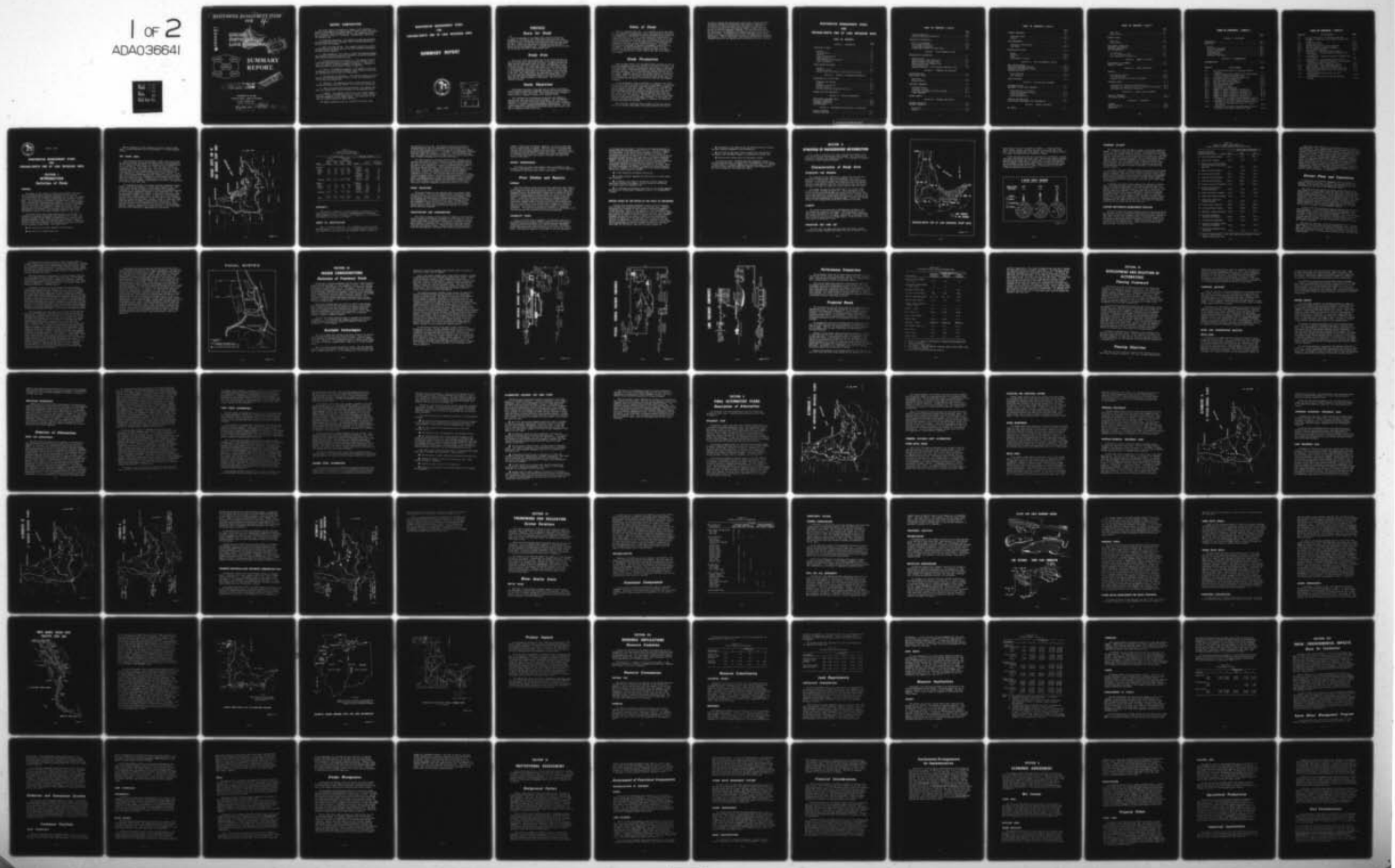
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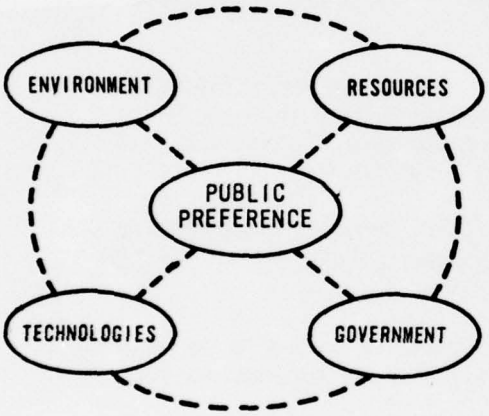


WASTEWATER MANAGEMENT STUDY FOR CHICAGO SOUTH END of LAKE MICHIGAN

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SUMMARY REPORT.

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DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, CORPS OF ENGINEERS
219 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60604

APRIL 1974
166p.
410 079

REPORT COMPOSITION

The survey report is divided into a Summary, and 9 Appendices. A charge for each appendix and Summary Report to cover the cost of printing will be required, should purchase be desired. The appendices each contain a different category of information. Alphabetically identified, the appendices are:

A. Background Information - This appendix includes the population and industrial projections, wastewater flows and the engineering data used as a basis for planning.

B. Basis of Design and Cost - This appendix contains the criteria and rationale used to design and cost the final alternative wastewater treatment system components.

C. Plan Formulation - This appendix presents the planning concepts and procedures used in developing the alternative wastewater management plans that were examined during the study.

D. Description and Cost of Alternatives - This appendix contains a cost description and construction phasing analysis for each of the final five regional wastewater management alternatives. Components of these alternatives are described in detail in Appendix B.

E. Social - Environmental Evaluation - This appendix provides an assessment of the social and environmental impacts likely to arise from the implementation of the final five alternatives.

F. Institutional Considerations - This appendix presents an assessment of the institutional impacts likely to arise from implementation of the final five alternatives.

G. Valuation - This appendix presents a broad evaluation of the implications and use potential inherent in the final five alternatives.

H. Public Involvement/Participation Program - This appendix documents the program used to involve the public in the planning process.

I. Comments - This appendix contains all of the formal comments from local, State and Federal entities as the result of their review of the other appendices and the Summary Report. Also capsulized are the views of citizens presented at public meetings.

The Summary document presents an overview of the entire study.

WASTEWATER MANAGEMENT STUDY
FOR
CHICAGO-SOUTH END OF LAKE MICHIGAN AREA

SUMMARY REPORT



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PREFACE

Basis for Study

With the enactment of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) new national goals have been established for the elimination of pollutant discharges into our streams and lakes. During the time that this legislation was being considered, five pilot studies were authorized to evaluate the implications of meeting such an environmental goal. Included among the five was a study for the Chicago-South End of Lake Michigan area.

Study Area

The bi-state study area includes most of the Chicago Metropolitan area of Illinois and a significant portion of the highly urbanized and industrialized northwestern corner of Indiana. Encompassed within the study area are some 2,600 square miles and a 1970 population of about 7.2 million people. As a major urban center, the area trends indicate a continuous growth pattern over the next 50 years. By the year 2020, it is estimated that approximately 11 million people will be residing in the area. More significantly, the land usage will change with much of the existing rural lands being converted to suburban usage. Thus, over time, the multi-governmental structure that now exists will be faced with the complex problems of urban growth - and the need for areawide solutions.

Study Objectives

The primary objectives of the study were to identify and evaluate viable alternative wastewater management systems that would be responsive to the intent of Public Law 92-500. These alternatives were designed to offer an array of regional solutions to an areawide problem.

Also considered was the potential for multiple-use planning in meeting local water and related land requirements. This included the opportunities for effectively recycling and reusing the area's natural resources. In addition, the on-going regional planning goals for meeting current water quality standards and guidelines were evaluated. This was done to identify the implications of the new national water quality goals and as a planning service to the area.

Value of Study

This is a planning study only. It is intended to assist the States and local agencies in northeastern Illinois and northwestern Indiana who are responsible for implementing wastewater management systems responsive to the provisions of PL 92-500. In net effect, the study provides a framework for decision. The three basic technologies which can be used to meet the national water quality goals are identified along with the design of each process. Also, the implications of incorporating these technologies into areawide plans have been evaluated. As would be expected, each technology and wastewater management system differs in its impacts. By identifying these variations in impact, and the potential for multiple-use planning, logical decisions as to which system, or portion thereof, is best suited to the area can be made by the residents.

Study Perspective

There are many factors to be considered before selecting the type of wastewater management system most suitable to the needs of the area. The three technologies capable of achieving the national goal of eliminating pollutants involve the Advanced Biological, Physical-Chemical and Land treatment processes. Each of these processes together with the rest of the system's components will affect the economic structure, resource use, environment, community cohesion and institutional make-up of the study and outlying areas. In net effect, such basic values as home-rule, cost to the taxpayer and the region's life style are tied into the planning framework.

As the environmental clean-up continues on a national scale, many decisions will have to be made at all levels of government. Of particular concern will be the priority of commitment accorded this environmental goal as opposed to other public needs. Included in this study are four multiple-purpose alternatives responsive to the national water quality goal. This implies that the wastewater management system could and does serve as a primary vehicle in meeting the water and related land needs of the area. In some cases, the system provides the resource base with which other benefits can be readily attained. In other cases, the potential for achieving the added benefit is enhanced, but additional resource commitments are required.

One of the most significant factors common to these four alternatives is the resource requirements (including financial) that will be

involved in meeting the national water quality goal. Because the level of resource expenditures are beyond a level heretofore experienced, a time-phasing of these commitments might ultimately be preferred. If so, the four alternatives, being multiple-purpose in nature can also provide an effective management framework. The rate with which any of the alternatives are implemented will depend on the priority for solving the area's needs. The programs for pollution abatement, flood control, potable water supply supplementation, stream flow augmentation, recreation improvements, wildlife conservation, open-space preservation and floodplain management generally are separable and can be phased over time if desired.

WASTEWATER MANAGEMENT STUDY
FOR
CHICAGO-SOUTH END OF LAKE MICHIGAN AREA

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APRIL 1974

WASTEWATER MANAGEMENT STUDY FOR CHICAGO-SOUTH END OF LAKE MICHIGAN AREA

SECTION I
INTRODUCTION
Definition of Study

PURPOSE

The purpose of this study is to identify and evaluate viable alternative areawide wastewater treatment technologies and systems that: (1) would eliminate the discharge of pollutants into the lakes and streams of the study area; and (2) could be incorporated into areawide or regional plans. Also examined was the potential for multiple-use planning, from both a resource conservation and reuse standpoint. All of these considerations are contained in the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) enacted by Congress on 18 October 1972. In addition, an alternative responsive to current water quality standards and guidelines was evaluated. This was done in order to identify the implications of going to the higher standards adopted for this study.

The national water quality goal established by PL 92-500 seeks to eliminate the discharge of pollutants into navigable water by 1985. The law also encourages the development and implementation of areawide waste treatment management plans. The plans would assure adequate control of pollutant sources and, implicitly, provide economies in cost. Furthermore, the law stresses the desirability of incorporating conservation practices into the treatment system design. This could involve:

- The recycling of nutrients combined in the wastewater;
- The reuse of the treated water; and

● The combining of system components with other resource commitments to provide additional social, environmental, or revenue-producing returns.

THE STUDY AREA

The Chicago-South End of Lake Michigan (C-SELM) study area includes all lands in Illinois and Indiana which drain either to Lake Michigan or the Des Plaines River upstream of its confluence with the Kankakee River. All, or portions of, four counties in Illinois and three counties in Indiana are included in the study area. The four counties in Illinois, which encompass some 2,589 square miles, had a 1970 population of about 6,620,000; and the three Indiana counties, which have a land area of 1,545 square miles, supported a 1970 population of some 736,000. Of the total of 4,134 square miles making-up the 7 counties, about 63 percent or some 2,600 square miles are included within the drainage boundaries which define the study area proper. Residing within this study area, in 1970, were about 7.2 million people or approximately 97 percent of the population of the entire seven county area.

The formulation of plans for regional wastewater management systems, however, involved consideration of a much larger geographic area - due to the various options available in designing the system components. Consequently, the initial planning effort involved considerations relating to the 12 counties immediately adjacent to the C-SELM study area. This was subsequently reduced to 10 counties as additional information became available and as designs were refined. In addition, special consideration was given to the reclamation of strip-mined areas in Knox and Fulton Counties, Illinois and Clay County, Indiana. Figure I-1 shows the C-SELM study area and the 10 counties in the adjacent outlying area. Table I-1 lists the land area and 1970 population for the seven counties lying, partially or wholly, within the study area and also for the ten adjacent counties. These ten counties have a total land area of some 5,400 square miles and a 1970 population of approximately 611,000 people.

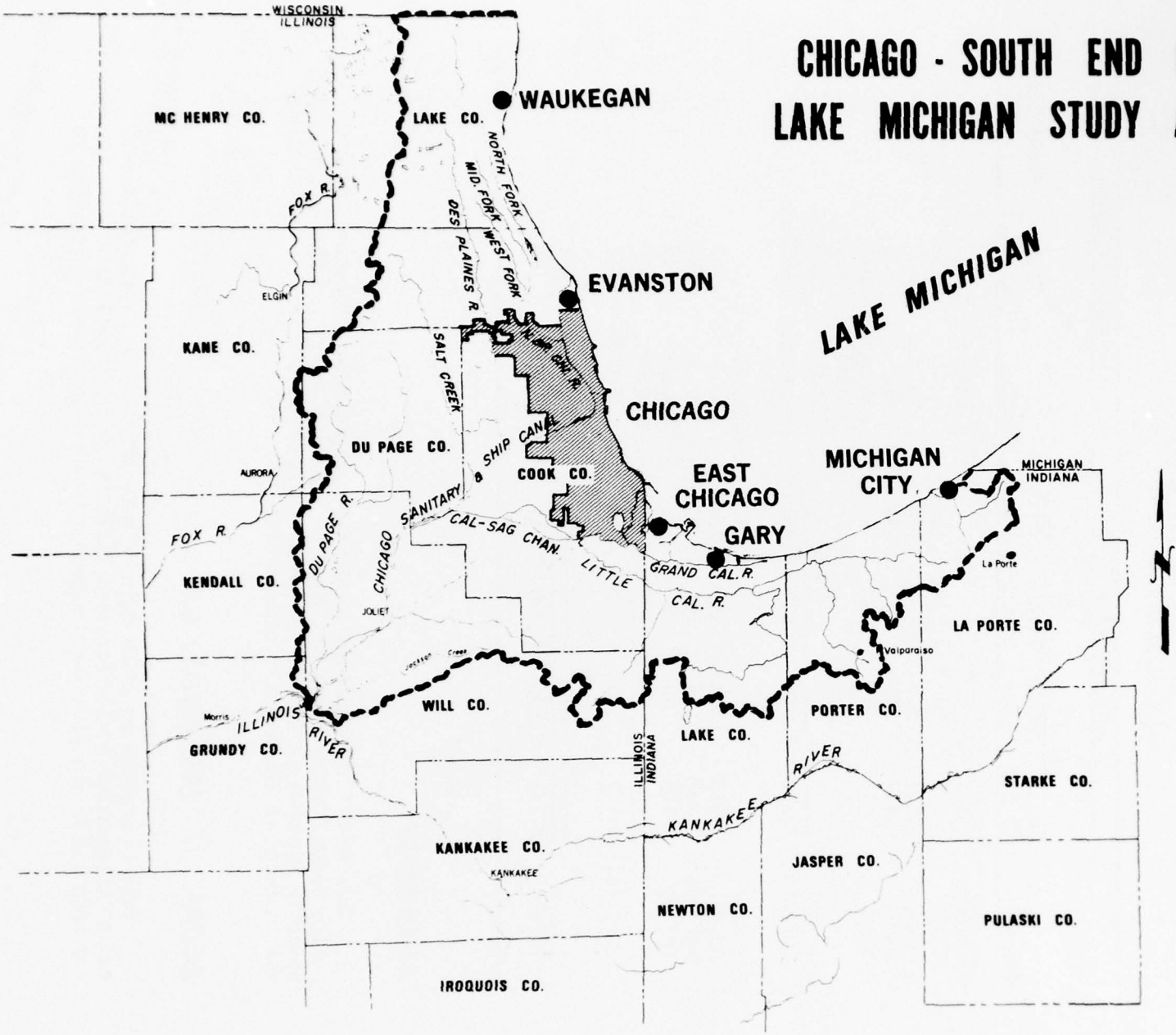

CHICAGO - SOUTH END OF
LAKE MICHIGAN STUDY AREA
WISCONSIN
ILLINOIS
MC HENRY CO.
LAKE CO.
WAUKEGAN
NORTH FORK
MID. FORK WEST FORK
DES PLAINES R.
FOX R.
ELGIN
EVANSTON
LAKE MICHIGAN
KANE CO.
SALT CREEK
CHI. R.
CHICAGO
DU PAGE CO.
SHIP CANAL
COOK CO.
MICHIGAN CITY
MICHIGAN
INDIANA
AURORA
EAST CHICAGO
GARY
FOX R.
DU PAGE R.
CHICAGO SANITARY
CAL-SAG CHAN.
LITTLE CAL. R.
GRAND CAL. R.
La Porte
KENDALL CO.
JOLIET
LA PORTE CO.
Valparaiso
Jackson Creek
Morris
ILLINOIS RIVER
WILL CO.
PORTER CO.
GRUNDY CO.
ILLINOIS
INDIANA
LAKE CO.
RIVER
STARKE CO.
KANKAKEE
KANKAKEE CO.
KANKAKEE
JASPER CO.
NEWTON CO.
PULASKI CO.
IROQUOIS CO.

Figure I-1

Table I-1
Area and 1970 Population
of C-SELM and Adjacent Counties

	C-SELM Counties				Adjacent Counties		
	Area (sq. mi.)		Population (1,000s)				
County	Total County	Study Area	Total County	Study Area	County	Area (sq. mi.)	Population (1,000s)
Illinois:					Illinois:		
Cook	954	905	5,494	5,452	Grundy	432	27
DuPage	331	320	493	489	Iroquois	1,122	34
Lake	457	330	383	313	Kane	520	251
Will	847	490	250	227	Kankakee	678	97
					Kendall	320	26
					McHenry	610	112
Subtotal	2,589	2,045	6,620	6,481	Subtotal	3,682	547
Indiana:					Indiana:		
Lake	513	260	546	524	Jasper	562	20
LaPorte	607	205	104	67	Newton	413	12
Porter	425	90	86	75	Pulaski	433	13
					Starke	310	19
Subtotal	1,545	555	736	666	Subtotal	1,718	64
TOTAL	4,134	2,600	7,356	7,147	TOTAL	5,400	611

AUTHORITY

This report is submitted in specific response to resolutions of the Public Works Committees of the House of Representatives and the Senate dated 10 November 1971 and 23 November 1971, respectively. The resolutions are included in the Annex to this report.

SCOPE OF INVESTIGATION

This is a planning study only. It is intended to assist the States and local agencies in northeastern Illinois and northwestern Indiana who are responsible for planning wastewater management systems responsive to

the provisions of PL 92-500. Such technical assistance should help designated agencies meet the requirements of Section 201(g)(2)(A) of PL 92-500 which stipulates that after 30 June 1974, requests for Federal grants must demonstrate that (1)...."alternative waste management techniques have been studied and evaluated..."; and (2)"... the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works..."

The study documents the planning objectives and strategies used to formulate and assess the array of alternative systems considered during the course of the investigation. It also presents engineering criteria pertinent to the technologies and design of treatment systems capable of meeting the new national goals. From a planning standpoint, the alternative systems were structured to meet the long-term needs for the year, 2020. Final design, though, was based on the more immediate requirements of 1990. An evaluation was made of each alternative retained for final study. This involved individual assessments of costs, social-environmental effects, resource use and conservation, institutional aspects, management options, multiple-use opportunities, public response, phasing and implementation programs, and considerable related technical data. These findings can be used by the States and local entities in selecting a wastewater management program best suited to their needs.

STUDY OBJECTIVES

The primary objective of the planning study is to provide a framework for decision. This involves identifying the technologies capable of meeting the criteria of "no discharge of critical pollutants" (NDCP) and evaluating the implications of incorporating these technologies into areawide plans. As would be expected, each technology and wastewater management system will differ in its impact. By identifying the variations in impact and the potential for multiple-use planning, logical decisions can be made concerning the selection of a system and its functional components.

PARTICIPATION AND COORDINATION

This study is complex, not only because it addresses highly technical issues concerned with wastewater treatment, but also because it seeks to include a multitude of related items dealing with environmental concerns, social aspects and regional needs. To effectively investigate the many facets involved in the study, the Chicago District sought and received assistance from numerous sources. These included responsible Federal, State and local agencies; consultants under contract; representatives of

commerce, industry and the academic community; farm leaders; environmentalists; and the public in general. While most of this assistance came from the study's Advisory Committees and Work Groups, a significant contribution was made through public forums and meetings. This participation is explained in greater detail throughout this report and appendices. This assistance was appreciated and has strengthened the quality and results of the study.

REPORT ARRANGEMENT

The details of survey scope planning study are presented in nine appendices and summarized in this report. A listing of the nine appendices is presented on the inside front cover of this report.

Prior Studies and Reports

GENERAL

There are numerous studies which have been conducted by other agencies or organizations concerning various topics pertinent to this study. These topics ranged from land use and population growth to regional wastewater management plans by the Northeastern Illinois Planning Commission and the Northwestern Indiana Regional Planning Commission, as well as the future programs of the Metropolitan Sanitary District of Greater Chicago and others. In addition, the Upper Mississippi River Comprehensive Basin Study and the on-going Great Lakes Basin Commission Study provided a broad based, regional analysis of water and related land resource needs. Since all or portions of the C-SELM area were included, the findings of these two latter reports served as this study's framework for reuse considerations. These studies are discussed in Appendix A - Background Information. Two other investigations are of particular significance to this area and study and are discussed in the following paragraphs.

FEASIBILITY STUDY

Early in 1971 the Corps of Engineers, in cooperation with the U. S. Environmental Protection Agency (USEPA), undertook five pilot planning studies to examine the feasibility of regional wastewater management alternatives for five key urban areas across the nation. The Greater Chicago Metropolitan Area and its environs was one of the sites investigated. That study was completed in the summer of 1971 and published as

a two volume report entitled: "Alternatives for Managing Wastewater in Chicago-South End Lake Michigan Area, July 1971." The study recognized that improvement of the water pollution abatement program was a matter of high priority in the nation's overall commitment to improve its environment and enhance its quality of life. To achieve a more effective pollution abatement program, the study explored alternative wastewater management systems that extended beyond the present level of areawide control. This included the examination of providing treatment beyond the level being considered in local plans and involved three different technologies (Advanced Biological, Physical-Chemical, and Land). While all three technologies were capable of attaining the desired objective and level of treatment, it was concluded that a more detailed planning effort (this study) should be initiated:

- To fill identified information deficiencies;
- To answer concerns regarding the effectiveness of various treatment processes;
- To develop a full range of alternatives and then compare the implication involved, with emphasis placed on gathering information on certain systems and components; and
- To investigate institutional considerations and include suggested modification to institutional arrangements necessary for implementation of plans.

SPECIAL STUDY BY THE OFFICE OF THE CHIEF OF ENGINEERS

The five Pilot Wastewater Management Program Feasibility Reports, which included the Chicago-South End of Lake Michigan study, contained preliminary cost estimates for the alternative wastewater management systems developed. Despite a clear warning as to the preliminary nature of the capital and annual costs presented in the reports, the cost figures were used out of context to justify a position that some waste treatment management systems were too costly to warrant serious consideration. Based on the nature of the cost data used, such conclusions were not justified or supportable. To place the cost of alternatives into perspective, the Office of the Chief of Engineers undertook a special study. The Chicago Metropolitan Area was selected from among the five pilot study areas for the special study with the express purpose of:

- Formulating a more realistic and cost-effective basis for designing waste treatment management system alternatives;

- Detailing the applicable items of capital costs and operation, maintenance, and replacement charges of the alternative systems; and

- Analyzing the relative merits of alternative systems.

The report entitled: "Regional Wastewater Management Systems for the Chicago Metropolitan Area, March 1972", was published in three volumes, a Summary Report, a Technical Appendix and a Cost Data Annex. As expected the special study identified significant omissions and discrepancies in the costs developed for the feasibility studies.

SECTION II

SYNOPSIS OF BACKGROUND INFORMATION

Prior to the initiation of this study, information pertinent to the study area and design considerations were obtained. This information is presented in Appendix A and summarized below. It is provided to establish an overview of the planning environment.

Characteristics of Study Area

TOPOGRAPHY AND DRAINAGE

The topography of the C-SELM area is comparatively flat with poor definition existing between some of the watersheds. This lack of separation or elevation was caused by the glaciers which passed through the area. As the glaciers melted, they overlaid the area with material ranging in depth upwards to 400 feet. The few hilly areas that do exist are made up of broad, low ridges and contain numerous lakes and swamps.

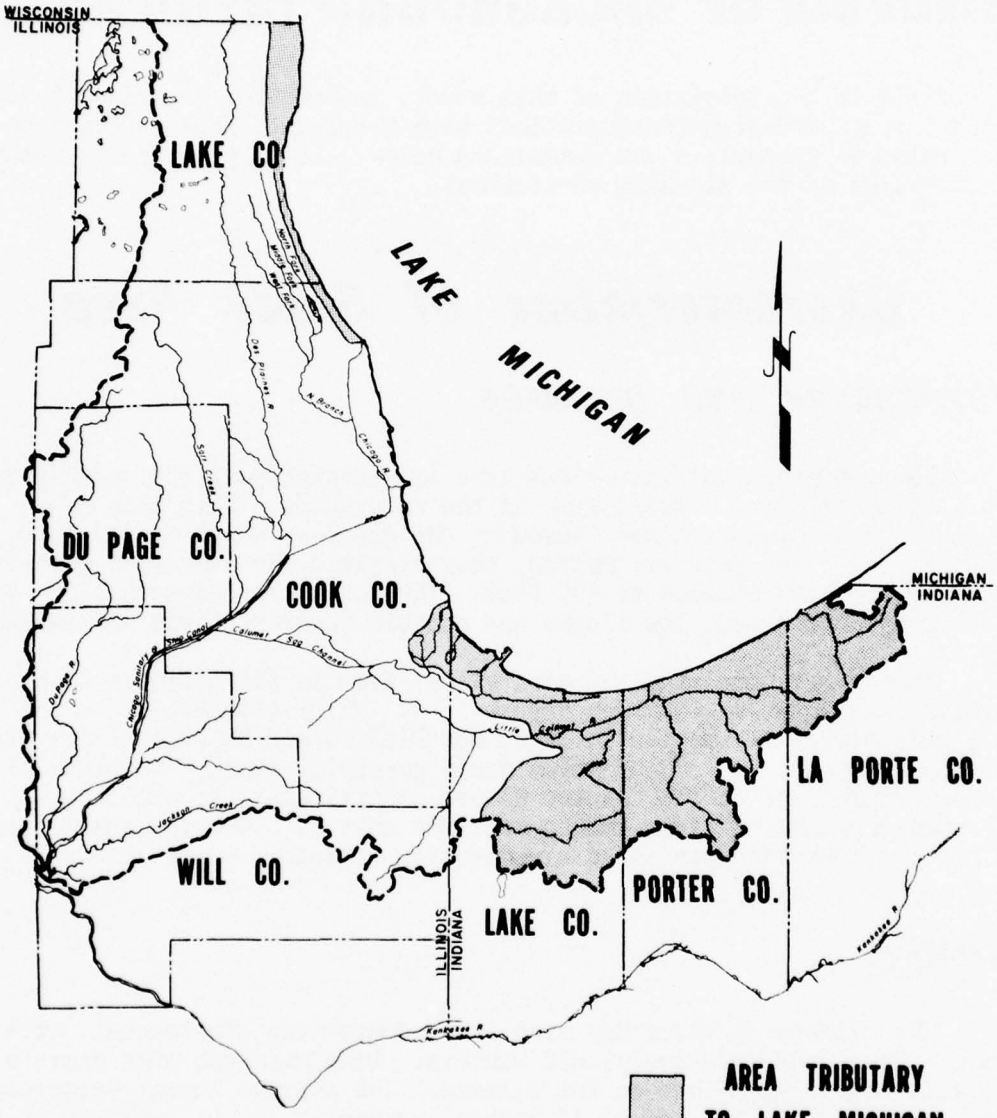
The streams draining the area either flow to the Illinois River, or Lake Michigan, as shown on Figure II-1. Major tributaries to the Illinois River include the Chicago, Des Plaines and Du Page Rivers plus the Cal-Sag Channel, all of which drain generally south. Portions of the Grand Calumet and Little Calumet Rivers are tributary to both the Cal-Sag Channel and Lake Michigan due to man-made changes. Several small streams along the Lake Michigan shore are directly tributary to the Lake.

CLIMATE

The climate in the study area is predominantly continental, with warm summers and relatively cold winters. Lake Michigan does exert a partial modifying effect on the climate. The average annual temperature and rainfall are 50°F and 33.18 inches, respectively, as measured at the Central Weather Bureau Station at Midway Airport. About one-tenth of the total annual precipitation is snow.

POPULATION AND LAND USE

The study area lies almost entirely within the Chicago, Illinois-Northwestern Indiana Standard Consolidated Area (SCA) as defined by the



CHICAGO-SOUTH END OF LAKE MICHIGAN STUDY AREA

Figure II-1

Census Bureau of The U.S. Department of Commerce. A small portion of LaPorte County, Indiana, outside of the SCA is also within the C-SELM area. The SCA includes Lake, Cook, DuPage, Kane, Will and McHenry Counties in Illinois, and Lake and Porter Counties in Indiana.

Present and projected land use is categorized as residential, regional open-space, agricultural and vacant lands. The two major regional planning agencies have developed plans for future land use in which they emphasize that developments should follow transportation corridors with open-space and recreational acreage between them. Figure II-2 shows the anticipated trends in population and land use (urban, suburban and rural) for the C-SELM area during the next 50 years.

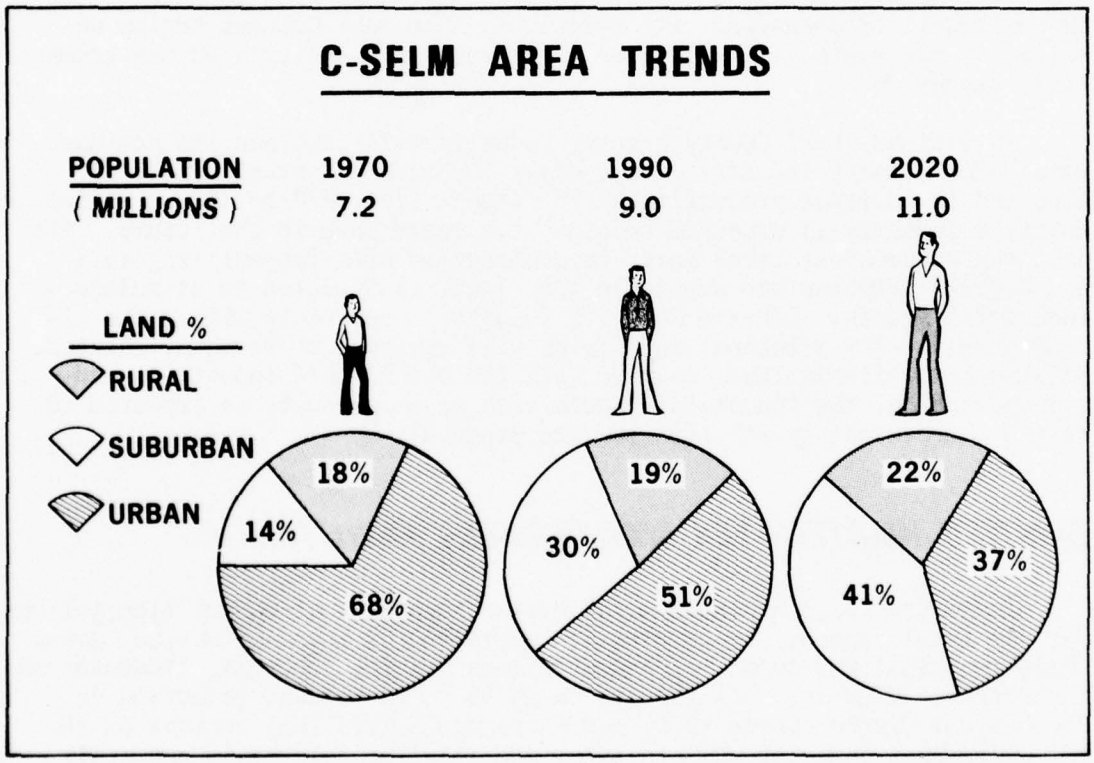


Figure II-2

ECONOMIC ACTIVITY

The foundation of the study area's economy is its diverse industrial complex. Presently, industrial jobs account for approximately 40 percent of the wages and salaries earned in the area. The primary industry groups and their specific values of output are displayed in Table II-1. The major industry, on the basis of value of production, is primary metals which also leads in volume of wastewater discharge. The next three highest ranking industry groups, electrical equipment, non-electrical machinery and fabricated metals, are all linked directly or indirectly to the primary metals industry. With regard to the future, industrial growth in the Chicago Metropolitan Area is expected to continue at a rate above the national average.

In Illinois, the major industrial growth areas beyond the 1970 decade will be in those counties, or sections thereof, which have vacant land in greatest abundance. The central city, even with industrial land clearance projects, will be unable to create sufficient vacant land to accommodate those industries demanding city locations. The Lake Calumet Region on Chicago's far south side will play a key role in the city's future industrial expansion.

In Indiana, Lake County's heavy industry will continue its dominant role. The largest industry group, blast furnaces and steel mills, is expected to increase production by 73 percent from 1970 to 2020. Porter County's industry is expected to grow at a rapid pace in the future. Its new deep water Great Lakes Port, in combination with the existing rail and highway networks and available open land, is expected to stimulate industrial growth. LaPorte County's industrial center is within the C-SELM area. Its principal industries will continue to be metal related. Because of available land, coupled with its established industries and transportation, the industrial growth rate of this county is expected to exceed the overall growth rate for the study area.

EXISTING WASTEWATER MANAGEMENT FACILITIES

There are 132 municipal sewage treatment plants of one million gallons per day (MGD) capacity or greater now operating in the C-SELM study area. These municipal wastewater treatment plants provide secondary treatment in most cases. Usually, this results in an 85 to 90 percent reduction in Biochemical Oxygen Demand (BOD) and Suspended Solids (SS) content of the raw wastewater entering the plants. Industrial wastewater is generally treated by the user industry itself, though, some are treated by the municipal plant servicing that area.

Table II-1
Industrial Output (Value Added) for
Chicago-Northwest Indiana Standard Consolidated Areas

Standard Industrial Classification (SIC)	Year -	Value Added ($1,000,000) 1958	1963	1967
20	Food and Kindred Products	1191.7	1424.3	1681.3
22	Textile Mill Products	48.9	43.8	37.5
23	Apparel and Finished Products made from fabrics and similar materials	206.3	212.6	228.0
24	Lumber and Wood Products	D	52.9	69.3
25	Furniture and Fixtures	161.6	196.3	246.4
26	Paper and Allied Products	222.0	303.9	431.5
27	Printing and Publishing	821.1	1058.1	1416.1
28	Chemicals and Allied Products	731.4	1044.9	1308.8
29	Petroleum Refining and Related Industries	190.1	233.3	345.2
30	Rubber and Plastic Products	154.1	265.7	352.0
31	Leather and Leather Products	60.6	59.5	74.1
32	Stone, Clay, Glass and Concrete Products	243.5	268.2	311.7
33	Primary Metal Industries	1395.4	1793.9	2146.4
34	Fabricated Metal Products	997.1	1266.0	1583.2
35	Machinery, except Electrical	947.0	1227.6	1760.7
36	Electrical Machinery, Equipment and Supplies	1193.0	1407.9	1926.0
37	Transportation Equipment	462.3	404.3	685.5
38	Technical Instruments, Photo and Optical Equipment	250.2	387.4	539.5
39	Miscellaneous Manufacturing Industries	240.0	269.7	345.2

1/ Census of Manufacturers', 1967, 1963; 1958 Chicago-Northwest Indiana Standard Consolidated Area.

Approximately 400 square miles of the study area are serviced by combined sewers. These combined sewers carry both wastewater and storm water runoff and are of primary concern because of their potential impact to public health and adverse effect on water quality whenever they overflow to local streams. Combined sewer systems are designed to spill excess flows into a receiving stream whenever the sewer's capacity is exceeded. Typically, combined sewers deliver dry weather (municipal) flows to an interceptor sewer which conveys the flow to the treatment plant; but rainfalls of only 1/2 to 1-1/2 times dry weather flows, a fairly common occurrence, result in overflows to the waterways. In addition, most sewage treatment plants have facilities to by-pass raw sewage when the volume of wastewater arriving at the plant exceeds the treatment plant's capacity. The combined impact of overflows and by-pass on stream water quality is significant.

Current Plans and Constraints

To insure that the wastewater management study was responsive to local objectives and concerns, the area's plans and constraints were examined. Where feasible, these proposals and requirements were then incorporated into the study's plan-formulation process.

Many plans have been proposed for meeting various portions of the area's needs, but legal problems, political feasibility and funding have prevented their implementation. Within the seven county study area there are two regional planning agencies. The Northeastern Illinois Planning Commission's (NIPC) area of responsibility includes all four of the counties in Illinois, while the Northwestern Indiana Regional Planning Commission (NIRPC) covers Lake and Porter Counties, Indiana. The LaPorte County Planning Commission accounts for the seventh county in the study area. Studies completed by the two regional planning agencies have indicated the utility of a regional resource management approach.

A study by NIPC has established a suggested regional plan for wastewater management. It would consolidate the existing treatment systems, expand and upgrade some of the existing facilities and construct some new plants to replace those that would be abandoned. One of the objectives is control of the area's growth pattern by limiting access to the collection and conveyance system. In this way a land-use control could be adopted that would maintain open-space usage between corridors of urban and suburban development.

Open space has more than a social and environmental value. The open-space areas can also be used to hold water, permanently or on a temporary basis. When this is done, the low-lying areas including flood plains can also serve to minimize the losses from storm water runoff. Both NIPC and NIRPC have these types of multiple-purpose open-space plans to balance and control growth.

The Metropolitan Sanitary District of Greater Chicago (MSDGC) is currently improving its system's operational and treatment level. Included in its upgrading program is the "Metropolitan Tunnel and Reservoir Plan". This plan involves the construction of a tunnel system, reservoir storage and additional treatment facilities. Implementation would control most of the flood and pollution problems presently caused by overflow from its existing combined sewer system.

Additional expansion and upgrading of existing treatment facilities are being planned in other portions of the study area. All are needed to meet current State water quality standards or guidelines. However, these upgrading programs are being designed on an individual basis rather than as a component of a regionalized system. This can only result in localized solutions to a regional problem.

Commitments on the part of local interests have been directed toward the preservation of Lake Michigan since it is one of the area's most valuable natural resources. Within the study area there are many miles of park and public lands along the Lake's shoreline, including the Indiana Dunes National Shoreline, which was established by PL 89-761. In order to protect the recreational and environmental integrity of these resources, major efforts have been made to insure that any discharge into the Lake be consistent with the use of the resource. The USEPA and the States have established water quality standards for discharge to the Lake and the city of Chicago has adopted a resolution prohibiting discharge to the Lake. The overall objective of these actions requires that areawide planning for wastewater management systems be consistent with the intent to preserve and enhance the quality of the Lake and surrounding environs.

The recreational value and usage of most streams in the study area have been limited because of the restricted water quality and lack of public lands. During dry weather periods, discharge from the existing treatment plants make up most, if not all, of the stream flow. Since the quality of discharge is below current State standards, the aquatic ecosystem and fishery value is also limited. At the same time, the urban-suburban buildup has increased the storm water runoff and with it, flood hazards. Thus, even the recreational usage of the flood plain is limited. If the streams are cleaned up and the flood hazards reduced, an extensive recreational program could be implemented. Both States are interested in improving the quality and quantity of fishery production of the area's streams. Included are salmon (coho) programs on some of the streams tributary to Lake Michigan. Other governmental levels have expressed interest in such programs as fishing ponds, recreational stream corridors and acreage for parks and preserve areas. In recent years most of the recreational developments that serve the urban demand have been provided outside the metropolitan area because of economics and availability of suitable water and lands. Now other competitive demands are reducing the availability of those remaining recreational sites. Until the natural resource bases of land and water are restored, the potential for meeting the recreational needs within the study area will be minimal.

Lake Michigan and local ground water are the two sources for the area's municipal and industrial water supply requirements. The Lake water is the primary source because of its quality and guaranteed availability. Its usage, however, differs between States. While there is some ground water consumed, most of Indiana's supplies come from the Lake. These withdrawals are treated and ultimately returned to the Lake with the notable exception of the Hammond Sanitary District which discharges into the Illinois River via the Grand Calumet River. The situation for the Illinois portion is more complex. In the past the City of Chicago constructed diversion canals to prevent the discharge of polluted flows into Lake Michigan. This involved diverting the Chicago and Little Calumet Rivers and tributaries to the Illinois River and providing control locks and dams at three points. See Figure II-3. These control structures divert Lake Michigan water to maintain sufficient flows in the Upper Illinois (River) Waterway system and also provide navigational access to and from the Lake. With growth and increased usage, the amount of Lake diversion now has been restricted to an average 3,200 cfs by the U. S. Supreme Court. Since Lake withdrawals for water supplies count against the diversion limit, increased usage of ground water has become a necessity. Unfortunately, water usage is already exceeding the recharge capability of the ground water aquifer in the western portion of the Illinois area. Therefore, additional water supply sources are needed or consideration could be given to reallocating the present Lake diversion between areas of need. An increase of the allowable diversion (3,200 cfs) from Lake Michigan requires a positive demonstration that all other sources have been examined and, where feasible, have been developed to their full potential.

