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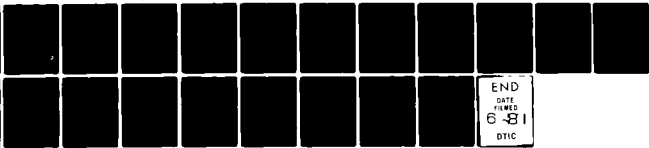
GREAT RIVER ENVIRONMENTAL ACTION TEAM  
GREAT II UPPER MISSISSIPPI RIVER, GUTTENBERG, IOWA TO SAVERTON,--ETC(U)  
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# Material and Equipment Needs Work Group Appendix

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FINAL  
DECEMBER  
1980

# GREAT II

Upper Mississippi River,  
(Guttenberg, Iowa to Saverton, Missouri)

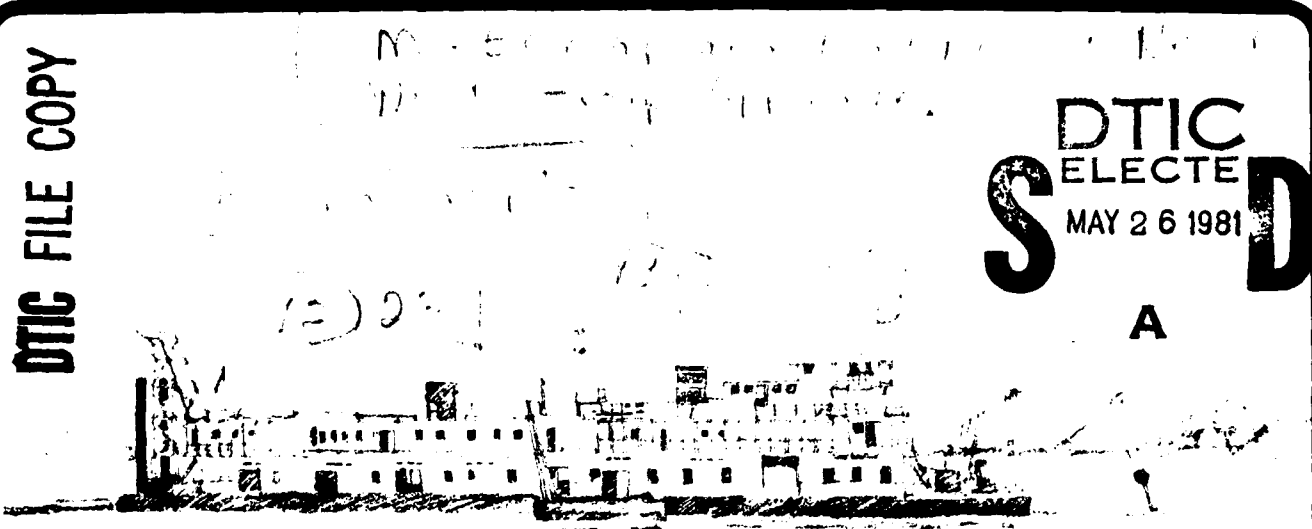
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## Great River Environmental Action Team

APPENDIX

MATERIAL AND EQUIPMENT NEEDS WORK GROUP

DECEMBER 1980

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Executive Summary

The Material and Equipment Needs Work Group (MENWG) differed from the other GREAT II work groups in that no final recommendations were produced. The primary function of the MENWG was to provide data and introduce ideas to the Plan Formulation Work Group (PFWG).

A contract for dredging equipment review was let to Battelle Memorial Institute in Washington DC. The Battelle research staff concluded that hydraulic dredges were superior to mechanical dredges in all GREAT II applications except for possible emergency work where local mechanical equipment might be leased for short periods. Battelle did detailed analysis of both pipeline and barge transport, either of which might have application in the GREAT II area. The costs of increasing present pipeline capability by several miles or providing a barge transport capability were shown to be 4 to 8 times 1979 figures for dredging in the Rock Island District.

