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ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MISS F/G 13/2
DREDGED MATERIAL RESEARCH. NOTES, NEWS, REVIEWS, ETC. VOLUME D---ETC(U)
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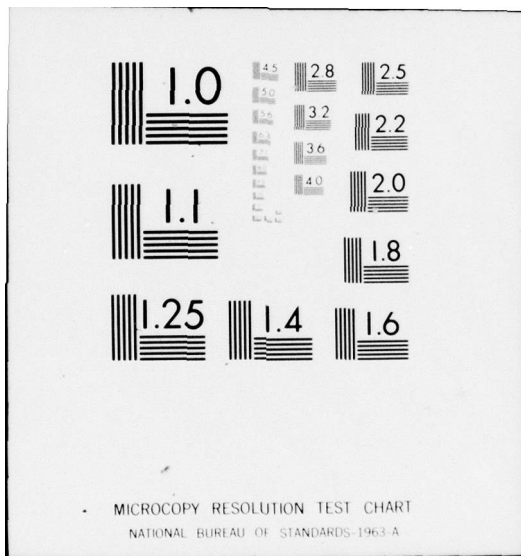
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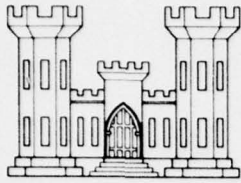
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DREDGED MATERIAL RESEARCH



U. S. ARMY CORPS OF ENGINEERS
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NOTES NEWS REVIEWS etc.

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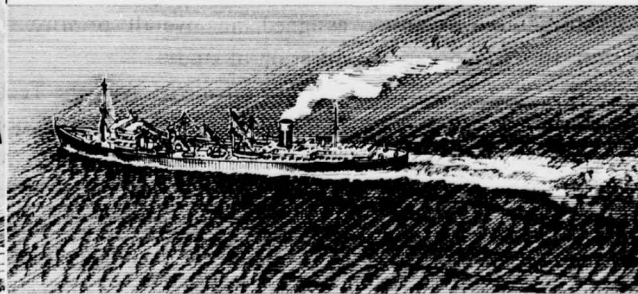
ENVIRONMENTAL PROTECTION AGENCY/
CORPS OF ENGINEERS
TECHNICAL COMMITTEE ON CRITERIA FOR
DREDGED AND FILL MATERIAL



ECOLOGICAL EVALUATION OF PROPOSED DISCHARGE OF DREDGED MATERIAL INTO OCEAN WATERS

Implementation Manual for Section 103 of Public Law 92-532
(Marine Protection, Research, and Sanctuaries Act of 1972)

July 1977



PUBLISHED BY
ENVIRONMENTAL EFFECTS LABORATORY
U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

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ENVIRONMENTAL EFFECTS LABORATORY
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VICKSBURG, MISSISSIPPI

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TUESDAY, JANUARY 11, 1977
PART VI



ENVIRONMENTAL
PROTECTION
AGENCY

OCEAN DUMPING

Final Revision of Regulations and Criteria

DISTRIBUTION STATEMENT A

Approved for public release;
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register

In the fall of 1975, an agreement was reached between the research and development offices of the U. S. Environmental Protection Agency (EPA) and the U. S. Army Corps of Engineers (CE) to form a joint Technical Committee on Criteria for Dredged and Fill Material. The committee was organized to focus attention on research coordination and needs of the two agencies. The First Annual Report of the Joint Committee and the publication of an Implementation Manual for Section 103 of Public Law 92-532 (shown above) are described in the following two articles.

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FIRST ANNUAL REPORT

March



**PUBLICATION OF THE EPA/CE
TECHNICAL COMMITTEE'S
FIRST ANNUAL REPORT**

The joint Technical Committee on Criteria for Dredged and Fill Material is cochaired by Dr. Frank Wilkes of the EPA and Dr. Robert M. Engler of the Corps. The First Annual Report presents the first year's effort to coordinate and disseminate results of agency research related to regulatory functions pursuant to Sections 404 and 103 of Public Laws (PL) 92-500 and 92-532, respectively.

