

IWR REPORT 72-3

[REDACTED]

RESERVE

AN ANALYSIS OF ENVIRONMENTAL STATEMENTS FOR CORPS OF ENGINEERS WATER PROJECTS



S# 28
Schultz
capt

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS



JUNE 1972

IWR REPORT 72-3

INSTITUTE FOR WATER RESOURCES

The Institute for Water Resources is the focal point of efforts to improve U. S. Army Corps of Engineers' planning for the development and management of the nation's water and related land resources, particularly as national objectives are affected by changing public values. Through in-house and contract studies, the Institute identifies emerging planning issues and requirements; evaluates planning efficiency and effectiveness; develops applications to Corps' planning of analytical and projectional techniques and planning management systems; and formulates the bases for improved Corps' planning policies and procedures. In concert with the Office, Chief of Engineers, it advises and assists Corps' agencies in utilizing such techniques and carrying out such procedures. Finally, it evaluates and recommends improvements in the professional development program for Corps' planners; develops training programs; and conducts training.

The Institute welcomes your comments and suggestions on its program and publications.



K. B. COOPER
Brigadier General, USA
Director

Reserve
Water
Resources

SH 28
Schwarz
Copy

Ortolano, Leonard, and William W. Hill

An Analysis of Environmental Statements
for Corps of Engineers' Water Projects,
June 1972. 135 pp.

U.S. Army Engineer Institute for Water
Resources

*IWR Report 72-3

A-2

Dennis Martin Box 1189 Apr. 8 1980

AN ANALYSIS OF ENVIRONMENTAL STATEMENTS
FOR CORPS OF ENGINEERS' WATER PROJECTS

A Report Submitted to the

U. S. Army Engineer Institute for Water Resources
2461 Eisenhower Avenue
Alexandria, Virginia 22314

By

Leonard Ortolano
William W. Hill

Civil Engineering Department
Stanford University
Stanford, California

Under Contract Number DACW 31-71-C-0127

Approved for public release; distribution unlimited.

Copies may be purchased from:

The National Technical Information Service
Department of Commerce
Springfield, Virginia 22151

June 1972

IWR Report 72-3

FOREWORD

The United States Army Corps of Engineers is committed to a continuing effort to improve planning efforts and procedures. The National Environmental Policy Act is, of course, one of the most important areas of concern. This report represents one effort, among several, to improve Corps responsiveness to this Act. The intent of this particular effort was to provide a perspective view of Corps Environmental Impact Statements at a particular stage. In this case the first 234 studies prepared by the Corps through August 1971 were examined.

In the course of this study, where the investigators felt the requirement, for these purposes, for standards, criteria or interpretations, they developed their own. Neither all of the premises, nor the observations, can be considered necessarily those of the Corps. The conclusions and recommendations are, of course, wholly the views of the investigators.

Agency Environmental Impact Statements have, through experience, improved during the second year of the Act. The Corps seeks from the contributions of efforts such as this, to maintain the standard for Federal agency responsiveness to the Act, in letter and intent.

Concurrently, it should be noted it is the policy of the Corps to integrate environmental considerations into the earliest stages of planning. When studies where this has been done begin to emerge at the end of the planning process, we expect to see additional improvements in the accompanying Environmental Impact Statements.

Corps environmental policy has been set forth in the Environmental Guidelines of the Civil Works Program of the Corps of Engineers (Appendix A to Engineer Regulation 1165-2-500 dated 30 November 1970). Environmental Impact Statement preparation and study efforts to provide feedback on their preparation will continue in conformity with these guidelines.

ACKNOWLEDGEMENTS

We would like to acknowledge Mr. Mark Wiesel, a Stanford student in civil engineering, for his very able assistance in the tedious task of reading and preparing abstracts for a large number of the environmental statements. We would also like to thank Mrs. Ditter Peschcke-Koedt for her excellent job of typing the final manuscript, and her many helpful editorial suggestions.

TABLE OF CONTENTS

	page
Acknowledgements -----	ii
List of Tables -----	vi
CHAPTER ONE: INTRODUCTION -----	1
ENVIRONMENTAL STATEMENTS AND PL 91-190 -----	1
RATIONALE FOR THE STUDY -----	2
APPROACH -----	3
PLAN OF THIS REPORT -----	4
CHAPTER TWO: ENVIRONMENTAL IMPACTS OF PROJECTS ON COASTAL WATERS	5
INTRODUCTION -----	5
DREDGING -----	6
Catalog of Impacts -----	6
Summary and Discussion -----	9
SPOIL DISPOSAL -----	10
Catalog of Impacts -----	11
Summary and Discussion -----	14
BREAKWATERS -----	15
Catalog of Impacts -----	16
Summary and Discussion -----	17
JETTIES AND GROINS -----	17
Catalog of Impacts--Jetties -----	18
Catalog of Impacts--Groins -----	19
Summary and Discussion -----	19
REVTMENTS, DIKES AND BARRIERS -----	20
PROJECT PURPOSE RELATED IMPACTS -----	21
Beach Restoration and Shore Protection -----	21
Navigation -----	22
CHAPTER THREE: ENVIRONMENTAL IMPACTS OF PROJECTS ON INLAND WATERS -----	23
INTRODUCTION -----	23
CHANNELIZATION -----	24
Catalog of Impacts -----	24
Summary and Discussion -----	31
DAMS AND RESERVOIRS -----	34
Catalog of Impacts -----	34
Summary and Discussion -----	43
LEVEES -----	47
Catalog of Impacts -----	47
Summary and Discussion -----	49
DREDGING -----	51
Catalog of Impacts -----	51
Summary and Discussion -----	52

	page
SPOIL DISPOSAL -----	54
Catalog of Impacts -----	54
Summary and Discussion -----	56
CONSTRUCTION ACTIVITIES -----	58
Catalog of Impacts -----	58
Summary and Discussion -----	59
MISCELLANEOUS STRUCTURES AND ACTIVITIES -----	61
Catalog of Impacts -----	61
Summary and Discussion -----	65
PROJECT PURPOSE RELATED IMPACTS -----	66
Impacts Induced by Flood Control and Multipurpose Projects -----	66
Catalog of Impacts -----	66
Summary and Discussion -----	71
Impacts Induced by Navigation Projects -----	73
Catalog of Impacts -----	73
Summary and Discussion -----	75
CHAPTER FOUR: ALTERNATIVES, PRODUCTIVITY, COMMITMENTS AND OTHER ISSUES -----	78
INTRODUCTION -----	78
ALTERNATIVES TO THE PROPOSED PROJECT -----	79
Projects on Coastal Waters--All Purpose -----	80
Navigation Projects on Inland Waters -----	80
Flood Control and Multipurpose Projects on Inland Waters -----	81
SHORT-TERM USES AND LONG-TERM PRODUCTIVITY -----	82
Projects on Coastal Waters--All Purposes -----	83
Navigation Projects on Inland Waters -----	84
Flood Control and Multipurpose Projects on Inland Waters -----	85
IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS -----	86
Projects on Coastal Waters--All Purposes -----	88
Navigation Projects on Inland Waters -----	88
Flood Control and Multipurpose Projects on Inland Waters -----	89
CONTROVERSIAL ISSUES AND THE ADHERENCE TO GUIDELINES--A STATIS- TICAL SUMMARY -----	90
Controversial Issues -----	91
Adherence to Guidelines -----	95
CHAPTER FIVE: SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR IMPROVEMENT	99
SUMMARY -----	99
Projects on Coastal Waters -----	99
Projects on Inland Waters -----	100

	page
Items (iii), (iv), and (v) of Section 102(2)(C) --	102
Controversial Issues and Adherence to Guidelines	104
THE ROLE OF ENVIRONMENTAL STATEMENTS -----	106
A GENERAL ASSESSMENT OF THE 234 STATEMENTS -----	109
SUGGESTIONS FOR IMPROVING ENVIRONMENTAL STATEMENTS -----	111
Improving the Description of Impacts -----	112
A Section-by-Section Analysis -----	121
Miscellaneous Suggestions for Improvement -----	126
AMBIGUITIES IN THE NEPA AND THE CEQ GUIDELINES -----	127
ENVIRONMENTAL IMPACT ANALYSIS AND THE PLANNING PROCESS ---	130
APPENDIX 1. Form Used in Reviewing Environmental Statements	131

LIST OF TABLES

TABLE		page
2-1	Summary of Reported Impacts--Dredging -----	9
2-2	" " " " "--Spoil Disposal -----	15
2-3	" " " " "--Breakwaters -----	17
2-4	" " " " "--Jetties -----	20
2-5	" " " " "--Groins -----	20
3-1	" " " " "--Channelization -----	31
3-2	" " " " "--Dams and Reservoirs ----	44
3-3	" " " " "--Levees -----	50
3-4	" " " " "--Dredging -----	53
3-5	" " " " "--Spoil Disposal -----	57
3-6	Summary of Reported Impacts Induced by Flood Control and Multipurpose Projects -----	72
3-7	Summary of Reported Impacts Induced by Navigation ---	76
4-1	Numbers of Alternative Projects Considered -----	80
4-2	Land, Labor and Materials as Resource Commitments ---	87
4-3	Statistical Summary of Some Controversial Issues and the Adherence to Guidelines -----	92

CHAPTER ONE
INTRODUCTION

ENVIRONMENTAL STATEMENTS AND PL 91-190

Section 102(2)(C) of the National Environmental Policy Act of 1969, Public Law 91-190, requires the preparation of "environmental statements" on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. The Corps of Engineers has responded to the provisions of Section 102(2)(C) by requiring the preparation of such statements on all proposed projects and a number of existing ones. Instructions to Corps personnel on the preparation of environmental statements are contained in various internal planning documents, and are contained in guidelines issued by the Council on Environmental Quality (CEQ).*

Public Law 91-190 and the CEQ Guidelines require that environmental statements include coverage of the following points:

- (i) The probable impact of the proposed action on the environment, including impact on ecological systems such as wildlife, fish and marine life;
- (ii) Any probable adverse environmental effects which cannot be avoided;
- (iii) Alternatives to the proposed action that might avoid some or all of the adverse environmental effects;
- (iv) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity;
- (v) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented; and,

*The most recent of these respective documents available at the time of this study were:

- ° U.S. Army, "Investigations, Planning, and Development of Water Resources--Preparation and Coordination of Environmental Statements," Office of the Chief of Engineers, Wash., D.C., (Reg. No. 1105-2-507), May 28, 1971.
- ° Council on Environmental Quality, "Statements on Proposed Federal Actions Affecting the Environment--Guidelines," in Federal Register, Vol. 36, No. 79, Friday, April 23, 1971, pp. 7724-7729.

- (vi) Where appropriate, a discussion of problems and objections raised by other Federal agencies and state and local entities in the review process, and the disposition of the issues involved.

The preparation of environmental statements is a relatively new endeavor for water resources planners as well as others. Although some written guidelines have been developed, there is not a great deal of literature available to assist directly those Corps planners charged with the preparation of these statements.

RATIONALE FOR THE STUDY

Before initiating the project described below, we were convinced that there would be a great deal of useful information contained within the environmental statements already prepared by the Corps. This conviction was nurtured by the recognition that a rather large array of individuals having widely varying backgrounds and perspectives had participated actively in the preparation of these statements. Prominent among these individuals were a substantial number of Corps of Engineers planners in Washington as well as in the various District and Division offices located throughout the country. Also involved were planners, engineers and scientists from a wide variety of federal, state and local agencies having the responsibility for reviewing and criticizing the Corps' environmental statements. To a somewhat lesser degree, interested citizens also participated in the preparation of these statements.

We were also confident that much of the information contained in the Corps' statements could be organized in the form of a catalog that listed the specific environmental impacts that were reported to be associated with various activities (dredging, spoil disposal, etc.) and structures (dams, canals, etc.) proposed by the Corps. The intent was not to organize such a catalog on the basis of what we believed the impacts to be, but merely to prepare such a catalog on the basis of what was reported by Corps planners as well as the various agencies and individuals involved in the review of the Corps' environmental statements.

We reasoned that such a catalog would enable individual water resources planners to learn from the collected efforts of a rather sizable

group. As noted above, the catalog would be descriptive of Corps' environmental statements as they are, not prescriptive. We recognize that a major limitation of a descriptive document is that the verity of postulated impacts would not be tested. However, we felt that by knowing what is contained in the statements prepared to date, those concerned with the preparation or review of environmental statements would be in a good position to discuss how they might be improved.

APPROACH

In order to prepare a catalog of reported impacts we set out to systematically review the majority of the Corps' environmental statements prepared through the summer of 1971. A total of 234 environmental statements were reviewed, 207 of which were final statements and 27 of which were draft versions. The 207 final statements represented nearly all of the statements considered to be in final form as of August, 1971.

To facilitate both the review of this large number of rather lengthy documents and the compilation of the catalog, a four-page form (Appendix 1) was developed for abstracting the essential material contained in each of the 234 statements. While our original intent was to simply abstract the material necessary for the catalog, i.e., the types and numbers of environmental impacts reported for the various structures and activities, we soon realized that there was much additional useful information which could easily be obtained by only modestly extending the scope of our review. The additional issues we chose to consider are those included in the last two pages of our abstracting form. These issues are described in the following section, which outlines the material presented in this report.

We expanded the scope of our review in one other very important respect. While we did not originally intend to prepare a critique of the Corps' environmental statements, there were a number of critical observations that more or less evolved from the process of organizing and analyzing the information. For example, in analyzing impacts reported in connection with a particular structure or activity, we attempted to identify characteristics of these impacts which lent themselves to generalization. This process often revealed weaknesses (in our view at least) which we noted in the context of the "Summary and Discussion" subsection for each structure or activity. These critical observations were later generalized and expanded upon, and are included, along with suggestions for improvement, in the

final section of this report. While our criticisms are admittedly subjective, we do feel that they are constructive. We are also confident of our position to offer them, as they are based on a comprehensive review of an extremely large sample of the Corps' environmental statements.

PLAN OF THIS REPORT

Chapters Two and Three are comprised, primarily, of the material we originally set out to prepare--the catalogs of environmental impacts reported for each structure and activity. Chapter Two summarizes the impacts reported in the statements for projects on coastal waters, while Chapter Three summarizes those impacts reported to result from projects on inland waters.

Chapter Four is devoted to those issues other than the environmental impacts, per se, which we chose to examine. The first part of this chapter deals with the Corp's response to the other requirements of Section 102(2)(C) of the NEPA, namely, alternatives to the proposed project, the conflict between local short-term uses of the environment and long-term productivity, and irreversible and irretrievable resource commitments. The final section of Chapter Four summarizes the frequency with which a number of items of interest were mentioned in the statements reviewed. These items included impacts or issues which we regarded as potentially controversial, e.g., the concept of "mitigation"; and issues, the inclusion of which was suggested or required by either the CEQ Guidelines or the Corps' regulations on the preparation of environmental statements, e.g., the mention of the occurrence (or lack thereof) of archaeological or historical sites.

Chapter Five is devoted primarily to an overall analysis of the 234 statements reviewed. Included in this chapter are: an assessment of the utility of the statements in light of the role we perceive for environmental statements, the identification of specific weaknesses we observed in the statements, suggested ways in which the Corps might improve the statements, and suggestions for clarification of the Guidelines directed to the CEQ.

By way of introduction to this final analysis, Chapter Five also includes a brief summary of the materials presented in Chapters Two through Four. This summary is intended to provide an adequate review for the reader interested in the general content and analysis of the Corps' environmental statements, but who might find the intermediary chapters too detailed for his interests.

CHAPTER TWO
ENVIRONMENTAL IMPACTS OF PROJECTS ON COASTAL WATERS

INTRODUCTION

A useful way of organizing the summary of reported impacts involves separating projects into two categories: inland and coastal. This chapter deals with coastal works which we define as projects located either on the ocean or in an estuarine environment. It turned out that roughly two-thirds of these projects were of the single purpose navigation type; most of the remainder involved either beach replenishment or shoreline protection works. A total of sixty-one environmental statements were examined, fifty-nine of which were final versions.

The most common activities associated with coastal projects are dredging and spoil disposal; these were noted in fifty-three of the sixty-one projects examined. The coastal projects examined contained relatively few structural works; only six of the projects involved breakwaters, eight involved jetties and groins, and three or less mentioned revetments or dikes.

In the following sections we describe the environmental impacts reported for dredging, spoil disposal, and each of the aforementioned structures. Although these sections contain nearly all the environmental impacts reported, there remain a group of impacts of a general nature that are more accurately associated with a given project purpose than with an activity or structure; a separate section is devoted to these more general impacts.

The procedure we follow in reporting impacts for a given activity or structure is to first present a catalog or listing of the impacts. The level of detail or specificity given in catalog entries is characteristic of the level of detail given in the environmental statements we examined. The classes and subclasses in these catalogs do not reflect an effort to logically group impacts per se; rather they stem from an effort to group those impacts that have been reported. Following the listings for a given activity or structure we present a brief summary and discussion.

DREDGING

Catalog of Impacts

The environmental impact reported for dredging in coastal waters in 53 projects are summarized below. In presenting these impacts we employ a rather elaborate form of organization; while it may appear cumbersome at first glance its ultimate utility is established by the role it plays in simplifying the presentation of the relative frequency of occurrence of various levels of detail.

I. Alterations in water quality

A. Increase in turbidity

This was by far the most common impact reported for dredging. Very often the terms "temporary" and "minor" were used to characterize the shift in turbidity. In some cases it was noted that dredging would be timed to minimize adverse effects and/or avoid periods of "maximum biological activity."

1. Adverse effects on shellfish

a. Reduction in oyster production and/or habitat

In some cases the area and expected change in yield was reported.

b. Reduction in clam production and/or habitat

In some cases the area and expected change in yield was reported.

2. Adverse effects on fish life and/or habitat

3. Decrease in light penetration with consequent reduction in local phytoplankton populations

4. Temporary reduction in productivity as a consequence of increased siltation

B. Resuspension of bottom sediments

Occasionally mention was made of the area of bottom sediments disturbed.

1. Increase in concentration of suspended solids

a. Damage to marine life

In some cases this was simply stated without additional explanation.

b. Damage to gill filaments and tissues of many kinds of animals

c. Decreased photosynthetic activity and production

- d. Decreased bouyancy of eggs of marine animals
- 2. Possible resuspension of incompletely digested sludge with consequent increases in biochemical oxygen demand
- 3. "No significant adverse impacts"

C. Settlement of resuspended bottom sediments

- 1. Creation of a coating which interferes with the "setting" or attachment of larval oysters
- 2. Formation of soft sediments or "floc" which is uninhabitable for many benthic species

D. Nutrient reduction

It was reported that the removal of dredged material might bring about a small reduction in the nutrients needed to sustain fish and shellfish.

II. Alterations in flow circulation patterns

A. Increase in tidal circulation

- 1. Beneficial to biota, particularly shellfish
- 2. Lower pollution levels and/or improve water quality
 - a. Improved conditions for shellfish
 - b. Improved marine life
- 3. Adverse effect due to increased salinity and erosion

B. Changes in salinity intrusion pattern

In one case it was reported that this would eliminate fresh water habitat and spawning areas.

III. Increased water depth

A. Improvement in bottom fishing

This was reported to apply especially for such species as snapper and grouper.

B. Possible effect on animal and plant populations

C. Possible effect on water's capacity to assimilate wastes

IV. Changes in benthic (i.e. bottom organism) populations

In some cases the areas involved were reported. In one case the types of organisms were mentioned to be polychaetes and small

crustaceans. The changes were generally reported as being temporary or "short term."

- A. Loss of feeding habitat for fish
- B. Loss of bottom vegetation
- C. Removal of substrate which may house burrowing organisms

V. Loss of marine fauna

- A. Damage to invertebrates in intertidal zone
- B. Damage to shellfish resources

VI. Loss of land

In some cases the area and/or type of land was reported.

- A. Removal of "unattractive tidal flats"
- B. Loss of valuable trees and scrub growth
- C. Loss of productive shallow land and high quality salt marsh

VII. Odor problems

- A. Creation of "noxious odors"
- B. Creation of "mild non-pungent odors"

VIII. General ecological implications

These were reported as follows:

- A. Reduction in full productivity of the area
- B. Disturbance of plankton and nekton
- C. Influence on migratory and wintering waterfowl and shorebirds
- D. Temporary "disturbance of marine ecology"
- E. Removal of "interfaces which may be areas of high biologic activity"
- F. Removal of polluted sediments deposited by industry
- G. Loss of rich nutrient deposits essential to development of aquatic plants and animals.

Summary and Discussion

Table 2-1 summarizes the impacts reported in five percent or more of the environmental statements involving coastal dredging. Since we intend to give only a rough indication of the frequency of occurrence of various impacts, all percentage figures given in the table (and throughout the entire report) are rounded off to the nearest five percent. Observe that if an impact appears in the catalog but not in the summary table, it means that impact was reported in less than five percent of the statements involving coastal dredging. (Summary tables of this type appear throughout Chapters Two and Three.)

TABLE 2-1
Summary of Reported Impacts--Dredging
(based on 53 statements)

	<u>% of statements</u>
I. <u>Alterations in water quality</u>	
A. Increase in turbidity	75 ⁺
1. Adverse effects on shellfish	20
2. Adverse effects on fish	5
B. Resuspension of bottom sediments	10
II. <u>Alterations in flow patterns</u>	
A. Increase in tidal circulation	10
III. <u>Increase in water depth</u>	5
(Affects fishing, marine life and assimilative capacity)	
IV. <u>Changes in bottom organisms</u>	30
(Affects fish life and habitat)	5
V. <u>Loss in marine fauna</u>	15
VI. <u>Loss of land</u>	15
(Details on land type)	10
VII. <u>Odor problems</u>	*
VIII. <u>General ecological implications</u>	15

⁺Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

By far the most commonly reported impact associated with coastal dredging was an increase in turbidity; this was reported in about 75 percent of the 53 statements involving dredging. However, of the cases in which turbidity was mentioned, less than half of these discussed further implications such as impacts on shellfish habitat. The second most commonly reported impact was a change in the population of bottom organisms. Typically, for both turbidity increases and changes in bottom organisms, the changes were asserted to be minor and/or temporary and the impression was given that they were of no consequence. This may explain why little substantive discussion as to the ultimate implications of these changes was given.

Of the remaining impacts, losses in marine fauna and land were mentioned in about fifteen percent of the cases. The remaining impacts were reported quite infrequently--generally ten percent or less of the statements.

A striking characteristic of the reported impacts, and one that is common to other activities and structures, is that the level of detail is quite inadequate in terms of assessing the ultimate implications of the reported change on human welfare. Of all the coastal dredging impacts reported, only those corresponding to changes in shellfish habitat and losses of land are likely to be helpful to decision makers. The other descriptions of impacts (e.g., loss of marine fauna) are not given in terms that are likely to be useful for most readers. One wonders, for example, if a loss in marine fauna is likely to be trivial or potentially serious. Clearly, the generality of the term "marine fauna" gives the reader relatively little information.

A second striking characteristic is that while many of the reported impacts were asserted to be minor and temporary, there was generally no evidence given to substantiate the assertions. Furthermore, it is not true in general that a minor increase in a given parameter will have ultimate implications that are also minor.

SPOIL DISPOSAL

The environmental impact reported for 53 coastal projects involving spoil disposed are summarized below.

Catalog of Impacts

I. Creation of land areas

A. Beaches--restoration or "nourishment"*

One report noted a possible "degradation of water and beach quality resulting from placement of contaminated sand from the borrow sources on the beach."

B. Waterfowl habitat areas

1. Feeding areas for shore birds
2. Nesting grounds for pelicans
3. Spoil islands that could be developed into rookeries for birds

C. Salt marshes

It was indicated that "new techniques are being studied for the placement of dredged spoil to form new marshes on unproductive bottoms adjacent to project channels."

D. "Valuable nursery and growing areas"

E. Clam beds

Usually the area involved was specified.

F. Road fill

It was reported that by building up a road bed with dredge spoil there would be a subsequent reduction in road maintenance costs.

II. Destruction of land areas

A. Salt marshes

The areas involved were sometimes indicated.

1. Destruction of estuary dependent fishing
2. Adverse effect on wildlife and/or waterfowl habitat

* Five additional projects involved the restoration of beaches by placement of fill obtained from inland sources as opposed to (in one case, in addition to) dredged materials. In referring to the sand borrow areas, three recorded no related impacts, one mentioned some loss in natural vegetation, and one made general reference to a possible "negative environmental impact."

3. Loss of bird habitat, and damage to feeding and breeding areas for estuarine species

B. Wildlife refuge areas

1. Loss of feeding areas for shore birds
2. Destruction of habitat for fiddler crabs, other crustaceans, rodents and several species of insects due to the covering with sand of voids and crevices in broken concrete and rubblestone seawalls

C. Loss of vegetative cover (on spoil banks)

The areas involved were sometimes indicated. A loss of wildlife habitat was frequently reported; in some cases the types and numbers of wildlife were recorded.

