APPENDIX C

LAKE MICHIGAN DIVERSION ACCOUNTING

WATER YEAR 1987 REPORT

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EXECUTIVE SUMMARY

In compliance with the modified 1980 U.S. modified U.S. Supreme Court decree, the WY87 diversion was computed using the best engineering technology available to date as applied to the diverted watersheds.

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 WY87 diversion accountable to the State of Illinois is 3,773.5 cfs. This is 573.5 cfs greater than the 3,200 cfs average specified by the Decree. The 40 year running average, rounded to the nearest cfs, beginning with WY81 is 3,462 cfs and the cumulative deviation from the 3,200 cfs average is -1,835 cfs-years. The negative cumulative deviation indicates a water allocation debt and the maximum allowable debt is 2,000 cfs-years.

INTRODUCTION

The diversion of water from the Lake Michigan watershed is of a major importance to the Great Lake 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. The computations for Water Year 1983 (WY83), WY84 and WY85 (1 October 1984 through 30 September 1985) were completed by the Northeastern Illinois Planning Commission (NIPC) for the Illinois Department of Transportation (IDOT). Prior to the WY83 report, the calculations were made by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) for IDOT. The Corps reviewed, modified, and updated the WY84 and WY85 diversion accounting completed by NIPC. The computations for WY86 were performed jointly by NIPC (under contract to the Corps of Engineers) and the Corps of Engineers. The computations for WY87 were performed solely by the Corps of Engineers. This report represents the final Lake Michigan diversion accounting for WY87.

AUTHORITY FOR REPORT

Under the provisions of the U.S. Supreme Court Decree in the Wisconsin, et al v. Illinois et al, 388 U.W. 426,87 S.Ct. 1774 (1967) as modified 449 U.S. 48, 101 S.Ct. 557 (1980), 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 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 1 October 1987.

HISTORY OF THE DIVERSION

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

With the development of the Chicago metropolitan area, drainage 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 as such 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. This increased the rate and volume of runoff and resulted in increased flooding.

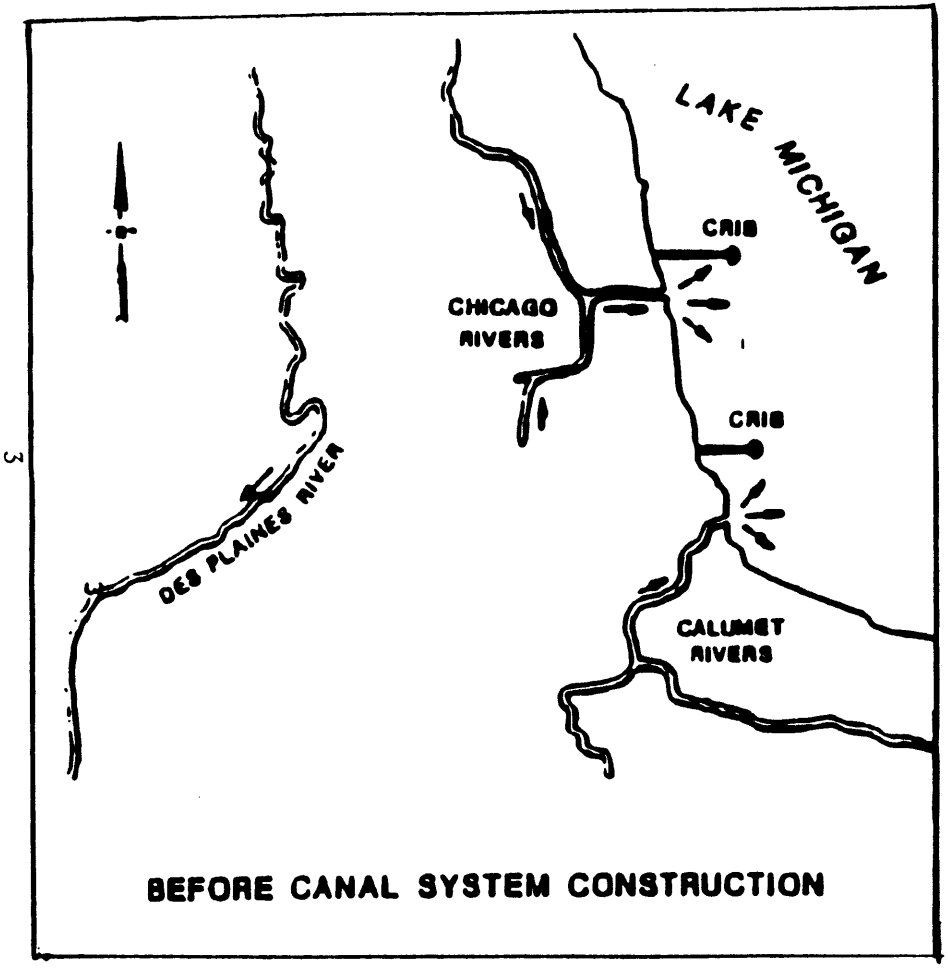
As a solution to the sanitation and flooding problems construction of the Chicago Sanitary and Ship Canal (CSSC) was undertaken. This construction allowed the flow direction of the Chicago River to be reversed (Figure 1). Construction of the Chicago Sanitary and Ship Canal was completed in 1900 by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) (formerly Metropolitan Sanitary District of Greater Chicago, MSDGC). The Sanitary and Ship Canal followed the course of the older I and M Canal. This canal is much larger than the I and M canal and can handle the Chicago River flow as well as increased shipping. The Chicago River Controlling Works was constructed at the mouth of the Chicago River. The lock regulates the amount of Lake Michigan water allowed to pass into the river and restricts river flooding from entering Lake Michigan.

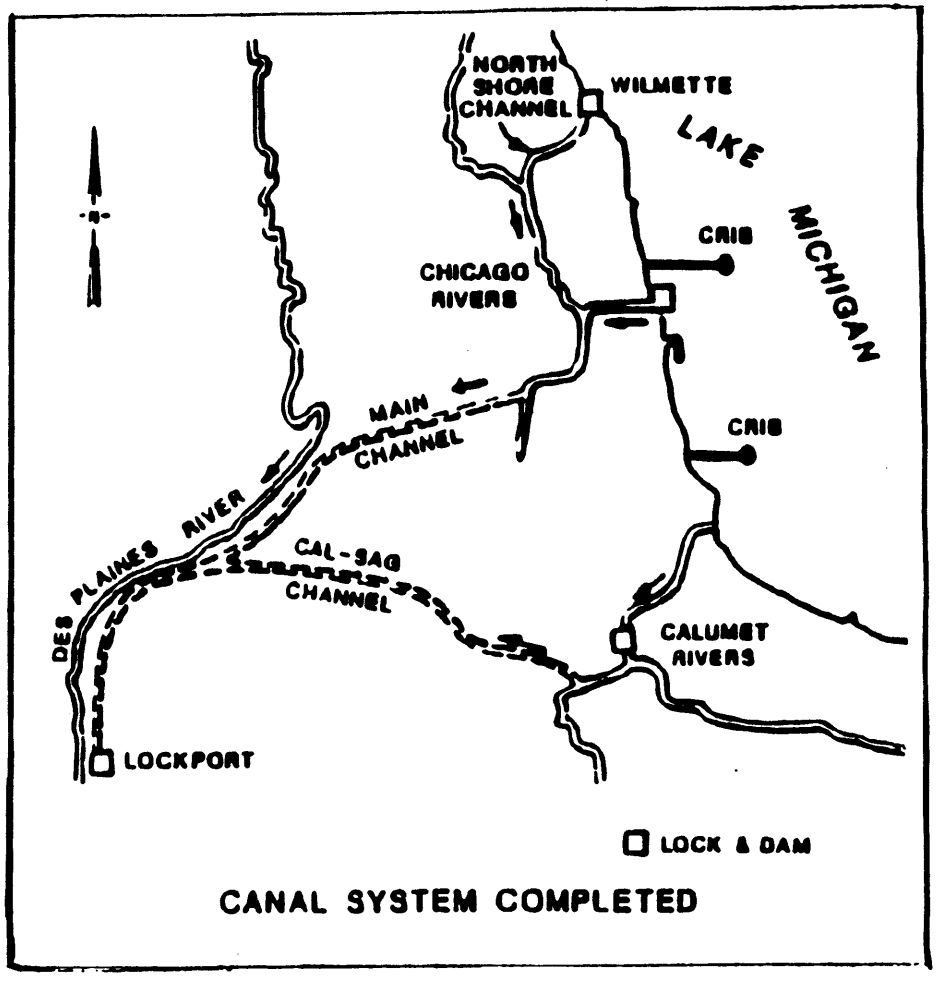
Between 1907 and 1910 the MWRDGC constructed a second sanitary canal called the North Shore Canal. It extended from Lake Michigan at Wilmette in a southerly direction 6.14 miles to the north branch of the Chicago River. The Wilmette Controlling Works regulate the amount of Lake Michigan flow allowed down the channel.

Construction of a third canal, the Calumet Sag Canal, was completed in 1922. The canal connects Lake Michigan through the Grand Calumet River, to the Sanitary and Ship Canal. This canal was constructed to carry sewage from South Chicago, Illinois and East Chicago, Indiana. The O'Brien Lock and Dam located on the Calumet River, regulates the flow of Lake Michigan waters down the canal.

Figure 1

Development of the Chicago Canal System





BACKGROUND OF LAKE MICHIGAN DIVERSION ACCOUNTING

The Lake Michigan diversion accountable to Illinois is limited to 3,200 cfs over a forty year averaging period. During the forty year period, the average diversion in any annual accounting period may not exceed 3,680 cfs except in any two accounting periods in which the average diversion may not exceed 3,840 cfs as a result of extreme hydrologic conditions. During the first 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 period beginning with WY81.

Prior to the 1983 accounting report, diversion accounting was done by the MWRDGC in the form of monthly hydraulic reports. As required by Supreme Court 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 Chicago Sanitary and Ship canal. Not all of the deductible flows could be measured, therefore MWRDGC used flow records from gaged areas to get typical flow values and then extrapolated to arrive at the total deduction.

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 identifying problem areas in the procedure. The procedure developed by NIPC is a significant improvement over the previous approach because of the more rigorous approach and because of the verification provided by the budgets.

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

The first technical committee was convened during the period that the diversion accounting was done by MWRDGC. 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).

In response to the Committee's concerns, the State of Illinois installed an acoustic velocity meter (AVM) at Romeoville five miles upstream of Lockport. The AVM is a highly accurate flow meter 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 AVM, a replacement AVM was installed in November 1988.

To provide flows during periods of malfunction, various regression analyses were done to relate the MWRDGC reported Lockport flows to the AVM flows. Several sets of equations were proposed by the Corps of Engineers, the 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 regression equations that were ultimately used to estimate missing AVM flows from WY86 through WY91 were developed by the USGS in a report tentatively titled "Discharge and Regression Analyses for Acoustical Velocity Meter Data for the Chicago and Sanitary Ship Canal at Romeoville, Illinois." The final publication of this report is expected to be available in the spring of 1993.

The second and most recent technical committee reviewed the NIPC hydrologic and hydraulic computer models and agreed that the approach was consistent with what was required by 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 (C. B. Burke Engineering, Ltd.) in September of 1988 to review and update the modeling parameters. The final report 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 the WY84 and all subsequent reports.

NIPC completed the WY84 diversion accounting report in April of 1988. It was subsequently reviewed by the Corps. The Corps found the report to be adequate with two exceptions. First, the 1984 accounting was completed with the modeling parameters questioned by the second technical committee. Second, MWRDGC reported Lockport flows, adjusted using the WES rating curves, were used instead of 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 of 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 U.S. Geological Survey (USGS) in their WY85 Water Resources Data for Illinois report. Since the publication of the WY85 USGS report, more reliable equations have been developed for calculating flows when the AVM was malfunctioning.

Upon completion of the analysis of the modeling parameters by Christopher B. Burke Engineering, LTD, 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 of Engineers 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 of Engineers) and the Corps of Engineers. The computation of Illinois' diversion from Lake Michigan for WY87 was performed solely by the Corps of Engineers. Significant revisions to the diversion accounting procedures were undertaken to account for the impact of Calumet TARP (Tunnel and Reservoir Plan). These revisions as well as other minor revisions will be addressed latter in this report.

DIVERSION ACCOUNTING PROCEDURES

The Lake Michigan diversion accountable to the State of Illinois is calculated by measuring the flow in the Chicago Sanitary and Ship Canal 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, runoff from the Des

Plaines River watershed that is discharged to the canal, Lake Michigan water supply pumpage from Indiana that is discharged to the canal, and water supply pumpage from Lake Michigan used for Federal facilities that is 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 Sanitary and Ship Canal. 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 Column 11 through Column 13 should theoretically equal the flow in Column 10.

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 13, "Runoff from the Diverted Lake Michigan Watershed." Budget 7 through Budget 13 compare simulated to measured flows at MWRDGC facilities. These budgets are for verification of the diversion accounting procedures and give an indication of the accuracy of the diversion accounting. Budget 14 compares canal system inflows and outflows.

Table 1

Description of the Diversion Accounting Columns

Column No.	Description
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 State of Illinois
12	Runoff from the Diverted Lake Michigan Watershed
13	Direct Diversions Through Lake Front Control Structures Which is Accountable to the State of Illinois

Table 2

Description of the Diversion Accounting Computational Budgets

Budget No.	Title	Description
1	Diverted Lake Michigan Pumpage	This budget sums Lake Michigan water diverted by the State of Illinois in the form of municipal and industrial 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 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 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 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 this budget are used in Budget 14 and Column 12.
7	MWRDGC Northside Water Reclamation	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 on Budget 14 and Columns 6 and 12.

Table 2 (cont)

Description of the Diversion Accounting Computational Budgets

Budget No.	Title	Description
8	MWRDGC 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.

Table 2 (cont)

Description of the Diversion Accounting Computational Budgets

Budget No.	Title	Description
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.

REVISIONS TO THE LAKE MICHIGAN DIVERSION ACCOUNTING PROCEDURES

Several minor revisions were incorporated in the budget and column computations to streamline the diversion computations. These minor revisions do not significantly change the computed diversion.

The most significant revision to the diversion accounting procedures for WY87 that affects the computed diversion is the inclusion of modeling of the Calumet TARP (Tunnel and Reservoir Plan) Pumping Station. TARP is a comprehensive flood control and pollution control plan to alleviate the adverse effects of overflows on the waterways and Lake Michigan in the Chicago area. TARP is designed to capture sewage that would be conveyed into streams with runoff in the form of combined sewer overflows from the 375 square miles of combined sewer area within the MWRDGC service basin. The introduction of the Calumet portion of the TARP system affects the methods employed to compute Illinois' diversion from Lake Michigan. Combined sewer overflows, which prior to TARP, discharged into a specific waterway, may now be discharged into a different waterway via the TARP Tunnels. In 1987, only a portion of Phase 1 of Calumet TARP was in operation.

ACCOUNTING RESULTS

The WY87 diversion accounting monthly summary is presented in Table 4. Table 3 shows the total WY87 Lake Michigan diversion accountable to the State of Illinois is 3,773.5 cfs (Column 10). This is 573.5 cfs greater 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 3,462 cfs and the cumulative deviation from the 3,200 cfs average is -1,835 cfs-years. The negative cumulative deviation indicates a water allocation debt and the maximum allowable debt is 2,000 cfs-years. Tabular data on daily diversion flows in 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
1981	3,106	3,106	+ 94
1982	3,087	3,097	+ 207
1983	3,613	3,269	- 206
1984	3,432	3,309	- 438
1985	3,472	3,342	- 710
1986	3,751	3,410	- 1,261
1987	3,774	3,462	- 1,835

Table 4

Lake Michigan Diversion Accounting – WY 1987

Summary of Diversion Flows (cfs)

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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
MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13
OCT 86	5244.1	1.7	5245.8	126.0	80.0	238.3	2.4	446.6	82.8	4882.1	1686.5	1388.3	943.8
NOV 86	3320.7	2.3	3322.9	111.9	77.7	138.2	2.2	330.0	82.3	3075.3	1653.7	746.2	209.3
DEC 86	2991.6	1.0	2992.6	107.7	77.3	161.4	2.3	348.7	81.8	2725.8	1625.9	631.1	150.1
JAN 87	2675.2	0.4	2675.6	125.8	78.0	154.0	1.7	359.5	86.4	2402.5	1632.0	574.9	123.9
FEB 87	2745.4	2.2	2747.6	94.0	77.6	96.7	27.1	295.4	84.4	2536.5	1639.8	445.8	110.5
MAR 87	3156.0	2.1	3158.1	108.3	76.6	116.0	1.9	302.8	84.1	2939.4	1640.9	520.3	283.3
APR 87	3553.1	0.5	3553.6	111.9	78.9	110.0	1.8	302.6	87.1	3338.0	1667.6	761.1	292.3
MAY 87	4142.5	2.5	4145.0	119.3	87.5	86.1	1.9	294.9	86.0	3948.0	1822.6	748.9	575.5
JUN 87	4198.5	1.0	4199.4	134.4	96.9	95.7	2.3	329.2	129.3	3999.6	2144.3	742.6	769.7
JUL 87	4426.2	0.8	4427.0	119.4	92.4	56.1	2.0	269.9	139.6	4295.7	2243.7	409.3	1287.9
AUG 87	6830.2	1.4	6831.5	168.0	87.3	399.5	2.1	656.9	108.7	6283.4	2042.0	2342.9	1175.9
SEP 87	4693.7	2.5	4696.2	106.6	69.6	93.3	2.0	271.5	97.6	4722.6	1849.3	378.4	1996.5
WY 87	4028.0	1.5	4029.5	119.8	81.6	146.4	4.2	352.0	98.0	3773.5	1804.9	811.7	665.4

COMPUTATIONS:

1. COLUMN 3 EQUALS THE SUM OF COLUMN 1 AND COLUMN 2.
2. COLUMN 8 EQUALS THE SUM OF COLUMN 4 THROUGH COLUMN 7.
3. COLUMN 10 EQUALS COLUMN 3 MINUS COLUMN 8 PLUS COLUMN 9.

DEDUCTIONS FROM THE ROMEOVILLE GAGE RECORD

ADDITIONS TO THE ROMEOVILLE GAGE RECORD

NOTES:

1. ALL VALUES ARE ROUNDED TO THE NEAREST TENTH.
2. MATHEMATICAL COMPUTATIONS BETWEEN COLUMNS UTILIZE UNROUNDED VALUES.
3. AVERAGE VALUES FOR WY87 WERE COMPUTED USING DAILY VALUES.

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 WY87 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 with seven budgets are used to verify the diversion simulation models. The columns are discussed first followed by the discussion of the budgets.

COLUMNS

The 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 columns display the three diversion components (Lake Michigan pumpage accountable to Illinois, runoff from the diverted watershed, and direct diversion through the lakefront control structures) and the sum of the three columns should theoretically equal the Romeoville based diversion calculation. A comparison of the sum of these three columns to the calculated diversion 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 WY87 is 4,028.0 cfs. For days when the AVM was inoperable, the flow at the Romeoville site was calculated from regression equations. It was determined previously that the regression equations using MWRDGC reported Lockport flows more accurately estimates the flow in the canal at Romeoville than the MWRDGC Lockport flows alone (USACE, 1989).