CANAL SYSTEM

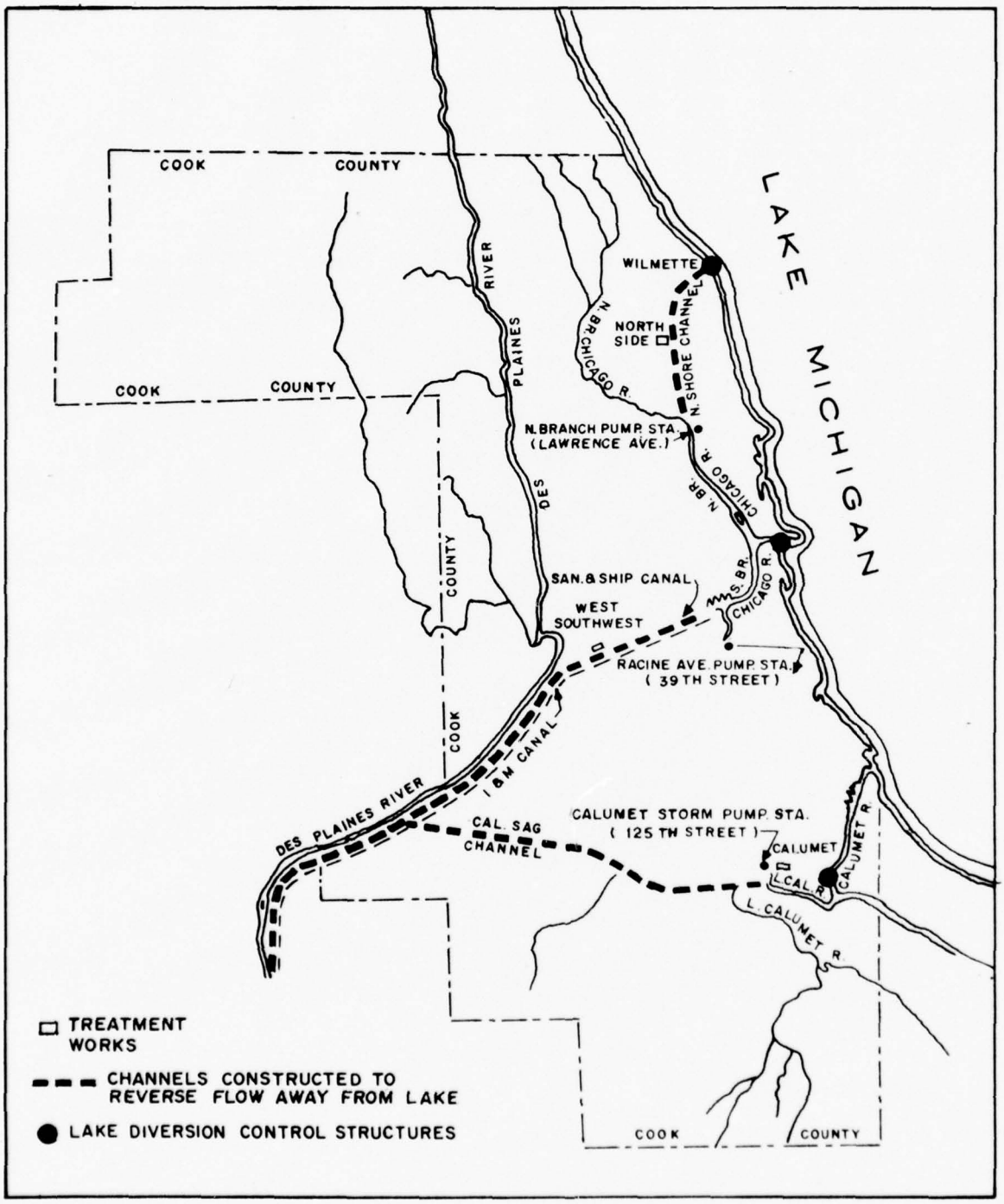


Figure II-3

SECTION III

DESIGN CONSIDERATIONS

Definition of Treatment Goals

Elimination of pollutant discharges into the area's streams required establishing the equivalent of a new treatment criterion. The criterion would have to be representative of the NDCP goal for achieving a maximum, but reasonable degree of water purity. Accordingly, a list of critical constituents and "acceptable" levels was prepared that was more detailed and more demanding than existing standards. Selection of the constituents and the concentration levels was based on desirable standards for drinking water, irrigation and livestock waters, and aquatic habitat. This "effluent" criterion actually represented a performance goal for the design of a treatment facility and characterized the output discharged into the receiving stream.

While these treatment goals are similar in intent to the national goal established by PL 92-500, they are not the result of that legislation. Rather, these goals were established for planning purposes by the Corps of Engineers for this and other pilot studies, which were authorized approximately one year prior to enactment of the law. Consequently, the specific water quality requirements do not represent Federally accepted or adopted standards.

The basis for establishing these goals is presented in Section III of Appendix C. Since the goals were somewhat dependent upon the technological process involved, the adopted performance criterion are presented in a later paragraph.

Available Technologies

Once the treatment goal had been established, attention was directed to the methods by which this goal could be achieved. There are three basic technological approaches which can be used to attain the treatment criterion. These are: (1) an Advanced Biological treatment plant system; (2) a Physical-Chemical treatment plant system; and (3) a Land treatment system.

None of the three are new or unique in concept. The unit processes of each system can be found in various parts of the nation and the world. What is comparatively new is: (1) the combination of these systems' unit

processes to achieve the treatment level desired; and (2) the scale to which these systems would be applied.

Most of the sewage treatment plants today achieve secondary treatment of wastewater prior to its discharge into nearby water courses. Conventional Biological treatment is the technology most widely used. It basically involves a two-step process. The first step, or primary treatment phase, consists of some form of mechanical screening and holding basins to remove the trash and settleable solids. The last step, or secondary treatment, utilizes bacteria to consume the organic portions of the wastes. Prior to being discharged, the treated effluent is usually chlorinated for disinfection purposes.

The Advanced Biological treatment system involves the addition of various biological and chemical unit processes to the Conventional Biological treatment plant. The add-on unit processes are designed to achieve removal of specific constituents. On the other hand, the Physical-Chemical treatment system uses the principles of physics and chemistry to accomplish the same functions that the bacteria and other components perform in the biological design. Both of these "plant" technologies considered in this study rely on incineration as an integral part of the process and internal recycling. The Land treatment system also adds various Biological and Physical-Chemical unit processes to the Cconventional Biological treatment process. The wastewater, having received the equivalent of conventional secondary treatment in aeration and storage lagoons, is sprayed on the soil by irrigation equipment for the final stage of purification. What is unique is that the biosystem of both the soil and cover crop provide the equivalent of the add-on unit process. Involved are the complex physical and chemical reactions in the soil, the biological processes of the soil's bacteria and fungi, and the natural crop uptake - all of which form the basis for designing the farmer's present fertility program and cropping practices.

In developing the design of the plant systems, certain basic assumptions were made. The most important related to the (1) sequential arrangements of the unit processes; and (2) design criteria for rating treatment performance under peak flow conditions. Similar design constraints were adopted in the Land treatment system for relating the application rates of the pre-treated irrigation water to the performance of the vegetative cover, soil column, and soil organisms. The various unit processes and sequential arrangements included in each of the three advanced treatment systems are graphically illustrated in Figures III-1 through III-3. Detailed discussions of each technology can be found in Appendix B.

ADVANCED BIOLOGICAL TREATMENT COMPONENTS

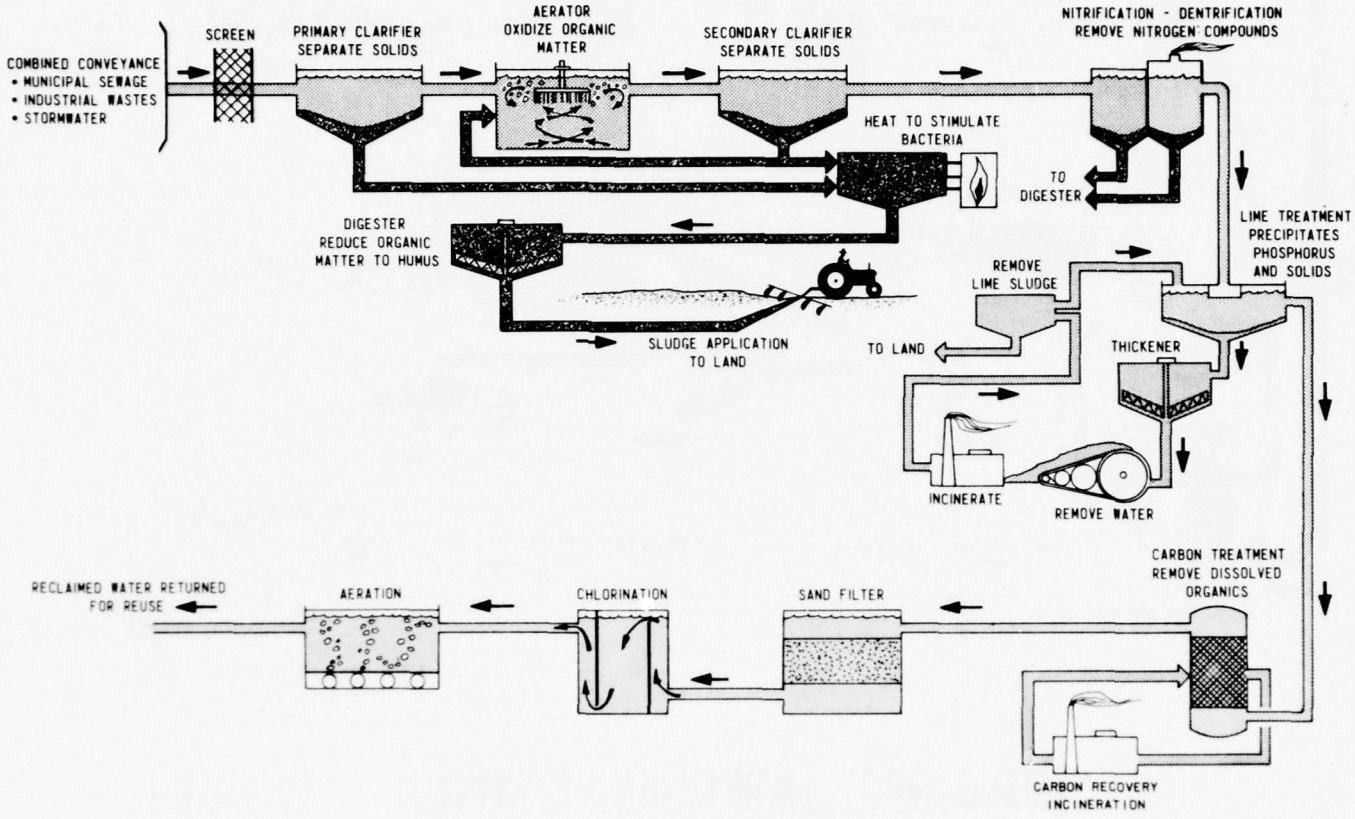


Figure III-1

PHYSICAL - CHEMICAL TREATMENT COMPONENTS

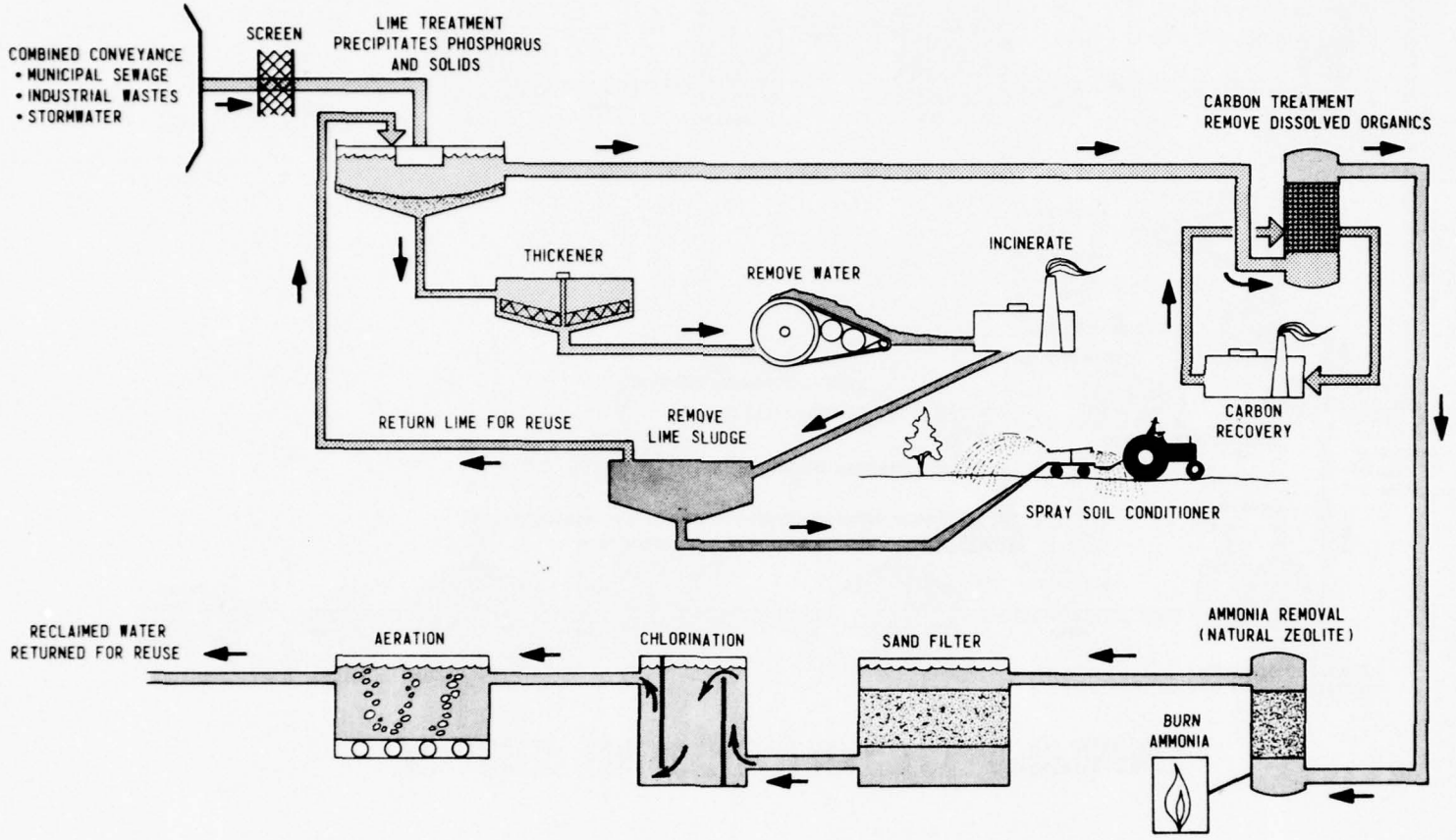


Figure III-2

LAND TREATMENT COMPONENTS

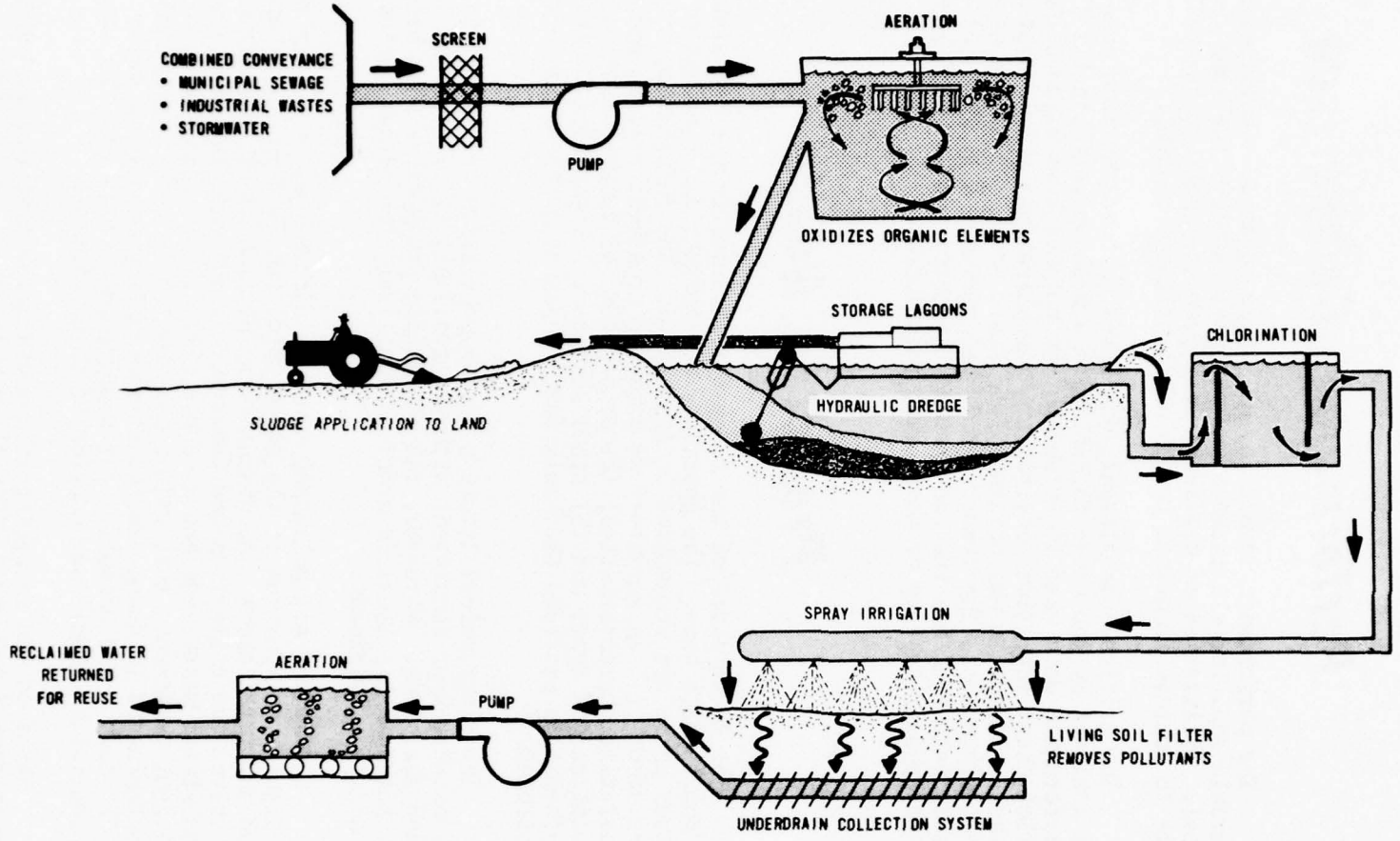


Figure III-3

Performance Comparison

The performance levels for all three advanced technologies are comparable and, for all intents and purposes, achieve the same treatment goal. Utilization of different unit processes make it virtually impossible to achieve identical levels of constituent removal.

The critical constituents and level of concentration expected to be achieved by the three technologies are shown in Table III-1. The performance data used to establish the outputs were based primarily on pilot plant operation, engineering investigations and laboratory studies. Other information was obtained from small scale operations of specific unit processes. The reader should be cautioned that zero (0) cannot be truly expected, but instead should be interpreted as meaning not detectable with present testing or monitoring techniques.

Projected Needs

The first phase of the study effort involved the preparation of an adequate data base. The approach, assumptions and findings of this study phase are summarized in Appendix A. The information collected included: (1) an inventory of existing treatment systems and their operating characteristics; (2) projections of future wasteloads by location and type; and (3) other pertinent resource data. As such, the information provided the basis for the planning and design efforts that followed.

The geographical location of the population and industrial projections were kept consistent with the availability of land and local land-use plans. Moreover, the population projections were broken down to the township level in order to facilitate the determination of municipal wasteloads.

Control of all pollutant sources involved the necessity to capture a significant portion of the storm water runoff from the urban, suburban and rural areas. As discussed in Section II of Appendix G, this involved the collection and treatment of not only the municipal and industrial wasteloads but also the first 2.5 to 2.85 inches of runoff. Without treatment, this volume of storm water runoff contained sufficient contaminants to downgrade the stream quality to a level below the desired NDCP goals. The potential for a degrading effect from the remaining uncontrolled runoff was considered to be minimal.

Based on the foregoing it was estimated that the area would have to treat some 3,650 and 4,080 million gallons per day (MGD) by the year 1990

Table III-1
Alternative Process System Performance Data

Constituents	Effluent Quality 1/		
	Advanced Biological	Physical-Chemical	Land Treatment
Chemical Oxygen Demand (mg/1) 2/	10	10	6
Biochemical Oxygen Demand (5-day) (mg/1)	3	3	2
Suspended Solids (mg/1)	1	1	~ 0
Dissolved Solids (mg/1)	500	535	500
Soluble Phosphorus (mg/1)	0.1 - 0.2	0.1 - 0.2	0.01
Ammonium (NH_4^+) (mg/1)	0.3	0.5	~ 0
Nitrate (NO_3^-)N & Nitrite (NO_2^-)N (mg/1)	2-5	2	2
Organic N (mg/1)	~ 0	~ 0	~ 0
Heat, Temp. (O_F)	53-78	53-78	53-78
Oils, Greases (mg/1)	1	1	~ 0
Phenols (mg/1)	0.01	0.01	~ 0
Pathogens, Viruses	Present 4/	Present 4/	Absent 1/
Trace Metals (mg/1) 3/	0.1	0.1	~ 0
Boron (mg/1)	1.0	1.0	0.7
Arsenic (mg/1)	0.03	0.03	~ 0
Cyanide (mg/1)	~ 0	~ 0	~ 0

1/ Absent or ~ 0, means not detectable by standard testing methods and current technology.
2/ Milligrams per liter (mg/1).
3/ Trace Metals: aluminum, cadmium, chromium, copper, lead, nickel, zinc, iron, manganese, mercury.
4/ Present with current disinfection practice.

and 2020, respectively. This figure excluded system losses due to leakage, and represented projected treatment requirements. The wasteload, however, was based on projections of water usage by all sources. The domestic and commercial wasteloads were projected to reach the equivalent of some 870 MGD (1990) and 1,300 MGD (2020). At the same time, the industrial flows would amount to only 1,240 MGD (1990) and 1,205 MGD (2020). The industrial flows reflected the current trend of reducing water intake by internal recycling and discharging the "blow-down" into the municipal system. System design and costs are based on the assumption that sufficient pre-treatment of the industrial wasteloads is provided on-site to meet inflow controls for the collection and conveyance systems. Runoff from the urban-suburban areas which would be captured and conveyed to the treatment plants was estimated at 890 MGD (1990) and 1,125 MGD (2020). An additional 650 MGD (1990) and 450 MGD (2020) of storm water runoff would be captured and treated in the rural area.

SECTION IV

DEVELOPMENT AND SELECTION OF ALTERNATIVES

Planning Framework

The feasibility study had underscored the need to evaluate each alternative in relation to its total implications. This reflected a concern for the consumptive demands being placed on our nation's natural resources, energy, and tax dollars - demands that have to be balanced against adopted environmental and social goals. Therefore, it was important to identify the variations in impacts on the study area and outlying area as well as the rest of the two states, the region and the nation. In this way, logical decisions as to which system is best suited to the area and most acceptable to the people can be made by those governmental units with that responsibility.

As with any other program involving water and related land resource developments, this study was also directed towards the attainment of the multiple objectives cited by Congress. These objectives, or over-all national planning goals, included the enhancement of the environment, social well-being, and the development of the regional and national economies. To translate these goals into usable planning guidelines, the regional studies for both the Upper Mississippi River and Great Lakes Basins were used. Both studies established a framework for development based on identified needs. These need inventories reflected trade-offs that in net effect would: (1) give a State-wide balance of water and related land resource development; (2) retain and emphasize the area's physical, cultural and aesthetic characteristics; and (3) provide the opportunity to apply multiple-use concepts and thereby utilize the resource bases in an efficient and balanced manner.

To obtain as comprehensive an evaluation as time permitted, assistance was sought from many sources. Various segments of the public and governmental agencies provided input to the study, both from a design and reuse standpoint. In addition, the services of experts in the fields of institutional and socio-environmental considerations were obtained on a consultant basis.

Planning Objectives

There were two basic objectives involved in the planning and subsequent design and impact evaluations. The first concerned identifying the

implications associated with the functional components that make-up an areawide wastewater management system. As such, it was technical in nature and differentiated between technologies, resource consumptions and degree of regionalization. The second objective concerned the potential for water reuse and conservation of resources through recycling of the wastewater and its residual by-products. This phase of evaluation differentiated between the potential for gain through the use of multiple-purpose programs as add-ons to system design.

TECHNICAL OBJECTIVE

There are four basic, functional components of a wastewater management system. These are: (1) the collection and storage system for both storm water and the municipal and industrial wastewater, (2) the conveyance system of the wasteload from main access (junction) points to the treatment site, (3) the treatment facilities and (4) the disposal of the residual by-product from the treatment process - called sludge. A fifth component, or a redistribution system, would be required if the treated water is to be reused.

The design, cost and resource consumption associated with all five components are effected to some degree by regionalization. Regionalization represents an effort to consolidate local facilities into more of an areawide system, thereby achieving capital and operational savings through economies of scale. The design, cost and resource consumption associated with the treatment facilities and sludge management component also will vary significantly with the treatment technology employed. At the same time there are socio-environmental and institutional considerations inherent in all five system components. Yet, even the major differences in impacts for these two considerations are due to regionalization and the treatment technology being utilized.

REUSE AND CONSERVATION OBJECTIVE

WATER REUSE

The necessity to capture and treat storm water runoff in itself imposed two new conditions. First, it provided a new source with which to meet the projected water requirements of the study area. Secondly, it effected a change in the existing stream flow characteristics and also provided the potential for land-use changes in the flood plain. Based on the foregoing factors, it became apparent that the wastewater management system could serve as a primary vehicle to meet the area's water and related land requirements. In lieu of a detailed water use assessment, the inventory of needs from the comprehensive studies for

the Upper Mississippi River and Great Lakes Regions were used. Among the water-based needs cited, flood control, general recreation, fish and wildlife conservation, commercial navigation, and water supply were pre-eminent. These needs served as the basic framework in evaluating the potential for the reuse and redistribution of the treated water.

The potential for meeting the projected water supply requirement was primarily a problem associated with the Illinois portion of the study area. The Indiana portion has no constraints imposed on its use of Lake Michigan waters. As a result attention was focused on the costs and energy demands required to meet the Illinois usage. Also involved were the institutional constraints of the Supreme Court decision and the possible necessity to either change the present withdrawal allocations or reuse the treated water.

RESIDUAL WASTES

The constituents removed by the treatment processes as sludge are actually the consumptive wastes from the municipal and industrial usage of our natural resources and agricultural products. These wastes are comparatively high in organic and nutrient value, but also contain such elements as heavy metals and other industrial by-products. None of the industrial wastes, though, are present in sufficient concentrations to prevent their use as a fertilizer. In fact, these sludges have been dried and marketed as a fertilizer or an additive to commercial fertilizer. In the latter case, the sludge is used to provide a slow release of the nitrogen contained in the organic solids. Accordingly, there is a real potential for the effective reuse of the generated wastes.

The method of recapture and potential for recycling the nutrients varies with each of the three treatment technologies. Therefore, the costs, socio-environmental, institutional and resource implications were assessed for the recycling options available with each technology. In both plant processes, the nutrients along with other elements are at least partially extracted from the wastewater and recovered in the sludge. The sludge from the Physical-Chemical process is rich in lime, but the nitrogen and organic matter have been lost by incineration. Consequently, it can only be used as a soil conditioner. On the other hand, the sludge from the Advanced Biological plant can be used as a fertilizer and humus builder since it contains much of the organic matter and nutrients removed from the wastewater.

The Land system achieves a recycling of the waterborne nutrients in a dual way. Part of the organic matter and nutrients are allowed to settle out in large storage lagoons like the Conventional Biological systems now being used. The sludge is similar in value to those of the other biological treatment processes and can be used as a fertilizer and humus builder.

However, the remaining treated wastes are now in the form of waterborne plant nutrients and other organic and mineral elements. These nutrients are applied by field irrigation equipment as fertilizer for the agricultural cover crop.

MULTIPLE-USE OPPORTUNITIES

Another possibility for resource conservation is the multiple-use potential inherent in the physical layout or design of a system component. These add-ons represent an opportunity to meet other area or regional needs with significant savings in costs and resources. In some cases, the system provides the resource base (clean water) with which the dual benefit (as improved fisheries) can be readily attained. In other cases, the potential for achieving the dual benefit (as clean water and electric power generation) is enhanced, but additional resource commitments (as money to build power plants) are required. In both cases, additional investments (although at a lower level) are needed but the opportunity for realization is greatly improved. Most of the potential for the add-on gains are dependent upon the technology involved, but a few are affected by other system components.

Selection of Alternatives

BASIS FOR DEVELOPMENT

The plan-formulation process used to generate, screen and retain those alternatives considered during the study effort is detailed in Appendix C. Basically, the planning process was divided into three stages. The first stage was used to help establish pertinent planning and design parameters in regard to an alternative's functional components. The functional components of each alternative were designed to treat the 2020 wasteloads. This provided an insight into the management and operational problems that the area would eventually face. As such, it also provided a planning framework within which to shape the 1990 systems. In addition, the design of the alternatives were modified to differentiate: (1) the economic effects of regionalization on the five functional components; (2) the extent to which the storm water could be used to meet the area's water demands; (3) the recycling potential and economic implication of various sludge utilization programs; (4) the economic relationship, based on both capital and annual costs, associated with each technology; (5) the comparative advantage of combining or separating the collection of storm water runoff and municipal and industrial wastes; (6) economic worth of siting the treatment facilities close to the water demand centers; and (7) the comparative merits of intermixing different technologies or using the technologies to accomplish other add-on gains.

The second stage involved a redirection of the design effort and basis of assessment. Basic planning guidelines had been established from the first stage of study. Now attention was focused on the evaluation of the socio-environmental, institutional and resource implications involved in those alternatives retained for further study. As the first step, all of the alternatives were redesigned to treat the 1990 wasteloads. Where economies of scale and construction dictated, the 2020 requirements were retained as part of the system design. Due to the volume of water involved for redistribution, attention was focused on economies of transportation and the use of Lake Michigan as a supply and return source. Adjustments were made in system design to reflect cost savings identified in the first study stage. Separate collection and storage of storm water runoff was found to be the most economical for suburban areas. Furthermore, the storage capacity of the suburban storm water systems were increased to reduce the peak treatment rates and costs of the plant technologies. At the same time the rural storm water system was developed on a modular basis and soil conservation practices incorporated into the design. Based on the foregoing, the degree of regionalization was again reexamined to further define the optimum point for consolidation. Once the redesign had been completed a preliminary evaluation was made of the impacts associated with each alternative. This information then was furnished to the public with an intent to determine their viewpoints and preferences.

The third stage involved a refinement of the design for the individual functional components and a more in-depth assessment of the alternatives retained for final study. A major effort was devoted to the redesign of the Land treatment system. The physical layout of the treatment facilities had been designed to achieve maximum efficiencies in operational and economic considerations. This resulted in large geographical areas being committed without proper regard to the growth patterns, environment and life style of the agricultural community. Consequently, a total redesign was completed - one that significantly changed the siting as well as the operational and managerial considerations. Another modification to design criteria involved the water (reuse) distribution program and its impact on Lake Michigan. The USEPA had expressed concern about the potential discharge of dissolved solids and the need to maintain the non-degradation provisions of the Lake. Accordingly, adjustments were made to conform to the current "return" regimen now in effect. This meant constraints for the Illinois portion of the study area as opposed to the Indiana area. These constraints primarily involved the necessity to continue diverting all treated water down the Illinois River. It also meant balancing this diversion and future water requirements within the 3,200 cfs limitation on Lake withdrawals imposed by the U.S. Supreme Court.

Subsequent to the final design, each alternative then was critically assessed. This involved the quantification or qualification of:

(1) changes in water quality; (2) changes in land use, both inside and outside the study area caused by the technology and system design; (3) consumption of resources; (4) displacement of people; (5) employment potential; (6) potential for meeting future water demands; (7) potential for multi-purpose add-ons, both water and land related; and (8) system associated costs. These assessments in turn, served as the basis for evaluating the socio-environmental and institutional implications inherent in each alternative.

FIRST STAGE ALTERNATIVES

The main intent in formulating the initial set of alternatives was to establish meaningful criteria for differentiating between any wastewater management system. The planning concepts along with the design criteria were the main considerations. The technical, reuse, and conservation issues and potentials were the bases with which the analyses were made.

The first point of interest was to determine the implications that ultimately would be involved in achieving the higher water quality goal rather than current standards. Accordingly, two alternatives were designed to meet current treatment standards and guidelines. One included 64 Conventional Biological treatment plants and reflected current plans for consolidation, but extended to meet 2020 treatment needs. The second plan was a more regionalized version of the first in order to determine if further economies in system design were possible.

Some 17 additional alternatives were designed to meet the NDCP treatment goals. With the volume of wastewater increased by the addition of storm water runoff, there were obvious potentials for savings in treatment costs from economies of scale. Therefore, alternatives were formulated to determine the economic implications of regionalization. This involved varying the range of treatment sites being considered from 8 to 64 for the treatment plant technologies and from 1 to 3 basic land sites. In this planning effort the location of an abandoned treatment facility became an access point to the conveyance system servicing the regional plant for that area. At the same time, the treatment plant alternatives were evaluated to determine the implications of using either the Advanced Biological or Physical-Chemical processes. Another variation concerned the intermix of technologies including the Land treatment system. Generally, the foregoing evaluations were concerned with the differentials in costs, collection and conveyance, and the sludge management aspects associated with the regionalization and the individual treatment processes.

The management options considered for the sludge generated by the three technologies basically involved land reclamation, agricultural

utilization and incineration. The first two options utilized sites outside the study area, while the third option involved disposal of the ash residue in local land fill sites. Also investigated were three different methods of transporting the sludge to various geographical site locations. The modes considered included pipeline, barge and railroad systems.

Since control of the area's water regimen is inherent in the NDCP design, the dual issues of redistribution and capability for meeting future water demands also were evaluated. There were two basic categories of water demand besides the flood control achieved by the storm water management system. The first involved meeting the area's water supply demands, particularly in the western portion of the Illinois counties within the study area. There the ground water, as the only source of available supply, is being locally overpumped and depleted. The second category of demand involved providing increased stream flows to support enhanced recreational and fishery opportunities and projected commercial waterborne traffic. To meet these demands, two options for redistribution were assessed. Both involved the use of Lake Michigan water to supplement the ground water and reuse of the treated wastewater. Two methods of redistribution were evaluated: (1) by pipeline exclusively; and (2) the use of local streams for conveyance with withdrawals by pipeline to the demand point.

Several variations in planning concepts also were reviewed. Most involved resource conservation and synergistic approaches. One involved the use of Land treatment both inside and outside the study area. Of interest was the multiple-use potential of the proposed open-space lands within the study area. Since the open-space lands were designed to control growth patterns, continuous blocks of lands could be located and used for treatment during the night and recreational pursuits during the day. This concept was similar to the one used in the Golden Gate Park in San Francisco, California. However, only storm water runoff from the suburban and rural areas would be treated.

The foregoing represents most of the issues evaluated during this initial stage. A more detailed discussion of the alternatives and concepts considered during this and the following stages is presented in Appendix C.

SECOND STAGE ALTERNATIVES

Once the initial set of 19 alternatives had been reviewed and selectively screened, an intermediate set of 11 alternatives were selected for further study. The design of the 11 alternatives was based on treating 1990 wasteloads and the planning and engineering criteria established

from the first stage assessment. Again, two of the alternatives were designed to meet current treatment standards and guidelines. These were retained for comparative purposes. The other (NDCP) alternatives were structured to evaluate the impacts caused by regionalization, the water balance and use of Lake Michigan, the different treatment technologies, and the potential for multiple use.

During this stage the design of each system's functional components was refined. However, the main objective was to evaluate the resource commitments and effects associated with the alternatives. This assessment then became the basis for both an institutional and socio-environmental evaluation.

The resources necessary to support the operation of the alternatives included:

- The electrical energy required for the collection and conveyance of the wastewater to the treatment facility (plant or land site); the redistribution of treated water; and the transportation of sludge.

- The fuel required for incineration as part of the plant treatment process.

- The chemicals used in the operation of the treatment facility.

- The land required for the various functional components both inside and outside the study area. Lands required in the study area included the acreage necessary for the storm water management system and the treatment plants. Lands also would be needed outside the study area. As a minimum, this would involve acreage required for the recycling of the treatment recovered sludge. The total acreage in the outlying area would be markedly increased if the Land treatment method was used.

Other impacts were identified on the basis of differentiating between water quality standards and alternatives. These involved:

- The relocation of people, both inside and outside the study area.

- Comparative impacts on the area's watercourses from a flood control and quality standpoint.

- Comparative impact relative to air emissions.

- Capital costs and annual costs including operation, maintenance and replacements.

ALTERNATIVES RETAINED FOR FINAL STUDY

Determining which alternatives should be retained for final study proved to be extremely difficult. Preliminary assessment of the resource consumption, costs, socio-environmental and institutional implications indicated a wide and diversified range of impacts. Furthermore, the concept of using agricultural lands to treat the study area's wastewater had generated a strong political and social opposition in the outlying area. Involved was a reluctance of the agricultural community to commit local resources to treat metropolitan wastes and their concerns as to the long-term effects on local land-use and socio-economic patterns. Accordingly, the legislative drafts for what eventually was enacted as PL 92-500 were reviewed. In order to be responsive to these intents, the following decisions were made:

- One of the two existing standard alternatives would be retained. The detailed assessment could provide information relative to on-going and near-future program committments at the local level. At the same time it would facilitate a comparison between water quality goals and identify the implication of going to such high effluent standards as were adopted for this study.

- Consideration should be given to retention of at least one alternative involving each of the three NDCP technologies. This would be responsive to the requirement, that after 30 June 1974 local interests must demonstrate that alternative waste management techniques have been studied and evaluated before Federal grant assistance can be made (Section 201(g)(2)(A)).

- The alternatives should reflect a variable degree of regionalization. This would be responsive to the requirement that to the extent practicable, waste treatment management shall be on an areawide basis (Section 201(c)).

- Consideration should be given to retention of at least one alternative involving a combination of treatment technologies. This would tend to underscore the inherent advantages and/or disadvantages of different system balances, particularly if designed from a geographical and wasteload standpoint.

- As much flexibility in system design should be maintained by using options as add-on considerations. This applied to both sludge management and withdrawals from Lake Michigan.

- Maximum effort be made to identify the potential for multiple-purpose planning ranging from revenue producing facilities (Section 201(d)) and integration of facilities with other pollution problems (Section 201(e)) to combining treatment management with open-space and recreational considerations (Section 201(f)).

The result of the foregoing was that it not only outlined the procedure to be used in the screening process, but also stressed the importance of structuring the system components in such a way as to provide the most effective evaluation of system performance.

Thus, to provide a useful framework for decision, five alternatives were retained for final study. The first was one designed to meet current standards, using the Conventional Biological treatment process. The remaining four were designed to meet the NDCP water quality goal. Two were pure treatment plant alternatives, one using the Advanced Biological process and the other, the Physical-Chemical technology. Similarly, the fourth alternative involved an all Land treatment system but dispersed over five different geographical areas. The fifth alternative involved an intermix of two technologies by combining Advanced Biological plants and Land treatment sites. This represents the best intermix since the Physical-Chemical process could be interchanged with the other plant technology.

SECTION V

FINAL ALTERNATIVE PLANS

Description of Alternatives

The following is a brief description of the five alternatives retained for final study. A more detailed presentation can be found in Appendix D.

REFERENCE PLAN

Alternative I reflects the study area's present planning goals for a regionalized wastewater management system. This plan employs 64 treatment plants, of which 54 are existing plants which would be up-graded and 10 would be new facilities. This represents an extensive reduction from the some 132 plants (one MGD capacity or greater) presently in operation. The 64 sites, as shown in Figure V-1, were based on the number and locations provided for in existing regional plans extended to meet 2020 conditions. As such, the alternative represents a screening base with which to compare the four other alternatives which are designed to the higher NDCP water quality goal and reuse considerations.

The regional treatment plants will meet the current effluent (plant discharge) standards and water quality guidelines (for receiving streams) of Illinois and Indiana. Moreover, the level of treatment will vary, depending upon the receiving stream. In general, those plants discharging into streams tributary to the Illinois River are designed to provide the equivalent of secondary treatment. On streams tributary to Lake Michigan, a higher level of treatment is to be achieved.

The existing or proposed collection systems in all areas would be utilized, with consolidation achieved by connecting conveyance systems. No treatment of storm water runoff is included, other than in areas serviced by present or proposed combined sewers. Nor does Alternative I (as per existing plans) provide for a redistribution of the treated water. This would adversely affect the aquatic ecosystem of some streams in dry periods, since many are presently dependent upon existing treatment plant discharges for their low flows. Without the potential for storm water reuse, problems in meeting future water requirements will remain. Both additional resources and financial commitments will be required if these needs are to be met.

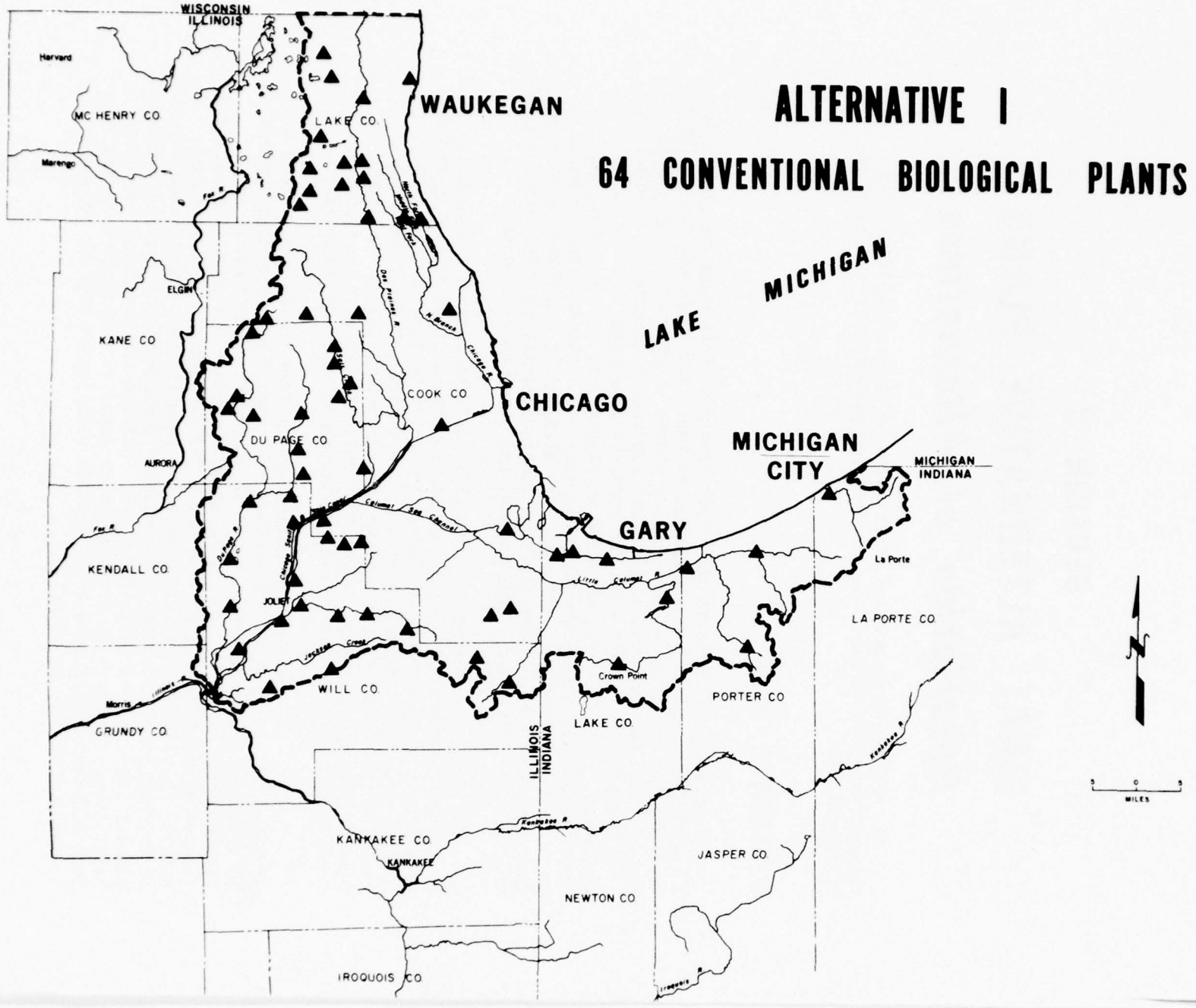

ALTERNATIVE I
64 CONVENTIONAL BIOLOGICAL PLANTS
WISCONSIN
ILLINOIS
Harvard
MC HENRY CO.
Marengo
LAKE CO.
WAUKEGAN
LAKE MICHIGAN
ELGIN
KANE CO.
COOK CO.
CHICAGO
DU PAGE CO.
AURORA
MICHIGAN CITY
MICHIGAN
INDIANA
GARY
KENDALL CO.
La Porte
LA PORTE CO.
JOLIET
WILL CO.
Crown Point
PORTER CO.
LAKE CO.
Morris
GRUNDY CO.
ILLINOIS
INDIANA
KANKAKEE CO.
KANKAKEE
JASPER CO.
NEWTON CO.
IROQUOIS CO.
N
5 0 5
MILES

Figure V-1

The sludge management system reflects the current trend of disposal by recycling the sludge as an agricultural fertilizer and humus builder. Some reclamation of surface mined land, however, is included where current arrangements exist. To insure that the sludge presents no health or odor-related problem, the process design requires stabilization by anaerobic biological digesters. A comparable constraint in one form or another is used in all the other alternatives too. The sludge produced in Illinois is utilized in Illinois and that produced in Indiana, on Indiana sites.