A major goal of the Technical Committee is the development of a comprehensive manual for technical implementation of all ecological testing phases of PL 92-500 and 92-532. (Publication of the Implementation Manual for Section 103 of PL 92-532 is discussed in the following article.) Other objectives of the Technical Committee are to recommend needed research priorities in order to implement fully Sections 404 and 103, establish joint research projects and priorities, conduct joint program reviews, avoid duplication of effort, and exchange and disseminate research results. The Technical Committee will also review and evaluate interim testing procedures promulgated by the CE for immediate implementation by field units. The group was also constituted to make recommendations to top-level agency management.

The Technical Committee was organized as an interagency committee limited to staff who have broad knowledge, responsibilities, and understanding of needs for research programs in dredged and fill material discharge activities. The Technical Committee consists of six subcommittees cochaired by EPA and CE personnel: the Bioassay/Bioevaluation, Area Definitions, Contaminants, Physical Impacts, Mixing Zone, and Fill Material Subcommittees. The scope of the Technical Committee and respective subcommittees includes all pertinent research, past, present, and future, conducted to determine the potential usefulness of or to modify methodologies to predict and determine ecological impacts. It also includes the assembly and synthesis of technical information for the purpose of developing an implementation manual suitable for conducting the evaluation mandated by both Section 404 and 103 of PL 92-500 and 92-532, respectively.

The following members are currently appointed by the respective agencies:

EPA

Dr. Frank Wilkes, Cochairman
Dr. William Brungs
Dr. Mark Carter
Mr. William S. Davis
Dr. Jack Gentile
Dr. Harold Kibby
Dr. Paul Lefcourt
Dr. Michael D. Mullin

CE

Dr. Robert M. Engler, Cochairman
Mr. M. Burton Boyd
Dr. John Harrison
Dr. John W. Keeley
Dr. Richard K. Peddicord
Dr. Roger T. Saucier

Presented in the First Annual Report is a listing of all related EPA and CE ongoing research programs directly related to dredged and fill material regulatory functions. The listing is presented and discussed by each subcommittee in order that there would be no duplication in recommending and assigning priorities for needed research programs. Presented also is a listing and thorough discussion of 16 research areas identified as requirements for complete implementation of Sections 404 and 103, with each area of research assigned an overall priority, projected costs, and duration of study.

The effectiveness of the Technical Committee can best be judged by the program coordination described in the Annual Report and by the research priorities described therein. Other direct measures of effectiveness are the workshops sponsored through the subcommittees to pursue highly specific goals for individual requirements of Section 404 and 103 of the Public Laws. Of equal importance, however, has been the significantly increased level of communication among CE and EPA research elements and field units. This increased communication will lead to a more effective and efficient management of each agency's respective regulatory and research program.

Copies of the report may be purchased from the National Technical Information Service (address: 5285 Port Royal Road, Springfield, Virginia 22151). In ordering, the NTIS ID number ADA 040 662 should be mentioned.

**IMPLEMENTATION MANUAL
PUBLISHED FOR SECTION 103 OF
PL 92-532 (MARINE PROTECTION,
RESEARCH, AND SANCTUARIES
ACT OF 1972)**

An ecological evaluation of the proposed discharge of dredged material into ocean waters to determine the potential for environmental impact is required by Section 103 of PL 92-532 (Marine Protection, Research, and Sanctuaries Act of 1972). Criteria for these evaluations were published in the *Federal Register* (Vol. 42, No. 7, Tuesday, 11 January 1977) by the EPA. These criteria specified in Section 227.27(b) that the EPA jointly with the CE would publish an implementation manual pursuant to the criteria. The Implementation Manual would provide procedures for the evaluation of the potential environmental impacts of the discharge of dredged material into ocean waters: an evaluation that is required in considering permit applications for the transportation of dredged material for ocean dumping.

The task of developing the specific approaches and procedures to be used in the evaluation process was undertaken by the EPA/CE Technical Committee on Criteria for Dredged and Fill Material (see Dredged Material Research Program (DMRP) Information Exchange Bulletin MP D-76-4, April 1976). At the request of the Office, Chief of Engineers, and the Marine Protection Branch (EPA), the Environmental Effects Laboratory (EEL) of the Waterways Experiment Station (WES) published this manual for the evaluation of permit applications and development of statements of findings.

