



**US Army Corps
of Engineers**

Waterways Experiment
Station

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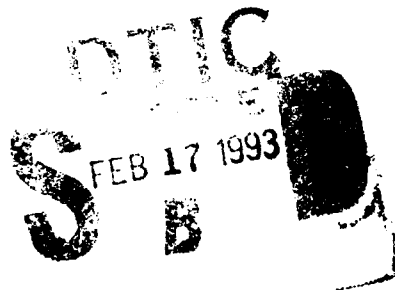


Instruction Report ITL-93-1
January 1993

②

Guide for Preparation of Waterways Experiment Station Technical Information Reports

*compiled by Editorial Section
Visual Production Center
Information Management Division
Information Technology Laboratory*



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Guide for Preparation of Waterways Experiment Station Technical Information Reports

by Information Technology Laboratory

U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

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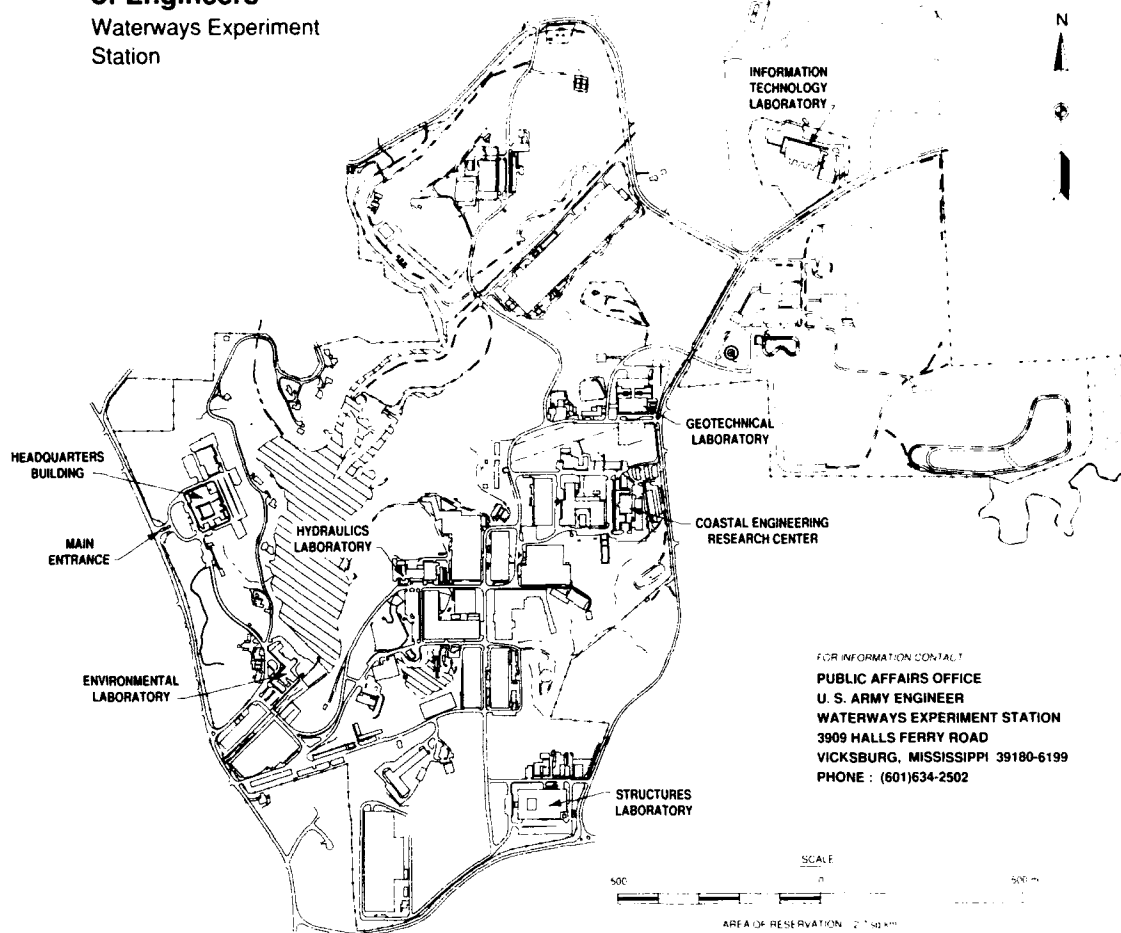
(Supersedes Instruction Report ITL-86-1, October 1986)

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**US Army Corps
of Engineers**
Waterways Experiment
Station



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Preface

This Guide will be used by those who prepare U.S. Army Engineer Waterways Experiment Station (WES) reports for publication. The Guide establishes procedures for ensuring uniformity of certain features common to all reports, while permitting flexibility in the presentation of the technical subject. Matters requiring uniform treatment are clearly indicated throughout the Guide. Suggestions for good practice in the presentation of data and text material are included to assist the author in producing a clear, concise, well-organized report. Comments and suggestions for changes are welcome and should be addressed to CEWES-IM-MV-E.

The Guide was prepared in accordance with Army Regulations 25-30 and 70-31 and American National Standards Institute Publication Z39.18-1987. It supersedes WES Instruction Report ITL-86-1, dated October 1986. The requirements of the Guide are implemented by Station Regulation 70-1-3; its provisions are mandatory for WES in-house and contractor-prepared technical-information reports.

Permission to use the copyrighted material from *A Style Manual for Technical Writers and Editors* was obtained from The Macmillan Company.

The Guide was compiled by members of the staff of the Editorial Section, Visual Production Center, Information Management Division, Information Technology Laboratory (ITL). Ms. Jamie W. Leach was Chief, Editorial Section, Mr. Timothy D. Ables was Chief, Visual Production Center, Mr. H. Murray Huffman was Chief, Information Management Division, and Dr. N. Radhakrishnan was Director, ITL. The painstaking efforts of Editorial Section and Visual Products Section staff members who participated in the preparation of the Guide are gratefully acknowledged.

Dr. Robert W. Whalin was Director of WES during the updating of the Guide. COL Leonard G. Hassell, EN, was Commander.

1 Introduction

Why Waterways Experiment Station Reports Are Written

Waterways Experiment Station (WES) reports constitute important end products of technical investigations and provide a formal record of data collected, results obtained, and analyses performed. As such, these reports should describe the investigations and the information obtained in a lucid and well-organized manner and in language easily understood by their intended audience. Reports should clearly communicate what was done and what was learned in relation to the purpose for which the investigations were initiated.

Some reports are prepared for general information purposes rather than to satisfy a particular requirement. Such reports usually are used to disseminate information of interest to other laboratories or offices, educational institutions, and the scientific and engineering community at large.

Other reports are written primarily to provide a permanent record of data and results for the investigating office and sponsor and thus receive only limited distribution. Though not given wide circulation, they should be complete and descriptive if they are to be of any future use.

In addition to disseminating information, technical reports encourage the exchange of information and technology with other research organizations in the scientific and engineering community.

Whatever their purpose, reports that are well written, organized, and reproduced can establish a highly favorable impression on the intended audience. Therefore, the mechanics of writing, preparing, and publishing reports can be most important to WES's professional image and reputation.

Factors Influencing Content and Format of WES Reports

The content of a report and the manner of presenting data are influenced by sponsor requirements and the extent of ultimate distribution. In general, a report that will receive broad distribution should be more comprehensive in detail than one of limited distribution. However, the main text of reports should not be burdened with a mass of detailed data. If the author desires to include a large amount of data, it should be in an appendix.

In contrast, the text of a report prepared for record purposes only or for limited distribution need not be as carefully edited, and the tables and illustrations need not be as mechanically perfect as those of a report prepared for broad distribution. WES authors may obtain a limited quantity (up to 100 copies) of such a report at minimal expense. For record purposes, a rough report (one in which little or no editing has been performed and in which illustrations and tables are in less polished form) may be published by the Visual Production Center (VPC) as a formal WES report at the discretion of the director of the laboratory involved. However, the original of such a report must be of sufficient graphic quality to permit reproduction of legible copies by VPC. This quality is essential so that subsequent reproduction of legible copies on a mass production basis by the Defense Technical Information Center and the National Technical Information Service of the Department of Commerce will be possible from the printed copies provided them by WES.

Philosophy of Reports

In writing a technical report, the author should keep in mind two principal requirements:

- a. The report must contain all essential information needed by those who must use it but should not include nonessential information that might burden or confuse the reader.
- b. The form and language of the report should be such that the information it contains can be efficiently absorbed at the executive, planning, using, and reference worker levels.

Compliance with the first requirement should minimize the size of a report. Reports are frequently too voluminous, the tendency being to include any and all available data. Which data to include or to omit varies with the report; these decisions are generally made by the author. However, only a *minimum* of data need be presented as long as the remainder is available for use by those interested (either in the form of appendixes to the report or in the files at WES) and a statement to that effect is included in the report.

Preparing the results of the investigation for publication is the responsibility of the author and his or her superiors. Research results should be published promptly. VPC personnel are available to assist with editing, graphics preparation, illustration, photography, design and preparation of reproduction copy, and other publication processes.

What the Guide Contains

This Guide lists certain items that must be included in all WES reports, gives the locations of these and other major elements, and outlines the types of information to be included in some of these elements. The Guide also prescribes ways of handling certain questions concerning format and style that confront most authors. Grammar is discussed only briefly; instead, reference is made to commonly used textbooks for this type of information.

References and a bibliography to this Guide are included at the end of the main text. A list showing the preferred spelling of difficult or uncommon words used in WES reports is included as Appendix A. A list of abbreviations commonly used at WES is included as Appendix B. Mathematical symbols and expressions are discussed in Appendix C. Format and physical characteristics of WES reports are described in detail in Appendix D. Appendixes E and F give guidance for the use of copyrighted material and multicolor illustrations, respectively. For the convenience of the user of this Guide, an index is included as Appendix G.

Adoption of SI Units

With this edition of the Guide, the International System of Units (SI) becomes the prescribed method for expressing units of measurement in WES reports. However, the units used in the study being reported will be those that are primary in the report. Thus, non-SI units may be included in WES reports. However, their use must be as described on page 16 in the discussion of use of a conversion factors table.

2 Designation, Organization, and Content of WES Reports

Designation and Cover of WES Reports

The principal categories of WES reports are as follows:

- a. Technical Reports.* Reports of major engineering and/or scientific investigations.
- b. Miscellaneous Papers.* Reports of investigations of limited scope and/or interest, reports prepared for publication by other agencies, papers prepared for professional journals, interoffice and intraoffice memoranda of sufficient importance to warrant making a record, or memoranda concerning technical investigations written for record purposes only.
- c. Instruction Reports.* Reports in which new or revised techniques and/or procedures are outlined or proposed for performing a particular scientific or engineering function, or reports which are user guides. (Additional information on user guides can be found in Appendix D.)
- d. Contract Reports.* Reports prepared by outside agencies or individuals under contract to WES.

Reports will be identified by a report number assigned by VPC that will consist of (a) a letter(s) identifying the WES laboratory or program responsible for the report, (b) the last two digits of the calendar year in which the report is being published, and (c) a number which will be the next number in that series of reports. The last-mentioned number will start over with 1 at the beginning of each year. All report covers will be of ivory antique paper stock with black ink. (Exceptions are permissible; e.g., reports of the Dredging Research Program; the Repair, Evaluation, Maintenance, and Rehabilitation

Research Program; Wetlands Research Program; and the Construction Productivity Advancement Research Program. See explanations in footnotes beneath tabulation below. Other programs may be added as necessary.) The prefix letters identifying WES reports will be:

Prefix Letter	Laboratory or Program	Ink Color
HL	Hydraulics Laboratory	Black
GL	Geotechnical Laboratory	Black
SL	Structures Laboratory	Black
EL	Environmental Laboratory	Black
CERC	Coastal Engineering Research Center	Black
ITL	Information Technology Laboratory	Black
A	Aquatic Plant Control Research Program	Black
CPAR	Construction Productivity Advancement Research Program	Black ¹
D	The D-series includes publications of the Environmental Effects of Dredging Programs: Dredging Operations Technical Support Long-Term Effects of Dredging Operations	Black
DRP	Dredging Research Program	Dark blue ²
IRRP	Installation Restoration Research Program	Black
R	Natural Resources Research Program Natural Resources Technical Support	Black
REMR	Repair, Evaluation, Maintenance, and Rehabilitation Research Program	Black ³
W	Water Operations Technical Support Program, Water Quality Research Program	Black
WIS	Wave Information Studies Program	Black ⁴
WRP	Wetlands Research Program	Dark blue ⁵
O	All others	Black

¹ Blue cover stock. CPAR reports contain both the CPAR prefix and the responsible laboratory prefix; i.e., CPAR-SL-92-1, etc.

² Gray cover stock.

³ Orange cover stock. REMR reports do not contain the last two digits of the calendar year; instead, the reports are numbered sequentially (beginning with 1) for each problem area.

⁴ Wave Information Studies reports are numbered sequentially; i.e., WIS Report 1, WIS Report 2, etc.

⁵ WRP reports do not contain the last two digits of the calendar year; instead, the reports are numbered sequentially (beginning with 1) for each task area.

Components of Reports

American National Standard Z39.18-1987 (American National Standards Institute 1987) "Scientific and Technical Reports—Organization, Preparation, and Production" prescribes the principal components of technical reports. These components must be included, if applicable, in all WES

Technical Reports, Miscellaneous Papers, and Instruction Reports except those sponsored by other agencies that require that their own specified formats be followed. The principal components of a WES report are listed below in the order in which they should be presented. Some reports may not contain all of them, as discussed in subsequent paragraphs.

- a.* Front cover.
- b.* Title page.
- c.* Cataloging-in-publication data.
- d.* Preliminaries.
- e.* Main text or body of the report.
- f.* References and/or bibliography.
- g.* Illustrations and tables; i.e., figures, tables, photos, and plates.
- h.* Appendixes.
- i.* Notation.
- j.* Index.
- k.* Distribution list (if required by sponsor).
- l.* Standard Form (SF) 298.
- m.* Back cover.

Cover

Front cover (outside)

The outside front cover of every WES report will include the following items:

- a.* Castle symbol (logotype as approved by the Chief of Engineers).
- b.* Report designation and number.
- c.* Publication date (month and year when report is sent to printing).
- d.* Title of report.
- e.* Name of author(s).

f. Name of performing organization; i.e., applicable laboratory, except in the case of contractor-prepared reports.

g. Distribution statement.

h. Name of sponsoring agency.

In addition to the items mentioned above, classified reports will also show the report and title classification and the declassification/downgrading schedule.

One of the seven primary distribution statements shown in Figure 1 will be included on the front cover of all reports as required by Department of Defense (DOD) Directive 5230.24 (DOD 1987). The statement will remain in effect until changed or removed by the controlling DOD office. Statements A and X cannot be used on classified documents.

Figures 2, 3, and 4 are examples of covers for unclassified reports, classified reports, and contractor-prepared reports, respectively. In the interest of projecting and reinforcing the corporate identity of WES,

☐ Statement A: Approved for public release; distribution is unlimited.	☐ Statement E: Distribution authorized to DOD components only; (fill in reason); (date). Other requests shall be referred to (insert controlling DOD office).
☐ Statement B: Distribution authorized to U.S. government agencies only; (fill in reason); (date). Other requests for this document shall be referred to (insert controlling DOD office).	☐ Statement F: Further dissemination of this document only as directed by (insert controlling DOD office); (date); or higher DOD authority.
☐ Statement C: Distribution authorized to U.S. Government agencies and their contractors; (fill in reason); (date). Other requests for this document shall be referred to (insert controlling DOD office).	☐ Statement X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with regulations implementing 10 U.S.C. 140c (date). Other requests must be referred to (insert controlling DOD office).
☐ Statement D: Distribution authorized to DOD and DOD contractors only; (fill in reason); (date). Other requests shall be referred to (insert controlling DOD office).	

☐ Foreign Government Information
☐ Proprietary Information
☐ Test and Evaluation
☐ Contractor Performance Evaluation
☐ Administrative or Operational Use
☐ Software Documentation
☐ Specific Authority (identification of valid documented authority)
☐ Premature Dissemination
☐ Software Documentation
☐ Critical Technology
☐ Specific Authority (identification of valid documented authority)

Figure 1. Distribution statements

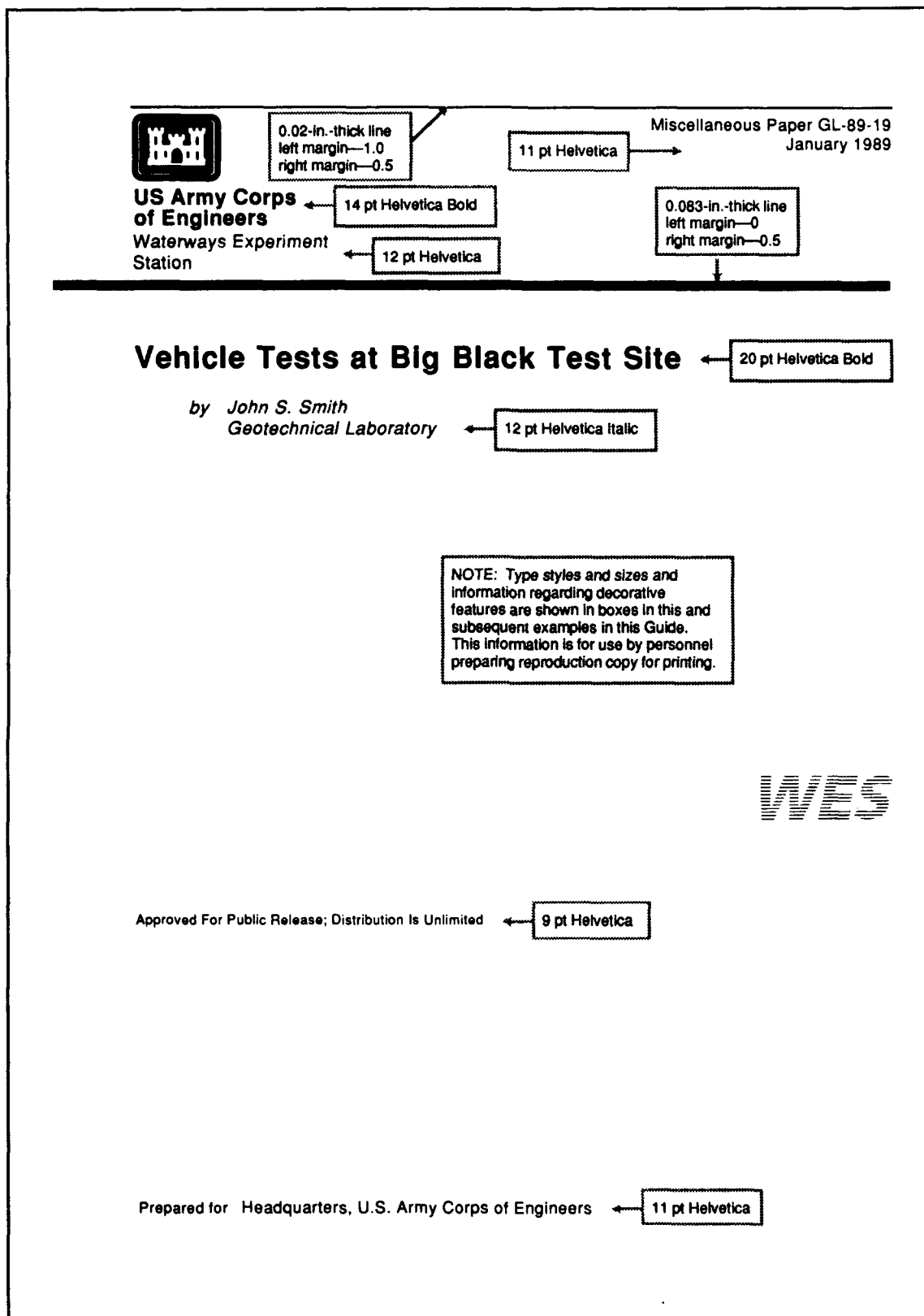


Figure 2. Example cover of unclassified report



**US Army Corps
of Engineers**
Waterways Experiment
Station

Technical Report SL-84-11
June 1984

20 pt Helvetica Bold

SECRET

Silo Test Program (STP) 3.5A Event (U)

Volume II: Structural Response (U)

16 pt Helvetica Bold

by *Author's Name*
Structures Laboratory

WES

Classified by DNA Silo 80
Declassify on OADR

Distribution authorized to U.S. Government agencies only; test and
evaluation; June 1984. Other requests for this document shall be referred to
Director, Defense Nuclear Agency, Washington, DC 20305-1000.

Prepared for Defense Nuclear Agency

20 pt Helvetica Bold

SECRET

Figure 3. Example cover of classified report. Note: This page is NOT CLASSIFIED; the "SECRET" markings at top and bottom are for illustrative purposes only



**US Army Corps
of Engineers**
Waterways Experiment
Station

Contract Report SL-88-1
September 1988

Effects of Material Property Uncertainties on Ground Shock Environments

Report 2 Two-Dimensional Calculations of Site 1 With Material Property Calculations

← 16 pt Helvetica Bold

*by Ivan S. Sandler, David Rubin
Weidlinger Associates, Inc.*

WES

Distribution authorized to U.S. Government agencies and their contractors;
critical technology; September 1988. Other requests for this document shall
be referred to Director, Defense Nuclear Agency, Washington, DC
20305-1000.