Most of the industries within the study area discharge their wastewater back into the watercourses rather than the municipal sewers. This practice would be expected to continue if current standards were to be retained as the governing water quality goals. Even so, industry would have to upgrade its treatment and incorporate these facilities into their manufacturing processes. This would include expanding the current trend of recycling the wastewater, which not only reduces the water volume used, but also, the cost of treatment. Since these requirements and costs are internal to the industry, and hence a cost of doing business, they have been classified as charges external to the alternative's construction and operation. From an areawide standpoint, though, these costs must be recognized as a related monetary commitment.

COMMON FEATURES, NDCP ALTERNATIVES

STORM WATER RUNOFF

Since all of the remaining alternatives are designed to meet the same water quality goal they have certain common features. All have the same storm water management system. Aside from the combined sewered areas, the first 2.5 to 2.85 inches of runoff are collected by separate pipeline and transported to localized storage sites in the urban and suburban areas. The captured runoff is then conveyed by gravity or force mains to access points where it is combined with other wastewaters. The access points either adjoin a treatment plant or interconnect with a larger conveyance system leading to a more regionalized treatment facility. A comparable approach is utilized in the rural area, except: (1) grassed waterways are used for the conveyance system; and (2) the runoff is treated by the Land treatment process with irrigation taking place on adjacent agricultural lands.

COLLECTION AND CONVEYANCE SYSTEMS

Another common feature concerns the areawide collection system. It was assumed that the existing collection systems for the municipal and industrial wastewater flows would be extended to the 64 plants recommended for consolidation by the regional planners. This collection system then served as a design base, common to all the other alternatives. The 64 plants became terminal points for the collection systems, except in the rural areas. In addition, these same plants served as access points to the major conveyance systems for transporting the combined flows to the regional treatment plants. All of the conveyance pipelines and tunnels have been placed under public rights-of-way, such as streets, highways and public waterway easements, in order to eliminate any costs for easements and mining rights.

SLUDGE MANAGEMENT

Two sludge options were retained for consideration during the final stage of study. These involved the basic recycling concepts of agricultural usage and rehabilitation of surface mines. However, two factors, the first a planning constraint and the second a design criterion are worth noting. First, it was decided that sludge should be utilized within the State boundaries where it was generated; primarily in response to the institutional concern over interstate transfers. The philosophy has been incorporated into the sludge management schemes for all but one of the four NDCP alternatives. The basic design criterion involved the sludge yield per million gallons of wastewater which became a major differential between each of the three technologies. The yield also affected the resultant land requirements which were controlled by the different application rates permissable under the two sludge options.

WATER REUSE

Still another common feature concerned the reuse of the treated water. With the treated storm water providing a supplemental source of additional supply, two reuse options were considered for each alternative. Constant to both was a redistribution system for augmenting the low-flows of selected streams. The difference between the two options involved how the potable water supply requirements in Illinois would be met. The primary intent was to analyze the reuse implications relative to the U. S. Supreme Court decision limiting Illinois withdrawals from Lake Michigan. In one option the withdrawal was limited to the restricted 3,200 cfs; the other had no such limitation. In net effect, the options focused on the problems that could

face the C-SELM area in the future. This included the necessity to reuse its treated wastewater in order to meet projected needs, particularly the potable supply deficiencies in the western portion of the Illinois area. It also involved providing in-stream flows that would maintain a higher level of recreational potential than is now available.

INDUSTRIAL WASTEWATER

The last common feature concerns a major decision which will face both industry and the operators of the wastewater management system. To achieve the equivalent of the NDCP water quality goals, the cost of industrial pre-treatment will be increased by some 40 percent. There are potential savings possible, however, if industry was to discharge its recycled wastewater into the regional system. This was the assumption used for the design of the NDCP systems. If this is done, the gross cost to industry and the regional system would generally be less than what industry would incur by itself. Under this situation, industry would still be required to pre-treat its wastewater, but would rely on the regional treatment plant to provide "final" treatment. The added cost incurred by the regional system would be recovered by user fees chargeable to industries. The magnitude of this added cost would vary, depending upon the treatment technology used by the regional entity.

PHYSICAL-CHEMICAL TREATMENT PLAN

Alternative II utilizes a Physical-Chemical treatment process to achieve the NDCP water quality goal. There are 33 plants located throughout the study area as shown in Figure V-2. The number of plants reflects an intermediate level in economies of scale that can be attained through regionalization of a treatment plant technology.

As previously noted, incineration is an integral part of the treatment process. This serves a dual purpose - recycling of the treatment chemicals and a partial removal of the ammonia nitrogen. As a result, there are considerable chemicals and particulates discharged into the air. These discharges meet current air emission standards established by the U.S. Environmental Protection Agency (USEPA) except for nitrogen oxides, a "burning type" irritant once inhaled. Unfortunately current technology is inadequate to maintain the level of nitrogen oxides within acceptable limits. Unless this problem can be overcome, some other unit process to remove nitrogen, such as a biological process, will have to be used. If this is done, the sequential order and complementary unit processes used to remove the other constituents

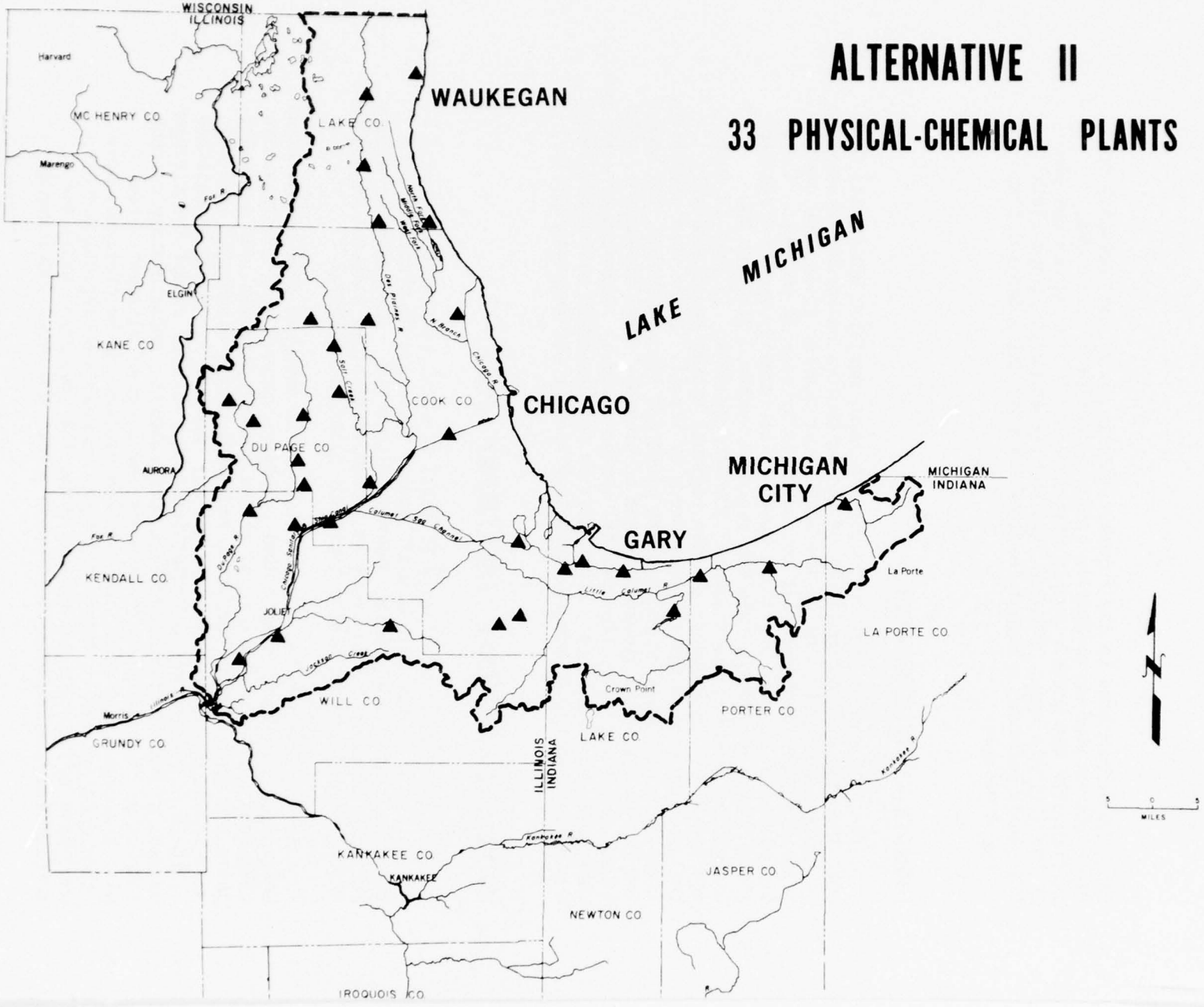

ALTERNATIVE II
33 PHYSICAL-CHEMICAL PLANTS
WISCONSIN
ILLINOIS
Harvard
MC HENRY CO
Marengo
LAKE CO
WAUKEGAN
LAKE MICHIGAN
ELGIN
KANE CO
COOK CO
CHICAGO
DU PAGE CO
AURORA
MICHIGAN CITY
MICHIGAN
INDIANA
GARY
KENDALL CO
JOLIET
La Porte
LA PORTE CO
WILL CO
Crown Point
PORTER CO
LAKE CO
Morris
GRUNDY CO
ILLINOIS
INDIANA
KANKAKEE CO
KANKAKEE
JASPER CO
NEWTON CO
IROQUOIS CO
MILES

Figure V-2

would have to be changed. The result would be that the overall composition of treatment would change to one closely approximating an Advanced Biological treatment system.

Unlike the other NDCP alternatives, the recycling potential of sludge from this process is limited, because of its high lime content, to an agricultural production program for soil conditioning and pH control.

ADVANCED BIOLOGICAL TREATMENT PLAN

Alternative III utilizes 17 Advanced Biological treatment plants to achieve the NDCP water quality goal. The location of these plants are shown in Figure V-3. For this treatment technology 17 plants represents the maximum level of regionalization considered advantageous from a combined economic, management and socio-environmental standpoint.

Unlike the Physical-Chemical process, the Advanced Biological system can make full and effective use of those major plants which otherwise would be abandoned and foregone with regionalization. Conversely, a similarity does exists in that incineration is also part of the Advanced Biological process. Nevertheless, while chemicals and particulates are discharged into the air, the air emissions do comply with current USEPA standards.

LAND TREATMENT PLAN

Alternative IV involves the use of five, separate land areas outside the study area to achieve the NDCP water quality goal. This plan represents still another maximum level of regionalization which could be considered. The location of the five areas are shown in Figure V-4. The areas shown merely indicate the geographic limits within which the actual Land treatment sites would be located. The design calls for the incorporation of the various system components into an area in such a way as to attain compatability with existing land-use and to minimize disruption to the area's socio-economic structure. To insure this was possible, studies were undertaken at three different geographic locations to establish a prototype model representative of the Land treatment sites under consideration. The results of this analysis indicated that on an average only approximately 40 percent of the land within a given area could be effectively utilized. This percentile was based on such considerations as existing and projected population distribution, environmentally unique areas as well as the need to avoid cultural

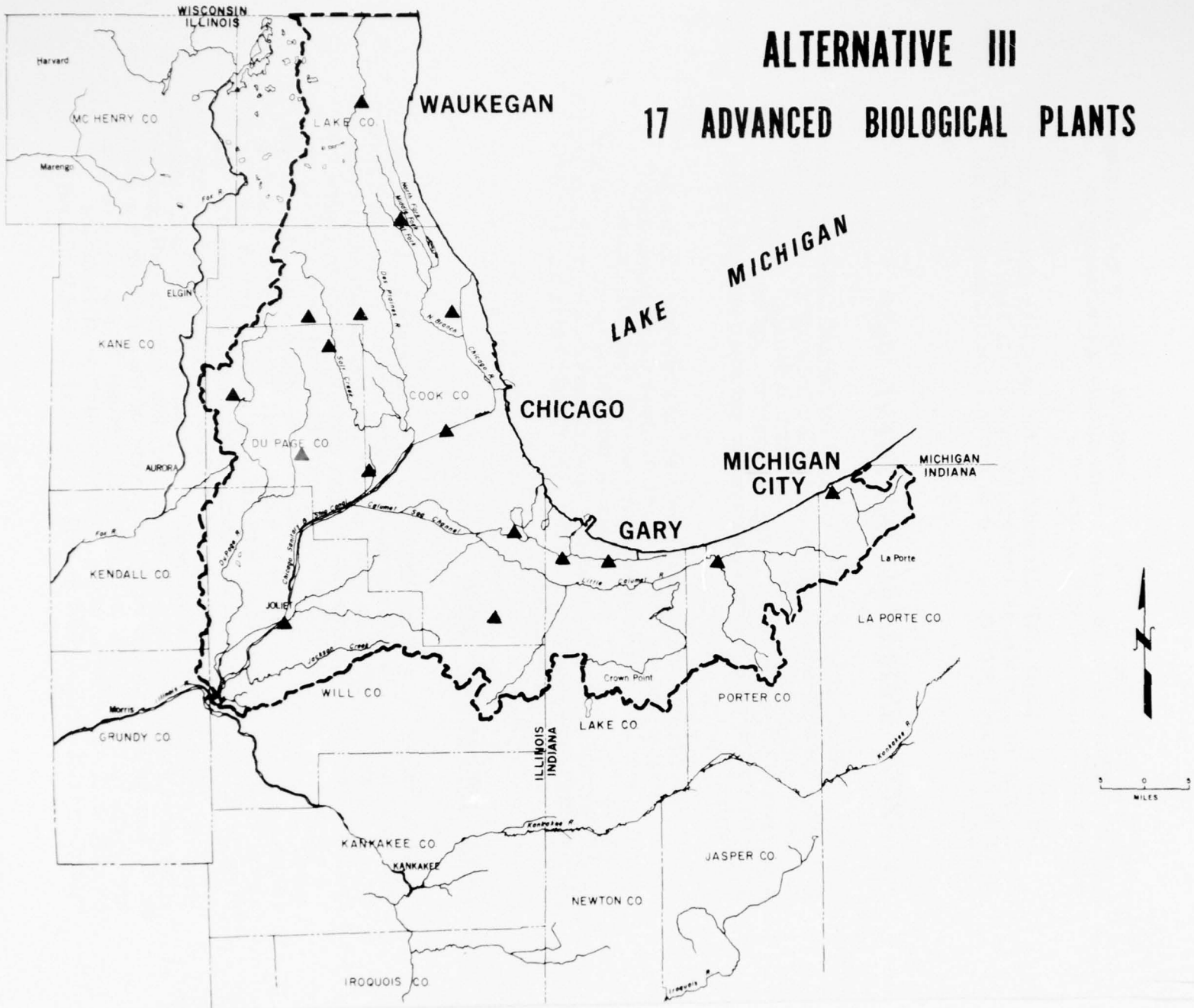

ALTERNATIVE III
17 ADVANCED BIOLOGICAL PLANTS
WISCONSIN
ILLINOIS
Harvard
MC HENRY CO
Marengo
LAKE CO
WAUKEGAN
LAKE MICHIGAN
ELGIN
KANE CO
COOK CO
CHICAGO
DU PAGE CO
AURORA
MICHIGAN CITY
MICHIGAN
INDIANA
GARY
KENDALL CO
JOLIET
La Porte
LA PORTE CO
Crown Point
WILL CO
PORTER CO
LAKE CO
GRUNDY CO
ILLINOIS
INDIANA
KANKAKEE CO
KANKAKEE
JASPER CO
NEWTON CO
IROQUOIS CO
MILES

Figure V-3

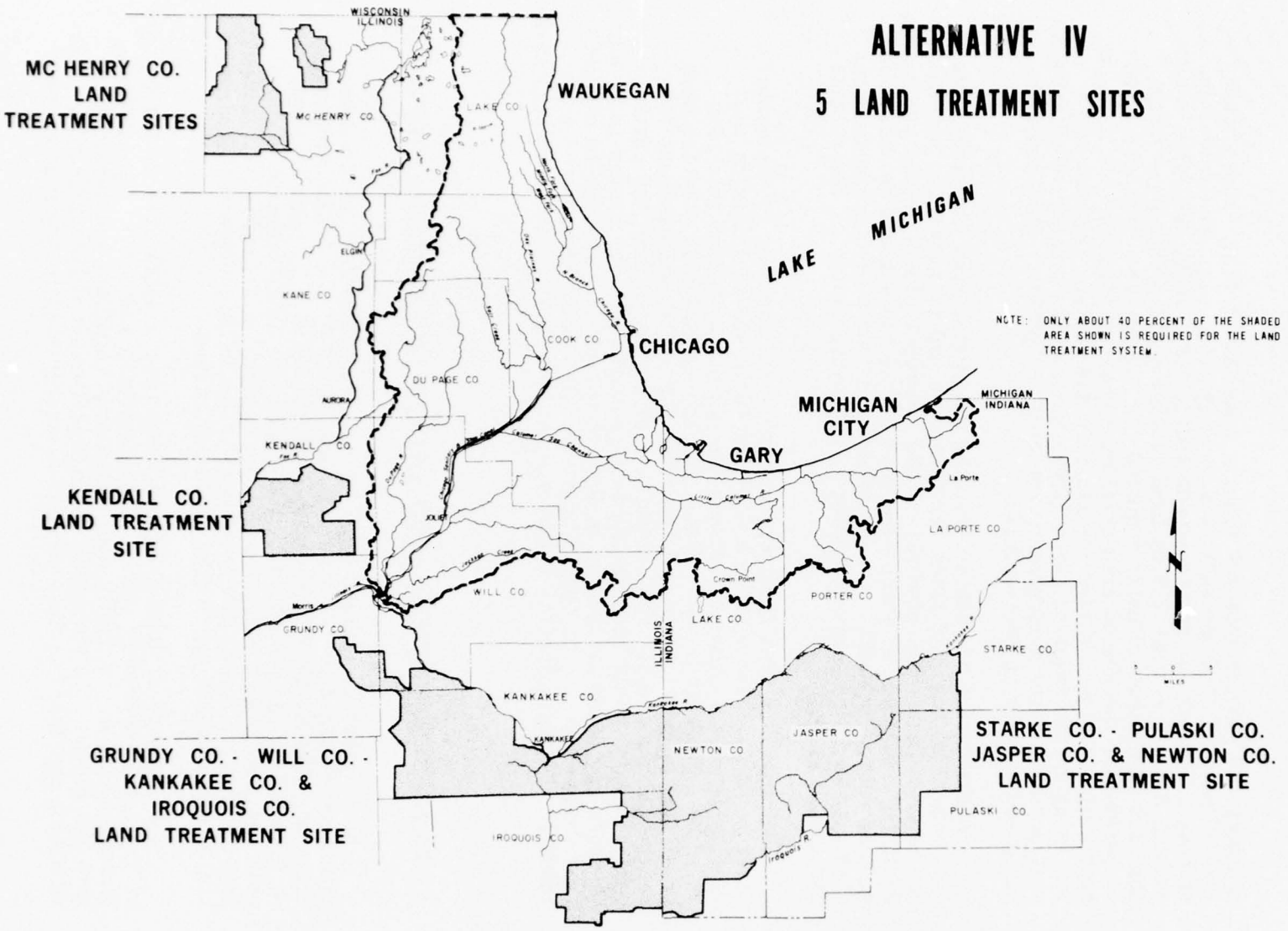

ALTERNATIVE IV
5 LAND TREATMENT SITES
MC HENRY CO. LAND TREATMENT SITES
KENDALL CO. LAND TREATMENT SITE
GRUNDY CO. - WILL CO. - KANKAKEE CO. & IROQUOIS CO. LAND TREATMENT SITE
STARKE CO. - PULASKI CO. JASPER CO. & NEWTON CO. LAND TREATMENT SITE
WAUKEGAN
CHICAGO
MICHIGAN CITY
GARY
LAKE MICHIGAN
NOTE: ONLY ABOUT 40 PERCENT OF THE SHADED AREA SHOWN IS REQUIRED FOR THE LAND TREATMENT SYSTEM.
WISCONSIN
ILLINOIS
MC HENRY CO.
LAKE CO.
KANE CO.
COOK CO.
DU PAGE CO.
KENDALL CO.
WILL CO.
GRUNDY CO.
KANKAKEE CO.
IROQUOIS CO.
LA PORTE CO.
PORTER CO.
STARKE CO.
JASPER CO.
NEWTON CO.
PULASKI CO.
MICHIGAN
INDIANA
ILLINOIS
INDIANA

Figure V-4

features and provide room for orderly community growth. Consequently, this 40 percent land-use ratio was used in the design and preparation of cost estimates for the treatment facilities. Thus, the areas shown on both Figures V-4 and V-5 as Land treatment sites encompass areas some 1.5 times that actually required for the system. Further, of the 40 percent of the shaded area utilized for the system only about 18 percent would involve purchase for aeration and storage lagoons; the remaining system required lands (approximately 82 percent) would involve contractual (lease) arrangements for crop irrigation. This topic is discussed further in Section VII.

In the design of this system, the wastewater from the study area is conveyed to the land sites for treatment and subsequently, returned for reuse. Under this plan all of the treatment plants in the study area would be abandoned, at which time most of the lands could be reclaimed to meet community needs. On the other hand, the outlying agricultural community would be asked to commit an extensive amount of their lands for system needs.

Because this plan involves the interstate transfer of wastewater for treatment, there will be a need for increased coordination and institutional arrangements between the two States before this plan could be implemented. Both States and the agricultural counties must be willing to participate and integrate the system requirements into their land-use plans. The contractual arrangements with the participating farmers would include payments to compensate for system-incurred expenses and potential losses in long-term capital gains due to changed land (use) values. The operating entity also would be expected to idemnify the participating farmer against any system associated crop loss.

ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN

Alternative V combines the 5 major Advanced Biological treatment plants of Alternative III with a reduced scale of the 5 Land treatment sites of Alternative IV. The graphical layout of this plan is shown on Figure V-5. As explained in the discussion of Alternative IV, the area shown as Land treatment sites encompasses an area about 1.5 times that required for the system and merely indicates the general geographic limits within which the system could be located.

The Advanced Biological plants treat approximately two-thirds or more of the total wastewater volume. As previously indicated, the Advanced Biological treatment plants would discharge chemicals and particulates into the air but the emissions would meet current USEPA standards. The remaining one-third or less of the wastewater load is transported to

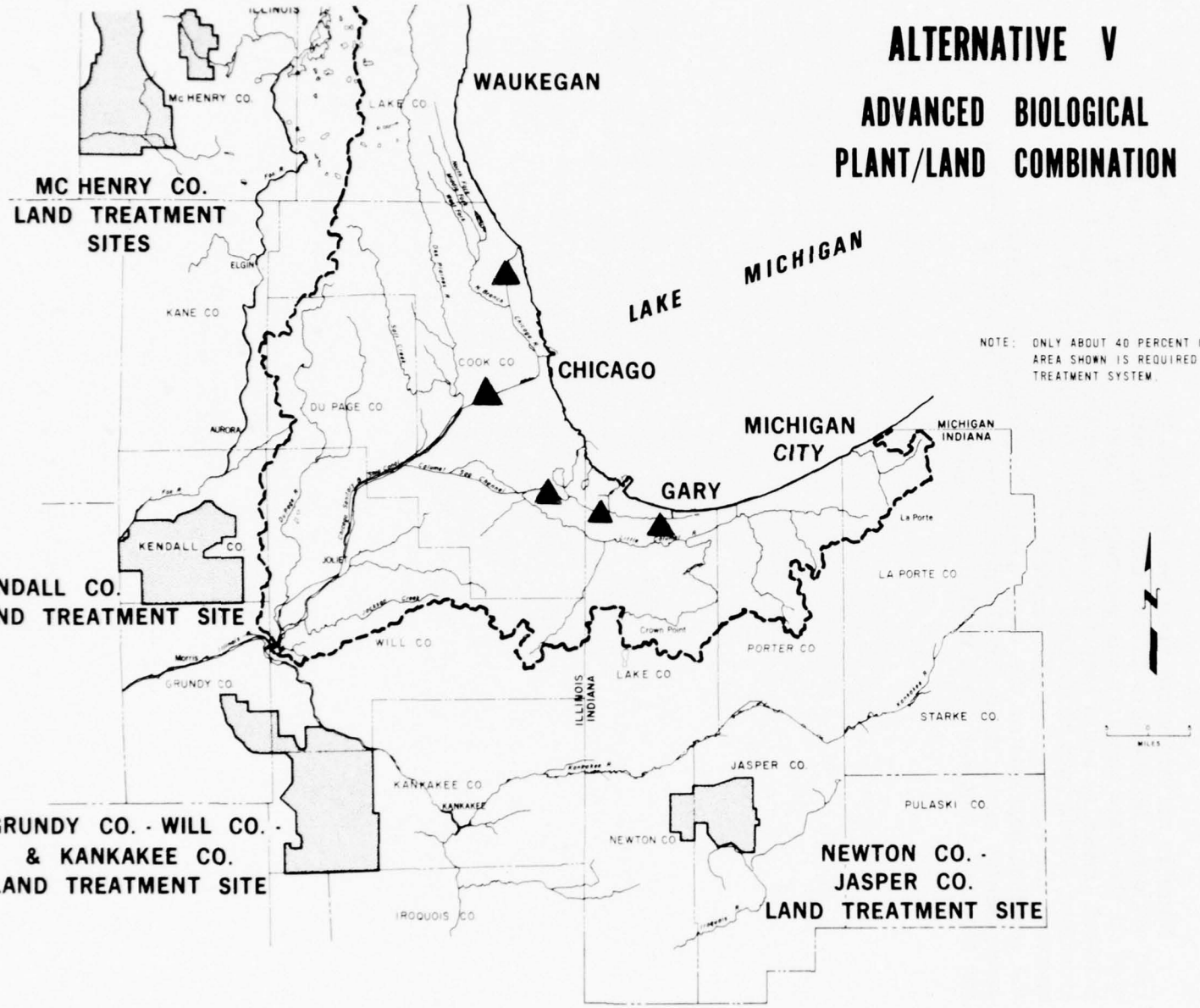

ALTERNATIVE V
ADVANCED BIOLOGICAL
PLANT/LAND COMBINATION
WAUKEGAN
MC HENRY CO.
LAND TREATMENT
SITES
LAKE MICHIGAN
CHICAGO
MICHIGAN
CITY
GARY
MICHIGAN
INDIANA
NOTE: ONLY ABOUT 40 PERCENT OF THE SHADED AREA SHOWN IS REQUIRED FOR THE LAND TREATMENT SYSTEM.
KENDALL CO.
LAND TREATMENT SITE
GRUNDY CO. - WILL CO. -
& KANKAKEE CO.
LAND TREATMENT SITE
NEWTON CO. -
JASPER CO.
LAND TREATMENT SITE
McHENRY CO.
LAKE CO.
KANE CO.
COOK CO.
DU PAGE CO.
KENDALL CO.
WILL CO.
GRUNDY CO.
LA PORTE CO.
PORTER CO.
STARKE CO.
JASPER CO.
KANKAKEE CO.
NEWTON CO.
PULASKI CO.
IROQUOIS CO.
ILLINOIS
INDIANA
ELGIN
AURORA
JOLIET
La Porte
Crown Point
KANKAKEE
MILES

Figure V-5

the five land areas for treatment. Because the volume to be treated is significantly less, the land sites are greatly reduced in size.

There is no interstate transfer of wastewater for treatment and like all other NDCP alternatives except Alternative IV, the sludge is used in the State where it was generated. Again, the outlying agricultural community would have to be willing to incorporate the Land treatment system into their land use plans. In this alternative, however, the wastewater to be treated would essentially come from the suburban portions of the study area. Comparable contractual arrangements, as outlined for Alternative IV, would have to be adopted for the Land treatment sites used in this plan.

SECTION VI

FRAMEWORK FOR EVALUATION

System Variations

The array of alternatives retained for final study were chosen to provide as much information as is possible from a planning, engineering and impact standpoint. This information is obtainable from an over-all assessment of the alternatives, both on an individual and comparative basis. As such, the evaluation will provide a framework for consideration upon which to base local and State efforts for meeting the new national water quality goals.

There are three different types of assessment that make-up the total evaluation. The first involves the differences in planning potential between the current standards and the NDCP water quality goals. Included in this assessment are identification of those add-on programs which can be incorporated with the wastewater management system in order to meet other needs. Information regarding this type of optional consideration is discussed below and detailed in Section VIII of Appendix G.

The findings of the other assessments are summarized in the subsequent sections of this report. Included are the resources required to operate the various alternative systems. These are presented in Section VII. The third category of pertinent data, concerns the impacts that may occur, should any of the alternatives be implemented. These impacts will be reflected in changes to the Socio-Environmental (Section VIII), Institutional (Section IX) and Economic (Section X) structures of both the study and outlying areas. Together, the information from all three categories characterizes the effects which must be balanced in the decision-making process.

Water Quality Goals

WATER REUSE

Regardless of the equivalent standards adopted, the water quality and environmental status of the study area will be improved. The degree to which this is achieved, though, will vary with the water quality goals. Even so, there are other implications involved that will effect the area's planning programs for water-related uses.

The NDCP goal with its capture and treatment of storm water runoff imposes the necessity to establish a regulated stream flow network, otherwise many of the tributary streams would have no sustained flows. Consequently, a distribution system was designed to improve the low-flow characteristics in all or portions of some 30 or more streams. These increased flows would enhance the value of the streams for fishing, aesthetics and general recreational purposes. Aside from the major water-courses, 26 of the streams were selected because they are near main population centers or pass through areas where some form of natural environment still exists. The streams and counties which would benefit from the increased flows and enhanced recreational potential are listed in Table VI-1. Other streams were excluded from consideration because their capacity might not be adequate to handle the seasonal variations in flow without damage. Of related interest are the effects that regionalization would have on the cost and energy requirements needed to maintain the same distribution system. At the same time, provisions were made to insure that sufficient flow would be available to accomodate the projected waterborne traffic in the Upper Illinois Waterway system. This included distribution of flows via the major water courses and pumps at the headwater locks to Lake Michigan.

REGIONALIZATION

Adoption of the NDCP goal will also require a reassessment of the degree of regionalization employed for treatment. The level (quality) of treatment and the volume to be treated will increase the actual cost to the taxpayer. However, these same factors also enhance the value of regionalization since efficiencies and economies can be achieved with larger scaled treatment facilities. This is true for all three advanced treatment technolgies. Nevertheless, while consolidation can achieve cost economies, it runs counter to the concern for maintaining local control (home rule). Final decision as to the advantage of regionalization will require a realistic evaluation of all the social, environmental and political trade-offs involved.

Functional Components

All of the five functional components that make-up a wastewater management system, can contribute to an area's planning needs and programs. The nature of the contribution, though, will vary significantly with the type of output ranging from a planning aid to a new resource base.

Table VI-1
Streams Selected for Augmentation

Main Stream and Tributaries	Location						
	Illinois Counties				Indiana Counties		
	Lake	Cook	Will	Du Page	Lake	Porter	LaPorte
North Branch Chicago River	X	X					
East Fork	X	X					
West Fork	X	X					
Des Plaines River	X	X	X	X			
Mill Creek	X						
Indian Creek	X						
Avon-Fremont Drainage Ditch	X						
Weller Creek		X					
Willow Creek		X					
Silver Creek		X					
Buffalo Creek		X					
Hickory Creek		X	X				
Spring Creek		X	X				
Jackson Creek			X				
Tinley Creek		X					
Salt Creek		X		X			
Addison Creek		X		X			
Du Page River		X	X	X			
East Branch		X		X			
West Branch		X		X			
Lilly Cache Creek		X	X	X			
Little Calumet River		X			X	X	X
Calumet Slough		X					
Butterfield Creek		X					
Thorn Creek		X	X				
Deer Creek		X	X				
Plum Creek-Hart Ditch		X	X		X		
Deep River					X	X	
Turkey Creek					X		
Salt Creek						X	
Grand Calumet River					X		

CONVEYANCE SYSTEM

PLANNING CONSIDERATIONS

The location as well as the size of the conveyance system can become a major factor in establishing land-use plans for developing areas. Inadequately sized sewers have proved to be a deterent to growth in many areas of the country. This situation underscores past failures in forecasting needs. In this planning study, tunnels serve as the major conveyance systems and have been designed and costed for the 50-year need, i.e. 2020. This approach was adopted to achieve long-range economies in construction costs and to provide a contingency against unforeseen future growth or water usage. This should allow the urban planner sufficient latitude in phasing the development of various areas.

At the same time, location of the conveyance system can be used to control the development patterns of a particular area. As concern for the environronment grows, more attention is being given the objective of providing open space as a method of controlling land-use densities. If desired, access to the conveyance system can be limited and development constrainted to fit the land's physical limitation, the area's land-use objectives and a selected regional growth pattern.

Both of the foregoing will be affected by the degree of region-alization eventually adopted. As the wastewater management system becomes more regional in nature, so does the capability for effective land-use planning. This imposes the potential for institutional concerns and a commitment as to the degree of regionalized planning desired.

ROCK AND SOIL MANAGEMENT

Construction of an areawide wastewater management system will also pose a potential problem, the disposal of enormous quantities of construction related material. Large amounts of soil will come from the storm water impoundments and the collection and redistribution systems. The greatest amount, however, will come from the construction of the conveyance systems and will involve extensive amounts of rock from the deep tunnels. Therefore, proper management is needed to not only minimize costs, but also any adverse effects. Actually, the disposal of the materials can provide a wide range of opportunities for constructive use within the region. These opportunities may be broadly classified as reclamation, recreation, or commerce. Selection of the final management procedures must be made on the basis of cost, compatibility with

regional goals, disruptive effects on the communities, environmental effects, and other factors. Some examples of possible reuse to meet public needs range from fill for local borrow pits and protection or stabilization of beach shoreline from erosion to construction of recreational islands in Lake Michigan. A more detailed discussion is presented in Section VIII of Appendix G.

TREATMENT FACILITIES

REGIONALIZATION

The implications of the treatment facilities to the plans and needs of the area are at least three-fold. Regionalization or consolidation, again, is a major factor to be considered. The sociological reaction to living near treatment facilities, regardless of the technology involved, presents a problem to the planner. At issue are the trade-offs involved in having to integrate either a few large sites or many smaller sites within the region. Interrelated factors of acreage required and displacement of people will further contribute to the reluctance of a community or area to forego their own desires for the sake of others. These latter factors, however, are functions of both the treatment technology and regionalization.

MULTIPLE-USE CONSIDERATIONS

The physical layout of the treatment facilities will provide an opportunity for obtaining other benefits. The potential for these add-on returns, however, are dependent upon the expenditure of additional monies before the benefits can be obtained. Thus, while these other programs are conceptual in design, they represent a secondary level of return and additional options to be considered.

For instance, both the plant and Land treatment systems have a recreational potential inherent in their design. As shown in Figure VI-1, the discharge from the treatment plants can be used to maintain a continuous through-flow for fishing impoundments located nearby or on-site. These impoundments would provide selective sport fishing for the residents of the surrounding area. On the other hand, regional parks can be incorporated into the perimeter of the irrigation sites of the Land treatment system and also serve as buffer zones. These same buffer zones also can be planted to provide a habitat for a variety of wildlife and birds including waterfowl and if desired, opened to the public for hunting.

SELECTIVE SPORT FISHERY MANAGEMENT PROGRAM

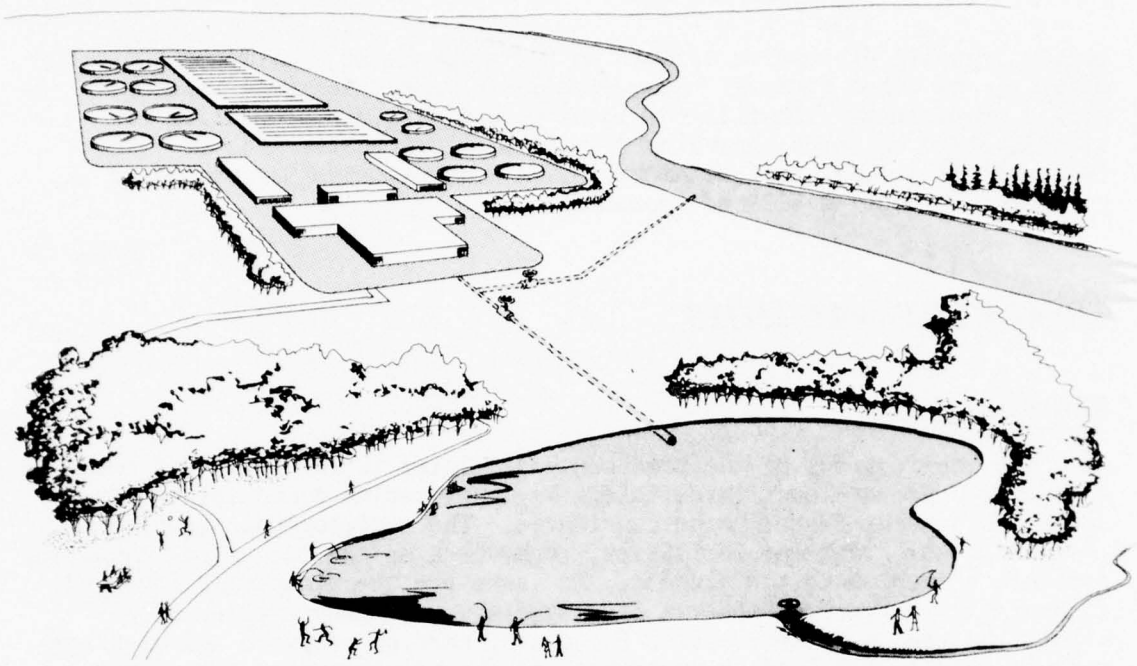


Figure VI-1

LAND TREATMENT - POWER PLANT COMBINATION

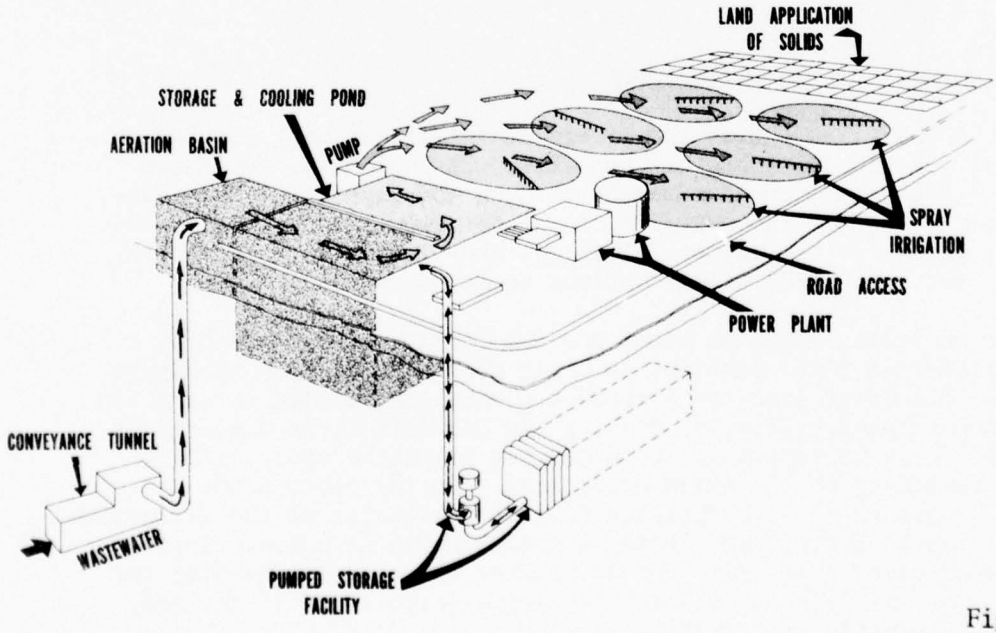


Figure VI-2

The storage lagoons of the Land treatment system can be used as a source of cooling water by electrical generating plants. The concept of co-siting the power plants with the lagoons, as shown in Figure VI-2 has the advantage of removing a potential source of heat pollution from the major lakes and waterways in the region. It also provides the land that otherwise would have had to be acquired for cooling ponds, if inland plants are to be built to meet the region's projected power requirements. Concurrently, there is the added potential of pumped-back power generation, using the surface impoundments and mined storage tied to the conveyance system for hydropower generation during peak demand periods.

ABANDONED PLANTS

The third factor involves the reuse potential of existing treatment plant sites. Both regionalization and the treatment technology impose the potential for having to abandon some, if not almost all, of the existing treatment plants. In fact, all of the five alternatives call for a reduction in the number of treatment plants which presently service the study area. Alternative I, which reflects current regional plans for consolidation, employs 64 treatment plants, 10 of which are new. Implementation of this plan would require abandonment of 78 of the 132 existing treatment plants of one million gallons a day capacity or greater. Comparison of Figure V-1 with Figures V-2 through V-5 will reflect the added degree of plant retirement associated with the regionalization inherent in each alternative. However, the economies of scale and the magnitude of total system costs make the bonded indebtedness involved a comparatively insignificant factor as such. Nevertheless, the planners should be aware of several related aspects. It is not known whether the Federal cost-sharing provisions of PL 92-500 will be extended to cover this type of cost. When the type of areawide planning sought by the law results in the recommendation to abandon facilities, the question of eligibility for assistance in paying off the outstanding indebtedness becomes particularly appropriate. There is the added benefit that will accrue to the community with regionalization. Once the decision is made to abandon a plant, the site becomes an access point to a conveyance system. This reduces the acreage required, and once existing plants are removed, would make additional acreage available to the community for its needs. The type of need which can be satisfied, though, will be dependent upon the acreage involved (plant size) and location (surrounding land use).

STORM WATER MANAGEMENT AND REUSE PROGRAMS

The potential changes in land and water uses due to these two components of the NDCP alternatives can prove advantageous to the local communities.

Both will provide the opportunity to solve a variety of problems facing the study area.

URBAN WATER DAMAGE

Control of the storm water runoff will reduce the frequency and depth of flooding within the area's flood plain. While the degree of relief has not been determined, it is estimated that the NDCP alternatives will achieve a significant level of flood reduction on some 69,900 acres. This in turn poses the obvious question as to the usage of these lands. The reduction in flood hazard will immediately generate competative demands for the use of those acreages. Whatever the decision, the resultant impact will have significant social and environmental implications. Moreover, the placement of the rural and suburban storm water systems can be designed to be responsive to local water damage problems. Proper siting of the storage sites can reduce local damage caused by basement floodings and blockage in traffic movement caused by surface ponding.

