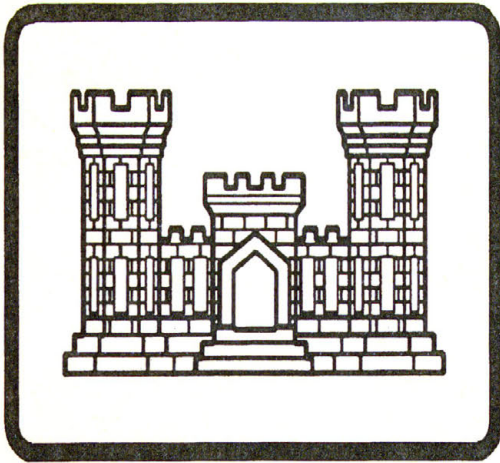
**Figure 2** Location Plan - Lake Michigan Diversion at Chicago

In response to the Committee's concerns, the State of Illinois installed an acoustic velocity meter (AVM) at Romeoville five (5) miles upstream of Lockport. The AVM is a highly accurate flow measuring device that proved to provide better flow measurements than the MWRDGC reported Lockport flows and the new Corps rating curves. The AVM became operational 12 June 1984. However, USGS did not publish the AVM flows until 1 October 1985. Because of significant equipment problems with the original AVM, a replacement AVM was installed in November 1988.

Additionally, the State of Illinois contracted with NIPC to revise the diversion accounting calculations. At the same time, the State of Illinois moved from monthly hydraulic reports to annual accounting reports. NIPC adapted computer models of the diverted Lake Michigan and the Des Plaines River watersheds previously developed for studies in Northeastern Illinois under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), to calculate those flows that could not be measured. Like MWRDGC, NIPC deducted non-diversion flows from the Lockport record and added those flows not discharged to the canal to calculate the Lake Michigan diversion. However, NIPC modeled both the gaged and ungaged areas to calculate much of the deduction and addition flows. Then computational budgets were developed around each of the gaged areas to verify the models. The budgets aid in calibrating the models and verifying the computational procedures. Due to the more rigorous approach and the verification provided by the budgets, the procedure developed by NIPC was a significant improvement over the previous approach.

The second technical committee reviewed the NIPC hydrologic and hydraulic computer models and agreed that the approach was consistent with the requirements of the decree (Espey et. al., 1987). However, the committee felt that some of the parameters used in the models were out of date and in need of revision. To address the committee's concerns, the Corps hired a consultant (Christopher B. Burke Engineering, Ltd., (CBBEL)) in September of 1988 to review and update the modeling parameters. The final report (CBBEL, 1990) concerning the updating of modeling parameters was submitted to the Corps in October 1990.

The Water Resources Development Act of 1986 gave the Corps of Engineers the full responsibility for computation of the Illinois Lake Michigan diversion as of 1 October 1987. When the Corps' new responsibility became effective, the WY84 diversion accounting report, developed by NIPC, had not been certified. As a result, the Corps was responsible for conducting the WY84 and all subsequent reports.



---

**US Army Corps of Engineers**  
**Chicago District**

# **Lake Michigan Diversion Accounting**

## **Water Year 1996 Report**



NIPC completed the WY84 diversion accounting analysis in April 1987 and the report was subsequently reviewed by the Corps. The Corps found the report to be adequate with two exceptions. First, the accounting was completed with the model parameters questioned by the second technical committee. Second, the MWRDGC Lockport flows, which were adjusted using the WES rating curves, were used rather than the AVM flows. The Corps, knowing that the modeling parameters required updating and that AVM flows for the period prior to installation could be calculated accurately using regression equations, refrained from certifying the WY84 report until these issues were resolved.

NIPC completed the WY85 diversion accounting report in December 1988 and the report was reviewed by the Corps. Like the WY84 report, the WY85 accounting was done with the modeling parameters questioned by the second technical committee. Additionally, NIPC used the AVM flows published by the USGS in their WY85 Water Resources Data for Illinois report. Since the publication of the WY85 USGS report, more reliable regression equations have been developed for calculating flows when the AVM was malfunctioning. These equations provide flow estimates based on flow components at Lockport. The equations are used to fill in missing records when the AVM malfunctions.

Over the years, various regression analyses have been performed to relate the MWRDGC reported Lockport flows to the AVM flows. Several sets of equations were proposed by the Corps of Engineers, the United States Geological Survey (USGS), Harza Engineering Co., and the Second Technical Committee. The report, *Chicago Sanitary and Ship Canal at Romeoville Acoustical Velocity Meter Backup System*, was completed September 1989 (USACE, 1989). The report documents the many efforts taken by various parties to develop useful regression equations. The regression equations that were ultimately used to estimate missing AVM flows from WY86 through WY96 were developed by the USGS in a report titled *Comparison, Analysis, and Estimation of Discharge Data from Two Acoustic Velocity Meters on the Chicago Sanitary and Ship Canal at Romeoville, Illinois* (USGS, 1994). This report is contained in the Lake Michigan Diversion Accounting WY93 Annual Report.

Upon completion of the analysis of the modeling parameters by CBBEL, the WY84 and WY85 diversion flows were recalculated using the revised modeling parameters and the Romeoville AVM flows. The diversion flows were certified by the Corps and transmitted to all interested parties in the Lake Michigan Diversion Accounting 1989 Annual Report (USACE, 1990).

The computation of Illinois' diversion from Lake Michigan for WY86 was undertaken as a joint effort between NIPC (under contract to the Corps) and the

Corps. The computation of Illinois' diversion from Lake Michigan for WY87 through WY90 was performed solely by the Corps.

Prior to the publication of the WY90 diversion accounting report, the third technical committee reviewed diversion accounting procedures and efforts to meet the recommendations of the first and second committees (Espey et. al., 1994). The committee expressed general satisfaction with the procedures and efforts to meet the recommendations of the previous committees. Emphasis was placed on the need for data and model quality plans, detailed accounting procedures, and more timely reports. Also recommended by the committee were detailed flow measurements at the lakefront structures and at the Upper Des Plaines Pump Station.

The WY91 and WY92 diversion accounting was performed as a joint effort between CBBEL (under contract to the Corps) and the Corps. The WY93, WY94, WY95 and WY96 accounting was performed solely by the Corps.

The WY86 through WY89 Diversion Accounting Reports are contained in the Lake Michigan Diversion Accounting Annual Report covering WY90 through WY92 (USACE, 1994). The WY90 Diversion Accounting Reports are contained in the Lake Michigan Diversion Accounting Water Year 1993 Annual Report (USACE, 1994). The WY91 and WY92 Diversion Accounting Reports are contained in the LMDA Water Year 1994 Annual Report (USACE, 1996). The WY93 and WY94 Diversion Accounting Reports are contained in the Lake Michigan Diversion Accounting Water Year 1995 Annual Report. The WY95 Diversion Accounting Report is contained in the Lake Michigan Diversion Accounting Water Year 1996 Annual Report (USACE, 1998).

The primary revision implemented for the WY90 diversion accounting was the incorporation of the new 25-gage precipitation network into the runoff simulation models. The 25-gage precipitation network replaces the previously used 13-gage network. The new precipitation network has solved many of the problems associated with the old network, such as poor exposure and distribution patterns. The Illinois State Water Survey (ISWS) installed and maintains the precipitation network for the Corps of Engineers. They also collect the data and adjust it if necessary. A description of the new 25-gage precipitation network can be found in the ISWS report titled *Installation and Operation of a Dense Raingage Network to Improve Precipitation Measurements for Lake Michigan Diversion Accounting: Water Year 1990* (ISWS, 1991). That report is contained in the Lake Michigan Diversion Accounting WY93 Annual Report.

In addition to the introduction of the new 25-gage precipitation network were the subsequent modifications to the hydrologic runoff models and hydraulic sewer

routing models. These models were revised in order to reflect the changes in the precipitation network and changes in land use and cover. Many of the model changes were completed by Rust Environment and Infrastructure under contract with the Corps. Their work culminated in a report titled *Diversion Accounting Update for the New 25-Gage Precipitation Network* (Rust, 1993). That report is also contained in the Lake Michigan Diversion Accounting WY93 Annual Report.

Rust's work involved reviewing and correcting map delineations of combined sewer special contributing areas, delineating precipitation gage assigned areas for the 25-gage network, land-use/land-cover delineation, modifying the hydraulic sewer routing model to reflect the revised precipitation network and land cover assignments, and assessing the model parameters used in the hydrologic runoff model, Hydrologic Simulation Program - FORTRAN (HSPF).

The Corps modified the hydraulic sewer model, Special Contributing Area Loading Program (SCALP), in the separate sewer areas in order to incorporate changes in the precipitation network. These changes were also incorporated in the WY90 accounting. Since actual boundaries have not been mapped for those areas, some assumptions as to the location of the separate sewer areas were made. These assumptions were necessary since effective (instead of actual) areas are used for separate sewer areas in the SCALP model. These assumptions will continue until a further study can be accomplished that will reflect actual boundaries for these separately sewered areas. These modifications were also incorporated into accounting procedures beginning with the WY90 accounting.

A study was also done by the Corps to improve the response of the HSPF hydrologic runoff models. Input on parameter improvements were received from NIPC and Rust. The study resulted in some minor parameter modifications to the HSPF runoff model to correct for past inconsistencies and improve parameter accuracy.

Beginning with the WY91 accounting all the computer models were revised to read and write to the Data Storage System (DSS) database, the Corps' standard database. In 1993 Aqua Terra Consultants, under contract to the Corps, revised the HSPF code to be compatible with the DSS database and in 1994 they provided a new release of HSPF, version 11. Christopher B. Burke Engineering in 1995 revised all hydrologic and computational HSPF input files, as well as SCALP input files to work in conjunction with the DSS database. The Corps revised the SCALP code to also work in conjunction with this database.

Beginning with the WY92 accounting, flows in the Grand Calumet were measured instead of estimated through regression equations. These flows are

critical in determining portions of the deductible water supply from Indiana contained in Column 5 of the report.

There were three primary revisions to the accounting procedures beginning with the WY93 accounting. The first revision involved a modification to the procedure for estimating the deductible Indiana water supply pumpage contained in the Grand Calumet River. This revision better accounts for the unique hydraulics of this river. The second revision involved modeling modifications for a portion of the Des Plaines TARP system that became operational in June 1993. These modeling modifications impact the deductible runoff from the Des Plaines River watershed contained in Column 6. The third revision to the accounting involved adjustments to correct for double accounting for a portion of the runoff originating from the ungaged Calumet watershed. This modification is reflected only in the results of Column 12, Runoff from the Diverted Lake Michigan Watershed, and therefore has no effect on the computed diversion.

Additional revisions to the accounting procedures were implemented in WY96. These revisions are detailed in this report in the section titled "WY96 Revisions to Diversion Accounting Procedures".

## **Diversion Accounting Procedures**

The Lake Michigan diversion accountable to the State of Illinois is calculated by using the AVM measured flow in the CSSC at Romeoville and deducting flows that do not constitute Lake Michigan diversion and are not accountable to the State of Illinois. Finally, additions are made to the Romeoville record for diversions that are not discharged to the canal. The deductions include groundwater water supply pumpage whose effluent is discharged to the canal, Lake Michigan water supply pumpage from Indiana discharged to the canal, runoff from the Des Plaines River watershed discharged to the canal, and water supply pumpage from Lake Michigan used for Federal facilities discharged to the canal. The additions to the Romeoville record include flows diverted from the canal upstream of Romeoville, and Lake Michigan water supply whose effluent is not discharged to the canal. This procedure represents the accounting method required by the Supreme Court Decree.

The diversion accounting results are presented as a series of columns that are listed in Table 1. Column 1 through Column 3 compute the total flow in the CSSC. Column 4 through Column 7 presents the deductions from the canal system flows with the total deduction being presented in Column 8. Column 9 presents the additions to the canal system record. Column 10 is the computed Lake Michigan diversion accountable to Illinois and is equal to the canal system flow minus the

deductions plus the additions. Columns 11 through 13 are independent flow estimates for the three sources of diversion: water supply pumpage from Lake Michigan, runoff from the diverted Lake Michigan Watershed, and direct diversion through the lakefront structures. Column 11 through Column 13 are not used in the diversion calculation but are included as another estimate of the diversion for verification of the accounting flows in Column 10. The sum of Columns 11 through 13 should theoretically equal the flow in Column 10 with one exception. The flows in Column 11 do not account for consumptive losses.

In addition to the diversion calculations presented in the 13 columns, 14 computational budgets are prepared as input to the diversion calculation and to verify the estimated flows that cannot be measured. A summary of these budgets is presented in Table 2. Budgets 1 and 2 do not compare simulated to measured flows but are summations of critical water supply pumpage data. Budget 3 through Budget 6 partition stream gage records into runoff and sanitary/industrial discharge components to estimate a portion of the runoff from the diverted watershed that is used as input to Column 12, Runoff from the Diverted Lake Michigan Watershed. Budget 7 through Budget 13 compare simulated to measured flows at MWRDGC facilities. These budgets simulate all the deductible Des Plaines River Watershed contained in Column 6 and the deductible groundwater seepage into TARP contained in Column 4. These budgets also are used for verification of the diversion accounting procedures and give an indication of the accuracy of the diversion accounting models. Budget 14 compares canal system inflows and outflows. It is used primarily as a verification of modeling results as well as an indicator of the accuracy and completeness of measured/reported flows.

**Table 1**  
Description of the Diversion Accounting Columns

<b>Column</b>	<b>Description</b>
1	Chicago Sanitary and Ship Canal (CSSC) at Romeoville AVM Gage Record
2	Diversion from the CSSC above the Romeoville AVM Gage
3	Total Flow Through the CSSC
4	Groundwater Pumpage Discharged into the CSSC and Adjoining Channels
5	Water Supply Pumpage from Indiana Reaching the CSSC
6	Runoff from the Des Plaines River Watershed which Reaches the CSSC
7	Lake Michigan Pumpage by Federal Facilities which Discharge to the CSSC and Adjoining Channels
8	Total Deduction from the CSSC Romeoville AVM Gage Record
9	Lake Michigan Pumpage Which is not Discharged into the CSSC
10	Total Diversion Accountable to the State of Illinois
11	Pumpage from Lake Michigan Which is Accountable to the State of Illinois
12	Runoff from the Diverted Lake Michigan Watershed
13	Direct Diversions Through Lakefront Control Structures Accountable to the State of Illinois

**Table 2**  
**Description of the Diversion Accounting Computational Budgets**

<b>Budget Number</b>	<b>Title</b>	<b>Description</b>
1	Diverted Lake Michigan Pumpage	This budget sums the Lake Michigan water diverted by the State of Illinois in the form of Industrial and Municipal water supply. The results of this budget are used in Column 11.
2	Groundwater Discharged to the CSSC	This budget sums groundwater pumpages that are discharged to the CSSC. The results of this budget are used in Column 4.
3	North Branch Chicago River at Niles, IL	This budget performs a simple separation of stream flow into sanitary and runoff portions. The results of this budget are used in Budget 14 and Column 12.
4	Little Calumet River at the IL-IN State Line	This budget performs a simple separation of stream flow into sanitary and runoff portions. The results of this budget are used in Budget 14 and Column 12.
5	Thorn Creek at Thornton, IL	This budget performs a simple separation of stream flow into sanitary and runoff portions. The results of this budget are used in Budget 14 and Column 12.
6	Little Calumet River at South Holland, IL	This budget performs a simple separation of stream flow into sanitary and runoff portions. The results of this budget are used in Budget 14 and Column 12.
7	MWRDGC Northside Water Reclamation Plant	This budget performs hydrologic and hydraulic simulation of the service basin tributary to the MWRDGC Northside Water Reclamation Facility. The simulations estimates the runoff from portions of the Lake Michigan and Des Plaines River watersheds within the Northside service basin that is diverted to the CSSC in the form of inflow-infiltration. The budget provides an internal verification of the accounting procedures. The results of this budget are used in Budget 14 and Columns 6 and 12.
8	Upper Des Plaines Pumping Station	This budget performs hydrologic and hydraulic simulation of the MWRDGC Upper Des Plaines Pumping Station. This budget provides a calibration point to verify models of the Des Plaines River watershed
9	MWRDGC Mainstream TARP Pumping Station	This budget performs hydrologic and hydraulic simulation of the MWRDGC Mainstream TARP Pumping Station. The results of this simulation are used in Budgets 10 and 14 and Columns 6 and 12. The budget also provides internal verification of the accounting procedures.
10	MWRDGC Stickney Water Reclamation Facility	This budget performs hydrologic and hydraulic simulation of the service basin tributary to the MWRDGC Stickney Water Reclamation Facility. The simulations estimates the runoff from portions of the Lake Michigan and Des Plaines River watersheds within the Stickney service basin that is diverted to the CSSC in the form of inflow-infiltration. The budget provides an internal verification of the accounting procedures. The results of this budget are used in Budget 14 and Columns 6 and 12.
11	MWRDGC Calumet TARP Pumping Station	This budget performs hydrologic and hydraulic simulation of the MWRDGC Calumet TARP Pumping Station. The results of this simulation are used in Budgets 12 and 14 and Columns 6 and 12. The budget also provides internal verification of the accounting procedures.
12	MWRDGC Calumet Water Reclamation Facility	This budget performs hydrologic and hydraulic simulation of the service basin tributary to the MWRDGC Calumet Water Reclamation Facility. The simulations estimates the runoff from portions of the Lake Michigan and Des Plaines River watersheds within the Calumet service basin that is diverted to the CSSC in the form of inflow-infiltration. The budget provides an internal verification of the accounting procedures. The results of this budget are used in Budget 14 and Columns 6 and 12.
13	MWRDGC Lemont Water Reclamation Facility	This budget performs hydrologic and hydraulic simulation of the service basin tributary to the MWRDGC Lemont Water Reclamation Facility. The simulations estimates the runoff from portions of the Des Plaines River watershed within the Lemont service basin that is diverted to the CSSC in the form of inflow-infiltration. The budget provides an internal verification of the accounting procedures. The results of this budget are used in Budget 14 and Column 6.
14	Chicago Canal System	This budget performs a water balance of the Chicago Canal System which includes the CSSC and adjoining channels. This budget provides a verification point for the accounting procedures.

## **WY96 Revisions to Diversion Accounting Procedures**

Four revisions were made to the diversion accounting procedures for WY96. First, a switch to using Argonne National Lab's direct solar radiation values was made because O'Hare Airport changed the way it reported cloud cover. A second revision was the improvement of the snowmelt computation by incorporating the newly available 3-hour meteorologic data at O'Hare Airport. Previously snowmelt was computed using daily values. Thirdly, the Calumet TARP model was updated to include new tunnel legs which went on-line during WY96. Finally, University of Chicago air temperature data is no longer used as input to HSPF due to the fact that records are no longer kept at the site.

The use of direct solar radiation at Argonne instead of using meteorologic data at O'Hare to calculate solar radiation was necessary due to a change in the reporting of cloud cover at O'Hare. Solar radiation data is used in the calculation of potential evapotranspiration (PET) along with the simulation of snowmelt. The cloud cover at O'Hare Airport historically had been reported based on manual observations using a single value to capture the "dawn-to-dusk" cloud cover. Beginning in WY96, the reporting of cloud cover changed to 3-hour ASOS (Automated Surface Observations System) readings reported on the climatological data sheets. In addition, the values reported were changed from a numeric value ranging from 1 to 10 to a written descriptor of the cloud cover condition. Because of the change to 3-hour ASOS reporting, the O'Hare Airport cloud cover data was not directly importable into the existing HSPF routines for calculating solar radiation. Instead, Argonne's direct measurements of daily solar radiation were used in the computation of PET. Argonne has an Eppley pyranometer which directly measures solar radiation. These measurements, along with other meteorologic data, are posted on the Argonne National Labs internet site and are downloaded for use in diversion accounting. Missing Argonne hourly solar radiation data was filled in using a correlation with available St. Charles direct solar radiation data. PET is computed on a daily basis using daily Argonne solar radiation, daily O'Hare Airport dew point, daily O'Hare Airport wind run values and daily maximum and minimum temperatures at O'Hare Airport. The daily PET value is then distributed into an hourly PET value using the previously established HSPF routine.

The snowmelt computation was improved in WY96 by incorporating hourly data. Previously snowmelt was computed using daily values from O'Hare Airport. In WY96 the O'Hare Airport climatological data sheets began to report 3-hour values for dew point, wind, temperature and cloud cover – which were previously reported only on a daily basis. This 3-hour data was transformed into hourly data (by direct interpolation) for use in improving the snow melt computations. In addition, the hourly solar radiation values, directly measured at Argonne Labs as discussed above, were also used in the computation of snowmelt.

The Calumet TNET model was also changed to reflect updates that CBBEL made under contract (CBBEL, 1999). These changes included tunnel geometry (slope, inverts, diameters, lengths, roughness) as well as adding new tunnel segments to account for tunnel reaches that have since been put in service. These new tunnel reaches (Indiana Ave, 140<sup>th</sup> St., and Markham) apparently were connected during WY95, although the associated dropshafts were not operational. For WY96, the new tunnel reaches were incorporated for the whole water year. The new dropshafts associated with the new tunnels were not activated in the TNET model until April 1, 1996, the approximate date at which MWRD physically activated them. In addition, information from MWRD indicated that many of the dropshafts which were previously modeled as gated were truly ungated. Although some of the dropshafts are ungated, there are orifice plates on most of them to restrict their flow, but many of them are open all the time – just in a restricted fashion. These changes were incorporated into the WY96 TNET model.

Finally, University of Chicago air temperature data is no longer used as input to HSPF – this was also the case for the WY95 accounting. This is due to the fact that records are no longer kept at this site. Thiessen polygon areas for precipitation gages that referenced University of Chicago air temperature in the hydrologic (HSPF) modeling were revised such that the closest of the three remaining air temperature gages (O'Hare Airport, Midway Airport and Park Forest) was used in the modeling.

## **Accounting Results**

The WY96 diversion accounting monthly summary is presented in Table 4. Table 4 shows the total WY96 Lake Michigan diversion accountable to the State of Illinois is 3,108 cfs (Column 10). This diversion is 92 cfs less than the 3,200 cfs average specified by the Decree. The 40 year running average (Table 3), rounded to the nearest cfs, beginning with WY81 is 3,418 cfs and the cumulative deviation from the 3,200 cfs average is -3,493 cfs-years. The negative cumulative deviation indicates a water allocation deficit. The maximum allowable deficit is 2,000 cfs-years. Tabular data on daily diversion flows is presented in Appendix A.