Preparation and publication of the Implementation Manual was conducted under the technical guidance of Dr. Richard K. Peddicord, EEL. Dr. Peddicord also co-chairs the Bioassay/Bioevaluation Subcommittee of the Technical Committee with Dr. Jack H. Gentile of the Environmental Research Laboratory, EPA, Narragansett, Rhode Island.

The manual was published and distributed in July 1977 to all Corps and EPA field elements in a document entitled "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters" (referred to as the Implementation Manual and available from WES as a joint EPA/CE publication). Procedures in the Implementation Manual represent a multidisciplinary

effort of both agencies to develop procedurally sound, routinely implementable guidance for complying with the *Federal Register*. Evaluation of ecological effects consists of two phases: selection of the appropriate tests or evaluation procedures and the interpretation of results for assessments of potential problems. The Implementation Manual defines the applicability of testing procedures to the evaluations specified in the *Federal Register* and presents limitations in interpreting the results.

The Implementation Manual is applicable to all activities involving the discharge of dredged material into ocean waters. The procedures presented are useful in evaluating the discharge from hopper dredges and from bottom- and end-dump barges and scows.

General approaches required for ecological evaluation involve estimation of potential impacts of the liquid, suspended particulate, and solid phases of dredged material; estimation of the bioaccumulation potential; and estimation of initial mixing. Detailed procedures include sediment and water sample collection, preparation, and preservation; chemical analysis of the liquid phase; bioassays of liquid, suspended particulate, and solid phases; estimation of bioaccumulation potential; the estimation of initial mixing; evaluation of prohibited materials; and interpretation of trace contaminant requirements.

The scope and comprehensiveness of the required evaluation may be seen in Figure 1, taken from the Implementation Manual, which shows the sequence of evaluation that must be applied. The Implementation Manual follows the general priority of importance of testing and evaluation procedures and the general order of test application given in the *Federal Register*.

During the conduct of the DMRP, it became apparent that an understanding of the potential for ecological harm from the discharge of dredged material into aquatic systems requires substantial state-of-the-art improvement in a number of fundamental technological areas. Therefore, such state-of-the-art improvements were included in appropriate DMRP tasks and respective work units and already have provided the basis for the evaluation procedures as well as the discussion of the applicability and limitations of test results in the Implementation Manual. Contributing DMRP tasks, primarily those in the Environmental Impacts and Criteria Development Project (EICDP) managed by Dr. Engler, are listed in Table 1. The