D. Tidal flats

The areas involved were sometimes specified.

1. Smothering of invertebrates now inhabiting the area
2. Loss of hiding places for "cryptic animals" as a consequence of the filling of crevices in the natural bottom
3. "Sessile organisms in adjacent areas may now find attachment more difficult and hold-fast mechanisms may become ineffective"
4. Creation of habitat for benthic organisms similar to that currently available, as the material spoiled on mud flats is similar to existing material.

E. Swampland

The loss of vegetation and wildlife cover was sometimes reported.

III. Modification of sub-aqueous land areas

A. Covering of submerged vegetation

Occasionally a temporary loss in waterfowl and fish habitat was reported. In one case it was mentioned that "experience indicates" that natural processes would quickly reestablish such vegetation.

B. Loss of bottom organisms

C. Loss of shellfish areas

An adverse effect on market crabs (*Cancer* sp.) was mentioned.

D. Loss of marine fauna and habitat

Loss of food producing areas was reported.

E. Covering of submerged reef

A loss of habitat for shallow net fishing was noted.

IV. Decrease in water quality

A. Increase in turbidity

The following was reported in one statement: Spoil disposal on a tidal flat leading to increased turbidity and consequent "effect" on organisms. During spoiling local turbidity may reach 900 parts per million (ppm); current background turbidity levels rarely exceed 56 ppm.

B. Increase in concentration of suspended solids

The following adverse effects were noted in connection with overboard disposal of dredged material:

1. Frequent damage to gill filaments and tissues of many kinds of animals
2. Decrease in photosynthetic activity and production
3. Decrease in bouyancy of eggs of marine animals

C. Decrease in dissolved oxygen

The following impact was noted: During spoiling on shallow (some intertidal) sediments dissolved oxygen concentrations will be reduced to 0.1 milligrams per liter, "far below the level required for most estuarine organisms."

D. Toxicants

In one case it was noted that small quantities of potentially toxic materials are contained in the spoil, but implications of this were difficult to determine.

V. Alterations in flow circulation patterns

A. Decreased circulation

B. Blockage of tidal creeks

VI. Alteration in aesthetic appearance of land

A "temporary scenic disturbance" was the extent of the description of this impact.

VII. Possible destruction of archeological sites

VIII. Vector control issues

A. Creation of nuisance and vector problems due to spoil handling

B. Alleviation of "nuisance and health vectors" due to filling of low marshlands

IX. Ocean disposal

In several cases it was stated that the spoil would be disposed of at sea. In such instances, environmental impacts were either not mentioned, or noted as having "temporary and minor effects on marine life."

Summary and Discussion

Table 2-2 summarizes the impacts reported for spoil disposal. Clearly, and as might be expected, the most common impacts reported relate to the nature of the modification of the land area that makes up the disposal site. In some cases the specific areas involved were reported, although in many cases they were not. Typically the implications of modifying the land area were not discussed except at a very general level (e.g., loss of vegetation and wildlife cover).

There were several projects that involved spoil disposal but did not mention the disposal site; such projects may not have reached the stage where the ultimate disposal site was decided upon.

It is noteworthy that relatively few of the statements examined dwelled upon issues unrelated to changes in land area. In particular, in only about ten percent of the cases was mention made of changes in water quality. Furthermore, ocean disposal, when mentioned, was generally treated as having no significant adverse impacts.

TABLE 2-2

Summary of Reported Impacts--Spoil Disposal

(based on 53 statements)

	<u>% of statements</u>
I. <u>Creation of land areas</u>	
A. Beach restoration	10 ⁺
B. Waterfowl habitats	10
II. <u>Destruction of land areas</u>	
A. Salt marshes	5
B. Wildlife refuge	5
C. Loss of vegetative cover	15
III. <u>Modification of sub-aqueous land areas</u>	
A. Loss of vegetation	5
B. Loss of bottom organisms	5
C. Loss of shellfish areas	10
D. Loss of marine fauna and habitat	10
IV. <u>Decrease in water quality</u>	10
V. <u>Alterations in flow circulation patterns</u>	*
VI. <u>Alteration in aesthetic appearance of land</u>	*
VII. <u>Possible destruction of archeological sites</u>	*
VIII. <u>Vector control issues</u>	*
IX. <u>Ocean disposal</u>	15

⁺Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

BREAKWATERS

A breakwater is a rock and/or concrete structure that protects a shore area, harbor or anchorage from wave action. Often it is built well out from shore to provide a substantial area of quiet water. ** The

**Bascom, W., Waves and Beaches, Doubleday, Garden City, N. Y., 1964, p. 247.

environmental impacts reported as being associated with breakwaters in six projects are summarized below.

Catalog of Impacts

- I. Protection of harbor from waves
 - A. Increase in pleasure craft use
 - B. Increase in sport fishing

- II. Decrease in tidal circulation
 - A. Increased potential for harbor icing
 - B. "Some impact on water quality"

- III. Aesthetic issues
 - A. Creation of an "attractive addition to coastal scenery"
 - B. Visual impairment

- IV. Biological issues
 - A. Creation of voids in breakwater provides a favorable environment for some species of marine life
 - B. Removal of clam habitat
 - In some instances the area involved was specified.

- V. Loss of tideland
 - In some instances the area involved was specified.

- VI. Issues relating to rock excavation
 - A. Construction of requisite haul road
 - 1. Destruction of flora
 - 2. Modification of land forms with consequent aesthetic impact
 - B. Quarrying
 - 1. Visual impairment at quarry site
 - 2. Loss of in-situ rock material and vegetation

Summary and Discussion

There was not a great deal reported for breakwaters (see Table 2-3). This stems in part from the small sample--a total of six statements involved breakwaters--and in part from the terseness of the descriptions given for impacts associated with breakwaters.

TABLE 2-3
Summary of Reported Impacts--Breakwaters
(based on 6 statements)

	<u>% of statements</u>
I. <u>Protection of harbor from waves</u>	15 ⁺
II. <u>Decrease in tidal circulation</u>	15
III. <u>Aesthetic issues</u>	35
IV. <u>Biological issues</u>	35
V. <u>Loss of tideland</u>	15
VI. <u>Issues relating to rock excavation</u>	
A. Construction of haul road	15
B. Quarrying	35

⁺Numerical values are rounded to the nearest five percent.

While breakwaters are constructed to modify tidal circulation patterns the implications of such a modification was only mentioned once, and in that case at a very general level. The visual appearance of a breakwater may be of some concern--in one case it was considered an improvement and in another a detraction.

A related issue of potential importance relates to the quarrying operations involved in obtaining the materials for construction. This was mentioned in some of the cases.

JETTIES AND GROINS

Jetties are rock and/or concrete structures that are usually constructed in pairs. They extend into the ocean at river entrances or bay

mouthes to confine the flow of water to a narrow zone. If concentrated between a pair of jetties, the ebb and flow of tidal water keeps the sand in motion and prevents shoaling in the channel.*

Groins are dam-like structures, usually a few feet high and about a hundred feet long, constructed perpendicular to the shoreline. They may be constructed using a variety of materials including timber, sheet steel pilings, stone or concrete. Groins are constructed to retard the loss of beach, widening it by trapping the passing sand.**

Catalog of Impacts--Jetties

I. Biological issues

A. Provision of enhanced fish habitat

On occasion specific mention was made of marine sport fishing and increased tourism.

B. Creation of habitat and shelter for marine organisms

C. Destruction of benthic organisms

II. Erosion issues

A. Possible minor changes in configurations of adjacent beaches

B. Beneficial impact

One statement reported that a weir section would provide for the orderly transfer of sand to a downdrift beach to offset existing erosion problems.

III. Miscellaneous issues

A. Reduced possibility of marine accidents involving oil or other environmentally noxious materials

B. Enhanced sport fishing opportunities

It was noted that a jetty with walkway provides access to deeper offshore waters.

*Bascom, W., Waves and Beaches, p. 246.

**Ibid., p. 232.

Catalog of Impacts--Groins

I. Biological issues

- A. Increase in turbidity during construction period with some loss of bottom organisms
- B. Burial of marine life by the deposition of fine sand caused by the groin
- C. Creation of underwater surface areas for the attachment of minute marine organisms

It was suggested that these organisms, serving as food sources, would attract "significant quantities of both inlet and ocean species," which, in turn, would attract anglers.

II. Erosion issues

The prevention of erosion of coarse underlying materials was reported.

Summary and Discussion

For both groins and jetties the reported impacts dealt, for the most part, with issues related to the provision of habitats for fish and the implications of changing patterns of erosion. Nearly all the impacts for these structures were reported in very general terms; and the level of substantive discussion was below that reported for other coastal structures and activities.

Tables 2-4 and 2-5 give an indication of the frequency with which various impacts were mentioned. Half of the statements involving groins and about 40 percent of the statements involving jetties contained no related impacts at all.

TABLE 2-4
Summary of Reported Impacts--Jetties
 (based on 8 statements)

	<u>% of statements</u>
I. <u>Biological issues</u>	
A. Enhancement of fish habitat	40 ⁺
B. Enhancement of marine organism habitat	15
C. Destruction of benthic organisms	15
II. <u>Erosion issues</u>	25
III. <u>Miscellaneous issues</u>	
A. Reduction of marine accidents	15
B. Increase of access for fishermen	15

⁺Numerical values are rounded to the nearest five percent.

TABLE 2-5
Summary of Reported Impacts--Groins
 (based on 6 statements)

	<u>% of statements</u>
I. <u>Biological issues</u>	
Loss of bottom organisms	35 ⁺
Enhancement of fish habitat	15
II. <u>Erosion issues</u>	
Prevention of erosion	15

⁺Numerical values are rounded to the nearest five percent.

REVETMENTS, DIKES AND BARRIERS

There were only three statements involving revetments. In two of these, mention was made of their adverse effects on scenic or aesthetic values. Brief mention was also made of the local siltation and erosion that may occur during the construction period.

Barrier beaches and dikes were also mentioned in three of the statements. In two of these a reduction in tidal circulation was noted, with a consequent decrease in water quality. In one instance specific reference was made to dissolved oxygen as a water quality indicator, and it was noted that the reduction in this parameter might lead to a "minor fish kill." One statement involving dikes reported that placing dike materials will have a "temporary and minor effect on marine life"; in addition it was noted that the dike would restrict views from both the land and water side. Barrier beaches were felt to stabilize bottom habitats and thereby enhance seasonal waterfowl usage due to increased food productivity. Construction of both dikes and barrier beaches would involve some coverage of existing bottom land.

PROJECT PURPOSE RELATED IMPACTS

As noted in the introduction to this chapter, there were a number of reported impacts that are more nearly related to the project purpose than any given activity or structure. These impacts are taken up in this section.

Beach Restoration and Shore Protection

Of the twenty projects in this class about one-quarter of them made specific reference to the restoration and preservation of beaches for future use as an environmental impact. In addition, about one-quarter of the statements made specific reference to the economic or recreational potential of the area as an impact; these statements were typically very general, as for example, the project will "enhance the useful potential of the area."

The following general impacts were each reported once:

- Degradation of the remaining barrier sand dunes or generation of objectionable noises, solid waste, etc., could occur as an indirect result of the completed project, but such effects can be minimized by local planning and control.
- There will be an intensified use of local environmental resources, but this will "temporarily relieve pressure for full public access to, and development of, coastal islands of superior ecological importance which are distributed throughout the coastal tributary area."

Navigation

There were 39 projects of the single purpose navigation type. Among these the following general impacts each appeared about 30 percent of the time:

- Social well-being will be improved as a consequence of industrial growth, increased employment and income, etc.
- There will be a reduction in "marine hazards" as a result of improved harbor facilities.

The following general impacts (or variations thereof) each appeared in about twenty percent of the environmental statements for coastal navigation projects:

- There will be increased boating and recreational use of the waters.
- There will be increased vessel traffic with attendant alterations (often specifically noted as degradation) in water quality.
- As a consequence of the anticipated use of larger commercial vessels there will be fewer trips per vessel, and therefore fewer accidents. In several instances the implications of a reduction in accidents were mentioned (e.g., reduced probability of oil spills).
- There will be an induced change in land use patterns (e.g., more industrial and commercial usage and less open space).

There were two project purpose related impacts that occurred only once or twice, but seemed to be carrying the implications of the project quite far. Thus, for example, two statements observed that the increase in industrial activity associated with the project would lead to increases in both air and water pollution. It was asserted that this could be controlled by local legislation. In another case, it was observed that the improvements in navigation would permit increased exports of phosphate. This, in turn, could accelerate the deterioration of the landscape by increasing the level of phosphate strip mining activities in the area.

CHAPTER THREE
ENVIRONMENTAL IMPACTS OF PROJECTS ON INLAND WATERS

INTRODUCTION

This chapter summarizes the environmental impacts reported in the statements included in our second category--projects on inland waters, which we defined as projects involving fresh water lakes, and rivers and streams not influenced by tidal action. A total of 173 projects falling into this category were read and abstracted; of these, 137 were flood control or multipurpose projects and 36 were navigation projects.

The most common structures encompassed in these projects were dams and levees. The section on dams and reservoirs below summarizes the impacts reported in 55 projects, while the section on levees is based on a total of 46 projects. The only other structures encountered were breakwaters, mentioned in seven projects, and locks, jetties, debris basins, and a few other miscellaneous structures mentioned in three or fewer statements. The impacts associated with all structures aside from dams and levees are summarized in the section entitled "Miscellaneous Structures and Activities."

The most common inland project by far was channelization. A total of 77 projects consisting wholly or partly of some form of channelization or channel improvement are included in the first section of this chapter. Moreover, this number does not include those channel projects which entailed only dredging and spoil disposal. These projects are included in the section on dredging, which summarizes the impacts from 41 projects, and the section on spoil disposal, which catalogs the impacts from 28 projects.

Environmental impacts caused by construction activities, with the exception of dredging and spoil disposal, for all projects on inland waters are lumped together and summarized in one section. Activities reported only occasionally are included in the miscellaneous section mentioned above.

As was the case with Chapter Two, a number of impacts of a general nature were reported which could not be conveniently tied to any structure

or activity. These impacts, mentioned in any of the 174 statements included in this chapter, are summarized in the final section entitled "Project Purpose Related Impacts." These impacts, in large part, might be referred to as "project induced," since they are effects caused by the social and economic changes brought about as a result of the project, as opposed to those impacts caused directly by the project, per se.

The format of this chapter is essentially identical to that of Chapter Two. The impacts reported for the structures or activities included in each section are presented in a catalog followed by a brief summary and discussion.

CHANNELIZATION

For the purpose of this report, channelization was construed to include the following types of projects: channel "improvement," excavation, enlargement, deepening, straightening, widening, and lining; snagging and clearing; and the construction of ditches and concrete chutes. It was found convenient to exclude from this section all channelization projects which involved only dredging and spoil disposal; these projects are included under the dredging and spoil disposal sections below. With the exception of three navigation projects involving new land excavation, the decision to exclude projects involving only dredging and spoil disposal served to restrict the projects falling in the channelization category to only flood control projects and multipurpose projects including flood control as a purpose.

The breakdown of the 77 projects included in this section is as follows: 29 flood control by channelization only; 32 flood control by channelization coupled with dikes, levees, etc.; eight flood control by dams and channels; five multipurpose projects involving dams and channels; and three navigation projects where the channel improvement involved the excavation of dry land.

Catalog of Impacts

I. Direct loss of land and/or productivity

The land use and number of acres involved were often reported. The various forms in which these impacts were described are outlined below:

A. Unspecified land use

Very often it was simply noted that the project would require the commitment of "x" acres of land.

B. Agricultural or grazing land

Practically all of these specified the number of acres; in a few cases the crop types lost were reported.

C. Forests, timberland, and forest products

Slightly more than half of these included the number of acres lost; two reported the types of trees lost.

D. Wetlands or marshlands

Approximately half of these included the number of acres lost. The following impacts were reported as a consequence of this loss of wetlands:

1. Elimination of the existing wetland "environmental community"
2. Disruption of wildlife migration patterns

E. Recreation land

F. Floodplain

Occasionally this was reported with no specification as to land use. The following ecological impacts were attributed to the loss of the floodplain:

1. Permanent alteration of the forest-water regimen of the remainder of the floodplain
2. Destruction of the floodplain ecosystem, or adverse effects on the ecology of the floodplain

G. Vegetation or trees

Often it was simply stated that the project would result in a loss of vegetation or trees.

H. Miscellaneous production losses

1. Commercial production of fish and crawfish
2. Gravel or sand quarries
3. Landowners' private fishing facilities

II. Loss of fish and wildlife habitat

The number of acres of wildlife habitat lost was reported in about ten percent of the cases.

A. Specification of habitat losses

In about twenty percent of the habitat losses reported, the particular wildlife types involved was reported. These included the following:

1. Upland game
2. Deer
3. Quail
4. Canada geese

B. Typical general statements describing habitat loss:

1. Decrease in the available space for biota
2. Reduction of the quality and quantity of the fishery and/or wildlife habitat
3. Compression of present habitat components and associated animal populations toward the river mouth
4. Reduction in the productivity of many biological elements of the aquatic and woodland ecosystems

III. Loss of fish and wildlife (as opposed to habitats)

This was frequently stated with little or no additional information. Often words like "minor" or "insignificant" were used to describe these effects. In about a third of the cases, the particular species involved were mentioned.

A. Specific losses of fish or fisheries

1. Elimination or decrease in stream fishery or fishery resources

A number of these fishery losses were reported as being caused by a loss in the natural channel. In particular, the loss of natural currents or deep holes and natural bottom were sometimes mentioned.

2. Adverse effect on anadromous fish

B. Specific losses of wildlife

1. Wood duck production

2. Upland game
 3. Fur-bearing animals
- C. Loss of hunting, fishing, or trapping opportunities
- In about half of the cases where this impact was mentioned, the number of man-days lost was also reported.

IV. Loss of the natural stream

In many cases the total number of miles of stream lost was reported.

A. Change in aesthetic quality

Phrases such as "minor aesthetic impact," "diminished visual aesthetics," and "visual scar on the natural setting" are typical of those used to describe this impact. Other descriptions employed include the following:

1. Substitution of an artificial and man-made shoreline for the natural shoreline
2. Change in the natural appearance and alignment of the stream
3. Lack of river variability

B. Loss of wild river

C. Loss of recreation potential of the natural stream

V. Loss of riparian vegetation or overstory

A. Loss of wildlife habitat

In a number of places the only vegetation of any significance is located along the stream bank, and hence it was noted that the loss of this vegetation represented a significant loss of wildlife habitat.

B. Decreased aesthetics

C. Increased light penetration

1. Loss of shaded area for fish
2. Increased water temperature

While this was the usual conclusion reached, in one case it was reported that there would be more heat exchange

with outer space and less with overstory leaf and limb surfaces resulting in greater diurnal energy fluctuations with a tendency to lower heat retention and hence a greater capacity for dissolved oxygen.

VI. Change in stream characteristics

A. Permanent effects on water quality

1. Change in turbidity

Both increases and decreases in turbidity were reported.

2. Decreased water quality due to swamp drainage

B. Increase in stream velocity

1. Increased bank erosion

2. Increased sediment load

3. Repositioning of river bottom substrate together with its associated benthos communities

4. Decrease in water temperature

In one case it was noted that this, together with the increased velocity, would "enhance the river's ability for self-purging of any oxygen-demanding pollutants."

5. Creation of unstable bottom conditions

6. Reduction of spawning, feeding, and nursery areas for young fish

7. Elimination of fish not capable of living in a strong current

C. Change in erosion/sedimentation characteristics

Both detrimental and beneficial impacts resulting from increases or decreases in erosion or sedimentation were reported with about the same regularity.

1. Increased aggradation downstream

a. Detrimental impact--reduction of sandbars and consequent reduction of nesting and hunting areas for waterfowl

b. Beneficial impact--elimination of sediment build-up and filling of wetland which would result in a loss of wildlife habitat

3. Change in rate of bank erosion
Here again both an increase in bank erosion and the control of bank erosion were reported.
 4. Decreased erosion around bridge piers
- D. Decreased frequency and duration of overbank flooding
1. "Alteration" of biota accustomed to periodic flooding
 2. Destruction of indigenous flora and fauna with the consequent loss of wildlife
 3. Reduction of soil moisture
- E. Lowering of the groundwater table
1. Localized reduction in soil moisture
 - a. Destruction of floodplain habitat
 - b. Reduction of growth rate of hardwoods
 - c. Destruction of flora and fauna
 2. Possible water supply problems
- F. Improved drainage
1. Elimination of mosquito breeding grounds
 2. Acceleration of runoff
 3. Loss of ability to retain surface water
 4. Loss of wildlife habitat
- G. Creation of oxbow lakes by channel straightening
1. Creation of nuisance (odor associated with excessive algae blooms)
 2. Creation of safety hazard (drowning)
 3. Creation of health hazard (toxin produced by certain algae; mosquitoes and other vectors)
- H. Impacts specifically related to concrete-lined channels
1. Degradation of aesthetics
 2. Reduction of groundwater recharge
 3. Prevention of growth of vegetation
 4. Restricted access and free circulation of humans and wildlife across stream
 5. Change in "channel characteristics"
- I. Improvement of fish habitat by channel deepening

VII. Loss or relocation of man-made structures, archaeological or historical sites

A. Archaeological sites

When mentioned, it was always noted that the possibility of such sites existing within the project boundaries would be further investigated.

B. Relocation or loss of buildings, bridges, highways, railroads, etc.

VIII. Miscellaneous adverse impacts

A. Detrimental effect upon the existing storm-sanitary sewerage system

B. Removal of attractive features "that caused a park to be established at the site in the first place."

C. "Reshaping" of small areas of natural rock outcropping

IX. Miscellaneous beneficial impacts

A. Aesthetic improvement

1. Reduction of debris in lagoon

2. Removal of unsightly dead trees and debris

B. Improved flow conditions

C. Creation of a green belt

D. Creation of hiking, bicycling, and horseback riding trails

E. Increase in the amount of water area

F. Improved access to forests via service roads resulting in better fire protection

G. Protection of wildlife habitat that might otherwise be lost to urban encroachment

H. Creation of an opening to the sea which would "enhance the ecology of the area"

I. Expectation that "the overall energy relationships ... can be expressed in a more favorable diversity of dominant life forms"

Summary and Discussion

A summary of the impacts reported for 77 channelization projects along with the approximate frequency with which they were mentioned is given in Table 3-1. The most immediately salient observation is the very low frequencies with which even the most obvious impacts were reported. The most commonly mentioned impact, the direct loss of land, was reported in less than half of the statements. This seemingly damning observation can be explained in part by noting that channelization projects include such a broad spectrum of activities and locations that one should not expect to find the same impacts reported for a majority of the projects. For example, snagging and clearing projects will not involve the direct loss of land, while a channel improvement project in downtown St. Louis will not destroy much wildlife habitat.

TABLE 3-1
Summary of Reported Impacts--Channelization
(based on 77 statements)

	<u>% of statements</u>
I. <u>Direct loss of land and/or productivity</u>	40 ⁺
A. Unspecified land use	10
B. Agricultural or grazing land	10
C. Forests, timberland, or forest products	15
D. Wetlands or marshlands	10
E. Recreation land	5
F. Floodplain	5
G. Vegetation or trees	10
H. Miscellaneous	5
II. <u>Loss of fish and wildlife habitat</u>	30
III. <u>Loss of fish or wildlife</u>	15
A. Specific losses of fish or fisheries	5
B. Specific losses of wildlife	*
C. Loss of hunting, fishing, or trapping opportunities	5

Table 3-1 is continued

Table 3-1 continued:

	<u>% of statements</u>
IV. <u>Loss of the natural stream</u>	30
A. Change in aesthetic quality	25
1. Decreased aesthetics	20
2. Improved aesthetics	5
B. Loss of wild river	*
C. Loss of recreation potential	*
V. <u>Loss of riparian vegetation or overstory</u>	20
A. Loss of wildlife habitat	5
B. Decreased aesthetics	*
C. Increased light penetration	5
VI. <u>Change in stream characteristics</u>	
A. Permanent effect on water quality	10
B. Increase in stream velocity	10
C. Change in erosion/sedimentation characteristics	
1. Increased aggradation downstream	
a. Detrimental impact	5
b. Beneficial impact	5
2. Increased erosion	
a. Detrimental impacts	5
b. Beneficial impacts	10
3. Change in rate of bank erosion	5
4. Decreased erosion around bridge piers	*
D. Decreased frequency and duration of overbank flooding	5
E. Lowering of the groundwater table	5
F. Improved drainage	*
G. Creation of oxbow lakes with their attendant problems	5
H. Impacts specifically related to concrete-lined channels	5
VII. <u>Loss of relocation of man-made structures, archaeological or historical sites</u>	10
VIII. <u>Miscellaneous negative impacts</u>	*
IX. <u>No adverse impacts reported</u>	5

⁺Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

As noted above, the most frequently reported impact was the direct loss of land, which was mentioned in about 40% of the statements. In approximately two-thirds of these statements the number of acres lost was reported, and in all but a few of these the land use was specified. In a number of statements mention was made only of a loss of vegetation or trees.