**Table 3**

**Status of the State of Illinois' Diversion from Lake Michigan Under the 1980  
Modified U.S. Supreme Court Decree**

Accounting Year	Certified Flow (cfs)	Running Average (cfs)	Cumulative Deviation (cfs-yrs)
1981	3,106	3,106	94
1982	3,087	3,097	207
1983	3,613	3,269	-206
1984	3,432	3,310	-438
1985	3,472	3,342	-710
1986	3,751	3,410	-1,261
1987	3,774	3,462	-1,835
1988	3,376	3,451	-2,011
1989	3,378	3,443	-2,189
1990	3,531	3,452	-2,520
1991	3,555	3,461	-2,875
1992	3,409	3,457	-3,084
1993	3,841	3,487	-3,725
1994	3,064	3,456	-3,589
1995	3,197	3,439	-3,586
1996	3,108	3,418	-3,493

**Table 4**  
Lake Michigan Diversion Accounting - WY1996  
Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEDEVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEDEVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
Oct-95	2,633.4	2.2	2,635.6	96.8	20.4	102.2	7.0	226.4	240.4	2,649.6	1,724.7	472.1	484.1
Nov-95	3,035.2	1.1	3,036.3	107.8	18.8	230.4	7.9	364.9	223.5	2,894.9	1,634.6	1,268.5	73.5
Dec-95	1,964.3	2.0	1,966.3	67.8	18.4	60.4	6.8	153.4	225.4	2,038.3	1,649.8	177.3	75.4
Jan-96	2,251.6	1.9	2,253.5	96.8	18.1	138.5	6.8	258.2	176.3	2,171.6	1,623.0	505.5	82.8
Feb-96	2,192.4	2.5	2,194.9	79.8	18.7	83.5	7.5	189.5	236.4	2,241.8	1,714.1	354.6	84.6
Mar-96	2,186.5	2.2	2,188.7	86.7	19.0	96.6	6.2	208.5	223.7	2,203.9	1,650.9	406.6	78.0
Apr-96	2,604.0	1.8	2,605.8	90.6	18.3	124.0	6.3	239.2	232.0	2,598.8	1,648.1	641.7	97.6
May-96	4,670.4	1.8	4,672.2	121.2	22.0	308.4	7.1	458.7	242.1	4,455.6	1,696.5	2,285.3	200.2
Jun-96	4,563.7	1.4	4,565.1	119.3	35.3	328.9	7.6	491.1	261.1	4,335.1	1,860.1	1,580.7	536.8
Jul-96	4,770.2	1.9	4,772.1	110.8	44.1	450.5	9.2	614.6	333.6	4,491.1	2,116.4	1,902.1	771.5
Aug-96	3,446.2	3.3	3,449.5	77.9	48.7	76.8	9.4	212.8	312.1	3,648.8	2,135.3	358.0	1,032.9
Sep-96	3,606.2	2.9	3,609.1	98.1	35.8	119.0	8.9	261.8	291.3	3,638.6	1,924.6	616.2	1,036.4
Averages	3,162.4	2.1	3,164.5	96.1	28.5	176.7	7.6	306.9	249.9	3,107.5	1,782.0	882.0	378.8

## Computations:

- Column 3 equals the sum of Columns 1 and 2.
- Column 8 equals the sum of Columns 4 through 7.
- Column 10 = Column 3 - Column 8 + Column 9.

Note: The averages presented in the final row are calculated from the daily values contained in Appendix A.

Deductions from the Romeoville Gage Record

Additions to the Romeoville Gage Record

## **Discussions of Results**

The following is a discussion of the column functions and computational budgets. The discussion of the column functions describes the purpose of each column, as well as some observations on the WY96 values in the columns. The discussion of the computational budgets presents the purpose of each budget and the results of the budget flow balances. The results of the computational budgets are used in the diversion calculations where seven (7) budgets are used to verify the diversion simulation models. The columns are discussed first, followed by the discussion of the budgets.

### **Columns**

The first ten (10) columns display the components of the diversion calculation and include the Romeoville flow, as well as the various deductions and additions to the Romeoville record. The final three (3) columns (Columns 11 through 13) display the three (3) diversion components (Lake Michigan pumpage accountable to Illinois, runoff from the diverted watershed, and direct diversion through the lakefront control structures). The sum of Columns 11 through 13 should theoretically equal the Romeoville based diversion calculation. A comparison of the sum of these three (3) columns to the calculated diversion (Column 10) is presented in the discussion of Column 11 through Column 13.

#### *Column 1: Chicago Sanitary and Ship Canal (CSSC) at Romeoville, USGS AVM Gage Record*

The discharge at Romeoville for WY96 was 3,162.4 cfs (based on an average of WY96 daily flows). For the twenty-four (24) days when the AVM was inoperable, the flow at the Romeoville site was calculated from the USGS regression equations.

#### *Column 2: Diversions from the CSSC Above the Gage*

Argonne Laboratories and Citgo Petroleum Corporation were the only diversions from the CSSC upstream of the Romeoville gage in WY96. The average withdrawal upstream of the AVM for WY96 was 2.1 cfs.

#### *Column 3: Total Flow Through the CSSC*

Column 3 is the sum of Column 1 and Column 2 and represents the total flow entering the canal system. The average CSSC flow was 3,164.5 cfs for WY96.

#### *Column 4: Groundwater Discharged to the CSSC And Adjoining Channels*

Column 4 is groundwater pumpage by communities, industrial users and other private users whose effluent is discharged to the CSSC. The groundwater pumpage data is reported by the Illinois State Water Survey (ISWS). It also includes the groundwater seepage into the TARP systems discharged to the CSSC. This quantity is determined by summing all reported groundwater pumpages tributary to the CSSC, along with the estimated groundwater seepage into the Mainstream and Des Plaines TARP (Budget 9) and Calumet TARP (Budget 11) systems. This total is then adjusted by subtracting the portion of groundwater present in the combined sewer overflows (CSO's) discharged to the Des Plaines River and other watercourses not tributary to the CSSC. This groundwater would normally have been discharged to the canal via treated sewage effluent had a CSO event not occurred. This method prevents double accounting of the combined sewer overflow portion of the groundwater supply pumpage.

Using ISWS groundwater records, groundwater pumpages were assumed to reach the CSSC and adjoining channels if they were located in the diverted Lake Michigan watershed in Illinois or if they were located within MWRDGC Water Reclamation Plant (WRP) service boundaries which discharged into the CSSC and adjoining channels. Groundwater seepage into the Mainstream and Des Plaines TARP systems and the Calumet TARP system was determined through simulation and is discussed in Budgets 9 and 11. The groundwater constituent of CSO's is determined entirely through simulation.

According to the Supreme Court Decree of 1967, groundwater pumpage from the Lake Michigan watershed whose effluent is discharged to the CSSC is a deduction, except to the extent that these groundwater sources are supplied by infiltration from Lake Michigan. Current piezometric levels indicate that groundwater is discharging to the lake, therefore, groundwater pumpage from within the Lake Michigan watershed that reaches the canal continues to be a deduction. Research literature will be reviewed periodically to verify this assumption, and to identify any changes that would indicate that Lake Michigan is recharging groundwater sources as a result of groundwater pumping.

Column 4 represents a deduction from the Romeoville record and averaged 96.1 cfs. This flow is an increase of 3.8 cfs from WY95. Groundwater pumpage tributary to the canal is composed of 21.1 cfs of groundwater pumpage from the Lake Michigan watershed, 16.1 cfs of groundwater pumpage from outside of the Lake Michigan watershed, 49.5 cfs of groundwater seepage into the Mainstream and Des Plaines TARP systems, and 9.5 cfs of groundwater seepage into the Calumet TARP system. The total of these components is 96.1 cfs, which equals the deduction from the Romeoville gage record. In most years, a small portion of this groundwater supply pumpage (normally tributary to CSSC) is determined, through

simulation, to be discharged to the Des Plaines River and other watercourses not tributary to the CSSC in the form of CSO's. The groundwater portion of these CSO's are then subtracted from the groundwater deduction of Column 4.

*Column 5: Water Supply Pumpage from Indiana Reaching the CSSC*

Column 5 represents the computation of Indiana water supply reaching the canal through the Grand Calumet and the Little Calumet Rivers. In the case of the Little Calumet River, a drainage divide exists east of the confluence with Hart Ditch. Therefore, flows from Hart Ditch, including virtually all dry weather flows, normally flow westward into Illinois. Under high flow conditions, the drainage divide may shift westward and a portion of the Hart Ditch flows may be diverted eastward to Burns Ditch and ultimately to Lake Michigan. However, it is believed that the occurrence in the shift in the drainage divide is infrequent and the flow that is diverted eastward is insignificant. Therefore, it is assumed that all effluent discharged into Hart Ditch and the Little Calumet River west of the divide flows westward. For WY96, total flow in the Little Calumet River was 86.3 cfs with 6.7 cfs of that flow determined to be Indiana water supply.

The Grand Calumet River has a summit. On one side of the summit the flow is toward Lake Michigan, on the other side of the side of the summit the flow is toward the Calumet Sag Channel which flows into the CSSC. However, the location of the summit is variable and highly influenced by Lake Michigan levels (USGS, 1984). Thus the calculation of this deduction from the Romeoville record is also influenced by Lake Michigan levels. Beginning with the WY92 accounting, Grand Calumet River flow was measured by a gage that was installed in 1991 that began officially measuring flows on 1 October 1991.

Flow in the Grand Calumet River contains a very high proportion of treatment plant discharge. Through WY92, the flow in the Grand Calumet River attributed to Indiana water supply pumpage was set to the sum of water supply for East Chicago, Whiting, and Hammond (whose pumpage includes water supply for Munster, Highland and Griffith). This method is an oversimplification of the actual conditions. Chicago District developed a reconnaissance level, unsteady state model of the river for the United States Environmental Protection Agency (US EPA). From this model, relationships were developed to proportion the treatment plant discharge into the flow to the CSSC and Lake Michigan. The flow summit generally occurs at the Hammond outfall or between the Hammond and East Chicago outfalls.

The equations below determine the percentage of flow from each treatment plant flowing west to the CSSC based on Lake Michigan water level:

For  $CCD < 0.3$  ft

$$\text{Flow} = 0.45 * HW$$

For  $CCD \geq 0.3$  ft and  $CCD < 1.5$  ft

$$\text{Flow} = (0.22 * CCD^3 - 0.15 * CCD^2 + 0.06 * CCD + 0.45) * HW$$

For  $CCD \leq 1.5$  ft and  $CCD < 1.8$  ft

$$\text{Flow} = HW + (CCD - 1.5) / 0.3 * EC$$

For  $CCD > 1.8$  ft

$$\text{Flow} = HW + EC$$

Where CCD is the lake level in feet (Chicago City Datum) measured at Calumet Harbor, HW is the daily combined water supply pumpage by Hammond and Whiting, and EC is the daily water supply pumpage by East Chicago.

The total Grand Calumet flow reaching Illinois in WY96 was measured as 36.3 cfs. Of that, 19.8 cfs was determined to be water supply pumpage. Therefore, the total WY96 Indiana water supply deduction, including the flow from the Little Calumet and Grand Calumet Rivers is 26.5 cfs. This flow is 8.0 cfs less than the Indiana water supply deduction for WY95, which was 34.5 cfs.

#### *Column 6: Runoff from the Des Plaines River Watershed Reaching the CSSC*

The WY96 average discharge of Des Plaines River watershed runoff reaching the canal (Column 6) is 176.7 cfs. This deduction is determined almost entirely through simulation. The runoff is composed of two elements, surface runoff and subsurface runoff. Surface runoff that enters sewers is referred to as inflow, while subsurface runoff is referred to as infiltration. The infiltration and inflow from the Des Plaines River watershed discharged to water reclamation plants tributary to the CSSC is 95.3 cfs, the infiltration and inflow reaching the canal through CSO's is 12.9 cfs and the runoff from the Lower Des Plaines and Summit Conduit areas is 68.4 cfs. The deduction is also influenced by the O'Hare basin flow transfer that contributed 8.7 cfs of the 95.3 cfs of runoff to the water reclamation facilities during WY96. The deductible Des Plaines River watershed runoff increased 8.9 cfs from WY95 to WY96.

***Column 7: Lake Michigan Pumpage by Federal Facilities Which Discharge to the CSSC***

Column 7 represents Lake Michigan diversions for Federal use, not chargeable to the State of Illinois, and is typically comprised of water supply pumpage used by federal facilities. Also included is emergency navigation makeup water used for federal purposes. Column 7 represents a deduction from the Romeoville record and the total amount of the WY96 deduction is 7.6 cfs.

***Column 8: Total Deductions from the CSSC Romeoville Gage Record***

Column 8 is the sum of Columns 4, 5, 6, and 7 and represents the total deduction from the Romeoville record. The total deduction for WY96 is 306.9 cfs.

***Column 9: Lake Michigan Pumpage Not Discharged to the CSSC***

This column represents water supply pumpage from Lake Michigan that is not discharged to the canal. The water supply pumpage not discharged to the canal is composed of two components:

- Lake Michigan water supply used by communities serviced by water reclamation facilities that do not discharge to the CSSC (249.2 cfs). This flow decreased 5.3 cfs from WY95.
- The Lake Michigan domestic water supply portion of CSO's bypassing the AVM from areas whose water reclamation facility discharge to the CSSC or its tributaries (0.7 cfs).

The communities that make up the flow in the first component are suburbs whose treated effluent is discharged to the Des Plaines River and other watercourses not tributary to the CSSC. The water supply agencies or communities are:

- Northwest Suburban Joint Action Water Agency (NWJAWA) - Member communities include Elk Grove Village, Hanover Park, Hoffman Estates, Mount Prospect, Rolling Meadows, Schaumburg and Streamwood.
- Northwest Water Commission - Member communities include Arlington Heights, Buffalo Grove, Palatine, Prospect Heights and Wheeling.
- Central Lake County Joint Action Water Agency (CLCJAWA) - Member communities include Grayslake, Gurnee, Lake County Public Works Department

(Vernon Hills and Wildwood-Gages Lake), Libertyville, Mundelein, Round Lake, Round Lake Park and Round Lake Beach.

- Lake County Public Water District - Member communities include Illinois Beach State Park, Winthrop Harbor and Zion.
- Du Page Water Commission - Member communities include Addison, Bensenville, Bloomingdale, Carol Stream, Citizen's Utilities (Arrowhead, Country Club Highlands, Lombard Heights and Valley View), Clarendon Hills, Darien, Downers Grove, Elmhurst, Glen Ellyn, Glendale Heights, Hinsdale, Itasca, Lisle, Lombard, Naperville, Oak Brook, Roselle, Villa Park, Westmont, Wheaton, Willowbrook, Wood Dale, Woodridge, and the DuPage County Water Works (Farmington, Glen Ellyn Heights, Hinsdale, Lake in the Woods, Rosewood Trace, Steeple Run).
- Lincolnshire
- Riverwoods
- Waukegan
- Lake County - Bradley Road

The communities of North Chicago and Des Plaines are separated into the percentage of each community that is not tributary to the Chicago River System.

- North Chicago - 76 percent
- Des Plaines - 38.2 percent

The communities of Lake Bluff and Knollwood-Roundout (who receive their water from CLCJAWA) are not included in Column 9, as they discharge their effluent into the Chicago River System.

It should also be noted that the Lake Michigan water supply component of the O'Hare flow transfer is subtracted from the total Lake Michigan water supply of the above communities since:

- The O'Hare flow transfer is treated at the Northside WRP which discharges sanitary effluent that is tributary to the CSSC.
- The entire Lake Michigan water supply component of the O'Hare flow transfer is from communities contained in the above list.

The Lake Michigan water supply for these communities is measured, while the sanitary portion of the CSO's is derived through simulation. Column 9 represents an addition to the Romeoville record and the total WY96 addition is 249.9 cfs. This flow is a decrease of 5.3 cfs from WY95 to WY96.

#### *Column 10: Total Diversion*

Column 10 is equivalent to Column 3 with the subtraction of Column 8 and the addition of Column 9. The total diversion for WY96 is 3,108 cfs. This amount is 92 cfs less than Illinois' long term diversion allocation of 3,200 cfs. The 40-year running average diversion, rounded to the nearest cfs, beginning with WY81, is 3,418 cfs and the cumulative deviation from the 3,200 cfs allocation is -3,493 cfs. The negative deviation indicates that the cumulative diversion is greater than an average of 3,200 cfs for the period.

#### *Column 11 Through Column 13: Lake Michigan Diversion Components*

Columns 11 through 13 represent the three (3) Lake Michigan diversion components:

- Column 11 - Lake Michigan pumpage accountable to Illinois (1,782.0 cfs)
- Column 12 - Runoff from the diverted Lake Michigan watershed (882.0 cfs)
- Column 13 - Direct diversion through the lakefront structures (378.8 cfs)

Prior to WY93, a double accounting of runoff from the Calumet ungaged watershed existed. The flow that was double accounted was the infiltration into the separate sanitary sewers within the Calumet ungaged watershed. For a detailed description of this double accounting refer to the Lake Michigan Diversion Accounting Water Year 1990 report contained in the Water Year 1993 Annual Report. This area is discussed in the section on ungaged watershed modeling under the main section on areas for improvement. The correction in WY93 for this double accounting was based solely on area proportioning from sewer maps. Unfortunately, separately sewer SCA's in SCALP do not contain actual areas. Therefore, the approximations that were made for tributary areas for the separate sewers could not be cross-checked against the SCALP models for accuracy. The infiltration into the separate sewers within the ungaged Calumet watershed was ultimately subtracted from the computation of runoff from the Lake Michigan watershed.

The sum of the columns (3,042.8 cfs) should theoretically equal the total diversion as shown in Column 10 (3,107.5 cfs), with one exception. The Romeoville record measures sewer effluent instead of water supply pumpage, while Column 11

(Lake Michigan water supply pumpage accountable to Illinois) does not account for consumptive use. This difference is consumptive loss, the water supply pumpage that is consumed or lost prior to reaching the water reclamation facilities. This consumptive loss is estimated as 10% of the water supply pumpage (International Great Lake Diversion Consumptive Use Study Board, 1981).

Because the diversion estimate from Columns 11 - 13 is based on simulation, suspect ratings of the lakefront structures (which underestimate leakage), and simple flow separation techniques, the estimate is not expected to be as accurate as the AVM based calculations. Consequently, a difference between estimates of 64.7 cfs or 2.1% is an excellent balance. However, this balance is largely due to the consumptive losses included in Column 11 being offset by underestimated flows in Column 13. The discrepancy between Column 10 and the sum of Columns 11, 12, and 13 is related to the canal system balance in Budget 14. This budget is discussed in a subsequent section, and potential sources of the discrepancy are addressed in that discussion.

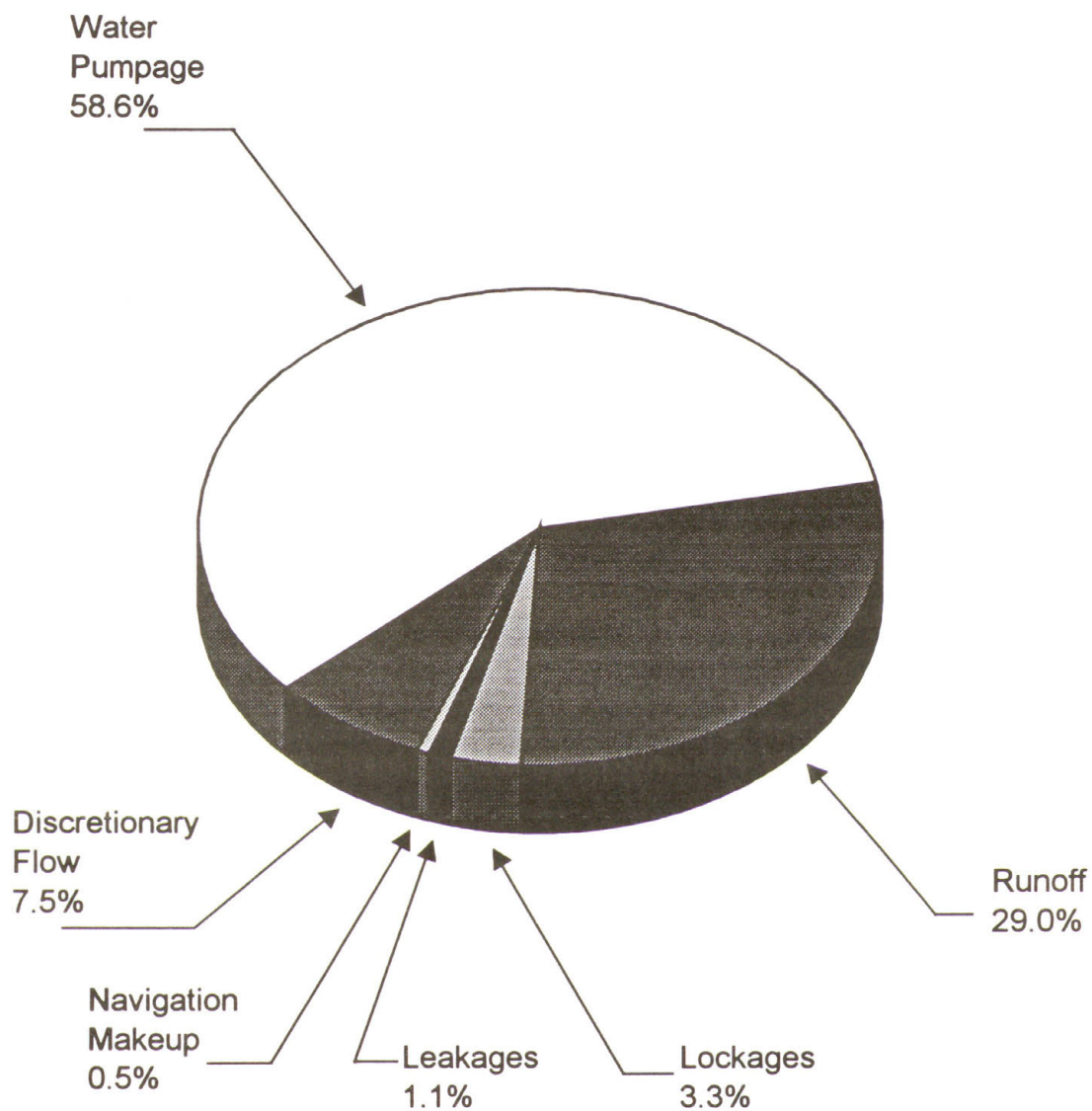
Using the figures from these three (3) columns, 58.6% of the WY96 Illinois diversion is attributable to pumpage from Lake Michigan for domestic water supply, runoff from the diverted Lake Michigan Watershed accounted for 29.0% of the diversion, and direct diversion through the lakefront structures accounted for 12.4% of the diversion. Water supply from Lake Michigan decreased 45.8 cfs from WY95 to WY96. Due to increased rainfall between WY95 and WY96, the runoff from the Lake Michigan watershed increased 84.4 cfs between WY95 and WY96. Direct diversions decreased 101.3 cfs between WY95 and WY96. A more detailed breakdown of these percentages is shown in Table 5 and Figure 3.