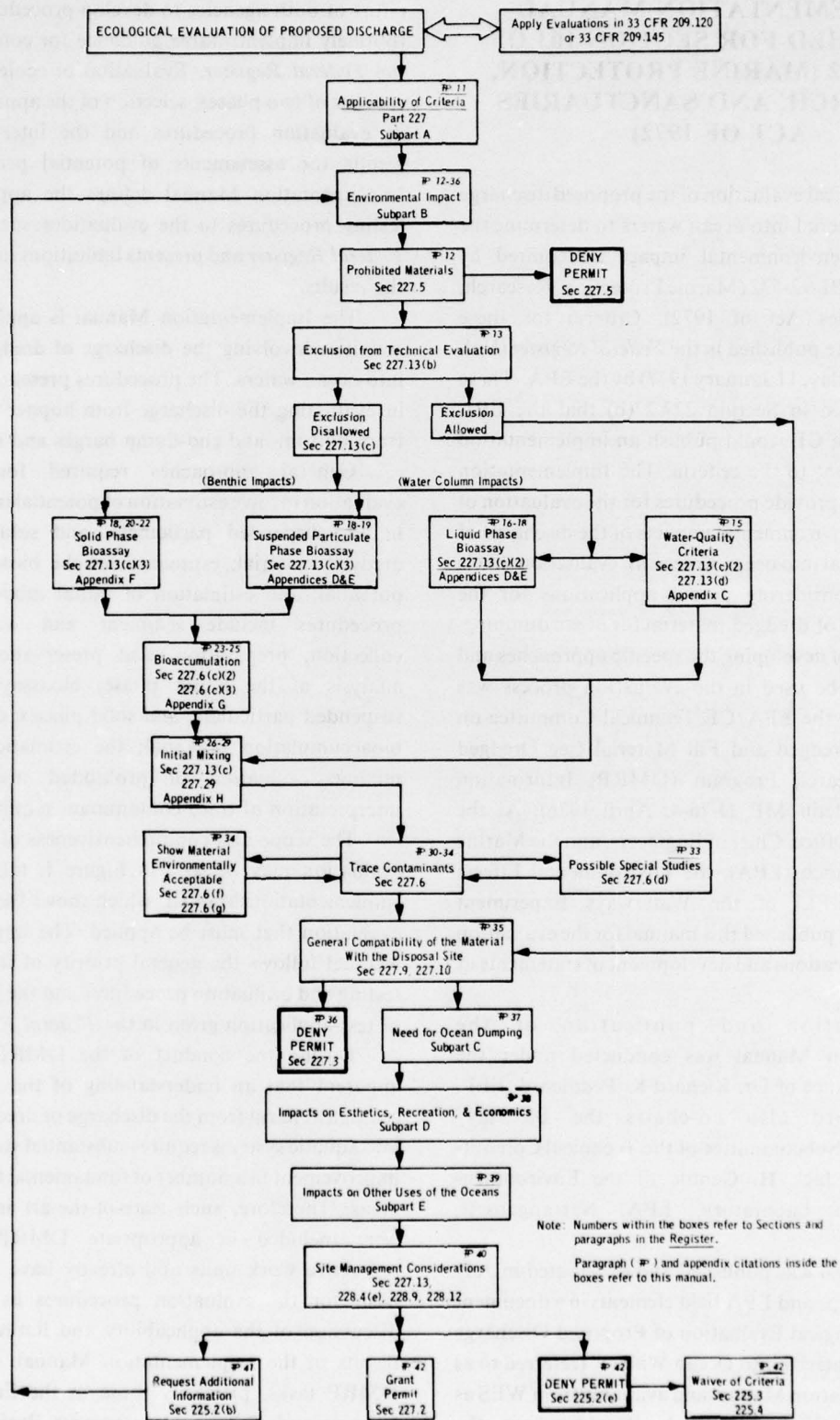


Figure 1. Sequence of testing and evaluation procedures

DMRP STATUS SUMMARY
30 June 1977

Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 1A: Aquatic Disposal Field Investigations				
1A01	Collection & Assessment of Data on Open-Water Disposal Sites	Interlaboratory team, WES ¹	Jun 75	\$124,785 Internal Working Document
1A02	Determination of Benthic Colonization Control Factors	EEL, ² WES	Jun 74	18,673 Completed. Data input to 1A05
1A03	Monitoring Equipment, Methodologies, and Institutional Capabilities	MESL, ³ WES	May 74	58,324 Internal Working Document
1A03A	A Nationwide Calibration, Standardization, and Evaluation of Environmental Monitoring Instrumentation for the Aquatic Disposal Research Project	National Oceanographic Instrumentation Center, NOAA, ⁴ Rockville, MD	May 76	95,000 Complete; no report planned
1A04	Development and Implementation of Information Storage Retrieval System	Concrete Lab, WES	Jun 75	291,410 User manual completed. System is active
1A05	Selection of Test Sites and Design of Field Studies, Open-Water Dredged Material Disposal Sites	Interlaboratory team, WES	Jan 75	63,890 Final report published: MP D-75-13
1A06	Eatons Neck (New York) Field Study			
1A06A	An Investigation of the Hydraulic Regime, the Meteorology, and the Physical Nature of Bottom Sedimentation in the Eatons Neck Disposal Site	Department of Geology and Geophysics, Yale University, New Haven, CT	Oct 75	145,390 Final report in publication
1A06B	An Investigation of the Water-Quality Parameters and the Physicochemical Sediment Parameters at the Eatons Neck Disposal Site	State University of New York at Stony Brook, NY	Jan 77	284,115 Final report in publication
1A06C	Baseline Studies of Plankton, Nekton, and Benthic Invertebrate Populations of the Eatons Neck Disposal Site	New York Ocean Science Lab, Mountauk, NY	Jan 77	264,717 Final report in publication
1A07	Columbia River (Oregon) Field Study			
1A07A	An Investigation of the Hydraulic Regime, the Meteorology, and the Physical Nature of Bottom Sedimentation in the Columbia River Disposal Site	Department of Oceanography, University of Washington, Seattle, WA	Dec 76	286,262 Final report being reviewed
