ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE

A Feasibility Study

TECHNICAL REPORT NO. 5-622

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U. S. Army Engineer Waterways Experiment Station
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PREFACE

This report presents the results of a nine-month feasibility study of environmental data for Office of Civil Defense use. The U. S. Army Engineer Waterways Experiment Station (WES) was authorized to conduct the study by Project Order No. OCD-OS-62-233, dated 6 June 1962, from the Contracts Branch, Office of Civil Defense, Department of Defense, to the Office, Chief of Engineers, Department of the Army.

The study described in this report was conducted by the Geology Branch, Soils Division, WES. Dr. David D. Smith, School of Geology, Louisiana State University (under subcontract), was the principal investigator and prepared the text of the report. Mr. Roger T. Saucier of the Geology Branch assisted in various phases of the study and prepared the engineering-geologic map folio (Appendix D). The study was accomplished under the direct supervision of Dr. Charles R. Kolb, Chief of the Geology Branch, and the general supervision of Mr. W. J. Turnbull and Mr. W. G. Shockley, Chief and Assistant Chief, respectively, of the Soils Division, WES.

Director of the WES during the conduct of this study and preparation and publication of this report was Col. Alex G. Sutton, Jr., CE. Technical Director was Mr. J. B. Tiffany.

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SUMMARY

The Office of Civil Defense (OCD) requested that the U. S. Army Engineer Waterways Experiment Station (WES) evaluate on a nationwide basis the present status of existing environmental data and data sources, and determine the feasibility of various possible methods for organizing and presenting such data for OCD use. Analysis indicates that OCD environmental data requirements are of two types: (a) detailed specific information, and (b) authoritative generalizations of relatively broad scope. The subject matter is highly variable; problems arise on relatively short notice, and generally require rapid solution. Further, a given data requirement is not likely to recur frequently, if at all. In addition, several lines of evidence show that advance preparation of data for possible use by the OCD is not presently feasible, except in carefully selected cases.

An appraisal of the status of existing environmental data held by the major cognizant Federal and state agencies indicates that voluminous, unpublished data in various stages of processing exist for all pertinent categories of information. The data are generally filed in local, state, or regional offices, and the practical difficulties in obtaining such information are significant. Adequate fulfillment of OCD environmental data requirements centers around establishing an effective organization structure which will facilitate communication and transfer of information from data sources to the user; in short, setting up a suitable information system.

Analysis of a variety of possible information systems indicates that those which appear to be feasible for OCD use include (a) a system based on a small in-house information center headed by a Staff Coordinator for Environmental Information, and (b) a system utilizing some type of nonmanned, nonautomated data base such as a directory of environmental data sources. Accordingly, recommendations are made for establishing a three-part information system which would consist of (a) an OCD Staff Coordinator for Environmental Information who would be a professional earth scientist, (b) a Board of Expert Advisers representing pertinent environmental disciplines, and (c) a directory of Federal, state, and other important environmental data sources. The Staff Coordinator and the Advisory Board should be selected and appointed as soon as practical. Preparation of the directory of data sources would follow after a six- to twelve-month period

during which the Staff Coordinator could determine the degree of detail and the scope of coverage which the directory should encompass.

An appraisal of various data presentation techniques appropriate to OCD environmental data problems shows that virtually the only pertinent technique not currently in widespread usage is the large-scale map presentation of critical environmental data which is fundamental to engineering construction problems. Because of the likelihood of an eventual major shelter construction program, a recommendation is made for initiation of a pilot program for the preparation of engineering-geologic map folios for parts or all of three major cities in the United States. An example of this type of map folio is included in Appendix D.

Appendix A lists the environmental data categories selected as pertinent in this study, and their application to OCD problems. Appendix B consists of ten tabular summaries of the status of available data on the pertinent environmental data sources. Appendix C is an example of a directory of environmental data sources. Appendix E contains the research designs and cost estimates for the recommended directory of environmental data sources and the pilot program for the preparation of engineering-geologic map folios for selected urban areas.

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PART I: INTRODUCTION

Objectives of Study

1. Many aspects of the programs carried out by Research and Technical Operations, Office of Civil Defense (OCD), require the use of various types of environmental information. In particular, problems related to fallout patterns, fire spread, thermal countermeasures, decontamination, post-attack water supply, evacuation, emergency communications, and the design, site selection, and construction of protective structures involve a wide range of environmental information in varying degrees of geographic coverage and detail.

2. Recognizing this need, the OCD requested that the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, carry out a study which would evaluate the present status of existing environmental data and environmental data sources, and determine the feasibility of various methods of organizing and summarizing such existing information for OCD use. Specifically, the goals of this feasibility study were: (a) analysis of OCD environmental data requirements, (b) identification of environmental data sources and appraisal of data held by each, (c) evaluation of the availability and suitability of existing data for fulfillment of OCD requirements, and (d) recommendations as to the desirability and feasibility of various approaches to organization, summarization, and presentation of environmental data.

Scopes of Study and This Report

3. Personnel of the WES conducted a series of conferences with representatives of the OCD Research and Technical Operations staffs and various research project contractors of the OCD to determine the agencies'

requirements for environmental data. Specifically, it was desired to learn the nature of typical problems requiring such information, in particular the degree of detail needed, and how often these problems might be expected to arise. Part II summarizes this analysis of data requirements.

4. Before the various data sources were contacted, it was necessary to establish a comprehensive checklist delimiting the categories of environmental information pertinent to OCD needs. Such a list (discussed in Part III) was prepared by the WES, and after some modification and rearrangement resulting from discussion with OCD staff members and contractors, the list included the following major categories: terrain, vegetation, hydrology, and climate. These categories and their appropriate subdivisions served as the basis for the appraisal of the status of environmental data and data sources.

5. The nationwide appraisal of the status of environmental information (Part IV) consisted of first identifying the principal data sources for each category and subdivision (chiefly, the cognizant Federal agencies), and then, for representative organizations, conducting a census-like survey of the information held, specifically with respect to extent of coverage, degree of detail, percentage published versus unpublished, format of unpublished, and availability and suitability of unpublished data for OCD use.

6. After (a) OCD requirements had been analyzed, (b) the principal data sources located, (c) the status of environmental information held appraised, and (d) the suitability of existing data for fulfillment of OCD needs evaluated, the next step was to analyze the various means for obtaining, organizing, and presenting this information for actual use by the OCD. This analysis (presented in Part IV) indicated that there were two major items to be considered: (a) information systems, and (b) data presentation techniques.

7. Information systems are essentially broad, flexible structures or frameworks designed to facilitate the transfer of information from source to user. Three types of information systems were considered for use by the OCD; those based on (a) electronic data processing (i.e. automated) systems, (b) manned information centers, and (c) nonmanned, nonautomated systems. The application of each type of information system to the problem

of fulfilling the environmental data requirements of the OCD was ther evaluated in terms of suitability and cost.

8. Specific data presentation techniques, on the other hand, apply ply to the solution of precisely defined data problems. Such techniques in- n- clude: (a) descriptive summaries, (b) handbooks, (c) bibliographies, (d) numerical data tabulations, and (e) various types of graphic presenta- nta- tion. Each technique was evaluated as to its application to the various us categories of environmental data. Then, in order to illustrate such appli- ppli- cation, a series of conceptual problems was formulated, and appropriate te presentation techniques were selected for each.

9. This report concludes with a series of recommendations for the the establishment of an environmental data information system which would be be appropriate to the OCD's requirements and available funds, and for utiliza- iliza- tion of particular data presentation techniques for selected aspects of of their environmental requirements.

10. A series of appendices at the end of this report includes: sum- sum- maries of data upon which the evaluations presented the text are based, ased, examples of an appropriate information system and o a special data presen- resen- tation technique, and detailed research designs and cost estimates for the r the recommended courses of action.

PART II: ANALYSIS OF OFFICE OF CIVIL DEFENSE REQUIREMENTS

11. The initial step in this feasibility study was an analysis of the environmental data requirements of the OCD. This analysis was carried out by means of conferences with Research and Technical Operations personnel of the OCD, a study of the work plans and project summaries for some 220 projects under Research and more than 100 projects under Technical Operations, and consultation and conferences with about 15 OCD research project contractors.

Types of Requirements

12. In the course of the analysis, it became clear that the requirements of both the OCD and its contractors for environmental data fall into two major classes: (a) detailed specific information, and (b) authoritative generalizations of relatively broad scope. In addition, personnel of the OCD expressed the need for a system or method of listing data sources for various categories of environmental information. The two major classes are examined individually.

Detailed specific information

13. Requirements for highly detailed, specific information typically apply to a given topic or geographic area. A number of requirements for this type of information were developed during the exploratory conferences, such as: the range in soil temperatures for different parts of the United States, flow rates for various reaches of specific rivers, rates of tidal flushing and depth variation in estuaries, the typical range of Na and Mg content of bricks and cement for various cities and areas in the United States, and the depth of expected snow cover during specific months for given cities in the northern states.

14. As is apparent from these examples, the subject matter varies widely. Further, it seems improbable that a specific item of information will be needed on more than a relatively few occasions. In addition, the information will generally be needed on relatively short notice.

15. As will be shown subsequently in this report, enormous volumes of highly detailed environmental data currently exist. The bulk of the

data, however, is unpublished; it rests in the files of the various repository organizations across the United States. The principal problems in obtaining such data would be in locating the pertinent data source, and in setting up an efficient procedure for retrieving the desired information.

Authoritative generalizations

16. Requirements for authoritative generalizations of relatively broad scope tend to be more fundamental in character, and typically apply to a wider range of cases than do specific information requirements. Although these broader requirements were encountered only in a general way during the exploratory conferences with staff and contract personnel of the OCD, it seems probable that they will eventually develop for such topics as availability of shallow, potable groundwater for emergency water supply, probability of snow cover affecting decontamination procedures and extent of effect, methods for characterizing terrain units for use in computer solutions of fire-spread problems, air and ground temperature in relation to shelter ventilation and cooling, trafficability problems as limiting factor in evacuation potential, and the delimitation of areas characterized by such construction difficulties as severe foundation settlement, high groundwater table, probable slope failure, etc.

17. Here again, the subject matter varies widely, and the information will probably be needed on relatively short notice. In addition, even though a given generalization typically has broader application than an item of specific information and thus may be useful in a somewhat greater number of cases, its frequency of use will probably be low.

18. The preparation of authoritative, fundamental generalizations requires the efforts of highly experienced specialists in the pertinent scientific or technical field. Such generalizations are based on the specialist's experience and his familiarity with masses of detailed information. Generalizations of this type are difficult to prepare in advance because many of the factors to be considered cannot be supplied in advance. Here the problem lies chiefly in the rapid location of the specialist or authority with the needed experience and background at the time that the need arises.

19. The time required for developing information of this type varies considerably, depending on the nature of the problem and amount of

background information available. In some cases, the problem will be such that no valid generalization can be formulated without considerable additional basic or applied research. In such an instance, the decision that additional research is required is, in itself, an important generalization of considerable value to the OCD. With this information, the OCD can determine whether the problem warrants financing the appropriate research.

20. It should be noted that frequently the files of unpublished data pertinent to OCD needs for detailed specific information and the highly experienced specialist are housed in the same agency or organization. Further, rapid retrieval of the detailed information requested is often dependent upon the knowledge and experience of the specialist in charge of the information files. Similarly, the preparation of an authoritative generalization by a given specialist may require considerable use of the detailed data available in the files of the organization. Thus, although seemingly widely different in character, the two environmental information needs are in fact closely related.

Summary

21. Generalizations concerning the two classes of environmental data requirements are as follows:

a. Both are highly variable as to subject matter, arise on relatively short notice, and require relatively rapid solution.

b. Needs for a given item of detailed information are not likely to recur frequently, if at all.

c. Needs for given authoritative, fundamental generalizations, although these generalizations apply to a larger number of individual cases than do detailed information, will also have a relatively low rate of recurrence.

Additional Considerations

22. Although OCD requirements can be more or less readily classed in two major types, the individual items within each type are not clearly defined at the present time. Further, because of the very nature of the many problems facing the OCD, it seems unlikely that more precise definition can be obtained in the near future. No relative rank, or order, of priority has been established by the OCD for the various environmental

data requirements listed in paragraphs 13 and 16, and there is no indication that such ranking is anticipated in the immediate future.

23. Although a definite need exists for detailed specific information such as that cited in paragraph 13, the importance of the information is not great enough to warrant a major effort on any given item or problem. The same holds true for the authoritative generalizations described in paragraph 16. On the other hand, it appears that a broad, flexible, relatively inexpensive organizational framework of information, within which appropriate emphasis can be given to the various types of specific problems as they arise, is warranted. This is in line with requests by OCD personnel for an approach that will cover as broad a spectrum of environmental data problems as possible with the funds available.

24. In light of the foregoing considerations, it appears that the first step in fulfilling OCD environmental data requirements should be the development of a relatively broad, flexible, and inexpensive information system. Subsequently, as individual environmental data problems become more clearly defined and priorities are assigned by the OCD, specific techniques for their solution can be developed. Development of such techniques could be carried out as an integral part of the basic information system.

PART III: CATEGORIES OF ENVIRONMENTAL DATA

Major Categories

25. To appraise the current national status of environmental information, it was first necessary to determine the various categories of data to be considered. Study indicated that the broad topics probably most pertinent to the needs of the OCD are: terrain, vegetation, hydrology, climate, and radio propagation. Personnel of the WES, working in cooperation with the OCD, compiled a list of 13 major categories based on these topics. This list, which provides the basic framework for the status appraisal, includes: terrain configuration, soils, bedrock, geologic phenomena, vegetation, groundwater, surface water, temperature, radiation, precipitation, winds, background radiation, and radio propagation and electromagnetic phenomena.

Category Subdivisions

26. Each of the above-listed categories may be further subdivided. In this way various aspects of the major categories can be considered. For example, subcategories within soils include: soil type (engineering and pedologic classification), chemical and mineralogical composition, physical properties, distributional data (thickness, areal extent), construction characteristics, and trafficability characteristics. These subcategories can be further subdivided; however, such subdivision is not only unnecessary for the purpose of this study, but also quickly reaches the point of diminishing returns in that some of the subdivisions are in fact derived from or based on other, more fundamental properties. For example, in the case of physical properties of soils, thermal properties are a function of composition, density, and moisture content. For these reasons, considerable time and effort were spent in arriving at a basic appraisal checklist which contained a realistic, yet workable, degree of detail. This list stresses the fundamental rather than the derived categories. It is an extension and subdivision of the framework listed in paragraph 25, and is presented in full as Appendix A.

Category Applications

27. Applications of the specific data categories to the mission and problems of the OCD are cited in detail in Appendix A. A summary of these applications is presented in table 1.

Table 1

Application of Environmental Data to OCD Problems

	Shelter Applications					Post-Attack Applications						General	
Categories	Design	Site Selection	Construction	Ventilation and Cooling	Water Supply	Emergency Water Supply	Fire Potential	Fallout Pattern	Decontamination Problems	Emergency Communications	Thermal Countermeasures	Evacuation	Public Relations
Terrain configuration	X	X					X	X	X	X		X	
Soils	X	X	X	X					X			X	
Bedrock	X	X	X	X									
Geologic phenomena	X	X	X										
Vegetation	X	X	X				X	X	X			X	
Groundwater	X	X		X	X	X							
Surface water	X	X	X	X		X	X		X			X	
Temperature	X			X		X		X			X		
Radiation				X									
Precipitation	X					X	X	X	X		X		
Winds				X			X	X	X				
Background radiation	X												X
Radio propagation and electromagnetic phenomena		X								X			

PART IV: APPRAISAL OF STATUS AND SUITABILITY OF EXISTING ENVIRONMENTAL DATA

28. To evaluate the various possible means for fulfilling OCD environmental data requirements, it was necessary first to appraise the current national status of environmental data, and second, to determine in what degree the existing data are suitable for OCD usage.

Appraisal of Status

Procedure and criteria

29. An appraisal of the status of existing environmental data held by the various cognizant Federal and state offices and agencies was carried out by WES personnel in the following manner. A list of pertinent agencies and organizations was compiled for each data category. Within each category the agencies and organizations were ranked as to probable importance as data sources. In most cases, visits were made to the three or four top-ranking sources. Each visit generally consisted of one or more interview-conferences in which the following aspects of the given data source were considered:

a. Organizational structure of agency.

b. Principal topic or geographic area of interest, or both.

c. Area of coverage.

d. Degree of detail.

e. Percentage of data published versus unpublished.

f. Typical format of unpublished data.

g. Availability of unpublished data, including where filed.

30. This information was recorded on a separate work sheet for each agency. After a preliminary study, the data were reduced to one overall status sheet for each category; the sheet contained a list of the sources contacted and a summarized appraisal of each source. The "category status sheets" (which comprise Appendix B) constitute the fundamental documents in the nationwide appraisal of the status of existing environmental data.

31. For conciseness of presentation, the voluminous, detailed information contained in Appendix B has been condensed to one overall

appraisal of status, which is presented in table 2. In this table, the status of environmental data for each category has been summarized under six headings. These headings are essentially the same as the topics covered in the original source interviews described in paragraph 29. Thus, the significant facts from more than 45 interviews are summarized in table 2.

Quality of sampling

32. In all, some 31 offices or branches of 14 major Federal agencies were contacted, along with five state organizations, five university departments, and five private research groups. Although the census was certainly not all-inclusive, the national-level organizations visited constitute close to 75 percent of the pertinent national data sources, and hold the bulk of the environmental data in most of the fields related to the present study. For this reason, it is believed that the data collected in this study represent a valid sampling of the national status of the data in each category. Although only a relatively small percentage of the possible state-level agencies was contacted, the sampling is considered to be representative of the type, general scope, and degree of detail of the information held by such sources across the nation. Also, it should be noted that an exhaustive appraisal of the status of environmental data was beyond the scope of this study.

Evaluation

33. The evaluation of the material presented in table 2 and in the more detailed status sheets upon which table 2 is based (see Appendix B) indicates that voluminous detailed information generally exists for virtually all aspects of the 13 categories listed, but that the bulk of the data is unpublished, and is held in files of the cognizant agencies. The format and degree of processing of these file data vary widely. In addition, file data generally are held at the local, state, or regional office level. Nationwide centralization exists only for weather records and a few highly selected aspects of other categories.

34. Although virtually all Federal and most state data files theoretically are available to the OCD, the practical difficulties involved in obtaining information from the files of the repository agency seriously limit the accessibility of most information. It should be emphasized that

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Terrain configuration	[illegible] Quartermaster [illegible] and [illegible] Military Geology [illegible] U. S. Geological Survey, universities	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Soils	Soil Conservation Service, [illegible] Survey, Highway Research Board, universities	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	
Bedrock	U. S. Geological Survey, U. S. Army Corps of Engineers, U. S. Bureau of Mines, State Geological Surveys, industry, universities	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Geologic phenomena	U. S. Geological Survey, U. S. Army Corps of Engineers, State Geological Surveys, universities	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Vegetation	U. S. Department of Agriculture ([illegible] Experiment Stations), State [illegible], universities	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Groundwater	U. S. Geological Survey, U. S. Army Corps of Engineers, State and municipal organizations	[illegible] quality, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Surface water	U. S. Geological Survey, U. S. Weather Bureau, U. S. Army Corps of Engineers, State and municipal organizations	[illegible] water quality, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Temperature	U. S. Weather Bureau, universities	A wide variety of [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Radiation	U. S. Weather Bureau, universities							
Precipitation	U. S. Weather Bureau, universities							
Winds	U. S. Weather Bureau, universities							
Background radiation	Atomic Energy Commission, National Bureau of Standards, U. S. Geological Survey, U. S. Department of Health, Education, and Welfare	Variations in [illegible] of radioactivity in [illegible] air, water, and [illegible]; intensity levels of cosmic radiation	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Radio propagation and electromagnetic phenomena	National Bureau of Standards, Federal Communications Commission, universities, commercial and private research organizations	Wide range of topics covering almost all aspects of radio propagation and electromagnetic phenomena	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	versities, commercial and private research organizations	electromagnetic phenomena		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

no significant deficiencies at the category level were found in the status of environmental information. No statements can be made concerning the existence of possible deficiencies at the subcategory level, inasmuch as the scope of this study did not permit sampling in sufficient detail to locate possible deficiencies at that level.

Appraisal of Suitability

35. The suitability for use by the OCD of a given type of environmental data in its existing format and state of processing is determined by the nature of the specific data problem at hand. Data in a given format and degree of detail might be suitable for one problem and unusable for another. The question of suitability can be answered only after a specific problem has been precisely defined, and the type of environmental data held by the principal data sources determined. In short, no general statement as to suitability can be formulated in advance; each case must be appraised separately as it arises.

PART V: INFORMATION SYSTEMS AND DATA PRESENTATION TECHNIQUES

General

36. Because requirements of the OCD for specific information cover an extremely wide range of topics, because a given item or type of information may be of value only on a single occasion or in a single set of circumstances, and because the needed format and degree of detail are generally difficult or impossible to visualize in advance, advance processing or preparation of environmental data for possible use by the OCD does not seem feasible, except in certain instances.

37. The problem, in short, is one of increasing the accessibility and usability of existing data, rather than collecting or processing additional basic data. This is true for both the highly detailed environmental information and the authoritative fundamental generalizations required by the OCD. The problem centers around how to facilitate the transfer of information from the pertinent data source or authority to the OCD. This appears to be basically a question of how to improve communication between user and source.

38. As stated in paragraph 24, development of a general information system appears to be the first step in fulfilling the OCD's environmental data requirements. The next step would be application of specific data presentation techniques to individual problems as they arise.

Information Systems

39. An information system is a broad framework or organizational structure established to facilitate the transfer of needed information from source to user. It may be as elaborate as the U. S. Information Agency, or as simple as the information operator for a telephone system. It may involve a number of personnel, or it may be as inanimate as an IBM computer, a stack of punch cards, or a telephone directory. Obviously, the order of magnitude and the cost of the system are dependent on the job to be done and the funds available.

40. In the course of this study, the application of several types of

information systems to the requirements of the OCD was examined. The types of information systems which were considered include: (a) a system which would utilize one or more of the currently existing information systems, (b) a system which would link together the various existing data centers, (c) a system focused on a small OCD in-house information center, and (d) a system utilizing one or more nonmanned, nonautomated data bases. Each type of system is considered individually in the following paragraphs, and is appraised in summary form in table 3.

Existing information systems

41. An OCD environmental information system could be set up so as to operate within the framework of an existing information system. At least six elaborate systems are currently in operation within various branches of the Federal government. These are: (a) Department of Defense Damage Assessment Center (DODDAC), (b) Office of Emergency Planning National Resources Evaluation Center (NREC), (c) Smithsonian Institution Scientific Information Exchange (SIE), (d) Armed Services Technical Information Agency (ASTIA), (e) Atomic Energy Commission Technical Information Service (TIS), and (f) Advanced Research Projects Agency VELA Uniform Seismic Information Center (VESIAC). Although most of the systems cited utilize machine data processing, storage, and recall, they vary widely as to goals, approach, equipment, capacity, and cost of operation.