COLUMN 2: DIVERSIONS FROM THE CSSC ABOVE THE GAGE

Argonne Laboratories and Uno-ven Corporation (net, withdrawal- discharge) were the only diversions from the Chicago Sanitary and Ship Canal upstream of the Romeoville gage in WY87. The average withdrawal upstream of the AVM for WY87 is 1.5 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 canal flow is 4,029.5 cfs for WY87.

COLUMN 4: GROUNDWATER DISCHARGED TO THE CSSC AND ADJOINING CHANNELS

Column 4 is the effluent whose source is groundwater water supply pumpage by communities, industrial users, and other private users as reported by the Illinois State Water Survey (ISWS). It also includes the groundwater seepage into the TARP system that is discharged to the canal. This quantity is determined by summing all reported groundwater pumpages tributary to the canal along with the estimated groundwater seepage into the Mainstream TARP (Budget 9) and Calumet TARP (Budget 11) systems. This total is then adjusted by subtracting the groundwater normally tributary to the canal that is contained in the combined sewer overflows that discharge to the Des Plaines River and other watercourses not tributary to the CSSC. 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 service boundaries. Groundwater seepage into the Mainstream TARP and Calumet TARP systems was determined through simulation and is discussed further in Budgets 9 and 11. The groundwater constituent of combined sewer overflows is determined entirely thorough simulation.

Groundwater pumpage from the Lake Michigan watershed whose effluent is discharged to the canal is a deduction except to the extent that the groundwater sources are recharged by Lake Michigan. Current piezometric levels indicate that groundwater is discharging to the lake. Therefore, groundwater pumpage from within the Lake Michigan Watershed and reaching the canal continues to be a deduction. Research literature will be reviewed periodically to verify this assumption.

Column 4 represents a deduction from the Romeoville record and averaged 119.8 cfs for WY87. Groundwater pumpage tributary to the canal is composed of 21.7 cfs of groundwater pumpage from the Lake Michigan watershed, 30.2 cfs of groundwater pumpage from outside of the Lake Michigan watershed, 50.7 cfs of groundwater seepage into the Mainstream TARP system, and 17.3 cfs of

groundwater seepage into the Calumet TARP system. The total of these components is 119.9 cfs. However, the deduction from the Romeoville gage record is 119.8 cfs since 0.1 cfs of this groundwater supply pumpage was determined, through simulation, to be discharged to the Des Plaines River and other watercourses not tributary to the CSSC in the form of combined sewer overflows.

COLUMN 5: WATER SUPPLY PUMPAGE FROM INDIANA REACHING THE CHICAGO SANITARY AND SHIP CANAL

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 accepted 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 flow westward. For WY87, total flow in the Little Calumet River was 65.3 cfs, with 4.4 cfs of that flow being 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. 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 influenced by Lake Michigan levels. In the absence of a stream gaging station on the Grand Calumet River to measure westward flow into Illinois, flow is computed based on a statistical relationship of which the principal variable is lake levels.

Flow in the Grand Calumet River is estimated to be in excess of 90% sanitary effluent. Therefore, it is assumed that the portion of this flow that is attributable to domestic water supply is equal to the sum of the daily water supply for East Chicago, Hammond, and Whiting unless this sum is greater than the flow in the Grand Calumet River. In the case that the combine water supply for these communities is in excess of the flow in the Grand Calumet River, it is assumed that the flow consists entirely of effluent that originates from water supply.

The total Grand Calumet flow reaching Illinois in WY87 was computed as 129.3 cfs. It was determined that 77.2 cfs of that flow was water supply pumpage. Therefore, the total WY87 Indiana water supply deduction, including the flow from the Little Calumet and Grand Calumet Rivers is 81.6 cfs.

COLUMN 6: RUNOFF FROM THE DES PLAINES RIVER WATERSHED REACHING THE CHICAGO SANITARY AND SHIP CANAL

The WY87 average discharge of Des Plaines River watershed runoff reaching the canal (Column 6) is 146.4. The infiltration and inflow discharged to the water reclamation plants is 88.2 cfs, the infiltration and inflow reaching the canal through combined sewer overflows is 10.5 cfs, and the runoff from the Lower Des Plaines and Summit Conduit areas is 47.7 cfs. The deduction is largely determined by simulation but it is also influenced by the O'Hare basin flow transfer which contributed 10.0 cfs of the 88.2 cfs runoff to the water reclamation facilities during WY87. O'Hare Basin flow transfer will be discussed in more detail later in the report.

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 State of Illinois, and is typically comprised of water supply used by federal facilities. Column 7 represents a deduction from the Romeoville record and the amount of the WY87 deduction is 4.2 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 WY87 is 352.0 cfs.

COLUMN 9: LAKE MICHIGAN PUMPAGE NOT DISCHARGED TO THE CANAL

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:

(1) Lake Michigan water supply used by communities serviced by water reclamation facilities that do not discharge to the CSSC (94.6 cfs). This is an increase of 66.7 cfs from WY86.

(2) The sanitary portion of combined sewer overflows that do not discharge to the CSSC that is attributable to Lake Michigan domestic water supply (1.4 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. These communities include Elk Grove Village, Hoffman Estates, Mount Prospect, Schaumburg, Hanover Park, Rolling Meadows, Streamwood, Arlington Heights, Buffalo Grove, Palatine, Wheeling, Lincolnshire, Riverwoods, Libertyville, Illinois Beach State Park, Winthrop Harbor, Zion, Waukegan, 76 percent of North Chicago, and 38.2 percent of Des Plaines. It should 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 (1) the O'Hare flow transfer is treated at the Northside WRP that discharges sanitary effluent that is tributary to the CSSC and (2) 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 WY87 addition is 96.0 cfs.

COLUMN 10: TOTAL DIVERSION

Column 10 is equivalent to Column 3 with the deduction of Column 8 and the addition of Column 9. The total diversion for WY87 is 3,773.5 cfs. This amount is 573.5 cfs greater than Illinois's long term diversion allocation of 3,200 cfs. The 40-year running average diversion, beginning with WY81, is 3,462 cfs and the cumulative deviation from the 3,200 cfs allocation is -1,835 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

Column 11 through Column 13 represent the three Lake Michigan diversion components: Lake Michigan pumpage accountable to Illinois (1804.9 cfs), runoff from the diverted Lake Michigan watershed (811.7 cfs), and direct diversion through the lakefront structures (665.4 cfs). The sum of the columns (3,282.0 cfs) should theoretically equal the total diversion as shown in Column 10 (3,773.5 cfs) with one exception. The Romeoville record receives effluent that is assumed to contain only 90% of the water supply pumpage while Column 11, Lake Michigan water supply pumpage accountable to Illinois, does not account for consumptive use. This is based on a consumptive loss (water supply pumpage that is consumed or lost prior to reaching the water reclamation facilities) estimate of 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, and simple flow separation techniques, the estimate is not expected to be as accurate as the AVM based calculations. However a difference between estimates of 491.5 cfs or 13% is only a marginal balance and is much greater than should be expected. This discrepancy becomes even greater when consumptive use is accounted for in Column 11. The discrepancy in these two estimates is related to the balance in Budget 14, discussed in a subsequent section, and potential sources of the discrepancy are addressed in that budget discussion.

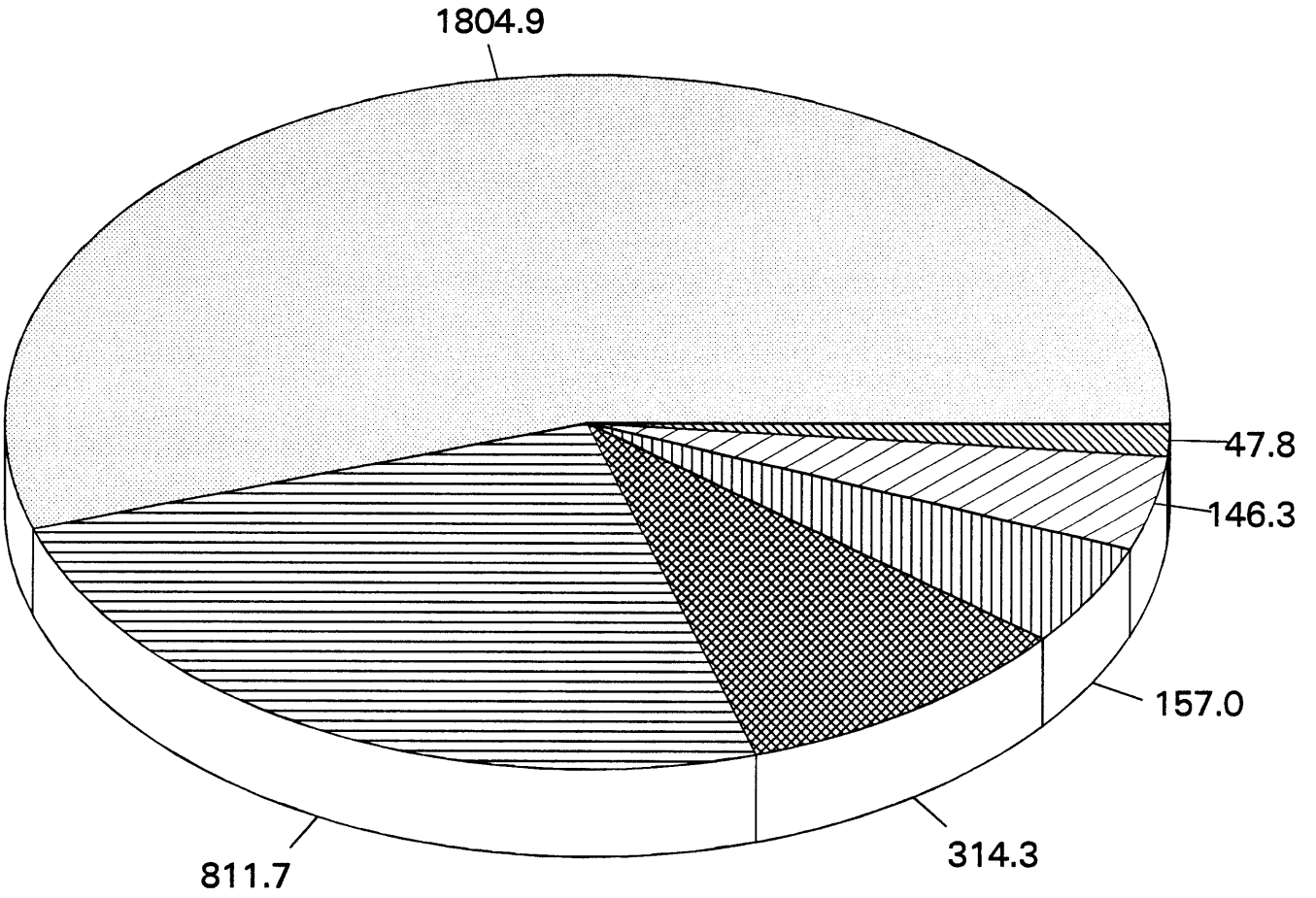
Using the figures from these three columns, approximately 55.0% of the WY87 Illinois diversion is attributable to pumpage from Lake Michigan for domestic water supply. Runoff from the diverted Lake Michigan Watershed accounted for 24.7% of the diversion and direct diversion through the lakefront structures accounted for 20.3% of the diversion. A more detailed breakdown of these percentages is shown in Table 5 and Figure 2.

Table 5

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

Category	Flow	Percentage
Lake Michigan Pumpage by the State of Illinois	1,804.9 cfs	55.0 %
Runoff from the Diverted Lake Michigan Watershed	811.7 cfs	24.7 %
Direct Diversions		
Lockages	146.3 cfs	4.5 %
Leakages	47.8 cfs	1.4 %
Navigation Makeup Flow	157.0 cfs	4.8 %
Discretionary Flow (adjusted for backflows)	314.3 cfs	9.6 %

Figure 2
Component Breakdown of Illinois' Diversion
Based on Columns 11 through 13



DIVERSION COMPONENTS

WATER SUPPLY 55.0 %	RUNOFF 24.7 %
DISCRETIONARY 9.6 %	NAV. MAKEUP 4.8 %
LOCKAGES 4.5 %	LEAKAGES 1.4 %

BUDGETS

The first two budgets are used to sum the water supply for the area influenced by the diversion. The following four 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 remaining seven budgets compare measured and simulated flows.

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 Chicago Sanitary and Ship Canal. Groundwater pumpage data is recorded 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. For WY87, the average annual Lake Michigan pumpage accountable to Illinois is 1,804.9 cfs.

BUDGET 2: GROUNDWATER DIVERTED TO THE CHICAGO SANITARY AND SHIP CANAL

Budget 2 is groundwater water supply pumpage by communities, industrial users, and other private users, as reported, by the Illinois State Water Survey (ISWS) whose effluent is discharged to the canal. This quantity is determined by summing all reported groundwater sources in the area tributary to the canal less groundwater not discharged to the canal in the form of combined sewer overflows.

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 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 51.9 cfs for WY87. It was determined through simulation that 0.2 cfs of this flow never reached the canal. Instead it was discharged to the Des Plaines River or other watercourses not tributary to the canal in the form of combined sewer overflows. The total groundwater pumpage reaching the canal represents a decrease of 23.8 cfs from WY86 to WY87.

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 flow at the stream gaging sites is also part of Budget 14, the canal system budget. Table 6 presents the estimated runoff from these budgets. It should be noted that Budgets 4 through 6 are a composite calculation of the runoff above the Little Calumet River at South Holland gage.

Table 6

Stream Gage Flow Separation

Budget	Location	Flow cfs	Sanitary cfs	Runoff cfs
3	North Branch Chicago River at Niles, IL	123.0	19.1	103.9
4	Little Calumet River at IL-IN State Line	65.3	3.6	61.7
5	Thorn Creek at Thornton, IL	107.9	16.6	91.3
6	Little Calumet River at South Holland, IL	188.4	19.4	169.0

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 and from precipitation-based runoff simulations. The estimated sanitary flow input to the simulation model 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 percent consumptive loss. 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 simulation, with the exception of Budget 11, as the development of these models have been discussed in previous reports. The discussion of Budget 11 will go in-depth into the development of the Calumet TARP model that was incorporated into the Lake Michigan diversion accounting program for WY87. A summary of the simulation results is presented in Table 7.

BUDGET 7: NORTHSIDE WATER RECLAMATION FACILITY

Budget 7 analyzes the water balance at the MWRDGC Northside Water Reclamation Facility (Figure 3). Overall, the balance for WY87 of the inflow to the Northside facility is good. The simulated to recorded flow ratio (S/R) for the Northside WRP is 0.95, indicating that the simulated inflow volume is extremely close to the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.69, indicating that the model predicted the inflow hydrograph to the Northside facility well.

BUDGET 8: UPPER DES PLAINES PUMP STATION

Budget 8 analyzes the water balance at Upper Des Plaines Pump Station (UDPPS) (Figure 4). The pump station budget is used to verify simulated flows. However it has no direct impact on the diversion calculation.

TABLE 7

WY 1987 SUMMARY OF SIMULATION STATISTICS

Budget No.->	7	8	9	10	11	12	13	14
Description	Northside WRP (1)	Upper Des Plaines Pump Station (1)	Mainstream TARP Pump Station (2)	Stickney WRP (1)	Calumet TARP Pump Station (2)	Calumet WRP (1)	Lemont WRP (1)	Chicago Canal System Balance (1)
Mean Recorded Flow, cfs	442.8	81.1	102.4	1203.8	39.4	361.4	2.2	3478.9
Max. Recorded Flow, cfs	667.1	152.9	542.3	2250.1	115.8	453.4	9.5	21867.0
Min. Recorded Flow, cfs	346.0	47.9	16.8	735.1	7.3	290.9	1.5	1832.8
Mean Simulated Flow, cfs	419.4	66.6	89.4	1193.3	43.6	311.9	1.9	4047.1
Max. Simulated Flow, cfs	707.1	233.5	410.2	3074.4	83.6	718.1	5.4	15849.0
Min. Simulated Flow, cfs	325.8	45.3	37.2	857.9	26.7	226.2	1.3	2186.8
Mean S/R	0.95	0.84	0.87	0.99	1.11	0.86	0.86	1.16
Max. S/R	1.37	3.06	6.47	1.72	5.64	1.89	1.70	1.95
Min. S/R	0.66	0.43	0.40	0.64	0.33	0.59	0.51	0.70
Correlation	0.69	0.59	0.80	0.76	0.53	0.42	0.73	0.90

(1) Based on daily values.
(2) Based on weekly values.

