US Army Corps
of Engineers
Chicago District

1985 Annual Report on Lake Michigan Diversion

(Including State of Illinois Water Year 1983 Accounting Report)

FEBRUARY 1986

ANNUAL REPORT

MONITORING OF DIVERSION OF LAKE MICHIGAN WATER AT CHICAGO, ILLINOIS

INCLUDING

ILLINOIS DEPARTMENT OF TRANSPORTATION DIVISION OF WATER RESOURCES REPORT ON ACCOUNTING OF DIVERSION FOR WATER YEAR 1983

FEBRUARY 1986

DEPARTMENT OF THE ARMY
Chicago District, Corps of Engineers
219 South Dearborn Street
Chicago, IL 60604-1797

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEPARTMENT OF THE ARMY
Chicago District, Corps of Engineers
219 South Dearborn Street
Chicago, IL 60604-1797

ANNUAL REPORT

MONITORING OF DIVERSION OF LAKE MICHIGAN WATER AT CHICAGO, ILLINOIS

INTRODUCTION

BACKGROUND

The City of Chicago, as well as some of its suburbs, have drawn on Lake Michigan for the source of their municipal water supply for practically their entire history. When the flow of the Chicago River was reversed and the Chicago Sanitary and Ship Canal was completed, this flow of water was effectively diverted from the Lake Michigan (St. Lawrence and Atlantic Ocean) Watershed to the Illinois River (Mississippi and Gulf of Mexico) Watershed. This practice continues today, although closely controlled by the State of Illinois, with the oversight of the U. S. Army Corps of Engineers, as decreed by the U. S. Supreme Court. This report is one of a series of Annual Reports prepared by the Corps of Engineers as a report on the monitoring activities of the Corps to the parties to the Supreme Court litigation and to the general public.

This report reviews the Corps findings concerning the computation and measurement of diversion flows for Water Year 1983 (1 October-30 September), as presented by the State of Illinois in its report, Lake Michigan Diversion Accounting for Water Year 1983 (attached as Appendix A). The report discusses the Corps activities, findings and conclusions, and other events concerning Lake Michigan water diversion for the period October 1982 through September 1985 inclusive.

AUTHORITY FOR REPORT

Under the provisions of the U.S. Supreme Court decree in 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 charged with monitoring the measurement and computation of diversion of Lake Michigan water by the State of Illinois. The responsible state agency is the Illinois Department of Transportation-Division of Water Resources (IDOT). Under the terms of the modified decree, the Corps is required to report annually to the parties of the litigation on the diversion activities of the State of Illinois.

HISTORY OF LAKE MICHIGAN DIVERSION

Water has been diverted from Lake Michigan at Chicago into the Mississippi River Basin beginning with completion of the Illinois and Michigan Canal in 1848. At that time, diversion averaged about 500 cubic feet per second (cfs). Upon completion of the Chicago Sanitary and Ship Canal in 1900, the flow direction of the Chicago River was reversed and a permit was issued by the Secretary of War for the diversion of 5,000 to 10,000 cfs.

In 1922, the State of Wisconsin, concerned about the effect of diversion on lowering Lake Michigan levels, sought an injunction to prohibit the State of Illinois from diverting Lake Michigan water. The Supreme Court issued a decree in 1930 establishing a phased reduction in the diversion down to an annual average of 1,500 cfs, in addition to domestic pumpage, by 30 December 1938.

Another U.S. Supreme Court decree in 1967 limited the diversion of Lake Michigan water by the State of Illinois and its municipalities, this time including domestic pumpage, to an average of 3,200 cfs over a five year period effective 1 March 1970.

The 1967 U.S. Supreme Court decree was amended on 1 December 1980 in response to action brought by the original complainants joined by the states of Minnesota, Ohio and New York. This modified decree extended the period for determining the running average diversion rate allowable from five years to forty years and changed the beginning of the accounting year from 1 March to 1 October.

Three specific provisions of the amended decree affected the role of the Corps of Engineers. First, the Corps may enter into an agreement with the State of Illinois to do the measurement and computation of diversion flows on a cost-sharing basis. The Corps has chosen to not exercise this option due to

the possible dilution of the Corps oversight function and the dependence of the monitoring and accounting on two independent sources of funding. As such an agreement is not in force, the measurement and computations of the diversion are being done by IDOT through its consultants, the Northeastern Illinois Planning Commission (NIPC), the Metropolitan Sanitary District of Greater Chicago (MSDGC), and the United States Geological Survey (USGS).

Second, the supervisory role for the Corps is increased, in that the Corps is responsible for auditing the State's computations and measurements.

Third, every five years the Chief of Engineers shall appoint a three-member Technical Committee to determine if the best current engineering practice and scientific knowledge for measuring the diversion is being employed and to make recommendations as appropriate. The decree stipulates that "...the members should be selected on the basis of recognized experience and technical expertise in flow measurement or hydrology." and be reconvened at least once every five years. The first Technical Committee was convened in June 1981 and completed its work in April 1982.

DIVERSION MONITORING PROGRAM

OVERVIEW OF PROGRAM

The Corps' Program Review has concentrated on IDOT's effort, with USGS, to improve the measuring and recording of flows at Lockport, a recommendation of the first Technical Committee, and on IDOT's development and calibration of a new accounting process.

Flow Measurement

The first Technical Committee questioned the accuracy of flows measured at Lockport and recommended that the flow rating curves be field checked and recalibrated if necessary. The Chicago District retained the Corps' North Pacific Division to prepare an estimate of cost to investigate and upgrade the turbine flow measuring process at the Lockport Powerhouse. The cost of completing this work was found to be prohibitive. The Corps' Waterways Experiment Station (WES) conducted mathematical studies to upgrade the stage-discharge rating curves for the powerhouse sluices and the controlling works sluices. The new stage-discharge curves, as developed by WES, were used to compute total flow at Lockport for the 1983 Water Year.

Rather than incur the expense of revising and recalibrating the several rating curves for the various structures at Lockport, IDOT opted to install an Acoustic Velocity Meter (AVM) in the Sanitary and Ship Canal upstream from Lockport at the Romeoville Bridge. The use of the AVM will resolve a number of issues raised by the first Technical Committee. The device was installed in March 1984 and calibration was completed in March 1985. Flow data from the AVM were used as an independent check on hydrologic trends developed by the new accounting process. IDOT intends to use AVM data for all Lockport measurements beginning with the 1985 water year.

The AVM employs acoustical transducers to measure the velocity of sound through water. The flow is determined from the downstream component of the sound waves. The AVM is positioned at the Romeoville Bridge, approximately six miles upstream of the Lockport facilities. The advantages of this location are that it is on a relatively uniform reach of the Chicago Sanitary and Ship Canal, no major inflows or outfalls exist between the AVM and the controlling works, and it is located far enough from the controlling works that pool drawdown is not a significant factor in the accuracy of measurements. While the AVM does not measure flow at Lockport, as specified by the decree, the flows measured by the AVM are the same flows which pass through the Lockport facilities downstream.

Calibration of the AVM was completed in March 1985. This consisted of seven sets of field measurements taken using standard Price AA current meters. The last set of these measurements was completed on 4 March 1985. Total flows for each set of field measurements were calculated and compared to the flows reported by the AVM for the same time period. The AVM record showed agreement within 2% for five of the seven field tests. The remaining two tests were conducted while the canal level was fluctuating and results varied by (+) 4.0% and (+) 8.8% from AVM records. Calibration checks are to continue quarterly to insure that the accuracy of the AVM is maintained.

A system flaw was found in March 1985 with a breakdown of the AVM device. A passing vessel severed the AVM transducer communications cable rendering the AVM inoperable. No data were gathered for thirty days. Following its repair in April 1985, the AVM was not recalibrated until a field check on 29 August which showed that the AVM was recording only 80% of field measured flow. IDOT reported that USGS is currently addressing the problem.

Under IDOT's direction, the USGS developed a backup system using a regression analysis of Brandon Road Lock flow records to determine flows in the event of AVM malfunction. The Corps plans to evaluate this method as well as alternatives and will

discuss endorsement of and the need for this backup system in the 1986 Annual Report.

Accounting Procedures

The Corps maintained close contact with IDOT and its agent, the Northeastern Illinois Planning Commission (NIPC), during the development of the new accounting procedure. This new procedure uses a hydrologic model to account for flows throughout the diversion area. The basic model is a variation of the Hydro-Comp Model originally developed by NIPC to conduct Section 208 Water Quality Studies. It has been used for several studies by NIPC and other agencies, including the Corps in its Chicago Underflow Plan (CUP) Study.

Using a form of comparative analysis of historical flows combined with samplings of flow computation checks, the Corps verified the reasonableness of the model. Simulated and reported flows for specific diversion components were compared with historic trends for the respective flow components (figure 2). The AVM data available were also used to determine the reasonableness of the hydrologic model. AVM records for 1985 were plotted with MSD Lockport records (figure 4) and the plots analyzed for trends. These trends were compared against similar plots of the hydrologic model's simulated flows vs. Lockport records for 1983 (figure 5).

In both cases, similar trends were observed. The simulated flows derived from the new accounting system tend to be higher than the Lockport record during low flow conditions. Conversely, during high flow, or storm events, the simulated flows are lower than the Lockport record. This same trend is established by the AVM for the 1985 data, indicating a strong degree of reliability in the hydrologic model. It is important to note that much of the formulation of the new hydrologic model was done prior to the availability of the AVM records; therefore, this type of a comparison is an excellent independent check.

Other Activities

The Corps finalized its Standard Operation Procedure (SOP) for the measurement of leakage at Lockport Lock. This SOP will be followed in the event that measurement of flow at Lockport is required (as opposed to the measurement of flow by use of the AVM at Romeoville). Copies of the SOP are available at the Chicago District Office of the Corps of Engineers.

DIVERSION ACCOUNTING REPORT FOR WATER YEAR 1983

On 27 November 1985, the State of Illinois submitted the revised Lake Michigan Diversion Accounting Report for Water Year 1983 to the Corps of Engineers (Appendix A). The report highlighted three areas of interest:

a. a major modernization of the accounting process,

b. the inclusion of sewer induced groundwater pumpage as a deduction, and

c. the use of new, Corps-developed, rating curves to modify the recorded flow at Lockport.

Hydrologic Model

The 1983 Accounting Year Report was developed using the hydrologic model described above. Use of the new model will result in improvement in the bookkeeping and computational areas of the accounting process while not changing the basic formula decreed by the Supreme Court. The model allows actual reported water supply data to be used where the earlier method relied on the previous year's supply data. Additionally, in areas where direct flow measurement is not feasible, the hydrologic modeling provides synthetic flow determination based upon actual rainfall, ground cover, and land use parameters for the ungaged area.

The hydrologic model used is a variation of the Hydro-Comp Model. The model was used to allocate flows entering the Chicago waterways among their various sources. The allocation is made between both point and non-point sources which include Lake Michigan, municipal treatment plants, combined sewers, groundwater, commercial and industrial plants and precipitation runoff.

In 1976, the basic NIPC Hydro-Comp Model was calibrated to local climatic, physiographic and anthropogenic conditions. This involved an adjustment of mathematical relations so that the relevant physical reactions are accurately represented by the model. For diversion accounting purposes, the model was modified by dropping water quality parameters.

Once calibrated, the model was verified for the years 1969 through 1982 by summing the component flows and comparing the sums with the total measured Lockport flow (Table 2). The sums ranged from 6% below to 10.8% above Lockport records. The synthetic (or non-measured) flow components for the annual sums ranged from 6% to 12.4% of the totals.

An integral part of the accounting system is the water budget system employed in the model which allows component verification at various checkpoints. Simulated flows (the sum of individual components) for a watershed sub-area are compared with recorded measurement at metered points such as sewage treatment plants or pumping stations. A variance in the comparison may provide indication of errors in the raw data or in the system itself.

Sluice Discharge Rating Curves

The first Technical Committee recommended that the flow rating curves for the Lockport facilities be checked and verified. The Corps conducted preliminary investigations on the turbines, powerhouse sluices, and controlling works sluices. The results indicated that the rating curves were inaccurate. In April 1983, the Corps' Waterways Experiment Station, through mathematical model and other analytical studies, developed new flow curves for the powerhouse sluices and controlling works sluices. This work is documented in Lockport Power Plant Sluice Gate and Control Works Discharge Evaluation, dated September 1985, and is available at the Chicago District Office of the Corps of Engineers. The new rating curves were used to modify the MSD Lockport flows by adjusting the flow computations for the sluices. For the 1983 water year, the modifications reduced the diverted flow by 180 cfs.

Sewer Induced Groundwater Pumpage

The State of Illinois, in a letter dated 7 May 1984, proposed that an unmeasured component of groundwater pumpage be treated as an allowable deduction. This component, termed "Sewer Induced Groundwater Pumpage," was defined by the State as "...that groundwater which would have evaporated or filtered into lower aquifers if not for the presence of the sewer networks."

The State based its proposal on the premise that, as the sewer action requires pumps to move the water from the upper water table to the treatment plants, this component is part of the allowable deduction for groundwater pumpage. For Water Year 1983, IDOT determined this component to be 47 cfs. This factor was not included in any flow computations.

Flow Computations

The total annual flow at Lockport for Accounting Year 1983 is reported as 3,991.5 cfs. The total reported deductions amounted to 403.5 cfs, as identified in columns 4, 5, 6 and 8 in

Table 1. The net total diversion for Accounting Year 1983 is reported as 3,613.1 cfs. As of 30 September 1983, the long-term average diversion flow is 3,268.8 cfs. (Averaging began with water year 1981). A graphic representation of component portions is given in figure 6.

FINDINGS CONCERNING DIVERSION ACCOUNTING PROGRAM

Domestic Pumpage

Domestic pumpage is water pumped from Lake Michigan or from groundwater sources for some purpose. The U. S. Supreme Court decree includes water pumped for industrial use as domestic pumpage. Domestic pumpage from Lake Michigan, and from groundwater sources recharged by Lake Michigan, is diversion when it reaches the river/canal system as sewage. Domestic pumpage from other groundwater sources is deducted from the Lockport flows.

Domestic pumpage is measured directly at the initial supply pump stations. Lake Michigan water is measured at the water intakes and the primary treatment plants. Groundwater withdrawals are measured at the pump stations. The new accounting system uses a consumptive use factor of 0.9 to represent water supply pumped which actually passes Lockport as sewage effluent.

The Corps interprets the language in the decree on domestic pumpage as implying municipal and industrial water supply. The use of the 0.9 factor in the new accounting model to represent a reduction due to consumptive uses appears reasonable.

Non-Diversion Runoff

Runoff from outside of the Lake Michigan Watershed which reaches Lockport through the sewer system is deducted from the total diversion. The primary source of this flow is from the Des Plaines Watershed. The Des Plaines Watershed is divided into three subareas for which non-diversion runoff flows are calculated. These are the Upper Des Plaines, Lower Des Plaines and Summit Conduit.

Upper Des Plaines Watershed

Under the old accounting system, water flows were measured at the Upper Des Plaines Pump Station (UDPPS). A correction factor was used to include areas not tributary to UDPPS. Any Lake Michigan water reaching the UDPPS was subtracted from the flow and the modified flow was deducted from the Lockport flow.

Under the new system, estimated flows based on water supply, precipitation, sewer infiltration and sewer treatment plant flows are used.

The Corps found that the simulated flows failed to match the recorded flows at the UDPPS (figure 7), but did match the flows at the West-Southwest Treatment Plant at Stickney (figure 8). A field inspection by the Corps verified that, during high flow periods, flows were capable of bypassing the UDPPS metering system. Conversely, during low or normal flows, effluent being pumped could leak back into the sump, resulting in double counting and high metered flows. During the 1983 water year, the new system reported 109 cfs of which 77 cfs flowed through the UDPPS. Direct measurements at the UDPPS were 85 cfs, or 10% higher than simulated.

Lower Des Plaines Watershed

The configuration of the Lower Des Plaines Watershed prevents the direct measurement of total flow at any single point. Under the old system, flows were measured on the Hart Ditch and substituted for the Lower Des Plaines Watershed. The Hart Ditch Watershed is similar in topography and geology. By multiplying Hart Ditch flows by a factor of .95 to account for a slight difference in area, a representative flow estimate was produced.

The first Technical Committee suggested that land use factors, such as surface cover, percent combined sewer use and population density, be compared to verify the substitution representation. The new system generates an estimate of flow using hydrologic simulation based upon data gathered directly from the Lower Des Plaines Watershed. The hydrologic simulation for Water Year 1983 resulted in a flow of 121 cfs compared to 90 cfs from the Hart Ditch substitution (figure 3). An investigation of precipitation records from the two watersheds showed that the Lower Des Plaines Watershed received approximately 36% more precipitation than the Hart Ditch Watershed. This fact accounts for a significant difference in the runoff of the two watersheds.

In the case of the Lower Des Plaines Watershed, all runoff is deductible since it is intercepted by the Cal-Sag Channel and carried directly to Lockport.

Summit Conduit

The Summit Conduit collects sewage and runoff from a small area of the Des Plaines Watershed. In prior years, the conduit was gaged and flows were directly recorded. The first Technical

Committee questioned the accuracy of the gaging system in use. The new accounting system replaces direct measurement with hydrologic simulation based on the characteristics of the drainage area. The hydrologic simulation for Water Year 1983 resulted in an average annual flow of 13.7 cfs. The gage recorded an average annual flow of 14.9 cfs.

Grand Calumet River

The Grand Calumet River flows into the Little Calumet River above the O'Brien Lock and Dam. The Indiana Canal connects the Grand Calumet with Indiana Harbor, allowing flow directly into Lake Michigan. Flow in the Grand Calumet between the Little Calumet River and Indiana Canal can go either east or west, depending upon the hydraulic gradient. The location of the hydraulic summit between the Indiana Canal and the Little Calumet River is dependent upon the elevation of Lake Michigan. As the lake level rises, the summit moves east, closer to the Indiana Canal. The amount of sewage effluent from the Hammond, Indiana treatment plant flowing into the Little Calumet River and then into Illinois is thus dependent upon the level of Lake Michigan. The publication titled Flows Crossing the Lake Michigan Diversion Boundary in Indiana, completed in 1978, documented a method of estimating the quantity of Indiana domestic pumpage which reaches Illinois as sewage effluent based upon the level of Lake Michigan and the record of domestic pumpage. For the 1983 Water Year, that quantity is estimated to be 50.7 cfs.

Summary

Historical flows at Lockport were plotted against historical runoff component flows (Figure 2). The plots did not result in a linear correlation between total flow at Lockport and runoff component flows. Instead, the plots showed a scattering of data points. The 1983 values for runoff components are reasonable when compared to the range of historic values, as shown in the table below.

Table 3 - Components of runoff

	1983	Historical Range (1969-1982)	% Difference
Lockport recorded	4170	3206 - 3795	+10%
Summit Conduit			
Recorded	14.9	8 - 14	+6%
Simulated	13.7		in range
Lower Des Plaines Watershed			
Hart Ditch Substitution	90	11 - 96	in range
Simulated	121		+25%
Upper Des Plaines			
Recorded	121	49 - 129	in range
Simulated	109		in range
Illinois Watershed			
Recorded	231	51 - 231	in range
Simulated	244		+5%
Total			
Recorded	461.9	119 - 470	in range
Simulated	487.7		+4%

FINDINGS CONCERNING DIVERSION ACCOUNTING REPORT FOR WATER YEAR 1983

The Corps' review of the State of Illinois' Lake Michigan Diversion Accounting Report for 1983 (Appendix A) can be summarized as follows:

a. the use of a hydrologic model in flow accounting is consistent with state-of-the-art technology and provides reasonable accounting of non-measured flows;

b. the use of Corps-developed flow rating curves for the Lockport Powerhouse and Controlling works sluices improves

the accuracy of measured flow for these flow components;

c. the inclusion of sewer induced groundwater pumpage as a deduction is not consistent with the U.S. Supreme Court decree and cannot be used; and

d. differences between precipitation data recorded by MSDGC and that provided by the National Oceanographic and Atmospheric Administration (NOAA) exist which may be greater than can be explained by localized meteorology.

Hydrologic Model

A two-tier approach to the final certification of the new accounting procedure is being taken by the Corps. The first level is a determination of the reasonableness of the simulated flows produced. This determination is based on comparative analysis of the simulated flows versus historical data for the same component flows. Sample procedures and results were discussed earlier in this report.

The second level will be a detailed analysis of the model's algorithms and flow parameters to be done during 1986. This analysis will be the basis for final certification of the accounting system. It is noted that approximately 80% of the flows are directly measured and that in those cases where measured data is in conflict with simulated flows, the measured data was used in the accounting report for Water Year 1983.

Flow Measurements

The Corps conducted several spot-checks of MSDGC computations of flow through the powerhouse, lock, and controlling works at Lockport. The total flows computed by MSDGC were also graphically compared with the modified (using the Corps-developed rating curves) Lockport flows reported by IDOT (figure 9). A number of differences in daily flows were identified. Those particular daily flows were then analyzed for reasonableness based on the anticipated effect of the new rating curves. Those daily flows which differed from the anticipated result were recalculated by the Corps. Apparent errors in calculations thus identified were reported to IDOT and corrected in the final IDOT Accounting Report.

Sewer Induced Groundwater Pumpage

IDOT's proposal to include sewer induced groundwater pumpage as a component of the groundwater pumpage deduction is based on an October 1981 study, summarized in Part III of the

Accounting Report for Water Year 1983 (Appendix A). In a May 1985 report, titled Report on a proposal by State of Illinois Department of Transportation, Division of Water Resources to Consider Induced Infiltration as a Deduction in the Lake Michigan Diversion Accounting Procedure, the Corps recognized that "...sewer joints, given surrounding positive head differential, will drain near subsurface flow, some of which would not have reached the Lake Michigan watershed if surface urbanization were as it is today and sewers had not been constructed...".

In a separate action (10 July 1985), the U. S. Department of Justice has rendered an opinion that the inclusion of sewer induced groundwater pumpage as an allowable deduction requires an amendment to the decree.

The State of Illinois has taken exception to the Justice Department's opinion as ignoring the State's allegation that sewer induced groundwater pumpage is a portion of the groundwater pumpage component which is already addressed in the decree. Justice has reaffirmed its position (23 August 1985).

The total quantity in question for Water Year 1983 is 47.1 cfs.

Precipitation Data

The Accounting Report for 1983 identifies a concern that precipitation data provided by MSDGC varies significantly from that received from NOAA. After review of the data used in the flow simulations, the Corps found that the precipitation data used by IDOT was significantly lower than the published data for MSDGC gages. While the total effect on diversion flows is small, correcting the precipitation data would result in an increase of deduction runoff and ultimately lower the total diversion for the 1983 water year.

Certification of Flows

After review of the Accounting Report for Water Year 1983 and the data from which it was derived, the Corps found the following flows to be correct and are certified:

Total annual average flow at Lockport	3,991.5 cfs
Total deductions from Lockport record	403.5 cfs
Lake Michigan domestic pumpage not reaching canal	25.1 cfs
Total diversion for Water Year 1983	3,613.1 cfs
40-year average	3,268.8 cfs
Total diversion to date (Water Years 1981 - 1983) above 3,200 cfs:	206.4 cfs-years

FUTURE PROJECTS AND STUDIES BY CORPS OF ENGINEERS

As a result of the recommendations of the first Technical Committee, the Corps is preparing a Master Plan for the Corps review of accounting procedures. The Master Plan is scheduled for completion in 1986.

Second Technical Committee

The second Technical Committee will be convened in Fiscal Year 1986. The committee is expected to further review the new accounting system and the reliability of the current system of measuring flows. The committee will be charged with providing overall review and recommendations to improve the technical processes used in diversion accounting considering the current best engineering and scientific methods.

Calibration and Documentation of Flow Components

The Corps will initiate procedures in Fiscal Year 1986 to establish and review calibration procedures and documentation for the primary diversion flow components. Currently, some calibration of primary flow devices is conducted, but little documentation is done. The Corps program will initiate a formal review which will add periodic document review to continuing field monitoring of calibration efforts.

The Corps will evaluate the proposed backup to the AVM. Alternatives will be evaluated based on accuracy, reliability and cost effectiveness.

The need for a gage at the Summit Conduit, discontinued in October 1984, will be evaluated. The previous gage was improperly located. Flow is currently being estimated by hydrologic simulation. The evaluation of a replacement gage will consider accuracy vs. hydrologic simulation as well as cost effectiveness of on-site metering.

Review of Hydrologic Model

Of immediate concern to the Corps is a comprehensive detailed analysis of the new accounting model. This review will transcend that done for this report in that the specific program logic, flow algorithms, hydrologic parameters and calibration procedures will be analyzed and reviewed by Corps experts on hydrologic modeling for the purpose of verifying the model for continued use as the sole accounting system.

Phase I TARP Effects on Accounting

The main stem of Phase I of the Tunnel and Reservoir Plan (TARP) was placed in operation on 25 May 1985. The impact of the system on accounting and any required modifications to the accounting program proposed and/or implemented by IDOT will be studied during the coming months.

RECOMMENDATIONS AND CONCLUSIONS

REVIEW OF STATE OF ILLINOIS' RECOMMENDATIONS

Based on IDOT's recommendations as provided in Section VII of the 1983 accounting report, the Corps concludes the following:

a. IDOT Recommendation:

Further investigations into the accuracy of recorded flows at the Controlling Works and Powerhouse at Lockport are needed. Particular attention is needed to quantify submergence at the Controlling Works and its cause.

Corps' Conclusions:

This is needed only if the controlling works and powerhouse at Lockport are used as the backup measurement system.

b. IDOT Recommendation:

The MSDGC should incorporate the revised Corps' ratings for free flow discharge into their calculation of discharge for the Controlling Works and Powerhouse. The MSDGC should also establish a continuous record of tailwater elevations at a suitable location downstream of the Controlling Works.

Corps' Conclusions:

MSDGC should use the revised rating curves. Furthermore, if the controlling works and powerhouse flows are needed as part of a backup measurement system, then tailwater and headwater gages should be installed at the controlling works. The responsibility for accomplishing these changes is IDOT's.

c. IDOT Recommendation:

Further investigation is needed to determine the reasons for imbalances between estimated and recorded flows at the three major MSDGC treatment plants. Are for investigation include the following:

1. Model assumptions with respect to sanitary return flow and infiltration and inflow quantities.

2. Possible leakage from the Canal through combined sewer overflow structures.

3. Possible unreported major discharges to the plant from groundwater or surface water supply return flows.

Corps' Conclusions:

We agree with IDOT's recommendation. It is expected that IDOT will sponsor such investigations as funding allows.

d. IDOT Recommendation:

The monitoring of flow at the Upper Des Plaines Pumping Station should be discontinued for diversion accounting purposes due to uncertainties in its record which cannot be resolved without significant increased maintenance and flow monitoring changes.

Corps' Conclusions:

We agree to discontinue the monitoring of this flow; however, it is expected that total flow records at this gage will continue to be maintained by IDOT in order to be used as a system check for any significant shifts in output trends from this service area. Data derived from the records should be provided in tabular format.

e. IDOT Recommendation:

Investigations into the possibility of long-term biases among precipitation gages reporting to NOAA, MSDGC and the City of Chicago should be undertaken based on significant differences noted during the 1983 water year.

Corps' Conclusions:

We support such an investigation by IDOT.

f. IDOT recommendation:

Flow monitoring at the Summit Conduit should be discontinued due to problems with frequent gage malfunctions, the relatively small amount of flow from this area, and the ability to reasonably estimate flows from this area using pumpage data and runoff simulation.

Corps' Conclusions:

The Corps is not convinced that this gage site should be discontinued. The measurement of this component will be a work task to be reviewed by the second Technical Committee in FY 1986.

g. IDOT Recommendation:

The flow transfers from the MSDGC's design O'Hare service area to the Northside Treatment Plant should be metered to provide a better estimate of quantity and flow variations.