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MATERIAL & EQUIPMENT NEEDS

WORK GROUP APPENDIX TABLE OF CONTENTS

ELEMENT

PAGE

Cover	
Title Page	
Executive Summary	
Table of Contents . . . . .	i
I. INTRODUCTION	
A. Study Authorization and Development . . . . .	1
B. Study Purpose and Scope . . . . .	1
C. Study Participation and Organization . . . . .	2
D. Material & Equipment Needs Overall Objective . . . . .	2
E. Material & Equipment Needs Work Group Organization . . . . .	3
1. Participants	
2. Meetings & Procedures	
3. Voting Procedures	
4. Division of Responsibilities	
II. PROBLEM IDENTIFICATION	
A. Process . . . . .	3
B. 1979 Conditions . . . . .	9
1. Present Equipment Capability	
2. Equipment Capability in Relation to Disposal Site Selection	
3. Knowledge of Existing Equipment Availability and Technology	
4. Ability to Change (Flexibility) Types of Equipment Used	
5. Impact of Equipment Type and Use on Industry and Area's Economy	
6. Public Concerns	
C. Projected Conditions - 2025 (w/o action) . . . . .	10
1. Projected Advances in Equipment Technology	
2. Projected Equipment Capability	
3. Projected General Knowledge of Equipment Availabilities, Capabilities, and Acquisition	
4. Federal Laws in Relation to Equipment Acquisition and/or Use	
5. Public Concerns	

D.	Statement of Problems (based on present conditions which are projected into the future to develop trends and the problems associated with those trends) . . . . .	14
E.	Material & Equipment Needs Work Group Sub-Objectives . .	15
F.	Material & Equipment Needs Work Group Plans-of-Action. .	15

III. WORK GROUP ACTIVITIES/ACCOMPLISHMENTS

A.	"Cookbook" Information . . . . .	16
B.	Technical Assistance . . . . .	17
C.	Dredging Equipment Inventory . . . . .	17
D.	Advances in Dredging Technology . . . . .	17

IV. FORMULATION OF ALTERNATIVES & RECOMMENDATIONS

A.	Process . . . . .	17
B.	General Recommendations . . . . .	19

## I. INTRODUCTION.

1. The Mississippi River gathers run-off from 31 states and two Canadian provinces, draining 1.5 million square miles. It is the third largest watershed in the world, flowing 2,500 miles to the Gulf of Mexico. Millions of people live on its banks and draw life from its waters. Over five hundred kinds of animals live among the diverse plant communities that thrive in and along the river.

2. Man, in his progress, has put the river to many varied and sometimes conflicting uses. The pressures of man's use are feared to be degrading the environmental qualities of the river. More information is needed on the complex interactions of the river's resources and these resource reactions to man's activities on the river. When this information is obtained, it can then be used to determine where problems exist and the alternatives available to man to solve these problems and coordinate river uses to minimize conflicts.

### A. Study Authorization and Development.

1. In response to increasing public concern for the environmental quality of the river the Great River Study was authorized by Congress in the Water Resources Development Act of 1976 (PL94-537). This legislation authorizes the U.S. Army Corps of Engineers..." to investigate and study, in cooperation with interested states and Federal agencies, through the Upper Mississippi River Basin Commission, the development of a river system management plan....".

2. The total study program includes three Great River Environmental Action Teams (GREAT), which have the responsibility for the river reaches from St. Paul/Minneapolis to Guttenburg, Iowa (GREAT I); Cuttenberg to Saverton, Missouri (GREAT II); and Saverton to the confluence of the Ohio (GREAT III).

3. The study programs and recommendations of the three GREAT Teams will be brought together into a river management strategy for the entire Upper Mississippi River. The goal of the study is to present to Congress and the people a river resource management plan that is, above all, realistic - a plan that is technically and economically sound, socially and environmentally acceptable, and capable of being put into action within a reasonable period of time.

### B. Study Purpose and Scope.

1. The purpose of the GREAT II Studies is to identify and resolve conflicts resulting from separate legislative actions of Congress which mandated that the Upper Mississippi River be managed in the national interest for commercial navigation and as a fish and wildlife refuge.

2. The concept of the study originated from a need to coordinate the maintenance activities of a nine-foot navigation channel by the U.S. Army Corps of Engineers from Guttenberg, Iowa, to Saverton, Missouri, with other river uses. GREAT II was founded because of increasing concern by conservationists and the general public over the lack of information available about the impacts of U.S. Army Corps of Engineers channel maintenance activities on many key resources of the river.

3. The scope of the GREAT II Study is directed toward developing a river system management plan incorporating total river resource requirements. GREAT II was organized early in fiscal year 1977 (October 1976 through September 1977) and is studying the river from Guttenberg, Iowa, to Saverton, Missouri.