The second most frequently reported impact was the loss of fish or wildlife habitat, which was mentioned in about a third of the 77 statements included in the section. Very often nothing further was said. The number of acres and/or the particular species involved were mentioned very infrequently (in 10 percent and 20 percent, respectively, of those statements reporting a loss of habitat). When a statement did expand upon this loss it was likely to be in very general terms, e.g., "a reduction in the quality and/or quantity of game habitat."

The loss of fish or wildlife was reported in about fifteen percent of the statements, or about half as frequently as the loss of habitat was reported. Here again, very little in the way of additional information was presented. Also, these losses were frequently described as "minor" or "temporary."

A loss of the natural stream was reported in about 30 percent of the statements; in about one third of these the length of stream involved was noted. The resultant loss of the stream fishery and decreased aesthetics were frequently reported here.

The loss of riparian vegetation was noted in only twenty percent of the statements, and in most of these statements nothing more was said. Only four statements mentioned further implications of the loss of bank overstory and, as noted in the catalog, there was disagreement among these as to its effect on stream temperature.

While most of these channelization projects would appear to alter the stream regimen to some degree, possible impacts resulting from any of the changed stream characteristics were mentioned in fewer than ten percent of the statements. One change caused by channelization is the altered erosion and sedimentation patterns due to increased channel velocities. This impact was reported in very few statements and then, as can be seen in Table 3-1, the impacts were reported as beneficial as often as they were reported as detrimental. There were as many channelization projects

reporting the control of bank erosion as there were reporting increased bank erosion. Similarly, the division between adverse and beneficial effects relating to downstream aggradation was about equal.

Some overall observations drawn from these 77 projects are that the impacts are often worded in extremely general terms; and the implications are rarely carried beyond a rather superficial level. One further point worthy of mention is that five statements reported "no apparent or predicted adverse environmental effects" or "little or no adverse impacts."

DAMS AND RESERVOIRS

The environmental impacts relating to dams and reservoirs are summarized in this section. Twenty of the total of 55 projects analyzed for this section were for flood control only; the remaining 35 were multipurpose.

Catalog of Impacts

I. Direct loss of land and/or productivity

Typically the statements reported a loss of land due to inundation, or simply stated that the project would require the commitment of "x" acres of land.

A. Specification of type of land use lost

The land uses mentioned included:

1. Agricultural or grazing land
2. Forests or timberland
3. Wetlands or marshes

In addition, losses of "natural vegetation" and "natural area" were reported.

B. Commercial productivity

1. Mineral resources

Items mentioned in this category included: gravel operations, limestone quarries, oil and gas fields, and, simply, "mineral resources."

2. Commercial fisheries

3. Other

- a. Future real estate development
- b. Snakes

The rather unusual loss of the local population of copperhead snakes (a source of venom for research and anti-venom for snake bite treatment) was reported in one statement.

II. Loss or relocation of man-made structures, archaeological or historical sites

A. Archaeological or historical sites

It was typically reported that these sites would be relocated or "further investigated" before inundation.

B. Villages, dwelling units, etc.

1. Relocation or loss of entire towns
2. Relocation of families

One statement noted that an "adverse psychological and sociological impact" would occur to many of the people displaced by the project.

C. Highways, railroads, bridges, etc.

1. Inundation of jeep trails resulting in reduced forest accessibility with attendant forest fire control problems
2. Loss of wooded areas induced by the relocation of highways

D. Cemeteries

E. Existing recreational facilities

It was usually noted that these facilities would be relocated or the loss "mitigated." In one statement a loss of summer cottages was reported as leading to a decreased level of outdoor recreation.

III. Loss of wildlife habitat

A. Specification of habitat types

In particular, habitat losses for small game, upland game, fur-bearing animals, and prairie chicken (an endangered species) were reported. The inundation of goose nesting areas was also mentioned.

B. Loss of hunting opportunities

In about half of the cases where this was reported, the number of man-days of hunting lost was specified. The loss of waterfowl hunting was specifically noted on occasion.

C. Adverse effect on "the wildlife habitat equilibrium along the shoreline where the displaced wildlife relocate"

IV. Change in aesthetic quality

A. Decreased aesthetics

The following are typical of the variety of descriptions that were used to characterize adverse aesthetic impacts:

1. Loss of the natural stream
2. Loss of "pastoral scenery"
3. Decreased aesthetics from the borrow operations for the dam
4. Loss of scenic bluffs and canyons
5. Loss of a steep valley, rapids and pools
6. Loss of the vista from the river
7. Intrusion on the scenic views of the ocean and mountains

B. Increased aesthetics

The following are examples of the types of positive aesthetic impacts reported:

1. "Enhancement of the natural features of the physical environment"
2. Improvement on the "scenic attractiveness of the area since it would provide a man-made lake in a rather primitive environmental setting"
3. Addition of a "new and attractive feature to the mountain-foothill-valley landscape found in the basin"
4. "Enhancement and enlargement of the aesthetic and recreational potential of the dam area"
5. Creation of an "attractive lake"
6. Construction of a "major aesthetic asset"
7. Creation of a reservoir with "immense aesthetic value"

V. Loss or inundation of the natural stream

A. Loss of the stream fishery

1. Elimination of species dependent on a free-flowing stream
2. Loss of spawning areas
3. Loss of small-mouth bass
4. "Substantial reduction" in the number of steelhead caught
5. Loss of "x" man-days of fishing

B. Loss of recreational potential

1. Loss of white water recreation
2. Loss of stream "swimming holes"

VI. Environmental impacts of the reservoir, per se

A. Substitution of a lake for a stream and the ecological implications thereof

A statement such as, "the substitution of slack water for flowing water" was mentioned with no further elaboration in many cases. A sample of other reported impacts in this vein, along with some further implications thereof, follow:

1. Transformation from a "river ecology to a static lake ecology"
2. Replacement of a "complex forest ecosystem with a simple aquatic ecosystem"
3. Alteration of the "flora and fauna environment"
4. Creation of a "new water-based ecosystem"
5. Conversion of the ecosystem from "lotic to lentic"
6. Substitution of a "lake environment for the current fluvial setting"
7. Change in "character of the fishing"
8. Replacement of a "stream-type ecosystem with a locustrine environment"
9. Alteration of the "ecology of the river"
10. Replacement of "hydric" with "mesophytic" forest types with an overall reduction in water tolerant forests

B. Creation of a warm water fishery

This commonly noted impact was also reported as a "substitution of lake fishing for stream fishing"

C. Creation of mosquito breeding grounds

D. Creation of wildlife habitat

1. Creation of feeding and nesting areas for a variety of waterfowl

2. Creation of a stopover for migratory birds

3. Creation of a "desert riparian community"

It was reported that this would "benefit wildlife by providing drinking water, improving soil moisture conditions, and enhancing the establishment of herbaceous and wood plants."

4. Make possible the growth of shoreline riparian vegetation

It was further noted that this would increase the present "edge-effect ratio" which would prove advantageous as this is the area where greatest wildlife diversification and density persists.

5. Creation of a larger water area which would "support an increased population of aquatic-oriented fur-bearers"

E. Preservation of open space

VII. Alterations in water quality due to impoundment

The following impacts were reported as possible:

A. Thermal stratification

1. Detrimental effect on water quality

2. Dissolving of iron and manganese

3. Production of hydrogen sulfide

4. Depression of pH

5. Reduction of aerobic biodegradation

B. Growth of algae, phytoplankton, zooplankton, etc.

1. Creation of aesthetically unpleasing scum

2. Taste and odor problems

3. Provision of food for a large number of resident fish per acre

4. Reduction of hardness due to algae production of carbon dioxide and subsequent precipitation of calcium carbonate
- C. Impoundment of nutrients and wastes
1. Decreased water quality
 2. Increased rate of eutrophication
In one case it was reported that this would result in degradation of downstream water quality.
 3. Enhancement of the fishery
 4. Taste and odor problems
 5. Increased demands on dissolved oxygen
 6. Improvement of downstream water quality (by impoundment of wastes)
 7. "Organic contamination"
- D. Increased water temperature
1. Adverse effect on composition of fish species inhabiting the reservoir
 2. Possible occurrence of inadequate dissolved oxygen
- E. Increased evaporation
1. Increase in total dissolved solids (TDS)
 2. Loss of water for downstream flows
- F. Larger detention times and lower velocities
- In a few cases it was reported that this could possibly lead to reductions in turbidity, color, biochemical oxygen demand (BOD), and the density of coliform bacteria. Other reported implications of increased detention times and decreased velocities were:
1. Less mixing
It was reported that this might cause wastes formerly distributed through the system to hug the shoreline.
 2. Decreased reaeration resulting in decreased dissolved oxygen (DO)
In one case it was stated that the larger volume and surface area of water plus factors of "reservoir dynamics" would offset any reduction in re-oxygenation capacity due to increased temperatures and decreased velocities.
 3. Reduction of bottom scour

VIII. Impacts resulting from the dam as a barrier

- A. Increased sediment deposition^{*}
 - 1. Aggradation of impoundment area
 - 2. Detrimental effect on aquatic plants
 - 3. Progressive change in aquatic habitat
- B. Loss of anadromous fish runs
Particular species mentioned included salmon, grayling, pike, and steelhead.
- C. Adverse effects on other projects on the river

IX. Impacts due to spillways

- A. Nitrogen gas supersaturation during high spillway flows resulting in fish kills downstream
- B. Incremental replenishment of D.O.
- C. Decreased aesthetics due to cut in hillside
- D. Loss of productive forests

X. Downstream effects

In one statement it was simply stated that "some adverse ecological effects to the downstream system may result."

- A. Decreased silt or sediment load in river
 - 1. Increase in erosion of downstream channel
 - 2. Improvement of water quality downstream
 - 3. Extension of downstream reservoirs
 - 4. Improvement of visual scenery downstream
 - 5. Enhancement of floodplain below the dam
- B. Effect on fishing and fish habitat
The following opposing impacts were reported:
 - 1. Improvement or enhancement of the downstream fishery
 - 2. Net gain in number and variety of fish
 - 3. Decline in the downstream fishery

*Downstream effects resulting from this increased sediment deposition are included below in item X.A.

C. Flow regulation or augmentation

1. Improvement of downstream water quality
2. Increased attractiveness of the stream
3. Enhancement of the recreational capabilities of the river
4. Reduction of mosquito problems downstream
5. Elimination of the flushing action of flood flows
6. Enhancement of the downstream fishery

In one instance it was noted that this would be true only if a multilevel outlet were used.

7. Reduction of downstream waste treatment costs
8. Reduction of the downstream effect of irrigation return flows
9. "Stabilization of downstream resources"

D. Increased stream temperature

1. Decreased dissolved oxygen (D.O.)
2. May violate stream temperature criteria

E. Increased turbidity during flood flows or when gates opened to flush sediment out of reservoir

1. Fish will be made unavailable to sport fishermen
2. Non-adherence to water quality standards
3. Salmon and steelhead mortalities

XI. Effects on groundwater resources

A. Increase in groundwater recharge

1. Reduction of salt water intrusion
2. Pollution of groundwater aquifers

B. Reduction of recharge below the dam

One statement reported a reduction in the groundwater recharge capability of the coastal plain. It was further noted that this reduction plus continued pumping would result in the increased possibility of salt water intrusion.

XII. Effects of periodic inundation or a fluctuating shoreline

One statement reported simply that this would "adversely affect the ecosystem."

A. Effects on wildlife

1. Temporary displacement of wildlife or loss of wildlife habitat
2. Decrease in the "quality of the wildlife habitat"
3. Possible flooding of wildlife refuge during the critical nesting period
4. Increased plant growth with the resultant attraction of ducks

B. Effects on vegetation

1. Possible damage to vegetation

It was occasionally noted that the area would be replanted with water tolerant vegetation if damage occurred.

2. Acceleration of plant growth due to silt deposition

The following statements were also reported: Periodic inundation is "not expected to be detrimental to the terrestrial environment"; "periodic inundation would convert a desert ecology to a vegetative ecology."

C. Decreased aesthetics during low storage periods

1. Reduction of the scenic qualities of the shore
2. Destruction of the shoreline
3. Exposure of unsightly mudflats

D. Creation of "shoreline management problems"

E. Infrequent and brief inundation of rare fossil deposits or archeological sites

XIII. No adverse environmental impacts

This alone was stated on occasion. Other typical statements in this vein follow:

- "Losses are minimal or may not occur at all."
- "Since the project is in an urban area, where existing features are all man-made, and since there are no natural environmental elements present (Flora, fauna, etc.) it follows that there is no impact."

Summary and Discussion

Table 3-2 summarizes the impacts due to dams and reservoirs and gives the frequency with which each major category of impact appeared in the 55 related environmental statements.

As in the case of channelization, the most frequently reported impact was the direct loss of land or commercial productivity. Approximately 80 percent of the statements reviewed for this section reported this loss; in about three quarters of these the number of acres which would be committed was specified. In practically all of these statements the present use of the land that would be lost was specified.

A loss of man-made structures and cultural items was noted quite frequently. However, in only a very few cases was a further implication of this impact noted. One of these was reference to the "adverse psychological and sociological impact" upon the persons displaced by the reservoir.

The loss of wildlife habitat was reported very nearly as often as was the loss of land. As was the case with the channelization projects, however, this impact was very often described with a simple statement, such as, "The project will result in the loss of wildlife habitat." In about twenty percent of the statements mentioning habitat losses, the loss was quantified in acres; the particular wildlife involved was specified in about fifteen percent of these statements. When a species was mentioned, it was typically a game animal or one with commercial worth, e.g., fur-bearing animals.

Aesthetic quality was a topic of mention in about 35 percent of the 55 statements. An increase in aesthetics was reported more often than a decrease or loss of aesthetics. There is, of course, a value judgement involved here. It is interesting to note, however, that among the writers of these statements, a lake or reservoir is generally considered more scenically attractive than a natural stream. Perhaps this value judgement should have been identified as just that, and the decision left to the reader.

The inundation of the natural stream was reported in 60 percent of the statements, although not stated as such in some of these. Approximately 80 percent of these quantified this loss in miles of stream. Another 65 percent of these mentioned the resultant loss of the stream fishery, although this was very frequently described as a "substitution

TABLE 3-2
Summary of Reported Impacts--Dams and Reservoirs
 (based on 55 statements)

	<u>% of statements</u>
I. <u>Direct loss of land and/or productivity</u>	80 ⁺
A. Specified land uses	
1. Agricultural or grazing land	40
2. Forests or timberland	25
3. Wetlands or marshes	5
B. Commercial productivity	
1. Mineral resources (gravel, limestone, oil, gas, etc.)	5
2. Commercial fisheries	*
II. <u>Loss or relocation of man-made structures, archaeo- logical or historical sites</u>	
A. Archaeological or historical sites	10
B. Homes or villages	30
C. Highways, railroads, and other transportation facilities	10
D. Cemeteries	5
E. Recreation facilities	5
III. <u>Loss of wildlife habitat</u>	75
A. Specification of habitat type	10
B. Loss of hunting opportunities	10
IV. <u>Change in aesthetic quality</u>	
A. Decreased aesthetics	15
B. Increased aesthetics	20
V. <u>Loss or inundation of the natural stream</u>	60
A. Loss of the stream fishery	40
B. Loss of recreation potential	5
VI. <u>Environmental impacts due to the reservoir, per se</u>	
A. Substitution of a lake environment for a stream environment	35
B. Creation of a warm water fishery	45
C. Creation of wildlife habitat	30

Table 3-2 is continued

Table 3-2 continued:

	<u>% of statements</u>
VII. <u>Alterations in water quality due to impoundment</u>	**
A. Thermal stratification	15
B. Growth of algae	10
C. Impoundment of nutrients and wastes	15
1. Decrease in water quality	*
2. Increase in rate of eutrophication	5
VIII. <u>Impacts resulting from the dam as a barrier</u>	
A. Increased sediment deposition	15
B. Loss of anadromous fish runs	5
IX. <u>Impacts due to spillways</u>	*
X. <u>Downstream effects</u>	
A. Decreased silt or sediment in downstream channel	10
1. Increased erosion downstream	10
2. Increased water quality downstream	5
B. Improvement or enhancement of downstream fishery	30
C. Flow regulation or low flow augmentation	
1. Improvement of water quality downstream	35
2. Improvement of downstream aesthetics	5
3. Improvement of recreation downstream	10
4. Reduction of mosquito problems downstream	5
XI. <u>Effects on groundwater recharge</u>	15
XII. <u>Effects of periodic inundation or a fluctuating shoreline</u>	35
A. Adverse effects on wildlife	15
B. Adverse effects on vegetation	10
C. Decreased aesthetics at low reservoir stages	15
XIII. <u>No adverse environmental impacts</u>	5

[†]Numerical values are rounded to the nearest five percent.

* This symbol (*) is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

** All water quality impacts included in the catalog--but not below--were mentioned in fewer than five percent of the statements.

of a lake fishery for the stream fishery," and often with adjectives such as "poor" or "marginal", modifying stream fishery, and "good" or "higher quality", modifying lake fishery. The number of man-days of fishing lost was reported in approximately ten percent of these statements. The loss of the recreation potential of the natural stream was reported in only a few cases, and then had usually been brought to light by a reviewing agency.

The substitution of a lake for a stream was reported in about 35 percent of the 55 statements. This impact was typically reported in "eco-terminology" as noted in the catalog, but generally little more than the obvious was said. These "jargon-loaded" phrases shed little light on the actual impacts, and offer small assistance to a decision maker reading these statements. One implication of this reservoir substitution which was frequently noted was the creation of wildlife habitats; this was reported in about 30 percent of the 55 statements.

A number of possible water-quality impacts due to impoundment were reported in the statements, none of them with any great regularity, however. The most commonly reported impacts were those resulting from stratification (fifteen percent), the impoundment of nutrients and wastes (fifteen percent), and the growth of algae (ten percent). All other water quality impacts reported were mentioned in fewer than five percent of the statements. In many of the statements which did report stratification, impoundment of nutrients, or algae growths, no further implications were given. The impacts which are listed under these headings in the catalog were generally reported only once each, and often came from the same statement. Thus, the majority of those statements reporting anything at all here were stating possible impacts in the most general of terms, e.g., "the reservoir will impound nutrients from upstream," or "thermal stratification may occur." It is debatable whether sentences such as these can really be called impacts; the worth of such statements to the reader and/or decision maker is obviously questionable.

Impacts resulting from the dam acting as a barrier were very infrequently reported. Increased sediment deposited behind the dam was mentioned in fifteen percent of the statements and the blocking of anadromous fish runs in about five percent.

A number of downstream effects were noted, although again not with

great frequency. Those mentioned most often were the beneficial effects of water quality improvement due to low flow augmentation (35 percent) and the enhancement of downstream fisheries (30 percent). Only ten percent of the statements mentioned increased downstream erosion as a result of the decreased sediment load of the water leaving the reservoir. This relatively low figure is noteworthy, because increased downstream erosion is an impact that has been fairly common knowledge among hydraulic engineers for a number of years.

The effects of a fluctuating shoreline due to flood control storage was noted in about 35 percent of the statements. Approximately 40 percent of these specified the number of acres that would be subject to periodic inundation. Effects on wildlife, vegetation, and aesthetics were frequently mentioned here.

Again, some statements reported that there would be no adverse impacts due to the project.

LEVEES

The environmental impacts reported for levees in 46 projects are summarized below.

Catalog of Impacts

I. Modification of land cover

A. Destruction of wildlife habitat

The species and/or land areas involved were sometimes mentioned, e.g., loss of wintering habitat for ringneck pheasant. In one instance the seriousness of the loss was discussed.

B. Elimination of vegetation

1. Loss of wildlife habitat

In one case a loss of hunting opportunity was noted.

2. Removal of trees

The relative scarcity of trees was noted in one case. Also, in some cases the fact that the trees were old and/or large was mentioned.

3. Reduction of riverbank overstory

It was reported that this would lead to increased solar

radiation and a consequent increase in river temperature.

4. Loss of open space or green space

II. Modification of flow pattern

A. Change in drainage

1. Improved drainage with a consequent lowering of the ground water table
2. Inundation of a slightly larger area during the occurrence of flooding outside the levee
3. Increased possibility of "interior flooding"

B. Adverse effects on fish life and habitat

1. Blocking of normal passage route for salmon fry
2. Destruction of salmon habitat in low-flow area and creation of salmon habitat in high-flow channel

III. Visual aesthetic issues

A. Obstruction of view of river or channel

B. Detraction from scenic qualities

1. Reduction of visual aesthetics
2. Substitution of an "artificial man-made appearance" for a natural one
3. Restriction of view of a scenic natural area
4. Loss of natural embankment

C. Change in overall appearance of the area

In several cases it was noted that the "aesthetics would be altered" with no further elaboration.

D. Use of landscaping to improve scenic qualities of levee

One statement noted as a positive impact that the levee would "screen" an ugly urban landscape.

IV. Reduced accessibility

A reduction (in one case simply a change) in the accessibility to the river for man and/or wildlife was reported.

V. Vector control issues

Both the reduction and creation of mosquito breeding grounds was reported

VI. Impacts relating to borrow operations

A. Loss of vegetation

The area and type were sometimes specified, e.g., loss of 75 acres of grassland.

B. Loss of wildlife habitat

The area was sometimes specified; the destruction of "established plant and sedentary animal communities" was reported in one case. However, it was noted that similar communities could be found nearby, with the implication that the loss was not too serious.

C. Increase in turbidity

In one case it was reported that silt introduced into the river would settle in a downstream reservoir, thereby reducing its storage capacity.

D. Temporary effect on fisheries

VII. "Adverse impacts on adjacent historical site"

Summary and Discussion

As seen from Table 3-3, which summarizes the nature of the issues, the most commonly reported impacts were related to the elimination of vegetation and wildlife habitats and alteration in the appearance of the area. For the most part, the land modification impacts were reported in very general terms with such simplistic indicators as areas and species involved not generally given. The aesthetic issues were described in even more general terms using such stock phrases as "reduced visual aesthetics" or "detraction from scenic qualities." While the description of alterations in aesthetic qualities is admittedly not a simple matter, the descriptions generally reported hardly enabled the reader to understand the issues involved at even a superficial level. In a few cases a "change in aesthetics" was reported with no further elaboration.

TABLE 3-3

Summary of Reported Impacts--Levees

(based on 46 statements)

	<u>% of statements</u>
I. <u>Modification of land cover</u>	
A. Destruction of wildlife habitat	20 ⁺
B. Elimination of vegetation	20
1. Loss of wildlife habitat	10
2. Removal of trees	10
3. Increased river temperature	*
II. <u>Modification of flow pattern</u>	
A. Change in drainage	10
B. Adverse effect on fish life and habitat	5
III. <u>Visual aesthetic issues</u>	
A. Obstruction of river view	5
B. Detraction from scenic qualities	20
C. Change in overall appearance	10
D. Use of landscaping to improve scenic qualities of levee	10
IV. <u>Reduced accessibility</u>	10
V. <u>Vector control issues</u>	5
VI. <u>Impacts relating to borrow operations</u>	
A. Loss of vegetation	5
B. Loss of wildlife habitat	5
C. Increased turbidity	5
D. Temporary adverse effect on fisheries	*
VII. <u>Adverse impacts on adjacent historical site</u>	*

⁺Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

Although a rather small portion of the statements focused on the impacts relating to borrow operations, those that did clearly demonstrate that this aspect of levee development is deserving of more attention than it received. Much the same can be said of the reduced accessibility issue.

DREDGING

The environmental impacts reported in 41 projects entailing dredging are summarized below.

Catalog of Impacts

I. Change in water quality

A. Increase in turbidity

Very often the terms "temporary" and "minor" were used to characterize the shift in turbidity.

1. Adverse effect on fish life and habitat

In one case the interference was described in terms of fish passage and rearing.

2. Smothering effect on bottom organisms

B: Increase in siltation and/or silt deposition

In one case damage to a spawning area was mentioned.

C. Suspension of bottom sediments

1. Release of phosphorous, some organic-nitrogen, ammonia-nitrogen and other nutrients

2. Release of mercury

3. Release of low-level radioactive wastes

D. Increase in suspended solids concentration

1. Increase in hardness and alkalinity

2. Decreased photosynthetic activity resulting from reduced light penetration

E. Increase in color

F. Improved water quality resulting from removal of polluted bottom sediments

II. Disturbance of bottom organisms

This was described in terms of smothering, destruction or removal of bottom organisms.