Corps' Conclusions:

We support IDOT's implementation of such metering.

SUMMARY CONCLUSIONS

The Lake Michigan diversion accounting program is going through significant modifications in the technical methodology used in computing total flows at Lockport and in the computation of the deductions. The main features of these changes are a result of the first Technical Committee review. These features are the concern over the installation and reliability of the AVM, the existing MSDGC total flow measurement procedure and results, and the NIPC water balance methodology.

As discussed in both the IDOT report on Water Year 1983 and the Corps review, some minor inconsistencies still exist within the accounting system. Notwithstanding these inconsistencies, the results represent an improvement in the accounting procedures. Just as the physical features of the diversion area are dynamic, so is the accounting system itself.

It is expected that the implementation of the first Technical Committee's recommendations will, over the next several years, continue to improve the diversion monitoring system. The review by the second Technical Committee, scheduled to begin in the spring of 1986, will result in future improvements to the overall system as well.

CORPS OF ENGINEERS' FINDINGS

Based on the review of the State of Illinois' report, Lake Michigan Diversion Accounting for Water Year 1983, data collected by agencies of the State of Illinois, computation sheets, field investigations and special studies conducted by or for the Corps of Engineers, the Corps reaches the following conclusions:

a. Annual Lake Michigan Diversion for Water Year 1983 is correctly reported by the State of Illinois as 3613.1 cfs. The long-term average diversion flow, as of 30 September 1983, is 3,268.8 cfs.

b. The new accounting system is reasonable in its approach and produces a final accounting product which is reasonable and in agreement with historic trends. The new accounting system produces overall results which are substantiated using state-of-the-art measuring techniques. Pending a rigorous and detailed analysis, the new accounting system is provisionally certified for future use. The Corps accepts the new accounting system for Water Year 1983. Use in subsequent years is subject to the results of further review.

c. A backup system to the AVM for measuring Lockport flows is still necessary and should be maintained.

d. The Department of Justice has taken the position that the proposal by the State of Illinois for "sewer induced groundwater pumpage" cannot be allowed as a deduction. Illinois will continue to report "sewer induced groundwater pumpage" as a component of diversion flow in their accounting program.

e. It is appropriate to account for the non-diversion flows from the Lower Des Plaines watershed using flow estimates derived from the hydrologic model rather than the substitution method previously used.

f. Variations in precipitation data gathered from different sources exceed what can be explained by localized meteorology. This may affect the accuracy of non-diversion runoff flows.

Frank R. Finch, P.E.
LTC, Corps of Engineers
District Engineer

REFERENCES:

1. COE, "Lake Michigan Diversion - Findings of the Technical Committee for Review of Diversion Flow Measurements and Accounting Procedures," October 1981.

2. Harza, An Evaluation of Flow Measurement and Accounting Method for Lake Michigan Diversion, October 1981.

3. Keifer, Flows Crossing the Lake Michigan Diversion Boundary in Indiana, September 1978.

4. COE, Report on a Proposal by State of Illinois Department of Transportation, to Consider Induced Infiltratin as a Deduction in the Lake Michigan Diversion Accounting Procedure, May 1985.

5. COE, Lockport Power Plant Sluice Gate and Control Works Discharge Evaluation, September 1985.

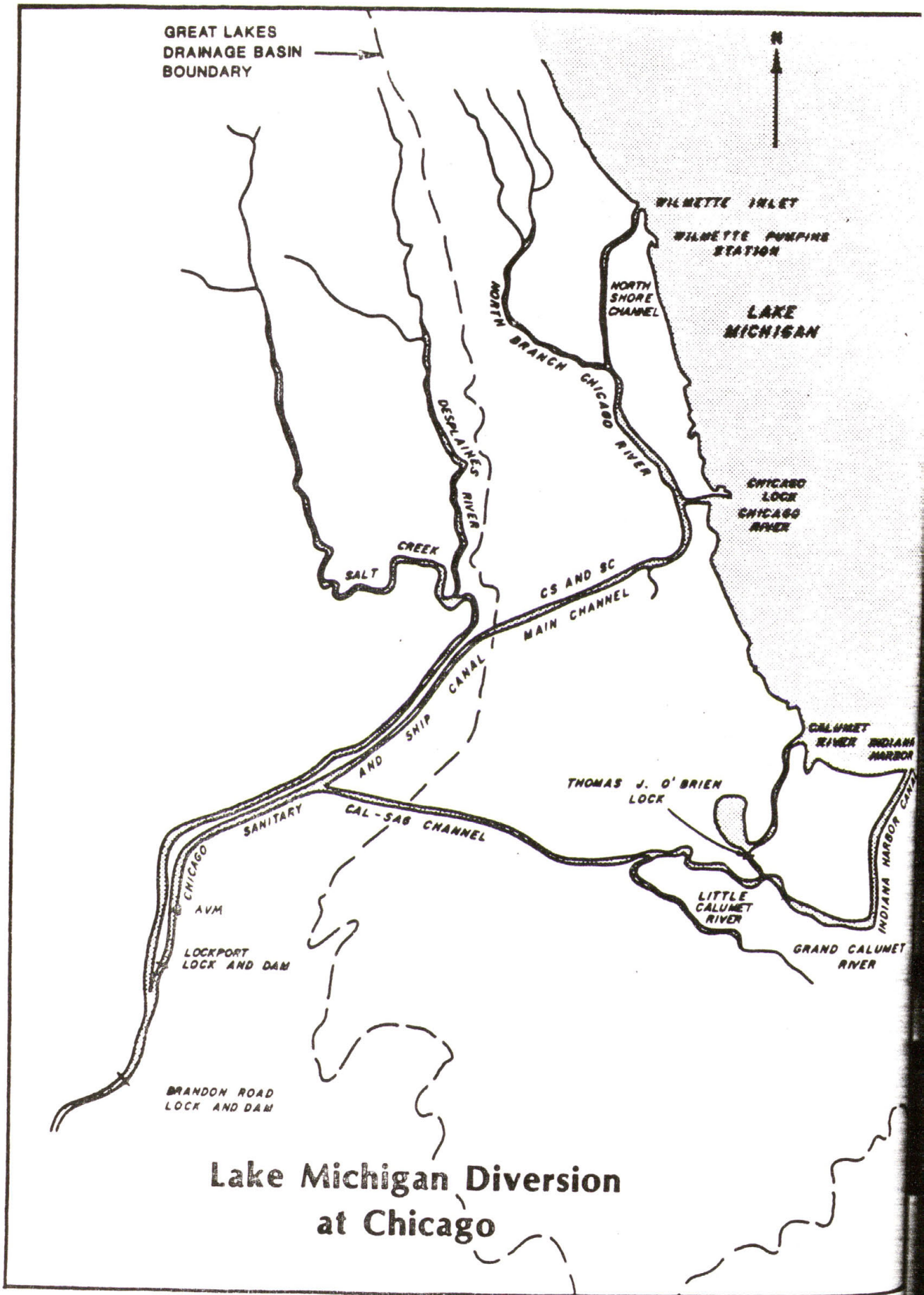
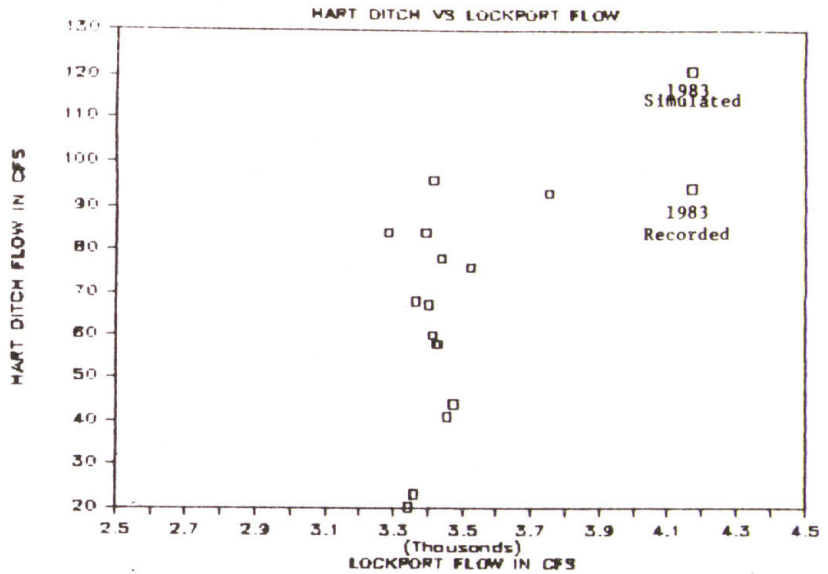
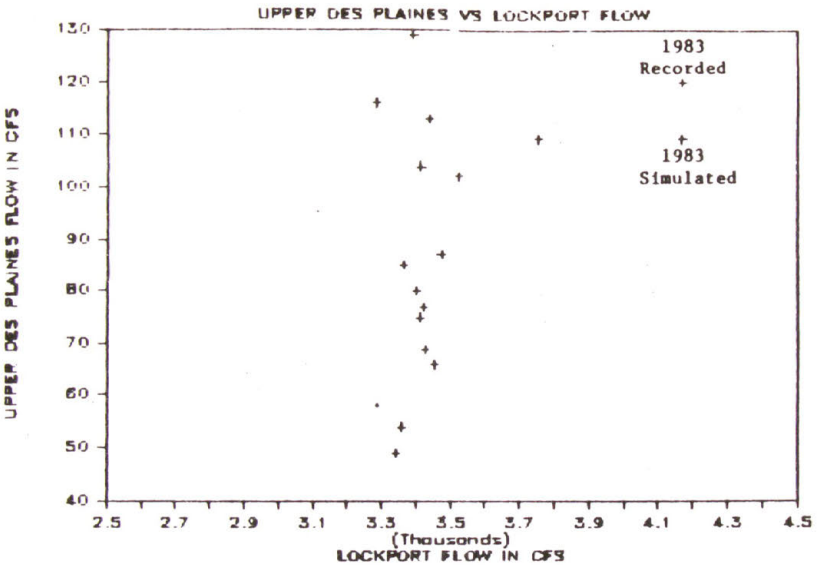


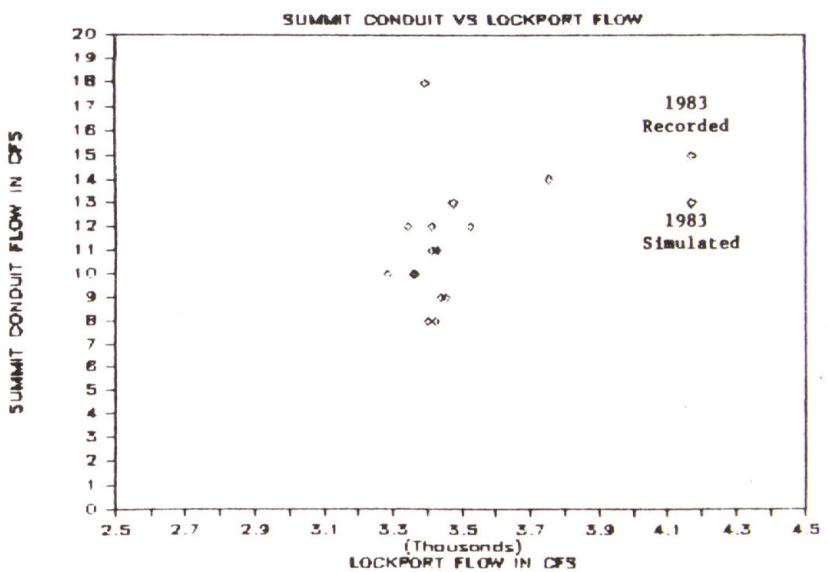
Figure 1 - Location plan

LOCKPORT VS COMPONENT FLOWS

HISTORICAL FLOWS OF 1969 –1983







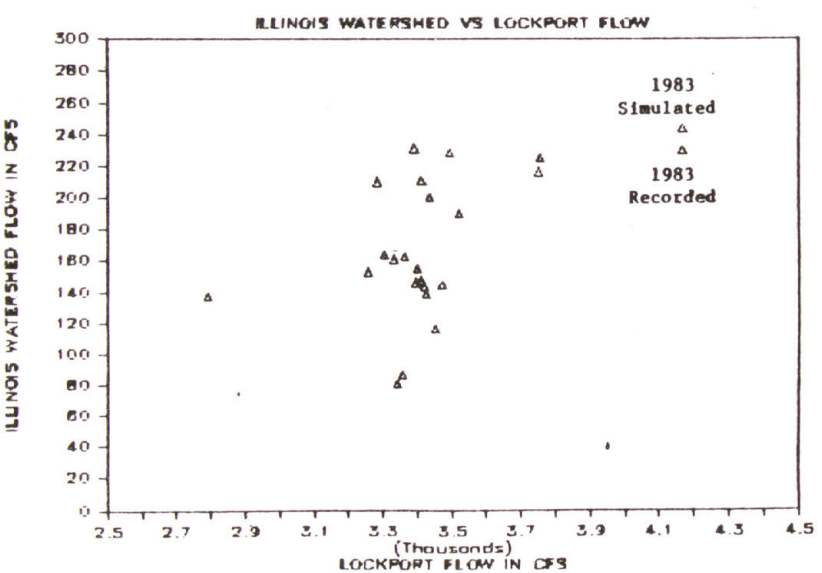
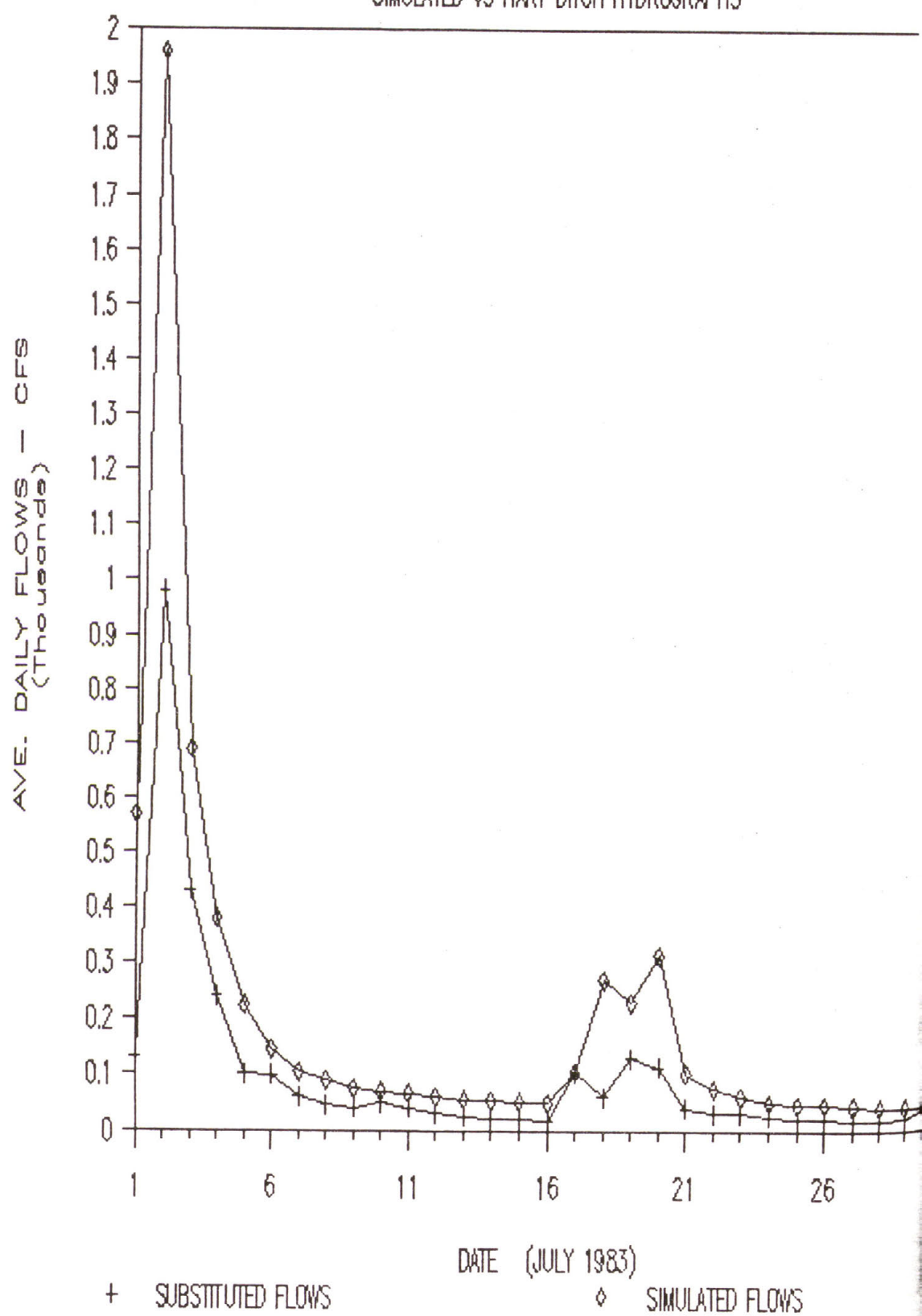


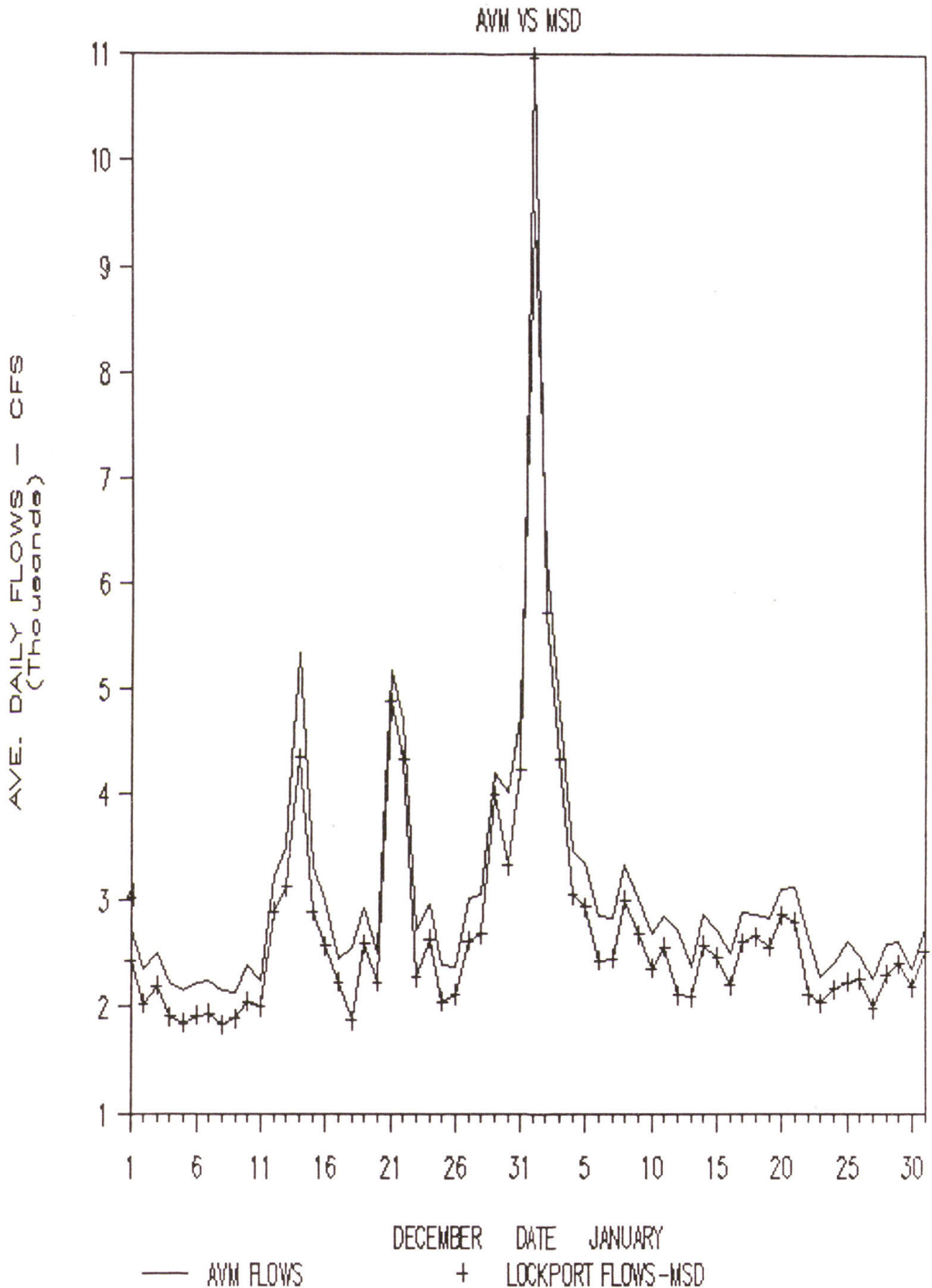
Figure 2

LOWER DES PLAINES WATERSHED

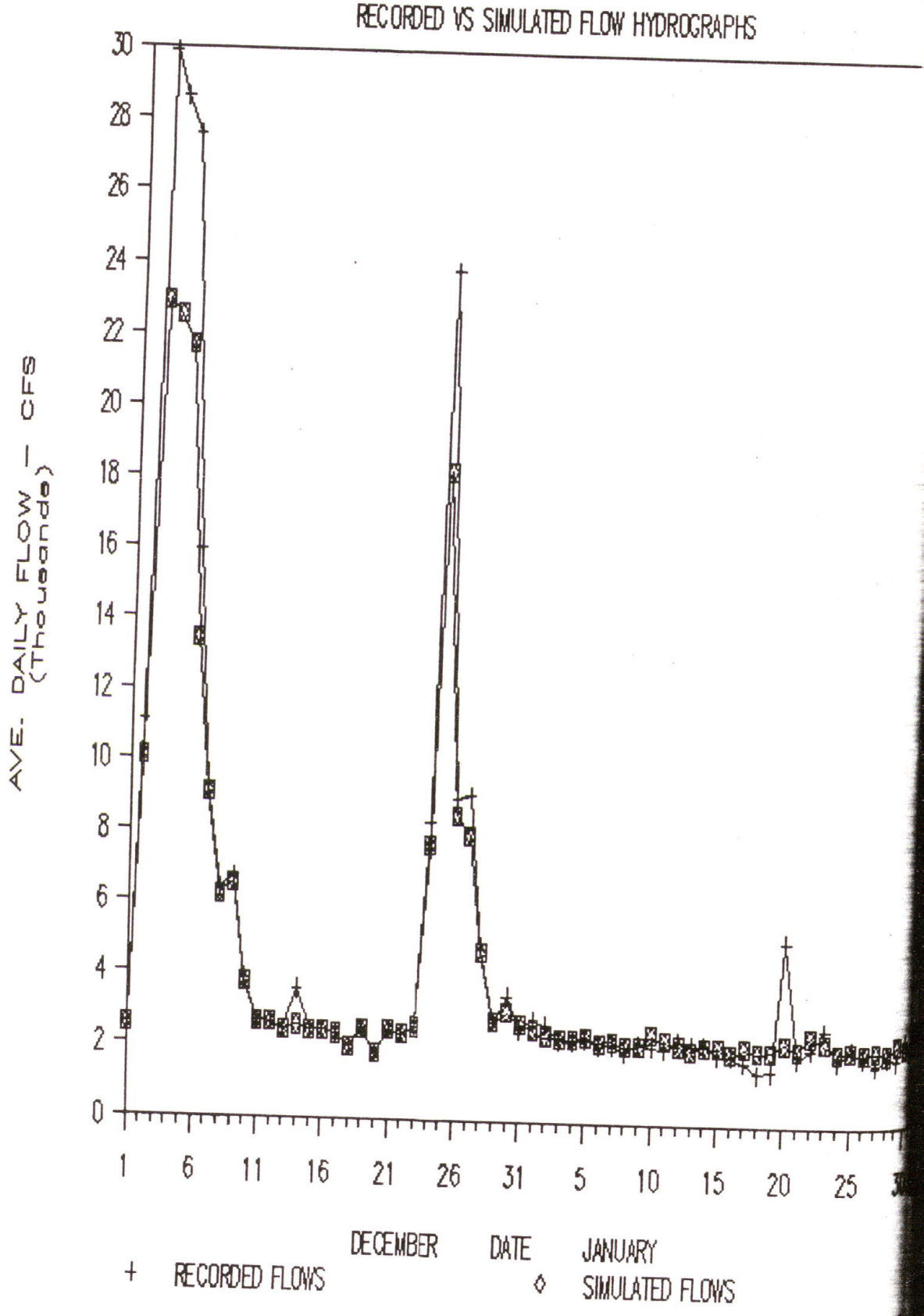


Figur

FLOW AT LOCKPORT - 1985



FLOW AT LOCKPORT - 1983



Figure

PRIMARY DIVERSION COMPONENTS
(ACCOUNTING YEAR 1983)