**Table 5**

**Components of the Diversion by the State of Illinois  
Based on Columns 11 Through 13**

<b>Description</b>	<b>Average Flow (cfs)</b>	<b>Percentage of Total Flow</b>
<b>Lake Michigan Pumpage by the State of Illinois</b>	<b>1,782.0</b>	<b>58.6%</b>
<b>Runoff from Diverted Lake Michigan Watershed</b>	<b>882.0</b>	<b>29.0%</b>
<b>Total Direct Diversions</b>	<b>378.8</b>	<b>12.4%</b>
<b>Breakdown of Direct Diversions</b>		
<b>Lockages</b>	<b>100.3</b>	<b>3.3%</b>
<b>Leakages</b>	<b>34.8</b>	<b>1.1%</b>
<b>Navigation Makeup Flow</b>	<b>16.1</b>	<b>0.5%</b>
<b>Discretionary Flow</b>	<b>227.5</b>	<b>7.5%</b>
<b>- Total Backflow for WY96 was -6.43 cfs (not included in the values above)</b>		

**Figure 3** Component Breakdown of Illinois' Diversion Based Upon Columns 11 through 13



## **Budgets**

The first two (2) budgets are used to sum the diverted water supply. The next four (4) budgets are of stream gage sites that are not simulated and are used as part of the calculation of the runoff from the diverted Lake Michigan watershed. The next seven (7) budgets compare measured and simulated flows and compute Column inputs used in the diversion computations. The final budget is a canal balance of total inflows and outflows. These fourteen budgets are listed in Table 2.

### ***Budget 1 and Budget 2: Water Supply Pumpage***

Budgets 1 and 2 are summations of critical water supply pumpage data. Budget 1 sums Lake Michigan water supply diverted by the State of Illinois. The Lake Michigan water supply data is supplied by the state as daily values for primary users and monthly data for secondary users. Budget 2 sums groundwater pumpages in the Lake Michigan and Des Plaines River watersheds that are diverted to the CSSC. Groundwater pumpage data is recorded by the ISWS as a total annual withdrawal based on calendar years.

#### **Budget 1: Diverted Lake Michigan Water Supply**

Budget 1 represents the summation of Lake Michigan pumpage accountable to the State of Illinois. This budget is a duplication of Column 11. For WY96, the average annual Lake Michigan pumpage accountable to Illinois is 1,782.0 cfs. This flow is a decrease of 45.8 cfs from WY95.

#### **Budget 2: Groundwater Diverted to the CSSC**

Budget 2 is groundwater water supply pumpage by communities, industrial users, and other private users whose effluent is discharged to the canal. The contents of this budget are also contained in Column 4. The groundwater pumpage data are reported by the ISWS on a calendar year basis. The groundwater quantity is determined by summing all reported groundwater sources in the area tributary to the CSSC, less groundwater not discharged to the CSSC in the form of CSO's.

Using the ISWS groundwater records, groundwater pumpages were assumed to reach the CSSC and adjoining channels if they were located in the diverted Lake Michigan watershed in Illinois, or if they were located within MWRDGC service boundaries in which their effluent was discharged into the CSSC and adjoining channels.

The total groundwater pumpage by communities, industrial users, and other private users whose sanitary effluent is tributary to the canal is 37.2 cfs for WY96. Simulation determined that all of this flow reached the canal. In most years a small

portion of the groundwater normally tributary to the CSSC is discharged to the Des Plaines River or other watercourses not tributary to the canal in the form of CSO's. The total groundwater pumpage reaching the canal represents an increase of 2.5 cfs from WY95 to WY96.

In addition to groundwater supply pumpage, there was also a significant amount of groundwater infiltration into the two TARP systems that ultimately reached the canal. Mainstream TARP and Calumet TARP accounted for 49.5 cfs and 9.5 cfs, respectively, of groundwater discharged to the canal during WY96.

### *Budgets 3 Through Budget 6: Stream Gaging Stations*

The stream gage budgets are used to make estimates of runoff from portions of the diverted Lake Michigan watershed. Sanitary and other point source flows are subtracted from the stream gaging record to develop the runoff estimates. The runoff estimates are used in Column 12. The flows at the stream gaging sites are also part of Budget 14, the canal system budget.

Table 6 presents the estimated runoff from these budgets. Note that Budgets 4 and 5 contribute flows to Budget 6 in that they are upstream of, or tributary to, the Little Calumet River at South Holland. Also note that the Little Calumet River is a losing stream (i.e. it recharges groundwater). The computations in deriving runoff account for this when recharge is significant (i.e., when groundwater recharge is computed). The streamflow in Budget 6 is the total flow at the gage, while the runoff is an incremental volume that occurs downstream of both the Little Calumet River at the State Line and Thorn Creek at Thornton.

**Table 6**  
**Stream Gage Flow Separation**

Budget Number	Location	Stream Flow (cfs)	Sanitary Flow (cfs)	Runoff (cfs)
3	North Branch Chicago River at Niles, IL	128.7	19.0	109.7
4	Little Calumet River at IL-IN State Line	86.3	5.9	80.4
5	Thorn Creek at Thornton, IL	123.3	18.9	104.4
6	Little Calumet River at South Holland, IL	209.8		12.5

## *Budgets 7 Through Budget 13: MWRDGC Water Reclamation Facilities*

The budgets for the water reclamation plants compare the simulated flows to the measured inflows at the MWRDGC facilities and perform verifications of the diversion accounting program. The simulated flows were developed from an estimated sanitary flow with a daily, weekly, and monthly flow variation, from hydrologic precipitation-based runoff models, and from hydraulic sewer routing models. The estimated sanitary flow input to the hydraulic simulation models is based on the population estimates for each plant's service basin. Per capita sanitary flows are determined based on the service basin's water supply minus an assumed 10% consumptive loss (International Great Lakes Diversion Consumptive Use Study Board, 1981). Simulated flows were compared with recorded inflows at each facility to assess the accuracy of the simulations. The discussion of the budgets will concentrate on the results of each individual simulation as the development of these models have been discussed in previous reports.

### **Budget 7: Northside Water Reclamation Facility**

Budget 7 analyzes the water balance at the MWRDGC Northside Water Reclamation Facility (Figure 4). The balance for WY96 of the inflow to the Northside facility is excellent. The simulated to adjusted recorded inflow ratio (S/R) for the Northside WRP is 0.96, indicating that the simulated inflow volume is slightly less than the adjusted observed inflow volume. The coefficient of correlation (R) of simulated to observed flow is 0.86, indicating that the model predicted the inflow hydrograph to the Northside facility well. Refer to table 7 for a statistical summary of the simulation results.

### **Budget 8: Upper Des Plaines Pump Station**

Budget 8 analyzes the water balance at Upper Des Plaines Pump Station (UDPPS) (Figure 5). The pump station budget is used to verify simulated flows. Although it has no direct impact on the diversion calculation, it is intended to be used as a primary calibration point for the models that simulate the deductible runoff from the Des Plaines watershed contained in Column 6. This will be possible only after the existing measurement problems at that site are resolved. This has been previously discussed in the WY90 diversion report. Since the records of the UDPPS were not available from the MWRDGC, a comparison of the simulated with the recorded flows was not possible for WY96.

While the statistical comparisons of simulated and recorded flows at the UDPPS are routinely conducted, there exists a need to investigate alternative flow

**Table 7**  
WY 1996 Summary of Simulation Statistics

Budget No.	7	8	9	10	11	12	13	14
Description	Northside WRP (1)	Upper Des Plaines Pump Station (1),(3)	Mainstream TARP Pump Station (2)	Stickney WRP (1),(4)	Calumet TARP Pump Station (2)	Calumet WRP (1),(4)	Lemont WRP (1)	Chicago Canal System Balance (1)
Mean Recorded Flow, cfs	409.4	N/A	88.0	1,088.7	47.1	367.0	2.7	3,178.7
Max. Recorded Flow, cfs	758.3	N/A	312.2	2,131.8	176.6	724.4	6.9	18,386.0
Min. Recorded Flow, cfs	156.0	N/A	12.6	726.6	5.5	111.5	1.6	1,622.0
Mean Simulated Flow, cfs	392.9	63.1	98.5	1,092.5	30.8	373.6	1.9	3,180.1
Max. Simulated Flow, cfs	621.9	170.0	210.4	2,560.7	135.4	635.8	5.4	21,523.0
Min. Simulated Flow, cfs	305.6	40.1	40.5	827.1	6.4	296.0	1.2	1,614.0
Mean S/R	0.96	N/A	1.12	1.00	0.65	1.02	0.69	1.00
Max. S/R	2.18	N/A	5.63	1.74	4.95	3.34	1.37	2.37
Min. S/R	0.70	N/A	0.43	0.66	0.18	0.77	0.36	0.58
Correlation	0.86	N/A	0.73	0.82	0.42	0.91	0.82	0.85

(1) Based on daily values.

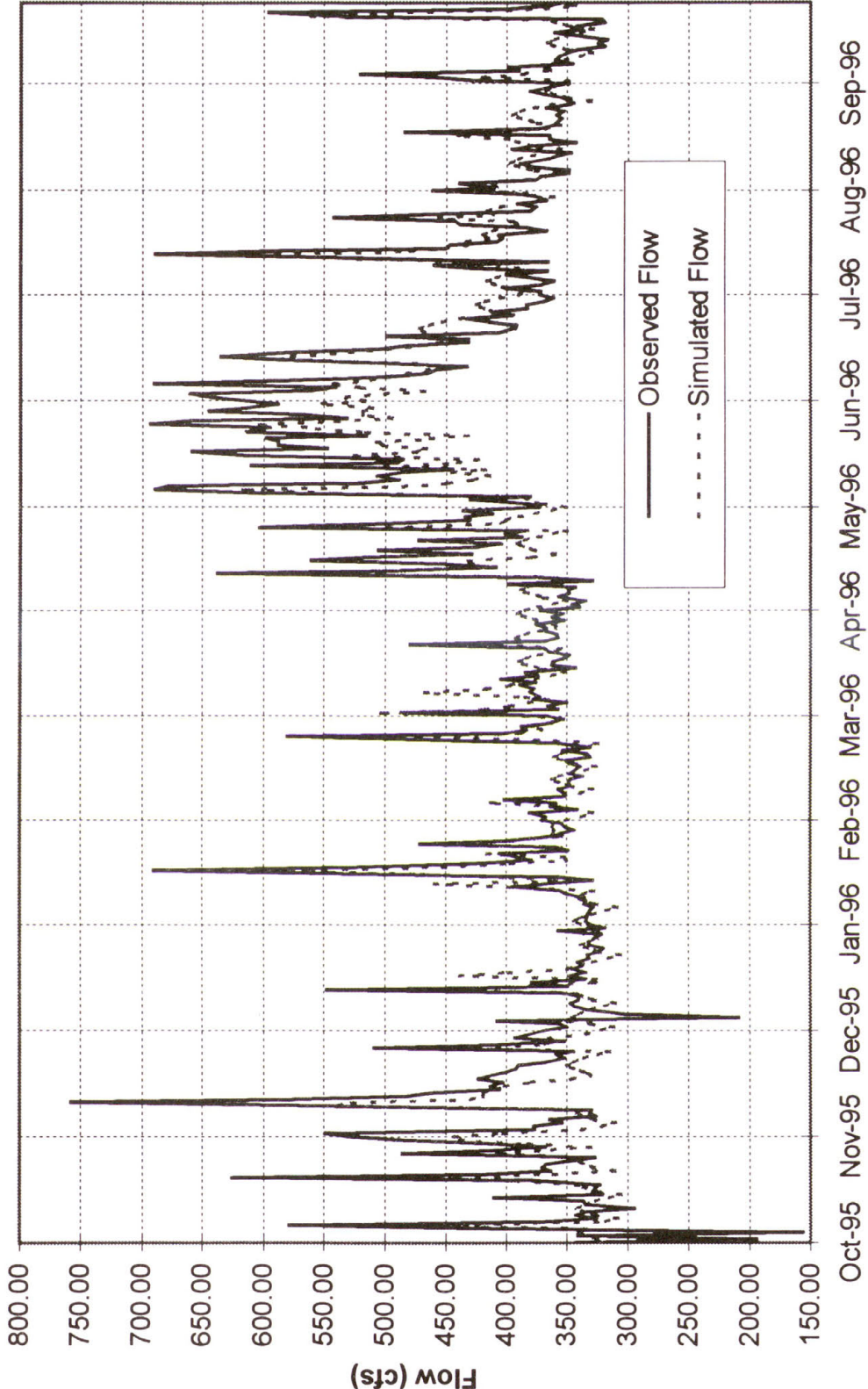
(2) Based on weekly values.

(3) Does not include days with missing records.

(4) Does not include pumpage from TARP.

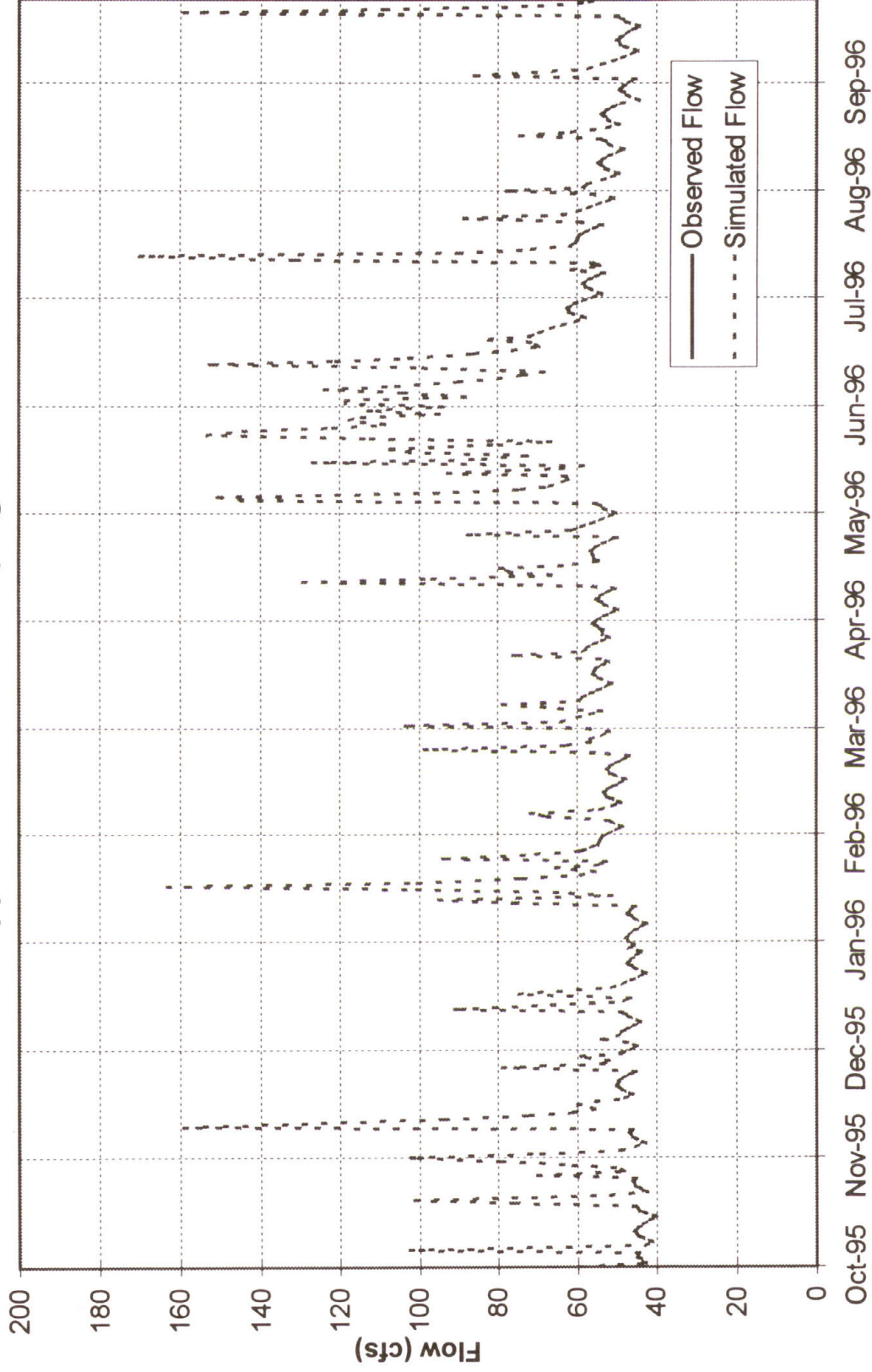
N/A - Data not available

# Northside WRP



**Figure 4** Budget 7 - Simulation of the MWRDGC Northside Water Reclamation Facility

## Upper Des Plaines Pumping Station



**Figure 5** Budget 8 - Simulation of the MWRDGC Upper Des Plaines Pump Station

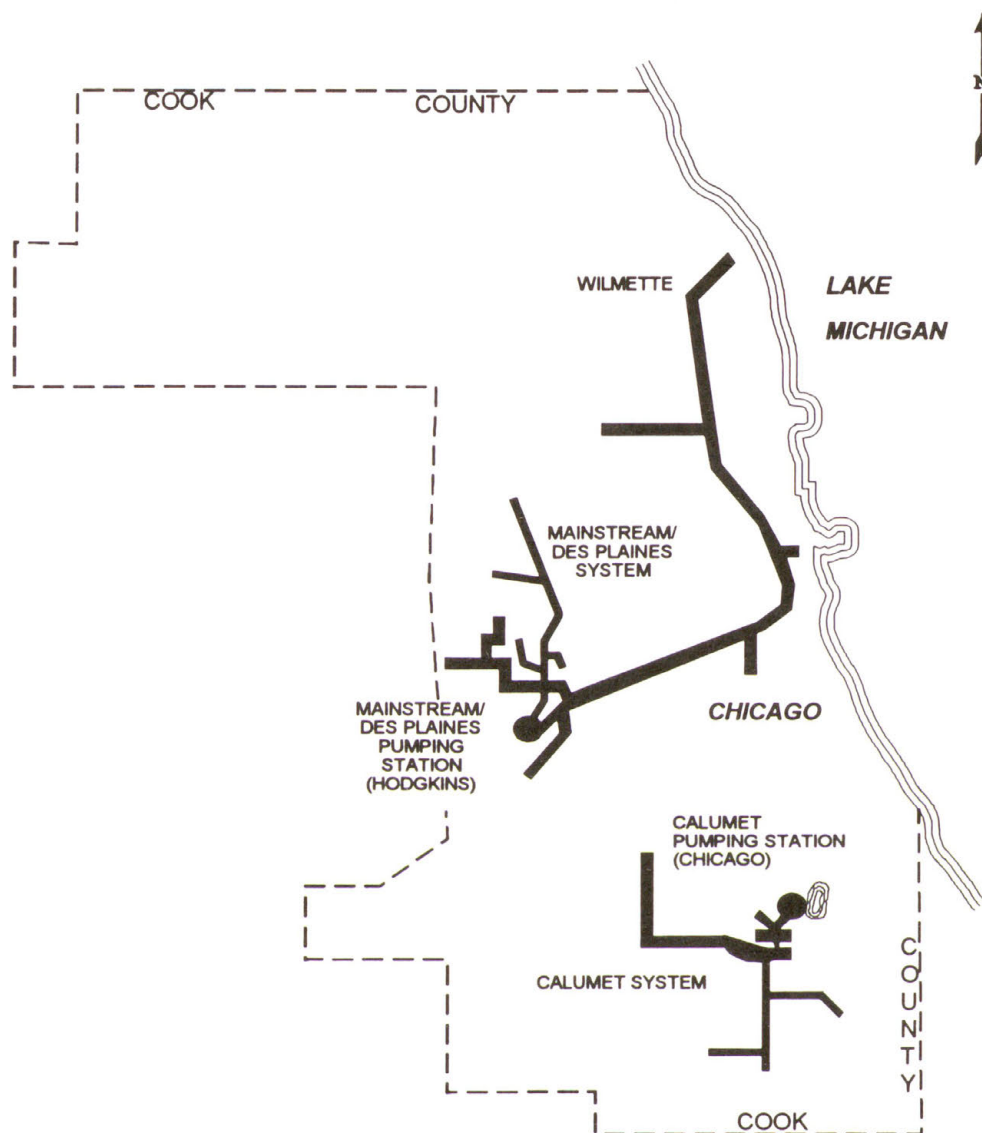
measurement techniques. This site has continued to experience its share of problems. Normally, a large number of days of records are unavailable due to meter malfunctions, problems with the recording charts which make data transformation impossible, and various other reasons. Since all of the records for WY96 were unavailable, the quantitative analysis of the simulation was not possible. Additionally, the accuracy of the flow meters at the pump station is questionable and unmetered bypass flows are a frequent occurrence. Therefore, total flow may not be measured in storm events and the recycling of flow is possible. Further investigation of the accuracy of flow measurement at the pump station is required to verify and calibrate the simulation models that compute the deductible runoff from the Des Plaines watershed contained in Column 6.

#### Budget 9: Mainstream and Des Plaines TARP Pumping Stations

Beginning 6 June 1993 the south and middle legs of the Des Plaines TARP system became operational. Consequently, these tunnels were added to the modeling of the TARP system for WY93. The Des Plaines tunnel system, like that of the Mainstream TARP system, flows by gravity to the West Southwest Water Reclamation facility in Stickney. Flows are pumped from the Des Plaines tunnel to the West Southwest plant using pumps independent of those used for the Mainstream tunnels. The Des Plaines system, like the Mainstream system, is modeled with independent index drop shafts which set the opening and closing sequence of various control structures along the tunnel system. The opening and closing sequences are based on water surface elevations at the index drop shafts. Water surface elevation trigger points are set at the downstream pumping station. These points tell the model when to turn the pumps on or off.

Budget 9 analyzes the water budget at the MWRDGC Mainstream and Des Plaines TARP Pumping Stations. The results of Budget 9 are used as a verification point for simulated flows. Budget 9 also is used for the purpose of computing a portion of Column 6 (Des Plaines River watershed runoff deduction). The deductible portion of Budget 9 includes groundwater seepage into the TARP tunnel walls and Des Plaines River watershed runoff captured by Mainstream and Des Plaines TARP as overflows. The modeling of Mainstream and Des Plaines TARP is performed using the Tunnel Network (TNET) dynamic hydraulic model. A simplified map of Mainstream and Des Plaines TARP is contained in Figure 6. A more in-depth description of Mainstream TARP and the simulation model is contained in the Water Year 1986 report, which is an appendix to the Diversion Accounting Annual Report for WY90-92 (USACE, 1994).

In analyzing the balance at the Mainstream and Des Plaines TARP Pumping Stations, weekly flows were used rather than daily flows. While MWRDGC maintains daily pumpage records, days with no pumpage occur frequently. Therefore, it is not appropriate to compute a daily S/R ratio. Additionally,



**Figure 6** Map of Mainstream, Des Plaines and Calumet TARP

MWRDGC tends to pump from the tunnels at night, while the model simulates pumpage based on water elevations at the downstream end of the tunnel.