III. Damage to fish life and habitat

A. Interruption of shad runs during spawning period

B. Possible loss of salmon and steelhead spawning areas

The percentage of the total number of spawners disturbed was reported in one instance.

C. Removal of log cribs and the consequent elimination of breeding and feeding areas for fish

IV. Damage to waterfowl

In one case it was mentioned that noises may interrupt feeding, breeding and nesting of waterfowl.

V. Loss of stream and riparian vegetation and wildlife habitat

In some instances it was noted that vegetation was already in short supply.

VI. Destruction of archeological sites

VII. Temporary hazards for boaters

Summary and Discussion

With the exception of an increase in turbidity, all impacts reported as being associated with dredging on inland waters were mentioned in ten percent or fewer of the 41 statements reviewed for this section (see Table 3-4). In almost all cases where an increase in turbidity was reported, the implications of such an increase were not mentioned at all. One possible explanation is that the turbidity increases were often characterized as being "temporary and minor"; also the implication was often made that such increases in turbidity would be inconsequential.

The effects on water quality of disturbing bottom sediments received relatively little attention. This is an issue that probably deserves a good deal more consideration than it has received up to now. Unfortunately

TABLE 3-4
Summary of Reported Impacts--Dredging
 (based on 41 statements)

	<u>% of statements</u>
I. <u>Change in water quality</u>	40 ⁺
A. Increase in turbidity	5
1. Adverse effect on fish life and habitat	*
2. Smothering effect on bottom organisms	5
B. Increase in siltation and/or silt deposition	5
C. Suspension of bottom sediments	5
D. Increase in suspended solids concentration	5
E. Increase in color	5
F. Improved water quality resulting from removal of polluted bottom sediments	*
II. <u>Disturbance of bottom organisms</u>	10
III. <u>Damage to fish life and habitat</u>	5
A. Interruption of shad runs during spawning	5
B. Possible loss of salmon and steelhead spawning areas	*
IV. <u>Damage to waterfowl</u>	*
V. <u>Loss of stream and riparian vegetation and wildlife habitat</u>	10
VI. <u>Destruction of archaeological sites</u>	*
VII. <u>Temporary hazards to boaters</u>	*

⁺Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

it is not a subject that has been studied intensively, and therefore its infrequent mention in these statements is not surprising.

The smothering, destruction, or removal of bottom organisms was reported in about ten percent of the statements. However, no attempt was made to pursue the implication of these disturbances to benthic communities.

The fact that the bottom organisms would be disturbed does not convey the sort of information that would be useful to potential decision makers.

The reported impacts relating to losses in vegetation and wildlife were especially vague. While dredging was noted as the cause of such losses, their nature and severity was generally unclear.

SPOIL DISPOSAL

Many projects involving dredging made no mention at all of plans for the disposal of spoil. In several cases where project descriptions mentioned spoil disposal there were no environmental impacts reported.

The environmental impacts relating to spoil disposal reported in the 28 projects mentioning this activity are summarized below.

Catalog of Impacts

I. Creation of land areas

A. Filling of low areas

In one case it was noted that mosquito breeding areas would be reduced; in another the possible creation of mosquito breeding areas was noted.

B. Creation or enlargement of islands

1. Creation of wildlife habitat
2. Elimination of danger to water craft

C. Beach replenishment

In one case it was noted that beach replenishment would provide a "protective barrier" for a breakwater.

D. Reclamation of woodland

The destruction of wildlife as a consequence of this was also reported.

E. Levee construction

II. Destruction of land areas

In many cases the areas involved were specified.

A. Forests

1. Loss of vegetation and bottom land hardwood

2. Loss of low-grade timber
- B. Vegetative cover and/or wildlife habitat
In one case it was noted that "natural growth will reclaim the area in a short time."
- C. Lake bottom
 1. Change in ecology
 2. Adverse effect on fish and wildlife food production
In one case, for example, the covering of feeding and spawning areas was noted.
- D. Natural backwater slough
The loss of vegetation and nursery for aquatic life was mentioned.

III. Aesthetic issues

- A. Adverse odors from organic matter in spoil
- B. Loss of visual aesthetics
A decrease in property values as a result of this was mentioned.
- C. Increased aesthetics
In one case the "preservation of aesthetic values" was mentioned in describing spoil placement.

IV. Runoff from spoil disposal areas

- A. Water pollution
In one statement the issue of polluted runoff from inland spoil disposal areas was noted by a reviewing agency, but this was as a general observation, and not a project impact per se.
- B. Vegetation damage due to high sediment load of runoff from spoil
This possibility was mentioned in one statement.
- C. Increased suspended solids in water
In the one case where this was mentioned in regard to spoil

disposal, it was reported that it would result in a disruption of fish breeding and spawning.

V. Miscellaneous

A. No impacts

In several cases the disposal site was mentioned but the consequences of disposal were not discussed.

B. Temporary adverse effects

This was simply stated in reference to spoil disposal in a number of instances; no further discussion was given.

Summary and Discussion

Spoil disposal for projects on inland waters involving dredging seemed, on the basis of casual observation, to be the single item that was most commonly either omitted completely in the description of impacts, or discussed very briefly. There were many projects involving dredging that made no mention at all of spoil disposal. In several cases where project descriptions made mention of spoil disposal, there were no environmental impacts reported.

This lack of mention of spoil disposal and/or related impacts was not nearly as notable in the environmental statements involving dredging and spoil disposal for coastal projects (see Chapter Two). It is difficult to isolate the precise reason for the neglect of spoil disposal related issues in the inland project statements, but a partial explanation may be that spoil disposal plans were not yet completed for several projects at the time the environmental statements were prepared. Still another reason may be that the volumes of dredged material were so small as to be of little significance. Whatever the reason, a concerted effort to keep track of the ultimate disposition of dredged material is in order.

The impacts reported in five percent or more of the 28 statements mentioning spoil disposal are summarized in Table 3-5. As might be expected, the most commonly reported impacts related, in one way or another, to the way in which land forms would be modified. Most of these modifications were reported as adverse consequences (e.g., "loss of bottom land hardwoods"), however, there were some changes that were considered to be beneficial. The question of whether a land form modification is beneficial

TABLE 3-5
Summary of Reported Impacts--Spoil Disposal
 (based on 28 statements)

	<u>% of statements</u>
I. <u>Creation of land areas</u>	
A. Filling of low areas	5 ⁺
B. Creation or enlargement of islands	5
II. <u>Destruction of land areas</u>	
A. Forests	5
B. Vegetative cover and/or wildlife habitat	20
C. Lake bottom	10
III. <u>Aesthetic qualities</u>	
A. Loss of visual aesthetics	5
B. Adverse odors	10
IV. <u>Runoff from spoil disposal areas</u>	10
V. <u>Miscellaneous</u>	
A. Mention of disposal site but no impacts	**
B. "Temporary adverse effects"	**

⁺Numerical values are rounded to the nearest five percent.

** Commonly mentioned; no statistics kept.

or detrimental in most cases involves a value judgement; however, the description of these modifications were not generally given in these terms.

The impairment of "aesthetic qualities" was mentioned occasionally. The main concerns related to foul odors generated by the natural decomposition of organic matter contained in the spoil. To a somewhat lesser degree, there was concern for the appearance of the spoil disposal areas. The descriptions characterizing these visual impacts were quite terse, as exemplified by the phrase "loss of visual aesthetics."

The issue of polluted runoff from spoil disposal areas was noted in three of the 28 statements. The low frequency of occurrence, and the reported concern with only solids concentrations, suggests that impacts relating to runoff from spoil disposal areas received limited attention.

CONSTRUCTION ACTIVITIES

The impacts summarized in this section are those arising from the actual construction of projects, as opposed to impacts due to the project itself after completion. The items in the catalog below represent all the impacts due to construction activities, with the exception of those due to dredging and spoiling,* that were reported in the 174 statements reviewed for this chapter.

Catalog of Impacts

I. Increased turbidity and/or siltation (due to activities other than dredging)

In approximately half of the cases this was reported as "temporary and/or minor!"

- A. Adverse effect on aquatic life
- B. Violation of water quality standards
- C. Possible adverse effects on downstream spawning beds
- D. "Sediment damage"
- E. Decreased aesthetics due to coloration

II. Adverse effects on fish and wildlife

- A. Some fish kills due to blasting
- B. "Short-term effect on aquatic ecology"
- C. Adverse effect on fish habitat
- D. Possible disturbance of an endangered species
- E. Temporary disturbance of biological systems

III. Disruption of vegetation

A. Construction scars

In one case it was reported that it would "... require five to ten years for natural ecological relationships to return to the disturbed areas."

*These impacts are summarized in the Dredging and Spoil Disposal sections above.

- B. "Adverse effect on vegetation"
- C. Accelerated erosion due to loss of vegetation
- D. Loss of wildlife habitat
- E. Decreased visual aesthetics

IV. Borrow operations

- A. Loss of productive forests
- B. Loss of "x" acres of "natural environment"
- C. Loss of vegetation
 - 1. Disruption of "herbaceous cover"
 - 2. Destruction of "established plant and sedentary animal communities"

V. Increased noise and/or dust

VI. Traffic congestion and/or inconvenience

- A. Temporary interruption on roads or railroads
- B. Short-term inconvenience in an urban area
- C. Limited access to recreation areas during construction
- D. Public inconvenience due to the presence of heavy equipment

VII. Disposal of cleared brush and trees

- A. Air pollution due to open burning
- B. Disposal by inundation
 - 1. Pollution of water with debris
 - 2. Depression of pH
 - 3. Reduction of dissolved oxygen

VIII. Short-term social impacts due to increased school enrollments from the construction crews' families

Summary and Discussion

A summary table is not included in this section for two reasons: (1) The catalog is so short and sparse as to be effectively little different from a table; (2) There was no construction activity which was

reported in ten percent or more of the 174 statements included in this section. Again, it should be noted that dredging and spoiling activities are included in separate sections and not cataloged herein. However, even if one uses only the 138 flood control and multipurpose projects to compute the percentages, there are still no impacts which were mentioned in more than ten percent of the statements.

The most frequently reported impact was an increase in turbidity and/or siltation. As was the case when this impact was reported for dredging, the words "temporary" and/or "minor" were often used to describe this effect. The comments given in the discussion in the Dredging section concerning increased turbidity apply equally well here. Further implications of turbidity increases were mentioned in only a few of the statements.

Effects on fish and wildlife resulting from construction were occasionally reported. Here also, they were often described as only "temporary" or "short-term" effects. Impacts due to blasting, which one would imagine to be a fairly common construction activity, were mentioned in only one statement.

A number of statements reported adverse impacts on the adjacent vegetation due to construction activities. Some of these simply stated that there would be an "adverse effect on vegetation."

Borrow operations and their related impacts were reported in only five statements aside from those projects where they formed an integral part of levee construction. (See the section on Levees above).

An increase in noise and/or dust was mentioned in only seven statements. Traffic congestion or temporary inconvenience due to construction was reported in six statements.

The impacts resulting from the disposal of cleared brush and trees, an activity common to many projects, was mentioned in very few statements. All of these reported temporary air pollution due to the burning of the brush; one discussed the impacts due to an alternative disposal method--inundation.

The low frequency with which impacts related to construction activities were mentioned is quite striking. It may be that the writers of these statements were lumping construction activities in with the overall project impacts when they reported a loss of vegetation or wildlife. It

may be, also, that many of the projects were not far enough along in the planning process to detail the construction processes, and hence no impacts thereof could be discussed. Whatever the reason, impacts due to construction warrant more consideration than they have been given.

MISCELLANEOUS STRUCTURES AND ACTIVITIES

The structures and activities discussed in this section appeared rather infrequently--there were less than eight environmental statements involving any single item. Rather than employ a large number of short sections, we found it convenient to group these miscellaneous items together. The structures and activities in this class are simply listed below together with their reported impacts.

Catalog of Impacts

Breakwaters

A. Adverse impacts

The following adverse impacts were reported among the seven projects involving the construction of breakwaters:

1. Some interference with small boats
2. Small disturbance to the natural setting
3. Increase in beach erosion
4. Loss of existing vegetation

One statement qualified this by saying that it would not cause a "significant impact on the terrestrial ecology."

5. "Possible effects on the shoreline"

B. Beneficial impacts

1. Reduction of wave action in harbor
 - a. Provision of an ideal resting place for migratory waterfowl
 - b. Possible attraction of fish
2. Scenic improvement to the shoreline environment
3. Physical change of the bottom

One statement reported that the rocky slopes of the breakwater would provide new bottom habitat. This would induce a more complex system of bottom organisms, which would, in turn, lead to a greater variety of fish species.

Locks

- A. Loss of land and associated vegetation due to the pool created by the lock
- B. Increase in fishing potential due to pool created
- C. Increase in noise level due to operation of locks
- D. "Subtle effect on the appearance of the area"
- E. Interference with anadromous fish runs

Kellner type jetties

In the three projects where these were to be used there was unanimous agreement that they would "detract from scenic qualities."

Power generating units

- A. Increased powerplant discharges during low flows
 - 1. Increase in the rate and frequency of river and pool fluctuations
It was reported that this would, in turn, produce the following adverse impacts:
 - a. Lakeshore erosion
 - b. Decrease in the biological potential due to problems with the beaching of small boats
 - 2. Increased velocities and turbulence downstream
- B. Less air pollution
This was mentioned as an indirect beneficial impact via the substitution of a hydroelectric facility for a thermal plant.

Power transmission lines

In the one project where this was reported, "some aesthetic effect" was mentioned.

Debris basins

- A. Loss of riparian woodland
- B. Eradication of existing biota

- C. Disruption of wildlife and wildlife habitat
- D. "Little or no effect on the existing aquatic environment"

Debris rack

In one case this was reported to severely restrict fish movement.

Riprap

- A. Obliteration of shore zone benthos
- B. Provision of a "firm substrate for the establishment of aufwuch communities"*

Debris removal from public harbors

- A. Possible air or land pollution problems resulting from debris disposal
- B. Loss of fish habitat resulting from the removal of sunken vessels

Bridge replacement

- A. Dredging impacts (included in the section on Dredging, above)
- B. Noise
It was reported that the noise from the bridge might interrupt the feeding, breeding, and nesting of waterfowl.

Interbasin transfers or exports of water

- A. Possible acid flows into unpolluted reservoirs during high flows
- B. Adverse ecological effects downstream in the delta due to lower flows resulting from the export of water from the basin

*"A German ecological term identifying the total assemblage of attached and free-living plants and animals of a submerged substrate, but do not penetrate it" [sic].

C. Exchange of water and aquatic biota between river systems

The following points were mentioned in regard to this:

- "... most fish species shared by the two river systems will not be altered to a great degree."
- The effects of the intermixing of fish species is unknown.
- "The mixture of botanical or other zoological forms is unlikely to result in an ecological imbalance."
- The effect on the mixing of larval insects (a major constituent of the stream benthos) is expected to be minor.

Building to house a hydraulic model and technical center with attendant parking facilities

A. Clearing of vegetation

1. Reduction in ground water percolation
2. Loss of wooded area
3. Possible high sediment loads during construction

B. Discharge of water from the model

It was reported that highly saline discharges could cause local shifts in estuarine plants and animals.

Sump (for flood control pumping plant)

A health danger was implied.

No impacts

The following miscellaneous structures or activities were reported to cause no known adverse environmental impacts: (Beneficial impacts, where given, are included in parentheses.)

- A. Modification of fish ladders, modification of spillway gates by increasing height, and acquisition of land
- B. Construction of additional gated openings in an existing sewer
- C. Installation of flap gates on culvert modification of culvert headwall
- D. Land acquisition for wildlife management (mitigation)

- E. Management of an existing lock and dam to provide a seasonal fish and wildlife pool
- F. Highway viaduct (would improve traffic conditions)
- G. Relocation of sewer outfall (would reduce pollution by placing in location where tidal flushing was better)
- H. Land or bank stabilization (This was reported to reduce erosion and turbidity, the later served to benefit the fishery.)
- I. Underground conduit (It was reported that this would improve the city appearance and traffic conditions by eliminating the present flow of irrigation waste water in the streets.)

Summary and Discussion

For obvious reasons there is no summary table of impacts included for the miscellaneous structures and activities. The rationale for a summary discussion is somewhat weak, since it would be difficult to justify any conclusions based on such small numbers of statements relating to each of the structures and activities. However, we feel justified in making a few observations.

In the case of breakwaters, the sample size is large enough (seven) to warrant the conclusion that possible impacts were not thoroughly investigated. While breakwaters often have a marked influence on beach (or more generally, shoreline) erosion, only two of the seven statements even mentioned this possibility. In the case of one of these two, only the phrase "possible effects on the shoreline" was mentioned. Furthermore, these seven statements generally ignored the influence of breakwaters on flow circulation patterns, or on bottom organisms.

Of the activities in the miscellaneous category, the "interbasin transfer of water" warrants a special note. While such transfers may have occurred in other projects it was specifically mentioned in only three or four. Although interbasin transfer could have important and far-reaching impacts, they were given relatively little consideration. One project in particular involved the intermixing of the water and biota of two river systems. The reported possible impacts due to this intermixing were generally dismissed as being "minor," "insignificant," or "unlikely."

Most of the other structures and activities in this miscellaneous category also received rather casual treatment. However, it is difficult to generalize on the basis of such small sample sizes. Furthermore, many of these structures and activities were a very small part of a larger project, and therefore their impacts were either included in those attributed to the whole project or overshadowed by the impacts resulting from other parts of the project.

Before leaving this section, mention might also be made of the large number of statements in this miscellaneous category which reported "no known adverse impacts."

PROJECT PURPOSE RELATED IMPACTS

This section summarizes those environmental impacts which could not conveniently be linked to a particular structure or activity, but could instead be associated with different project purposes. These "project purpose related impacts" summarized below were abstracted from the 174 statements covering inland water projects included in this chapter. For ease of categorization, projects are divided into two groups: (1) flood control and multipurpose projects, and (2) navigation projects.

A large number of these project purpose related impacts might well be labeled as project-induced impacts. This possibly confusing term is used herein to identify those impacts which are not a direct result of physical perturbations on the environment by the project, per se, but result from the economic and social changes induced by the project.

Impacts Induced by Flood Control and Multipurpose Projects

Project-induced impacts for 138 flood control and multipurpose projects are summarized below.

Catalog of Impacts

I. Project-induced changes in land use

This was by far the most frequently mentioned project-induced impact. However, two points must be noted at this juncture:

- (1) Every mention of a project-induced land conversion was tabulated here, regardless of whether a detrimental or beneficial impact thereof was implied;* and
- (2) the majority of these

*A large number of the beneficial impacts noted below (see III. Beneficial Impacts Induced by the Project) could be considered as impacts resulting from changes in land use.

project-induced impacts were not mentioned in the body of the statement by the Corps, but were brought to light by reviewing agencies' comments.

The flood control project statements quite often described land use changes by reporting, for example, that the project would "accelerate land development," or "increase the pressure for urbanization," or reclaim "good agricultural land for suburban development." The notion of increasing the intensity of flood plain development, per se, also came up in several statements. A typical description took the following form: "Flood control will permit further encroachment on downstream floodplains for purposes such as urban development."

Below we catalog the more specific impacts resulting from project-induced changes in land use.

A. Loss of wildlife or wildlife habitat

1. Loss of upland game
2. Loss of hunting or fishing opportunities

The number of man-days lost was specified in a few cases.

- a. Loss of pelts
- b. Loss of fisheries

B. Loss of forest or timberland

In a few cases the number of acres lost was given.

1. Loss of aesthetics
2. Loss of recreation potential

C. Loss of marshlands

D. Loss of open space

E. Change in agricultural land use

1. Creation of new agricultural land

It was frequently reported that flood protection would make possible "more intensive farming." (It was occasionally noted that agricultural land in the region was already available in excess.)

- a. Increased erosion
- b. Degradation of water quality (see F below)

2. Loss of agricultural land to urbanization
 - a. Adverse effect on the agricultural economy of the region
 - b. Adverse effects on "agriculture interests who wish to retain their present holdings"

F. Degradation of water quality induced by changes in land use

1. Increased sediment load, turbidity, or siltation
These increases were reported as being a result of land clearing, or increased runoff from agricultural use of the land.
2. Increased waste loads
These increases were reported as being due either to urban and industrial growth or increased agricultural land use. In the latter case, irrigation return flows, biocides, pesticides, and other agricultural chemicals were specifically implicated.
3. Increased stream temperatures due to the clearing of riparian vegetation

G. Increased population densities

1. Increased requirements for water supply and waste treatment which could lead to "further adverse effects"
2. Increased noise levels

H. "Ecological" effects

1. "Drastic alterations" of the "ecological conditions which support the forestry, wildlife, and fishery resources" as a result of land reclamation
2. Change in the "natural character of the stream"
3. "Considerable depreciation of the natural beauty of the area"

I. Increased tax rates due to increased land values

II. Impacts induced by increased recreation

A. Land clearing for recreation facilities

1. Loss of forests
2. Decreased aesthetics

3. Loss of wildlife due to clearing of habitat

In addition, the "elimination of plants and animals from concentrated centers of activity," and the reduction in value (as wildlife habitat) of land adjacent to recreation areas were noted.

B. Increased pollution

1. Water pollution

This was reported as caused by increased population densities at and around recreation areas, and the use of marine toilets on small pleasure boats.

2. Automobile pollution

3. Possible "aesthetic pollution"

4. Noise pollution

5. "Destruction of tranquility"

6. Increased litter

C. Intrusion of roads on the natural environment

D. Increased potential for forest fires

E. Potential environmental health problems due to the increased availability of water contact recreation

F. Increased population densities due to recreation facilities

1. Loss of rural area

2. Encouragement of the clearing of adjacent lands for increased commercial use

G. Loss of privacy for residents adjacent to recreation areas

III. Beneficial impacts induced by the project

Frequently reported examples of beneficial project-induced or purpose related "impacts" are listed below. Most of these "impacts" are essentially those items which appear as "tangible" economic benefits in benefit-cost analyses for project justification; they were noted in a majority of the statements. The so-called "intangible" benefits commonly associated with flood control projects were also reported as impacts.

A. Land enhancement

1. Enhancement of "the desirability of owning property and living in the floodplain"
 2. Increased property values
 3. Possible development of marginal land
 4. Elimination of "poor land management practices generated by annual flooding"
 5. Land enhancement through increased levels of land utilization
- B. Improvement in the "quality of life"
1. Enhancement of "social well-being"
 2. Improvement of living conditions
 3. Increased "civic pride"
 4. Lessening of "destruction, hardship, and health problems"
 5. Improvement in the "appearance of rural dwellings"
- C. Decrease in flood frequencies
1. Elimination of the "fear of levee failure"
 2. Restriction of the river "and its heavy pollution load" to within its banks
 3. Increased "peace of mind"
 4. Prevention of building deterioration
 5. Encouragement of "more efficient use of the floodplain"
- D. Enhancement of the environment
1. "Preservation of quality fishing and hunting"
 2. Improvement of the urban environment"
 3. Induction of a "significant beneficial environmental impact"
 4. Provision of "greater opportunity for the inhabitants to enhance the environment for their visual and physical enjoyment"
 5. "Enhancement of the human environment"
- E. Induced economic growth and development
1. Creation of a higher tax base
 2. Stimulation of economic growth
 3. Increased crop yields

4. "Stimulation of redevelopment"
5. Elimination of "economic hazards"

F. Improved recreation

1. Provision of a recreation base
2. Reduction of the shortage of leisure time facilities
3. Enhancement of the visual attractiveness of previously damaged downstream recreation areas

Summary and Discussion

Table 3-6 summarizes the impacts induced by flood control and multi-purpose projects. In the interest of saving time during the abstracting process, statistics were not tabulated for the majority of the beneficial project-induced impacts. For this reason, these beneficial impacts are omitted from the table, although they do appear in the catalog.

As seen in Table 3-6, all the remaining impacts can be categorized under either of two main headings--impacts resulting from induced changes in land use, or impacts induced by increased levels of recreation.

Project-induced changes in land use were mentioned in about 40 percent of the statements. The majority of these changes were induced by measures which allowed for either increased residential and urban development of the floodplain due to increased levels of flood protection, or increased agricultural development due to improved drainage and/or flood protection. The 40 percent figure applies to all induced land use changes, regardless of whether they were reported as beneficial or adverse. The question of concern here is not whether the land use changes themselves are beneficial or adverse--value judgements are certainly involved; and many of these projects were no doubt justified on the basis of economic values attributed to these land use changes. The relevant question here should be, "What are the possible environmental consequences that might result from these induced changes in land use?" As can be seen in Table 3-6, relatively few statements addressed themselves to this question.

Impacts that were mentioned as being associated with induced land use changes were typically reported in very general terms. For example, the loss of wildlife habitat, noted in fifteen percent of the statements, was usually reported in exactly those words, with no further discussion or explanation. Aside from wildlife habitat losses, no other induced impact was mentioned in greater than ten percent of the statements.