Prepared for Defense Nuclear Agency (SPWE)

Figure 4. Example cover of contractor-prepared report

departures from the standard cover design are discouraged. However, reports of major research programs and other special-purpose reports may have a cover that differs from the standard design. To obtain a special cover, the program manager or author should forward a request for VPC to develop a special design through his or her respective laboratory director to the chief of VPC. A VPC publication designer will then be assigned to work with the requestor in developing an appropriate design.

Front cover (inside)

The inside of the front cover of all reports will contain instructions on such matters as report disposition instructions and use of trade names.

- a. Disposition instructions.* All reports marked with distribution statements B, C, D, E, F, or X will be marked as follows:

DESTRUCTION NOTICE—For classified documents, follow the procedures in DOD 5200.22-M, Industrial Security Manual, Section II-19, or DOD 5200.1-R, Information Security Program Regulation, Chapter IX. For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

All technical documents that are determined to contain export-controlled technical data will be marked as follows:

WARNING—This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751 *et seq.*) or Executive Order 12470. Violations of these export laws are subject to severe criminal penalties.

- b. Trade names.* WES reports should not contain material that may be construed as advertising or that implies that the Government endorses or favors a proprietary product or service manufactured or provided by a specific supplier. Sometimes, however, it is essential that trade names or names of manufacturers of materials or equipment be given (under the assumption that certain parts of the report are meaningless without them, or that a description included to avoid use of the trade name would be excessively long and involved). All reports will contain a notice on the inside front cover which reads as follows:

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Back cover (inside)

The inside back cover of WES reports may be used to include lists of associated reports, lists of committee members, if appropriate, and similar information. The inside of the front cover may also be used for this purpose if there is sufficient space.

In addition, all unclassified, unlimited reports (distribution statement A) will be marked as follows:

Destroy this report when no longer needed. Do not return it to the originator.

Back cover (outside)

The outside back cover of WES reports is reserved for use in labeling and distribution.

Title Page

The title page (Figure 5) will include the following:

- a. Name of program, if applicable.*
- b. Report designation and number.*
- c. Publication date (month and year when report is sent to printing).*
- d. Title of report.*
- e. Name of author(s).*
- f. Name and address of performing organization.*
- g. Type of report; i.e., interim, final, report in a series, etc.*
- h. Distribution statement.*
- i. Name and address of sponsoring agency.*
- j. When appropriate, contract, project, subtask, and work unit numbers.*
- k. When appropriate, name and address of monitoring agency.*
- l. The reverse side of the title page will include the cataloging-in-publication data.*

In addition to the above, classified reports will also show the report and title classification.

Environmental Impact Research Program	← 12 pt Helvetica Bold	11 pt Helvetica	→ Technical Report EL-91-10 March 1991
Species Profiles: Life Histories and Environmental Requirements of Coastal Vertebrates and Invertebrates, Pacific Ocean Region			← 20 pt Helvetica Bold
Report 5 The Parrotfishes, Family Scaridae			← 16 pt Helvetica Bold
by Robert E. Brock SeaGrant College Program and Hawaii Institute of Marine Biology University of Hawaii P.O. Box 1346, Coconut Island Kaheohe, HI 96744			
			← 11 pt Helvetica
Report 5 of a series	← 11 pt Helvetica	9 pt Helvetica	
Approved for public release; distribution is unlimited			
Prepared for U.S. Army Corps of Engineers Washington, DC 20314-1000			
Under	EIRP Work Unit 31627	← 11 pt Helvetica	
Monitored by Environmental Laboratory U.S. Army Engineer Waterways Experiment Station 3909 Halls Ferry Road, Vicksburg, MS 39180-6199			

Figure 5. Sample title page

Preliminaries

Order

The preliminary pages or sections usually included in WES reports will be arranged in the order below. In the discussion that follows of what these sections contain, conditions under which they are mandatory are explained.

- a.* Contents. A list of figures and/or a list of tables may be included in the contents when five or more tables and/or figures are integrated in text. If figures, tables, or other such items are grouped after the main text, the total number of each should be shown in the contents.
- b.* Preface.
- c.* Table of factors for converting non-SI units of measurement to SI units.
- d.* Key.
- e.* Summary.

What they contain

Table of contents. A table of contents will be included in reports that are of a length and complexity that its inclusion will provide an aid to the reader. The table of contents will contain the exact titles and page numbers of all the preliminaries and of all first- and second-level headings in the main report and in the appendixes. Additional levels of headings may be included in the table of contents at the author's discretion. The contents herein is an example showing headings to the third level.

Lists of figures and tables. If lists of figures and/or tables are used, they will be arranged in numerical order, and their captions or titles and page numbers will be given. If a figure has a long descriptive title, only a portion will be given. Figure 6 contains examples of such lists.

Preface. A preface will be included in all WES reports. The preface should be used to present information that must appear in the report but which is irrelevant to and would detract from the technical text. The preface will include such information as authorization, pertinent dates, names of WES and other personnel who actually participated in or made a technical contribution to the investigation or report, author(s), WES supervisory personnel, and any items required for record or acknowledgment purposes. Acknowledgments of work routinely performed by support personnel (e.g., editors, typists, and illustrators) are ordinarily not included. If copyrighted material has been quoted or reproduced, the preface will include a statement that permission to use the material has been obtained.

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Figure 6. Examples of lists of figures and tables

Conversion factors table. Use of SI units of measurement is prescribed for WES reports. Non-SI units also may be used. However, if non-SI units of measurement are used, the report generally must contain a conversion factors table (see Figure 7). However, if the report is short and/or the number of units few, their soft-converted equivalent may be given in parentheses. The conversion factors table, if required, should be arranged by listing the non-SI units alphabetically. American Society for Testing and Materials (ASTM) Designation: E 380-91a states that "... the DOD policy for the spelling of meter and liter is "-er," with the provision that agencies have the option of using "-re" when appropriate in international relations." Whether to use "er" or "re" is left to the discretion of each WES laboratory. Conversion factors will be taken from the most current issue of ASTM Designation: E 380, "Standard Practice for Use of the International System of Units (SI)."

Conversion Factors, Non-SI to SI Units of Measurement		
Non-SI units of measurement used in this report can be converted to SI units as follows:		
Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
Fahrenheit degrees	5/9	Celsius degrees or kelvins ¹
feet	0.3048	meters
inches	0.0254	meters
pound (force) inches	0.1129848	newton meters
miles (U.S. statute)	1.609347	kilometers
pounds (force) per square foot	47.88026	pascals
pounds (mass)	0.4535924	kilograms
¹ To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.		

Figure 7. Example of a conversion factors table

Key. A key lists designations and names of proprietary products and/or equipment that should not be mentioned by name in text. When a report describes tests or evaluations of specific materials or types of equipment, the author may want to be very restrictive in the use of trade names or names of the manufacturers. In such cases, the materials or equipment will be referred to in the text as "Product A," "Device B," "Sample RCD-1," etc., and the designations will be identified in a key. Usually, the key will be printed on cherry (red) paper, and it will not be bound in

the report but will be hand-inserted in the copies of the report distributed to persons qualified to receive the key. The author will indicate which recipients should receive the key. For identification purposes, the key will bear the report number and title at the top of the page. Figure 8 is an example of a key.

Sometimes an author may choose to use a key for the sake of simplicity or brevity only. In such cases, it will be bound in the report just before the main text or summary, if used.

Technical Report SL-70-1 Effects of Temperature on Moist-Curing of Concrete		
Key		
Manufacturer	Symbol	Product
Lone Star Cement Co. Spocari, AL	RC-572 and RC-579	Portland cement, type II
North American Cement Corp. Alsen, NY	RC-555(2)	Portland cement, type II
Bessemer Limestone and Cement Co. Youngstown, OH	RC-550(2)	Air-entraining portland blast-furnace slag cement, type IS
Century Cement Co. Rosendale, NY	RC-573	Air-entraining natural cement, type NA

Figure 8. Example of a key

Summary. A summary may be included in a report at the author's discretion. The summary should be an informative synopsis of the main body of the report, not merely a statement of the results and conclusions, nor a listing of what the report contains. It should describe in a brief, coherent form why the work was done (the problem); the specific purpose or objective of the study; the scope of the work if pertinent; what was done (test methods or investigational means used); what was learned (results and conclusions); and recommendations made. The summary necessarily repeats information from the body of the report, but it should never contain information not given in the body of the report. It should be no longer than one or two pages. The summary should not contain illustrations, tabular material, or references.

Main Text

The main text or body of the report should describe and discuss in a technically complete manner what was done and found in the investigation. The body of the report will normally have the following major subdivisions:

- a. An introduction.
- b. For an experimental study, a description of the test apparatus, materials, and procedures.
- c. A description and discussion of what was done and of the information or results obtained.
- d. An analysis or interpretation of the results or findings.
- e. Conclusions and recommendations.

Sometimes one subdivision is so brief that it can be combined with another. The author should not include a subdivision that tells little or nothing, or is repetitious, just to follow a preconceived outline.

Introduction

The introduction usually contains background information that the reader needs to understand the rest of the report. It may include (a) the problem addressed by the investigation being reported; (b) the history or theory behind the investigation; (c) mention of other reports or investigations on the subject; (d) the specific purpose or purposes of the investigation; (e) the scope of the investigation; (f) the reason for selecting the method of investigation; (g) definitions of specialized terms; and (h) a description of the plan and content of the remainder of the report. This last is usually necessary only when the report is long and complicated.

The introduction should be written to attract and hold the attention of the reader. To do this, the author should reduce background material to only the facts that are necessary for an understanding of the problem that led to the investigation, making sure that only the pertinent facts are covered and that the material is presented as succinctly as possible. For example, in a report of a model study of a navigation structure on the Warrior River, it is not necessary to present the history of navigation on that river. The particular structure should be pinpointed with an explanation of why it is to be built. A good introduction is essential to a good report, and it should be as carefully written as any other section.

Description of study

When preparing the description of the test equipment and materials and the narrative of tests and results, the writer should ensure that these sections are developed in a logical manner, that emphasis is properly placed, and that the material is so arranged that needless repetition is avoided. For example, instruments, equipment, and processes that are very likely known to the majority of readers or for which descriptions are readily available in the literature need not be described in detail; sometimes a footnote telling where a description can be found is helpful.

The information or results obtained may be presented either along with the various test or investigatory phases or in a separate section following the narrative of each major phase. If a separate section is used, the author should be careful to avoid repetition of the description of the tests. In a long report involving many tests or phases, a summary of all results may be useful in reviewing and emphasizing the most important findings for the reader.

Analysis

A separate section should be devoted to the analysis or interpretation of results to provide a clear and logical approach to the conclusions. However, in a short report, the results or findings may be analyzed or interpreted as they are introduced, thus eliminating the need for a separate section. In all instances, the author should follow a scientific approach in the presentation of results. The author should analyze all results and give reasons for placing more importance on some than on others. In addition, he or she must present the data objectively so as to convince the readers of an impartial viewpoint. All of the facts should be explained, including the reasons for using certain information while discarding other data.

Conclusions and recommendations

Conclusions and recommendations must be supported by material included in the text. In writing the conclusions, the author should bear in mind the purposes of the investigation to ensure that they have all been covered in some way, even if negatively. Besides specific conclusions, a discussion of additional work needed to expand the knowledge obtained in the investigation may be included in this section.

Sometimes it is better to present recommendations separately since they tend to limit application of the conclusions to one specific problem when they are presented with the conclusions, whereas the findings may be useful in solving other types of problems. In some cases, very general recommendations for application of the findings may be made and an example of such an application included.

References to Source Material

If four literature references or fewer are cited in the body of the report, the citations will be included as footnotes keyed to the appropriate portion of the text. If *five or more* citations are used, they will be grouped in a "References" section at the end of the main text. If it is desired to list pertinent literature that is not referred to in the text, such entries will be in a "Bibliography." The bibliography will be located after, or in place of, the references section following the main text. A combination of two of the methods of citing source material may be used. For example, footnotes for three cited references may be used together with a bibliography, or a references section may be used in conjunction with a bibliography.

In general, the references or bibliography should contain only documents that are unclassified, available on loan, and bound in some form.¹ However, bibliographic material for classified references can be listed in WES unclassified reports that are restricted by means of distribution statement B. References or bibliography should not list correspondence or interoffice or intraoffice memoranda that are not suitable for loan. If the author wishes to acknowledge material not suitable for loan, he may do so in the preface or in a footnote. Personal communications should be referenced in the text only and should be footnoted such as:

³ Personal Communication, 17 May 1989, Jack Way, Civil Engineer, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Bibliographic material for classified references will not be listed in WES unclassified reports for unlimited distribution; i.e., those reports covered by distribution statement A. If it is considered essential to cite a classified reference in an unclassified report marked with statement A, the following footnote will be used:

³ Classified reference. Bibliographic material for the classified reference will be furnished to qualified agencies upon request.

¹ While it is not encouraged, WES internal working documents may be included in the References or Bibliography so long as a ready source for them is given.

Illustrations and Tables

Illustrations

Good illustrative material in the form of computer graphics, maps, drawings, or photos is a highly effective means of presenting information. Illustrations should be carefully selected and prepared to ensure that they accomplish their intended purpose. They should reinforce and augment text descriptions or tabulations but generally should not duplicate data and/or descriptive matter also given in detail in the text or in tables.

Only those computer graphics, maps, drawings, or photos that illustrate the main points or features of a study should be presented. The remainder of the illustrative material can be placed in a separate appendix that might be reproduced in only a few copies for use by the sponsor, if requested, and those other readers interested in the detailed data.

Tables

Tables are an effective means of presenting numerical data. However, long tabulations in the body of a report detract from its readability. Two means of avoiding long tables while still utilizing the effectiveness of tabular material are as follows:

- a. Place excerpts from long tables in the text, and group the complete tabulations at the end of the report.
- b. Break up the long tables into several short tabulations that can be more easily interpreted, and insert them in appropriate locations in the text.

Appendixes

Appendixes may be (a) bound with the main report, (b) issued separately but simultaneously with the main report either in equal numbers or in a limited edition, or (c) published later to add supplementary information acquired after the main report was issued. Appendixes should be arranged in a logical order and must be referred to in the main text.

Some of the types of material that may be included in appendixes issued simultaneously with the main report are as follows:

- a. Illustrations or tables not necessary to an understanding of the main report or which have been abstracted in the body of the report.
- b. Detailed descriptions of methods or apparatus.

- c. Descriptions of rejected methods or tests that should be included for record purposes.
- d. Theoretical analyses and mathematical derivations that are used in but need not be explained in the body of the report.
- e. Samples of forms, data sheets, etc.
- f. Sample calculations.
- g. Plans or recommendations for future action.

Some of the types of material that can be published later to supplement the main report are as follows:

- a. Data from tests conducted after completion of the investigation as a result of a technological breakthrough.
- b. Data from tests conducted as a result of a recommendation made in the earlier investigation.

Notation

A notation is a listing of characters, symbols, or abbreviations used to express technical facts or quantities; e.g., A = area, D = diameter, t = time. If symbols and/or unusual abbreviations are numerous, they will be listed and defined in a notation. For ease of reference, the notation will be the last appendix in a report. At the first mention of the first symbol or abbreviation that will be included in the notation, the following footnote should be added:

¹ For convenience, symbols and abbreviations are listed in the notation (Appendix).

Index

In an extremely long or involved report, an alphabetical index may be included for ease of reference. The index should be as complete as the nature of the report and probable usage require. The index herein is an example.

Distribution List

WES reports will be distributed as widely as interest dictates and security and other legal constraints allow. Initial or primary distribution may include Government agencies and their contractors and grantees, industrial and university technical groups, and individuals with specialized knowledge. Primary distribution will be accomplished by VPC according to instructions provided by the author.

VPC compiles and maintains computerized distribution lists and will assist authors and/or program managers in developing new distribution lists upon request. Numerous standard lists (e.g., Concrete Research, Wave Dynamics, and Soil Mechanics) are maintained. For each WES report, the author should carefully review the established (or proposed) distribution list to ensure that all interested agencies will receive copies as well as to eliminate agencies not interested in the information reported. Both foreign (Headquarters approved) and domestic (Research Library arranged) exchanges are a part of each standard distribution list for civil works reports in the fields of concrete, hydraulics, and soils. Less than 100 copies are required to honor these exchange agreements. This number of copies is included in all standard lists, but exchange agreements should be honored in special or limited publication distribution whenever feasible. Information concerning foreign and domestic exchange agreements should be completed on WES Form 1064.

AR 25-30 requires that all distribution lists be updated annually. The names and addresses of individuals or organizations not expressing an interest in remaining on the mailing list will be eliminated.

As part of the primary distribution, VPC will send two copies of classified reports or reports with other limitations on distribution and twelve copies of unclassified reports without distribution limitations to the Defense Technical Information Center (DTIC). DTIC will accomplish subsequent or secondary distribution of the reports as follows: (a) unlimited distribution reports will be made available to the National Technical Information Service of the Department of Commerce for sale to the general public, and (b) limited distribution reports will be distributed subject to the limitations imposed by the sponsoring agency. As part of the primary distribution, one to three copies of WES reports will also be placed in the WES Research Library.

A copy of the distribution list will not be included in WES reports unless specifically requested by the sponsoring agency. If included, it will be the last item in the text prior to the Standard Form 298.

Report Documentation Page, Standard Form 298

A completed Standard Form 298, Report Documentation Page, will be included as the last sheet in each WES report. The form is filled out by VPC in accordance with information furnished by the author. Normally, it is completed when the final draft of a report is prepared, and is submitted for approval with the final draft. An example of a completed form is shown in Figure 9. The subject terms (key words) to be included in Block 14 are for cataloging purposes. They may be technically meaningful terms or short phrases that identify the principal subjects covered in the report, or they may be equipment model designations, trade names, military project code names, or geographic locations. If the author does not choose to supply the subject terms, VPC will refer the report to the WES Research Library for this purpose. The author will prepare an abstract for completing Block 13. The abstract should be an informative synopsis of the report.

REPORT DOCUMENTATION PAGE			Form Approved OMB No 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE July 1991	3. REPORT TYPE AND DATES COVERED Final report		
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13. ABSTRACT (Maximum 200 words) The seventh Corps Chemists Meeting was held in Portland, OR, on 22-24 May 1990. Attendees included chemists and other interested personnel from the various Corps Divisions, Districts, research labs, and Headquarters offices. Presentations were given on field-laboratory interactions, analytical procedures for metals, ion chromatography, data comparisons, data quality objectives, laboratories as generators of hazardous wastes, environmental laws and regulations, and air sampling methods. Informal discussion sessions were held on problems facing Corps chemists and the future thrust of Corps programs as they affect the chemists.				
10 pt Times Roman				
14. SUBJECT TERMS See reverse		15. NUMBER OF PAGES 157		
16. PRICE CODE		17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED		
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Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

Figure 9. Example of Report Documentation Page, SF 298 (Continued)

14. (Concluded).

Air sampling

Data quality objectives

Explosives

Formerly used defense sites (FUDS)

Gas chromatography/mass spectrometry (GC/MS)

Hazardous wastes

Ion chromatography

Laboratory Information Management Systems (LIMS)

Metals

Polychlorinated biphenyls (PCBs)

Quality assurance

Underground storage tanks (UST)

Figure 9. (Concluded)

3 Format and Style

"Format" is the general makeup of the report and involves such items as page size and numbering, typography, layout, systems of headings, arrangement of tables and illustrations, and arrangement of lists of references or bibliographies. Sample pages of WES format are given in Appendix D. "Style" is the plan followed in dealing with such details as spelling, capitalization of punctuation, and abbreviations.

Format for Preliminaries and Main Text

Page numbering

The first right-hand page after the cover in each WES report will be the title page. It will be counted as page i but will not bear a page number. All preliminary pages will be numbered consecutively at the bottom of the page and on the outside margin in lowercase Roman numerals. Main text pages will carry Arabic numerals. Odd-numbered pages will be right-hand pages, and even-numbered pages will be left-hand pages. Both sides of the page will be used to the extent practical. However, each appendix will begin a new right-hand page. A page requiring folding will be a right-hand page, and the back of a foldout page will be counted in the page numbering even though it is blank.

The pages used for illustrations or tables within the text are numbered if the illustration or table does not occupy the entire area available for printed or typed matter. If there is no space for the page number, it is omitted but the page is counted. When tables or illustrations follow the main text in a group, there is no necessity for page numbers. Each group will begin on a right-hand page.

Paragraph numbering

Paragraphs of the report are not numbered. Subparagraphs are preceded by a lowercase italicized letter followed by a period.