The balance for WY96 of the inflow to the Mainstream and Des Plaines TARP Pumping Stations is good. The simulated to recorded flow ratio (S/R) for the Mainstream and Des Plaines TARP Pumping Stations is 1.12, indicating that the simulated inflow volume is greater than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.73, which is significantly better than the 0.51 correlation in WY95. However, there remains room for improvement in the ability of the model to predict trends in the pump station flows. Table 7 presents a statistical summary of the simulations results.

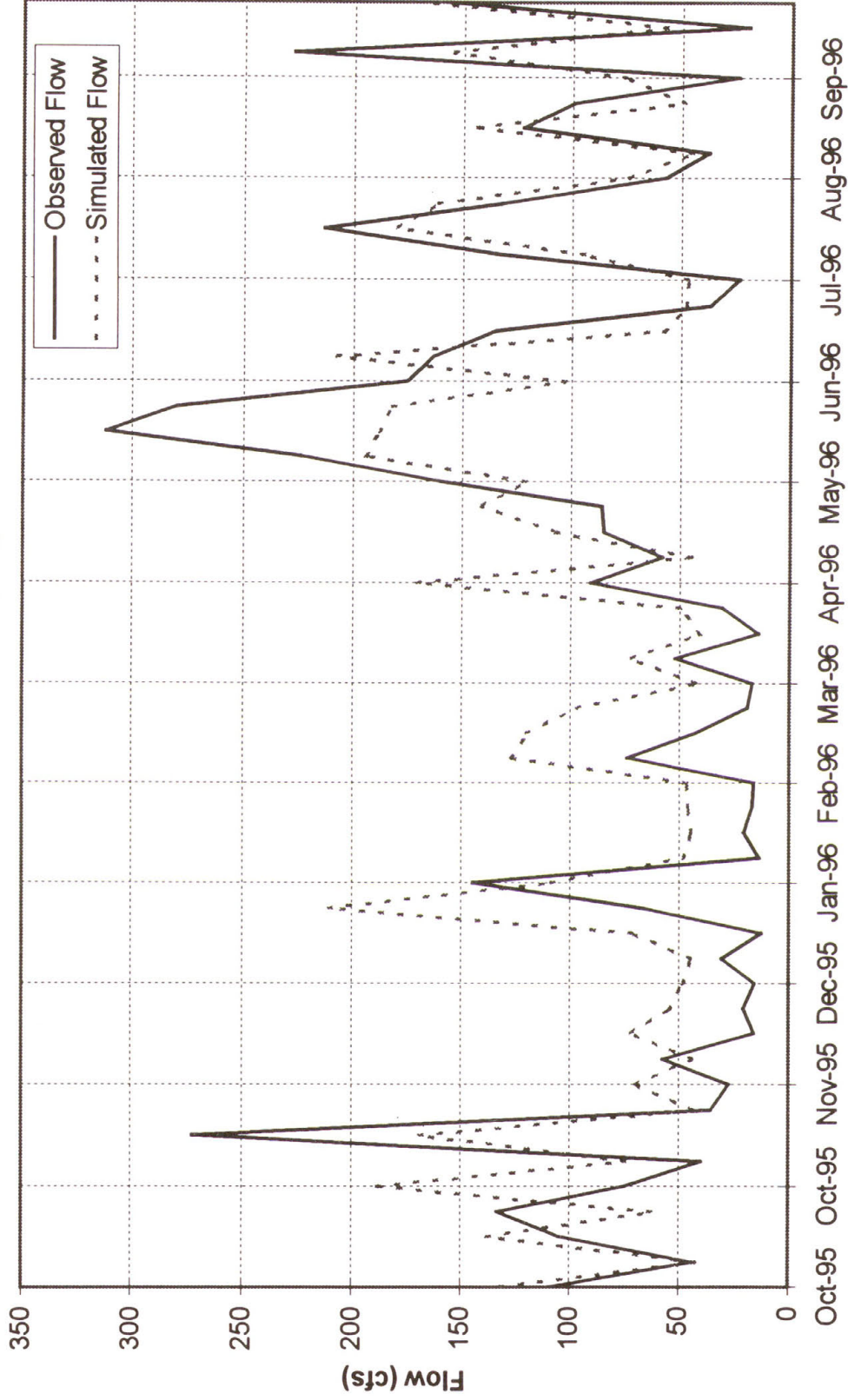
From a review of the plot of the simulated versus recorded flow at the pump station (Figure 7), it appears that the model responds similarly to the recorded pumpage record. However, the model is sometimes out of phase with the observed record. This could be the result of simulated pumpages occurring sooner and more frequently than actual pumpages. The TNET model simulated pumpage that normally turned on sooner and pumped more frequently in order to maintain computational stability during a simulation.

In summary, it appears that the simulation of the Mainstream and Des Plaines TARP systems is reasonable. However, there is concern regarding the difference in simulated and recorded pumpage time series.

#### Budget 10: Stickney Water Reclamation Facility

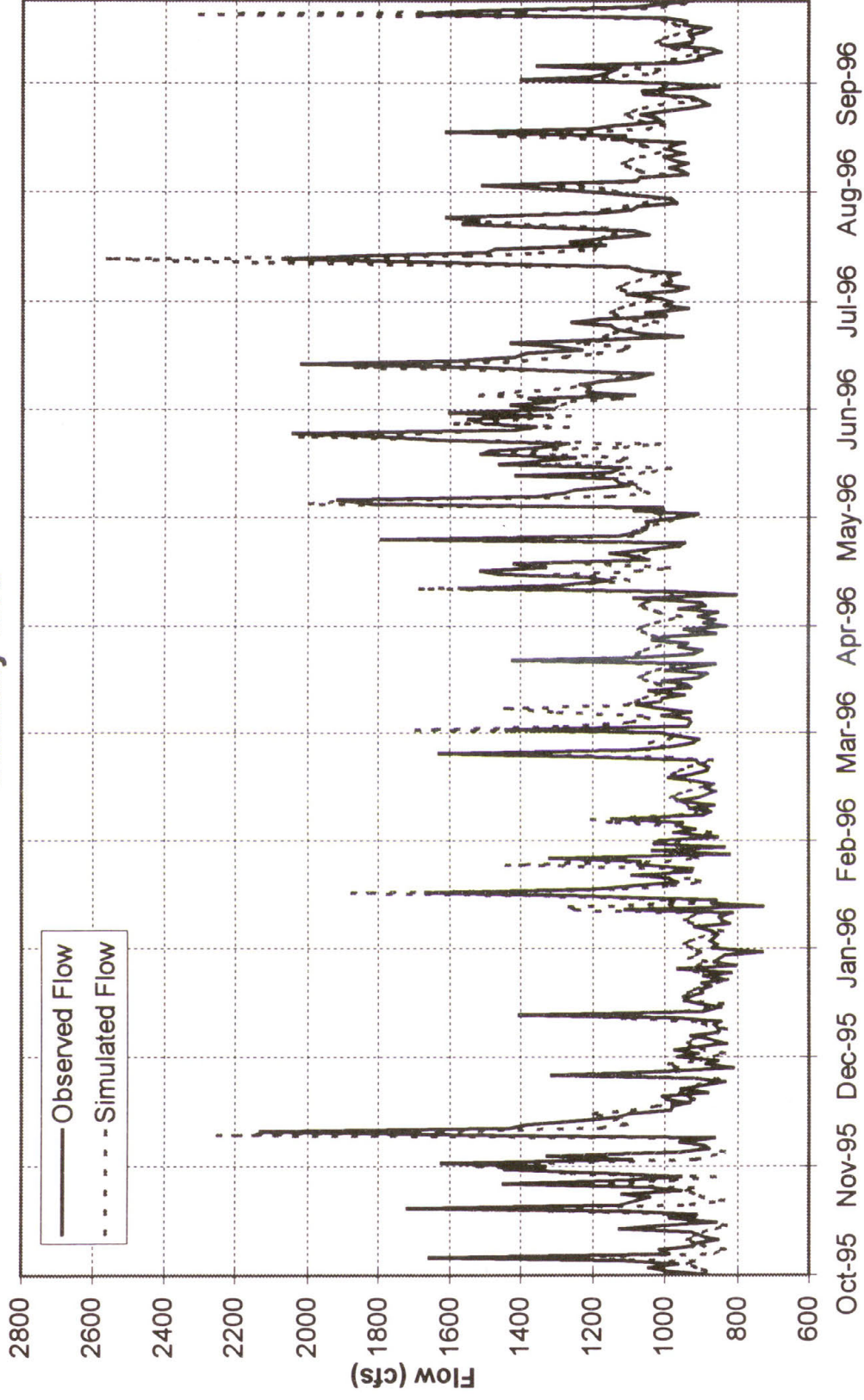
Budget 10 analyzes the water balance at the MWRDGC Stickney Water Reclamation Facility (Figure 8). Simulated Mainstream and Des Plaines TARP pumpages from Budget 9 are no longer combined with simulated interceptor inflow to the Stickney Water Reclamation Facility to derive the total simulated inflow to the Stickney Facility. Instead, only simulated interceptor inflows are compared with recorded interceptor inflows to assess the accuracy of the simulation. The decision to not include TARP pumpages in the treatment plant budgets was based on the fact that the TARP systems are already analyzed in separate budgets. Including TARP pumpages in the treatment plant budgets is detrimental to the statistical results of the treatment plant budgets, since the TARP models generally do not respond as well. When simulations of interceptor flows are treated separately, the response of the hydrologic runoff models (HSPF) and the hydraulic sewer routing models (SCALP) can be better isolated and not diluted by the TARP model results, which are analyzed separately on their own merits and contained in their own budgets (Budgets 9 and 11).

## Mainstream TARP Pumping Station



**Figure 7** Budget 9 - Simulation of the MWRDGC Mainstream and Des Plaines TARP Pumping Station

## Stickney WRP



**Figure 8** Budget 10 - Simulation of the MWRDGC Stickney Water Reclamation Facility

Overall, the balance for WY96 of the inflow to the Stickney facility is excellent. The simulated to recorded flow ratio (S/R) for the Stickney plant is 1.00, indicating that the simulated interceptor inflow volume is matching the recorded interceptor inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.82, indicating that the model performed well in predicting the trends in the interceptor inflow hydrographs to the Stickney facility. Refer to table 7 for a statistical summary of the simulation results.

#### Budget 11: Calumet TARP Pumping Station

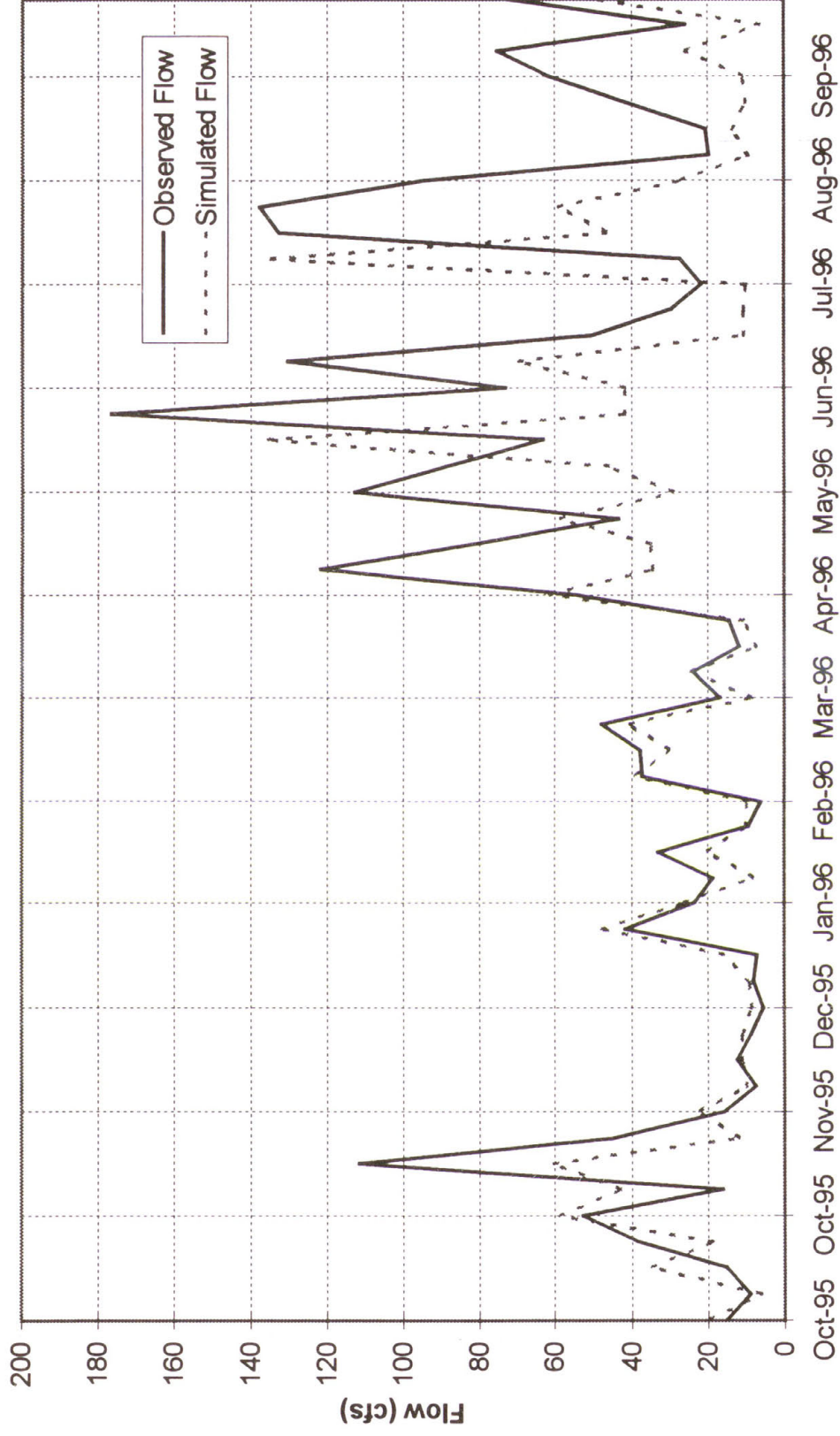
Budget 11 analyzes the water budget at the MWRDGC Calumet TARP Pumping Station (Figure 9). The results of Budget 11 are used as a verification point for simulated flows. The modeling of Calumet TARP is performed using the Tunnel Network (TNET) dynamic hydraulic model. A simplified map of Calumet TARP is contained in Figure 6. A more in-depth description of Calumet TARP and the simulation model is contained in the Water Year 1987 report contained in the Diversion Accounting Annual Report for WY90-92 (USACE, 1994). For WY96 the Calumet TNET model was changed to incorporate additional tunnel segments that went on line. Some modifications to the tunnel geometry (slope, invert, diameters, lengths, roughness) of existing reaches was also changed to reflect as-built drawings. For WY96, the new tunnel reaches (Indiana Ave, 140<sup>th</sup> St., Markham) were added and the dropshafts associated with the new tunnel were not activated in the TNET model until April 1, 1996, the approximate date at which they were physically activated by MWRDGC.

In analyzing the balance at the Calumet TARP Pumping Station, weekly flows were used instead of daily flows. While MWRDGC maintain daily pumpage records, days with no pumpage occur frequently. Additionally, MWRDGC tends to pump at night, while the model pumps more frequently based on water elevations at the downstream end of the tunnel. Therefore, it is not appropriate to compute a daily S/R ratio.

The balance for WY96 of the inflow to the Calumet TARP Pumping Station is fair. The simulated to recorded flow ratio (S/R) for the Calumet TARP Pumping Station is 0.65 indicating that the simulated inflow volume is less than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.42, indicating a need for improvement in the ability of the model to predict trends of the recorded Calumet TARP pumpages. Table 7 contains a statistical summary of the simulation results.

Volume matching between the simulated and recorded Calumet TARP pumpages also was more difficult for WY96 as evidenced by the 0.65 S/R ratio. Because of the instability of the TARP model, as well as uncertainties in the Calumet TARP system, it was difficult to improve on this ratio. However, as the

## Calumet TARP Pumping Station



**Figure 9** Budget 11 - Simulation of the MWRDGC Calumet TARP Pumping Station

system is presently modeled, this does not impact the computed diversion, since all Des Plaines River watershed areas whose overflows are modeled as tributary to Calumet TARP are also modeled such that "non-captured" overflows flow to rivers that are tributary to the CSSC. Therefore, whether or not these Des Plaines River watershed runoff flows enter the tunnel or not, they are presently included in the Des Plaines River watershed runoff deduction in Column 6. This assumption will remain until separately sewerage areas are modeled such that actual areas are used instead of effective areas in the hydraulic models. This has been discussed in the WY90 diversion accounting report.

#### Budget 12: Calumet Water Reclamation Facility

Budget 12 analyzes the water balance at the MWRDGC Calumet Water Reclamation Facility (Figure 10). Simulated Calumet TARP pumpages from Budget 11 are no longer combined with simulated interceptor inflows to the Calumet Water Reclamation Facility to derive the total simulated inflow to the Calumet Facility. Instead, only simulated interceptor inflows are compared with recorded inflows to assess the accuracy of the simulation. This was revised for the same reasons as outlined previously in the discussion for Budget 10.

The annual simulated to recorded flow ratio (S/R) and the coefficient of correlation for the Calumet Water Reclamation Facility are considered excellent. The S/R ratio is 1.02 indicating that the simulated Calumet interceptor flow volume was slightly more than the recorded interceptor flow volume. The coefficient of correlation was 0.91 indicating a very good correlation between simulated and recorded interceptor flows. Refer to table 7 for a statistical summary of the simulation results.

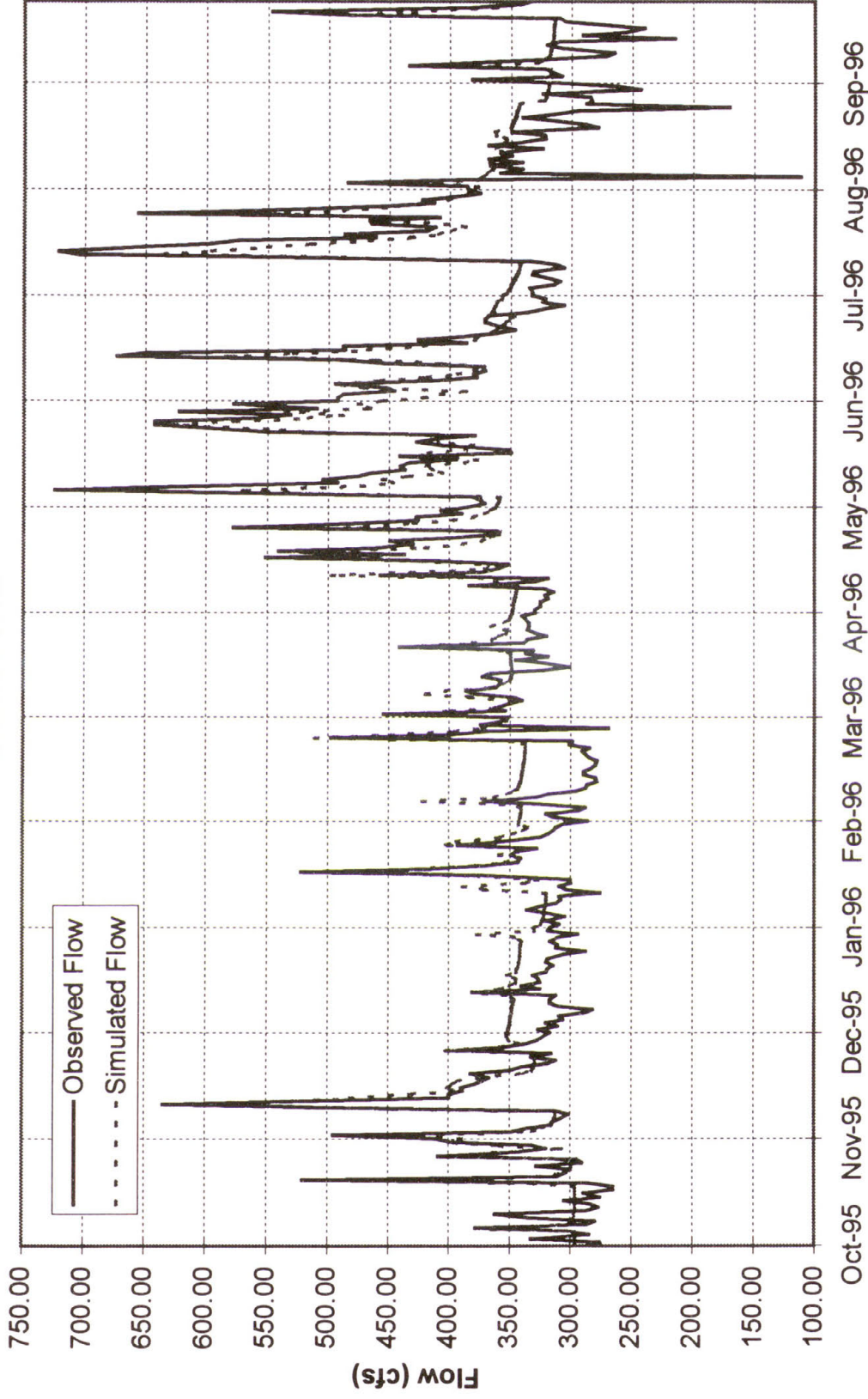
#### Budget 13: Lemont Water Reclamation Facility

Budget 13 analyzes the water balance at the MWRDGC Lemont Water Reclamation Facility (Figure 11). Overall, the balance for WY96 of the inflow to the Lemont facility is good. The simulated to recorded flow ratio (S/R) for the Lemont is 0.69, indicating that the simulated inflow volume was less than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.82, indicating that the model predicted the inflow hydrograph to the Lemont facility reasonably well. Table 7 contains a statistical summary of the simulation results.