TABLE 3-6

Summary of Reported Impacts Induced by Flood Control and Multipurpose Projects
(based on 138 statements)[†]

	<u>% of statements</u>
I. <u>Project induced changes in land use</u>	40 [‡]
A. Loss of wildlife habitat	15
B. Loss of forests or timberland	5
C. Loss of marshland	*
D. Loss of open space	10
E. Change in agricultural land use	
1. Creation of new agricultural land	10
2. Loss of farm land to urbanization	*
F. Degradation of water quality induced by land use changes	10
1. Increased turbidity or sediment load	*
2. Increased waste loads	5
3. Increased stream temperatures	*
G. Increased population densities	*
H. "Ecological" effects	*
II. <u>Impacts induced by increased recreation</u>	
A. Clearing of land	*
B. Loss of wildlife	*
C. Increased pollution	5
D. Intrusion of roads on the natural environment	*
E. Increased potential for forest fires	*
F. Potential environmental health problems	*
G. Increased population densities	*
H. Loss of privacy	*

[†]Catalog item III, "Beneficial impacts induced by the project," is not included in this table.

[‡]Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

The degradation of water quality due to induced land use changes, while mentioned in only a few statements, was described in some detail. The sources of pollution involved in these descriptions were generally related to either agriculture or urbanization.

A small number of the statements mentioning recreation as a project purpose also reported impacts induced by the increased levels of recreation. Table 3-6 shows that none of these impacts was reported in five percent or more of the statements; however, this percentage is a bit difficult to interpret since many of the 138 projects included in this summary did not involve recreation as a project purpose. The most commonly mentioned impacts induced by increased levels of recreation related to land clearing and the loss of wildlife habitat. Only a few statements discussed the increased levels of pollution that might accompany an increase in recreation.

One area which was generally quite thoroughly covered, but does not appear in the summary table, was the reporting of the beneficial impacts induced by the project. Typical or otherwise noteworthy wordings of the usual "tangible" and "intangible" project benefits are included in the catalog. Again, due to the time element and the fact that this was not our primary area of concern, no tabulations were made as to the frequency with which these "impacts" were reported. Suffice it to say that they were frequently mentioned.

Impacts Induced by Navigation Projects

Project-induced impacts for 36 navigation projects included in this chapter are summarized below.

Catalog of Impacts

I. Increased boat traffic (more or larger vessels)

- A. Increased water pollution
- B. Increased wavewash or wakes
 - 1. Greater shore erosion
 - 2. Reduction of benthic, aquatic and alluvial life in areas adjacent to channel
 - 3. Creation of extensive "splash zone" conducive to propagation of nuisance species such as non-biting midges

- C. Increased turbulence due to propellor action
 - 1. Increased dissolved oxygen
 - 2. Increased turbidity
 - 3. Disturbance of bottom sediments
- D. Decreased air quality
- E. Increased possibility of accidental oil spills
- F. Minor adverse effects on waterfowl and fishing
- G. Reduction of recreation value due to increased commercial use of river

II. Induced industrial growth and/or development due to improved navigability

- A. Clearing of timber and vegetation
The loss of wildlife was occasionally reported as resulting from this.
- B. Decreased aesthetics
- C. Increased water pollution potential
- D. Increased air pollution
- E. Increased noise levels

III. Miscellaneous adverse impacts

The following adverse impacts were also reported as resulting from navigation projects:

- ° Decreased releases at the end of the navigation season will isolate the winter food supplies and dens of fur-bearing animals.
- ° Increased fishing activity in the harbor will place increased demands on access roads.
- ° The extension of the navigation season further into the fall will adversely affect goose hunting.
- ° The project will cause an adverse short-term effect on the local tax base.

IV. Beneficial impacts induced by the project

Again, the more or less standard "tangible" and "intangible" project benefits were reported as environmental impacts with regularity. No tabulations were made, but common and/or noteworthy examples are listed below:

- A. Increase in economic growth through improved navigable waterways
 - 1. Enhancement of long-term productivity of the region
 - 2. Increase in tourism
 - 3. Increase in per capita income
 - 4. Reduction of unemployment
 - 5. Increase in real estate values
 - 6. Increase in "regional economic well-being"

- B. Reduction of danger of navigation accidents
 - 1. Reduction of danger of oil spills
 - 2. Increase in the safety of residents, property, and natural resources
 - 3. Improvement of health and safety of recreational boating interests

- C. Improvement in the "quality of life"
 - 1. Enhancement of the well-being of residents
 - 2. Improvement in the appearance of farmsteads and the urban community"
 - 3. Improvement of the "quality of the urban environment through visual aesthetics and the providing of a safer boat harbor"
 - 4. "Stimulation of needed development and beautification"

Summary and Discussion

Table 3-7 summarizes the impacts induced by increased navigation capabilities. For the same reasons mentioned in the discussion of impacts induced by flood control and multipurpose projects, the induced beneficial impacts reported for navigation projects were brought together in one section in the catalog and are omitted from the table. The majority of the impacts remaining can be grouped into two main categories--those induced

TABLE 3-7

Summary of Reported Impacts Induced by Navigation Projects
(based on 36 projects)[†]

	<u>% of statements</u>
I. <u>Increase in boat traffic</u>	
A. Increased water pollution	30 [‡]
B. Impacts caused by increased wakes and wavewash	10
C. Impacts due to increased turbulence	5
D. Degradation of air quality	*
E. Increased possibility of oil spills	*
F. Adverse effects on waterfowl and fishing	*
G. Reduction of recreation value	*
II. <u>Induced industrial growth and development</u>	
A. Land clearing	5
B. Degradation of aesthetics	*
C. Increased water pollution	5
D. Increased air pollution	5
E. Increased noise pollution	*

[†]Beneficial induced impacts are not included in this table, although they do appear in the catalog.

[‡]Numerical values are rounded to the nearest five percent.

This symbol () is to be interpreted as "less than five percent." It appears in the summary table only to conserve the consistency between the numbering scheme here and in the Catalog of Impacts.

by increased levels of boat traffic, both commercial and pleasure craft; and those resulting from industrial growth and development induced by increased navigation facilities.

The most frequently mentioned impact was the possibility of increased water pollution. Thirty percent of the 36 statements mentioned this in regard to increased boat traffic; five percent reported it as a result of induced economic growth. Increases in air and noise pollution were also reported under both categories.

Ten percent of the statements reported impacts resulting from the increased wakes and wavewashes of the larger ships that could be accommodated as a result of the project. These impacts, summarized in the catalog, are an example of the level to which these project-induced and purpose-related impacts can be carried.

The two remaining sections of the catalog, neither of which is included in Table 3-7, should be mentioned at this point. The miscellaneous section summarizes four additional impacts which were occasionally reported as being induced by navigation projects. The final section of the catalog contains a representative sample of the project benefits which were regularly reported as environmental "impacts."

CHAPTER FOUR
ALTERNATIVES, PRODUCTIVITY, COMMITMENTS AND OTHER ISSUES

INTRODUCTION

Chapters Two and Three summarize the views of the Corps of Engineers, reviewing agencies, and individuals in response to items (i) and (ii) of the National Environmental Policy Act (NEPA). In particular, these chapters delineate the environmental impacts, both beneficial and adverse, that was reported in the 234 environmental statements we examined. This chapter considers a number of issues that are somewhat less well defined.

The following three sections concern the nature of the Corps' response to items (iii), (iv) and (v) of Section 102(2)(C) of the NEPA. These items relate, respectively, to alternatives to the proposed projects, the conflicts between short-term uses of the environment and long-term productivity, and irreversible and irretrievable resource commitments. The material presented in these three sections was developed from short abstracts that were made of the relevant arguments (in the 234 statements reviewed) in response to each of the above-mentioned items in Section 102(2)(C).

The remaining section of this chapter relates to the frequency with which a number of items appeared in the 234 environmental statements reviewed. The items tabulated here fall into three general categories. The first includes particular arguments which seemed to appear with regularity, and which we viewed as potentially controversial. The best example of this is the "mitigation argument" which involves the addition of elements to a project in an effort to eliminate, or compensate for, any detrimental aspects of the proposed action. The second category includes some specific items or impacts which were recommended as worthy of mention in either CEQ guidelines or Corps circulars on the preparation of environmental statements. Examples of this are the questions relating to the mention of project dimensions, the quantification of impacts, and the occurrence of archaeological or historical sites. The third category includes a number of beneficial impacts which seemed, on the basis of those statements reviewed while designing the abstracting scheme, to appear with high frequency. The reporting of landscaping as a positive environmental impact is an example of the type of item included in this category.

ALTERNATIVES TO THE PROPOSED PROJECT

Section 102(2)(D) of the NEPA requires that the agency preparing the environmental statement "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." Furthermore, Section 102(2)(C) requires that all environmental statements provide a discussion of "alternatives to the proposed action." In our review of the 234 environmental statements we were interested in getting a general feeling for the types of alternatives considered and the level of detail presented. Because alternatives are entirely project specific we made no attempt to develop statistics indicating the frequency with which various alternatives were considered.

Typically, the section of the environmental statement dealing with alternatives consisted of a brief paragraph or two describing some or all of the following items in a summary fashion:

- Implications of not building the project;
- Mention of structural alternatives with or without a discussion of their economic and/or environmental ramifications; and
- Mention of non-structural alternatives, in many cases with reasons for not pursuing them.

A quite common theme regardless of project purpose or location was a discussion of the impact of constructing no project at all--the so-called "no-project" or "do-nothing" alternative. Discussions of the no-project alternative appeared in approximately 85 percent of statements. Table 4-1 gives a breakdown by broad project purpose categories, of the percent of statements that considered the no-project alternative. Quite often this alternative was summarily dismissed on the basis that it would result in "x" dollars per year of net benefits foregone.

The average number of alternatives presented for coastal, inland navigation, and inland flood control and multipurpose projects is shown in Table 4-1. As indicated, two was the average number of alternatives considered, except for the inland flood control and multipurpose projects; these averaged three alternatives per statement. Below we consider the nature of the alternatives presented in terms of the three general categories introduced in Table 4-1.

TABLE 4-1

Numbers of Alternative Projects Considered

	Average Number of Alternatives Considered	Percent of statements examining the "no-project" alternative
Coastal--all purposes	2	95
Inland--navigation	2	90
Inland--flood control and multipurpose	3	80

Projects on Coastal Waters--All Purpose

For projects on coastal waters, specific reasons for dismissing the no-project alternative were given in a number of cases. Typically, it was argued that in the absence of the proposed project one or more of the following would occur:

- Local interests would undertake the project; and (generally for an undisclosed reason) the Corps would provide "better developmental and environmental results."
- Various marine hazards would be perpetuated.
- There would be a continued loss of aesthetic appeal and/or the general environmental quality of the area.
- There would be increased development of alternative modes of transportation; and this would lead to adverse environmental effects.

In many cases alternatives other than the no-project alternative were discussed. The options mentioned included variations in channel alignments and dimensions, and variations in the locations of structural works and spoil disposal areas. The descriptions of alternatives were generally given in summary fashion, as, for example, "Two alternative spoil disposal sites were considered." Whenever alternatives were mentioned they were rejected as being technically infeasible, too costly, or having impacts on the environment that were even more serious than those associated with the proposed project.

Navigation Projects on Inland Waters

Specific reasons for rejecting the no-project alternative reported in

these statements included the following typical arguments. The no-project alternative would:

- involve the loss of costs already invested in the project;
- lead to increased transportation costs;
- involve foregoing economic gains;
- maintain the existence of hazardous conditions;
- lead to improvements by local interests which, because they would be undertaken in a piece-meal fashion, would be inferior from an environmental and developmental viewpoint.

The other alternatives presented were, for the most part, of the structural variety. They included alternative small boat harbor locations, channel dimensions, lock sizes, waterway routes, breakwater materials, and dredging methods. In most cases alternatives were rejected because they involved lower benefit-cost ratios than the proposed project.

In only a relatively few cases were the environmental implications of the alternatives discussed in specific terms. In one case, for example, it was argued that the use of shallower channels would involve less dredging, and consequently would result in fewer of the adverse impacts associated with dredging. In another case, the use of a bucket dredge was proposed as an alternative to a hydraulic dredge. It was reported that this would lead to a reduction in turbidity during dredging and also to a reduction in the size of the requisite spoil disposal area. The bucket dredge alternative was rejected because it would involve higher costs.

Flood Control and Multipurpose Projects on Inland Waters

For this group of environmental statements the no-project alternative was typically rejected because it would result in:

- extensive economic and environmental damages;
- loss of the advantages of flood control;
- postponement of the "inevitable project" since the flood plain would be developed even in the absence of the project;
- loss of the present land use patterns; and
- loss of project induced employment and income.

In three or four instances it was argued that since there were no adverse impacts associated with the proposed project, there was no basis for considering the no-project alternative.

A very wide variety of structural alternatives were mentioned. These involved designs that included alternative channel dimensions, dam sites, floodwall and levee alignments, bypass diversions and pumping schemes. The use of several upstream storage facilities as opposed to a single downstream reservoir was occasionally proposed, as was the use of unlined canals in place of lined ones. Snagging and clearing was sometimes suggested as an alternative to structural measures. In a few cases acquiring flood easements was suggested, as was the consideration of the proposed project with additional "mitigation" features.

Rejection of the alternatives noted above was commonly based on economic infeasibility (higher costs). In some cases general statements concerning increased environmental damage were offered as additional grounds for rejection. More specific statements were made in several cases; e.g., unlined canals (as opposed to lined ones) would require more land, the resettlement of residents, and greater excavation and spoil disposal.

Non-structural flood protection measures were also considered. In about ten instances the idea of relocating the entire population and all man-made structures in the flood plain was suggested. This was usually dismissed as either impractical or "economically unfavorable."

The classic non-structural approaches involving alternative flood plain zoning schemes were commonly mentioned and dismissed for a variety of reasons. Such approaches were reported as:

- being ineffective and difficult to administer;
- giving no "positive protection" to health and safety;
- providing no sense of well-being for the community;
- being unsuitable for flood plains already highly developed or involving extensive agricultural areas;
- being unacceptable to local interests; and
- not leading to the use of land up to "its estimated economic value."

SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Section 102(2)(C) of the NEPA also requires that all environmental statements discuss "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term

productivity." The Council on Environmental Quality (CEQ) in their guidelines for the preparation of environmental statements, has indicated that this "in essence requires the agency to assess the action for cumulative and long-term effects from the perspective that each generation is trustee of the environment for succeeding generations."*

In our review of the Corps' environmental statements, we were interested in getting a general idea of how the above requirement was being interpreted. In particular, we were especially interested in how the phrase "long-term productivity" was being construed.

For the most part, the Corps' statements dealt with this issue in a brief paragraph or two. A substantial number of statements, regardless of project location or purpose, dealt with the issue by elaborating on the benefits that would accrue if the project were constructed. For example, in the case of a flood control project this might include mention of flood damages avoided, land values enhanced, loss of life avoided, community security enhanced, etc. In other words, a statement of the more or less standard tangible and intangible consequences of flood control works in general.

An argument that appeared in about fifteen percent of the statements was that since the project would not change the manner in which the water and/or the adjacent land was to be used, there would be no conflict between short-term uses and long-term productivity. Other responses to this requirement of the NEPA are best discussed in the context of the broad categories introduced in the previous section.

Projects on Coastal Waters--All Purposes

We were very much concerned with identifying patterns in the Corps' response to this portion of the NEPA. In reviewing the coastal works projects we observed each of the following types of responses in several cases:

- Statements concerning items that would increase in the long-term:
The item typically mentioned here was economic productivity.
- Statements concerning items that represent long-term losses:
The most common statement of this type was that there would be "no long-term losses." In one or two cases

* Council on Environmental Quality, in Federal Register, April 23, 1971, op. cit., p. 7725.

fish feeding grounds and fishery resources were singled out.

- Statements of particular activities that would be improved as a result of the project:

Recreation was by far the most commonly mentioned, but navigation and fishing were also noted.

- Statements concerning the "commitment of the present generation":

This came up in three or four cases, in each of which the loss of a specified area of bay bottom was noted.

- Statements that suggested a clear trade-off between long-term losses and gains. The following pairs were mentioned:

<u>Losses in terms of:</u>	<u>Associated gains in terms of:</u>
clam habitat	provision of harbor facilities
swampland	"higher use of land"
fish and wildlife production	recreational use

Navigation Projects on Inland Waters

For this group of projects we observed each of the following kinds of responses in several cases.

- Statements concerning items that would increase in the long term:

As in the case of coastal works, the item typically mentioned was economic productivity.

- Statements concerning items that represent long-term losses:

As in the case of coastal works, the most common statement of this type was that there would be "no long-term losses or adverse effects." In one case a loss in biological productivity was noted.

- Statements concerning items that would incur losses in the short term:

Statements of this kind appeared in only a few cases--the items mentioned included recreation and "aquatic biota."

- Statements of particular activities that would be improved as a result of the project:

As in the case of coastal works, recreation was mentioned most often, however navigation, waterfowl habitat and "environmental quality" were also noted.

- Statements that suggested a clear trade-off between long-term losses and gains. (This occurred in only a few statements.)

The following pairs were mentioned:

Losses in terms of:
wildlife
"flora and fauna"
fish and wildlife

Associated gains in terms of:
recreation
social well-being and income
a good spoil disposal site (which
could eventually serve as a park)

There were also statements to the effect that the project was in keeping with "our trustee relation with future generations."

Flood Control and Multipurpose Projects on Inland Waters

These projects represented the largest single grouping and, as might be anticipated, contained the largest number of diverse interpretations of the CEQ guidelines. The following types of responses each occurred in several cases:

- Statements concerning items that would increase in the long term:
About two dozen statements contained this type of response. Among these the most commonly mentioned item was economic productivity. In several cases agricultural productivity was mentioned, and in three or four cases biological productivity was singled out. While these alternative interpretations of the term "productivity" are noteworthy, and perhaps reflect the ambiguity of the CEQ guidelines, the term productivity was used in other ways as well. For example, reference was found to increases in productivity in terms of land, renewable natural resources, forest land, wildlife habitat, "protected urban areas," and "man's environment." In a few cases we noted general statements to the effect that productivity (unspecified) would be enhanced.
- Statements concerning items that represent long-term losses:
Items mentioned here include inundated lands and fish and wildlife habitats.
- Statements of particular activities that would be improved as a result of the project:
Here, as in the case of coastal works, and inland navigation works, the most commonly mentioned item was recreation; it was noted in about a dozen statements. Other activities mentioned were flood control and recreation. The "efficient use of land" was noted in a few cases.
- Statements that suggested a clear trade-off between long-term losses and gains. This type of response occurred in about a dozen statements. The pairs involved were as follows:

Losses in terms of:
agriculture
wildlife habitat
wildlife refuge
"environment"
"x" miles of stream
land use alteration
flora and fauna

Associated gains in terms of:
flood control
economic productivity
crop production
flood control benefits
flood control benefits
"human environment"
higher uses of land

- Statements that suggested a clear trade-off between short-term losses and long-term gains:

<u>Losses in terms of:</u>	<u>Associated gains in terms of:</u>
impacts of construction	security and community improvements
flora and fauna	security and community improvements
crop and wildlife production	flood protection
trees	boating opportunities

- Statements concerning the "commitment of the present generation":

This came up in three or four cases; these commitments were specified in terms of land areas and/or lengths of stream.

- Statements concerning changes in land uses:

This particular response was relatively common; it occurred about a dozen times. The one shift mentioned most often was the project-induced acceleration of urbanization, typically on lands currently used for agricultural purposes. In a few of these cases it was observed that the shift in land use would occur even in the absence of the project. A second shift commonly noted was the loss of woodlands and/or wildlife habitat resulting from induced agricultural use of land. Shifts in land use from agriculture to recreation, and from scenic "open space" to water-based recreation were each mentioned once or twice.

IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Section 102(2)(C) of P.L. 91-190 also requires that environmental statements discuss "any irreversible and irretrievable commitments of resources which would be involved in the proposed action, should it be implemented." In addition, the Guidelines of the Council on Environmental Quality require the agency to "identify the extent to which the action curtails the range of beneficial uses of the environment."

Most of the environmental statements we examined responded briefly to this section of P.L. 91-190. There were three items, in particular, that were mentioned quite commonly. One item was the land that was to be committed to project related activities--quite often the total number of acres involved was specified. A second item was the labor involved in constructing and operating the project. The third item was the material used in project construction.

Table 4-2 lists the frequency with which each of these three items was mentioned for each of three general categories: projects on coastal

TABLE 4-2

Land, Labor and Materials as Resource Commitments

	Number of <u>statements</u>	<u>% of statements</u>		
		<u>Land</u>	<u>Labor</u>	<u>Materials</u>
Coastal--all purposes	61	35	70	25
Inland--navigation	36	40	55	35
Inland--flood control and multipurpose	137	60	60	55
	<u>234</u>			

waters (all purposes), navigation projects on inland waters, and flood control and multipurpose projects on inland waters. As indicated in the table, labor was the most commonly mentioned irreversible and irretrievable resource commitment noted for the coastal and inland navigation projects. Reference to labor commitments appeared in 70 percent of the statements for coastal projects, and 55 percent of the statements involving inland navigation. In the case of inland flood control and multipurpose projects land and labor commitments were each mentioned in 60 percent of the statements.

The description of these commitments of land, labor and materials were, for the most part, given in very general terms. The following phrases are typical of those employed: "'x' acres of land [will be] dedicated to project use"; and, there will be a commitment of "the labor and material associated with project construction and operation."

A total of thirteen of the 234 statements indicated that there would be no irreversible or irretrievable commitments of resources. A very few of the statements responded to this section of P.L. 91-190 by restating the environmental impacts of the project; occasional reference was made to the mitigation features of the project.

A number of statements were somewhat more specific in referring to irreversible and irretrievable resource commitments. Below we describe these more specific references in the context of the three general categories used in Table 4-2.

Projects on Coastal Waters--All Purposes

For coastal projects, the most commonly mentioned specific item (in addition to land, labor and material) was the loss of bottom organisms and/or bottom habitat; this appeared in six of the 61 statements. A few statements referred to losses of "marine fauna," and two made mention of shellfish growing areas. The loss of quarry stone was also mentioned in several cases. The following were each mentioned once: the loss of wildlife habitat as a result of spoil disposal; and the loss of marshland as a result of borrow operations.

General references to losses in time, manpower, and "financial resources" each appeared in one or two statements. In a few cases it was suggested that "economic growth induced by the project may also generate other commitments of land, labor and materials." Eight of the 61 statements argued that there would be no irreversible or irretrievable resource commitments.

Navigation Projects on Inland Waters

Several of the statements for inland navigation projects made specific reference to losses in fish and wildlife habitats. (In one of these cases, a loss in hunting and trapping opportunities was noted.) Several others referred to changes in channel bottom areas (generally as a consequence of dredging).

There was occasional reference to losses in "financial resources," archeological sites and historic sites. One statement noted that the future agricultural use of the land would be lost. Another observed that economic growth induced by the project could generate further resource commitments.

The following were each mentioned only once or twice: physical change in landscapes; loss of marshland; loss of "x" miles of river; lowering of the groundwater table; and an irreversible commitment to the interbasin transfer of flow.

There were a few cases where the complex nature of the interrelationships between plants and animals in a given community was discussed. A few cases also speculated as to whether or not "pre-project" conditions could be re-instituted, in one way or another, following the completion of the project. Only three statements considered that there would be no irreversible or irretrievable commitments at all.

The most unusual response to the NEPA mandate to describe irreversible and irretrievable resource commitments was (in its entirety) as follows:

"Allocation of labor and capital resources to construction of the navigation channel would preclude the investment of these resources elsewhere. Thus, society would forego whatever returns an equivalent investment elsewhere would bring. However, economic analysis shows a favorable benefit-to-cost ratio, which indicates a net gain in resources (saving of capital). The capital generated or saved by the project could be invested elsewhere with resultant benefits to society."

Quite apart from the validity of the economic argument, this response does not capture the spirit of the NEPA. It appeared only once.

Flood Control and Multipurpose Projects on Inland Waters

The 137 environmental statements for inland flood control and multipurpose projects made reference to a diverse array of specific irreversible and irretrievable resource commitments. The most commonly mentioned item was the loss of "x" miles of free flowing stream; this appeared in thirteen statements.

Many of the statements described the losses of land in terms of land type as well as the number of acres involved. The following land types or uses were noted: agricultural land, timber and forest areas, marshes, wetlands, "green space" and residential property. A few statements noted shifts in land use, as for example, the change from rural to suburban use.

The irretrievable loss of minerals or mining opportunities was also noted in several statements. Specific reference was made to losses of sand and gravel, quarry rock, and "strip mining opportunities." Losses of vegetation, fish habitat and wildlife habitat were each mentioned in several statements. Items mentioned only once or twice each include the loss of "aesthetic value," and the possibility of an increase in the rate at which downstream reservoirs would be "silted up."