Existing data centers

42. Another possibility would be the establishment of an OCD information system designed to operate primarily by linking together the various existing data centers that cover selected aspects of environmental information. These existing data centers include: National Weather Records Center, National Oceanographic Data Center, Infra-red Information Center, a VELA Uniform Seismic Information Center, and several Glaciological Data Centers. In addition, a National Geodetic and Geomagnetic Data Center has been formally proposed, and a National Geologic Data Center is currently under study. An information system encompassing such centers would be quite elaborate, and would require extensive interagency cooperation.

OCD in-house information center

43. An environmental information system could also be built around a relatively small information center within the OCD. The in-house center

would consist of an experienced professional scientist and adequate supporting secretarial personnel. The scientist's primary responsibility would be the coordination of the environmental information system of the OCD. The coordinator and the system would serve the needs of both the Research and Technical Operations staffs of the OCD. Possible utilization of available electronic data processing capabilities is envisioned.

Nonmanned, nonautomated data base

44. An environmental information system utilizing one or more nonmanned, nonautomated data bases would be relatively simple and inexpensive to set up and use, but flexibility, capacity, and the product are proportionately more limited. Such a system could be based on a directory of environmental data sources, or on one or more reference libraries.

Evaluation of proposed systems

45. The detailed study of the appraisals summarized in table 3 has led to the following generalizations. In the case of an information system for the OCD which would utilize the facilities of one of the currently existing information systems, it seems evident that the present facilities are already either fully committed or nearly so, and that the present organizational structure of the existing systems, with the possible exception of NREC, is not particularly suited to the requirements of the OCD. The data base presently used by DODDAC and NREC also appears to be inappropriate for environmental data use by the OCD. Until the OCD's specific data needs are more precisely defined, several of the existing systems are too complex for practical use by the OCD. Further, the cost of adding the necessary voluminous environmental data to an existing system would be high, and as the scope of stored data broadens, the possibility of significant unnecessary overlap with other systems would materially increase. In short, the establishment of an information system for the OCD utilizing the facilities of one of the existing information systems is not a feasible solution to the environmental data requirements of the OCD.

46. In the case of an information system for the OCD which would link together existing data centers, each center currently in operation has clearly defined goals and responsibilities. It is doubtful that any given center could readily assume the additional organizational and administrative responsibilities attendant upon establishment of an information system for

Table [illegible]

Summary Appraisal of Existing and Proposed Information Systems and Data Centers

System or Center	Current Status	Availability for OCD Use	Type and Extent of Data and/or Information Coverage	Cost of Use	Comments
Existing Information Systems					
DCPIAC	Functioning	Not available	Military damage assessment, not pertinent to environmental data problems	Not applicable	
NMCC	Functioning	Limited availability of computer time	Present data base not pertinent to environmental data problems	High	Would have to punch the pertinent environmental information into storage; great cost
SIE	Functioning	Product available, but not basic system	Summary of unclassified Federally financed research projects at time of inception; no published data	None	Sophisticated computer system; valuable source of environmental data for OCD
ASTIA	Functioning	Product available, but not basic system	Summary of military-financed research only, published and unpublished	Low to none	Relatively elementary data storage and processing system
TI.	Functioning	Product available, but not basic system	Central information source and index for unclassified publications and data of Atomic Energy Commission	None	Selected aspects of information should be of great value to OCD; most information, however, not related to OCD applications
VESIAC	Functioning	Product available, but not basic system	Unclassified information on seismic research and techniques related to detection of underground nuclear detonations	None	Supplies reference material, bibliographical data, and published material on specified seismic problems; restricted subject matter limits value to OCD
Existing or Proposed Data Centers					
National Weather Record Center	Functioning	Product available, but center not currently prepared to incorporate significant additional responsibilities related to an OCD information system	National archives for climatological and meteorological data	Relatively low to none	Subject matter of data held at this center closely related to many OCD environmental problems
National Oceanographic Data Center	Functioning	Product available, but center not currently prepared to incorporate significant additional responsibilities related to an OCD information system	Will have national archival responsibility for oceanographic and related data	Relatively low to none	Center just getting under way; operations presently limited; only selected aspects of the data held are pertinent to OCD problems
VESIAC	Functioning	See VESIAC appraisal presented in section above on existing information systems			
Glaciological World Data Centers	Functioning	Product available as above in VESIAC	Archival responsibility for selected aspects of IGY glaciologic data	Relatively low to none	Data generally have little pertinence to OCD environmental problems
Infrared Information Center	Functioning	Unclassified product available; availability of classified product limited	Mostly aspects of infrared research work; coverage probably international	Low to none	Data held directly related to narrow range of OCD problems
National Geodetic and Geomagnetic Data Center	Possibly to be created	Presumably product will be available	Will have national archival responsibility for geodetic and geomagnetic data	Presumably low to none	This center has been formally proposed } Cost of establishing one or both of these centers will run into the millions
National Geologic Data Center	Possibly to be created	Presumably product will be available	Probably will have national archival responsibility for selected types of geologic data	Presumably low to none	This center is under study, but has not yet been formally proposed } (see above)
Small OCD In-House Information Center	To be created	Would operate solely for OCD use	To be determined, but probably limited in-house storage with emphasis on maximum utilization of information from cognizant agencies and data centers	Relatively low, generally function of scope of program	Information center would probably consist of one professional scientist who would coordinate OCD environmental data needs, and serve both the Research and Technical Operations of OCD; the center would serve as a communication channel between in-house users and various other agencies and organizations which are the data sources
OCD Nonmanned, Nonautomated Data Base					
Directory of data sources	To be created	Would operate solely for OCD use	Could be designed to cover all pertinent environmental fields	Moderate cost to establish; moderate cost to update every few years	Would include state and Federal agencies, universities, private organizations, existing data centers, and pertinent individual authorities
Reference library	Functioning (in part)	OCD library recently combined with Army library	Emphasis on bibliographic services	Low	Relatively slow method; available principally to in-house personnel; field offices and contractors have limited access only

the OCD. Also, existing centers cover relatively few scientific fields of direct concern to problems of the OCD. The cost of setting up additional information centers in the various pertinent scientific fields to provide thorough coverage for the OCD would be enormous. Such a system would also involve considerable interagency cooperation, and would require an appreciable period of time to establish. Accordingly, this type of information system for the OCD does not appear feasible at the present time.

47. An information system for the OCD built around a small in-house coordinator and information center would afford an effective and relatively inexpensive means for fulfilling environmental information requirements of the OCD. The professional scientist who would head the center as Staff Coordinator for Environmental Data should have not only a broad background in pertinent scientific fields, but also a high degree of awareness of typical problems and data requirements of the OCD as well. Although not elaborate, a center consisting of a coordinator and supporting personnel would offer a high degree of flexibility as well as a moderate speed of operation. Therefore, an information system focused on an in-house coordinator and information center would constitute an effective means of providing the needed environmental data at a reasonable cost.

48. In the case of an information system for the OCD utilizing one or more types of a nonmanned, nonautomated data base, a detailed directory of environmental data sources subdivided by category and cross-referenced by geographic area would provide a moderate-cost data base for a workable information system. Utilizing such a directory, the staff or contract personnel of the OCD could quickly determine the principal data sources for a given topic as well as the type, approximate extent of coverage, and degree of detail of the information held by each source. Subsequent direct contact with the pertinent data source (agency or specialist) would then produce the best available information on the question at hand. Such a directory would have the following advantages: (a) the directory framework could be highly flexible; (b) the degree of detail contained could vary as desired; (c) it would be suitable for use by the Research and Technical Operations staffs, contractors, and local field offices of the OCD; and (d) it would be only moderately expensive.

49. A reference library is another type of nonautomated data base.

An information system for the OCD utilizing such a data base would constitute probably the simplest and most limited framework which can be considered an information system. In such a framework (as in the case of the directory described in paragraph 48), various components of the information system would be informal, i.e. the users would work directly with the sources, and there would be virtually no intermediate steps except perhaps the work of a reference librarian who would direct the user to the pertinent reference source. In such a situation (and this also holds true for the directory), the user would realize a profit generally in direct proportion to the effort which he expended on the system. Although perhaps not formally defined as such, the reference library-based information system currently exists in the OCD. Because much of the environmental data which is needed by the OCD is relatively inaccessible, unpublished file material, it seems clear that an information system based solely on a standard reference library of published works is not an adequate solution to environmental data requirements of the OCD.

Data Presentation Techniques

50. As individual data problems become more precisely defined through the established information system, specific carefully designed data presentation techniques should be worked out to solve them. Accordingly, the application of various types of data presentation techniques to the environmental information problems of the OCD was considered in this study.

Techniques considered

51. The various data presentation techniques which were considered include general descriptive summaries, handbooks, bibliographies, tabulations of numerical data, and various types of graphic summaries, including maps. The applicability of any given data presentation technique depends, of course, upon the nature of the information problem at hand.

52. The terms used in this study for the various techniques are defined as follows:

a. General descriptive summary refers to a comprehensive and authoritative treatment of a given problem or series of

problems by a recognized expert. Theoretical concepts would be treated thoroughly. The scope of the summary might range from a concise treatment of a restricted problem to a monographic coverage of a major research project. An example might be a descriptive summary of some aspect of heat flow through various types of earth materials.

b. Handbook is considered here to be a compilation of useful factual data, generally presented in a ready-to-use form. Stress would be on practical applications. The preparation of a handbook requires direction by highly trained specialists in the fields covered. Such a technique would be valuable in presenting to engineering firms and construction companies the effects of environmental conditions on the cost of shelter construction.

c. Bibliography is used in the standard sense. The preparation of a bibliography would require the work of trained specialists in the pertinent technical field.

d. Tabulations of numerical data may be prepared either manually or by machine for use in solution of a variety of problems. Such tabulations can be prepared only if problem requirements have been defined precisely. Examples of problems utilizing such tabulations include point-to-point rate of flow for a given river system. Problems related to climatic parameters also normally require tabular data.

e. Graphic summaries include graphs, cross sections, diagrams, charts, and maps. Selection of the specific type to be used depends on such factors as purpose, degree of detail desired, and type and quantity of basic data available. Several categories of environmental information lend themselves to graphic summarization; for example, summarized climatic data are commonly presented on graphs and maps. Some hydrologic data follow similar patterns. The effects of soil, bedrock, and water-table conditions on shelter construction can best be shown on maps.

Application to environmental data categories

53. As a means of appraising the applicability of the various data presentation techniques, individual techniques were considered for each major category of environmental data. This evaluation is summarized in table 4.

54. A brief study of table 4 shows that each of the five types of data presentation techniques applies to some aspect of almost every category of environmental information. Thus, when a given problem is clearly defined, the user can work cooperatively with the pertinent data source or

Table 4

Appraisal of Data Presentation Techniques

Categories	Applications of Techniques: (A) Descriptive	(B) Hardbook	(C) Bibliographies	(D) Numerical Tabulations	(E) Graphic Summaries (Graphs, Charts, Diagrams, Maps)
Terrain configuration	Possibly analysis of effect of terrain configuration on blast overpressures	Presentation of slope data for site selection and construction	Support of research, and of production of other presentation methods	Terrain unit squares used in fire-spread computer problems, and maximum safe slope angle for given earth material	Applies to A, B, and D of this category, i.e. (A) presentation of slope data for site selection and construction; (B) illustration of hardbook material; (D) curves, graphs, and maps summarizing distribution of quantitative data
Soils	Analysis of soil effects on design of shelters, and soil contamination effects on induced radiation in fallout	Presentation of soil data for site selection and construction	Support of research, and of production of other presentation methods	Variation in chemical composition; variation in mechanical composition	Applies to presentation of thickness, composition, and engineering effects of soils; also to (A) in part, and to (B)
Bedrock	Analysis of effects of bedrock on design of shelter	Presentation of bedrock data for site selection and construction	Support of research, and of production of other presentation methods	Variation in chemical and mineralogic composition, and fabric data	Applies to presentation of depth, composition, and engineering effects of bedrock, and in part to (D)
Seismic phenomena	Analysis of seismic and mass-wasting effects on shelter design	Presentation of seismic phenomena data for site selection and construction, with emphasis on prediction of [illegible]	Support of research, and of production of other presentation methods	Intensity of seismic shock as function of distance from epicenter; maximum safe slope angle for given earth material	Applies to presentation of areal distribution of seismic data and of mass-wasting potential
Vegetation	Analysis of effects of vegetation on selected aspects of OCD problems	Not applicable	Support of research, and of preparation of monographic and other summaries	Vegetation unit squares used in fire-spread computer problems; density of crop coverage in agricultural areas	Applies to presentation of statistical data as curves and graphs for (A); map presentation shows areal distribution of quantitative data
Groundwater	Analysis of groundwater effects and use in regard to selected OCD problems	Presentation of groundwater effects data for shelter site selection and construction, and presentation of data on emergency water supply	Support of research, and of preparation of monographic and other summaries	Volumes of groundwater; variation in temperature, pressure, and chemical composition; groundwater hardware information	Applies to presentation of areal distribution of depth to water table, variation in temperature, pressure, chemical composition of groundwater and effect on shelter design, site location, and construction; emergency water supply for drinking and cooking, water for cooling shelters and shelter machinery
Surface water	Analysis of surface-water effects and use in regard to selected problems of OCD	Presentation of surface-water effects data for shelter site selection and construction, and presentation of data on emergency water supply, emphasis on probable limits of surface flooding	Support of research, and of preparation of monographic and other summaries	Discharge volumes, flow rates, temperature, chemical composition, point-to-point travel time on major rivers	Applies to presentation of areal distribution of data in (D), and areal distribution of limits of surface flooding
Temperature	Analysis of temperature effects in regard to selected problems of OCD	Presentation of temperature effects data for shelter site selection and construction, and presentation of data on emergency water supply; emphasis on temperature gradient in shelters; (a) earth temperature, and (b) air temperature	Support of research, and of preparation of monographic and other summaries	As prepared and published by the U. S. Weather Bureau, selected aspects on temperature data pertinent to OCD problems could be emphasized in additional tabulations	Applies to graphic presentation of statistical data; some emphasis on map presentation of areal distribution and variation of values
Solar radiation	Analysis of effects of solar radiation on shelter design and maintenance	Possibly in presentation of solar heat load data for architectural use in shelter design	Support of research, and of preparation of monographic and other summaries	Standard technique, together with curves or bar graphs, for analysis and presentation of most atmospheric data	
Precipitation	Analysis of effects and applications of precipitation in regard to selected OCD problems	Condensed treatment for effects of precipitation on decontamination techniques	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Standard technique, together with curves or bar graphs, for analysis and presentation of most precipitation data; maps are also extremely useful here
Winds	Analysis of effects and applications of winds in regard to selected OCD problems	Condensed treatment for effects of winds on decontamination techniques	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Standard technique, together with curves or bar graphs, for analysis and presentation of most wind data; maps are also useful here
Background radiation count	Analysis of areal variation of total natural background radiation as a reference for comparison of artificial radiation	Not applicable	Support of research, and of preparation of monographic and other summaries	Numerical tabulations are standard technique	Maps are particularly useful for showing areal variation
Radio propagation and electromagnetic phenomena	Analysis of effects of nuclear detonation on radio propagation and electromagnetics	Practical for presentation of applied information related to radio communications, i.e. favorable and unfavorable channels for given areas	Support of research, and of preparation of monographic and other summaries	Numerical tabulations and series of curves are standard technique, maps are particularly useful for showing areal variation	

authority to select the most suitable data presentation technique for the problem at hand.

Conceptual problems

55. To appraise further the various data presentation techniques, WES personnel developed a number of conceptual problems, and attempted to select the most suitable presentation technique or combination of techniques for each. A list of such problems along with suggested techniques is as follows:

a. Problem: Effects of environment on shelter site location and construction. Suggested data presentation technique: Prepare special maps interpreting restrictive effects of critical environmental conditions on shelter construction in major urban areas.

b. Problem: Effects of environment on cost of shelter construction. Suggested technique: Prepare a series of regional descriptive summaries treating the problem; use curves, tables, and graphs to accompany the text. Condensed results might well be presented in handbook form.

c. Problem: Probable soil temperature variations with depth and season by regions. Suggested technique: Prepare maps of interpreted data accompanied by a brief descriptive text. Considerable bibliographic work and possible basic research might be required to obtain the needed data.

d. Problem: Estimated point-to-point rates of flow of major rivers of the United States. Suggested technique: Prepare descriptive text and a series of curves derived from tabular numerical summaries based on computer analysis of machine-stored data.

e. Problem: Predicted periodicity of freezing and thawing for pertinent United States cities. Suggested technique: Use tabular numerical summaries based on computer analysis of machine-stored data. The results of the analysis would probably best be presented in a descriptive text supported by maps and numerical tables.

f. Problem: Periodicity, intensity, and duration of climatic conditions affecting active thermal countermeasures. Suggested technique: Prepare a descriptive summary based on extensive computer analysis of machine-stored data. The text should probably utilize extensive curves, tables, and maps to present results.

g. Problem: Prediction of the most suitable post-attack radio frequencies and their probable variation in performance with time after detonation. Suggested technique: Prepare descriptive summaries supported by curves and tables. Condensed results might also be presented advantageously in handbook form.

Evaluation

56. An appraisal of the status of current usage of each major type of data presentation technique indicates that descriptive summaries, handbooks, bibliographic compilations, and various types of numerical tabulations and graphic summaries are in wide use. However, the map presentation of critical types of environmental data which are fundamental to engineering construction problems (paragraph 55a) is not in general use, and it is believed that this moderately specialized technique may prove very useful in connection with the environmental data problems of the OCD concerning fallout shelter construction in large urban areas.

PART VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

57. Voluminous unpublished data in various stages of processing exist for all pertinent categories of environmental information; the data are generally filed in local, state, or regional offices, and the practical difficulties in obtaining such information are significant. For various reasons, advance processing or preparation of environmental data for possible use by the OCD is not feasible, except in certain selected cases. Emphasis should be on increasing the accessibility and usability of existing data rather than on the collection or processing of additional basic data.

58. It seems clear that adequate fulfillment of the environmental data requirements of the OCD centers around establishing an effective organizational structure which will facilitate communication and transfer of information from the data sources to the user, i.e. establishment of a moderately well-defined, yet relatively inexpensive, information system. Information systems which appear to be feasible for use by the OCD include: (a) a system based on an in-house information center headed by a staff coordinator for environmental information, and (b) a system utilizing some type of nonmanned, nonautomated data base such as a directory of environmental data sources.

59. As individual data problems become more clearly defined through the functioning of the information system, carefully selected data presentation techniques can be worked out to solve them. Virtually the only data presentation technique which is pertinent to the problems of the OCD and not currently in wide use is the large-scale map presentation of critical environmental data which is fundamental to engineering construction problems.

Recommendations for Information System

60. Based on the conclusions just outlined, it is recommended that the OCD set up the following three-part information system in a series of

three steps. The recommended system would consist of: (a) an OCD Staff Coordinator for Environmental Data who would be a professional earth scientist, (b) a Board of Expert Advisers representing pertinent environmental disciplines, and (c) a directory of Federal, state, municipal, and private environmental data sources.

61. The selection and appointment of the staff coordinator (step one) and the board of advisers (step two) should be carried out as soon as practical. The preparation of the data source directory (step three) would follow steps one and two after a six-month to one-year period during which time the staff coordinator could determine the degree of detail and the scope of coverage which the directory should encompass.

Staff coordinator

62. The OCD Staff Coordinator for Environmental Data and a small secretarial and clerical staff would comprise a small but effective environmental information center within the OCD. This center would serve as the nucleus or keystone for the information system.

63. The coordinator should have as broad an experience background in earth sciences as possible. His chief function would be to coordinate and expedite the transfer of environmental data from the various source agencies to the users (in-house staff and contract personnel of the OCD). Wherever appropriate, he would endeavor to place the user in direct communication with the pertinent data source. In addition, it would be his responsibility to determine, in a six-month to one-year period, the scope, extent of coverage, and degree of detail which would be desirable in the data source directory. He would then recommend to the OCD the preparation of this directory at the appropriate time.

Board of advisers

64. A board of advisers representing the pertinent physical environmental sciences would provide a source of highly competent opinion on environmental data problems available to the staff coordinator, and to the in-house and contract personnel of the OCD when appropriate. Such a board should probably consist of ten to twelve professional scientists, and should include individuals representing as many as possible of the following disciplinary backgrounds:

Earth Sciences	Atmospheric Sciences	Hydrospheric Sciences
Engineering Geology	Climatology	Hydrology
Soil Mechanics	Meteorology	Estuarine Oceanography
Pedology	Atmospheric Physics	Estuarine Ecology
Groundwater Geology		
Geomorphology		
Seismology		

65. To insure maximum effectiveness, the selection of the advisory board should be made by a person or persons familiar with both the scientific fields involved and the range of the environmental data requirements of the OCD. Where necessary, the assistance of the appropriate national professional societies could be utilized. It is respectfully submitted that the individuals who carried out the study reported herein, because of their familiarity with the needs of the OCD and with the pertinent sciences, would be the logical persons to select the advisory board.

Directory of environmental data sources

66. A detailed directory of environmental data sources, subdivided by category, and cross-referenced by topic, geographic area, and source agency, would provide a valuable supplementary element in the recommended information system. Such a directory, which could be prepared under contract, would include a comprehensive listing of virtually all Federal and state agency environmental data sources, as well as most of the appropriate private organizations. Its principal purpose would be to serve as a supplement and support to the work of the staff coordinator in facilitating contact between personnel of the OCD and various source agencies or individual authorities. The directory would be useful at several levels within the OCD, i.e. by Research and Technical Operations staffs, by research project contractors, and by personnel in state and local offices of the OCD. Such a directory would serve in a coordinator-like fashion. Obviously, it would not be as flexible, and thus not as helpful, as the staff coordinator, but through wide distribution, it could perform its substitute "coordinator" function at a variety of places concurrently. Consequently, only the more critical problems would be brought to the staff coordinator, and his work load would remain within reason.

67. The determination of the appropriate degree of hierarchical

breakdown required for a workable directory is probably the most critical step in its planning and preparation, because cost is a direct function of the degree of subdivision. This decision should be arrived at jointly by the staff coordinator and the responsible contractor.

68. It should be noted that concurrently with compilation of the basic information for the production of the directory, much of the same information could be added to IBM punch cards at little additional cost. The punch card deck could be used for machine sorting and retrieval with the IBM equipment currently available to the Technical Operations staff of the OCD. The punch card deck could also be used for periodic updating and revision of the distributed copies of the directory.

69. An example of a detailed directory of environmental data sources is included as Appendix C. In addition, a complete research design for producing such a directory, along with cost estimates, is presented in Appendix E.