#### Aggregated Results of Four MWRDGC Water Reclamation Facilities

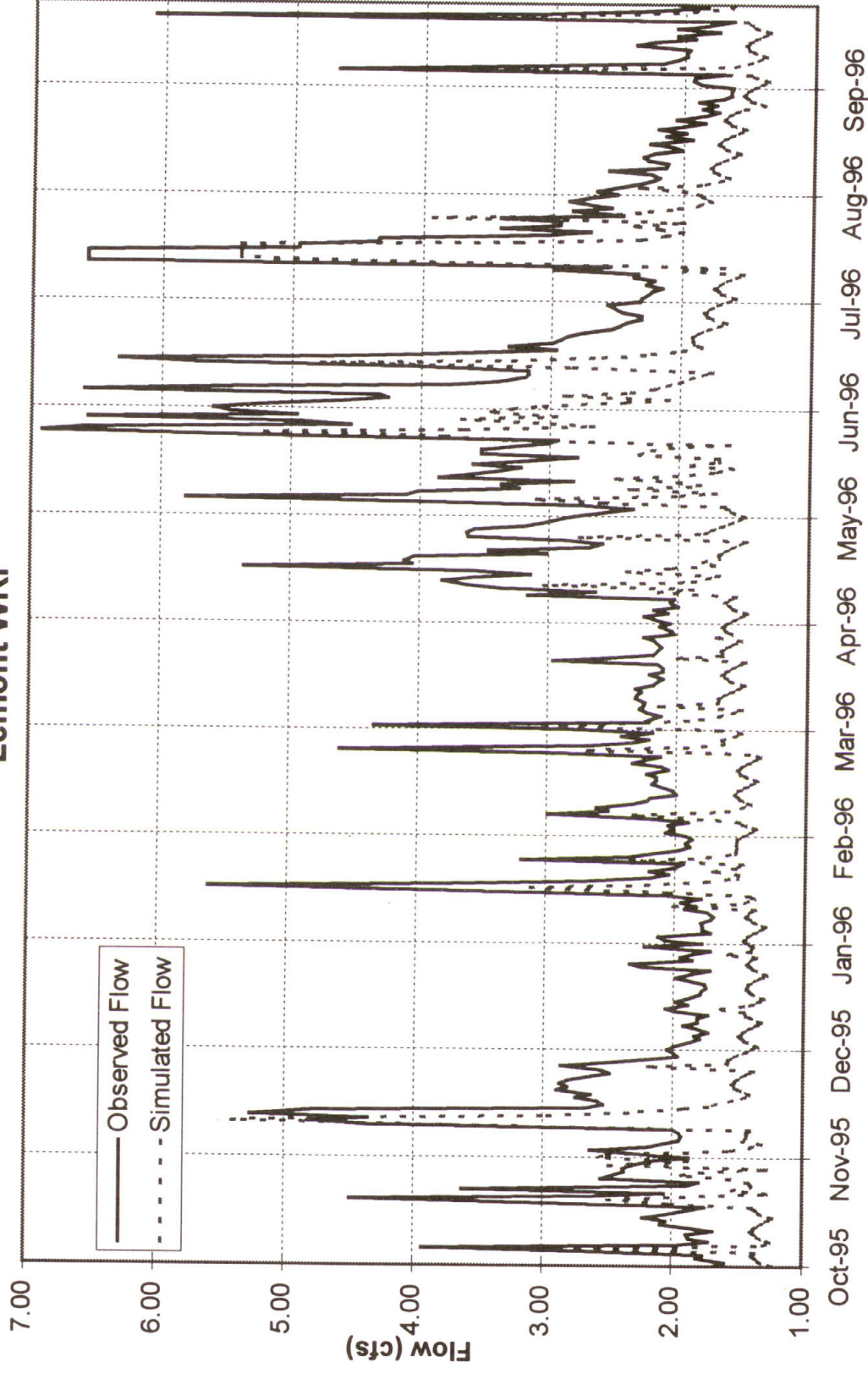
The aggregated simulated inflows (not including TARP) to the four modeled MWRDGC water reclamation facilities are 1860.9 cfs while the measured inflows are 1867.8 cfs. This results in an excellent aggregated S/R ratio of 0.996.

# Calumet WRP



**Figure 10** Budget 12 – Simulation of the MWRDGC Calumet Water Reclamation Facility

# Lemont WRP



**Figure 11** Budget 13 – Simulation of the MWRDGC Lemont Water Reclamation Facility

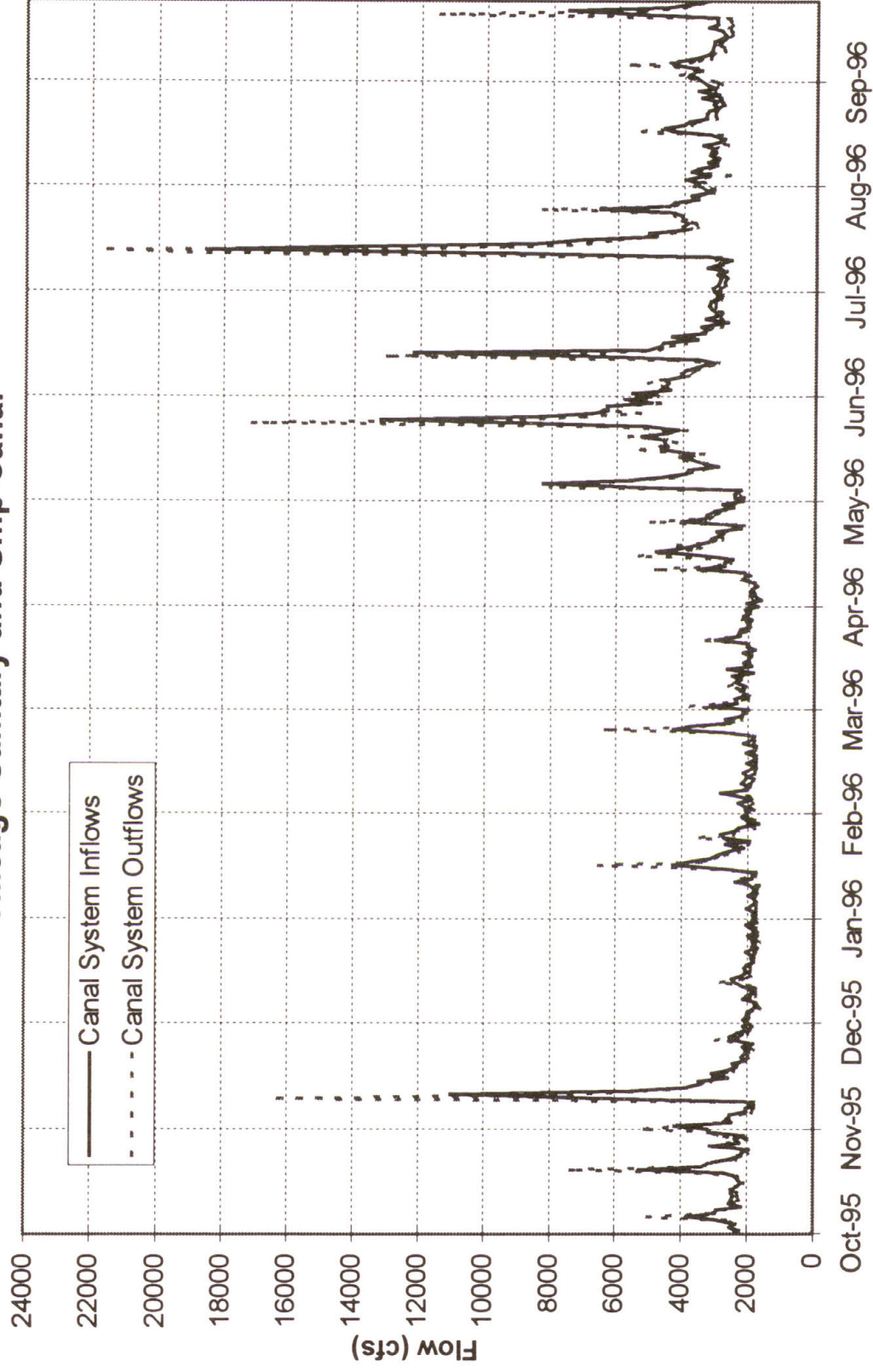
#### *Budget 14: CSSC System Balance*

Budget 14 compares the inflows and outflows to the CSSC system (Figure 12). The inflow components include direct diversions through the lakefront structures, stormwater runoff discharged to the canal system, and domestic water supply whose effluent discharges to the canal system. The outflows from the canal system include the discharge past the Romeoville AVM, backflows through the lakefront structures and withdrawals upstream of Romeoville by Argonne National labs and Citgo Petroleum Corporation. The individual components are presented in Table 8 for WY96.

Overall, the balance for WY96 between the inflows to the canal system and the outflows from the canal system is excellent. The S/R (inflow/outflow) for the canal system is 1.00, indicating that the inflow to the canal system matches the outflow from the canal system. The average measured/simulated inflow was 3,180.1 cfs while the average measured/simulated outflow was 3,178.7 cfs. The difference is 1.4 cfs (less than 0.1%) for WY96, as compared to 4.5 cfs (0.1%) for the previous water year, WY95. Refer to table 7 for a statistical summary of the measured/simulated results.

The coefficient of correlation (R) of inflow to outflow is 0.85, indicating that the time series trends of inflow to outflow are well correlated. The coefficient of correlation is based on daily flows. Timing between inflows and measured outflows at Romeoville is the major factor in the differences, especially during changes in flow that occur at the beginning or end of a day. Also, part of the difference in the correlation is the result of travel time from inflow locations downstream to the Romeoville AVM site. Therefore, variability in the coefficient of correlation from year to year may be attributed to the variability in the timing of significant flow changes during a particular year.

## Chicago Sanitary and Ship Canal



**Figure 12 Budget 14 – CSSC System Balance**

**Table 8 – WY1996 Summary of Flow Components for the CSSC System Balance**

<b>INFLOWS (cfs)</b>	
Lake Controlling Structures (measured)	
- Wilmette Controlling Works	29.1
- Chicago River Controlling Works	149.6
- O'Brien Lock and Dam	200.1
Streamflows (measured)	
- North Branch Chicago River at Niles	128.7
- Little Calumet River at South Holland	209.8
- Grand Calumet River at Hohman Ave.	36.3
MWRDGC Water Reclamation Facilities (measured)	
- Northside	409.5
- Stickney	1,178.6
- Calumet	414.3
- Calumet TARP Pumpage to River	0.0
- Lemont	2.7
Other Point Sources (measured)	6.4
Summit Conduit (simulated)	12.3
Combined Sewer Overflows (simulated)	219.9
Direct Runoff to CSSC (simulated)	182.9
<b>TOTAL INFLOWS (cfs)</b>	<b>3,180.1</b>
<b>OUTFLOWS (cfs)</b>	
Cal-Sag Flow Transferred to Calumet WRP as Steel Mill Blow-down	2.5
Lake Front Backflows	6.4
Argonne Laboratory	0.6
Citgo Petroleum Corporation	6.8
USGS AVM Record	3,162.4
<b>TOTAL OUTFLOWS (cfs)</b>	<b>3,178.7</b>
<b>DIFFERENCE (cfs)</b>	<b>1.4</b>

## **Areas for Improvement**

### *Impervious Model Estimates*

During a review of the detailed Lake Michigan watershed runoff study conducted by the Corps of Engineers during the Lake Michigan Diversion Accounting mediations, it was determined that the hydraulic connectivity of the impervious areas used in the rainfall-runoff modeling was not fully accounted for when the models were revised for the WY90 accounting. As a result, the models appear to overestimate runoff. However, the treatment plant balances remained very good after the model revisions. The most significant effect is in the simulated overflows, which greatly increased after WY90. A detailed study should be conducted of the pervious and impervious percentages applied to the various land use types used for the model and, if necessary, the hydraulically connected impervious areas within the SCALP models should be adjusted for each SCA.

### *Tunnel and Reservoir Plan Models*

The primary purpose of the TARP models is to accurately estimate deductible components of the diversion such as the Des Plaines River watershed runoff and groundwater infiltration through tunnel walls. Low flows, or dry weather flows, must be modeled accurately so that groundwater infiltration into the two TARP systems is properly modeled. These flows constitute a substantial deduction to the diversion and are included in the deductible groundwater flows of Column 4. Therefore, the estimates of simulated groundwater infiltration rates need to be updated periodically to better match the simulated to the recorded dry-weather flows. Procedures for updating simulated dry-weather flows are similar to those used for improving the simulated groundwater infiltration rates for WY89 Calumet TARP as discussed in the WY89 Accounting Report in the Lake Michigan Diversion Accounting Annual Report for WY90-92.

In the Calumet system, some sanitary sewers are connected to TARP. These sewers must be accurately accounted for in the modeling of groundwater infiltration since they contribute to the baseflow, or dry weather, flow into TARP. Currently, some uncertainty remains as to the connection of the separately sewered areas. For accurate modeling of the Calumet TARP system, these connections need to be verified and adjusted if necessary.

Due to model instability, simulated gate closing and pump operation parameters have been simplified or modified. Improvements for model stability are

required before the models can better represent the operating procedures. Even after this change, representation of "actual" operating procedures may be difficult due to deviations from the TARP system operation plan, i.e. pumping at night, down times for various pumps, changes in pump ratings, implementation of forecasting algorithms, etc. If possible, the TARP models should be revised to better represent actual operating conditions. First, the modeling should more accurately simulate MWRDGC operational procedures that include less frequent pumping and pumping during the night. Second, the incorporation of a pseudo-forecasting algorithm would allow the model to simulate MWRDGC dewatering procedures prior to a storm. Third, dynamic constituent (inflow-infiltration versus sanitary versus groundwater) tracking can be incorporated to allow more accurate determination of the deductible components of TARP flow. Currently, constant constituent proportions, based on annual volumes, are applied to all simulated pumpages from the TARP tunnels. Therefore, constituent flow percentages from TARP remain unchanged during an entire water year. Fourth, the inclusion of an algorithm to operate index dropshafts based on average water surface elevation in a tunnel reach would provide better simulation of "actual" operations. Sudden, localized changes in water surface elevations would not result in frequent opening and closing of control structure gates that regulate the flows into the drop shafts.

#### *MWRDGC Upper Des Plaines Pump Station*

A review of the Upper Des Plaines pump station and its flow record indicates that the flow at the pump station is suspect and subject to operator error. Better flow measurements are needed at the pump station. With better flow measurements, this site will become the most important point for calibrating and verifying the simulation models for the Des Plaines watershed. In the diversion calculation, the primary purpose of modeling is to calculate the deduction for runoff from the Des Plaines watershed that enters the CSSC. The Upper Des Plaines Pump Station is the only point at which a model of the inflow-infiltration can be calibrated and extrapolated to the remaining portions of the Des Plaines River watershed. Because of the many problems associated with the current measurements of flow at this site, the benefits as the primary model calibration point have yet to be realized. Refer to the discussion of Budget 8 for additional details of some of the problems with the current measurements. Installation of better flow measurement equipment at the pump station would facilitate better model calibration.

#### *Assessment of Impact of Using Direct Solar Radiation Versus Cloud Cover*

As mentioned earlier in this report, the computation of potential evapotranspiration (PET) has been changed in WY96. Prior to WY96 the cloud

cover at O'Hare Airport was used in the computation of solar radiation which is then used in the computation of PET. For WY96 a direct measurement of solar radiation from Argonne National Labs was used because the reporting of cloud cover at O'Hare Airport had changed. An assessment of the impact of using direct solar radiation versus cloud cover may be warranted in the future.

### *O'Hare and Egan Basin Flow Transfer*

A portion of the flows originating in the O'Hare and Egan Water Reclamation Plants' (WRP) service basins is transferred east to the Northside WRP. The extent of this transfer of flow is not known and the diverted flow is not currently measured. An estimate of the annual flow transfer is provided by MWRDGC. The total O'Hare-Egan flow transfer has been estimated by the MWRDGC as 31 cfs for the past several years.

This transfer is significant to diversion since the O'Hare and Egan facilities discharge outside of the CSSC while the Northside WRP discharges flows that reach the CSSC. Therefore, this transfer contains two components that are deductions to the flow measured in the CSSC. The two deductible components are groundwater pumpage contained in the sanitary portion of the transfer (Column 4), and diverted Des Plaines River watershed runoff (Column 6).

To determine the two deductible components requires an estimate of the sanitary and runoff portions of the flow transfer. Presently the sanitary and runoff portions of the flow transfer are estimated using the same constituent (sanitary, inflow, and infiltration) proportions simulated for the Upper Des Plaines Pump Station by SCALP. Additionally, estimates must be made of the groundwater and Lake Michigan water components of the sanitary portion of the transfer. For WY96, the estimated water supply from the O'Hare and Egan service basins was composed of 2.2% groundwater (0.5 cfs) and 97.8% Lake Michigan water (21.7 cfs). The diverted Des Plaines River watershed runoff was estimated at 8.7 cfs.

For future accounting, simply measuring the basin transfer will not provide any information on the component makeup of the transfer. Thus, a review of the complex hydraulics and hydrology is necessary to determine the best procedure for estimating these flows. Several alternatives, including flow measurement and modeling are under consideration. A more detailed discussion of the flow transfer can be found in the Lake Michigan Diversion Accounting WY86 Report in the Lake Michigan Diversion Accounting WY90-92 Annual Report.

## **Summary**

In compliance with the 1967 U.S. Supreme Court decree as modified in 1980, the WY96 diversion was computed using the best current engineering practice and scientific knowledge.

Overall, the simulations that comprise a significant portion of the diversion accounting computations worked well. The two most significant budgets to the diversion accounting computations, Budget 7, Northside Water Reclamation Facility, and Budget 10, Stickney Water Reclamation Facility, performed very well. Together, Budgets 7 and 10 compute the majority of the deductible Des Plaines River watershed runoff. These budgets have simulated to recorded ratios of 0.96 and 1.00 and correlations of 0.86 and 0.82, respectively. Given the complexity of the hydrologic cycle in the heavily urbanized Chicago metropolitan area, and given the number of human and other factors that cannot be adequately represented in numerical modeling procedures, the results of these two (2) budgets are very good. Additionally, results for Budget 12, the Calumet WRP, were very good. This budget also models a portion of the deductible Des Plaines River watershed runoff. The S/R ratio was 1.02 while the coefficient of correlation was 0.91.

The WY96 diversion accountable to the State of Illinois is 3,108 cfs. This flow is 92 cfs less than the 3,200 cfs average specified by the Decree. The 40 year running average beginning with WY81 and rounded to the nearest cfs is 3,418 cfs, and the cumulative deviation from the 3,200 cfs average is -3,493 cfs-years. The negative cumulative deviation indicates a water allocation deficit and the maximum deficit allowed by the Decree is 2,000 cfs-years.

## **References**

1. Barkau, Robert L. 1991. *Modeling of the Chicago Tunnel and Canal System*. Prepared for Christopher B. Burke Engineering Ltd. as part of reference 2.
2. Christopher B. Burke Engineering, Ltd. 1991. *Data Collection and Model Revisions*. Prepared for the U.S. Army Corps of Engineers, Chicago.
3. Christopher B. Burke Engineering, Ltd. 1990. *Infiltration and Inflow Study and Diversion Accounting Model Modification*. Prepared for the U.S. Army Corps of Engineers, Chicago.
4. Christopher B. Burke Engineering, Ltd. 1999. *Hydrologic and Hydraulic Study of the Calumet Watershed*. Prepared for the U.S. Army Corps of Engineers, Chicago.
5. Espey, William H., Harry H. Barnes, and Svein Vigander. 1981. *Lake Michigan Diversion Findings of the Technical Committee for Review of Diversion Flow Measurements and Accounting Procedures*. Prepared for the U.S. Army Corps of Engineers, Chicago.
6. Espey, William H., Harry H. Barnes, and David Westfall. 1987. *Lake Michigan Diversion Findings of the Second Technical Committee for Review of Diversion Flow Measurements and Accounting Procedures*. Prepared for the U.S. Army Corps of Engineers, Chicago.
7. Espey, William H., Oscar G. Lara, and Robert L. Barkau. 1994. *Lake Michigan Diversion Findings of the Third Technical Committee for Review of Diversion Flow Measurements and Accounting Procedures*. Prepared for the U.S. Army Corps of Engineers, Chicago.
8. Hart, Dale E., and Richard G. McGee. 1985. *Final Report - Lockport Power Plant Sluice Gate and Control Works Discharge Evaluation*. Waterways Experiment Station. Vicksburg, MS.
9. Illinois State Water Survey. 1991. *Installation and Operation of a Dense Raingage Network to Improve Precipitation Measurements for Lake Michigan Diversion Accounting: Water Year 1990*.
10. International Joint Commission. 1981. *Great Lakes Diversions and Consumptive Uses, Annex F, Consumptive Use*.

11. Keifer Engineering. 1982. *Input Data CRSM for Existing Conditions - Mainstream System*. Prepared for the U.S. Army Corps of Engineers, Chicago.
12. Kleinbaum, David G., and Lawrence L Kupper. 1978. *Applied Regression Analysis and Other Multivariable Methods*. Wadsworth Publishing Company.
13. Metropolitan Water Reclamation District of Greater Chicago. 1984. *1984 Facility Planning Study - MSDGC Update Supplement and Summary*.
14. Metropolitan Water Reclamation District of Greater Chicago. 1989. *1988 Annual Report of the Maintenance and Operations Department*.
15. Neubauer, Ronald A. 1990. Request for TARP Information from the Army Corps of Engineers. Memorandum to Mr. William Eyre, Supervising Civil Engineer, Metropolitan Water Reclamation District of Greater Chicago.
16. Northeastern Illinois Planning Commission. 1985. *Lake Michigan Diversion Accounting Manual of Procedures*.
17. Kleinbaum, David G., and Lawrence L Kupper. 1978. *Applied Regression Analysis and Other Multivariable Methods*. Wadsworth Publishing Company.
18. Rust Environment & Infrastructure. 1993. *Diversion Accounting Update for the New 25-Gage Precipitation Network*.
19. Steel, Robert G. D., and James H. Torrie. 1980. *Principles and Procedures of Statistics - A Biometrical Approach*. McGraw-Hill, Inc.
20. U.S. Army Corps of Engineers. 1990. *Lake Michigan Diversion Accounting 1989 Annual Report Including WY84 and WY85 Accounting*.
21. U.S. Army Corps of Engineers. 1990. *Current Meter Measurements of Discretionary and Leakage Flows at the Chicago River Controlling Works, O'Brien Lock and Dam, and the Wilmette Controlling Works*.
22. U.S. Army Corps of Engineers. 1994. *Lake Michigan Diversion Accounting Annual Report, Water Years 1990-92*.
23. U.S. Army Corps of Engineers. 1995. *Lake Michigan Diversion Accounting Water Year 1993 Annual Report*.
24. U.S. Army Corps of Engineers. 1996. *Lake Michigan Diversion Accounting Water Year 1994 Annual Report*.

25. U.S. Army Corps of Engineers. 1998. *Lake Michigan Diversion Accounting Water Year 1996 Annual Report* (contains WY1995 Accounting).
26. U.S. Army Corps of Engineers. 1994. *Lake Michigan Diversion Accounting Water Year 1986 Report*.
27. U.S. Army Corps of Engineers. 1994. *Lake Michigan Diversion Accounting Water Year 1987 Report*.
28. U.S. Army Corps of Engineers. 1994. *Lake Michigan Diversion Accounting Water Year 1988 Report*.
29. U.S. Army Corps of Engineers. 1994. *Lake Michigan Diversion Accounting Water Year 1989 Report*.
30. U.S. Army Corps of Engineers. 1995. *Lake Michigan Diversion Accounting Water Year 1990 Report*.
31. U.S. Army Corps of Engineers. 1996. *Lake Michigan Diversion Accounting Water Year 1991 Report*.
32. U.S. Army Corps of Engineers. 1996. *Lake Michigan Diversion Accounting Water Year 1992 Report*.
33. U.S. Geological Survey. 1984. *Streamflow and Water Quality of the Grand Calumet River, Lake County, Indiana, and Cook County, Illinois*.
34. U.S. Geological Survey. 1992. *Water Resources Data, Illinois, Water Year 1991, Volume 2, Illinois River Basin*.
35. U.S. Geological Survey. 1994. *Comparison, Analysis, and Estimation of Discharge Data from Two Acoustic Velocity Meters on the Chicago Sanitary Ship Canal at Romeoville, Illinois*.
36. U.S. Geological Survey. 1994. *Measurements of Leakage through Chicago River Controlling Works and Other Control Structures Near Chicago Illinois*.
37. Wisconsin et. al., v. Illinois et. al., Michigan v. Illinois et. al. New York v. Illinois et. al. U.S. 2, 3, and 4, Original 1 - 18, 1980.