Occasional reference was made to losses in "financial resources," "time, money and effort," historic sites, archeological sites, "project water" and resources required to relocate families and buildings. The most common of these socio-economic items was the commitment of land, labor and materials that might be occasioned by induced economic growth; this item appeared in six statements.

One of the most intriguing responses to the question of irreversible and irretrievable resource commitments among the statements involving inland flood control and multipurpose projects concerned the ability of project lands to return to their "pre-project" state over time. The nature of the reasoning employed is contained in the following passage from one of the statements:

"... the nature of channel improvement on this project will not impose physically irreversible or irretrievable losses of these resources. Comparable river basins within the _____ District provide striking examples of early channeling projects developed by local people which, over the years, deteriorated through lack of proper maintenance, causing them to become constricted with debris and sediment. Subsequently, the flood plains rapidly regained a striking similarity to their original condition. Historical evidence of this nature confirms that the process of ecological succession will eventually restore a natural flood plain environment if an improved channel is not maintained. This process could be greatly accelerated by vegetative seeding or planting, systematic plugging of the improved channel and opening of old bendways in the original channel. Fish and wildlife resources associated with the flood plain would eventually return naturally to approximately their original composition and numbers."

Arguments of this sort appeared, in one form or another, in twenty of the 138 statements dealing with inland flood control and multipurpose projects. (Similar arguments appeared in only four of the 96 statements not in this category.)

CONTROVERSIAL ISSUES AND THE ADHERENCE TO GUIDELINES--A STATISTICAL SUMMARY

This section presents a statistical summary of the frequency with which a number of items of special interest were presented in the 234 environmental statements reviewed. The data for this section is derived from results obtained using the final page of the abstracting form (Appendix 1) which consists of a "questionnaire" requiring one dozen yes or no answers based on each of the environmental statements in its entirety.* This questionnaire was completed for each of the 234 environmental statements.

*Results from the question on "social costs" were discarded, because of inconsistencies in interpretation among those abstracting the statements.

There were a number of different reasons for including the twelve questions we did in our "questionnaire." However, with minor exceptions, the questions can be classified into two main categories--impacts or issues which we regarded as possibly controversial, and issues, the inclusion of which was suggested or required by either the CEQ Guidelines or Corps circulars on the preparation of environmental statements. Another rationale underlying the inclusion of all of these questions was the intention of saving valuable time in the abstracting procedure by providing a checklist for impacts and issues which were both frequently mentioned and of special interest.

A more complete discussion of the rationale for including each item is given in a short question-by-question discussion below. The frequencies with which each item was mentioned, broken down according to project type, are summarized in Table 4-3.

Controversial Issues

The four questions below relate to issues which we viewed as potentially controversial in terms of the spirit of the NEPA. These issues concern the concept of mitigation, and the reporting of economic benefits, recreation, and landscaping as positive environmental impacts. Our purpose here is not to make value judgements on these issues, but merely to provide basic information relative to these issues with the hope that it will provoke further discussion.

"Is the mitigation argument used?"

In the context of Corps reports and environmental statements, mitigation is used to mean the addition of elements to a project in order to compensate for detrimental effects caused by the project. Common examples of mitigation are the purchase of additional lands to "mitigate" the loss of wildlife habitat, the inclusion of a fish hatchery in the project to "mitigate" the loss of anadromous fish runs, and the provision of funds for new recreational facilities to "mitigate" the loss of same due to the project. While the mitigation argument may, in many cases, be based upon sound economic reasoning, we sense a potential controversy in the acceptability of an argument that suggests, for example, that the inundation of "x" acres of redwood trees can be compensated for by the purchase of a nearby "x" acre tract of redwoods.

TABLE 4-3

Statistical Summary of Some Controversial Issues and the Adherence to Guidelines

	Frequency of "yes" response			
	All Projects (234)	All Coastal Projects (61)	Inland Navigation Projects (36)	Inland Flood Control & Multipurpose Projects (137)
Is the mitigation argument used?	30%	*	15%	45%
Are economic benefits mentioned or implied as positive impacts?	80	85%	55	85
Is recreation mentioned as a positive impact?	50	60	60	45
Is landscaping or beautification mentioned?	45	25	20	60
Are impacts quantified?	15	10	20	15
Are project dimensions given?	70	75	65	65
Is mention made of the occurrence (or lack thereof) of:				
a. Archaeological or hist. sites?	55	55	40	60
b. Rare or endangered species?	25	35	20	25
Are "secondary impacts" induced by the project mentioned?	45	35	45	45
Are "ecological" impacts mentioned?	15	15	30	5
Does the Corps regard any of the environmental impacts as serious enough to warrant project modification?	*	*	*	*

* Less than five percent.

Since mitigation, as it was being used in these statements, was felt to be somewhat controversial, we decided that it might be useful to know just how often it was being employed. Hence it was included in our "questionnaire."

As can be seen from Table 4-3, the mitigation argument was used in about 30 percent of the statements. When this is broken down, however, one sees that it was reported in very few of the statements for coastal and inland navigation projects (less than five percent and fifteen percent, respectively), but in 45 percent of the statements for inland flood control and multipurpose

projects. This is not surprising in light of the way the Corps has chosen to define mitigation. Since the majority of the coastal and inland navigation projects entail mainly work within existing waterways, there are no losses to those items which are usually "mitigated", i.e., wildlife habitat, recreation facilities, or fish runs.

"Are economic benefits mentioned as a positive impact?"

It was quite obvious, after reading only a small sample of statements, that the project benefits would be reported as environmental impacts in the majority of the statements. Therefore, this question was included primarily in the interest of saving time in the abstracting process. However, this item was regarded as potentially controversial, particularly in light of the Corps' internal documents giving directions for preparing the statements.* While it was stated in these that both the beneficial and detrimental aspects of the environmental changes should be discussed, there was no specific indication that project benefits should be considered as beneficial environmental impacts. Also, these directions specifically stated that, "the statements should not be construed as a further means for assisting or supporting project justification."** Whether the reporting of project benefits as positive environmental impacts is contrary to the above is a matter which perhaps warrants some discussion among the Corps' policy makers.

Table 4-3 demonstrates that our initial observations as to the frequency with which this impact would be mentioned were correct. Eighty percent of the statements taken as a group reported economic benefits as positive impacts. Eighty-five percent of the statements for coastal projects and inland flood control and multipurpose projects reported this impact, while only 55 percent of the statements for inland navigation projects made mention of it.

"Is recreation mentioned as a positive impact?"

The rationale for this question was likewise largely that of convenience. However, it was felt that this issue was somewhat controversial, and the statistics on its frequency of mention are of interest.

* U.S. Army, "Investigation, Planning and Development of Water Resources--Preparation and Coordination of Environmental Statements," Office of the Chief of Engineers, Washington, D.C., (Reg. No. 1120-2-56), Sept. 25, 1970.

** Ibid, p. 2.

Referring once again to Table 4-3, one can see that recreation was reported as a positive environmental impact in about half of the 234 statements reviewed. The most surprising result here is that statements for coastal and inland navigation projects reported recreation as an environmental impact more frequently than did statements for flood control and multipurpose projects. The lower frequency in the latter category is due, no doubt, to the large number of single purpose flood control projects included in this category. The fact that 60 percent of the inland navigation projects reported recreational benefits suggests that navigation projects today, to a large extent, serve the recreational boating interests as well as the interests of commercial shipping.

"Is landscaping or beautification mentioned?"

While our abstracting form included the additional phrase, "... as a positive impact," attached to the above question, this qualification was discarded in the abstracting process. Thus, any mention of landscaping or beautification measures was tabulated here. The rationale for this question was also primarily that of a time-saving convenience, as it was apparent from the first statements read that this item would be appearing quite frequently. However, the inclusion of this question was also rationalized, in part, on the basis of the controversial nature of the issue. Frequently, beautification measures were used to de-emphasize visual aesthetic impacts by mentioning, often in the same sentence, that, in essence, these impacts could be ignored as extensive landscaping was to be included in the project. It was felt that, if this issue were being frequently reported, some discussion might be in order concerning violations of the spirit of the NEPA.

Table 4-3 shows that 45 percent of the statements mentioned landscaping or beautification. Sixty percent of the statements pertaining to inland flood control and multipurpose projects reported it, while it was a topic of mention in only twenty percent of the inland navigation statements and only 25 percent of the statements for coastal projects. A likely explanation for this wide variation among the three project categories is that the flood control category includes a large number of levee and channelization projects which frequently employed landscaping in an attempt to beautify the channel banks or levees.

Adherence to Guidelines

The following six questions might be interpreted as a measure of the adherence of the environmental statements to the guidelines set forth by either the CEQ or the Office of the Chief of Engineers of the Corps. The bases for these questions are included in the CEQ Guidelines and various "circulars" and "regulations" prepared by the Office of the Chief of Engineers.* The statistics concerning the relative frequency of occurrence of these items must be interpreted very loosely, since the guidelines and directives have been updated regularly since passage of the NEPA. The statements we reviewed were therefore subject to varying (but not inconsistent) sets of guidelines.

"Are impacts quantified?"

The basis for this question is contained in the Appendix B of the first Corps circular (EC 1120-2-56) which states, "Quantitative estimates of losses or gains (e.g., acres of marshland, number of ducks nesting or harvested) will be set forth whenever practicable." This wording was repeated in the Corps regulations dated 28 May 1971.

Only fifteen percent of the 234 statements reviewed did quantify impacts. Statements for inland navigation projects had the best record in this regard with twenty percent, while only ten percent of the statements for coastal projects quantified impacts. It must be noted that in our interpreting of the "quantification of impacts" we specifically did not include the inundation of "x" acres of land as a quantified impact.

"Are project dimensions given?"

This question pertains, not to environmental impacts, per se, but to the section of the environmental statement devoted to the project description. The basis for this question is contained in Appendix C of Corps regulation ER 1105-2-507 on the preparation of impact statements, which suggests (specifically in regard to reservoirs) that project dimensions be made a part of the project description. While, as noted above, those statements

* U.S. Army, (Reg. No. 1120-2-56), Sept. 25, 1970, op. cit.; U.S. Army, (Reg. No. 1105-2-507), May 28, 1971, op. cit.; Council on Environmental Quality, "Statements on Proposed Federal Actions Affecting the Environment-- Interim Guidelines," April 30, 1970; and Council on Environmental Quality, in Federal Register, April 23, 1971, op. cit.

prepared prior to the issuance of this regulation could not be expected to comply (many were already including them, anyway), it was felt that it would be of interest to see how many statements did include this item.

As shown in Table 4-3, project dimensions were reported in 70 percent of the statements, with little variation among the three categories.

"Is mention made of the occurrence (or lack thereof) of archeological or historical sites?"

Appendix B of Corps circular EC 1120-2-56 specifically suggested that archaeological, historical, and cultural elements be considered in order "to assure treatment responsive to the full concern of the NEPA." This suggestion was reiterated in the May 1971 regulations.

Fifty-five percent of the statements reviewed mentioned something in regard to archaeological or historical sites. Typically, it was observed that "preliminary investigations (had) turned up no evidence to suggest the occurrence of any archaeological or historical sites of interest within the project boundaries." As shown in Table 4-3, statements for flood control and multipurpose projects reported this most frequently (60 percent), while statements for inland navigation projects reported it least frequently (40 percent). This is quite likely due to the nature of the projects included within these two categories, i.e., work requiring the commitment of new land versus work within existing waterways.

"Is mention made of the occurrence (or lack thereof) of rare or endangered species?"

The basis for this question is contained indirectly in both the Corps circular of September 1970 and regulations of May, 1971. An allusion to endangered species is inferred in a statement (identical in both documents) that emphasis should be given to the establishment of whether "environmental elements" are "unique, endangered, old, popular, etc." As shown in Table 4-3, endangered species were mentioned in a quarter of the 234 statements read. This mention typically stated that, "There are no known endangered species within the project area." The breakdown of this question by project location shows that endangered species were mentioned in 35 percent of the coastal projects, as opposed to only twenty to 25 percent of the inland projects.

"Are 'secondary impacts' induced by the project mentioned?"

Although this question was worded slightly differently in the abstracting form, it was interpreted to mean essentially what we referred to as "project-induced" impacts in the final sections of Chapters Two and Three. While these impacts were tabulated there, this question serves to give an indication of the overall frequencies with which these impacts were mentioned in the three broad project categories we have defined.

The basis for this question is contained in both the CEQ Guidelines and the Corps planning documents. The CEQ Guidelines state that, "Both primary and secondary significant consequences for the environment shall be included in the analysis," and give as an example the possible effects due to changes in population patterns resulting from projects. The Corps documents reiterated this intention in advising that impacts resulting from both "direct and indirect consequences of the proposed action" should be identified.

Table 4-3 shows that slightly less than half of the 234 statements complied with this section of the guidelines. There was not a great deal of variation among the three categories of projects in response to this question, with "secondary impacts" being reported in 35 and 45 percent of the statements for coastal and inland projects, respectively.

"Are 'ecological' impacts mentioned?"

The basis for this question lies directly in the mention of "ecological" impacts and systems in both the Corps documents and the CEQ Guidelines. However, the basis for such a question is really much broader than this. The very nature of the NEPA and the meaning of environment should preclude the omission of ecological impacts from environmental statements. Indeed, environmental impacts are difficult to discuss without considering ecological relationships.

The statistics for this particular question, however, are perhaps suspect since they clearly depend on what is meant by "ecological impacts." The types of items we were looking for were arguments relating to food chains, biological interrelationships, changes in photosynthetic productivity, and the like. What we were specifically not tabulating here were statements to the effect that, "... the project may result in some adverse effects on the ecology of the area," or similar general statements which gave no further elaboration or explanation.

Ecological impacts, as we interpreted them, were mentioned in only fifteen percent of the 234 statements. The most frequent mention (30 percent) occurred in the 36 statements on inland navigation projects. This could be due to the large number of dredging projects included in this category, and the fact that it is now widely recognized that in many cases the materials dredged from channel bottoms serve as habitat for a large number of organisms which make up the bottom rung of many food chains. The fifteen percent figure for coastal projects is also most likely related to the "ecological impacts" reported in association with dredging projects. Only five percent of the 137 statements in the flood control and multipurpose category reported "ecological impacts" as we defined them.

The following question does not fit under either of our two categories --controversial issues or adherence to guidelines--although it could well be argued that both headings apply equally well. It is certainly potentially controversial; and, in the sense that it relates to the spirit of NEPA, it does qualify as a matter of adherence to guidelines. The question is worded as follows:

"Does the Corps regard any of the environmental impacts (resulting from the project) as serious enough to warrant project modification?"

One measure of the effectiveness of the NEPA might be considered to be the extent to which it forces a re-examination of projects resulting in a change in project design. While we do not claim that this particular question serves to indicate the effectiveness (or lack thereof) of Section 102(2)(C) of the Act, we do think that the response to this question might be of interest.

In only a few of the 234 environmental statements reviewed did the Corps regard any environmental impacts as serious enough to warrant project modification. In none of these was the modification initiated by the Corps. Project modification, in those few cases where reported, was always in response to requests by other reviewing agencies. These modifications typically involved a deletion of a small portion of the project or the use of an alternative solution for part of the project. Additional mitigation measures were more frequently added to a project in response to agencies' requests; however, these modifications were not tabulated here. In no case did a statement conclude that further project modifications were necessary in light of the seriousness of the environmental impacts discovered.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR IMPROVEMENT

SUMMARY

As suggested in Chapter One, there may be some readers interested in our general conclusions and suggestions for improvement, but not interested in the detailed material presented in Chapters Two, Three, and Four. For this reason, we present below a summary of the principal points presented in the middle chapters of this report. This brief review also serves as an introduction to, and a foundation for, the remainder of the chapter.

Projects on Coastal Waters

We defined coastal works as projects located either on the ocean or in an estuarine environment. There were 61 environmental statements in this category, about 39 of which were of the single-purpose navigation type; most of the remaining projects were for purposes of beach restoration or shore protection.

The main activities associated with coastal projects were dredging and spoil disposal. The most commonly reported impacts for dredging related to increases in turbidity and changes in the habitats of bottom organisms. In the majority of cases the implications of these changes were not discussed, except for the assertion that the changes would be temporary and/or minor.

Most of the impacts reported for spoil disposal involved the modification of land forms. The creation of new beaches and waterfowl habitats were noted as beneficial impacts, whereas the loss of vegetation covers, wildlife refuges, salt marshes and shellfish areas were noted as adverse impacts. There were a number of statements for projects involving spoil disposal that did not report any related impacts; possibly these projects had not reached the stage where the ultimate disposal sites were decided upon. Ocean disposal, when mentioned, was generally treated as having no significant impacts.

The structures most commonly associated with projects on coastal waters included breakwaters, jetties and groins. Many of the statements involving such structures reported no environmental impacts that could be linked to the structures themselves. For breakwaters, the commonly reported impacts related to aesthetic changes and habitat modification. Impacts associated with quarrying were also noted. For jetties and groins the most commonly reported impacts concerned the provision of new habitats for fish and the modification of erosion patterns.

There were a number of reported impacts that were more closely related to project purpose than to any particular structure or activity. In the case of beach restoration and shore protection projects, the impacts reported most often related to enhanced economic or recreational potentials. For the single-purpose coastal navigation projects, these "induced" impacts related to the improved social well-being that would accompany economic growth, the reduction in "marine hazards," and the modification of land use patterns. The implications of changes in vessel traffic were noted as follows: increased boat traffic would result in water quality degradation; and decreased boat traffic (a consequence of using larger commercial vessels with fewer trips per vessel) would reduce the probability of accidental spills of "noxious materials."

Projects on Inland Waters

Projects on inland waters were defined as those involving fresh water lakes, and rivers and streams not influenced by tidal action. Of the 173 projects on inland waters, 36 were for navigation, and 137 were either flood control or multipurpose projects.

Channelization, which was by far the most common element of inland projects, was construed to include the following: channel "improvement," excavation, enlargement, deepening, straightening, widening and lining; snagging and clearing; and construction of ditches and concrete chutes. The most frequently reported impact associated with channelization was the direct loss of land--in many cases the number of acres and land use involved were specified. Other impacts reported with high relative frequencies were the loss of fish and wildlife habitat, loss of fisheries, and "changes in aesthetics."

Fifty-five projects involved dams and reservoirs. As in the case of channelization, the loss of land to project purposes was the impact mentioned most often; typically, the number of acres involved and the change in land use were noted. The loss of wildlife habitat was reported in three-quarters of the statements involving dams and reservoirs.

The necessity of relocating houses and families as a result of inundation was noted regularly in statements involving reservoirs. The loss of the natural stream was also noted, often in terms of substituting a lake for a stream and/or creating a warm water fishery. Changes in water quality due to impoundment were not mentioned in many statements. In cases where such changes were noted, the main emphasis was on thermal stratification, the impoundment of nutrients, and the possibility of algae growth.

Aesthetic issues were mentioned with some regularity in statements involving dams and reservoirs. Slightly more than half of the aesthetic changes were reported to be beneficial. The adverse effects of periodic inundation or a fluctuating shoreline were also occasionally noted.

The environmental impacts associated with levees were not described in great detail in the 41 statements which included these structures. The elimination of wildlife habitat and/or the loss of vegetation were the impacts reported most frequently. Also, adverse visual aesthetic changes and impacts related to borrow operations were reported as being potentially significant in many statements involving levees.

Approximately 40 percent of the 41 statements involving dredging on inland waters mentioned temporary and/or minor increases in turbidity as an adverse impact; the implications of such turbidity increases were generally not elaborated upon any further. Disturbance of bottom organisms, damage to fish life and habitat, and loss of stream and riparian vegetation were all mentioned occasionally. The effects on water quality due to the disruption of bottom sediments was mentioned infrequently.

Many inland projects that clearly involved dredging made no mention at all of plans for the disposal of spoil. In several cases where the environmental statements mentioned spoil disposal, there were no environmental impacts reported. Most of those impacts that were reported related, in one way or another, to the way in which land forms would be

modified. Aesthetic issues relating to both visual impairment and odor problems were mentioned occasionally, as was the problem of polluted runoff from spoil disposal areas.

Impacts from construction activities, aside from dredging and spoil disposal, were not commonly reported. Those reported related to changes in turbidity and adverse effects on vegetation and habitats. Also mentioned were increased noise and dust, and traffic congestion or inconvenience. Several statements discussed impacts associated with borrow operations and problems related to the disposal of cleared brush and trees.

As in the case of coastal projects, we observed a number of impacts that were more closely related to project purpose than any activity or structure. For inland flood control and multipurpose projects, these impacts were most commonly associated with induced changes in land use, e.g., the loss of wildlife habitat or open space and the creation of lands suitable for agriculture. The majority of these changes were induced by measures which allowed for increased residential and urban development of the flood plain due to increased levels of flood protection, or increased agricultural development due to improved drainage and/or flood protection. Impacts induced by increased levels of recreational development were mentioned occasionally (e.g., land clearing and loss of wildlife habitat). The well-known "tangible" and "intangible" benefits from flood control and multipurpose projects were often mentioned as environmental impacts.

Project purpose-related impacts for inland navigation were associated primarily with increased boat traffic and induced industrial growth and development. Frequently, these increases were reported as leading to possible increases in water pollution. Again, the well-known "tangible" and "intangible" benefits for single-purpose navigation projects were often mentioned as environmental impacts.

Items (iii), (iv) and (v) of Section 102(2)(C)

In reviewing the 234 environmental statements we were interested in getting a general feeling for the types of alternative projects considered (and the level of detail presented) in the section of the state-

ments dealing with item (iii) of Section 102(2)(C), i.e., "alternatives to the proposed project." Typically, the section of the environmental statement dealing with alternatives consisted of a brief paragraph or two describing some or all of the following: the implications of not building the project; the nature of the "structural alternatives," with or without a discussion of their economic and/or environmental ramifications; and the nature of the "non-structural alternatives," usually with the reasons for not pursuing them.

The implications of not building the proposed project were mentioned in about 85 percent of the statements. Commonly, the alternatives presented were rejected for being technically infeasible, too costly, or having impacts on the environment that were even more serious than those associated with the proposed project.

Item (iv) of Section 102(2)(C) requires that the environmental statement address itself to the nature of conflicts between short-term uses of the environment and long-term productivity. In the statements we examined, this mandate of the NEPA was generally dealt with in a paragraph or two. The types of responses that we observed commonly included statements relating to the following (examples are given in parentheses): items that would increase in the long term (economic productivity); items that represent long-term losses (inundated lands); activities that would improve as a result of the project (recreation); trade-offs between long-term or short-term losses and gains (the loss of "x" miles of free flowing stream vs. the benefits of flood protection); and descriptions of changes in land use.

A substantial number of statements dealt with item (iv) of Section 102(2)(C) by elaborating on the benefits that would accrue if the project were constructed. About fifteen percent of the statements argued that because the project would not change the use of the water or adjacent land, there would be no conflict between short-term losses and long-term gains.

Section 102(2)(C) of the NEPA also requires that the environmental statement discuss "any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." More than half of the environmental statements responded to this requirement by making general reference to losses in land, labor and/or materials. The references to land often included the current land use and number of acres involved; however, the references to labor and material were seldom elaborated upon. Thirteen of the 234 environmental statements indicated that there would be no irreversible or irretrievable resource commitments.

The specific items mentioned as resource commitments were quite diverse in nature. In addition to losses in land, these included losses in fish and wildlife habitats, minerals and mining opportunities, archaeological and historic sites, and free flowing streams. Several statements observed that economic growth induced by the project could generate further resource commitments. Twenty-four of the 234 statements argued that, if desired, pre-project conditions could be reinstated following completion of the project.

Controversial Issues and Adherence to Guidelines

There were several issues which we viewed as potentially controversial in terms of the spirit of the NEPA. The first of these related to the practice of "mitigating" an adverse effect with the addition of an "offsetting" project element, e.g., the inclusion of a fish hatchery in a project to compensate for the loss of anadromous fish runs. While the mitigation argument may, in many cases, be based on sound economic reasoning, we sense a potential controversy in the acceptability of an argument that suggests, for example, that the inundation of "x" acres of redwood trees can be compensated for by the purchase of a nearby "x" acre tract of redwoods. Mitigation features were most commonly observed in the inland flood control and multipurpose projects; they appeared in 45 percent of the 137 projects in that category.

It was not at all clear to us whether the various guidelines for preparing environmental statements could be interpreted to mean that the

standard economic benefits of a project should be considered as environmental impacts. We found that they were mentioned this way in about 80 percent of the statements. A similar question arose with regard to recreational benefits which were mentioned as environmental impacts in about half of the statements. Approximately 45 percent of the statements described landscaping and beautification measures, frequently in a manner which served to de-emphasize adverse visual aesthetic impacts; e.g., it was often implied that, in essence, these impacts could be ignored as extensive landscaping would be included in the project.