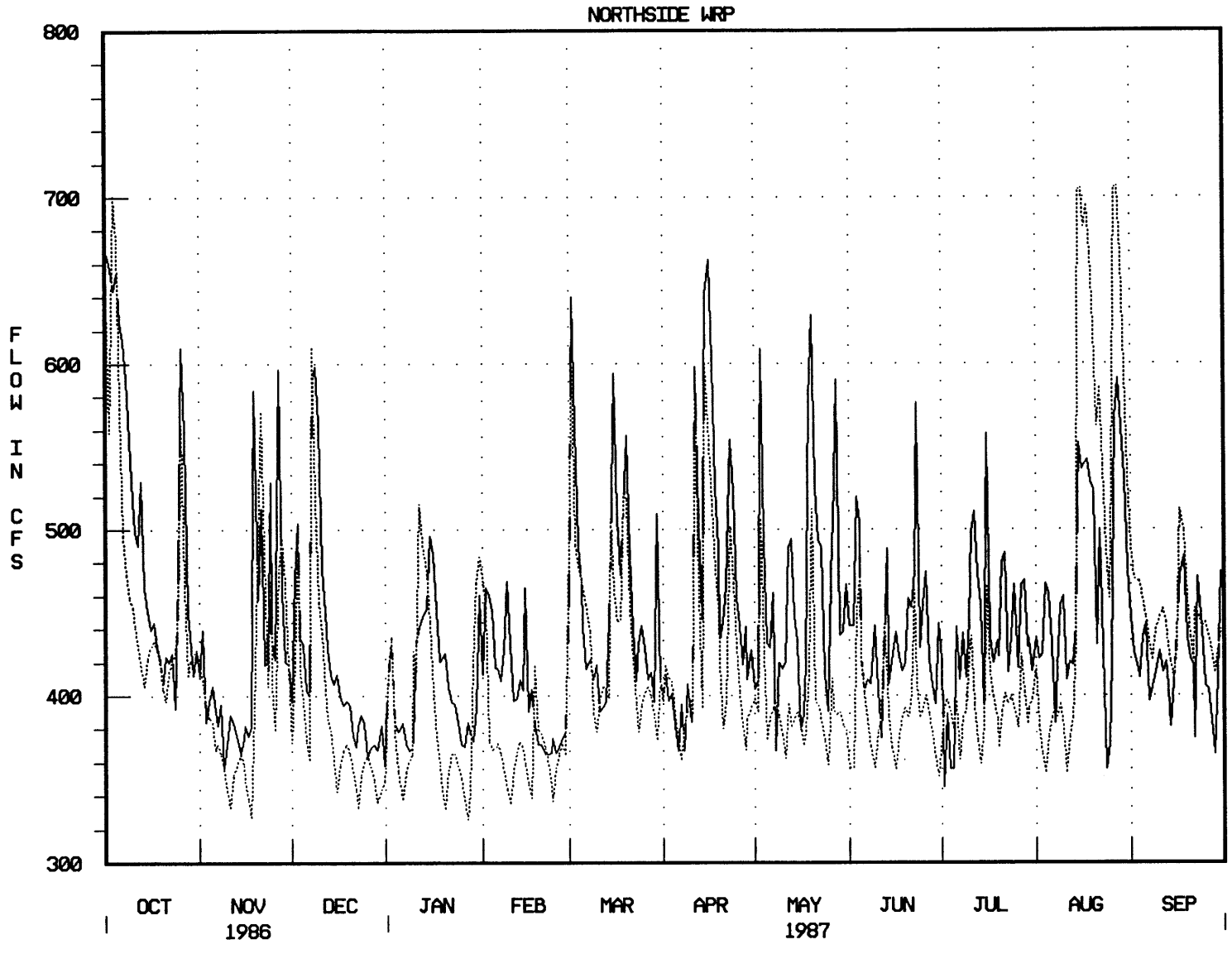


Figure 3

TOTAL PLANT FLOW OBSERVED FLOW
TOTAL PLANT FLOW SIMULATED FLOW

Budget 7 - Simulation of the MWRDGC Northside Water Reclamation Facility

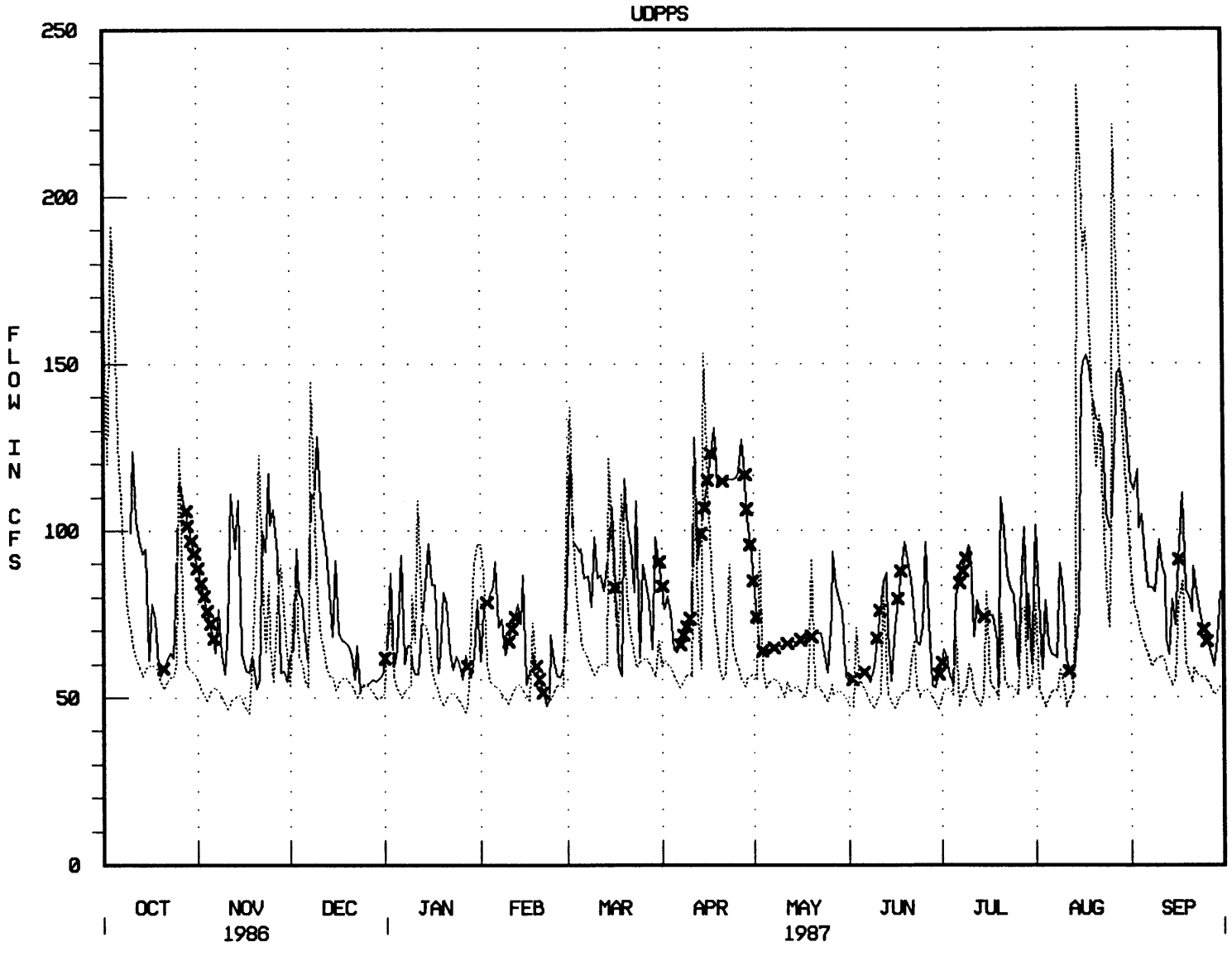


Figure 4

TOTAL PLANT FLOW OBSERVED FLOW
TOTAL PLANT FLOW SIMULATED FLOW

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

The balance at UDPPS for WY87 was fair. The simulated to recorded flow ratio (S/R) for the UDPPS is 0.84, indicating that the simulated inflow volume to UDPPS is close to the recorded inflow volume. However, the daily S/R ratio shows a high degree of variability which ranges from 0.43 to 3.06. The coefficient of correlation (R) of simulated to recorded flow is 0.59. This indicates that the time series trends in the simulated inflow compared marginally with the time series trends of recorded inflow. Nevertheless, this is a significant improvement over WY86 coefficient correlation (R) of 0.24.

While the statistical results for WY87 at the Upper Des Plaines Pump Station are much improved, this does not lead to the conclusion that flow measurement alternatives should not be investigated. This site has continued to experience its share of problems. During WY87, 90 days of records were unavailable due to meter malfunctions, problems with the recording charts that made data transformation undoable, and various other reasons. In view of the significant quantity of missing data (25 % missing data), the quantitative analyses of the simulation are of limited value. Second, 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 TARP

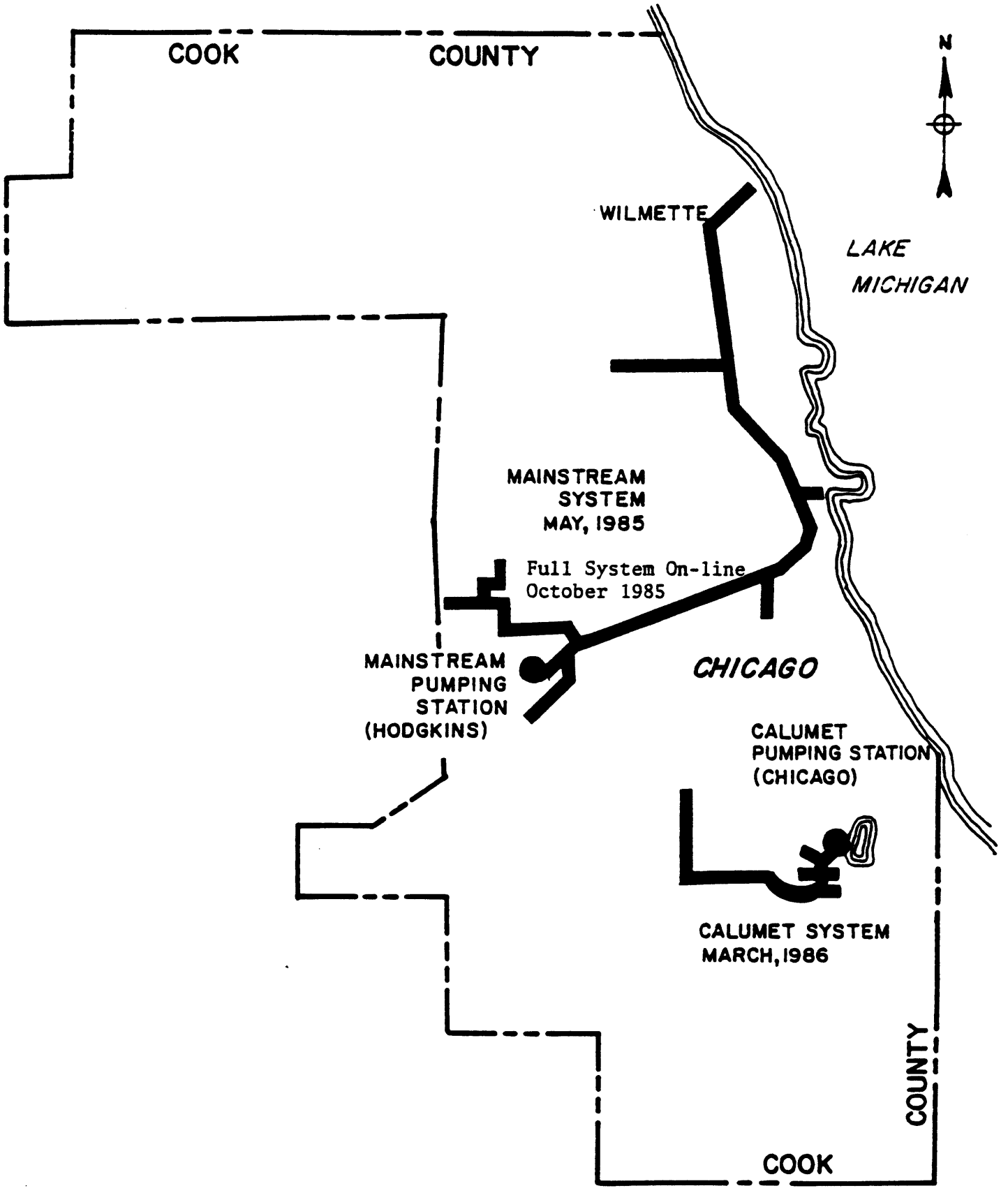
Budget 9 analyzes the water budget at the MWRDGC Mainstream TARP Pumping Station. The results of Budget 9 are used as input to Budget 10 in addition to providing a verification point for simulated flows. A simplified map of Mainstream TARP is contained in Figure 5.

In analyzing the balance at the Mainstream Pumping Station, weekly flows were used instead of daily flows. While MWRDGC maintains daily pumpage records, days with no pumpage occur frequently. Therefore, it is not possible to compute a daily S/R ratio.

The balance for WY87 of the inflow to the Mainstream Pumping Station is good. The simulated to recorded flow ratio (S/R) for the Mainstream Pumping Station is 0.87, indicating that the simulated inflow volume is slightly less than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.80. This indicate that the model predicts the inflow hydrograph to the Mainstream Pumping Station very well.

Figure 5

Map of Mainstream and Calumet TARP



From a review of the plot of the simulated versus recorded flow at the pump station (Figure 6), it appears that the model responds similarly to recorded pumpage record. However, the model tends to have slightly lower peak flows. This results in the simulated pumpage volume being less than the recorded pumpage volume. The one exception is during the cold months, ie. January and February, when the simulated pumpage exceeds the recorded pumpage.

In summary, it appears that the simulation of the Mainstream TARP system is reasonable. However, there is concern regarding the consistent underestimation of pumpage volume and the difference in simulated (hourly) pumpage and recorded (daily) pumpage time series. A review of MWRDGC information regarding Mainstream TARP indicates that bypass flows are discharged to TARP, when available, via drop shaft 11 (DSN 11). Further coordination with MWRDGC established that this is a frequent occurrence. This may account for the simulation of a pumpage volume that is less than the recorded pumpage volume. Records concerning the dates and pumpages back to TARP were not maintained for WY87. Therefore, data necessary to evaluate the impact of pumping back into TARP is not available. Therefore, it was decided that the model would not be adjusted so as to avoid double accounting of flows. This will be investigated further in the future to assess the affects of return flow to TARP on the Mainstream TARP TNET simulation results.

BUDGET 10: STICKNEY WATER RECLAMATION FACILITY

Budget 10 analyzes the water balance at the MWRDGC Stickney Water Reclamation Facility (Figure 7). In the computation of this Budget, simulated Mainstream TARP pumpages from Budget 9 were combined with simulated interceptor inflow to Stickney Water Reclamation Facility to derive the total simulated inflow to the Stickney Facility. Total simulated inflow was compared with recorded inflow to assess the accuracy of the simulation.

Overall, the balance for WY87 of the inflow to the Stickney facility is exceptionally good. The simulated to recorded flow ratio (S/R) for the Stickney is 0.99, indicating that the simulated inflow volume is extremely close to the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.76, indicating that the model predicted the inflow hydrograph to the Stickney facility exceptionally well.

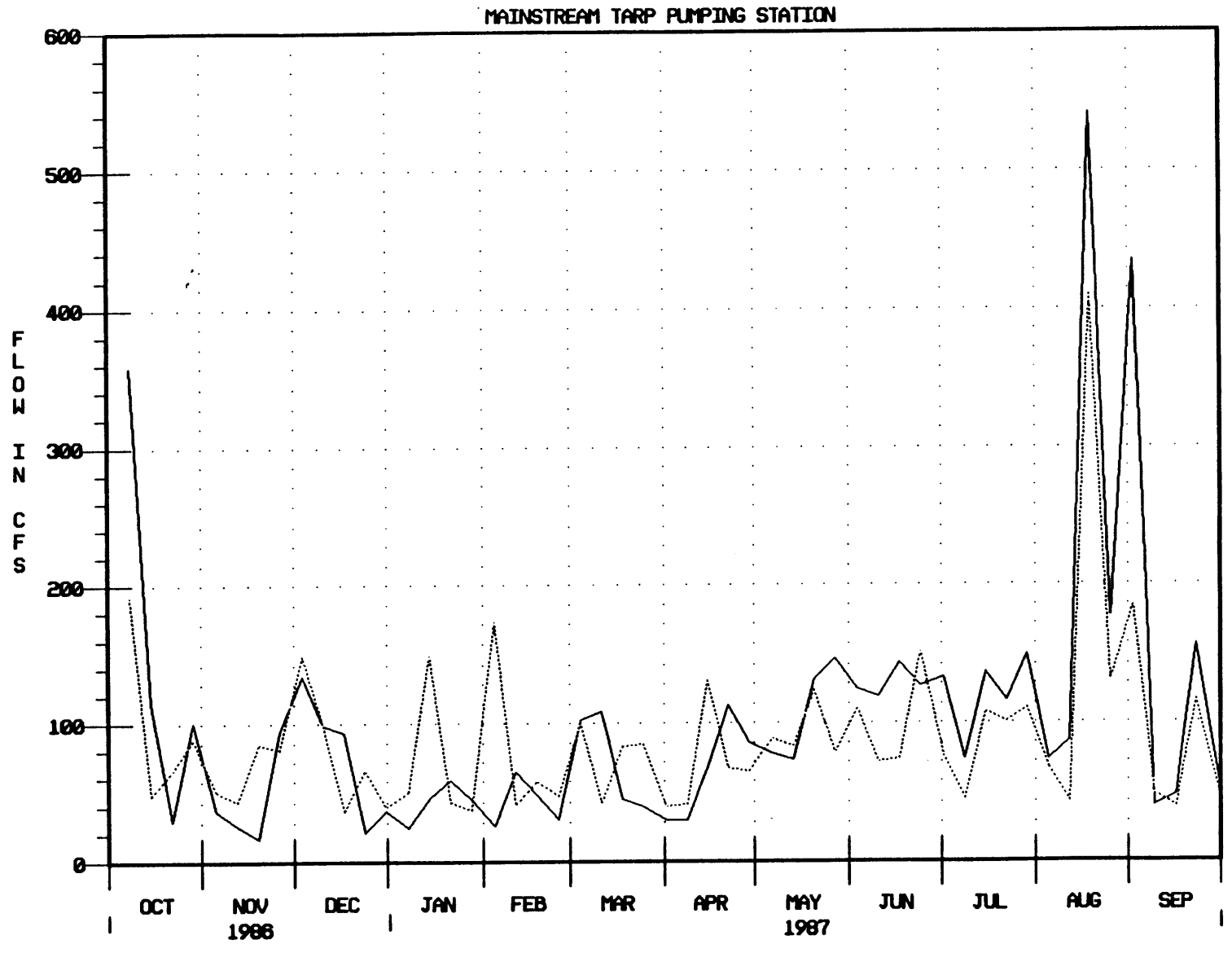


Figure 6

Budget 9 - Simulation of the MWRDGC Mainstream Pumping Station.

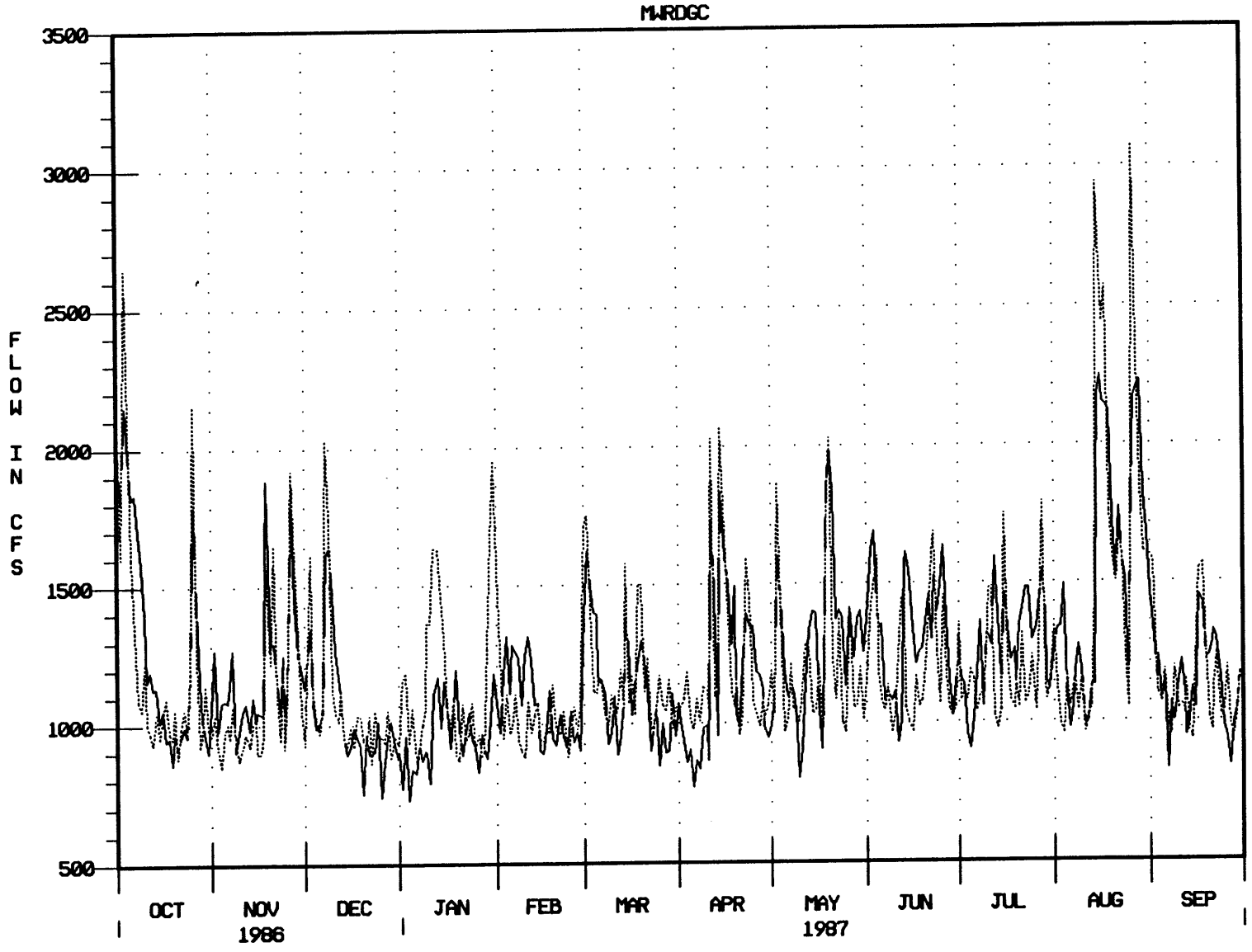


Figure 7

STICKNEY WRP OBSERVED FLOW
STICKNEY WRP SIMULATED FLOW

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

BUDGET 11: CALUMET TARP

Budget 11 analyzes the water budget at the MWRDGC Calumet TARP Pumping Station. The results of Budget 11 are used as input to Budget 12 in addition to providing a verification point for simulated flows.