Appendix A - Summary of Daily Diversion Flows

**Computations:**

- 1. Column 3 equals the sum of Columns 1 and 2.
- 2. Column 8 equals the sum of Columns 4 through 7.
- 3. Column 10 = Column 3 - Column 8 + Column 9.

Note: The averages presented in the final row are calculated from the daily values contained in Appendix A.



Deductions from the Romeoville Gage Record



Additions to the Romeoville Gage Record

# Lake Michigan Diversion Accounting – WY 1996 October 1995 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEOVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEOVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Oct-95	2,370.0	1.9	2,371.9	107.1	22.4	64.1	7.0	200.6	243.7	2,416.0	1,877.6	89.5	530.0
02-Oct-95	2,335.0	1.9	2,336.9	41.8	21.8	9.7	6.9	80.1	243.9	2,500.7	1,911.1	43.6	635.0
03-Oct-95	2,503.0	1.6	2,504.6	49.5	21.2	12.7	7.3	90.7	241.8	2,555.7	1,818.0	57.6	624.0
04-Oct-95	2,341.0	0.9	2,341.9	76.9	20.3	20.5	7.6	125.2	242.3	2,459.0	1,810.3	66.7	685.0
05-Oct-95	2,962.0	0.5	2,962.5	53.0	21.8	14.8	6.9	96.6	241.5	3,107.5	1,774.8	73.6	536.0
06-Oct-95	3,796.0	0.5	3,796.5	313.8	20.2	888.4	6.4	1,028.9	244.1	3,011.8	1,724.3	2,498.6	659.0
07-Oct-95	2,956.0	0.6	2,956.6	135.1	20.4	50.2	6.6	212.2	238.3	2,982.7	1,691.3	252.6	669.0
08-Oct-95	2,917.0	1.3	2,918.3	55.0	20.1	17.2	6.4	98.7	238.2	3,057.8	1,688.5	99.5	613.0
09-Oct-95	2,169.0	1.1	2,170.1	85.0	20.5	26.4	6.4	138.4	241.9	2,273.7	1,759.0	87.7	664.0
10-Oct-95	2,544.0	2.2	2,546.2	53.0	21.1	15.1	6.6	95.7	245.3	2,595.8	1,798.4	57.2	686.0
11-Oct-95	2,454.0	2.8	2,456.8	41.7	20.0	11.0	6.7	79.3	244.1	2,621.5	1,816.5	37.8	634.0
12-Oct-95	2,412.0	3.1	2,415.1	99.7	22.2	29.2	7.1	158.2	243.3	2,500.3	1,833.4	67.1	578.0
13-Oct-95	2,466.0	3.0	2,469.0	41.8	20.2	9.9	6.8	78.8	240.8	2,631.0	1,826.5	32.5	611.0
14-Oct-95	2,462.0	2.8	2,464.8	50.3	20.1	13.0	6.3	89.7	240.7	2,615.8	1,676.7	59.4	473.0
15-Oct-95	2,275.0	3.6	2,278.6	59.1	20.6	15.0	6.5	101.1	238.8	2,416.4	1,652.2	53.2	581.0
16-Oct-95	2,155.0	3.2	2,158.2	69.3	19.9	18.8	7.4	115.4	242.0	2,284.8	1,705.7	46.4	548.0
17-Oct-95	2,262.0	4.0	2,266.0	41.7	19.1	9.4	7.8	78.1	242.1	2,430.1	1,751.6	27.9	525.0
18-Oct-95	2,351.0	3.2	2,354.2	109.8	21.1	31.3	7.6	169.7	243.0	2,427.5	1,762.5	60.1	599.0
19-Oct-95	2,681.0	3.0	2,684.0	48.0	20.0	331.3	8.0	407.3	246.3	2,623.0	1,742.8	1,331.0	531.0
20-Oct-95	5,248.0	2.0	5,250.0	307.2	19.2	671.7	7.5	1,005.6	234.9	4,479.3	1,677.0	4,908.1	650.0
21-Oct-95	3,353.0	2.3	3,355.3	205.6	19.4	96.6	7.8	329.5	235.2	3,261.1	1,642.0	513.6	514.0
22-Oct-95	3,162.0	1.6	3,163.6	50.8	21.4	20.9	7.7	100.8	235.2	3,298.0	1,617.0	156.4	513.0
23-Oct-95	2,481.0	2.1	2,483.1	41.8	19.1	15.5	7.4	83.8	237.1	2,636.4	1,687.4	105.3	415.0
24-Oct-95	2,156.0	2.1	2,158.1	88.9	19.1	29.2	6.3	143.5	237.5	2,252.1	1,667.8	114.7	213.0
25-Oct-95	2,144.0	2.2	2,146.2	41.7	19.7	13.2	6.2	80.7	239.6	2,305.1	1,693.2	73.2	99.0
26-Oct-95	1,923.0	2.8	1,925.8	104.4	18.7	36.8	7.4	167.2	238.2	1,996.8	1,659.4	195.4	104.0
27-Oct-95	3,022.0	2.8	3,024.8	159.4	19.0	200.6	7.1	386.1	240.4	2,879.1	1,639.3	893.3	89.0
28-Oct-95	2,218.0	3.3	2,221.3	45.6	21.2	106.6	6.9	180.4	235.8	2,276.8	1,623.8	418.3	102.0
29-Oct-95	2,349.0	2.7	2,351.7	99.6	18.7	46.5	6.9	171.7	238.4	2,418.5	1,655.7	193.6	112.0
30-Oct-95	2,074.0	2.4	2,076.4	63.7	19.8	280.1	6.7	370.2	236.5	1,944.7	1,651.1	1,001.9	95.0
31-Oct-95	3,093.0	2.1	3,095.1	261.6	24.7	262.6	7.0	555.9	240.1	2,779.3	1,632.5	1,020.7	100.0
Averages	2,633.4	2.2	2,635.6	96.8	20.4	102.2	7.0	226.4	240.4	2,649.6	1,724.7	472.1	464.1

Lake Michigan Diversion Accounting – WY 1996  
November 1995 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEIOVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEIOVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Nov-95	3,183.0	1.5	3,184.5	119.4	18.4	617.4	7.0	762.2	228.9	2,651.1	1,653.6	3,223.2	109.0
02-Nov-95	4,148.0	1.1	4,149.1	372.7	19.7	374.5	7.9	774.8	224.7	3,699.0	1,634.4	1,676.3	105.0
03-Nov-95	2,465.0	0.3	2,465.3	126.3	17.8	70.2	8.0	222.3	222.5	2,465.6	1,644.9	502.1	78.0
04-Nov-95	2,573.0	0.4	2,573.4	41.4	18.6	32.3	8.6	101.0	221.9	2,694.3	1,614.2	295.0	68.0
05-Nov-95	2,505.0	1.1	2,506.1	109.3	18.2	48.6	8.5	184.6	223.2	2,544.7	1,621.8	254.9	61.0
06-Nov-95	1,997.0	1.5	1,998.5	41.7	18.0	24.2	7.9	91.8	223.4	2,130.1	1,655.2	168.7	78.0
07-Nov-95	2,029.0	2.3	2,031.3	52.8	18.3	26.0	7.6	104.6	222.6	2,149.3	1,652.7	144.0	74.0
08-Nov-95	1,784.0	3.7	1,787.7	86.3	17.7	36.0	8.0	148.0	223.1	1,862.9	1,660.7	145.1	79.0
09-Nov-95	2,036.0	3.5	2,039.5	52.9	19.7	24.4	8.8	105.7	221.4	2,155.2	1,627.2	113.5	55.0
10-Nov-95	6,860.0	0.9	6,860.9	76.0	18.0	2,464.3	8.5	2,566.8	241.5	4,636.6	1,645.6	15,888.6	55.0
11-Nov-95	10,973.0	0.3	10,973.3	221.7	23.4	849.4	8.0	1,102.5	223.8	10,094.7	1,635.5	4,101.8	49.0
12-Nov-95	5,511.0	0.3	5,511.3	315.6	17.3	446.3	8.2	787.3	222.6	4,946.5	1,625.2	2,404.3	63.0
13-Nov-95	3,912.0	1.9	3,913.9	280.8	20.7	290.8	8.4	600.6	224.2	3,537.6	1,651.3	1,371.5	93.0
14-Nov-95	3,427.0	0.5	3,427.5	58.1	18.5	160.7	8.4	245.6	223.6	3,406.7	1,671.5	982.5	94.0
15-Nov-95	3,454.0	0.3	3,454.3	114.2	19.0	138.6	8.4	280.2	219.5	3,393.6	1,623.9	804.0	82.0
16-Nov-95	2,570.0	0.4	2,570.4	74.7	17.6	156.9	8.5	257.7	221.2	2,533.9	1,653.9	832.7	72.0
17-Nov-95	3,043.0	0.3	3,043.3	127.9	18.9	152.0	8.5	307.1	223.2	2,969.3	1,633.1	710.4	76.0
18-Nov-95	2,570.0	0.4	2,570.4	50.3	18.2	106.0	7.7	182.2	223.2	2,611.4	1,620.4	579.9	93.0
19-Nov-95	2,315.0	0.3	2,315.3	61.9	18.2	96.8	7.1	183.9	222.6	2,353.9	1,617.5	523.6	81.0
20-Nov-95	2,441.0	0.5	2,441.5	92.5	19.7	64.1	7.9	184.1	223.1	2,480.5	1,666.3	304.9	67.0
21-Nov-95	2,041.0	0.3	2,041.3	56.4	17.9	48.1	7.4	129.8	222.9	2,134.4	1,639.1	245.5	62.0
22-Nov-95	2,161.0	0.4	2,161.4	41.6	18.8	42.2	7.5	110.1	224.9	2,276.2	1,691.6	196.9	65.0
23-Nov-95	2,046.0	0.8	2,046.8	64.3	18.3	49.3	7.2	139.1	223.9	2,130.9	1,615.5	187.5	76.0
24-Nov-95	2,007.0	0.7	2,007.7	76.2	17.5	52.3	7.4	153.3	221.2	2,076.3	1,591.0	169.6	61.0
25-Nov-95	2,113.0	1.0	2,114.0	54.3	18.6	45.5	7.5	125.9	220.4	2,208.5	1,591.4	152.6	61.0
26-Nov-95	1,806.0	0.9	1,806.9	91.4	18.1	57.7	7.7	174.9	222.3	1,854.3	1,578.0	165.8	64.0
27-Nov-95	2,346.0	1.1	2,347.1	129.4	25.3	218.4	8.0	381.2	225.1	2,191.0	1,615.5	1,083.7	68.0
28-Nov-95	2,526.0	1.0	2,527.0	105.5	18.2	89.5	7.9	221.0	221.5	2,527.5	1,623.4	347.1	81.0
29-Nov-95	2,272.0	1.5	2,273.5	37.2	17.5	51.9	7.9	114.5	223.1	2,382.1	1,648.4	205.4	66.0
30-Nov-95	1,941.0	2.4	1,943.4	101.3	16.8	79.1	8.0	205.3	220.6	1,969.0	1,634.5	272.8	70.0
Averages	3,035.2	1.1	3,036.3	107.8	18.8	230.4	7.9	364.9	223.5	2,994.9	1,634.6	1,268.5	73.5

Lake Michigan Diversion Accounting – WY 1996  
December 1995 – Summary of Diversion Flows (All in cfs)

Lake Michigan Diversion Accounting WY 1996	Romeoville AVM Gage Record	Diversions Above the Gage	Total Flow Through the Canal	Groundwater Pumpage Discharged into the Canal	Water Supply Pumpage from Indiana Reaching the Canal	Runoff from the Des Plaines River Watershed Reaching the Canal	Lake Michigan Pumpage by Federal Facilities Discharged to the Canal	Total Deduction from the Romeoville Gage Record	Lake Michigan Pumpage Not Discharged to the Canal	Total Diversion Accountable to the State of Illinois	Pumpage from Lake Michigan Accountable to the State of Illinois	Runoff from the Diverted Lake Michigan Watershed	Direct Diversion Accountable to the State of Illinois
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Dec-95	2,101.0	4.3	2,105.3	44.1	19.7	47.7	8.0	119.6	223.4	2,209.1	1,646.1	184.8	70.0
02-Dec-95	1,958.0	1.7	1,959.7	57.7	18.8	50.1	7.6	134.3	228.6	2,052.0	1,617.7	187.5	91.0
03-Dec-95	2,105.0	1.7	2,106.7	70.6	17.5	54.2	7.6	150.0	227.0	2,183.7	1,594.6	188.8	66.0
04-Dec-95	2,012.0	1.4	2,013.4	73.5	18.0	53.7	7.9	153.1	224.8	2,085.1	1,642.6	180.1	65.0
05-Dec-95	1,981.0	1.4	1,982.4	44.2	18.3	50.0	7.6	120.1	226.8	2,088.9	1,632.2	172.3	73.0
06-Dec-95	1,805.0	1.1	1,806.1	111.4	17.1	65.0	7.8	201.3	225.7	1,830.5	1,632.7	186.4	71.0
07-Dec-95	1,648.0	1.2	1,649.2	37.2	18.3	41.8	7.8	105.0	225.7	1,769.9	1,624.9	134.9	66.0
08-Dec-95	1,745.0	1.4	1,746.4	63.8	18.3	48.3	7.8	138.2	223.5	1,831.7	1,619.8	142.7	73.0
09-Dec-95	2,098.0	2.5	2,100.5	41.5	18.2	41.2	7.5	108.4	223.4	2,215.5	1,578.5	113.1	68.0
10-Dec-95	2,007.0	2.6	2,009.6	74.9	19.1	51.6	7.4	153.0	225.2	2,081.8	1,657.4	125.0	69.0
11-Dec-95	1,763.0	2.4	1,765.4	41.7	17.3	39.9	7.9	106.8	226.9	1,885.6	1,678.2	103.1	68.0
12-Dec-95	1,927.0	2.5	1,929.5	120.7	17.3	63.4	7.6	209.0	225.7	1,946.3	1,673.4	141.6	74.0
13-Dec-95	2,176.0	1.4	2,177.4	40.8	20.4	55.8	7.4	124.5	226.3	2,279.1	1,683.5	279.3	88.0
14-Dec-95	2,359.0	1.7	2,360.7	134.9	18.6	270.1	7.4	431.0	230.0	2,159.7	1,684.3	713.6	75.0
15-Dec-95	2,470.0	1.3	2,471.3	85.2	17.9	93.1	7.0	203.2	228.2	2,496.3	1,679.6	318.7	80.0
16-Dec-95	2,155.0	1.1	2,156.1	44.5	18.9	47.9	6.9	118.1	224.0	2,262.0	1,689.9	159.4	78.0
17-Dec-95	1,998.0	0.7	1,998.7	98.1	18.7	61.5	6.7	184.9	224.8	2,038.6	1,686.0	181.0	75.0
18-Dec-95	2,071.0	1.2	2,072.2	79.2	17.8	89.3	6.9	193.2	226.7	2,105.7	1,689.8	291.8	82.0
19-Dec-95	2,000.0	0.9	2,000.9	50.1	21.3	64.3	6.6	142.4	227.0	2,085.6	1,701.0	249.0	97.0
20-Dec-95	1,802.0	2.4	1,804.4	44.5	17.4	41.4	6.8	110.1	228.9	1,921.2	1,681.6	127.2	72.0
21-Dec-95	1,855.0	3.5	1,858.5	109.6	17.9	59.9	6.7	194.1	227.9	1,892.3	1,682.8	143.8	88.0
22-Dec-95	1,872.0	5.0	1,877.0	41.7	18.8	36.3	6.6	103.4	225.4	1,999.0	1,673.1	93.9	79.0
23-Dec-95	2,036.0	4.7	2,040.7	60.9	19.3	40.7	5.8	126.8	224.8	2,138.6	1,645.0	100.3	75.0
24-Dec-95	1,844.0	3.0	1,847.0	93.6	17.2	51.4	4.7	166.9	224.3	1,904.4	1,653.4	109.3	71.0
25-Dec-95	1,840.0	1.6	1,841.6	41.3	18.2	33.8	4.9	98.2	222.7	1,966.1	1,566.7	78.3	77.0
26-Dec-95	1,820.0	1.4	1,821.4	58.7	18.7	38.2	5.4	121.0	222.9	1,923.3	1,630.7	81.4	82.0
27-Dec-95	1,847.0	1.5	1,848.5	92.9	19.1	49.6	5.5	167.1	223.2	1,904.6	1,649.7	103.6	70.0
28-Dec-95	1,959.0	1.6	1,960.6	57.1	18.5	37.0	5.5	118.1	226.2	2,068.8	1,647.9	87.5	88.0
29-Dec-95	1,735.0	1.4	1,736.4	41.9	18.9	32.1	5.9	98.7	225.2	1,862.9	1,653.0	74.7	66.0
30-Dec-95	1,880.0	1.7	1,881.7	69.6	18.1	88.0	5.4	181.1	223.8	1,924.3	1,643.6	204.8	71.0
31-Dec-95	2,025.0	1.9	2,026.9	75.7	17.7	75.8	5.9	175.2	223.4	2,075.2	1,614.1	237.7	68.0
Averages	1,964.3	2.0	1,966.3	67.8	18.4	60.4	6.8	153.4	225.4	2,038.3	1,649.8	177.3	75.4

Lake Michigan Diversion Accounting – WY 1996  
January 1996 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	1	2	3	4	5	6	7	8	9	10	11	12	13
	DATE	ROMEOVILLE AVM GAGE RECORD	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEOVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
	01-Jan-96	1,848.0	1.9	1,849.9	54.0	18.8	39.4	6.4	118.6	1,903.8	1,590.5	102.4	79.0
	02-Jan-96	1,789.0	1.8	1,790.8	37.2	19.6	33.5	6.5	96.8	1,870.8	1,633.2	98.1	93.0
	03-Jan-96	1,836.0	3.4	1,839.4	97.2	17.6	50.0	6.7	171.5	1,846.7	1,667.0	114.9	84.0
	04-Jan-96	1,754.0	5.0	1,759.0	41.5	18.3	31.8	6.7	98.3	1,837.7	1,658.7	75.2	80.0
	05-Jan-96	2,006.0	2.8	2,008.8	96.6	17.0	49.0	6.8	169.3	2,015.1	1,626.9	99.9	87.0
	06-Jan-96	1,855.0	1.9	1,856.9	41.2	18.5	30.6	6.6	96.9	1,938.3	1,632.0	66.4	88.0
	07-Jan-96	1,715.0	1.5	1,716.5	53.6	19.1	34.5	6.5	113.7	1,777.7	1,619.6	69.7	84.0
	08-Jan-96	1,777.0	1.0	1,778.0	96.5	17.9	46.7	7.2	168.4	1,776.6	1,659.7	93.1	85.0
	09-Jan-96	1,955.0	1.1	1,956.1	60.7	17.6	38.0	6.8	123.1	2,005.0	1,630.5	73.7	87.0
	10-Jan-96	1,815.0	1.5	1,816.5	37.2	17.9	28.4	5.6	89.1	1,903.5	1,653.4	59.9	82.0
	11-Jan-96	1,761.0	1.3	1,762.3	111.7	17.8	50.4	6.8	186.7	1,752.1	1,638.6	100.9	76.0
	12-Jan-96	1,925.0	1.5	1,926.5	37.2	16.9	27.4	6.8	88.3	2,016.0	1,642.7	59.3	75.0
	13-Jan-96	2,245.0	1.8	2,246.8	157.8	18.7	270.5	6.8	453.9	1,971.3	1,636.2	861.3	65.0
	14-Jan-96	1,866.0	2.2	1,868.2	243.0	18.1	285.4	6.7	553.2	1,492.7	1,617.6	1,093.9	92.0
	15-Jan-96	1,815.0	2.0	1,817.0	63.5	18.3	54.8	7.5	144.0	1,850.9	1,652.7	169.6	72.0
	16-Jan-96	1,892.0	1.3	1,893.3	37.2	17.1	57.4	8.9	120.7	1,950.3	1,665.1	203.7	71.0
	17-Jan-96	2,722.0	1.2	2,723.2	193.0	18.6	311.4	7.4	530.4	2,370.4	1,635.9	1,214.5	75.0
	18-Jan-96	4,240.0	0.8	4,240.8	164.6	16.5	896.4	6.5	1,084.0	3,337.5	1,635.3	4,301.5	167.0
	19-Jan-96	3,777.0	0.4	3,777.4	311.6	17.0	320.3	6.8	655.7	3,296.7	1,648.6	1,403.4	72.0
	20-Jan-96	3,133.0	1.5	3,134.5	120.6	20.4	169.8	5.3	316.2	2,993.9	1,627.3	655.2	60.0
	21-Jan-96	2,941.0	3.6	2,944.6	37.2	17.9	95.0	6.3	156.5	2,963.7	1,145.3	381.4	70.0
	22-Jan-96	2,580.0	3.4	2,583.4	84.5	17.5	80.4	7.1	189.6	2,572.6	1,642.6	296.7	73.0
	23-Jan-96	2,106.0	1.7	2,107.7	60.2	18.3	120.5	7.0	206.0	2,077.5	1,613.4	498.8	84.0
	24-Jan-96	2,660.0	0.5	2,660.5	75.1	18.3	73.4	7.0	173.7	2,664.0	1,642.1	284.3	77.0
	25-Jan-96	1,926.0	0.7	1,926.7	57.7	16.9	55.3	6.8	136.7	1,965.9	1,643.0	184.3	88.0
	26-Jan-96	2,710.0	1.1	2,711.1	101.0	17.8	421.5	7.0	547.3	2,340.7	1,642.7	1,650.7	92.0
	27-Jan-96	2,798.0	1.4	2,799.4	299.7	18.4	226.4	6.9	551.3	2,420.4	1,621.3	622.9	70.0
	28-Jan-96	2,403.0	2.7	2,405.7	52.2	19.6	102.4	6.7	180.8	2,401.0	1,630.5	270.1	81.0
	29-Jan-96	2,277.0	2.4	2,279.4	41.6	17.9	94.7	6.9	161.0	2,297.7	1,626.9	229.4	71.0
	30-Jan-96	1,670.0	2.3	1,672.3	71.4	17.6	71.4	6.9	167.2	1,679.1	1,654.7	184.6	76.0
	31-Jan-96	2,002.0	2.4	2,004.4	65.3	17.9	63.4	7.3	153.9	2,030.8	1,677.5	150.5	110.0
Averages		2,251.6	1.9	2,253.5	96.8	18.1	136.5	6.8	258.2	2,171.6	1,623.0	505.5	82.8