1A07B	An Investigation of the Water-Quality Parameters and the Physicochemical Sediment Parameters at the Columbia River Disposal Site	Oregon State University, Corvallis, OR	Jan 77	264,890 Draft report in preparation*
1A07C	Baseline Studies of Benthic Invertebrate Populations at the Columbia River Disposal Site	Oregon State University, Corvallis, OR	Jan 77	251,412 Draft report in preparation*
1A07D	Baseline Studies of Plankton Populations at the Columbia River Disposal Site	Oregon State University, Corvallis, OR	Jan 77	94,135 Draft report in preparation*
1A07E	Baseline Studies of Fisheries at the Columbia River Disposal Site	National Marine Fisheries Service NOAA, Seattle, WA	Jan 77	114,522 Draft report in preparation*
1A07F	Assistance of Portland District Personnel for the Oregon State University Research Team	Portland District, CE	Mar 76	8,000 Completed; no report planned
1A08	Ashtabula (Ohio) Field Study			
1A08A, 1A08C	Investigation of Planktonic Communities, Benthic Assemblages, Fishery, Water-Quality Parameters, and Physicochemical Sediment Parameters Associated with the Ashtabula Harbor Disposal Site	The Great Lakes Laboratory, SUNY, Buffalo, NY	Jul 77	641,938 Draft report in preparation
1A08B	Investigation of the Hydraulic Regime and the Physical Nature of Bottom Sedimentation Associated with the Ashtabula Harbor Disposal Site	NALCO Environmental Sciences, Burlingame, CA	Feb 77	254,075 Draft report in preparation
1A09	Galveston (Texas) Field Study			
1A09A	An Investigation of the Hydraulic Regime and Physical Nature of Sedimentation at the Galveston Disposal Site	Texas A&M Research Foundation, College Station, TX	Jan 77	178,752 Final draft received

(Continued)

NOTES: Work unit titles in vertical lettering indicate efforts in progress or completed. Titles in italic lettering indicate efforts in advanced planning stages or contract negotiation.

- 1 Waterways Experiment Station
- 2 Environmental Effects Laboratory
- 3 Mobility and Environmental Systems Laboratory
- 4 National Oceanic and Atmospheric Administration
- 5 Soils and Pavements Laboratory
- 6 Pacific Northwest Environmental Research Laboratory, EPA
- 7 Cold Regions Research and Engineering Laboratory, U. S. Army
- 8 Construction Engineering Research Laboratory, U. S. Army

* Where the work unit status is marked by an asterisk, the report will be an appendix to a field site report.

	Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 1A: Aquatic Disposal Field Investigations (Continued)					
1A09B	An Investigation of the Biota at the Galveston Disposal Site	Texas A&M University, College Station, TX	Jan 77	\$168,507	Final report in preparation
1A09C	An Investigation of the Water-Quality Parameters and Physicochemical Parameters at the Galveston Disposal Site	Univ. of Texas, Dallas, TX	Dec 76	176,220	Final report in preparation
1A09D	Assistance of Galveston District's Contracts Branch for Contracting 1A09 Studies	Galveston District, CE	Feb 76	26,226	Completed; no report planned
1A10	Duwamish Waterway (Washington) Field Study				
1A10A	Pilot Survey - Selection of Research Area	National Marine Fisheries Service, Seattle, WA	Dec 75	23,954	Draft report being reviewed*
1A10B	Baseline, Disposal, and Post-Disposal Biological Studies for the Duwamish Waterway Aquatic Disposal Field Investigation	Northwest Fisheries Center, National Marine Fisheries Service, Seattle, WA	Mar 77	202,336	Active*
1A10C	Baseline, Disposal, and Post-Disposal Sediment and Water Chemistry Studies for the Duwamish Waterway Aquatic Disposal Field Investigation	Environmental Protection Agency, Environmental Research Lab, Corvallis, OR	Jan 77	299,844	Active*
1A10D	Continuation of the Sediment and Water Physicochemical Studies Associated with the Disposal Operation of Duwamish River Sediments in Elliott Bay, Puget Sound, Washington	Univ. of Washington, Seattle, WA	Jul 77	114,042	Active*
1A11	An Assessment of the Potential Impact of Dredged Material Disposal in the Open Ocean	Tereco, Inc., College Station, TX	Aug 77	80,190	Final report in preparation
3A01	Investigation of Subaqueous Borrow Pits as Potential Sites for Dredge Material Disposal	SPL, ⁵ WES	Oct 74	57,400	Completed; final report in press
3A02	State-of-the-Art Survey and Evaluation of Open-Water Dredged Material Placement Methodology	JBF Scientific Corporation, Burlington, MA	Jan 75	70,421	Final report published: CR D-76-3
Task 1B: Movements of Dredged Material					
1B01	Investigation of Mathematical Models for Predicting the Physical Fate of Dredged Material	Hydraulics Lab, WES	Oct 73	28,400	Final report published: TR D-74-1
1B02	Development of a Model for Prediction of Short-Term Fate of Dredged Material Discharged in the Estuarine Environment	Tetra Tech, Inc., Pasadena, CA	Jun 75	98,310	Final report published: CR D-76-5
1B03	Model on WES Computer and Survey of Sites to Determine Applicability to	Hydraulics Lab, WES	Jun 74	14,100	Complete; no formal report planned
1B04	Assessment of Factors Controlling the Long-Term Fate of Subaqueous Banks of Dredged Material	Texas A&M Research Foundation, College Station, TX	Apr 74	26,777	Final report published: CR D-74-8
1B05	Development of a Two-Dimensional Sediment Transport Model	Univ. of California, Davis, CA	May 76	120,719	Final report received
1B06	Evaluation of Koh-Chang Model (Phase I) and Sensitivity Analyses	Hydraulics Lab, WES & EPA Corvallis Lab ⁶	Jun 75	20,730	Draft report being reviewed
1B07	Participation in Field Verification of Koh-Chang Model and Further Sensitivity Analysis	Hydraulics Lab, WES	Jun 77	62,000	Active
1B08	A Field Investigation of the Effects of Storms on the Stability and Fate of Dredged Material in Subaqueous Disposal Areas	Yale University, New Haven, CT	Jul 76	6,275	Final report in preparation
1B09	An Investigation of the Physical Characteristics of Dredged Material and the Effects of Dispersion Behavior During Open-Water Disposal Operations	Yale University, New Haven, CT	Dec 77	242,942	Active
1B10	Implementation, Evaluation, and Documentation of Estuarine Sediment Transport Models and Planning for Field Verification	Hydraulics Lab, WES	Jan 78	65,000	Active
Task 1C: Effects of Dredging and Disposal on Water Quality					
1C01	Determination of Chemical Migration Control Factors	EEL, WES	Aug 73	2,750	Internal Working Document
1C03	Direct and Indirect Effects of Sediment Organic Fractions on the Mobilization and Immobilization of Various Contaminants During Dredging and Disposal of Sediments	CRRL ⁷	Feb 75	126,600	Final report published: CR D-76-7
1C04	Study of Mobilization and Immobilization of Pesticide and PCB Materials into Water Column During Dredging and Disposal	Envirex, Inc., Milwaukee, WI	Jun 75	103,686	Final report published: CR D-75-6