Mode of operation

70. These recommendations should serve to establish an effective information system for solving various individual environmental data problems as they arise. It is envisioned that the recommended system would function in approximately the following manner:

a. The in-house staff and contract personnel of the OCD would discuss their respective environmental data problems with the staff coordinator.

b. The coordinator would then suggest the appropriate source for the data required (for example: published texts, monographs, tables, maps, etc., when such are known to him). If little or no published information exists, then the coordinator would suggest the appropriate source agency or individual authority to be consulted.

c. The staff or contract personnel would then consult the published or unpublished source or sources suggested by the staff coordinator.

d. When the problem warrants, the staff coordinator would seek advice from the board of expert advisers on where the needed information or professional opinions might be obtained. This information would then be communicated to the user who would in turn contact the source directly.

e. When the work load of the staff coordinator (i.e. the number of requests for assistance) so warrants, step three (preparation, printing, and distribution of the data source

directory) should be carried out under contract. The use of the directory would supplement the work of the staff coordinator as outlined in paragraph 66.

Adequate utilization of this information system should allow rapid location of the appropriate data source and subsequent transfer of data from source to user.

Recommendations for Data Presentation Techniques

71. The OCD specifically requested that wherever possible in this feasibility study, attempts be made to project the planning and probable needs of the OCD for at least five years, and that recommendations be based on this long-range view. In this regard, the probability seems great that a large-scale shelter construction program will eventually be carried out, even though such a program is not currently under way. Any such construction program would require extensive detailed data on the effects of environmental conditions on shelter site selection and construction. It is believed that the most practical and, in the long run, the most inexpensive way of presenting such data is by means of large-scale specialized maps of the type described in Appendix D.

72. Accordingly, it is recommended that a pilot program be initiated in which engineering-geologic map folios would be prepared for parts or all of three major cities in the United States. The three cities should represent: (a) widely divergent environmental conditions, (b) varying quantities of existing and available environmental data, and (c) divergent conditions in regard to the character and number of shelter spaces currently available. Cities which might meet such criteria include San Francisco, Seattle Phoenix, Denver, Kansas City, St. Louis, Minneapolis, Detroit, Atlanta, Philadelphia, and Boston. Various types of cooperative financing should be sought for this pilot program.

73. The OCD Staff Coordinator for Environmental Data should serve in an advisory capacity in the implementation of this program. A research design and a cost estimate for the program are included in Appendix E.

APPENDIX A: ENVIRONMENTAL DATA CATEGORIES

APPENDIX A: ENVIRONMENTAL DATA CATEGORIES

General Statement

1. The following list of environmental data categories was prepared by personnel of the WES, working in cooperation with OCD personnel and research project contractors of the OCD. It serves as a basis for an appraisal of the current national status of environmental information pertinent to the needs of the OCD.

2. Underscored subcategories are those which appear to be derivatives or functions of other, more fundamental subcategories.

3. Probable OCD applications of the various data categories listed below are represented by a series of numbers in parentheses following the headings to which they apply. The specific applications which these numbers represent are as follows:

1. General shelter design problems
2. Shelter site selection
3. Shelter construction
4. Shelter ventilation and cooling
5. Shelter water supply
6. Post-attack emergency water supply
7. Fire potential
8. Fallout pattern
9. Decontamination problems
10. Emergency communications
11. Thermal countermeasures
12. Evacuation
13. Public relations

Data Categories

I. TERRAIN CONFIGURATION
   A. Megageometry (1, 2, 7, 8, 9, 10, 12)
   B. Microgeometry (9)

II. SOILS

- A. Soil type (engineering and pedologic classification) (1, 2, 3)
- B. Chemical and mineralogical composition (2, 3, 9)
- C. Physical properties (1, 2, 3, 4)
- D. Distributional data (thickness, areal extent) (1, 2, 3)
- E. Construction characteristics (1, 2, 3)
- F. Trafficability characteristics (2, 12)

III. BEDROCK

- A. Rock type (engineering and geologic classification) (1, 2, 3)
- B. Chemical and mineral composition (2, 3)
- C. Weathering characteristics (2, 3)
- D. Physical properties (1, 2, 3, 4)
- E. Distributional data (thickness, areal extent)
- F. Construction characteristics (1, 2, 3)

IV. GEOLOGIC PHENOMENA

- A. Structural relations (1, 2, 3)
- B. Mass-wasting potential (2, 3)
- C. Seismic potential (1, 2, 3)

V. VEGETATION

- A. Major vegetative types (7, 9)
- B. Physiognomy (1, 2, 3, 8)
- C. Fire propagation characteristics (1, 2, 3, 7, 12)

VI. GROUNDWATER

- A. Type of groundwater body (4, 5, 6)
- B. Distributional data (depth, extent) (1, 2, 4, 5, 6)
- C. Geologic relation of groundwater body (5, 6)
- D. Permeability and transmissibility of aquifer and valdose zone (5, 6)
- E. Physical properties of water (4, 5, 6)
- F. Chemical properties (1, 5, 6)
- G. Feasibility of well installation (4, 5, 6)
- H. Hardware data on existing wells (5, 6)

VII. SURFACE WATER

- A. Runoff velocity and discharge (1, 2, 3, 6)

B. Inflow-outflow relations for standing water bodies (6, 9) 9)

C. Distribution data (drainage basin limits, etc.) (6, 7)

D. Physical and chemical characteristics (4, 12)

E. Storm and tidal effects (1, 2, 3)

F. Utilization (6, 9)

VIII. TEMPERATURES

A. Air temperature; standard observational data and micro- o-
climatic data (4, 8, 11)

B. Earth temperature (1, 4, 6)

IX. RADIATION

A. Type

B. Dimensional data (intensity, duration) (4)

C. Modifying effects (cloud cover, etc.) (4)

X. PRECIPITATION AND OTHER ATMOSPHERIC MOISTURE

A. Type

B. Dimensional data (volume, intensity, frequency, direction) ction)
(1, 6, 7, 8, 9)

C. Cloud cover and fog (8, 11)

XI. WINDS

A. Near surface (4, 7, 9)

B. Winds aloft (8)

XII. BACKGROUND RADIATION COUNT

A. Cosmic (13)

B. Soils and bedrock (1, 13)

C. Water

D. Food products

XIII. RADIO PROPAGATION AND ELECTROMAGNETIC PHENOMENA

A. Ground conductivity (10)

B. Spectrum characteristics (10)

C. Climatological and auroral effects (10)

D. Secular effects

E. Level of ambient industrial noise

F. Terrain and architectural obstructional effects (2, 10) ɔ)

APPENDIX B: APPRAISAL OF STATUS OF ENVIRONMENTAL DATA, TABULAR SUMMARIES BY CATEGORY

Table B1

Appraisal of Status of Terrain Configuration Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION	Reports and maps	Development of techniques and methodology for quantitative description of terrain configuration; application of these techniques to selected areas in U. S. and overseas	Highly detailed for some studies, generalized for others	Published data on [illegible] limited to descriptions of techniques and methodology	Terrain analog maps of southwest U. S. in preparation; currently available in manuscript form	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping program
QUARTERMASTER RESEARCH AND ENGINEERING COMMAND							
Environmental Protection Research Division	Reports and journal articles	Development of techniques for selected aspects of quantitative terrain analysis problems	Generally highly detailed for selected problems	Probably significant unpublished material	No information	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping program
U. S. GEOLOGICAL SURVEY							
Geologic Division							
Military Geology Branches	Reports and map folios	Qualitative or semiquantitative description of terrain units related principally to military ground movement (men and vehicles); almost exclusively foreign areas	Relatively generalized	Not applicable because of foreign subject matter		Not applicable	
UNIVERSITIES							
e.g. Vanderbilt University, University of Southern California	Reports and journal articles	Research on development of basic principles and techniques for quantitative analysis of terrain; applied research on selected problems	Generally highly detailed for selected problems	Most research work data published upon completion of project	No information	Direct contact required	Emphasis is on development of technique and its application to selected areas, rather than on extensive data collection and mapping program

Table B2

Appraisal of Status of Soils Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION	Site maps, reports, samples, boring logs, cores	Engineering soil quadrangle maps, summaries of geology and soil data available, and site investigations data for Lower Mississippi Valley area	Varies, but typically moderately to highly detailed	Considerable published material, but bulk unpublished	Manuscripts, maps, boring records, file data	Direct contact required	Some work on soils done in cooperation with Department of Agriculture
U. S. ARMY CORPS OF ENGINEERS							
Division and District Offices	Maps, reports, etc.	Roughly similar to above	Varies, but typically moderately to highly detailed	Bulk of material unpublished	Manuscripts, maps, boring records, file data	Direct contact required	Emphasis on engineering sites
U. S. GEOLOGICAL SURVEY							
Geologic Division							
Engineering Geology Branch	Quadrangle and site maps, boring logs, samples, cores	Engineering geology maps, depth to bedrock maps; urban geology program; site investigations generally for other government agencies; engineering soils data and engineering boring and water-well logs for urban and other areas of interest	Urban program maps generally 1:24,000, but 1:10,000 in Boston; site maps very large scale; engineering borings very detailed, water-well logs more generalized	Bulk of material unpublished	Manuscripts, maps, boring records, file data	Direct contact required	Emphasis varies between soils and bedrock depending on which causes engineering problems
Ground Water Branches	Maps, reports, well logs, pumping test data	Extensive area or county map and report program; depth to aquifer maps; probable best source of well log information, but probably little or no engineering soils information	Maps typically 1:63,000 or larger, emphasis on aquifers	Considerable published material, but bulk unpublished	Manuscripts, maps, boring records, file data	Direct contact required	Little data on soils except where they contain major water sources
Military Geology Branches	Engineering soil maps	Data on foreign areas compiled from published sources; little or none on U. S.	Moderately detailed to very generalized	Information of little interest to the OCD because foreign in character			Valuable mapping technique developed to a very high degree, particularly for generalized maps
U. S. BUREAU OF RECLAMATION	Engineering soil maps, boring logs, physical test data on soils at engineering project sites; majority of data pertinent to soil mechanics	Activities limited to arid and semiarid portions of west and southwestern U. S.	Moderate to highly detailed	Considerable data published in technical records, engineering laboratory reports, geology reports, and others; however, probably bulk of data unpublished	Maps, manuscripts, reports, file data	Direct contact required	Most published and unpublished data held in Denver office; agency also maintains 7 field offices

(Continued)

soil mechanics

others; however, probably bulk of data unpublished

(Continued)

Table B. (Concluded)

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
BUREAU OF PUBLIC ROADS	Site and strip maps, reports	Engineering soil investigations; coverage of public lands only; most data held in regional or divisional offices; some few special maps and reports, i.e. Yellowstone Park	Moderately detailed to very generalized	Almost all unpublished	Maps, manuscripts, reports, file data	Direct contact required	Bulk of program is cooperative with states; therefore, most soil data obtained from states. Mechanical analysis data processed at only 4 of 11 regional offices; analysis program limited
SOIL CONSERVATION SERVICE	Soil maps and profile data, and chemical and mineralogical analyses	Soil classification and mapping data, generally for shallow depths (about 6 ft), stress pedologic and agricultural aspects; mechanical analysis data for each unit; surveys generally by counties	Maps range from 1:3,300 to 1:20,000; basic field mapping uses very large scale	Sizeable publication program, but voluminous unpublished material	Maps, manuscripts, reports, file data	Direct contact required	Limited centralization of chemical, mineralogical, and mechanical analysis data in Beltsville, Maryland, laboratories
STATE HIGHWAY DEPARTMENTS	Route (strip) and site maps, and fit investigation records	Extensive programs for geologic strip maps in many states; maps stress highway routes, not quadrangles; 14 or 15 states have statewide soil and material surveys under way; 6 states have statewide engineering-soil surveys	Moderate to highly detailed logs of borings and auger holes; stress engineering properties rather than geology	Bulk of material unpublished	Maps, manuscripts, reports, file data	Direct contact required	
STATE GEOLOGICAL SURVEYS	Engineering soil maps, site maps, boring logs	Relatively few state surveys have engineering soils programs, but those with such programs generally have extensive files for state; surveys commonly cooperative with state highway department	Moderate to highly detailed	Large volume of unpublished data	Maps, manuscripts, reports, file data	Direct contact required	
FOUNDATION ENGINEERING FIRMS	Boring logs	Voluminous files for areas of interest	Logs and soil test data very detailed, but generally stress engineering properties rather than geology	Data almost completely unpublished	Maps, manuscripts, reports, file data	Direct contact required	Because of commercial nature, such data may be difficult to obtain

Table B3

Appraisal of Status of Bedrock Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. GEOLOGICAL SURVEY							
Geologic Division							
Regional Geology Branches	Descriptive reports and maps for quadrangles and other selected areas; well logs, cuttings, and cases; measured sections; some information on geologic processes; stratigraphic, structural, and compositional information; U. S. and territories covered, with emphasis on areas of geologic interest		Map scales vary from 1:24,000 to 1:500,000; 1:63,000 probably most typical	Large volume of published material, but even more unpublished	Manuscripts, well logs, file data of a variety of types	Direct contact required	Agency has national archival responsibility for bedrock information; size of agency precludes comprehensive appraisal of all its branches
Economic Geology Branches	Areal distribution, geologic occurrence, and compositional information on (1) base and ferrous metals, (2) light metals and industrial minerals, (3) organic fuels, (4) radioactive materials, and (5) minor elements (in tables, maps, sections, and reports), plus geochemical exploration information; engineering geologic data in the form of quadrangle maps, engineering data on bedrock, engineering boring and water-well logs; site maps; U. S. and territories, but emphasis is definitely on areas of potential or actual mineral resources; engineering geology program emphasis on urban areas (20 or so) and other selected areas		Varies widely (highly detailed for mineral areas), but occurrences typically summarized at small scale; engineering geology maps and urban program maps typically on 1:24,000 scale	Large volume of published material, but even more unpublished	Manuscripts, maps, statistical data, well logs, sample test data	Direct contact required	
Experimental Geology Branches	Data include studies and reports and voluminous unpublished data on several aspects of geochemistry, on theoretical geophysics, mineralogy, composition of rock materials, and isotopic geology; U. S. and territories covered by topics as outlined above		Varies greatly with area and topic	Large volume of published material, but even more unpublished	Manuscripts, statistical data, sample analyses, file data	Direct contact required	Chemical analysis of rock composition recorded on punch cards, and retrieved by machine
Other Branches, including: Military Geology, Special Projects, and Astrogeology Branches	Selected aspects of geologic data which apply to military problems, problems of nuclear testing, and problems related to lunar and other space work; Military Geology Branches have limited information for some U. S. military reservations		Varies widely	Large volume of published material, but even more unpublished	No information	Direct contact required	
U. S. ARMY CORPS OF ENGINEERS							
Division and District Offices, and Waterways Experiment Station	Engineering reports and maps, boring records, samples, cores, sections	Site investigations, detailed depth to bedrock, structure and composition of bedrock; engineering properties; general geologic data	Generally limited to and highly detailed for construction sites; some regional mapping	Most site investigations data published, but voluminous data unpublished	Manuscripts, boring logs, sample analyses, maps	Direct contact required	File data held at district and local office level

(Continued)

(Continued)

Table B3 (Concluded)

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
STATE GEOLOGICAL SURVEYS	Similar to U. S. Geological Survey, but much less comprehensive; area of coverage restricted to given state		Varies widely from state to state; county report and map series relatively common	Varies, but large volume of work unpublished	Manuscripts, boring logs, sample analyses, maps	Direct contact required	
UNIVERSITIES	Theses and dissertations	Selected geologic problems are subject of intensive research	Highly detailed for subjects covered	Many theses and dissertations published	Reports, maps, file data	Direct contact required; completed but unpublished theses and dissertations available from university libraries	Character of subject matter for research varies widely from university to university

Table 54

Appraisal of Status of Soil Phenomena Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. GEOLOGICAL SURVEY							
Geologic Division							
Engineering Geology Branches	Reports, maps, bore hole records, samples, cores	Selected areas of U. S. and territories; (a) and (b)*	Varies, but typically highly detailed	Voluminous unpublished data	Manuscripts, maps, bore hole records, file data	Direct contact required	
Regional Geology Branches	Reports, maps, bore hole records, samples, cores	Selected areas of U. S. and territories; (a)	Varies	Voluminous unpublished data	Manuscripts, maps, bore hole records, file data	Direct contact required	
Geophysics Branches	Reports, maps	Selected areas of U. S. and territories; (c)	Varies	Voluminous unpublished data	Manuscripts, maps, file data	Direct contact generally required	
U. S. ARMY CORPS OF ENGINEERS							
District and local offices, and Waterways Experiment Station	Reports, maps, bore hole records, samples, cores	Most of U. S.; (a) and (b)	Varies with area; highly detailed for smaller construction sites	Voluminous unpublished data	Manuscripts, maps, bore hole records, file data	Direct contact required	
HIGHWAY RESEARCH BOARD	Reports, special studies	Item (b), with particular emphasis on landslides and frost effects; no comprehensive areal coverage	Typical problems considerable detail	Most data published	No information	No information	
SEISMOLOGICAL INSTITUTIONS (university connected) and DATA CENTER (VESIAC)	Reports, maps, seismic records	Seismic activity of appropriate areas; more emphasis on nature of specific quakes than on general seismicity; (c)	Generally very detailed; length and quality of seismic records vary	Probably considerable unpublished data	Seismograms and supplemental analyses	Direct contact required.	
PROFESSIONAL SOCIETIES							
American Society of Civil Engineers, Soil Mechanics and Foundation Division. American Seismological Society	List of specialists	(a), (b), and (c)	Not applicable	Not applicable	Not applicable	Direct contact required	
FOUNDATION ENGINEERING FIRMS	Case histories, boring records	(a) and principally (b) for engineering sites	Very detailed	Unpublished data	Boring records, site investigations	Direct contact required; commercial interests commonly restrict availability of data	

* Symbols indicate which of the following phenomena are involved: (a) structural relations; (b) mass-wasting potential; (c) seismic potential

* Symbols indicate which of the following phenomena are involved: (a) structural relations; (b) mass-wasting potential; (c) seismic potential

Table B5

Appraisal of Status of Vegetation Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. DEPARTMENT OF AGRICULTURE							
U. S. Forest Service There are more than 6 branches of Forest Service, plus 10 Regional Forest Experiment Stations. Branches with information of particular value to the OCD include: Forest Survey, Range Research, Fire Research	Reports, maps, statistical data; extensive program under way for mapping areal extent of major forest types; maps (in Forest Service "Inter Resources reports) are available for all states except Alaska, Arizona, Colorado, Hawaii, Kansas, Nevada, New Mexico, Utah, West Virginia, Wyoming; reports with maps should be available within 2 years; reports on counties or forest areas and contain maps of major forest types; most basic information such as forest resource statistics, etc., is held in files of Regional Forest Experiment Stations		Varies widely from county to county and state to state, depending on extent of forest resources present	Voluminous unpublished material	Varies	Direct contact required	Forest Service apparently has national archival responsibility for a wide variety of [illegible] data. Various branches of Forest Service hold different types of information, i.e. (1) Character of vegetation cover (timber inventory) would be within purview of Forest Survey Division, and (2) fire-spread problems would utilize data held by (a) Forest Survey, (b) Range Research, and (c) Fire Research Branches
ATOMIC ENERGY COMMISSION (AEC)							
Technical Analysis Branch	Wide variety of information on vegetation	Various topics and areas, but emphasis on application to AEC problems	Normally highly detailed	Volume of work and literature so enormous that person seeking information should go directly to AEC Technical Information Service, then to Nuclear Science Abstracts; this is the only satisfactory course since there are thousands of published references on almost every conceivable topic related to nuclear problems, vegetation included Much of this material is probably so highly technical in character that it has relatively little application to the work of the OCD			
STATE FORESTRY AGENCIES	Maps, reports, statistical data	Generally similar to programs of U. S. Forest Service, but on smaller scale and restricted to given state; typically cooperative with U. S. Forest Service	Varies from highly detailed reports to generalized state summaries	Voluminous unpublished material	Largely maps and statistical data	Direct contact required	
UNIVERSITIES	Theses, dissertations, reports	Selected problems are subject of intensive research	Highly detailed for subjects covered	Considerable unpublished material in regard to research projects; many theses and dissertations published	Reports, file data	Completed but unpublished theses and dissertations available from university libraries	

[illegible] tions published

Table B6

Appraisal of Status of Groundwater Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. GEOLOGICAL SURVEY							
Water Resources Division							
Ground Water Branches	Descriptive reports on groundwater and water resources; maps, charts, tables, cross sections, and extensive file data	Water-table configuration including variation in groundwater levels and artesian pressures; dimensions and character of aquifers; groundwater movement and recharge; saltwater intrusion in coastal areas; water-use data; some data on water-supply systems; some data on relation of water table, surface drainage, and engineering soils; for U. S. and territories; greater detail for areas where groundwater or lack of it is critical factor	Reports and maps vary from moderately detailed (1 and 2 in./mile) for metropolitan areas, to moderately generalized for a state, to generalized for a region (such as Atlantic Coastal Plain)	Voluminous published product, but still more voluminous in-house data files	Varies widely; reports, maps, numerical tabulations, and probably considerable unprocessed data as well	Data concerning groundwater levels, artesian pressures, and water quality may be obtained in advance of publication on request to the Director, U. S. Geological Survey, Washington, D. C.; other data may be obtained by direct contact with local offices	
Quality of Water Branches	Reports, tabular summaries of analyses, maps	Quality of groundwater, i.e. chemical characteristics; U. S. and territories	Data moderately detailed, but number of sampling localities varies with area	Condensed summary published annually; complete data in files	Numerical tabulations, and basic chemical analyses	Direct contact with local offices required	
U. S. ARMY CORPS OF ENGINEERS	Engineering reports and maps, plus voluminous file data	Water-table configuration, chemical quality, groundwater movement, pressures, and recharge	Generally limited to and highly detailed for construction sites; some regional mapping	Most site investigation data published; also much unpublished data	Boring and excavation records	File data held in district and local offices	
STATE ORGANIZATIONS							
Surveys, Boards, and Authorities	Similar to U. S. Geological Survey information	Subject matter similar to U. S. Geological Survey; area of coverage restricted to given state; degree of coverage for given state varies widely	Varies widely from state to state and for areas within state; reports and maps for counties and parts of state common	Varies, but large volume of data unpublished	Varies widely; probably similar to U. S. Geological Survey above	Direct contact required; file data held in state and local offices	
MUNICIPAL ORGANIZATIONS							
Boards, Authorities, and Departments	Limited reports; principally unpublished file data	Subject matter varies widely; area restricted to given city and related water source area	Varies, quite detailed for critical problem areas	Varies, but principally unpublished	Varies; maps, well records	Direct contact required	

(Continued)

[illegible] problem areas

(Continued)

Table B6 (Concluded)