Headings

Headings provide the author with a framework for the text and signify to the reader a change in subject. However, headings must be descriptive to be of any value; such uninformative words as "General" or "Discussion" should not be used alone as headings. Too many headings may detract from the text, making it choppy and repetitious rather than a smooth narrative. Authors should be consistent in the use of headings and ensure that headings of proper weight are used for the various sections of a report.

The headings system for WES reports is illustrated by the headings used in this Guide. The primary subdivision is into chapters. Chapters are further subdivided by means of second- and third-level headings. If further headings are necessary, they take the form of paragraph, subparagraph, and sub-subparagraph headings. The various parts of a report should not contain second-level headings unless first-level headings have been used first. Also, each heading should have at least one additional corresponding heading; i.e., under a given second-level heading, there must be at least two third-level headings or else third-level headings should not be used under that particular second-level heading.

Illustrations

Illustrations included in WES reports are generally referred to as "Figures." Figures are numbered consecutively using Arabic numerals and are given distinctive captions or titles; i.e., no two are the same. Figures may include engineering drawings, maps, photographs, plots, artistic illustrations, and other such illustrative materials. They are usually incorporated in the text, but when the text of a report is very short or when many figures are to be included in the report, they may be placed at the end of the text. The pages on which these grouped figures are included will not be numbered.

At the discretion of the laboratory, two other designations of illustrations may also be used, "Photos" and "Plates." Photos are grouped at the end of the text and generally illustrate series of test results such as flow conditions at various discharges or test lane conditions after various amounts of traffic. Plates are line drawings or plots that are grouped at the end of the text and generally consist of a series of diagrams of the model layout or test sections, plots of test results, etc. Like figures, photos and plates are numbered consecutively with Arabic numerals. Photos have distinctive captions or titles just like figures; plate titles are distinctive also but are titled within their borders.

Because illustrations make up a major part of a report, considerable care should be taken in their selection and/or preparation. As examples, Figure 10 shows a good photograph and Figure 11 shows a good line drawing suitable for inclusion in a WES report. In preparing captions or titles, the author should strive to be concise, specific, and informative while

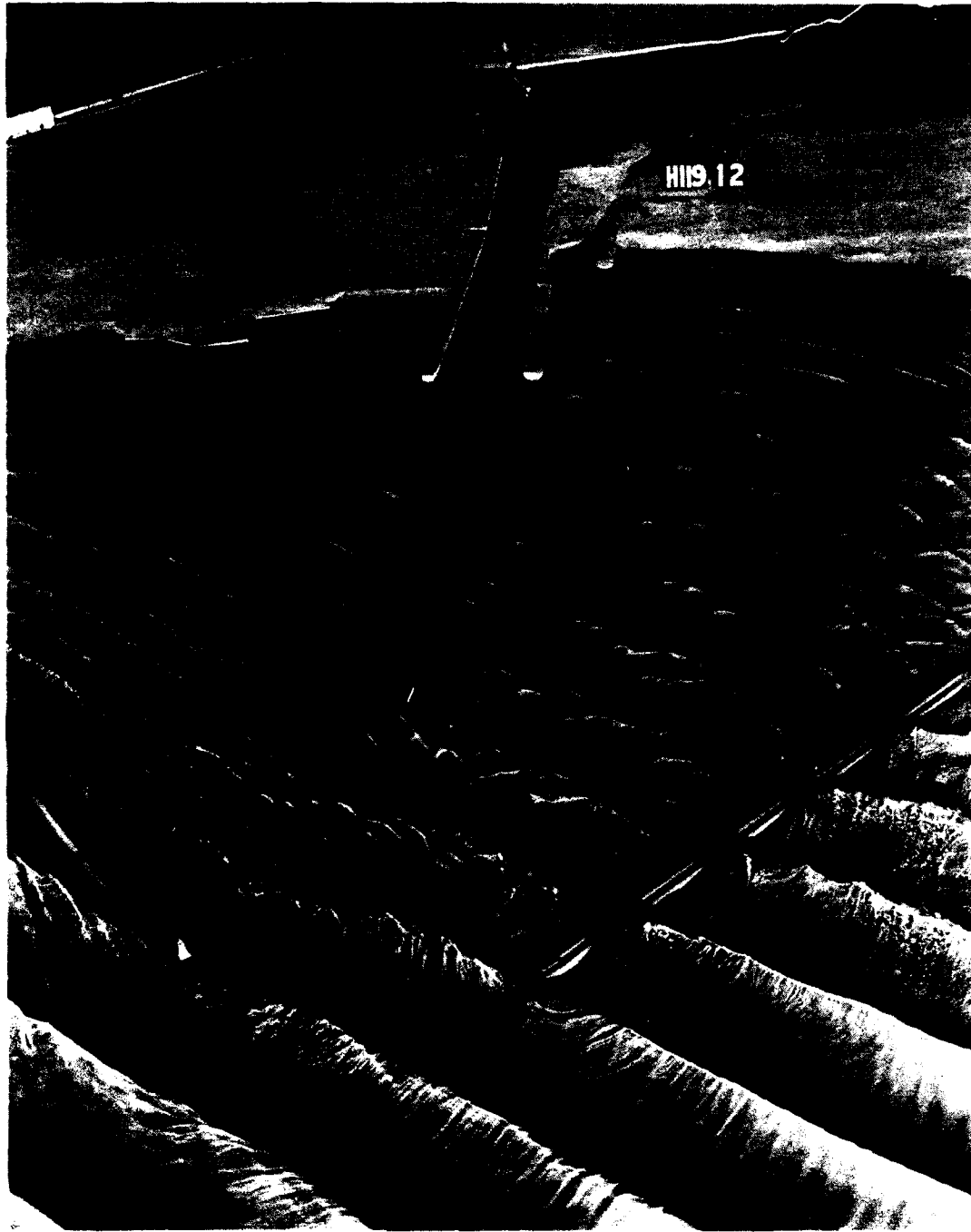


Figure 10. Example of a good photograph

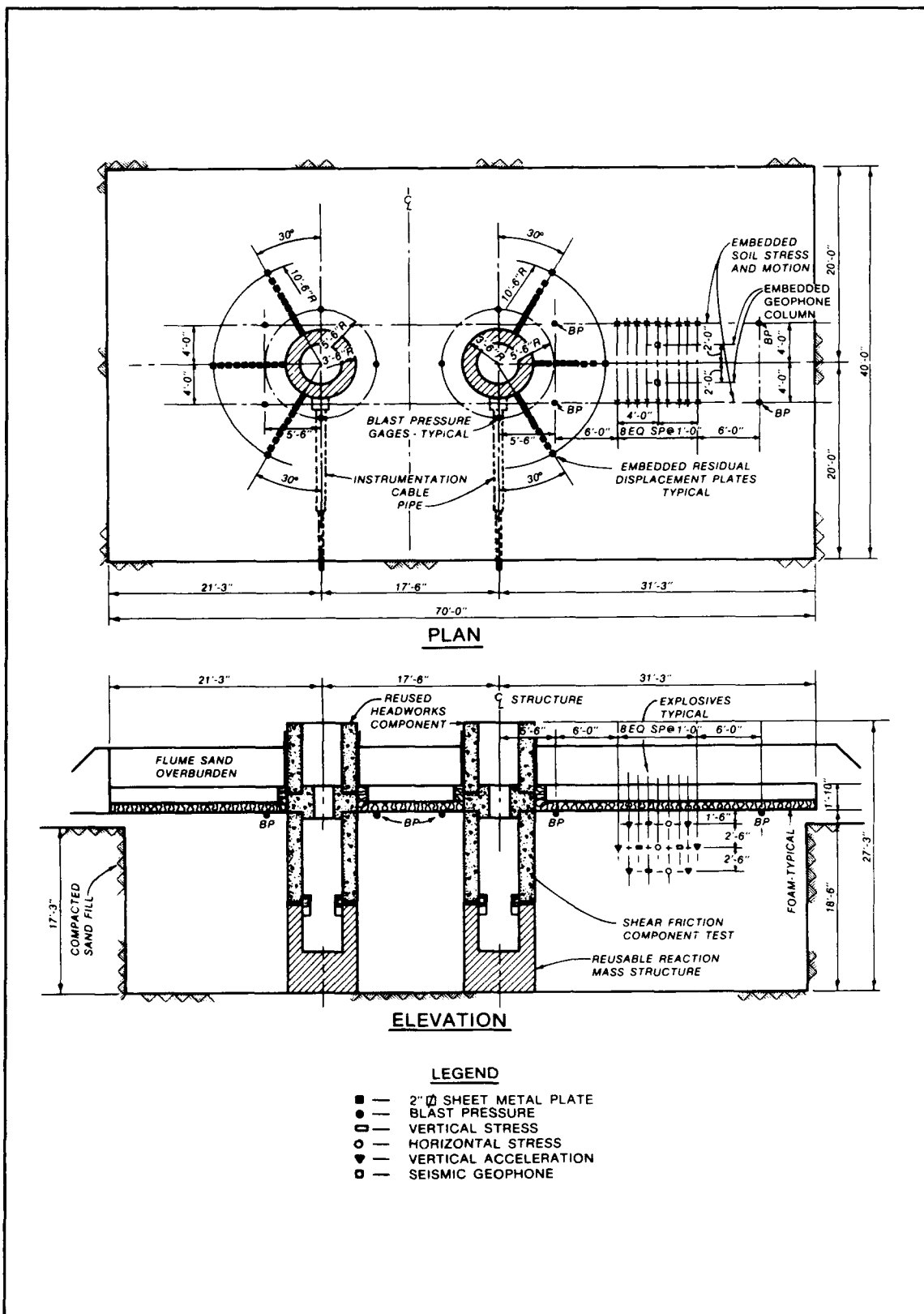


Figure 11. Example of a good line drawing

ensuring distinctiveness. When possible, the author should combine several plots or curves in one illustration; this is not only more economical but also facilitates comparison of data.

Standard size drawings with standard, legible lettering should be used throughout reports. In the interest of economy, every effort should be made to ensure that drawings are page size or less. If this is not possible, folded sheets may be used. A separate volume is sometimes the most convenient method of handling a number of oversize drawings.

For detailed information on appropriate lettering sizes for various elements of drawings of different dimensions that are to be reduced to page size, refer to WES Instruction Report O-77-1 (U.S. Army Engineer Waterways Experiment Station 1977).

VPC can provide guidance and assistance in the form of drafting (both traditional and computer-aided), cartography, artistic illustration, and photographic support for illustrations used in WES reports.

Tables

All tables, except brief listings or descriptive tabulations incorporated in the text, will be numbered using Arabic numbers and given a descriptive title for convenient reference. Generally, they are grouped at the end of the text, following figures (if any). The brief tabulations mentioned above are not numbered, do not have an overall title, and are generally referred to only once.

Each column in a table must have a heading. If no common heading for all the items in a column is possible, the table should be broken up into several tables or several subdivisions that will permit use of headings. Units of measurement should be shown in either the column headings or the title of the table. Figure 12 is an example of a well-organized table. Figure 13 gives an alternate table format designed for use in "talking tables."

Computer program documentation

Illustrative computer screens, input files (listings), output files (listings), and program listings can be handled several different ways. Standard WES format requires each illustration to be numbered and to have a unique caption. This format is acceptable for computer program documentation, but unlike standard WES reports, is not required. Screens can be inserted in the text as necessary without numbering. When able, authors are encouraged to save screens as TIF files so they can be more readily incorporated electronically in the publication.

Table 8
Aerator Slot Pressures, Feet of Water
Series B

Test No.	Gate Opening ft	Item ¹	Air Discharge cfs	Transducer Location					
				AR1	AR2	AR3	AR4	AR5	AR6
Gate 1									
4	1.0	Max	2,655	-0.53	-0.65	-1.43	-1.45	-0.55	-0.65
		Mean	2,277	-0.39	-0.48	-1.22	-1.25	-0.42	-0.48
		Min	2,209	-0.25	-0.32	-0.81	-0.95	-0.28	-0.35
3	5.0	Max	4,748	-1.89	-1.75	-2.01	-2.49	-2.40	-1.96
		Mean	3,980	-1.43	-1.31	-1.55	-2.03	-1.98	-1.36
		Min	3,556	-1.06	-1.02	-1.22	-1.57	-1.64	-1.02
Gate 2									
2	9.0	Max	5,823	-2.77	-2.70	-2.93	-3.41	-3.11	-2.81
		Mean	4,614	-1.94	-1.80	-1.98	-2.49	-2.35	-1.80
		Min	3,584	-1.27	-1.18	-1.20	-1.78	-1.66	-1.11
1	13.0	Max	2,655	-3.41	-1.75	-2.17	-2.15	-2.95	-2.21
		Mean	2,277	-2.49	-1.31	-1.59	-1.55	-2.33	-1.59
		Min	2,209	-1.78	-1.02	-1.18	-1.15	-1.91	-1.18

¹ Max = highest recorded discharge, most negative aerator pressure; Mean = average discharge, average aerator pressure; Min = lowest recorded discharge, least negative aerator pressure.

Figure 12. Example of a well-organized table

Table 5
Description of Subroutines in Program MONOSUMMARY

Name	Description
INPUT	Queries user for input parameters
CASE	Case or run number for individual test cases
HUNT	Hunt's method for wavelength
SPEED	Wave celerity or speed
KHCALC	Nondimensional water depth ratio
GROUP	Group speed
ANGLE2	Offset angle for integer number of paddles to produce desired wave direction angle
SPURIOUS	Minimum wave period below which spurious waves will be generated
HSRATIO	Two-dimensional wave-height-to-stroke transfer function
HEIGHT	Two-dimensional wave height
HTHETA	Three-dimensional wave height based on effects of wave direction angle
HBREAK	Maximum breaking wave height for laboratory waves

Figure 13. Example of alternate table format designed for "talking tables"

Entries in references and/or bibliography

Entries in the references and in the bibliography will be listed by authors in alphabetical-chronological order. All authors will be listed. In listing a corporate author or organization, list from the larger to the smaller unit. The *text* will include the author's name and the year of the publication in parentheses unless the reference is pertinent to the sentence. If the author's name is a part of the sentence, then only the year will be enclosed in parentheses. For references of multiple authorship, use the full form of citation for one to three authors, but use an abbreviated form for four or more. For example: Three authors should be cited as (Smith, Jones, and Brown 1984) but four authors (Smith, Jones, Brown, and Green) should be cited as (Smith et al. 1984).

Essential information to be included for each entry and the manner in which it is to be arranged are as follows:

a. Articles. Bibliographical references to articles published in periodicals will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of publication (in parentheses), followed by a period.
- (3) Title of article (in quotes), with only the first word and proper nouns capitalized, followed by a comma.
- (4) Title of publication, italicized, with all principal words capitalized. Journal or magazine titles may be abbreviated.
- (5) Volume number followed by issue number (if any) in parentheses (e.g., "14(3)"), followed by a comma.
- (6) Inclusive page numbers (e.g., "477-79"), followed by a period.

Bennett, J. W. (1964). "The interpretation of Pueblo culture: A question of values," *Southwestern Journal of Anthropology* 12(3), 361-74.

b. Books. Bibliographical references to books will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of publication (in parentheses), followed by a period.
- (3) Chapter title in quotes, if applicable, with only the first word and proper nouns capitalized, followed by a period.

- (4) Title of book, italicized, with only the first word and proper nouns capitalized, followed by a period.
- (5) Name of editor, if applicable, followed by the abbreviation "ed." and followed by a comma.
- (6) Edition number, if necessary (e.g., "1st ed."), followed by a comma.
- (7) Name of publisher in shortened form (e.g., "Macmillan" not "The Macmillan Company"), followed by a comma.
- (8) Publisher's location, followed by a comma.
- (9) Inclusive page numbers (e.g., "6-10"), if applicable, followed by a period.

Stockwell, R. P., Smith, P. A., and Turner, J. K. (1980).
 "The outline." *The major structures of English*. J. Smith,
 ed., 1st ed., Holt, Rinehart & Winston, New York, 6-8.

c. *Technical reports, pamphlets, etc.* Bibliographical references to technical reports, pamphlets, etc., will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of publication (in parentheses), followed by a period.
- (3) Title of report or pamphlet in quotes, with only the first word and proper nouns capitalized, followed by a comma.
- (4) Designation and/or number of report or pamphlet, followed by a comma.
- (5) Name of publisher, followed by a comma. (If the publisher is the same as the author, it is not necessary to repeat the name.)
- (6) City and state in which the volume was published, followed by a period.
- (7) For an internal working document or similar unpublished document cited in the references or bibliography, include a parenthetical statement of its availability; e.g., "(Copies can be requested from U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-ER-R, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.)."

Henderson, J. E., and Peyman, L. D. (1986). "Applicability of environmental laws to REMR activities," Technical Report REMR-EI-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

d. *Transactions or proceedings.* Bibliographical references to transactions or proceedings will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of publication (in parentheses), followed by a period.
- (3) Title of article in quotes, with only the first word and proper nouns capitalized, followed by a period.
- (4) Title of the transactions or proceedings, italicized, followed by a period.
- (5) Name of proceedings editor, if applicable, followed by the abbreviation "ed." and followed by a comma.
- (6) Name of the society or name of the publisher, followed by a comma.
- (7) Publisher's location, followed by a comma.
- (8) Inclusive page numbers, followed by a period.

Chave, K. E. (1981). "Skeletal durability." *Approaches to paleoecology*. J. Imbrie and N. Newel, ed., Wiley, New York, 377-87.

e. *Theses or dissertations.* Bibliographical references to theses or dissertations will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of publication (in parentheses), followed by a period.
- (3) Title of thesis or dissertation in quotes, with only the first word and proper nouns capitalized, followed by a comma.
- (4) Identification of degree (e.g., "Ph.D. diss." or "M.S. thesis"), followed by a comma.
- (5) Name of university, followed by a comma.
- (6) City (and state if necessary) in which the university is located, followed by a period.

Smith, J. G. (1980). "The theory of sunspots," Ph.D. diss., University of California, Berkeley.

f. Computer software. Bibliographical references to computer software will be arranged as follows:

- (1) Name of author(s) with surname preceding initials, followed by a period.
- (2) Year of release (in parentheses), followed by a period.
- (3) Title of computer program in quotes, with only the first word and proper nouns capitalized, followed by the words "computer program" in parentheses and a comma.
- (4) Specifics of the program (e.g., "IBM-PC, 4 disks"), followed by a comma.
- (5) Name of developer or publisher, followed by a comma.
- (6) City and state in which program was developed, followed by a period.

Roberts, J. T. (1989). "GATES, A computerized revision program" (computer program), IBM-PC, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Format for Appendixes

Appendixes in WES reports will be designated by capital letters (Appendix A, Appendix B, etc.). Each appendix will have its own page numbering system, being differentiated from like-numbered pages in the main text by the use of a prefix letter corresponding to the letter designation of the appendix. For example, the first page of Appendix A will be numbered A1. (The appendixes herein can be used as examples.) Each appendix will begin on a right-hand page.

Paragraphs in appendixes will not be numbered. Subparagraphs will be identified by a lowercase italicized letter followed by a period.

Headings in appendixes will be in accordance with the system described for the main text.

Illustrations (figures, photos, and plates) and tables in appendixes will be numbered consecutively with Arabic numerals preceded by the letter designation of the appendix; e.g., Figure A1 or Table A1. Generally, requirements for main text tables and illustrations are also applicable to appendix tables, tabulations, and illustrations.

References in the appendixes will be included in the "References" at the end of the main text. The first reference citation in each appendix

should be footnoted with an explanation of where the references section is located.

¹ References cited in this appendix are located at the end of the main text.

Format for Notation

The entries in a notation will be listed alphabetically in order as follows: lower case, upper case, English letters, Greek letters, subscripts, superscripts. Figure 14 is an example page from a notation. Even though symbols and

Appendix C Notation	
a	Distance along x-axis, ft
A	Amplitude constant
b	Distance along y-axis, ft
C	Amplitude constant
d	Depth of water, ft
d_a	Water depth a distance a from shore, ft
e	Base of natural logarithms
g	Acceleration of gravity
H_{avg}	Average runup height, ft
i	Tsunami intensity
J_0	$J_0()$ Zeroth order Bessel function of the first kind
k	Variable, ft^{-1}
L	Characteristic length of the wave in its direction of propagation
n	Refers to a time, $n\Delta t$
$n()$	Tsunami probability function
r_e	Radius of the earth
t	Time, hr
u	Depth-averaged wave velocity component in the θ -direction
v	Depth-averaged wave velocity component in the ϕ -direction
x	Distance, ft
ΔS	Dimension of a boundary cell face normal to the boundary
Δt	Length of a half-time step
ε	Phase factor
η	Wave elevation from reference water level
θ	Latitude measured from the north pole
ϕ	Longitude measured from Greenwich
ω	Wave frequency, sec^{-1}
∂	Partial differential

Figure 14. Example of a notation

abbreviations are defined in the notation, they should also be defined when first mentioned in the main text of the report but not thereafter.