C. Study Participation and Organization.

1. The GREAT II Team is composed of representatives from the following Upper Mississippi Basin States and the Federal River Resource-oriented agencies

State of Illinois

State of Iowa

State of Missouri

State of Wisconsin

U.S. Department of the Interior - Fish and Wildlife Service

U.S. Department of Agriculture - Soil Conservation Service

U.S. Department of Defense - Department of the Army - Corps of Engineers

U.S. Department of Transportation - U.S. Coast Guard

U.S. Environmental Protection Agency

Upper Mississippi River Conservation Committee (ex officio)

2. GREAT II is organized into 12 functional work groups and the Plan Formulation Work Group. Each work group is to accomplish the study objectives as they relate to the work group's functional area and as directed by the team. Work groups are composed of persons having expertise and interest in the work group's area of study.

3. This report summarizes the concerns, objectives, activities, conclusions, and recommendations of the Material and Equipment Needs Work Group as they relate to the GREAT II Study area.

D. Material and Equipment Needs Overall Objective.

The overall objective is to define equipment capabilities necessary to maintain the total river resources on the Upper Mississippi River in an environmentally sound manner. To do this, the following subobjectives are identified:



1. Identify and evaluate all known types of dredging equipment appropriate to the area of GREAT II.
2. Develop cost data for the identified dredging equipment.
3. Investigate technologically advanced methods and equipment used in the dredging industry.

E. Material and Equipment Needs Work Group Organization.

1. The Corps of Engineers is responsible for the chairmanship of this work group and for the preparation of all documents generated. Representatives from all state and federal agencies associated with GREAT II were invited to participate.
2. Meetings were held periodically, as the need arose, to develop work group plans of action, to undertake studies, to review products and formulate recommendations, and to provide input to other work groups and the GREAT II Team.

II. PROBLEM IDENTIFICATION.

A. Study Process and Description

1. Once the twelve GREAT II functional work groups and their overall objectives were formulated, the work group members began to identify public concerns, use conflicts and other problems related to their overall objective and area of study. A work group's list of problems was composed of those problems identified in any of the following ways:
  - a. The problem was identified in GREAT I and was applicable to the GREAT II area.
  - b. The particular work group recognized an existing problem based on existing conditions.
  - c. The particular work group recognized a potential problem based on future projections of existing conditions and trends.
  - d. Other work groups identified concerns relating to the particular work group's area of study.
  - e. The public expressed concerns and problems directly to the particular work group.
  - f. The public expressed concerns and problems to a particular work group through the public participation and information work group (ie. town meetings: houseboat trips: etc.).

2. These problems were compiled into a list to be evaluated by the particular work group for their relevancy to the study; the urgency or certainty of the problem; and the potential for resolving the problem within the time-frame of the study. Certain problems were eliminated from further study based on criteria guidelines developed by the Upper Mississippi River Basin Commission in 1974. The list of remaining problems was then prioritized by the work groups. (See Plan Formulation Work Group Appendix for the listing of these problems.)

3. The results of this screening process were put into tables and displayed in the Preliminary Feasibility Report.

4. Once the work groups had developed a set of problems and needs, they formulated a list of objectives designed to address and, at a minimum, partially resolve their problems. These objectives were then used to identify tasks and/or studies which the work group needed to accomplish in order to identify the possible alternative solutions to their respective problems. The problems, objectives, and tasks therefore represent the plans-of-action each work group used to derive their final conclusions and recommendations.

5. The conditions, both existing and future, which were used to identify a work group's problems are discussed in the following sections. The year 1979 was chosen as a base point for existing conditions, and a project life of fifty years was used to predict future conditions. Attachments 1, 2 and 3 summarize the plan-of-action for the Material and Equipment Needs Work Group.

(LIST IN CHRONOLOGICAL ORDER)

	IDENTIFIED	GROUP, ETC. WHO IDENTIFIED	BLEM BEING ADDRESSED BY GREAT II?	BY WHICH TASKS	WHY NOT
1. Moratorium on Federal equipment acquisition.	1976	GREAT I	No		GREAT I has taken respon. for def. of prob.
2. Inadequate equipment capability in study area.	1976	GREAT I	Yes	1, 3, 5	
3. Lack of knowledge of equipment availability and capability.	1976	GREAT I	Yes	3, 4	
4. Lack of general knowledge about dredging equipment and dredging operations.	1977	Material & Equipment Needs	Yes	1, 2, 3, 4, & 6	
5. Advances in dredging technology need to be investigated.	1977	Material & Equipment Needs	Yes	4	

STATEMENT OF OBJECTIVES

WORK GROUP Material & Equipment Needs

OVERALL OBJECTIVE: To define the equipment capabilities necessary to maintain the total river resources in an environmentally sound manner.