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Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status	
Task 1C: Effects of Dredging and Disposal on Water Quality (Continued)					
1C05	Study of Eh, pH, and DO Effects on Chemical Constituent Migration During Open-Water Disposal of Dredged Material	Agronomy Dept., Louisiana State Univ., Baton Rouge, LA	Jun 75	\$ 91,171	Final report in publication
1C06	Research Study on the Effect of Dispersion, Settling, and Resedimentation on Migration of Chemical Constituents During Open-Water Disposal of Dredged Material	Dept. of Environmental Engineering, University of Southern California, Los Angeles, CA	Mar 75	97,565	Final report published: CR D-76-1
Task 1D: Effects of Dredging and Disposal on Aquatic Organisms					
1D01	Assessment of Aesthetic and Ecological Significance of Turbidity in Various Aquatic Environments	Living Marine Resources, Inc., San Diego, CA	Sep 77	46,329	Draft report being rewritten
1D02	Assessment of Equipment, Methodologies, and Institutional Capabilities Available for Conducting or Developing Bioassays	Wapora, Inc., Washington, D. C.	Sep 74	49,664	Final report in preparation
1D03	Determination of the Vertical Migration Ability of Benthos in Dredged Material Deposits	Univ. of Delaware, Newark, DE	Jul 77	127,163	Final report in preparation
1D04	Application of Simulated Ecosystem Modeling to Dredged Material Research (Phase I)	EEL, WES	Jun 74	74,553	Final report published: TR D-76-3
1D06	Study of the Availability of Sediment-Sorbed Heavy Metals to Benthos with Particular Emphasis on Deposit Feeding Infauna	Texas A&M Research Foundation, College Station, TX	Jun 77	136,706	Active
1D07	Study of the Availability of Sediment Adsorbed Pesticides (DDT, Chlordane, Malathion) to Benthos with Particular Emphasis on Deposit Feeding Infauna	LFE Environmental Analysis Labs, Richmond, CA	May 76	106,282	Report in publication
1D08	Design and Establish Estuarine Ecosystem Simulation (Phase I)	EEL, WES	Jun 74	203,164	Draft report being reviewed
1D09	Response of Selected Aquatic Organisms to Suspended Dredged Material	Bodega Bay Marine Lab, Bodega Bay, CA	Mar 77	167,250	Final report in preparation
1D10	Effects of Dredging and Dredged Material Disposal on Benthos and the Marine Environment	San Jose State University, San Jose, CA	Mar 76	106,662	Final report in preparation
1D11	An Evaluation of Oil and Grease Contaminations Associated with Dredged Material-Ecological Aspects	Office of Naval Research, Naval Biomedical Res Lab, Oakland, CA	Mar 77	72,402	Draft report being reviewed
1D12	Biological Effects of Fluid Mud	Virginia Institute of Marine Science, Gloucester Point, VA	Mar 77	13,353	Draft report being reviewed
Task 1E: Pollution Status of Dredged Material					
1E03	Development of Dredged Material Disposal Criteria	Texas A&M Univ., College Station, TX (Subcontract to Univ. of Texas at Dallas)	Dec 75	133,018	Final report published: CR D-75-4
1E03A/B	Refinement of Current Disposal Criteria, Identification of Subject Areas for Further Development and Refinement of Bioassay Procedures for Disposal Criteria and Field Testing and Verification of Dredged Material Disposal Criteria	Univ. of Texas at Dallas	May 77	301,540	Final draft in review
1E04	Investigation of Partitioning of Various Elements in Dredged Material	EEL, WES	Aug 75	312,600	Final report published: TR D-76-7
1E06	Biological Assessment of Standard Elutriate Test	EEL, WES	Jun 75	297,220	Final report published: TR D-77-3
1E07	Long-Term Release of Contaminants from Dredged Material	EEL, WES	Jul 77	69,500	Final draft in preparation
1E08	Development of Bioassay Methodologies Using Selected Benthic Organisms	EEL, WES	Sep 77	270,000	Final draft in preparation
Task 2A: Effects of Marsh and Terrestrial Disposal					
2A01-2B01	Methodology for Assessing the Social, Economic, and Environmental Effects of Dredged Material Disposal on Marsh and Upland Areas	Battelle Memorial Institute, Columbus, OH	Sep 74	119,620	Completed; IWD D-77-11
2A02-2B02	Collection and Assessment of Data on Upland and Wetland Disposal Sites and Selection of Initial Test Sites	Interlaboratory team, WES	Nov 74	73,750	Completed; IWD D-77-17
2A03-4A02	Design of Basic Field Investigation Programs	MESL, WES	Jun 74	106,350	Completed; IWD D-77-4