Style

Spelling

Webster's Third New International Dictionary (Gove 1986) will be used as the primary authority in matters of spelling and hyphenation of words.¹ When equal variants of spelling are given, one will be used consistently in the same report. The Government Printing Office (GPO) *Style Manual* (1984) also contains excellent sections on spelling and compound words. A list showing the preferred spelling of difficult or uncommon words used in WES reports is included herein as Appendix A. These words are often troublesome because of confusion regarding whether they are one-word or two-word forms, hyphenated or unhyphenated, etc. Reference should be made to this list when preparing materials for inclusion in WES reports.

Capitalization

The generally accepted rules of capitalization, summarized in the GPO *Style Manual* (1984), will be followed. Special uses of capitals in WES reports are as follows:

- a. *All capitals.* Abbreviated forms of proper names; e.g., USACE, WES, and DNA.
- b. *Initial capitals.* Major words of report headings; major words of titles, subtitles, and column headings of tables; trade names; military project or operation names; and the words "Chapter," "Appendix," "Figure," "Table," "Photo," "Plate," and "Equation" when followed by a letter or number. Words such as gage and profile are also capitalized when followed by a number; e.g., Gage 1, Profile 3.

Punctuation

Discussion of the rules for punctuation is beyond the scope of this Guide. WES authors should consult good standard works such as the *Harbrace College Handbook* (Hodges, Whitten, and Webb 1990), *Words Into Type* (Skillin and Gay 1974), and GPO's *Style Manual* (1984). Specific usages and/or misusages of certain types of punctuation are discussed in detail in Chapter 6.

¹ Referred to as Webster's Unabridged Dictionary hereinafter.

Abbreviations and symbols

The basic philosophy in the use of abbreviations and symbols in a report is to gain conciseness—but never to impose a hardship in understanding on the reader. In WES reports, essentially three types of shortened word forms are acceptable: units of measurement, acronyms, and symbols.

Units of measurement. Abbreviations will be used for units of measurement in the text when the units are immediately preceded by numerals.

Incorrect:

Current velocity, in fps, was...

Correct:

Current velocity, in feet per second, was...

or

Current velocity was 15 fps...

Internal and terminal punctuation will be omitted in abbreviations, except where such omission may introduce ambiguity. For example, the period is always used in the abbreviation for inch; thus, "in." is correct.

Be consistent in both usage and style. It is permissible to spell out words in the text and abbreviate the same words in tables and illustrations. However, the same form should be used consistently in all tabular and illustrative material, and the form adopted for the text should be used consistently in the text material. For example, do not use "20 feet per second" in one place in the text, "20 fps" in another, and "20 ft/sec" in still another.

Appendix B is a list of abbreviations commonly used at WES. Though by no means complete, it does include most unit-of-measurement abbreviations and other closely related abbreviations used in WES reports. For additional guidance on abbreviations, refer to the *GPO Style Manual* (1984) and Webster's Unabridged Dictionary.

Acronyms. The first time an agency or program name is used in the preface and the main text, it should be written out and followed by its proper abbreviation in parentheses if it is to be used again therein. Such abbreviations will be written in all capital letters, with no space or periods between the letters. The abbreviations alone may be used thereafter.

Examples:

...at the U.S. Army Engineer Waterways Experiment Station (WES). Personnel at WES associated with the study were...

...for the Aquatic Plant Control Research Program (APCRP). Further work under the APCRP showed that...

Abbreviations for agency names are found in AR 310-50 (Headquarters, Department of the Army 1985).

Symbols. Greek letters and mathematical symbols are used freely in technical reports. Those editing reports and preparing reproducible copy must follow the author's manuscript. Therefore, mathematical copy must be clear and unambiguous. If the manuscript is handwritten, the author should distinguish between uppercase and lowercase letters and between similar Greek and English letters and should indicate superscripts and subscripts. The author should adopt a consistent style to indicate multiplication of numbers and numerical fractions; i.e., cross, center dot, or parentheses, brackets, and braces. Greek letters and mathematical symbols commonly used in WES reports are listed in Appendix C.

Chemical symbols may be used freely in tables and illustrations. Generally, clarity to the reader is the controlling rule for these. In the text, symbols should be avoided when the terms constitute only a general reference.

Preferred:

The barium compounds and the nickel and iron alloys were...

Not preferred:

The Ba compounds and the Ni and Fe alloys were...

Symbols for isotopes, using superscript numerals, may be used in the text.

Preferred:

...consisting of barium-36 and iron-23.

or

...consisting of ^{36}Ba and ^{23}Fe

Numerals

The following are guidelines for the use of numerals in WES reports based on Strange and Mather (1966).

Spell out any numbers from one through nine (except in tables or lists), with the following exceptions:

- a. Use numerals when the quantity is partly fractional, such as "1.15," "1-1/2 in." (note the hyphen in the second expression). However, fractions standing alone (with no whole number) are usually spelled out, such as "three fourths of the dam," "half a mile," or "a half mile."

- b. Use numerals with units of measurement, such as "2 by 4 in.," "5 psi," etc.
- c. In contrasted statements, if some numbers must be numerals, use numerals for all, such as "Gages A and B require 2 bolts and 16 bolts, respectively."
- d. In a series of connected numerical statements implying precision, use numerals, such as "2 years 5 months 3 days." The use of numerals (especially the "1") is not recommended for numbers occurring in precise statements similar to the following: "by connecting the two test coils"; "one testing machine."
- e. Use numerals after certain abbreviations that are not units of measurement, such as "Vol V," "sta 1."
- f. Use numerals in proportions, such as "a ratio of 1 to 5" or "a 1:10 scale."

Use numerals for all numbers of 10 or higher, with the following exceptions:

- a. Do not begin a sentence with a numeral.
- b. Spell out round numbers used in an indefinite sense unless accompanied by a label such as "about" or "approximately," or "a hundred feet or so," or "approximately 100 ft."
- c. Spell out numbers of less than 100 that precede another number, as in the following: "fifteen 2-in. rods," but "120 8-in. rods."

In expressing percentages, precise figures, etc., use decimals; e.g., use "4.5 percent," not "4-1/2 percent."

In decimal numbers less than unity, place a cipher before the decimal point, such as "0.65 in.," not ".65 in."

Use a comma in numbers of four or more figures in text and tabular matter, such as "1,000," not "1000."

Always use numerals for the time of the day and the day of the month: such as "2:30 p.m." or "25 January 1984"; but spell out such phrases as "the first of May," when not referring to specific days. Spell out the numeral when referring to specific days by ordinal number: "the fifteenth of May."

Mathematical expressions

WES style for presentation of equations and other mathematical expressions is summarized in Appendix C.

4 Report Preparation, Processing, and Distribution

A flowchart indicating the usual path a WES report follows in the process of publication is shown in Figure 15. The various steps are discussed in detail in this chapter.

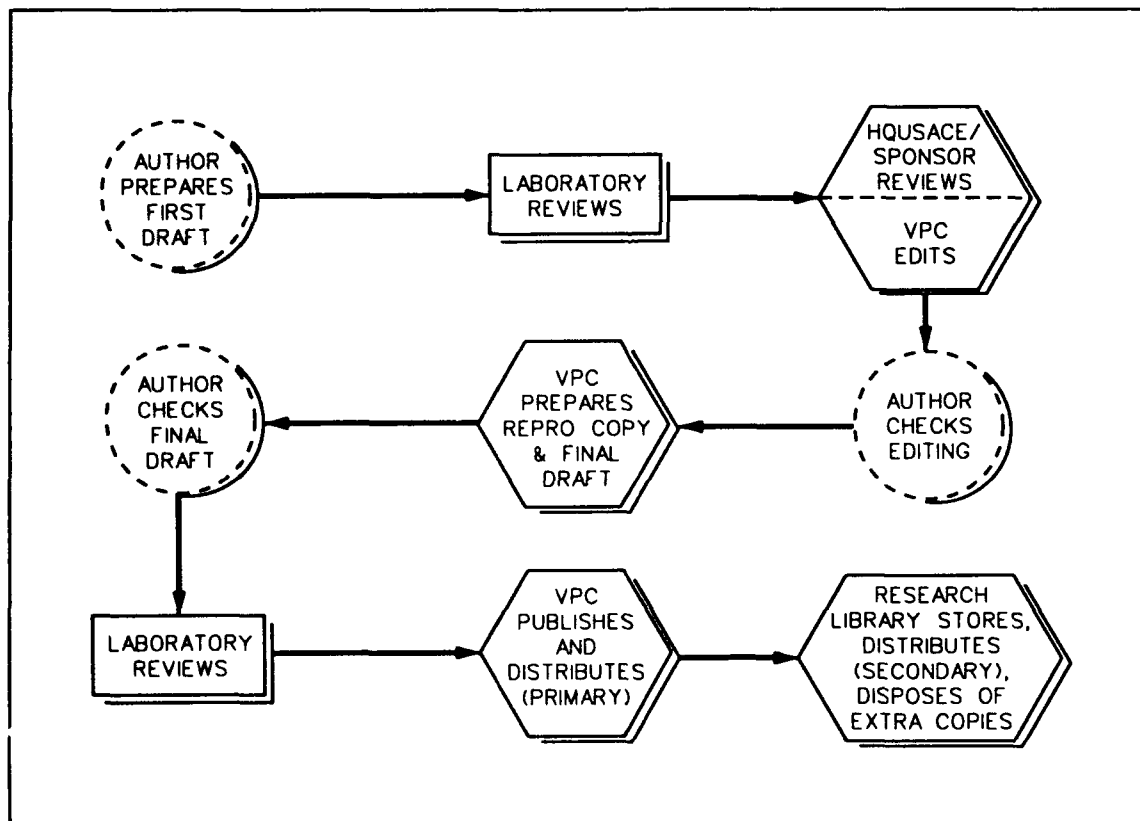


Figure 15. Flowchart for WES reports

Planning

To expedite the publication of a report, the author should: (a) begin planning and writing the report concurrently with his investigation whenever feasible, and (b) obtain the advice and services of VPC in planning the report, arranging for timely graphic arts support, setting up tables of data, and resolving questions of organization, format, etc.

Technical reports should give a complete, accurate account of the work accomplished, but they should contain only information, illustrations, and data essential to an understanding of the subject matter. During the preliminary phase of assembling the material that will go into the report, the author should decide which data are essential and which can be put into appendixes or simply filed. Early determination of what need not be included in the report will save time and money. In the case of computer-generated information, a format should be selected in the beginning that will facilitate assembling the data.

Preliminary Draft

Author

The author, in preparing a preliminary draft of a report, must ensure that the draft is complete, accurate, and technically correct. Preliminary illustrations should be complete, legible, and accurate, and prepared with a view toward final report standards. To save money and time, hand-drawn illustrations that are neat and legible may be used in Miscellaneous Papers, and computer printouts of data may be used in all types of reports.

Technical organization review

After the preliminary draft has been reviewed in the technical organization, WES Form 1064 (Figure 16) will be completed, signed by the division chief or laboratory director or by the support element chief, and attached to the draft. The report, along with a signed ENG Form 1309, will then be sent to VPC for processing.

WES Form 1064 should be filled out carefully and completely. Upon request, VPC will prepare a cost estimate for completion of the report. The distribution statement to be printed on the report cover should be selected from those on the back of the form.

INSTRUCTIONS TO VPC

Report Title: _____

Proposed designation:

TR _____ MP _____ IR _____

CR _____ Other _____

Distribution list number _____

Person to contact in Lab: _____

Format and style:

WES _____ Other _____

Org. Code _____

Job No. _____

Remarks: _____

Editorial Work to be Done in VPC

☐ **Type 1 Editing.** Editor will check for:

1. Effective organization of contents and expression of ideas (i.e., good paragraph and sentence structure, logical progression of ideas, proper emphasis, deletion of redundancies and unnecessary repetitions, clarity, parallelism, consistency, brevity, and best word choice).
2. Conformance with format and style specified above.
3. Agreement of data in text, figures, tables, photos, plates, and references.
4. Correctness of grammar.
5. Effective and economic use of illustrations and tabular material.
6. Proper use of bibliographic references.

☐ **Type 2 Editing.** Same as Type 1 Editing except that editor will **not** check for agreement of data in text, figures, tables, photos, and plates.

☐ **Type 3 Editing.** Editor will check for:

1. Logical overall organization of report. (Major structural flaws, if any, will not be changed but will be pointed out to the author. Existing sentences and paragraphs will be changed only as necessitated by items 2-5 below.)
2. Conformance with format and style specified above.
3. Correctness of grammar.
4. Effective and economic use of illustrations and tabular material.
5. Proper use of bibliographic references.

☐ **Type 4 Editing.** Editor will merely check to see that report complies with the requirements of ANSI Z39.18-1987; i.e., check to see that report contains proper cover, SF 298, summary (if necessary), preface, table of contents (if necessary), conversion factors table and footnote, and distribution list (required in some DNA reports). The editor will not read the report.

Graphics, Layout, and Printing to be Coordinated by VPC

- | | |
|----------------------------------|--|
| 1. Have graphics prepared _____ | 4. Prepare reproducible copy _____ |
| 2. Have graphics corrected _____ | 5. Number of draft copies required _____ |
| 3. No graphics required _____ | 6. Number of printed copies required _____ |

Date _____

(Signature of Division Chief or Laboratory Director)

Wes Form No. 1064
Rev Nov 1991

(Over)

Figure 16. Instructions to VPC (Continued)

NOTICES TO GO IN WES REPORTS

(Please check proper notice to use of those in paragraphs 1 and 2)

1. **Distribution Statement.** Indicate which of the following statements (required by DOD Directive 5230.24 and Army Regulation 70-11) is to be put on front cover and SF 298 of report. If Statement B, C, D, or E is to be used, please indicate which of the reasons is to be cited.

- | | |
|--|---|
| <p>☐ Statement A: Approved for public release; distribution is unlimited.</p> <p>☐ Statement B: Distribution authorized to U.S. government agencies only; (fill in reason); (date). Other requests for this document shall be referred to (insert controlling DOD office).</p> <p style="margin-left: 20px;"> ☐ Foreign Government Information
 ☐ Proprietary Information
 ☐ Test and Evaluation
 ☐ Contractor Performance Evaluation
 ☐ Administrative or Operational Use
 ☐ Software Documentation
 ☐ Specific Authority (identification of valid documented authority) </p> <p>☐ Statement C: Distribution authorized to U.S. Government agencies and their contractors; (fill in reason); (date). Other requests for this document shall be referred to (insert controlling DOD office).</p> <p style="margin-left: 20px;"> ☐ Critical Technology
 ☐ Administrative or Operational Use
 ☐ Specific Authority (identification of valid documented authority) </p> <p>☐ Statement D: Distribution authorized to DOD and DOD contractors only; (fill in reason); (date). Other requests shall be referred to (insert controlling DOD office).</p> | <p style="margin-left: 20px;"> ☐ Premature Dissemination
 ☐ Software Documentation
 ☐ Critical Technology
 ☐ Specific Authority (identification of valid documented authority) </p> <p>☐ Statement E: Distribution authorized to DOD components only; (fill in reason); (date). Other requests shall be referred to (insert controlling DOD office).</p> <p style="margin-left: 20px;"> ☐ Export Limitations
 ☐ Foreign Government Information
 ☐ Premature Dissemination
 ☐ Software Documentation
 ☐ Critical Technology
 ☐ Specific Authority (identification of valid documented authority) </p> <p>☐ Statement F: Further dissemination of this document only as directed by (insert controlling DOD office); (date); or higher DOD authority.</p> <p>☐ Statement X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with regulations implementing 10 U.S.C. 140c (date). Other requests must be referred to (insert controlling DOD office).</p> |
|--|---|

2. **Disposition Instructions.** Unless special instructions regarding the report's disposition are necessary, one of the following notices will be used.

Unclassified, unlimited reports:

- ☐ Destroy this report when no longer needed. Do not return it to the originator.

Reports marked with distribution statements B, C, D, E, F, or X:

- ☐ **DESTRUCTION NOTICE:** For classified documents, follow the procedures in DOD 5200.22-M, Industrial Security Manual, Section II-19, or DOD 5200.1-R, Information Security Program Regulation, Chapter IX. For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

Figure 16. (Concluded)

VPC processing

When the preliminary draft of a report is delivered to VPC for processing, it will be reviewed to determine what procedures will be necessary to meet deadlines or target dates. Any questions will be resolved by the person designated on WES Form 1064. The report will then be processed through editing, photography, layout, etc., according to the instructions provided.

Author's check of editing

The edited draft will be returned to the author for check of VPC's editing. The author should resolve the editor's questions, if any, at this time. On completion of this check, the draft will be returned to VPC for preparation of the reproducible copy/final draft.

Final Draft

VPC

VPC will prepare the final draft of the report in accordance with the appropriate standards of format, arrangement, and style. A sufficient number of copies of the final draft will be prepared for final review: a single copy if it is to be reviewed only at WES, or several copies if it is to be sent to the sponsoring office, consultants, etc., for review.

Technical organization

The final draft will be thoroughly and carefully checked in the author's technical organization to ensure the accuracy and adequacy of the completed report. Copies of the final draft will then be forwarded by the author's technical organization to the sponsor or other office as required (see following paragraph), to consultants, or back to VPC if outside review is not required.

Sponsoring office

The final draft will be forwarded to the sponsoring office for review if requested by that office or if considered desirable by the WES technical organization concerned.

The letter forwarding the draft will call attention to the proposed distribution (the distribution list may be included in the draft) and the distribution statement appearing on the cover page, and the letter will request concurrence. It will also ask how many copies of the report the sponsor desires if

this has not already been established. The letter will also request that the report be returned promptly. When the draft is returned to WES, it will be routed to the technical organization concerned, where any necessary changes will be indicated, and then to VPC with any additional or revised information on distribution or restrictions.

Final approval

The responsible laboratory director and support element chiefs have final approval authority for all Technical Reports, Instruction Reports, Miscellaneous Papers, and Contract Reports.

Final corrections and reproduction

Upon receipt of the approved final draft, VPC will make any required final corrections in the reproducible copy prior to processing the report through printing. In accordance with AR 25-30 (Headquarters, Department of the Army 1989), VPC is the *only* authorized source for printing and duplicating services for use in reproducing WES publications. Based on customer requirements and work load, VPC will determine whether in-house, GPO, or direct commercial resources or some combination thereof will be used to reproduce a given report.

Distribution

Primary

Technical publications are normally distributed by VPC, which keeps a record of the number of copies produced, primary distribution made, and any foreign recipients.

Numerous standard computerized distribution lists for WES reports are maintained by VPC. Both foreign and domestic exchanges are designated on these lists and should be honored whenever possible. For reports for which one of the standard distribution lists is not appropriate, the author or technical organization will originate a list for forwarding with the final draft, taking into consideration the established foreign and domestic exchanges (approximately 100 copies required).

Except for reports published in only a few copies, two copies of all reports will be forwarded to DTIC on initial distribution. Distribution statements will remain in effect until changed or removed by the controlling DOD office. When notified by the controlling DOD office that limited distribution can be removed, the Research Library will notify primary

distribution recipients and cognizant document handling facilities that Statement A should be applied.

Secondary

Secondary distribution is provided by the Research Library. After a report is first published, all extra copies are transferred to the Research Library for use in filling individual requests for reports. (Due to space limitations, it is recommended that not more than 100 copies be sent to the Research Library.) After the first year, the number of reports kept for secondary distribution is reduced annually with any excess copies being returned to the author or his/her organizational element. After 6 years, all remaining copies are returned.

Exceptions

Miscellaneous Papers and Instruction Reports for limited distribution

Miscellaneous Papers and Instruction Reports that will receive only *limited* distribution (100 copies or less) need not follow all the procedures prescribed thus far. In addition, they need not be as finished in style or format as technical publications given broad distribution. However, they should be technically correct and well written, and all illustrations and tables should be neat and legible. Even though these reports will receive only limited distribution, they must be reviewed and approved by the responsible laboratory or support element chief before being printed. Printing and duplicating services will be obtained from VPC.

Contract Reports

Contract Reports must be reproduced by VPC from reproducible copy prepared by the contractor or from reproducible copy prepared at WES from a draft furnished by the contractor. Government Printing and Binding Regulations published by the Joint Committee on Printing, Congress of the United States, specifically state that *contractors shall not become prime or substantial sources of printing*. Paragraph 35-1 of the regulations reads as follows:

The inclusion of printing...within contracts...for services such as...engineering, and research, is prohibited unless authorized by the Joint Committee on Printing.

The contract will specify the format for the report, which will be that prescribed by the Guide (except DNA Contract Reports) with respect to spacing, page size, use of both sides of sheets, keeping illustrations to the minimum necessary for a clear understanding of the subject matter, and making illustrations page size or smaller whenever possible. In addition, Contract Reports will contain the proper distribution and disposition statements and a completed Standard Form 298.