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
COMMERCIAL ORGANIZATIONS							
Well drillers	Normally only background experience; little or no written or published data available	Depth to water table	Commonly very detailed, but reliability sometimes questionable	Not applicable	Not applicable	Direct contact required	
FOUNDATION ENGINEERING FIRMS	File data	Depth to water table	Varies with quality of records and significance of problem	Data unpublished	Boring records	Direct contact required. (Commercial interest may restrict availability of data)	

Table 57

Appraisal of Status of Surface-water Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. GEOLOGICAL SURVEY							
Water Resources Division							
Surface Water Branches	Descriptive reports, statistical summaries, and hydrologic investigation atlases	Surface-water runoff (streamflow, i.e. data from 7400 control points collected daily); discharge; travel time (point to point) for major U. S. rivers; floods (magnitude and frequency); drought studies; water use; some information on water-supply systems; hydraulics and hydrology, including theoretical and experimental work	Reports and maps vary from moderately detailed (1 mi/in. or more) for metropolitan areas, to moderately generalized for a state, to generalized for a region (such as Atlantic Coastal Plain)	Voluminous published product, but still more voluminous unpublished data files	Most data printed in form of numerical tabulation	Streamflow data may be obtained in advance of publication on request to the Director, U. S. Geological Survey, Washington, D. C., or from local offices	Cooperative programs with U. S. Army Corps of Engineers, Public Health Service, Soil Conservation Service, and Bureau of Public Roads
Quality of Water Branches	Reports and numerical summaries	Water chemistry (including occurrence and disposition of radioisotopes in natural waters); dissolved solids and suspended sediment load; chemical characteristics sampled at 750 points	Data moderately detailed, but number of sampling localities varies with area	Voluminous published product, but still more voluminous unpublished data files	Most data printable in form of numerical tabulation	Quality-of-water data available generally, but direct contact probably required	
U. S. ARMY CORPS OF ENGINEERS							
District Offices	Yearly publication (since 1932) of stage and discharge records for all major streams	River stage information related to flood control along major U. S. rivers; some gage records duplicated by U.S.G.S. and U. S. Weather Bureau; most detailed records concern reservoirs and sites of engineering projects	Varies from area to area	All records published yearly	Not applicable	Not applicable	All summary records, although published, are kept on microfile in District Offices; generally cooperative with U. S. Geological Survey
U. S. WEATHER BUREAU							
Hydrologic Services Section	Forecasts via mass media; various reports	Quantitative precipitation forecasts to aid prediction of flood runoff; prediction of hurricane-produced coastal flooding; and storm-wave damage; variety of other hydrometeorological studies and analyses; U. S. and territories	Detailed for most areas	Voluminous unpublished file data	Statistical summaries, processed basic data machine-stored at Weather Records Center	Generally readily available	The more specific the request, the more easily is the data retrieved

(Continued)

analyses, U. S. and territories

(Continued)

Table B7 (Concluded)

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Publication Unpublished	Format of Unpublished	Availability of Unpublished	Remarks
STATE ORGANIZATIONS							
(Boards and Authorities)	Special reports	Studies on selected hydrologic problems generally utilizing the basic data held by the U.S.G.S.; generally relatively little data collection capability, but some states have large programs	Detailed for subjects considered	Varies	Varies	Direct contact required	Generally interested in cooperative work with U.S.G.S.
MUNICIPAL ORGANIZATIONS	Mostly special reports	Drainage problems, variability of floods, inundation, water supply, pumping plants, and hardware; rely heavily on basic data and studies of federal and state organizations; area is given city and environs	Detailed for subjects considered	Principally unpublished data	Varies	Direct contact required	Generally programs are cooperative with state and federal organizations
UNIVERSITIES AND INSTITUTES	Reports	Selected aspects of surface-water and water-resource problems	Generally highly detailed	Varies	Varies	Direct contact required	

Table B3

Appraisal of Status of Climatic Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
U. S. WEATHER BUREAU							
National Weather Records Center	Has national archival responsibility for compiling and maintaining records of climatological and meteorological data	(a), (b), (c), (d)* considered from such aspects as: weather forecasting, meteorology, climatology, and atmospheric physics	12,000 local observing points; length of record and spacing of observing points varies	Voluminous published summaries, but unpublished material much more voluminous	Primarily punch card data base and program library	Readily available through machine recall and printout	Information desired should be stated as specifically as possible; Navy and Air Force weather services are linked with National Weather Records Center
Office of Meteorological Research	Is responsible for the various basic and applied meteorological research and development programs	(a), (b), (c), (d)	Not applicable	Probably considerable unpublished material	Manuscripts, file data	Probably direct contact required	Information desired should be stated as specifically as possible
National Meteorological Center	Forecasts	Areas as large as Northern Hemisphere for weather forecasts of (a) through (d) (daily and 5-day forecasts); 30-day outlook	Records from sea level to 60,000 ft; taken as often as 8 times daily	Most data published	Not applicable	Not applicable	
NATIONAL BUREAU OF STANDARDS							
Meteorology Division	Reports	Following selected aspects of items (a) through (d): photometry and colorimetry, refractometry, engineering meteorology, volumetry, densimetry	Very detailed on pertinent topics	Probably voluminous unpublished data	No information	Probably direct contact required	
UNIVERSITIES - including National Center for Atmospheric Research	Reports and studies	Research on selected aspects of (a) through (d) for solving meteorological and climatological problems	Generally highly detailed for specific topics	Varies, but probably significant amount unpublished	No information	Direct contact required	
PROFESSIONAL SOCIETIES							
American Meteorological Society	Technical and popular articles in journals and bulletins; periodic publication of abstracts and bibliographies	International in scope; covers all aspects of atmospheric sciences	Varies from generalized to highly detailed	Not applicable	Not applicable	Not applicable	Activities include: abstracting service, translation service, scientific committees, professional directory, national register

* Symbols indicate which of following phenomena are involved: (a) temperature, (b) radiation, (c) precipitation and other atmospheric moisture, (d) wind

Table 39

Appraisal of Status of Background Radiation Count Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs Unpublished	Format of Unpublished	Availability of Unpublished	Comments
ATOMIC ENERGY COMMISSION	Literature summaries, reports of investigations	Summaries and investigations cover many aspects of (a) through (d)*	Detailed	Voluminous published product, but presumably still larger volume of unpublished data	No data	Contact through TIS of AEC; security classification may restrict availability of much data	
NATIONAL BUREAU OF STANDARDS	Reports	(a) presumably one of the subjects studied by Ionosphere Research, and Upper Atmosphere and Space Physics Divisions of the National Bureau of Standards	No data	No data	No data	Presumably contact through Technical Information Office of National Bureau of Standards	
U. S. GEOLOGICAL SURVEY							
Various branches	Reports	Primarily (b) and (c); derived data incidental to major projects of the U.S.G.S.	No data	Probably bulk is unpublished	No data	Probably direct contact required	
U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE							
U. S. Public Health Service							
Division of Radiologic Health	Monthly summary	(c) and (d); wide sampling coverage for water and milk, occasional scattered sample of other foodstuffs; some data on soils for scattered localities	Varies	Most appears to be published	No data	Direct contact required	
U. S. DEPARTMENT OF AGRICULTURE	No information	Various aspects of (d)	No information	No information	No data	Presumably direct contact required	

* Symbols indicate which of following phenomena are involved: (a) cosmic, (b) soils-bedrock, (c) water, (d) food products

* Symbols indicate which of following phenomena are involved: (a) cosmic, (b) soils-bedrock, (c) water, (d) food products

Table B10

Appraisal of Status of Radio Propagation and Electromagnetic Phenomena Data

Source	Type of Information	Subject and Area of Coverage	Degree of Detail	Published vs. Unpublished	Format of Unpublished	Availability of Unpublished	Comments
NATIONAL BUREAU OF STANDARDS							
Central Radio Propagation Laboratory	The laboratory consists of the following divisions: (1) Ionosphere Research and Propagation (2) Radio Propagation and Engineering (3) Radio Communication and Systems (4) Upper Atmosphere and Space Physics Extremely wide variety of subject matter appropriate to mission of each division; National Bureau of Standards is official N.B.S. repository for this type of data; reports and journal articles		Probably highly detailed	Voluminous unpublished data	Varies; most raw data machine-stored	Direct contact through [illegible] Office of Technical Information	
FEDERAL COMMUNICATIONS COMMISSION	Various types of technical reports and publications	Selected aspects of radio propagation and interference problems	Varies	Probably large volume of unpublished data	No information	Presumably direct contact required	
UNIVERSITIES	Journal papers	Presumably considerable research work on selected aspects of radio propagation and electromagnetic problems	Highly detailed on particular topics	Probably large volume of unpublished data	No information	Probably direct contact required	
COMMERCIAL AND PRIVATE RESEARCH ORGANIZATIONS e.g. Electromagnetic Compatibility Analysis Center of Armour Research Foundation	Journal and in-house papers	Research on extremely wide range of radio propagation and electromagnetic problems; emphasis generally on applied research; generally no major effort on compilation of basic data	Highly detailed on particular topics	Probably bulk of information is not published	No information	Commercial interest probably reduces or eliminates availability of much of this work	

A DIRECTORY OF ENVIRONMENTAL DATA SOURCES

Prepared for the

OFFICE OF CIVIL DEFENSE

By

U. S. Army Engineer Waterways Experiment Station

CORPS OF ENGINEERS

Vicksburg, Mississippi

C3 C3

Prefatory Note

The following pages are an example of a highly detailed or first, second, and third order directory of environmental data sources (see Appendix E, paragraph 6). This example includes only representative pages selected from the Bedrock and Climate categories. These illustrate the type of subject matter, coverage, degree of detail, and format of the proposed directory. Examples of index pages are also included.

It is emphasized that the data contained in this example have not been checked with the source agencies, and must therefore be considered illustrative only.

DIRECTORY OF ENVIRONMENTAL DATA SOURCES

CONTENTS

C5 C5

VEGETATION

NATIONAL
- General
- Physiognomy
- Fire propagation characteristics

BY STATES
- Same topics as applicable

GROUNDWATER

NATIONAL
- General
- Type and dimensions of water body
- Geological relationship of water body
- Physical properties of aquifer
- Physical and chemical properties of water
- Feasibility of well installation
- Hardware information

BY STATES
- Same topics as applicable

SURFACE WATER

NATIONAL
- General
- Physical and chemical characteristics
- Dimensional information (size of drainage basin, etc.)
- Volume and discharge information
- Utilization

BY STATES
- Same topics as applicable

EXAMPLE MPLE

CLIMATE

NATIONAL
- General
- Temperature
- Precipitation
- Other atmospheric moisture
- Radiation
- Winds
- Special climatic effects

BY STATES
- Same topics as applicable

BACKGROUND RADIATION

NATIONAL
- General
- Cosmic
- Soils and bedrock
- Other materials

BY STATES
Same topics as applicable

RADIO PROPAGATION AND ELECTROMAGNETIC PHENOMENA

NATIONAL
General
Ground conductivity
Spectrum characteristics
Climatological and auroral effects
Secular effects
Man-made noises
Others

BY STATES
Same topics as applicable

C7 :7

B E D R O C K

BEDROCK - NATIONAL

GENERAL

AGENCIES:

Geologic Division, U. S. Geological Survey,

General Services Administration Building
F Street between 18th and 19th Sts., N.W.
Washington 25, D. C.
Area Code: 202, REpublic 7-1820 (Fed. Code 183)
T. B. Nolan, Director; *Charles S. Anderson*, Chief Geologist

Geologic Division activities include geologic, geochemical, and geophysical investigations in following branches:

1. Economic Geology Branches:
   - Base and Ferrous Metals
   - Engineering Geology
   - Geochemical Exploration and Minor Elements
   - Light Metals and Industrial Minerals
   - Organic Fuels
   - Radioactive Materials

2. Regional Geology Branches:
   - New England
   - Eastern States
   - Kentucky
   - Southern Rocky Mountains
   - Northern Rocky Mountains
   - Southwestern States
   - Pacific Coast States
   - Alaska
   - Paleontology and Stratigraphy
   - Paleotectonic Maps
   - Regional Geophysics

3. Experimental Geology Branches:
   - Crustal Studies
   - Experimental Geochemistry and Mineralogy
   - Field Geochemistry and Petrology
   - Isotope Geology
   - Theoretical Geophysics
   - Geochemical Census

4. Other Branches:
   - Analytical Laboratories
   - Astrogeology
   - Foreign Geology
   - Library
   - Military Geology
   - Special Projects

Principal Offices at Federal Center, Denver 25, Colorado, and at 345 Middlefield Road, Menlo Park, California.

BEDROCK - NATIONAL

GENERAL

MAPS:

1. "Geologic map of the United States," U. S. Geolor cal Survey, 1932. Scale - 1:2,500,000.
2. "Tectonic map of the United States," American Association of Petroleum Geologists, 1944. Scale - 1:2,500,000. Out of print, being revised.
3. "Basement rock map of North America from 20° to 60° N. latitude," U. S. Geological Survey. Scale - 1:5,000,000. Compiled by a committee of the American Association of Petroleum Geologists, P. T. F awn, chairman.
4. "Rock types map of Alaska," by L. A. Yehle. U. S Geological Survey, research in progress, 1961.
5. "Map of the landforms of the United States," by E. Raisz. Institute of Geographical Exploration, Cambridge, 1943. 3d rev. ed. Copies may be obtained from the author (Harvard University) at $0.50 each.

BIBLIOGRAPHIES:

1. "Bibliography of North American geology," U. S. Geological Survey. Published in the Bulletin series as follows: 746-747 (1785-1918), 823 (1919-28), 937 (1929-39), 938 (1940-41), 949 (1942-43), 952 (1944-45), 958 (1946-47), 968 (1948), 977 (1949), 985 (1950), 1025 (1951), 1035 (1952-53), 1049 (1940-49), 1054 (1954). Listed in Publications of the U. S. Geological Survey with prices of those in print.
2. "Geological abstracts," Geological Society of America. Published quarterly for the American Geological Institute. Contains authors' abstracts reproduced from most U. S. journals and publications of Government agencies. Limited foreign coverage. Order from the Geological Society of America.
3. "Bibliography of theses in geology," Petroleum Research Corporation, 1252 Arapahoe St., Denver, Colo. Lists name of author, title of thesis, degree, and data. Includes 84 colleges and universities.
4. "Directory of geological material in North America," by J. V. Howell and A. I. Levorsen. American Geological Institute, Washington, 1957. (NAS-NRC Publication No. 556).

LISTS OF PUBLICATIONS:

1. "Publications of the U. S. Geological Survey" (1880-1958). Revised and reprinted every 5 years (last issued in 1958); yearly supplement. Also issues monthly notices of new publications. Free on application to U. S. Geological Survey, Washington 25, D. C., Denver Federal Center, Denver, Colo., and Public Inquiries Offices at Denver, Salt Lake City, Utah, Los Angeles, Calif., and Anchorage, Alaska (see under states for local addresses).

BEDROCK - NATIONAL

GENERAL

LISTS OF PUBLICATIONS (Con't):

2. "Reports and maps of the Geological Survey released only in the open files, 1961," Betsy A. Weld, Erwin S. Asselstine, and Arthur Johnson, Geological Survey Circular 463, free on application to the U. S. Geological Survey, Washington 25, D. C.

3. "List of publications of the U. S. Bureau of Mines," order from U. S. Government Printing Office, Washington 25, D. C. Includes listings of bibliographies on various subjects. Cumulative list of publications issued by the Bureau of Mines from July 1, 1910, to Jan. 1, 1960.

   List of Bureau of Mines publications and articles, Jan. 1 to Dec. 31, 1961, with subject and author index.

ROCK TYPE - GEOLOGICAL CLASSIFICATION

MAPS:

"Geologic map of the United States" (above). Shows areal distribution of rock systems with some subdivided into groups.

Larger scale geologic maps (of smaller areas of the United States) show areal distribution of groups and formations. Legend generally gives average rock types representative of the mapped stratigraphic units, i.e. Sundance sandstone or Morrison formation: shales, thin sandstones, etc. Larger scale maps give approximate thickness of unit, some information on lithologic variation vertically and laterally. See Index of Geologic Mapping (U. S. Geological Survey) for each state.

HANDBOOKS AND OTHER REFERENCES:

"Lexicon of geologic names of the United States," M. Grace Wilmarth, U. S. Geological Survey Bulletin 896, Part 1, A-L, Part 2, M-Z, 1938 ($5.25 per set).

PHYSICAL PROPERTIES (Specific Gravity, Strength Properties, Deformation Characteristics)

AGENCIES:

1. Theoretical Geophysics Branch, Geologic Division, U. S. Geological Survey, Washington 25, D. C.

   _____, Chief

   Area Code: 202, REpublic 7-1820, Ext. _____

BEDROCK - NATIONAL

PHYSICAL PROPERTIES (Specific Gravity, Strength Properties, Deformation Characteristics)

AGENCIES (Con't):

2. Geophysical Laboratory, Carnegie Institute of Washington
   Washington 5, D. C.
   Dr. Philip H. Abelson, Director
   Area Code: 202, WOodley 6-0334

3. Applied Physics Research Laboratory
   U. S. Bureau of Mines
   College Park, Maryland
   Dr. Leonard Obert, Chief
   Area Code: 202, UNiversity 4-3100

HANDBOOKS AND REFERENCES:

1. "Physics of the crust," by F. Birch. In: "Crust of the earth," Geological Society of America, Special Paper 62, 1955.

2. "Rock deformation," edited by D. Griggs and J. Handin. Geological Society of America, Memoir 79, 1960.

3. "Physical properties of evaporite minerals," by E. C. Robertson. U. S. Geological Survey, Open File Report No. TEI-821, 1962.

4. Papers published in: "Transactions of the Society of Rheology," E. H. Lee, Brown University, editor. New York: Interscience Publishers. Issued annually since vol. 1, 1957.

5. Papers published in: "Symposia on rock mechanics." The symposia are sponsored by the mining engineering departments of the University of Minnesota, Pennsylvania State University, and the Colorado School of Mines. First symposium 1956 through fifth symposium to be held April 1963 at the University of Minnesota.

6. Papers published in: "Journal of geophysical research." Issued monthly by the American Geophysical Union, 1515 Massachusetts Ave., N.W., Washington 5, D. C. Vol. 1 (1895) - present.

PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

AGENCIES:

1. Cold Regions Research & Engineering Laboratory
   U. S. Army Materiel Command
   P. O. Box 282
   Hanover, New Hampshire

2. Geophysics Branch, U. S. Geological Survey
   Menlo Park, California
   Dr. Arthur Lachenbruch, Chief
   Area Code: 415, DAvenport 5-6761

BEDROCK - NATIONAL

PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

AGENCIES (Con't):

3. Division of Building Research
   National Research Council of Canada
   Ottawa, Canada

BASIC REFERENCES:

1. "Frost action in roads and airfields, a review of the literature 1765-1951," Highway Research Board, Special Report No. 1, National Academy of Sciences - National Research Council Publication 211, 2101 Constitution Ave., Washington 25, D. C. 1952.
2. "Frost action in soils" (a symposium), Highway Research Board, Special Report No. 2, National Academy of Sciences - National Research Council Publication 213, 2101 Constitution Ave., Washington 25, D. C. 1952.
3. Publications of the Cold Regions Research & Engineering Laboratory (formerly SIPRE). Cover many aspects of frost action and frozen-ground phenomena. See particularly: "Review of properties of snow and ice," SIPRE Report 4, July 1961.

BIBLIOGRAPHIES:

1. "A bibliography on snow and ice," by D. C. Pearce. National Research Council of Canada, Publication No. 2534, October 1951.
2. "Bibliography on snow, ice, and permafrost with abstracts" (vols. 1 through 4 were titled "Annotated bibliography on snow, ice, and permafrost"), SIPRE. Vols. 1 (Sept. 1951) through 13 (Jan. 1959).

INDIVIDUAL AUTHORITIES:

1. *Prof. A. L. Washburn*
   Department of Geology
   Yale University
   New Haven, Connecticut
   (Frost action, mass wasting, solifluction, patterned ground)
2. *Prof. Troy L. Péwé*
   Department of Geology
   University of Alaska
   College, Alaska
   (Permafrost phenomena related to engineering problems)
3. *Mr. J. A. Philainen*
   Division of Building Research
   National Research Council of Canada
   Ottawa, Canada
   (Permafrost phenomena in relation to engineering problems)

BEDROCK - NATIONAL

PHYSICAL PROPERTIES (Freeze-Thaw Characteristics and Frozen-Ground Phenomena)

INDIVIDUAL AUTHORITIES (Con't):

4. *Prof. K. B. Woods*
   Joint Highway Research Project
   Purdue University
   Lafayette, Indiana
   (Frost action)

5. See also individuals cited in "Frost action in soils," Highway Research Board, Special Report No. 2, NAS-NRC Publication 213, 1952.

CONSTRUCTION CHARACTERISTICS

Note: Little or no tabulated data are available for individual formations but considerable data are available in agency files concerning the properties of a given rock type. Some degree of prediction is possible with respect to specific characteristics. This is based on a detailed knowledge of the given rock type, its structural fabric, its past geologic history, and the historic record of its performance as an engineering material.

AGENCIES:

1. U. S. Army Corps of Engineers, Division and District Offices
   (See sections on various states for addresses)

2. Engineering Geology Branch, U. S. Geological Survey
   Branch and Local Offices
   (See sections on various states for addresses)

   Main Office:
   Federal Center
   Denver, Colorado
   Bldg. 25, Room 1830, Entrance G
   Mr. David J. Varnes, Chief
   Area Code: 303, BEImont 3-3611, Ext. 371

3. See also State Geological Surveys and State Highway Departments.

INDIVIDUAL AUTHORITIES:

1. *Mr. Manuel G. Bonilla*
   11 Rosalita Lane
   Millbrae, California

2. *Mr. Edward B. Burwell, Jr.*
   P. O. Box 116
   Upperville, Virginia

3. *Mr. Edwin B. Eckel*
   U. S. Geological Survey
   Federal Center
   Denver, Colorado

BEDROCK - NATIONAL

CONSTRUCTION CHARACTERISTICS

INDIVIDUAL AUTHORITIES (Con't):

4. *Mr. Clifford A. Kaye*
   U. S. Geological Survey
   270 Dartmouth St.
   Boston 16, Massachusetts

5. *Mr. George A. Kiersch*
   Department of Geology
   Cornell University
   Ithaca, New York

6. *Dr. Charles R. Kolb*
   A.P.O. 731
   Seattle, Washington
   U. S. Army Research & Development Office, Alaska

7. *Dr. John T. McGill*
   Department of Geology
   University of California
   Los Angeles 24, California

8. *Mr. Robert H. Nesbitt*
   Office, Chief of Engineers
   Bldg. T-7
   Gravelly Point
   Washington, D. C.