POTABLE WATER SUPPLY

The water supply deficiency in the western portion of the study area in Illinois is another such problem. The capture of storm water and level of treatment required by the NDCP goal would increase the quality and volume of water available to meet future potable water supply needs. Consequently, the treated wastewater can be used to help solve the deficiencies caused by the limitations imposed on Illinois withdrawals from Lake Michigan. One solution would be to reallocate the allowable withdrawals (3,200 cfs) and meet the remainder of the projected requirements with ground water and treated wastewater. To determine the implications of this approach, two potable water supply options were studied. Under Option 1, Lake withdrawals were confined to the allowable limit; under Option 2, they were not. In the first option, the reuse amounted to some 272 and 702 million gallons per day in order to meet the projected Illinois demands for 1990 and 2020, respectively. In Option 2, the requirements are totally met by withdrawals from Lake Michigan and the treated wastewater is used exclusively for in-stream flow augmentation. Under this second option, Illinois withdrawals would increase some 113 and 134 percent by the year 1990 and 2020, respectively. While both options involve a reallocation of Lake Michigan withdrawals, the cost variations between the two options and implications of regionalization are factors which also must be considered.

RECREATIONAL CONSIDERATIONS

Another concern is to affect a more balanced land usage in relation to the population growth experienced over the past 20 years. The storm

water management system provides a realistic basis for not only controlling growth patterns, but also providing open space and recreational opportunities. The impoundments provided for storage of runoff in both the suburban and rural areas have the potential for limited water-base recreational usage. A permanent pool can be incorporated into the impoundment's design. While body contact pursuits would be prohibited, the impoundments can serve as the base source of park-type developments. This concept together with the irrigation sites of the rural treatment program could also be used to establish green belt areas that can shape and control growth patterns. The concept is reflective of the fact that all of the improvements are local in nature. Hence, the site locations must be worked into the land-use plans of the various communities, townships and counties.

In addition, the regional planning agencies of both States have sought to retain the flood plain in open space and develop some of these lands for recreational usage. The storm water runoff control and redistribution programs jointly enhance the recreational and open-space value of the flood plains. If desired, both programs can provide the basis for creation of recreational - environmental land corridors bordering the stream. This will also provide those communities with stream frontage, the opportunity to develop various types of recreational parks responsive to their needs. Furthermore, these parks would be augmented by a series of linear connecting corridors which would be used either for nature trails or to preserve the stream's environment. An intermix of both public and private ownership would be maintained with restrictive land-use easements incorporated where necessary. To determine the potential for such a corridor, a prototype study was made of the North Branch of the Chicago River. See Figure VI-3. Subsequently, the results of this study were applied to the other 26 streams included in the redistribution (flow) program. It was estimated that some 500 miles of corridor could be established along these streams. Within these corridors, some 19,000 acres would be acquired, primarily for park developments. The parks, in turn, would be able to accommodate some 110,000,000 user-days annually. The basis and results of the study for developing the corridors are presented in Annex B of Appendix G.

SLUDGE MANAGEMENT

As mentioned in Sections IV and V, the treatment technologies produce two distinctly different types of sludges. The sludge from the Conventional and Advanced Biological as well as the Land treatment technologies is rich in nutrients and organic materials and is therefore suitable as a fertilizer and humus builder. The sludge from the Physical-Chemical process, conversly, has lost these properties. This mainly is due to the internal recycling process requiring incineration,

NORTH BRANCH, CHICAGO RIVER PROTOTYPE STUDY AREA

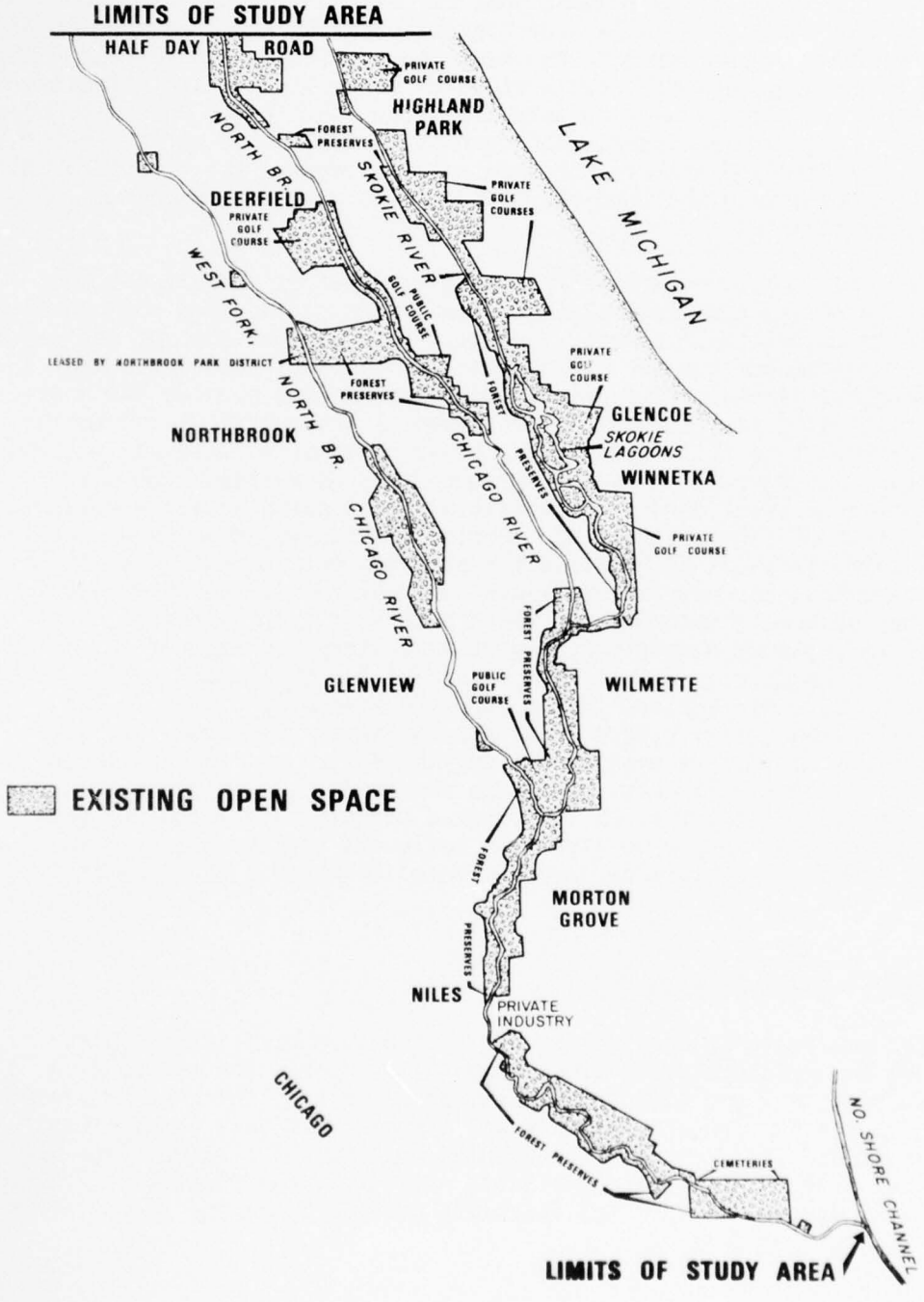
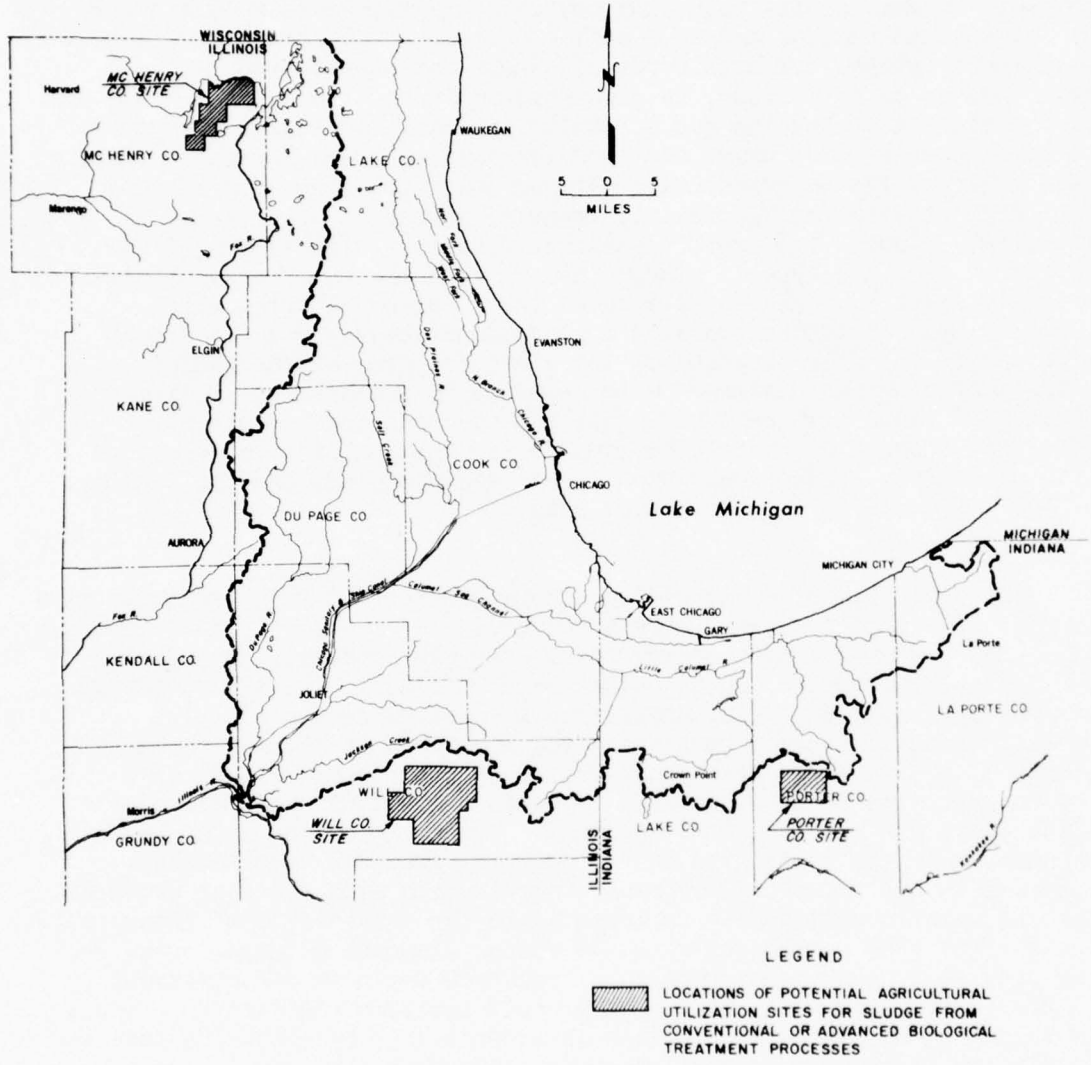


Figure VI-3

however, because of its high lime content this sludge is suitable for use in soil pH control and as a soil conditioner. A number of sludge management options for both types of sludge were considered in the early phases of this study, as discussed in Appendix C. As a result of the study's evaluation and screening process, two sludge management options (agricultural usage and land reclamation) were retained. Figure VI-4 outlines the geographical locations which could be used if the option to utilize the "fertilizer" type of sludge in agriculture is selected. Figure VI-5 depicts possible areas for utilization if the option to use this type of sludge in land reclamation of strip-mined areas is selected. Figure VI-6 shows the location of sites which could be used in connection with a management program for the "lime" type of sludge. The location of the sites for each of the sludge management programs discussed were selected on the basis of availability of areas with suitable soils and economic considerations. Other sites could be used. The final determination of site selection will ultimately be dependent upon local land-use plans and the feelings of the residents in the management area.

The effective disposal of the sludge generated during treatment is a growing source of concern. From a conservation standpoint, the recycling of sludge represents another way to effectively conserve, yet utilize our natural resources. On the other hand, the agricultural use option has the potential for being considered a constrained use of still another resource (land), because of the long-term commitment to apply sludge as a fertilizer each year, over a 50-year lease period. The option involving land reclamation involves a one-time application after which reuse can be effectively planned. The key planning issue is the dependency of the study area on the outlying area and commitments inherent in the recycling program. Coordination with the coal producers has indicated a willingness to investigate the feasibility of intergrating the surface mine operations with the sludge disposal program. Even so, the program is contingent upon local county acceptance and agreement as to the future land-use. This option would increase the outlying area's inventory of usable acreage. This is accomplished by enhancing the land's capability to support vegetative growth and using the reclaimed land to meet the needs of the counties where the mines are located. Some additional cost sharing might be necessary, particularly if the selected restoration program would require a level of investment greater than normally required to achieve a reasonable land-use objective. Nevertheless, the economic base as reflected in assessed property values, would be enhanced and this would assist the outlying local governments in providing additional services.



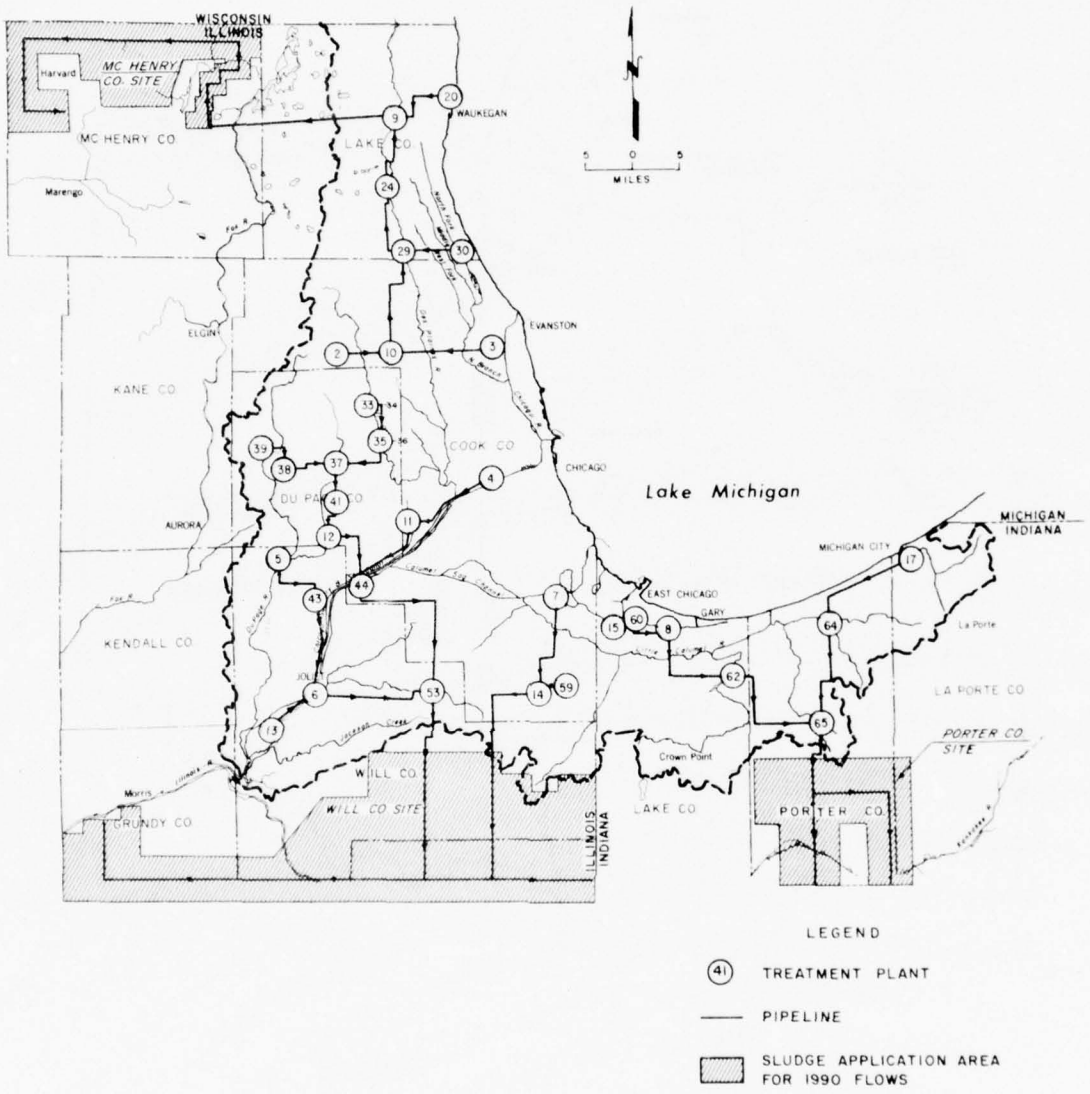
POTENTIAL SLUDGE DISPOSAL SITES FOR AGRICULTURAL UTILIZATION

Figure VI-4



POTENTIAL SLUDGE DISPOSAL SITES FOR LAND RECLAMATION

Figure VI-5



AGRICULTURAL UTILIZATION OF PHYSICAL - CHEMICAL SLUDGE

FOR ALTERNATIVE II

Figure VI-6

Primary Impacts

The alternatives retained for final study have been purposely structured to focus on those planning and policy considerations discussed in the foregoing paragraphs. The extent to which these add-on programs are incorporated in the system design must be resolved. Only then can the States and local interests make a decision as to how the total needs of the area, including wastewater management, can best be met.

The total resource commitments associated with the alternatives also have to be evaluated. These data are required to further differentiate between the alternatives. Resource consumption associated with each of the alternative systems and the technological processes has implications beyond the local level. At the local level, the area resources of land (required), people (affected or displaced), social well-being (human dimension) and costs are basic considerations. At the regional level, the competative demands induced by the wastewater system on such growth factors as energy, chemicals, labor skills and land-use have to be identified and the causal effects scaled. Finally, an assessment has to be made of the national implications of both the foregoing and the capability to meet those needs that contribute to the nation's economic development and the national environment quality goals.

To accomplish the above, the resource commitments, engineering data, and costs associated with each alternative and the individual components were determined. This information then served as the basis for an evaluation of the impacts and causal affects on the social, environmental, institutional and economic conditions of the study and outlying areas, the rest of the two States and region, and the nation.

SECTION VII

RESOURCE IMPLICATIONS

Resource Evaluation

In analyzing the resource requirements associated with the five alternatives, it became apparent that there were three differenct types of needs involved. The first concerned the resources actually used in the treatment processes. The second group of needs were the resources required to operate the management system. Land requirements with its social implications were evaluated separately.

The following is a summary of the resource assessment. A more detailed presentation, including a breakdown among functional components and by State, can be found in Appendix G.

Resource Consumption

NATURAL GAS

The resources required in the operation of the treatment processes involved fuel for incineration and chemicals for the various unit processes. Natural gas was used as the fuel because of its cost and ability to meet air pollution abatement (emission) standards. Since its use is confined to the Advanced Biological and Physical-Chemical technologies, the need applies to Alternatives II, III and V only. Alternative V uses the least amount of fuel since only part of the wastewater volume is treated by the Advanced Biological plants. The 2020 fuel requirements for Alternatives III and II range from 1.6 to 2.6 times that of Alternative V, respectively.

CHEMICAL

The chemical requirements reflected the nature of the process. Common to all was the use of chlorine as a disinfectant. As such, it is the only chemical used by Alternatives I and IV. The remaining alternatives use a combination of different chemicals. On a ton per day basis, the 2020 chemical consumption for Alternatives II, III and V varies from some 42 to 99 times the requirements of Alternatives I and IV.

The fuel and chemical requirements for the five alternatives are summarized below in Table VII-1.

Table VII-i
Fuel and Chemical Requirements

REQUIREMENTS		ALTERNATIVE I	II	III	IV	V
Natural Gas: (million cubic feet/day)	1990	-	156	85	-	61
	2020	-	169	102	-	65
Chemicals: (tons/day)	1990	44	4,160	2,700	49	1,987
	2020	51	5,030	3,270	60	2,130

Resource Commitments

ELECTRICAL ENERGY

Operation of the system will require electrical energy mainly for: (1) transporting the wastewater and storm water runoff to the regional treatment facilities; (2) conveying the sludge from the treatment facilities to the disposal sites; and (3) redistributing the treated water. Alternative I, as would be expected, requires the least amount of electrical energy while Alternative IV (the all Land system) requires the most, some 7.2 times as much. The electrical demands for the plant Alternatives, II and III, are somewhat comparable, requiring some 3.4 and 3.9 times the demand of Alternative I, respectively. The comparative demand ratio for Alternative V is somewhat higher, amounting to some 5.1 times as much electrical energy.

MANPOWER

The manpower requirements for the treatment system also will change with the water quality goals. Not only will there be an increase in the total manpower requirements, but the ratio of skilled to unskilled labor will increase. This is particularly true for the plant technologies which contain highly technical unit processes. In terms of total manpower, Alternatives II and III require approximately 4 times the personnel needs

as that of Alternative I. On the other hand, the Land treatment system increases are comparatively smaller. Hence, the personnel needs of Alternatives IV and V are only some 1.5 and 3 times that required for Alternative I.

The electrical and labor requirements for the five alternatives are summarized in Table VII-2.

Table VII-2
Electrical and Labor Requirements

REQUIREMENTS		ALTERNATIVE I	II	III	IV	V
Electrical Power: (megawatt hours per day)	1990	3,200	10,300	11,600	22,000	14,700
	2020	3,600	12,300	13,900	26,000	18,500
Labor Requirements: (man-year equiv.)	1990	2,930	11,170	11,580	5,460	9,950
	2020	3,380	12,510	13,000	5,540	10,340

Land Requirements

CONTRACTUAL CONSIDERATIONS

The land requirements for each of the alternatives represented one of the most critical of all system-related needs. Any commitments as to use will directly affect the social, environmental and economic aspects which together comprise the life style of the study and outlying areas. All of the alternatives rely on some land-use commitments, both in the study area and the outlying area. The extent (magnitude) and nature (purchase or contractual), however, vary considerably between alternatives - basically due to the water quality goal and the treatment technology involved.

Three of the five system components require some form of land commitments for operation. These include the treatment facilities, the storm water management program, and the sludge management program. Where feasible, every effort was made to reduce the requirements for purchase. Instead, contractual (lease) arrangements were used to insure retention of the land in private ownership. This tended to minimize the impact on the local tax base. The arrangements for the treatment plant technologies involve an out-right purchase of the required lands. The Land treatment system involves the use of both purchase and lease

arrangements. A similar intermix of both arrangements was also used for the storm water program. Implementation of the sludge options are based on contractual agreements only. It should be noted that the contractual agreements are generally more costly than outright purchase. Nevertheless, the trade-offs in impact on the local government and land owners warrant the difference.

LAND NEEDS

The land requirements vary significantly between the study and outlying area. In the study area, the acreage required for the storm water management program is the major land use factor involved. Conversely, the purchase and lease arrangements associated with the Land treatment process (Alternative IV and V) are the most significant in the outlying area. At the same time, the acreage for the sludge management program is common to all alternatives and also imposes the possibility for long-term commitments in the outlying area. Because of this and the potential for gains in the local environment and economic base, the option for reclamation of surface mines should be considered, whenever possible. The land requirements for the five alternatives are summarized in Table VII-3.

Resource Implications

Subsequent to the foregoing assessments, the implications of the resource requirements were evaluated. The obvious impact was the substantial increase in all the supportive resource demands, including manpower. This in itself became the framework for identifying other causal impacts.

ENERGY

The resource implications for both energy forms, electrical and natural gas, are similar. Both demands will require expansion of the existing energy base. This, in turn, will impose the need for a range of decisions. The source of the required energy is a basic concern. So is the allied question of priority for meeting this (environmental) and other competitive needs. Furthermore, the investment required by the utilities to provide the energy demand may, in itself, create a secondary impact. Construction of new plants and transmission lines will require additional capital and the cost of obtaining the money may result in increased user-rates to the local consumers.

Table VII-3
Land Requirements (Acres) a/

REQUIREMENTS	ALTERNATIVES I	II	III	IV	V
C-SELM Area					
1990: Purchase b/	1,500	63,900	66,700	63,200	65,100
Lease	-	116,300	116,300	116,300	116,300
Total	1,500	180,300	183,300	179,500	181,400
2020: Purchase	1,500	63,900	66,700	63,200	65,100
Lease c/	-	87,100	87,100	87,100	87,100
Total	1,500	151,000	153,800	150,300	152,200
Outlying area					
1990: Purchase	-	-	-	63,400	17,200
Lease d/	57,000	649,000	51,200	300,000	121,700
Total	57,000	649,000	51,200	363,400	138,900
2020: Purchase	-	-	-	76,700	27,300
Lease d/	67,100	767,800	308,400	602,200	426,900
Total	67,100	767,800	308,400	696,900	454,200
Total System					
1990: Purchase	1,500	63,900	66,700	126,600	82,300
Lease d/	57,000	765,300	167,500	416,300	238,000
Total	58,500	829,200	234,200	542,900	320,300
2020: Purchase	1,500	63,900	66,700	139,900	92,400
Lease d/	67,100	854,900	395,500	707,300	514,000
Total	68,600	918,800	462,200	847,200	606,400

NOTES:
a/ Additional detail on land requirements is presented in Appendix G in Tables G-IV-5 and G-IV-6.
b/ Reflects acquisition of 2020 needs for plant technologies and storm water storage to safeguard against land-use encroachment.
c/ Reflects transition in land-use from rural to suburban and corresponding change in method of runoff treatment.
d/ Includes agricultural utilization of sludge for Alternatives I and II and reclamation of surface mines for Alternatives III, IV and V. In the case of the Land treatment technology, it should be noted that the sludge will accumulate in the storage lagoons initially. Hence the acreage for the sludge management program is not required until after 1990.

CHEMICALS

The increased demand for chemicals probably will cause some secondary impacts. Added power, not included in the previous tabulation, will be needed for the increased production demand. This, together with the higher consumptive rate, may also contribute to increased unit prices of the chemicals and thereby affect other commercial uses.

In addition, the use of chemicals may effect the study area's air and water quality. The chemicals used in the two plant technolgies will be part of the emissions discharged into the air from the incineration process. These chemicals and particulates will impact on other aspects of the environment. A similar problem exists for the treated water. Some of the chemicals used in the unit processes of the Advanced Biological and Physical-Chemical processes, particularly the latter, will contribute to the amount of dissolved solids contained in the treated water.

LABOR

The manpower needs also pose potential concerns. The first is to provide assistance in job relocation, due to regionalization, and labor training programs to meet the required increased skilled levels. In addition, there is a definite need to keep and attract qualified personnel. In the past, the lack of a good job-related salary and image have contributed to a rapid turn-over, primarily in the skilled labor categories. This situation must be overcome if the treatment facilities are to be properly operated and maintained.

DISPLACEMENT OF PEOPLE

The land requirements will cause some disturbance to the social structure of the study and the outlying area, depending upon the treatment technology being considered. While every attempt has been made to minimize disruption to the residents of the two areas, land purchases will require relocation. The number of people being displaced will be the greatest in the study area, because of the high population density of the urban and suburban areas. The major contributor to the displacement problem is the storm water management program and not the treatment plants.

In the outlying area, the lands acquired for the aeration and storage lagoons of the Land treatment system will be the only cause for displacement. As discussed in Section V, system design of the irrigation sites

was based on prototype models and takes into account the present and projected distribution of population, growth centers and environmentally unique areas. This resulted in a 40 percent land-use ratio being used in the design and preparation of cost estimates for the Land treatment facilities. This means that within the boundary of each area considered for the Land treatment system only about 40 acres in each 100 acres would be utilized; the remaining 60 acres, which could include roads, forests, streams, homes, farmhouses, farmyards, communities, open space, space for orderly community growth, etc., would not be utilized.

In all cases, relocation assistance is to be provided under the provisions of the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The number of people displaced for the five alternatives are summarized in Table VII-4.

Table VII-4
Displacement of People

Location	ALTERNATIVES I	II	III	IV	V
Study Area:					
1990	3,400	18,800	29,600	17,500	25,620
2020	3,400	18,800	29,600	17,500	25,620
Outlying Area:					
1990	-	-	-	2,750	920
2020	-	-	-	3,380	1,440
Total System:					
1990	3,400	18,800	29,600	20,250	26,540
2020	3,400	18,800	29,600	20,880	27,060

SECTION VIII

SOCIO - ENVIRONMENTAL IMPACTS

Basis for Evaluation

The impact of the five alternatives on the area's environment and human activities was evaluated in terms of over-all implications, rather than on a site specific basis. It was recognized that one of the major factors in the final decision-making process would be the extent to which the area's treatment system would be consolidated. Aside from the effects that resource commitments impose on a community's life style, regionalization was considered the one variant with the most potential for impacting on the natural and social environment. Therefore, attention was focused on evaluation of the socio-environmental effects associated with the system components and the implications of each alternative's degree of regionalization.

Impacts specific to a site and surrounding locality should, of necessity, be evaluated once a wastewater management program is adopted for the study area. At that time, an Effect Assessment and Environmental Impact Statement must be prepared before any phase of the plan of improvement is implemented. Two general comments, however, will apply to most of the system's functional components: (1) the construction of these features, especially in the urban area will cause some disruption to existing public access and traffic flow; and (2) there will also be some temporary inconveniences because of the noise and dust created by the construction works.

In order to insure its relevancy, the socio-environmental evaluation was done by a group of academicians from a number of universities located in the study area. The members of the evaluation team included such special fields of competence as Environmental Health Engineering, Biology, Aquatic Biology and Chemistry, Urban Sociology and Urban Systems Planning, Water Resources Planning, Geology and Economics. The results of their assessment, the methodology they used to analyze alternatives and their conclusions are presented in Appendix E. The following is a summary of the key observations evaluated within the context of ecological, social, aesthetic and hygienic considerations.

Storm Water Management Program

As previously indicated, the degree of regionalization for Alternative I would affect the aquatic ecosystem and environment of many

small streams. The consolidation, without redistribution of the treated flow, would eliminate the small treatment plants as the only dependable source of stream flow. In addition, the degrading impacts of the pollutants contained in the untreated surface runoff would still be experienced, even though the diluting capability of the major streams would be improved.

The storm water management program associated with the NDCP alternatives is localized with respect to design and, therefore, independent of system regionalization. Capture and treatment of surface runoff would not only improve the water quality, but also effectively regulate the streams flow. At the same time, construction of the impoundments, especially in the rural portion of the study area, would result in an increase of standing water biotic (aquatic organisms) communities and a reduction in flowing water and terrestrial (flora and fauna) communities. This trade-off was not viewed as a negative effect on the distribution or diversity of the biotic communities since most areas have already been highly modified by man. However, care should be exercised in the final siting studies to avoid disruption of any eco-unique areas that may still exist.

Collection and Conveyance Systems

The collection and conveyance systems are a function of the degree of regionalization being considered. Most of the impacts associated with these functional components are directly related to the construction phase and its resultant effect in terms of the surface disruption to the total environment. Some of the biotic communities would be irreparably altered during the installation of the pipeline systems for either the collection or redistribution system elements. Conversely, tunnel construction for the various regional conveyance systems would not involve surface distribution and so was not considered detrimental. In fact, the rock and spoil material from tunneling and excavating can be put to good use as has been previously discussed.

Treatment Facilities

PLANT TECHNOLOGY

The plant technologies were evaluated together, since the facilities impacted only on the study area. Moreover, the evaluation involved only the plant's direct impact on the total environment. Specifically excluded

was any consideration of the highly desirable gain in water quality. In this way, attention was focused on the relative negative aspects of each technology, since either could be independently used, regardless of the degree of regionalization ultimately adopted.

The Physical-Chemical process was consistently downgraded in relation to the Advanced Biological process primarily due to the adverse impact on air quality previously discussed. It was generally felt that the long-term effects, when added to those emissions already present in the urbanized area, would adversely impact on the residential patterns, biotic communities, aesthetic (visual and odors), and hygienic (irritants and particulates) facets of the environment. In addition, the Physical-Chemical process did not foster as wise a use of resources as the Advanced Biological technology. It consumes more of nature's natural resources and converts them into noxious air pollutants as well as less usable sludge.

LAND TECHNOLOGY

ENVIRONMENTAL

The Land system would involve some disruption of the natural biotic communities due to construction of the aeration amd storage lagoons; but the planning constraints relative to protection of the eco-unique areas should minimize the impact. At the same time, the extensive number and location of storage lagoons in Altertnative IV will undoubtedly attract waterfowl into the area, particularly since an abundance of vegetative cover and food crops would be nearby. The significance of this aspect and its effects on the migration pattern for the Mississippi River fly way is not known at this time.

WATER BALANCE

The Land treatment method imposes the potential for a change in the outlying area's water balance. The change would result from an increase in evapotranspiration rates and the control of the ground water table under the irrigated fields. This would apply only to Alternative IV since the acreage involved is extensive and fairly well concentrated.

Preliminary assessments indicate that the evapotranspiration rates resulting from the increased crop cover would approximate the average annual rainfall in the outlying area. If true, the net storm water runoff contribution from the effected lands to the area's stream flow regimen would be lost. Furthermore, the necessity to maintain a depressed

water table under the irrigated area could have a minor, but additional effect on the underground water movements. Accordingly, there may be a need to offset the potential change in the average annual and low-flow patterns in the area's streams, using the renovated water. Since the water is of high quality, no degradation should be experienced. In addition, the subsurface water quality over a long period of time would approximate the same constituent levels obtained from the higher water quality standard. This would include a level of total dissolved solids that could be higher than exists there now, but still within potable water supply standards.

SOCIAL

The impact on the sociological and community political structure was the major concern of the evaluators as well as the residents of the agricultural areas. It was noted that some of the employment skills associated with the Land treatment process could effectively use the manpower available in the area. Employment of those small farmers and local residents that need an outside source of income would help them remain in the area, rather than work in or migrate to the city. The concept of controlling the use of such large parcels of land within the outlying agricultural area, however, was the basic concern.

The extensive nature of Land treatment suggested in Alternative IV, an established trend away from agricultural land-use. For example, prediction of a growth vector to the south of the Calumet Region was made as early as 1966. This would affect such rural areas as the Newton-Jasper County area in Indiana where construction of Interstate Highway I-65 has opened a new path to urbanization. Consequently, treatment or storage sites along the I-65 right-of-way, especially near exits, could result in major dislocations, unless properly planned.

Although the Land treatment alternatives would prevent a large scale commercial and industrial development; they provide a long-range opportunity to shape the regional growth pattern and avoid an uncontrolled urban expansion. One solution is the creation of satellite cities - self contained communities - located on the perimeter of the Land treatment sites. The wastewater of these communities can be easily integrated into the treatment process at minimal costs. At the same time, control of the transportation network and development patterns would be helpful in maintaining a balance between population concentrations and land-use commitments.

Key to assessing the final impact will be the rural communities willingness to work with the urban communities and forego certain values, both social and economic, implicit within their long-range plans. The use of long term contractual arrangements (50 years) and the magnitude

of land commitments will constrain any real flexibility in land-use planning and growth patterns. On the other hand, the agricultural economy would grow since the Land treatment system has been designed to be responsive to farm-related income and production. However, until it can be conclusively demonstrated that the participating farmers would benefit and the existing life style would not be disrupted, there would be no gains apparent to those residing in the rural area. Therefore, the location of Land treatment sites in the outlying area has generated a strong political and social opposition.

Sludge Management

No appreciable difference in the use-value of the various sludges was noted, except for the sludge from the Physical-Chemical process. The differential in impact due the constituent composition and use potential of the sludges was previously discussed from a land-use aspect.

Land reclamation and agricultural disposal of biological sludges has been adopted by the Metropolitan Sanitary District of Greater Chicago and the North Shore Sanitary District in Lake County, Illinois. The Gary Sanitary District has two borrow pits (from construction of the Indiana Toll Road) for sludge disposal and these pits will be useful until 1990. Since approximately one half of the sludge from wastewater treatment in the C-SELM area is already being utilized or disposed on land sites, total agricultural utilization of sludge was considered only a slight improvement over current practices. Furthermore, restricting land for agricultural uses faces the same social and political problems confronting the implementation of the all Land treatment system (Alternative IV). Therefore, the option of land rehabilitation was judged to have the most beneficial potential, especially from a local and regional standpoint.

Surface-mined areas, when reclaimed, can become useful sites for recreational purposes. For example, Shakamac State Park and Green-Sullivan State Forest in southwest Indiana were once strip-mined areas. Today, they provide for a wide range of recreational opportunities including: hiking, horse-back riding, picnicing, boating, swimming, camping and fishing. Given the increasing population projected for the C-SELM region in 1990 and the expected increase in leisure time, there is also anticipated a need for increased recreational opportunities near the metropolitan areas. Surface-mined areas that are currently unproductive and those that will be surface mined in the future, could well utilize the soil building qualities of the biologically produced

sludges for reclamation purposes. With land reclamation, the land becomes available for a variety of potential uses once the character of the soil has been made productive again and vegetative cover introduced. Other use could include such diverse purposes as residential development, open-space, agricultural and beef production, or regional industrial and light commercial park sites. Regardless of the selected use, such areas should be incorporated into local land-use plans. This, in turn, should lead to an orderly development in compliance with local thinking and growth patterns.

SECTION IX

INSTITUTIONAL ASSESSMENT

An evaluation and analysis of the institutional impacts is presented in Appendix F and summarized below. The assessment identifies: (1) institutional, including financial, impacts of the five alternatives based upon a cross-section of existing institutions; (2) the types of changes which would be necessary for implementation by existing institutions; and (3) alternative institutional arrangements which also could be considered if so desired.

Background Factors

Current Federal policies seek to encourage regional solutions to areawide needs with emphasis on the most efficient use of national and local resources. This could run counter to the emphasis of maintaining the integrity of home rule for local counties and communities. In short, the technological trend is toward greater consolidation of wastewater management services because of greater economies in scale, and the concern over the mounting costs associated with these services. Although these realities of home rule and regionalization are somewhat in conflict, this does not necessarily mean a solution is not possible. To the contrary, it means these issues demand close attention and a realistic evaluation of the issues involved.

Along with the concerns effecting wastewater management programs, several local factors are of equal significance. The C-SELM area is a bi-state area and includes most of the Chicago Metropolitan Area and the highly urbanized and industrialized northwestern corner of Indiana. As a result, the study area is affected by two distinct sets of institutions. Three types of institutions currently provide wastewater management or treatment services within the C-SELM area: municipalities, counties, and special districts. In Indiana, there is also an authority to establish regional water and sewage districts; however, no public demand for such a district has been expressed.

While there are attempts in Indiana to widen the institutional authority to provide wastewater management services, certain limits have been imposed. Legislation recently has been passed in Indiana which would prohibit the interstate transfer of sewage and the implementation of any Land disposal system without State and county approval.

Similar legislation has been enacted by the State of Illinois which would inhibit intercounty transfers. This Legislation will certainly have a negative effect on any regional proposals which include outlying portions of Indiana and Illinois. Moreover, no interstate or regional institutions exists in either State with the authority or jurisdiction to implement or operate regional wastewater management programs.

Assessment of Functional Components

REGIONALIZATION OF TREATMENT

GENERAL

There are more similarities than differences in institutional impacts between the five alternatives. All alternatives would regionalize or consolidate services beyond the existing treatment system. This would require the coordination of planning, operation and management activities. Accordingly, the number of plants utilized determines the number of institutions affected by the abandonment of existing plants. This, in turn, creates a secondary level of institutional concerns: (1) the assumption of the outstanding debts and compensation due the abandoned plant owners; and (2) the need for consolidation and contractual arrangements between institutions.

LAND TREATMENT

The use of the Land treatment system (Alternatives IV and V) would have significant institutional impacts outside, as well as inside the study area. Within the study area, the alternatives would have a similar impact because of the common need for a cooperative arrangement to regulate the use of shared facilities. Outside of the study area, the impact would be more widespread. Affected would be those agencies responsible for the relocation of people, and land-use planning and control. In addition, Alternative IV would have a greater impact because it utilizes components which cross State lines. This would require some type of interstate compact and Congressional approval.

The major impact, however, would stem from the need to incorporate citizens living outside of the C-SELM area in the wastewater management

decision-making process. In order for these citizens to be assured that their own self-interests and values are protected, it is important for them to have administrative responsibility over their lands. A good technique for incorporating such citizens in the decision-making process would be to establish locally controlled agencies which would be responsible for acquisition and operation of the spray irrigation sites. The local agency would contract with wastewater management agencies within the study area for the treatment of the wastewater. A second alternative would be to coordinate operation of the locally operated irrigation sites and the existing collection systems through a regional body composed of representatives from within and outside of the C-SELM area.

STORM WATER MANAGEMENT SYSTEMS

Two basic types of storm water collection and storage systems are utilized by the alternatives. The impact of collecting storm water via combined sewers would be minimal since only existing systems or locally approved extensions are included. The NDCP alternatives, however, would add a more complex storm water treatment system involving storage and releases at a controlled rate for treatment. This system would have several institutional impacts. First, it would be necessary to acquire the storage sites. Second, institutional adjustments would be necessary if storage sites are utilized for recreation. Third, a cooperative mechanism would be required to control the release of water from storage sites to the treatment plants or land sites.

SLUDGE MANAGEMENT

Two sludge disposal options have been proposed as part of the regional wastewater systems. These options raise several institutional implications. The impacts associated with Option 1, agricultural utilization, are similar to the impacts connected with the lease of spray irrigation sites, in that contractual agreements to use farm land for sludge disposal would have to be acquired. Option 2, land rehabilitation, would require contractual arrangements with the coal companies or other owners of the land to be reclaimed. Furthermore, both options would have to be coordinated with applicable land-use plans; and also require cooperative arrangements to regulate the use of shared facilities such as conveyance systems and disposal sites.

REUSE CONSIDERATIONS

All alternatives, except for Alternative I (current standards), consider comparable reuse capability of the wastewater. The four

NDCP alternatives consider, to some degree, such reuse opportunities as recreation, land reclamation, power production, stream flow augmentation and water supply. To cope with these resource management considerations, existing institutions must either be granted new authorities, or cooperative arrangements should be developed with those agencies that have the authority. At the same time, all treatment and reuse options must be integrated with land-use planning. This will be required, regardless of which alternative is adopted.

Financial Considerations

Under present arrangements, wastewater financing is obtained from three sources: Federal cost sharing, State bonding (Illinois only) and local contributions. All of the alternatives would strain these resources beyond their present capabilities. This suggests that existing institutions may not be able to accommodate such a financial burden without radically affecting the tax structure and without allocating resources from other public services. The significant institutional question raised is how to meet these financial requirements. Potential answers include modifications to existing institutions, the creation of new authorities or increases in State and Federal cost sharing.

Local institutions will be unable to finance any of the alternatives even if they have sufficient legal bonding capacity remaining (they generally do not) or have their bonding authority increased. Therefore, the State and Federal government will likely be required to ease the local financing burden. If the States are to take a more viable role, Indiana would have to pass a Constitutional amendment that would enable it to issue general obligation bonds and assume bonded indebtedness. Illinois can issue general obligation bonds, but would have to increase its level of contributions.

A necessary measure for meeting the costs of the five technical alternatives will be an increased Federal role in financing. Some commitment to this increased role is evident from the Congressional wastewater financing provisions contained in PL 92-500. In particular, the Environmental Financing Authority contained in this law creates a fund to assist local government in borrowing construction funds at reasonable terms. The law also authorizes the Federal government to provide 75 percent of the capital costs for wastewater projects, but requires that a system of user fees be established to meet the annual operation, maintenance and replacement costs, which must be borne totally by local interests.