In reviewing drafts of Contract Reports, the responsible technical organization will ensure that the final reproducible copy meets the following requirements. The preface will include the sponsoring agency, statements indicating authorization for the work, numbers and titles of the DA Project/Task under which the work was accomplished, and the relation of the work to the overall program. It will also include a statement similar to the following, generally as the last paragraph: "The contract was monitored by Mr. _____, _____ Branch, _____ Division, of the _____ Laboratory of the U.S. Army Engineer Waterways Experiment Station. Contracting Officer was COL _____, EN. Director was Dr. Robert W. Whalin." Other WES personnel, such as branch and division chiefs and laboratory directors, may be named at the discretion of the technical organization concerned.

The reproducible copy of Contract Reports to be published by WES must be submitted on white bond paper, illustrations must be neat, legible, and preferably suitable for reduction to a 6- by 9-in. size or smaller, and photographs must be good, continuous-tone prints. The reproducible copy will be furnished to VPC for printing.

All Contract Reports will be bound with the prescribed WES cover, which will show the name of the contractor. The Standard Form 298 will also contain the contractor's report number and other information desired by the contractor. These reports will be distributed by VPC. Up to 25 copies of a report may be furnished to the contractor. If the Contract Report is acceptable "as is" to the Principal Investigator, type 4 editing should be considered.

Reports prepared by WES but printed elsewhere

Reports prepared by WES technical organizations but printed by the sponsoring office will also be incorporated in the appropriate WES report series. At least three copies of the published edition of all such unclassified reports (a maximum of two copies of classified reports) will be forwarded to VPC, which will assign a report number, have a WES cover attached over the sponsor's cover, and send the reports to the Research Library for filing.

Reports prepared for record purposes only

Reports prepared for record purposes only (no distribution except to the Research Library and possibly to the technical organization involved) will be designated Miscellaneous Papers and filed in the Research Library, provided their content will not be included in a future, more comprehensive report. These reports should contain a preface, or at least an introductory paragraph, giving the administrative background, pertinent dates, and any acknowledgments desired. WES Form 1064 showing the distribution statement to be printed on the cover (for use by the Research Library) will be sent to VPC along with the reproducible copy. VPC will assign a report number, reproduce and bind the report, and send three copies to the Research Library. A few copies for the files of the technical organization concerned can also be reproduced and bound at the same time, if desired.

Papers prepared for professional societies and/or journals

Papers prepared for presentation at symposiums or meetings of professional societies will be bound as WES Miscellaneous Papers unless the papers are based on information that is or will be available in another WES publication. Clearance for presentation of such papers will be obtained in accordance with provisions of WES Station Regulation 360-1-2 (U.S. Army Engineer Waterways Experiment Station 1984).

After a paper is presented, the author should furnish the Research Library the following: title, author, date, and location at which it was presented, probable publication date and journal, and the availability of reprints.

Theses and dissertations

In most cases, a thesis and dissertation completed by a WES employee as a result of Corps-sponsored academic work will be published as a formal WES report. Such a report can be printed basically "as is" as a WES Technical Report. For information on the handling of theses and/or dissertations that are not published as formal WES reports, see WES Station Regulation 25-1-9 (U.S. Army Engineer Waterways Experiment Station 1990).

5 Writing, Editing, and Layout

The purpose of a technical report is not only to record the results of an investigation but also to present the details and associated reasonings in a form that is easily referred to and readily understood by the audience for which the report is intended. With this basic purpose of reports in mind, the following discussion of the writing and editing functions as practiced at WES was compiled.¹

Writing

Approach to writing

An outline delineating the proposed organization of the material to be presented is recommended when planning and preparing a report. In preparing an outline, the author must decide whether a topical or a chronological approach will be used, or perhaps a combination of the two. Generally, the topical approach (telling why and how the study was made and what was learned) is preferred. The topical approach may also include a chronological account of the events leading up to the study or of test procedures, etc. Conversely, the purely chronological approach hinders an author in emphasizing the important features of a study and is ordinarily used only when an historical account is desired.

Another means of expediting completion of reports and simplifying their preparation is the report-while-testing procedure. The author may use this procedure to describe each test series as it is finished and prepare pertinent tables and illustrations. Thus, when the investigation is completed, the report also is essentially complete. An additional advantage of the report-while-testing procedure is that the test data are analyzed as the

¹ This discussion was compiled in great measure from *Technical Editing*, edited by B. H. Weil (1975); "Clarity in Technical Reporting" by S. Katzoff (1968); and *Writing and Editing Reports* by R. R. Rathbone (1961).

study progresses. This may assist the investigator in determining the next steps in the testing program. When an investigation consists of several phases, reports may be prepared on each phase to provide the sponsor information as promptly as possible.

Duty of writer

The primary duty of a technical writer is to convey information accurately and clearly. However, many writers seem to subordinate this purpose and forget the reader when preparing a report. For example, when a reviewer or editor points out that a certain word seems incorrect or ambiguous, the writer may proceed to an unabridged dictionary and triumphantly point out the rare definition that clarifies his sentence. Obviously such an author is not presenting information clearly to the reader; if the reader had been kept in mind, an attempt would be made to substitute a more common word.

Today, nearly all readers of technical literature are in a hurry. They have so much to read that they have to skim nearly everything if they are to get through the daily pile of papers on their desks. They also have to read discontinuously since job pressures seldom permit reading a report from cover to cover in one sitting. Therefore, from a practical viewpoint, writers should cater to these needs. They should build ease of reading into their style and format. Actually the job is not so difficult if writers will use the following suggestions for tailoring their report to the rapid reader:

- a. *Use descriptive headings and subheadings freely.* They act as signposts, group related material, and show the interrelation of the parts and their contribution to the whole. Newspapers use headings, why not reports?
- b. *Put the topic sentence at the beginning of a paragraph.* This gives readers a choice. They can either read the details on the topic or skip to the next paragraph.
- c. *Use a simple structure for a complex idea.* Whenever the thought is involved or otherwise difficult to convey, the grammatical structure should be simple. Three short sentences are easier to read in this case than one long one; a paragraph of technical description more than a page long usually has to be reread.
- d. *Relegate secondary material to an appendix.* Main ideas will stand out if not buried by incidentals, however pertinent.
- e. *Make full use of illustrations and tables.* Illustrations and tables that summarize detailed results are invaluable. Most readers have trained themselves to extract the information they need at a glance. But always supply captions and legends, and refer to the illustration

or table at that point in the text where the reader needs the information.

The following paragraphs give helpful suggestions on word usage, sentence structure, and paragraphing.

Choice of words

Avoid using a rare word unless it is essential. Foreign words and phrases should not be used when they can be avoided; whatever elegance or subtlety they may add to the paper or report is probably lost on the reader who will merely find the paper or report that much more difficult to follow. Technical words commonly used in a particular branch of science or engineering can, of course, be used. Be sure, however, that the technical words are not merely WES jargon, because such language can be meaningless to others.

The need for precise, straightforward language cannot be over-emphasized. Readers seek information, not an emotional experience. They ask for clarity and efficiency of expression, not impressive language. Other things being equal, choose (a) a short rather than a long word; (b) a plain, familiar word rather than a fancy, unusual one; and (c) a concrete word rather than an abstract one. Some major word faults include the following:

Fuzzy words:

Plates of *appreciable* thickness...
A *relatively high* temperature...
A *small number* of failures...

Obscure words:

Conditions should *ameliorate* as soon as the maintenance crews are *inculcated* in the theory of operation.

Jargon and coined words:

The system can be introduced with *effectivity* within 6 months.

Cliches:

Last but not least, we intend, *in the long run*, to *explore every avenue* that might lead us to a solution *along this line*.

Sentences

For sentences, “do” and “don’t” suggestions are not as simple and obvious as those just presented for words. However, the basic purpose of presenting material as clearly as possible is still the guide.

The length of a sentence should generally not exceed about 35 words, unless it is broken up (as by semicolons) into two or three distinct and logically consecutive parts. Simple sentence structure requiring a minimum of punctuation is desirable. Longer, more complex sentences should be used less frequently and should be used to lend variety rather than as the primary means of expression.

An equally important principle is that a sentence should generally contain some indication of how it is related to the preceding sentence or to the development of the paragraph. This indication is best placed near the beginning of the sentence. For example, in the first three sentences of this paragraph, the opening phrases (“An equally important principle,” “This indication,” and “For example”) all serve to show relation to what has gone before. Omitting such tie-in wording may not essentially alter the main content of the sentence, but doing so can make readers struggle to determine for themselves how the sentence fits into the train of thought.

Make every effort to eliminate ambiguity from sentences. Ask about whether the meaning of each word, phrase, or sentence will be clear or whether it has a chance of being even momentarily misunderstood.

Sometimes readers may attach undue weight to a statement simply because the writer was not careful in separating and labeling primary and secondary information. Improper emphasis can, and frequently does, occur at the sentence level. The rule is: *Put main ideas in main (independent) grammatical constructions; secondary ideas, in secondary (dependent) grammatical constructions.* For example, the writer who says “The solution is best determined by field test and is 50 psi” has assigned equal weight to two ideas. The statement that the value is 50 psi is the more significant, and the following revision would so indicate: “The solution, best determined by field test, is 50 psi.”

Frequently a particular fact or idea must be stated more than once in a report; for example, it may be given in the introduction and then also in the description of the tests and in the discussion. Rather than treating it every time as brand new material, consider introducing the repetition with a phrase such as “As has already been mentioned,” or “Here, again, the fact that...”; otherwise, readers may wonder whether their memories are playing tricks. Such introductory phrases are not always essential, but their omission can sometimes be very annoying.

Paragraphs

A paragraph is usually thought of as a group of sentences developing a single topic, but a paragraph may consist of a single sentence. Like the sentence, a paragraph must have unity, coherence, and emphasis. Unity is attained when every sentence bears directly upon the topic of that particular paragraph; any departure from the central topic means that a new paragraph should be formed. A topic sentence (i.e., the sentence that expresses the topic to be discussed) is generally placed at the beginning of the paragraph. However, its position can be varied to avoid monotony. Coherence in a paragraph results from the correct arrangement of the parts of the paragraph—an arrangement in which each part leads to the next. Emphasis in the paragraph results from stressing the important ideas, either by devoting more space to them or by their position in the paragraph; the beginning and the close of the paragraph are the most emphatic positions.

In clear paragraphs, each sentence is related to the preceding and following sentences by transitional words or phrases. In addition, it may be desirable to indicate definitely the relation of each paragraph to the preceding or the following one. Usually, the relation to preceding material is indicated in the opening sentence or sentences of the paragraph; and relation to the following material is indicated in the final sentence or sentences of the paragraph. In any case, make sure that the readers are not required to proceed very far into a paragraph (i.e., beyond the second sentence) before the general drift of the subject matter becomes apparent. Do not make them read on and on while wondering just how the paragraph fits into the report. You, as the author, are in a much better position than the readers to organize the material; and the responsibility both for organizing it and for showing the organization rests on you.

Do not make paragraphs too long. Just as a sentence with too many phrases is difficult to grasp as a unit, so is the paragraph with too many sentences. A long paragraph should not, of course, be broken up into shorter ones by arbitrary subdivision. If a paragraph is getting very long, either simplify the idea or break up the idea into smaller units, with a paragraph for each.

Editing

Excellent research poorly reported may sometimes be interpreted as of less worth than less significant research that has been well reported. Therefore, the careful editing of reports to improve their organization, grammar, and communications value enhances their overall quality and subsequent use of the results reported.

Author-editor relation

Editors assist authors in completing reports that reflect both technical excellence and the views of management relative to the mission of WES. If an understanding is reached between editors and authors of the importance and mutual advantages of teamwork, effective technical reports are produced with a minimum of effort.

The efforts of technical writers, technical editors, illustrators, and publishers are all ultimately directed toward producing documents suited to the intended readers. This means that the technical editor must keep the needs and interests of the intended readers foremost in mind when editing each document, and must judge and mold the writer's efforts in these respects.

Accordingly, the technical editor must remember that readers are discouraged by overdetailed discussions, vague statements, and overuse of synonyms, acronyms, unfamiliar jargon, and obscure units. The editor must also coordinate with VPC publication designers to ensure that documents are as attractively presented as budgets will permit since many readers react unfavorably to publications that are poorly designed, poorly duplicated, or inadequately bound.

A VPC technical editor is both the junior partner of an author-editor team and a representative of management. Editors are charged with the task of seeing that technical content is reported in a manner suited to the WES mission and within prescribed standards for such publications. It is hoped that this Guide will be helpful in establishing "ground rules" to assist both authors and editors in producing effective technical reports. However, to perform editing tasks effectively, the editor must have a ready knowledge of the special language of various disciplines in addition to a thorough knowledge of grammar, punctuation, etc. The editor must accept the fact that most words have several meanings or exact shades of meaning and learn to identify these meanings with precision.

If an author fails to follow prescribed guidance on presentation as described herein, the editor can easily refer the author to this Guide. However, matters of literary style are considerably more delicate. It is not the function of the editor to rephrase a report in his or her own literary style. Usually, style is not the important aspect of a report. The content of a report need only be understandable, readable, written in clear, concise language, and complete.

Standardization of format and grammar aids in making the report more understandable. A report must be presented in such a way that technical details are easily interpreted by the intended audience.

Functions of VPC editors

As already stressed, the job of VPC editors is to ensure production of accurate, well-written, well-organized, and readily understandable technical reports as efficiently and economically as possible. The general functions of editors are outlined below:

- a.* Maintain established publication standards of content, organization, style, and format.
- b.* Review reports and/or other documents for proper presentation.
- c.* Counsel authors on report problems.
- d.* Coordinate the various processes in the publication of reports.

In accomplishing these general functions, editors must perform the following, more detailed services:

- a.* Correct grammar, punctuation, format, and style.
- b.* Indicate or question apparent errors in fact.
- c.* Question vague or ambiguous statements, unfamiliar jargon, and obscure units.
- d.* Indicate redundancy and inconsistencies.

Editors must guard against trying to impose their own preference for words or their own writing style on the author.

Four types of editing are available for WES reports. These types of editing are described in detail on WES Form 1064 (Figure 16). Standard WES report policy requires either type 1 or type 2 editing for all reports to be given Corps-wide or greater distribution. Type 3 editing is acceptable when there is a severe shortage of funds and/or time. Type 4 editing is acceptable only for reports being published in limited quantity (100 copies or less) for limited distribution. An exception to this is the Contract Report. As long as the technical content of the Contract Report is acceptable to the responsible technical organization and the mechanics of the reproducible copy are acceptable to VPC, type 4 editing is acceptable for Contract Reports for distribution that exceeds the 100-copy limitation specified above.

Functions of VPC proofreaders

VPC provides proofreading services for copy prepared in VPC and, if requested, for copy prepared in the technical organizations. Proofreading is an important function since it is almost impossible to prepare copy without making errors.

The editorial marks in general usage by VPC proofreaders and editors are as follows:

<i>Markings in edited draft</i>	<i>Meaning of the mark</i>
Since ~~one notices that~~ the data	Delete "one notices that"
The ~~no~~ clear test series	Transpose letters
had ~~gone~~ <u>not</u> far enough	Transpose words
~~stat~~ Director of WES ^{sp}	Restore deleted, crossed-out, or altered material
It was ~~not~~ found that	Spell out
The fall ~~out~~ contaminated	Insert at indicated point
in anisotropic medium	Close up space
¶ The instruments showed that	Space properly between characters
marked. 2 The proof was read by	Make new paragraph
The Holt Lock and ~~dam~~	Run on. No new paragraph
The Holt ~~Project~~	Upper case the "d"
<u> </u> the tests were run	Lower case the "P"
the tests were run <u> </u>	Move to l. f. to point indicated
<u> </u> Purpose and Scope <u> </u>	Move to right to point indicated
15 <u> </u> 25	Center horizontally on page
20	Move up to point indicated
15 <u> </u> 25	Move down to point indicated
20	
l.c.	Lower case
Cap. or "All caps"	Capital letters
c. & l.c.	Capitals and lowercase letters
#	Add space
^	Insert

Checklist for Authors and Editors

A checklist for use by both authors and editors is outlined below and on the following pages.

a. Preface:

- (1) Does the preface give the necessary administrative background, such as authorization, sponsor, dates when study was started and completed, acknowledgment of personnel of sponsoring

office or other agencies who were involved in the study and of WES personnel?

- (2) Does the preface contain technical background information that can be more properly or appropriately put in the main body of the report?

b. Introduction:

- (1) Is background information sufficient?
- (2) Are purposes of study clear and complete?
- (3) Are scopes of study and report given?
- (4) Should any of the material be removed and put in the preface?

c. Main narrative:

- (1) Are test equipment and procedures clearly described?
- (2) Are tests or investigations clearly described? Are they given in logical order? Are the purposes of each specific test given? Is each type of test tied in with the purpose of the overall investigation as stated in the introduction?
- (3) Are the test data clearly presented in best form? If given in more than one form, do the data agree? Are there too many detailed presentations of data; i.e., could some of the repetition be deleted or put in an appendix?
- (4) Does the discussion or summary of results, or both, bring out the important findings of the tests? Do the results cover the purposes of the investigation?
- (5) Are the conclusions really conclusions and not results?
- (6) Are the recommendations relevant and reasonable based on the results of the study?

d. Illustrations. Illustrations should be used when needed to improve the report. They should be used when necessary to clarify the text; they can sometimes be used instead of long descriptions or tabulations.

- (1) Are the illustrations in the text kept to the minimum needed to illustrate certain points?
- (2) Are the tables properly arranged? Can any be combined, put in an appendix, put in text, or omitted? Excellent suggestions for use in editing tables are provided by the "Checklist" and

"Suggestions" given in Chapter 16 of *Technical Editing* (Weil 1975).

- (3) Are there too many photos or not enough? Should any have labels to clarify them? How can they best be cropped to avoid large reductions or to emphasize important features? How can they best be arranged for comparison or economy?
- (4) Are the plates understandable? Are they uniform in lettering and wording? Can any be combined economically? Does each have a distinctive title?
- e. *Headings*. Check the headings to ensure that the format is correct and that there are headings for each major section but not so many headings that the text is choppy. See that the headings are of appropriate weight for the material they cover. Can any be changed to make them more descriptive?
- f. *Summary*. Is the summary an adequate synopsis of the report; i.e., does it say why the study was made, how it was made, what was learned, and what was concluded? Does it mention all appendixes? In most reports, any recommendations included in the main text of the report should also be included in the summary.
- g. *Report title*. Does the title of the report adequately describe the contents? Can it be shortened if long?
- h. *Abstract*. Is the abstract as complete as possible within the usual limit of approximately 200 words?
- i. *Contents*. Does the table of contents show all changes made in headings, figures, tables, etc.?

Layout

Visual information specialists in VPC serve as publication designers to plan, design, and prepare layouts for use in the preparation and production of printed materials such as newsletters, brochures, pamphlets, and technical reports. The standards which they apply to these tasks are fully illustrated by the design and layout of this Guide. Refer to Appendix D for detailed information on layout, type styles and sizes, etc.

6 Common Errors

Some of the grammatical and stylistic errors often found in WES report manuscripts are discussed in the following paragraphs.

Voice

The simpler, more direct, and more forceful active voice is preferred wherever possible. To avoid first-person-singular construction, many WES writers eliminate all personal pronouns and even words for active agents, leading to excessive use of the passive voice.

Weak:

Drainage of the area is accomplished by three streams.

Stronger:

Three streams drain the area.

Weak:

Telemetry of the data from the reservoir is done by a PAM-FM system.

Stronger:

A PAM-FM system telemeters data from the reservoir.

In addition to being the weaker form, passive voice often leads to ambiguity as to who or what is performing the action.

Use of Weak Verbs

Weak verbs (e.g., be, is, make) often lead to less economical sentence structure, as well as to a general weakness in expression. Notorious in poor technical writing is the conversion of a strong verb into a noun, which is then combined with a weak verb.

Poor:

Dose-rate *measurements were made* by the ion chambers to provide...

Better:

Dose rate *was measured* by the ion chambers to provide...

Still better (active voice):

The ion chambers *measured* dose rate to provide...

Nomenclature Inconsistency

Consistency in the use of technical terminology and abbreviations throughout a given report is essential. When an otherwise common word is used in a particular context (such as "gust" for the dynamic pressure wave), it should be clearly defined the first time it appears. It must then be used the same way throughout the report.

Once some object, material, event, behavior, or other thing relevant to the study being described has been given a name, and that name defined (if a definition is needed), do not use a synonym for that thing. If the same thing has been called by more than one name, the reader may rightly assume it is not the same thing.

The author should never assume that the reader has a full understanding of the terminology of a particular scientific field. Even if such is the case, the reader may have forgotten the meaning of a term when used in a special context.

Do not use an incorrect term unless circumstances necessitate, and when this is the case, explain the incorrect usage. It may be necessary to say "waterproof" or "fireproof" even though these terms cannot be accurately used under any circumstances. When they must be used, put them in quotation marks.

"Weight" means the force of gravity acting on a mass. It is very often used incorrectly to refer to mass. This is because in non-SI and old metric the term "pound" and the term "kilogram" were used for both mass and force. In SI, kilogram is only a mass unit; the force unit is the newton. For this reason, ASTM E380-91a says "this term (weight) should be avoided in technical practice." "Weigh" should be changed to "determine the mass of" in most cases.