SUB-OBJECTIVE:

1. To identify and evaluate all known types of dredging equipment appropriate to the area of GREAT II.
2. To develop cost data for the identified dredging equipment.
3. To investigate technologically advanced methods and equipment used in the dredging industry.

DESCRIPTION OF TASK	PURPOSE OF TASK	PERSON(S) OR GROUP(S) RESPONSIBLE FOR COMPLETION OF TASK	PROBLEMS ADDRESSED BY TASK	ANTICIPATED COMPLETION DATE OF TASK
1. Update "Cookbook" Information	To guide other work groups - provides comparison of dredging costs, equipment capabilities, and environmental concerns	Work group chairman	2, 4	complete
2. Provide Technical Assistance	To provide other work groups with various dredging costs depending on equipment, also est. disposal costs based on site specific parameters - to determine present equipment capabilities	Work group chairman	4	complete
3. Inventory of Dredging Equipment	To determine the equipment available in GREAT II area - to identify data that could provide more flexibility in selection of disposal sites	Work group chairman	2, 3, 4	complete
4. Investigation of Advances in Dredging Technology	To look at equipment used in Japan and Western Europe to update American technology to conduct new equipment demonstrations - to determine feasibility	Work group chairman	3, 4, 5	complete
5. Equipment Needs Identification Based on Disposal Site Selection	To look at the disposal sites selected by the disposal site selection task force and determine what piece(s) of equipment is (are) necessary to reach these sites.	MEN Work Group	2	complete
6. Work Group Meetings and Discussions	To disseminate news or existing information to other work group members and to discuss information and suggestions from other work groups.	MEN Work Group		ongoing

#### 1. 1979 Conditions.

1. The Rock Island District Corps of Engineers currently owns no dredging equipment. The dredging that is accomplished yearly throughout the District is done by the use of the dredging equipment owned and operated by the St. Paul District Corps of Engineers. Most of the dredging is accomplished by the 20-inch hydraulic dredge William A. Thompson. Added capability is provided to this dredge by the use of the Booster Pump Mullen. Operating together, these two pieces of equipment can move 1,000 cubic yards of material per hour and move it up to 10,00 feet from the dredge site.

2. Material that is pumped from the channel by this combination of dredging equipment is a slurry consisting of about 10% solids. It is pumped at a rate of approximately 25,000 gallons per minute. A hydraulic dredge will operate most efficiently when it can bury the cutterhead into the face of the cut at a depth of at least one and a half times the pipe diameter. Because of the small face of cut usually encountered (1' to 2') and the large size of the cutter head on the Thompson, the efficiency of the existing Corps equipment is somewhat limited.

3. Other equipment available from the St. Paul District is the Dredge Dubucan, which is a 12-inch hydraulic dredge with 2,500 feet of floating pipe and 1,000 feet of shoreline pipe. This dredge is primarily used for dredging small boat harbors and access channels. The Derrick Barge Hauser is also available from the St. Paul District. This is a 4-cubic-yard deck mounted crane dredge.

4. Presently, the existing Corps equipment capability in relationship to GREAT II selected disposal sites is inadequate. The Corps cutterhead dredges are limited to a maximum transport distance of approximately 1,000 feet.

5. The knowledge of existing equipment and technology for dredging is available from a number of sources. All Corps of Engineers existing dredging equipment is listed in EP 1125-2-1. This Corps pamphlet lists all civil-owned and -operated items of floating plants employed on civil works activities. It has a complete category index and an alphabetical-numerical listing of floating plants showing principle dimensions, capacities, ratings, special equipment, radio call letters, date of construction, district ownership, bridge clearance requirements, and other pertinent data. This pamphlet is available to all field operating agencies performing civil works functions. Concerning private dredging equipment, contractors' dredging equipment on inland waterways can be found in the Inland River Guide which is published by the Waterways Journal. These two publications basically list all available equipment to do dredging on inland waterways. The above sources do not, however, provide the capability to easily compute cost data for dredging and disposal operations in the GREAT II area.