Lake Michigan Diversion Accounting – WY 1996  
February 1996 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	1 DATE	2 DIVERSIONS ABOVE THE GAGE RECORD	3 TOTAL FLOW THROUGH THE CANAL	4 GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	5 WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	6 RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	7 LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	8 TOTAL DEDUCTION FROM THE ROMEIOVILLE GAGE RECORD	9 LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	10 TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	11 PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	12 RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	13 DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
01-Feb-96	2,170.0	2.0	2,172.0	70.7	19.4	60.5	7.6	156.2	234.5	2,248.4	1,716.8	139.4	100.0
02-Feb-96	2,001.0	4.2	2,005.2	44.7	18.9	49.4	9.3	122.4	236.4	2,119.2	1,785.2	125.9	114.0
03-Feb-96	2,067.0	1.6	2,068.6	108.1	20.0	88.5	7.6	204.2	242.0	2,106.3	1,788.6	148.0	107.0
04-Feb-96	2,089.0	1.7	2,090.7	41.7	19.7	45.9	7.9	115.1	243.5	2,219.1	1,798.5	107.5	92.0
05-Feb-96	2,274.0	1.7	2,275.7	56.1	18.9	48.7	8.2	131.9	241.7	2,386.5	1,822.2	115.1	94.0
06-Feb-96	1,858.0	2.9	1,860.9	86.9	18.6	58.4	9.0	172.8	243.7	1,931.8	1,844.8	126.1	71.0
07-Feb-96	2,256.0	3.7	2,259.7	55.1	18.6	123.8	8.4	205.9	238.6	2,292.4	1,763.8	321.8	54.0
08-Feb-96	2,814.0	3.7	2,817.7	133.3	18.5	228.7	8.3	388.8	240.2	2,669.1	1,766.1	751.2	70.0
09-Feb-96	1,997.0	2.5	1,999.5	62.3	19.0	77.2	7.7	166.2	237.2	2,070.5	1,766.1	307.5	66.0
10-Feb-96	1,928.0	2.3	1,930.3	37.2	19.1	58.2	7.5	122.0	235.8	2,044.1	1,747.2	227.9	64.0
11-Feb-96	2,183.0	2.2	2,185.2	73.4	19.1	62.5	7.5	162.4	237.0	2,269.8	1,695.8	210.0	74.0
12-Feb-96	2,068.0	2.9	2,070.9	75.1	19.0	59.3	8.2	161.6	238.5	2,145.8	1,735.3	164.0	87.0
13-Feb-96	2,014.0	4.2	2,018.2	37.2	19.4	46.9	8.2	111.7	238.4	2,145.0	1,731.5	120.7	71.0
14-Feb-96	2,141.0	3.8	2,144.8	75.6	19.1	57.0	7.0	158.7	232.4	2,218.5	1,689.1	143.7	90.0
15-Feb-96	1,941.0	2.9	1,943.9	44.6	18.5	46.2	7.0	116.4	232.7	2,060.2	1,682.7	119.0	96.0
16-Feb-96	1,759.0	1.8	1,760.8	103.7	18.5	65.2	7.1	194.4	234.8	1,801.0	1,712.6	143.1	68.0
17-Feb-96	2,000.0	2.0	2,002.0	41.7	19.2	44.6	7.0	112.5	234.3	2,123.8	1,653.7	106.0	87.0
18-Feb-96	1,756.0	1.5	1,757.5	58.6	18.5	48.9	6.8	132.7	235.0	1,859.8	1,667.1	111.4	76.0
19-Feb-96	1,773.0	1.9	1,774.9	79.9	18.1	56.1	6.4	160.5	236.0	1,850.4	1,705.9	115.2	58.0
20-Feb-96	2,029.0	3.3	2,032.3	57.0	16.8	47.3	6.8	127.8	235.8	2,140.1	1,661.9	107.9	64.0
21-Feb-96	1,771.0	2.7	1,773.7	37.2	18.5	41.8	7.2	104.7	233.0	1,902.0	1,657.8	101.2	85.0
22-Feb-96	1,748.0	2.0	1,750.0	101.3	18.7	60.6	7.3	187.9	234.3	1,796.4	1,654.0	136.0	79.0
23-Feb-96	2,105.0	1.8	2,106.8	61.1	16.9	47.1	7.0	132.0	232.4	2,207.2	1,679.7	118.9	67.0
24-Feb-96	1,843.0	2.4	1,845.4	56.7	19.9	46.4	6.7	129.6	233.0	1,948.8	1,657.1	117.1	80.0
25-Feb-96	1,776.0	2.6	1,778.6	41.2	18.4	40.2	6.6	106.4	235.6	1,907.7	1,660.3	112.0	84.0
26-Feb-96	2,673.0	2.4	2,675.4	99.3	19.7	84.4	6.9	210.3	236.7	2,701.9	1,667.2	428.0	79.0
27-Feb-96	4,239.0	2.2	4,241.2	245.7	17.5	484.8	6.7	754.6	238.2	3,724.8	1,650.4	3,631.0	220.0
28-Feb-96	3,771.0	2.1	3,773.1	273.9	18.6	182.6	7.1	482.1	235.0	3,526.0	1,671.8	1,358.1	81.0
29-Feb-96	2,536.0	2.0	2,538.0	54.2	18.1	81.0	7.5	160.8	232.0	2,609.3	1,676.9	570.4	75.0
Averages	2,192.4	2.5	2,194.9	79.8	18.7	83.5	7.5	189.5	238.4	2,241.8	1,714.1	354.6	84.6

**Lake Michigan Diversion Accounting – WY 1996**  
**March 1996 – Summary of Diversion Flows (All in cfs)**

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEIOVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEIOVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Mar-96	2,663.0	2.1	2,665.1	37.2	17.5	59.8	6.9	121.4	223.8	2,767.4	1,652.2	360.4	68.0
02-Mar-96	2,152.0	2.0	2,154.0	65.8	18.7	59.3	5.2	149.0	221.1	2,226.1	1,634.2	279.2	72.0
03-Mar-96	2,127.0	1.6	2,128.6	77.6	18.2	57.8	5.1	158.8	227.7	2,192.6	1,625.7	210.9	63.0
04-Mar-96	1,952.0	1.6	1,953.6	50.7	17.8	61.0	5.5	135.0	223.6	2,042.2	1,682.5	202.5	76.0
05-Mar-96	3,140.0	1.0	3,141.0	199.9	18.1	535.4	7.2	760.5	228.8	2,609.3	1,668.3	1,674.1	91.0
06-Mar-96	2,314.0	0.8	2,314.8	226.0	19.8	196.6	6.8	449.1	225.4	2,091.1	1,648.8	951.2	95.0
07-Mar-96	2,385.0	1.3	2,386.3	60.4	18.4	87.2	6.6	172.5	221.2	2,436.0	1,669.1	240.5	91.0
08-Mar-96	2,072.0	0.5	2,072.5	114.6	16.8	85.1	6.4	222.8	223.9	2,073.5	1,650.8	232.8	79.0
09-Mar-96	2,105.0	0.3	2,105.3	37.2	18.8	51.8	6.1	113.8	223.0	2,214.5	1,683.5	238.7	76.0
10-Mar-96	2,112.0	1.8	2,113.8	146.8	18.2	177.3	6.2	348.5	223.6	1,989.1	1,659.2	868.6	59.0
11-Mar-96	2,069.0	2.9	2,071.9	223.2	18.0	238.2	6.6	486.0	229.5	1,816.4	1,669.7	1,280.1	69.0
12-Mar-96	2,307.0	3.2	2,310.2	85.9	17.8	84.5	6.5	194.7	224.9	2,340.4	1,663.3	583.8	64.0
13-Mar-96	2,227.0	2.1	2,229.1	41.3	19.3	52.5	6.7	119.8	225.2	2,334.5	1,670.1	334.0	74.0
14-Mar-96	2,451.0	1.2	2,452.2	113.5	17.5	70.8	6.8	208.6	223.6	2,467.3	1,666.5	325.8	80.0
15-Mar-96	1,840.0	1.7	1,841.7	41.5	17.2	45.4	5.9	110.0	222.0	1,963.8	1,643.0	263.4	72.0
16-Mar-96	2,598.0	4.1	2,602.1	63.0	18.4	50.4	5.7	137.4	226.1	2,690.8	1,649.1	253.3	78.0
17-Mar-96	1,872.0	3.0	1,875.0	37.2	17.7	42.9	6.1	103.9	224.0	1,996.1	1,637.3	211.8	86.0
18-Mar-96	2,098.0	1.6	2,099.6	110.6	18.0	64.1	5.8	198.5	225.0	2,126.1	1,636.2	235.7	71.0
19-Mar-96	1,984.0	1.7	1,985.7	37.2	18.2	42.1	5.5	103.0	221.9	2,104.6	1,644.5	189.9	83.0
20-Mar-96	1,883.0	4.2	1,887.2	60.3	46.3	47.9	6.3	160.8	225.0	1,961.4	1,652.8	211.5	110.0
21-Mar-96	2,145.0	5.9	2,150.9	50.6	17.4	45.0	6.1	119.1	223.3	2,256.1	1,660.9	178.0	93.0
22-Mar-96	1,789.0	5.4	1,794.4	85.9	20.2	56.3	6.2	168.6	224.6	1,850.6	1,662.1	175.9	77.0
23-Mar-96	2,003.0	2.8	2,005.8	51.5	17.9	44.5	6.0	119.9	222.3	2,108.2	1,645.2	150.1	77.0
24-Mar-96	1,992.0	2.8	1,994.8	96.9	17.6	65.7	7.1	187.3	224.0	2,031.5	1,634.7	304.6	87.0
25-Mar-96	2,972.0	1.8	2,973.8	139.9	19.5	298.7	6.1	464.1	224.7	2,734.4	1,649.3	1,103.1	53.0
26-Mar-96	2,243.0	1.7	2,244.7	99.2	17.5	76.7	6.7	200.0	221.8	2,266.5	1,646.4	365.4	67.0
27-Mar-96	2,251.0	2.2	2,253.2	41.5	17.3	49.6	6.6	114.9	222.3	2,360.5	1,633.3	239.9	71.0
28-Mar-96	2,208.0	2.1	2,210.1	108.2	17.7	67.5	6.2	199.5	222.6	2,233.2	1,655.3	242.6	98.0
29-Mar-96	1,939.0	1.7	1,940.7	41.7	17.7	41.9	7.0	108.2	222.5	2,055.1	1,640.7	184.2	75.0
30-Mar-96	2,010.0	1.9	2,011.9	54.5	18.2	43.8	6.6	123.1	220.0	2,108.8	1,628.9	179.8	78.0
31-Mar-96	1,878.0	2.1	1,880.1	87.3	18.1	93.3	4.8	203.5	223.2	1,899.8	1,614.7	332.9	86.0
Averages	2,186.5	2.2	2,188.7	86.7	19.0	96.6	6.2	208.5	223.7	2,203.9	1,650.9	406.6	78.0

Lake Michigan Diversion Accounting – WY 1996  
April 1996 – Summary of Diversion Flows (All in cfs)

Lake Michigan Diversion Accounting WY 1996	Romeoville AVM Gage Record	Diversion Above the Gage	Total Flow Through the Canal	Groundwater Pumpage Discharged into the Canal	Water Supply Pumpage from Indiana Reaching the Canal	Runoff from the Des Plaines River Watershed Reaching the Canal	Lake Michigan Pumpage by Federal Facilities Discharged to the Canal	Total Deduction from the Romeoville Gage Record	Lake Michigan Pumpage Not Discharged to the Canal	Total Diversion Accountable to the State of Illinois	Pumpage from Lake Michigan Accountable to the State of Illinois	Runoff from the Diverted Lake Michigan Watershed	Direct Diversion Accountable to the State of Illinois
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Apr-96	2,126.0	2.2	2,128.2	54.6	17.1	51.0	6.3	129.0	231.8	2,231.0	1,649.3	189.5	73.0
02-Apr-96	2,004.0	2.6	2,006.6	37.2	17.4	40.3	6.0	100.9	232.1	2,137.8	1,663.0	161.9	76.0
03-Apr-96	2,080.0	3.2	2,083.2	109.4	17.8	61.7	6.0	194.9	233.0	2,121.3	1,656.4	203.1	90.0
04-Apr-96	1,720.0	2.2	1,722.2	41.9	20.1	39.8	6.1	107.9	231.1	1,845.5	1,654.1	173.4	88.0
05-Apr-96	2,038.0	2.0	2,040.0	54.4	18.9	42.5	6.5	122.3	230.4	2,148.1	1,632.8	159.3	72.0
06-Apr-96	1,613.0	2.3	1,615.3	37.2	18.9	36.0	5.7	97.8	231.1	1,748.6	1,649.5	136.3	97.0
07-Apr-96	1,784.0	2.4	1,786.4	92.2	17.4	53.1	5.8	168.4	231.3	1,849.3	1,548.7	163.9	72.0
08-Apr-96	1,923.0	2.4	1,925.4	51.2	18.1	40.1	6.2	115.6	232.2	2,042.0	1,657.4	133.6	84.0
09-Apr-96	1,896.0	2.2	1,898.2	87.7	17.3	50.1	5.6	160.7	233.2	1,970.7	1,664.8	145.6	83.0
10-Apr-96	1,710.0	2.4	1,712.4	55.5	17.4	39.9	6.3	119.1	231.2	1,824.5	1,669.7	127.7	76.0
11-Apr-96	1,820.0	2.5	1,822.5	42.0	15.8	34.9	6.7	99.4	232.1	1,955.2	1,708.2	117.2	71.0
12-Apr-96	2,156.0	2.4	2,158.4	49.9	17.8	35.4	6.7	109.8	238.2	2,284.7	1,668.7	133.7	102.0
13-Apr-96	2,047.0	2.0	2,049.0	79.6	18.6	49.4	6.5	154.2	230.9	2,125.7	1,618.0	206.4	124.0
14-Apr-96	2,106.0	1.6	2,107.6	56.5	18.6	141.7	6.2	223.0	233.9	2,118.4	1,613.8	234.0	107.0
15-Apr-96	3,538.0	1.8	3,539.8	206.4	17.7	593.8	6.0	823.9	233.3	2,949.3	1,634.2	2,884.9	114.0
16-Apr-96	2,715.0	1.6	2,716.6	233.3	17.9	214.7	6.1	472.0	231.7	2,476.3	1,658.0	874.0	91.0
17-Apr-96	2,708.0	1.6	2,709.6	57.4	17.7	79.1	6.6	160.9	231.5	2,780.2	1,658.4	372.5	90.0
18-Apr-96	2,479.0	2.0	2,481.0	60.3	17.6	124.3	6.6	208.9	231.9	2,504.1	1,670.3	421.8	95.0
19-Apr-96	3,254.0	2.2	3,256.2	139.1	19.2	594.9	7.7	760.8	231.0	2,726.4	1,648.8	2,197.5	98.0
20-Apr-96	4,770.0	2.0	4,772.0	211.3	18.9	213.7	6.5	450.4	229.4	4,551.0	1,621.6	1,578.5	85.0
21-Apr-96	4,054.0	1.3	4,055.3	58.1	18.1	102.8	5.6	184.6	230.2	4,100.9	1,626.2	825.9	134.0
22-Apr-96	3,605.0	0.6	3,605.6	76.5	18.3	161.9	6.3	263.1	232.5	3,674.9	1,634.5	1,541.2	99.0
23-Apr-96	3,197.0	0.5	3,197.5	108.6	18.1	85.0	6.6	218.3	232.8	3,212.0	1,659.0	935.3	107.0
24-Apr-96	3,112.0	0.5	3,112.5	42.2	18.1	53.2	6.8	120.2	231.3	3,223.6	1,667.5	591.4	114.0
25-Apr-96	2,813.0	1.0	2,814.0	54.0	18.6	50.0	6.5	129.0	229.6	2,914.6	1,664.4	470.6	103.0
26-Apr-96	2,945.0	1.9	2,946.9	90.8	18.8	58.7	6.6	174.9	232.8	3,004.8	1,657.7	397.5	115.0
27-Apr-96	2,233.0	1.1	2,234.1	51.4	18.4	44.7	6.0	120.6	231.4	2,344.9	1,660.3	297.9	150.0
28-Apr-96	2,362.0	1.1	2,363.1	41.8	19.6	40.2	6.4	108.0	234.1	2,489.2	1,623.5	247.0	125.0
29-Apr-96	4,012.0	1.1	4,013.1	183.2	21.1	430.1	6.4	640.8	234.9	3,607.2	1,655.9	2,407.5	86.0
30-Apr-96	3,301.0	0.9	3,301.9	255.1	19.1	157.2	6.2	437.5	231.4	3,095.8	1,648.4	921.8	108.0
Averages	2,604.0	1.8	2,605.8	90.6	18.3	124.0	6.3	239.2	232.0	2,598.6	1,648.1	641.7	97.6

**Lake Michigan Diversion Accounting – WY 1996**  
**May 1996 – Summary of Diversion Flows (All in cfs)**

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEDEVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEDEVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-May-96	3,255.0	1.0	3,256.0	56.1	18.7	70.4	6.6	151.9	239.2	3,343.3	1,661.7	521.8	111.0
02-May-96	2,994.0	1.5	2,995.5	37.2	19.8	51.8	6.7	115.6	238.0	3,117.9	1,680.8	378.5	150.0
03-May-96	2,453.0	2.5	2,455.5	49.2	20.9	49.4	6.2	125.8	238.9	2,569.7	1,688.8	312.1	163.0
04-May-96	2,788.0	2.3	2,790.3	79.0	20.8	55.3	8.5	163.6	238.7	2,865.4	1,661.6	312.9	178.0
05-May-96	2,187.0	1.8	2,188.8	55.6	20.8	45.8	7.7	129.8	239.4	2,298.4	1,607.5	290.5	152.0
06-May-96	2,415.0	1.8	2,416.8	63.2	21.9	45.9	7.1	138.1	239.0	2,517.7	1,690.1	275.2	142.0
07-May-96	2,442.0	2.0	2,444.0	65.4	21.6	46.1	6.5	139.6	239.4	2,543.8	1,671.9	259.7	138.0
08-May-96	2,230.0	2.6	2,232.6	41.7	21.9	38.1	6.7	108.4	239.0	2,363.2	1,662.7	246.5	136.0
09-May-96	5,687.0	2.3	5,689.3	125.3	21.4	732.8	6.9	886.5	248.9	5,061.8	1,670.3	6,555.4	394.0
10-May-96	8,234.0	1.3	8,235.3	226.7	27.6	756.5	6.6	1,017.3	243.1	7,461.1	1,652.1	5,229.7	250.0
11-May-96	5,659.0	2.3	5,661.3	283.9	25.4	295.4	6.5	611.2	238.5	5,288.6	1,626.2	2,530.4	169.0
12-May-96	4,600.0	1.4	4,601.4	145.1	20.6	173.6	6.5	345.7	237.6	4,493.4	1,615.0	1,314.2	156.0
13-May-96	3,895.0	1.9	3,896.9	60.9	19.6	124.8	6.9	212.1	239.8	3,924.7	1,681.2	1,158.2	134.0
14-May-96	3,837.0	2.4	3,839.4	83.1	18.8	95.6	6.8	204.3	242.9	3,878.1	1,658.8	941.1	153.0
15-May-96	2,932.0	2.3	2,934.3	70.6	21.7	82.2	5.3	179.7	241.6	2,996.2	1,679.0	765.9	150.0
16-May-96	3,368.0	2.2	3,370.2	56.6	22.1	231.5	7.2	317.4	241.4	3,294.2	1,651.1	826.2	137.0
17-May-96	3,681.0	2.9	3,683.9	270.1	20.6	262.2	7.2	560.1	242.1	3,365.9	1,715.6	1,518.4	183.0
18-May-96	4,070.0	2.1	4,072.1	51.4	21.4	105.0	7.4	185.2	247.6	4,134.7	1,887.6	1,246.2	201.0
19-May-96	3,666.0	2.5	3,668.5	41.6	20.9	80.7	7.3	150.5	245.4	3,763.4	1,939.1	885.2	175.0
20-May-96	4,649.0	2.3	4,651.3	136.6	19.3	335.3	7.6	498.8	247.3	4,399.9	1,806.6	2,151.4	827.0
21-May-96	4,459.0	2.3	4,461.3	176.1	19.4	159.7	7.4	362.6	240.2	4,338.9	1,774.9	2,233.4	166.0
22-May-96	4,519.0	2.6	4,521.6	57.3	19.3	91.3	8.5	176.4	242.1	4,587.3	1,805.2	1,607.9	174.0
23-May-96	4,571.0	1.5	4,572.5	139.4	20.5	221.7	7.8	389.4	245.1	4,428.3	1,730.2	1,753.8	147.0
24-May-96	5,244.0	1.3	5,245.3	200.7	19.0	713.7	7.6	941.0	243.2	4,547.5	1,683.4	2,976.8	362.0
25-May-96	4,508.0	1.7	4,509.7	277.4	21.6	296.4	7.4	602.8	239.5	4,146.4	1,656.8	1,488.8	219.0
26-May-96	4,134.0	1.6	4,135.6	51.1	25.5	125.4	7.3	209.2	239.4	4,165.8	1,611.7	1,010.8	203.0
27-May-96	5,089.0	1.1	5,090.1	154.7	27.0	610.3	7.4	799.3	239.7	4,630.6	1,593.8	3,739.5	202.0
28-May-96	8,904.0	0.4	8,904.4	200.8	28.0	2,061.3	7.5	2,297.6	256.2	6,863.0	1,662.9	15,137.1	86.0
29-May-96	13,165.0	0.6	13,165.6	87.6	28.2	732.5	7.3	855.5	244.3	12,554.4	1,696.2	6,625.9	39.0
30-May-96	8,399.0	0.2	8,399.2	171.3	24.1	496.6	7.3	699.3	243.7	7,943.7	1,727.9	4,251.3	112.0
31-May-96	6,749.0	0.6	6,749.6	241.6	24.4	374.7	7.4	647.9	241.3	6,342.9	1,740.7	2,298.3	397.0
Averages	4,670.4	1.8	4,672.2	121.2	22.0	308.4	7.1	458.7	242.1	4,456.6	1,696.5	2,285.3	200.2