Specific gravity is the ratio of the mass of a volume of a material at a stated temperature to the mass of the same volume of distilled water at a stated temperature. When possible, it is preferable to use density (mass per unit volume) conveniently expressed in megagrams per cubic meter since it is numerically equal to grams per cubic centimeter, which is numerically equal to specific gravity at 4 °C. By using megagrams per cubic meter, use of a prefix in the denominator is avoided, which is a feature of good SI use.

Imprecision in Use of Terms

WES writers are sometimes careless in the use of certain terms, such as in the use of the word "sample" when actually "specimen" is meant. Other examples include "mix" when "mixture" is intended, "bomb" or "weapon" when "device" is intended, "batch" when "round" is intended, etc.

Use of Pronouns

Special care should be exercised in using such words as "this," "it," and "which" to avoid ambiguity. The author knows what is meant, but will the reader?

Vague:

The data recorded by the oscillograph from the radiometer were not significant since it was inaccurate.

What was inaccurate: The radiometer? The oscillograph? The data?

Pronouns are handy for preventing objectionable repetition of the same words and phrases and should be used freely for this purpose, as long as care is taken in sentence construction to ensure that the reference is clear.

Collective Nouns

Whether a collective noun (e.g., group, number, majority, pair) takes a singular or plural verb depends upon its sense. When it refers to the whole group as a unit, the collective takes a singular verb. When it refers to the separate entities that make up the group, the collective takes a plural verb. (In case of doubt, the safest form to use is usually the singular.) The following examples represent good usage:

Ten grams of the isotope was collected.

A million dollars is a lot of money.

A number of specimens were placed in the fallout area.

The number of specimens used was increased to twelve.

A total of 50 units were used.

Meaning or emphasis is the controlling factor. In the examples above, "grams" and "dollars," though plural in form, are considered to be singular collective nouns. In the third example, "number," though singular in form, requires a plural verb for best agreement.

Subjects such as "all," "any," "half," "most," "none," and "some" may take a singular or plural verb. The context generally determines the choice of verb forms.

Tense

Since WES reports are published after the test, the past tense should be used to describe what was done and what was found. Eternal truths, established physical laws, instructions, and conclusions should be written in the present or future tense. Care should be exercised to avoid confusing specific test information with eternal truths and established laws. The operation or design of a particular piece of instrumentation used during a specific test should not be considered as an eternal truth and, therefore, should generally be described in the past tense.

Dangling Modifiers

A dangling modifier is a phrase or a clause that because of its position in a sentence appears to modify a word that it actually does not modify. The error is usually found in the use of participial phrases and gerunds:

By specifying standard resistors, the cost of the instrumentation can be reduced.

The cost of the instrumentation can be reduced by specifying standard resistors.

In both examples above, "specifying" wants to modify a noun or take a subject. The subject of the clause is the closest thing that could fulfill this requirement. But did "cost" specify the resistors? No. The three best ways of clearing up these examples are by (a) supplying a subject, (b) changing the verb form to a word that is obviously a noun and that therefore does not want to claim a subject, or (c) rewriting the sentence completely. The third method is usually the best.

Supplying subject:

By specifying standard resistors, *the designer* can reduce the cost of the instrumentation.

Changing verb to noun:

By *the specification of* standard resistors, the cost of the instrumentation can be reduced.

Rewriting:

The use of standardized resistors will reduce the cost of the instrumentation.

Restrictive and Nonrestrictive Phrases and Clauses

Clauses should be carefully worded and punctuated. Often the editor will be unable to ensure proper punctuation and clarity, so the author should be careful in usage. "That" is generally used to introduce restrictive clauses; "which" may introduce either restrictive or nonrestrictive clauses, but confining its use to nonrestrictive clauses will help maintain clarity, and the editor will then be able to more easily check the punctuation.

Restrictive:

The devices *that* were tested during Operation Redwing varied in yield. (Only *certain devices* were tested.)

Nonrestrictive:

The devices, *which* were tested during Operation Redwing, varied in yield. (*All the devices* were tested.)

The most important point to remember about restrictive and nonrestrictive phrases and clauses is: *Set off by commas all nonrestrictive phrases or clauses.* "Nonrestrictive" implies a sentence element added only to amplify the meaning of or to add an afterthought to the main sentence thought. Conversely: *Do not set off with commas restrictive phrases or clauses.* "Restrictive" implies a sentence element that is essential to or limits (restricts) the main sentence thought. The distinction between restrictive and nonrestrictive is often very important.

With commas:

The gamma radiation data, which were recorded to an accuracy of 10 percent, were used as a basis for...

This sentence means that all the gamma radiation data recorded were accurate to 10 percent—nonrestrictive.

Without commas:

The gamma radiation data which were recorded to an accuracy of 10 percent were used as a basis for...

This sentence means that only gamma radiation data actually accurate to 10 percent were used—restrictive. Thus, the presence or absence of the commas defines the meaning.

Correct Use of Notations Involving Powers of Ten

The notation " $\times 10^n$ " is common enough in scientific work and usually correctly used in text material. However, care must be taken in certain applications of this notation to tabular matter to avoid ambiguity or give a misleading impression to the reader. A typical set of columnar entries might be as follows:

Bending Moment lbf-in.
36,500,000
6,400,000
22,000,000
321,000,000

In this example, the large numerical size of the data necessitates many zeros and makes the information harder than necessary to read. Appropriate use of powers of ten would improve the column. One of the notations in the following tabulation might be used—two that are ambiguous and should be avoided, and two that are correct:

<i>Ambiguous</i>	<i>Ambiguous</i>	<i>Correct</i>	<i>Correct</i>
Bending Moment lbf-in. $\times 10^6$	Bending Moment lbf-in. $\times 10^{-6}$	Bending Moment 10^6 lbf-in.	Bending Moment lbf-in.
36.5	36.5	36.5	3.65×10^7
6.40	6.40	6.40	6.40×10^6
22.0	22.0	22.0	2.20×10^7
1.43	1.43	1.43	1.43×10^6
321	321	321	3.21×10^8

In the first ambiguous example, the notation for the unit of measurement reads, literally, "pound (force) inches multiplied by one million." Does this mean that the value 36.5, for instance, has already been multiplied by one million? Or, should it be multiplied by one million? (Is the true value 0.0000365 or 36,500,000?) In the second example, the same kind of ambiguity results. In the third example, the notation for the unit of measure reads, literally, "millions of pound (force) inches." This means that the first value, for instance, is 36.5 "millions of pound (force) inches," which is correct. This form of the notation is *most applicable* when it is desired to point out a comparison of the values in the columns. The fourth example also shows good use of the " 10^n " notation but should be used only when it is desired to emphasize the accuracy to which the instrument used could be read; i.e., it indicates that an instrument was used which could be read to hundredths and which had scale settings that read in millions, tens of millions, and hundreds of millions.

The notation used in the third example is preferred from the standpoint of ease of composition and clean appearance of the table; the fourth example is applicable in the special case where emphasis of the instrument accuracy is the more important consideration.

Use of Text to Amplify, Discuss, and Explain Tables and Illustrations

The technical report text should be used to amplify, discuss, and explain tables and illustrations, not just to repeat what appears therein. The function of a table or illustration is to condense and thereby efficiently present a quantity of data. Therefore, repeating such data in the text is unnecessary. Rather, the text should be the writer's medium for explaining

the significance of the tabular or illustrative material, calling the reader's attention to special facts, making important comparisons, etc. From this, it is obvious that each table or illustration must be referenced in the text—if a table or illustration cannot be so referenced, it does not belong in the report. Similarly, it is usually unnecessarily redundant to repeat the same data in both a table and an illustration.

An exception to this rule might occur when a smooth curve appears on a graph which does not permit the reader to extrapolate the actual data values needed. In this case, the smooth curve and a table of the values might be appropriate. The order of reference to a series of tables or illustrations should generally be in numerical sequence throughout a report for utmost utility to the reader.

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Appendix A

Word List

This word list includes difficult or generally uncommon words used in WES reports. It also includes words that are often troublesome because of the confusion regarding whether they are one-word or two-word forms, hyphenated or unhyphenated, etc. Much time and money will be saved if WES personnel will refer to this list when preparing reports and illustrations.

A

aboveground (adj)	air mass
above ground (adv)	airmobile (adj)
above-mentioned	air photo
above-water (adj)	airspeed
acre-ft (in text)	airstream
aesthetics	alignment (WES)
aforementioned	alinement (DNA)
aforesaid	alongshore
after-dredging	anticyclone
airblast	archeological
airborne	armor stone
airburst	armor-stone slope
air-dry (v, adj)	artwork
airflow	asphaltic concrete pavement

B

back-bay (adj)	bank fill (n)
back draft	bank-fill (adj)
backfill	bank flow
backflow	bank-full
backhaul	bank line
back pressure	bank side (n)
backshore	bank-side (adj)
back slope	bank slope
back up (v)	baseline
backup (n, adj)	baseplate
backwall	Base Test
bandwidth	beach face

beach fill (n)
 beach-fill (adj)
 beach-filled (adj)
 beachfront
 beach grass
 beachhead
 beachline
 beach side (n)
 beachside (adj)
 bed form
 bed load (n)
 bed-load (adj)
 bedrock
 bed slope
 bell mouth
 bell-mouthed
 benchmark
 bendway
 Bermuda grass

birdbath
 borderline (adj)
 border line (n)
 borehole
 bottleneck
 bottomland
 bottom lift (n)
 bottom-lift (adj)
 Bouyoucos gage
 breakaway
 breakpoint
 broad-crested weir
 broadleaf
 buildup (n)
 build up (v)
 built-up (adj)
 bullnose pier
 bypass
 by-product

C

call-up (tow)
 cap rock
 capstone
 Cartesian
 Cartesian coordinates
 centerline (n, adj) (DNA)
 center line (n) (WES)
 center-line (adj)(WES)
 channel side (n)
 channel-side (adj)
 checkpoint
 cleanup (n, adj)
 clean up (v)
 close-up (n)
 closeup (adj)
 close up (v)
 cnoidal
 coastline
 cold mix (n)
 cold-mix (adj)
 coldwater (adj)
 continental shelf
 core stone
 Coriolis effect
 Corps' (possessive)
 Corps-wide
 cost-effective (adj)
 cost-efficient

counterclockwise
 court-martial (n, v)
 cover layer (n)
 cover-layer (adj)
 cover plate
 cover stone
 crossarm
 cross-bedded
 cross-bedding
 cross-check (n, v)
 crosscurrent
 crossflow
 cross over (v)
 crossover (n, adj)
 crossover culvert
 cross plot
 crossroad
 cross section (n)
 cross-section (v, adj)
 cross-sectional (adj)
 cross wave
 crosswind
 crownwall
 cutback (n, adj)
 cut back (v)
 cutoff (n, adj)
 cut off (v)

D

damsite	discretize
Darcy's law	disk (floppy)
database	downcoast
data set	downcut
dead load	downcutting
dead water (n)	downdrift
dead-water (adj)	downpull
deadweight	downriver
deadweight tons or tonnage (dwt)	downslope
de-air	downtime
deep water (n)	downvalley
deepwater (adj)	drag arm
Delft Hydraulics Laboratory	drainpipe
depth-limited (adj)	draw down (v)
dew point (n)	drawdown (n)
dew-point (adj)	dump truck
dial-up	duneline
dieback	dust-free (adj)
disc (CD ROM)	dwt (deadweight tonnage)

E

earth fill (n)	enclosure
earth-fill (adj)	end point
earthflow	end sill
earthwork	endorsement
ebb flow	endwall
ebb-tidal	exceedance
ebb tide	extratropical
eigenvalue	extremize

F

far field	flood tide (n, adj)
farmland	floodwall
farther (distance)	floodwater
Fathometer	floodway
fetch-limited (adj)	flowchart
fiberglass (n, adj)	flow field
fieldwork	flow line
finite-amplitude (adj)	flowmeter
finite difference model	flow rate
finite element grid	fly ash
flap gate	follow-up (n, adj)
flatland	follow up (v)
flip bucket	foreshore
flood-control (adj)	forklift
flood flow	FORTTRAN
floodgate	free-air (adj)
floodplain	free body (n)
flood stage	free-body (adj)
flood-tidal	free-fall

free flow (n)
free-flow (adj)
fresh water (n)
freshwater (adj)
freeze-up
front line (n)

frontline (adj)
frost-free
further (extent)
fuse
fuseplug

G

gauge
Gage 1
gap-width (n)
geosim (geometrically similar)
Gobi Blocks
Gobimat
go-no go
gradeability
grade line

grid point
ground cover
groundline
groundwater
grumusol
guardrail
guard wall
guideline
guide wall

H

half-space (n, adj)
handlaid
handline
harbor-side (adj)
harbor side (n)
hard points
hard-wire (v)
headbay
headbox
head loss
headroom
headwall
headwater

headwater el
high-velocity (adj)
high velocity (n)
high water (n)
high-water (adj)
hometown (n, adj)
hot-mix (adj)
hot mix (n)
hot plate
hybrid model (combination of
mathematical/numerical physical
model)
hydraulic-jump basin

I

ice cap
ice-free
infill
inner Continental Shelf

in place
in-place stress field
in situ

J

jobsite

judgment

K

Kellner jack
Kellner Jack Field

kelvin (n)
Kelvin (adj)

L

LaGuardia
lake bed

lakeshore
lakeside

landfall
landfill (n, adj)
landform
landlocked
landmass
landside
land wall
lead line (n)
least squares (adj, n)
leeside (adj)
life cycle (n)
life-cycle (adj)

lightboat
lightweight (adj)
Lixator
load line
lock wall
longshore
longtime (adj)
loose-leaf (adj)
low tide (adj)
low water (n)
low-water (adj)

M

mainframe
main-line (adj)
main stem
mainstream
man-hour
man-made
Manning's n
Mercator
microcomputer
midbank
midchannel
middepth
middleground (adj)
midheight

mid-latitude
midpoint
midspan
midsurf
mile 194
mile point
minicomputer
Monoslab
mud flats
mudflows
mud-free (adj)
mudline
mudslide
multimode

N

namelist
National Oceanic and Atmospheric
Administration (NOAA)

near field
nearshore
no-go

O

oceangoing
ocean side (n)
ocean-side (adj)
off-coast (n, adj)
off-road
offshore
offsite
offslope (n, adj)
onboard
ongoing
on-line (adj, adv)
onshore

onsite
onslope
outlet works
oven-dry (v)
ovendry (adj)
overall
overbank
overland
overpressure
overrun
overwater (adj, adv)

P

payload
percent

perigee-syzygy
perigee-syzygean (adj)

Petersen dredge
 pipeline
 pitot tube
 Plan 1 and 1A designs
 planform
 Plexiglas
 point bar (n, adj)
 Pontacyl Brilliant Pink
 portland cement
 posttest
 powerhouse
 power plant
 Precambrian
 pretest
 print out (v)
 printout (n, adj)

Profile 3
 programmed
 programmer
 programming
 propwash
 pug mill
 pull down (v)
 pulldown (n, adj)
 pullout (n)
 pulvimeter
 pumpback
 pump house
 pushbar
 pushtow
 Pyrex

Q

quarry-run stone
 quarystone

quarter point
 quasi-two-dimensional

R

rainwater
 Ramm
 Range 5
 rattail
 real-time
 reentrants
 reevaluation
 resave (computer command)
 reuse
 reverse tainter valve
 Reynolds number
 ridge-and-runnel
 ridge crest
 ridgetop
 riprap
 riverbank
 riverbed
 river bend
 riverflow

riverside
 river wall
 roadbed
 rockbound (adj)
 rockfall (n)
 rock-fill (adj)
 rock fill (n)
 rollcrete (roller-compacted concrete)
 rollout
 rubble-mound (adj)
 rundown (n)
 run-down (adj)
 run down (v)
 runoff
 run-on
 runout
 run up (v)
 runup (n)

S

salt water (n)
 saltwater (adj)
 sandbar
 sand bed
 sand bypassing
 sand fill
 sandpit
 sand trap

seabed
 sea bottom
 seacoast
 seafloor
 seagoing
 sea level (n, adj)
 sea side (n)
 sea-side (adj)

sea state
 seawall
 seawater
 semidiurnal
 Series A and B
 set down (v)
 setdown (n)
 set up (v)
 setup (n)
 shallow water (n)
 shallow-water (adj)
 sheet metal
 sheet pile (n)
 sheet-pile (adj)
 sheetpiling (n)
 ships data
 shoreline
 shore-normal
 shore-parallel
 short-time (adj)
 shutoff
 side-cast (adj)
 sidecast dredge
 side-scan sonar
 side slope
 sidewall
 signal-conditioning
 sinkhole
 skin plate
 slack-water (adj)
 slack water (n)
 slip form (n)
 slipform (v, adj)

slipformed (v, adj)
 slipforming (v, adj)
 slowdown
 snow cover
 snowfall
 snowmelt
 soil-cement
 soliton
 sound-side (adj)
 splash over (v)
 splashover (n)
 standby
 standoff (n, adj)
 standpipe
 Sta-Pod
 start-up
 state-of-the-art (adj)
 state of the art (n)
 steerageway
 Step 1
 still-water (adj)
 still water (n)
 stop log
 storm drain
 streambank
 streambed
 streamflow
 streamline
 Styrofoam
 Surfa-aero-sealz
 surf beat
 swing-around

T

tack-weld (v)
 tack weld (n)
 tailbay
 tailgate
 tailpipe
 tailwater el
 tailwater
 take off (v)
 takeoff (n)
 tar-rubber
 taxilane
 template
 Tenite butyrate
 Terra-tire
 Test 2 and 2B results
 thalweg
 The Netherlands
 The Rigolets

Thiokol
 thousands of cubic feet per
 second, yards, etc.
 tidal elevation time history
 tidal influence
 tidal prism
 tide gage location
 tide gate location
 tide height data
 tidewater
 tieback levee
 tie-down
 time-consuming
 time frame
 time-history
 time-level
 time-step
 timetable

toe-fill
top-lift (adj)
topside
topsoil
top stratum
trade-off (n, adj)
trade off (v)
trapdoor
trashrack
Tri-Cone

Tropical Storm Chris
turndown (adj)
two-dimensional (2-D)
Tygon tubing
type 1 (original) design
type 1 and 2 deflectors
type 6 (recommended) design
types 3 and 4
type of model

U

underlayer
underside
underwater (n, adj, adv)
underway (adj)
under way (adv)

upcoast
upriver
upslope
up-to-date
Uranine

V

varved
venturi
Vermilion Bay
videotape

von Karman
von Mises
vortices
vortimeter

W

waist-deep
warm water (n)
warmwater (adj)
wastewater (n, adj)
water body
waterborne
water-course (concrete)
watercourse (hydraulics)
waterhyacinth
waterline
water stop
water table (n, adj)
watertight
water-wave (adj)
wave board
wave field
wave form
wave front
wave-gage (adj)
wave gage (n)
wavelength
wave number
wave setdown

wave train
wave wash
wave-wave interaction
weighhouse
well flow
wellpoint
Wentworth grade scale
wet well
wind field
wind-field (adj)
wind speed
wind-stress (adj)
wind stress
wind wave
wing wall
wirebound
work force
work load
workboat
worldwide
worthwhile
wraparound

X

x-axis
x-coordinate

x-direction
X-ray (n, adj, v)

Y

y-axis
y-coordinate

y-direction

Appendix B

Abbreviations Guide

The following abbreviations should be used in WES reports. For additional abbreviations refer to the Government Printing Office's *Style Manual* (1984) and Webster's Unabridged Dictionary.

Term	Abbreviation
acre	spell out
acre-foot	acre-ft
alternating current	a-c (adj); AC (noun)
ampere	A
angstrom	Å
antilogarithm	antilog
approximate	approx
atmosphere	atm
average	avg
bar	spell out
barrel	bbl
Baumé	Bé
biochemical (or biological) oxygen demand	BOD
brake horsepower	bhp
British thermal unit	Btu
California bearing ratio	CBR
calorie	Cal
center line	CL
center to center	c-c, c to c
centigram	cg
centiliter	cl or cL
centimeter	cm
centimeter-gram-second (system)	cgs
centimeters per second ¹	cm/sec
centipoise	cp

¹ The word "per" can be substituted for the diagonal (/). But in any one report, be consistent.