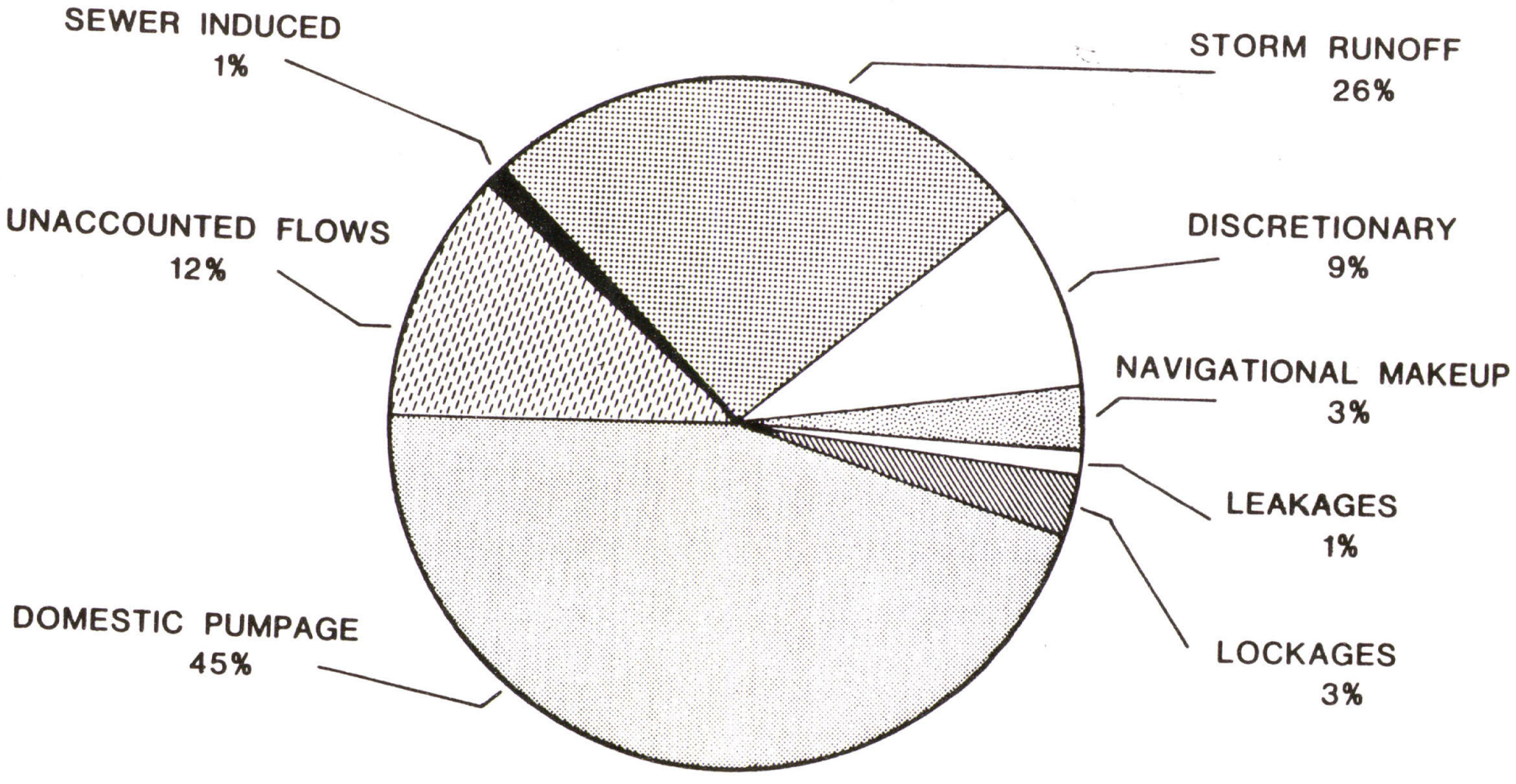
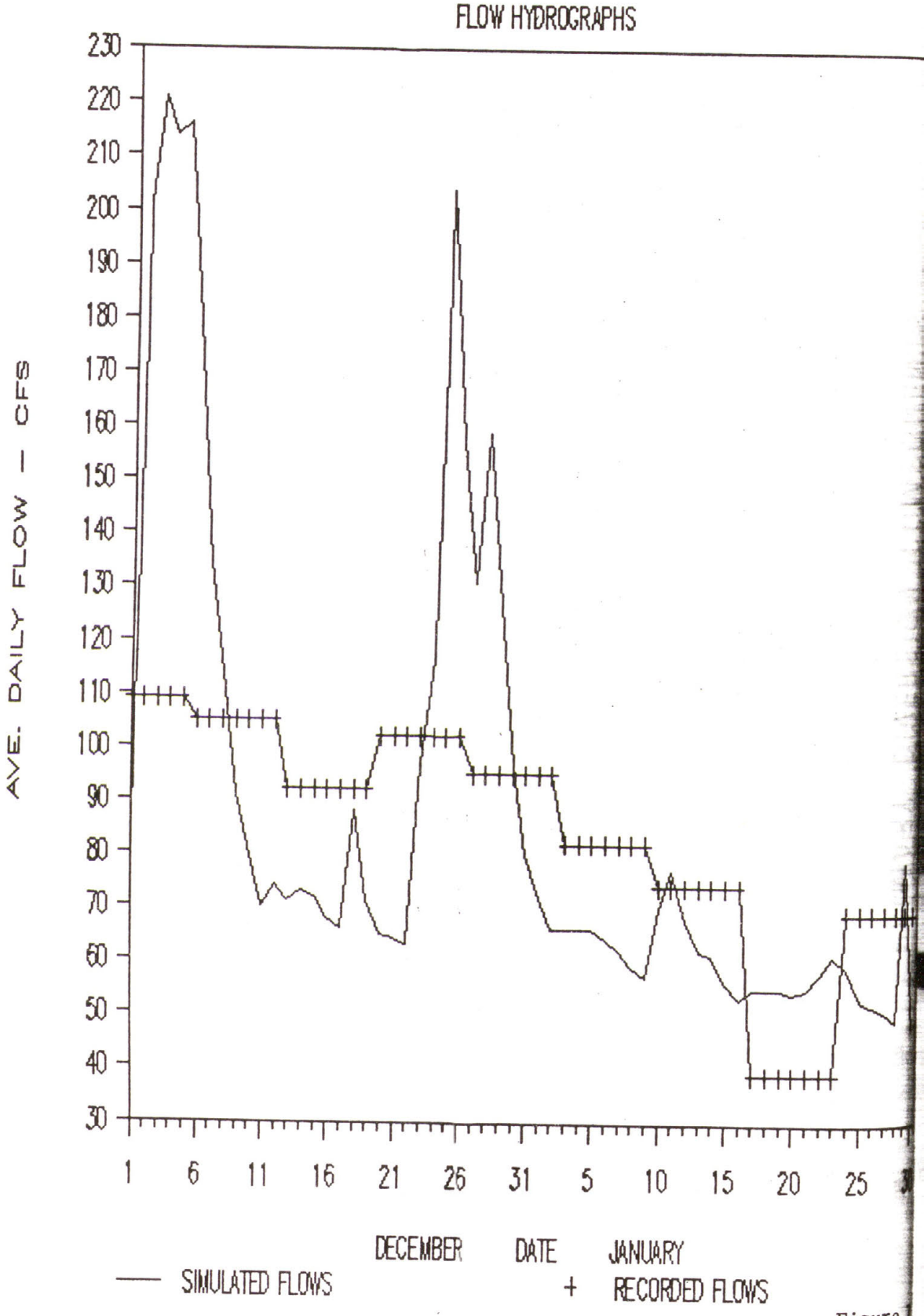


Figure 6

UPPER DES PLAINES WATERSHED FLOWS



Figure

WEST-SOUTHWEST TREATMENT PLANT

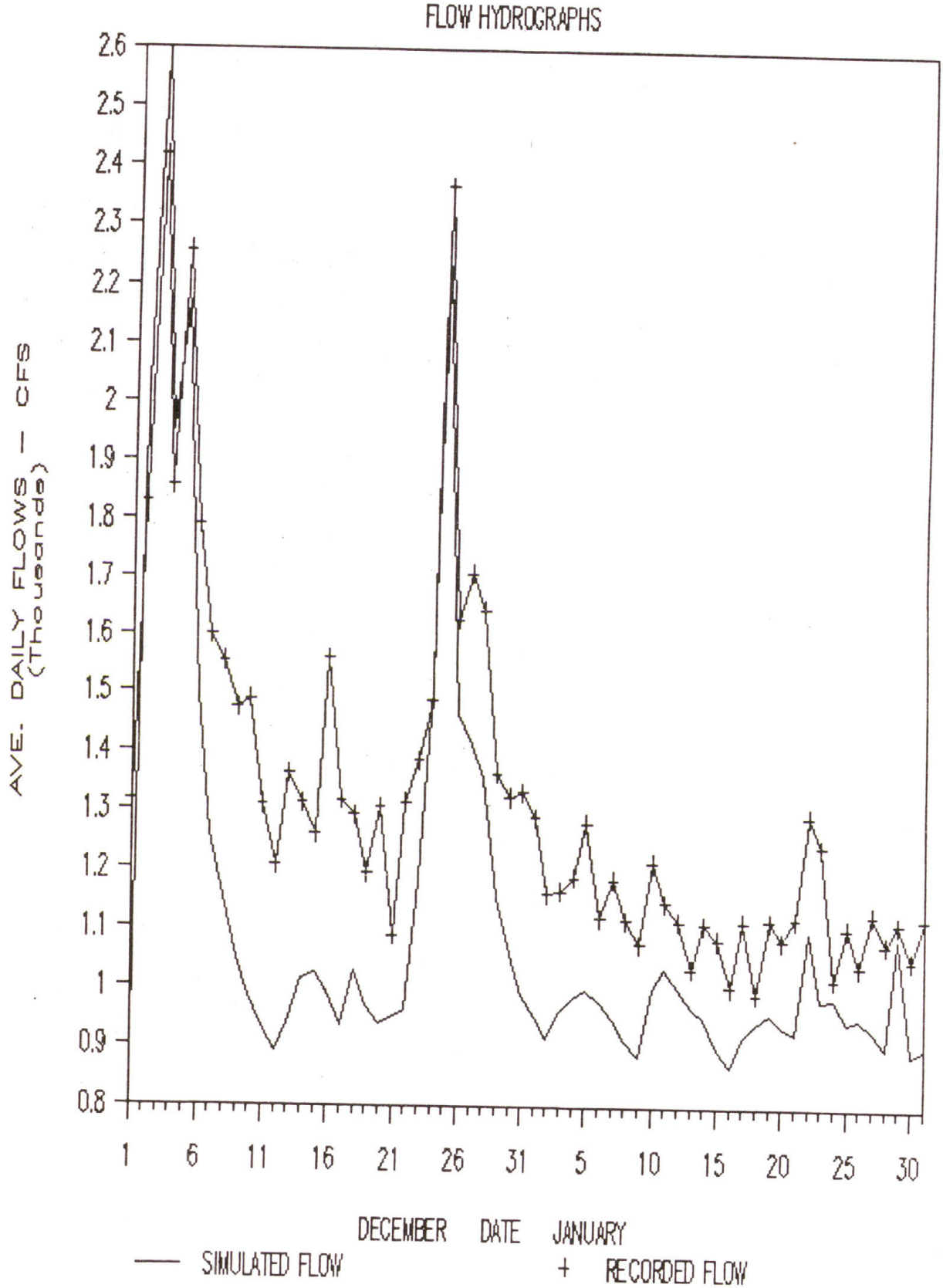


Figure 8

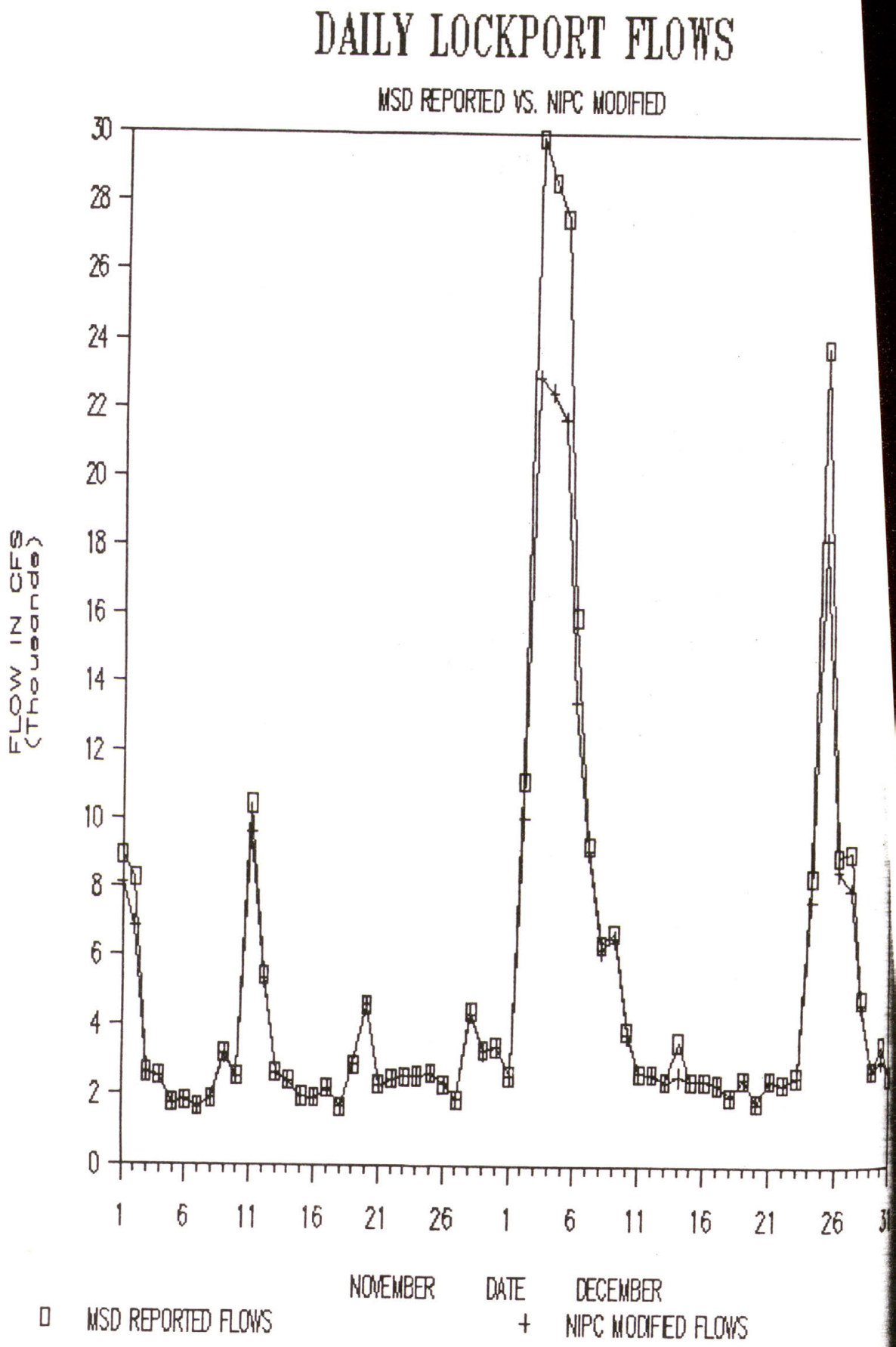

DAILY LOCKPORT FLOWS
MSD REPORTED VS. NIPC MODIFIED
FLOW IN CFS (Thousands)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
1
6
11
16
21
26
1
6
11
16
21
26
NOVEMBER
DATE
DECEMBER
MSD REPORTED FLOWS
NIPC MODIFIED FLOWS

Figure 9

Table 1 - Average flow quantities
For water year 1983

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
FOR THE PERIOD FROM: OCTOBER, 1982 TO: SEPTEMBER, 1983
ALL DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLINOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHING CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHING CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLINOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTABLE TO ILLINOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
OCT1982	2559.6	0.6	2560.1	50.2	55.2	26.4	0.0	43.2	1.8	175.0	23.3	2408.4	1539.8	95.9	695.6
NOV1982	3214.3	0.4	3214.8	50.2	54.8	26.2	0.3	255.2	62.3	386.5	23.3	2851.6	1478.3	985.6	157.1
DEC1982	6637.1	0.2	6637.3	50.2	54.7	27.1	1.7	542.4	239.0	674.3	22.2	5985.2	1449.9	2492.1	186.0
JAN1983	2198.1	0.2	2198.3	50.2	55.2	30.1	0.1	129.9	14.7	265.3	20.8	1953.7	1456.8	290.2	97.7
FEB1983	2815.3	0.2	2815.5	50.2	55.0	30.2	0.2	192.0	28.6	327.4	22.8	2511.0	1451.2	711.4	94.0
MAR1983	3156.8	0.3	3157.0	50.2	54.9	41.7	0.6	297.6	29.3	444.4	22.1	2734.7	1447.1	932.1	122.3
APR1983	5764.0	0.2	5764.2	50.2	54.5	45.1	1.3	651.5	79.8	801.3	25.9	4988.8	1447.8	2329.1	178.7
MAY1983	4277.5	0.4	4277.9	50.2	54.9	66.4	0.9	745.9	33.9	517.4	25.1	3785.6	1483.7	1220.9	310.5
JUN1983	3676.6	0.7	3677.3	50.2	55.1	81.6	0.1	130.9	-6.8	319.8	27.8	3385.2	1781.4	440.1	924.2
JUL1983	5459.0	0.9	5459.9	50.2	55.0	83.2	2.4	198.8	60.6	387.3	30.2	5102.8	2035.0	1000.3	1457.3
AUG1983	3963.3	1.0	3964.3	50.2	55.2	86.2	0.1	90.7	4.2	242.3	31.1	3753.1	2097.4	246.8	1478.5
SEP1983	4082.1	0.5	4082.6	50.2	55.0	61.2	0.3	113.4	25.9	299.8	26.1	3808.8	1699.8	531.7	1145.6
MEAN	3991.0	0.5	3991.5	50.2	55.0	50.7	0.7	247.6	46.4	403.6	25.1	3613.1	1613.7	940.8	574.2

(* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
(** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

STATUS OF ILLINOIS' LAKE MICHIGAN DIVERSION

UNDER 1980 AMENDED U.S. SUPREME COURT DECREE

Accounting Year	Annual Diversion (% of 3,200 cfs)	40 Year Running Avg.	CFS - Years Annual	CFS - Years Cumulative Sum
1981	3106 cfs (97)	3106	+ 94	+ 94
1982	3087 cfs (96.5)	3096	+113	+207
1983	3613 cfs (113)	3269	-413	-206

Table 2 - Summation of component flows and Recorded Lockport measured flow For water year 1983

Year	'1969	'1970	'1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Connection to lake Wilmette Chicago River O'Brien															
Total	1441.0	941.0	1129.0	1230.0	639.0	311.0	495.0	527.0	911.0	692.0	745.0	685.0	684.0	549.0	574.0
Stream flow North Branch Little Calumet															
Total	311.0	301.0	239.0	348.0	452.0	437.0	312.0	277.0	166.0	317.0	355.0	310.0	360.0	346.0	430.0
Sewage Treatment Plants Northside Central South Lemont															
Total	2107.0	2109.0	2042.0	2161.0	2278.0	2215.0	2128.0	2421.0	2000.0	2070.0	2166.0	2061.0	2022.0	2113.0	2137.0
Other point sources	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	13.0
Summit Conduit	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
CSO's	222.0	254.0	177.0	269.0	258.0	261.0	235.0	212.0	150.0	240.0	355.0	235.0	260.0	250.0	271.0
Tributary area runoff	99.0	116.0	65.0	109.0	130.0	155.0	110.0	90.0	36.0	112.0	130.0	110.0	130.0	125.0	193.0
Sum	4203.0	3744.0	3675.0	4140.0	3780.0	3402.0	3299.0	3550.0	3286.0	3454.0	3774.0	3424.0	3479.0	3406.0	3634.0
Lockport recorded flow	3795.0	3416.0	3341.0	3748.0	3590.0	3295.0	3519.0	3318.0	3205.0	3344.0	3664.0	3286.0	3347.0	3308.0	4170.0
Sum - Lockport	408.0	328.0	334.0	392.0	190.0	107.0	-220.0	232.0	81.0	110.0	110.0	138.0	132.0	98.0	-536.0
% difference	10.8	9.6	10.0	10.5	5.3	3.2	-6.3	7.0	2.5	3.3	3.0	4.2	3.9	3.0	-12.9
Precipitation (O'Hare)	33.2	37.1	27.2	44.0	43.4	32.0	38.2	31.3	39.7	36.0	37.4	37.9	40.5	32.6	53.5

ANNUAL REPORT

MONITORING OF DIVERSION OF LAKE MICHIGAN WATER AT CHICAGO, ILLINOIS

APPENDIX A

Lake Michigan Diversion Accounting For Water Year 1983

(Prepared for IDOT by NIPC)

LAKE MICHIGAN DIVERSION ACCOUNTING FOR WATER YEAR 1983

Prepared by

THE NORTHEASTERN ILLINOIS PLANNING COMMISSION

For

THE ILLINOIS DIVISION OF WATER RESOURCES

November, 1985

TABLE OF CONTENTS

LAKE MICHIGAN DIVERSION ACCOUNTING FOR WATER YEAR 1983

I. Introduction

The 1983 water year accounting for the State of Illinois' diversion of Lake Michigan water is the result of a major effort by the state to improve the accounting procedure. Previous accounting procedures had relied on estimation techniques which met the directives of the U.S. Supreme Court decree but did not attempt to cross check measured and estimated values. The new accounting procedure also meets the directives of the U.S. Supreme Court decree and at the same time, through a system of water budgets, checks whether the water entering key points in the diverted watershed system balances with the total water leaving those points.

A. Budgets

A total of 13 water budgets were prepared using both measured and estimated data, the latter obtained from simulation of the hydrologic response of the major sewer systems and ungaged watersheds. The water budgets are the starting point for the analysis of data collected to prepare the diversion accounting report. These budgets are discussed in detail in the Lake Michigan Diversion Accounting Manual of Procedures (NIPC, 1985). In balancing against the most important flow budget, Lockport Powerhouse and Controlling Works, over 85 percent of the flow data was measured and less than 15 percent estimated.

Table 1 shows the budgets used in the new accounting procedure. Budgets 1 through 3 are not true budgets, in the sense that inputs are measured against outputs, but rather are summations of critical water supply pumpage data by user. Further, Budgets 4,9,10, and 11 do not independently balance inputs versus outputs. These budgets are used to estimate stormwater runoff at stream gages by subtracting sanitary and point source flow from the streamflow record. Budgets 5,6,7,8,12 and 13 compare measured and estimated inputs against measured output. At the Metropolitan Sanitary District of Greater Chicago (MSDGC) treatment plants (Budgets 5,7,8 and 12) this is actually a balancing of estimated inputs versus measured inputs to the treatment plants, since plant effluent is not measured.

Table 1: Water Budgets

No.	Name	Tributary to Nos.
1	Lake Michigan Water Supply	4-11, 13
2	Groundwater Supply Lake Michigan Watershed	4-11, 13
3	Groundwater Supply Des Plaines Watershed	5-8, 12, 13
4	North Branch Chicago River at Touhy Avenue	13
5	Northside Treatment Plant	13
6	Upper Des Plaines Pumping Station	7
7	West-Southwest Treatment Plant	13
8	Calumet Treatment Plant	13
9	Little Calumet River at State Line	11
10	Thorn Creek at Thornton	11
11	Little Calumet River at South Holland	13
12	Lemont Treatment Plant	13
13	Lockport Powerhouse and Controlling Works	-

B. The Accounting Report

Following the preparation of these budgets, their components are used to compute the accounting report. Table 2 is the new accounting report for the 1983 water year. Table 3 shows the MSDGC hydraulic report format. Columns 1 through 6 of the MSDGC hydraulic report format have been condensed into a single Column 1, Total Measured Flow at Lockport. Eventually, this column will be reserved for total flow measured by the AVM station near Romeoville. Column 2 of the new report is the same as Column 7 of the MSDGC format, accounting for withdrawals above Lockport. Column 3 is the same as Column 8 of the MSDGC format and is the summation of total flow past Lockport plus canal water supply withdrawals. Column 4 (MSDGC Column 9) is groundwater pumpage from the Lake Michigan watershed by Illinois the sewage effluent derived from which reaches Lockport. Column 5 (MSDGC Column 10) is groundwater pumpage by Illinois outside the Lake Michigan watershed the effluent from which reaches Lockport. Column 6 (MSDGC Column 11) is all Indiana domestic pumpage the sewage effluent derived from which reaches Lockport.

Columns 7 and 9, sewer induced groundwater pumpage from Indiana and Illinois, respectively, have no equivalent in the MSDGC reports. The concept of sewer induced groundwater pumpage refers to subsurface runoff, or groundwater, which ordinarily would not reach a stream but because of the presence of sanitary or combined sewers, is "pumped" due to increased hydraulic efficiency to treatment plants as sewer infiltration and then

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
OR THE PERIOD FROM: OCTOBER, 1982 TO: SEPTEMBER, 1983
LL DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

Table 2

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
OCT1982	2559.6	0.6	2560.1	50.2	55.2	26.4	0.0	43.2	1.8	175.0	23.3	2408.4	1539.8	95.9	695.6
NOV1982	3214.3	0.4	3214.8	50.2	54.8	26.2	0.3	255.2	42.3	386.5	23.3	2851.6	1478.3	985.6	157.1
DEC1982	6637.1	0.2	6637.3	50.2	54.7	27.1	1.7	542.4	239.0	674.3	22.2	5985.2	1449.9	2492.1	186.0
JAN1983	2198.1	0.2	2198.3	50.2	55.2	30.1	0.1	129.9	14.7	265.3	20.8	1953.7	1456.8	290.2	97.7
FEB1983	2815.3	0.2	2815.5	50.2	55.0	30.2	0.2	192.0	28.6	327.4	22.8	2511.9	1451.2	711.4	94.0
MAR1983	3156.8	0.3	3157.0	50.2	54.9	41.7	0.6	297.8	29.3	444.4	22.1	2734.7	1447.1	932.1	122.3
APR1983	5764.0	0.2	5764.2	50.2	54.5	45.1	1.3	651.5	79.8	801.3	25.9	4988.8	1447.8	2329.1	178.7
MAY1983	4277.5	0.4	4277.9	50.2	54.9	65.4	0.9	745.9	33.9	517.4	25.1	3785.6	1463.7	1220.9	310.5
JUN1983	3676.6	0.7	3677.3	50.2	55.1	83.6	0.1	130.9	-6.8	319.8	27.8	3385.2	1781.4	448.1	924.2
JUL1983	5459.0	0.9	5459.9	50.2	55.0	83.2	2.4	198.8	60.6	387.3	30.2	5102.8	2035.0	1000.3	1457.3
AUG1983	3963.3	1.0	3964.3	50.2	55.2	86.2	0.1	50.7	4.2	242.3	31.1	3753.1	2097.4	246.8	1478.5
SEP1983	4082.1	0.5	4082.6	50.2	55.0	61.2	0.3	113.4	25.9	299.8	26.1	3808.8	1699.8	531.7	1145.6
MEAN	3991.0	0.5	3991.5	50.2	55.0	50.7	0.7	247.6	46.4	403.5	25.1	3613.1	1613.7	940.8	574.2

(* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
(** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

STATUS OF ILLINOIS' LAKE MICHIGAN DIVERSION

UNDER 1980 AMENDED U.S. SUPREME COURT DECREE

Accounting Year	Annual Diversion (% of 3,200 cfs)	40 Year Running Avg.	CFS - Years Annual	CFS - Years Cumulative Sum
1981	3106 cfs (97)	3106	+ 94	+ 94
1982	3087 cfs (96.5)	3096	+113	+207
1983	3613 cfs (113)	3269	-413	-206

Table 3: MSDGC Hydraulic Report Format

Column Number	Entry
1	Turbines 1 & 2
2	Exciters
	Sluice Gates
3	Powerhouse
4	Controlling Works
5	Leakages
6	Lockages
7	Industrial and other Withdrawals
8	Total Flow at Lockport
	Domestic Pumpage
9	Groundwater Sources in the Lake Michigan Watershed
10	Groundwater Sources Outside the Lake Michigan Watershed
11	Indiana and Wisconsin
12	Storm Runoff and Infiltration from Illinois River Watershed
13	Diversions into Lake Michigan
14	Total Deductions
15	Total Diversion Entering Canal
16	Lake Michigan Pumpage Entering Canal
17	Direct Diversion and Storm Runoff from the Lake Michigan Watershed
18	Domestic Pumpage from Lake Michigan by Illinois Bypassing Canal
19	Total Diversion from Lake Michigan by Illinois

recorded at Lockport. Although this is essentially groundwater pumpage and does not represent a component of Lake Michigan diversion, the U.S. Dept. of Justice has issued an opinion that the current wording of the decree does not allow this to be included as a deduction to the Lockport record. Illinois disagrees with this interpretation, but has not included this component of groundwater as a deduction. Hence, this component of flow is included as part of Illinois' Lake Michigan diversion.

Column 8, (MSDGC Column 12) is runoff from the Des Plaines River watershed which reaches Lockport. Column 10 is the summation of Columns 4 through 9 and it is the same as MSDGC Column 14. It represents the total deductions from the record at Lockport. Column 11 (MSDGC Column 18) is Lake Michigan pumpage diverted past Lockport, and therefore not measured, which must be added to the record at Lockport. Included in the value of this column are Lake Michigan water supply pumpage to communities in the Des Plaines watershed, Lake Michigan pumpage diverted to the Des Plaines by the North Shore Sanitary District (NSSD) and the portions of the combined sewer overflows to the Des Plaines which are derived from Lake Michigan water supply pumpage. Adjustments are made in this column for pumpage by federal facilities which reaches Lockport. Column 12 is the same as Column 19 of the MSDGC report and it is the sum of Column 3 and Column 11 minus Column 10.

Columns 13 through 15 present additional information not actually used in the computation of Illinois diversion. Column 13 is total water supply pumpage from Lake Michigan by users in Illinois. Pumpage by federal facilities (Ft. Sheridan, Great Lakes Naval Training Center, Glenview Naval Air Station and Hines Veterans Hospital) is not included. This column is similar to MSDGC Column 16 except for the addition of Glenview Naval Air Station. Column 14 is stormwater runoff reaching Lockport from the diverted watershed. The MSDGC did not compute a separate stormwater number but rather computed a value by subtracting Lake Michigan domestic pumpage (MSDGC Column 16) from total diversions entering the canal (MSDGC Column 15) calling it stormwater and direct diversion (MSDGC Column 17). These values, given the MSDGC procedures, were sometimes negative. This seemingly anamolous result can be explained by residual error (resulting from computational procedures) and consumptive water supply losses (evaporation, transpiration, and industrial consumption above Lockport). The new Column 14 is the summation of direct runoff and treatment plant infiltration and inflow reaching Lockport from the diverted watershed. Thus it is an independent estimate of runoff. Direct diversions through lake controlling structures by Illinois are now covered separately by Column 15 of the new accounting format. Lockage, leakage, navigational makeup (including ice control), and discretionary diversion at Wilmette, O'Brien and the Chicago River Controlling Works as reported by MSDGC are included in this column.