Institutional Arrangements for Implementation

On the basis of the foregoing, consideration was then directed to the political, economic and administrative implications of implementing each of the alternatives. It was concluded that: (1) the existing institutions and structures should be maintained and utilized whenever possible; and (2) new institutional arrangements should be introduced only when existing institutions would be unable to implement the alternatives. The range of institutional approaches considered included three basic types of institutional arrangements. The first, referred to as the local approach, emphasizes the maximum use of bilateral and multilateral contractual agreements. The second approach goes beyond the local level and, as an intermediate regional approach, would involve a greater restructuring of service districts. This approach would require State enabling legislation to create the required service districts and would conflict with home rule advocates. The third approach goes further still and would create one service area, or perhaps a few multi-county service areas. This approach would also require new State enabling legislation. This latter approach referred to as the areawide approach, would be the most far reaching in terms of institutional, political, economic and administrative implications.

SECTION X

ECONOMIC ASSESSMENT

The economic impact associated with any alternative reflects the direct and indirect effects on those factors that make up the economic structure of both the study and outlying areas. Primarily, these effects are the result of potential changes in net income, property values, water and land uses, industrial and agricultural productivity and costs. Another consideration, the level of employment, has already been discussed under resource impacts. What follows is an overview of the economic assessment similar to those for the socio-environmental and institutional considerations. A more detailed discussion is presented in Appendix G.

Net Income

STUDY AREA

The first, and most personal effect, relates to an individual's net income. In the study area, the property owners and industries who discharge their wasteloads into the collection system will face higher user charges. This increase will reflect the need to pay the annual equivalent of the (NDCP) system-related costs, some 3 to 3 1/2 times the level associated with attaining current standards. The increased sewer charges will reduce the net or disposable income that the taxpayer has left to spend and, in turn, affects the sale of consumer items.

OUTLYING AREA

INCOME PROTECTION

The potential for affecting the net income of those residing in the outlying area exists for both the sludge management program and the Land treatment system. To safeguard against any adverse impact, provisions for compensatory payments were included in both the design and costing of the two functional components. The option involving the reclamation of surface mines would not directly affect the citizens and could prove beneficial to the area, as previously discussed. The agricultural sludge

management option does have the potential for affecting the participating farmer's income. Therefore, payments have been included in the cost estimates to compensate for any system-related losses. This applies to the farmer's annual income and the long-term capital gain from the increased land value normally obtained when the land is sold. Similar provisions were made in connection with the Land treatment system. In addition, it was considered necessary that the operating entities for the systems indemnify (insure) the participants against any crop losses directly associated with the system's operation. As with any large entity, it would probably be self-insuring.

UNPAID-FOR-GAINS

Aside from the concern over net income protection, there is a potential for economic gain. This income gain would come from the nutrient recycle achieved in both the sludge management program and Land treatment component. In both cases, the costs of commercial fertilizer would be practically eliminated and the farmer would achieve a significant reduction in his total production cost budget. See the discussion on Land System Design in the Data Annex to Appendix B. Another consideration is the gain attributable to the irrigation and drainage systems of the Land treatment process. The unpaid-for capital improvements represent a level of improvement beyond that normally installed from an agricultural risk-decision standpoint. Consequently, both installations will help increase the farmer's average net income by practically eliminating the reduced yields heretofore incurred during excessively wet or dry years.

Property Values

STUDY AREA

Achievement of the NDCP goals will impose an intermix of impacts on the property values within the study area. The assessed roles of property values will be reduced with the transfer of lands and improvements from private to public ownership. This reduction will be caused by the purchase of lands necessary for the storm water storage sites and the treatment sites, if either of the two plant technologies are used. On a comparative (to the total value) basis, the effect of the reduction should prove minor. Moreover, the reduction should be more than offset by: (1) the enhanced value of properties located along the improved watercourses, (2) the increased value of the lands made available for community usage with the abandonment of existing treatment plants, (3) the potential changes in land values in the flood plains, and (4) the intensification of agricultural production in the rural area gained from the storm water management program.

OUTLYING AREA

The property values in the outlying areas would be affected by the Land treatment process which would impose a retention of an agriculturally-related economic base and life style. Thus, in any one locality, the acreage retained in agricultural usage would probably be greater than might ordinarily be experienced over time. In other words, the 50-year duration of the contractual arrangements would probably run counter to both the desires of some of the residents and the present pattern of regional growth. However, while the retention of a farming life style is a personal consideration, the inability for land usage to change in market value represents a potential economic impact.

In addition, the Land treatment system will require purchase of land for the aeration and storage lagoons. The potential losses in property value and accruing tax revenues were offset by providing yearly compensatory payments to the municipalities or counties.

Agricultural Productivity

The main impact from an agricultural productivity standpoint is again the scale of lands which conceivably could be retained in agricultural usage. Additional impacts could accrue from the crop selectivity possible under either the agricultural programs for the Land treatment or sludge systems. The double cropping system of corn and rye, the illustrative example used in the design and evaluation of the Land system, is a case in point. Concern over the selective crops feasible for system use is valid, but can be overcome with development of special hybrids as has been done in the past. Even so, the corn and rye represent a base with which to expand the potential of the present agri-economic structure. Consequently, the implications extend to the national level and the present crop support program's interrelationship with both the domestic and international market demands.

Industrial Implications

The impact to industry will be felt in at least three different ways. The first impact involves treatment costs, the second involves the reuse potential of the renovated water, and the third impact involves the potential for gains resulting from industrial recycling efforts.

Industries, especially major water users, presently are readjusting their manufacturing processes to minimize the treatment costs required to meet current water quality standards. To achieve the equivalent of the higher NDCP goal, however, the cost of industrial treatment will have to be materially increased. Regardless of how the treatment is achieved (on-site and/or by the regional system), the increased capital and operating expenditures will be reflected in the manufacturing costs and passed on to the consumer. Accordingly, this too could have an impact on the interrelationship between the domestic and international markets.

Another factor to be considered is that the renovated water from the NDCP alternatives could be usable for most industrial processes. This represents a new source of water and has the potential for reducing the competitive demands on existing supplies. However, this potential would apply to only those processes where the total dissolved solid (TDS) level can exceed 500-600 milligrams per liter.

In addition there will be the potential for added gains from the recycling efforts. Industrial recycling has already provided other fringe benefits. Some industries have reduced costs by recovering some of the constituents contained in its residual wastes and reusing them in the manufacturing process. Similarly attention is being focused on the potential to combine the organic-based sludges with solid wastes to generate synthetic fuels and other recoverable by-products. If this proves successful, another option can be added to the sludge management program for the Advanced Biological and Land treatment technologies.

Cost Considerations

The evaluation up to this point has underscored the interdependency between the social and resource base of the study area and the outlying area. However, the financial cost is also a resource which is subject to competative demands from ever-changing priority needs. As such the use of the tax dollar affects all political levels - from the study area to the national budget.

An estimate of costs, both capital and annual has been prepared for each of the five alternatives. These costs are basic to any financial cost-sharing consideration and essentially include the major economic factors that ultimately must be considered. In essence, these costs are really comparative in nature and are designed to display the economic implications involved in such related management considerations as regionalization, treatment technology, sludge utilization and water reuse. The cost comparison also underscores the economic impact involved in upgrading our current water quality standards as part of the national objective to improve our total environment.

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COST OMISSIONS

There are several cost items which are not included in the estimates. These items have been excluded because of an inability to determine actual costs with any degree of relevancy. Information concerning these omissions are discussed below.

INTERCONNECTION WITH EXISTING SYSTEM

The cost relationships identified in the four NDCP alternatives represent an extension of the current, local planning objectives for consolidation as expressed in the Reference Plan, Alternative I. What is not included are the costs for reducing the present 132 plants to the recommended 64 plant system contained in the Reference Plan. To what extent this degree of consolidation is to be achieved, particularly in light of the new NDCP standards and its total implications cannot be ascertained at this time. The actual costs incurred will be identified only when those State and local entities responsible for this decision select the degree of regionalization most acceptable to the area's total needs. In the interim, however, an estimate of the capital cost required for the interconnection has been made, based on anticipated 2020 flow conditions. The cost amounts to some $28.8 million.

PLANTS RETIRED FROM SERVICE

Another cost factor not included is the outstanding bonded indebtedness of the existing treatment plants that would be abandoned if any of the five alternatives were implemented. The amount of indebtedness associated with each plant could not be determined primarily because the information was unavailable. Instead, an estimate was made of the total outstanding indebtedness in order to determine the overall magnitude of cost involved. This was based on unit values derived from service areas where this information was known and extended to the total area. Based on this approach, the total outstanding indebtedness for the existing treatment facilities was estimated at approximately $401,500,000 or $23,700,000 per year if amortized over a 50-year period using an interest rate of 5.5 percent. This represents the maximum cost level which could be incurred if all plants were abandoned, as would happen under Alternative IV. This figure represents only about four percent of that system's annual costs. A portion of these costs may have to be assumed or reimbursed when trying to consolidate existing operations and upgrade treatment for the other NDCP alternatives. Determination of these costs, as well as the amount to be reimbursed, will rest with the USEPA, the States and others responsible for these decisions.

The cost of dismantling and scrapping the abandoned plants also is not included in the estimates for the alternatives. It was assumed that the salvage value of the existing treatment facilities, and especially the land made available, would equal or exceed the cost of razing the plants to be retired from service.

COST OF ALTERNATIVE PLANS

The costs, both capital and annual, for each of the five alternatives are summarized in Table XI-1. The annual costs were computed using the current Federal interest rate of 5.5 percent. There were seven special cost considerations that were incorporated into the design of these estimates that warrant special mention because subsequent economic conditions may warrant a change. The cost implications in changing some of these design considerations and the interest rate are discussed in Appendix D.

The main line conveyance systems were designed for 2020 flows to recognize the economics inherent in the construction. This was based on the assumption that treatment facilities planned for 1990 would be expanded over time to accept the projected increased flows. Thus, definite cost savings could be achieved by avoiding phased construction of this particular system component.

The treatment system costs were based on the physical layout and capacity required to meet 1990 design flow conditions. However, in all cases, except for the Land treatment system, the 2020 acreage was acquired initially. This assured the capability to expand in accordance with future needs and minimize any long-range disruption to local land-use planning efforts.

The capital cost for the Land treatment systems includes only the lands required for the lagoons and buffer zones needed in conjunction with 1990 flows. Lands required for the 2020 flows could be safeguarded by negotiating a "first-right-to-buy" option. This would not limit the owner from selling at any time, but only guarantee the operating entity the first right to negotiate and purchase the land at a mutually agreeable price. Time-phasing of the acquisition program was adopted to minimize the economic impact to the outlying area. This approach would retain the lands in private ownership and production for as long as is possible. At the same time the payment compensating local interests for the loss of tax revenue on purchased land has been included in the annual operating costs. This amounts to $1.1 million and $0.3 million for Alternatives IV and V, respectively.

The cost for the rock and soil management system included in all five alternatives was based on the option of making the maximum commercial use of the material. This would involve strategically stock-piling

Table X-1
Alternative Cost Comparisons
Costs ($ Million) a/

	Alternative I		Alternative II		Alternative III		Alternative IV		Alternative V	
	Total Project Cost	Annual Cost	Total Project Cost	Annual Cost	Total Project Cost	Annual Cost	Total Project Cost	Annual Cost	Total Project Cost	Annual Cost
Treatment System:										
Capital Costs	1,310	61	4,078	191	5,611	264	2,508	118	4,376	206
O, M & R Costs b/	-	27	-	230	-	235	-	98	-	197
Total Costs		88		421		499		216		403
Conveyance System:										
Capital Costs	846	45	995	53	1,055	56	1,942	103	1,551	83
O, M & R Costs	-	5	-	6	-	6	-	9	-	7
Total Costs		50		59		62		112		90
Storm Water Management System:										
Capital Costs	834	39	2,534	123	2,534	123	2,582 c/	125	2,582 c/	125
O, M & R Costs	-	4	-	44	-	44	-	44	-	44
Total Costs		43		107		167		169		169
Sludge Management System:										
Capital Costs	262	12	1,231	58	343	16	206	6	294	14
O, M & R Costs	-	9	-	21	-	13	-	5	-	12
Total Costs		21		79		29		11		26
Reuse:										
Capital Costs	-	-	327	12	325	12	1,376	64	930	42
O, M & R Costs	-	-	-	7	-	6	-	21	-	15
Total Costs				19		18		85		57
Total Plan:										
Capital Costs	3,252	157	9,165	437	9,868	471	8,614	416	9,733	470
O, M & R Costs		45		308		304		177		275
Total Costs		202		745		775		593		745

a/ Total project cost is equivalent to the capital expenditure required for the alternative to be operational and treat 1990 flows. Annual costs were computed using a phased schedule of implementation with capital and annual costs discounted (present worth) to the base year of 1975 and amortized over a 50-year economic life using a 5.5 percent interest rate.

b/ Operation, maintenance and replacements.

c/ Includes the cost of diurnal storage at access points which is normally associated with smaller plant design.

the material and using the material over time. This would safeguard the resource base of the study area and help hold material costs to a reasonable level. As such, it represents but one cost option that could be used.

Option 1 of the potable reuse system was used in the summary estimates. This option requires that the Illinois portion of Lake Michigan withdrawal be maintained within the present 3,200 cfs constraint.

The cost estimates do not include any equivalent for interest during construction. Due to the uncertainties of funding and potential variation in implementation scheduling, allowances for this type of cost was not included.

An intermix of two sludge options also are involved in the cost summary table. The sludge option involving the utilization of surface mines was used for Alternatives III, IV and V. On the other hand, the option of agricultural utilization of sludge was used for Alternatives I and II. Adoption of this latter option follows the current practices (Alternative I) and the use constraint of the sludge from the Physical-Chemical process (Alternative II). Utilization of the surface mine reclamation option would minimize the impact on the resource base of outlying areas while at the same time providing increased opportunity to meet a range of land-related needs.

COST COMPARISON OF ALTERNATIVES

OVERVIEW

Meeting the goals of PL 92-500 will require approximately three times the capital expenditure needed to consolidate the existing plants and upgrade the remaining plants to meet current standards (Alterantive I). At the same time, the adjusted annual costs for operation, maintenance and replacement will increase by some 4 to 6 1/2 times, depending upon the technology used. Most of the increase is attributable to three factors: (1) the differential in water quality goals; (2) the necessity to collect and treat storm water runoff; and (3) the reuse and redistribution system provided to meet local needs including potable water supply deficiencies. Three of the functional components, the treatment, storm water management, and conveyance systems account for 80 to 90 percent of the five alternatives' total capital expenditures. The operational, maintenance and replacement costs were analyzed in a similar manner. Only the annual costs associated with the treatment systems were predominant. The annual operating costs for this functional component amounted to 60 percent of the total for Alternative I. The corresponding equivalent percentile was approximately 75 percent for Alternatives II and III; 55 percent for Alternative IV; and 70 percent for Alternative V.

NATURE OF COSTS

The system related costs discussed in the previous paragraph are only part of the financial consideration. Very few of the costs are single-purpose and, hence, related only to the water quality control. Multiplicity exists in many of the functional components - for example, the storm water management program. This program will not only be responsive to the need for the capture and treatment of runoff as a source of pollution, but also provide significant reductions in urban water damage problems as well as a source for water supplies. It is within the broader framework of fulfilling part of the area's total needs that the alternatives' cost must be assessed. Moreover, it is because of the multiple-purpose nature of the alternatives that the actual extent of the Federal, State and local participation and cost sharing cannot be determined at this time. The development of this type of information is beyond the scope of study. What is required is a detailed investigation as to the economic justification and cost effectiveness of project elements in meeting a multiplicity of needs. However, in the absence of this type of input the costs for each alternative should be apportioned in relation to the guidelines set forth in PL 92-500. This will provide at least some indication of the costs to the people at the National, State and local levels.

SECTION XI

SUMMARY OF FINDINGS

Relationship of Assessment

During this study care has been taken to avoid characterizing the impacts of the alternatives and various options. The characterizing of an impact and its effect as either beneficial or detrimental is considered the responsibility of those who are either directly or indirectly affected. Each concerned individual must analyze the impacts and decide, based on his or her own feelings and circumstances, whether or not an impact is good or bad.

The impact assessment involved a two part process: (1) the identification of impacts; and (2) the measurement of impacts. An impact is any potential change to existing conditions brought about by the alternative plan. Accordingly, the alternative's resource requirements, functional components, operational considerations and potential changes in water and land uses all served as the basis for evaluating the resultant impacts. The measurement of these impacts which followed, essentially identified the potential effects of the alternative on the current social, environmental, institutional and economic conditions of the affected areas.

The measurement of the impacts involved either quantifying or providing qualitative descriptions in such a manner that a limited number would define a comprehensive summary of an alternative's impact. Care was taken to minimize the use of subjective judgments. Whenever possible, impacts have been measured using numbers derived from design data. Verbal descriptions supplement the numbers where numbers are either not available or inappropriate.

The decision as to which of the five alternatives, if any, is to be adopted is not just a matter of local concern. The implications extend beyond just the study area, since many of the resource impacts will interact with the preferences and objectives of those people that reside in the rest of the States, the Region and the Nation. At each of these socio-political levels, there is a causal relationship that must be recognized.

Summary of Impacts

In order to provide a proper framework of analysis, the impacts for each alternative have been summarized in Tables XI-1 through XI-5. The information is displayed in such a way as to identify the type of impact

which would result if the alternative would be implemented and the geographical division affected. The individual socio-political divisions are identified by a series of column headings along the top of the table to clarify the causal relationship involved. In addition, there are subcategories within each division to help further define the various social interest group(s) that would be affected.

The individual categories of impacts are listed vertically along the side of the table. Each characterizes a particular aspect of a change. The first, ecological, describes the environmental output and effects for the alternative. The next category shows the primary resources required for system operation. Secondary impacts are not included, though some are discussed in Appendix B. The third category indicates the changes in water and land usage, both direct and potential. Other categories are provided which further tend to indicate the range of system-related impacts. The category regarding the change in public perception reflects some of the reactions perceived during the study effort. This will be supplemented over time as each of the socio-political areas establish closer working relationships in what must be a common concern for improving the environment and conserving the nation's resources.

Whenever any component of the alternative or the alternative as a whole causes an impact in a certain area, an entry is made in the tabular display. Where blank "boxes" occur, no impact has been identified. This in itself may be beneficial or detrimental. Moreover, the same vertical and horizontal category headings are used on all of the summary impact displays. This should facilitate comparing alternatives. In this manner, the entries in the same "box" on all five displays can be compared to determine what one alternative will or will not do in relation to the other alternatives.

Table XI-1

Summary of Impacts Produced by Alternative I

(64 Conventional Biological Treatment Plant Plan)

	Page
Chicago-South End of Lake Michigan Study Area	XI-4
Outlying Area of Influence	XI-6
Rest of States, Region, Rest of Nation, and International	XI-8

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
I. ECOLOGICAL					
1. Water Quality	Produces measurable increase in dissolved oxygen. No reduction in phosphorus content from municipal and industrial sources for streams tributary to the Illinois River. For flows tributary to Lake Michigan, phosphorus content reduced to 90 percent. Intermittant degradation will be effected by untreated storm water runoff.				
*Water Quality Output (mg/liter) BOD - 20 Phosphorus: Ill. R. - 5 L. Mich. - 1 Nitrogen - 17 Suspended Solids - 25 Total Dissolved Solids - 600 * Variable, subject to dilution flows.					
2. Air Quality	Plan would facilitate future efforts to attain desired ambient levels.			Aerosols will be present but should not constitute a hazard.	
3. Aquatic Life: (a) Fishery	Provides an enhanced ecosystem for increased production of desireble species.				
(b) Other Biota	Plant consolidation without redistribution of treated water will adversely effect the ecosystem of small streams in dry periods and cause a reduction in flowing water biotic (aquatic organisms) communities.				
4. Terrestrial Attributes (Wildlife)	Limited increase in birds and other animals which feed on aquatic organims inhabiting the improved water courses.				
II. RESOURCE REQUIREMENTS a/					
1. Electrical (Megawatt Hours/Day)	Power needs range from some 3,200 (1990) to 3,600 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	Produce no net fuel needs. Sufficient synthetic gas generated in process to meet treatment needs.	
3. Chemicals (Tons/Day)	--	--	--	Chemical needs for treatment range from 44 (1990) to 51 (2020).	
III. WATER AND LAND USE CHANGES					
Water Use:					
1. Water Supply	This plan could not meet the area's water supply requirements over the next 50 years nor eliminate current depletion of ground water table in western portion of Illinois area.				
2. Water Damages	Provides some degree of flood control only in those areas served by combined storm water and sewage sewer systems			--	--
3. In-Stream Recreation	Provides limited increase in water-based recreation and use potential on those streams with improved flows.			--	--
4. Commercial Navigation	Provides potential for deficiency in flows necessary to sustain projected waterborne traffic.			--	--
Land Use:					
1. Changed Land Uses:					
a. Fee Purchase b/	--	--	--	Some 1,500 acres required for treatment and storm water management systems.	
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--
2. Intensified Land Use:					
a. Irrigation Facilities Contractual	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1- Contractual)	--	--	--	--	--
3. Recreation & Open-Space	Provides limited increase in water based recreation and use potential on those streams with improved flows.			--	--

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Minor losses From property tax rolls for purchased lands.	--	--	Anything in addition to reimbursement for either income protection (leased lands) or the full market value of lands and relocation assistance inherent in the potential displacement of some 3,400 people.	
2. Potential Unpaid for Gains	Tax revenue gain and increase in property values.	Enhanced property values along streams of improved quality.	Provides additional land for other uses due to abandonment of existing treatment plants.	--	--
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	--	--	--	--	--
2. Industrial Manufacturing	--	--	Industries experience net increase in wastewater treatment cost.	--	--
3. Power Plants	--	--	--	--	--
VI. EMPLOYMENT a/	Potential employment ranges from some 2,610 persons in 1990 to 3,040 persons in 2020 to operate and maintain municipal treatment plants and related works.				
VII. INSTITUTIONAL a/	Represents current planning goals for regionalization. Coordination throughout the study area would be necessary and would involve adoption of contractual and/or consolidation arrangements. Sludge management program would also necessitate cooperative arrangements with the outlying area of influence.				
VIII. COST OF PLAN ($ MILLION) a/ d/					
1. Capital Costs (present worth)	$670				
2. Capital Costs (average annual)	$ 39				
3. Operation, Maintenance & Replacement Costs (average annual)	$ 45				
4. Total Average Annual Costs	$ 84				
5. Industrial Pretreatment Costs (average annual) e/			Ranges from 62.1 (1972) to 142.0 (1990).		
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Decrease in disposable income caused by sewer patterns.	Enhancement of property values and recreational potential on major streams only. Inconvenience during construction and some disruption to community cohesion and growth patterns.		Anxiety from interest acquisition proceedings.	

NOTES:

a/ Applies to the agricultural utilization of sludge.

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level which would be incurred by industry to meet current State standards or guidelines. These costs are not included in the plan's cost estimate. While present expenditures levels may exceed the cited costs, the additional capital investments required would be offset by savings in operating costs.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

OUTLYING AREA OF INFLUENCE

IMPACTS OR CHANGES PRODUCED BY PLAN	ILLINOIS				INDIANA	
	OWNERS OF SYSTEM REQUIRED LANDS				OWNERS OF SYSTEM REQUIRED LANDS	
	FARMERS	RESIDENTS	OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	FARMERS	RESIDENTS
I. ECOLOGICAL						
1. Water Quality	--	--	--	--	--	--
2. Air Quality	--	--	--	--	--	--
3. Aquatic Life:						
(a) Fishery	--	--	--	--	--	--
(b) Other Biota	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/						
1. Electrical (Megawatt Hours/Day)	The associated investment program may increase both the area's prime loan interest rates and the consummers' power rates.					
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	--	--	--
3. Chemicals (Tons/Day)	--	--	--	--	--	--
III. WATER & LAND USE CHANGES						
Water Use:						
1. Water Supply	--	--	--	--	--	--
2. Water Damages	--	--	--	--	--	--
3. In-Stream Recreation	--	--	--	--	--	--
4. Commercial Navigation	--	--	--	--	--	--
Land Use:						
1. Changed Land Uses:						
a. Fee Purchase b/	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--	--
2. Intensified Land Use:						
a. Irrigation Facilities (Contractual)	--	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1- Contractual)	Phased leasing of acreage from 47,300 in 1990 to 57,000 in 2020.	--	Imposes need for local counties to incorporate long-term agricultural commitments in land-use plans.		Phased leasing of acreage from 9,700 in 1990 to 10,100 in 2020.	--
3. Recreation & Open-Space	--	--	--	--	--	--

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

OUTLYING AREA OF INFLUENCE

IMPACTS OR CHANGES PRODUCED BY PLAN	ILLINOIS			INDIANA	
	OWNERS OF SYSTEM REQUIRED LANDS		OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS
	FARMERS	RESIDENTS			FARMERS RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.		--	--	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.
2. Potential Unpaid for Gains	--	--	Potential for increase in land values and economic base due to reclamation of surface mines owned by system.		-- --
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	Potential for net income gain from nutrient recycle in lieu of commercial fertilizer.		Potential for reduction in demand for commercial agri-fertilizer.		Potential for net income gain from nutrient recycle in lieu of commercial fertilizer.
2. Industrial Manufacturing	--	--	--	--	-- --
3. Power Plants	--	--	--	--	-- --
VI. EMPLOYMENT a/	Potential for employment ranging from some 260 persons in 1990 to 280 persons in 2020 to operate and maintain the sludge management program.			Potential for employment relatively constant, requiring some 60 persons in both 1990 and 2020 to operate and maintain sludge management program.	
VII. INSTITUTIONAL a/	Cooperative arrangements and coordination of sludge utilization sites required in order to insure compliance with Counties' land-use plans.				
VIII. COST OF PLAN ($ MILLION) a/ d/					
1. Capital Costs (present worth)					
2. Capital Costs (average annual)					
3. Operation, Maintenance & Replacement Cost (average annual)					
4. Total Average Annual Costs					
5. Industrial Pretreatment Costs (average annual) e/					
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				

NOTES:

a/ Applies to the agricultural utilization of sludge.

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level which would be incurred by industry to meet current State standards or guidelines. These costs are not included in the plan's cost estimate. While present expenditures levels may exceed the cited costs, the additional capital investments required would be offset by savings in operating costs.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES		REST OF NATION				
	ILLINOIS	INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	FEDERAL TAXPAYERS	OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
I. ECOLOGICAL							
1. Water Quality	Meets the current effluent and water quality guidelines for Illinois and Indiana, respectively		Minor response to level A, Water Resource Council's Comprehensive Basin Studies (WRCCBS) inventoried needs.	Does not meet the 1985 goal of PL 92-500 and only partially achieves 1983 goal.			--
2. Air Quality	Plan would be consistent with current programs for air emission control in both States.		--	Plan consistent with current Federal Air Quality Act Requirements.			--
3. Aquatic Life:							
(a) Fishery	--	--	--	--	Partially fulfills the goals of relevant conservation groups.	--	--
(b) Other Biota	--	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/							
1. Electrical (Megawatt Hours/Day)	Increases the demand for power supply areas 14 & 40 by 2,630 (1990) and 3,060 (2020).	Increases the demand for power supply area 12 by 540 (1990) and 550 (2020).	Imposes need for decision concerning type of fuel (nuclear/fossil) to be used and siting of new power plants.	Requires expansion of Nation's power base. Imposes need for review of policies regarding extent to which this and other competitive power needs will be met.	--	--	--
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	--	--	--	--
3. Chemicals (Tons/Day)	Increased demand for treatment chemicals will not effect current production markets.			--	--	--	--
III. WATER AND LAND USE CHANGES							
Water Use:							
1. Water Supply	Imposes potnetial need to either reallocate Lake Michigan withdrawals or seek additional supplies.	--	This plan would not contribute to the WRCCBS inventoried need for the study area thereby necessitating the expenditure of an additional capital investment.	--	--	Supreme Court Approval and U.S.-Canada agreement may be required if capture, treatment and reuse of storm water runoff is not necessary before Illinois can obtain an increase in the withdrawal allocation from Lake Michigan.	
2. Water Damages	--	--	Provides a limited response to the inventoried need for flood control in the study area.	May require additional expenditure of capital investment to meet study area needs.	--	--	--
3. In-Stream Recreation	Provides limited potential for meeting State and WRCCBS inventoried deficiencies in water based recreation.			May require additional expenditure of capital investment to meet study area needs.	--	--	--
4. Commercial Navigation	--	--	Provides potential for additional investment if reallocation of water supplies changes the water regimen in the Upper Illinois Waterway system.	May require additional expenditure of capital investment to meet study area needs.	--	--	--
Land Use :							
1. Changed Land Uses:							
a. Fee Purchase b/	--	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--	--	--
2. Intensified Land Use:							
a. Irrigation Facilities (Contractual)	--	--	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	Potential for retaining more land in agricultural production than might ordinarily be experienced over time.			--	--	--	--
3. Recreation & Open-Space	--	--	Plan would not contribute to the WRCCBS inventoried need for the study area thereby necessitating the expenditure of an additional capital investment.	May require additional expenditure of capital investment to meet study area needs	--	--	--

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE I

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES			REST OF NATION			
	ILLINOIS	INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	FEDERAL TAXPAYERS	OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
IV. LAND VALUES a/							
1. Potential Unrecovered Losses c/	--	--	--	--	--	--	--
2. Potential Unpaid for Gains	--	--	--	--	--	--	--
V. REVENUES FROM RECYCLING & REUSE a/							
1. Agriculture	--	--	--	Economic impact of retaining the level of acreage required by this plan in agricultural production could be classified as either beneficial or adverse depending upon the forecast of commodity markets.			
2. Industrial Manufacturing	Potential for incorporating sludge disposal with the recycling of solid wastes and generate synthetic fuel and other recoverable by-products.			--	--	Potential for increase in unit price of manufactured items.	--
3. Power Plants	--	--	--	--	--	--	--
VI. EMPLOYMENT a/	Potential for State assistance in job relocation and labor training programs.		--	Increases need for labor training programs.	--	--	--
VII. INSTITUTIONAL a/	Imposes need to coordinate inter-county transfer of sludge. Enabling legislation necessary to modify present institutional and financial constraints.		--	//. . . . Does not meet the intent of PL 92-500. . . . . //			--
VIII. COST OF PLAN ($ MILLION) a/ d/							
1. Capital Costs (present worth)				$2,010		$2,680	
2. Capital Costs (average annual)				$ 118		$ 157	
3. Operation, Maintenance & Replacement Costs (average annual)				--		$ 45	
4. Total Average Annual Costs				$ 118		$ 202	
5. Industrial Pretreatment Costs (average annual) c/							
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Contributes to the States efforts to meet current water quality goals.			//. . . . Does not meet the intent of PL 92-500. . . . .//			

NOTES:

a/ Applies to the agricultural utilization of sludge.

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ *Potential unrecovered* losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level which would be incurred by industry to meet current State standards or guidelines. These costs are not included in the plan's cost estimate. While present expenditures levels may exceed the cited costs, the additional capital investments required would be offset by savings in operating costs.

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Table XI-2

Summary of Impacts Produced by Alternative II

(33 Physical-Chemical Treatment Plant Plan)

	Page
Chicago-South End of Lake Michigan Study Area	XI-12
Outlying Area of Influence	XI-14
Rest of States, Region, Rest of Nation, and International	XI-16

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE II

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS
I. ECOLOGICAL					
Water Quality Output (mg/liter) BOD 3 Phosphorus 0.1 - 0.2 Nitrogen 2.5 Suspended Solids 1 Total Dissolved Solids 535					
1. Water Quality	Produces measurable increase in dissolved oxygen. Reduces phosphorus and nitrogen discharges from municipal and industrial sources and the first 2.5 - 2.85 inches of storm water runoff by 99 and 97 percent, respectively - - thereby reducing potential for algal blooms.				
2. Air Quality	Emits some 552 to 667 tons of chemicals and particulates daily for 1990 and 2020, respectively. Discharges are within acceptable USEPA air emission standards except for nitrogen oxides, which has potential for being an infrequent source of irritants.				
3. Aquatic Life:					
(a) Fishery	Provides an enhanced ecosystem for increased production of desirable species.				
(b) Other Biota	// . . . Increases the standing water biotic (aquatic organisms) communities. . . . //				
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organisms inhabiting the improved watercourses and standing water impoundments.				
II. RESOURCE REQUIREMENTS a/					
1. Electrical (Megawatt Hours/Day)	Power needs range from some 10,300 (1990) to 12,300 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				
2. Natural Gas (Million Cubic Feet/Day)	Fuel needs range from 156 (1990) to 169 (2020). Commitment could curtail efforts to supply other competitive needs with higher use priorities. Increased demand would probably increase consumer rates.				
3. Chemicals (Tons/Day)	--	--	--	Chemical needs for treatment range from 4,160 (1990) to 5,030 (2020).	
III. WATER & LAND USE CHANGES					
Water Use:					
1. Water Supply	This plan would meet the area's water supply requirements over the next 50-years and eliminate the current depletion of ground water table in the western portion of the Illinois area.				
2. Water Drainage	Provides significant reduction of overflow on some 69,900 flood plain acres.			--	--
3. In-Stream Recreation	Provides enhanced potential for water-based recreational opportunities. Imposes need for decisions regulating flow distribution and stream usage.			--	--
4. Commercial Navigation	Redistribution of flows and lock passage sufficient to sustain projected water-borne traffic.			--	--
Land Use:					
1. Changed Land Uses:					
a. Fee Purchase b/	--	--	--	63,900 acres acquired for the treatment and storm water management systems.	
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--
2. Intensified Land Use:					
a. Irrigation Facilities Contractual	Provides basis to control growth patterns and maintain balance between intensive area developments and open-space usage.			Phased leasing of acreage decreases with changed land use from 116,300 in 1990 to 87,100 in 2020.	
b. Agricultural Sludge Utilization (Sludge Option #1- Contractual)	--	--	--	--	--
3. Recreation & Open-Space	Provides potential for development of recreational and environmental corridors along some 500-miles, or more, of stream. Additional potential is provided by the rural and suburban storm water impoundments, and by treatment plants with sufficient capacity to maintain through flows for selective fishery impoundments.				

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE II

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Minor losses from property tax rolls for purchased lands.	--	--	Anything in addition to reimbursement for either income protection (leased lands) or the full market value of lands and relocation assistance inherent in the potential displacement of some 18,800 people.	
2. Potential Unpaid for Gains	Tax revenue gain and increase in property values.	Enhanced property values along streams of improved quality.	Provides additional land for other uses due to abandonment of existing treatment plants.	Potential increase in crop production. Capital improvements to land (drainage and irrigation systems) for rural storm water program.	
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	--	--	--	Treatment of rural runoff may stimulate agricultural production.	
2. Industrial Manufacturing	--	--	Industries experience net increase in wastewater treatment cost.	Sufficient quality in treated water to meet most industrial process needs.	
3. Power Plants	--	--	--	--	--
VI. EMPLOYMENT a/	Potential employment ranges from some 9,610 persons in 1990 to 10,670 persons in 2020 to operate and maintain highly technical municipal and storm water treatment plants and related works.				
VII. INSTITUTIONAL a/	Exceeds current planning goals for regionalization. Coordination throughout the study area would be necessary and involve adoption of contractual and/or consolidation arrangements. Treatment of a portion of the wastewater and the sludge management program would necessitate cooperative arrangements with the outlying area of influence.				
VIII. COST OF PLAN ($ MILLION) a/ d/					
1. Capital Costs (present worth)	$1,852				
2. Capital Costs (average annual)	$ 109				
3. Operation, Maintenance & Replacement Costs (average annual)	$ 308				
4. Total Average Annual Costs	$ 417				
5. Industrial Pretreatment Costs (average annual) e/			Ranges from $50.0 (1972) to $103.0 (1990).		
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Decrease in disposable income caused by increased sewer charges.	Enhancement of property values and potential for increase in total recreational opportunities. Inconvenience during construction and some disruption to community cohesion and growth patterns. Anxiety from the effects of air pollution.		Anxiety from leasing and interest acquisition proceedings.	

NOTES:

a/ Applies to agricultural utilization of sludge (Option #1) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NECP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE II

OUTLYING AREA OF INFLUENCE

IMPACTS OR CHANGES PRODUCED BY PLAN	ILLINOIS			INDIANA		
	OWNERS OF SYSTEM REQUIRED LANDS				OWNERS OF SYSTEM REQUIRED LANDS	
	FARMERS	RESIDENTS	OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	FARMERS	RESIDENTS
I. ECOLOGICAL						
1. Water Quality	--	--	--	--	--	--
2. Air Quality	--	--	--	--	--	--
3. Aquatic Life:						
(a) Fishery	--	--	--	--	--	--
(b) Other Biota	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/						
1. Electrical (Megawatt Hours/Day)	The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.					
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	--	--	--
3. Chemicals (Tons/Day)	--	--	--	--	--	--
III. WATER & LAND USE CHANGES						
Water Use:						
1. Water Supply	--	--	--	--	--	--
2. Water Damages	--	--	--	--	--	--
3. In-Stream Recreation	--	--	--	--	--	--
4. Commercial Navigation	--	--	--	--	--	--
Land Use:						
1. Changed Land Uses:						
a. Fee Purchase b/	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--	--
2. Intensified Land Use:						
a. Irrigation Facilities (Contractual)	--	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1- Contractual)	Phased leasing of acreage from 551,700 in 1990 to 652,600 in 2020.	--	Imposes need for local counties to incorporate long-term agricultural commitments in land-use plans.		Phased leasing of acreage from 97,300 in 1990 to 115,200 in 2020.	--
3. Recreation & Open-Space	--	--	--	--	--	--

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE II

OUTLYING AREA OF INFLUENCE

IMPACTS OR CHANGES PRODUCED BY PLAN	ILLINOIS				INDIANA	
	OWNERS OF SYSTEM REQUIRED LANDS		OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS	
	FARMERS	RESIDENTS			FARMERS	RESIDENTS
IV. LAND VALUES a/						
1. Potential Unrecovered Losses c/	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.		--	--	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.	
2. Potential Unpaid for Gains	--	--	--	--	--	--
V. REVENUES FROM RECYCLING & REUSE a/						
1. Agriculture	Agricultural use of sludge may stimulate crop production.		--	--	Agricultural use of sludge may stimulate crop production.	
2. Industrial Manufacturing	--	--	--	--	--	--
3. Power Plants	--	--	--	--	--	--
VI. EMPLOYMENT a/	Potential for employment ranging from some 1,310 persons in 1990 to 1,570 persons in 2020 to operate and maintain the sludge management program.			Potential for employment ranging from some 250 persons in 1990 to 270 persons in 2020 to operate and maintain the sludge management program.		
VII. INSTITUTIONAL a/	Cooperative arrangements and coordination of sludge utilization sites required in order to insure compliance with Counties' land-use plans.					
VIII. COST OF PLAN ($ MILLION) a/ d/						
1. Capital Costs (present worth)						
2. Capital Costs (average annual)						
3. Operation, Maintenance & Replacement Cost (average annual)						
4. Total Average Annual Costs						
5. Industrial Pretreatment Costs (average annual) e/						
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Anxiety from leasing arrangements and the effects that sludge utilization program would have on land use and future growth patterns.					

NOTES:

a/ Applies to agicultural utilization of sludge (Option #1) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NDCP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SUMMARY OF IMPACTS PROJECTED BY ALTERNATIVE II

IMPACTS OR CHANGES PROJECTED BY PLAN	REST OF STATES: ILLINOIS	REST OF STATES: INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	REST OF NATION: FEDERAL TAXPAYERS	REST OF NATION: OTHER (INCLUDING PRIVATE GROUPS)	REST OF NATION: THE NATION AS A WHOLE	INTERNATIONAL
I. BIOLOGICAL							
1. Water Quality	Exceeds States' current effluent and water quality guidelines. This plan would contribute its proportional share of the States' efforts for meeting PL 92-500 goals.		Enhanced flow regimen contributes to potential for meeting this and other related needs inventoried by the Water Resources Council's Comprehensive Basin Studies (WRCCRS).	Meets intent and time-phased goals of PL 92-500.			
2. Air Quality	Plan would be consistent with current programs for air emission control in in both States, except for nitrogen oxide levels.			Plan consistent with current federal Air Quality Act requirements, except for nitrogen oxide levels.			
3. Aquatic Life:							
(a) Fishery	Contributes to States' program for improving stream production of sport fishery.		Contributes to meeting a portion of the deficiency in fishing opportunities in the study area.		Fulfills goals of relevant conservation groups.		
(b) Other Biota	--	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/							
1. Electrical (Megawatt Hours/Day)	Increases demand for Power Supply Areas 11 & 10 by 8,670 (1990) and 10,560 (2020).	Increases demand for Power Supply Area 12 by 1,660 (1990) and 1,740 (2020).	Imposes need for decision concerning type of fuel (nuclear/fossil) to be used and siting of new power plants.	Requires expansion of nation's power base. Imposes need for review of policies regarding extent to which this and other competitive power needs will be met.			
2. Natural Gas (Million Cubic Feet/Day)	Potential reduction in available supplies could impose decision to use alternative fuels, thereby increasing costs for air emission controls; fuel consumption may effect growth patterns, existing contractual arrangements and commodity movements.			Requires expansion of Nation's fuel base. Imposes need for review of policies regarding priority of natural gas and other alternative fuels for boiler fuel/recreational fuel use.			Import of this or other alternative fuels may be required.
3. Chemicals (Tons/Day)	Increased demand for treatment chemicals will impose added power needs for manufacturing and contribute to a higher resource consumptive rate and possible unit price of chemicals.				Potential increase in unit prices of mined or manufactured chemicals.		
III. WATER AND LAND USE CHANGES:							
Water Use:							
1. Water Supply	Imposes need for reallocation of Lake Michigan withdrawals and assessment of cost-sharing arrangements.		Precludes additional investment to meet WRCCRS inventoried needs for the study area.			Supreme Court approval and U.S.-Canada agreement may be required for increased withdrawals from Lake Michigan if this content in Lower Option #1 proves to be a problem.	
2. Water Damages	Storm water runoff control requires coordination of flood plain management studies and possible supplemental funding.		May precludes additional investment to meet WRCCRS inventoried needs for the study area.	Multiple purpose design provides potential savings in federal related programs.			
3. In-Stream Recreation	Contributes to potential for meeting States' needs for water-based recreation.						
4. Commercial Navigation	--	--	Defers long-term need for investment if reallocation of water supplies in study area changes flow regimen in Upper Illinois Waterway System.	Multiple purpose design provides potential savings in federal related programs.			
Land Use:							
1. Changed Land Uses:							
a. Fee Purchase b/							
b. Restoration of Surface Mines (Sludge Option #2 Contractual)							
2. Intensified Land Use:							
a. Irrigation Facilities (Contractual)							
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	Potential for retaining more land in agricultural production than might ordinarily be experienced over time.						
3. Recreation and Open-Space	--	--	Increases potential for meeting a portion of inventoried recreational deficiency in the study area by reducing the required financial investment.	Imposes potential for additional financial investment to meet needs.			