Term	Abbreviation
chemical oxygen demand	COD
cologarithm	colog
cosecant	csc
cosine	cos
cotangent	cot
cubic	cu
cubic centimeter	cu cm, cc, cm ³
cubic feet	cu ft, ft ³
cubic feet per minute	cfm, cu ft/min, ft ³ /min
cubic feet per second	cfs, cu ft/sec, ft ³ /sec
cubic inch	cu in., in. ³
cubic meter	cu m, m ³
cubic micron	cu μ, μ ³
cubic millimeter	cu mm, mm ³
cubic yard	cu yd, yd ³
cycles per minute	cpm
cycles per second	cps
day	spell out
decibel	db
decibels referred to one milliwatt	dbm
degree ¹	deg or °
degree Celsius	°C
degree Fahrenheit	°F
degree Rankine	°Ra
degree Reaumur	°R
degrees per second	deg/sec
diameter	diam
direct current	d-c (as adj); DC (as noun)
dissolved oxygen	DO
downstream	DS
dozen	doz
electromotive force	emf
elevation	el
equation	spell out generally (use "Eq" in tables or drawings where space is a factor)
feet per minute	fpm, ft/min
feet per second	fps, ft/sec
feet per second per second	ft/sec ²
foot	ft
foot-pound	ft-lb
foot-pound-second (system)	fps
gallon	gal
gallons per day	gpd, gal/day

¹ Use "degree" symbol in tabulations where space is an important factor or in a situation where an abbreviation would be awkward; i.e. 40°4'12" (in text use 32 °F).

Term	Abbreviation
gallons per minute	gpm, gal/min
gallons per second	gps, gal/sec
gigahertz	GHz
gram	g
gravity (units)	g's
Greenwich time	GW
ground zero	GZ
hectare	ha
hertz	Hz
high explosive	HE
high-water interval	HWI
horsepower	hp
hour	hr
hundredweight	cwt
hyperbolic cosecant	csch
hyperbolic cosine	cosh
hyperbolic cotangent	coth
hyperbolic sine	sinh
hyperbolic tangent	tanh
inch	in.
inches per second	ips, in./sec
inside diameter	ID
joule	J
kelvin	K
kilobar	kbar
kilocalorie	kcal
kilocycle	kc
kilocycles per second	kcps
kilogram	kg
kilogram-meter	kg·m
kilograms per cubic meter	kg/cu m, kg/m ³
kilohertz	kHz
kiloliter	kl or kL
kilometer	km
kilonewton	kN
kilopound (1,000-lb deadweight load)	kip
kiloton	kt
kilovolt	kV
kilovolt-ampere	kV·A
kilowatt	kW
kips per square inch	ksi
knot	spell out
linear	lin
liter ¹	l (or L)

¹ A script L (ℓ) is preferred if available.

Term	Abbreviation
logarithm (common)	log
logarithm (natural)	ln, log _e
magnified 50 times	×50
Manning's roughness	n
maximum	max
mean higher high water	mhhw
mean lower low water	mlw
mean low tide	mlt
megahertz	MHz
megapascal	MPa
megaton	Mt
meter	m
meter-kilogram	m·kg
mho	spell out
microampere	μA
microinch	μin., micron
micrometer	μm
microsecond	μsec
microvolt	μV
microwatt	μW
mile	spell out
miles per hour	mph
milliampere	mA
millibar	mb
milligram	mg
milliliter	ml or mL
millimeter	mm
millimicron	mμ
million electron volts	Mev
million gallons per day	mgd
millisecond	msec
millivolt	mV
minimum	min
minute	min
minute (angular)	'
month	spell out
nanosecond	nsec
National Geodetic Vertical Datum	NGVD
nautical mile	n.m.
newton	N
nuclear explosive	NE
number(s)	No.
ohm	Ω
ohm-centimeter	ohm·cm
ounce	oz
outside diameter	OD
parts per million	ppm
parts per thousand	ppt

Term	Abbreviation
pascal	Pa
percent (tabular)	spell out or %
pint	pt
pores per linear inch	ppi
pound (force)	lbf
pound (force) foot	lbf·ft
pound (force) inch	lbf·in.
pounds (force) per square foot	lbf/ft ²
pounds (force) per square inch	psi, lbf/in. ²
pounds (force) per square inch absolute	psia
pounds (force) per square inch differential	psid
pounds (force) per square inch gage	psig
pound (mass) (avoirdupois)	lb
pounds (mass) per cubic foot	lb/cu ft, lb/ft ³
pounds (mass) per square foot	lb/sq ft, lb/ft ²
pounds (mass) per square inch	lb/sq in., lb/in. ²
quart	qt
radian	rad
revolutions per minute	rpm's
revolutions per second	rps
Reynolds number	R
rod	spell out
roentgen	spell out
secant	sec
second	sec
second (angular)	"
sine	sin
slope	1 V on 2H or 1V:2H
specific gravity	sp gr
square centimeter	sq cm, cm ²
square foot	sq ft, ft ²
square inch	sq in., in. ²
square kilometer	sq km, km ²
square meter	sq m, m ²
square micron	sq μ, μ ²
square mile	spell out
square millimeter	sq mm, mm ²
station	sta
still-water level	swl
tangent	tan
thousand pounds	kip
ton	spell out
tons per square foot	tons/sq ft, tons/ft ² , tsf
total Kjeldahl nitrogen	TKN

<i>Term</i>	<i>Abbreviation</i>
upstream	US
volt	V
volt-ampere	V·A
watt	W
week	spell out
yard	yd
year	spell out

Appendix C

Greek Alphabet, and Mathematical Symbols and Expressions¹

Greek Alphabet

Greek letters available on standard word processing packages are as follows:

Letters			Letters			Letters		
Name			Name			Name		
A	α	Alpha	I	ι	Iota	P	ρ	Rho
B	β	Beta	K	κ	Kappa	Σ	σ	Sigma
Γ	γ	Gamma	Λ	λ	Lambda	T	τ	Tau
Δ	δ	Delta	M	μ	Mu	Υ	υ	Upsilon
E	ε	Epsilon	N	ν	Nu	Φ	φ	Phi
Z	ζ	Zeta	Ξ	ξ	Xi	X	χ	Chi
H	η	Eta	O	ο	Omicron	Ψ	ψ	Psi
Θ	θ	Theta	Π	π	Pi	Ω	ω	Omega

¹ This appendix, including the tabulation, figures, and equations, was typed and output in reproducible form using WordPerfect 5.1.

Mathematical Symbols and Expressions

The following list provides the most common conventions used in mathematics:

$+$ plus	$>$ greater than
$-$ minus	$<$ less than
$\pm$ plus or minus	$\geq$ greater than or equal to
$\times$ multiplied by	$\leq$ less than or equal to
$\div$ divided by	$\gg$ much greater than
$=$ equal to	$\ll$ much less than
$\neq$ not equal to	$\propto$ varies as
$\approx$ approximately equal to	$:$ is to, ratio
$\equiv$ identical with	$\rightarrow$ approaches limit of
$\ncong$ not identical with	$ $ absolute value
$\sim$ similar to	$\sqrt{}$ radical; root, square root
$\cong$ congruent to	$\sqrt[3]{}$ cube root
Δ difference; increment	∇ del or nabla; vector
d differential	differential operator
∂ partial differential	$\therefore$ therefore
$!$ factorial	$\parallel$ parallel
$\bar{x}$ mean of x	$\perp$ perpendicular
Σ summation	$\angle$ angle
$\int$ integral	$\angle$ right angle
$f()$ function of	$\triangle$ triangle
∞ infinity	$\square$ square
i imaginary unit; the square root of -1	$\square$ rectangle
$()$ parentheses	$\square$ parallelogram
$[]$ brackets	$\circ$ circle
$\{\}$ braces	$\widehat{AB}$ arc of circle between points A and B

WES style¹ for presentation of equations and other mathematical expressions is summarized as follows:

- a. Use the sequence $\{[()]\}$ for signs of aggregation, except where conventional notation specifies brackets or braces.
- b. Make aggregation, integral, and summation signs the same height as, or slightly larger than, the expressions which they include.
- c. Place subscripts and superscripts, respectively, half a line below and above the lowest and highest characters in the related material.

Examples: $R_1, 2 \left(\frac{N_{\Delta_1}}{Eh} \right)^{1/2}$

- d. Align subscripts with superscripts.

Examples: $P_n^2, F_{\epsilon}^{(p,q)}, P_n^{-2}$

- e. Place sub-subscripts half a line below the subscripts.

Example: E_{x_o}

- f. Raise *th* to a superscript position.

Examples: n^{th}, i^{th}

- g. In equations, leave one space before and after the operational signs $+$, $-$, $\pm$, $\times$, $\div$, and $\cdot$.

Exception: leave no space before and after such signs in subscripts and superscripts.

Examples: $a + b, \dots$ if $a + b = 10$ and the...

$$na^{n-1}, \sum_{x=0}$$

¹ *A Style Manual for Technical Writers and Editors*, edited by S. J. Reisman, and *Mathematics Into Type*, by Ellen Swanson, were used extensively in developing the WES style of presentation of mathematical material.

- h. Leave no space after + , - , and $\pm$ when these indicate the sign of a single term in the text or a single term enclosed in parentheses or brackets in an equation.

Examples: ...within ± 4 cm..., $P(x) = -\phi_o(-x) + R$

...at an elevation of +10 msl...

- i. Leave one space before and after = , < , > , $\leq$, and $\geq$ in displayed and in-text equations.

Exception: Leave no space before and after these signs in subscripts and superscripts.

Examples: ...when $2xy > b$ we find... $\left\{ \begin{array}{l} \text{in-text} \\ \text{equation} \end{array} \right.$

$$\sum_{k=0}^{\infty} a_k(z - a)^k = z_a \quad \left\{ \begin{array}{l} \text{displayed} \\ \text{equation} \end{array} \right.$$

- j. Align the bar of a built-up fraction with the equals sign. Center the numerator and denominator relative to the horizontal bar in a built-up fraction.

Example: $a = \frac{-K'_a + \sqrt{(K'_2)^2 + 4K'_a C}}{2C}$

- k. Type any required bar or dot immediately above the mathematical symbol, so that it will be obvious that the bar or dot and the symbol constitute a unit.

Examples: $\bar{K}$, $\bar{k}$, $\dot{i}$, $\dot{r}$

- l. Leave no space between the single-line elements of a product, and leave no space before and after punctuation within such material. Leave one space between double-line (built-up) elements of a product.

Examples: $2xy$, $2C$, $I(M_o, N)$

$$I_o^2(A_o^2, N), \quad \frac{1}{2m} \frac{(j+m)}{(j-m)}$$

- m. Leave one space before and after trigonometric, logarithmic, or exponential functions, and between the parts of such functions.

Examples: $v \cos \theta$, $Y \ln x$, $2 \log y \log z$,

$$\frac{1}{2} \exp \left(a + \frac{h}{2} \right)$$

- n. Leave one space before and after differentials and between differentials.

Examples: $x \, dx$, $(x^2 + y^2) \, dx \, dy$

- o. Use signs of aggregation large enough to enclose the material within. Center signs of aggregation relative to the equals sign. Leave no space between adjacent signs of aggregation.

Exception: When the material contains only simple superscripts or simple subscripts (but not both), use the standard-size characters for the signs.

Examples: $(K^2 + A)$, $(K^2 + A_1 + K_2 + B^2)$

$$A = \left\{ (x_a + x_b)^2 + [1 - \sin^2 \Delta \cos (\theta - \Delta)] \right\}$$

$$x = \begin{bmatrix} \xi_1 \\ \xi_2 \\ \vdots \\ \xi_n \end{bmatrix} = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ t_{21} & t_{22} & \cdots & t_{2n} \\ & & \ddots & \\ t_{n1} & t_{n2} & \cdots & t_{nn} \end{bmatrix} \begin{bmatrix} \bar{\xi}_1 \\ \bar{\xi}_2 \\ \vdots \\ \bar{\xi}_n \end{bmatrix} = T \bar{x}$$

- p. Use an integral sign large enough so that it is not overshadowed by the material on either side.

$$\text{Examples: } \sqrt{\frac{a}{g}} \int_0^{h+1} \frac{dx}{\sqrt{hx - x^2}} \left(1 - \frac{x}{2a} \right)^{1/2}$$

$$\sin^{-1} x = \int_0^x \frac{dz}{\sqrt{1 - z^2}}$$

- q. Center material above and below a summation sign.

Example: $\sum_{i=1}^n$

- r. Make parallel lines long enough to extend to the top and bottom of the material between them.

Example: $|E_x^2|$

- s. The following rules apply only to the spacing of in-text mathematical material:

- (1) Leave one space before and after a mathematical symbol or equation.

Examples: ...corresponding to $\bar{k}^T$ which equals...

...the term $\bar{k}^T$. Then the...

...the case $c = (10 - t + T)$ estimates...

- (2) If an in-text equation must be broken, break it before the equals sign or operational sign.

- t. Displayed equations are always displayed with special indention and layout (see Figures C1-C5). If a displayed equation must be broken, break it before the equals sign or operational sign.

$$\vec{A}(q') = \int_S G(q', p) \vec{J}(p) dS - \frac{1}{k^2} \int_S \Delta' \Delta G(q', p) \cdot \vec{J}(p) dS \quad (1)$$

$$\vec{A}_2(q') = \int_S \Delta' \Delta G(q', p) \cdot \vec{J}(p) dS \quad (2)$$

Figure C1. Display of single-line equations

$$y = c_1 e^{ax} \cos ax + c_2 e^{ax} \sin ax + c_3 e^{-ax} \cos ax \quad (1)$$

$$+ c_4 e^{-ax} \sin ax + c_5 e^{-ax} \cos ax + c_6 e^{-ax} \sin ax$$

$$(\mu + v \tan \mu \cot v)v = -T(mr)^{-1} \cos \mu \cos \theta \sin \epsilon$$

$$- \frac{P}{2} SV^2 C_L(mr)^{-1} \sin \phi \cos \mu \quad (2)$$

$$- \frac{3g_o R^2}{2r^2} K_\Delta \sin 2\mu \sin 2 \sin 2v$$

$$\phi = \omega_x + \epsilon \sin \Delta - \omega_{x_o} \cos \Delta \cos \epsilon - \omega_{y_o} \cos \Delta \sin \epsilon$$

$$+ \omega_{z_o} \sin \Delta$$

(3)

$$= \omega_x + \tan \Delta (\omega_4 \sin \phi + \omega_z \cos \phi) - \omega_{x_o} \cos \Delta \cos \epsilon$$

$$- \omega_{y_o} \cos \Delta \sin \epsilon + \omega_{z_o} \sin \Delta$$

Figure C2. Display of stacked right-hand members

$$\int_{-1}^1 P_m(x) \frac{d}{dx} \left[(1-x^2) P_n'(x) \right] dx - \int_{-1}^1 P_n'(x) \frac{d}{dx} \left[(1-x^2) P_m'(x) \right] dx$$

$$+ (n-m)(n+m+1) \int_{-1}^1 P_m(x) P_n(x) dx = 0 \quad (1)$$

$$(z-z_1)^r \frac{d^r w}{dz^r} + (z-z_1)^r p_1(z) \frac{d^{r-1} w}{dz^{r-1}} + (z-z_1)^{r-2} p_2(z) \frac{d^{r-2} w}{dz^{r-2}}$$

$$+ \dots + P_r(z) w = 0 \quad (2)$$

$$\sum_n \left\{ \left[\Delta_n^2 \Delta_n^2 f_n + \frac{ik^2}{a} \cdot \frac{1}{2} \left(\frac{1}{a} + \frac{1}{b} \right) \Delta_n^2 f_n \right] \cos n\theta + \frac{ik^2}{a} \cdot \frac{1}{4} \left(\frac{1}{b} - \frac{1}{a} \right) \right.$$

$$\cdot \left[\frac{d^2 f_n}{dr^2} - \frac{(2n+1)}{r} \frac{df_n}{dr} + \frac{n(n+2)}{r^2} f_n \right] \cos (n+2)\theta$$

$$\left. + \left[\frac{d^2 f_n}{dr^2} + \frac{(2n+1)}{r} \frac{df_n}{dr} + \frac{n(n-2)}{r^2} f_n \right] \cos (n-2)\theta \right\} = 0 \quad (3)$$

Figure C3. Display of stacked left-hand members

$$\begin{aligned}
& \frac{1}{2\pi} \int_{-\infty}^{\infty} \frac{\exp(-itw_1)}{2\sigma_{11}\sigma_{12} \sin \theta_{12}} \\
& \cdot \frac{dt}{\left\{ \left[\frac{1}{4} \left(\frac{1}{\sigma_{12}^2 \sin^2 \theta_{12}} - \frac{1}{\sigma_{12}^2} \right) \right]^2 + \left[\frac{1}{4} \left(\frac{1}{\sigma_{11}^2 \sin^2 \theta_{12}} + \frac{1}{\sigma_{12}^2} \right) - it \right]^2 \right\}^{1/2}} \\
& = \frac{1}{2\pi} \int_{-\infty}^{\infty} \exp(-itw_1) \left\{ \frac{1}{2\sigma_{11}\sigma_{12} \sin \theta_{12}} \int_0^{\infty} \exp \left[-\frac{1}{4} \left(\frac{1}{\sigma_{11}^2 \sin^2 \theta_{12}} + \frac{1}{\sigma_{12}^2} \right) s \right] \right. \\
& \quad \left. J_0 \left[\frac{1}{4} \left(\frac{1}{\sigma_{11}^2 \sin^2 \theta_{12}} - \frac{1}{\sigma_{12}^2} \right) s \right] e^{ist} ds \right\} dt \\
& \frac{(-)^n}{n!} y^{2n} [(2 + 3 + 4... + n) + 2(3 + 4... + n)... \\
& \quad + i(i + 1 + ... + n)... + (n - 1)n] \\
& = \frac{(-)^n}{n!} y^{2n} \left[\frac{(n - 1)(n + 2)}{2} + \frac{2(n - 2)(n + 3)}{2} ... + i \frac{(n - i)(n + i + 1)}{2} ... \right] \\
& = \frac{(-)^n}{n!} y^{2n} \sum_{i=1}^n [(n^2 + n)i - i^2 - i^3]
\end{aligned}$$

Figure C4. Display of stacked right-hand and left-hand members

$$\begin{aligned}
 & I_x \omega_x + h_x + \omega_y \omega_x (I_z - I_y) + \omega_y h_z - \omega_z h_y \\
 & = + \frac{3g_o R^2}{r^3} (I_x \sin^2 \theta - I_y + I_z \cos^2 \theta) \phi \cos \theta + \frac{P}{2} u^2 S l_x C_y
 \end{aligned} \tag{1}$$

$$\begin{aligned}
 & -\Delta^2 \int_{\Delta u_i} \frac{1}{3 \Sigma_a \xi \Sigma_s} q(\vec{r}) du + \int_{\Delta u_i} \frac{\Sigma_a}{\xi \Sigma_s} q(\vec{r}) du \\
 & = -q(\vec{r}, u_i) + q(\vec{r}, u_{i-1}) + P(\vec{r}) \int_{\Delta u_i} X du + \int_{\Delta u_i} Q(\vec{r}) du
 \end{aligned} \tag{2}$$

Figure C5. Display of equations with both members more than half a line, but less than a full line

Appendix D

Copy Preparation

Format

This appendix contains sample pages of WES technical reports. Two basic formats are considered acceptable—a one-column version and a two-column version. This Guide is an example of the one-column version. Figures D1 and D2 identify the typefaces, styles, and sizes used in WordPerfect to create the one-column format. Figures D3 and D4 are samples of the two-column version. The one-column version is the preferred version for all WES reports and is strongly recommended for reports with extensive mathematical equations.

Titles of Chapters and Other Major Parts

The titles of each of the major parts of a report should be of the same style and form throughout the report, and no other headings should be similar in style. These titles are used for the preface, contents, lists of figures and tables, conversion factors table, chapters, references, and appendixes. Frequently, appendixes are composed almost entirely of tables, illustrations, or computer printouts, and there may be no page of text on which to type the title of the appendix. In these cases, the appendix title will be printed on a fly leaf and used as the first page of the appendix. The back of a fly leaf may be used.

Captions

Captions (titles) for illustrations (figures and photos) should be placed beneath the illustration preceded by the word "Figure" or "Photo" typed flush left and followed by the appropriate number and a period. The caption should have the first letter of the first word and proper nouns capitalized. If the caption requires carry-over lines, they should be typed single

24 pt Helvetica Bold; followed by 0.4-in. blank space,
0.035-in. margin-wide line, and 0.3-in. blank space;
Top margin for 1st page of chapter—2.0 in.;
thereafter 1.0 in.; bottom margin—1.0 in.
Text margins for left- and right-hand pages
left—1.5 in.; right—2.0 in.

2 Finite Element Dynamic Analysis of a Simplified Structure

Section of a Simplified Structure

The simplified cantilever structure representative of an idealized gravity dam (Figure 1), finite element models, parameters, and recommendations established in Phase Ia of this study were used here. Again, the finite element runs were all made using GTSTRUDL. The program can be used in the analysis of the static and dynamic response of linear two- and three-dimensional (2- and 3-D) structural systems. The element used was the "IPQQ" eight node isoparametric quadratic quadrilateral element.