The new accounting report simplifies the procedure specified in the U.S. Supreme Court decree and highlights Lake Michigan water supply pumpage diverted to the Des Plaines River. This will be an area of increased interest as more communities outside of the diverted watershed begin to use Lake Michigan water but do not return it past Lockport.

The decree states that total Lake Michigan pumpage by Illinois, the sewage effluent derived from which reaches Lockport, must first be subtracted from the record at Lockport. Later, the decree states that total Lake Michigan water supply pumpage, the sewage effluent derived from which reaches the Illinois waterway either above or below Lockport, must be added to the record at Lockport. This is the same quantity shown in Column 13 of the new accounting report. The difference between these two water supply pumpage numbers is Lake Michigan pumpage by Illinois, the sewage effluent from which is diverted to the Des Plaines River and reaches the Illinois waterway below Lockport. This quantity is the same as Column 11, Lake Michigan Domestic Pumpage Not Discharged to the canal, (allowing for adjustments for federal water supply pumpage from the lake).

II. Problems Encountered

Since this was the first year the new accounting report procedure was used it was anticipated that problems could be encountered in balancing flows. This was indeed the case as can be seen from the following discussions.

A. Record at Lockport

Perhaps the most significant question raised during the preparation of the 1983 accounting report was the accuracy of the record at Lockport. Upon completion of the initial estimate of total flow past Lockport (Budget 13) it was noted that the measured record was about 580 cfs higher than the sum of contributing flow components on an annual basis. This was of great concern since over 85 percent of the estimated record was measured data (i.e., direct diversion, treatment plant flows, etc.) An investigation into possible explanations for the difference focused on when the differences occurred. It was noted that the sum of contributing flow components was significantly lower than the measured record at Lockport during storm runoff periods and matched or was slightly higher (50-100 cfs) than the measured record during extended dry periods. Analysis of runoff in inches at Lockport and two other stream gages for the four largest storm events during the 1983 water year yielded the following data.

	Dec. 2-10, 1982		Dec. 23-29, 1982		April 1-6, 1983		July 1-6, 1983	
	Runoff	Precip.	Runoff	Precip.	Runoff	Precip.	Runoff	Precip.
CSSC subwatershed at Lockport (431 mi^2)	6.0	3.8	2.3	2.4	3.1	2.3	2.9	2.2
Little Calumet at South Holland (208 mi^2)	2.3	4.3	0.7	2.0	1.0	1.6	1.3	4.0
North Branch at Niles (100 mi^2)	2.4	4.1	0.8	1.2	1.4	3.0	0.3	1.9

Since snowmelt was not a factor in any of these events, more runoff than precipitation in the Sanitary and Ship Canal basin was an obvious impossibility.

The U.S. Army Corps of Engineers (COE) had recently completed an analysis of the sluice gate ratings at the Lockport Powerhouse and of the free flow and submerged weir ratings at the Controlling Works sluice gates about 2 miles upstream (COE, 1983; COE, 1983; COE, 1984). The conclusion of these studies was that significantly less flow could be expected through these structures using revised ratings developed by the COE. Of special interest was the submerged discharge rating for the Controlling Works and data obtained by the MSDGC during the 1983 water year which indicated tailwater head on the gate sills up to 92 percent of upstream head on the gate sills.

Using the COE ratings, discharge through the Lockport Powerhouse sluice gates was recomputed. This resulted in a 3.0 percent decrease in sluice gate discharge or 23.0 cfs. Next, free flow discharge through the Controlling Works was recomputed using COE ratings. Further, discharges through the Controlling Works were recomputed to account for submergence on days when actual MSDGC tailwater observations were available. Also, for hours when at least 5 gates were open (with gate 7 one of the five) but no tailwater data was available, an average submergence of 0.89, based on MSDGC observations for other days, was applied and the flows recomputed (NIPC, 1985). This analysis indicated that submergence could explain at least 148 cfs of the difference between the measured record at Lockport and the sum of contributing flow components. With these corrections to the Lockport record, the flow balance was improved. However, the

Lockport record remains 400 cfs greater than the sum of measured and estimated component flows as shown in Table 4.

Table 4: Summary of Flow Components above Lockport (Budget 13) Water Year 1983 (cfs)

Lake Controlling Structures (Measured)	
Wilmette	63.6
CRCW	257.0
O'Brien	253.6
Backflows	-2.2
Stream Flows (Measured)	
North Branch at Touhy	156.1
Little Calumet at South Holland	274.0
MSDGC Treatment Plants (Measured)	
Northside	448.8
West-Southwest	1312.4
Calumet	336.7
Adjustment for Interlake-Riverdale	-4.4
Lemont	2.0
Other Point Sources (Measured)	6.1
Summit Conduit (Measured)	15.8
Argonne Withdrawal (Measured)	-0.5
Grand Calumet Stream Flow (Estimated)	50.3
Combined Sewer Overflows in Ungaged Watershed (Simulated)	255.2
Direct Runoff in Ungaged Watershed (Simulated)	166.1
Total	3590.6
Lockport Recorded Flow (Revised)	3991.0
Difference	400.4

B. Water Budgets at MSDGC Treatment Plants

The water budgets at the MSDGC Northside (Budget 5), West-Southwest (Budget 7) and Calumet (Budget 8) treatment plants did not balance. Estimated inputs are from 10 to 13 percent below measured inputs. This results in an overall difference of about 240 cfs. The budgets for the MSDGC treatment plants are constructed by estimating an hourly sanitary return flow pattern and quantity and then simulating infiltration, inflow and combined sewer overflows. Sanitary return flow to the MSDGC treatment plants was assumed to be 90 percent of service area water supply pumpage. Except for some revisions in the representation of separately sewered areas, model parameters used to govern infiltration, inflow, and combined sewer overflow quantities were those established during calibration in 1977 and modified by recalibration in 1979 (NIPC, 1977; NIPC, 1980). Since about 80 percent of simulated influent to these MSDGC treatment plants is sanitary flow, the estimation of influent is highly sensitive to return flow assumptions and relatively insensitive to infiltration and inflow parameters. With a 100 percent sanitary return flow assumption, simulated influent totals nearly match recorded flows, but are still slightly lower.

Possible reasons why these budgets did not balance, assuming plant influent records are accurate, include model assumptions, recycle of river water through combined sewer overflow structures, and unreported discharges to the treatment plants. An analysis of treatment plant influent components indicated that

infiltration and inflow would have to be increased 50 percent to balance the plant budgets since these sources account for only about 20 percent of the simulated plant influent. This appears to be an unreasonably large amount especially since this would place runoff yields at about 80 percent of rainfall. Also, based on observations from plots of simulated and measured treatment plant influent flows, it appears that the discrepancy in flow is in the dry weather flow component and could not be made up by an increase in simulated storm runoff. The correctness of model parameters, and the resultant infiltration and inflow components, will be re-evaluated as additional years of data become available.

Leakage through improperly seated gates on combined sewer overflows is another possible explanation for the difference between estimated and recorded treatment plant flows. The MSDGC feels that leakage to the plants through combined sewer overflow structures is minimal. But actual data on this phenomenon are not available. If leakage does occur, NIPC's estimate of influent does not account for it and so would be expected to be lower than the measured record.

Another possible explanation for the budget differences is unreported discharges to MSDGC plants. This explanation is unlikely because of the large difference of 240 cfs. However, if there are industries or commercial buildings using groundwater or river water whose water supply pumpage has not been counted and

who return the sewage effluent from these flows to MSDGC plants, NIPC's estimate of influent would not include them.

This is an important issue since accurate flow balances at treatment plants can assist in the verification of estimated infiltration and inflow components, which are used in the computation of deductions.

C. Upper Des Plaines Pumping Station

Problems were encountered in balancing Budget 5, the MSDGC Upper Des Plaines Pumping Station. From the measured record it appears that influent to the station does not respond to hydrologic conditions in the station's watershed. Several occasions were noted when heavy rainfall in the watershed produced no corresponding rise in pumping station inflow. Several occasions were also noted when pumping station inflows increased dramatically with no significant rainfall in the watershed. The pumping station flow also did not correspond with the West-Southwest flow record in terms of hydrograph peaks and dry periods.

Attempts to estimate pumping station inflow using NIPC's computer model resulted in a reasonable overall water balance. However, there was a prevailing inability to match the timing and volume of flow peaks and dry periods. In contrast, the simulation of the West-Southwest treatment plant watershed, of which the pumping station is a part, matched the shape of the measured plant influent hydrograph reasonably well.

Based on the inconsistencies between the Upper Des Plaines pumping station record and the record at West-Southwest, the fact that flow can bypass the pumps and not be recorded, the fact that flows can be recycled through the station, the fact that the orifice plates by which discharge is measured have not been inspected in 20 years, and the fact that the station is unmanned, it was concluded that the record at the station could not be used to balance simulated flows in the watershed.

D. Precipitation Gages

Thirteen hourly precipitation records are used to estimate flow components to MSDGC treatment plants and streamflow for ungaged watersheds. The average precipitation at these gages in the 1983 water year was 42.4 inches with a standard deviation of 6.5. The variability among the measured precipitation totals was substantial and the differences seemed to correlate with the reporter of the data. It was noted, for example, that the average for the four gages reported to the National Oceanic and Atmospheric Administration (NOAA) was 49.7 inches whereas the average for the five gages operated by the MSDGC was 37.5 inches. The average of the remaining four gages was quite close to the overall average.

Such a difference between gages is, in itself, not unusual since precipitation is highly variable spatially. However, the fact that four gages located some distance from one another are relatively similar to each other in total precipitation yet

substantially different from other gages in the same geographical area operated by other agencies, is cause for concern.

If precipitation is being undermeasured it would of course affect estimates of infiltration and inflow to MSDGC treatment plants and estimates of total runoff and flow passing Lockport. This would help to balance the estimates at the treatment plants (Budgets 5,7,8) and the total flow estimate past Lockport (Budget 13).

After discussion with MSDGC staff concerning these differences, no explanation was apparent. Differences have been noted between records at the 95th Street pumping station which reports to the Calumet plant and the Calumet plant's raingage to Chicago at the MSDGC Waterways Control Center. No explanation for these differences is available.

The impact of these differences in terms of the total increase in discharge passing Lockport is estimated to be 32 cfs if all the MSDGC gages were assumed to have undermeasured rainfall by 12 inches (NOAA 49.7 - MSDGC 37.5). However, the impact on diversion for which Illinois is responsible is minor since only the MSDGC west-southwest raingage was assigned to simulate any runoff from the Des Plaines watershed and its areal representation was relatively minor. Changes in MSDGC rainfall amounts therefore would increase deductions for stormwater runoff from the Des Plaines, but not to a substantial degree.

E. O'Hare Treatment Plant Watershed Transfers

Although the O'Hare Water Reclamation Plant is now fully on line, a significant quantity of flow is still being routed from its design watershed to the Northside plant. The MSDGC has estimated this quantity at 24.8 cfs but has not specified its origin within the O'Hare watershed (MSDGC, 1985). It is assumed that sewage effluent derived from groundwater supply in Des Plaines, Mt. Prospect, Prospect Heights, and Arlington Heights, along with infiltration and inflow, comprise this flow. However, the lack of any metering of this flow along with uncertainties about its origin or flow pattern suggest that further analysis of this source may be necessary.

F. Summit Conduit

The measured record at Summit Conduit contains many gaps due to gage malfunction. The location of this gage also has been criticized by previous investigators (Harza, 1981). As part of Budget 13 a balance was made between the measured record and the sum of measured point source inputs and runoff estimated using NIPC's computer model. In addition to problems with the measured record, the flow balance was made more difficult to achieve due to the hydrologic/hydraulic complexity of the 5.4 square mile watershed. Contributing to this complexity are quarry dewatering operations and the possible existence of combined sewer overflows. A flow record exists for the quarry dewatering operation (Material Service) and in water year 1983 it was

observed that this flow source contributed greater than 50 percent of the total Summit Conduit flow.

The quarry dewatering operation is somewhat confusing with respect to its implications on diversion accounting. A small portion of this pumpage, 0.15 cfs, was subtracted from the Summit Conduit flow in previous accounting years because this amount had been counted as a deduction (in Column 5) as non-public groundwater pumpage reported to the ISWS. The current report follows the same procedure. Though this flow is quite small, it should be verified that 0.15 cfs is still the amount reported to the ISWS by Material Service as groundwater pumpage.

III. Sewer Induced Groundwater Pumpage

Sewer induced groundwater pumpage refers to subsurface runoff (sometimes called groundwater flow or baseflow) which is induced to occur because of the presence of a very efficient underground collection system of sewers, and which would not have occurred in an unsewered, undeveloped watershed. In effect, the sewer system "pumps" this induced groundwater to wastewater treatment plants and to the river system. This is the first year in which this component has been computed and reported.

Sewer induced groundwater pumpage is determined by hydrologic simulation. Subsurface runoff from pervious areas in the combined sewer watershed was compared to subsurface runoff from a

pre-development pervious segment. A pre-development pervious segment could be characterized as relatively flat, poorly drained, woody and marshy. The expected hydrologic response of this pre-development "lowland/forest" segment was developed originally during a hydrologic study of the effects of urbanization (NIPC, 1976).

The estimating procedure for sewer induced groundwater pumpage is discussed in detail in the accounting manual of procedures. Very simply, the amount of induced infiltration is based on the difference in subsurface runoff between developed grassland and undeveloped lowland/forest segments.

The computation of sewer induced groundwater pumpage is performed for Columns 7 and 9. In water year 1983, 308 square miles of combined sewer area in the diverted watershed yielded 41.11 cfs of induced infiltration. Separately sewered areas in the diverted watershed in Illinois totalling 106 square miles, yielded an additional 5.26 cfs. Finally, sewered areas in the Indiana diverted watershed yielded 0.66 cfs. The total estimate for sewer induced groundwater pumpage is 47.03 cfs.

IV. Diversion Accounting Report Results For Water Year 1983

The accounting report for the 1983 water year by month was shown in Table 2. Monthly reports by day are shown in Appendix A. The monthly numbers in Table 2 reflect the dominant hydrologic

features of the 1983 water year, large runoff volume and high lake levels. Discussions of significant column results follow.

A. Column 1: The Record at Lockport

The 3991.0 cfs recorded at Lockport is the highest amount since 1957 and the second highest in the last 43 years. However, the 1957 discharge amount included a one year increased diversion authorization not to exceed 8500 cfs in addition to domestic pumpage, thus the 1983 water year is easily the highest discharge under modern diversion restrictions.

One indication of the frequency of large runoff events was the fact that the MSDGC opened the Controlling Works on 34 different days during the water year. There were backflow events at Wilmette on December 2 and 3, 1982 (143 million gallons) and August 17, 1983 (10.5 million gallons), and at the Chicago River Controlling Works (248 million gallons) and the O'Brien Locks (124 million gallons) on December 3, 1982. The December total Lockport discharge of 6637.1 cfs is the highest discharge for that month since 1938. In fact, excluding January and February of 1957, and an unusual March of 1979, December of 1982 is the highest monthly discharge recorded at Lockport since 1938. The discharges for other months in the 1983 water year also rank very high as shown below.

Again, community groundwater pumpage records for the 1983 water year were combined with ISWS groundwater usage data for industrial and other private users to compute the values in this column. The average value of this column, also representing a deduction, is 55.0 cfs for the year.

F. Column 6: Water Supply Pumpage from Indiana Reaching the Canal

This column is the computation of Indiana water supply reaching Illinois via the Grand Calumet and Little Calumet Rivers, which is deductible from the Lockport record. The influence of high Lake Michigan levels (annual average = 579.5 I.G.L.D. with over 80 percent of the levels above +1.0 C.C.D.) in the new computation procedure resulted in a relatively large estimate of 47 cfs for the Grand Calumet deduction. The total deduction computed for this column is 50.7 cfs.

G. Columns 7 and 9: Sewer Induced Groundwater Pumpage

As previously discussed, sewer induced groundwater pumpage is not included as a deduction even though it is a component of groundwater. Columns 7 and 9 report the quantities of sewer induced groundwater pumpage for Indiana and Illinois, respectively. They contribute a total flow to Lockport of about 47 cfs for this year.

Of interest is the -6.8 cfs value for June, 1983. As explained in Section III, the procedure for computing induced infiltration compares subsurface runoff from a typical post-development grassland area which is underlain with sewers to subsurface runoff from a typical pre-development, unsewered lowland/forest area. In the long run the post-development area yields significantly more subsurface runoff than the pre-development area as a result of increased drainage efficiency due to sewer installation; hence, "sewer induced groundwater pumpage". The presence of sewers in the post-development area causes not only more subsurface runoff but it also causes that runoff to reach a stream, or treatment plant, more quickly than under pre-development conditions. As a result during some periods of the year the pre-development area may have higher subsurface runoff yields than the post-development segment due to its slower release of subsurface runoff. To avoid biasing the computation of sewer induced groundwater pumpage, these "negative" flows are included in the computation of the final number. The negative value for June of 1983 is an example of this situation.

H. Column 8: Runoff from the Des Plaines Watershed Reaching the Canal

The runoff from the Des Plaines watershed can be separated into five categories: (1) infiltration and inflow from the upper Des Plaines watershed to separate and combined sewers tributary to the three major MSDGC treatment plants which discharge to the canal system; (2) total runoff, including infiltration and

inflow, from the lower Des Plaines watershed to the canal; (3) infiltration, inflow, and combined sewer overflow from the Lemont service area; (4) runoff from the Summit Conduit watershed; and (5) runoff pumped from 13A pumping station to the West-Southwest treatment plant. Total infiltration and inflow from the upper Des Plaines watershed was 109 cfs for the 1983 water year. Total runoff from the lower Des Plaines watershed was 123 cfs. Runoff from the Lemont service area was estimated at 1.4 cfs. Deductible runoff from Summit Conduit was estimated at 13.7 cfs. Finally, runoff from the 13A pumping station was determined to be 0.2 cfs, a nearly insignificant amount. Total 1983 water year runoff from the Des Plaines watershed was 247.6 cfs. Of this amount, about 233 cfs is determined by simulation.

I. Column 10: Total Deductions

Column 10 is the sum of columns 4, 5, 6, and 8. The total deduction from the Lockport record in water year 1983 is 403.5 cfs. The portion of this amount estimated by hydrologic simulation is about 233 cfs. An additional 47 cfs for the Grand Calumet pumpage deduction is estimated using methods described in the manual of procedures (NIPC, 1985).

J. Column 11: Domestic Pumpage from Lake Michigan Not Discharged to the Canal, With Adjustments

This column represents a slight modification to the accounting procedure outlined in the U.S. Supreme Court decree to adjust for pumpage by federal facilities, as discussed in Section I. The

total addition to the record at Lockport from Column 11 is 25.1 cfs. This is composed primarily of pumpage by primary diverters at Waukegan, North Chicago (minus Knollwood-Rondout), and Lake County Public Water District, and secondary diversions by Riverwoods and Lincolnshire. Also, the sanitary portion of Des Plaines River combined sewer overflows which is derived from Lake Michigan pumpage is added into the value of this column. As indicated, pumpage by federal facilities the sanitary effluent from which reaches Lockport, is subtracted from the above.

K. Column 12: Total Diversion

Column 12 is determined by subtracting Column 10 from Column 3 and adding Column 11. The total diversion for water year 1983 is 3613.1 cfs. This amount is substantially greater than Illinois' long term diversion allowance of 3200 cfs. However, it is less than the 3840 cfs allowed by the Supreme Court decree under extreme hydrologic conditions and less than the 3680 cfs maximum permitted annual diversion (U.S. Supreme Court, 1980).

L. Columns 13-15: Lake Michigan Water Supply Pumpage, Stormwater Runoff, and Direct Diversion at Lake Controlling Structures

Columns 13 through 15 are not used in the computation of diversion. However, these columns represent the actual categories of diversion for which Illinois is accountable: Lake Michigan water supply pumpage by non-federal entities in Illinois, runoff from the diverted watershed, and direct

diversion through lake controlling structures. The sum of Columns 13 through 15 is 3128.7 cfs. The difference between this amount and the total diversion determined in Column 12 is 430 cfs. Coincidentally, this amount is similar to the estimated 393 cfs difference in the Lockport flow balance.

Theoretically, the sum of Columns 13 through 15 should be close to the value of diversion. This assumes that measurements of major flow components, such as Lockport and the lake controlling structures, are accurate. One reason for expecting some difference in the two amounts is consumptive loss from water supply. The computation of diversion from the Lockport record does not charge Illinois for consumptive loss of pumpage whose sanitary effluent reaches Lockport; i.e., water which is withdrawn from the Lake and then consumed or lost before reaching the canal. However, this would suggest that Column 12 should be less, not greater, than the sum of Columns 13 through 15.

Pursuing the difference between Column 12 and the sum of Columns 13-15 further, one might conclude that error lies in one or more components. The Lockport measurement has already been discussed. If it is truly biased high, then Illinois is being charged for more diversion than it should. An error of 10-12 percent in the Lockport record could explain the observed difference. Error could lie in the estimate of runoff. However, to explain the observed difference, simulated runoff would have to increase nearly 50 percent. Based on the extensive

calibration to which the model has been subjected and the yields such an increase would represent, this seems particularly unlikely. The measurement of direct diversion at Lake controlling structures could also be in error. To account for the observed flow differences, however, this component would have to be increased nearly 80 percent, which also seems quite unlikely

The discrepancies observed in the comparisons between Column 12 and the sum of Columns 13-15 and in the flow balance at Lockport are reason for concern. If error lies in the Lockport record, then Illinois is being overcharged substantially for diversion. If error lies in the estimation of runoff components, the computation of diversion will be affected to a lesser extent. Runoff simulation accounts for a deduction of 233 cfs in water year 1983. A potential 50 percent increase in runoff could result in an additional 120 cfs deduction.

V. CONCLUSIONS

A. The total revised measured discharge of 3991.0 cfs is the largest recorded at Lockport since 1938. The December, 1982, April, 1983 and July, 1983 discharges are among the top ten monthly discharges recorded at Lockport since 1938, excluding two months in 1957 when increased diversion at the lakefront was allowed. Total diversion by Illinois was 3613.1 cfs for water year 1983.

B. The estimated record at Lockport, determined by the diversion accounting procedures, is 400 cfs lower (10 percent) then the record measured by MSDGC and revised using COE ratings and estimated and recorded submergence values.

C. Based on COE ratings, the record at the Lockport Powerhouse Sluice Gates was reduced by 23.0 cfs for the 1983 water year from a reported 774 cfs to a new value of 751 cfs.

D. Based on COE ratings under both free flow and submergence conditions and tailwater observations obtained by the MSDGC for several large runoff events, the record at the Controlling Works, was reduced by 148 cfs for the 1983 water year from a reported 369 cfs to a new value of 221 cfs.

E. The estimated influent to the three major MSDGC sewage treatment plants (Northside, West-Southwest, and Calumet) using the diversion accounting procedure is 243 cfs (1 percent) less than the amount recorded by the MSDGC.

F. Although a reasonable overall flow balance was obtained at the Upper Des Plaines Pumping Station between the estimated total influent and the MSDGC recorded total influent, several problems in the timing of runoff flows prevents this budget from being used to check total infiltration and inflow estimates from the Des Plaines watershed.

G. Significant differences were noted among the average precipitation amounts recorded at the NOAA gages (49.7 inches), the MSDGC gages, (37.5 inches), and the City of Chicago gages (41.3 inches). It is unlikely that these differences can be explained by spatial variability. The MSDGC has noted differences in values recorded at their 95th Street pumping station and values recorded at the Calumet plant and telemetered to their downtown recording station. No explanation for these differences is apparent. Adjustment of MSDGC rainfall amounts to NOAA average amounts could result in an estimated 32 cfs of additional runoff from the ungaged diverted watershed. This would help only minimally to explain the current 400 cfs difference between estimated and recorded flow at Lockport. Increasing the rainfall at the MSDGC raingages would have only a minor impact on Illinois' diversion since the MSDGC gages were used for the simulation of runoff from only a small portion of the Des Plaines watershed.

H. Sanitary flow, infiltration, and inflow are still being sent from the design MSDGC O'Hare treatment plant service area to the MSDGC Northside treatment plant. These flows are not recorded, but were estimated by MSDGC to be about 25 cfs in the 1983 water year.

I. The Summit Conduit flow record is unreliable due to significant gage malfunctions. A balance was made between this record and estimated and measured flows in the Summit

Conduit watershed. Estimated runoff and measured quarry and industrial flows could be used to compute the Summit deduction in future accounting years, rather than relying on the Summit Conduit record.

J. The diversion accounting procedure estimated about 47 cfs of sewer induced groundwater pumpage for the 1983 water year. Since this is essentially groundwater pumpage which would not have reached Lockport except for the presence of sewers, this should be taken as a deduction by the State of Illinois. However, the U.S. Dept. of Justice has found that the wording of the current decree does not allow this. Hence, it has not been included as a deduction for the 1983 accounting year.

VII. RECOMMENDATIONS

A. Further investigations into the accuracy of recorded flows at the Controlling Works and Powerhouse at Lockport are needed. Particular attention is needed to quantify submergence at the Controlling Works and its cause.

B. The MSDGC should incorporate the revised COE ratings for free flow discharge into their calculation of discharge for the Controlling Works and Powerhouse. The MSDGC should also establish a continuous record of tailwater elevations at a suitable location downstream of the Controlling Works.

C. Further investigation is needed to determine the reasons for imbalances between estimated and recorded flow at the three major MSDGC treatment plants. Areas for investigation include the following:

1. Model assumptions with respect to sanitary return flow and infiltration and inflow quantities.
2. Possible leakage from the Canal through combined sewer overflow structures.
3. Possible unreported major discharges to the plant from groundwater or surface water supply return flows.

D. The monitoring of flow at the Upper Des Plaines Pumping Station should be discontinued for diversion accounting purposes due to uncertainties in its record which cannot be resolved without significant increased maintenance and flow monitoring changes.

E. Investigations into the possibility of long-term biases among precipitation gages reporting to NOAA, MSDGC and the City of Chicago should be undertaken based on significant differences noted during the 1983 water year. Preliminary investigation into these differences has not yielded any explanations.

F. Flow monitoring at the Summit Conduit should be discontinued due to problems with frequent gage malfunctions, the relatively small amount of flow from this area, and the ability to reasonably estimate flows from this area using pumpage data and runoff simulation.

G. The flow transfers from the MSDGC's design O'Hare service area to the Northside treatment plant should be metered to provide a better estimate of quantity and flow variations.

REFERENCES

Northeastern Illinois Planning Commission, "Lake Michigan Diversion Accounting Manual of Procedures," 1985.

U.S. Army Corps of Engineers, "Memorandum for the Record -- Lockport Control Works Rating Curve," February 3, 1983.

U.S. Army Corps of Engineers, "Memorandum for the Record -- Lockport Powerhouse Sluice Discharge Rating," April 25, 1983.

U.S. Army Corps of Engineers, "Memorandum for the Record -- Lockport Control Works Submerged Flow Rating Curves," March 21, 1984

Northeastern Illinois Planning Commission, Correspondence dated March 29, 1985 and May 23, 1985 from G.C. Schaefer to H. Krampitz, Hydrologic Engineer, COE.