The operation of the Calumet TARP Pumping Station to Calumet WRP was initiated in March, 1986. However, TARP flows were not recorded until October 1986. Additionally, operational procedures were being modified as additional segments of the system became operational. Therefore, it was impractical to model Calumet TARP prior to WY87 due to the dynamics of the system as additional segments of Calumet TARP came online as well as the fact that pumping records were not available to calibrate the model.

Calumet TARP (Figure 5) for WY87 consists of large tunnels constructed 225 to 325 feet below the Cal-Sag Channel as well as four low-level interceptor relief tunnels (18-E Extension A, Cal-Sag Relief Tunnel, Tunnel 19R-1, and Tunnel 20R-2) constructed 150 to 225 feet below the Cal-Sag Channel and its tributaries.

For WY87, Calumet TARP contains 9.2 miles of primary tunnel ranging from 9 ft. to 21 ft. in diameter and 15.9 miles of low-level interceptors ranging from 8.5 ft. to 17 ft. in diameter. The total tunnel storage volume is 509 acre-feet. There are 25 drop shafts ranging in size from 6 ft. to 15 ft. in diameter. There are also 21 access manholes containing ungated drop pipes. These access manholes range from 6.6 ft. to 7 ft. in diameter. The drop shafts provide for the dropping of combined sewer flow to the TARP tunnels from connecting structures near the ground surface. The access manholes with drop pipes provide relief to overtaxed separate sewers by dropping overflows into TARP via the ungated and uncontrolled drop pipes.

The modeling of Calumet TARP is performed using the TNET (Tunnel Network) dynamic hydraulic model. TNET simulates one-dimensional unsteady flow through a full network of open channels and conduits in both free surface and pressure flow conditions. Free surface flow is modeled using unsteady flow equations for open channel flow. In pressure flow situations, pressure flow is approximated using the concept of an infinitesimal slot (Preismann). This feature preserves the open channel nature of flow, but forces the high celerity of pressure waves.

In developing the Calumet TARP TNET model, existing tunnel conditions were determined from the MWRDGC 1986 TARP atlas and available as-built drawings of the tunnels. Drainage areas that are tributary to Calumet TARP were determined by Christopher B. Burke Engineering, LTD (Burke, 1991) and the Corps of Engineers from the Preliminary Design report for the Calumet System of the Tunnel and Reservoir Plan (Keifer, 1976) and other related documents. Operating procedures for the Calumet TARP were obtained from MWRDGC for Water Year 1987. These operating procedures included guidelines for the operation of gated drop shafts under dry weather, wet weather, and emergency conditions. Pumping capacity for both the Calumet Water Reclamation Facility and the Calumet Pumping Station were obtained from MWRDGC as well (MWRDGC, 1990).

The operational data and pumping capacities obtained from MWRDGC were incorporated into the Calumet TARP TNET model. Operational rules for gated drop shafts were incorporated in the form of a tunnel stage-percent drop shaft capacity rating curves referenced from one index drop shaft. Only one index drop shaft was used since the information on gate closures provided by the MWRDGC did not differentiate between the closure sequences for different segments of Calumet TARP. The curves were based on MWRDGC procedures regarding the relation of water surface elevation to gate closures in the Calumet TARP tunnels. A smooth curve over 2 ft. of elevation was used to prevent "slamming shut" of the gates. This unrealistic condition would cause severe wave oscillation in the tunnels and instability the numerical computations. The lower end of this curve, or the point at which gate closure begins, was derived from MWRDGC operational data.

Pumping from the Calumet Pumping to the Calumet Water Reclamation Facility is determined based on the minimum of (1) available capacity at the Calumet Water Reclamation Facility and (2) pumping capacity at the Calumet Pumping Station. Available capacity was determined as the difference between treatment capacity and simulated inflow from interceptor sewers.

Treatment capacity of the Calumet Water Reclamation Facility is variable. Normal pumping/secondary treatment capacity is about 354 cfs. Under high flow conditions, maximum pumping/ primary treatment capacity is about 450 cfs with flows exceeding secondary treatment capacity being bypassed to the Little Calumet River. This is also contingent on the number of treatment batteries that are operational at any given time.

In the development of the Calumet TARP TNET model, it is necessary to distinguish between conditions that would require only normal treatment capacity and those requiring maximum capacity. It was assumed that conditions requiring maximum treatment capacity would only occur in extreme hydrologic events. Therefore, an extreme hydrologic event was defined as occurring when the total combined sewer overflows into the Calumet TARP system exceed 30 cfs. This became the change point between normal and maximum treatment capacities. When the composite combined sewer overflow routed to Calumet TARP exceeds 30 cfs, then maximum treatment capacity conditions are applied.

Another factor in the development of the Calumet TARP TNET model is the simulation of dry weather flow. Dry weather flow can consist of groundwater seepage and/or discharge from sewered areas that directly connect to Mainstream TARP. Through the Preliminary Design report for the Calumet System of the Tunnel and Reservoir Plan (Keifer, 1976) and through construction drawings, it was determined that two low level interceptor relief tunnels, the Cal-Sag tunnel and tunnel 19R-1, receive a significant amount of dry weather sanitary flow from separately sewered areas. Since leakage is considered to be small, it was assumed that dry weather flow consisted entirely of groundwater seepage and sanitary flows from some separately sewered areas collected by the Cal-Sag and 19R-1 low-level interceptor relief tunnels.

Design seepage in the tunnel is 0.05 million gallons per day per mile. Calumet TARP has 25.1 miles of tunnel, giving a total design seepage of approximately 1.9 cfs. The Calumet TARP TNET model was tested using a uniform distribution of flow within each reach of the tunnel network that resulted in a total groundwater seepage of 1.9 cfs. It was observed that the total simulated volume was significantly less than the recorded Calumet Pumping Station discharge volume. Therefore, 3 separate dry weather periods during WY87 were used to calibrate the groundwater seepage rate so that the total simulated pumpage volume at the Calumet Pump Station was almost the same as the recorded pumpage volume. Using this calibration technique, it was determined that the total groundwater seepage be set at approximately 17.0 cfs. The Calumet TARP TNET model was then tested using a uniform distribution of flow within each reach of the tunnel network that resulted in a groundwater seepage rate of 17.0 cfs. This resulted in a significant improvement of the water balance at the Calumet TARP Pumping Station.

Although effort was made to incorporate Calumet TARP operating procedures into the TNET model, it was not feasible to incorporate all features of the operating procedures. First, operating procedures for Calumet TARP are divided into three categories, dry weather, wet weather, and emergency operations. Dry weather operations tend to focus operating Calumet TARP in the most economical fashion. Therefore, dry weather groundwater flows are allowed to accumulate, and are then pumped at night once there has been sufficient accumulation. Per MWRDGC correspondence, dry weather flows are normally pumped at night when costs for electrical service are reduced and normally requires the use of a high head pump.

The Calumet TNET model was developed to simulate MWRDGC procedures for pumping of dry weather flows. However, there are two major short comings of the model in simulating pumpage of dry weather flows. First the model cannot determine the optimum pumping time, therefore pumping can be initiated at any time if pumping is needed as indicated at the pump sense point. The pump sense point activates/deactivates the pumping algorithm of the model based on water surface elevation in the tunnel. Second, the TNET model cannot simulate the designated operation of a high head pump, but simulates based on available pumping capacity. Nevertheless, the TNET model did simulate dry weather operations of Calumet TARP reasonable well.

A second limitation of the Calumet TARP TNET model is the inability to "forecast" precipitation events. MWRDGC operational procedures call for the dewatering of the tunnel system of accumulated dry weather flow prior to a precipitation event to maximize storage of combined sewer overflows. The incorporation of a pseudo-forecast routine into the model would be helpful. However, the development of a pseudo-forecast algorithm into the model is logically complex and would require considerable effort and was therefore considered to be unfeasible at this time.

A third limitation is the limited number of sense points in the model, and the inability of the model to simulate gate closure based on an average water surface elevation within a tunnel reach. Incorporating a procedure based on improved sense point modeling would be more reflective of MWRDGC operating procedures and would provide for a better simulation.

In analyzing the balance at the Calumet Pumping Station, weekly flows were used instead of daily flows. While the MWRDGC maintain daily pumpage records, days with no pumpage occur frequently. Therefore, it is not possible to compute a daily S/R ratio.

The balance for WY87 of the inflow to the Calumet Pumping Station is fair. The simulated to recorded flow ratio (S/R) for the Mainstream Pumping Station is 1.11, indicating that the simulated inflow volume is only slightly larger than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.53. This indicates that there is similarity in the trends between the simulated and observed inflow, but there is room for improvement in the model's ability to predict the inflow hydrograph to the Calumet Pumping Station record.

From a review of the plot of the simulated versus recorded flow at the pump station (Figure 8), it appears that the model responds similarly to recorded pumpage record. However, the model tends to have a smaller range of flows, ie. recorded peak flows have lower simulated flows while recorded low flows have higher simulated flows. The one exception is during the cold months, ie. January and February, when the simulated pumpage exceeds the recorded pumpage.

In summary, it appears that the simulation of the Calumet TARP system is fair. However, there is concern regarding the difference in simulated pumpage and recorded pumpage time series. Unfortunately, the inability of the Calumet Water Reclamation Facility simulation (Budget 12) to adequately simulate plant inflows has an adverse effect on the results of this budget, and until simulated interceptor flows improve this budget will not result in a good simulation.

BUDGET 12: CALUMET WATER RECLAMATION FACILITY

Budget 12 analyzes the water balance at the MWRDGC Calumet Water Reclamation Facility (Figure 9). The annual simulated to recorded flow ratio (S/R) for Calumet Water is good (0.86), but the daily S/R shows a high degree of variability (0.59 to 1.89). The coefficient of correlation of simulated inflow to recorded inflow (R) is 0.42. Both the high variability in S/R and the poor correlation seem to indicate that the simulation does not provide a satisfactory representation of the hydrology and/or hydraulics of the Calumet service basin.

The hydraulic response to storm events at the Calumet facility was compared to that of the Northside and the Stickney facilities. Base flow at Calumet is about 320 to 360 cfs while peak storm flows in response to inflow-infiltration are on the order of 400 to 440 cfs. At Northside and Stickney, peak flows can be twice as high or greater relative to base flow. Therefore, it appears that the model is simulating proper hydraulic response, but the treatment facility cannot accommodate the storm inflow. This will be investigated at a later date.

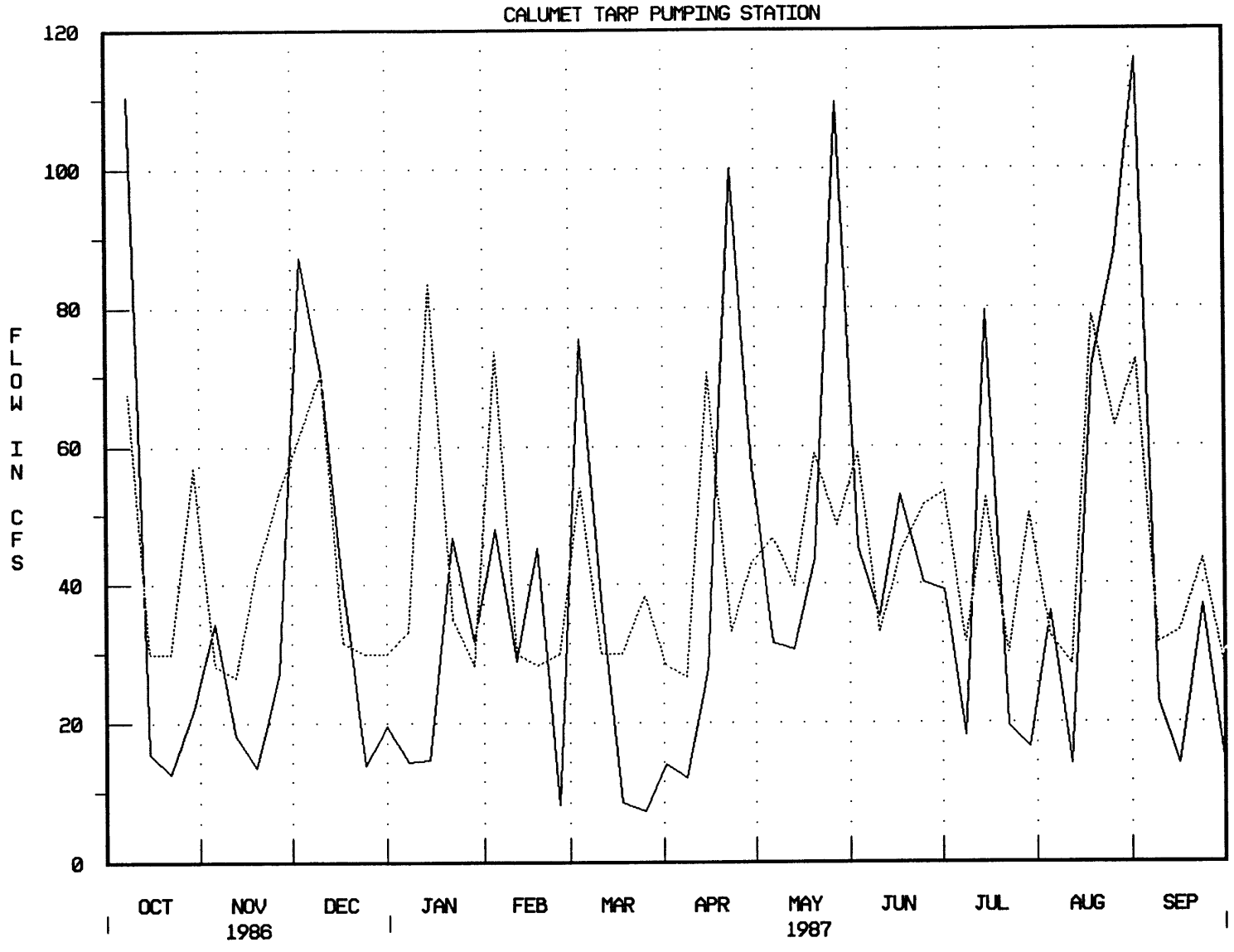


Figure 8

OBSERVED FLOW TO CALUMET WRP AND LITTLE CALUMET RIVER
SIMULATED FLOW TO CALUMET WRP AND LITTLE CALUMET RIVER

Budget 11 - Simulation of the MWRDGC Calumet Pumping Station

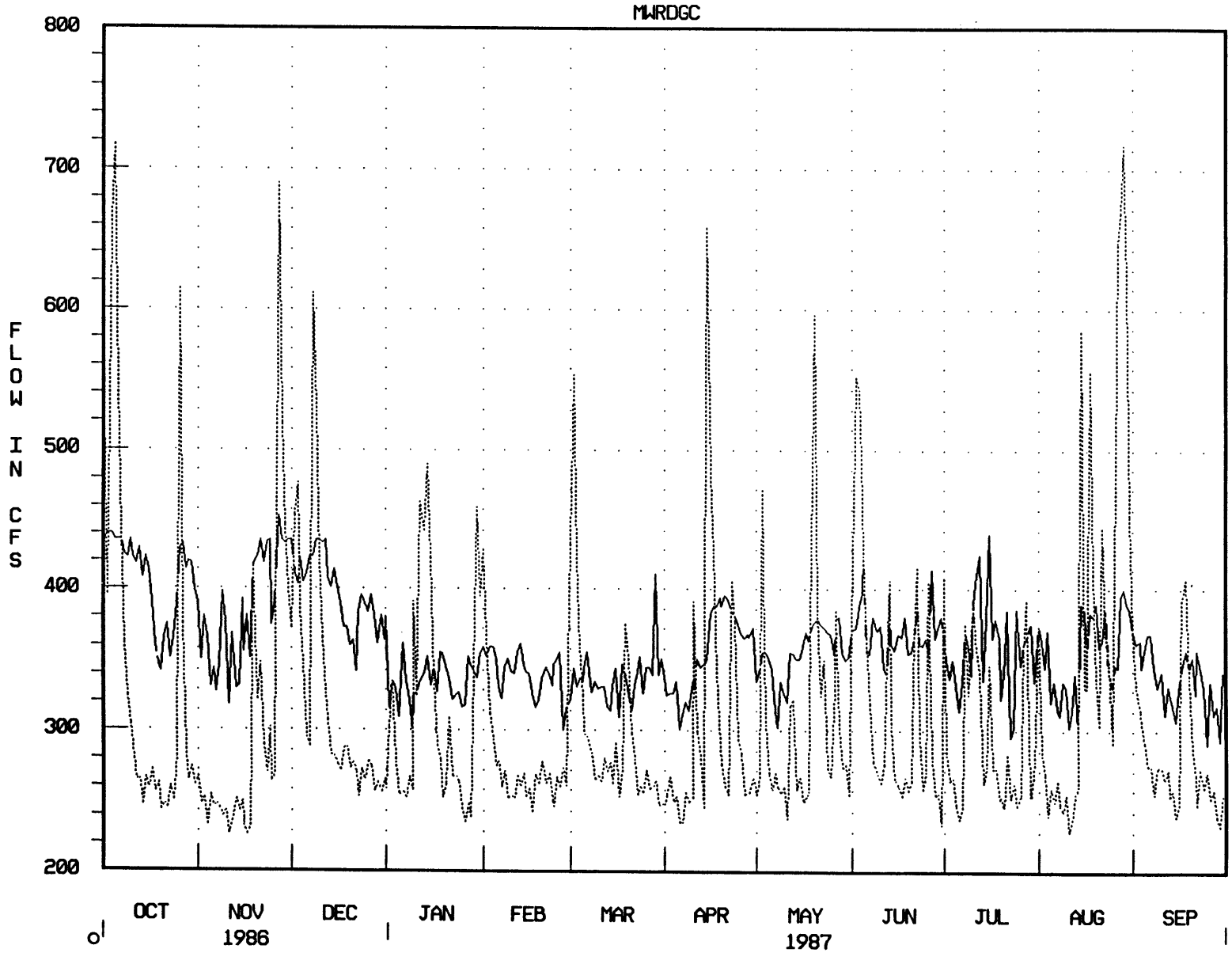


Figure 9

CALUMET WRP OBSERVED FLOW
CALUMET WRP SIMULATED FLOW
Budget 12 - Simulation of the MWRDGC Calumet Water Reclamation Facility.