6. Material dredged in the GREAT II area is primarily glacial sand with a high content of heavy silica components derived from Pre-Cambrian rocks of the continental shield areas to the north of the GREAT II study area. This sand, along with gravel lenses and silt/clay overburden, fills the bedrock basin of the Mississippi River to depths exceeding 100 feet in many areas. Sedimentary rock outcrops are rare, but cause severe problems where they exist as in the area of Rock Island, Illinois. Glacial boulders likewise interfere with dredging operation where they exist, as do logs and tree stumps.

Tributary streams provide sand to the main channel at about the same rate that it is eroded and moved downstream, so that little overall accretion or degradation occurs. Dredging is usually necessary in areas where stage fluctuations have produced temporary transport imbalances or where chronic velocity losses occur due to broadening of the channel or dissipation of flow down side channels. Problems also occur where the maximum tributary sand resupply is not synchronous with main channel transport capability.

7. In terms of geomorphological science, the most rational dredging strategy is one in which the natural regime of sand movement would be disrupted as little as possible. This would usually consist of moving sand from crossing ridges to downstream pools or adjacent deep water areas. In the reaches south of the GREAT II area, this is the normal practice.

Due to the attractiveness of the sand for recreation beaches and due to the preception that main channel disposal might be contributing to dredging problems downstream, traditional practice in the GREAT II areas has been to dispose of dredged material along shorelines or in wetlands. Federal, state, and local agencies, including the Corps of Engineers, have observed that such disposal has reduced or destroyed aquatic and wildlife habitat. With the advent of GREAT II, disposal sites have been selected by teams which represent the various governmental interests. Extensive long-range disposal plans have also been prepared. These exceed present equipment capabilities in many cases.

#### C. Projected Conditions - 2025 without action.

1. As long as the Mississippi River is used for commercial navigation, dredging will be necessary for continued maintenance of the navigation channel. Future volumes of dredged material are projected to decrease slightly since the depth of dredging has been altered somewhat through the ongoing GREAT effort. The U.S. Army Corps of Engineers will continue to give consideration to comments from fish and wildlife agencies and will be subject to increasing legal constraints on dredged material disposal. It is expected that the inherent conflict between the economics of maintaining a 9-foot channel in the Mississippi River and its water quality implications will continue to remain unresolved. Barge and recreational traffic will increase as will impacts on fish and wildlife attributable to these acts.

2. Advances in equipment technology will continue over the next 50 years. However, the existing technology and existing equipment available appears to be adequate to dredge and move dredged material to almost any selected disposal site, but economic considerations set practical limits. As

new equipment becomes available, this information can be used in the determination of what type of new equipment should be purchased. If economics remain the deciding factor, the Corps will probably continue to dredge with the existing types of equipment. Therefore, equipment with the sole purpose of removing dredged material to sites out of the floodplain or across wetlands would not be acquired unless externally-imposed disposal regulations interfere.

2. Federal laws which relate to equipment acquisition and use have been described in the GREAT I study and also in the GREAT I report. The following information on the legal framework and constraints on dredging has been taken from the GREAT I Draft Material and Equipment Needs Work Group Appendix dated April 1979.

#### LEGAL FRAMEWORK AND CONSTRAINTS IMPOSED ON PURCHASE OF DREDGES AND DREDGING EQUIPMENT

Beginning in the mid- to late-1960's, controversy developed over Corps vs. private industry dredging. The dredging industry opposed the Corps plans to replace several older dredges and build several new dredges claiming the willingness and, if the work was offered, the ability to acquire the capability to do the work of the new dredges. The Corps took the position that its responsibilities could not be met without its own dredging fleet.

The House Committee on Appropriations stated in its "Report on the Corps of Engineers FY 1973 Budget Request" (House Report 92-1151):

"The Committee has placed a moratorium on all proposed plans for replacement or modification of dredges which are not presently under contract, including hopper dredges, pending the comprehensive study of the national pipeline dredging requirements which the Deputy Secretary of the Army for Installations and Housing has agreed to undertake pursuant to the recommendations of the General Accounting Office in its report on May 23, 1972."