REFERENCES:

1. "Engineering properties of rocks," in: Principles of Engineering Geology and Geotechnics, by D. P. Krynine and W. R. Judd. New York: McGraw-Hill, 1957.

2. "Rock as a construction material," in: Principles of Engineering Geology and Geotechnics (see above).

3. "Symposium on surface and subsurface reconnaissance," American Society for Testing Materials, Special Technical Publication 122, Philadelphia, 1952.

4. "Geologic structure stability and deep protective construct...," Air Force Special Weapons Center, Kirtland AF Base, New Mexico, Report No. TDR-61-93, November 1961.

5. "Engineering geology principles of subterranean installations," by G. A. Kiersch. Economic Geology, vol. 46, No. 2, pp. 208-222. Mar. 1951.

6. "Behavior of materials in the earth's crust," Quarterly of the Colorado School of Mines, vol. 52, No. 3, 1957. Includes papers on: (1) basic concepts of materials behavior, (2) deformation in geologic masses, (3) stress instrumentation and interpretation, and (4) support of underground openings.

BEDROCK - NATIONAL

CONSTRUCTION CHARACTERISTICS

REFERENCES (Con't):

7. "Effects of elastic properties of rocks on civil-engineering structures," by W. R. Judd. (Abstract) Bulletin of the Geological Society of America, vol. 69, No. 12, Part 2, p. 1595, Dec. 1958.

8. "Graphical statistical analysis of fracture patterns in rock encountered in engineering projects," by A. E. Aho, Bulletin of the Geological Society of America, vol. 71, No. 11, pp. 1719-1720, Nov. 1960.

BEDROCK - BY STATES

ALABAMA

GENERAL

AGENCIES:

Geological Survey of Alabama
P. O. Drawer "O"
University, Alabama
Phone: 758-1604 Area Code: 205
Philip E. LaMoreaux, State Geologist
Staff of five geologists

U. S. Geological Survey
Fuels Branch
Northington Campus, University of Alabama
University, Alabama

U. S. Geological Survey
Ground Water Branch
Building 6
University, Alabama

U. S. Army Corps of Engineers
(Mobile District Office)
2301 Grant St., Box 1169
Mobile 7, Alabama

MAPS:

"Geologic map of Alabama," by Alabama Geological Survey, scale – 1:500,000, 1926

BIBLIOGRAPHIES:

"Bibliography of Alabama geology," E. L. Hastings, Alabama Geological Survey Bulletin 67. This publication, along with Bulletin 47 of the Alabama Geological Survey, gives a complete bibliography of Alabama geology through 1958.

OTHERS:

Alabama Geological Survey Library, *Mrs. Betty Thomas*, Librarian.
This library contains extensive holdings of Alabama geology.

BEDROCK - BY STATES

ALABAMA

ROCK TYPE - GEOLOGICAL CLASSIFICATION

MAPS:

1. "Geologic map of Alabama," by Alabama Geological Survey, scale - 1:500,000, 1926. Legend gives columnar sections for Cenozoic, Mesozoic, and Paleozoic. Representative thickness of units and characteristic lithology are shown.

2. "Geologic index map of Alabama," by L. Boardman and E. Watson. U. S. Geological Survey, 1951. Outlines areas covered by geologic mapping and references each map or report cited.

   Note: Best map coverage is in the central and east central parts of the state (east and northeast of Tuscaloosa). Scales range from 1:38,000 to 1:1,280,000.

3. County geologic maps in progress include the following:

Autauga	Etowah	Marengo
Bullock	Franklin	Morgan
Calhoun	Hale	Pickens
Colbert	Lauderdale	St. Clair
Escambia	Limestone	Tuscaloosa

SECTIONS:

1. State geologic map (cited above). Shows lithology and folding along four structure sections which cross the map at various trends.

2. Larger scale sections for selected areas are contained in specific reports by the Alabama Geological Survey and by the U. S. Geological Survey (Bulletins and Water Supply Papers). Sections related to field trips published by the Southeastern Geological Society, Box 841, Tallahassee, Fla.

SUBSURFACE:

1. The Alabama Geological Survey has extensive files of unpublished graphic and descriptive logs from oil and water wells. Consult *Mr. Charles Copeland.*

ROCK TYPE - ENGINEERING GEOLOGICAL CLASSIFICATION

MAPS:

1. No state map available. Large-scale maps of selected sites available from the U. S. Army Engineer District, Mobile. Additional data available from the Bureau of Materials and Research, Alabama State Highway Department. Contact *Mr. Donald Palmore,* Montgomery office.

BEDROCK - BY STATES
ALABAMA

ROCK TYPE - ENGINEERING GEOLOGICAL CLASSIFICATION

FOUNDATION ENGINEERING FIRMS:

1. R. E. Strickland and Associates
   701 South 37th Street
   Birmingham, Alabama
   Area Code: 205, AL 1-5239

2. Law Engineering Testing Co.
   2920 Seventh Avenue South
   Birmingham, Alabama
   Area Code: 205, AL 1-5408

CHEMICAL AND MINERALOGICAL COMPOSITION

AGENCIES:

1. Geological Survey of Alabama
   P. O. Drawer "O"
   University, Alabama
   Holds basic information and is conducting research on iron ore, rocks and minerals of Alabama, mineral resources for use as lightweight concrete aggregate, etc.

2. U. S. Bureau of Mines
   Southern Experiment Station
   P. O. Box "L"
   Tuscaloosa, Alabama

HANDBOOKS AND REFERENCES:

1. "Symposium on mineral resources of the southeastern United States," University of Tennessee Press, 1950.

WEATHERING CHARACTERISTICS

AGENCIES:

1. See information at national level.

2. For Alabama, consult Geological Survey of Alabama, U. S. Geological Survey, and U. S. Army Corps of Engineers.

REFERENCES:

1. "Description and origin of stone layers in soils," by E. J. Parizek. Journal of Geology, vol. 65, No. 1, pp. 24-34, 1957.

BEDROCK - BY STATES

ALABAMA

PHYSICAL PROPERTIES

AGENCIES:

1. U. S. Army Engineer District, Mobile
   (Cited above)
   Strength properties and deformation characteristics
2. Geological Survey of Alabama
   U. S. Geological Survey
   (Cited above)
   Structural fabric, porosity, and permeability

CLIMATE

CLIMATE - NATIONAL

GENERAL

AGENCIES:

1. **U. S. Weather Bureau, Department of Commerce**
   24th at M Street, N.W.
   Washington 25, D. C.
   F. W. Reichelderfer, Chief
   Area Code: 202, 965-2400, Federal Code: 191

   Bureau consists of:
   Central Office
   Office of Meteorological Research
   Office of Climatology
   Hydrologic Services Division
   Instrumental Engineering Division
   Observations and Station Facilities Division
   National Meteorological Center

   Telephone and personal requests for general technical information can be made to any U. S. Weather Bureau field station or the U. S. Weather Bureau Central Office in Washington, D. C. Mail requests should be addressed to: Chief, U. S. Weather Bureau, Washington 25, D. C. All inquiries concerning active or completed U. S. Weather Bureau research projects should be addressed to: Director, Meteorological Research, U. S. Weather Bureau, Washington 25, D. C.

   The U. S. Weather Bureau Library maintains a personnel list of subject specialists who are equipped to provide detailed information on their respective areas of research.

   The U. S. Weather Bureau's research and development programs produce scientific and technical information in the following categories:
   (a) Meteorology: Synoptic and dynamic meteorology, upper atmosphere research, atmospheric and solar radiation, micrometeorology, mesometeorology, meteorological statistics, polar research, atmospheric circulation, air pollution, and oceanographic meteorology
   (b) Physics of the atmosphere: Physics of precipitation, cloud particles, atmospheric electricity and acoustics
   (c) Climatology: Synoptic climatology, upper atmosphere climatology, bioclimatology, climatic trends, statistical climatology, and microclimatology
   (d) Hydrology: Hydrometeorology; river stages; and flood, river, and water-supply forecasting
   (e) Weather forecasting: Numerical prediction, short-range forecasting, extended-range forecasting, and severe storm forecasting
   (f) Instrument engineering: Engineering development of weather instruments, meteorological satellites

   Office of Climatology
   Federal Office Bldg. No. 4
   Suitland, Maryland
   Dr. Helmut E. Landsberg, Director
   Area Code: 202, REpublic 5-2000, Ext. 7287
   Includes: Climatologic Investigations Branch, Climatic Field Service Branch, Climatic Advisory Service Branch, and the National Weather Records Center.

CLIMATE - NATIONAL

GENERAL

AGENCIES (Con't):

1. U. S. Weather Bureau (Con't)

National Weather Records Center
Asheville, North Carolina
Dr. Gerald Barger, Director
Area Code: 704, [illegible]
The center is the principal statistical center and archive for weather records.

The United States is divided into six areas, each under the responsibility of an Area Climatologist. Climatologists are also located in most states and territories.

2. Air Weather Service, U. S. Air Force
Climatic Center
Annex 2, 225 D Street, S.E.
Washington 25, D. C.
Lt. Col. G. E. Mo[illegible], Director
Area Code: 202, STerling 3-5200, Ext. 351
Air Force weather records are incorporated in the National Weather Records Center at Asheville, North Carolina.

PUBLICATIONS:

1. "Scientific information activities of Federal agencies, U. S. Weather Bureau," National Science Foundation, Publication No. NSF 60-58, Washington, 1960.

The U. S. Weather Bureau publications are arranged in five types: Research Publications, Technical Publications, Climatological Publications, Training Publications, and Miscellaneous. The Climatological Publications include the following summaries:

1. "Monthly and annual national summary of climatological data." Includes surface, storm, flood, upper air, solar radiation, temperature, and precipitation data.
2. "Climatography of the United States." Decennial census of U. S. climate (hourly observations) and other summarized climatological data. Published irregularly since 1955.
3. "Monthly and annual state summaries of climatological data." Includes tabulations on temperature, precipitation, evaporation, and wind. In some cases, data are included on soil temperature, snowfall, and snow accumulation.
4. Local summaries of climatological data are published monthly and annually for several thousand stations in the United States. Tabulations include temperature, precipitation, wind, sunshine, sky cover, and summary of hourly observations.

CLIMATE - NATIONAL

GENERAL

PUBLICATIONS (Con't):

5. "Hurricane packages." Special publications including extensive data on severe storms.

6. Miscellaneous:

   (a) "U. S. Weather Bureau synoptic weather maps for the northern hemisphere."

   (b) "U. S. Weather Bureau rainfall frequency map," scale - 1:10,000,000. For durations from 30 minutes to 24 hours and return periods from 1 to 100 years.

   (c) "Sheet of the national atlas of the United States," scale - 1:10,000,000. Mean data of first 32° F temperature in autumn.

   (d) A series of 49 rainfall frequency maps of the United States, scale - 1:10,000,000. Durations from 30 minutes to 24 hours and return periods from 1 to 100 years. In publication.

HANDBOOKS AND REFERENCES:

1. The following periodicals are the primary sources of technical articles in all aspects of climatology:

   Bulletin of the American Meteorological Society
   Journal of Meteorology
   Journal of Geophysical Research
   Tellus
   Review of Scientific Instruments
   Journal of Atmospheric and Terrestrial Physics

2. "Meteorological and geoastrophysical abstracts," published monthly by the American Meteorological Society.

3. Various technical papers published by the U. S. Weather Bureau, i. e. "Rainfall frequency atlas of the United States," by D. M. Hershfield. U. S. Weather Bureau, Technical Paper No. 40, 1960.

4. "Climatology at work," by G. L. Barger. U. S. Weather Bureau, Washington, 1960.

INDIVIDUAL AUTHORITIES:

1. *Prof. Phil E. Church*, Chairman
   Department of Meteorology and Climatology
   University of Washington
   Seattle, Washington

2. *Prof. Ried A. Bryson*, Chairman
   Department of Meteorology
   University of Wisconsin
   Madison, Wisconsin

CLIMATE - NATIONAL

GENERAL

INDIVIDUAL AUTHORITIES (Con't):

3. *Prof. J. E. Miller*, Chairman
   Department of Meteorology and Oceanography
   New York University
   New York, New York

4. *Prof. D. F. Leipper*, Chairman
   Department of Oceanography and Meteorology
   Texas A & M College
   College Station, Texas

5. *Prof. W. LeRoy Decker*
   Atmospheric Science Department
   University of Missouri
   Columbia, Missouri

6. *Mr. Arno R. Kassander*, Director
   Institute of Atmospheric Physics
   University of Arizona
   Tucson, Ariz.

INDEX

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INDEX - AGENCIES

APPENDIX D: EXAMPLE OF ENGINEERING-GEOLOGIC MAP FOLIO

APPENDIX D: EXAMPLE OF ENGINEERING-GEOLOGIC MAP FOLIO

Introduction

1. The engineering-geologic map folio developed in this study is specifically designed to assist in the solution of the site selection and construction problems that will be encountered in a large-scale shelter program. As an example of the involved mapping technique and the format considered most suitable, a folio covering part of the city of New Orleans, Louisiana, was prepared and is contained in the pocket attached to the back cover of this report. The folio and its accompanying descriptive material present and evaluate the significance of various environmental factors with respect to shelter problems principally in terms of architectural engineering. Because it is assumed that many, if not all, shelters will be located underground, particular attention has been given to the environmental factors that affect foundation design and placement.

2. The map folio developed is intended for implementation only in large metropolitan or urbanized areas. Such areas have the highest population densities, and thus have a greater need for shelter spaces per unit area than elsewhere. Also, only for large cities and urbanized areas is there generally a sufficient amount of available data regarding soils, bedrock, water-table conditions, and other engineering-geologic factors to permit adequate map presentation.

3. The optimum map scale for use in the presentation of environmental data in urbanized areas is considered to be either 1:24,000 or 1:25,000. The most complete coverage of the larger cities in the United States (estimated at about 75 percent) by topographic maps is in the form of the 1:24,000-scale sheets prepared by the U. S. Geological Survey, and the 1:25,000-scale sheets prepared by the U. S. Army Map Service. Various smaller scale maps were evaluated for use in the mapping program, and were found to be wholly inadequate.

Explanation of Mapping Technique

4. The four environmental factors which form the basis of the

mapping technique used to produce the attached map folio are: (a) the engineering classification of the soil cover, (b) the engineering classification of the bedrock, (c) the thickness of the soil cover or the depth to the bedrock, and (d) the depth to the water table.

5. In the example map folio of a portion of the New Orleans, Louisiana, area, the soil cover is mapped to an arbitrarily selected depth of 30 ft. Since all of the soils are depositional, the classification is based on environments of deposition. Each environment of deposition contains one or more engineering soil types, according to the Unified Soil Classification System.* Differences in the areal distribution of the environments of deposition or significantly differing combinations of environments of deposition constitute the bases for map units. Each map unit is designated by a color or color pattern on the quadrangle map in the example folio.

6. Although environments of deposition would be an inappropriate classification for the soil cover in many areas, there are numerous other classification systems or methods of division which could be used. Subdivision of the area under consideration into map units should be possible using almost any type of classification.

7. No true bedrock is encountered at shallow depths (< 100 ft) in the New Orleans area. However, to illustrate how a bedrock surface can be represented by contours, a near-surface formation has been contoured on the example map. From the standpoint of foundation design, the contoured formation actually is a quasi-bedrock surface.

8. In those areas where bedrock is present, it should be differentiated into its component rock types wherever this is applicable (e.g. granite and sandstone). The choice of a technique for representing the rock types on the map largely will depend on the number and the areal distribution of the rock types. In cases where various rock types occur at depths less than 30 ft, they should constitute the bases for creating map units. For example, an area characterized by 15 to 20 ft of sand overlying

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* Military Standard MIL-STD-619A (CE), Unified Soil Classification System for Roads, Airfields, Embankments and Foundations, 20 March 1962.

granite should be included in a different map unit than an area characterized by 15 to 20 ft of sand overlying shale.

9. The depth to the groundwater table in the New Orleans area is indicated on the example map by a series of spot elevations. Each elevation was obtained from soil borings which were made at various times during)g the past 20 years. The relative uniformity of the water table throughout the area and the limited number of elevations prevented the contouring of the groundwater surface. Contouring of the groundwater surface is considered advisable wherever the data permit, particularly in those areas where there are significant areal or seasonal variations in level.

10. The textual data contained in the map folio include discussions)s of two important aspects of groundwater, i.e. the possibility of excess hydrostatic pressures, and the chemical quality. In certain respects, these may be considered as special factors that are unique to the New Orleans area. It is important to note, however, that special factors simi-)i- lar to those mentioned above are likely to occur in most areas. If they are of significant importance from the standpoint of engineering, they should be discussed in the folio or portrayed on the map, or both. The greatest value will be derived if they can be described or portrayed in quantitative terms.

11. The occurrence of extensive zones of peat and highly organic clay is a highly significant factor in the New Orleans area. Large quantities of subsurface data have made it possible to illustrate the thickness s of these deposits by means of isopachs (lines showing equal thickness). These serve to illustrate how another special factor of interest in a particular area can be included in a map folio.

12. Actually there is almost no limit to the number of special factors that could be presented in the map folios. According to the suggested d format, each factor is presented in such a way as to be independent of other factors, i.e. one is not a prerequisite for another. Care should be exerted in all cases, however, to insure that an excessive amount of data is not presented on the map. Selection and mapping of only a few of the more significant factors will be necessary in many areas to avoid detracting from the basic factors.

13. The subdivisions of the table giving the engineering

characteristics of the soils encountered in the New Orleans area should be applicable to any areas that might be mapped. Likewise, a table indicating how the various environmental factors would interrelate to affect the design and construction of various types of shelters would be applicable. The effectiveness of this table should improve in the future as more data become available concerning acceptable designs for actual shelter types. Perhaps at that time, the emphasis of the data in the table could be directed more toward the actual suitability of various areas for the utilization of a shelter type or types.

14. The presentation of nonenvironmental data in the map folio is not and should not be excluded. In the example folio, the locations of the existing fallout shelters are included on a transparent overlay. A list of other information that might be of value in shelter site selection or construction would include such items as locations of potential building sites for shelters, locations of existing communication facilities, and the distribution of potential or existing evacuation routes. Data presented on overlays have the advantage of being readily subject to amendment or revision.

15. The sources of much additional information and more specific data concerning the engineering geology of the mapped area can be obtained by referring to the list of references included in the folio. This list is supplemented by an equally important listing of repository agencies for borings, soils reports, and similar data, and also a list of the foundation engineering firms that have conducted projects in the area. Lists of these types certainly warrant the relatively small amount of time necessary for their preparation.

APPENDIX E: DETAILED RESEARCH DESIGNS AND COST ESTIMATES FOR RECOMMENDED COURSES OF ACTION

APPENDIX E: DETAILED RESEARCH DESIGNS AND COST ESTIMATES FOR RECOMMENDED COURSES OF ACTION

1. This appendix contains the research designs and cost estimates for the preparation of a directory of environmental data sources, and a pilot program for the preparation of engineering-geologic map folios for selected urban complexes.

Environmental Data Source Directory

Degree of detail

2. Selection of the degree of detail required in the directory is the fundamental controlling factor in working out its research design and cost estimate. Inasmuch as the recommendation for preparation of the directory (paragraph 66 in main text) specifies that the Staff Coordinator for Environmental Data should be responsible for determining (a) the need for preparation of the directory, and (b) the degree of detail required for optimum coverage, the development of a highly detailed research design at the present time is not feasible. On the other hand, the hierarchical character of the envisioned directory lends itself to a preliminary evaluation in terms of three orders of detail. The research design for all three orders consists of the same basic steps; considerable variation exists, however, in the degree of elaborateness involved in some of the steps for the three different cases. Cost estimates are presented for each of the three orders of detail.

3. The three orders considered here include: (a) generalized or first-order directory, (b) moderately detailed or first- and second-order directory, and (c) highly detailed or first-, second-, and third-order directory. As apparent, these are merely three arbitrarily defined entities selected from a continuous intergradational series. Other intermediate levels could also be established. The examples cited, however, are adequate for developing a preliminary research design and cost estimate.

4. At the generalized or first-order level, only the three or four principal national agency data sources would be listed for each of the thirteen data categories. Addresses and phone numbers of key personnel in

each agency would be given. The various divisions or branches of the agency would be named, but neither their exact location nor the names, addresses, and phone numbers of key personnel at that level would be listed. Specialists outside these agencies would not be listed, nor would such materials as handbooks, bibliographies, maps, etc. If a directory average of one to two pages per agency, and four agencies per category is assumed, such a directory would probably total 75 to 100 pages, and would probably cost about $15,000 to compile and print.

5. At the moderately detailed or first- and second-order level, the information contained in the directory would also include: principal subdivisions of the basic data categories with the name, address, and telephone number data for the pertinent branches and units of the appropriate major national agencies, additional secondary national agency sources, and a listing of appropriate major state agencies. A directory of this type would probably total 400 to 600 pages, and would cost about $30,000 to produce.

6. At the highly detailed or first-, second-, and third-order level (see example in Appendix C), the directory would also contain listings of other data sources such as: universities, libraries, handbooks, bibliographies, maps, basic published references, and individual authorities pertinent to each category and subcategory. It would also contain expanded sections for individual states. In addition, annotations delineating subject matter, format, degree of detail, geographic coverage, etc., would be included for the majority of the sources listed. A directory of this type would probably total well over 1200 pages, and would cost at least $70,000 to produce.

Basic concept

7. The basic concept underlying the use of the directory requires the user to consult the information category or subcategory that is appropriate to his problem, and to select the seemingly pertinent information sources. The user would then contact the sources directly. In most cases, the initial contact would probably be made by telephone. As apparent, by increasing the degree of detail contained in the directory, the number of calls required to locate the proper office or individual to answer a given question can be reduced appreciably. On the other hand, increasing the

contained detail increases the cost of preparation and the need for periodic revision to insure accuracy. Quite obviously, a balance exists between cost of preparation and cost of use. This balance point is dependent upon the overall need for environmental data by OCD in-house and contract research personnel. As presented in Part VI (paragraph 63), it should be the responsibility of the Staff Coordinator for Environmental Data for the OCD to decide this question.

8. It should be noted, however, that the experience of the National Register of Scientific and Technical Personnel Agency, which has prepared a somewhat similar directory, indicates that the average user generally does not make more than a very limited use of the information contained in the directory before him. Rather, he telephones the first likely source that he finds in the directory and requests directions as to where to proceed next. Accordingly, Dr. Milton Levine, Director of the Register, forcefully recommends inclusion of only first-order, or at most, first- and second-order detail in such a directory. He emphasized that the increase in the degree of detail quickly reaches the point of diminishing returns. For these reasons, one of the principal responsibilities of the OCD staff coordinator should be the determination of just what degree of detail is actually necessary and practical.