We also kept a record of the frequency with which several items, mentioned as desirable in various Corps and CEQ guidelines, were incorporated into the environmental statements. We observed, for example, that project dimensions were included in about 70 percent of the statements, but that impacts per se were generally not quantified. (We did not interpret the inundation of "x" acres of land as a quantified impact.) Mention was made of the occurrence (or lack thereof) of archaeological or historic sites in about 55 percent of the statements; similar mention of rare or endangered species occurred in about one-quarter of the statements.

Slightly less than half of the 234 statements incorporated what we referred to above as project-induced effects on the environment, e.g., a discussion of future pollution problems that would obtain as a result of induced economic growth. (The Corps and CEQ guidelines have used the terms "indirect" and "secondary" consequences, respectively, to mean much the same thing.) Since these chains of induced impacts are, in actuality, never ending, it follows that further guidance is required in regard to the level to which these secondary effects should be pursued.

Since concern with "ecological impacts" looms large in both Corps and CEQ instructions for preparing environmental statements, we were concerned with how often arguments relating to food chains, biological interactions, changes in photosynthetic productivity, and the like, were being considered. We found, quite apart from very general phrases, e.g., a change in the "overall ecology of the area", that such ecological arguments appeared in only about fifteen percent of the statements.

Finally, we observed that in only a few of the 234 environmental statements did the Corps regard any adverse environmental effects as serious enough to warrant project modification. In those few cases where modifications were involved, they were initiated in response to requests by other reviewing agencies; typically, they involved a deletion of a small portion of the project or the use of an alternative solution for part of the project. More commonly observed was the addition of mitigation measures in response to reviewing agency comments.

THE ROLE OF ENVIRONMENTAL STATEMENTS

In the remainder of this chapter we present a number of observations concerning the utility of the environmental statements we reviewed, and suggestions as to how future statements might be improved. While we neither expect nor desire everyone to agree with these observations, we do feel that we are in a rather unique position to offer constructive criticism, in that our impressions are based, not on the brief review of only a few statements, but on a quite detailed analysis of 234 statements prepared by the Corps.

Obviously, it is impossible to make observations on the utility of an environmental statement without first providing a basis for this judgment. That is to say, a person's evaluation of the efficacy of a statement depends, to a very large extent, on his perception of what an environmental statement should accomplish. Unfortunately, there is at the present time a divergence of opinion in regard to the "proper" role of the environmental statement. The CEQ took the first step in defining this role in their Guidelines, which, in essence, set forth their interpretation of Section 102(2)(C) of the NEPA. Further attempts at definition of the role of the statements have been made in the procedures prepared by each of the various federal agencies charged with the preparation of environmental statements. The courts, via their decisions in regard to litigation concerning the NEPA, have also played an important part in the interpretation of the intended role of the statements. Needless to say, these various interpretations are not in complete agreement.

It is likely that questions relating to the role of the environmental statements will remain unsettled for some time to come. Therefore, in the absence of agreement on this issue, we employ our own interpretation of the role of environmental statements as a basis for evaluating the statements we reviewed. Below, we discuss our perception of the intended role of the environmental statement in water resources planning. In subsequent sections we present our evaluation of the utility of the statements we reviewed in terms of this role.

To put our perception of the role of environmental statements in context, it is necessary to consider the process of project evaluation. Traditionally, the major emphasis in water resources project evaluation has been on costs and benefits measurable in dollar terms. These form the basis of the so-called benefit-cost analysis which has been widely used by all major water resources agencies in the United States. The so-called "intangibles", that is, costs and benefits not measurable in monetary terms, have also played a role in project evaluation; but this role has been a relatively minor one for a number of reasons. One reason is the clear absence of an accepted methodology for incorporating intangibles into the project evaluation process in a systematic way. Another is the emphasis that the standard guidelines for project evaluation, contained in Senate Document No. 97, place on showing a ratio of measurable benefits to costs greater than unity.* While these guidelines recognize the importance of intangibles, no similar emphasis is placed on the manner in which they are to be dealt with. This concern for benefit-cost ratios has greatly influenced the key budget reviewing agency in the Executive Branch, the Office of Management and Budget (formerly the Bureau of the Budget). For these reasons, the Federal water resources agencies have been preoccupied with benefit-cost ratios.

We view the preparation of environmental statements, in part, as an opportunity to give at least some of these intangibles the stature and

* The President's Water Resources Council, "Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources," 87th Congress, 2nd Session, Senate Document 97, 1962.

emphasis they deserve in project evaluation. We note, parenthetically, that the U.S. Water Resources Council's recent efforts to develop a new "system of accounts" for project evaluation represents still another manifestation of the need to incorporate these intangible costs and benefits in project evaluation in a more systematic way.*

Another aspect of our view of the environmental statements involves recognition of the fact that many people in the United States are undergoing a profound transition in their view of man's relationship to the natural environment. The manifestations of this transition, characterized by a concern for "ecology", are commonplace and need not be belabored. Suffice it to say that we feel the environmental statement is intended to formally recognize this concern for the "quality of the environment".

Still another consideration that influences our view of the role of environmental statements is the increasing level of public participation in the decision-making processes for water resources projects. The evidence exists to show that such groups as the Environmental Defense Fund and the Sierra Club, as well as a host of less well-organized groups of interested citizens, can and will play a central role in the evaluation of water resources projects. Consequently, we feel that environmental statements should be written in a manner that informs a concerned citizenry of the environmental implications of the proposed structures and activities.

Based on these perceptions of the role of environmental statements, it follows that they should contain nothing less than a complete accounting of all the significant environmental implications of a project. To achieve completeness, such an accounting must recognize the limited information and understanding we have concerning many environmental impacts. These limitations may lead to descriptions of impacts that are acknowledged as being uncertain, controversial, or poorly understood.

Statements should reflect the fact that much of their utility may ultimately come in the form of reactions by individual citizens who are

* U.S. Water Resources Council, "Proposed Principles and Standards for Planning Water and Land Resources," in Federal Register, Vol. 36, No. 245, Part II, December 21, 1971, pp. 24144-24194.

not trained as scientists or engineers. Environmental impacts should therefore be described in terms that will make sense to such readers. In particular, impacts ought not to be described exclusively in terms of chemical, physical or biological parameters. Rather, impacts ought to be described either in terms that relate the implications of the proposed action to human welfare, or to changes in resources or characteristics of the environment that may be considered as worth preserving. This holds even when, because of limitations in our understanding, the precise implications of these changes cannot be well articulated.

Our interpretation of the role of environmental statements is in some respects not dissimilar from the one held by Meyers and Tarlock. They have presented their views in the following terms:

At the very least, NEPA is an environmental full disclosure law. The Congress, by enacting it, may not have intended to alter the then existing decisionmaking, but it certainly intended to make such decisionmaking more responsive and more responsible.

The "detailed statement" required by § 102(2)(C) should, at a minimum, contain such information as will alert the President, the Council on Environmental Quality, the public, and indeed, the Congress, to all known possible environmental consequences of proposed agency action. [*italics in the original*] Where experts, or concerned public or private organizations, or even ordinary lay citizens, bring to the attention of the responsible agency environmental impacts which they contend will result from the proposed agency action, then the § 102 statement should set forth these contentions and opinions, even if the responsible agency finds no merit in them whatsoever. Of course, the § 102 statement can and should also contain the opinion of the responsible agency with respect to all such viewpoints. The record should be complete. Then, if the decisionmakers choose to ignore such factors, they will be doing so with their eyes wide open.*

A GENERAL ASSESSMENT OF THE 234 STATEMENTS

In terms of the role of the environmental statement that we described above, the majority of the 234 environmental statements that we examined

* Meyers, C. J. and A. D. Tarlock, Water Resource Management, Foundation Press, Mineola, New York, 1971, p. 951.

were decidedly less than adequate. They were, in general, not comprehensive, nor did they seem to be written with the view of providing non-technically oriented readers with the kinds of insights and information that would be required if they were to participate effectively in the decision-making process. In short, they did not seem to add a great deal of information, in terms of new data or analyses, to that contained in existing project documents. While they did not reflect the careful integration of environmental issues into the project evaluation process, this could not be expected considering that many of the projects were in rather advanced stages of design.

There were other, more specific, weaknesses, but we will not dwell upon them here; they can be dealt with more constructively in the following section where we discuss suggestions for improving future statements.

While we feel that the statements reviewed were inadequate in terms of the role described above, we recognize that there were a number of factors that severely constrained those responsible for their preparation. Most obvious among these are that environmental statements are a new entity; there are no models to indicate what they should be, nor are there established methodologies for the preparation of statements. Furthermore, this lack of procedural methodology is compounded by a number of ambiguities in the NEPA and the CEQ Guidelines that serve to further frustrate efforts to prepare good statements. (This latter point is taken up in more detail in another section of this chapter.)

Another obvious set of constraints relates to budgets and manpower. If the Corps had been faced only with preparing environmental statements for projects in the early stages of planning (e.g., "pre-authorization"), the budget and manpower constraints might not have been overwhelming. However, this was not the case at all. The Corps set out to prepare statements for an enormous backlog of projects at various stages in the planning and construction processes. (Furthermore, statements are also being prepared for projects already completed whose routine operations may create adverse environmental effects.) Combined with the relatively small budgets and limitations on appropriately trained personnel was the pressure to complete statements in relatively short periods of time. Thus, given the backlog of projects at various stages of planning and construction

that required environmental statements, the limited time, budget and man-power available for the task played a crucial role in limiting the quality of the statements.

While on the subject of assessment, there is one issue deserving of special mention--namely, the extent to which more recent statements (i.e., those completed in Summer 1971) were observed to be "better" than the earliest statements (i.e., those completed in Autumn 1970). Although we did not undertake a systematic analysis of this issue, we feel it is one worth mentioning.

On the basis of casual observation, we found the later statements to be longer, slightly more complete, and somewhat more carefully written. In addition, the review by other government agencies and citizens' groups appeared to be more thorough. The slight improvement observed probably reflects both the experience gained by those preparing the statements, and the revised and more comprehensive guidelines and regulations issued, respectively, by the CEQ and the Corps in Spring 1971.

However, with relatively few exceptions, the only statements that appeared to be substantially more thorough and sophisticated, were those associated with projects involved in litigation alleging violations of the NEPA.

To summarize, the general impression we received upon reviewing 234 environmental statements, is that these statements, as presently prepared are less than adequate in fulfilling the role of environmental statements as we perceive it. While it is not likely that this situation can be remedied in the very short term, we do feel that there are a number of weaknesses which could be eliminated with a minimum of effort. Below we describe the deficiencies which we perceived in the statements, along with suggestions for improving future statements.

SUGGESTIONS FOR IMPROVING ENVIRONMENTAL STATEMENTS

By way of introduction to our specific criticisms and suggestions, we feel it useful to clarify the context in which they are offered. First, the criticisms are, obviously, subjective. They are founded upon

our interpretation of the NEPA and our perception of the ultimate role of environmental statements. Second, the listing of deficiencies and suggestions for improvement is neither unique nor exhaustive; others examining the statements might easily have emphasized different points. Third, and finally, the categories used were developed primarily for ease of presentation and are therefore somewhat arbitrary. In particular, the order of presentation is not meant to suggest a ranking of criticisms according to their relative importance.

The first group of suggestions below deal specifically with ways in which the statements can be made more meaningful to those persons (and especially those with little technical knowledge in the water resources field) who must make a decision or form an opinion as to the relative merits of a given project. For the most part, these suggestions concern the manner in which impacts are described.

The second group of suggestions concentrates on the individual sections that make up an environmental impact statement. The discussion focuses on commonly observed deficiencies, some of which are matters of form, and ways in which these deficiencies might be eliminated.

The third group, collected under the rubric of Miscellaneous Suggestions for Improvement, considers some additional issues which do not fall conveniently within either of the categories above.

Improving the Description of Impacts

Reducing Levels of Generality

One of the strongest impressions we had following the review of the statements was that a large number of the reported impacts were so general as to be not terribly useful. The following are typical of these general descriptions: elimination of vegetation, loss of wildlife habitat, alteration of aesthetics, and the modification of flora and fauna.

The utility of such phrases for purposes of decision making is terribly limited for a number of reasons. For one thing, such general descriptions do not indicate the scope or importance of the change in either relative or absolute terms. For example, one aspect of whether or not the "elimination of vegetation" is a substantive issue is the

extent to which vegetation is scarce or plentiful; this issue was pursued only occasionally in the statements.

Another limitation of these general descriptions, and indeed, of the great majority of descriptions employed in the statements, is that they are not given in terms that are likely to be understood by the general reader. We suggest that it is essential to carry the description far past the general level, and indeed past the point of relating changes only in physical, chemical or biological parameters. If environmental statements are to be useful for decision making, it will be necessary to trace the implications of changes in these parameters to the point where the influence of the changes on human welfare, interpreted in the broadest sense, is clear. For example, it would not be meaningful to most readers to learn that the dissolved oxygen of a river would decrease as a result of a project; however, the influence of such a decrease on fish is something to which most readers would be able to relate. In a somewhat different vein, learning that the benthos would be destroyed by a breakwater is not something that would make sense to most people. More relevant would be a description of the implication of such a change on other plants and animals; but even this is incomplete. Cases such as this call for a discussion of broader issues relating to irreversible ecological change and the limitations and uncertainty associated with our ability to forecast the nature of such change.

To further document the need for more sophisticated descriptions of impacts, we cite below three examples of the limited usefulness of general descriptions. The first example concerns the manner in which aesthetic issues were treated in projects involving levees. These issues were described in general terms using phrases such as "reduced visual aesthetics" or "detraction from scenic qualities." While the description of alterations in aesthetic qualities is admittedly not a simple matter, the descriptions generally reported hardly enabled the reader to understand the issues at even a superficial level.

The second illustration of the limits of these general phrases is the frequently used argument that dredging will lead to increases in turbidity that are temporary and minor. Several questions remain un-

answered. Should one worry about this increased turbidity? What are the implications of such changes? The changes in turbidity were asserted to be temporary and minor, but does it follow that the implications of such changes will also be temporary and minor? It certainly is not true in general that a minor change in a given parameter will have implications that are also minor.

The third and final point relating to vague and general descriptions concerns what might be called the use of "eco-terminology." Many of the arguments that were given in terms of jargon phrases from the biological sciences, could have been made more clearly without such phrases. This technical jargon is easily misused by non-specialists. The Catalog of Impacts for Dams and Reservoirs in Chapter Three provides numerous examples of cases where jargon from the biological sciences was not enhancing the clarity of the descriptions. We have in mind, for example, such phrases as the following: conversion of the system from "lotic to lentic"; replacement of "hydric" with "mesophytic" forest types; and alteration of "the flora and fauna environment."

Identifying All Significant Impacts

A substantial number of the statements we examined appeared especially incomplete in the sense of not setting out all the probable significant environmental impacts. The most disconcerting example of statements deficient in this respect are those which simply asserted that the project would have no impact on the environment. When presented without a well-reasoned defense for this position, such an assertion leaves the impression that a comprehensive attempt to identify potential impacts was not made.

While we could cite examples of the incomplete identification of significant impacts in statements relating to every possible structure and activity, three particularly noteworthy examples should suffice to make the point. First, statements for projects involving spoil disposal were consistently incomplete in that often impacts related to spoil disposal were not mentioned at all. In fact, as noted in the sections on Spoil Disposal in Chapters Two and Three, there were a number of statements for projects involving dredging that failed even to mention the necessity of spoil disposal.

Second, there was a striking need observed for more completeness with regard to the identification of the impacts of water resources projects on water quality. This need is readily established by observing (Table 3-2) that fewer than twenty percent of the projects involving dams and reservoirs even mentioned changes in water quality that might occur as a result of impoundment. In practically all of the statements reviewed, water quality considerations did not receive the attention that we feel is warranted.

A third matter worthy of mention concerns the identification of secondary or indirect impacts. The inclusion of secondary impacts in the environmental statements was specifically required by both the CEQ guidelines and the Corps regulations. However, as noted in Chapter Four (Table 4-3), less than half of the statements reviewed included secondary impacts.

In regard to suggestions for improvement, it is impossible, of course, to make a definitive pronouncement as to what a "complete" identification of impacts would entail. We might suggest that one way to improve the statements within the existing constraints would be to use the catalog presented herein as a starting point in developing a more complete list of possible potential impacts. We would advise, though, that these catalogs be used with discretion, since, as noted above, the descriptions in the catalogs are not always the relevant ones.

Identifying Speculative and Controversial Arguments

For the purpose of this discussion, we define speculative impacts as those which are not obviously true, but are presented without qualification. Controversial impacts are defined as those which are questioned by agencies or individuals reviewing the statements, but remain unresolved in the final statements. Very often not only do these impacts remain unresolved, but the controversy is not even acknowledged by the Corps. Examples of speculative and controversial arguments are presented below, together with suggestions for dealing with them.

We came across a number of impacts which we viewed as clearly speculative. In one coastal project, for example, it was argued that groins would create underwater surface areas for "minute microorganisms." These microorganisms, serving as food sources, would attract "significant quantities of both inlet and ocean [fish] species," which, in turn would attract anglers.

A second example of a speculative argument, this one from an inland flood control project, is presented below in its entirety:

Reduction of river bank overstory along the length of the levee would increase solar radiation input to the ___ River, thus tending to increase water temperature. However, the increase in river velocity will tend to offset the temperature increase within the lower reach. Because of reduced overstory, river waters will exchange heat energy more with outer space (absolute zero temperature) and less with overstory leaf and limb surface. The overall alteration, by the project, on the river's energy budget would be a somewhat greater diurnal fluctuation with a tendency to lower heat retention. This would provide the river greater capacity for dissolved oxygen; this, together with somewhat increased water velocity would enhance the river's ability for self-purging of any oxygen-demanding pollutants.

Where arguments that are not obviously true are employed, we feel they should be documented in the usual way by making reference to sources in the literature or personal communication.

There were several cases where impacts delineated by the Corps were questioned by reviewing agencies, and, despite the exchange of communication, the question remained unresolved. For the most part, the discussion of such controversial impacts was relegated to the final section of the environmental statement which summarizes the "coordination" of the statement. Thus, for example, if the Corps believed that a given impact would occur, and a reviewing agency felt that it would not, the entire controversy would appear only in the final section of the statement. We feel that the statements would be improved if the controversial issues were described as such wherever the impact was mentioned. While such controversies were not commonly observed, they can relate to important questions, as the following example suggests.

In describing the impacts of a given project, the Corps argued as follows:

The total available oxygen due to larger volumes and surface areas, coupled with other factors of reservoir dynamics, will more than offset any reduction in re-oxygenation capacity due to reduced velocity and temperature increase.

One of the reviewing agencies disagreed with this conclusion and stated the following:

The impoundments created by the locks and dams will increase the overall water temperature and decrease the water's capacity for absorption of oxygen.... Studies on other similar streams indicate that although some pick-up of oxygen can be realized in the spillway discharges, the assimilative capacity of the stream and its overall oxygen content after being converted to a waterway by the use of impoundment will be less than that for the free flowing stream.

The coordination section of the report contained a précis of the reviewing agency's observation, the Corps' original argument (above), and the following additional Corps response, concluding the discussion:

... The existing impoundments on the nearby and very similar ___ River System exhibit the ability to recover rapidly from even gross pollution loadings and indicate good levels of re-oxygenation by spillway aeration.

In a case such as this there is a clear-cut and unresolved controversy concerning the nature of the impact. We feel the statement would have been improved if both sides of the controversy had been given consideration in the sections of the environmental statement concerning the delineation of impacts.

Dealing with Uncertainty

The fact that all forecasts are uncertain is common knowledge, and we have no intention of belaboring this fact. Since the description of probable environmental impacts resulting from a project can certainly be categorized as a forecast, one would expect to find some discussions of the uncertainty of these impacts in the environmental statements. However, the statements we reviewed uniformly failed to deal with this concept. It is our view that a more considered view of the role of uncertainty in forecasting environmental impacts would, among other things,

largely eliminate the difficulties involved with speculative and controversial impacts noted above.

We have no intention of presenting a discourse on probability theory and the methods for dealing with uncertainty. This body of knowledge, while well established, has yet to be utilized in the process of forecasting environmental impacts. We do feel, however, that there are two points worth mentioning concerning the possible role of uncertainty in the environmental statements.

One point is that a more forthright approach toward the limitations of our present understanding of natural processes, social behavior and economic interactions would help to put the descriptions of environmental impacts in perspective. In the statements we reviewed, there were surprisingly few that elaborated upon the limits of our understanding. If little is known about a possible impact, then this fact is, in itself, useful to a reader attempting to assess the environmental implications of a proposed project.

A second point is that although it is admittedly difficult, it would be useful to work toward introducing formal measures of uncertainty into the statements. Our understanding and ability to forecast is not at a uniform level. That is, there are some outcomes that can be predicted with more confidence than others. Information on the level of confidence associated with the forecasts, probability measures if you will, would be most helpful to readers.

Identifying the Recipients

The Corps' regulations on the preparation of environmental statements draw a strong distinction between impacts, which they imply should be value free, and their effects (who or what is affected by the change).^{*} While we do not necessarily agree with this distinction, it is necessary as an introduction to the next line of the regulation which directs the writers of the statements to "Identify the recipient (environmental element, interest group, industry, agency) of these effects and the nature and extent of the impacts on them."

^{*}U.S. Army, (ER 1105-2-507), May 1971, op. cit., p. C-4.

In our view, the identification of the recipients of a project's effects, both beneficial and adverse, is of paramount importance if these statements are to become a useful tool in the planning process. The traditional economic efficiency criteria for project justification have notoriously failed to take into account this "impact recipient," or distribution issue. The question of distribution is central to an understanding of a project's economic implications; it is no less important in understanding a project's environmental implications.

In the 234 statements reviewed, only rarely did we observe any attempt to identify the specific individuals or groups that would be affected by the various environmental changes reported. Often the recipient could be discerned by inference; e.g., a loss of hunting opportunities would adversely influence hunters as a group. For many impacts, however, the group or "elements" affected was much less obvious; it is here that some attention should be directed toward the identification of recipients.

The importance of information on the distribution of impacts to the decision process is suggested by the following hypothetical circumstance. We would contend that it would be advantageous for a decision maker to know that the beneficial impacts of a navigation project, for example, would accrue primarily to petroleum interests, whereas the adverse impacts, perhaps only an aesthetic impairment associated with spoil disposal, would accrue to thousands of persons who had to view the project as they traveled to and from work. We are not drawing any conclusions as to what the value judgement should be, but merely suggesting that this type of information should be available to readers of environmental statements.

Identifying Value Judgments

Whether value judgments should or should not be included in the environmental statements is a matter which we feel deserves further attention by those concerned with the preparation of statements. At issue here is not whether value judgments have a place in the statements, but rather that they are recognized and identified as such when they are used. While we would readily admit that the description of impacts in completely value-free terms is a difficult task, we do feel that some flagrant abuses in this regard could be eliminated.

It could be argued that any one of the reported impacts that were described as beneficial might as easily be described as adverse by a person having a value system different from that of the person preparing the statement. The most obvious example of this concerns the issue of aesthetics. Consider, for example, the alteration of aesthetic qualities brought about by the construction of a dam, an issue raised in about 35 percent of the 55 statements involving dams and reservoirs. An improvement in aesthetic qualities was reported more often than a reduction; the point is, a value judgement is clearly involved. The only conclusion warranted by these statistics concerning the aesthetic impact of reservoirs is, that among the writers of environmental statements, a lake or reservoir is generally felt to be more attractive than a natural stream. Perhaps the value judgement should have been identified as just that, and the decision left to the reader.

Another common example relates to the effect of spoil disposal in modifying land forms. Most often, these modifications were reported as adverse impacts (e.g., the loss of wetlands); however, in some cases the changes were considered to be beneficial (e.g., the creation of valuable land out of swampland). The question of whether a land form modification is beneficial or detrimental obviously involves a value judgement. The descriptions of these modifications generally did not acknowledge this fact.

Another area in which value judgements could constructively be eliminated is in the use of value-loaded adjectives to describe supposedly value-free impacts. A number of the statements contained what appeared to be somewhat less-than-objective accountings of the environmental impacts. This impression is probably most readily conveyed by the use of value-loaded adjectives to emphasize the beneficial impacts while minimizing the adverse impacts. We have in mind such phrases as the replacement of a "marginal stream fishery" with an "excellent warm water fishery," or the substitution of the "clean lines" and "gentle curves" of a new channel for the "unsightly and sluggish" stream, or the creation of "a major aesthetic asset" which might result in "some short-term changes in the fish and wildlife habitat." As can be seen in the catalogs in Chapters Two and Three, phrases of this sort were used frequently.