"In summary, the GAO report outlines the Corps' alternatives for accomplishing the dredging workload, including: (1) maintaining the current level of effort with existing Corps plant, (2) taking over a larger share of the program by expanding the Corps plant capability, or (3) curtailing the Corps role and/or getting out of dredging completely. The Comptroller General also recommended that the Corps of Engineers should furnish the results of its comprehensive study to the appropriate Congressional legislative committees for their consideration in providing guidance as to the federal role in meeting the future national dredging requirements."



The Senate concurred with this statement (Senate Report 92-923) and added:

" . . . (that the) comprehensive study must include consultation with the dredging industry, including their views and recommendations on various alternatives for meeting the national dredging requirements."

This study was commissioned by the Chief of Engineers and is the "National Dredging Study" by Arthur D. Little, Inc. it is often referred to as "The Little Report." It was completed in 1974.

From the results of this study, the Chief of Engineers concluded that a program to solicit bids for work traditionally done by Corps dredges was desirable. The program would determine the interest private industry had in doing the work (TOM - test of the market) and the capability of the industry to do the work at reasonable prices and on time (ICP - industry capability program). The Corps already had authority to develop these programs. The details of the ICP are presented in a later section.

The moratorium was of considerable concern early in the GREAT I study because it specifically "placed a moratorium on all proposed plans for replacement or modification of dredges." Therefore, GREAT could not easily recommend new or different dredges and the options were severely limited. A recommended plan that included a new or different dredge would have considerably less chance of being adopted than if the moratorium were not in effect. The Team and work group decided to proceed as if the moratorium did not exist. If a new or different dredge was needed, the justification would have to be strong enough to overcome the constraint of the moratorium. In this case, a backup plan relying on existing equipment would also be developed to meet the GREAT objectives as nearly as possible.

The moratorium did not significantly affect St. Paul District operations. The District acquired the Dredge Colorado from the Bureau of Reclamation during the moratorium with the specific approval of Congress and the Office of Management and Budget on the condition that it will:

1. Be used only as a booster unit for the Thompson.
2. Not be converted to a dredge.
3. Be rehabilitated by St. Paul District.

Public Law 95-260, discussed later in detail, also lessened some of the constraints of the moratorium. This law describes a "minimum federally owned fleet" of dredges and states that this fleet "shall be maintained to technologically modern and efficient standards, including replacement as necessary." This law removed the need for GREAT to develop an "existing equipment" plan except as a tool in plan formulation.

The acquisition of new dredges directly is still not provided for under current legal restraints. Therefore, GREAT plans which include a new or different dredge must also determine and evaluate the future use of existing plant.

#### INDUSTRY CAPABILITY PROGRAM

The original intent of the ICP (Industry Capability Program) as proposed by the Chief of Engineers was to determine the capability of the dredging industry to perform, at reasonable cost and in a timely manner with hopper dredges and sidecasting dredges, the dredging done in the past by the Corps. The use of cutterhead, dustpan, and mechanical dredges was added.

Several meetings were held with industry representatives to discuss details of the program during the development of procedures. Significant differences in cost accounting, labor commitments, wage and salary policies, overhead expenses, and staffing charges were identified between Corps and industry procedures. These differences called for substantial changes in the estimating procedures used by the Corps for work done under the ICP. The new accounting procedures are documented in Corps regulations FF 1110-2-1300, FF 1130-2-307, and FF 1125-2-15.

In the past, the industry and Corps selected dredging projects for the ICP through a complex series of steps. The industry began by indicating interest in bidding on particular jobs. The Districts sent lists of these sites to the Division offices. The Divisions forwarded these lists to the Chief of Engineers after attempting to package the work into easy units for bidding. On the basis of the types and amounts of work, the Chief of Engineers allocated ICP dredging to the Divisions. A minimum of 25 percent of Corps dredging nationwide was to be available for contract. The selection of jobs to be advertised was left to the Divisions.

In practice, the Divisions have reserved (not advertised) enough work to keep Corps-owned plant active even if some of the work had been listed by the industry. The rest of the dredging was then combined into units for bidding. The contracting was handled by each District.

In coastal areas and harbors, shoals develop slowly enough so that contracts based on unit cost can be developed and precontract surveys are accurate enough at the time of dredging to be reliable for pay quantities. However, on the Upper Mississippi River, shoals can develop much faster than the 30 days needed to advertise a dredging contract. Also, the volumes of dredging often change right up to the moment of dredging and a unit price or lump sum contract becomes very unwieldy. Therefore, this section of river was exempted from the policy change for 1 year. For the 1980 dredging season, St. Paul District plans to advertise a plant rental contract with standby payment provisions.