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE #1

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES: ILLINOIS	REST OF STATES: INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGION	REST OF NATION: FEDERAL TAXPAYERS	REST OF NATION: OTHER CONCERNED GROUPS	REST OF NATION: THE NATION A SUMMARY	INTERNATIONAL
IV. LAND VALUES a/							
1. Potential Unrecovered Losses c/	...	...	...	...	...	...	...
2. Potential Unpaid for Gains	...	...	...	...	...	...	...
V. REVENUES FROM RECYCLING & REUSE a/							
1. Agriculture	...	...	...	Economic impact of retaining the level of acreage required by this plan in agricultural production could be classified as either beneficial or adverse depending upon forecast of commodity markets.			...
2. Industrial Manufacturing	...	...	...	...	Potential for increase in unit prices of manufactured items.		...
3. Power Plants	...	...	...	...	...	...	...
VI. EMPLOYMENT a/	Potential for State assistance job relocation and labor training programs.			Increases need for labor training programs.	...	...	...
VII. INSTITUTIONAL a/	Imposes need to coordinate intercounty transfer of sludge. Enabling legislation necessary to modify present institutional and financial constraints.			//. . . . . Meets the intent of PL 92-500. . . . . //			...
VIII. COST OF PLAN ($ MILLIONS) a/ d/							
1. Capital Costs (present worth)				$5,555	$7,407		
2. Capital Costs (average annual)				$ 328	$ 437		
3. Operation, Maintenance & Replacement Costs (average annual)				...	$ 308		
4. Total Average Annual Costs				$ 328	$ 745		
5. Industrial Pretreatment Costs (average annual) e/							
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Contributes to the States' efforts to meet water quality goals.		Responsive to and increases potential for concurrently meeting an array of water and related land needs.	//. . . . . Meets the intent of PL 92-500. . . . . //			

NOTES:

a/ Applies to agricultural utilization of sludge (Option #1) and Water Reuse (Option #1 (2,068,300 (5,200 c/s) constraint).

b/ Based on 2020 requirements being purchased in 1980 unless phasing indicated. Excludes some 1,100 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imputed losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operating, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NPDES quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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Table XI-3

Summary of Impacts Produced by Alternative III

(17 Advanced Biological Treatment Plant Plan)

	Page
Chicago-South End of Lake Michigan Study Area	XI-20
Outlying Area of Influence	XI-22
Rest of States, Region, Rest of Nation, and International	XI-24

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE III

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
I. ECOLOGICAL					
Water Quality Output (mg/liter)					
BOD 3					
Phosphorus 0.1-0.2					
Nitrogen 2-5					
Suspended Solids 1					
Total Dissolved Solids 500					
1. Water Quality	Produces measurable increase in dissolved oxygen. Reduces phosphorus and nitrogen discharges from municipal and industrial sources and the first 2.5 - 2.85 inches of storm water runoff by 99 and 97 percent, respectively - - thereby reducing potential for algal blooms.				
2. Air Quality	Emits some 10 to 11 tons of chemicals and particulates daily for 1990 and 2020, respectively. Discharges are within acceptable USEPA air emission standards.				
3. Aquatic Life: (a) Fishery	Provides an enhanced ecosystem for increased production of desirable species.				
(b) Other Biota	Increases the standing water biotic (aquatic organisms) communities.				
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organims inhabiting the improved watercourses and standing water impoundments.				
II. RESOURCE REQUIREMENTS a/					
1. Electrical (Megawatt Hours/Day)	Power needs range from some 11,600 (1990) to 13,900 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				
2. Natural Gas (Million Cubic Feet/Day)	Fuel needs range from 85 (1990) to 102 (2020). Commitment could curtail efforts to supply other competitive needs with higher use priorities. Increased demand would probably increase consummer rates.				
3. Chemicals (Tons/Day)	--	--	--	--	Chemical needs for treatment range from 2,700 (1990) to 3,270 (2020).
III. WATER & LAND USE CHANGES					
Water Use:					
1. Water Supply	This plan would meet the area's water supply requirements over the next 50-years and eliminate the current depletion of ground water table in the western portion of the Illinois area.				
2. Water Damages	Provides significant reduction of overflow on some 69,900 flood plain acres.			--	--
3. In-Stream Recreation	Provides enhanced potential for water-based recreational opportunities. Imposes need for decisions regulating flow distribution and stream usage.			--	--
4. Commercial Navigation	Redistribution of flows and lock pumpage sufficient to sustain projected water-borne traffic.			--	--
Land Use:					
1. Changed Land Uses:					
a. Fee Purchase b/	--	--	--	--	66,700 acres acquired for the the treatment and storm water management systems.
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--
2. Intensified Land Use:					
a. Irrigation Facilities (Contractual)	Provides basis to control growth patterns and maintain balance between intensive area developments and open-space usage.				Phased leasing of acreage decreases with changed land use from 116,300 in 1990 to 87,100 in 2020.
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	--	--	--	--	--
3. Recreation & Open-Space	Provides potential for development of recreational and environmental corridors along some 500-miles, or more, of stream. Additional potential is provided by the rural and suburban storm water impoundments, and by treatment plants with sufficient capacity to maintain through flows for selective fishery impoundments.				

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE III

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Minor losses from property tax rolls for purchased lands.	--	--	Anything in addition to reimbursement for either income protection (leased lands) or the full market value of lands and relocation assistance inherent in the potential displacement of some 29,600 people.	
2. Potential Unpaid-for Gains	Tax revenue gain and increase in property value.	Enhanced property value along streams of improved quality.	Provided additional land for other uses due to abandonment of existing treatment plants.	Potential increase in crop production. Capital improvements to land (drainage & irrigation systems) for rural storm water program.	
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	--	--	--	Treatment of rural runoff may stimulate agricultural production.	
2. Industrial Manufacturing	--	--	Industries experience increase in wastewater treatment costs.	Sufficient quality in treated water to meet most industrial process needs.	
3. Power Plants	--	--	--	--	--
VI. EMPLOYMENT a/	Potential employment ranging from some 11,130 persons in 1990 to 12,510 persons in 2020 to operate and maintain highly technical municipal and storm water treatment plants and related works.				
VII. INSTITUTIONAL a/	Exceeds current planning goals for regionalization. Coordination throughout the study area would be necessary and would involve adoption of contractual and/or consolidation arrangements. Sludge management program would also necessitate cooperative arrangements with outlying area of influence.				
VIII. COST OF PLAN ($MILLION) a/d/					
1. Capital Costs (Present Worth)	$1,993				
2. Capital Costs (Average Annual)	$118				
3. Operation, Maintenance & Replacement Costs (Average Annual)	$304				
4. Total Average Annual Costs	$422				
5. Industrial Pretreatment Costs (Average Annual) c/			Ranges from $50.0 (1972) to $103.7 (1990)		
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Decrease in disposable income caused by increase in sewer charges.	Enhancement of property values and potential for increase in total recreational opportunities. Inconvenience during construction and some disruption to community cohesion and growth patterns.		Anxiety from leasing and interest acquisition proceedings.	

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines and Water Reuse Option #1 (2068 MGD (3200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayer will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by the designated regional clearinghouses and the States and approved for funding under the construction grant program of the USEPA. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than that required if industry would totally pretreat its waste load on site to NDCP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE III

IMPACTS OR CHANGES PRODUCED BY PLAN	OUTLYING AREA OF INFLUENCE					
	ILLINOIS				INDIANA	
	OWNERS OF SYSTEM REQUIRED LANDS				OWNERS OF SYSTEM REQUIRED LANDS	
	FARMERS	RESIDENTS	OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	FARMERS	RESIDENTS
I. ECOLOGICAL						
1. Water Quality	--	--	--	--	--	--
2. Air Quality	--	--	--	--	--	--
3. Aquatic Life: (a) Fishery	--	--	--	--	--	--
(b) Other Biota	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/						
1. Electrical (Megawatt Hours/Day)	The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.					
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	--	--	--
3. Chemicals (Tons/Day)	--	--	--	--	--	--
III. WATER & LAND USE CHANGES						
Water Use:						
1. Water Supply	--	--	--	--	--	--
2. Water Damages	--	--	--	--	--	--
3. In-Stream Recreation	--	--	--	--	--	--
4. Commercial Navigation	--	--	--	--	--	--
Land Use:						
1. Changed Land Uses:						
a. Fee Purchase b/	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	Increases use potential of 42,500 acres by 2020.	Increases use potential of 8,700 acres by 2020.	--	--
2. Intensified Land Use:						
a. Irrigation Facilities (Contractual)	--	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	Phased leasing of acreage ranging from 47,300 (1990) to 57,000 (2020).		Imposes need for local counties to incorporate long-term agricultural commitments in land-use plans.		Phased leasing of acreage ranging from 9,700 (1990) to 10,100 (2020).	
3. Recreation & Open-Space	--	--	--	--	--	--

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE III

IMPACTS OR CHANGES PRODUCED BY PLAN	OUTLYING AREA OF INFLUENCE: ILLINOIS — OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	ILLINOIS — OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS	ILLINOIS — OTHER CONCERNED GROUPS	INDIANA — OTHER CONCERNED GROUPS	INDIANA — OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	INDIANA — OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS
IV. LAND VALUES a/						
1. Potential Unrecovered Losses c/	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.		--	--	Anything in addition to reimbursement for both income protection and long-term capital gains (alternative uses) for leased lands.	
2. Potential Unpaid for Gains	--	--	Potential for increase in land values and economic base due to reclamation of surface mines.		--	--
V. REVENUES FROM RECYCLING & REUSE a/						
1. Agriculture	Potential for net income gain from nutrient recycle in lieu of commercial fertilizer.		Potential for reduction in demand for commercial agri-fertilizer.		Potential for net income gain from nutrient recycle in lieu of commercial fertilizer.	
2. Industrial Manufacturing	--	--	--	--	--	--
3. Power Plants	--	--	--	--	--	--
VI. EMPLOYMENT a/	Potential for employment ranging from some 380 persons in 1990 to 410 persons in 2020 to operate and maintain the sludge management program.			Potential for employment ranging from some 70 persons in 1990 to 80 persons in 2020 to operate and maintain the sludge management program.		
VII. INSTITUTIONAL a/	Cooperative arrangements and coordination of sludge utilization sites required in order to insure compliance with Counties' land-use plans.					
VIII. COST OF PLAN ($ MILLION) a/ d/						
1. Capital Costs (present worth)						
2. Capital Costs (average annual)						
3. Operation, Maintenance & Replacement Cost (average annual)						
4. Total Average Annual Costs						
5. Industrial Pretreatment Costs (average annual) e/						
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Anxiety from leasing arrangements and the effects that sludge utilization program would have on land use and future growth patterns.					

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NEEP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE III

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES		RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	REST OF NATION			
	ILLINOIS	INDIANA		FEDERAL TAXPAYERS	OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
I. ECOLOGICAL							
1. Water Quality	Exceeds States' current effluent & water quality guidelines. This plan would contribute its proportional share of the states efforts for meeting PL92-500 goals.		Enhanced flow regimen contributes to potential for meeting this and other water-related needs inventoried by the Water Resources Council's Comprehensive Basin Studies (WRCCBS).	Meets intent and time phased goals of PL92-500.			--
2. Air Quality	Plan consistent with current program for air emission control in both States.		--	Consistent with current Federal Air Quality Act requirements.			
3. Aquatic Life: (a) Fishery	Contributes to States' programs for improving stream production of sport fishery.		Contributes to meeting a portion of the deficiency in fishing opportunities in the study area.	--	Fulfills goals of relevant conservation groups.	--	--
(b) Other Biota	--	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	--	--	--	--	--
II. RESOURCE REQUIREMENTS a/							
1. Electrical (Megawatt Hours/Day)	Increases demand for Power Supply Areas 14 & 40 by 9,770 (1990) and 11,900 (2020).	Increases demand for Power Supply Area 12 by 1,870 (1990) and 2,000 (2020).	Imposes need for decisions concerning type of fuel (nuclear/fossil) to be used and siting of new power plants.	Requires expansion of nation's power base. Imposes need for review of policies regarding extent to which this and other competitive power needs will be met.			--
2. Natural Gas (Million Cubic Feet/Day)	Potential reduction in available supplies could impose decision to use alternative fuels thereby increasing costs for air emission controls. Fuel consumption may affect growth patterns, existing contractual arrangements and commodity movements.			Requires expansion of nation's fuel base. Imposes need for review of policies regarding priority of natural gas and other alternative fuels for boiler (incineration) fuel use.			Import of this or other alternative fuels may be required.
3. Chemicals (Tons/Day)	Increased demand for treatment chemicals will impose added power needs for manufacturing and contribute to a higher resource consumption rate and possible unit price of chemicals.			--	--	Potential increase in unit prices of mined or manufactured chemicals.	--
III. WATER AND LAND USE CHANGES							
Water Use:							
1. Water Supply	Imposes need for reallocation of Lake Michigan withdrawals & assessment of cost-sharing arrangements.	--	Precludes additional investment to meet WRCCBS inventoried need for study area.	--	--	Supreme Court approval and U.S.-Canada agreement may be required for increased withdrawals from Lake Michigan if TDS content in Waste Option #1 proves to be a problem.	
2. Water Damages	Storm water runoff control requires coordination of flood plain management studies and possible supplemental funding.		May preclude additional investment to meet WRCCBS inventoried need for study areas.	Multiple-purpose design provides potential savings in Federal-related programs.	--	--	--
3. In-Stream Recreation	Contributes to potential for meeting States and WRCCBS inventoried needs for water-based recreation.			--	--	--	--
4. Commercial Navigation	--	--	Defers long-term need for investment if reallocation of water supplies in study area changes regimen in Upper Illinois Waterway System.	Multiple-purpose design provides potential savings in Federal-related programs.	--	--	--
Land Use:							
1. Changed Land Uses a. Fee Purchase b/	--	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	Enhances the aesthetics of the surface mines and increases the potential for meeting local and State land-related needs at a reduced investment level.			--	--	--	--
2. Intensified Land Use a. Irrigation Facilities (Contractual)	--	--	--	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	Potential for retaining more land in agricultural production than might ordinarily be experienced over time.			--	--	--	--
3. Recreation & Open Space	--	--	Increases potential for meeting portion of inventoried recreational deficiency in study area by reducing the required financial investment.	Imposes potential for additional financial investment to meet needs.			

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SUMMARY OF IMPACTS INDUCED BY ALTERNATIVE III

IMPACTS OR CHANGES INDUCED BY PLAN	REST OF STATES: ILLINOIS	REST OF STATES: INDIANA	REST OF NATION: RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGION	REST OF NATION: FEDERAL TAXPAYERS	REST OF NATION: OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
IV. LAND VALUES a/							
1. Potential Unrecovered Losses c/	--	--	--	--	--	--	
2. Potential Unpaid for Gains	--	--	--	--	--	--	
V. REVENUES FROM RECYCLING & REUSE a/							
1. Agriculture	Potential for increasing crop and beef production and enhancing agric economic base with reclamation of surface mines.			Economic impact of retaining the level of acreage required by this plan in agricultural production could be classified as either beneficial or adverse depending upon forecast of commodity markets.			
2. Industrial Manufacturing	Potential for incorporating sludge disposal with the recycling of solid wastes and generate synthetic fuel and other recoverable by-products.			--	--	Potential for increase in unit prices of manufactured items.	
3. Power Plants				--	--	--	
VI. EMPLOYMENT a/	Potential for State assistance in job relocation and labor training programs.			Increases need for labor training programs.	--	--	
VII. INSTITUTIONAL a/	Imposes need to coordinate inter-county transfer of sludge. Enabling legislation necessary to modify present institutional and financial constraints.			Meets the intent of PL92-500.			
VIII. COST OF PLAN (\$ 1,000,000) a/ d/							
1. Capital Costs (present worth)				\$5,980		\$7,973	
2. Capital Costs (average annual)				\$311		\$471	
3. Operation, Maintenance & Replacement Costs (average annual)				--		\$304	
4. Total Average Annual Costs				\$353		\$775	
5. Industrial Pretreatment Costs (average annual) e/							
IX. CHANGES IN PLAN'S PERTINENT CONDITIONS WHICH CAUSE NEEDS AND IMPACTS FROM PLAN a/	Contributes to the States' efforts to meet water quality goals. Provides potential for improving the storm quality and aesthetics in surface mine areas.		Responsive to and increases potential for concurrently meeting an array of water and related land needs.	Meets the intent of PL92-500			

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that could be incorporated into action (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imputed losses in excess of net average annual income for owners of leased lands, or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs (i.e., that the study area taxpayer will finance the remaining 25 percent of the capital cost [less any assistance the States may elect to contribute]) plus 100 percent of the operation, maintenance and replacement costs, provided the plan is certified by designated regional clearinghouse and the State and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to meet quality goals. Furthermore, the total cost represents a level of investment which is actually less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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Table XI-4

Summary of Impacts Produced by Alternative IV

(5 Land Treatment Sites)

	Page
Chicago-South End of Lake Michigan Study Area	XI-28
Outlying Area of Influence	XI-30
Rest of States, Region, Rest of Nation, and International	XI-32

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF STSTEM REQUIRED LANDS FARMERS	RESIDENTS
I. ECOLOGICAL					
Water Quality Output (mg/liter)					
BOD 2					
Phosphorus* 0.01					
Nitrogen 2					
Suspended Solids 0					
Total Dissolved Solids 500					
*Without any consideration for background level *in soil column.*					
1. Water Quality	Produces measurable increase in dissolved oxygen. Reduces phosphorus and nitrogen discharges from municipal and industrial sources and the first 2.5 - 2.85 inches of storm water runoff by 99 and 97 percent, respectively - - thereby reducing potential for algal blooms.				
2. Air Quality	Plan would facilitate efforts to attain desired ambient levels.			Aerosols will be present, but should not constitute a hazard.	
3. Aquatic Life: (a) Fishery	Provides an enhanced ecosystem for increased production of desireble species.				
(b) Other Biota	Increases the standing water biotic (aquatic organisms) communities.				
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organims inhabiting the improved watercourses and standing water impoundments.				
II. RESOURCE REQUIREMENTS a/					
1. Electrical (Megawatt Hours/Day)	Power needs range from some 22,000 (1990) to 26,000 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	--	--
3. Chemicals (Tons/Day)	--	--	--	--	--
III. WATER AND LAND USE CHANGES					
Water Use					
1. Water Supply	This plan would meet the area's water supply requirements over the next 50 years and eliminate the current depletion of ground water table in the western portion of the Illinois area.				
2. Water Damages	Provides significant reduction of overflow on some 69,900 flood plain acres.			--	--
3. In-Stream Recreation	Provides enhanced potential for water-based recreational opportunities. Imposes need for decisions regulating flow distribution and stream usage.			--	--
4. Commercial Navigation	Redistribution of flows and lock pumpage sufficient to sustain projected water-borne traffic.			--	--
Land Use					
1. Changed Land Uses a. Fee Purchase b/	--	--	--	--	63,200 acres acquired for the storm water management systems.
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	--	--	--
2. Intensified Land Use a. Irrigation Facilities (Contractual)	Provides basis to control growth patterns and maintain balance between intensive area developments and open space usage.				Phased leasing of acreage decreases with changed land use from 116,300 in 1990 to 87,100 in 2020.
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	--	--	--	--	--
3. Recreation & Open Space	Provides potential for development of recreational and environmental corridors along some 500 miles, or more, of stream. Additional potential is provided by the rural and suburban storm water impoundments.				

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Minor losses from property tax rolls for purchased lands.			Anything in addition to reimbursement for either income protection (leased lands) or the full market value of lands and relocation assistance inherent in the potential displacement of some 17,500 people.	
2. Potential Unpaid for Gains	Tax revenue gain and increase in property value.	Enhanced property value along streams of improved quality.	Provides additional land for other uses due to abandonment of existing treatment plants.	Potential increase in crop production. Capital improvements to land (drainage and irrigation systems) for rural storm water program.	
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	--	--	--	Treatment of rural runoff may stimulate agricultural production.	
2. Industrial Manufacturing	--	--	Industries experience some increase in wastewater treatment costs.	Sufficient quality in treated water to meet most industrial process needs.	
3. Power Plants	--	--	--	--	--
VI. EMPLOYMENT a/	Potential for employment decreasing from some 2,600 persons in 1990 to 2,110 persons in 2020 to operate and maintain storm water management program and the conveyance and redistribution systems.				
VII. INSTITUTIONAL a/	Exceeds current planning goals for regionalization. Coordination throughout the study area would be necessary and involve adoption of contractual and/or consolidation arrangements. Treatment of wastewater and the sludge management program would necessitate cooperative arrangements with the outlying area of influence.				
VIII. COST OF PLAN ($ MILLION) a/ d/					
1. Capital Costs (present worth)	$1,764				
2. Capital Costs (average annual)	$104				
3. Operation, Maintenance & Replacement Cost (average annual)	$177				
4. Total Average Annual Costs	$281				
5. Industrial Pretreatment Costs (average annual) e/			Ranges from 50.0 (1972) to 103.7 (1990).		
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Decrease in disposable income caused by increased sewer charges.	Enhancement of property values and potential for increase in total recreational opportunities. Inconvenience during construction and some disruption to community cohesion and growth patterns.		Anxiety from leasing and interest acquisition proceedings.	

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NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NPDP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

IMPACTS OR CHANGES PRODUCED BY PLAN	OUTLYING AREA OF INFLUENCE: ILLINOIS — OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	ILLINOIS — OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS	ILLINOIS — OTHER CONCERNED GROUPS	INDIANA — OTHER CONCERNED GROUPS	INDIANA — OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	INDIANA — OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS
I. ECOLOGICAL						
1. Water Quality	--	--	--	--	--	--
2. Air Quality	Aerosols will be present but should not constitute a hazard.		Potential for infrequent odors from lagoons.		Aerosols will be present but should not constitute a hazard.	
3. Aquatic Life:						
(a) Fishery	--	--	--	--	--	--
(b) Other Biota	// . . . . . Increase the standing water biotic (aquatic organisms) communities. . . . . //					
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organisms inhabiting the lagoons.		Provides potential for increasing available habitat areas through reclamation of surface mines.		Increase in birds and other animals which feed on aquatic organisms inhabiting the lagoons.	
II. RESOURCE REQUIREMENTS a/						
1. Electrical (Megawatt Hours/Day)	The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.					
2. Natural Gas (Million Cubic Feet/Day)	Increased crop production will impose added fuel needs for drying.		--	--	Increased crop production will impose added fuel needs for drying.	
3. Chemicals (Tons/Day)	Chemical needs for treatment range from 25 (1990) to 32 (2020).		--	--	Chemical needs for treatment range from 24 (1990) to 28 (2020).	
III. WATER & LAND USE CHANGES						
Water Use:						
1. Water Supply	Ground water in irrigation sites will change and approximate the quality of the treated water.		--	--	Ground water in irrigation sites will change and approximate the quality of the treated water.	
2. Water Damages	Control of storm water runoff on irrigated lands will minimize crop losses during wet years and concurrently provide some reduction in small floods on local streams.					
3. In-Stream Recreation	Potential for change in water balance due to increase in evapo-transpiration rates and control of ground water table in irrigation sites. Current average and low-flow patterns in area's streams would need to be maintained by transfer from C-SEIM waters.					
4. Commercial Navigation	--	--	--	--	--	--
Land Use:						
1. Changed Land Uses:						
a. Fee Purchase b/	Phased acquisition of acreage ranges from 32,400 (1990) to 40,700 (2020).		--	--	Phased acquisition of acreage ranges from 31,000 (1990) to 36,000 (2020).	
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	Increases use potential of 128,600 acres by 2020.	Increases use potential of 128,600 acres by 2020.	--	--
2. Intensified Land Use:						
a. Irrigation Facilities (Contractual)	Phased leasing of acreage ranging from 153,100 (1990) to 192,300 (2020).		Imposes potential for long-term constraint on land use patterns and economic base in the surrounding geographical area ranging in size from 195,900 acres in 1990 to 243,500 acres in 2020.	Imposes potential for long-term constraint on land use patterns and economic base in the surrounding geographical area ranging in size from 221,100 acres in 1990 to 256,300 acres in 2020.	Phased leasing of acreage ranging from 146,900 (1990) to 170,700 (2020).	
b. Agricultural Sludge Utilization (Sludge Option #1 Contractual)	Phased leasing of acreage ranging from 28,000 (1990) to 33,600 (2020).		Imposes added commitment for local counties to incorporate into land-use planning objectives.		Phased leasing of acreage ranging from 29,000 (1990) to 33,500 (2020).	
3. Recreation & Open-Space	Lagoons would reduce open-space supplies but irrigation sites would preserve long-term farm base.		Potential for increase in recreational lands and wildlife preserves through reclamation of surface mines.		Lagoons would reduce open-space supplies but irrigation sites would preserve long-term farm base.	

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

IMPACTS OR CHANGES PRODUCED BY PLAN	OUTLYING AREA OF INFLUENCE — ILLINOIS: OWNERS OF SYSTEM REQUIRED LANDS — FARMERS	ILLINOIS: OWNERS OF SYSTEM REQUIRED LANDS — RESIDENTS	ILLINOIS: OTHER CONCERNED GROUPS	INDIANA: OTHER CONCERNED GROUPS	INDIANA: OWNERS OF SYSTEM REQUIRED LANDS — FARMERS	INDIANA: OWNERS OF SYSTEM REQUIRED LANDS — RESIDENTS
IV. LAND VALUES a/						
1. Potential Unrecovered Losses c/	Anything in addition to reimbursement for both income protection & long-term capital gains (alternative uses) for leased lands or the full market value of lands inherent in the potential displacement of 1,665 persons in 1990 and 2,120 persons in 2020.		--	--	Anything in addition to reimbursement for both income protection & long-term capital gains (alternative uses) for leased lands; or the full market value of lands inherent in the potential displacement of 1,085 persons in 1990 and 1,260 persons in 2020.	
2. Potential Unpaid for Gains	Potential increase in crop production and net income. Capital improvements to cropped lands with drainage and irrigation systems.		Potential for increase in land values and economic base due to reclamation of surface mines.		Potential increase in crop production and net income. Capital improvements to cropped lands with drainage and irrigation systems.	
V. REVENUES FROM RECYCLING & REUSE a/						
1. Agriculture	Potential for net income gain from nutrient recycle of over $40/acre/year. Agricultural use of sludge may further stimulate production.		Potential for reduction in demand for commercial agri-fertilizer.		Potential for net income gain from nutrient recycle of over $40/acre/year. Agricultural use of sludge may further stimulate production.	
2. Industrial Manufacturing	--	--	--	--	--	--
3. Power Plants	Water quantity in storage lagoons provide potential for use as cooling water & pump-back peak power generation.		Provides potential for increase in local assessed valuation base.		Water quantity in storage lagoons provide potential for use as cooling water & pump-back peak power generation.	
VI. EMPLOYMENT a/	Potential for employment ranging from some 1,460 persons in 1990 to 1,810 persons in 2020 to operate and maintain the treatment facilities and sludge management program.			Potential for employment ranging from some 1,400 persons in 1990 to 1,620 persons in 2020 to operate and maintain the treatment facilities and sludge management program.		
VII. INSTITUTIONAL a/	Coordination of the siting, management and operation of the treatment facilities and sludge management program is required. Institutional and cooperative (contractual) arrangements required to safeguard local interests and planning objectives.					
VIII. COST OF PLAN ($ MILLION) a/ d/						
1. Capital Costs (present worth)						
2. Capital Costs (average annual)						
3. Operation, Maintenance & Replacement Cost (average annual)						
4. Total Average Annual Costs						
5. Industrial Pretreatment Costs (average annual) e/						
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Produces anxiety from leasing and interest acquisition proceedings; inconvenience from construction; disruption to community cohesion; and changes in current farming practices. Provides potential for increase in agricultural economic base. Reluctance to commit local resources to treat metropolitan wastes and forego own desired land use and socio-economic patterns.					

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NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NEEP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES		REST OF MATCH				
	ILLINOIS	INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	FEDERAL DEPARTMENTS	OTHER CONCERNED GROUPS	THE NATION AS A WHOLE	INTERNATIONAL
I. ECOLOGICAL							
1. Water Quality	Exceeds States' current effluent and water quality guidelines. This plan would contribute its proportional share of the States' efforts for meeting PL92-500 goals.		Enhanced flow regimen contributes to potential for meeting this and other water related needs inventoried by the Water Resources Council's Comprehensive Basin Studies (WRCCBS).	Meets intent and time-phased goals of PL92-500.			--
2. Air Quality	Plan would be consistent with current programs for air emission control in both States.		--	Plan consistent with current Federal Air Quality Act requirements.			--
3. Aquatic Life:							
(a) Fishery	Contributes to States' program for improving stream production of sport fishery.		Contributes to meeting a portion of the deficiency in fishing opportunities in the study area.	--	Fulfills goals of relevant conservation groups.	--	--
(b) Other Biota	--	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	Provides potential for contributing to the migratory waterfowl needs.	--	--	--	--
II. RESOURCE REQUIREMENTS a/							
1. Electrical (Megawatt Hours/Day)	Increases demand Power Supply Areas 14 & 40 by 11,200 (1990) and 13,800 (2020).	Increases demand for Power Supply Area 12 by 10,800 (1990) and 12,200 (2020).	Imposes need for decision concerning type of fuel (nuclear/fossil) to be used and siting of new power plants.	Requires expansion of nation's power base. Imposes need for review of policies regarding extent to which this and other competitive power needs will be met.			--
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	Increases demand on nation's fuel base. Imposes need for review of policies regarding priority of natural gas or other alternative fuels for use in meeting agricultural-related needs.			Import of this or other alternative fuels may be required.
3. Chemicals (Tons/Day)	Increased demand for treatment chemicals will not affect current production markets.			--	--	Insignificant.	
III. WATER AND LAND USE CHANGES							
Water Use:							
1. Water Supply	Imposes need for reallocation of Lake Michigan withdrawals and assessment of cost-sharing arrangements.	--	Precludes additional investment to meet WRCCBS inventoried needs for study area.			Supreme Court approval and U.S.-Canada agreement may be required for increased withdrawals from Lake Michigan if this constant in Basin Option #1 proves to be a problem.	
2. Water Damages	Storm water runoff control requires coordination of flood plain management studies and possible supplemental funding.		May preclude additional investment to meet WRCCBS inventoried needs for study area.	Multiple-purpose design provides potential savings in Federal-related programs.	--	--	--
3. In-Stream Recreation	Contributes to potential for meeting States and WRCCBS inventoried needs for water-based recreation.			--	--	--	--
4. Commercial Navigation	--	--	Defer long-term need for investment if reallocation of water supplies in study area changes regimen in Upper Illinois Waterway System.	Multiple-purpose design provides potential savings in Federal-related programs.	--	--	--
Land Use:							
1. Changed Land Uses:							
a. Fee Purchase b/	--	--	--	--	--		
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	Enhances the aesthetics of the surface mines and increases the potential for meeting local and State land-related needs at a reduced investment level.						
2. Intensified Land Use:				--	--		
a. Irrigation Facilities (Contractual)	Areal extent of acreage affected directly or indirectly imposes need for decision by the Counties and States whether to retain basic agricultural-related economy and life-style and forego other types of socio-economic gains.		Potential for retaining more land in agricultural production than might ordinarily be experienced over time.				
b. Agricultural Sludge Utilization (Sludge, Option #1 - Contractual)	Increases potential for retaining more land in agricultural production than might ordinarily be experienced over time.			--	--	--	
3. Recreation & Open Space	Preservation of open space, agricultural usage will be counter to current trends in some areas.		Increases potential for meeting a portion of inventoried recreational deficiency in the study area by reducing required financial investment.	Imposes potential for additional financial investment to meet needs.	--		

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE IV

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES: ILLINOIS	REST OF STATES: INDIANA	REST OF STATES: RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	REST OF NATION: FEDERAL TAXPAYERS	REST OF NATION: OTHER CONCERNED GROUPS	REST OF NATION: THE NATION A SUMMARY	INTERNATIONAL
IV. LAND VALUES a/							
1. Potential Unrecovered Losses c/	--	--	--	--	--	--	--
2. Potential Unpaid for Gains	--	--	--	--	--	--	--
V. REVENUES FROM RECYCLING & REUSE a/							
1. Agriculture	Potential for increasing crop and beef production and enhancing agri-economic base with land technology and reclamation of surface mines.		--	Economic impact of increased production and retaining the level of acreage required by this plan in agricultural production could be classified as either beneficial or adverse depending upon forecast of commodity markets.			--
2. Industrial Manufacturing	Potential for incorporating sludge disposal with the recycling of solid wastes and generate synthetic fuel and other recoverable by-products.			--	--	Potential for increase in unit prices of manufactured items.	--
3. Power Plants	Co-siting of power plants with storage lagoons would remove potential source of heat pollution from Lake Michigan and other major watercourses.			--	--	--	--
VI. EMPLOYMENT a/	Potential for state assistance in job relocation and labor training programs.		--	Increases need for labor training program.	--	--	--
VII. INSTITUTIONAL a/	Proposed Inter-State and inter-county transfers will impose necessity for approval by both State legislatures and the Counties (land use). Enabling legislation also necessary to modify present institutional and financial constraints.		Inter-State compact required.	Meets the intent of PL92-500.		Congressional approval required for inter-State transfer.	
VIII. COST OF PLAN TO NATION a/ d/							
1. Capital Costs (present worth)				$5,293		$7,057	
2. Capital Costs (average annual)				$312		$416	
3. Operation, Maintenance & Replacement Cost (average annual)				--		$177	
4. Total Average Annual Costs				$312		$593	
5. Industrial Pretreatment Costs (average annual) e/							
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING QUALITY OF CLEAN WATER AND BENEFITS FROM PLAN g/	Concern over the socio-economic effects implicit in the long-range extensive land commitments necessary to meet water quality goals. Provides potential for improving the stream quality and aesthetics in surface mine areas.		Imposes potential for delay in meeting the time-phased goals of PL92-500 since an interim time frame would be required to demonstrate workability and its comparative socio-economic advantages to the agricultural community.	Meets the intent of PL92-500			

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,060 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to MDCP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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Table XI-5

Summary of Impacts Produced by Alternative V

(Combination of 5 Land Treatment Sites
and 5 Advanced Biological Treatment Plants)

	Page
Chicago-South End of Lake Michigan Study Area	XI-36
Outlying Area of Influence	XI-38
Rest of States, Region, Rest of Nation, and International	XI-40

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
I. ECOLOGICAL					
1. Water Quality	Produces measurable increase in dissolved oxygen. Reduces phosphorus and nitrogen discharges from municipal and industrial sources and the first 2.5 - 2.85 inches of storm water runoff by 99 and 97 percent, respectively - - thereby reducing potential for algal blooms.				
2. Air Quality	Emits some 6.8 to 7.1 tons of chemicals and particulates daily for 1990 and 2020, respectively. Discharges are within acceptable USEPA air emission standards. Aerosols also will be present, but should not constitute a hazard.				
3. Aquatic Life:					
(a) Fishery	Provides an enhanced ecosystem for increased production of desirable species.				
(b) Other Biota	// . . . Increases the standing water biotic (aquatic organisms) communities. . . . //				
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organisms inhabiting the improved watercourses and standing water impoundments.				
II. RESOURCE REQUIREMENTS a/					
1. Electrical (Megawatt Hours/Day)	Power needs range from some 14,700 (1990) to 18,500 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.				
2. Natural Gas (Million Cubic Feet/Day)	Fuel needs range from 61 (1990) to 65 (2020). Commitment could curtail efforts to supply other competitive needs with higher use priorities. Increased demand would probably increase consumer rates.				
3. Chemicals (Tons/Day)	--	--	--		Chemical needs for treatment range from 1,970 (1990) to 2,110 (2020).
III. WATER & LAND USE CHANGES					
Water Use:					
1. Water Supply	This plan would meet the area's water supply requirements over the next 50 years and eliminate the current depletion of ground water table in the western portion of the Illinois area.				
2. Water Damages	Provides significant reduction of overflow on some 69,900 flood plain acres.			--	--
3. In-Stream Recreation	Provides enhanced potential for water based recreational opportunities. Imposes need for decisions regulating flow distribution and stream usage.			--	--
4. Commercial Navigation	Redistribution of flows and lock passage sufficient to sustain projected water borne traffic.			--	--
Land Use:					
1. Changed Land Uses:					
a. Fee Purchase b/	--	--	--		65,100 acres acquired for the the treatment and storm water management systems.
b. Restoration of Surface Mines (Sludge Option #2 Contractural)	--	--	--	--	--
2. Intensified Land Use:					
a. Irrigation Facilities (Contractural)	Provides basis to control growth patterns and maintain balance between intensive area developments and open-space usage.				Phased leasing of acreage decreases with changed land use from 116,300 in 1990 to 87,100 in 2020.
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractural)	--	--	--	--	--
3. Recreation & Open Space	Provides potential for development of recreational and environmental corridors along some 500 miles, or more, of stream. Additional potential is provided by the rural and suburban storm water impoundments, and by treatment plants with sufficient capacity to maintain through flows for selective fishery impoundments.				

Water Quality Output (mg/liter)

BOD	2 - 3
Phosphorus*	0.01 - 0.2
Nitrogen	2 - 5
Suspended Solids	0 - 1
Total Dissolved Solids	500

* Without any consideration for background level in soil column.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

CHICAGO - SOUTH END OF LAKE MICHIGAN STUDY AREA

IMPACTS OR CHANGES PRODUCED BY PLAN	STUDY AREA TAXPAYERS	LANDOWNERS ALONG STREAMS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS FARMERS	OWNERS OF SYSTEM REQUIRED LANDS RESIDENTS
IV. LAND VALUES a/					
1. Potential Unrecovered Losses c/	Minor losses from property tax rolls for purchased lands.	--	--	Anything in addition to reimbursement for either income protection (leased lands) or the full market value of lands and relocation assistance inherent in the potential displacement of some 25,620 people.	
2. Potential Unpaid for Gains	Tax revenue gain and increase in property values.	Enhanced property values along streams of improved quality.	Provides additional land for other uses due to abandonment of existing treatment plants.	Potential increase in crop production. Capital improvements to land (drainage and irrigation systems) for rural storm water program.	
V. REVENUES FROM RECYCLING & REUSE a/					
1. Agriculture	--	--	--	Treatment of rural runoff may stimulate agricultural production.	
2. Industrial Manufacturing	--	--	Industries experience net increase in wastewater treatment cost.	Sufficient quality in treated water to meet most industrial process needs.	
3. Power Plants	--	--	--	--	--
VI. EMPLOYMENT a/	Potential employment ranges from some 8,840 persons in 1990 to 8,810 persons in 2020 to operate and maintain highly technical municipal and storm water treatment plants and related works.				
VII. INSTITUTIONAL a/	Exceeds current planning goals for regionalization. Coordination throughout the study area would be necessary and involved adoption of contractual and/or consolidation arrangements. Treatment of a portion of the wastewater and the sludge management program would necessitate cooperative arrangements with the outlying area of influence.				
VIII. COST OF PLAN ($ MILLION) a/ d/					
1. Capital Costs (present worth)	$1,986				
2. Capital Costs (average annual)	$ 118				
3. Operation, Maintenance & Replacement Costs (average annual)	$ 275				
4. Total Average Annual	$ 393				
5. Industrial Pretreatment Costs (average annual) e/			Ranges from 50.0 (1972) to 103.7 (1990).		
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Decrease in disposable income caused by increased sewer charges.	Enhancement of property values and potential for increase in total recreational opportunities. Inconvenience during construction and some disruption to community cohesion and growth patterns.		Anxiety from leasing and interest acquisition proceedings.	

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50-years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NDCP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

IMPACTS OR CHANGES PRODUCED BY PLAN	OUTLYING AREA OF INFLUENCE: ILLINOIS			INDIANA		
	OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS	OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS: FARMERS	OWNERS OF SYSTEM REQUIRED LANDS: RESIDENTS
I. ECOLOGICAL						
1. Water Quality	--	--	--	--	--	--
2. Air Quality	Aerosols will be present but should not constitute a hazard.		Potential for infrequent odors from lagoons.		Aerosols will be present but should not constitute a hazard.	
3. Aquatic Life:						
(a) Fishery	--	--	--	--	--	--
(b) Other Biota	// . . . . . Increase the standing water biotic (aquatic organisms) communities. . . . . //					
4. Terrestrial Attributes (Wildlife)	Increase in birds and other animals which feed on aquatic organisms inhabiting the lagoons.		Provides potential for increasing available habitat areas through reclamation of surface mines.		Increase in birds and other animals which feed on aquatic organisms inhabiting the lagoons.	
II. RESOURCE REQUIREMENTS a/						
1. Electrical (Megawatt Hours/Day)	Power needs range from some 14,700 (1990) to 18,500 (2020). The associated investment program may increase both the area's prime loan interest rates and the consumers' power rates.					
2. Natural Gas (Million Cubic Feet/Day)	Increased crop production will impose added fuel needs for drying.		--	--	Increased crop production will impose added fuel needs for drying.	
3. Chemicals (Tons/Day)	Chemical needs for treatment range from 14 (1990) to 17 (2020).		--	--	Chemical needs for treatment is essentially a constant of 3.	
III. WATER & LAND USE CHANGES						
Water Use:						
1. Water Supply	Ground water in irrigation sites will change and approximate the quality of the treated water.		--	--	Ground water in irrigation sites will change and approximate the quality of the treated water.	
2. Water Damages	Control of storm water runoff on irrigated lands will minimize crop losses during wet years and concurrently provide some reduction in small floods on local streams.					
3. In-Stream Recreation	Potential for change in water balance due to increase in evapo-transpiration rates and control of ground water table in irrigation sites. Current average and low-flow patterns in area's streams would need to be maintained by transfer from C-SFLM waters.					
4. Commercial Navigation	--	--	--	--	--	--
Land Use:						
1. Changed Land Uses:						
a. Fee Purchase b/	Phased acquisition of acreage ranges from 15,600 (1990) to 23,700 (2020).		--	--	Phased acquisition of acreage ranges from 1,600 (1990) to 3,600 (2020).	
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	--	--	Increases use potential of 251,100 acres by 2020.	Increases use potential of 46,700 acres by 2020.	--	--
2. Intensified Land Use:						
a. Irrigation Facilities (Contractual)	Phased leasing of acreage ranging from 73,600 (1990) to 112,300 (2020).		Imposes potential for long-term constraint on land use patterns and economic base in the surrounding geographical area ranging in size from 77,500 acres in 1990 to 123,600 acres in 2020.	Imposes potential for long-term constraint on land use patterns and economic base in the surrounding geographical area ranging in size from 6,400 acres in 1990 to 16,200 acres in 2020.	Phased leasing of acreage ranging from 7,500 (1990) to 16,800 (2020).	
b. Agricultural Sludge Utilization (Sludge Option #1- Contractual)	Phased leasing of acreage ranging from 47,300 (1990) to 57,000 (2020).		Imposes added commitment for local counties to incorporate into land-use planning objectives.		Phased leasing of acreage ranging from 9,700 (1990) to 10,100 (2020).	
3. Recreation & Open-Space	Lagoons would reduce open-space supplies but irrigation sites would preserve long-term farm base.		Potential for increase in recreational lands and wildlife preserves through reclamation of surface mines.		Lagoons would reduce open-space supplies but irrigation sites would preserve long-term farm base.	