Northeastern Illinois Planning Commission, "NIPC Chicago Waterways Model: Verification/Recalibration," 1980.

Northeastern Illinois Planning Commission and Hydrocomp, Inc., "Chicago Sanitary and Ship Canal Hydrologic Calibration," 1977.

Metropolitan Sanitary District of Greater Chicago, Correspondence to the Illinois Division of Water Resources, 1985

Harza Engineering Company, "An Evaluation of Flow Measurement and Accounting Methods for Lake Michigan Diversion," 1981.

Northeastern Illinois Planning Commission and Hydrocomp, Inc., "Water Yield, Urbanization and the North Branch of the Chicago River," 1976.

Wisconsin et al. v. Illinois et al. Michigan v. Illinois et al. New York v. Illinois et al. U.S. 2, 3, and 4, Original 1-18, 1980.

APPENDIX

Monthly Accounting Reports

- MONTH OF: OCTOBER, 1983

TA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
982	2612.1	1.0	2613.1	50.2	55.3	26.4	0.0	29.6	2.5	161.4	25.3	2477.1	1672.9	28.4	824.0
982	2709.7	0.5	2701.2	50.2	55.3	26.4	0.0	29.3	2.4	161.1	22.0	2562.1	1611.4	26.4	824.0
982	2626.0	0.9	2626.9	50.2	55.3	26.4	0.0	29.0	2.4	160.9	21.1	2487.2	1569.8	32.0	821.0
982	2717.9	0.6	2718.5	50.2	55.3	26.4	0.0	28.7	2.4	160.5	25.1	2583.1	1666.4	31.2	1033.0
982	2542.2	0.8	2543.0	50.2	55.3	26.4	0.0	28.5	2.3	160.3	24.6	2407.3	1702.2	34.5	935.0
982	3660.0	0.8	3660.8	50.2	55.2	26.4	0.0	90.6	1.9	222.4	27.9	3466.3	1689.0	111.1	625.0
982	2613.0	0.7	2613.7	50.2	55.2	26.4	0.0	52.3	1.2	184.1	23.0	2452.6	1579.2	108.9	737.0
982	2589.7	0.7	2589.7	50.2	55.3	26.4	0.0	30.4	1.7	162.3	25.9	2452.4	1596.9	37.9	729.0
982	4413.0	0.5	4413.5	50.2	54.9	26.4	0.0	98.4	0.4	229.9	22.3	4205.9	1485.2	437.6	1020.0
982	2458.5	0.6	2459.1	50.2	55.3	26.2	0.0	30.8	1.1	162.4	18.0	2314.7	1440.0	149.9	1179.0
982	2358.3	0.6	2358.9	50.2	55.3	26.4	0.0	30.8	1.7	162.6	22.7	2219.0	1537.4	85.1	615.0
982	2739.0	0.5	2739.5	50.2	55.3	26.4	0.0	29.3	2.0	161.1	27.5	2605.8	1550.7	53.6	672.0
982	2721.1	0.6	2721.7	50.2	55.3	26.4	0.0	30.0	2.1	161.8	25.6	2585.5	1540.4	46.5	774.0
982	2731.6	0.5	2732.1	50.2	55.3	26.4	0.0	28.8	2.2	160.6	23.9	2595.4	1552.0	41.1	715.0
982	2762.0	0.6	2762.6	50.2	55.3	26.4	0.0	27.7	2.1	159.5	24.7	2627.8	1525.8	36.0	929.0
982	2236.2	0.3	2236.5	50.2	55.3	26.4	0.0	29.4	2.1	161.3	21.5	2096.7	1452.7	33.4	915.0
982	2642.9	0.4	2643.3	50.2	55.3	26.4	0.0	28.7	2.1	160.6	21.7	2504.4	1418.1	31.1	923.0
982	2592.7	0.7	2593.4	50.2	55.3	26.4	0.0	28.4	2.0	160.2	21.0	2454.2	1544.6	25.3	834.0
982	2653.0	0.6	2653.6	50.2	54.8	26.4	0.0	152.7	1.6	284.1	27.9	2397.5	1533.9	321.4	738.0
982	3545.0	0.4	3545.4	50.2	55.2	26.4	-0.0	182.9	-2.0	314.5	29.0	3259.9	1518.9	830.7	115.0
982	2741.0	0.5	2741.5	50.2	55.3	26.4	0.0	36.0	0.3	167.8	24.3	2598.0	1521.0	104.8	1049.0
982	2664.2	0.5	2664.5	50.2	55.3	26.4	0.0	30.0	1.4	161.8	21.5	2524.2	1509.9	63.4	1122.0
982	2590.0	0.3	2590.3	50.2	55.3	26.4	0.0	28.7	1.9	160.6	22.6	2452.3	1459.3	46.2	980.0
982	2706.6	0.4	2707.0	50.2	55.3	26.4	0.0	29.5	2.1	161.3	18.4	2564.1	1416.2	34.1	949.0
982	2190.6	0.5	2191.1	50.2	55.3	26.4	0.0	28.3	2.2	160.1	25.1	2056.0	1521.0	30.2	555.0
982	1149.4	0.4	1149.8	50.2	55.3	26.4	0.0	27.9	2.3	159.8	23.1	1013.1	1547.5	32.3	142.0
982	2443.1	0.5	2443.6	50.2	55.3	26.4	0.0	29.1	2.3	160.9	22.1	2304.7	1542.8	26.6	112.0
982	1749.6	0.5	1750.1	50.2	55.3	26.4	0.0	26.6	2.2	158.4	22.4	1614.1	1535.9	25.1	376.0
982	1761.0	0.4	1761.4	50.2	55.3	26.4	0.0	27.7	2.2	159.5	22.2	1624.1	1525.8	25.7	84.0
982	1604.0	0.5	1604.5	50.2	55.3	26.4	0.0	27.4	2.2	159.3	20.7	1466.0	1473.5	27.2	126.0
982	1834.0	0.5	1834.5	50.2	55.3	26.4	0.0	31.1	2.1	162.9	18.8	1690.3	1468.8	55.1	113.0
	2559.6	0.6	2560.1	50.2	55.2	26.4	0.0	43.2	1.8	175.0	23.3	2408.4	1539.0	95.9	695.6

FR INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
LUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
IS IS A JOB TO OUTPUT TABLES ****
****

AILY'

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
FOR THE MONTH OF: NOVEMBER, 1982
ALL DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NOV1982	8085.0	0.5	8085.5	50.2	52.2	26.2	0.0	1069.3	6.1	1197.9	40.5	6928.1	1508.1	5388.2	64.0
NOV1982	6849.0	0.6	6849.6	50.2	54.7	26.2	0.3	340.9	48.3	472.0	24.2	6401.8	1525.6	1502.2	257.0
NOV1982	2631.8	0.3	2632.1	50.2	55.3	26.2	0.2	131.5	27.6	263.1	22.7	2391.7	1508.0	537.0	77.0
NOV1982	2525.8	0.5	2526.3	50.2	55.3	26.2	0.1	83.8	16.2	215.4	20.2	2331.1	1518.9	242.8	73.0
NOV1982	1771.4	0.4	1771.8	50.2	55.3	26.2	0.1	58.3	10.6	189.9	19.6	1601.5	1512.6	147.5	78.0
NOV1982	1846.5	0.5	1847.0	50.2	55.3	26.2	0.1	46.1	7.8	177.8	19.2	1688.4	1465.1	111.0	83.0
NOV1982	1655.0	0.5	1655.5	50.2	55.3	26.2	0.0	40.0	6.3	171.7	19.3	1503.1	1422.9	92.6	93.0
NOV1982	1900.0	0.6	1900.6	50.2	55.3	26.2	0.0	37.3	5.4	168.9	21.1	1752.7	1515.4	76.4	81.0
NOV1982	3193.8	0.5	3194.3	50.2	53.6	26.2	0.2	356.5	24.0	486.4	32.8	2740.7	1505.0	1690.4	70.0
NOV1982	2531.5	0.6	2532.1	50.2	55.3	26.2	0.2	84.4	23.3	216.0	21.9	2338.0	1522.8	278.6	77.0
NOV1982	9972.0	0.6	9972.6	50.2	53.2	26.2	0.5	623.4	74.8	753.1	35.1	9254.6	1507.0	2700.5	1027.0
NOV1982	5339.0	0.7	5339.7	50.2	54.5	26.2	0.7	467.1	102.0	598.0	25.4	4767.2	1504.2	1679.4	1172.0
NOV1982	2639.0	0.4	2638.4	50.2	55.3	26.2	0.5	190.9	67.2	322.5	19.0	2334.8	1426.9	623.6	84.0
NOV1982	2419.3	0.4	2419.7	50.2	55.3	26.2	0.3	119.1	39.0	250.7	17.8	2186.8	1411.7	369.3	113.0
NOV1982	1968.9	0.5	1969.4	50.2	54.3	26.2	0.2	83.3	25.0	215.0	23.2	1777.7	1489.1	254.5	69.0
NOV1982	1941.2	0.5	1941.7	50.2	55.3	26.2	0.1	64.9	18.0	196.6	19.7	1764.8	1502.6	194.9	58.0
NOV1982	2201.8	0.5	2202.3	50.2	55.3	26.2	0.1	56.6	14.5	188.2	22.1	2036.1	1499.1	158.6	88.0
NOV1982	1691.9	0.5	1692.4	50.2	55.3	26.2	0.1	51.7	12.7	183.3	21.7	1530.8	1499.9	132.5	88.0
NOV1982	2878.1	0.5	2878.6	50.2	54.2	26.2	0.2	460.8	28.8	591.4	29.4	2316.5	1502.8	1482.6	74.0
NOV1982	4531.0	0.5	4531.5	50.2	54.0	26.2	0.7	556.1	98.6	686.5	27.6	3872.6	1446.2	1738.7	282.0
NOV1982	2303.8	0.4	2304.2	50.2	55.3	26.2	0.5	214.5	72.1	346.2	17.2	1975.3	1415.1	571.8	153.0
NOV1982	2485.0	0.6	2485.6	50.2	55.1	26.2	0.3	153.7	44.8	285.2	22.5	2222.8	1499.9	478.2	91.0
NOV1982	2558.1	0.4	2558.5	50.2	55.1	27.7	0.3	313.4	48.1	446.4	21.7	2133.8	1499.2	1129.5	67.0
NOV1982	2579.7	0.2	2579.9	50.2	55.3	26.2	0.3	140.2	42.1	271.9	23.8	2331.9	1516.5	514.4	49.0
NOV1982	2644.4	0.2	2644.6	50.2	55.2	26.2	0.2	113.3	30.9	244.9	19.8	2419.5	1433.8	377.3	48.0
NOV1982	2336.9	0.1	2337.0	50.2	55.2	26.2	0.2	104.7	26.2	236.3	16.1	2116.8	1409.3	324.1	66.0
NOV1982	1903.6	0.2	1903.8	50.2	55.2	26.2	0.2	99.9	23.9	231.5	17.6	1699.9	1417.0	286.9	80.0
NOV1982	4371.7	0.2	4371.9	50.2	52.6	26.2	0.8	982.1	114.1	1111.0	32.5	3293.4	1391.8	3884.4	57.0
NOV1982	3290.3	0.4	3290.7	50.2	54.6	26.2	0.9	391.7	129.6	522.7	23.4	2791.3	1489.1	1674.1	42.0
NOV1982	3385.6	0.2	3385.8	50.2	55.2	26.2	0.6	221.6	81.1	353.3	20.7	3053.2	1484.2	926.8	53.0
MEAN	3214.7	0.4	3214.8	50.2	54.8	26.2	0.3	255.2	42.3	386.5	23.3	2851.6	1478.3	985.6	157.1

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8)
*** COLUMN 12=COLUMNS 3-10+11)

****
THIS IS A JOB IO OUTPUT TABLES ****
****

IS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
F MONTH OF: DECEMBER, 1982
TA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

E	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1982	2567.9	0.3	2569.2	50.2	55.3	26.2	0.4	137.3	54.6	268.9	20.4	2319.8	1507.0	596.4	61.0
1982	10060.5	0.5	10060.5	50.2	51.9	26.2	3.0	1702.1	422.1	1830.3	40.8	8271.0	1486.2	10947.1	1237.0
1982	23320.0	0.4	23320.4	50.2	51.5	26.2	12.2	2282.8	1722.4	2410.7	41.4	20951.1	1477.9	10947.0	0.0
1982	22502.0	0.1	22502.1	50.2	52.6	26.2	6.4	1389.1	907.1	1518.1	34.1	21018.1	1445.5	7285.5	35.0
1982	21688.0	0.1	21688.1	50.2	52.8	37.3	4.6	1417.7	649.9	1558.0	30.0	20160.1	1407.9	6908.7	44.0
1982	13425.0	0.3	13425.3	50.2	54.8	26.2	2.8	820.6	393.4	951.7	19.9	12493.5	1485.2	4333.4	638.0
1982	9090.6	0.2	9090.8	50.2	55.3	26.2	1.6	512.1	230.4	643.7	20.0	8467.1	1495.5	2788.1	202.0
1982	6221.5	0.5	6222.0	50.2	55.2	29.9	1.0	345.8	142.8	481.1	18.6	5759.5	1485.2	1863.2	88.0
1982	6544.9	0.3	6545.2	50.2	55.3	26.2	0.7	243.3	97.8	374.9	20.9	6191.2	1480.1	1416.9	83.0
1982	3777.8	0.2	3778.0	50.2	55.3	26.2	0.5	194.7	74.2	326.3	19.8	3471.5	1470.0	1057.3	82.0
1982	2673.5	0.1	2673.6	50.2	55.3	26.2	0.4	168.7	61.0	300.3	18.4	2391.7	1416.9	950.3	69.0
1982	2653.1	0.2	2653.3	50.2	55.3	26.2	0.4	154.1	53.0	285.7	17.3	2384.9	1402.1	834.7	65.0
1982	2454.1	0.3	2454.4	50.2	55.3	26.2	0.3	145.6	47.6	277.2	20.2	2197.4	1482.6	660.3	50.0
1982	3550.0	0.2	3550.2	50.2	55.2	26.2	0.3	179.3	43.6	310.9	21.2	3260.6	1472.3	615.8	53.0
1982	2452.4	0.2	2452.6	50.2	55.3	26.2	0.3	176.3	40.0	307.9	20.4	2165.1	1476.3	553.8	65.0
1982	2448.1	0.2	2448.3	50.2	55.3	37.3	0.3	146.9	37.7	289.6	23.3	2202.1	1476.4	531.0	96.0
1982	2364.3	0.2	2364.5	50.2	55.3	26.2	0.3	136.2	35.5	267.8	19.0	2115.7	1488.1	442.4	70.0
1982	2002.2	0.1	2002.3	50.2	55.1	26.2	0.3	231.9	37.8	363.4	18.1	1657.0	1440.5	615.3	61.0
1982	2489.6	0.2	2489.8	50.2	55.2	26.2	0.3	212.6	37.2	344.1	17.9	2163.6	1395.7	509.2	60.0
1982	1824.2	0.3	1824.5	50.2	55.3	26.2	0.2	153.9	33.3	285.5	16.7	1555.6	1471.4	408.4	70.0
1982	2475.4	0.2	2475.6	50.2	55.3	26.2	0.2	135.3	30.6	267.0	19.6	2228.3	1470.8	354.2	75.0
1982	2383.5	0.2	2383.7	50.2	55.3	26.2	0.2	124.0	28.4	255.6	19.4	2147.6	1474.2	305.5	77.0
1982	2579.0	0.1	2579.0	50.2	53.0	26.2	0.3	245.4	40.2	376.7	20.3	2223.6	1429.0	763.1	89.0
1982	7677.0	0.2	7677.2	50.2	54.3	26.4	0.6	641.3	86.6	772.1	23.4	6928.5	1426.2	3625.9	1762.0
1982	18454.0	0.1	18454.1	50.2	52.5	26.2	6.6	2308.1	931.8	2437.0	32.7	16049.8	1351.5	8635.4	23.0
1982	8552.0	0.2	8552.2	50.2	54.6	26.2	3.7	774.1	521.6	905.1	19.7	7666.8	1340.1	3062.0	262.0
1982	9873.0	0.3	9873.3	50.2	54.7	28.6	2.0	572.3	278.7	705.8	20.5	8188.1	1433.4	1971.3	124.0
1982	1706.0	0.2	1706.2	50.2	54.6	26.2	1.1	506.2	160.6	637.2	21.5	1090.6	1450.1	1770.1	58.0
1982	2739.6	0.3	2739.9	50.2	55.3	26.2	0.7	325.8	97.1	457.4	17.4	2299.9	1455.4	1138.2	52.0
1982	3455.0	0.2	3455.2	50.2	55.3	26.2	0.5	238.3	64.4	369.9	17.6	3102.9	1437.1	780.4	44.0
1982	2726.9	0.2	2727.1	50.2	55.3	26.2	0.3	192.7	46.9	324.3	16.6	2419.4	1416.4	583.2	50.0
*	6637.1	0.2	6637.3	50.2	54.7	27.1	1.7	542.4	239.0	674.3	22.2	5985.2	1449.9	2492.8	186.0

WEP INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
OLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
HIS IS A JOB TO OUTPUT TABLES ****
****

DAILY*

INDIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
THE MONTH OF: JANUARY, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1JAN1983	2836.4	0.2	2836.6	50.2	55.3	26.2	0.3	169.9	37.1	301.5	15.1	2550.2	1359.3	483.6	51.0
2JAN1983	2702.4	0.2	2702.6	50.2	55.3	26.2	0.2	156.6	31.2	288.2	16.6	2431.1	1372.1	418.1	71.0
3JAN1983	2269.9	0.4	2270.3	50.2	55.3	26.2	0.2	148.5	27.2	280.1	22.6	2012.8	1471.1	366.8	76.0
4JAN1983	2251.5	0.3	2251.8	50.2	55.3	26.2	0.2	143.1	24.2	274.7	21.2	1998.3	1468.2	334.5	62.0
5JAN1983	2337.7	0.4	2338.1	50.2	55.3	26.2	0.2	138.6	21.9	270.2	21.2	2089.1	1467.9	317.2	71.0
6JAN1983	2147.4	0.3	2147.7	50.2	55.3	26.2	0.1	134.4	19.8	266.1	21.1	1902.7	1465.3	301.0	71.0
7JAN1983	2170.0	0.3	2170.3	50.2	55.3	25.9	0.1	130.7	17.9	262.0	22.1	1930.4	1461.8	289.2	97.0
8JAN1983	2028.3	0.2	2028.5	50.2	55.3	26.2	0.1	127.2	16.2	258.8	19.5	1789.1	1409.1	273.8	67.0
9JAN1983	2222.6	0.3	2222.9	50.2	55.3	26.2	0.1	128.2	14.7	259.8	18.6	1981.6	1412.2	264.1	93.0
0JAN1983	2153.0	0.3	2153.3	50.2	55.2	26.2	0.1	169.3	12.3	300.9	21.5	1873.9	1475.7	323.8	209.0
1JAN1983	2096.0	0.2	2096.2	50.2	55.1	36.9	0.1	183.2	10.1	325.3	23.2	1794.1	1485.1	400.9	95.0
2JAN1983	2315.2	0.2	2315.5	50.2	55.3	26.2	0.1	151.4	8.9	283.0	21.3	2053.8	1481.6	298.9	79.0
3JAN1983	2206.8	0.2	2207.0	50.2	55.3	24.2	0.1	130.1	9.1	261.7	22.5	1967.8	1480.3	259.3	96.0
4JAN1983	2233.2	0.2	2233.4	50.2	55.3	48.7	0.1	120.6	8.8	274.7	20.9	1979.5	1462.5	273.1	100.0
5JAN1983	1944.3	0.1	1944.4	50.2	55.3	61.8	0.1	111.7	8.5	278.9	19.4	1684.9	1441.1	232.9	117.0
6JAN1983	1942.3	0.1	1942.4	50.2	55.3	30.9	0.1	106.1	8.0	242.4	18.9	1718.9	1420.1	217.8	89.0
7JAN1983	1751.2	0.3	1751.5	50.2	55.3	48.5	0.1	101.7	7.5	255.6	22.0	1517.8	1488.3	207.1	108.0
8JAN1983	1473.0	0.2	1473.2	50.2	55.3	36.4	0.0	98.0	7.0	239.8	22.2	1255.6	1496.9	198.9	152.0
9JAN1983	1492.0	0.2	1492.2	50.2	55.3	26.2	0.0	94.8	6.5	226.5	22.7	1288.4	1490.8	181.4	66.0
0JAN1983	5121.1	0.2	5121.3	50.2	55.3	26.2	0.0	91.7	6.0	223.3	22.3	4920.3	1500.6	174.5	332.0
1JAN1983	1477.3	0.2	1477.5	50.2	55.3	30.8	0.0	96.0	5.5	232.2	22.1	1667.4	1479.3	176.9	118.0
2JAN1983	2145.9	0.1	2146.0	50.2	55.1	36.7	0.1	277.8	9.1	419.8	21.1	1747.3	1439.2	407.5	86.0
3JAN1983	2659.9	0.1	2660.0	50.2	55.2	26.0	0.2	174.2	21.8	305.6	17.2	2371.6	1393.6	373.6	79.0
4JAN1983	1827.7	0.3	1828.0	50.2	55.3	26.2	0.2	125.1	24.6	256.7	22.3	1593.6	1480.9	330.3	85.0
5JAN1983	2159.1	0.2	2159.3	50.2	55.3	26.2	0.1	95.4	18.9	227.1	21.6	1953.8	1479.9	231.7	88.0
6JAN1983	1949.9	0.3	1950.2	50.2	55.3	26.2	0.1	86.1	12.3	217.7	20.8	1753.3	1473.3	202.4	84.0
7JAN1983	1726.5	0.2	1726.7	50.2	55.3	26.2	0.1	80.5	8.6	212.2	21.1	1535.6	1486.1	184.1	90.0
8JAN1983	1961.8	0.2	1962.0	50.2	55.3	26.2	0.0	77.0	6.7	208.6	20.6	1774.0	1485.9	172.0	71.0
9JAN1983	1832.1	0.1	1832.2	50.2	54.9	26.2	0.1	190.7	11.9	322.0	23.9	1534.0	1443.6	576.7	70.0
0JAN1983	2385.3	0.2	2385.5	50.2	55.3	26.2	0.1	102.1	20.3	233.7	18.1	2169.9	1402.4	299.0	83.0
1JAN1983	1920.0	0.3	1920.3	50.2	55.3	26.2	0.1	84.7	14.1	216.3	20.4	1724.4	1488.0	225.3	75.0
MEAN	2198.1	0.2	2198.3	50.2	55.2	30.1	0.1	129.9	14.7	265.3	20.8	1953.7	1456.8	290.2	97.7

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
* THIS IS A JOB TO OUTPUT TABLES *
****

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
FOR THE MONTH OF: FEBRUARY, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLINOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FEB1983	1866.1	0.2	1866.3	50.2	55.3	26.2	0.1	90.0	10.2	221.7	20.4	1665.0	1478.5	215.7	113.0
FEB1983	9607.0	0.2	9607.2	50.2	53.7	53.7	0.1	489.6	17.9	647.2	30.5	8990.5	1481.7	2173.4	82.0
FEB1983	6496.5	0.3	6496.8	50.2	55.3	61.7	0.2	90.6	21.8	257.7	19.6	6258.6	1471.6	1830.7	87.0
FEB1983	4840.7	0.3	4841.0	50.2	55.3	34.8	0.1	72.9	14.7	213.2	22.5	4650.3	1472.0	830.7	78.0
FEB1983	3176.0	0.1	3176.1	50.2	55.3	26.2	0.1	65.9	9.8	197.6	18.5	2997.0	1421.1	563.8	85.0
FEB1983	2717.0	0.1	2717.1	50.2	55.3	26.2	0.1	61.5	7.3	193.2	19.2	2543.2	1396.6	453.9	72.0
FEB1983	2898.0	0.3	2898.3	50.2	55.3	27.0	0.1	59.4	8.2	191.9	20.0	2726.4	1453.6	493.0	102.0
FEB1983	2581.6	0.1	2581.7	50.2	55.3	26.2	0.1	75.6	10.9	207.3	20.9	2395.3	1476.5	340.3	96.0
FEB1983	2229.1	0.3	2229.4	50.2	55.3	31.8	0.1	100.7	16.0	238.0	21.2	2012.6	1474.1	359.0	112.0
FEB1983	2322.2	0.2	2322.4	50.2	55.3	31.7	0.2	163.3	24.4	300.5	21.1	2043.0	1465.2	508.9	105.0
FEB1983	2209.5	0.1	2209.6	50.2	55.2	31.6	0.3	253.5	36.4	390.4	22.2	1841.3	1472.4	740.7	120.0
FEB1983	2021.2	0.2	2021.4	50.2	54.9	26.2	0.3	293.1	41.8	424.3	21.7	1618.8	1425.2	682.7	100.0
FEB1983	1934.5	0.2	1934.7	50.2	53.8	26.2	0.4	586.7	49.5	717.0	29.7	1247.4	1390.9	1401.3	68.0
FEB1983	2146.0	0.3	2146.3	50.2	53.1	26.2	0.5	861.5	71.0	991.1	37.4	1192.6	1474.0	1952.3	78.0
FEB1983	2276.1	0.3	2276.4	50.2	54.6	26.2	0.6	332.9	83.0	463.9	26.7	1839.2	1454.1	1008.9	98.0
FEB1983	2148.3	0.2	2148.5	50.2	54.4	26.2	0.7	361.8	96.0	492.6	26.3	1682.2	1467.0	1089.0	77.0
FEB1983	2455.2	0.2	2455.4	50.2	55.1	26.2	0.6	220.5	84.1	352.1	22.6	2126.0	1469.0	663.6	72.0
FEB1983	2584.9	0.3	2585.2	50.2	54.9	26.2	0.4	201.0	62.0	332.4	25.4	2278.3	1472.0	691.6	62.0
FEB1983	2376.7	0.1	2376.8	50.2	55.1	26.2	0.3	179.3	46.9	310.9	20.0	2065.9	1426.6	662.1	269.0
FEB1983	2127.8	0.2	2128.0	50.2	55.3	26.2	0.2	107.8	27.6	239.4	18.7	1907.3	1385.9	522.5	79.0
FEB1983	2452.5	0.3	2452.8	50.2	55.3	26.2	0.1	89.1	18.6	220.8	22.0	2254.1	1473.3	461.9	77.0
FEB1983	2585.2	0.3	2585.5	50.2	55.3	27.0	0.1	82.9	11.3	215.3	23.8	2393.9	1469.1	415.0	89.0
FEB1983	2266.5	0.3	2266.8	50.2	55.3	26.2	0.1	83.2	7.4	214.8	20.6	2072.6	1458.8	370.3	89.0
FEB1983	2223.8	0.4	2224.2	50.2	55.3	37.4	0.0	84.9	6.7	227.8	22.0	2018.4	1461.6	335.9	96.0
FEB1983	2347.9	0.3	2348.2	50.2	55.3	37.2	0.0	93.4	5.5	236.0	22.4	2134.5	1456.6	345.9	90.0
FEB1983	2073.2	0.1	2073.3	50.2	55.3	26.2	0.0	90.5	5.6	222.1	20.3	1871.5	1432.4	287.6	89.0
FEB1983	2031.5	0.2	2031.7	50.2	55.3	26.2	0.0	91.4	4.7	223.1	19.7	1828.4	1391.4	265.0	68.0
FEB1983	1833.5	0.4	1833.9	50.2	55.3	26.2	0.0	92.7	3.1	224.3	23.3	1632.8	1463.4	252.3	88.0
MEAN	2815.3	0.2	2815.5	50.2	55.0	30.2	0.2	192.0	28.6	327.4	22.8	2511.0	1451.2	711.4	94.0