Public Law 95-269 basically takes the ICP out of the status of a trial program and makes it law. The moratorium on acquiring new dredging equipment is modified by the statement: "... shall be maintained to technologically modern and efficient standards including replacement as necessary." Also, as a part of this act, the Corps is directed to prepare a report determining "... the number of federally owned fleet required to perform emergency and national defense work." This report is in draft form and is scheduled to be submitted to Congress in date not yet established - the language in the law is "... within two years after enactment ...").

The main thrust of this law is to have as much dredging as possible done by private industry. Practically, it requires that dredging be done in the most economical and advantageous way to benefit the Nation.

Due to the observed environmental problems associated with shoreline and wetland disposal and due to the very high costs associated with out-of-bankland disposal, there is considerable sympathy within the Rock Island District Corps of Engineers for the type of open water disposal practiced in southern reaches of the river. Since this practice is also favored by the States of Illinois and Missouri, it is likely that, without CEAT, main channel disposal would become the primary disposal method in the Rock Island District, if it is determined to be environmentally acceptable.

#### 4. Statement of Problems.

During the CEAT I, CEAT II, and CEAT III studies, the following six problems have been identified:

- a. Moratorium on Federal equipment acquisition.
- b. Inadequate equipment capability in study area.
- c. Lack of knowledge of equipment availability and capability.
- d. Lack of general knowledge about dredging equipment and dredging operations.
- e. Advances in dredging technology need to be investigated.

2. In summary, problem a, the moratorium on Federal equipment acquisition, has been discussed previously, and the CEAT I study team is addressing this problem. Problems b, c, d, and e basically can be grouped together as one overall problem. This problem is the inadequate capability of the existing Corps dredging equipment in the study area to dredge and dispose of dredged material in a manner which is both economically feasible and environmentally acceptable. This is the problem that this Work Group intends to address.

E. Material and Equipment Needs Work Group Subobjectives.

1. The subobjectives of the Material and Equipment Needs Work Group are as follows:

- a. To identify and evaluate all known types of dredging equipment appropriate to the area of CREAT II.
- b. To develop cost data for the identified dredging equipment.
- c. To investigate technologically advanced methods in equipment use in the dredging industry.

2. The analysis of the above subobjectives should lead to the development of a plan which should assure the necessary capability of the dredging equipment to maintain the total river resources in an environmental and economical manner.

F. Material and Equipment Needs Work Group Plan of Action.

1. In order to analyze a wide range of equipment possibilities for dredging, dredge disposal, and dredge material transport, the following criteria was established by the Work Group.

a. The dredging season was established as 60 calendar days, 300,000 cubic yards per year, 10 locations of dredging (an average of 30,000 cubic yards per job), and 60 miles per move of the dredging equipment which would involved two lockages.

b. The following five types of disposal sites were to be analyzed:

- (1) Behind the levee, including pump back.
- (2) Historic shoreline disposal sites.
- (3) Wetland crossing.
- (4) Stockpile on land including lowhead and highhead lifts.
- (5) Three miles of pipe in open water including a possible channel crossing.

c. Types of hydraulic equipment to be analyzed included:

- (1) Hydraulic dredges 12 to 24 inches in size.
- (2) Booster dredges allowing the capability of three miles of pumping.

- included:
- d. Types of mechanical dredging equipment to be analyzed
    - (1) Back hoe.
    - (2) Clamshell
    - (3) Dragline
    - (4) Bucket ladder dredge (bucket ladder dredge will be confined to those currently built).
  - e. Types of loading and unloading methods.
    - (1) Plastic pipe.
    - (2) A mixture of plastic and steel pipe.
    - (3) Steel pipe.
    - (4) Barging of material.
    - (5) Trucking of material.

2. In order to obtain an outside opinion of the above plan of action, the Material and Equipment Needs Work Group has let a contract to analyze dredging equipment needs based on the criteria listed above. The final report from the contractor is available from the work group chairman.