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SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

OUTLYING AREA OF INFLUENCE

IMPACTS OR CHANGES PRODUCED BY PLAN	ILLINOIS				INDIANA	
	OWNERS OF SYSTEM REQUIRED LANDS		OTHER CONCERNED GROUPS	OTHER CONCERNED GROUPS	OWNERS OF SYSTEM REQUIRED LANDS	
	FARMERS	RESIDENTS			FARMERS	RESIDENTS
IV. LAND VALUES a/						
1. Potential Unrecovered Losses c/	Anything in addition to reimbursement for both income protection & long-term capital gains (alternative uses) for leased lands or the full market value of lands inherent in the potential displacement of 860 persons in 1990 and 1,310 persons in 2020.		--	--	Anything in addition to reimbursement for both income protection & long-term capital gains (alternative uses) for leased lands; or the full market value of lands inherent in the potential displacement of 60 persons in 1990 and 130 persons in 2020.	
2. Potential Unpaid for Gains	Potential increase in crop production and net income. Capital improvements to cropped lands with drainage and irrigation systems.		Potential for increase in land values and economic base due to reclamation of surface mines.		Potential increase in crop production and net income. Capital improvements to cropped lands with drainage and irrigation systems.	
V. REVENUES FROM RECYCLING & REUSE a/						
1. Agriculture	Potential for net income gain from nutrient recycle of over $40/acre/year. Agricultural use of sludge may further stimulate production.		Potential for reduction in demand for commercial agri-fertilizer.		Potential for net income gain from nutrient recycle of over $40/acre/year. Agricultural use of sludge may further stimulate production.	
2. Industrial Manufacturing	--	--	--	--	--	--
3. Power Plants	Water quantity in storage lagoons provide potential for use as cooling water & pump-back peak power generation.		Provides potential for increase in local assessed valuation base.		Water quantity in storage lagoons provide potential for use as cooling water & pump-back peak power generation.	
VI. EMPLOYMENT a/	Potential for employment ranging from some 960 persons in 1990 to 1,320 persons in 2020 to operate and maintain the treatment facilities and sludge management program.			Potential for employment ranging from some 140 persons in 1990 to 210 persons in 2020 to operate and maintain the treatment facilities and sludge management program.		
VII. INSTITUTIONAL a/	Coordination of the siting, management and operation of the treatment facilities and sludge management program is required. Institutional and cooperative (contractual) arrangements required to safeguard local interests and planning objectives.					
VIII. COST OF PLAN ($ MILLION) a/ d/						
1. Capital Costs (present worth)						
2. Capital Costs (average annual)						
3. Operation, Maintenance & Replacement Cost (average annual)						
4. Total Average Annual Costs						
5. Industrial Pretreatment Costs (average annual) e/						
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Produces anxiety from leasing and interest acqusition proceedings; inconvenience from construction; disruption to community cohesion; and changes in current farming practices. Provides potential for increase in agricultural economic base. Reluctance to commit local resources to treat metropolitan wastes and forego own desired land-use and socio-economic patterns.					

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NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be Incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and the regional system will be less than required if industry would totally pretreat its wasteload on site to NDCP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES		REST OF NATION				
	ILLINOIS	INDIANA	RELEVANT PORTIONS OF *UPPER MISSISSIPPI RIVER* AND GREAT LAKES REGIONS	FEDERAL TAXPAYERS	OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
I. ECOLOGICAL							
1. Water Quality	Exceeds States' current effluent and water quality guidelines. This plan would contribute its proportional share of the States' efforts for meeting PL 92-500 goals.		Enhanced flow regimen contributes to potential for meeting this and other related needs inventoried by the Water Resources Council's Comprehensive Basin Studies (WRCCBS).	Meets intent and time-phased goals of PL 92-500.			--
2. Air Quality	Plan would be consistent with current programs for air emmission control in both States.		--	Plan consistent with current Federal Air Quality Act requirements.			--
3. Aquatic Life:							
(a) Fishery	Contributes to States' program for improving stream production of sport fishery.		Contributes to meeting a portion of the deficiency in fishing opportunities in the study area.	--	Fulfills goals of relevant conservation groups.	--	--
(b) Other Biota	--	--	--	--	--	--	--
4. Terrestrial Attributes (Wildlife)	--	--	Provides potential for contributing to the migratory waterfowl needs.	--	--	--	--
II. RESOURCE REQUIREMENTS a/							
1. Electrical (Megawatt Hours/Day)	Increases demand Power Supply Areas 14 & 40 by 12,300 (1990) and 15,800 (2020).	Increases demand for Power Supply Area 12 by 2,400 (1990) and by 2,700 (2020).	Imposes need for decision concerning type of fuel (nuclear/fossil) to be used and siting of new power plants.	Requires expansion of nation's power base. Imposes need for review of policies regarding extent to which this and other competitive power needs will be met.			--
2. Natural Gas (Million Cubic Feet/Day)	--	--	--	Increases demand on nation's fuel base. Imposes need for review of policies regarding priority of natural gas or other alternative fuels for use in meeting agricultural related needs.			Import of this or other alternative fuels may be required.
3. Chemicals (Tons/Day)	Increased demand for treatment chemicals will impose added power needs for manufacturing and contribute to a higher resource consumptive rate and possible unit price of chemicals.			--	--	Potential increase in unit prices of mined or manufactured chemicals.	--
III. WATER AND LAND USE CHANGES							
Water Use:							
1. Water Supply	Imposes need for reallocation of Lake Michigan withdrawals and assessment of cost-sharing arrangements.	--	Precludes additional investment to meet WRCCBS inventoried needs for the study area.	--	--	Supreme Court approval and U.S.-Canada agreement may be required for increased withdrawals from Lake Michigan if TDS content in Reuse Option #1 proves to be a problem.	--
2. Water Damages	Storm water runoff control requires coordination of flood plain management studies and possible supplemental funding.		May preclude additional investment to meet WRCCBS inventoried needs for the study area.	Multiple-purpose design provides potential savings in Federal related programs.	--	--	--
3. In Stream Recreation	Contributes to potential for meeting States and WRCCBS inventoried needs for water-based recreation.			--	--	--	--
4. Commercial Navigation	--	--	Defer long-term need for investment if reallocation of water supplies in study area changes flow regimen in Upper Illinois Waterway System.	Multiple-purpose design provides potential savings in Federal related programs.	--	--	--
Land Use:							
1. Changed Land Uses:							
a. Fee Purchase b/	--	--	--	--	--	--	--
b. Restoration of Surface Mines (Sludge Option #2 Contractual)	Enhances the aesthetics of surface mines and increases the potential for meeting local and State land-related needs at a reduced investment level.			--	--	--	--
2. *Intensified Land Use:*							
a. Irrigation Facilities (Contractual)	Areal extent of acreage affected directly or indirectly imposes need for decision by the Counties and States wheather to retain basic agricultural-related economy and life-style and forego other types of socio-economic gains.		Potential for retaining more land in agricultural production than might ordinarily be experienced over time.	--	--	--	--
b. Agricultural Sludge Utilization (Sludge Option #1 - Contractual)	Increases potential for retaining more land in agricultural production than might ordinarily be expected over time.			--	--	--	--
3. Recreation & Open-Space	*Preservation of open-space, agricultural* usage could be counter to current trends in some areas.		*Increases potential for meeting* a portion of inventoried recreational deficiency in the study area by reducing the required financial investment.	Imposes potential for additional financial investment to meet needs.	--	--	--

SUMMARY OF IMPACTS PRODUCED BY ALTERNATIVE V

IMPACTS OR CHANGES PRODUCED BY PLAN	REST OF STATES		REST OF NATION				
	ILLINOIS	INDIANA	RELEVANT PORTIONS OF UPPER MISSISSIPPI RIVER AND GREAT LAKES REGIONS	FEDERAL TAXPAYERS	OTHER CONCERNED GROUPS	THE NATION A SUMMARY	INTERNATIONAL
IV. LAND VALUES a/							
1. Potential Unrecovered Losses c/	--	--	--	--	--	--	--
2. Potential Unpaid for Gains	--	--	--	--	--	--	--
V. REVENUES FROM RECYCLING & REUSE a/							
1. Agriculture	Potential for increasing crop and beef production and enhancing agri-economic base with land technology and reclamation of surface mines.		--	Economic impact of increased production and retaining the level of acreage required by this plan in agricultural production could be classified as either beneficial or adverse depending upon forecast of commodity markets.			--
2. Industrial Manufacturing	Potential for incorporating sludge disposal with the recycling of solid wastes and generate synthetic fuel and other recoverable by-products.			--	--	Potential for increase in unit prices of manufactured items.	--
3. Power Plants	Co-siting of power plants with storage lagoons would remove potential source of heat pollution from Lake Michigan and other major watercourses.			--	--	--	--
VI. EMPLOYMENT a/	Potential for State assistance in job relocation and labor training programs.		--	Increases need for labor training programs.	--	--	--
VII. INSTITUTIONAL a/	Imposes need to coordinate inter-county transfer of sludge. Enabling legislation also necessary to modify present institutional and financial constraints.		--	//. . . . Meets the intent of PL 92-500. . . . .//			
VIII. COST OF PLAN ($ MILLION) a/ d/							
1. Capital Costs (present worth)				$5,956		$7,942	
2. Capital Costs (average annual)				$ 352		$ 470	
3. Operation, Maintenance & Replacement Costs (average annual)				--		$ 275	
4. Total Average Annual Costs				$ 352		$ 745	
5. Industrial Pretreatment Costs (average annual) e/							
IX. CHANGES IN PUBLIC PERCEPTION CONCERNING WORTH OF CLEAN WATER AND IMPACTS FROM PLAN a/	Concern over the socio-economic effects implicit in the long range land commitments necessary to meet water quality goals. Provides potential for improving the stream quality and aesthetics in surface mine areas.		Imposes potential for delay in meeting the time-phased goals of PL 92-500 since an interim time frame would be required to demonstrate workability and its comparative socio-economic advantages to the agricultural community.	//. . . . Meets the intent of PL 92-500. . . . .//			--

NOTES:

a/ Applies to utilization of sludge for reclamation of surface mines (Option #2) and Water Reuse Option #1 (2,068 MGD (3,200 cfs) constraint).

b/ Based on 2020 requirements being purchased in 1990 unless phasing indicated. Excludes some 1,190 acres already owned in the study area that would be incorporated into system (plant or access points).

c/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

d/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by designated regional clearinghouses and the States and approved for funding under the construction grant program of the U.S. E.P.A. All costs are computed over 50 years at 5.5 percent interest rate.

e/ Cost level incurred by industry for pretreatment prior to discharge into regional system. This cost is not included in the cost estimate. Reimbursable cost (user fee) incurred by regional system and included in the project estimate varies with treatment technology. However, total cost level to both industry and regional system will be less than required if industry would totally pretreat its wasteload on site to NECP quality goals. Furthermore, the total cost represents a level of investment which is generally less than that required to meet current standards with additional capital investments estimated to be offset by operational savings.

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SECTION XII

IMPACT PERSPECTIVE

Overview

Tables XI-1 through XI-5 and the preceding text have presented a large amount of information in a relatively few pages. From this overview it should be clear that the study is complex. It not only addresses highly technical and unfamiliar issues, but also seeks to include a multitude of related items dealing with environmental concerns, social aspects and regional needs. Thus, after examining the impact summary tables for the five alternatives, it should become readily apparent that there is no one "best" solution as such. Instead, the final answer must be determined by the residents of both the study and outlying areas working with the States in determining a solution acceptable to all.

In reality, there are two aspects to consider. What is one's preference and what is one willing to forego. It is within this context of consideration that the alternatives should be evaluated and, thus, balanced within a personal framework of desires or goals.

One such framework of goals are the national objectives established by Congress for any program involving water and related resource developments. Therefore, it may be helpful to summate the alternatives' contributions to the national objectives of Environmental Quality, Social Well-Being, and both Regional and National Economic Development.

ENVIRONMENTAL QUALITY

Each of the five alternatives would enhance the water quality of the area; but the degree of water quality improvement, the costs and the impacts would be significantly different. Alternative I will meet current water quality standards and guidelines, but would not meet the long-range national goal expressed in Public Law 92-500. The four NDCP alternatives will. The NDCP alternatives would achieve a higher degree of phosphorus and nitrogen removal (from the wastewater) than that required for the current standards. Thus, the NDCP alternatives would reduce the potential for algal bloom in the receiving streams and lakes.

Implicit in the design of the NDCP alternatives would be an increase in the standing water biotic (aquatic organisms) communities. This in turn will provide the potential for increasing the birds and wildlife that feed on the aquatic organisms in the streams and standing water impoundments. Concurrent with this enhancement would be a reduction in the flora and fauna. Most of this reduction would be attributable to

the surface disruption caused by construction of the system components. Nevertheless, the negative effects on the distribution and diversity of the biotic communities should not be severe, since most of the areas have already been extensively changed.

Air quality impacts would be associated with the Advanced Biological and Physical-Chemical technologies. Both use incineration as part of the treatment process and discharge chemicals and particulates into the air. The discharge from the Advanced Biological System would meet current USEPA air emission standards. The Physical-Chemical process would not. The nitrogen oxides would exceed current standards, only because the technology is not presently available to effectively remove the ammonia nitrogen in a pure Physical-Chemical process. In addition, there would be a potential for infrequent odors in the spring from the storage lagoons used in the Land treatment system.

Finally, there would be a potential for establishing recreational parks and wildlife areas with the sludge reclamation program of surfaced-mined areas. This applies to all of the alternatives except Alternative II which utilizes the Physical-Chemical technology. The sludge from the Physical-Chemical process would be limited to essentially agricultural usage, since the organic and humus-building qualities have been lost through incineration.

SOCIAL WELL-BEING

The contribution to the study area's social well-being would be comparable for all alternatives. There would be temporary inconveniences to public access and traffic flows and interim aesthetic blights caused by noise, dust, and visual contrasts with present conditions. A key contribution to regionalization would be the opportunity to control development and balance open-space with areas of intensified growth. This could be done by controlling access to the conveyance systems and using the storm water management systems (NDCP alternatives only), to provide greenbelt areas.

Location of the treatment facilities, plant or Land technologies, would be a disruptive factor to the social pattern in the immediate area. There is a general public adversion to living near such a facility. As a result there may be a temporary drop in property values in and around the adjacent area. This would continue until land demands become great enough to change the sociological attitude and obtain an acceptance on the part of the citizenry. The impact of the Land treatment system would be even greater in that it would also affect the community political structure of the outlying area. The scale of Alternative IV is such as to

cause the residents in those areas to forego many of their own social and growth desires. Also implicit is the general reluctance of the agricultural areas to use their resources to solve an urban problem. Similar concerns would apply to the sludge management programs especially the agricultural option.

REGIONAL AND NATIONAL ECONOMIC DEVELOPMENT

The water and related land requirements used for this study are reflective of the need inventories established for the Upper Mississippi River and Great Lakes Basins Studies. As such, they provided an interrelationship between the Nation and the Region with its subdivisions for the production of goods and services and population distribution. Consequently, any proposals to meet these needs would contribute to the development of both the Region and the Nation.

All five alternatives would contribute to the conservation of our natural resource base with the recycling of industrial water and the sludge from the wastewater treatment processes. The manner in which the latter would be achieved varies, however, among the technologies employed for treatment. All five alternatives would provide the potential for effecting savings (regionalization) in the cost of wastewater treatment, though again, the degree of economies would vary with the alternatives.

The four NDCP alternatives would provide: (1) a significant degree of areawide flood control; (2) the capability of meeting future potable water supply requirements; (3) enhanced in-stream recreational usage including fishing; and (4) an improved flow regimen to sustain commercial navigation in the Upper Illinois Waterway System. All four of these contributions are responsive to the regional need inventory and would preclude additional investments on the part of the Federal, State and local governments. The applicable impacts, including costs, would differ considerably between alternatives. On the other hand, similar contributions from Alternative I, current standards, would be limited at best. Flood control would be affected only in those areas where existing combined sewers are in operation. The potential for meeting future water supply requirements would not be realized nor would the improved flow regimen for in-stream recreational usage and commercial navigation. For all four water need categories, additional levels of investment would be required in order for Alternative I to provide the equivalent degree of service or contribution achieved by the four NDCP alternatives.

In addition, all four NDCP alternatives would provide the base resources to meet other urban recreational demands. The improved flow regimen, quantity and quality, enhances the potential for providing

recreational land corridors along the area's streams. Moreover, the degree of flood control concurrently provided would also increase the number of days and usage of land-based recreational developments. An additional level of investment, though, would be required for development of the corridors. This represents but one use which could be applied to the flood plain, once the adopted level of storm water run-off control is achieved. Other uses would require higher levels of investment and cause other types of impacts which would have to be assessed. At the same time, the NDCP plant alternatives would have the added potential of providing sufficient through-flows to sustain specially constructed impoundments for quality game fish. None of these gains could be provided by Alternative I without additional financial investments for augmenting and redistributing the stream flows.

The Land treatment systems in Alternatives IV and V would provide a resource base with which to meet the specific needs of: (1) regional parks; (2) wildlife and waterfowl areas; (3) the cooling water requirements for power generation; and (4) the basis for metropolitan-related satellite cities. This treatment system also would have the potential for enhancing agricultural production. In each, an additional investment would be required, but the level of investment would be less than if undertaken on a single-purpose basis.

Preference Array

To provide further insight into the implications of the alternatives, three "Preference Set" tables have been prepared. These tables rephrase the type of impacts and concerns facing each socio-political level. As is evident, the impacts of each alternative would vary in its implications to the: (1) Study and Outlying areas; (2) the rest of the two States and the Region; and (3) the rest of the Nation in a collective sense. This means that each socio-political level would have a different framework within which to assess their preferences and what they are willing to forego. This is not to imply that there are cross-purposes involved; rather it underscores the different perspectives within which the selection may be viewed. In all cases, the factors common to the alternatives have been excluded in an effort to isolate the major items for consideration.

PREFERENCE SET, STUDY AREA AND OUTLYING AREA

The preference set for the study and outlying areas is presented in Table XII-1. In combining the two geographical areas, it was

recognized that the implications extend beyond drainage and county borders and require an areawide decision. The preference set sets forth the basis for selecting the type of environment and life style that both areas collectively desire. To determine this answer requires that the residents realize the implications of choosing one alternative over all others. Thus, the preference set identifies not only the types of change inherent in each alternative, but also, the trade-offs that one must be willing to accept. These trade-offs cover a wide range of concerns, but basically relate to the resource commitments and potential for gain that must be balanced in making a selection.

PREFERENCE SET, REMAINING PORTIONS OF THE STATES AND REGION

The preference set for those people who reside in the remaining portions of the two States and the Region is presented in Table XII-2. The preference set contains a much broader framework for consideration. At issue are the social, environmental and economic objectives that the two States have adopted for those areas located within the Great Lakes and Upper Mississippi River Regions. In each case, a framework for water and related land developments has been established to meet an inventory of needs. Thus, the preference set is structured to focus on the effects that selection of a particular alternative would have on the development goals outlined in the regional framework studies. This should provide the basis for balancing State objectives with local desires. The potential for obtaining various development goals is reflected in the preference of choosing one plan over the others. The trade-offs involved in reordering planning objectives and resource commitments, including financial, are identified in the opportunities foregone.

PREFERENCE SET, THE REST OF THE NATION

The preference set for the rest of the Nation is presented in Table XII-3. The comparative evaluation between preferences and willingness to forego reflect the degree to which the alternative achieve the stated national objectives. This includes the water quality and resource conservation goals set forth in PL 92-500. It also includes those resource implications affecting the national budget and Federal programs.

PREFERENCE SET FOR CHOICE AMONG ALTERNATIVE PLANS BY RESIDENTS OF THE STUDY AREA AND ADJAC

1990 DESIGN CAPACITY; LAND RECLAMATION SLUDGE MANAGEMENT OPTION 1/; REUSE OPTION
(HOLD 3,200 cfs); 5.5 PERCENT INTEREST RATE; 50-YEAR AMORTIZATION PERIOD

ALTERNATIVE I
(Reference Plan - 64 Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE STUDY AREA AND RESIDENTS OF THE ADJACENT COUNTIES MUST PREFER TO:

1. Select the plan with the lowest annual cost to study area taxpayers, $84 million yearly 2/, and thus save some $197 million annually over the least costly plan to achieve the higher water quality goals ($281 million vs. $84 million per year), and accept the consequences of releasing greater amounts of pollutants to lakes and streams and of not treating and controlling storm water runoff.

2. Accept the applicable water quality goals established by Illinois and Indiana as the desired environmental goal.

3. Minimize the consumption of chemical resources for wastewater treatment by choosing this plan which requires 44 tons per day (the least of all plans), and accept the consumption of other resources to produce and deliver these chemicals.

4. Experience no net increase in fuel consumption by selecting this plan which can recover sufficient synthetic natural gas from the wastes to meet treatment system fuel requirements.

5. Adopt a treatment process which avoids air emissions, other than aerosols.

6. Consume 7,100 megawatt hours per day less power than the plan having the next lowest power consumption (10,300 mwh/day vs. 3,200 mwh/day) and accept the consumption of natural resources to generate this power.

7. Continue to lower groundwater levels in the western portion of the study area to meet local water uses, unless Lake Michigan withdrawals are modified.

8. Provide an employment level of about 2,930 people (the least of all plans) to operate and maintain the wastewater treatment system and related works.

9. Attain the current planning goals for consolidation of wastewater treatment facilities and thus realize efficiencies of operation and maintenance and other cost savings represented by this level of regionalization and system characteristics.

10. Minimize the institutional changes required for implementation both within and outside the study area by consolidation of the 132 existing treatment plants to 64 regional plants; and seek cooperative arrangements for sludge management on 57,000 acres of land in adjacent counties.

11. Forego capital improvements and associated increased farm productivity attainable when recycling and treating wastewater by irrigation of selected crops on sites in adjacent counties.

AND BE WILLING TO:

1. Purchase an additional 1,500 acres 4/ of land in the study area required for construction of the new or expanded treatment facilities.

2. Negotiate long-term leases on about 47,300 acres in Illinois and about 9,700 acres in Indiana for agricultural utilization of stabilized sludge.

3. Accept a limited opportunity for water based recreation and use potential on those streams with improved flows and forego the opportunity to construct impoundments for selected fish species at treatment plants with sufficient flows.

4. Forego the water reuse potentials inherent in meeting the higher water quality goals and thus continue to place increasing demands on sources of potable water, unless additional capital is invested.

5. Accept the anxiety of about 3,400 people residing in the study area who may experience unrecovered losses 3/ inherent in being relocated because of construction of the proposed treatment facilities.

6. Forego the opportunity for multiple-use of wastewater for storage lagoons as cooling lakes for electric power generation plants and either discharge waste heat to our lakes and streams or require power companies to build their own cooling lakes and/or their own cooling towers.

7. Forego the potential revenue and increased local tax base resulting from the incorporation of electric power generation facilities into the overall plan.

8. Forego the opportunity for land reclamation of strip-mined areas by limiting the sludge management program to agricultural utilization.

ALTERNATIVE II
(33 Physical-Chemical Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE STUDY AREA AND RESIDENTS OF THE ADJACENT COUNTIES MUST PREFER TO:

1. Secure the highest level of wastewater treatment technically available and consistent with the National environmental goals of PL 92-500.

2. Consume the least amount of power (10,300 megawatt hours per day) to achieve the higher water quality goals, and accept the consumption of natural resources to generate this power plus possible increases in consumer rates.

3. Eliminate depletion of groundwater sources used to meet local water uses in the western portion of the study area.

4. Exceed the current planning goal for consolidation of wastewater treatment facilities, and thus, realize efficiencies of operation and maintenance and other cost savings represented by this level of regionalization and system characteristics.

5. Provide opportunities for potential development of recreational corridors along some 500 miles of streams in the study area (because of high water quality and stabilized flows), for the potential development of parks and recreation areas adjacent to storm water impoundments; and the potential to construct impoundments for selected fish species at treatment plants.

6. Treat wastewater and storm water to the higher water quality goal to produce water of sufficient quality to meet drinking water standards and be suitable for both municipal and most industrial reuses, thereby conserving an essential resource (water).

7. Forego capital improvements and associated increased farm productivity attainable when recycling and treating wastewater by irrigation of selected crops on sites in adjacent counties.

AND BE WILLING TO:

1. Increase the annual cost to the study area taxpayer by $333 million 2/ (from $84 million to $417 million per year) over the least expensive plan, but attain the higher water quality goals, the water reuse potential and the treatment and control of storm water runoff.

2. Forego the opportunity to minimize the use of chemical resources by consuming 4,111 tons more per day than the least consumptive of the NDCP plans (4,160 Tons vs. 49 Tons) and accept the consumption of other resources to produce and deliver these chemicals.

3. Consume 156 million cubic feet of gas each day to treat wastewater to the higher water quality goals and accept possible increases in consumer rates, unless alternative fuels are used.

4. Accept an emission of 552 tons of chemicals and particulates into the air daily, even though the discharges are within current Federal EPA standards, except for nitrogen oxides, which may, under certain conditions, be an infrequent source of irritants.

5. Purchase an additional 63,900 acres 4/ of land within the study area required for construction and operation of the proposed storm water management and wastewater treatment facilities.

6. Negotiate long-term leases outside the study area on about 551,700 acres in Illinois and 97,300 acres in Indiana for application of stabilized sludge as a soil conditioner and also obtain long-term leases on 116,300 acres within the study area required for storm water management.

7. Forego the opportunity to maximize employment levels for wastewater and storm water treatment systems and related works by providing about 11,170 positions as compared to a maximum of 11,580 positions (Alt. III).

8. Accept the institutional changes reflected in consolidating to 33 treatment plants and seek cooperative arrangements for application of sludge as a soil conditioner on farm lands adjacent to the study area.

9. Accept the anxiety of about 18,800 people residing in the study area who may experience unrecovered losses 3/ inherent in being relocated because of construction of the proposed storm water management and wastewater treatment facilities or related works.

10. Forego the opportunity for multiple-use of wastewater storage lagoons as cooling lakes for electric power generation plants and either discharge waste heat to our lakes and streams or require power companies to build their own cooling lakes and/or their own cooling towers.

11. Forego the potential revenue and increased local tax base resulting from the incorporation of electric power generation facilities into the overall plan.

12. Forego the opportunity for land reclamation of strip-mined areas and the associated increase in land values, improved aesthetics, potential for other land uses and increase of the local economic base.

ALTERNATIVE III
(17 Advanced Biological Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE STUDY AREA AND RESIDENTS OF THE ADJACENT COUNTIES MUST PREFER TO:

1. Secure the highest level of wastewater treatment technically available and consistent with the National environmental goals of PL 92-500.

2. Eliminate depletion of groundwater sources used to meet local water uses in the western portion of the study area.

3. Provide an employment level of about 11,580 people (the highest for all plans) to operate and maintain the wastewater and storm water treatment system and related works.

4. Exceed the current planning goal for consolidation of wastewater treatment facilities, and thus, realize efficiencies of operation and maintenance and other cost savings represented by this level of regionalization and system characteristics.

5. Provide opportunities for potential development of recreational corridors along some 500 miles of streams in the study area (because of high water quality and stabilized flows), for the potential development of parks and recreation areas adjacent to storm water impoundments; and the potential to construct impoundments for selected fish species at treatment plants.

6. Treat wastewater and storm water to the higher water quality goal to produce water of sufficient quality to meet drinking water standards and be suitable for both municipal and most industrial reuses, thereby conserving an essential resource (water).

7. Improve the aesthetics, value and potential land use of 271,100 acres in Illinois and 55,500 acres in Indiana (based on 1990 flows over a 50-year period) which have been strip-mined and also gain the associated increase in the local economic base.

8. Forego capital improvements and associated increased farm productivity attainable when recycling and treating wastewater by irrigation of selected crops on sites in adjacent counties.

AND BE WILLING TO:

1. Increase the annual cost to the study area taxpayer by $338 million 2/ (from $84 million to $422 million per year) over the least expensive plan, but attain the higher water quality goals, the water reuse potential and the treatment and control of storm water runoff.

2. Forego the opportunity to minimize the use of chemical resources by consuming 2,651 tons more per day than the least consumptive of the NDCP plans (2,700 Tons vs. 49 Tons) and accept the consumption of other resources to produce and deliver these chemicals.

3. Consume 85 million cubic feet of gas each day to treat wastewater to the higher water quality goals and accept possible increases in consumer rates, unless alternative fuels are used.

4. Accept an emission of 10 tons of chemicals and particulates into the air daily, and the presence of aerosols at treatment plants and storm water treatment sites in the study area.

5. Accept an increase in power consumption of 1,300 megawatt hours per day over the least consumptive NDCP plan (11,600 mwh/day vs. 10,300 mwh/day), and accept the use of natural resources to generate this power plus possible increases in consumer rates.

6. Purchase an additional 66,700 acres 4/ of land within the study area required for construction and operation of the proposed storm water management and wastewater treatment facilities.

7. Negotiate long-term leases outside the study area on about 42,500 acres in Illinois and 8,700 acres in Indiana for the rehabilitation of strip-mined areas by application of stabilized sludge and also obtain long-term leases on 116,300 acres within the study area required for storm water management.

8. Accept the institutional changes reflected in consolidating to 17 treatment plants and seek cooperative arrangements for reclamation of strip-mined area by application of stabilized sludge outside of the study area.

9. Accept the anxiety of about 29,600 people residing in the study area who may experience unrecovered losses 3/ inherent in being relocated because of construction of the proposed storm water management and wastewater treatment facilities or related works.

10. Forego the opportunity for multiple-use of wastewater storage lagoons as cooling lakes for electric power generation plants and either discharge waste heat to our lakes and streams or require power companies to build their own cooling lakes and/or their own cooling towers.

11. Forego the potential revenue and increased local tax base resulting from the incorporation of electric power generation facilities into the overall plan.

1/ Alternatives I and II involve agricultural utilization (Option 1) as the sludge management program, while the remaining alternatives employ the land reclamation program (Option 2).

2/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs;

3/ Potential unrecovered losses are generally co
lands; or in excess of the full market value for
Assistance and Real Property Acquisition Policies

4/ Excludes some 1,190 acres already owned in th

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ITIVE PLANS BY RESIDENTS OF THE STUDY AREA AND ADJACENT COUNTIES

CLAMATION SLUDGE MANAGEMENT OPTION 1/; REUSE OPTION NO. 1
CENT INTEREST RATE; 50-YEAR AMORTIZATION PERIOD

ALTERNATIVE III
(17 Advanced Biological Plants)

HIS PLAN OVER ALL OTHER ALTERNATIVES, RESI-
REA AND RESIDENTS OF THE ADJACENT COUNTIES

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AND BE WILLING TO:

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NDCP plans (2,700 Tons vs. 49 Tons) and accept
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water quality goals and accept possible
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and the presence of aerosols at treatment
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ate heat to our lakes and streams or require
build their own cooling lakes and/or their own

tential revenue and increased local tax base
incorporation of electric power generation
overall plan.

ALTERNATIVE IV
(5 Land Treatment Sites)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE STUDY AREA AND RESIDENTS OF THE ADJACENT COUNTIES MUST PREFER TO:

1. Select the least costly plan which meet the higher water quality goals ($281 million annually 2/), and thus, increase annual cost to the study area taxpayers by $197 million annually ($281 million vs. $84 million per year), but attain the higher water quality goals, the water reuse potential and the treatment and control of storm water runoff.

2. Secure the highest level of wastewater treatment technically available and consistent with the National environmental goals of PL 92-500.

3. Consume the least amount of chemical resources (49 tons per day) of all plans achieving the higher water quality goal, and accept the consumption of other resources to produce and deliver these chemicals.

4. Conserve natural and synthetic gas resources by selecting this plan which does not require fuel for treatment to meet the higher water quality goals, although the increased crop production associated with this plan will cause added fuel needs for drying.

5. Adopt a treatment process which avoids air emissions, other than aerosols, but does have a potential for producing infrequent odor emissions from lagoons located near crop irrigation sites.

6. Eliminate depletion of groundwater sources used to meet local water uses in the western portion of the study area; and accept the long-term change of groundwater at irrigation sites to about the same quality as the potable treated water.

7. Exceed the current planning goals for consolidation of wastewater treatment facilities, and thus, realize efficiencies of operation and maintenance and other cost savings represented by this level of regionalization and system characteristics.

8. Provide opportunities for potential development of recreational corridors along some 500 miles of streams in the study area (because of high water quality and stabilized flows), and for the potential development of parks and recreation areas adjacent to storm water impoundments.

9. Treat wastewater and storm water to the higher water quality goal to produce water of sufficient quality to meet drinking water standards and be suitable for both municipal and most industrial reuses, thereby conserving an essential resource (water).

10. Take advantage of the plan's multiple-use potentials by supporting the use of wastewater storage lagoons as cooling lakes for electric power plants, and/or as part of a pump-storage power generation system.

11. Maximize the potential for revenue to the treatment system and an increase in the tax base of adjacent counties due to the opportunity for incorporating electric power generation facilities in this plan.

12. Improve the aesthetics, value and potential land use of 326,600 acres in Illinois and Indiana (based on 1990 flows over a 50-year period) which have been strip-mined and also gain the associated increase in the local economic base.

13. Furnish participating farmers free capital improvements for irrigation and drainage systems which provide opportunities for increased production without out of pocket expense to the farmer; and further pay the farmer to compensate for the use restrictions and value foregone because of participation.

AND BE WILLING TO:

1. Acept an increase in power consumption of 11,700 megawatt hours per day over the least consumptive NDCP plan (22,000 mwh/ day vs. 10,300 mwh/day) and accept the use of natural resources to generate this power plus possible increases in consumer rates.

2. Purchase an additional 63,200 acres 4/ of land within the study area and about 63,400 acres of land in the adjacent counties required for the construction and operation of the proposed storm water management and wastewater treatment facilities, respectively.

3. Negotiate long-term leases outside the study area on about 153,100 acres in Illinois and 146,900 acres in Indiana for spray irrigation of pretreated wastewater, and on 257,200 acres (2020) in Illinois and Indiana for rehabilitation of strip-mined areas by application of sludge, and also obtain long-term leases on 116,300 acres within the study area for storm water management.

4. Forego the opportunity to maximize employment levels for wastewater and storm water treatment systems and related works by providing about 5,460 positions as compared to a maximum of 11,580 positions (Alt. III).

5. Accept the significant institutional changes reflected in the elimination of all existing study area treatment plants; and the need to purchase land inside and outside of the study area as well as to seek cooperative arrangements with the outlying area for the dual functions of wastewater treatment and sludge management; recognizing such arrangements would involve State and Congressional approval of the interstate transfer inherent in system design.

6. Accept the anxiety of about 2,750 people residing in counties adjacent to the study area and about 17,460 people residing in the study area who may experience unrecovered losses 3/ inherent in being relocated because of construction of the proposed storm water management and wastewater treatment facilities or related works.

ALTERNATIVE V
(Land/Adv. Biological Combination)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE STUDY AREA AND RESIDENTS OF THE ADJACENT COUNTIES MUST PREFER TO:

1. Secure the highest level of wastewater treatment technically available and consistent with the National environmental goals of PL 92-500.

2. Eliminate depletion of groundwater sources used to meet local water uses in the western portion of the study area; and accept the long-term change of groundwater at irrigation sites to about the same quality as the potable treated water.

3. Exceed the current planning goal for consolidation of wastewater treatment facilities, and thus, realize efficiencies of operation and maintenance and other cost savings represented by this level of regionalization and system characteristics.

4. Provide opportunities for potential development of recreational corridors along some 500 miles of streams in the study area (because of high water quality and stabilized flows), for the potential development of parks and recreation areas adjacent to storm water impoundments; and the potential to construct impoundments for selected fish species at treatment plants.

5. Treat wastewater and storm water to the higher water quality goal to produce water of sufficient quality to meet drinking water standards and be suitable for both municipal and most industrial reuses, thereby conserving an essential resource (water).

6. Take advantage of the plan's multiple-use potentials by supporting the use of wastewater storage lagoons as cooling lakes for electric power plants, and/or as part of a pump-storage power generation system.

7. Include, but to a lesser degree, the potential for revenue to the treatment system and an increase in the tax base of adjacent counties due to the opportunity for incorporating electric power generation facilities in this plan.

8. Improve the aesthetics, value and potential land use of 271,100 acres in Illinois and 55,500 acres in Indiana (based on 1990 flows over a 50-year period) which have been strip-mined and also gain the associated increase in the local economic base.

9. Furnish participating farmers free capital improvements for irrigation and drainage systems which provide opportunities for increased production without out of pocket expense to the farmer; and further pay the farmer to compensate for the use restrictions and value foregone because of participation.

AND BE WILLING TO:

1. Increase the annual cost to the study area taxpayer by $309 million 2/ (from $84 million to $393 million per year) over the least expensive plan, but attain the higher water quality goals, the water reuse potential and the treatment and control of storm water runoff.

2. Forego the opportunity to minimize the use of chemical resources by consuming 1,938 tons more per day than the least consumptive of the NDCP plans (1,987 Tons vs. 49 Tons) and accept the consumption of other resources to produce and deliver these chemicals.

3. Consume 61 million cubic feet of gas each day to treat wastewater to the higher water quality goals and accept possible increases in consumer rates, unless alternative fuels are used.

4. Accept an emission of 7 tons of chemicals and particulates into the air daily, and the presence of aerosols at treatment sites both in the study area and in adjacent counties, as well as the potential for infrequent odors from lagoons located near crop irrigation sites in adjacent counties.

5. Accept an increase in power consumption of 4,400 megawatt hours per day over the least consumptive NDCP plan (14,700 mwh/ day vs. 10,300 mwh/day) and accept the use of natural resources to generate this power plus possible increases in consumer rates.

6. Purchase an additional 65,100 acres 4/ of land within the study area and about 17,200 acres of land in the adjacent counties required for the construction and operation of the proposed storm water management and wastewater treatment facilities.

7. Negotiate long-term leases outside the study area on about 73,600 acres in Illinois and 7,500 acres Indiana for spray irrigation of pretreated wastewater, and on 251,000 acres (2020) in Illinois and 46,700 acres (2020) in Indiana for rehabilitation of strip-mined areas, and also obtain long-term leases on 116,300 acres within the study area for storm water management.

8. Forego the opportunity to maximize employment levels for wastewater and storm water treatment systems and related works by providing about 9,940 positions as compared to a maximum of 11,580 positions (Alt. III).

9. Accept the institutional changes required to consolidate to five treatment plants plus land treatment sites without interstate transfer; and the need to purchase land both inside and outside the study area as well as to seek cooperative arrangements with the outlying area for the dual functions of wastewater treatment and sludge management.

10. Accept the anxiety of about 8,160 people residing in the study area and 920 people in adjacent counties who may experience unrecovered losses 3/ inherent in being relocated because of construction of the proposed wastewater treatment facilities and related works plus an additional 17,460 people residing on lands in the study area required for the storm water management facilities.

3/ Potential unrecovered losses are generally considered to be any real or imagined losses in excess of net average annual income for owners of leased lands; or in excess of the full market value for the purchased lands and relocation assistance available under the provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

4/ Excludes some 1,190 acres already owned in the study area by existing treatment plants which would be incorporated into the system as treatment

TABLE XII-1

PREFERENCE SET FOR CHOICE AMONG ALTERNATIVE PLANS BY RESIDENTS OF THE REMAINING PORTION O
PLUS RELEVANT PORTIONS OF THE UPPER MISSISSIPPI RIVER BASIN AND THE GREAT LAKES ST. L

1990 DESIGN CAPACITY; LAND RECLAMATION SLUDGE MANAGEMENT OPTION 1/; REUSE OP
(HOLD 3,200 cfs); 5.5 PERCENT INTEREST RATE; 50-YEAR AMORTIZATION PERIO

ALTERNATIVE I
(Reference Plan - 64 Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA AND THE RESIDENTS OF THE REGION MUST PREFER TO:

1. Allow the C-SELM study area to adopt the applicable water quality goals established by Illinois and Indiana as the desired environmental goal, and thereby limit the potential to meet related water resource needs.

2. Avoid a plan requiring high consumption of treatment chemicals which would impose added power needs for manufacture and contribute to a higher resource consumption rate and may cause possible increases in the price of chemicals.

3. Conserve natural and synthetic gas resources by selecting a plan which does not draw upon National reserves of these resources.

4. Achieve wastewater treatment by a plan consistent with current programs for air emission control in both States.

5. Minimize the consumption of added power needed to operate the treatment system to 3,200 megawatt hours per day (the least of all plans), and be prepared to make a decision concerning the source of this power (nuclear/fossil fuel) and the siting of power plants.

6. Have available a potential of incorporating sludge disposal with the recycling of solid wastes and generation of other recoverable by-products.

AND BE WILLING TO:

1. Specify that the C-SELM study area forego the opportunity to meet water quality goals consistent with the objectives of PL 92-500, and also forego opportunities to improve stream production of sport fisheries and related recreational deficiencies.

2. Accept the potential need to either reallocate or seek increases of Lake Michigan withdrawals for water supply needs and forego the contributions inherent in the other plans toward meeting these needs.

3. Accept the limited response to storm water runoff control, in-stream recreation needs and water damage reduction reflected in the plan and be willing to expend additional State funds to meet these needs.

4. Accept the potential for additional investment of State funds if reallocation of water supplies change the water regimen in the Upper Illinois Waterway System.

5. Forego the opportunity for enhancement of aesthetics, value and potential land use of strip-mined areas and the possibility of meeting local and State land-related needs at a reduced investment level.

6. Forego the opportunity to preserve and maintain, through the wastewater management program, open-space around the urban area to control urban sprawl; and forego the opportunity to increase farmer income through agricultural recycling of nutrients and water by spray irrigation of pretreated wastewater.

7. Forego potential increase in crop and beef production and associated gains in the agricultural economic base resulting from opportunities inherent in either the land treatment technology and/or land reclamation.

8. Forego the opportunity for co-siting of power plants with storage lagoons and, thus, accept the potential for the discharge of waste heat to Lake Michigan and major streams.

9. Forego possible delays in implementing the plan because of public skepticism concerning the workability of the system, in as much as the proposed technology already has tacit public acceptance.

ALTERNATIVE II
(33 Physical-Chemical Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA AND THE RESIDENTS OF THE REGION MUST PREFER TO:

1. Obtain a substantial improvement in water quality in the lakes and streams of the C-SELM study area consistent with the National goals expressed in PL 92-500, and thereby provide the potential to meet related water resource needs.

2. Contribute to State's programs for improving stream production of sport fisheries and thus meet a portion of the deficiency of fishing opportunities in the study area.

3. Achieve wastewater treatment by a plan consistent with current programs for air emission control in both States, except for nitrogen oxide levels.

4. Consume the least amount of power (10,300 mwh per day) to achieve the higher water quality goals, and be prepared to make a decision concerning the source of this power (nuclear/fossil fuel) and the siting of power plants.

5. Take advantage of the contributions inherent in the plan toward meeting identified projected water requirements, and accept the need to reallocate present Lake Michigan withdrawals and the need to assess cost-sharing arrangements.

6. Take advantage of the contribution inherent in the plan toward meeting erosion and sedimentation control, in-stream recreation needs and water damage reduction, and thus, possibly preclude the need to make additional investments to meet these needs.

7. Defer long-term need for investment if reallocation of water supplies in study area changes the water regimen in the Upper Illinois Waterway System.

AND BE WILLING TO:

1. Accept the increased demand for treatment chemicals and the added power needs to manufacture the chemicals as well as the associated increased resource consumption and potential for higher chemical prices.

2. Accept the potential reduction in available supplies of natural and synthetic gas and the possible need to use alternative fuels, thereby increasing costs for air emission controls; and be willing to accept the possible effects fuel uses would have on growth patterns, existing long-term supply commitments and commodity movements.