BUDGET 13: LEMONT WATER RECLAMATION FACILITY

Budget 13 analyzes the water balance at the MWRDGC Lemont Water Reclamation Facility (Figure 10). Overall, the balance for WY87 of the inflow to the Lemont facility is good. The simulated to recorded flow ratio (S/R) for the Lemont is 0.86, indicating that the simulated inflow volume was slightly less than the recorded inflow volume. The coefficient of correlation (R) of simulated to recorded flow is 0.73, indicating that the model predicted the inflow hydrograph to the Lemont facility well.

BUDGET 14: CHICAGO CANAL SYSTEM BALANCE

Budget 14 compares the inflows and outflows to the canal system (Figure 11). 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 at Lockport, backflows through the lakefront structures, and withdrawals upstream of Lockport by Argonne National labs and Uno-ven corporation. The individual components are presented in Table 8 for WY87.

Overall, the balance for WY87 of the inflow to the canal system to the outflows from the canal system is fair. The S/R (outflow/inflow) for the canal system is 1.16, indicating that the inflow to the canal system is considerably less than the outflow from the canal system. The coefficient of correlation (R) of inflow to outflow is 0.90, indicating that the time series trends of inflow to outflow are well correlated. Therefore, based on the fact that the inflow is well correlated with the outflow, it appears that there is a moderately variable to constant underreported or unreported inflow.

In this balance the measured/simulated inflows are 566.0 cfs (14%) less than the measured/simulated outflows. In the Lake Michigan Diversion Accounting 1989 Report (USACE, 1990), it was reported that the Chicago Harbor wall was in poor condition and was not repaired until WY87. Therefore, discrepancies in this budget should be reduced for WY87. The difference between inflows and outflows has dropped 41.0 cfs (7%) from WY86 to WY87. This may be attributable to the repair of the Chicago Harbor wall.

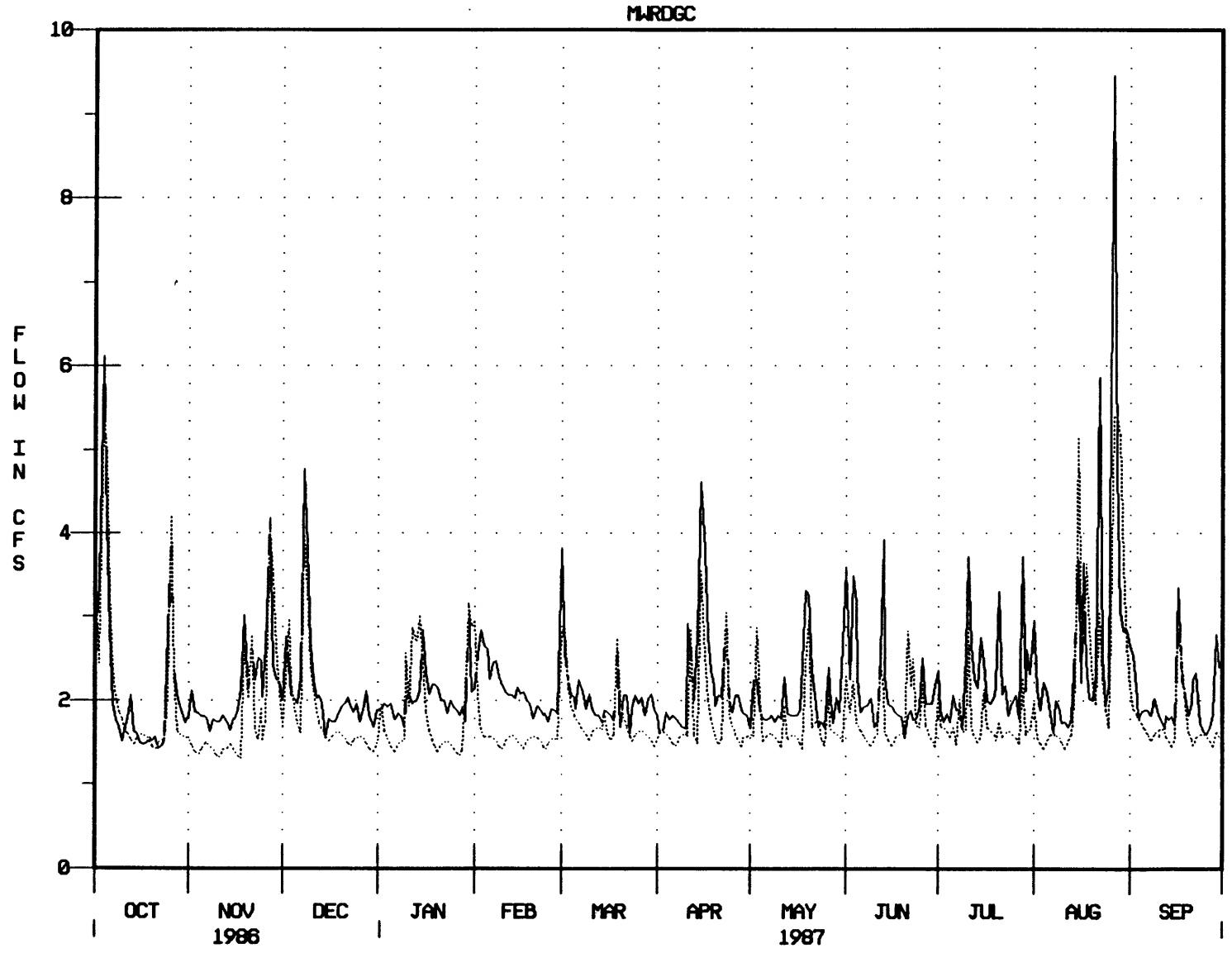


Figure 10

Budget 13 - Simulation of the MWRDGC Lemont Water Reclamation Facility.

TABLE 8

SUMMARY OF FLOW COMPONENTS FOR
CANAL SYSTEM BALANCE – WY 1987

INFLOWS (cfs)	
Lake Controlling Structures (measured)	
– Wilmette Controlling Works	32.2
– Chicago River Controlling Works	350.6
– O'Brien Lock and Dam	290.9
Streamflows (measured)	
– North Branch Chicago River at Niles	123.0
– Little Calumet River at South Holland	188.4
Streamflow (estimated)	
– Grand Calumet River at Holman Ave.	129.3
MWRDGC Water Reclamation Facilities	
– Northside	442.8
– Stickney	1203.8
– Calumet	361.4
– Calumet TARP Pumpage to River	29.0
– Lemont	2.2
Other Point Sources (measured)	7.9
Summit Conduit (simulated)	9.5
Combined Sewer Overflows	191.0
Direct Runoff to CSSC (simulated)	119.1
TOTAL INFLOWS (cfs)	3481.1

OUTFLOWS (cfs)	
Cal–Sag Flow Transferred to Calumet WRP as Steel Mill Blow–down	3.5
Lake Front Backflows	8.4
Argonne Laboratory	0.5
Uno–ven Corporation	6.7
USGS AVM Record	4028.0
TOTAL OUTFLOWS (cfs)	4047.1

DIFFERENCE (cfs)	–566.0

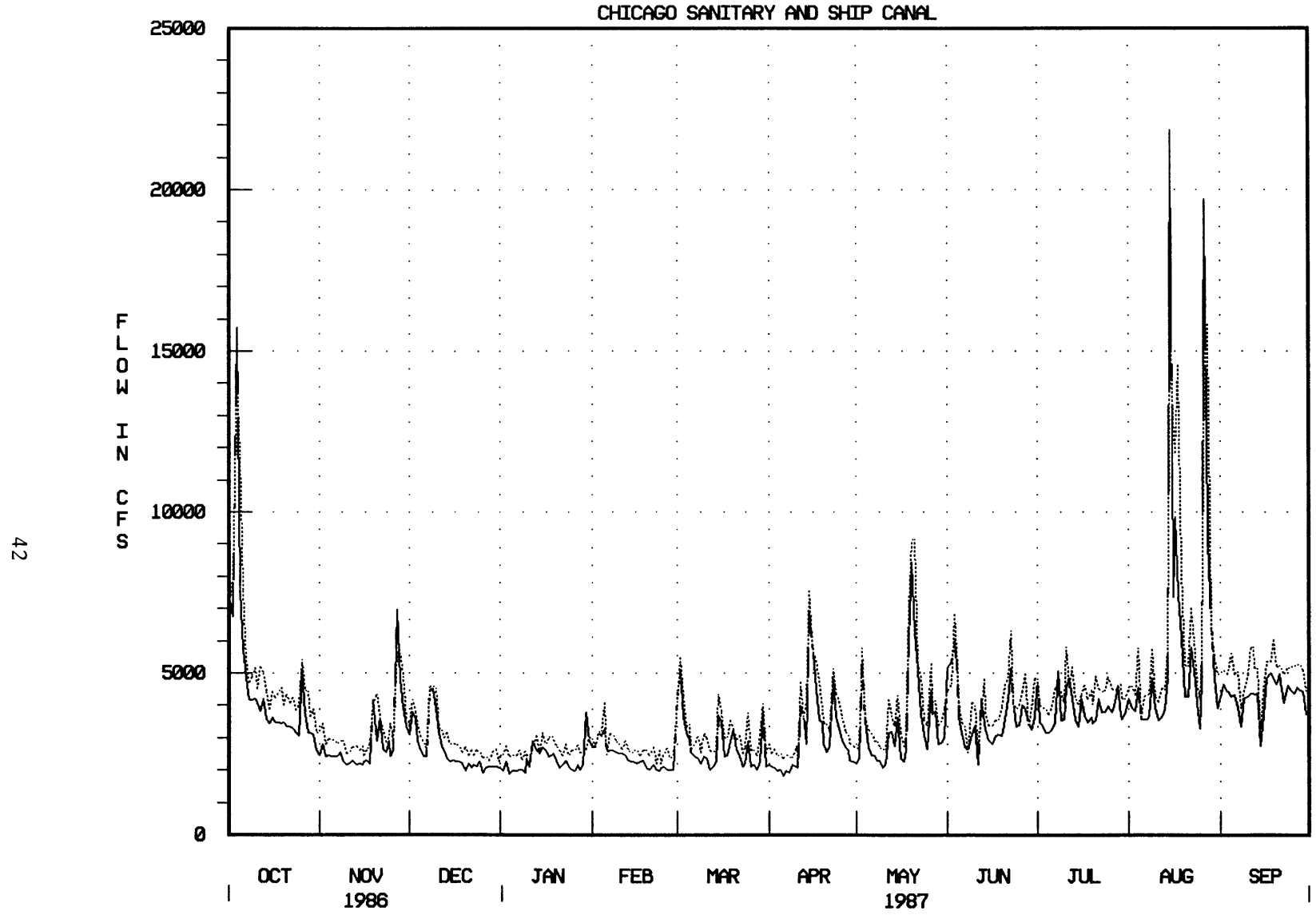


Figure 11

Budget 14 - Canal System Balance

Still, there remains a significant quantity of unaccounted flows in the water budget. Other possible sources of the canal flow imbalance may include underreporting of the lakefront flows through the sluice gates and locks and unaccounted for flow sources. The underreporting of the lakefront flows could be the result of both inaccurate rating curves for the lakefront control structures and leakage through those structures. Flow meter measurements at the lakefront direct diversion points were done to assess if leakage is significant. This study (USACE, 1990) showed that, given the accuracy limits of the Price AA current meter, lakefront flows are underreported, but the magnitude of underreporting could not be determined. Unaccounted flows could include unreported discharges to the canal.

AREAS FOR IMPROVEMENT IN THE DIVERSION ACCOUNTING PROCEDURES

As a result of reviewing and calculating the WY87 diversion accounting, and referencing the results of the WY84, WY85, and WY86 diversion accounting, a number of areas of potential improvement have become evident. The following paragraphs discuss those areas where improvement is needed.

O'HARE AND EGAN BASIN TRANSFER

A portion of the flows originating in the O'Hare and Egan Water Reclamation Plants' (WRP) service basins are transferred east to the Northside WRP. The extent of the O'Hare service area being diverted is not known and the diverted flow is not measured. Thus an estimate of the annual basin transfer is provided by MWRDGC. The total O'Hare-Egan flow transfer for WY87 was estimated by the MWRDGC to be 30.9 cfs (20 MGD).

This transfer is significant to diversion accounting because the O'Hare and Egan facilities discharge outside of the CSSC while the Northside facility 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, and diverted Des Plaines River watershed runoff. These two deductible components are contained in Columns 4 and 6, respectively.

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 contained in the sanitary portion of the transfer. For WY87 it was estimated that the water supply for the O'Hare and Egan

service basins was composed of 13.9 percent groundwater (2.9 cfs) and 86.1 percent Lake Michigan Water (18.0 cfs). The diverted Des Plaines River watershed runoff was estimated at 10.0 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 at this time. A more detailed discussion of the O'Hare and Egan basin transfer can be found in the Lake Michigan Diversion Accounting WY86 Report (USACE, 1991).

GRAND CALUMET RIVER

The flow in the Grand Calumet River drains both to the Lake Michigan via Indiana Harbor and to the Calumet Sag Channel that is tributary to the CSSC. When lake levels are high a larger portion of the flow drains to the Calumet Sag Channel. The Grand Calumet River flow calculation is currently based on a regression equation relating Lake Michigan stages and measured flows in Hart Ditch to the Grand Calumet River flow. Through current meter measurements by MWRDGC and other agencies, it was determined that the accuracy of the regression equation is questionable.

The Grand Calumet River flow to Illinois is important to diversion accounting because the majority of the flow in the Grand Calumet River is water supply effluent. This is a deduction to the AVM gage record and is contained in Column 5, Water Supply Pumpage from Indiana Reaching the CSSC. The Indiana water supply deduction is equal to the total water supply pumpage discharged to the Grand Calumet River if the pumpage rate is less than the calculated river flow. The deduction is equal to the river flow if the pumpage rate is greater than the river flow since under these conditions it is assumed that the river flow is composed entirely of sanitary effluent.

This procedure is the only method currently available to calculate the Indiana deduction. A stream gage has been installed in the West Branch of the Grand Calumet River to measure flow into Illinois. This should increase the accuracy of this computation significantly. The same computational procedure for separating stream flow into sanitary and runoff will be used with the Grand Calumet stream gage record.

MWRDGC CALUMET WATER RECLAMATION FACILITY

The MWRDGC Calumet Water Reclamation Plant (WRP) balance was discussed in a previous section where it was noted that although the annual S/R ratio was reasonable, the simulated inflows exhibited poor correlation to the recorded inflows. For WY87 the Corps of Engineers attempted to improve the SCALP (Special Contributing Area Loading Program) hydraulic simulation model so as to better reflect more recent hydraulic conditions of the Calumet service basin. However, the response of the revised simulation model for WY87 did not result in an improved response. Review of recent sewer studies and field evaluation of the sewer system may be required to develop a model that would more accurately represent the hydraulic response of the Calumet WRP service basin. One other possible explanation of the poor simulated to recorded correlation that should not be overlooked is inaccurate flow measurement at the plant. Personnel at MWRDGC need to be consulted on this issue to determine if current flow measurement techniques need to be improved. In addition, a portion of the Calumet WRP service area in the vicinity of the Calumet River needs to be investigated to correct errors regarding the presence of combined versus separate sewers.

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 measurement is needed at the pump station. With better flow measurement, this will become the most important balances for calibrating and verifying the simulation models of the Des Plaines watershed. In the diversion calculation, the primary use of the models is to calculate the deduction for runoff from the Des Plaines watershed discharged to the canal. All of the runoff draining to the pump station is from the Des Plaines watershed, is deductible, and is from somewhat similar land cover as the remaining deductible Des Plaines watershed. Thus, the characteristics of the Upper Des Plaines watershed may be the gaged area that is the most representative of the total deductible Des Plaines watershed. Installation of better flow measurement equipment at the pump station is being investigated.

CANAL SYSTEM BALANCE

As discussed previously, the canal system balance indicated that the total inflows were 14% less than the outflows. The discrepancy in this water balance dropped 41.0 cfs from WY86 to WY87. This may be attributable to the repair of the Chicago Harbor wall in WY87.

Flow meter measurements at the lakefront direct diversion points were done to assess if leakage is still significant. This study (USACE, 1990) showed that, given the accuracy limits of the Price AA current meter in extremely low velocity profiles, the lakefront flows are underreported. However, sound conclusions cannot be drawn regarding the magnitude of the underreporting.

In addition to the problems previously noted, there may be unreported discharges to the CSSC and adjoining waterways that affect the canal system balance. Reconnaissance missions should be made to determine if there are any unreported discharges that are being made directly to the canal system.

PRECIPITATION DATA

The runoff simulation models used to accomplish the diversion accounting are driven by precipitation and other meteorologic data. In performing the WY83 diversion accounting, NIPC discovered problems with the precipitation data related to shielding of the rain gages by buildings and other obstructions. To address this problem, the Illinois State Water Survey (ISWS) was contracted to assess the problem and adjust the precipitation data. The ISWS has also adjusted the WY84 though WY89 data used for Lake Michigan diversion accounting. To resolve the problem, a precipitation gage network of 25 gages was installed by the ISWS under contract with the Corps. However, no data will be available from the network until WY90. Prior to WY90, the precipitation data will be adjusted as in the past.

TUNNEL AND RESERVOIR PLAN

The model developed for the Mainstream Pumping Station performed acceptably for WY87 while the Model developed for the Calumet Pumping Station performed only marginally. There are several areas in which the models can be improved. First, modeling of dry weather flow can be improved to more accurately simulate MWRDGC operational procedures. Second, the incorporation of a pseudo-forecasting algorithm would allow the model to simulate MWRDGC dewatering procedures prior to a storm.

Third, dynamic constituent (I-I versus sanitary versus groundwater) tracking can be incorporated to allow more accurate determination of the deductible components of TARP flow. Fourth, the inclusion of an algorithm to operate gaged dropshafts based on average water surface elevation in a tunnel reach would provide better simulation of gage operations.

SUMMARY

In compliance with the modified 1980 U.S. modified U.S. Supreme Court decree, the WY87 diversion was computed using the best engineering technology available to date as applied to the diverted watersheds. In the development of WY87 Lake Michigan diversion accounting, a Calumet TARP model, was incorporated into the computations to model the Calumet TARP system.

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 exceptional well. These two budgets combined compute the majority of the deductible Des Plaines River watershed runoff. These budgets have simulated to recorded ratios of 0.95 and 0.99 and correlations of 0.69 and 0.76. 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 budgets are excellent. Other simulation budgets have performed well, but there is room for improvement. Areas of improvement previously outlined will be considered in order to improve the accuracy of the diversion computation.

The WY87 diversion accountable to the State of Illinois is 3,773.5 cfs. This is 573.5 cfs greater than the 3,200 cfs average specified by the Decree. The 40 year running average, rounded to the nearest cfs, beginning with WY81 is 3,462 cfs and the cumulative deviation from the 3,200 cfs average is -1,835 cfs-years. The negative cumulative deviation indicates a water allocation debt and the maximum allowable debt is 2,000 cfs-years.

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Lake Michigan Diversion Accounting

Water Year 1987 Report

Appendix A

Summary of Daily Diversion Flows

COLUMN COMPUTATIONS

1. COLUMN 3 EQUALS THE SUM OF COLUMN 1 AND COLUMN 2.
2. COLUMN 8 EQUALS THE SUM OF COLUMNS 4 THROUGH COLUMN 7.
3. COLUMN 10 EQUALS COLUMN 3 LESS COLUMN 8 WITH THE ADDITION OF COLUMN 9.