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

```
*****************************************
** THIS IS A JOB TO OUTPUT TABLES ****
*****************************************

MONTHLY
ARTY3=1983  STARTMN=3;

LUMN=(1)=BD1
```

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
FOR THE MONTH OF: MARCH, 1983
ALL DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1MAR1983	2237.5	0.4	2237.9	50.2	55.3	26.1	0.0	90.8	1.9	222.4	19.5	2035.0	1466.4	243.3	75.0
2MAR1983	2023.4	0.3	2023.7	50.2	55.3	26.1	0.0	91.5	0.7	223.1	22.3	1822.9	1487.8	227.1	97.0
3MAR1983	1812.6	0.3	1812.9	50.2	55.3	26.1	-0.0	91.9	-0.4	223.5	22.9	1612.4	1484.4	220.0	101.0
4MAR1983	2311.7	0.3	2312.0	50.2	55.3	36.6	-0.0	91.7	-1.4	233.8	20.9	2099.1	1479.9	209.9	96.0
5MAR1983	1873.7	0.1	1873.8	50.2	55.3	42.5	-0.0	92.9	-2.4	240.9	20.4	1653.3	1437.8	206.0	96.0
6MAR1983	3306.8	0.4	3307.2	50.2	55.0	42.7	-0.1	256.0	-7.5	403.9	19.2	2922.5	1385.5	502.0	526.0
7MAR1983	3281.5	0.4	3281.9	50.2	55.2	26.4	-0.2	274.7	-23.5	406.5	22.1	2897.5	1461.8	704.5	93.0
8MAR1983	2523.6	0.3	2523.9	50.2	55.1	26.1	-0.1	274.0	-18.1	405.5	21.1	2139.6	1462.7	685.1	85.0
9MAR1983	2353.4	0.5	2353.9	50.2	55.3	31.5	-0.1	165.1	-12.3	302.1	21.0	2072.8	1454.8	426.1	89.0
0MAR1983	2151.5	0.2	2151.7	50.2	55.3	65.1	-0.1	124.5	-9.2	295.1	20.2	1876.8	1446.4	365.2	97.0
1MAR1983	2433.3	0.2	2433.5	50.2	55.2	48.8	-0.0	180.5	-2.6	334.7	23.1	2121.9	1463.1	459.9	82.0
2MAR1983	1951.6	0.1	1951.7	50.2	55.3	25.9	-0.0	114.9	-2.6	246.2	19.3	1724.7	1425.8	287.9	99.0
3MAR1983	2148.7	0.2	2148.9	50.2	55.3	26.1	-0.1	101.5	-7.2	233.1	19.0	1934.8	1378.4	259.6	86.0
4MAR1983	2003.8	0.3	2004.1	50.2	55.3	25.9	-0.0	93.1	-6.8	224.5	21.8	1801.4	1447.8	239.0	83.0
5MAR1983	2011.5	0.5	2012.0	50.2	55.3	25.8	-0.0	88.2	-6.9	219.5	21.6	1814.1	1481.2	218.7	93.0
6MAR1983	1995.6	0.3	1995.9	50.2	55.3	36.6	-0.1	85.1	-7.3	227.1	20.9	1789.7	1480.0	202.6	95.0
7MAR1983	2253.5	0.2	2253.7	50.2	55.3	42.4	-0.1	84.1	-7.8	232.0	21.6	2043.3	1470.7	235.8	97.0
8MAR1983	5698.0	0.2	5698.2	50.2	51.8	56.6	-0.1	949.1	-13.3	1107.7	41.5	4632.0	1446.3	2963.7	85.0
9MAR1983	4170.3	0.1	4170.4	50.2	55.0	59.4	-0.0	598.2	-2.8	762.8	20.5	3428.1	1414.1	1858.4	221.0
0MAR1983	3848.8	0.1	3848.9	50.2	55.1	61.2	0.0	446.1	1.1	612.6	18.0	3254.3	1381.9	1537.7	85.0
1MAR1983	3327.3	0.3	3327.6	50.2	55.3	65.8	0.2	296.1	4.3	467.4	17.7	2877.9	1444.6	984.9	93.0
2MAR1983	3412.5	0.2	3412.7	50.2	55.3	43.9	0.0	199.1	3.4	348.5	19.9	3084.1	1458.9	747.3	111.0
3MAR1983	3182.7	0.2	3182.9	50.2	54.8	32.2	0.1	305.1	18.4	442.4	24.1	2764.7	1480.1	968.1	101.0
4MAR1983	2664.2	0.2	2664.4	50.2	54.8	37.8	0.3	362.8	42.2	505.6	23.0	2181.7	1463.4	1008.5	94.0
5MAR1983	2836.3	0.3	2836.6	50.2	55.2	43.6	0.3	309.5	46.2	458.6	22.1	2400.1	1457.1	798.1	107.0
6MAR1983	3377.8	0.2	3378.0	50.2	54.6	67.0	2.0	518.8	49.1	690.7	22.3	2709.6	1415.8	1317.6	264.0
7MAR1983	7190.3	0.2	7190.5	50.2	52.0	64.4	8.6	1211.5	203.5	1378.2	36.0	5848.4	1376.2	4316.3	269.0
8MAR1983	7025.1	0.3	7025.4	50.2	55.3	66.1	5.4	704.4	331.8	876.0	18.6	6168.0	1457.5	2872.3	78.0
9MAR1983	4879.4	0.3	4879.7	50.2	55.3	46.8	1.3	436.7	177.6	589.0	21.5	4312.1	1459.9	1784.6	86.0
0MAR1983	4314.9	0.3	4315.2	50.2	55.3	33.7	0.7	310.3	102.7	449.4	20.2	3886.0	1452.9	1124.8	110.0
1MAR1983	3258.4	0.2	3258.6	50.2	55.1	32.9	0.4	276.6	58.9	414.8	22.1	2865.9	1437.6	941.8	98.0
MEAN	3156.8	0.3	3157.0	50.2	54.9	41.7	0.6	297.6	29.3	444.4	22.1	2734.7	1447.1	932.1	122.3

(* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
(** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
**** THIS IS A JOB TO OUTPUT TABLES ****
****

LINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
THE MONTH OF: APRIL, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
APR1983	6485.4	0.1	6485.5	50.2	53.1	44.4	0.4	742.2	59.7	889.9	34.2	5629.8	1398.1	3048.1	436.0
APR1983	23332.0	0.1	23332.1	50.2	49.7	63.6	13.3	2408.8	315.0	2572.3	51.5	20811.3	1362.3	9433.6	46.0
APR1983	15502.0	0.4	15502.4	50.2	52.7	62.1	9.0	1506.3	212.3	1671.2	31.9	13953.1	1340.0	5719.4	49.0
APR1983	6399.0	0.1	6399.1	50.2	54.8	38.5	0.9	952.5	122.5	1095.9	22.7	5325.9	1433.9	3394.0	65.0
APR1983	9235.2	0.2	9235.4	50.2	54.1	46.7	0.5	824.9	75.3	975.9	29.0	8288.5	1448.2	2919.1	146.0
APR1983	4213.4	0.3	4213.7	50.2	55.1	51.3	0.3	631.0	47.6	787.6	21.6	3447.8	1452.0	2037.4	177.0
APR1983	4350.6	0.3	4350.9	50.2	55.3	33.1	0.3	407.3	36.7	545.8	22.7	3827.8	1445.8	1515.0	98.0
APR1983	4371.4	0.1	4371.5	50.2	55.3	44.4	0.2	312.6	29.6	462.4	21.6	3930.7	1457.6	1201.4	373.0
APR1983	10062.0	0.2	10062.2	50.2	52.1	64.2	3.7	1262.3	212.8	1428.7	38.6	8672.0	1386.9	5663.1	413.0
APR1983	6522.0	0.1	6522.1	50.2	54.9	54.2	1.2	984.9	165.0	1144.2	18.6	5396.5	1364.8	3014.1	107.0
APR1983	4635.3	0.2	4635.5	50.2	55.2	39.4	0.7	630.2	91.8	775.0	22.4	3882.9	1458.6	1943.1	90.0
APR1983	4382.0	0.4	4382.4	50.2	55.3	51.0	0.4	432.3	54.1	588.7	22.4	3816.1	1464.9	1386.7	366.0
APR1983	8123.0	0.1	8123.1	50.2	52.7	57.6	1.5	1642.0	207.7	1802.4	36.6	6357.3	1478.6	5805.0	258.0
APR1983	11059.0	0.1	11059.1	50.2	52.5	26.5	3.0	1576.0	423.9	1705.0	38.3	9392.5	1474.9	5734.8	49.0
APR1983	6852.0	0.2	6852.2	50.2	55.1	26.3	1.6	891.4	221.0	1022.9	22.5	5851.8	1465.6	3332.4	79.0
APR1983	5151.4	0.1	5151.5	50.2	54.9	29.7	0.8	636.4	117.0	771.2	23.2	4403.5	1433.0	2067.3	130.0
APR1983	3701.1	0.3	3701.4	50.2	55.2	33.7	0.4	446.1	63.2	585.2	17.7	3133.8	1383.9	1547.3	122.0
APR1983	3297.0	0.1	3297.1	50.2	55.3	38.6	0.2	335.1	34.9	479.1	20.8	2838.6	1464.7	1132.8	88.0
APR1983	3254.1	0.2	3254.3	50.2	55.3	43.9	0.1	272.5	19.5	421.8	21.2	2853.7	1486.9	906.5	126.0
APR1983	2720.4	0.2	2720.6	50.2	55.3	37.7	0.1	237.0	10.2	380.1	23.0	2363.6	1488.1	776.3	124.0
APR1983	2819.6	0.2	2819.8	50.2	55.3	32.0	0.0	216.1	4.2	353.5	22.9	2489.2	1481.3	685.5	140.0
APR1983	2621.4	0.3	2621.7	50.2	55.3	49.5	0.0	201.9	0.2	356.8	21.9	2286.9	1488.2	617.7	173.0
APR1983	2583.9	0.2	2584.1	50.2	55.3	62.5	-0.0	189.6	-2.9	357.5	21.4	2247.9	1428.2	551.5	199.0
APR1983	2206.7	0.2	2206.9	50.2	55.3	55.7	-0.0	177.4	-5.6	338.5	17.6	1886.0	1333.5	504.2	132.0
APR1983	2407.6	0.4	2408.0	50.2	55.3	37.1	-0.1	165.8	-7.8	308.3	22.8	2122.6	1512.9	455.0	159.0
APR1983	2468.4	0.5	2468.9	50.2	55.3	31.5	-0.1	154.6	-9.4	291.5	25.3	2202.7	1546.2	391.8	154.0
APR1983	2387.1	0.4	2387.5	50.2	55.3	42.8	-0.1	145.7	-10.4	293.9	25.3	2118.9	1556.5	354.3	175.0
APR1983	4001.5	0.4	4001.9	50.2	54.6	49.4	-0.3	337.3	-36.7	491.4	28.7	3539.2	1501.1	918.7	518.0
APR1983	2396.0	0.5	2396.5	50.2	54.8	43.2	-0.2	271.8	-28.1	419.9	25.5	2002.0	1478.5	821.3	169.0
APR1983	5290.0	0.3	5290.3	50.2	54.6	63.7	-0.2	553.5	-29.3	721.9	24.0	4592.4	1418.3	1997.0	203.0
MEAN	5764.0	0.2	5764.2	50.2	54.5	45.1	1.3	651.5	79.8	801.3	25.9	4988.8	1447.8	2329.1	178.7

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
** THIS IS A JOB TO OUTPUT TABLES ****
****

F='DAILY'
AUTY2=1983 START#N=5;

NOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
THE MONTH OF: MAY, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
TE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Y1983	9302.0	0.3	9302.3	50.2	53.5	63.8	3.6	1118.8	137.6	1286.3	30.2	8046.3	1367.8	5469.9	437.0
Y1983	14759.0	0.5	14759.5	50.2	53.9	67.0	9.6	995.7	390.4	1166.8	31.0	13623.6	1456.6	4417.1	61.0
Y1983	7298.0	0.4	7298.4	50.2	55.3	63.5	1.3	554.1	188.6	723.0	22.6	6597.9	1469.7	2412.7	108.0
Y1983	5017.0	0.3	5017.3	50.2	55.3	53.4	0.6	347.6	87.2	506.4	26.0	4536.6	1473.0	1398.1	143.0
Y1983	3150.0	0.4	3150.4	50.2	55.3	44.8	0.3	239.9	36.2	390.1	23.1	2783.1	1477.7	979.0	178.0
Y1983	3805.7	0.4	3806.1	50.2	55.3	57.2	0.1	184.9	10.2	347.5	21.9	3335.5	1480.6	790.6	191.0
Y1983	2989.1	0.3	2989.4	50.2	55.0	66.3	-0.1	315.0	-7.2	486.5	23.5	3343.1	1446.1	1044.6	439.0
Y1983	2723.1	0.6	2723.7	50.2	55.3	63.9	-0.1	234.0	-20.7	403.3	19.0	2605.1	1379.0	896.1	106.0
Y1983	2869.0	0.4	2869.4	50.2	55.3	69.5	-0.1	174.6	-20.1	349.5	22.8	2397.0	1485.9	595.7	163.0
Y1983	2460.8	0.4	2461.2	50.2	55.3	63.2	-0.1	144.2	-20.1	312.8	23.2	2579.8	1500.7	476.3	209.0
Y1983	2634.7	0.4	2635.1	50.2	55.3	70.0	-0.1	126.3	-20.1	301.7	24.0	2183.4	1529.2	405.7	250.0
Y1983	3518.0	0.6	3518.6	50.2	54.5	68.9	-0.1	114.7	-20.1	289.0	23.1	2369.2	1529.8	366.8	219.0
Y1983	7741.0	0.4	7741.4	50.2	53.8	69.5	0.0	736.5	0.9	910.7	28.9	2636.8	1541.3	2216.9	231.0
Y1983	3705.8	0.3	3706.1	50.2	55.3	67.8	4.1	785.7	102.2	957.5	30.9	6814.9	1434.3	1596.3	701.0
Y1983	3298.9	0.5	3299.4	50.2	55.3	65.1	1.7	405.3	38.5	575.8	19.7	3150.0	1390.9	871.5	180.0
Y1983	2999.4	0.4	2999.8	50.2	55.3	69.4	0.4	275.2	9.8	450.0	22.8	2872.2	1461.6	675.8	186.0
Y1983	3444.2	0.5	3444.7	50.2	55.3	69.1	-0.0	192.3	-4.6	366.8	23.6	2656.6	1503.6	487.1	222.0
Y1983	4639.2	0.4	4639.6	50.2	55.3	68.0	-0.1	147.9	-11.8	321.3	27.2	3150.6	1488.2	393.8	440.0
Y1983	2459.9	0.4	2460.3	50.2	54.3	69.7	-0.1	438.6	-10.7	612.8	30.6	4057.5	1487.3	1425.6	969.0
Y1983	3576.9	0.3	3577.2	50.2	55.3	68.9	-0.1	235.8	-14.2	410.1	22.6	2072.8	1493.7	613.4	286.0
Y1983	7567.0	0.3	7567.3	50.2	55.3	67.2	-0.1	167.0	-16.7	339.6	21.9	3259.5	1466.2	453.1	541.0
Y1983	3335.9	0.5	3336.4	50.2	54.8	70.1	2.7	643.4	63.5	818.4	24.7	6773.6	1422.3	2737.2	1145.0
Y1983	3787.2	0.5	3787.7	50.2	54.2	70.6	1.6	453.0	90.2	628.0	29.4	2737.8	1516.0	1702.4	205.0
Y1983	2450.8	0.7	2451.5	50.2	55.0	70.4	0.3	286.5	42.2	462.1	32.4	3358.0	1555.3	759.5	228.0
Y1983	2680.4	0.6	2681.0	50.2	55.2	72.6	0.7	223.8	15.8	401.7	27.8	2077.5	1513.3	580.3	241.0
Y1983	2731.5	0.5	2732.0	50.2	55.3	69.6	-0.0	159.1	-1.1	334.1	28.0	2374.9	1510.8	396.8	213.0
Y1983	2764.9	0.3	2765.2	50.2	55.3	71.5	-0.1	129.4	-9.6	306.3	29.2	2454.9	1499.5	329.5	247.0
Y1983	2255.0	0.2	2255.2	50.2	55.3	67.8	-0.1	111.0	-13.9	284.2	29.7	2501.7	1371.3	314.8	298.0
Y1983	2576.3	0.3	2576.3	50.2	54.1	67.5	0.8	357.0	19.6	528.8	27.5	4753.9	1337.2	1661.7	316.0
Y1983	3403.0	0.4	3403.4	50.2	55.2	63.6	0.6	239.3	15.2	408.3	17.9	2185.9	1329.3	840.1	308.0
N	4277.5	0.4	4277.9	50.2	54.9	66.4	0.0	345.9	33.9	517.4	25.1	3785.6	1463.7	1220.9	310.5

WER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
LUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

NIS IS A .PDF TO OUTPUT TABLES ****

S DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
MONTH OF: JUNE, 1983
A ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
83	2397.9	0.4	2398.3	50.2	55.3	77.7	-0.1	137.1	-12.4	320.2	24.0	2102.1	1496.2	351.0	254.0
83	2774.0	0.5	2774.5	50.2	55.3	74.8	-0.1	112.2	-15.1	292.5	22.7	2504.8	1491.6	289.5	208.0
83	2729.9	0.4	2751.7	50.2	55.3	74.9	-0.1	100.1	-16.3	280.4	24.2	2495.5	1479.4	347.7	246.0
83	2641.0	0.5	2730.3	50.2	55.3	74.4	-0.1	93.0	-16.9	272.8	24.2	2479.2	1473.7	275.5	329.0
83	2369.5	0.4	2641.5	50.2	55.3	72.4	-0.1	86.4	-17.0	264.2	22.2	2399.5	1407.4	233.1	292.0	240.3	232.0
83	2405.0	0.8	2369.9	50.2	55.3	74.7	-0.1	82.5	-16.9	262.6	23.0	2130.2	1490.0	211.9	269.0
83	2551.4	0.9	2405.8	50.2	55.3	77.1	-0.1	78.3	-16.7	260.8	23.7	2168.7	1529.4	202.6	241.0
83	2797.9	0.7	2552.3	50.2	55.3	79.8	-0.1	74.3	-16.0	259.6	24.4	2317.1	1624.4	175.1	638.0
83	3071.3	1.1	2798.6	50.2	55.3	77.0	-0.1	70.7	-15.2	253.1	26.4	2571.9	1573.9	839.7	376.0
83	2437.2	0.7	3072.4	50.2	54.4	82.2	-0.1	164.6	-18.0	351.4	31.3	2752.3	1608.7	193.5	353.0
83	2362.2	0.2	2437.9	50.2	55.3	83.5	-0.1	91.5	-16.4	280.5	25.3	2182.7	1700.7	163.6	333.0
83	2196.9	1.1	2362.4	50.2	55.3	83.0	-0.1	76.4	-14.2	264.8	24.9	2122.5	1808.6	134.6	351.0
83	3905.1	0.7	2198.0	50.2	55.3	91.2	-0.1	67.3	-12.4	263.9	30.4	1964.5	2034.0	1000.1	596.0
83	3817.7	0.4	3905.8	50.2	54.3	92.6	-0.1	287.6	-16.2	484.6	34.3	3455.5	1914.3	1757.6	472.0	884.0
83	3342.1	0.6	3819.1	50.2	55.0	81.9	-0.3	133.8	-35.3	320.9	27.0	3524.1	1782.2	191.1	1501.0
83	3499.6	0.8	3342.7	50.2	55.3	84.8	-0.2	86.6	-21.5	276.8	28.3	3094.2	1737.5	149.0	1641.0
83	4072.7	0.2	3500.4	50.2	55.3	85.1	-0.1	70.7	-13.9	261.2	26.9	3266.1	1656.2	134.8	1374.0
83	3215.7	0.8	4072.9	50.2	55.3	83.8	-0.1	61.1	-9.9	250.3	24.9	3847.8	1576.9	122.6	1530.0
83	3638.2	0.4	3216.5	50.2	55.3	80.6	-0.1	54.1	-7.5	240.2	23.2	2999.5	1934.6	100.3	1267.0
83	3669.9	0.8	3638.6	50.2	55.3	93.5	-0.0	50.7	-6.0	249.6	27.8	3416.7	2150.7	83.4	1457.0
83	3556.7	0.7	3670.7	50.2	55.3	100.5	-0.0	48.3	-4.7	254.3	30.5	3446.9	2219.5	83.7	1367.0
83	3823.4	1.2	3557.4	50.2	55.3	92.3	-0.0	47.3	-3.7	245.0	33.0	3345.3	2329.3	83.1	1358.0
83	3898.9	0.4	3824.6	50.2	55.3	92.3	-0.0	45.6	-2.8	243.3	36.3	3617.7	2145.1	78.3	1571.0
83	4193.0	1.0	3899.3	50.2	55.3	92.3	-0.0	43.1	-2.0	240.9	34.6	3693.1	2196.7	74.9	1954.0
83	4127.2	1.1	4194.0	50.2	55.3	92.3	-0.0	41.8	-1.4	239.5	30.2	3984.7	2307.6	70.4	1798.0
83	10184.0	0.6	4128.3	50.2	55.3	84.5	-0.0	39.6	-0.8	229.5	29.9	3928.7	1917.1	5108.7	777.0
83	9926.6	0.8	10184.6	50.2	52.9	90.4	0.8	929.6	19.4	1123.0	41.6	9103.2	1650.1	1040.8	1436.0
83	3981.6	0.5	9926.8	50.2	54.6	77.0	2.4	295.3	55.7	477.1	28.8	9478.5	1670.3	477.1	1405.0
83	3960.9	1.2	3982.1	50.2	55.1	81.9	1.4	269.3	33.0	456.5	24.7	3550.3	1777.4	515.1	1687.0
	3676.6	0.7	3677.3	50.2	55.1	83.6	0.1	130.9	16.6	374.2	26.6	3614.3	1781.4	448.1	924.2

INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
VN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
IS A JOB TO OUTPUT TABLES ****
****

VS
983 STARTMN=7;

INOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
THE MONTH OF: JULY, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
JUL 1983	5789.0	0.7	5789.7	50.2	54.4	78.8	0.2	562.4	32.5	745.8	30.4	5074.3	1711.3	2255.9	929.0
JUL 1983	24278.0	0.6	24278.6	50.2	52.1	78.1	32.6	1952.2	798.7	2132.6	39.4	22185.4	1597.9	11389.6	77.0
JUL 1983	7054.0	0.5	7054.5	50.2	55.2	76.6	18.4	692.1	444.0	874.1	24.3	15414.4	1628.3	4334.4	643.0
JUL 1983	4747.5	0.7	4748.2	50.2	55.3	75.7	9.6	380.3	227.2	561.4	21.6	6514.7	1525.5	2282.5	1687.0
JUL 1983	4512.5	0.5	4512.5	50.2	55.3	78.8	5.0	230.1	118.3	414.3	23.7	4357.6	1571.4	1220.4	824.0
JUL 1983	4529.3	0.7	4530.0	50.2	55.3	81.8	2.6	150.4	63.2	337.6	23.4	4198.3	1628.1	764.2	1806.0
JUL 1983	4125.0	0.7	4125.7	50.2	55.3	86.1	0.2	110.8	35.1	302.3	23.7	4251.4	1757.0	500.5	1771.0
JUL 1983	4181.7	0.5	4182.2	50.2	55.3	70.9	0.1	88.0	20.5	264.3	26.9	3888.3	1843.6	373.5	1763.0
JUL 1983	4383.6	0.0	4384.5	50.2	55.3	91.1	0.6	75.0	12.8	271.5	27.2	3937.9	1925.8	303.6	1872.0
JUL 1983	4164.6	0.0	4165.5	50.2	55.3	84.6	0.4	69.9	8.7	259.9	27.4	4151.9	1901.0	264.3	1880.0
JUL 1983	4267.6	1.0	4268.6	50.2	55.3	85.5	0.0	65.4	6.5	256.3	30.4	3939.6	2227.6	218.0	1768.0
JUL 1983	4049.5	1.0	4050.5	50.2	55.3	85.3	0.0	61.0	5.4	251.7	32.5	4049.4	2146.5	178.3	1769.0
JUL 1983	3976.3	0.7	3977.0	50.2	55.3	85.2	0.0	58.3	4.8	248.9	32.6	3834.2	2142.4	148.3	1829.0
JUL 1983	4163.0	1.3	4164.3	50.2	55.3	85.1	0.0	56.1	4.6	246.6	33.9	3764.3	2456.9	136.1	1740.0
JUL 1983	4203.4	0.9	4204.3	50.2	55.3	85.0	0.0	55.1	4.2	245.5	34.7	3953.5	2448.3	126.0	1692.0
JUL 1983	3780.8	0.9	3781.7	50.2	55.1	87.1	0.0	52.5	4.1	242.9	30.2	3991.6	2377.4	122.8	1629.0
JUL 1983	5270.0	0.7	5270.7	50.2	53.9	85.1	0.0	113.4	2.9	305.8	32.6	3508.5	2233.3	796.9	1254.0
JUL 1983	5628.0	0.8	5628.8	50.2	54.9	83.6	-0.0	257.9	-1.7	447.1	38.3	4861.9	2007.6	1248.3	646.0
JUL 1983	6436.0	1.1	6437.1	50.2	54.7	82.0	0.7	232.6	15.8	421.2	33.6	5241.2	2089.4	1171.7	1460.0
JUL 1983	4554.2	1.2	4555.4	50.2	55.3	78.0	0.5	316.0	11.8	502.9	30.3	5964.6	2062.0	913.8	2134.0
JUL 1983	4856.6	1.0	4857.6	50.2	55.3	87.9	0.1	104.5	11.3	287.9	31.7	4299.2	2349.7	343.7	1668.0
JUL 1983	4157.4	1.0	4158.4	50.2	55.3	94.2	0.4	75.2	7.9	268.6	32.1	4621.1	2442.1	237.4	1646.0
JUL 1983	3945.1	1.2	3946.3	50.2	55.3	83.1	0.2	59.2	6.3	248.9	27.0	3936.5	2022.1	241.3	2485.0
JUL 1983	3843.9	1.3	3845.2	50.2	55.3	90.9	0.2	51.6	5.4	240.1	25.3	3731.4	1832.7	199.0	1620.0
JUL 1983	3948.5	1.0	3949.5	50.2	55.3	93.6	0.2	47.3	4.7	243.6	30.4	3632.0	1912.4	151.5	1694.0
JUL 1983	4049.0	1.4	4050.4	50.2	55.3	85.0	0.2	44.5	4.3	243.6	29.7	3735.7	2106.4	119.2	1825.0
JUL 1983	3727.8	1.0	3728.8	50.2	55.3	84.9	0.0	42.7	4.2	233.1	33.0	3850.3	2227.3	101.4	1656.0
JUL 1983	3511.6	1.6	3513.2	50.2	55.3	85.1	0.0	41.3	4.2	231.6	34.2	3531.4	2552.7	96.5	1747.0
JUL 1983	4076.0	0.8	4076.8	50.2	55.3	79.7	0.1	41.9	4.0	232.4	36.4	3317.2	2415.4	362.9	439.0
JUL 1983	2756.9	0.7	2757.6	50.2	55.3	77.0	0.1	39.0	3.0	224.2	32.9	3805.5	1987.4	224.6	621.0
MEAN	5459.0	0.9	5459.9	50.2	55.0	83.2	2.4	198.9	60.6	387.3	30.2	5102.8	2035.0	1000.3	1457.3

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
* THIS IS A JOB TO OUTPUT TABLES *
****

IC DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
E MONTH OF: AUGUST, 1983
TA ARE PRESENTED IN CUBIC FEET PER SECOND (CPS)