Lake Michigan Diversion Accounting – WY 1996  
June 1996 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEOVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEOVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
DATE													
01-Jun-96	6,273.0	0.5	6,273.5	221.8	22.5	672.1	7.4	923.7	261.1	6,610.8	1,721.5	3,118.7	438.0
02-Jun-96	6,301.0	0.7	6,301.7	251.7	29.4	479.4	6.7	767.3	260.2	6,794.6	1,707.3	2,438.0	545.0
03-Jun-96	4,945.0	0.5	4,945.5	191.3	22.8	324.5	7.3	545.8	258.5	4,658.2	1,724.6	1,607.9	555.0
04-Jun-96	5,657.0	0.7	5,657.7	105.7	26.9	805.5	7.1	945.3	259.3	4,971.7	1,710.0	2,208.7	436.0
05-Jun-96	4,985.0	0.6	4,985.6	196.9	25.1	350.5	7.4	580.0	257.4	4,663.1	1,741.3	1,504.2	549.0
06-Jun-96	5,525.0	0.7	5,525.7	103.4	26.5	285.9	7.4	423.2	259.6	6,362.1	1,741.4	1,395.2	851.0
07-Jun-96	4,367.0	0.5	4,367.5	111.9	59.2	248.3	7.9	427.2	259.4	4,199.7	1,722.0	1,241.3	789.0
08-Jun-96	4,546.0	0.4	4,546.4	37.2	41.6	158.9	7.0	242.7	254.3	4,558.0	1,664.4	1,049.3	581.0
09-Jun-96	4,418.0	0.4	4,418.4	73.9	43.7	388.1	8.2	513.8	258.8	4,163.3	1,630.0	2,751.8	304.0
10-Jun-96	4,546.0	0.6	4,546.6	215.2	24.9	406.8	7.0	653.9	260.0	4,152.7	1,697.9	1,816.9	451.0
11-Jun-96	4,007.0	0.6	4,007.6	150.7	30.6	258.2	6.6	446.1	258.2	3,819.7	1,712.8	1,296.8	377.0
12-Jun-96	4,054.0	0.8	4,054.8	94.6	28.8	187.3	6.7	317.4	260.0	3,997.4	1,790.7	1,002.8	528.0
13-Jun-96	3,902.0	0.9	3,902.9	60.9	27.5	148.7	7.9	245.0	259.7	3,917.6	1,868.4	732.4	646.0
14-Jun-96	3,465.0	2.0	3,467.0	40.1	26.0	125.8	8.6	200.5	264.4	3,530.9	1,897.6	571.5	624.0
15-Jun-96	3,067.0	2.1	3,069.1	58.3	28.5	120.8	6.2	213.8	264.1	3,119.4	1,967.3	505.3	649.0
16-Jun-96	3,520.0	2.6	3,522.6	153.2	30.5	264.9	7.5	456.0	263.8	3,330.4	1,846.2	1,788.2	489.0
17-Jun-96	6,835.0	2.5	6,837.5	241.0	41.3	1,858.1	7.8	2,148.2	266.7	4,966.0	1,782.9	10,636.3	701.0
18-Jun-96	12,177.0	0.8	12,177.8	113.7	34.7	719.1	7.3	874.9	259.0	11,561.9	1,801.1	3,402.1	318.0
19-Jun-96	5,013.0	1.2	5,014.2	170.4	40.5	401.0	7.3	619.2	257.2	4,652.1	1,769.1	1,885.3	196.0
20-Jun-96	4,668.0	0.9	4,668.9	212.9	49.0	296.6	7.6	566.1	261.0	4,363.8	1,870.8	1,414.5	486.0
21-Jun-96	4,603.0	1.2	4,604.2	191.4	28.2	228.4	7.7	453.7	258.0	4,408.4	1,875.7	1,024.1	477.0
22-Jun-96	3,582.0	1.0	3,583.0	56.3	49.7	150.5	7.2	263.7	260.8	3,580.1	1,880.3	703.8	617.0
23-Jun-96	4,336.0	1.6	4,337.6	40.1	35.8	146.8	7.4	230.0	257.5	4,365.1	1,769.9	633.9	426.0
24-Jun-96	3,361.0	1.0	3,362.0	146.7	59.5	223.1	7.3	436.6	259.5	3,184.9	1,821.5	710.4	474.0
25-Jun-96	3,299.0	1.3	3,300.3	53.7	36.4	128.3	7.5	226.0	255.9	3,330.3	1,837.5	471.5	581.0
26-Jun-96	3,459.0	2.4	3,461.4	39.9	62.0	109.0	7.6	218.5	264.4	3,607.3	1,966.0	361.1	633.0
27-Jun-96	2,657.0	3.1	2,660.1	109.8	27.2	120.5	9.0	266.6	264.4	2,667.9	2,071.8	376.2	632.0
28-Jun-96	3,341.0	3.4	3,344.4	40.1	31.5	91.9	7.8	171.4	269.4	3,442.4	2,330.8	297.0	618.0
29-Jun-96	2,995.0	4.5	2,999.5	58.6	29.2	91.8	8.8	188.4	268.9	3,080.0	2,429.2	285.6	589.0
30-Jun-96	3,007.0	2.2	3,009.2	37.2	39.8	78.9	10.1	166.0	271.8	3,115.0	2,454.1	210.3	543.0
Averages	4,563.7	1.4	4,565.1	119.3	35.3	328.9	7.6	491.1	261.1	4,335.1	1,860.1	1,580.7	536.8

Lake Michigan Diversion Accounting – WY 1996  
July 1996 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEDEVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER PUMPAGE DISCHARGED INTO THE CANAL	WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEDEVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION TO THE STATE OF ILLINOIS
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Jul-96	3,146.0	2.9	3,148.9	101.4	43.4	94.4	9.4	248.5	337.1	3,237.6	2,389.0	210.8	852.0
02-Jul-96	3,221.0	2.7	3,223.7	41.5	44.8	71.7	7.8	165.8	333.6	3,391.5	2,185.3	169.9	989.0
03-Jul-96	3,173.0	2.5	3,175.5	57.2	40.7	105.6	9.3	212.7	333.2	3,296.0	2,180.8	186.6	1,002.0
04-Jul-96	3,004.0	2.2	3,006.2	99.2	38.2	84.9	8.3	230.7	332.5	3,108.0	2,124.5	185.4	1,027.0
05-Jul-96	2,959.0	3.0	2,962.0	56.7	41.1	67.0	9.1	174.0	332.1	3,120.1	2,238.4	139.1	937.0
06-Jul-96	3,078.0	3.2	3,081.2	54.8	36.2	62.4	8.5	161.9	337.9	3,257.3	2,347.5	139.9	969.0
07-Jul-96	3,128.0	2.5	3,130.5	37.2	45.4	52.3	9.0	143.9	342.4	3,329.0	2,453.9	105.5	957.0
08-Jul-96	2,967.0	2.7	2,969.7	107.6	43.0	71.1	8.8	230.4	347.8	3,086.8	2,439.7	141.1	718.0
09-Jul-96	2,895.0	1.7	2,896.7	41.9	60.8	48.1	10.0	160.8	338.5	3,074.4	2,266.1	86.1	930.0
10-Jul-96	2,850.0	1.8	2,851.8	61.3	43.7	51.0	10.0	165.9	340.4	3,026.3	2,275.1	95.4	914.0
11-Jul-96	2,976.0	2.6	2,978.6	84.5	44.6	56.1	9.4	194.6	340.6	3,124.7	2,368.3	99.8	904.0
12-Jul-96	2,716.0	3.7	2,719.7	58.2	40.9	45.9	10.6	155.7	340.5	2,904.6	2,390.9	86.7	896.0
13-Jul-96	3,272.0	3.7	3,275.7	50.6	43.8	40.5	9.4	144.3	336.9	3,468.3	2,395.8	73.7	959.0
14-Jul-96	2,971.0	2.6	2,973.6	84.9	41.2	61.3	8.7	196.2	338.3	3,115.7	2,293.6	186.0	966.0
15-Jul-96	2,549.0	3.6	2,552.6	111.0	43.1	58.9	10.5	223.4	330.7	2,669.9	2,165.0	253.6	859.0
16-Jul-96	3,202.0	3.4	3,205.4	53.5	33.3	36.8	9.9	133.4	332.3	3,404.3	2,273.4	124.6	885.0
17-Jul-96	7,878.0	1.9	7,879.9	70.0	33.9	3,549.1	9.0	3,662.0	351.0	4,569.0	2,157.8	16,389.9	294.0
18-Jul-96	17,202.0	1.1	17,203.1	102.3	69.6	3,905.3	9.5	4,086.6	339.6	13,456.3	1,902.5	16,209.7	34.0
19-Jul-96	13,947.0	0.5	13,947.5	125.6	74.5	959.4	9.0	1,168.4	326.0	13,106.1	1,947.0	6,034.5	117.0
20-Jul-96	8,423.0	0.5	8,423.5	223.7	70.3	652.9	9.0	955.9	324.8	7,792.4	1,881.3	3,553.0	189.0
21-Jul-96	7,060.0	0.6	7,060.6	305.9	37.7	460.7	8.6	812.9	320.1	6,567.7	1,741.4	2,219.9	646.0
22-Jul-96	4,842.0	0.7	4,842.7	257.4	34.9	310.9	8.7	611.9	327.6	4,558.4	1,904.3	1,572.0	779.0
23-Jul-96	5,050.0	0.8	5,050.8	129.9	35.6	187.3	8.4	361.3	331.6	5,021.2	2,005.2	993.3	1,014.0
24-Jul-96	3,998.0	0.9	3,998.9	58.0	35.5	204.1	9.3	306.9	332.1	4,024.0	1,984.0	820.6	797.0
25-Jul-96	4,040.0	0.7	4,040.7	56.7	38.2	132.2	9.3	236.5	332.7	4,136.9	1,978.2	571.7	953.0
26-Jul-96	3,887.0	0.9	3,887.9	101.5	42.5	120.3	9.8	274.1	332.3	3,946.1	2,018.9	439.8	964.0
27-Jul-96	4,047.0	0.6	4,047.6	102.0	50.5	200.0	9.6	362.2	330.3	4,015.7	1,955.7	707.0	690.0
28-Jul-96	4,028.0	0.9	4,028.9	226.9	38.3	452.4	9.2	726.8	322.1	3,824.1	1,766.1	1,458.3	377.0
29-Jul-96	4,411.0	0.9	4,411.9	185.0	37.5	304.9	8.9	536.3	329.0	4,204.6	1,866.5	1,470.4	815.0
30-Jul-96	6,536.0	0.8	6,536.8	206.0	48.9	1,243.6	9.4	1,507.9	322.5	5,361.4	1,850.9	3,218.9	658.0
31-Jul-96	4,420.0	0.9	4,420.9	181.6	34.5	274.7	8.0	498.9	326.3	4,248.3	1,862.4	1,023.5	825.0
Averages	4,770.2	1.9	4,772.1	110.8	44.1	450.5	9.2	614.6	333.6	4,491.1	2,116.4	1,902.1	771.5

# Lake Michigan Diversion Accounting – WY 1996 August 1996 – Summary of Diversion Flows (All in cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1996	ROMEDEVILLE AVM GAGE RECORD	DIVERSIONS ABOVE THE GAGE	TOTAL FLOW THROUGH THE CANAL	GROUNDWATER		WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CANAL	RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CANAL	LAKE MICHIGAN PUMPAGE BY FEDERAL FACILITIES DISCHARGED TO THE CANAL	TOTAL DEDUCTION FROM THE ROMEDEVILLE GAGE RECORD	LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL	TOTAL DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS	PUMPAGE FROM LAKE MICHIGAN ACCOUNTABLE TO THE STATE OF ILLINOIS	RUNOFF FROM THE DIVERTED LAKE MICHIGAN WATERSHED	DIRECT DIVERSION ACCOUNTABLE TO THE STATE OF ILLINOIS
				PUMPAGE DISCHARGED INTO THE CANAL	4									
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	
01-Aug-96	4,291.0	0.8	4,291.8	61.7	55.5	167.7	9.6	294.4	306.7	4,304.2	1,890.0	578.8	1,003.0	
02-Aug-96	3,572.0	0.9	3,572.9	42.3	53.8	121.6	9.0	226.6	309.1	3,655.4	1,994.4	398.4	993.0	
03-Aug-96	3,776.0	1.8	3,777.8	59.3	59.6	103.7	8.1	230.6	314.6	3,861.8	2,012.3	306.6	1,004.0	
04-Aug-96	3,194.0	3.0	3,197.0	91.2	58.7	100.8	8.1	258.8	314.2	3,262.5	2,035.9	267.2	1,014.0	
05-Aug-96	3,370.0	3.0	3,373.0	57.7	51.1	83.9	10.1	202.8	318.4	3,488.7	2,301.1	208.3	893.0	
06-Aug-96	3,559.0	2.6	3,561.6	101.4	51.0	117.8	11.0	281.2	316.8	3,597.2	2,470.7	335.7	1,183.0	
07-Aug-96	3,569.0	4.7	3,573.7	52.3	45.7	114.2	11.2	223.4	313.0	3,663.3	2,563.2	306.4	793.0	
08-Aug-96	3,962.0	3.3	3,965.3	175.6	48.8	198.6	9.2	432.2	313.1	3,846.2	2,173.4	705.2	815.0	
09-Aug-96	3,227.0	2.2	3,229.2	52.4	52.9	74.4	8.6	188.3	309.7	3,350.6	2,094.3	202.4	435.0	
10-Aug-96	3,765.0	2.4	3,767.4	41.4	58.9	62.7	9.0	172.0	312.2	3,907.7	2,088.8	131.6	1,171.0	
11-Aug-96	3,566.0	2.6	3,568.6	52.0	53.1	60.8	8.6	174.5	306.2	3,700.4	1,924.8	120.9	1,165.0	
12-Aug-96	3,003.0	3.3	3,006.3	85.7	43.9	66.7	8.9	205.1	310.4	3,111.6	2,101.1	133.9	1,169.0	
13-Aug-96	3,284.0	4.1	3,288.1	55.9	44.3	54.6	9.0	163.9	314.6	3,438.9	2,245.0	110.6	1,117.0	
14-Aug-96	3,021.0	4.1	3,025.1	72.7	46.0	57.1	10.2	185.9	315.4	3,154.6	2,236.0	126.5	1,077.0	
15-Aug-96	3,221.0	3.4	3,224.4	85.4	53.9	58.4	10.5	208.3	313.5	3,329.6	2,174.2	113.5	1,199.0	
16-Aug-96	3,173.0	3.1	3,176.1	39.9	45.3	41.6	9.3	136.1	315.3	3,355.3	2,158.7	80.1	1,153.0	
17-Aug-96	3,094.0	3.0	3,097.0	46.1	52.2	41.0	9.1	148.4	315.1	3,263.7	2,164.7	69.0	1,136.0	
18-Aug-96	3,419.0	3.1	3,422.1	77.3	48.0	71.6	9.3	206.1	315.2	3,531.2	2,044.7	119.4	781.0	
19-Aug-96	2,953.0	4.1	2,957.1	58.5	42.9	46.0	9.9	157.3	311.2	3,111.0	2,032.0	98.7	883.0	
20-Aug-96	2,777.0	3.9	2,780.9	65.3	45.0	45.8	10.5	166.6	308.6	2,922.9	2,089.8	99.1	1,022.0	
21-Aug-96	3,196.0	3.6	3,199.6	81.5	44.2	48.8	9.0	183.5	308.1	3,324.2	2,199.5	104.4	838.0	
22-Aug-96	4,357.0	4.0	4,361.0	44.1	42.4	142.2	9.0	237.8	317.7	4,441.0	2,229.8	4,966.0	816.0	
23-Aug-96	4,567.0	4.4	4,571.4	231.4	51.7	139.0	9.4	431.4	304.5	4,444.4	1,961.5	858.3	1,434.0	
24-Aug-96	3,993.0	4.3	3,997.3	237.8	44.1	107.7	9.1	398.7	306.7	3,905.3	2,007.0	229.7	1,040.0	
25-Aug-96	3,861.0	3.5	3,864.5	47.0	35.2	39.2	8.9	130.2	308.0	4,042.3	2,008.2	76.2	1,067.0	
26-Aug-96	3,331.0	3.9	3,334.9	40.1	42.1	32.8	9.3	124.3	312.5	3,523.1	2,136.8	51.2	1,083.0	
27-Aug-96	3,340.0	4.0	3,344.0	70.2	50.1	39.4	9.2	168.9	312.0	3,487.1	2,152.3	67.7	1,105.0	
28-Aug-96	3,264.0	4.1	3,268.1	66.3	50.7	35.3	9.0	161.3	309.1	3,415.9	2,153.1	57.0	1,154.0	
29-Aug-96	2,987.0	4.2	2,991.2	54.2	46.8	30.5	9.5	140.9	311.8	3,162.0	2,161.1	51.2	1,145.0	
30-Aug-96	3,132.0	4.0	3,136.0	74.0	45.4	35.6	11.0	166.0	315.0	3,285.0	2,200.5	61.3	1,162.0	
31-Aug-96	3,009.0	3.8	3,012.8	95.8	45.3	40.4	9.3	190.7	316.7	3,138.8	2,189.1	63.8	1,169.0	
Averages	3,446.2	3.3	3,449.5	77.9	48.7	76.8	9.4	212.8	312.1	3,548.8	2,135.3	358.0	1,032.9	

Lake Michigan Diversion Accounting – WY 1996  
September 1996 – Summary of Diversion Flows (All in cfs)

Lake Michigan Diversion Accounting WY 1996	Romeoville AVM Gage Record	Diversion Above the Gage	Total Flow Through the Canal	Groundwater Pumpage Discharged into the Canal	Water Supply Pumpage from Indiana Reaching the Canal	Runoff from the Des Plaines River Watershed Reaching the Canal	Lake Michigan Pumpage by Federal Facilities Discharged to the Canal	Total Deduction from the Romeoville Gage Record	Lake Michigan Pumpage Not Discharged to the Canal	Total Diversion Accountable to the State of Illinois	Pumpage from Lake Michigan Accountable to the State of Illinois	Runoff from the Diverted Lake Michigan Watershed	Direct Diversion Accountable to the State of Illinois
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13
01-Sep-96	3,478.0	3.8	3,481.8	52.6	40.4	26.3	8.6	127.9	300.2	3,654.0	2,149.7	42.5	1,241.0
02-Sep-96	2,955.0	3.8	2,958.8	39.9	40.7	21.2	8.9	110.6	302.0	3,150.2	2,212.8	33.5	1,251.0
03-Sep-96	3,585.0	3.6	3,588.6	46.4	39.5	21.7	8.9	116.5	301.2	3,773.3	2,230.1	62.3	1,182.0
04-Sep-96	3,081.0	3.7	3,084.7	89.8	38.3	34.9	10.8	173.8	301.5	3,212.4	2,265.0	91.1	1,210.0
05-Sep-96	3,330.0	3.9	3,333.9	47.6	37.3	20.4	11.4	116.7	300.2	3,517.4	2,261.5	33.5	1,232.0
06-Sep-96	3,467.0	3.7	3,470.7	54.6	39.5	22.2	9.5	125.9	300.1	3,646.0	2,256.1	40.8	1,235.0
07-Sep-96	3,633.0	3.8	3,636.8	215.0	38.9	76.0	8.5	338.4	297.5	3,696.9	2,093.2	727.5	1,043.0
08-Sep-96	3,863.0	2.9	3,865.9	164.9	34.3	155.5	8.9	363.5	300.0	3,802.4	1,983.7	2,259.7	632.0
09-Sep-96	3,625.0	3.3	3,628.3	331.5	34.9	142.8	9.0	518.3	292.3	3,402.3	1,934.4	476.1	1,056.0
10-Sep-96	3,829.0	3.5	3,832.5	39.9	36.7	27.7	9.3	113.5	290.8	4,009.6	1,968.2	59.9	1,370.0
11-Sep-96	4,324.0	3.7	4,327.7	165.0	35.8	622.1	9.2	832.2	292.9	3,788.4	1,947.6	1,129.1	1,054.0
12-Sep-96	4,197.0	1.8	4,198.8	57.9	37.1	36.8	8.9	140.7	288.4	4,346.5	1,834.8	146.2	1,376.0
13-Sep-96	3,617.0	1.9	3,618.9	55.2	38.2	28.6	9.0	131.0	287.2	3,776.1	1,814.4	67.9	1,172.0
14-Sep-96	3,312.0	1.9	3,313.9	37.2	39.7	18.9	9.1	104.9	287.9	3,496.9	1,814.3	34.3	1,165.0
15-Sep-96	3,171.0	1.7	3,172.7	75.2	40.6	29.3	8.8	154.0	288.7	3,307.5	1,796.8	52.3	1,165.0
16-Sep-96	3,165.0	2.0	3,167.0	101.0	42.1	36.2	8.9	188.2	289.2	3,268.0	1,852.8	62.0	1,183.0
17-Sep-96	3,129.0	2.4	3,131.4	55.7	42.8	20.7	8.7	128.0	293.5	3,296.9	1,891.3	30.6	1,207.0
18-Sep-96	3,093.0	2.9	3,095.9	40.0	45.3	15.7	8.7	109.7	290.8	3,277.0	1,905.4	24.3	1,136.0
19-Sep-96	2,885.0	3.0	2,888.0	105.0	39.0	34.9	9.1	188.0	289.7	2,989.7	1,928.6	61.8	998.0
20-Sep-96	2,776.0	2.6	2,778.6	40.1	32.4	14.8	9.0	96.3	290.9	2,973.2	1,883.1	25.4	874.0
21-Sep-96	2,883.0	2.1	2,885.1	56.6	33.1	19.1	8.8	117.6	285.1	3,052.6	1,821.3	32.3	970.0
22-Sep-96	3,268.0	4.0	3,272.0	56.0	31.5	19.1	8.7	115.3	285.6	3,442.3	1,821.9	35.2	996.0
23-Sep-96	3,014.0	3.4	3,017.4	93.6	32.8	30.5	9.0	165.8	287.2	3,138.9	1,869.9	56.5	800.0
24-Sep-96	3,035.0	3.1	3,038.1	37.2	33.1	12.2	8.3	90.8	284.5	3,231.7	1,793.6	20.4	948.0
25-Sep-96	3,001.0	2.9	3,003.9	109.1	27.7	34.8	8.2	179.8	284.7	3,108.8	1,809.2	58.5	901.0
26-Sep-96	5,478.0	1.7	5,479.7	81.5	36.4	1,432.1	8.4	1,558.4	297.0	4,218.3	1,740.6	9,983.7	539.0
27-Sep-96	7,510.0	2.1	7,512.1	233.6	35.2	316.6	7.6	593.0	282.3	7,201.4	1,704.7	2,010.6	563.0
28-Sep-96	4,457.0	1.8	4,458.8	339.7	25.3	187.4	7.4	559.9	282.7	4,181.6	1,706.2	522.0	854.0
29-Sep-96	3,777.0	2.2	3,779.2	84.5	20.8	71.7	8.0	184.9	281.8	3,875.8	1,679.8	202.5	851.0
30-Sep-96	3,249.0	2.5	3,251.5	37.2	25.4	38.7	8.7	110.0	284.8	3,426.3	1,766.2	103.3	887.0
Averages	3,606.2	2.9	3,609.1	98.1	35.8	119.0	8.9	261.8	291.3	3,638.6	1,924.6	616.2	1,036.4