NOTES

1. ALL VALUES ARE ROUNDED TO THE NEAREST TENTH.
2. MATHEMATICAL COMPUTATIONS BETWEEN COLUMNS UTILIZE UNROUNDED VALUES.
3. AVERAGE VALUES FOR WY87 WERE COMPUTED USING DAILY VALUES.

LEGEND

DEDUCTIONS FROM THE ROMEOVILLE GAGE RECORD

ADDITIONS TO THE ROMEOVILLE GAGE RECORD

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-86	7329	1.7	7330.7	250.7	79.9	549.1	2.4	882.1	90.4	6538.9	1740.0	3644.9	1321.8
02-Oct-86	7946	1.7	7947.7	269.3	80.0	322.8	2.3	674.4	89.5	7356.7	1742.3	2322.2	1916.4
03-Oct-86	14079	1.7	14081.0	208.4	79.9	1763.0	2.4	2053.6	97.0	12124.0	1687.3	10724.0	838.0
04-Oct-86	11810	1.7	11812.0	268.0	79.9	796.6	2.3	1146.8	85.5	10750.0	1615.6	5068.4	261.0
05-Oct-86	7556	1.7	7557.7	215.9	79.7	507.0	2.4	804.9	91.6	6834.4	1594.2	2831.2	385.9
06-Oct-86	5418	1.7	5419.7	174.1	79.9	350.9	2.4	607.2	92.3	4894.7	1714.6	1777.5	516.1
07-Oct-86	4733	1.7	4734.7	65.7	80.0	230.4	2.4	378.5	91.8	4437.9	1723.7	1239.0	382.5
08-Oct-86	4897	1.7	4898.7	65.7	79.9	167.1	2.3	315.0	83.4	4667.0	1738.5	923.9	739.9
09-Oct-86	5150	1.7	5151.7	170.7	80.0	138.0	2.3	391.1	91.2	4841.8	1716.3	877.0	1138.6
10-Oct-86	4512	1.7	4513.7	65.7	80.0	116.5	2.4	264.6	83.2	4332.3	1702.0	727.2	1315.1
11-Oct-86	5203	1.7	5204.7	61.1	79.9	105.6	2.3	248.9	79.0	5034.8	1662.9	647.8	1133.1
12-Oct-86	4997	1.7	4998.7	65.7	79.9	100.1	2.4	248.0	79.0	4829.6	1628.9	578.3	1577.1
13-Oct-86	4404	1.7	4405.7	147.0	79.9	98.1	2.3	327.2	82.8	4161.3	1705.6	579.2	1103.6
14-Oct-86	3899	1.7	3900.7	65.7	79.9	92.5	2.3	240.4	82.2	3742.5	1688.0	490.5	1092.2
15-Oct-86	4416	1.7	4417.7	92.0	80.0	90.2	2.4	264.6	83.2	4236.2	1698.2	502.2	1276.4
16-Oct-86	4250	1.7	4251.7	122.3	79.9	89.5	2.3	294.1	81.7	4039.3	1702.1	502.8	1270.9
17-Oct-86	4430	1.7	4431.7	61.1	80.0	84.2	2.4	227.7	82.5	4286.5	1633.6	486.9	1262.6
18-Oct-86	4588	1.7	4589.7	65.7	79.9	82.6	2.4	230.6	79.9	4438.0	1590.5	454.4	1367.3
19-Oct-86	4045	1.7	4046.7	143.1	79.9	82.1	2.6	307.7	81.3	3820.3	1630.3	478.4	1344.3
20-Oct-86	4353	1.7	4354.7	65.7	79.9	77.4	2.5	225.5	80.4	4209.6	1704.7	399.2	1223.1
21-Oct-86	4061	1.7	4062.7	94.0	79.9	75.1	2.6	251.5	83.4	3894.6	1748.5	416.4	1221.3
22-Oct-86	4299	1.7	4300.7	124.7	80.0	74.1	2.5	281.3	83.1	4102.4	1756.3	417.6	1151.2
23-Oct-86	3845	1.7	3846.7	61.1	79.9	68.7	2.6	212.3	81.4	3715.7	1725.3	388.7	1043.9
24-Oct-86	4074	1.7	4075.7	93.7	79.8	126.1	2.5	302.1	83.9	3857.5	1700.4	681.7	523.8
25-Oct-86	5443	1.7	5444.7	325.6	79.7	475.3	2.4	883.0	84.9	4646.6	1637.4	2104.9	1054.5
26-Oct-86	4473	1.7	4474.7	147.5	79.9	244.4	2.4	474.2	82.0	4082.5	1677.7	1149.5	425.0
27-Oct-86	4473	1.7	4474.7	65.7	80.5	134.9	2.5	283.6	80.1	4271.2	1671.4	687.8	449.4
28-Oct-86	3624	1.7	3625.7	61.1	80.6	102.9	2.4	247.0	83.7	3462.4	1716.2	519.5	656.8
29-Oct-86	3897	1.7	3898.7	161.0	80.0	90.8	2.4	334.2	80.7	3645.2	1690.8	570.4	601.7
30-Oct-86	3172	1.7	3173.7	61.1	80.1	77.5	2.4	221.0	82.6	3035.2	1692.6	450.8	448.9
31-Oct-86	3192	1.7	3193.7	65.7	80.0	72.6	2.4	220.7	81.6	3054.6	1647.0	393.5	216.4
OCT 86	5244.1	1.7	5245.8	126.0	80.0	238.3	2.4	446.6	82.8	4882.1	1686.5	1388.3	943.8

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Nov-86	3466	2.3	3468.2	124.3	77.2	70.2	2.2	273.8	79.1	3273.5	1624.3	464.7	328.0
02-Nov-86	2810	2.3	2812.2	84.7	77.1	66.7	2.3	230.8	80.3	2661.8	1595.1	419.3	267.1
03-Nov-86	2982	2.3	2984.2	81.1	77.3	63.0	2.3	203.8	83.5	2864.0	1679.4	355.2	217.0
04-Nov-86	2960	2.3	2962.2	99.6	77.4	63.2	2.3	242.5	80.7	2800.4	1659.8	395.4	189.5
05-Nov-86	2890	2.3	2892.2	100.3	77.3	60.9	2.3	240.7	83.6	2735.1	1665.3	354.1	201.2
06-Nov-86	2809	2.3	2811.2	81.1	77.2	57.9	2.3	198.5	82.4	2695.2	1674.6	299.8	201.5
07-Nov-86	2896	2.3	2898.2	136.3	77.3	59.1	2.3	274.9	80.6	2703.9	1671.1	352.8	187.2
08-Nov-86	2973	2.3	2975.2	79.8	77.3	55.6	2.3	214.9	82.9	2843.3	1642.1	284.2	279.0
09-Nov-86	2498	2.3	2500.2	65.8	77.3	54.4	2.3	199.6	75.8	2376.5	1579.4	243.2	152.0
10-Nov-86	2569	2.3	2571.2	98.2	77.4	53.6	2.2	231.4	82.5	2422.3	1679.1	267.1	169.7
11-Nov-86	2700	2.3	2702.2	102.6	77.6	52.5	2.3	234.9	79.5	2546.8	1671.7	300.3	169.7
12-Nov-86	2743	2.3	2745.2	65.7	77.4	50.5	2.3	196.0	82.2	2631.5	1651.6	262.4	167.3
13-Nov-86	2605	2.3	2607.2	93.6	77.4	49.7	2.3	223.0	83.7	2468.0	1682.9	246.9	124.0
14-Nov-86	2774	2.3	2776.2	125.8	77.3	50.3	2.3	255.7	81.1	2601.7	1665.3	205.4	141.6
15-Nov-86	2460	2.3	2462.2	61.1	77.4	46.2	2.2	186.9	80.7	2356.0	1636.1	194.5	190.4
16-Nov-86	2651	2.3	2653.2	79.8	77.3	45.7	2.3	205.0	79.6	2527.9	1615.6	242.6	200.0
17-Nov-86	2818	2.3	2820.2	130.7	77.5	46.9	2.3	257.4	83.7	2646.5	1671.2	272.8	165.4
18-Nov-86	4049	2.3	4051.2	205.1	77.4	270.7	2.3	555.5	85.0	3580.8	1662.0	1232.9	150.3
19-Nov-86	4357	2.3	4359.2	126.5	77.4	179.7	2.2	385.9	82.7	4056.1	1663.1	789.7	183.7
20-Nov-86	3640	2.3	3642.2	196.8	77.4	313.4	2.3	589.9	85.9	3138.3	1660.3	1221.7	742.9
21-Nov-86	3275	2.3	3277.2	100.0	77.4	151.8	2.3	331.4	83.8	3029.6	1659.3	706.8	148.0
22-Nov-86	2876	2.3	2878.2	65.7	77.5	98.6	2.2	244.1	79.5	2713.7	1646.4	470.3	155.5
23-Nov-86	3043	2.3	3045.2	136.3	77.4	171.7	2.2	389.7	81.5	2737.1	1592.1	918.8	136.4
24-Nov-86	3429	2.3	3431.2	65.7	77.4	105.2	2.3	250.6	82.1	3262.8	1651.3	542.4	136.8
25-Nov-86	2942	2.3	2944.2	149.5	77.4	101.1	2.3	330.2	81.8	2695.9	1665.5	512.7	147.9
26-Nov-86	5653	2.3	5655.2	213.2	77.4	711.3	2.2	1004.1	85.7	4736.8	1652.9	3612.6	325.0
27-Nov-86	5642	2.3	5644.2	232.2	77.3	423.0	2.2	734.7	81.9	4991.4	1596.0	2791.0	89.0
28-Nov-86	4940	2.3	4942.2	163.1	77.3	304.3	2.2	546.9	79.6	4475.0	1571.5	1845.1	96.0
29-Nov-86	3656	2.3	3658.2	85.5	77.3	204.0	2.2	369.0	79.2	3368.5	1578.7	1161.0	114.2
30-Nov-86	3375	2.3	3377.2	70.6	77.3	154.6	2.2	304.7	79.0	3151.6	1559.7	1001.4	147.5
NOV 86	3282.7	2.3	3284.9	112.8	77.4	137.9	2.3	330.2	81.7	3036.4	1640.8	732.2	197.5

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-86	4219	1.0	4220.0	106.9	77.4	299.9	2.2	486.3	84.1	3817.9	1654.4	1477.4	411.9
02-Dec-86	3800	1.0	3801.0	272.6	77.2	389.4	2.3	741.4	82.3	3141.9	1659.2	1534.0	292.9
03-Dec-86	3424	1.0	3425.0	97.9	77.4	248.2	2.2	425.7	82.6	3082.0	1654.6	882.3	109.3
04-Dec-86	3046	1.0	3047.0	70.3	77.4	170.0	2.2	320.0	80.8	2807.9	1646.2	615.6	129.7
05-Dec-86	2866	1.0	2867.0	61.1	77.3	125.4	2.3	266.2	82.7	2683.5	1638.3	456.8	138.6
06-Dec-86	2656	1.0	2657.0	149.4	77.4	109.4	2.3	338.4	81.5	2400.2	1618.9	467.9	118.0
07-Dec-86	4587	1.0	4588.0	196.4	77.2	601.6	2.2	879.5	89.8	3798.4	1574.8	2266.7	433.1
08-Dec-86	4614	1.0	4615.0	315.3	77.4	520.5	2.3	915.4	85.2	3784.8	1649.5	2049.4	330.8
09-Dec-86	4588	1.0	4589.0	84.7	77.4	308.1	2.3	472.5	82.3	4198.8	1639.1	1332.2	150.8
10-Dec-86	3304	1.0	3305.0	70.3	77.3	217.5	2.2	367.4	82.6	3020.2	1651.7	877.0	100.2
11-Dec-86	3260	1.0	3261.0	65.7	77.5	161.8	2.3	307.3	83.1	3036.8	1644.4	550.7	105.8
12-Dec-86	2998	1.0	2999.0	146.1	77.4	136.9	2.2	362.6	83.4	2719.8	1651.3	541.5	128.0
13-Dec-86	3130	1.0	3131.0	61.1	77.4	118.5	2.3	259.3	81.1	2952.8	1615.1	438.7	142.7
14-Dec-86	2795	1.0	2796.0	65.7	77.2	117.1	2.2	262.3	82.1	2615.8	1625.1	374.5	105.8
15-Dec-86	2795	1.0	2796.0	132.4	77.5	106.4	2.2	318.5	83.6	2561.1	1686.6	421.7	135.9
16-Dec-86	2792	1.0	2793.0	61.1	77.4	99.7	2.3	240.5	82.6	2635.0	1673.8	377.1	107.0
17-Dec-86	2699	1.0	2700.0	112.2	77.2	99.5	2.2	291.1	80.9	2489.7	1665.5	399.2	131.7
18-Dec-86	2497	1.0	2498.0	103.3	77.4	96.9	2.3	279.8	83.5	2301.7	1641.6	388.1	132.4
19-Dec-86	2782	1.0	2783.0	61.1	77.4	92.6	2.2	233.4	80.2	2629.9	1656.6	335.5	115.9
20-Dec-86	2476	1.0	2477.0	65.7	77.4	91.5	2.2	236.8	80.1	2320.3	1628.3	369.4	127.0
21-Dec-86	2616	1.0	2617.0	149.3	77.2	92.4	2.3	321.2	81.0	2376.8	1572.9	395.1	111.3
22-Dec-86	2456	1.0	2457.0	61.1	77.2	86.6	2.3	227.3	80.4	2310.1	1653.4	265.3	104.5
23-Dec-86	2634	1.0	2635.0	143.4	77.4	88.3	2.5	311.5	83.2	2406.7	1639.1	336.2	112.9
24-Dec-86	2580	1.0	2581.0	79.9	77.3	83.4	2.4	243.1	79.6	2417.6	1623.9	333.4	113.0
25-Dec-86	2387	1.0	2388.0	65.7	77.2	81.6	2.3	226.9	79.6	2240.8	1531.5	303.7	104.0
26-Dec-86	2437	1.0	2438.0	65.7	77.4	79.7	2.3	225.1	79.2	2291.0	1552.5	293.6	110.0
27-Dec-86	2330	1.0	2331.0	143.4	77.2	80.0	2.3	302.9	79.1	2107.3	1549.6	326.9	103.4
28-Dec-86	2580	1.0	2581.0	65.7	77.1	76.7	2.3	221.8	79.1	2438.3	1537.5	250.2	104.2
29-Dec-86	2650	1.0	2651.0	115.0	77.2	78.7	2.6	273.5	80.2	2457.7	1616.2	341.6	122.7
30-Dec-86	2264	1.0	2265.0	95.8	77.4	74.2	2.2	239.5	82.3	2107.8	1624.0	316.5	108.4
31-Dec-86	2477	1.0	2478.0	61.1	77.4	70.7	2.3	211.4	81.9	2348.4	1625.9	244.9	111.6
DEC 86	2991.6	1.0	2992.6	107.7	77.3	161.4	2.3	348.7	81.9	2725.8	1625.9	631.1	150.1

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Jan-87	2457	0.4	2457.4	87.6	78.0	139.9	1.7	307.2	84.1	2234.2	1527.8	516.4	91.0
02-Jan-87	2756	0.4	2756.4	157.9	78.0	126.5	1.8	364.3	83.7	2475.8	1574.1	556.5	119.9
03-Jan-87	2401	0.4	2401.4	65.7	77.9	90.3	1.7	235.6	83.4	2249.2	1575.1	325.4	112.9
04-Jan-87	2467	0.4	2467.4	155.8	77.9	81.5	1.7	316.9	83.9	2234.4	1575.4	350.6	99.6
05-Jan-87	2461	0.4	2461.4	65.8	78.0	72.4	1.7	217.9	85.3	2328.8	1645.5	256.2	126.6
06-Jan-87	2636	0.4	2636.4	61.1	78.3	67.5	1.7	208.5	87.0	2514.9	1645.0	244.7	112.9
07-Jan-87	2308	0.4	2308.4	98.2	77.9	66.7	1.7	244.5	84.7	2148.6	1652.2	280.9	127.0
08-Jan-87	2586	0.4	2586.4	120.0	77.9	64.7	1.8	264.4	88.1	2408.1	1634.5	255.8	94.8
09-Jan-87	2440	0.4	2440.4	123.9	77.9	263.7	1.7	467.2	89.5	2062.7	1630.6	807.6	135.1
10-Jan-87	2445	0.4	2445.4	210.1	77.9	182.7	1.7	472.4	85.7	2058.6	1583.9	668.4	124.0
11-Jan-87	2674	0.4	2674.4	129.0	77.9	387.3	1.7	595.8	90.3	2168.9	1588.6	1435.6	123.0
12-Jan-87	3044	0.4	3044.4	277.5	77.9	341.6	1.7	698.7	87.9	2433.6	1626.6	1047.2	128.4
13-Jan-87	2532	0.4	2532.4	158.3	77.9	364.1	1.7	602.0	89.1	2019.5	1661.1	1085.8	115.5
14-Jan-87	3141	0.4	3141.4	138.0	78.0	257.4	1.8	475.1	85.6	2751.9	1635.1	903.1	108.5
15-Jan-87	2788	0.4	2788.4	65.7	78.0	154.9	1.7	300.4	88.6	2574.6	1638.9	616.1	117.2
16-Jan-87	3023	0.4	3023.4	61.1	78.0	102.1	1.7	242.9	85.8	2866.2	1636.7	473.6	102.5
17-Jan-87	3032	0.4	3032.4	149.4	78.0	85.3	1.7	314.4	85.0	2803.0	1603.6	456.1	120.5
18-Jan-87	2951	0.4	2951.4	61.1	78.0	71.0	1.6	211.8	89.4	2822.9	1583.5	339.0	133.6
19-Jan-87	2754	0.4	2754.4	65.7	78.0	66.5	1.7	212.0	88.4	2628.7	1638.0	352.3	111.0
20-Jan-87	2609	0.4	2609.4	156.7	78.3	67.4	1.6	304.1	88.7	2392.0	1655.1	394.6	123.9
21-Jan-87	2398	0.4	2398.4	65.7	78.1	60.6	1.7	206.1	88.2	2278.5	1652.3	228.5	131.1
22-Jan-87	2805	0.4	2805.4	61.1	78.1	57.0	1.7	198.0	85.8	2693.2	1648.8	307.5	138.8
23-Jan-87	2465	0.4	2465.4	146.2	78.2	58.2	1.7	284.4	85.9	2266.9	1654.9	300.4	172.0
24-Jan-87	2597	0.4	2597.4	61.1	78.1	52.6	1.7	193.5	84.2	2488.1	1660.7	204.9	157.3
25-Jan-87	2618	0.4	2618.4	113.1	78.0	52.5	1.7	245.3	83.8	2456.9	1629.2	234.4	141.0
26-Jan-87	2816	0.4	2816.4	85.6	78.2	49.9	1.7	215.4	87.6	2688.6	1691.7	227.3	134.3
27-Jan-87	2570	0.4	2570.4	61.1	78.2	46.7	1.7	187.6	84.7	2467.4	1669.4	164.9	139.2
28-Jan-87	2493	0.4	2493.4	172.7	78.2	148.9	1.7	401.6	88.4	2180.3	1677.5	607.8	151.9
29-Jan-87	2663	0.4	2663.4	170.2	78.2	535.0	1.7	785.0	83.0	1971.3	1679.1	1780.4	101.8
30-Jan-87	2979	0.4	2979.4	388.1	78.3	299.5	1.7	767.6	91.3	2303.0	1671.4	1251.3	134.6
31-Jan-87	3023	0.4	3023.4	166.6	78.2	358.0	1.7	604.5	88.7	2507.6	1646.0	1148.2	111.2
JAN 87	2675.2	0.4	2675.6	125.8	78.0	154.0	1.7	359.5	86.4	2402.5	1632.0	574.9	123.9