### III. WORK GROUP ACTIVITIES AND ACCOMPLISHMENTS.

A. The Work Group provided requested information on equipment to the GREAT II team.

F. Technical Assistance. The Work Group has provided technical assistance to all of the other work groups as requested. The Work Group has also participated in the onsite inspections of the yearly dredging activities. The Work Group has participated each year in the development of the GREAT II recommendations concerning the channel maintenance activities.

C. Dredging Equipment Inventory. The Material and Equipment Needs Work Group has contacted various manufacturers of different kinds of dredging equipment. The Material and Equipment Needs Work Group has various literature on different types of dredging equipment. It has also made an analysis from this material as to the characteristics of this dredging equipment and the availability of the equipment.

D. Advances in Dredging Technology. The Material and Equipment Needs Work group has researched various types of advances in dredging equipment. Some of these have been the hydroclone dredge, the use of plastic pipe, and the bucket ladder dredge. A more complete analysis of this and other equipment are provided in the contractor's report.

#### IV. FORMULATION OF ALTERNATIVES AND RECOMMENDATION.

A. Formulation of alternative solutions and development of recommendations process.

1. The tasks that each work group in GREAT II chose to accomplish varied by work group, by type of problem they were addressing and by the existing knowledge they had about that problem. All work groups needed to collect and organize background information. This background information was used to identify further problems, to provide input and data for other work groups and as part of the narrative for their work group appendix. Where little background information existed, baseline data were collected and/or research studies conducted.

2. As all tasks were completed, the results were distributed to members of the pertinent work group. Conclusions were then drawn by members of the work group based on the results of their work group's tasks.

3. The conclusions developed by each work group led to the identification and consequent development of potential alternatives to their problems. The results of some tasks indicated that there still was not enough available information to ensure a knowledgeable assessment of the potential alternative solutions to a problem. In these cases, no alternatives could be formulated and the only recommendation which could be made was for further study of the problem. Where completion of work group tasks led to identification of potential solutions, the alternatives were displayed on Attachment 4. The alternatives varied in specificity from site specific guidelines to general policy changes, dependent upon the problem they were addressing. Alternatives displayed on Attachment 4 were assessed and an alternative selected on the basis of a judgemental impact assessment. Once an alternative was selected, the rationale for its selection and all available supporting documents, information and studies supporting its selection were

identified and displayed on Attachment 4. This information (and other), was used to compile a brief summary of the types of impacts that would result if the recommendation were implemented. Based on the impact assessment and careful evaluation of the recommendation the work group, through various voting procedures, either approved or rejected the recommendation.

4. All work group-approved recommendations were sent to the GREAT II impact assessment coordinator for review and advice. The coordinator would then mail this information, complete with comments, back to the appropriate work group chairman. The work group then did a more thorough and detailed assessment of the impact potential of their recommendations. This information was recorded on Attachment 7. Each work group was responsible for obtaining or estimating the necessary information for their impact assessment through their studies, work group meetings, discussions with other work groups, discussions with other agencies having expertise in that particular field, discussions with economists and discussions with the impact assessment coordinator. When Attachment 7 was completed to the work group's satisfaction sufficient copies of Attachment 4 and 7 were brought to the next Plan Formulation Work Group meeting. The impact assessment was reviewed by all members present and additions, changes, or suggestions were made to the impact assessment. Each work group chairman made the appropriate revisions and brought a final version of the impact assessment to the next Plan Formulation Work Group meeting for final review.

5. At this time, these recommendations were dropped from further active consideration, until all recommendations were submitted by all of the work groups. When all of the recommendations had been submitted to the Plan Formulation Work Group, the development of integrated and final plans began.

6. The recommendations brought to the Plan Formulation Work Group varied in specificity and implementability and were grouped into the following general categories:

- a. Implementable actions with existing authority.
- b. Implementable actions requiring legislation.
- c. Implementable studies within existing authority.
- d. Implementable studies requiring legislation.
- e. Feasibility studies, etc.
- f. Policy changes.

7. Within each of the six groups above, the recommendations varied from general recommendations applying to the river as a whole to those recommendations site specific in nature. Three categories of specificity used to help organize the recommendations into action plans are listed below:

- a. General - apply to entire GREAT II reach or entire Upper Mississippi River Basin.

b. Pool - apply to a specific pool or group of pools.

c. Site - apply to a specific site(s) within a pool.

8. The Material and Equipment Needs Work Group provided data, but no final recommendations, to the Plan Formulation Work Group.



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