Research design

9. The research plan for the preparation of a directory involves the following four steps: (a) collection of basic data, (b) compilation and evaluation of data, (c) design of format, and (d) printing. The elaborateness of steps (a) and (b) would vary considerably, depending upon the level of detail selected; steps (c) and (d), however, do not vary appreciably for the different levels of detail. The following discussions apply primarily to the highly detailed type of directory. Proportionately less elaborate steps are necessary for the other two types.

Collection of basic data

10. For the highly detailed (first-, second-, and third-order) directory, the data collection program would require a thorough nationwide census of potential data sources. This census would include: (a) wide circulation of a questionnaire, (b) a literature search, (c) a search of key information centers (such as the Scientific Information Exchange), and

(d) consultation with recognized specialists in each pertinent scientific field.

11. The questionnaire presumably would be sent to virtually every likely Federal and state agency, university, and private research organization. It might also be sent to commercial organizations, but such a program would raise a variety of serious problems. Probably the most immediate problem would be the vast number of such organizations involved. On the basis of preliminary estimates, logical recipients total about 1200, exclusive of commercial organizations.

12. The actual design of the questionnaire will require considerable effort, supported as necessary by appropriate professional consultants. Proper selection of the topics to be covered and the manner in which questions are worded are critical to the success of the questionnaire program. In addition, because the basic data will probably also be compiled on a punch card master for OCD in-house retention, the questionnaire design must be built around a compatible numerical base.

13. Because most questionnaires elicit only partial returns, an essential part of the questionnaire census program would be an effective "reminder letter-telephone call-visit" follow-up system to insure the receipt of an adequate volume of information.

Compilation and evaluation

14. Compilation of the large volumes of data required for the highly detailed directory will necessitate a carefully prepared processing and recording system. In addition, the evaluation of the compiled data to insure adequacy of coverage should be made by competent specialists in each pertinent scientific field.

Cost estimate

15. Cost estimates for the preparation of data source directories at the three successive levels of detail follow. Because of the uncertainties inherent in many of the items included, the sums specified should be considered as minima. Costs may run appreciably higher.

a. Highly detailed (first-, second-, and third-order) directory

Data collection

(1) Questionnaire

Formulation of questionnaire	$ 5,000.00

Compilation of addresses	$ 1,000.00	
Printing, addressing, and mailing	2,000.00	
Follow-up system	10,000.00	
(2) Information center queries	500.00	
(3) Literature search	2,000.00	
(4) Travel for consultation with specialists in selected scientific fields	4,000.00	)
Subtotal	$24,500.00	)
Compilation and evaluation		
(1) Compilation	$20,000.00	0
(2) Conversion to punch cards	2,000.00	0
(3) Evaluation of coverage by competent scientists	5,000.00	)0
Subtotal	$27,000.00	)0
Design of format	$ 3,000.00	)0
Printing		
Note: Cost will vary as a function of format, type style, quality of paper, type of binding, and number of copies	$15,000.00	0
Total	$69,500.00	)

b. Moderately detailed (first- and second-order) directory (The following cost estimate assumes that level of effort would be roughly one-third of that required for highly detailed directory.)

Data collection			
Note: Only very limited distribution of questionnaire would be used	$ 8,000.00	to	$10,000.00
Compilation and evaluation	10,000.00	to	12,000.00
Design of format	1,000.00	to	1,500.00
Printing	5,000.00	to	7,000.00
Total	$24,000.00	to	$30,500.00

c. Generalized (first-order) directory

Data collection	
Note: No questionnaire	$ 5,000.00

Compilation and evaluation		$ 7,000.00
Design of format		500.00
Printing		2,000.00
	Total	$14,500.00

Engineering-Geologic Map Folio

16. The recommended course of action for preparation of engineering-geologic map folios is a pilot program to be carried out in three large urban areas. The objectives of the pilot program would be to: (a) test the validity of the general format of the map folio, (b) provide an indication of what types of special factors of local importance should be added to the folio, (c) evaluate the relative efficiency of various individuals, private concerns, or state and Federal agencies in conducting a mapping program, (d) permit the development of a reasonably accurate cost estimate for a large-scale mapping program, and (e) indicate the type and level of cooperative financing that could be obtained in a large-scale program.

Research design

17. The research plan for implementation of a pilot program involves the following three major steps: (a) initiation of the program in three cities, (b) development of the map folios, and (c) investigation of potential local interest.

18. The criteria to be used in the selection of the three cities are listed in paragraph 72 of main text. Once a decision on the cities has been reached, the next step in the pilot program would be the selection of competent individuals or groups to conduct the actual mapping and folio preparation under contract. Potential contractors can be grouped into two classes. The first includes the large Federal organizations, such as the U. S. Geological Survey and the U. S. Army Corps of Engineers, that have primary national responsibility for work of this type. These groups have the organizational structure and the overall capability for performing such a program, but do not necessarily have individuals who are familiar with the city in question or with immediate access to the bulk of the raw data required. The second class includes individuals or small groups at a local

level who would have the requisite familiarity with the city in question, and for at least some cases, easier access to pertinent data. State geological surveys and members of the engineering and geology staffs of universities would fall within this class. Since appreciable differences in the quality and cost of the product would likely occur, depending upon the individuals or groups involved, it is recommended that representatives of more than one of the classes mentioned in this paragraph be used to prepare the map folios. This would permit a careful evaluation of the cost-quality ratio.

19. In the actual preparation of the folios, it is recommended that complete map coverage of each city be accomplished. This will permit the derivation of a detailed cost estimate, and also negate any further consideration of the three cities involved.

20. During the preparation of the folios, some attention should be devoted to increasing their scope or effectiveness through the addition of supplemental data. Suggestions concerning how this might be done are included in paragraphs 10 through 12 in Appendix D. For uniformity of product, however, the basic factors should not be changed.

21. The final step in the pilot program will be to determine how much local interest could be developed in the folio. It is suggested that this might be accomplished by circulating printed copies of the map folios to state agencies and governments, local engineering firms, and municipal or regional planning commissions throughout the United States. In all probability, the wider the circulation, the greater will be the possibility for obtaining cooperative funding.

Cost estimate

22. Had the map folio contained in Appendix D of this report been prepared in a manner similar to that to be used in a pilot program, i.e. based on an already established format, it is estimated that it would have involved two to three man-months work by an experienced engineering geologist at an estimated cost of about $4000 to $6000. Although six quadrangles would be needed to cover the New Orleans area, the total cost would not be six times greater than the cost of preparing the one quadrangle presented in the folio. The descriptive materials in the folio would not have to be prepared for each additional quadrangle. Thus, the total cost

for a 6-quadrangle folio would be about $15,000 to $20,000.

23. The figures quoted above should be applicable to the folios that would be prepared in a pilot program. However, it is not possible to make an accurate estimate of how much the first and third steps in the program would cost, i.e. initiation of the program and investigation of potential local interest. Therefore, it can only be stated at this time that the total cost of the pilot program will probably be on the order of $100,000 to $150,000.

U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE; A Feasibility Study, by D. D. Smith and R. T. Saucier. April 1963, viii, 29 pp and 5 appendices - tables. (Technical Report No. 5-622)

Unclassified report

A nationwide appraisal of the status of the environmental data held by major Federal and state agencies indicates that voluminous unpublished data in various stages of processing exist for all pertinent categories of information. The fulfillment of data requirements for the Office of Civil Defense (OCD) depends upon the establishment of an effective information system which will facilitate communication and transfer of information from data sources to user. The three-part information system which appears most feasible for OCD use and which is recommended consists of: (a) a small in-house information center headed by a Staff Coordinator for Environmental Data, (b) a Board of Expert Advisers, and (c) an annotated directory of major environmental data sources. An appraisal of various data presentation techniques indicates a need for consideration of large-scale map presentation of environmental data, and a pilot program for preparing engineering-geologic map folios fundamental to fallout shelter construction for three major U. S. cities is recommended.

UNCLASSIFIED
1. Environmental studies
2. Information retrieval

I. Smith, D. D.
II. Saucier, R. T.
III. Waterways Experiment Station, Technical Report No. 5-622

U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. ORGANIZATION AND PRESENTATION OF ENVIRONMENTAL DATA FOR OFFICE OF CIVIL DEFENSE USE; A Feasibility Study, by D. D. Smith and R. T. Saucier. April 1963, viii, 29 pp and 5 appendices - tables. (Technical Report No. 5-622)

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program for preparing engineering-geologic
fundamental to fallout shelter construction for three
major U. S. cities is recommended.

1

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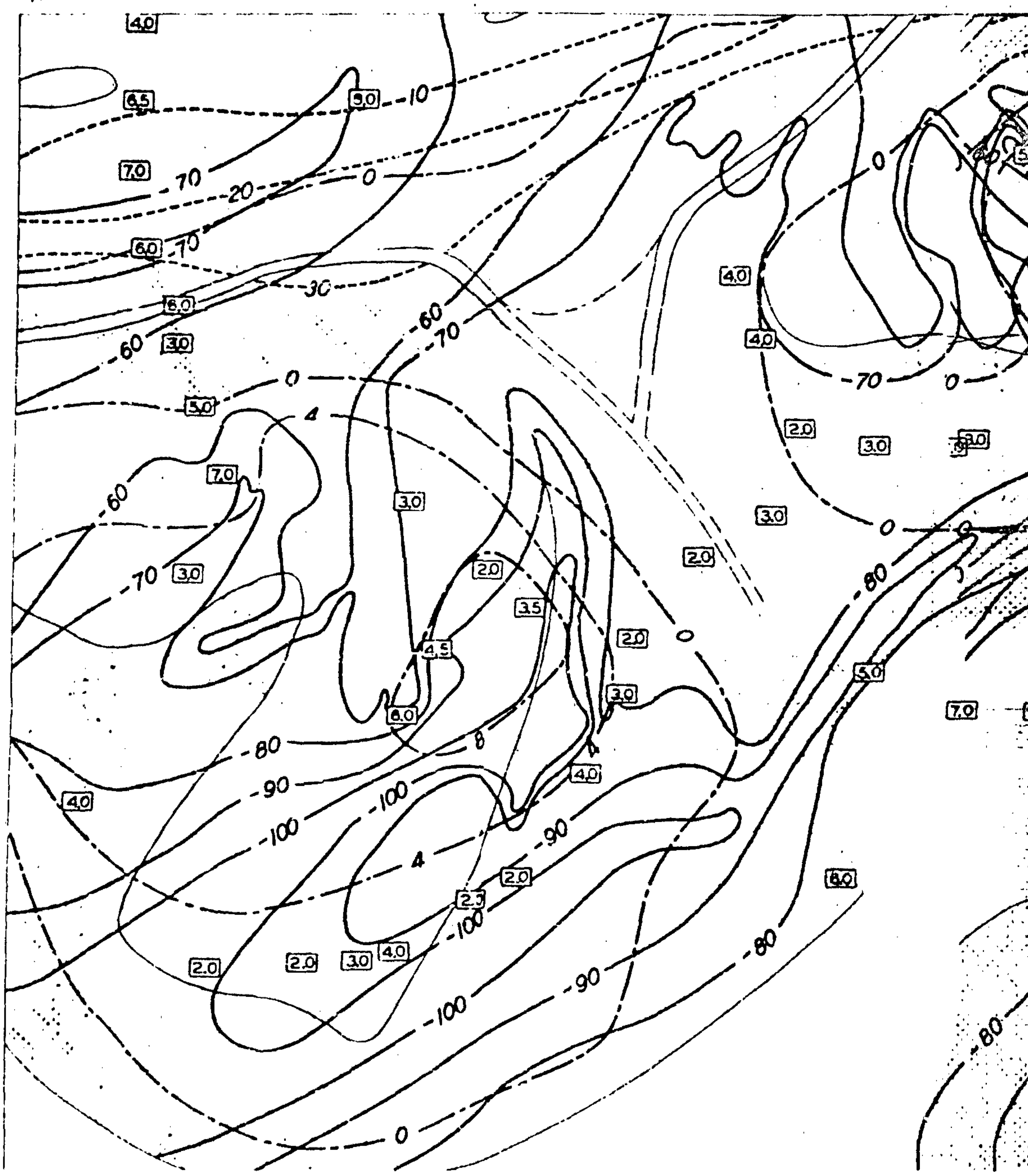
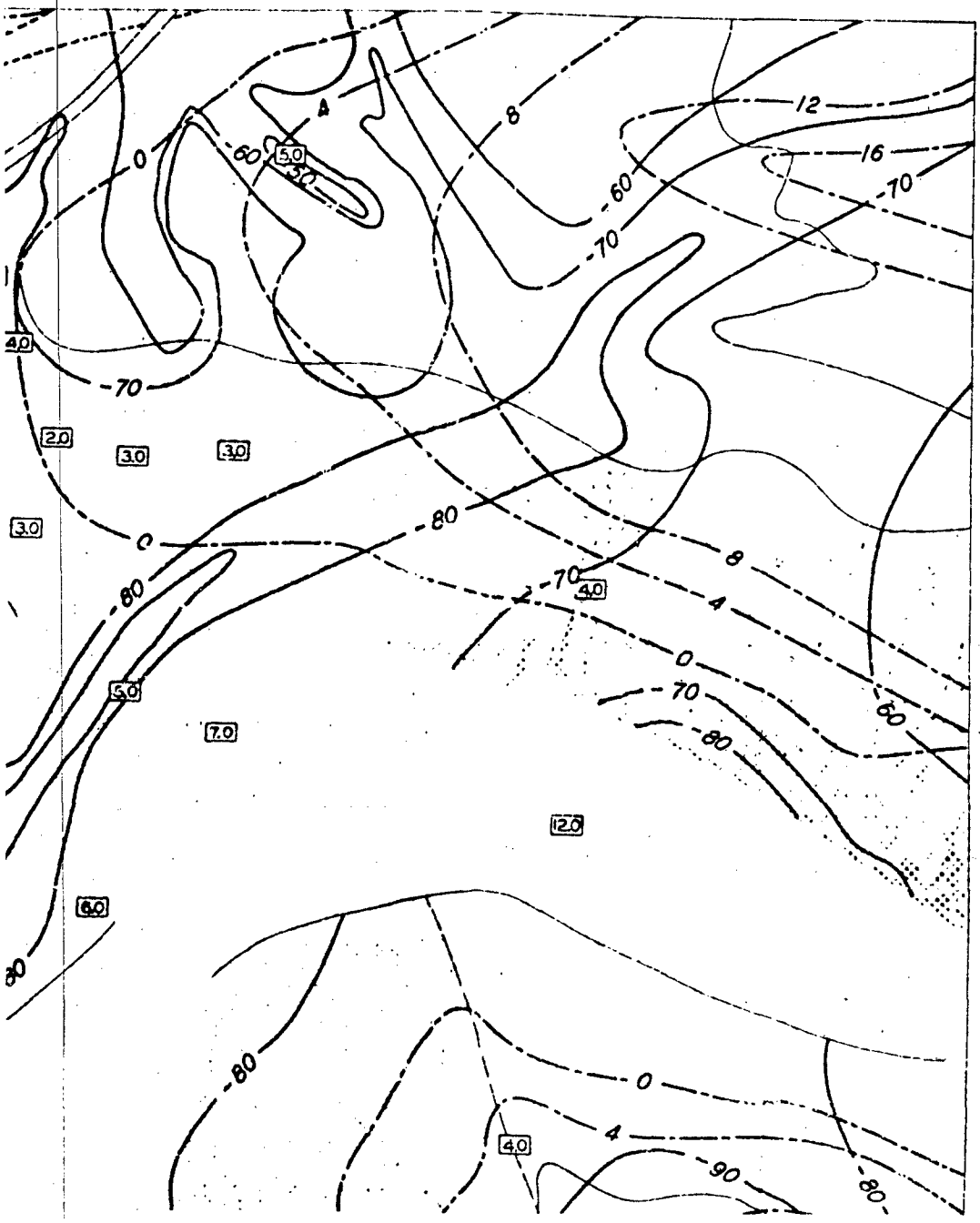


ANS EAST, LOUISIANA



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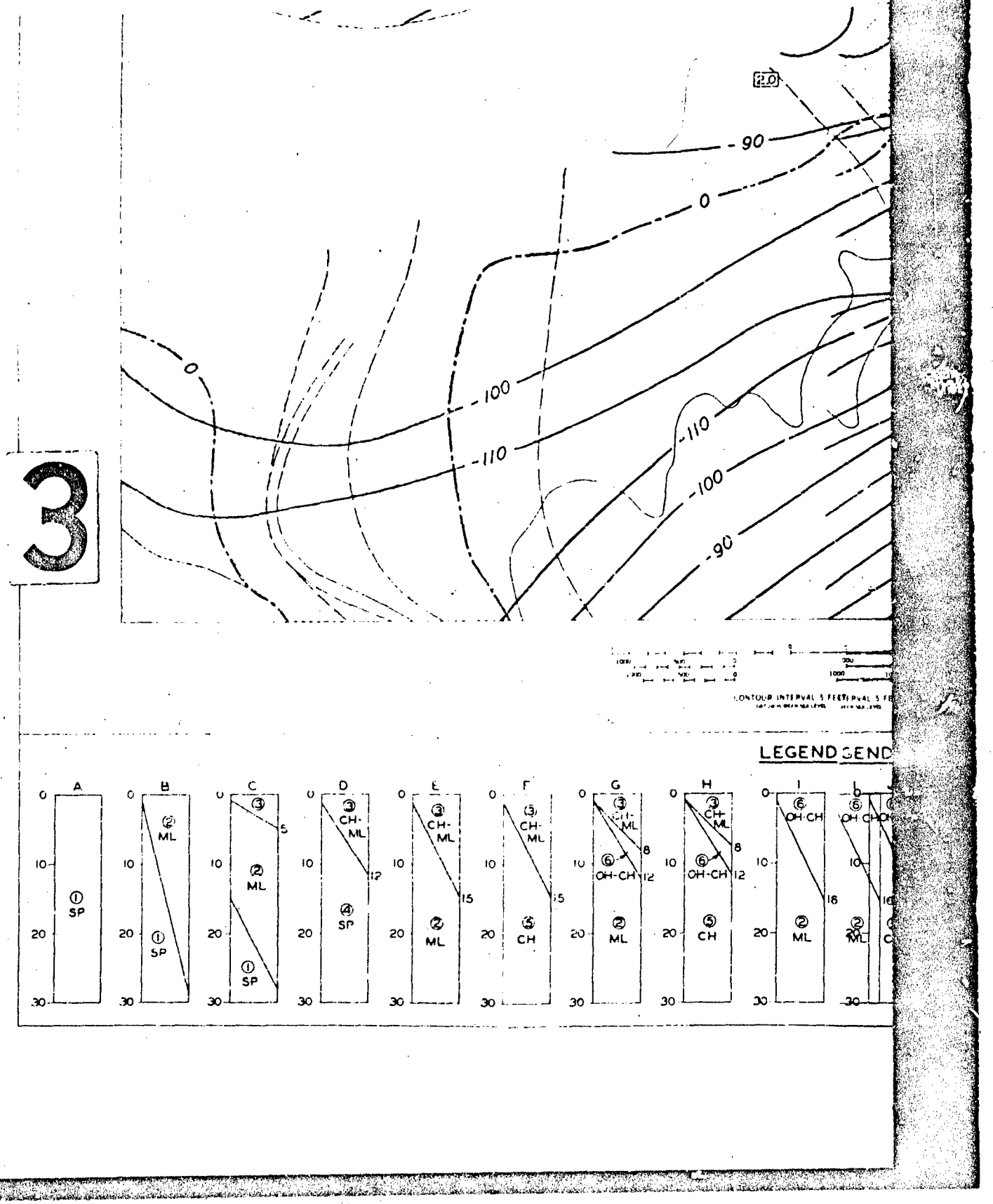
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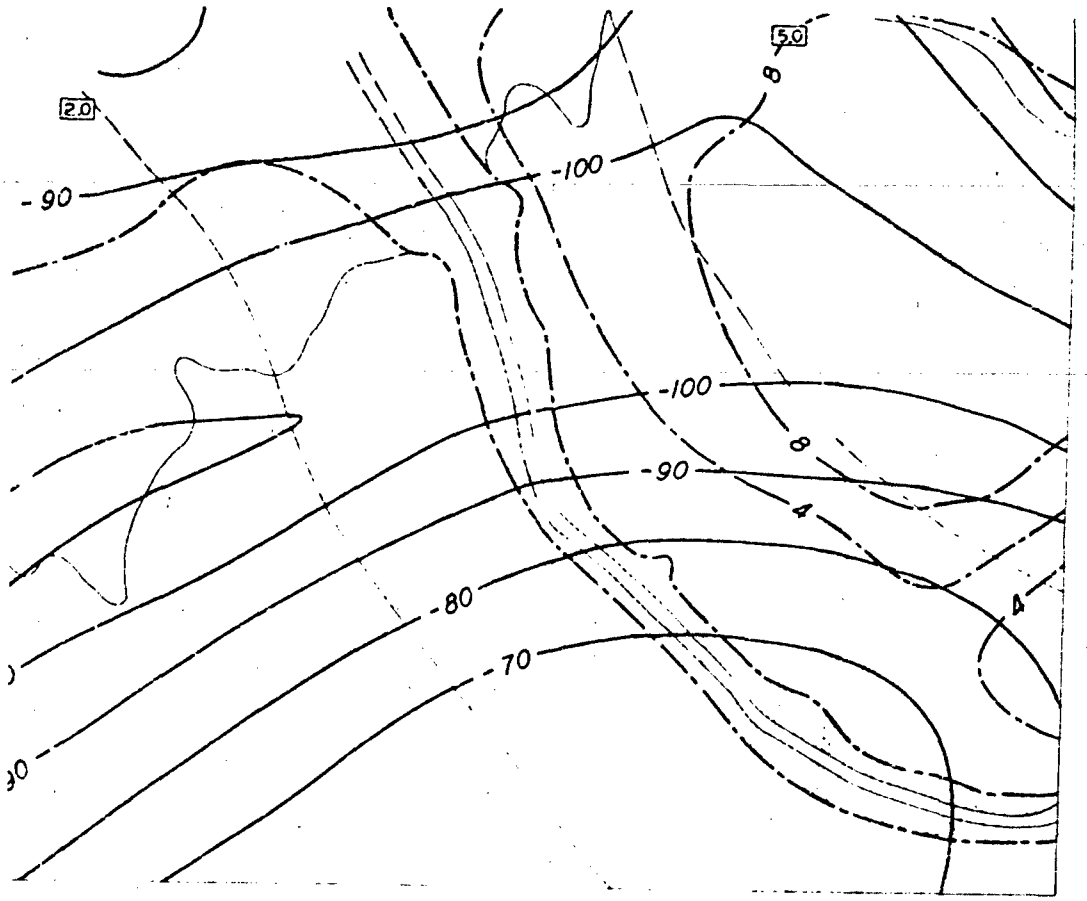

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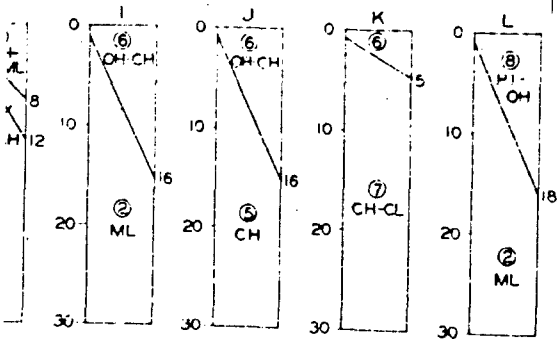
LEGEND



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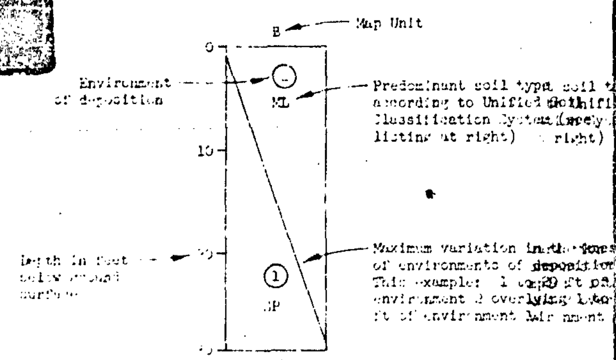
5.0

EXPLANATION OF LEGEND

The near-surface formations in the New Orleans area have been mapped to an arbitrarily selected depth of 30 ft beneath the ground surface. Environments of deposition are the bases for division of the materials within this depth range. Each environment is characterized by a relatively distinct soil type or range of soil types. Differences in the areal distribution of the environments or significantly differing combinations of environments constitute the bases for map units. Designations of the units and environments and an explanation of other notations [illegible]



ENVIRONMENTS OF DEPOSITION

GENERAL

All of the near-surface deposits [illegible] in the New Orleans area are [illegible] and were deposited in a deltaic or marginal deltaic environment by the Mississippi River. None of the deposits are lithified; all may be referred to as soils. No true bedrock is encountered within the limits of normal construction; poorly consolidated materials occur to depths of at least several hundred feet.