We would suggest that "slanted" arguments involving such high levels of subjectivity ought not be contained in environmental statements without qualification. If they are included, then, in the interests of presenting a balanced view of the impacts, alternative subjective impressions ought also to be included.

A Section-by-Section Analysis

In its directions on the preparation of environmental statements, the Office of the Chief of Engineers prescribed that the environment statement would contain eight separate sections.* The discussion thus far has centered around specific recommendations for improving only two of these -- those relating primarily to the discussion of impacts. Additional deficiencies perceived in each of the individual sections of the statements are described below in short section-by-section discussions.

Project Description

While this section generally contained sufficient information to categorize the projects, its utility, especially for the general public, could be somewhat improved with a minimal amount of effort.

Project dimensions, while included in a majority of the statements, ought always to be included. It is especially difficult to assess the impact of an "inundation of wildlife habitat" when there is no indication of whether it is 200 or 20,000 acres that are to be inundated.

In addition, if the public is to be effectively brought into the planning process, then projects must be described in terms understandable to laymen. While this is probably not a problem in most projects, some of the more "esoteric" structures, e.g., floodwalls, jetties, groins, flap gates and sumps, may have little meaning to someone outside the field of water resources. A possible solution to this problem is to include with each statement a layman's glossary of technical terms used in the statement.

A final suggestion concerns the issue of completeness. If all the structures and activities entailed in a project were set down in the project description, there would be less likelihood of impacts being neglected.

*Ibid., p. C-3.

Thus, if a project involved channelization via dredging, the project description should list both dredging and spoil disposal as project activities.

Environmental Setting without the Project

An important part of this section, as outlined in the Corps' Regulations on preparing environmental statements, is a description of what "the future environmental setting is likely to be in the absence of the proposed project." This information is vital to the decision maker in the planning process, yet it was uniformly omitted in the statements reviewed.

The recommendation in the Corps' regulations which was apparently taken to heart by many of the writers of these statements, and which resulted in a net decrease in the utility of this section in many statements, was the admonishment against "focusing only on the immediate area at the risk of ignoring important regional aspects critical to the assessment of environmental impacts."* This suggestion resulted in a large number of statements presenting very general descriptions of the entire watershed, but completely neglecting to describe the immediate project area. While the point on the importance of regional considerations is well taken, it needs to be tempered with good judgement. Although a description of the fauna and flora and climate of the higher elevations of the Southern Rockies may be interesting, its relevance to a channelization project in downtown Albuquerque is questionable. What is lamentable is that often one would have to read through the whole statement and perhaps the agency comments to find out that the project was in an urban environment and not in the bucolic setting described.

Environmental Impacts and Adverse Effects

These two sections will not be discussed in detail here, as most of the other criticisms and suggestions for improvement pertain directly or indirectly to these two issues. However, in regard to format there are three problems concerning these sections.

One point is that in most of the statements we reviewed, it was quite difficult to sort out the linkages between impacts and individual structures or activities. In some cases as many as four or five impacts were

* Ibid.

discussed in a single paragraph, with no indication as to the cause of the impacts.

This ambiguity that exists in determining the relationship between project components and environmental impacts should be eliminated. One way to do this might be to provide, for each structure and activity, a list of the associated impacts. Each item in the list could then be developed fully at the level of detail suggested above. Furthermore, separate discussions could be provided for impacts not associated with any particular structure or activity, i.e., the "project-induced impacts" mentioned above.

A second point concerns the interpretation that many authors of these statements were giving to the role of these two sections. Quite frequently the section on environmental impacts was devoted only to project benefits, and the (other) environmental impacts were first introduced in the following section on adverse effects. Some clarification on the purposes of, and the differences between, these sections is in order. However, the root of this problem may be the lack of operational definitions of words like impacts, effects, and adverse. The need for clarification of these terms is taken up in the following section of this report.

The third and final point is that in a number of cases the impacts were not restricted to these two sections, but were scattered throughout the statements. For instance, environmental impacts were occasionally mentioned for the first time in the section on irreversible and irretrievable commitments of resources.

Alternatives to the Proposed Action

The main criticism of this section is that instead of a discussion of alternatives which might avoid some of the adverse environmental effects resulting from the proposed project, we found terse paragraphs to the effect that other alternatives (usually of the structural variety) were considered in the planning stage but were found infeasible from either an economic or technological point of view. In the majority of the statements the environmental implications of the alternatives were not even discussed.

It appears likely that the constraints on time were largely responsible for the inadequate treatment of this section. The planning process was nearly or wholly complete on most of these projects, and

any discussion of alternatives not considered originally would have been, of necessity, somewhat superficial. We anticipate that this section will improve as environmental considerations begin to be introduced early in the planning process.

The constraints on time did not prevent the reviewing agencies from taking the Corps to task on the question of alternatives. Their letters, which form the final part of the environmental statement, frequently argued that the Corps' view of the range of alternatives was too restricted. In this regard, "non-structural" alternatives such as flood plain zoning were sometimes suggested by reviewing agencies, usually only to be dismissed as "infeasible" by the Corps.

Relationships between Local Short-Term Uses and Long-Term Productivity

The utility of this section was minimal. For the most part very little in the way of new information or insight was offered. Frequently the project benefits were reiterated under the guise of long-term productivity.

From the wide variety of responses to this section it was clear that no one knew what was called for. In the following section of this report we pursue the discussion of why we feel that confusion over the meaning of this item in the NEPA is well founded.

Irreversible and Irretrievable Commitments of Resources

As discussed in Chapter Four, this section generally received only superficial attention in the statements we reviewed. Commonly, the only relevant portion of the usually brief discussion was a statement to the effect that the project would require the commitment of land, labor, and/or materials. Such general statements do not contribute a great deal to the planning process. As a first step in the improvement of this section, then, these commitments should be further elaborated upon.

However, there is some question as to whether this section can be significantly improved simply by greater attention to detail. The impression we received from the majority of the statements reviewed was one of attention to meeting only the formal requirements of the NEPA. There were very few discussions which addressed themselves to the required point, ". . . the extent to which the action curtails the range of beneficial uses of the environment." We would suggest that in future statements, more attention be given to satisfying the intent, as well as the letter of the law in regard to this section.

Coordination with Other Agencies and the Public

We view the coordination section as potentially one of the most useful components of the environmental statement. If the statements accomplish nothing else, they are at least valuable in that they serve as vehicles for the coordination of the various federal and state agencies, interest groups, and individual citizens. While more effort is still required, the coordination section was the one part of the statements which we felt showed the most notable improvement over the period of time covered by the statements we reviewed (November 1970 through August 1971). In this regard, the improved participation by the reviewing agencies was most notable. Most of the letters attached to the earlier statements appeared to contain little more than formalities; indeed, a number of the letter writers frankly admitted that they had neither the time nor the personnel to adequately review the statements. Apparently this situation is improving somewhat, as a number of the agency comments on the more recent statements raised points for clarification or offered fairly substantial arguments. The overall quality of these review letters, however, remains poor, as many of the agencies have yet to demonstrate any intention of seriously reviewing these statements. Viewed as a check on the validity and thoroughness of the Corps' environmental statements, the agency review process has been generally inadequate.

In the statements we reviewed, there was very little in the way of review by private interest groups or individual citizens. We feel that the short time available for the review of a statement, while serving to seriously limit the comprehensiveness of the agency review, has effectively eliminated the possibility of individual citizen review. Hopefully this time constraint can be relaxed as the review process is integrated into the overall planning process.

All of the above is beyond the control of the Corps. The Corps is responsible, however, for the consideration of the recommendations contained in the review letters, and in this regard, there is room for improvement. While agency comments were generally incorporated into the final statements, there were a number of cases where these comments were either ignored or inadequately treated. One particularly common example of this was the Corps' response to the suggestion, previously mentioned, that non-structural alternatives be given more consideration. This recommendation was typically dismissed in a word--infeasible.

In general, we would suggest that more consideration need be given to these review letters if the coordination section is to function as a useful part of the planning process.

Miscellaneous Suggestions for Improvement

The first group of suggestions for improving environmental statements dealt with broad questions concerning the manner in which impacts are described. The second group concerned each of the individual sections that comprise an environmental statement. We conclude the discussion of suggested changes by considering a number of special issues not falling conveniently into either of the two groups above.

The Concept of Wildlife

It was our impression upon reading a number of these statements that, to many Corps planners, wildlife is synonymous with game. This highly subjective impression is based upon the fact that when and if a loss of wildlife was elaborated upon, the discussion was apt to include only those species of wildlife which are hunted for game. There was generally no mention of those species which have not traditionally been "valued" by man. This, we would contend, implies too narrow a view of the concept of wildlife.

This restricted definition of wildlife is not surprising, however. The concept, prevalent in the United States, that the only wildlife of value are those which can be directly "used" by man is a remnant of our frontier ethos. Indeed, this "use" concept pervades our view of the value of all our natural resources. It is a view that we feel should and will be questioned with increasing frequency in the future.

We recognize that it is perhaps unfair to criticize the Corps on this issue when the agencies charged with protecting our wildlife seem to subscribe to this same restricted view. Until these agencies adopt a broader environmental view, it is unreasonable to expect those agencies charged with developing our natural resources to change their views.

As an aside, we would contend that the mitigation issue, which we have previously indicated as being potentially controversial, is directly related to this concept of the "use," as opposed to the protection, of our natural resources.

The Use of Water Quality Standards

The statements in general failed to examine in a comprehensive fashion, changes in water quality resulting from the proposed projects. In addition, the statements consistently failed to deal explicitly with water quality standards. While there were occasional casual assertions to the effect that local water quality standards would (or would not) be met, such general arguments fail to reflect the importance of these standards in water quality management programs. Standards are taking on increasing importance as an instrument for controlling water quality, and as such, we feel they should be dealt with comprehensively in the environmental statements.*

The Consideration of Alternative Operating Policies

With few exceptions, the impacts reported in the statements we reviewed related almost exclusively to activities involved in the construction of projects, the structures per se, and the induced effects of the projects. One consideration which was generally neglected was the impacts and implications of alternative operating policies on the environment. We feel that this is an issue worthy of more consideration in both the discussion of alternatives and the discussion of environmental impacts in general. A good illustration of the potential importance of alternative operating policies is contained in a recent study for the Portland District of the Corps of Engineers by the Stanford Research Institute.**

AMBIGUITIES IN THE NEPA AND THE CEQ GUIDELINES

In reviewing the 234 environmental statements, it became obvious that a number of confused or inconsistent responses in the statements were a

* The extent to which a demonstrated compliance with water quality standards fulfills the intent of the NEPA is currently a subject of controversy. In the Galvert Cliffs Coordinating Committee v. AEC decision, the District of Columbia Court of Appeals ruled that a certificate of compliance with the State standards did not constitute an adequate discussion of the impacts of the project on water quality. However, this decision would likely be overruled if the new Federal Water Pollution Control Act is passed, as both Senate and House versions of the bill (S.2770 and HR 11896) contain provisions to this effect.

** Stanford Research Institute, "Summary Report on the Bonneville Environmental Impact Study," Menlo Park, Calif., July 2, 1972.

direct consequence of ambiguities in the NEPA and the CEQ Guidelines. These ambiguities relate to the following: lack of definition of "environment", "impact" and "effect"; confusion over the role of value judgments; and confusion as to the meaning of "short-term uses" and "long-term productivity". We discuss these points of confusion below.

The lack of an operational definition of the term "environment" has led to a major point of confusion regarding the role of the typical "tangible" and "intangible" benefits commonly associated with water resources projects. In some cases, the term environment has been interpreted to relate primarily to what one might intuitively call the natural environment. In such cases the more or less standard types of project benefits are not emphasized, nor are they referred to as environmental impacts; rather the emphasis is placed on intangible issues relating to loss of wildlife, wetlands, and the like. This view of the term environment seems consistent with its use in Section 102(2)(B) of the NEPA which requires agencies to develop methods and procedures which will insure that "presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical consideration."

Far more commonly, the term environment has been interpreted broadly, and taken to include everything influencing man. In such cases the standard types of tangible and intangible benefits associated with the project are described as environmental impacts. This broad view of the term environment, might, for example, be defended in terms of Section 101(a) of the NEPA which states that Congress recognizes "...the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man...."

Further evidence of this duality in interpretation is contained in several environmental statements which actually made a distinction between the "natural environment" and the "human environment." So, for example, it might be argued that while a flood control project has an adverse impact on the natural environment in that it results in the destruction of a marsh, there are beneficial environmental impacts to the human environment in the form of the increased "sense of well-being" that accompanies flood protection.

There are two other words in the NEPA that are especially unclear. Before reviewing the statements we were prepared to observe a possible distinction between environmental "impacts" (as per item (i) of Section 102(2)(C)) and environmental "effects (as per item (ii) of Section 102(2)(C)). That is, given that both the words "impacts" and "effects" appear in the NEPA, we anticipated that there might be some confusion over the meaning of each. This concern turned out to be ill-founded, since, so far as we could discern, the words were used synonymously. If a distinction between the two was (or is) intended, it will be necessary to supply appropriate definitions. As it stands now, neither is carefully defined by the NEPA or the CEQ Guidelines.

Another serious point of confusion relates to the role of value judgements in describing impacts. Both the NEPA and the CEQ Guidelines encourage the use of value judgements on the part of the agencies by the explicit requirement (in Section 102(2)(C)(ii)) to provide a detailed statement on "any adverse environmental effects which cannot be avoided...." The problem is that "adverse," and its mirror image, "beneficial," are subjective descriptors; i.e., an environmental impact or effect that appears beneficial to one individual, may be considered adverse by another. A striking example is provided by the case we encountered wherein the "elimination of unsightly mud flats" in a coastal area was considered as being clearly beneficial by those preparing the environmental statement. We suspect that some persons may have viewed the same impact as one that was clearly adverse.

The role of value judgements might be clarified by simply requiring that they be identified as value judgements wherever they appear in the statements; in addition, the existence of alternative interpretations of such impacts could be discussed. Another approach to clarification might involve setting out the impacts in "value-free" terms, i.e., requiring that impacts be reported without reference as to whether they are adverse or beneficial. The readers of the statements would then be left to draw their own conclusions.

A final note on issues in need of clarification concerns item (iv) of Section 102(2)(C). This item in the NEPA requires a discussion of "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." According

to the CEQ Guidelines this "in essence requires the agency to assess the action for cumulative and long-term effects from the perspective that each generation is trustee of the environment for succeeding generations."

This section of the statements was, in general, simply not worth reading. It very often contained a selective reiteration of points made in earlier sections of the statements. Furthermore, the responses were very often confused and inconsistent; they contained, for example, a wide variety of interpretations for the phrase "long-term productivity". Viewed as a response to a mandate in the NEPA, we would argue that the lack of clarity in the responses is a direct consequence of the obtuseness of the mandate. A much more precise interpretation of this item will be required if it is to become a useful component in future environmental statements.

ENVIRONMENTAL IMPACT ANALYSIS AND THE PLANNING PROCESS

Many of the suggestions discussed above can be implemented with only minor changes in the manner in which impact statements are presently prepared. However, lest our opinions be misinterpreted, we hasten to add that the kinds of substantive improvements which we feel are necessary cannot possibly be attained without an order-of-magnitude increase in the levels of time and budget allocated per statement. In addition, resources will have to be marshalled to accomplish the field level studies that are so necessary for (and so obviously missing from) the preparation of statements. Also, more attention will have to be given to developing a pool of manpower trained in the diverse disciplines required for dealing with these broad environmental issues.

Analyses of the environmental impacts of Corps' projects are, in our view, no less important than studies undertaken to examine a project area's hydrology or soil characteristics; nor are they any less important than the economic analyses which are traditionally undertaken. It follows from this view that the examination of environmental impacts should be placed on a level comparable to these more traditional areas of analysis. We fully expect, that as environmental impact analysis is more completely integrated into the planning process, that this kind of balance will obtain.

APPENDIX 1

Form Used in Reviewing Environmental Statements

I. DISTRICT: _____ PURPOSE: _____

TITLE: _____ NO. _____

DATE: Summary: _____ Impact Statement: _____ Draft _____ Final _____

PAGES: Description & setting: _____ Impact statement: _____ Coord. & letters _____

STRUCTURES: _____

ACTIVITIES: _____

PROJECT DESCRIPTION: (Brief, but quantitative) _____

II. ENVIRONMENTAL SETTING WITHOUT PROJECT: (Check all descriptions appropriate to project area.)

Land use: Urban _____ Residential _____ Rural _____ Agricultural _____ Wilderness _____

Vegetation: Forests _____ Shrubs _____ Grassland _____ Crops _____ Wetlands _____

Other (specify): _____

Water: River or stream _____ Lake _____ Estuary _____ Ocean _____ Other _____

Brief description of setting: _____

III. ENVIRONMENTAL IMPACTS:

No.	Structure or Activity	Where Mentioned	+ or - Impact	Impact (Denote secondary impacts by "⇒")
1				
2				
3				
4				

No.	Structure or Activity	Where Mentioned	+ or - Impact	IMPACT
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Agency or Interest Group

Comments, questions, recommendations, etc.

VIII. OVERALL: (Refer to the entire environmental statement in answering these questions.)

- | | <u>Yes</u> | <u>No</u> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| 1. Is the mitigation argument used? | ___ | ___ |
| 2. Are project dimensions given? (e.g. reservoir surface acres, etc.) | ___ | ___ |
| 3. Are impacts quantified? (e.g., number of ducks, acres of redwoods, etc.; N.B. total acres inundated, etc. does <u>not</u> count.) | ___ | ___ |
| 4. Is landscaping or beautification mentioned as a positive impact? | ___ | ___ |
| 5. Is recreation mentioned as a positive impact? | ___ | ___ |
| 6. Are economic benefits mentioned or implied as a positive impact? | ___ | ___ |
| 7. Are "social costs", per se, mentioned? | ___ | ___ |
| 8. Are "ecological" impacts mentioned? (e.g., interrelationships, food chains, nutrient cycles, etc.) | ___ | ___ |
| 9. Are "secondary impacts" induced by project benefits mentioned? (e.g., change in land use patterns, increased population, pollution, etc.) | ___ | ___ |
| 10. Is mention made of the occurrence (or lack thereof) of: | | |
| Archaeological or historical sites? | ___ | ___ |
| Rare or endangered species? | ___ | ___ |
| 11. Does the Corps regard any of the environmental impacts as serious enough to warrant project modification? | ___ | ___ |

IX. RATINGS: (check one:)

- Intent: Used this statement to further "sell" the project: ___ ___
- Treated it as a bureaucratic exercise: ___ ___
- Made good attempt to find environmental impacts: ___ ___
- Very good; appear to have captured the spirit of the Act: ___ ___

Comprehensiveness:

Zero ___ cursory ___ appear to have gone beyond project report ___
very comprehensive attempt ___

Overall rating:

Terrible ___ poor ___ fair ___ good ___ very good ___ excellent ___

ADDITIONAL COMMENTS, INSIGHTS, GENERALIZATIONS, ETC.:

Reviewed by: _____ Date: _____

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Department of Civil Engineering Stanford University Stanford, California 94305		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED
		2b. GROUP N/A
3. REPORT TITLE AN ANALYSIS OF ENVIRONMENTAL STATEMENTS FOR CORPS OF ENGINEERS' WATER PROJECTS		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report		
5. AUTHOR(S) (First name, middle initial, last name) Leonard Ortolano William W. Hill		
6. REPORT DATE June 1972	7a. TOTAL NO. OF PAGES 141	7b. NO. OF REFS n/a
8a. CONTRACT OR GRANT NO. DACW 31-71-C-0127	9a. ORIGINATOR'S REPORT NUMBER(S) IWR Report 72-3	
b. PROJECT NO. c. d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) None	
10. DISTRIBUTION STATEMENT This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES None	12. SPONSORING MILITARY ACTIVITY US Army Engineer Institute for Water Resources, 2461 Eisenhower Avenue, Alexandria, Virginia 22314	
13. ABSTRACT This publication presents the results of an intensive analysis of 234 Corps of Engineers environmental impact statements prepared in accordance with Sec. 102 (2)(c) of the National Environmental Policy Act (NEPA). The analysis includes a detailed catalog and summary of impacts included in the statements for: 1) projects on coastal waters including dredging, spoil disposal, breakwaters, jetties and groins, revetments, dikes and barriers; and 2) projects on inland waters including channelization, dams and reservoirs, levees, dredging spoil disposal, construction and other miscellaneous structures and activities. In addition, the analysis catalogs and summarizes the impacts of various project purposes. A summary of the coverage of other points required by Sec 102(2)(c) of NEPA is also included. The proper role of environmental statements is suggested and, within that context, an assessment of the 234 statements is rendered, together with suggestions for improvement.		

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Water Resources Development Water Resources Planning Environmental Impacts Environmental Impact Analysis Environmental Impact Statements National Environmental Policy Act Coastal Projects Inland Projects						

INSTRUCTIONS TO FILL OUT DD FORM 1473 - DOCUMENT CONTROL DATA
(See ASPR 4-211)

1. **ORIGINATING ACTIVITY:** Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (*corporate author*) issuing the report.

2a. **REPORT SECURITY CLASSIFICATION:** Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. **GROUP:** Automatic downgrading is specified in DoD directive 5200.10 and Armed Forces Industrial Security Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. **REPORT TITLE:** Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. **DESCRIPTIVE NOTES:** If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. **AUTHOR(S):** Enter the name(s) of the author(s) in normal order, e.g., full first name, middle initial, last name. If military, show grade and branch of service. The name of the principal author is a minimum requirement.

6. **REPORT DATE:** Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. **TOTAL NUMBER OF PAGES:** The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. **NUMBER OF REFERENCES:** Enter the total number of references cited in the report.

8a. **CONTRACT OR GRANT NUMBER:** If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, and 8d. **PROJECT NUMBER:** Enter the appropriate military department identification, such as project number, task area number, systems numbers, work unit number, etc.

9a. **ORIGINATOR'S REPORT NUMBER(S):** Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. **OTHER REPORT NUMBER(S):** If the report has been assigned any other report numbers (*either by the originator or by the sponsor*), also enter this number(s).

10. **DISTRIBUTION STATEMENT:** Enter the one distribution statement pertaining to the report.

Contractor-Imposed Distribution Statement

The Armed Services Procurement Regulations (ASPR), *para 9-203* stipulates that each piece of data to which limited rights are to be asserted must be marked with the following legend:

"Furnished under United States Government Contract No. _____. Shall not be either released outside the Government, or used, duplicated, or disclosed in whole or in part for manufacture or procurement, without the written permission of _____, except for: (i) emergency repair or overhaul work by or for the Government, where the item or process concerned is not otherwise reasonably available to enable timely performance of the work; or (ii) release to a foreign government, so the interests of the United States may require; provided that in either case the release, use, duplication or disclosure hereof shall be subject to the foregoing limitations. This legend shall be marked on any reproduction hereof in whole or in part."

If the above statement is to be used on this form, enter the following abbreviated statement:

"Furnished under U. S. Government Contract No. _____. Shall not be either released outside the Government, or used, duplicated, or disclosed in whole or in part for manufacture or procurement, without the written permission of _____, per ASPR 9-203."

DoD Imposed Distribution Statements (*reference DoD Directive 5200.20*) "Distribution Statements (*Other than Security*) on Technical Documents," March 29, 1965.

STATEMENT NO. 1 - Distribution of this document is unlimited.

STATEMENT NO. 2 (UNCLASSIFIED document) - This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of (*fill in controlling DoD office*).

(CLASSIFIED document) - In addition to security requirements which must be met, this document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval (*fill in controlling DoD Office*).

STATEMENT NO. 3 (UNCLASSIFIED document) - Each transmittal of this document outside the agencies of the U. S. Government must have prior approval of (*fill in controlling DoD Office*).

(CLASSIFIED document) - In addition to security requirements which apply to this document and must be met, each transmittal outside the agencies of the U. S. Government must have prior approval of (*fill in controlling DoD Office*).

STATEMENT NO. 4 (UNCLASSIFIED document) - Each transmittal of this document outside the Department of Defense must have prior approval of (*fill in controlling DoD Office*).

(CLASSIFIED document) - In addition to security requirements which apply to this document and must be met, each transmittal outside the Department of Defense must have prior approval of (*fill in controlling DoD Office*).

STATEMENT NO. 5 (UNCLASSIFIED document) - This document may be further distributed by any holder only with specific prior approval of (*fill in controlling DoD Office*).

(CLASSIFIED document) - In addition to security requirements which apply to this document and must be met, it may be further distributed by the holder ONLY with specific prior approval of (*fill in controlling DoD Office*).

11. **SUPPLEMENTARY NOTES:** Use for additional explanatory notes.

12. **SPONSORING MILITARY ACTIVITY:** Enter the name of the departmental project office or laboratory sponsoring (*paying for*) the research and development. Include address.

13. **ABSTRACT:** Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.