	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
F	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1983	3460.0	1.5	3461.5	50.2	55.3	86.2	0.0	37.5	3.8	229.1	34.1	3266.5	2059.6	125.5	582.0
1983	3576.7	1.5	3578.2	50.2	55.3	85.6	0.0	36.7	3.9	227.7	32.5	3383.0	2156.3	89.9	1769.0
1983	4284.0	1.3	4285.3	50.2	55.3	70.4	0.0	36.9	4.0	212.7	35.4	4107.9	2161.9	66.7	1546.0
1983	3611.0	1.5	3612.5	50.2	55.3	92.2	0.1	36.2	4.1	233.8	33.9	3412.6	2165.7	62.7	1453.0
1983	3667.7	1.1	3668.8	50.2	55.3	91.7	0.1	35.6	4.1	232.7	33.6	3469.7	2131.2	77.0	1359.0
1983	4039.8	0.9	4040.7	50.2	55.3	93.1	0.0	34.0	4.1	232.6	33.5	3841.7	2138.3	61.6	1962.0
1983	3087.5	0.9	3088.4	50.2	55.3	85.2	0.0	33.1	4.1	223.7	30.8	2895.4	2148.1	55.2	1150.0
1983	3240.0	1.4	3241.4	50.2	55.3	77.6	0.0	33.7	4.1	216.7	34.0	3058.7	2374.5	50.2	1329.0
1983	4392.3	1.1	4393.4	50.2	55.3	93.0	0.0	33.0	4.1	231.4	37.0	4189.0	2259.0	46.5	1806.0
1983	4260.6	1.1	4261.7	50.2	55.3	85.1	0.0	32.4	4.1	222.9	35.6	4074.4	2130.2	39.2	1888.0
1983	3797.5	0.5	3798.0	50.2	55.3	87.6	0.1	32.0	4.0	225.0	27.3	3600.3	1816.5	217.9	1969.0
1983	3869.1	0.3	3969.4	50.2	55.3	92.2	0.1	31.6	3.9	229.2	28.5	3668.6	2003.3	86.6	1880.0
1983	4070.0	0.8	4070.8	50.2	55.3	92.9	0.0	31.1	3.9	229.4	28.3	3869.7	2019.9	45.8	1864.0
1983	3873.8	0.2	3874.0	50.2	55.3	85.0	0.0	25.8	3.9	216.2	26.5	3684.2	1986.7	39.9	1833.0
1983	3429.3	1.3	3431.3	50.2	55.3	92.8	0.0	29.4	3.8	227.6	30.9	3234.6	2253.1	34.6	1753.0
1983	4027.3	1.1	4028.4	50.2	55.2	85.0	0.0	43.6	3.8	233.9	34.3	3828.8	2450.7	65.8	1677.0
1983	9889.0	1.3	9890.3	50.2	52.8	80.1	0.0	594.7	6.3	777.8	46.0	9158.5	2056.5	4469.8	568.0
1983	4163.3	1.2	4164.5	50.2	55.3	85.7	0.0	49.5	6.4	240.6	32.3	3956.2	2071.7	519.5	1677.0
1983	3534.7	1.5	3536.2	50.2	55.3	70.8	0.0	38.2	5.3	214.1	30.6	3352.7	2458.7	180.5	595.0
1983	3737.6	1.0	3738.6	50.2	55.3	85.2	0.0	33.7	4.8	224.3	29.3	3543.6	2168.3	122.8	1621.0
1983	4304.5	1.2	4305.7	50.2	55.3	85.2	0.0	31.2	4.5	221.8	26.9	4110.9	2116.8	98.2	1679.0
1983	3495.9	1.2	3497.1	50.2	55.3	90.2	0.2	29.8	4.3	225.4	31.2	3302.9	2057.2	77.7	1652.0
1983	3826.0	0.6	3826.6	50.2	55.3	92.5	0.1	29.1	4.2	227.0	29.8	3628.4	2051.0	48.7	1437.0
1983	3421.0	1.3	3422.3	50.2	55.3	93.0	0.0	28.4	4.0	226.8	29.6	3225.1	2144.7	38.0	-1330.0
1983	4301.5	0.9	4302.4	50.2	55.3	85.0	0.0	30.7	3.7	221.1	29.0	4110.3	1959.7	90.3	1504.0
1983	3318.8	0.9	3319.7	50.2	55.3	84.8	0.1	28.1	3.5	218.3	29.5	3130.9	1946.6	156.3	987.0
1983	4546.1	0.7	4546.8	50.2	55.3	85.3	0.0	28.5	3.6	219.2	26.8	4354.5	1785.0	110.9	2013.0
1983	3291.8	0.7	3292.5	50.2	55.3	85.2	0.0	27.8	3.5	218.4	23.1	3097.2	1958.0	81.6	1323.0
1983	3073.7	0.7	3074.4	50.2	55.3	85.1	0.0	27.3	3.5	217.8	27.6	2884.2	2166.9	46.7	843.0
1983	4137.0	0.9	4137.9	50.2	55.3	77.5	0.2	27.0	3.8	209.9	29.1	3957.1	2003.4	279.6	1524.0
1983	3145.1	0.7	3145.8	50.2	55.3	91.7	0.2	26.6	5.6	223.8	26.6	2948.6	1918.0	146.8	1260.0
	3963.3	1.0	3964.3	50.2	55.2	86.2	0.1	50.7	4.2	242.3	31.1	3753.1	2097.4	246.8	1478.5

ER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
LUMN 10=COLUMNS 4+5+6+8) (*** COLUMN 12=COLUMNS 3-10+11)

****
S IS A JOB TO OUTPUT TABLES ***
****

ILY*

ILLINOIS DIVISION OF WATER RESOURCES DIVERSION ACCOUNTING REPORT
FOR THE MONTH OF: SEPTEMBER, 1983
DATA ARE PRESENTED IN CUBIC FEET PER SECOND (CFS)

DATE	LOCK-PORT RECORD	DIVERSN ABOVE GAGE	TOTAL FLOW THROUGH CANAL (1+2)	GRNDWTR PUMPAGE FROM LAKE MICH. WATRSHD IN ILLNOIS	GRNDWTR PUMPAGE FROM DES PLAINES WATRSHD	WATER SUPPLY PUMPAGE FROM INDIANA REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * INDIANA	RUNOFF FROM DES PLAINES WATRSHD REACHNG CANAL	SEWER INDUCED GRNDWTR PUMPAGE FROM DIVERTD WATRSHD IN * ILLNOIS	TOTAL DEDUC-TIONS FROM LOCK-PORT RECORD **	LAKE MICH. DOMEST. PUMPAGE NOT DISCHRG TO CANAL (W/ADJ)	TOTAL DIVERSN ***	PUMPAGE FROM LAKE MICH. ACCTBLE TO ILLNOIS	RUNOFF FROM DIVERTD WATRSHD	DIRECT DIVERSN THROUGH LAKE CONTROL STRCTRS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SEP1983	2879.6	0.5	2880.1	50.2	55.3	84.0	0.0	26.5	4.5	216.0	28.7	2692.8	1973.8	41.8	767.0
SEP1983	3119.6	0.6	3120.2	50.2	55.3	69.0	0.0	27.3	3.9	201.9	28.5	2946.8	2056.4	34.4	960.0
SEP1983	3274.0	0.7	3061.2	50.2	55.3	69.1	0.0	26.1	3.6	200.6	25.3	2885.9	2007.0	30.9	996.0
SEP1983	3759.7	0.9	3274.9	50.2	55.3	69.0	0.0	25.9	3.4	193.4	24.4	3105.9	1929.0	29.9	969.0
SEP1983	7496.1	0.7	3760.4	50.2	54.7	62.0	0.0	112.9	3.9	266.6	26.9	3520.7	1902.9	896.3	954.0
SEP1983	3310.4	0.4	7496.8	50.2	54.3	48.8	0.0	282.7	19.3	436.3	33.8	7094.3	1770.5	1919.9	1417.0
SEP1983	2881.2	1.0	3310.8	50.2	55.3	49.1	0.1	40.8	12.4	208.3	25.2	3127.7	1727.7	225.9	843.0
SEP1983	2879.4	0.9	2882.2	50.2	55.3	62.0	0.1	33.9	8.3	194.6	24.9	2712.5	1804.4	91.7	876.0
SEP1983	3500.0	0.7	2880.3	50.2	55.3	55.2	0.1	29.7	6.2	184.0	26.9	2723.2	1977.8	54.4	872.0
SEP1983	3246.7	0.3	3500.7	50.2	55.3	48.8	0.0	55.0	5.1	215.5	28.4	3313.6	2016.0	148.0	946.0
SEP1983	3343.5	0.5	3247.0	50.2	55.0	55.3	0.0	30.4	4.7	198.3	21.7	3070.4	1611.1	156.1	1213.0
SEP1983	4037.8	0.3	3344.0	50.2	55.3	62.4	0.0	28.2	4.3	210.1	24.3	3158.3	1675.5	72.6	1257.0
SEP1983	3745.4	0.3	4038.1	50.2	55.3	76.4	0.0	27.4	6.5	209.9	23.8	3852.0	1649.5	425.1	397.0
SEP1983	4319.2	0.3	3745.7	50.2	55.3	77.0	0.2	26.7	6.1	201.3	24.5	3568.9	1634.9	64.3	941.0
SEP1983	4537.3	0.4	4319.5	50.2	55.0	69.1	0.0	194.7	4.6	355.4	27.2	3991.3	1613.3	357.4	1117.0
SEP1983	5182.0	0.2	4537.7	50.2	55.2	55.5	0.0	94.5	3.9	269.2	24.2	4292.6	1580.7	304.1	1127.0
SEP1983	5841.6	0.3	5182.2	50.2	54.4	69.3	0.0	168.7	6.3	342.5	27.8	4867.4	1548.9	892.1	1302.0
SEP1983	11691.0	1.1	5841.3	50.2	53.9	69.2	0.2	787.6	31.6	954.4	29.1	4916.1	1529.6	3741.5	1632.0
SEP1983	5511.0	0.4	11692.1	50.2	53.8	62.6	1.4	709.8	199.3	878.4	31.9	10845.6	1642.8	3222.6	253.0
SEP1983	4100.0	0.3	5511.4	50.2	53.8	64.5	4.1	551.0	137.8	729.8	34.5	4816.1	1620.2	1684.5	1626.0
SEP1983	3810.4	0.2	4100.3	50.2	55.3	74.7	0.7	199.4	96.4	367.6	25.9	3758.6	1568.6	601.9	1080.0
SEP1983	3260.0	0.3	3810.6	50.2	55.3	62.7	0.4	121.3	55.3	289.3	25.8	3547.2	1532.7	276.6	1429.0
SEP1983	3600.0	0.3	3260.3	50.2	55.3	62.5	0.2	81.5	34.8	242.6	23.9	3041.6	1546.4	167.4	1513.0
SEP1983	3549.2	0.2	3610.2	50.2	55.3	55.6	0.2	60.9	24.6	209.3	21.7	3412.6	1501.6	116.3	1469.0
SEP1983	3377.2	0.3	3548.6	50.2	55.3	42.9	0.1	50.7	19.3	199.1	18.9	3368.3	1436.1	91.4	1383.0
SEP1983	3454.0	0.3	3377.5	50.2	55.3	42.9	0.1	45.9	16.6	200.5	24.9	3201.9	1559.1	85.2	1542.0
SEP1983	3867.2	0.4	3454.3	50.2	55.3	49.1	0.1	43.3	15.1	197.8	22.7	3279.3	1624.0	66.5	1564.0
SEP1983	3957.1	0.5	3867.6	50.2	55.3	49.0	0.1	38.8	14.1	206.5	24.7	3685.8	1645.1	55.7	1875.0
SEP1983	3473.7	1.0	3474.7	50.2	55.3	62.2	0.1	39.7	13.2	207.3	24.6	3174.9	1660.8	49.1	1477.0
MEAN	4082.1	0.5	4082.6	50.2	55.0	62.1	0.1	40.0	12.6	207.6	26.5	2293.6	1646.5	46.3	571.0

* SEWER INDUCED GROUNDWATER PUMPAGE (COLUMNS 7 AND 9) NOT INCLUDED AS A DEDUCTION PER U.S. JUSTICE DEPT. OPINION)
** COLUMN 10=COLUMNS 4+5+6+8)
*** COLUMN 12=COLUMNS 3-10+11)

FINAL END FOR THIS JOB***

ANNUAL REPORT

MONITORING OF DIVERSION OF LAKE MICHIGAN WATER AT CHICAGO, ILLINOIS

APPENDIX B

Significant Events (Hydrolgic and General)

Water Years 1983-1985

SIGNIFICANT HYDROLOGIC EVENTS

The following is a detailed itemization of events of strictly a hydrologic nature which occurred during accounting years 1983-1985 inclusive:

2-3 December 1982 - The Chicago District area experienced heavy rainstorms on the 2nd and 3rd of December 1982 which resulted in flooding. Saturated ground from a wet November and a lack of vegetation to intercept the precipitation contributed to the flooding. During the entire storm event, the gage at O'Hare Airport recorded 5.37 inches of precipitation. As a direct result of this storm and subsequent flooding, backflows into Lake Michigan occurred at all control points in the Chicago area on December 2 and 3 as follows:

- The sluice gate at Wilmette was open from 10:08 P.M. on 2 December until 3:23 A.M. on 3 December, resulting in a discharge of 142.9 million gallons.

- The sluice gate at the mouth of the Chicago River (Chicago River Controlling Works) was open from 12:11 A.M. until 3:40 A.M. on 3 December, resulting in a discharge of 247.6 million gallons.

- The sluice gate at O'Brien Lock and Dam was open from 6:08 A.M. until 8:25 A.M. on 3 December, resulting in a discharge of 124.2 million gallons.

- The bypass at the 95th Street Pumping Station was operating from 8:55 P.M. on 2 December until 4:20 A.M. on 3 December, resulting in a discharge of 151.8 million gallons.

- The bypass at the 122nd Street Pumping Station was operating from 9:05 P.M. on 2 December until 3:55 A.M. on 3 December, resulting in a discharge of 12.0 million gallons.

17 August 1983 - The northwestern portion of Cook County experienced an early morning thunderstorm that resulted in a rainfall measurement of approximately 2 inches over a period of 3 hours. Wilmette experienced 2.12 inches of precipitation. To alleviate flooding conditions, the Metropolitan Sanitary District of Greater Chicago issued a backflow order at the Wilmette Pumping Station. The backflow began on 17 August at 7:50 A.M. and ended at 8:52 A.M. resulting in a discharge of 10.6 million gallons.

22 October 1983 - On 22 October, the Chicago District area experienced a heavy rainstorm. This storm, which was concentrated in the northern and central portions of the area, resulted in average rainfall amounts of 2.53 inches and 1.69 inches, respectively for the total period of the storm. In particular, the gages at the Northside Sewage Treatment Works and Wilmette Pumping Station recorded 1.63 inches of precipitation and 1.30 inches of precipitation respectively, both occurring within a three-hour period. To alleviate flooding conditions, the Metropolitan Sanitary District of Greater Chicago issued a backflow order at the Wilmette Pumping Station. The backflow began on 22 October 1983 at 4:15 P.M. and ended at 8:08 P.M., resulting in a discharge of 112.2 million gallons.

31 December 1984 - 1 January 1985 - Major winter snow storm dumped 4 to 8 inches of snow on the Chicago area. High water levels at Lockport resulted for a three day period.

1 - 5 September 1984 - Diversion was increased approximately 300 cfs each day over the five day period at the request of the Corps North Central Division (NCD). The increase was required due to critically low levels in the Lagrange Pool of the Illinois Waterway. In the request, the Corps indicated its understanding that the diversion was outside the purposes for which IDOT is authorized to divert Lake Michigan water under the U.S. Supreme Court decree.

22 - 27 February 1985 - A spring rain followed by fog and warm weather melted the 14 inch snow pack over a three day period. High water with localized flooding resulted in the Chicago area. The event resulted in peak flows of over 30,000 cfs as measured at Lockport.

4 March 1985 - On 4March, the Chicago District area experienced a major rainstorm. The storm was concentrated in the southern portion of the area and resulted in rainfall amounts of 1.15", 1.67", and 1.85" at Kankakee, Lockport, and O'Brien Dam respectively. The average precipitation over the entire Chicago area was 2.00". To alleviate flooding conditions, the Metropolitain Sanitery District of Greater Chicago issued a backflow order at the Wilmette Pumping Station. The total backflow consist of two separate events. The first backflow began on 4 March at 4:15 A.M. and ended at 9:28 A.M. Due to a continuing rise in water levels, a second backflow began at 10:20 A.M. and ended at 2:11 P.M. The total discharge into Lake Michigan was 153 million gallons.

24 March 1985 - Spring storm resulted in three days of high water peaking at 23,000 cfs as measured at Lockport.

6 August 1985 - On 6 August, the Chicago District area experienced a heavy rainstorm. The storm was concentrated in the central and northern portions of the area and resulted in rainfall amounts of 2.64", 1.12", and .50" at Skokie, O'Hare Airport, and Barrington respectively. By comparison, only .11" of precipitation was measured at Kankakee in the southern portion of the area. To alleviate flooding conditions, the Metropolitan Sanitary District of Greater Chicago issued a backflow order at the Wilmette Pumping Station. The backflow began at 2:38 A.M. and ended at 5:08 A.M., resulting in a discharge of 58 million gallons into Lake Michigan.

OTHER SIGNIFICANT EVENTS RELATING TO THE DIVERSION

The following is a detailed itemization of events of a more general nature affecting the diversion accounting system during accounting years 1983-1985 inclusive:

7 October 1982 - Letter sent from Chicago District, COE, to Illinois Department of Transportation (IDOT) in response to IDOT's 13 September 1982 letter requesting comments concerning the draft proposal submitted to IDOT by the Northeastern Illinois Planning Commission (NIPC) regarding development of the new Lake Michigan diversion accounting system. Letter stated that Corps was in basic agreement with the concepts of the proposal, but also stated some areas of concern.

8 October 1982 - Letter sent from Chicago District to IDOT in response to IDOT's 21 September 1982 letter requesting comments concerning the draft report summarizing the findings and recommendations of the AVM study committee. Letter stated that Corps was in basic agreement with the concepts of the report, but also stated some areas of concern.

26 October 1982 - Coordinated draft letter between the Chicago District and IDOT concerning the recommendations of the first three-member technical committee and development of improved plan for diversion measurements and accounting procedures forwarded to Office of the Chief of Engineers (OCE) through Corps' North Central Division (NCD).

1 November 1982 - NCD forwards above 26 October coordinated draft letter to OCE for review.

16 November 1982 - Meeting held between Corps, IDOT and United States Geological Survey (USGS) for discussion of the installation and backup system for the acoustical velocity flowmeter (AVM) to measure total flow at Lockport. Topics discussed included data needs, storage capabilities, and potential backup system.

20 December 1982 - Letter sent from OCE to State of Wisconsin summarizing the development of an improved plan for Lake Michigan diversion measurements and accounting procedures.

3 January 1983 - Letters sent from OCE to remaining parties of the Lake Michigan diversion litigation with identical information as described in 20 December letter above.

19 January 1983 - Letter sent from USGS to IDOT (copy furnished to Chicago District) providing guidelines for estimate of Lockport daily discharges in the event of equipment malfunction of the AVM system.

31 January 1983 - Meeting held between Corps, IDOT, and NIPC for discussions involving development of new Lake Michigan diversion accounting system.

3 February 1983 - First draft report submitted by Corps' Waterways Experiment Station (WES) to Chicago District regarding development of new discharge rating curves for determining flow rates through Lockport Controlling Works.

7 February 1983 - Letter sent from Chicago District to USGS (copy furnished IDOT) in response to above 19 January letter. Letter suggested consideration adopting the current accounting system used by the Metropolitan Sanita District of Greater Chicago (MSDGC) as a backup system in the event of A failure.

25 April 1983 - First draft report submitted by WES to Chicago Distric regarding development of new discharge rating curves for determining flow rate through Lockport Powerhouse sluice gates.

15 June 1983 - Meeting held between Corps, IDOT, and MSDGC for discussion of Corps' annual report on Lake Michigan diversion (accounting years 1981 and 1982).

16 June 1983 - Letter sent from IDOT to Chicago District (copy furnished t MSDGC) relating that average diversion for 1983 accounting year through Apri 1983 was averaging substantially above normal due to above average precipitation during first six months of the accounting year. Letter expressed concern regarding possibility of average diversion flows for the entire accounting year exceeding limitations set by modified Supreme Court decree.

7 July 1983 - Letters sent from Chicago District to NCD, MSDGC, USGS, and IDOT with draft reports prepared by WES (controlling works and powerhouse sluice gates) as enclosures. Letter requested comments on the reports by 22 July 1983.

19 July 1983 - Letter sent from USGS to Chicago District in response to above 7 July letter. Letter stated that approach and equations used in developing new rating curves were reasonable.

20 July 1983 - Letter sent from NCD to Chicago District in response to above 7 July letter. Letter expressed concern over possibility of submergence with respect to the controlling works and requested an evaluation of impact.

21 July 1983 - Letter enclosing explanatory memorandum sent from Chicago District to IDOT in response to above 16 June letter. Letter stated that close surveillance of running diversion averages would be continued in order to determine any conditions having a potential effect on the provisions of the modified Supreme Court decree.

1 August 1983 - Chicago District provides draft of Corps' annual report on Lake Michigan diversion covering accounting years 1981 and 1982 to NCD, IDOT, and MSDGC for review and comment. Comments were requested to be returned by 31 August 1983.

4 August 1983 - Letter sent from MSDGC to Chicago District in response to above 7 July letter. Letter stated that WES rating curves for powerhouse sluices and controlling works sluices indicated lower flows, in general, than the MSDGC rating curves for these structures. Letter also stated that WES curves for the controlling works did not account for submergence and, as a result, tend to yield higher values than actual flows when six or seven controlling works gates are in the open position.

8 August 1983 - Letter sent from IDOT to Chicago District in response to above 7 July letter. Letter had no comments regarding technical aspects of WES reports but expressed concern over possibility of submergence at the Controlling Works. Additional letter sent from MSDGC to Chicago District providing comments on Corps' draft annual report (as requested in 1 August letter above).

24 August 1983 - NCD provides comments regarding Corps' draft annual report, as requested in 1 August letter above.

25 August 1983 - Meeting held between Corps, IDOT, and NIPC for discussion of new Lake Michigan diversion accounting system.

31 August 1983 - Letter sent from IDOT to Chicago District providing comments on Corps' draft annual report, as requested in 1 August letter above.

30 September 1983 - Letter sent from Chicago District to IDOT providing assessment of material and documentation received from IDOT and NIPC at 25 August meeting. Letter stated that methodology presented in the documentatiom was technically sound, but requested additional information concerning the computation of Lake Michigan diversion.

20 October 1983 - Letter sent from Chicago District to Corps' WES with comments inclosed from COE, USGS, IDOT and MSDGC concerning first drafts of new rating curves (controlling works sluices and powerhouse sluices) developed by WES. Letter stated that Chicago District would contact WES for discussion of the comments.

18 November 1983 - Chicago District provides final distribution of Corps' initial annual report on Lake Michigan diversion covering accounting years 1981 and 1982. Distribution of the report was made to the Supreme Court through the NCD and OCE. Additionally, the report was provided to all parties of the diversion litigation as well as other involved agencies and individuals.

29 November 1983 - Letter sent from Chicago District to IDOT concerning IDOT's production schedule for calculation of diversion flows for the 1983 accounting year as well as associated annual summary to be completed by IDOT. Letter emphasized the need for establishment of definitive schedules and requested any actions that could be taken on the part of IDOT to expedite the diversion accounting process.

12 December 1983 - Letter sent from Chicago District to MSD with regard to new WES rating curves for Lockport Controlling Works. Letter stated that WES reviewed comments provided by MSD and was in agreement that the submergence effect should be considered in the evaluation of flow computations. Letter stated that Chicago District would be taking action to incorporate a tailwater consideration into the computational procedure. Letter also expressed opinion of WES technical staff that the present location of the tailwater gage was probably in a zone of high turbulence with a recommendation to relocate the gage approximately 150 feet downstream of the gates. Letter also expressed concern of WES staff with regard to possibility of headwater gage being located within zone of drawdown. Finally, letter requested views of MSD with respect to enhancing the measurement system.

13 December 1983 - Letter sent from Chicago District to IDOT acknowled Corps' review of the final report and recommendations of the AVM s committee. Letter requested specific coordination between involved agen concerning AVM calibration procedures and establishment of a backup syst Letter also requested proposed schedule for the above items.

16 January 1984 - Letter sent from MSDGC to Chicago District in response above 12 December letter. Letter stated that Sanitary District was not ir position to take any action or to fund relocation of the gages at the Lockp Controlling Works.

1 February 1984 - Letter sent from IDOT to Chicago District in response to abo 29 November and 13 December letters. Letter provided information concerni status of AVM gaging station, planned calibration procedures and proposed back system. Letter also addressed IDOT's schedule for completion of 1983 accountin report. Additionally, letter requested a re-evaluation of cost on the part o the Corps to assume all diversion accounting responsibilities.

3 March 1984 - IDOT provides initial version of Operations Manual detailing the new diversion accounting system to the Corps for review and comment.

23 March 1984 - Two letters sent from Chicago District to IDOT in response to above 1 February IDOT letter. The first letter addressed the technical concepts associated with the AVM installation. Letter acknowledged field measurements to be performed by USGS. Additionally, letter recommended a thirty day overlap between AVM and current measurement system. Letter also stated Corps' concurrence with concept of using the existing measurement system as backup for the AVM. The second letter addressed the potential for Corps' takeover of the entire diversion accounting program. Letter emphasized the developmental state of the new accounting system and the many associated costs that could not be determined as a result. Letter stated that Corps favored a one year operation of the new system with subsequent data review and evaluation before cost estimates for takeover of the accounting program could be prepared.

26 March 1984 - Second draft report (Lockport Controlling Works) submitted by WES to Chicago District.

9 April 1984 - Letter sent from Chicago District to IDOT providing Corps' comments on initial version of Operations Manual. A major concern was expressed by the Corps concerning the addition of a new deduction termed "induced infiltration."

12 April 1984 - Letters sent from Chicago District to NCD, IDOT, MSD and USGS with above second draft report as an inclosure to each letter. Letters requested comments by 9 May 1984.

26 April 1984 - Meeting between Corps and IDOT for mutual discussion of Corps' comments on Operations Manual and other topics related to development of the new accounting system.

4 May 1984 - Letter sent from IDOT to the Corps outlining expected completion dates for preparation and completion of a draft hydraulic report for the 1983 accounting year using the new diversion accounting system. Letter was requested of IDOT by the Corps at above 26 April meeting.

7 May 1984 - Letter sent from IDOT to the Corps providing additional background information concerning topic of induced infiltration and its use as a potential deduction. Additionally, letter requested a meeting between IDOT and Corps for further discussion of the matter. Letter was requested of IDOT by the Corps at above 26 April meeting.

14 May 1984 - Letter sent from USGS to Chicago District in response to above 12 April 1984 letter. Letter stated that approach and equations were reasonable but that the maximum total error of about ± 10 percent was too low, especially for high flows. Letter also stated that the lowest estimate for maximum total error for submerged weir flow was at least ± 17 percent.

21 May 1984 - Letter sent from MSD to Chicago District in response to above 12 April 1984 letter. Letter stated that general methodology used, the submerged crest coefficient graph and the flow computations followed accepted hydraulic practices.

25 May 1984 - Letter sent from NCD to Chicago District in response to above 12 April 1984 letter. Letter stated that computed rating curves should be checked against actual discharge measurements in the field. Letter also expressed concern about c values greater than 3.07 in terms of reasonableness.

1 June 1984 - Meeting held between Corps and IDOT as requested by IDOT in above 7 May letter. Purpose of the meeting was to discuss the topic of induced infiltration in greater detail and, more specifically, to allow IDOT to express its views on the subject to the Corps. Matter was taken under advisement by Corps at conclusion of the meeting.