Four complexly interfingered environments are present in the deltaic plain. Fluvial sediments are deposited principally in the inland areas within and along streams and in fresh to brackish water. This group includes natural levee, point bar, and abandoned distributary deposits. Fluviomarine deposits are laid down off the mouths of the [illegible] in brackish to marine waters. This group includes interdistributary and intradelta deposits. The paludal environment, which includes marsh and swamp deposits, consists of organic materials formed in situ. The marine environment includes beach and [illegible] deposits resulting from erosion and deposition by the sea.

①

Environment of deposition: Beach

Method of deposition: Once characterized a shoreline of the Gulf of Mexico. Beach deposit is 3 to 5 miles wide, over 20 miles long, and 35 to 40 ft thick.

Textural groups: Approximately 90 percent poorly graded fine to medium sand (SP), 5 percent silt (ML), and 5 percent shell. Silt and shell are normally not localized in strata; rather they are mixed with the sand.

Organic content: Very low to none. Brown organic stain may be present where deposits are in contact with highly organic materials.

Water content: Saturated below the water table.

Angle of internal friction: 30 to 35 deg

②

Environment of deposition: Intradelta

Method of deposition: Intricately interfingered, relatively coarse deposits disposed in broad wedges about abandoned courses and major distributaries. Thickness of deposits averages between 25 and 50 ft.

Textural groups: Intricately interfingered zones of fairly dense silt (ML) and silty sand (SM) with minor quantities of clay (CH and CL) in thin, dis-

⑥

Environment of deposition: Marsh and swamp (artificially drain[illegible]

Method of deposition: Formed in basin areas away from active [illegible] (distributaries and courses). Areas characterized at one time [illegible] mulation and preservation of plant debris. Materials have [illegible] subsided as a result of artificial drainage.

Textural groups: [illegible] medium, poorly stratified zones of [illegible] (CH), [illegible] clay (CL), and peat (Pt) with scattered thin [illegible] silt (ML). Data are insufficient to permit a percentage breakdown. [illegible] materials may be either fibrous or woody. Large pieces of wood [illegible] and stumps may be encountered throughout the deposits [illegible]

Organic content: Excluding peat horizons, actual organic content [illegible] not exceed [illegible] percent.

Water content: Data limited but values are probably between 15[illegible] [illegible] dry weight.

⑦

Environment of deposition: Abandoned distributary

Method of deposition: Elongate zones of fine-grained materials [illegible] abandoned distributaries. Zones vary in width from several [illegible] or more and are from 10 to 50 ft thick. A downstream-thinning [illegible] coarser material fills the base of the old channel.

Textural groups: In the upper portion, very soft to medium fat [illegible] lean clays (CL) with scattered thin layers of silt (ML) and silt [illegible] The layers of silt and sand become more numerous with depth and [illegible] grade into a basal sand (SP) or silty sand (SM) wedge. Data are [illegible] to permit a percentage breakdown.

Organic content: Normally low. Scattered small particles of organic [illegible] may be present in the upper portion of the unit.

Water content: Data limited, but values are probably high[illegible]

⑧

Environment of deposition: Marsh and swamp

Method of deposition: Essentially the same as in environment [illegible] except that organic accumulation is still progressing. [illegible] been artificially drained.

Textural groups: Very soft humus and/or peat (Pt) varying from [illegible]

ANATION OF LEGEND

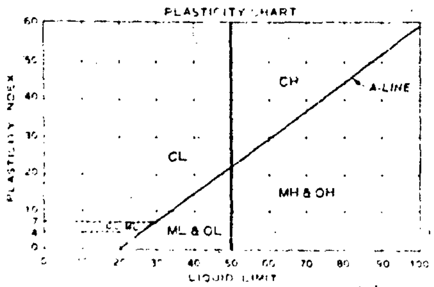
— Map Unit

— Preliminary soil type according to Unified Soil Classification System (see listing at right)

— Maximum variation in thickness of environments of deposition. This example ... ft ...

THE UNIFIED SOIL CLASSIFICATION SYSTEM

CH	clay
CL	silty clay, sandy clay
ML	silt, sandy silt, clay silt
MH	inorganic silt
SC	clayey sand
SM	silty sand
OL	organic silt
OH	organic clay
Pt	peat
SP	poorly graded sand
SW	well graded sand
GC	clayey sand gravel
GM	silty sand gravel
GW	well graded sand gravel
GP	poorly graded sand gravel



⑦

Abandoned distributary

...ate zones of fine-grained mate... filling ... vary in width from several hundred to ... ft ... 50 ft thick. A downstream-thinning wedge of ... base of the old channel.

...pper portion, very soft to medium fat clays (CH) and ...ered thin layers of silt (ML) and silty sand (SM). ...d become more numerous with depth and eventually ...P) or silty sand (SM) wedge. Data are insufficient ...akdown.

...low. Scattered small particles of organic matter ...r portion of the unit.

...ed, but values are probably high.

⑥

Marsh and swamp

...entially the same as in environment of deposition 6 ...lation is still progressing. These areas have not

...t humus and/or peat (Pt) varying from several inches

... and/or hydrogen ...

... most of the ... deposits in the New Orleans area lack sufficient strength to support ... piles must be utilized to transfer the loads to a stronger unit located at a greater depth. If the structural loads are not too great, piles sometimes can be driven to sand units lying 40 to 70 ft beneath the surface. These sand units provide adequate pile support only if they are not underlain by compressible clays.

Where compressible clays are present or where the structural loads are great, piles must be driven into the deeper Pleistocene formation. The deposits in this formation have higher strengths than are present in any of the overlying Recent deposits. Probably over 75 percent of the piles used for large buildings, bridges, etc., in the area penetrate into Pleistocene deposits.

Pleistocene deposits typically consist of about 40 percent fat clay (CH), 25 percent lean clay (CL), 25 percent silt (ML) and silty sand (SM), and 10 percent sand (SP). Natural water contents vary from about 20 to 80 percent dry weight for fat clays (CH) and 15 to 60 percent for lean clays (CL). Cohesive strengths for fat clays vary from about 400 to over 3000 lb per sq ft and for lean clays from 300 to about 2500 lb per sq ft.

The contours on the inclosed map indicate the general depth to the surface of the Pleistocene formation. Since the control used in contouring the surface is poor in many cases and since there is both lateral and vertical variability within the formation, the precise nature and occurrence of the formation at each site should be determined by borings. Moreover, borings will be necessary to determine how far into the deposits piles will have to be driven to obtain the necessary resistance.

CONSTRUCTION MATERIALS

[illegible] continuous lentils. [illegible] onsidered as a unit, intradelta deposits consist of about 45 percent silt, 30 percent sand, and 25 percent clay. These deposits usually grade laterally into and interfinger with the predominantly clayey interdistributary deposits.

Organic content: Usually quite low. A few small, widely disseminated particles may be present.

Water content: Varies from 40 to [illegible] percent dry weight for clays (CH) and from [illegible] percent for silts (ML) and sandy silts (SM).

③

Environment of deposition: Natural levee

Method of deposition: [illegible] of interfingering layers of clays and silts [illegible] in narrow bands flanking the Mississippi River and its abandoned [illegible] distributaries. Natural levees along abandoned distributaries are usually of finer grain and smaller in size than those along the Mississippi River.

Textural groups: [illegible] percent fat clay (CH), [illegible] percent lean clay (CL), [illegible] percent silt (ML), and [illegible] percent silty sand (SM). [illegible] usually [illegible] [illegible] small [illegible] [illegible] well [illegible].

Organic content: Normally extremely low.

Water content: [illegible] the lowest [illegible] in the area; values range from [illegible] percent dry weight.

Cohesive strength: Varies from [illegible] lb per sq ft for fat clay (CH) [illegible] lb per sq ft for lean clay (CL).

④

Environment of deposition: Point bar

Method of deposition: Formed [illegible] the present Mississippi River and its abandoned [illegible] and distributaries. Deposits frequently over 100 ft thick along the present river.

Textural groups: Mixtures of about 15 percent fat clay (CH), 1[illegible] percent lean clay (CL), 35 percent silt (ML), 15 percent silty sand (SM), and [illegible] percent sand (SP). The percentages of clay and silt increase with depth.

Organic content: Normally quite low. Some organic clay (OH) may be present in shallow swales at or near the surface of the deposits.

Water content: Varies from 30 to [illegible]0 percent dry weight for clays and 25 to 35 percent for silts.

Angle of internal friction: 25 to 35 deg for sand (SP).

⑤

Environment of deposition: Interdistributary

Method of deposition: Formed as clay wedges between major distributaries. Clay sequence interrupted by silty or sandy materials associated with myriad small distributaries. Thickness similar to intradelta deposits.

Textural groups: About 80 percent very soft to medium fat clays (CH), 10 percent silt (ML), and 10 percent lean clay (CL), silty sand (SM), and sand (SP). The silt and sand normally occur as thin partings between slightly thicker clay lenses.

Organic content: Very thin layers of finely divided particles or zones of moderately organic clay (OH) in the upper portions of the unit where there is usually a gradation into overlying marsh or swamp deposits.

Water content: Varies from 50 to 100 percent dry weight for fat clays (CH) and from 70 to 210 percent for organic clays (CH).

Cohesive strength: Ranges between 100 and 450 lb per sq ft for fat clays. When organic matter is present, the strengths are considerably lower.

3

[illegible]
Thin (up to 3 in.) layers of silt (ML) or silty sand (SM) [illegible]
In marsh areas, a 6-in. to 12 in. [illegible]
Stumps and logs occur frequently throughout the deposits [illegible]

Organic content: Normally about 10 to [illegible] percent by volu[illegible] tend to have higher organic contents than swamp deposits.

Water content: Highest of any in the area. The normal r[illegible] between 75 and 500 percent dry weight.

Cohesive strength: No data available for marsh deposits. [illegible] tween 250 and 900 lb per sq ft for organic clays in swamp[illegible]

SPECIAL CONSIDERATIO[illegible]

Certain special conditions exist in the New Orleans [illegible] taken into consideration in nearly all types of construct[illegible] the conditions described below only occur in one or two o[illegible] [illegible] of the map units, others may be encountered through[illegible]

PEAT AND ORGANIC DEPOSITS

The widespread occurrence of materials of this type [illegible] in the New Orleans area. These deposits necessita[illegible] and expensive excavation and construction. It is emphas[illegible] [illegible] may be encountered in areas other than those in w[illegible] at the surface (Map Units I through L). Zones up to 4 f[illegible] in Map Units [illegible] and H, and minor occurrences can be expec[illegible] [illegible] usually have a lower water content and a[illegible] than the surficial ones.

Occasional logs, stumps, and other large pieces of [illegible] designated by Map Units [illegible] through L. Less frequent occu[illegible] [illegible] in the natural levee deposits (environment of dep[illegible] areas designated by Map Units C through F. Well-preserv[illegible] having diameters as large as 12 to 1[illegible] ft have been encou[illegible] these areas at depths as great as 15 ft below the ground [illegible]

GROUNDWATER CONDITIONS

General The permanent water table in the New Orleans a[illegible] little from a depth of [illegible] to 1[illegible] ft below the ground surfa[illegible] year. This is a [illegible] of the nature of the deposit[illegible] of the land surface (average elevation = 5 ft above mean [illegible] relatively high precipitation (average annual rainfall = [illegible]

Water tables in the predominantly clayey deposits v[illegible] and usually slowly. The variations that do occur are us[illegible] local precipitation. The highest water tables occur in [illegible] deposits (see environment of depositions 6 and 8). Those [illegible] the limits of artificial levee protection (Map Unit L) a[illegible] to a depth of at least several inches at various times th[illegible] to a depth of several feet during tropical storms (about [illegible] yr). The groundwater in the beach sand (environment of [illegible] Units A, B, and C) is hydraulically connected with Lake [illegible] occasionally become brackish at the lower depths during [illegible] rainfall.

Hydrostatic pressures Greatest fluctuations in the wate[illegible] point-bar deposits (environment of deposition 4, Map Uni[illegible] Mississippi River. Highest water tables occur during sp[illegible] on the river (17 to 20 ft msl) while lowest water tables [illegible] and winter low-water stages (0 to 5 ft msl).

During high-water stages, excess hydrostatic pressu[illegible] in the point-bar silts and sands. The periodic occurren[illegible] must be considered in foundation design and in deeper ex[illegible] tions greater than about 10 ft in depth are to be mainta[illegible] stages, techniques must be employed that will prevent pi[illegible]

Similar hydrostatic pressures may occur in sand uni[illegible] of 30 ft. The effectiveness of the overlying clays or o[illegible] venting seepage into an excavation and the need for reli[illegible] will vary considerably from one area to another and will [illegible] for each particular site.

Chemical quality In general, corrosion of steel piling [illegible] piling is not a problem in the New Orleans area. Since [illegible] most always high throughout the year, alternate wetting [illegible] piling normally does not occur. Where such exposure mig[illegible] steel piling can be protected by a bituminous coating or [illegible] Numerous large buildings in the city are constructed on [illegible] yellow pine piles which, after a period of 20 or more ye[illegible] indications of rotting.

L CONSIDERATIONS

FOUNDATION ENGINEERING DATA

The foundation conditions which exist in the New Orleans area demand that thorough subsurface investigations be conducted for all large structures. Consequently, a large collection of boring logs, soils reports, and related data exists for the area. These data can usually be examined and/or obtained from numerous organizations or government agencies. A partial list of the more important agencies is as follows:

U. S. Army Engineer District, New Orleans, La.
U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Orleans Levee Board, New Orleans, La.
Louisiana Department of Public Works, Baton Rouge, La.
Louisiana Department of Highways, Baton Rouge, La.
New Orleans Railroad Terminal Board, New Orleans, La.

(Continued on last page)

In addition to the preceding sources, there are a number of foundation engineering firms or consultants which have had considerable experience in the area. A partial list of the larger firms having offices in the city is given below:

B. M. Dornblatt & Associates, Inc.
ETCO Engineers & Associates
Eustis Engineering Co.
Gillen Engineering Co.
McClelland Engineers, Inc.
Nelson Waldemar & Co., Inc.
Palmer & Baker Engineers, Inc.

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Fisk, H. N., "Recent Mississippi River Sedimentation and Peat Accumulation," Compte Rendu du quatrième Congrès pour l'Avancement les Études de Stratigraphie et de Géologie du Carbonifère. (Heerlen, 15-21 Septembre 1951) - 1952. pp. 187-199.

Kaston, R. T., Recent Geomorphic History of the Pontchartrain Basin, Louisiana. Coastal Studies Inst., Louisiana State Univ., Tech. Rpt. No. 1, Baton Rouge, February 1953.

U. S. Army Engineer Waterways Experiment Station, Geological Investigation of the New Orleans Harbor Area. Tech. Mem. No. 3-391, Vicksburg, June 1954.

_____, Geology of the Mississippi River Deltaic Plain, South-eastern Louisiana, by C. R. Kolb and J. R. Van Lopik, Vicksburg, July 1958. (Tech. Rpt. No. 3-483, 2 vols.).

_____, Distribution of Soils Bordering the Mississippi River from Donaldsonville to Head of Passes, by C. R. Kolb. Tech. Mem. No. 3-461, Vicksburg, June 1958.

Works Progress Administration of Louisiana, Some Data in Regard to Foundations in New Orleans and Vicinity. New Orleans, 1937.

ENGINE

CHARACTERISTIC MATERIAL	ENVIRONMENT OF DEPOSITION	EXCAVATION CHARACTERISTICS
CH, SM	1, 2, 4	Excavation above water table is easy and can be performed with conventional equipment. Soils below the water table must be dewatered.
ML	2, 3, 4	See above.
CH, CL	3, 5, 6, 7	Difficulty generally increases with increased water content.
Pt, OH	6, 8	Difficult under most conditions. Stumps and logs frequently present, particularly in swamp

ASPECTS OF SHELTER CONS

The engineering characteristics of the soils represented in each of the map units are described below in terms of their influence on the design and construction of specific structures. Three general types and/or sizes of structures were assumed for the descriptions. For the purposes of this map folio, each of the structures represents an assumed fallout shelter style or type. Although the dimensions given for the shelter types may depart considerably from those being considered by the Office of Civil Defense, they nevertheless represent a range of sizes sufficiently great to include a wide variety of types. Furthermore, the information contained in this table can be modified to apply to any size or type of shelter which may be developed for general utilization.

SHELTER TYPE 1

Single-level, above-ground shelters. Designed for (a) family use, 100 sq ft, or (b) community use, 1000 sq ft. Maximum floor depth is 2 to 3 ft below ground surface. Concrete or brick walls with concrete roof slab and a 3-ft earth cover are assumed. Walls will be protected by an earth fill at least 3 ft thick.

Multilevel, below use, 200 sq ft. Concrete or brick 20 ft with a multi cover and

MAP UNIT	ENVIRONMENTS AND PREDOMINANT LITHOLOGIC UNITS	SHELTER TYPE	CONSTRUCTION ASPECTS
A	0 / 10 / (1) SP	1	A1a. No excavation or dewatering problems should occur since the water table is generally more than 5 ft below surface. Sandy material removed from shallow excavations is excellent for fill when barged. When used as an unprotected earth cover, the material is susceptible to wind and water erosion. Most of the necessary fill material must be hauled to the site.
		2	A2a. In excavations below the normal water table (about 5 ft) provisions should be made for dewatering. The use of wellpoints is probably the most practical dewatering method. Assuming adequate dewatering, excavation slopes of 1 on 1-1/2 should be satisfactory. Excavated material is suitable for backfill and fill cover (see section A1a above).

ENGINEERING CHARACTERISTICS OF SOILS

EXCAVATION CHARACTERISTICS	DEWATERING REQUIREMENTS	STABILITY OF EXCAVATION SLOPES	BEARING PRESSURES AND SETTLEMENT
Excavation above water table is easy and can be performed using conventional equipment. Soils below the water table must be dewatered.	Soils below the water table must be dewatered. Large diameter wells or wellpoint systems are required. Capacity of system based on maximum river stages anticipated.	Slopes of 1 on 1-1/2 for soils above the water table and, with effective dewatering, below the water table. Slopes of 1 on 3 for slopes subjected to emergent seepage.	Favorable foundation conditions. High bearing pressures may be used; values depend on size of footings. Settlements will be minor. Control of uplift pressures is necessary below the water table.
See above.	Soils below the water table usually require dewatering. Wellpoint systems are usually adequate. Effective dewatering is sometimes difficult to attain.	Slopes of 1 on 3 for soils above the water table, and with effective dewatering, below the water table. Flatter slopes for slopes subjected to emergent seepage.	Favorable foundation conditions. Moderately high bearing pressures may be used. Settlements will be minor. Control of uplift pressures is usually necessary for foundations below the water table.
Difficulty generally increased with increased water content.	None required, although pressure relief in underlying pervious strata is sometimes necessary. Surface water is controlled by ditches and sumps.	Vertical cuts to depth, H_c : Very soft clay, $H_c \leq 5$ ft Soft clay, $H_c = 5$ to 10 ft Medium clay, $H_c = 10$ to 15 ft Design of slopes in clay is usually complex.	Bearing pressures medium to low. Settlement large to medium, depending primarily on water content and degree to which structure loads exceed loads previously imposed during geologic history.
Difficult under most conditions. Stumps and logs frequently present, particularly in swamps.	Very difficult to dewater. Drainage ditches or wellpoints are sometimes satisfactory.	Flat slopes usually required, unless test based on local experience. Bracing and shoring are usually not satisfactory if depth of deposit is great.	Unfavorable foundation conditions. Bearing pressures are very low and settlements as a rule very great.

SHELTER CONSTRUCTION

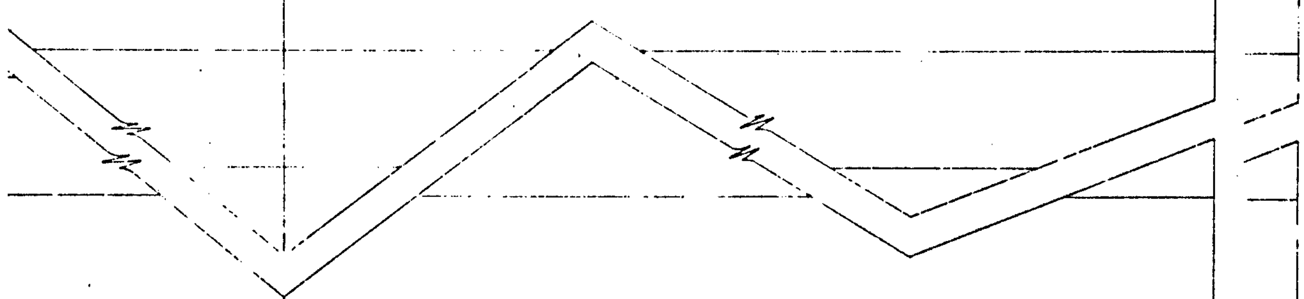
	SHELTER TYPE 2	SHELTER TYPE 3
(a) fam- ft. ase. id a ated	Multilevel, below-ground shelters designed for community use, 2000 sq ft or more. Maximum floor depth is 40 ft. Concrete or brick walls extending to a maximum depth of 30 ft with two shelter levels which form the basement for a multistoried building, or are overlain by a concrete cover and an earth fill 3 ft thick.	Single-level, below-ground shelters designed for (a) family use, 150 sq ft, or (b) community use, 1000 sq ft. Maximum floor depth is 10 ft. Concrete or brick walls with concrete roof slab and a 3-ft-thick earth cover are assumed. Above-ground walls to be protected by an earth fill at least 3 ft thick.