Finite Element Models

Finite element meshes

Three different models previously developed in the Phase Ia report to compare the convergence characteristics were used again. The various models are called the coarse, fine, and very fine meshes to indicate the relative degree of refinement. They are also referred to as Meshes 1, 2, and 3. These meshes are illustrated in Figures 2, 3, and 4, respectively. The node and elements are labeled in these figures. A summary of the

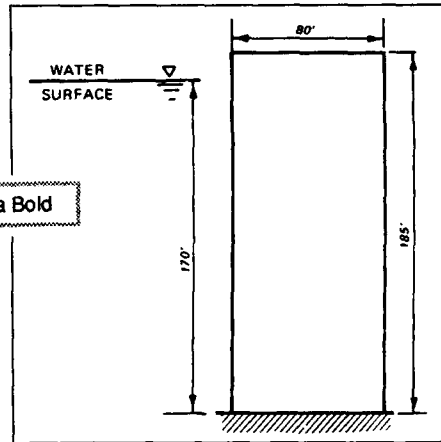


Figure 1. Simplified structure

Footer—8 pt Helvetica; page number
11 pt Helvetica. Footer margins:
Right-hand page—left margin 1.0 in.;
right margin 1.0 in.
Left-hand page—left margin 0.5 in.;
right margin 1.5 in.

Figure title—10 pt Helvetica
Ruling box around figure—0.010 in.

Figure D1. Sample of single-column format containing a figure (not to scale)

Table 1
Convergence Characteristics Models

Mesh No.	Description	Number of Nodes	Number of Elements (All IPQQ's)
1	Coarse	45	10
2	Fine	149	40
3	Very fine	537	160

Modeling procedure

11 pt Times Roman Bold.

assumed to be completely restrained along their bases and e stress.

Material properties. The weight density of the material was assumed to be 150 pcf.

Previous results indicated that a mesh with four elements across the base, Figure 14, was a reasonable compromise between accuracy and cost. The mesh contained 36 elements and 135 nodes. The monolith was assumed to be completely restrained along the base.

The structure was loaded by hydrostatic and hydrodynamic loadings starting at 170 ft above the base and a self-weight of the concrete of 150 pcf. The hydrostatic pressures were input as uniform edge loads on the upstream elements. The hydrodynamic effect was approximated by attaching Westergaard's (1933) "added masses" to the

Table title—11 pt Helvetica Bold
Table heads—8 pt Helvetica Bold
Table text—8 pt Helvetica

Table 2
Structure Loading for Gravity Dam Example

Node	Elevation	X, ft	Y, ft	$\bar{Y}$, ft	y, ft	Hydrostatic Pressure psf	Added Mass slugs/ft
113	480.00	150.00	170.00	0.00	0	0	0
108		130.00		5.00	2.50	312	231
99	470.00	132.00	160.00	10.00	7.50	624	463
94		110.00		18.50	14.25	1,154	761
85	453.00	120.00	143.00	27.00	22.75	1,685	1,136

Figure D2. Sample of single-column format containing tables of two different widths (not to scale)

24 pt Helvetica Bold; followed by 0.4-in. blank space,
0.035-in. margin-wide line, and 0.3-in. blank space;
Top margin for 1st page of chapter—2.0 in.;
thereafter 1.0 in.; bottom margin—1.0 in.
Text margins for left- and right-hand pages—1.0 in.
Column width—3.05 in., gutter width—0.4 in.

2 Finite Element Dynamic Analysis of a Simplified Structure

Section of a Simplified Structure

The simplified cantilever structure representative of an idealized gravity dam (Figure 1), finite element models, parameters, and recommendations established in Phase Ia

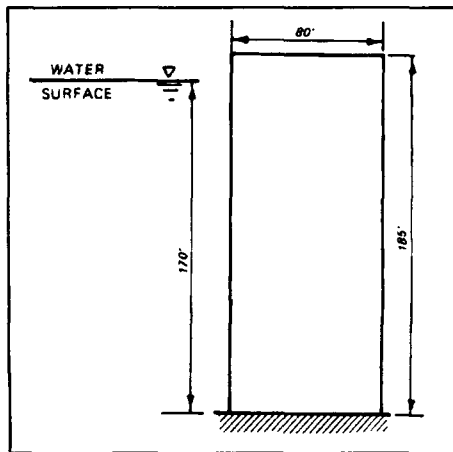


Figure 1. Simplified structure

of this study. The program can be used in the analysis of the static and dynamic response of linear two- and three-dimensional (2- and 3-D) structural systems. The element used was the "IPQQ" eight node isoparametric quadratic quadrilateral element.

Finite Element Models

Finite element meshes

Three different models previously developed in the Phase Ia report to compare the convergence characteristics were used again. The various models are called the coarse, fine, and very fine meshes to indicate the relative degree of refinement. They are also referred to as Meshes 1, 2, and 3. These meshes are illustrated in Figures 2, 3, and 4, respectively. The node and elements are labeled in these figures. A summary of the meshes is presented in Table 1.

Table title—11 pt Helvetica Bold
Table heads—8 pt Helvetica Bold
Table text—8 pt Helvetica

Table 1 Convergence Characteristics Models			
Mesh No.	Description	Number of Nodes	Number of Elements (All IPQQ's)
1	Coarse	45	10
2	Fine	149	40
3	Very fine	537	160

Modeling procedure

The models were assumed to be completely restrained along their bases and to be in a stress.

Material properties. The weight density of the material was assumed to be 150 pcf.

Figure D3. Sample of two-column format containing a figure and a table each within a single column (not to scale)

Previous results indicated that a mesh with four elements across the base, Figure 14, was a reasonable compromise between accuracy and cost. The mesh contained 36 elements and 135 nodes. The monolith was assumed to be completely restrained along the base.

The structure was loaded by hydrostatic and hydrodynamic loadings starting at 170 ft above the base and a self-weight of the concrete of 150 pcf. The hydrostatic pressures were input as uniform edge loads on the upstream elements. The hydrodynamic effect was approximated by attaching Westergaard's (1933) "added masses" to the upstream face nodes, Table 7.

Analysis

The analysis is performed in two parts. The static (stiffness) analysis and dynamic analysis are performed separately. These results are then combined to give the final results. The static analysis consisted of two load cases, hydro-static pressure on the upstream face of the dam, and self-weight (dead load) of concrete.

Results of analysis

Results of the independent load cases were obtained. It should be noted that elements incident on a common node will have different stresses at the same node. This is due to the fact that continuity of stresses is not enforced or required for the finite elements in GTSTRUDL, as is true in all other major finite element programs.

To obtain a more useful representation of the stresses, one can use the CALCULATE AVERAGE command. To compute the weighted average, GTSTRUDL sums the stresses for all elements incident on a given node, and then divides the sum by the number of elements which are incident on the node.

Using the COMBINE command, it is then possible to combine the independent loading conditions to obtain a final result. In this example, one would add the two static loading cases (loads 1 and 2) to obtain a total static loading response (loading combination 5). The static loading condition then can be combined with the dynamic loading.

It is first necessary to operate on the dynamic loading (load 3) to transform the results into the form of a static loading condition. The result is called a pseudostatic loading. The command performs this function by

Table 7
Structure Loading for Gravity Dam Example

Node	Elevation	Y, ft	$\bar{Y}$, ft	y, ft	Hydro-static Pressure pcf	Added Mass slugs/ft
113	480.00	170.00	0.00	0	0	55
108			5.00	2.50	312	231
99	470.00	160.00	10.00	7.50	624	463
94			18.50	14.25	1,154	761
85	453.00	143.00	27.00	22.75	1,685	1,136
80			39.13	33.07	2,442	1,580
71	428.75	118.75	51.25	45.19	3,198	1,811
66			63.38	57.32	3,955	2,012
57	404.50	94.50	75.50	69.44	4,711	2,199
52			87.63	81.57	5,468	2,367
43	380.25	70.25	99.75	93.69	6,224	2,527
38			111.88	117.94	7,738	2,742
29	356.00	46.00	124.00	117.94	7,738	2,742
24			135.50	129.75	8,455	2,909
15	333.00	23.00	147.00	141.25	9,173	2,909
10			158.50	152.75	9,890	3,021

Figure D4. Sample of two-column format containing a table wider than a single column (not to scale)

space and indented to align with the first word of the caption. For example:

For *unclassified* reports:

Figure 2. Verification of current velocities in the north jetties with tide running out; Range 1, sta 2

Photo 1. Effects of Plans 9 and 10 on surface current patterns, ocean tide range, 5.0 ft, depth, 9 ft 6 in.

For *classified* reports:

Figure 1. (U) Major dimensions of aircraft studies

For illustrations requiring more than one sheet:

Unclassified:

Figure 2. Two-layer flexible pavement expected value, variance, and rutting models (Continued)

Figure 2. (Concluded)

Figure 3. Construction of support foundations (Sheet 1 of 3)

Figure 3. (Sheet 2 of 3)

Figure 3. (Sheet 3 of 3)

Classified:

Figure 1. (U) Major dimensions of aircraft studies (Continued)

Figure 1. (U) (Concluded)

Tables

Table arrangement should be planned carefully to ensure a readable format. Each table is numbered and has a title. Each column has a heading or subheading and, if required, a unit of measurement.

Tables in WES reports are generally reproduced on 8.5- by 11-in. paper. Occasionally, tables contain so much information they must be printed on larger size paper and folded.

Tables are generally arranged in the 5- by 9-in. format. However, tables frequently require more area than this, and they can be sized to accommodate the material they contain. The arrangement should be planned so that the width-to-length ratio is approximately 2 to 3. These oversize tables are then reduced photographically. Common table sizes and reductions are:

<u>Size</u>	<u>Reduce to</u>
9.7 by 13.9 in.	52%
8.7 by 12.4 in.	57%
8.1 by 11.6 in.	62%

If the table requires more than one page, the table number should appear on subsequent sheets, but not the title. For example:

Table 1 (Continued)—on second and subsequent sheets

Table 1 (Concluded)—on last sheet only

The word "Continued" is typed in parentheses inside the table box and flush with the right margin at the bottom of the first sheet of a two-page table. Tables of more than two pages will be identified at the bottom right corner of each page as follows:

Sheet 1 of 3

Sheet 2 of 3

Sheet 3 of 3

A column heading should be placed flush left over each column (Figure D5). The words in the column heading should be typed in initial capitals, except the unit of measurement (if there is one), which is typed in lowercase letters and separated from the rest of the heading by a comma (Figure D6). (The comma is not used if the unit of measurement is on a line by itself.) Units of measurement are abbreviated (Figure D6). Multiline headings should be single spaced.

Data having the same dimensions should be aligned by the decimal point or by the last digit, whichever is appropriate (Figures D5 and D6).

Tables having specific footnotes should have corresponding numerals identifying the footnoted item in the table (Figure D6). Footnote numbers should be arranged in proper sequence line by line, from left to right across the table. Footnote symbols used in WES reports are superscript Arabic numerals. As an alternate, superscript lowercase letters are acceptable if needed for clarity. Footnotes are typed single space (Figure D6).

Table 17
Effects of Dredged Material Disposal Island Plans 5, 6, and 7
on Channel Shoaling in Hoquiam Reach

Channel Section No.	Base		Shoaling Index		
	Volume of Material Retrieved cc	Percent of Total Material Retrieved	Plan 5	Plan 6	Plan 7
32	215	2.0	1.5	1.8	1.7
33	290	2.7	2.2	2.5	2.2
34	395	3.7	3.5	3.7	3.6
35	410	3.8	3.8	4.1	3.6
36	295	2.7	3.9	3.9	3.6
37	585	5.5	5.5	5.7	5.6
38	660	6.2	6.1	6.1	6.2
39	740	6.9	7.2	6.8	7.1
40	845	7.9	8.1	7.6	7.8
41	940	8.9	8.8	9.0	9.0
42	1,005	9.4	9.6	9.7	9.4
43	1,005	9.4	9.2	9.8	9.0
44	990	9.3	8.6	9.6	8.8
45	1,120	10.5	10.1	10.2	10.3
46	1,190	11.1	10.1	10.9	10.9
Total	10,685	100.0	98.2	101.4	98.8

Figure D5. Example of table column heading and subheadings

Table 2
Basic Model Data of Conditions That Induced Failure of Cellular Block
Channel Expansions

Model Culvert Size, ¹ ft	Dis-charge cfs	Tailwater Depth ² ft	Depth of Flow at Culvert Outlet ² ft	$\frac{Q}{D_o}$	F	$\frac{T_B}{D_o}$	$\frac{T_W}{D_o}$	$\frac{T_B}{D_o} \times \frac{T_W}{D_o}$
0.5 by 0.5	1.20	0.25	0.50	6.70	1.20	0.17	0.50	0.085
	2.00	0.50	0.50	11.30	2.00	0.17	0.87	0.150
	2.00	0.25	0.50	11.30	2.00	0.17	1.00	0.170
	2.40	0.90	0.50	13.60	2.39	0.17	1.80	0.310
1.0 by 1.0	1.00	0.10	0.25	1.00	1.40	0.08	0.10	0.008
	2.20	0.36	0.40	2.20	1.53	0.08	0.37	0.029
	2.40	0.61	0.57	2.40	0.98	0.08	0.61	0.049
	2.40	0.19	0.40	2.40	1.67	0.08	0.19	0.015
	3.10	0.61	0.60	3.10	1.17	0.08	0.61	0.049
	3.10	0.63	0.63	3.10	1.10	0.08	0.63	0.051
	3.30	0.60	0.60	3.30	1.25	0.60	0.048	0.051
	4.00	1.00	1.00	4.00	0.70	0.06	1.00	0.080
	4.50	1.30	0.99	4.50	0.80	0.06	1.30	0.104
	5.30	1.00	1.00	5.30	0.94	0.06	1.00	0.080
	5.80	1.50	1.00	5.80	1.02	0.06	1.50	0.120
	6.20	1.50	1.00	6.20	1.10	0.06	1.50	0.120
2.0 by 2.0	4.95 ³	0.64	0.52	0.87	1.18	0.04	0.32	0.013
	5.25	0.30	0.46	0.92	1.50	0.04	0.14	0.006

(Continued)

¹ Model culvert sizes of 0.5, 1.0, and 2.0 ft correspond to prototype sizes of 2, 4, and 8 ft, respectively.

² Measured from invert of culvert.

³ Estimated value (instrumentation failure).

Figure D6. Example of a two-page table (Continued)

Table 2 (Concluded)

Model Culvert Size, ft	Dis-charge cfs	Tailwater Depth ft	Depth of Flow at Culvert Outlet ft	$\frac{Q}{D_o}$	F	$\frac{T_B}{D_o}$	$\frac{TW}{D_o}$	$\frac{T_B}{D_o} \times \frac{TW}{D_o}$
2.0 by 2.5	7.40	0.70	0.81	1.30	0.90	0.04	0.35	0.014
	10.20	1.20	1.20	1.78	0.67	0.04	0.60	0.024
	14.20	1.72	1.80 ⁴	2.50	0.52	0.04	0.86	0.034

⁴ Maximum depth.

Figure D6. (Concluded)

Computer Program Documentation and Illustrations

The format of computer program documentation and illustrations should generally follow the requirements of standard WES format with a few exceptions. For the document to be more user friendly, in some instances a smaller page size is advisable. While the page size of most WES reports is 8-1/2 by 11 in., computer program documentation can be 5-1/2 by 8-1/2 in. This smaller page size may be more appropriate for users working at a computer. In addition, while most reports are perfect bound, computer program documentations can be either perfect bound, spiral bound, or loose-leaf. Perfect binding or spiral binding is appropriate for one-time publications; i.e., not scheduled for periodic updates. If periodic updates are expected, the user would be better served by a document in loose-leaf form for insertion into a notebook, which may or may not be issued along with the document.

Illustrative computer screens, input files (listings), output files (listings), and program listings can be handled several different ways. Standard WES format requires each illustration to be numbered and to have a unique caption. This format is acceptable for computer program documentation, but unlike standard WES reports, is not required. Screens can be inserted in the text as necessary without numbering. When able, authors are encouraged to save screens as TIF files so they can be more readily incorporated electronically in the publication.

Another option available in computer program documentation is the use of bold typeface to indicate commands the user should input when running a specific computer program. The use of bold clearly indicates the proper input command.

Other changes to the format of computer program documentation are acceptable; however, these changes should be coordinated with VPC personnel prior to final preparation of the reproducible copy.

The "style" of the computer program documentation (i.e., the plan followed in dealing with such details as spelling, capitalization, punctuation, and abbreviation) should be the same as that for standard WES reports.

Appendix E

Use of Copyrighted Material

A copyright provides exclusive rights granted by Congress under authority of the Constitution to authors or proprietors for the protection of their literary and other intellectual productions.

Whenever copyrighted material is to be used in a WES report, the WES author will obtain the prior written consent of the copyright owner or the copyright owner's duly authorized agent. This written consent should accompany the report when it is sent to VPC for publication.

A credit line will be used whenever it is requested by the copyright owner or his agent.

The following checklist will be used in requesting a copyright release:

- a. The request will be for no greater rights than actually needed.
- b. The request will fully identify the material for which permission to publish is requested.
- c. The request for license will explain the proposed use and contain the conditions of license, so that the licensor need only give his consent.
- d. The request will be submitted to the copyright owner or his duly authorized agent in duplicate so that the owner or agent may retain one copy and return the other copy with his assent written thereon.
- e. A self-addressed return envelope will be enclosed.

Figure E1 is a suggested format of request for release to use copyrighted material.

Additional information regarding the use of copyrighted material may be obtained from the Office of Counsel.

LETTERHEAD

(Name of Company)

(Address)

(Salutation)

RELEASE

This office is preparing manuscript material for a publication to be issued for defense purposes under the title (insert title when known).

Permission is requested to include in this publication the following material: (insert specific information regarding the pages and lines of the illustration and/or text matter to be released) from the work entitled _____, written by _____, which was published by your company.

Would you please indicate on one copy of this letter, in the space provided below, whether this material may be used in the publication this office is preparing and whether an appropriate credit line is desired. A self-addressed envelope is enclosed for your use.

(Signature of requester)

(Title)

Publisher's permission:

RELEASE to use requested material is hereby granted, royalty free.

The material covered by this release (may) (may not)* be placed on sale by the U.S. Government Printing Office.

If the Government publication is made available to the public for inspection and copying in accordance with the Freedom of Information Act or any other law, the material covered by this release may be similarly made available for inspection and copying in context.

Credit line (is)(is not)* requested.

(Name of copyright owner
or authorized agent)

By _____

(Company officer)

(Title)

Date _____

* Line out response not applicable.

Figure E1. Suggested format of request for permission to use copyrighted material

Appendix F

Multicolor Printing

Printing in two or more colors increases the cost of a publication and as such is generally prohibited by Army Regulation 25-30, paragraph 11-22 (Headquarters, Department of the Army 1989),¹ except when such color meets the valuable contribution requirement described therein. Therefore, multicolor printing (and multicolor photocopying) in WES reports will be approved only when it will make a valuable contribution to the purpose of the report. When in doubt as to whether or not use of multiple colors would make a valuable contribution to the report, the author should consult VPC.

Multicolor printing or copying meets the valuable contribution requirement in the following cases:

- a.* Maps and technical diagrams where additional color is needed for clarity.
- b.* Object identification, such as plant specimens and diseases.
- c.* Areas where definite savings in costs can be predicted based on multicolor use.
- d.* Programs that are required by law and whose success depends on the degree of public response.

Multicolor printing or copying does not meet the valuable contribution requirement if one or more of the following conditions apply:

- a.* Additional color is used mainly for decorative effect.
- b.* Additional color is used instead of effective layout and design.
- c.* Additional colors are used to excess; i.e., four colors are used when three will suffice, three when two will do, etc.

¹ References cited in this appendix are located at the end of the main text.

- d.* Use of multicolor does not show careful, competent planning that recognizes the contribution of color and how it should be used to achieve a publication's purpose.

A justification and request for approval of the use of additional colors in a WES report should be submitted to the Chief, VPC, Information Management Division, Information Technology Laboratory, prior to transmitting the report for publication. If the use of color meets the requirements stated above, approval is granted and the approval request is returned to the author. The author should attach a copy of the approval memorandum to the report when forwarded to VPC and keep the original in the report file.

An example of an approval request is shown in Figure F1.

MEMORANDUM THRU CEWES-HE-S
CEWES-HE
CEWES-HV-Z

FOR CEWES-IM-MV

SUBJECT: Request for Approval of Use of Color Graphics in Shell Beach
Reports 11, 12, and 13

1. The Shell Beach Bay 50-Year Prediction study is in final report status. The end product of this multimillion dollar project is a set of 15 bathymetric predictions of delta growth, depicting bay shallowing with time for various base/plan configurations. Several attempts have been made unsuccessfully to clearly indicate the minor changes of base to plan test with shades of gray and/or stippling. Computer-generated gray tone attempts lack differentiation between base and plan. Manual redrafting cannot be done with sufficient accuracy for subtle plan effects. The Visual Production Center has been consulted and has advised color printing for clarity. The four bands required to describe adequately the bathymetry may be accomplished with three shades of blue and a green for new land. A test will be conducted to verify the success of using two colors.

2. I request approval of the use of color printing for reporting the bathymetric predictions of the Shell Beach Bay Delta Growth study.

AUTHOR E. WRITER
PI, Shell Beach Bay Project

Figure F1. Example of a justification for multicolor printing

Appendix G

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