5 July 1984 - Letter sent from Chicago District to WES with above comments from NCD, USGS and MSDGC as enclosure. Letter stated that WES would be contacted for further discussions.

27 July 1984 - Letter sent from Chicago District to NCD regarding topic of induced infiltration and intention of IDOT to use this component as a deduction. Letter stated that such a departure from the existing practice would require confirmation from other interested parties in order for the Corps to accomplish its monitoring role.

17 August 1984 - Letter sent from NCD to the Department of Justice (DOJ) with above described 7 May 1984 IDOT letter and 27 July 1984 Chicago District letter as enclosures. Letter requested advice from the DOJ concerning IDOT's intention to use the component of induced infiltration as a deduction. Concurrent letter also sent from NCD to Chicago District requesting District to solicit comments from parties of litigation on induced infiltration topic.

29 August 1984 - Letter sent from DOJ to NCD in response to 17 August letter above. Letter stated that IDOT's proposed change in accounting procedure to include induced infiltration as a deduction would necessitate a modification to the Supreme Court decree.

10 September 1984 - Letter sent from Chicago District to parties of litigation with above described 7 May 1984 IDOT letter as enclosure. Letter requested comments from parties of litigation on the issue of induced infiltration. Letter stated that Corps would consolidate any comments received and forward them to DOJ for further review and consideration.

10 October 1984 - Letter sent from State of Michigan to Chicago Distric response to District's 10 September 1984 letter requesting comments on inc infiltration issue. Letter requested additional documentation for evalua purposes.

11 October 1984 - Letter sent from MSDGC to Chicago District in response District's 10 September 1984 letter requesting comments on induced infiltrat issue. Letter supported position of IDOT with regard to use of indu infiltration as a deduction.

31 October 1984 - Letter sent from WES to Chicago District in response to ab 5 July letter. Letter addressed comments from NCD, USGS and MSDGC.

1 November 1984 - Letter sent from State of Wisconsin to Chicago District response to District's 10 September 1984 letter requesting comments on induc infiltration issue. Letter stated opposition to position of IDOT with regard use of induced infiltration as a deduction.

2 November 1984 - Letter sent from Chicago District to State of Michig providing additional documentation as requested in 10 October 1984 letter above

9 November 1984 - Letter sent from State of Ohio to Chicago District in respons to District's 10 September 1984 letter requesting comments on induce infiltration issue. Letter stated opposition to position of IDOT with regard use of induced infiltration as a deduction.

3 December 1984 - Memorandum for Record (MFR) dated 28 November 1984 sent fr WES to NCD. MFR stated that additional uncertainties were evident regardi rating curve accuracy for Lockport Controlling Works. Specifically, MFR stat that three items needed to be resolved by some type of field calibration:

> (a) upstream total head-upstream gage reading is not a true measure total head in the approach flow; (b) submergence-the downstream gage readi is not a true measure of submergence: (c) extremely shallow weir -the 1 f weir height is not large relative to the possible effects of aging a sediment and debris accumulation or erosion. MFR additionally stated th only when these uncertainties are resolved is a confidence level comparab to that of the laboratory - based rating (±8-10%) achieved.

4 December 1984 - Letter sent from State of Wisconsin to Chicago District response to District's 10 September 1984 letter requesting comments on induce infiltration issue. Letter stated opposition to position of IDOT with regard use of induced infiltration as a deduction.

21 January 1985 - Letter sent from State of Wisconsin to Chicago District as follow-up to 1 November 1984 letter above. Letter emphasized Wisconsin continuing review of induced infiltration issue and requested additiona documentation for evaluation. Additionally, letters sent from Chicago Distri to MSDGC and USGS (copies to IDOT) forwarding replies by WES to comments made above agencies with regard to effects of submergence on Lockport Controlli Works rating curves (as provided in 31 October letter above).

25 January 1985 - Coordination meeting held between IDOT, NIPC, and Chicago District for discussion of topics relating to development of new diversion accounting system.

30 January 1985 - Letter sent from Chicago District to State of Wisconsin providing additional documentation as requested in 21 January 1985 letter above.

1 February 1985 - Letter sent from State of New York to Chicago District in response to District's 10 September 1984 letter requesting comments on induced infiltration issue. Letter stated opposition to position of IDOT with regard to use of induced infiltration as a deduction.

11 February 1985 - Letter sent from State of Pennsylvania to Chicago District in response to District's 10 September 1984 letter requesting comments on induced infiltration issue. Letter stated opposition to position of IDOT with regard to use of induced infiltration as a deduction.

19 February 1985 - Coordination meeting held between IDOT, NIPC, NCD, and Chicago District. Principal topics of the meeting included induced infiltration, IDOT's 1983 annual diversion summary, recommendations of the three-member technical committee, NIPC's new diversion accounting system, and AVM status.

5 March 1985 - Chicago District convenes in-house ad-hoc committee to study topic of induced infiltration in detail.

20 March 1985 - AVM malfunctioned; cause unknown.

19 April 1985 - Based on above ad-hoc committee review, preliminary investigation report prepared by Chicago District and forwarded to NCD.

22 April 1985 - AVM repaired and online. Breakdown the result of a broken cable.

31 May 1985 - Letter sent from Chicago District to IDOT requesting additional information regarding use of AVM system. Letter requested specific information concerning type of backup measurement system planned. Letter also requested information regarding time frame during which MSDGC would continue providing flow measurement computations at Lockport.

14 June 1985 - Letter sent from IDOT to Chicago District forwarding copy of Lake Michigan Diversion Accounting Report for 1983 water year along with copy of Operations Procedure Manual describing methodology used to compute diversion. Letter also stated State's intention to begin using the AVM as a primary measurement station at Lockport beginning with October 1984 and addressed plans for backup system.

1 July 1985 - Letter sent from Chicago District to NCD forwarding final version of status report regarding recommendations made by the first three-member technical committee.

10 July 1985 - Letter sent from DOJ to NCD regarding IDOT's intention to ta deduction for induced infiltration. Letter stated that any change in approved method of calculating the diversion would require a modification of Supreme Court decree.

25 July 1985 - Letter sent from NCD to IDOT regarding induced infiltrat issue. Letter emphasized Corps' technical review and advice rendered by DOJ above 10 July letter. Letter additionally stated that Corps would not accep deduction for induced infiltration and requested IDOT's 1983 divers accounting report to be revised.

30 July 1985 - Letter sent from IDOT to Chicago District forwarding let reports from USGS regarding AVM calibration checks and backup system.

5 August 1985 - Letter sent from IDOT to DOJ regarding induced infiltrati issue. Letter conveyed IDOT's opinion and comments regarding acceptability the sewer induced groundwater pumpage component as a deduction under terms Supreme Court decree. Letter encouraged continuation of discussions on t issue (Copy of this letter furnished to NCD).

7 August 1985 - Letter sent from Chicago District to IDOT regarding Corps review of IDOT's 1983 diversion accounting report. Letter emphasize mathematical errors determined during review process, particularly as found i Lockport sluice discharge calculations. Letter also emphasized discrepanci regarding precipitation values used in NIPC simulation. Letter requested ID to furnish Corps with detailed computations and an analysis of the impact whi the precipitation discrepancies would have on the final report.

15 August 1985 - Letter sent from Chicago District to NIPC regarding IDOT's 19 diversion accounting report (above 7 August letter enclosed). Letter request errors in report to be corrected. Letter also requested copies of computatio and worksheets to be forwarded to Chicago District.

19 August 1985 - Letter sent from IDOT to MSDGC (copy furnished to Chic District) requesting a meeting to be convened (between IDOT and MSD) t discussion of precipitation discrepancies as described in 7 August letter abo

23 August 1985 - Letter sent from DOJ to IDOT (copy furnished to NCD) response to 5 August letter above. Letter expressed DOJ's continued adheren to views expressed in 10 July letter above (with regard to induced infiltrati issue).

26 August 1985 - Letter sent from Chicago District to IDOT (copy furnished USGS) regarding trend reversal in AVM flow record versus MSD Lockport record normal flow conditions. Letter expressed the fact that, prior to March 19 the AVM record tended to be 300-500 cfs higher than MSD Lockport record normal flows. Letter continued on to discuss trend reversal since April 19 Letter requested expediting of AVM field check and reactivation of MSD sys for streamflow measurements at Lockport until above situation was resolved.

27 August 1985 - Letter sent from NCD to IDOT regarding drawdown of Lockport pool (at Corps' request) for purposes of lock maintenance. Lowering of pool was effective for period of 27-28 August and resulted in increase in diversion (10-15 cfs) on annual basis. Corps recommended drawdown not be charged to diversion.

29 August 1985 - USGS conducted field check showing AVM recording 80% of field calculated flow.

4 September 1985 - Letter sent from NIPC to Chicago District (copy furnished to IDOT) in response to 7 August and 15 August letters above. Letter stated that computations for adjustments to flow at Lockport Powerhouse and Controlling Works were rechecked and enclosed copy of results. Additionally, as requested, letter enclosed copies of computation sheets used in the development of discharge estimates at Lockport. Letter finally stated that hydraulic report for accounting yr. 83 would be modified in accordance with above findings after confirmation of accuracy from Corps.

25 September 1985 - WES provides final report on newly developed rating curves for Lockport Powerhouse sluice gates and Lockport Controlling Works sluice gates to Chicago District.

ANNUAL REPORT

MONITORING OF DIVERSION OF LAKE MICHIGAN WATER AT CHICAGO, ILLINOIS

APPENDIX C

Correspondence

Illinois Department of Transportation

Division of Water Resources
300 North State Street/Room 1010
Chicago, Illinois 60610
Telephone 312/793-3123

May 7, 1984

LTC Christos A. Dovas
District Engineer
Chicago District
U.S. Corps of Engineers
219 South Dearborn-Room 604
Chicago, IL 60604

RE: Diversion Accounting - Induced Infiltration

Dear Colonel Dovas:

We need additional discussions regarding our position that induced infiltration in the Lake Michigan basin is a legitimate deduction under the current United States Supreme Court Decree.

Induced infiltration, as we have defined it, is a component of groundwater which would not have entered Lake Michigan or any other body of surface water in the area if urbanization had not occurred and sewers had not been constructed. It is a component of groundwater pumpage which is not recharged by Lake Michigan and, hence, is an eligible deduction. Induced infiltration, as we have defined it, does not include components of sewer flow which are not eligible deductions, i.e., infiltration attributable to water main leakage, inflow (runoff related, which is accounted for separately), and that quantity of infiltration to the sewer network which would have become base flow to a surface water system. It is essentially that amount of groundwater which, under pre-development conditions, would have been either evapotranspirated or recharged to groundwater aquifers.

The derivation of an estimate of induced infiltration for both the combined sewer area and separately sewered areas within the Lake Michigan basin is difficult, since this flow component cannot be directly measured. However, we believe that the simulation modelling of the Northeastern Illinois Planning Commission and their analysis to determine the additional 'induced' yield of the combined sewer areas is a technically sound procedure, and gives a realistic estimate of the magnitude of induced infiltration. Enclosed with this letter

is a copy of the report NIPC prepared for Harza Engineering as part of our diversion accounting study. Also, the procedure we plan to use to develop the amount of induced infiltration in the combined sewer area and separately sewered area is described on pages 32-34 of the draft Hydraulic Report Manual (pages attached).

I would appreciate the opportunity to further discuss this issue with the District and Division. It is my understanding that your determination that induced infiltration within the Lake Michigan basin is not an eligible deduction stems from a legal interpretation of the wording in the Supreme Court Decree. I would therefore request that both technical and legal staff attend the meeting.

Please feel free to call me to set up an acceptable date for this meeting.

Very truly yours,

Neil R. Fulton
Chief

BUREAU OF RESOURCE MANAGEMENT

NRF:DI:pz

Enclosure

cc: Sandy Solomon, Central Division

U.S. Department of Justice
Office of the Solicitor General

LFC:JRA:AFW
90-1-2-595

Washington, D.C. 20530

July 10, 1985

Brigadier General Jerome B. Hilmes
Commanding
North Central Division
U.S. Army Corps of Engineers
536 South Clara Street
Chicago, Illinois 60606-1592

Dear General Hilmes:

Re: Wisconsin v. Illinois, Nos. 1, 2, 3, Orig.

We are in receipt of your recent letter advising us of Illinois' intent to "take a deduction for induced infiltration for the 1983 water year" and requesting our advice on the matter. You also transmitted the comments of the states of Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin--each of which was opposed to the proposed method of calculating the diversion--and the Metropolitan Sanitary District of Greater Chicago and the Illinois Water Survey Division, both in support of the proposal.

We adhere to our previous advice to you of August 29, 1984 that any change in the approved method of calculating the diversion would require a modification of the decree. In our view, that would be true even if all parties to the litigation agreed to the proposed change. All the more so, of course, if there is not general agreement. As it happens, none of the states involved agrees. Accordingly, we believe that the prudent course for the Corps to follow, once it confirms that the State has put into operation this method of calculating the diversion, is to advise Illinois that its action in changing the approved accounting procedure requires modification of the decree. Inquiry should be made as to Illinois' intentions with regard to seeking such a modification.

We are not taking a position on the merits of the proposal by the State of Illinois, but simply advising that procedurally the proper course for the State to follow is to secure modification of the decree.

As before, we ask that you keep us advised of the communications between the parties, with copies to be sent to Andrew F. Walch of the Lands Division. It will be appreciated if you will also send me copies of the correspondence.

Sincerely,

LOUIS F. CLAIBORNE
Deputy Solicitor General

United States Department of the Interior

GEOLOGICAL SURVEY

Champaign County Bank Plaza
102 East Main Street
Fourth Floor
Urbana, IL 61801
July 16, 1985

Mr. Daniel Injerd
Lake Michigan Management Section
Illinois Department of Transportation
Division of Water Resources
310 S. Michigan Avenue
Room 1606
Chicago, IL 60604

Dear ~~Mr. Injerd:~~ Dan

The calibration test of the acoustic velocity meter (AVM) on the Chicago Sanitary and Ship Canal at Romeoville is a continual process. Occassional discharge measurements are to be made to verify that the flowmeter is functioning as designed and no changes have occurred in the canal cross-section.

Discharge measurements 1-4 and 6-7 were within a range of -0.6 to 4.0 percent of the discharge values obtained from the AVM. This is within our ability to measure flow using a standard Price AA current meter. Measurement 5 (+8.8%) exceeded this range and a discussion of this measurement is in a following section.

A summary listing of discharge measurements, form 9-207, is attached. Measurement #1 used the two-point method of measuring stream velocities, observations are made in each vertical at 0.2 and 0.8 of the depth of water below the surface. The two-point method is the one generally used by the U.S. Geological Survey to measure stream discharge. This measurement was made to verify the discharge output of the flowmeter during installation.

Measurements 2-7 used the vertical-velocity curve method, a series of vertical observations at points well distributed between the water surface and the stream bed. The velocity observations are taken at 0.1 depth increments between 0.1 and 0.9 of the depth. A vertical-velocity curve for each vertical is based on the observed velocities plotted against depth. The mean velocity in the vertical is obtained by measuring the area between the curve and the ordinate axis with a planimeter. This method gives more consistent results and is considered more accurate than the two-point method.

The discharge value, listed in the remarks column on form 9-207, was computed by adding the 15 minute discharge readings from the AVM printout and dividing by the number of 15 minute periods during the time of the discharge measurement.

The accuracy of the measured discharge compared to the flowmeter value is listed in the percent difference column. The percent difference is computed by subtracting the AVM discharge from the measured discharge and dividing by the measured discharge. The percent difference of measurement 1-4 and 6-7 range from -0.6 to 4.0 percent and are within the rating accuracy when using a Price AA current meter. Measurement 5 was made during periods of plus and minus stage fluctuations and a barge passing through the measurement section in a downstream direction.

The AVM operates on a one minute cycle obtaining velocity and stage readings every 2 to 3 seconds which are stored and the 15 minute summary values are printed on the deckwriter. Only one point value of velocity is obtained for one depth elevation in one vertical during a discharge measurement compared to 7 to 14 stage and velocity readings of the whole cross-section obtained by the flowmeter. The AVM discharge is more representative of the canal flow than the discharge measurement during stage fluctuations, closing of the Control Works downstream, and barge traffic through the discharge measurement section.

The cross-sectional area stored within the flowmeter used in the discharge calculation was checked. A stage-area graph (attached) for the AVM was drawn and the area from the discharge measurements was plotted on this relationship. The maximum difference in area found for one measurement (3) was 2.2%.

Our Hydrologic Instrumentation Facility has recently run tests on the water-level sensing device used in the type flowmeter installed at Romeoville. Stage readings were found to be less than 0.10 ft in error.

Based on the analysis of the discharge, cross-sectional area, and water surface elevations obtain from the AVM, we recommend October 1, 1984 as the starting date for publication of the daily discharge values obtained with the AVM.

Sincerely,

Larry G. Foler
District Chief

AWN:LGT:bw
Enclosures

United States Department of the Interior

GEOLOGICAL SURVEY
Champaign County Bank Plaza
102 East Main Street
Fourth Floor
Urbana, IL 61801
July 18, 1985

Mr. Daniel Injerd
Lake Michigan Management Section
Illinois Department of Transportation
Division of Water Resources
310 S. Michigan Avenue, Room 1606
Chicago, IL 60604

Dear Dan,

A procedure to estimate daily discharge values for missing-record periods at Chicago Sanitary and Ship Canal at Romeoville gaging station was established. The procedure uses stage data from the Rock Island Army Corps of Engineers Illinois River Hydraulic Daily Report for Des Plaines River at Brandon Road Lock and Dam, stage data obtained for Des Plaines River at Riverside gaging station, and a regression analysis.

The Hydraulic Daily Report lists 5 reading per day of pool elevation, tainter, and headgate openings. The stage-discharge relation for Brandon Road site (Mades, 1981) is used to convert the stage readings with gate openings into discharge for a time period. These values are added for the day and converted into a daily discharge value. The discharge rating does not include leakage through the headgates which is approximately 850 cfs.

The daily discharge for Des Plaines River at Riverside gaging station is obtained by use of the stage record with the station's discharge rating table and the results of the current discharge measurement.

The discharge value from the Riverside gage is subtracted from the Brandon Road value, the resulting discharge approximates the flow in the Chicago Sanitary and Ship Canal at Romeoville.

A log regression analysis was made using a SAS Institute computer program with 42 concurrent discharges at Romeoville with the discharge at Riverside subtracted from the Brandon Road value (fig. 1). The SAS program lets the user split the sample into two regressions as described

in a report "Use of Qualitative Variables in Regression Analysis" by Wilbert O. Thomas, USGS, Water Resources Division Bulletin, May-August, 1982. The following regression equations were obtained to estimate discharge for the period March 21 to April 17 (Table 1).

If flow at Brandon Road is less than 3980 cubic feet per second (cfs)

$$v_2 = \text{Antilog } (0.565 \log v_1 + 1.56$$

If flow at Brandon Road is more than 3980 cfs

$$v_2 = \text{Antilog } (1.121 \log v_1 - 0.41)$$

$$R_2 = 0.971 \text{ with a standard error of estimate of } 9.2\%$$

where,

v_1 = Daily discharge at Brandon Road minus Riverside value

v_2 = Estimated Daily discharge at Chicago Sanitary and Ship Canal at Romeoville

To test the above equations the May 7 to June 6 period was estimated and compared to the daily discharge obtained from the flowmeter. The results show a maximum daily error of 34 to -38 percent with an average error for the period of -1.2 percent. The individual error may be large for only one day comparison but for extended periods an average error of 1.2 percent is acceptable. Table 2 lists the discharge figures used and estimated for this study.

In the future for periods of no record this procedure will be used after testing a few discharge values before and after the missing record period to see if the regression analysis is valid or a new analysis will be developed using the above procedures.

Reference

Mades, D.M., 1981, Stage-discharge relation at dams on the Illinois and DesPlaines Rivers in Illinois: U.S. Geological Survey open-file report, 81-1009, 56 p.

Sincerely,

Allen W. Noehre

Allen W. Noehre
Surface Water Specialist

AWN:bw
Enclosure

Illinois Department of Transportation
Division of Water Resources
310 South Michigan Avenue / Room 1606
Chicago, Illinois 60604

August 5, 1985

Mr. Andrew S. Walch
Lands Division
Office of the Solicitor General
U.S. Department of Justice
Main Justice Building
10th & Constitution Avenue, N.W.
Washington, D.C. 20530

Dear Mr. Walch:

I recently received a copy of a July 10, 1985 letter from the Department of Justice to Brigadier General Hilmes directing the Corps of Engineers to inform the State of Illinois that one element of our new diversion accounting procedures (induced infiltration, or more properly, sewer induced groundwater pumpage) cannot be included without modifying the United States Supreme Court Decree.

I am disappointed that the State of Illinois was not involved in the discussions and negotiations between the Corps of Engineers and the Department of Justice in this matter. I deeply regret that we were unable to offer our comments and opinions regarding the acceptability of the sewer induced groundwater pumpage component prior to the Department of Justice taking a position. Nevertheless, I would still like to convey our reasons why we believe this hydrologic component needs to be included in our accounting system and is appropriate for us to do so in compliance with the decree.

Subsequent to the approval of the amended decree in 1980 and the followup work of the Corps of Engineers' Three Member Committee and our own consultants, Illinois has invested a tremendous amount of time and money aimed at improving the accuracy with which we measure and compute our diversion of water from Lake Michigan. Building on many of the recommendations of the Three Member Committee and of our consultant, we have developed an improved diversion accounting system. This accounting system incorporates state of the art technology in flow measurement and in computer simulation of complex urban watershed areas. For example, in cooperation with the U.S. Geological Survey, we have installed an accoustic velocity flowmeter system to measure total flows passing the Sanitary and Ship Canal near Lockport. We have also contracted with the Northeastern

Illinois Planning Commission to take advantage of their computer capabilities to develop a system of checks and balances to ensure that the many hydraulic components which are necessary to compute our diversion are accurate and representative of the hydraulic characteristics of this heavily urbanized area.

In consultation with the Corps of Engineers, the State of Illinois decided to use this improved diversion accounting system beginning with the 1983 accounting year. Recently we sent the Corps a revised manual of procedures for measuring and accounting Illinois' diversion along with a annual hydraulic report for the 1983 water year.

I would like to emphasize that the development of these improved diversion accounting procedures are entirely consistent with the general accounting guidelines specified in paragraph 2 of the decree. Furthermore, our efforts to improve diversion accounting reflect a desire to implement the guidance contained in paragraph 3 that states:

> "all measurements and computations required by this decree shall be made by the appropriate officers, agencies or instrumentalities of the State of Illinois . . . using the best current engineering practice and scientific knowledge."

I believe that the improvements incorporated into the 1983 diversion accounting report follow this guidance.

After 1-1/2 years of reviewing the subject of sewer induced groundwater pumpage, the Corps of Engineers has concluded that our method of calculating the quantity of this component is technically sound, and more importantly, that this hydrologic component is not Lake Michigan water. Since they have concluded that sewer induced groundwater pumpage is not Lake Michigan water but rather is groundwater, I don't see how the decree can be interpreted so that this component should be overlooked, or ignored by the state in its diversion accounting procedures.

I believe this would set a new precedent that clearly is contrary to the intent of the decree by not allowing Illinois to claim as a deduction a specific component of groundwater flow. In fact, it is our opinion that by not properly accounting for sewer induced groundwater pumpage (a deduction to the total flow at Lockport) we are being directed by the Corps and the Department of Justice to violate the decree.

It has been our belief that the decree specifies a general accounting framework designed simply to require Illinois to report

as diversion all Lake Michigan water withdrawn from the lake and not returned and the stormwater runoff which has been prevented from reaching the lake. Over the years, numerous changes and improvements have been made to the accounting procedure to reflect changing hydraulic conditions and improvements in the ability to measure and account for both diversion and non-diversion flows. In the past, these changes have been recommended by the State of Illinois and approved by the Corps of Engineers without any formal approval process being forwarded to either the Department of Justice or to the other parties to the decree. Rather we, and I assume the other parties, have assumed this to be a proper exercise of the Corps supervisory role.

By abdicating this supervisory role over this particular flow component, they cast serious questions about the propriety of all the previous changes that have been made to the accounting procedure. Of more concern to Illinois, however, is the obvious inconsistency of singling out one minor component of our new diversion accounting procedures and concluding that legally this revision requires specific court approval while at the same time an entirely upgraded diversion accounting system has been incorporated which has not gone through the same level of review to the other parties or to the Department of Justice that the sewer induced groundwater pumpage component has.

I believe that the decree shows a clear indication by the Court that they do not wish to be involved in the technical matters pertaining to specific components of Illinois diversion. Rather they have assigned that role to the Corps of Engineers, and we believe it most appropriate for them to make these decisions based on the technical merits of whether it is or is not a component of Illinois' diversion.

I urge the Department of Justice to review their position on this matter. At a minimum I would request a more detailed legal explanation as to why the Department of Justice feels that sewer induced groundwater pumpage is not an eligible deduction under the decree.

The magnitude of the sewer induced groundwater pumpage deduction is small compared to the overall diversion. However, we are extremely reluctant to manage a diversion accounting program that does not represent our best efforts at diversion accounting and which is not reflective of the best scientific knowledge and engineering practice available to us.

I believe it would be in our best collective interests to continue our discussions on this issue. I would welcome the opportunity to meet with you on this issue. Please feel free to call me at (312) 793-3123 if you need additional information or to set up a meeting.

I urge the Department of Justice to review their position on this matter.

Very truly yours,

Neil R. Fulton
Chief

BUREAU OF RESOURCE MANAGEMENT

NRF:DI:dn
cc: Zane Goodwin, NCD
08411

August 23, 1985

Mr. Neil K. Fulton, Chief
Bureau of Resources Management
Illinois Department of Transportation
Chicago, Illinois 60604

Dear Mr. Fulton:

Re: Nos. 1, 2, 3, Orig., Wisconsin v. Illinois.

We have given careful consideration to your letter of August 5, 1985 to Andrew F. Walch and continue to adhere to the views expressed in our letter of July 10, 1985 to the Corps of Engineers.

One of the bases for the modification of the 1967 decree adopted by the parties in 1980 was a 30% imperviousness factor to approximate the conditions of the entire Lake Michigan diversion watershed at that time due to urbanization, with provision for exceeding the allowable diversion of 3200 cfs by 15% due to uncertainties created by the short period of record and "the likelihood of increased runoff resulting from urbanization". Wisconsin v. Illinois, 449 U.S. 48, 53 (Statement of Intent and Technical Basis for Proposed Amendments to 1967 Decree). The "induced infiltration" deduction is just one of several components of urbanization which impacts on the runoff hydrology of the basin, an extremely complex phenomena that is incapable of precise measurement. By singling out one factor as a deduction without relating "induced infiltration" to other factors effecting the runoff hydrology or to the 30% imperviousness factor previously agreed to as a basis for the 1980 modification to the decree is, in our view, an impermissible increase in the amount of diversion from Lake Michigan. Absent a further modification of the decree, Illinois should not deduct the amount of calculated induced infiltration from Lockport flows. We also note that each of the States in these proceedings has objected to a unilateral deduction by the State of Illinois.

We appreciate the efforts taken by the State of Illinois, working in close cooperation with the Corps of Engineers, to better quantify and account for the water diverted from Lake Michigan. "Induced infiltration" is precisely the type of factor impacting the diversion with which the Supreme Court has concerned itself in the past. We trust that our views will assist you in determining whether to seek modification of the decree to allow for this deduction.

Sincerely,

Louis F. Claiborne
Deputy Solicitor General

cc: Frank Forak, Esquire
Army Corps of Engineers
North-Central Division
536 S. Clark Street
Chicago, Illinois 60605