	DESIGN ASPECTS
is generally more than 5 ft for fill when hogged. When water erosion. Most of the	Alb. Sand will support structures with little settlement resulting. Slab- or footing-type foundations will be adequate for family-type shelters. Footings normally will be required for larger structures. Allowable bearing pressures are relatively high.
could be made for dewatering. suming adequate dewatering, is suitable for backfill and	A2b. The depth of the foundation should be influenced by the amount of material required for cover and backfill. No settlement of structures is anticipated. Slab-type foundations should be designed to withstand anticipated uplift pressures, or adequate provisions should be made for relief of these pressures.

	20–30	3	A3a. A substantial dewatering system, probably consisting of wellpoints, will be required. Excavation [illegible] slopes of 1 on 2 should be satisfactory. Where size of excavation is restricted by adjacent buildings, bu[illegible] etc., sheeting or bracing may be required, and disposal of spoil may be a problem.
B	0–30: ② ML; ① SP	1	B1a. No excavation or dewatering problems should occur since the water table is generally more than 5 ft below surface. Materials excavated from either environment of deposition can be used for fill if [illegible] For further information concerning earth fill, see section A1a above.
		2	B2a. In excavations below the normal water table (about 5 ft) control of groundwater should not be a[illegible] major problem. [illegible] into [illegible] ditches and sumps will be adequate; the [illegible] will depend [illegible] the nature of the soil. Excavation slopes between 1 on 2 and 1 on 3 should be satisfactory. Determina[illegible] tion of slopes will depend primarily on the nature and thickness of the soil in environment of deposition [illegible] a. This type soil will be suitable for backfill and cover if compacted by power tampers.
		3	B3a. Provision should be made for dewatering of the excavation. Wellpoints will probably be the most [illegible] satisfactory method. Assuming adequate dewatering, excavation slopes of about 1 on 2 or 1 on 3 should be [illegible] adequate. Final determination of the most practicable excavation slopes will depend on the local stra[illegible] tigraphy. Where size of excavation is restricted by adjacent buildings, etc., sheeting or bracing may be [illegible] required, and disposal of spoil may be a problem.
L	0–30: ⑧ Pt-OH (5); ② ML (18)	1	
		2	Construction of shelters o[illegible] map unit is inadvisable. [illegible] control of surface water, [illegible] removal and wasting of up to [illegible] portation of large quantities [illegible] tion treatment would be required [illegible] struction in these areas is [illegible]
		3	

3

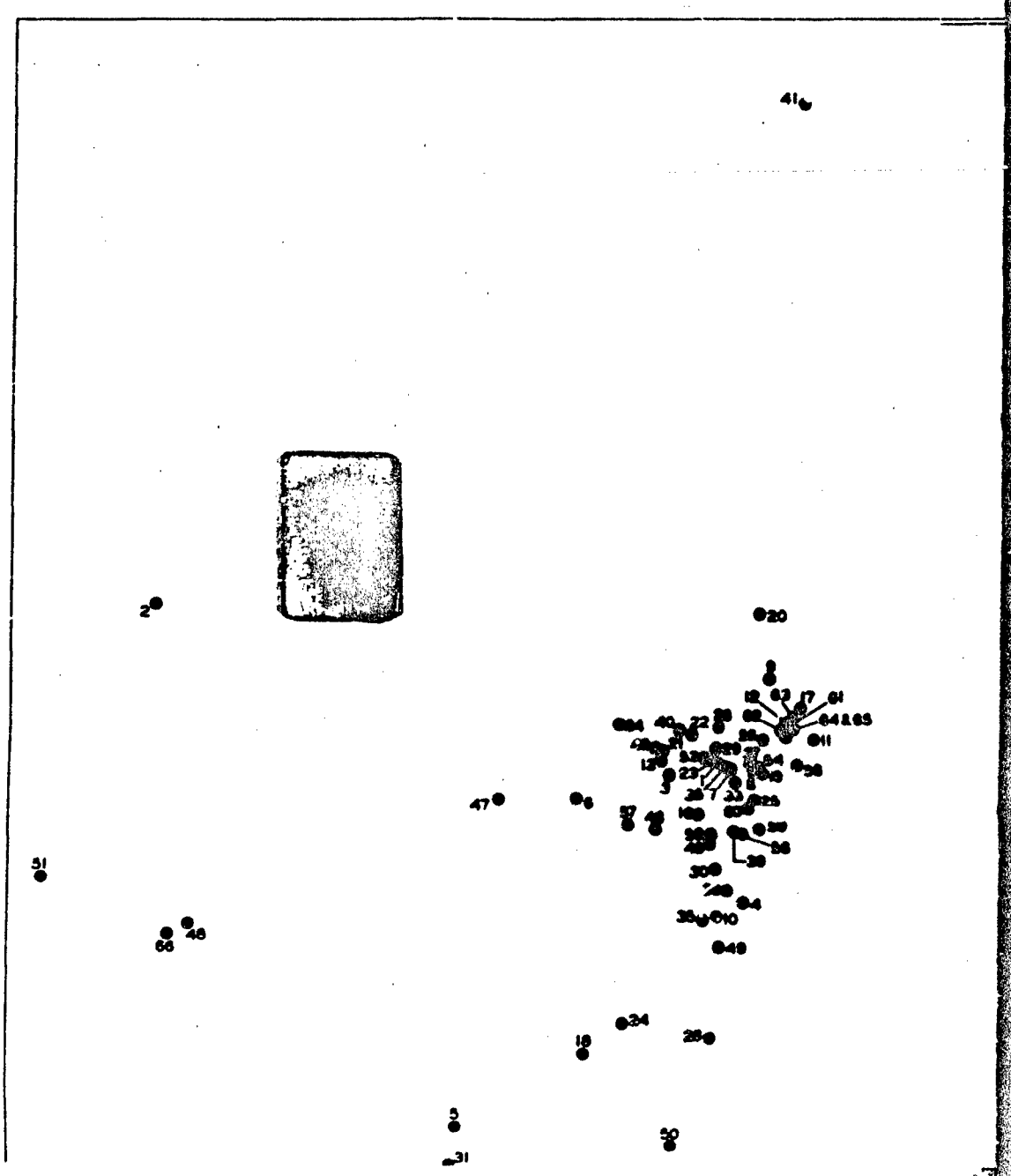
[illegible] be required. Excavation [illegible] by adjacent buildings, [illegible]	A. [illegible] foundations [illegible] designed to withstand anticipated uplift pressures, or adequate provision [illegible] for relief of these pressures. Depending on the extent and character of underlying [illegible] settlement may be a problem for multistory structures. Pile foundations [illegible] if differential settlements would be significant. A possible alternate method would be to design the structure with [illegible] foundations [illegible] weight of structure is balanced by weight of excavated materials. Advice of an experienced foundation engineer is [illegible] (Foundation Engineering Data Section).
[illegible] generally more than [illegible] fill [illegible]	B. Sand in environment of deposition 1 will support structures with little settlement resulting. Some detrimental settlement may occur if significant amounts of the fine-grained materials in environment of deposition [illegible] occur beneath the foundations. [illegible] foundations generally will be adequate for family-type shelters. [illegible] normally will be required for larger structures. Allowable bearing pressures are [illegible] lowest in the environments of deposition but highest in environment of deposition 1.
[illegible] water should not [illegible] method will depend on [illegible] satisfactory. [illegible] in environment of deposition [illegible] power tampers.	C. The depth of foundation should be independent of the amount of material required for cover and backfill. Some differential settlement may occur due to the placement of fill and backfill, the amount of settlement will largely depend on the quantity of fine-grained materials present below the foundations (environment of deposition [illegible]). [illegible] foundations should be designed to withstand anticipated uplift pressures or adequate provision should be made for relief of these pressures.
[illegible] will probably be the most [illegible] should be [illegible] depend on the local [illegible], sheeting or bracing may be	D. The [illegible] are similar to those listed in section A above. The presence of the fine-grained materials in environment of deposition [illegible] should not be very significant. However, a thorough subsurface exploration might reveal that a more favorable foundation could be achieved by lowering the foundation [illegible] the relatively [illegible] materials in environment of deposition 2.



nstruction of shelters of any type in the area designated by this [illegible] unit is inadvisable. It would require clearing of vegetation, ntrol of surface water, building of access roads, flood protection, moval and wasting of up to 1[illegible] ft of organic peat and muck, and imrtation of large quantities of fill. Extensive and costly foundaon treatment would be required. A favorable aspect of shelter conruction in these areas is the generally lower land acquisition costs.

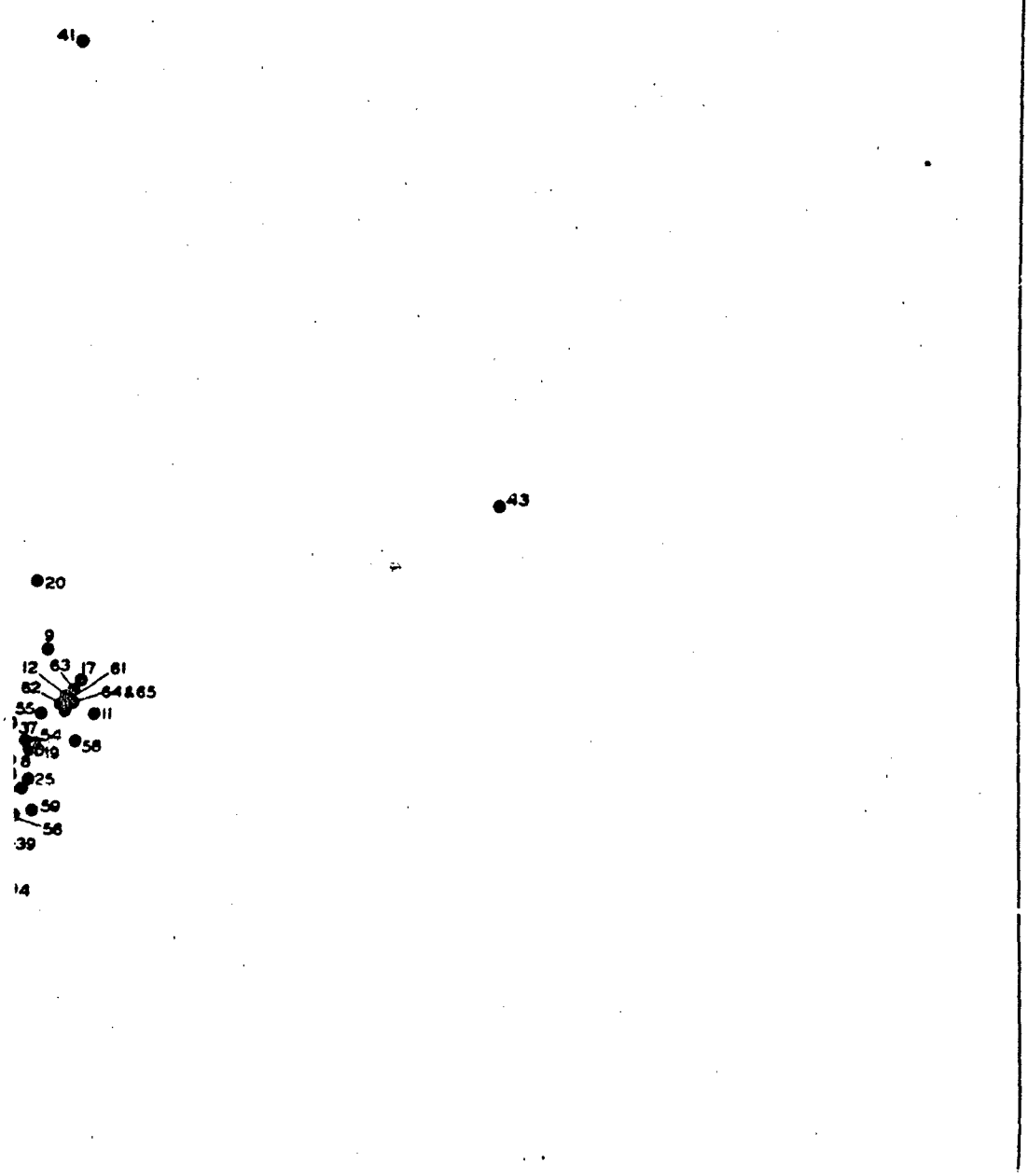
EXISTING FALLOUT SH

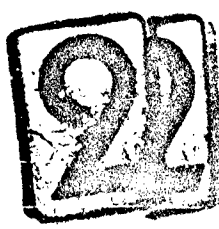
DECEMBER 1962 1962

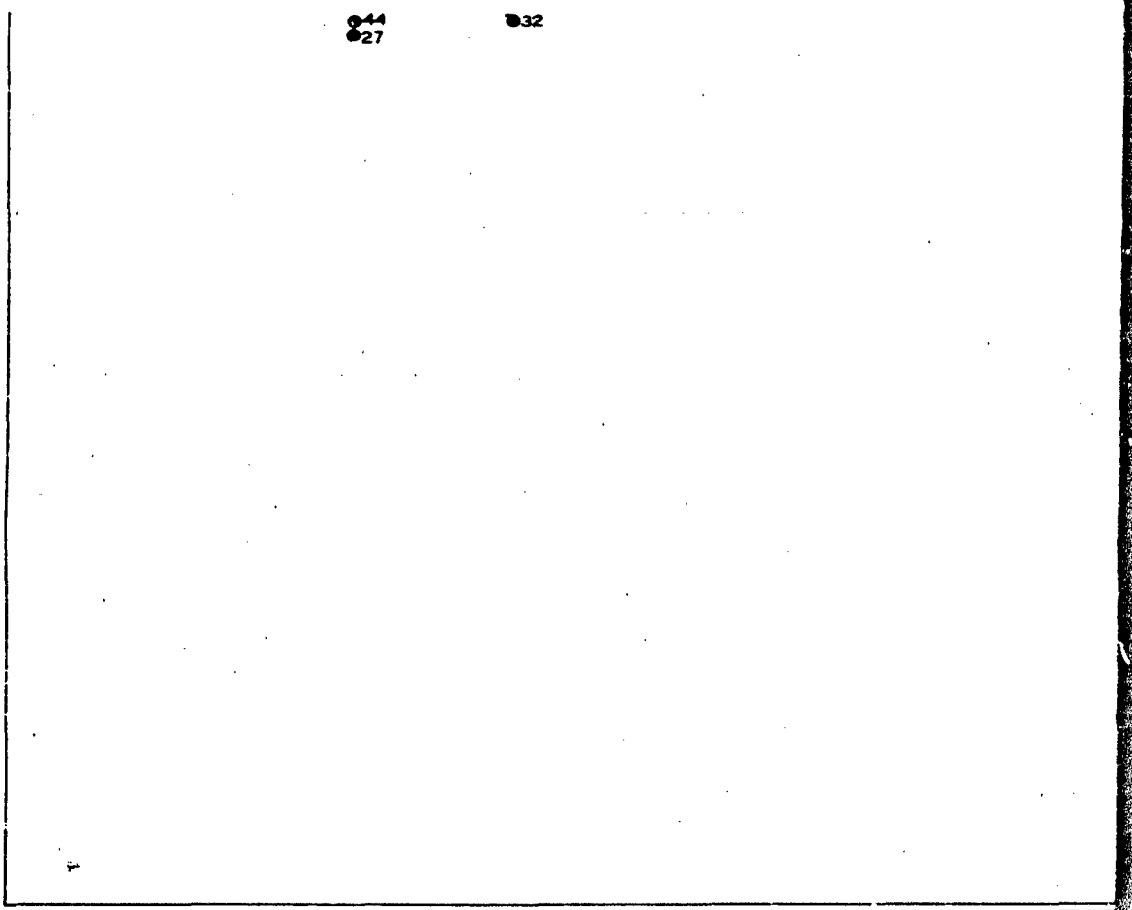


G FALLOUT SHELTERS

DECEMBER 1962







The fallout shelters designated on this map were established as a result of Phases 1 and 2 of the nationwide Fallout Shelter Survey and Marking Program conducted by the U. S. Army Corps of Engineers. The data included herein were furnished by the Orleans Parish Civil Defense Director, New Orleans, La.

DESIGNATED SHELTERS

		Capacity (Persons)
1.	BARONNE BLDG. 305 Baronne St.	1463
2.	BURTON MEMORIAL HOME 3320 S. Carrollton Ave.	180
3.	CIVIL COURTS BLDG. Loyola Ave.	530
4.	GALLAGHER STORAGE 945 Magazine St.	171
5.	GHISALBERTI APTS. 3405 St. Charles Ave.	50
6.	GIBBONS SEED BLDG. 2700 Howard Ave.	81
7.	HIBERNIA NATIONAL BANK 812 Canal St.	2278
8.	INTERNATIONAL HOUSE 607 Gravier St.	1590
9.	MRS. MARY KELLY - KELSTO CLUB	196
10.	LEE CIRCLE BLDG. 1040 St. Charles St.	479
11.	LEHMAN NOVELTY CO. 301 Decatur St.	101
12.	LOUBAT GLASSWARE CO. LTD. 516 Bienville St.	309
13.	LA. STATE OFFICE BLDG. 325 Loyola Ave.	597
14.	*LSUNO GENERAL CLASSROOM Lakeshore Drive	160
15.	*LSUNO SCIENCE BLDG. Lakeshore Drive	
16.	LA. STATE WELFARE DEPT. 915 Lafayette St.	
17.	LA. WILDLIFE & FISHERIES BLDG. 418 Royal St.	
18.	MAYFLOWER APTS. 2203 St. Charles Ave.	
19.	MEYER MEMORIAL 211 Camp St.	
20.	MUNICIPAL AUDITORIUM 1201 St. Peter St.	
21.	NEW ORLEANS CITY HALL 399 Gerdudi St.	
22.	NEW ORLEANS PUBLIC LIBRARY 215 Loyola Ave.	
23.	NEW ORLEANS PUBLIC SERVICE INC. 317 Baronne St.	
24.	PONTCHARTRAIN HOTEL 2031 St. Charles Ave.	
25.	QUEEN & CRESCENT BLDG. 344 Camp St.	
26.	ROOSEVELT HOTEL 120 University Pl.	
27.	ST. ELIZABETH SCHOOL 1314 Napoleon Ave.	
28.	ST. VINCENT HOSPITAL 1507 Magazine St.	
29.	SEARS, ROEBUCK & CO. 201 Baronne St.	
30.	STEPHEN CHEVROLET CO. 840 Carondelet St.	
31.	TOURO CONVALESANT PAVILLION 3516 Prytania St.	
32.	TOURO GODCHAUX PAVILLION 3516 Prytania St.	
33.	UNITED FRUIT CO. 321 St. Charles St.	
34.	VETERANS HOSPITAL 1601 Perdido St.	
35.	WOHL APTS. 211 St. Charles Ave.	
36.	Y.M.C.A. 936 St. Charles St.	
37.	WHITNEY BANK BLDG. 226 St. Charles St.	
38.	PAN AMERICAN BLDG. 610 Poydras St.	
39.	LAFAYETTE HOTEL 628 St. Charles St.	
40.	Y.W.C.A. 929 Gravier St.	

3

CE BLDG. Lakeshore Drive	144
ELFARE DEPT. 915 Lafayette St.	1097
E & FISHERIES BLDG. 419 Royal St.	1922
ITS. 220 St. Charles Ave.	2073
[illegible] Camp St.	247
DITORIUM [illegible] St. Peter St.	1690
CITY HALL 399 Gerdudi St.	1260
PUBLIC LIBRARY 215 Loyola Ave.	931
PUBLIC SERVICE INC. 317 Baronne St.	1495
IN HOTEL 2031 St. Charles Ave.	56
SCENT BLDG. 344 Camp St.	495
OTEL 120 University Pl.	29,621
TH SCHOOL 131 Napoleon Ave.	288
HOSPITAL 1507 Magazine St.	254
UCK & CO. 201 Baronne St.	4168
VROLET CO. 340 Carondelet St.	768
LESANT PAVILLION 3516 Prytania St.	281
AUX PAVILLION 3516 Prytania St.	438
T CO. 321 St. Charles St.	2589
SPITAL 1601 Perdido St.	4368
211 St. Charles Ave.	8418
36 St. Charles St.	498
K BLDG. 226 St. Charles St.	16,904
N BLDG. 610 Poydras St.	1643
OTEL 623 St. Charles St.	364
49 Gravier St.	499

41.	DILLARD UNIVERSITY 2601 Gentilly Blvd.	78
42.	SARATOGA BLDG. 212 Loyola Ave.	--
43.	NICHOLLS SCHOOL 3820 St. Claude Ave.	--
44.	WRIGHT HIGH SCHOOL 1426 Napoleon Ave.	--
45.	RABOUIN HIGH SCHOOL 715 Carondelet St.	--
46.	MOSS SCHOOL CLINIC 214 Girod St.	--
47.	B. T. WASHINGTON SCHOOL AUDITORIUM 1201 St. Roman St.	--
48.	MC MAIN HIGH SCHOOL 2815 Nashville Ave.	--
49.	JACKSON SCHOOL 1408 Camp St.	--
50.	LAUREL SCHOOL 841 Phillip St.	--
51.	LUSHER SCHOOL 7331 Willow St.	--
52.	BAUER-NICHOLAS BLDG. 703 Carondelet St.	--
53.	COMMERCE BLDG. 821 Gravier St.	--
54.	SHERATON-CHARLES HOTEL 213 St. Charles St.	--
55.	MARK ISAACS CO. 715 Canal St.	--
56.	U.S. POST OFFICE 600 Camp St.	--
57.	POST OFFICE - FEDERAL BLDG. 701 Loyola Ave.	--
58.	U.S. CUSTOM HOUSE 423 Canal St.	--
59.	FEDERAL OFFICE BLDG. 600 South St.	--
60.	TIMES-PICAYUNE CO. 615 North St.	--
61.	MONTELEONE HOTEL 208 Royal St.	--
62.	MONTELEONE HOTEL ANNEX 202 Royal St.	--
63.	MONTELEONE HOTEL ANNEX 228 Royal St.	--
64.	MONTELEONE GARAGE 623 Bienville St.	--
65.	MONTELEONE GARAGE 624 Bienville St.	--
66.	URSULINE CONVENT 2635 State St.	--

* Not shown on this map.

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