3. Forego the opportunity for enhancement of aesthetics, value, and potential land use of strip-mined areas and the possibility of meeting local and State land-related needs at a reduced investment level.

4. Forego the opportunity to preserve and maintain, through the wastewater management program, open-space around the urban area to control urban sprawl; and forego the opportunity to increase farmer income through agricultural recycling of nutrients and water by spray irrigation of pretreated wastewater.

5. Forego potential increases in crop and beef production and associated gains in the agricultural economic base resulting from opportunities inherent in either the land treatment technology and/or land reclamation.

6. Forego the potential for incorporating sludge disposal with the recycling of solid wastes and generation of synthetic fuel and other recoverable by-products.

7. Forego the opportunity for co-siting of power plants with storage lagoons and, thus, accept the potential for the discharge of waste heat to Lake Michigan and major streams.

8. Accept the need for pilot studies to refine designs and workability of the system under peak loads and in relation to air emission standards.

ALTERNATIVE III
(17 Advanced Biological Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA AND THE RESIDENTS OF THE REGION MUST PREFER TO:

1. Obtain a substantial improvement in water quality in the lakes and streams of the C-SELM study area consistent with the National goals expressed in PL 92-500, and thereby provide the potential to meet related water resource needs.

2. Contribute to State's programs for improving stream production of sport fisheries and thus meet a portion of the deficiency of fishing opportunities in the study area.

3. Achieve wastewater treatment by a plan consistent with current programs for air emission control in both States.

4. Take advantage of the contributions inherent in the plan toward meeting identified projected water requirements, and accept the need to reallocate present Lake Michigan withdrawals and the need to assess cost-sharing arrangements.

5. Take advantage of the contribution inherent in the plan toward meeting erosion and sedimentation control, in-stream recreation needs and water damage reduction, and thus, possibly preclude the need to make additional investments to meet these needs.

6. Defer long-term need for investment if reallocation of water supplies in study area changes the water regimen in the Upper Illinois Waterway System.

7. Enhance the aesthetics, value and potential land use of strip-mined areas and increases the potential for meeting local and State land-related needs at a reduced investment level.

8. Have available the potential for increasing crop and beef production and, thus, enhancing the agricultural economic base by reclamation of surface mines.

9. Have available a potential of incorporating sludge disposal with the recycling of solid wastes and generation of other recoverable by-products.

AND BE WILLING TO:

1. Accept the increased demand for treatment chemicals and the added power needs to manufacture the chemicals as well as the associated increased resource consumption and potential for higher chemical prices.

2. Accept the potential reduction in available supplies of natural and synthetic gas and the possible need to use alternative fuels, thereby increasing costs for air emission controls; and be willing to accept the possible effects fuel uses would have on growth patterns, existing long-term supply commitments and commodity movements.

3. Accept an increase of 1,300 megawatt hours per day over the least consumptive plan meeting the higher water quality goals (11,600 mwh/day vs. 10,300 mwh/day), and be prepared to make a decision concerning the source of this power (nuclear/ fossil fuel) and the siting of power plants.

4. Forego the opportunity to preserve and maintain, through the wastewater management program, open-space around the urban area to control urban sprawl; and forego the opportunity to increase farmer income through agricultural recycling of nutrients and water by spray irrigation of pretreated wastewater.

5. Forego the opportunity for co-siting of power plants with storage lagoons and, thus, accept the potential for the discharge of waste heat to Lake Michigan and major streams.

6. Accept the need for pilot studies to refine designs and workability of the system under peak loads.

1/ Alternatives I and II involve agricultural utilization (Option 1) as the sludge management program, while the remaining alternatives employ the land reclamation program (Option 2).

2/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 percent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs; provided the plan is certified by the designated regional clearinghouses and the States and approved for funding under the construction grant program of the

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ATIVE PLANS BY RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA
R MISSISSIPPI RIVER BASIN AND THE GREAT LAKES ST. LAWRENCE RIVER BASIN

D RECLAMATION SLUDGE MANAGEMENT OPTION 1/; REUSE OPTION NO. 1
5 PERCENT INTEREST RATE: 50-YEAR AMORTIZATION PERIOD

ALTERNATIVE III
(17 Advanced Biological Plants)

I ORDER TO CHOOSE THIS PLAN OVER ALL OTHER
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the urban area to control urban sprawl; and
the opportunity to increase farmer income
h agricultural recycling of nutrients and water
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with storage lagoons and, thus, accept the
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an and major streams.

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rkability of the system under peak loads.

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eplacement costs;

ALTERNATIVE IV
(5 Land Treatment Sites)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA AND THE RESIDENTS OF THE REGION MUST PREFER TO:

1. Obtain a substantial improvement in water quality in the lakes and streams of the C-SELM study area consistent with the National goals expressed in PL 92-500, and thereby provide the potential to meet related water resource needs.

2. Contribute to State's programs for improving stream production of sport fisheries and thus meet a portion of the deficiency of fishing opportunities in the study area; and provide a potential for contributing to the migratory waterfowl needs.

3. Avoid a plan requiring high consumption of treatment chemicals which would impose added power needs for manufacture and contribute to a higher resource consumption rate and may cause possible increases in the price of chemicals.

4. Conserve natural and synthetic gas resources by selecting a plan which does not draw upon National reserves of these resources, except for additional fuel requirements for crop drying caused by increased crop production associated with this plan.

5. Achieve wastewater treatment by a plan consistent with current programs for air emission control in both States.

6. Take advantage of the contributions inherent in the plan toward meeting identified projected water requirements, and accept the need to reallocate present Lake Michigan withdrawals and the need to assess cost-sharing arrangements.

7. Take advantage of the contribution inherent in the plan toward meeting erosion and sedimentation control, in-stream recreation needs and water damage reduction, and thus, possibly preclude the need to make additional investments to meet these needs.

8. Defer long-term need for investment if reallocation of water supplies in study area changes the water regimen in the Upper Illinois Waterway System.

9. Enhance the aesthetics, value and potential land use of strip-mined areas and increases the potential for meeting local and State land-related needs at a reduced investment level.

10. Have available the potential for increasing crop and beef production and, thus, enhancing the agricultural economic base by both the opportunities inherent in the land technology and by the reclamation of surface mines.

11. Have available a potential of incorporating sludge disposal with the recycling of solid wastes and generation of other recoverable by-products.

12. Have available the opportunity for co-siting of power plants with storage lagoons and, thus, provide cooling ponds for waste heat rather than using Lake Michigan or larger streams.

AND BE WILLING TO:

1. Accept an increase of 11,700 megawatt hours per day over the least consumptive plan meeting the higher water quality goals (22,000 mwh/day vs. 10,300 mwh/day), and be prepared to make a decision concerning the source of this power (nuclear/fossil fuel) and the siting of power plants.

2. Commit more land to agricultural production than might ordinarily be expected over time and thus, impose the need for a decision by the Counties and States whether to retain a basic agriculture-related economy and life style and forego other types of socio-economic gains.

3. Accept the anxiety over the socio-economic effects implicit in the long-range land commitments necessary to meet water quality goals with the land technology; and accept possible delays in meeting the time-phased goals of PL 92-500, since an interim period would be required to demonstrate workability and socio-economic advantages to potential participating farmers through pilot programs.

ALTERNATIVE V
(Land/Adv. Biological Combination)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, RESIDENTS OF THE REMAINING PORTION OF ILLINOIS AND INDIANA AND THE RESIDENTS OF THE REGION MUST PREFER TO:

1. Obtain a substantial improvement in water quality in the lakes and streams of the C-SELM study area consistent with the National goals expressed in PL 92-500, and thereby provide the potential to meet related water resource needs.

2. Contribute to State's programs for improving stream production or sport fisheries and thus meet a portion of the deficiency of fishing opportunities in the study area; and provide a potential for contributing to the migratory waterfowl needs.

3. Consume moderate amounts of natural gas to achieve treatment of wastewater to the higher water quality goals.

4. Achieve wastewater treatment by a plan consistent with current programs for air emission control in both States.

5. Take advantage of the contributions inherent in the plan toward meeting identified projected water requirements, and accept the need to reallocate present Lake Michigan withdrawals and the need to assess cost-sharing arrangements.

6. Take advantage of the contribution inherent in the plan toward meeting erosion and sedimentation control, in-stream recreation needs and water damage reduction, and thus, possibly preclude the need to make additional investments to meet these needs.

7. Defer long-term need for investment if reallocation of water supplies in study area changes the water regimen in the Upper Illinois Waterway System.

8. Enhance the aesthetics, value and potential land use of strip-mined areas and increases the potential for meeting local and State land-related needs at a reduced investment level.

9. Have available the potential for increasing crop and beef production and, thus, enhancing the agricultural economic base by both the opportunities inherent in the land technology and by the reclamation of surface mines.

10. Have available a potential of incorporating sludge disposal with the recycling of solid wastes and generation of other recoverable by-products.

11. Have available the opportunity for co-siting of power plants with storage lagoons and, thus, provide cooling ponds for waste heat rather than using Lake Michigan or larger streams.

AND BE WILLING TO:

1. Accept the increased demand for treatment chemicals and the added power needs to manufacture the chemicals as well as the associated increased resource consumption and potential for higher chemical prices.

2. Accept an increase of 4,400 megawatt hours per day over the least consumptive plan meeting the higher water quality goals (14,700 mwh/day vs. 10,300 mwh/day), and be prepared to make a decision concerning the source of this power (nuclear/fossil fuel) and the siting of power plants.

3. Commit more land to agricultural production than might ordinarily be expected over time and thus, impose the need for a decision by the Counties and States whether to retain a basic agriculture-related economy and life-style and forego other types of socio-economic gains.

4. Accept the anxiety over the socio-economic effects implicit in the long-range land commitments necessary to meet water quality goals with the land technology; and accept possible delays in meeting the time-phased goals of PL 92-500, since an interim period would be required to demonstrate workability and socio-economic advantages to potential participating farmers through pilot programs.

TABLE XII-2

PREFERENCE SET FOR CHOICE AMONG ALTERNATIVE PLANS BY RESIDENTS OF THE REST O

1990 DESIGN CAPACITY; LAND RECLAMATION SLUDGE MANAGEMENT OPTION 1/; REI
(HOLD 3,200 cfs); 5.5 PERCENT INTEREST RATE: 50-YEAR AMORTIZATION

ALTERNATIVE I
(Reference Plan - 64 Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, THE RESIDENTS OF THE REST OF THE NATION MUST PREFER TO:

1. Select the plan with the lowest annual cost to the Federal taxpayer, $118 million yearly 2/, and thus save $194 million annually over the least costly plan to achieve the higher water quality goals and be able to use the savings to finance other high priority Federal programs.

2. Allow the C-SELM study area to adopt a water quality goal which does not meet the 1985 goal of PL 92-500 and only partially achieves the 1983 goal.

3. Minimize added demands upon reserves of chemical resources and thus avoid possible impacts on supplies, unit prices and the Nation's transportation system.

4. Avoid placing added demands on National reserves of natural gas and other fuels.

5. Provide air emission control consistent with current Federal Air Quality Act requirements.

AND BE WILLING TO:

1. Forego the opportunity to fulfill fully the water quality goals expressed by relevant conservation groups during the drafting of PL 92-500.

2. Secure Supreme Court approval and U.S.-Canada agreement to increase the withdrawal from Lake Michigan for water supply once demand exceeds supply, unless alternative sources, as renovated storm water, are provided at an additional cost.

3. Forego the opportunities for potential savings inherent in the multiple-purpose designs of all other plans in implementing Federal-related programs for flood control, in-stream recreation and commercial navigation.

4. Expend greater sums for open-space and recreation developments in lieu of integrating such efforts with a multiple-purpose plan.

5. Forego the opportunity to meet the intent of PL 92-500 in terms of water quality and conservation of resources by recycling and multiple-use.

ALTERNATIVE II
(33 Chemical-Physical Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, THE RESIDENTS OF THE REST OF THE NATION MUST PREFER TO:

1. Have the C-SELM study area treat its wastewater to water quality levels consistent with the National goals and time-phasing expressed in PL 92-500.

2. Provide wastewater treatment levels consistent with aquatic enhancement objectives of relevant conservation groups and thus fulfill their water quality goals.

3. Provide air emission control consistent with current Federal Air Quality Act requirements, except for nitrogen oxide levels.

4. Take advantage of opportunities inherent in multiple-purpose designs to provide potential savings in Federal-related programs for flood control and commercial navigation.

5. Have the opportunity to develop recreation areas and lands along streams as well as open-space connecting corridors between streams which would link recreation nodes and be part of a related water, recreation and land-use plan.

6. Meet the intent of PL 92-500 in terms of water quality, conservation of resources by recycling, multiple-use, and area wide planning.

AND BE WILLING TO:

1. Increase the annual cost to Federal taxpayers by $16 million 2/ over the least costly plan to achieve the higher water quality goals ($328 million vs. $312 million per year) and forego investing these funds in other high priority Federal programs.

2. Accept the possibility of increases in the unit cost of mined or manufactured chemicals and accept the consumption of other resources to produce and deliver chemicals required in the treatment process.

3. Accept the required expansion of the Nation's fuel base and possible need to import natural gas or alternative fuels to meet the requirements of this plan, and further accept the need to review policies regarding priorities concerning the use of natural gas and other fuels for incineration.

4. Secure Supreme Court approval and U.S.-Canada agreement to increase withdrawals from Lake Michigan if TDS content in renovated water of Reuse Option No. 1 proves to be a problem.

ALTERNATIVE III
(17 Advanced Biological Plants)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, THE RESIDENTS OF THE REST OF THE NATION MUST PREFER TO:

1. Have the C-SELM study area treat its wastewater to water quality levels consistent with the National goals and time-phasing expressed in PL 92-500.

2. Provide wastewater treatment levels consistent with aquatic enhancement objectives of relevant conservation groups and thus fulfill their water quality goals.

3. Provide air emission control consistent with current Federal Air Quality Act requirements.

4. Take advantage of opportunities inherent in multiple-purpose designs to provide potential savings in Federal-related programs for flood control and commercial navigation.

5. Have the opportunity to develop recreation areas and lands along streams as well as open-space connecting corridors between streams which would link recreation nodes and be part of a related water, recreation and land-use plan.

6. Meet the intent of PL 92-500 in terms of water quality, conservation of resources by recycling, multiple-use, and area wide planning.

AND BE WILLING TO:

1. Increase the annual cost to Federal taxpayers by $41 million 2/ over the least costly plan to achieve the higher water quality goals ($353 million vs. $312 million per year) and forego investing these funds in other high priority Federal programs.

2. Accept the possibility of increases in the unit cost of mined or manufactured chemicals and accept the consumption of other resources to produce and deliver chemicals required in the treatment process.

3. Accept the required expansion of the Nation's fuel base and possible need to import natural gas or alternative fuels to meet the requirements of this plan, and further accept the need to review policies regarding priorities concerning the use of natural gas and other fuels for incineration.

4. Secure Supreme Court approval and U.S.-Canada agreement to increase withdrawals from Lake Michigan if TDS content in renovated water of Reuse Option No. 1 proves to be a problem.

1/ Alternatives I and II involve agricultural utilization (Option 1) as the sludge management program, while the remaining alternatives employ the la reclamation program (Option 2).

2/ Assumes that the Federal taxpayers will finance 75 percent of the capital costs and that the study area taxpayer will finance the remaining 25 per cent of the capital cost (less any assistance the States may elect to contribute) plus 100 percent of the operation, maintenance and replacement costs provided the plan is certified by the designated regional clearinghouses and the States and approved for funding under the construction grant program of the USEPA. All costs are computed over 50 years at 5.5 percent interest rate.

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ALTERNATIVE PLANS BY RESIDENTS OF THE REST OF THE UNITED STATES

RECLAMATION SLUDGE MANAGEMENT OPTION 1/; REUSE OPTION NO. 1
PERCENT INTEREST RATE: 50-YEAR AMORTIZATION PERIOD

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ALTERNATIVE III
17 Advanced Biological Plants)

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cure Supreme Court approval and U.S.- agreement to increase withdrawals ake Michigan if TDS content in ted water of Reuse Option No. 1 to be a problem.

ALTERNATIVE IV
(5 Land Treatment Sites)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, THE RESIDENTS OF THE REST OF THE NATION MUST PREFER TO:

1. Minimize Federal taxpayer cost for a plan to attain the higher water quality goals (at a cost of $312 million annually 2/ and thus forego a potential savings of $194 million annually in order to secure the higher water quality and related land and water resource improvement opportunities.

2. Have the C-SELM study area treat its wastewater to water quality levels consistent with the National goals and time-phasing expressed in PL 92-500.

3. Provide wastewater treatment levels consistent with aquatic enhancement objectives of relevant conservation groups and thus fulfill their water quality goals.

4. Minimize added demands upon reserves of chemical resources and thus avoid possible impacts on supplies, unit prices and the Nation's transporation system.

5. Provide air emission control consistent with current Federal Air Quality Act requirements.

6. Take advantage of opportunities inherent in multiple-purpose designs to *provide potential savings in Federal-related* programs for flood control and commercial navigation.

7. Have the opportunity to develop recreation areas and lands along streams as well as open-space connecting corridors between streams which would link recreation nodes and be part of a related water, recreation and land-use plan.

8. Meet the intent of PL 92-500 in terms of water quality, conservation of resources by recycling, multiple-use, and area wide planning.

AND BE WILLING TO:

1. Accept the increased demand on the Nation's fuel reserves due to additional fuel requirements for crop drying caused by increased crop production associated with this plan, the possible need to import fuel to meet this demand, and the need to review policies regarding priorities concerning the use of natural gas and other fuels in meeting agricultural related needs.

2. Secure Supreme Court approval and U.S.-Canada agreement to increase withdrawals from Lake Michigan if TDS content in renovated water of Reuse Option No. 1 proves to be a problem.

ALTERNATIVE V
(Land/Adv. Biological Combination)

IN ORDER TO CHOOSE THIS PLAN OVER ALL OTHER ALTERNATIVES, THE RESIDENTS OF THE REST OF THE NATION MUST PREFER TO:

1. Have the C-SELM study area treat its wastewater to water quality levels consistent with the National goals and time-phasing expressed in PL 92-500.

2. Provide wastewater treatment levels consistent with aquatic enhancement objectives of relevant conservation groups and thus fulfill their water quality goals.

3. Provide air emission control consistent with current Federal Air Quality Act requirements.

4. Take advantage of opportunities inherent in multiple-purpose designs to provide potential savings in Federal-related programs for flood control and commercial navigation.

5. Have the opportunity to develop recreation areas and lands along streams as well as open-space connecting corridors between streams which would link recreation nodes and be part of a related water, recreation and land-use plan.

6. Meet the intent of PL 92-500 in terms of water quality, conservation of resources by recycling, multiple-use, and area wide planning.

AND BE WILLING TO:

1. Increase the annual cost to Federal taxpayers by $40 million 2/ over the least costly plan to achieve the higher water quality goals ($352 million vs. $312 million per year) and forego investing these funds in other high priority Federal programs.

2. Accept the possibility of increases in the unit cost of mined or manufactured chemicals and accept the consumption of other resources to produce and deliver chemicals required in the treatment process.

3. Accept the increased demand on the Nation's fuel reserves due to incineration and additional fuel requirements for crop drying caused by increased crop production associated with this plan, the possible need to import fuel to meet this demand, and the need to review policies regarding priorities concerning the use of natural gas and other fuels in meeting agricultural related needs and for incineration.

4. Secure Supreme Court approval and U.S.-Canada agreement to increase withdrawals from Lake Michigan if TDS content in renovated water of Reuse Option No. 1 proves to be a problem.

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ea taxpayer will finance the remaining 25 per- operation, *maintenance and replacement costs*; funding under the construction grant program

TABLE XII-3

SECTION XIII

VIEWS OF LOCAL INTERESTS

Over-All Viewpoints

The report has purposely refrained from characterizing an impact and its effect as being either beneficial or detrimental. Nevertheless, opinions as to the implications of these potential impacts have been voiced and recorded at the series of public meetings and work group sessions held during the course of this study. Since the transcripts of the public meetings are an integral part of the study findings, these documents will reflect the positions of those citizens and organizations that make up the affected public.

The study has focused on four basic issues. The first concerned the implications involved in meeting an effluent standard that would be representative of the higher (1985) water quality goal set forth in Public Law 92-500. This involved a three step process of: (1) developing the engineering and design data pertinent to those treatment technologies capable of meeting the criteria of "no discharge of critical pollutants" (NDCP), (2) quantifying the resource requirements associated with the construction and operation of areawide management systems, including the NDCP treatment facilities; and (3) comparing these requirements, including costs, to similar data for achieving, the then-current water quality standards and guidelines in order to obtain a more meaningful evaluation of the NDCP goal. Implicit within this comparative assessment was the second issue. The second issue involved the differentiation between the then-current standards and those standards representative of the NDCP goal, particularly the sources and types of pollutants to be controlled and treated.

The foregoing two issues were essentially technical in nature. The remaining two issues were not. The third issue concentrated on identifying the impacts resulting from a consolidation of the local treatment facilities into more of an areawide system. This process of "regionalization" has significant implication to the taxpayer, since it can effect economies in scale, both in capital investment and annual operating charges. However, regionalization does run counter to the concern for maintaining local control (home rule). Therefore, the economic gains eventually must be balanced against social and institutional trade-offs.

The fourth issue dealt with the subject of resource conservation. The potential for such an objective was examined by assessing the opportunities for satisfying various water and related land requirements

through recycling and the reuse or multiple usage of the area's resources. These add-on considerations represent opportunities to meet other area or regional needs with significant savings in cost and resources. In some cases, the system provides the resource base with which the added benefit(s) can be readily attained. In other cases, the potential for achieving multiple returns are enhanced, but additional financial and resources commitments are required. In all cases, the opportunity for multiple-use and return is greatly improved and the level of expenditure will be lower than that which would be incurred on a single-purpose basis. Some of the potential for add-on gains were found to be dependent upon the technology involved, while the remainder were effected by other system components.

In addition to the foregoing, the potential for change in the social, environmental and institutional structures of the affected areas were either quantified or qualified. All of these findings were based on an evaluation of five different alternative wastewater management systems and various optional considerations which evolved from a three-stage plan-formulation process.

The public reaction to the study has been diverse. All desire and support the objective of cleaning up our environment and improving the recreational potential of the area's streams. At the same time, there is a concern over the cost and increased sewer charges that will have to be borne, if and when plans are implemented to achieve the NDCP water quality goal. Concurrent with this concern is an anxiety relating to the disposal of the sludge that would be generated as a residual product of the treatment process. At issue are the implications concerning land-use plans and future growth patterns resulting from the sludge recycling option selected. Further, the use of sludge as a nutrient and humus builder introduces implications relative to the commercial fertilizer industry.

Impacts pertinent to the individual treatment technology also became the focus of public attention. There was a major concern regarding the Physical-Chemical technology and its adverse effects on the ambient level of air quality. The Physical-Chemical treatment technology utilizes incineration not only to recycle and reclaim the treatment chemicals, but also, to effect a partial removal of the ammonia nitrogen. As a result, the process discharges considerable chemicals and particulates into the air. Aside from the noxious effects, the large amount of emissions were also a matter of concern, since they were considered a potential detriment to the vegetation and ground cover within the study area.

Strong social and political opposition was expressed to the Land treatment technology by those people residing in the outlying area. The concerns voiced by those people reflected the fact that the technology would directly impact on their life style. There was anxiety over the fact that the Land treatment system could affect the cohesion of the

agricultural community, current farming practices, economic growth and freedom of action. Basically, the land-use plan would be restricted to one reflective of its present agricultural base, rather than encouraging conversion to other types of development. While provisions were made for continued growth of the communities, retention of large blocks of land in agricultural usage would tend to disrupt long-term regional growth patterns emanating out from the metropolitan area. Therefore, it was not unexpected that the attitude of the residents in the outlying area reflected a natural unwillingness to commit their land to treat the wastes of somebody else.

Members of the agricultural communities also felt that there was a definite need to demonstrate the workability of the Land treatment system. Of concern was the extent to which the participating farmer would have to adjust his present farming operations, adopting field practices that lend themselves to an irrigation system. Moreover, there was a need to prove that the economic gain from using the nutrients in the treated wastewater in lieu of commercial fertilizer would not be offset by development of phytotoxic conditions. The psychological reaction to using treated wastewater, concern for freedom from transmissible disease, potential restraints to the type of crops and cropping pattern which can be used because of the importance of crop uptake and nutrient balance, were all factors that contributed to the farmers unwillingness to accept the Land treatment process without an extensive pilot study. It is anticipated that the demonstration program of the USEPA at Muskegon, Michigan will provide much of the needed data. That research program represents a full-scale, pilot study of the Land treatment system. Similar research projects on land reclamation and sludge disposal also are in operation throughout the country. Therefore, it is to be expected that within the next five years extensive technical data concerning the recycling of wastewater and its residual by-products will become available.

The level of resource expenditures associated with the NDCP alternatives was thought to be too extensive and some indicated that perhaps the water quality goal should be modified. It was felt that the extent and priority with which this nation commits its resources in achieving this environmental goal should be assessed in relation to its causal effects on those programs responsive to other public needs. These concerns will be assessed by the National Commission on Water Quality which was established by PL 92-500. It is the function of this Commission to study all of the technological aspects for achieving the more immediate, 1983 effluent limitations and water quality goals established by Congress. In addition, the Commission will assess the total economic, social and environmental aspects of achieving or not achieving the 1983 goals. The Commission also intends to examine progress towards the "elimination of the discharge of pollutants" as an indication of what will have to be done after 1983. This report hopefully will contribute to the assessment by the Commission.

Finally, there was a basic concern that the present institutional arrangements have helped inhibit attempts to achieve an effective urban wastewater management system. It is felt that if a realistic program is to be achieved and the economies of scale (regionalization) realized, institutional arrangements must be adopted that reasonably maintain the integrity of home rule by the individual counties and communities.

Individual Viewpoints

Implicit in the NDCP water quality goal is the control of both point and non-point sources of pollution. This objective makes it more advantageous to plan and design the wastewater management systems as a primary vehicle with which to meet the area's other water and related land needs. So will the objective for resource conservation and reuse. Acceptance of these two objectives as planning goals will complicate the decision-making process for upgrading the level of treatment and modifying existing wastewater management systems. Such decisions cannot be made on just a technical and cost-effective basis. Instead the final decisions must be made by the residents of both the study and outlying areas working with the States in determining a solution acceptable to all and reasonably responsive to individual objectives.

This study has identified the potential changes to existing conditions that would be brought about by alternative management systems designed to achieve the NDCP water quality goal and concurrently encourage resource conservation. Due to the complexity of these findings, individual viewpoints were solicited from those citizen groups who participated in the study effort as well as those Federal, State and local governmental agencies known to have an interest in this study. Each group or agency was furnished a copy of the draft report and asked to comment on the desirable and undesirable aspects of each alternative and planning options as perceived by that organization. It was hoped that these perspectives would assist those responsible for selecting the type of action programs which should be implemented over time. The letters which were received, along with a response from the Chicago District, have been reproduced in Appendix I, Comments.

The individual perspectives generally tended to reflect the same concerns expressed at the public meetings held during the final stage of study. However, there were additional insights provided, the major points of which are summarized below.

The need and validity for capturing and treating storm water runoff, other than in combined sewered areas was a comment common to some of the letters. In absence of a national policy, there was a general tendency to require some justification rationale, other than just water quality considerations. Most of this reaction reflected a concern over the costs

and resource impacts associated with this source of pollutants. In addition, the hydraulic flow regimen currently used as criteria to assess the assimilative capacity of the stream was thought to be too restrictive. This criteria, equivalent to the seven-day, 10-year low flow, was practically zero or at best the flow from existing treatment plants. In either case, the dilutive capacity of higher in-stream flows could not be recognized in establishing the effluent standards for the NDCP water quality goal.

The institutional problems involved in seeking a more effective urban management system were also a concern. The desire of local officials to retain control of their own facilities was identified as a significant obstacle to any effective attempt for regionalization of the area's facilities. Because of this concern, several agencies expressed disappointment that the study did not: (1) describe a method of implementation; (2) delineate a decision-making time table for selection of an optimum wastewater management system; nor (3) recommend transitional actions which should be taken to achieve implementation of the NDCP goal by 1990. All of these considerations, however, were matters outside the purview of the study and were not addressed.

Other comments focused on the various design and planning options. These involved: (1) support for the use of sludge to rehabilitate surface-mined areas; (2) the recreational potential of the storm water retention basins, the corridors and improvements that could be incorporated into either the plants or land technologies; (3) use of electrical energy for incineration and drying in lieu of natural gas or petroleum products; and (4) the continued discharge of treated effluent into Lake Michigan as now permitted by State and Federal approved programs.

Finally there was a specific concern that in the absence of any official requirement for upgrading the treatment facilities and other system components to NDCP standards, local interests have no choice but to continue to proceed with planned capital improvements responsive to current standards. To some this has the potential for commiting expenditures that, over time, may prove ineffective and a waste of funds. However, until guidance is forthcoming from the USEPA and the National Commission on Water Quality, no other options are readily discernable.

SECTION XIV

DISCUSSIONS

Overview

There are many factors to be considered before selecting the wastewater management system most suitable to the needs of the area. The first factor concerns the water quality standards and guidelines approved by the USEPA. Final selection of the specific water quality requirements in terms of constituent control can have a major impact. One of the key considerations will be the extent to which the capture and treatment of storm water runoff (as a nonpoint pollutant source) will be required, in response to the water quality goals of PL 92-500. The NDCP goal provides an effective multiple-purpose management framework for achieving water quality and other water and related land resource objectives. The programs for pollution abatement, flood control, potable water supply supplementation, stream flow augmentation, recreation improvements, wildlife conservation, open space preservation, and floodplain management, however, generally are separable and can be phased over time, if desired.

The impact of regionalization is probably one of the most significant factors involved in establishing the character of any management system. It affects the cost, resource use, environment, community cohesion and institutional structure of the area. In net effect, such basic values as home rule, cost to the taxpayer and the community's life style are all bound up in what is a matter of institutional concern. Accordingly, the five alternatives have been structured to provide basic design and impact assessments for varying degrees of regionalization. This includes the basis for consolidating the present 132 facilities to a 64 plant system. From this base, alternative levels of regionalization are achieved for 33 (Alternative II) and 17 (Alternative III) plants, respectively. The comparative studies made during the plan-formulation process indicate that no further regionalization would be feasible unless the Land treatment process is to be employed. Then, two additional ranges of regionalization would be feasible for consideration, the extent of which would be represented by Alternative IV or Alternative V.

It also should be noted that Alternative V can be used to approximate the differential in costs and other impacts for treating (regardless of the technology) the wastewater from various subareas. The five major plant sites are common to Alternatives II and III. Therefore, the comparative values between technologies for treating the wasteloads from

the mainly urban or suburban areas can be determined. For all NDCP alternatives, treatment in the rural area is confined to storm water run-off and, hence, is common to all. This should provide an additional planning tool to those who have the responsibility for the system design.

State of the Art

The design of the Advanced Biological, Physical-Chemical and the Land treatment processes, used in this study to achieve advanced treatment, are based on a level of information consistent with today's state of the art. Sufficient scientific knowledge together with engineering and performance data are available to make this type of study a meaningful planning framework.

The basic feasibility of these technologies has been demonstrated, but, as yet, there are no universally accepted design criteria for the unit processes of the treatment systems. Consequently, in developing the design of these treatment systems, a great deal of reliance had to be placed on theory now being applied at the "drawing board" or obtained from pilot plant and resource studies. In many cases, this was supplemented by actual information on specific unit processes recently placed in service. However, certain basic assumptions had to be made. The most important relates to the unit process concept and the design criteria for rated treatment performance under peak loads. Critical to both these aspects are the sequential order in which the treatment components are placed and the reliability for maintaining a fixed level of treatment effectiveness.

Implicit in these assumptions are some technical uncertainties that must be resolved prior to final design and implementation. These uncertainties primarily relate to the large scale operations and management problems associated with monitoring and controlling the treatment process. In essence, these uncertainties are similar in nature to engineering issues that have arisen in the past as other new technological objectives were being faced. Present experience with advance treatment operations has been limited to small scale facilities. Currently, many medium-sized facilities are being designed and constructed, based upon extrapolations of experience. Little work, though, is being done to investigate the potential of large scale operations and the adoption of new unit processes to minimize costs. However, as the environmental clean-up continues on a national scale, these uncertainties will be resolved as a matter of priority. Nevertheless, until these new facilities and pilot programs, demonstrating the efficiencies and effectiveness of the different unit processes, become operational, certain questions concerning performance characteristics will remain.

There are many examples of concern that must be resolved before final design of the three technologies is undertaken. These concerns are outlined in Section XI of Appendix G to help identify the areas of design and performance that should be investigated. Thus, the universities, private consulting firms and the States will be able to use this information as the basis for pilot model studies within their own field of expertise. Hopefully, these studies can be joint investigative efforts sponsored by those governmental agencies authorized to conduct research and development programs.

Recognizing that time will be required to resolve these uncertainties, implementation of the alternatives has been phased to accommodate undertaking pilot studies, should the need still exist. Construction of the pilot models would be included in the first phase of implementation. This phase involves construction of the functional components such as the conveyance systems that are basic to any system, regardless of the technology eventually chosen. It is during this time that the research and development required in conjunction with the selected technology can be undertaken. Once completed, the information and data will be available for the final design of the treatment facilities required in the latter phase of implementation. The results would also have an educational value in demonstrating that the selected technology will: (1) meet the desired goals; and (2) not effect the area's environment, life style and economic structure in ways not previously assessed.

Perspective

One of the most significant factors common to the NDCP alternatives is the resource consumption involved in meeting the higher water quality goal. The rate of expenditures for such items as energy (electrical and fuel), chemicals, land and money will vary between alternatives. Nevertheless, all will require commitments beyond a level heretofore required, regardless of the treatment technology used. This, in turn, will require decisions at all levels of government as to the extent and priority for meeting this (environmental) and other needs.

With the concern over the costs and other resource commitments, interest was expressed in a plan comparable to Alternative I, but upgraded to meet the volume and treatment standards of the NDCP goals. The interest stemmed from an optional consideration for attaining the higher water quality in stages. If so, the logical procedure would be to first consolidate the existing plants, upgrading the remaining facilities to meet current standards. This should comply with the requirements of Section 301b(1)(B) that publicly owned treatment works provide the equivalent of secondary effluent as defined by the USEPA. As such, this requirement would be

met by implementing Alternative I. In addition, the same alternative may also comply, at least to some degree, with the interim national water quality goal set forth in Section 101a(2). This interim water quality goal provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water to be achieved by July 1, 1983. The degree to which Alternative I meets this interim goal must rely on the judgment of the USEPA. That agency is required to establish effluent limitations which: (1) require application of the best practicable waste treatment technology and (2) that will result in reasonable further progress toward the NDCP goal (Sections 201g(2) and 301(b) of PL 92-500).

Based on the foregoing, it was feasible to consider reaching the NDCP goal in at least two stages. If this were done, the question would naturally arise as to the economic implications of upgrading those plants to the NDCP treatment standards. To realistically assess this question required adoption of a basic assumption. That the first stage, upgrading to current standards (Alternative I) would be accomplished first and within a 10-year period, starting in 1975. This would closely approximate the July 1983 deadline and assumes that the resultant water quality would at least partially satisfy the interim national goal. The second stage, upgrading to the NDCP goal would follow at some later date and again be completed within a 10-year period.

Prior to implementing the suggested second stage under this timing, a major decision will have to be made as to which technology is to be employed in the transition from current standards to the NDCP goal. Either of the plant technologies, Advanced Biological and Physical-Chemical, can be used to upgrade the 64 plant facilities. Additionally, the decision could also be made to abandon the plant sites and employ either the all Land treatment system or a combination of the Advanced Biological and Land technologies. Accordingly, a preliminary analysis was made of the costs that would be involved in this type of staging and for the range of optional technologies. The results of the analysis (presented in Appendix G) indicated that the two-stage implementation would increase the capital costs for achieving the NDCP 1985 goal. This increase, or savings foregone, would range from $601,000,000 (for the Advanced Biological process) to $2,076,000,000 (for the Physical-Chemical process). Not included in these estimates are allowances for plant abandonments, salvage, and the substantial write-off of any indebtedness that would be incurred in the first stage and would have to be underwritten in the second stage. The extent of these allowances would be minimal if the Advanced Biological process was used, and major for the other two technologies.

A comparable relationship applies to the operational costs. In this case, the annual savings foregone would range from $21,000,000 (for the Advanced Biological process) to $60,000,000 (for the Physical-Chemical process). The figures are discounted to the base year of the two, 10-year time stages and were computed using an interest rate of 5.5 percent over 50 years.

SECTION XV

CONCLUSIONS

Introduction

This study has examined a wide range of wastewater management alternatives as well as: (1) the energy and natural resource demands and implications associated with each alternative system design; (2) the related social, environmental, and economic impacts; (3) potential reuse and synergistic add-ons to meet the area's water resource and related land needs; and (4) the related institutional considerations. This information was developed to surface pertinent issues and concerns connected with wastewater management in the C-SELM study area, and provide a framework to assist State and local governments in their decision-making process for meeting the goals and objectives of PL 92-500. This information is summarized in the Impact Summary (Tables XI-1 through XI-5), the Preference Sets (Tables XII-1 through XII-3) and is detailed in Appendix G.

The implications associated with each alternative and its relative attractiveness will vary with the point of view and place of residence of the individual making the choice. Thus, conclusions based upon an analysis of the same information will also vary. The Chicago District has strived to maintain objectivity throughout the course of this study, and the conclusions which follow pertain only to the planning-framework for the area's wastewater management systems.

Conclusions

GENERAL

The general conclusions are:

- If implemented, any of the five final alternatives would improve the quality of Lake Michigan and the Illinois River as well as tributary streams in the study area;

- Existing plans for wastewater management (Alternative I) will fully meet neither the reuse and conservation objectives nor the ultimate water quality goal expressed in PL 92-500;

- An areawide wastewater management system can serve as the primary vehicle to meet other water resource and related land needs, especially if the control and treatment of storm water runoff is required;

- Any of the alternatives can be implemented on a variable time schedule, and further, construction of the system components can be phased to accommodate the undertaking of pilot model studies if additional research is considered necessary to resolve some of the design and performance aspects of the three advance treatment technologies;

- Industry has the option for either providing total on-site treatment and directly discharging to receiving waters or relying on the regional system for some treatment of its wasteloads. Final decisions will depend upon the economic comparison between total on-site treatment and the combination of partial on-site treatment and final treatment by the regional system. PL 92-500 requires industry to pay user fees for the services provided by the regional system;

- Local interests tend to favor those plans reflecting local objectives, modified by existing institutional considerations, and not favor systems which are regional in objectives and design;

- Treatment to the level exemplified by the NDCP water quality goal would enhance the recreational potential of the area's streams and flood plains; provide another source of water for industrial and municipal needs; and increase the property value along the streams. All of these returns would accrue without any additional investment; and

- None of the alternatives is clearly "best" from all perspectives.

STORM WATER MANAGEMENT

With respect to storm water management it is concluded that:

- Storm water runoff is a source of pollutants. Thus, a storm water management system, including treatment, will be required if the ultimate water quality goal of PL 92-500 is to be met;

- Additional study, particularly the gathering of basic data on the types and concentrations of pollutants in areas separate storm sewers, is required to better define the potential degrading effects of various storm events (intensity and duration). This information would serve as the basis for determining the volume of runoff control warranted from both an environmental and instream use standpoint and also from a cost effectiveness viewpoint; and

- The capture, storage and distribution of treated storm water runoff to local streams would provide measurable flood control benefits and a more stable stream flow regimen.

RESOURCE REQUIREMENTS

With respect to resource requirements it is concluded that:

- All four of the NDCP alternatives will place greater demands on the nation's energy and natural resource reserves than the existing standards plan (Alternative I); and

- The degree of resource implications varies with: (1) the technology employed; (2) the extent of regionalization; and (3) the level of treatment.

REGIONALIZATION

With respect to regionalization it is concluded that:

- The degree to which treatment facilities are consolidated is one of the most significant factors involved in defining the overall character of a wastewater management system, affecting not only costs, but also resource use, stream flows and water balances, and institutional aspects, especially home rule; and

- The existing plan (Alternative I) reflects an approximate optimum level of regionalization for current water quality goals. However, the need to treat storm water runoff as a source of pollutants introduces the potential for additional economies of scale involving a further degree of regionalization than presently contemplated.

SLUDGE MANAGEMENT

With respect to sludge management it is concluded that:

- Very little difference exists in the potential use value of the sludges produced by the various treatment processes considered, except for the sludge from the Physical-Chemical process;

- The biological type sludge, because of its nutrient and humus content, has the best reuse potential (especially from a local and regional standpoint) and the option for reclaiming surface-mined areas is the most acceptable from a resource restoration standpoint; and

- Utilization of sludge in either an agricultural production or surface-mined restoration program will require close coordination and cooperative arrangements that are responsive to the social and land-use objectives of the affected counties.

CONCERNS OF THE PUBLIC

With respect to the study's public involvement program it is concluded that:

- There is public support for cleaning up the environment, but there are diverse opinions about the degree (and associated costs) to which this nation should commit itself in attaining this goal;

- Residents of the agricultural area do not want to commit their resources to solve an urban problem without conclusive assurances that the benefits from such an undertaking would far outweigh any losses or inconvenience they may incur;

- Wherever possible, system related lands should be obtained through leasing arrangements rather than by purchase in order to keep the lands in private ownership and minimize the effects on the local tax base; and

- Decisions concerning the adoption of a plan to upgrade the level of treatment and modify existing wastewater management systems cannot be made on just a technical and cost-effective basis. Instead, such decisions must be made on a broad base of assessment considering all of the impacts associated with the system design and operation. Final selection must involve a cooperative effort on the part of the residents in the affected areas working together with the States in determining an acceptable solution.

SECTION XVI

RECOMMENDATIONS

Recommendations

It is recommended:

- That the report be made available to all Federal, State, Regional Clearinghouses, and local governmental agencies having an interest in the control and development of water and related land resources, including wastewater management systems, in the area affected by the study;

- That the report be used by those agencies responsible for planning wastewater management systems to help to meet the requirements of Section 201(g)(2)(A) of PL 92-500; and

- That this report be transmitted to Congress for its information.

JAMES M. MILLER
Colonel, Corps of Engineers
District Engineer

ANNEX

AUTHORIZATION

This report is submitted in specific response to the following authorizations:

a. Resolution of the House Public Works Committee, adopted 10 November 1971:

> *"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors is requested to determine the advisability of improvements in the interest of wastewater management and alternatives thereto, in the Chicago, Illinois metropolitan area in connection with investigations authorized by Section 206 of the Flood Control Act of 1958."*

b. Resolution of the Senate Public Works Committee, adopted 23 November 1971:

> *"Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors is requested to determine the advisability of improvements in the interest of wastewater management and alternatives thereto, in the Chicago, Illinois metropolitan area in connection with investigations authorized by Section 206 of the Flood Control Act of 1958. In carrying out the aforesaid investigation, the Board shall evaluate general alternatives for the management of wastewater on a regional basis, including the elimination of pollutant discharges and shall conduct such investigation with the participation, consultation and cooperation of the Environmental Protection Agency and State and local water pollution control agencies and, where appropriate, State and local agencies with environmental planning responsibilities.*


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