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Feb-87	2724	2.4	2726.4	141.5	77.5	260.6	1.7	481.3	83.6	2328.7	1616.2	1087.6	125.2
02-Feb-87	3189	2.4	3191.4	65.7	77.5	215.7	1.7	360.6	85.6	2916.4	1696.5	982.0	89.3
03-Feb-87	3216	2.4	3218.4	155.8	77.5	131.4	1.8	366.5	84.1	2935.9	1668.5	770.3	114.9
04-Feb-87	4061	2.4	4063.4	61.1	77.6	79.6	785.6	1004.0	85.7	3145.0	1679.8	493.2	97.1
05-Feb-87	2474	2.4	2476.4	65.7	77.7	69.0	1.7	214.1	82.6	2345.0	1651.0	411.1	109.8
06-Feb-87	3127	2.4	3129.4	144.8	77.6	81.0	1.6	305.1	85.5	2909.8	1653.3	443.2	110.3
07-Feb-87	3120	2.4	3122.4	65.7	77.7	69.4	1.7	214.6	81.7	2989.4	1632.3	363.8	102.7
08-Feb-87	2886	2.4	2888.4	61.1	77.7	67.3	1.7	207.8	83.9	2764.4	1582.9	542.3	117.0
09-Feb-87	2845	2.4	2847.4	65.7	77.6	67.2	1.8	212.3	83.6	2718.7	1665.7	354.4	115.7
10-Feb-87	2624	2.4	2626.4	143.8	77.8	69.4	1.7	292.6	85.8	2419.6	1655.6	370.7	97.0
11-Feb-87	2946	2.4	2948.4	65.7	77.8	67.7	1.7	212.9	83.2	2818.7	1659.1	316.4	122.3
12-Feb-87	2597	2.4	2599.4	91.6	77.8	68.5	1.7	239.6	84.0	2443.8	1660.8	339.4	96.0
13-Feb-87	2526	2.4	2528.4	123.1	77.9	70.7	1.6	273.3	84.6	2339.7	1640.2	330.0	127.7
14-Feb-87	2628	2.4	2630.4	61.1	77.8	68.1	1.7	208.7	83.3	2505.0	1601.4	361.2	130.6
15-Feb-87	2615	2.4	2617.4	83.4	77.6	69.6	1.7	232.4	82.9	2467.9	1573.0	338.8	107.0
16-Feb-87	2440	2.4	2442.4	123.3	77.6	70.0	1.7	272.6	84.7	2254.4	1676.2	351.1	101.0
17-Feb-87	2632	2.4	2634.4	65.7	77.9	93.9	1.7	239.1	86.6	2481.8	1657.4	391.2	113.4
18-Feb-87	2670	2.4	2672.4	159.9	77.8	77.8	1.7	317.2	83.6	2438.8	1665.4	335.8	118.0
19-Feb-87	2407	2.4	2409.4	65.7	77.9	70.8	1.7	216.0	85.1	2278.5	1668.7	251.4	88.0
20-Feb-87	2719	2.4	2721.4	61.1	77.7	67.9	1.6	208.4	84.2	2597.3	1649.4	244.2	138.5
21-Feb-87	2215	2.4	2217.4	127.0	77.6	69.6	1.7	275.9	85.8	2027.2	1622.7	282.4	98.0
22-Feb-87	2608	2.4	2610.4	79.7	77.5	66.4	1.6	225.1	82.0	2467.3	1593.2	246.3	88.0
23-Feb-87	2175	2.4	2177.4	61.1	77.6	64.9	1.6	205.3	86.8	2058.9	1673.8	241.6	132.0
24-Feb-87	2520	2.4	2522.4	82.8	77.6	65.6	1.7	227.7	83.5	2378.2	1655.5	252.7	98.0
25-Feb-87	2729	2.4	2731.4	120.1	77.6	65.6	1.9	265.2	86.5	2552.6	1650.0	271.9	98.8
26-Feb-87	2377	2.4	2379.4	65.7	77.6	63.6	2.0	208.8	85.2	2255.8	1653.2	234.5	114.4
27-Feb-87	2477	2.4	2479.4	120.3	77.5	64.1	1.9	263.8	85.3	2300.8	1643.7	274.1	120.4
28-Feb-87	4065	2.4	4067.4	118.7	77.6	473.7	1.8	671.8	93.6	3489.2	1609.7	2031.6	118.0
FEB 87	2771.9	2.4	2774.3	94.5	77.7	98.9	29.7	300.8	84.8	2558.2	1644.8	461.2	110.3

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Mar-87	5502	2.1	5504.1	258.0	76.6	444.9	2.0	781.5	84.2	4806.8	1578.7	2109.5	955.0
02-Mar-87	4273	2.1	4275.1	226.6	76.7	287.5	1.9	592.8	83.0	3765.3	1657.9	1359.4	91.0
03-Mar-87	3357	2.1	3359.1	65.7	76.7	184.2	2.0	328.6	86.3	3116.8	1664.8	834.2	90.8
04-Mar-87	3464	2.1	3466.1	65.7	76.6	133.5	2.0	277.8	82.6	3270.8	1648.7	622.0	113.8
05-Mar-87	2678	2.1	2680.1	97.3	76.6	108.3	2.0	284.2	85.6	2481.4	1646.7	539.4	109.8
06-Mar-87	2749	2.1	2751.1	116.7	76.7	96.1	1.9	291.3	83.9	2543.6	1647.9	461.1	117.8
07-Mar-87	3077	2.1	3079.1	65.7	76.9	86.4	1.9	230.8	84.5	2932.7	1635.3	353.9	135.5
08-Mar-87	2577	2.1	2579.1	61.1	76.5	80.1	2.0	219.7	81.0	2440.4	1604.4	346.7	186.3
09-Mar-87	3160	2.1	3162.1	148.9	76.5	80.1	1.9	307.2	85.0	2939.8	1627.9	479.3	104.3
10-Mar-87	3025	2.1	3027.1	61.1	76.7	73.3	2.1	213.1	83.4	2897.3	1655.1	319.3	99.0
11-Mar-87	2604	2.1	2606.1	65.7	76.6	70.6	2.0	215.0	85.9	2477.0	1661.0	272.9	105.3
12-Mar-87	2552	2.1	2554.1	136.2	76.6	68.4	2.0	283.2	83.7	2354.5	1662.2	297.1	160.5
13-Mar-87	2629	2.1	2631.1	65.7	76.6	64.8	1.9	209.1	84.2	2506.3	1652.7	251.2	109.3
14-Mar-87	4358	2.1	4360.1	217.1	76.6	193.8	1.9	489.3	89.2	3960.0	1614.2	821.3	1046.5
15-Mar-87	3771	2.1	3773.1	65.7	76.6	129.0	1.9	273.2	82.4	3582.3	1584.5	508.4	842.0
16-Mar-87	2990	2.1	2992.1	163.8	76.5	101.2	2.0	343.4	84.1	2732.7	1656.5	498.3	155.3
17-Mar-87	2994	2.1	2996.1	65.7	76.6	83.6	1.9	227.8	83.8	2852.2	1684.8	388.4	108.3
18-Mar-87	3548	2.1	3550.1	90.6	76.6	266.9	1.9	435.9	80.3	3204.4	1645.0	1071.4	107.0
19-Mar-87	3262	2.1	3264.1	208.3	76.5	188.7	1.8	475.3	84.8	2873.6	1667.0	882.7	481.3
20-Mar-87	2965	2.1	2967.1	65.7	76.5	123.3	1.9	267.3	82.6	2782.4	1671.3	490.4	124.5
21-Mar-87	3074	2.1	3076.1	167.0	76.6	100.2	1.8	345.7	81.7	2812.1	1615.7	454.5	123.8
22-Mar-87	2500	2.1	2502.1	61.1	76.6	79.3	1.8	218.9	82.2	2365.5	1608.4	329.0	121.0
23-Mar-87	2727	2.1	2729.1	65.7	76.9	70.6	1.8	215.1	83.1	2597.1	1678.9	298.6	124.8
24-Mar-87	3800	2.1	3802.1	76.2	76.7	64.8	1.9	219.7	83.0	3665.4	1667.5	286.8	766.8
25-Mar-87	2607	2.1	2609.1	139.3	76.5	64.1	1.8	281.7	84.5	2411.9	1643.2	303.8	197.0
26-Mar-87	2643	2.1	2645.1	61.1	76.6	58.0	1.8	197.6	84.2	2531.7	1658.9	226.7	118.5
27-Mar-87	2425	2.1	2427.1	61.1	76.6	55.9	1.9	195.5	84.4	2316.0	1642.2	225.0	94.0
28-Mar-87	3101	2.1	3103.1	145.5	76.5	57.8	1.8	281.5	83.8	2904.9	1616.5	280.6	276.3
29-Mar-87	4078	2.1	4080.1	61.1	76.4	52.5	1.8	191.9	81.6	3969.7	1573.0	257.4	1485.2
30-Mar-87	2520	2.1	2522.1	110.8	76.5	72.2	1.9	261.3	83.7	2344.4	1634.9	327.1	124.8
31-Mar-87	2825	2.1	2827.1	98.3	76.5	54.7	1.8	231.3	85.2	2681.0	1662.9	234.0	108.3
MAR 87	3156.0	2.1	3158.1	108.3	76.6	116.0	1.9	302.8	84.1	2939.4	1640.9	520.3	283.3

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Apr-87	2536	0.5	2536.5	61.1	78.8	53.7	1.8	195.4	84.8	2426.0	1656.8	218.5	106.6
02-Apr-87	2643	0.5	2643.5	79.9	78.8	50.4	1.8	210.8	85.2	2517.9	1635.2	263.2	100.0
03-Apr-87	2394	0.5	2394.5	133.9	78.9	51.2	1.8	265.8	85.5	2214.2	1632.8	251.1	134.1
04-Apr-87	2512	0.5	2512.5	65.7	78.8	46.4	1.9	192.8	84.5	2404.2	1614.2	212.0	121.4
05-Apr-87	2371	0.5	2371.5	61.1	78.8	44.3	1.8	185.9	84.7	2270.3	1534.8	212.6	97.4
06-Apr-87	2464	0.5	2464.5	141.2	78.9	45.6	1.8	267.5	85.5	2282.5	1656.1	236.4	124.1
07-Apr-87	2417	0.5	2417.5	65.7	78.9	41.8	1.8	188.2	87.9	2317.2	1666.0	166.9	188.2
08-Apr-87	2372	0.5	2372.5	112.9	78.9	41.3	1.8	234.9	84.8	2222.4	1686.8	192.8	204.0
09-Apr-87	2768	0.5	2768.5	95.6	78.9	39.2	1.8	215.6	86.8	2641.7	1705.3	159.7	162.4
10-Apr-87	2402	0.5	2402.5	93.7	78.9	42.1	1.8	216.4	87.5	2273.6	1717.6	276.9	170.1
11-Apr-87	4697	0.5	4697.5	262.1	78.9	328.9	1.8	671.6	87.9	4118.8	1621.2	1499.5	522.0
12-Apr-87	3636	0.5	3636.5	65.7	78.9	109.3	1.8	255.7	84.7	3465.5	1598.9	697.0	703.6
13-Apr-87	4112	0.5	4112.5	152.9	78.9	68.9	1.8	302.5	87.3	3897.3	1672.6	444.2	619.2
14-Apr-87	7556	0.5	7556.5	172.4	78.9	605.5	1.8	858.6	86.4	6796.3	1665.1	3544.5	722.0
15-Apr-87	5640	0.5	5640.5	250.1	78.9	320.5	1.8	651.2	86.8	5078.0	1646.6	3018.9	245.2
16-Apr-87	5428	0.5	5428.5	176.3	78.8	210.0	1.8	466.9	85.6	5047.2	1646.3	2002.8	147.0
17-Apr-87	4778	0.5	4778.5	65.7	78.9	131.7	1.8	278.0	87.7	4588.2	1654.1	1201.7	224.4
18-Apr-87	3878	0.5	3878.5	61.1	78.9	94.3	1.8	236.1	84.7	3727.1	1656.7	868.7	281.0
19-Apr-87	3460	0.5	3460.5	158.8	78.8	79.0	1.8	318.4	86.8	3228.9	1595.5	692.0	296.5
20-Apr-87	3434	0.5	3434.5	65.7	79.1	64.5	1.8	211.2	85.7	3309.1	1760.8	498.4	216.9
21-Apr-87	3217	0.5	3217.5	61.1	78.8	56.6	1.8	198.3	86.2	3107.5	1706.8	469.4	185.4
22-Apr-87	5141	0.5	5141.5	100.2	78.9	251.8	1.8	432.7	90.6	4799.4	1648.0	1350.8	1448.5
23-Apr-87	4394	0.5	4394.5	246.1	78.8	128.0	1.8	454.7	85.0	4024.8	1658.9	1324.0	198.8
24-Apr-87	4148	0.5	4148.5	61.1	78.9	86.3	1.9	228.1	86.5	4006.9	1681.5	838.9	184.5
25-Apr-87	3627	0.5	3627.5	65.7	78.9	67.7	1.8	214.1	85.8	3499.2	1663.6	551.1	292.9
26-Apr-87	3200	0.5	3200.5	61.1	78.8	56.5	1.8	198.2	85.1	3087.4	1649.4	428.9	288.9
27-Apr-87	3094	0.5	3094.5	145.1	78.8	53.8	1.9	279.6	86.0	2903.0	1730.4	390.4	242.9
28-Apr-87	2867	0.5	2867.5	61.1	78.9	45.9	1.8	187.7	86.0	2765.9	1732.7	270.5	163.1
29-Apr-87	2767	0.5	2767.5	80.5	78.9	43.9	1.9	205.2	86.6	2650.8	1811.9	270.3	188.7
30-Apr-87	2640	0.5	2640.5	134.3	78.9	42.5	1.7	257.4	86.6	2469.6	1722.5	280.1	187.8
APR 87	3553.1	0.5	3553.6	111.9	78.9	110.0	1.8	302.6	87.1	3338.0	1667.6	761.1	292.3

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-May-87	2790	2.5	2792.5	65.7	87.8	38.8	2.0	194.2	97.0	2695.3	1739.0	206.3	206.0
02-May-87	5803	2.5	5805.5	244.6	87.7	274.7	1.9	608.9	100.9	5297.5	1626.4	1594.6	1646.0
03-May-87	3623	2.5	3625.5	190.4	87.7	141.3	1.9	421.3	94.9	3299.1	1582.1	838.3	589.0
04-May-87	3268	2.5	3270.5	65.7	87.7	53.3	1.9	218.6	95.0	3146.9	1669.0	465.9	204.0
05-May-87	3166	2.5	3168.5	61.1	87.7	50.1	1.9	200.8	96.9	3064.6	1712.9	322.1	213.0
06-May-87	2927	2.5	2929.5	161.7	87.7	47.5	1.8	298.7	98.4	2727.1	1773.5	326.9	227.0
07-May-87	2882	2.5	2884.5	61.1	87.7	38.9	1.9	189.6	96.7	2791.6	1725.3	229.8	212.0
08-May-87	2710	2.5	2712.5	61.1	87.7	35.9	1.9	186.7	97.8	2623.6	1805.8	200.7	234.0
09-May-87	2682	2.5	2684.5	65.7	79.8	33.9	1.9	181.3	98.0	2599.1	1901.1	170.4	285.0
10-May-87	2594	2.5	2596.5	150.3	87.6	33.9	1.9	273.7	97.4	2420.1	1836.5	232.3	291.0
11-May-87	4172	2.5	4174.5	88.2	87.9	147.3	2.0	325.4	101.7	3950.8	1924.6	996.6	186.0
12-May-87	3679	2.5	3681.5	219.3	87.7	50.0	1.9	358.9	96.9	3419.5	1751.4	584.6	337.0
13-May-87	3366	2.5	3368.5	61.1	87.7	33.5	1.9	184.2	97.8	3282.1	1801.9	221.9	255.0
14-May-87	4314	2.5	4316.5	65.7	87.8	30.6	1.9	186.0	90.8	4227.3	1815.5	173.1	1196.0
15-May-87	3158	2.5	3160.5	162.0	87.7	30.9	2.1	282.7	95.8	2973.6	1821.6	236.5	295.0
16-May-87	2732	2.5	2734.5	65.7	87.8	25.9	1.9	181.4	98.6	2651.7	1959.2	146.2	343.0
17-May-87	3083	2.5	3085.5	65.7	87.7	32.2	2.0	187.6	97.8	2995.8	1961.7	265.1	295.0
18-May-87	7108	2.5	7110.5	251.6	87.7	178.6	2.0	519.8	102.8	6692.9	1826.7	1575.4	1792.0
19-May-87	9110	2.5	9112.5	251.4	87.8	522.4	2.0	863.6	109.4	8352.4	1782.4	4869.9	403.0
20-May-87	9164	2.5	9166.5	159.9	87.7	93.3	2.1	343.0	97.2	8920.7	1752.9	2250.9	1219.0
21-May-87	5322	2.5	5324.5	65.7	86.0	66.0	2.1	223.8	97.1	5197.8	1900.6	1198.5	1335.0
22-May-87	4924	2.5	4926.5	193.3	87.9	76.5	1.8	349.4	99.9	4676.0	1770.2	941.9	612.0
23-May-87	3583	2.5	3585.5	61.1	87.8	39.2	1.9	190.0	94.2	3489.8	1637.3	510.7	290.0
24-May-87	3359	2.5	3361.5	65.7	87.4	34.6	1.9	189.6	92.6	3264.5	1584.7	389.0	272.0
25-May-87	5317	2.5	5319.5	133.4	87.6	160.8	1.8	383.5	95.8	5031.7	1623.7	932.7	1355.0
26-May-87	4074	2.5	4076.5	237.9	87.8	83.0	2.1	410.8	99.0	3763.8	1842.5	806.8	674.0
27-May-87	4198	2.5	4200.5	65.7	86.2	51.2	1.9	206.9	100.2	4093.9	2036.2	416.8	1131.0
28-May-87	3378	2.5	3380.5	61.1	86.2	36.9	1.9	190.1	99.1	3289.5	2074.4	298.4	254.0
29-May-87	3514	2.5	3516.5	159.3	86.1	36.5	2.1	286.1	101.8	3332.3	2170.5	293.5	359.0
30-May-87	3955	2.5	3957.5	61.1	86.1	30.4	2.1	181.7	99.9	3875.7	2049.9	354.5	564.0
31-May-87	4461	2.5	4463.5	86.1	86.0	147.7	2.0	323.7	101.2	4241.1	2039.9	1165.2	566.0
MAY 87	4142.5	2.5	4145.0	119.3	87.5	86.1	1.9	294.9	98.0	3948.0	1822.6	748.9	575.5

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Jun-87	4670	1.0	4671.0	241.2	96.6	179.1	2.3	519.2	129.6	4280.4	2009.5	2709.0	366.0
02-Jun-87	6819	1.0	6820.0	127.6	96.6	296.7	2.2	522.9	131.2	6428.4	1879.1	3237.5	388.0
03-Jun-87	5164	1.0	5165.0	334.6	96.6	151.7	2.1	584.9	125.1	4705.2	1833.2	2391.9	471.0
04-Jun-87	4108	1.0	4109.0	101.7	96.5	98.8	2.2	299.2	126.6	3936.5	1866.9	1275.9	235.0
05-Jun-87	3514	1.0	3515.0	65.7	96.6	63.6	2.2	228.1	124.4	3411.3	1942.9	739.1	283.0
06-Jun-87	3416	1.0	3417.0	65.7	96.8	47.2	2.1	211.8	125.4	3330.6	2095.3	493.6	311.0
07-Jun-87	2584	1.0	2585.0	140.0	96.6	40.2	2.3	279.1	125.0	2430.9	2183.6	403.4	275.0
08-Jun-87	4107	1.0	4108.0	65.7	96.9	32.9	2.4	197.9	127.6	4037.6	2109.6	280.6	868.0
09-Jun-87	4042	1.0	4043.0	61.1	96.4	29.0	2.3	188.8	126.6	3980.8	1919.6	255.1	1131.0
10-Jun-87	2653	1.0	2654.0	170.1	96.7	31.5	2.2	300.6	126.8	2482.2	1966.6	257.7	220.0
11-Jun-87	3787	1.0	3788.0	77.8	96.6	360.1	2.2	536.7	134.8	3386.2	1956.2	1777.0	215.0
12-Jun-87	4798	1.0	4799.0	268.9	96.9	97.5	2.3	465.6	127.0	4460.5	2020.8	780.6	244.0
13-Jun-87	3786	1.0	3787.0	65.7	96.9	52.5	2.3	217.4	131.2	3700.8	2206.7	288.5	391.0
14-Jun-87	3390	1.0	3391.0	61.1	96.7	37.6	2.4	197.9	126.9	3322.0	2616.0	202.0	327.0
15-Jun-87	3374	1.0	3375.0	65.7	97.0	30.8	2.5	195.9	133.5	3312.6	2403.2	175.3	430.0
16-Jun-87	3547	1.0	3548.0	140.7	97.0	26.3	2.5	268.5	134.7	3414.3	2410.8	195.7	797.0
17-Jun-87	3538	1.0	3539.0	65.7	97.0	23.5	2.6	188.8	135.2	3485.4	2616.4	141.6	790.0
18-Jun-87	4003	1.0	4004.0	61.1	97.1	20.8	2.5	181.5	133.1	3955.6	2852.4	127.2	777.0
19-Jun-87	4611	1.0	4612.0	142.5	97.3	23.0	2.5	265.2	134.6	4481.3	2623.0	168.4	1196.0
20-Jun-87	4879	1.0	4880.0	167.5	97.1	299.0	2.4	566.1	132.8	4446.3	2194.4	754.6	1127.0
21-Jun-87	6343	1.0	6344.0	173.9	96.7	232.0	2.3	504.9	131.6	5970.7	1933.3	1973.8	1358.0
22-Jun-87	4153	1.0	4154.0	325.6	96.8	186.2	2.2	612.8	126.5	3669.7	1939.7	853.2	1079.0
23-Jun-87	3907	1.0	3908.0	172.6	96.9	64.1	2.2	335.8	129.2	3701.4	2120.9	284.7	824.0
24-Jun-87	4022	1.0	4023.0	65.7	97.2	41.4	2.2	206.5	131.0	3947.5	2419.8	156.2	824.0
25-Jun-87	4406	1.0	4407.0	177.5	97.0	131.4	2.1	408.1	129.5	4128.4	2102.4	740.5	473.0
26-Jun-87	4965	1.0	4966.0	116.6	97.1	48.9	2.2	264.8	128.1	4849.3	2014.2	343.4	1211.0
27-Jun-87	3384	1.0	3385.0	61.2	96.9	33.2	2.1	193.3	124.6	3316.3	2010.7	149.6	1274.0
28-Jun-87	3882	1.0	3883.0	81.6	96.9	27.4	2.2	208.2	127.6	3802.3	2069.9	116.6	1226.0
29-Jun-87	4848	1.0	4849.0	119.3	96.9	24.3	2.3	242.8	127.9	4733.2	2064.4	197.1	1432.0
30-Jun-87	4846	1.0	4847.0	194.4	96.9	131.7	2.2	425.1	126.2	4550.1	1915.9	649.7	2102.0
JUN 87	4185.5	1.0	4186.5	132.6	96.8	95.5	2.3	327.3	129.3	3988.6	2143.2	737.3	754.8

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Jul-87	4021	0.8	4021.8	65.7	97.4	38.2	2.2	203.4	126.5	3944.8	1934.4	259.2	1267.0
02-Jul-87	3953	0.8	3953.8	61.1	97.6	28.6	2.1	189.4	129.4	3893.8	2111.3	163.9	1251.0
03-Jul-87	3873	0.8	3873.8	65.7	97.4	24.8	2.1	190.0	129.4	3813.2	2279.4	123.7	1236.0
04-Jul-87	3724	0.8	3724.8	139.5	97.4	24.1	2.1	263.1	129.4	3591.1	2155.2	152.7	1318.0
05-Jul-87	3999	0.8	3999.8	127.1	97.4	55.1	1.9	281.5	125.6	3843.9	1876.7	240.5	1237.0
06-Jul-87	4595	0.8	4595.8	102.5	97.5	23.3	2.1	225.3	126.5	4496.9	2047.8	154.1	1315.0
07-Jul-87	4573	0.8	4573.8	70.4	97.5	91.0	2.0	260.8	126.0	4441.0	2166.3	1277.8	1575.0
08-Jul-87	4435	0.8	4435.8	79.7	97.6	50.8	2.2	230.3	129.1	4333.6	2344.6	539.6	1113.0
09-Jul-87	4066	0.8	4066.8	150.4	94.5	50.9	2.2	298.0	129.9	3898.7	2388.9	574.8	888.0
10-Jul-87	5856	0.8	5856.8	105.1	94.6	218.4	2.2	420.3	132.8	5569.3	2185.1	1305.4	925.0
11-Jul-87	4551	0.8	4551.8	309.9	92.6	80.0	2.1	484.5	127.8	4195.0	2202.6	1054.7	1559.0
12-Jul-87	5193	0.8	5193.8	75.1	93.4	49.5	1.9	219.9	126.8	5102.8	2165.3	475.9	1114.0
13-Jul-87	4250	0.8	4250.8	61.1	97.3	35.0	2.1	195.4	127.2	4182.5	1968.0	230.2	1065.0
14-Jul-87	4045	0.8	4045.8	65.7	97.2	29.5	2.0	194.3	125.4	3976.9	1877.8	175.5	1148.0
15-Jul-87	4318	0.8	4318.8	263.7	97.1	152.1	2.0	514.8	131.5	3935.4	1832.8	1129.5	1023.0
16-Jul-87	4675	0.8	4675.8	130.7	97.3	38.3	1.9	268.3	124.8	4532.3	1914.0	293.0	1208.0
17-Jul-87	4194	0.8	4194.8	65.7	81.9	29.7	2.0	179.3	127.0	4142.5	2175.5	160.4	1249.0
18-Jul-87	4485	0.8	4485.8	61.1	81.8	24.8	2.0	169.8	126.0	4442.0	2318.1	118.2	1376.0
19-Jul-87	4037	0.8	4037.8	145.9	85.6	26.1	2.2	259.8	128.8	3906.8	2527.7	150.6	1365.0
20-Jul-87	4935	0.8	4935.8	60.8	86.4	75.1	2.5	224.8	124.8	4845.5	2708.4	295.0	1080.0
21-Jul-87	4537	0.8	4537.8	213.2	85.6	39.0	2.1	340.0	130.7	4328.5	2521.9	297.3	1687.0
22-Jul-87	4431	0.8	4431.8	61.1	86.7	21.2	1.7	172.7	129.9	4388.0	2625.2	103.4	1395.0
23-Jul-87	4448	0.8	4448.8	65.7	78.0	19.9	1.8	165.3	129.4	4412.9	2731.4	94.4	1378.0
24-Jul-87	4892	0.8	4892.8	157.4	78.0	21.1	1.8	258.2	131.1	4765.7	2676.8	135.5	1674.0
25-Jul-87	4501	0.8	4501.8	65.7	91.8	17.4	1.8	176.7	126.6	4453.7	2579.2	70.5	1511.0
26-Jul-87	4457	0.8	4457.8	152.5	97.5	61.2	1.8	313.0	129.3	4274.1	2639.9	749.3	1129.0
27-Jul-87	4513	0.8	4513.8	324.0	94.0	239.5	1.8	659.2	130.0	3984.5	1944.6	1099.9	1283.0
28-Jul-87	4679	0.8	4679.8	116.3	89.5	29.3	2.0	237.0	127.1	4569.9	1995.7	169.9	1257.0
29-Jul-87	4209	0.8	4209.8	61.1	89.5	22.6	1.9	175.0	125.3	4160.1	2150.2	87.4	1426.0
30-Jul-87	4181	0.8	4181.8	91.4	94.3	20.9	1.8	208.3	129.7	4102.1	2333.2	105.0	1656.0
31-Jul-87	4586	0.8	4586.8	186.3	97.8	101.8	2.4	388.3	129.9	4328.3	2176.4	901.6	1216.0
JUL 87	4426.2	0.8	4427.0	119.4	92.4	56.1	2.0	269.9	128.6	4285.7	2243.7	409.3	1287.9

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Aug-87	4600	1.4	4601.4	114.7	92.7	37.0	1.9	246.3	104.7	4459.8	2326.8	466.0	1300.0
02-Aug-87	4314	1.4	4315.4	65.7	88.3	26.7	2.0	182.7	105.3	4238.0	2487.5	188.2	1424.0
03-Aug-87	5819	1.4	5820.4	61.1	83.4	21.0	2.0	167.5	109.8	5761.6	2528.2	120.1	2010.0
04-Aug-87	3650	1.4	3651.4	143.1	94.3	21.6	2.1	261.0	107.2	3497.6	2243.3	150.7	1463.0
05-Aug-87	4276	1.4	4277.4	61.1	94.5	16.3	2.2	174.1	107.1	4210.4	2211.4	82.0	1652.0
06-Aug-87	4329	1.4	4330.4	92.0	89.4	17.2	2.1	200.8	108.3	4237.9	2336.9	76.6	1664.0
07-Aug-87	4323	1.4	4324.4	114.0	84.0	16.8	2.5	217.3	108.4	4215.5	2464.7	87.5	1610.0
08-Aug-87	5735	1.4	5736.4	61.1	87.1	25.9	2.3	176.3	105.4	5665.4	2001.1	100.2	2620.0
09-Aug-87	4263	1.4	4264.4	158.5	94.2	27.3	2.2	282.2	101.3	4083.5	1852.0	221.5	1701.0
10-Aug-87	4120	1.4	4121.4	61.1	94.3	14.7	2.0	172.1	104.3	4053.5	2059.5	86.0	1622.0
11-Aug-87	4596	1.4	4597.4	61.1	95.0	14.2	2.3	172.6	104.2	4529.0	2221.1	56.9	1707.0
12-Aug-87	4457	1.4	4458.4	65.7	94.8	14.6	2.0	177.1	105.6	4386.9	2332.8	52.3	1831.0
13-Aug-87	5070	1.4	5071.4	154.0	92.1	206.5	2.0	454.6	113.0	4729.8	2260.0	1332.4	877.1
14-Aug-87	14623	1.4	14624.0	204.5	94.3	1700.4	2.0	2001.2	140.1	12763.0	1974.9	18060.0	86.1
15-Aug-87	12917	1.4	12918.0	560.1	84.1	532.1	2.0	1178.2	118.1	11858.0	2012.4	3831.5	1176.0
16-Aug-87	11889	1.4	11890.0	492.8	87.4	727.1	2.4	1309.6	114.1	10695.0	1953.2	4913.9	1975.0
17-Aug-87	14567	1.4	14568.0	527.1	94.4	635.6	2.0	1259.0	114.3	13424.0	2023.6	4726.7	152.0
18-Aug-87	8201	1.4	8202.4	113.2	83.0	466.0	2.0	664.2	119.0	7648.2	1949.0	2419.0	1169.0
19-Aug-87	5274	1.4	5275.4	185.5	87.4	290.0	2.0	564.8	109.6	4816.2	1943.4	1349.9	523.0
20-Aug-87	5207	1.4	5208.4	189.9	83.2	192.7	2.0	467.8	104.9	4845.5	2002.4	904.2	1215.0
21-Aug-87	7034	1.4	7035.4	124.3	74.9	452.1	2.0	653.3	119.4	6492.5	1935.3	1890.5	1457.0
22-Aug-87	6030	1.4	6031.4	252.6	94.2	274.5	2.0	623.3	102.1	5510.2	1858.3	1604.9	1133.0
23-Aug-87	4667	1.4	4668.4	131.4	86.3	178.5	2.2	398.4	101.4	4371.4	1759.6	782.5	1228.0
24-Aug-87	4184	1.4	4185.4	65.7	81.9	120.6	2.2	270.5	101.4	4016.3	1878.7	480.1	1029.0
25-Aug-87	5679	1.4	5680.4	149.1	73.4	287.0	2.2	511.7	106.4	5275.1	1822.9	1072.5	1575.0
26-Aug-87	14286	1.4	14287.0	104.0	93.7	2808.9	2.1	3008.7	136.6	11415.0	1806.6	12911.0	342.0
27-Aug-87	15838	1.4	15839.0	83.1	94.4	1288.8	2.0	1468.2	119.5	14482.0	1821.2	6345.8	80.0
28-Aug-87	6348	1.4	6349.4	113.9	94.2	819.1	2.0	1029.2	105.9	5426.0	1821.7	3584.5	194.0
29-Aug-87	5441	1.4	5442.4	162.1	75.7	533.6	2.0	773.3	101.5	4770.5	1788.1	2139.4	229.0
30-Aug-87	4989	1.4	4990.4	229.0	52.9	367.4	2.2	651.5	102.0	4430.8	1771.6	1466.8	222.0
31-Aug-87	5011	1.4	5012.4	306.0	76.5	252.0	2.1	636.6	102.0	4477.7	1854.9	1125.6	1187.0
AUG 87	6830.2	1.4	6831.5	168.0	87.3	399.5	2.1	656.9	109.7	6283.4	2042.0	2342.9	1175.9

LAKE MICHIGAN DIVERSION ACCOUNTING WY 1987	ROMEOVILLE 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-Sep-87	5096	2.5	5098.5	330.6	64.9	186.8	2.0	584.3	99.0	4613.2	1891.8	930.5	1880.0
02-Sep-87	4980	2.5	4982.5	65.9	86.0	142.1	2.1	296.1	97.2	4783.7	1877.3	593.4	1972.0
03-Sep-87	5081	2.5	5083.5	65.7	78.2	122.5	2.0	268.4	97.2	4912.3	1885.6	459.2	2039.0
04-Sep-87	5660	2.5	5662.5	65.7	70.0	110.4	2.0	248.2	99.7	5514.0	1984.3	387.5	2053.0
05-Sep-87	4965	2.5	4967.5	149.7	67.7	104.5	2.0	323.8	97.0	4740.7	1985.7	391.0	2096.0
06-Sep-87	5048	2.5	5050.5	65.7	67.6	95.7	2.0	231.1	99.1	4918.5	1909.8	307.1	2092.0
07-Sep-87	3912	2.5	3914.5	61.1	75.7	90.0	1.9	228.7	96.7	3782.5	1809.7	278.1	1243.0
08-Sep-87	4441	2.5	4443.5	170.8	73.4	90.6	2.0	336.8	100.0	4206.7	1879.1	336.4	2215.0
09-Sep-87	4978	2.5	4980.5	65.7	69.7	82.9	1.9	220.2	98.6	4858.9	1920.1	262.6	2134.0
10-Sep-87	5045	2.5	5047.5	61.1	71.1	78.4	2.0	212.6	99.3	4934.3	1933.2	236.4	1443.7
11-Sep-87	5076	2.5	5078.5	65.7	71.8	75.7	2.0	215.2	98.6	4962.1	1986.4	224.1	1581.7
12-Sep-87	5153	2.5	5155.5	140.2	65.8	74.5	1.9	282.5	96.5	4971.5	1904.7	279.5	2431.0
13-Sep-87	5145	2.5	5147.5	65.7	62.7	69.6	1.9	199.9	97.4	5045.1	1816.4	235.8	2452.0
14-Sep-87	3130	2.5	3132.5	61.1	58.5	66.0	2.0	187.7	99.1	3043.0	1936.4	199.6	750.0
15-Sep-87	4457	2.5	4459.5	139.9	59.9	66.3	1.9	268.0	99.4	4290.9	1889.1	326.1	1686.0
16-Sep-87	5375	2.5	5377.5	158.1	63.9	262.0	1.9	486.0	103.2	4994.7	1862.0	896.8	2047.0
17-Sep-87	5378	2.5	5380.5	226.3	76.6	199.9	1.9	504.7	101.6	4977.4	1833.7	940.4	2159.0
18-Sep-87	6056	2.5	6058.5	136.8	86.0	120.9	2.0	345.7	99.6	5811.9	1809.1	619.1	2342.0
19-Sep-87	5162	2.5	5164.5	65.7	66.7	84.8	1.9	221.0	97.7	5041.2	1745.4	332.0	2351.0
20-Sep-87	5279	2.5	5281.5	65.7	70.6	73.9	1.9	212.2	96.8	5164.7	1665.6	274.5	2651.0
21-Sep-87	5150	2.5	5152.5	145.4	85.9	80.6	2.0	313.9	99.5	4938.2	1765.1	412.4	2356.0
22-Sep-87	4954	2.5	4956.5	165.4	85.8	73.9	2.0	327.0	99.6	4728.3	1778.8	463.3	1640.1
23-Sep-87	5142	2.5	5144.5	61.1	64.0	60.6	1.9	187.7	96.4	5053.3	1801.8	276.8	2371.1
24-Sep-87	5219	2.5	5221.5	65.7	65.9	56.5	1.9	212.0	96.9	5107.5	1803.2	234.7	2540.0
25-Sep-87	5187	2.5	5189.5	165.7	60.8	59.0	2.0	287.4	98.7	4998.9	1838.6	276.9	2499.0
26-Sep-87	5243	2.5	5245.5	65.7	54.7	53.7	1.9	176.0	96.1	5167.6	1832.9	202.1	2820.0
27-Sep-87	5247	2.5	5249.5	61.1	61.2	50.6	1.9	174.8	96.7	5171.4	1828.7	187.2	2601.0
28-Sep-87	5133	2.5	5135.5	79.8	50.7	74.0	2.0	206.4	99.6	5028.4	1895.6	269.3	2492.0
29-Sep-87	4459	2.5	4461.5	140.4	55.9	63.4	2.0	261.7	98.6	4298.5	1839.6	314.8	1542.0
30-Sep-87	3363	2.5	3365.5	61.1	65.4	47.6	2.0	176.1	99.1	3287.6	1771.6	189.1	1196.0
SEP 87	4950.5	2.5	4953.0	108.0	69.3	94.0	2.0	273.2	98.6	4778.2	1856.0	377.9	2055.9