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(Sheet 3 of 11)

	Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 2A: Effects of Marsh and Terrestrial Disposal (Continued)					
2A04	Environmental Impact of Dredging at Crosby Slough	Univ. of Wisconsin, LaCrosse, WI	Jun 75	\$ 25,274	Final draft report being reviewed
2A05	Marsh-Estuarine Nutrient and Heavy Metal Cycling	EEL, WES	Jun 76	92,150	Complete; in press
2A06	Study of the Vascular Plants on Dredged Material Sites in Pool 8, Upper Mississippi River	Univ. of Wisconsin, LaCrosse, WI	Dec 76	7,391	Final draft report in review
2A07	Effect of Dredged Material Deposition on Short Form <i>Spartina alterniflora</i> Marsh	Univ. of Georgia, Marine Resources Extension Center, Brunswick, GA	Sep 77	87,839	Active
2A08	<i>Assessment of Impacts of Marsh and Terrestrial Disposal of Dredged Material: A Synthesis</i>	EEL, WES	Jul 78		Being planned
2A09	<i>Criteria for Selection of Habitat Development Alternatives: A Synthesis</i>	EEL, WES	Jul 78		Being planned
Task 2C: Containment Area Operations					
2C02	Study of the Feasibility of the Functional Use of Vegetation for Slurry Filtering, Pollutant Constituent Removal, and Dredged Material Desiccation	EEL, WES	Dec 74	52,330	Final report published: TR D-76-4
2C03	Problems and Practices in Current Disposal Methods	SPL, WES	May 74	55,387	Final report published: TR D-74-2
2C04	Development of Design and Construction Guidelines for Dredged Material Retaining Dikes	Savannah District, CE, Savannah, GA	Open	63,895	Final report in preparation
2C05	Analysis of Functional Capabilities and Performance of Pervious Dikes, Sandfill Weirs, and Related Effluent Filtering Systems	Dept. of Civil Engineering, Northwestern University, Evanston, IL	Jul 75	86,786	Final report published: CR D-76-8
2C06	Identification of Nature and Distribution of Objectionable Environmental Conditions in Confined Disposal Areas	Arthur D. Little, Inc., Cambridge, MA	Sep 74	34,990	Final report published: CR D-74-4
2C08	Development of Guidelines for Containment Facility Design	Interlaboratory team, WES	Oct 74	65,015	Final report published: TR D-76-1
2C09A	Development of Concepts Using Low-Ground-Pressure Construction Equipment for Containment Area Operation and Maintenance (Equipment Inventory)	MESL, WES	Oct 74	24,600	Final report published: TR D-77-1
2C09B	Development of Concepts Using Low-Ground-Pressure Construction Equipment for Containment Area Operation and Maintenance (Development of Field Evaluation Investigations)	MESL, WES	Aug 76	88,400	Final report in preparation
2C09C	Procedures and Practices Used in Construction, Maintenance, and Management of Dredged Material Containment Areas: A Synthesis	MESL, WES	Dec 76	70,000	Final report in preparation
2C10	Demonstration of Dredged Material Drying by Use of Vegetation	Biological Water Purification, Inc., New York, NY	Apr 77	27,500	Active
2C11	Investigation of Physical, Chemical, and/or Biological Treatment for Odor Control in Dredged Material Disposal Areas	Argonne National Laboratory, Argonne, IL	Feb 76	67,120	Final report published: CR D-76-9
2C12	Investigation of Physical, Chemical, and/or Biological Control of Mosquitoes in Dredged Material Disposal Areas	The Citadel, Charleston, SC	May 77	71,845	Active
2C14	European Dredging and Disposal Practices	Adrian Volker Dredging Company, Rotterdam, The Netherlands	Dec 76	83,800	Final report in preparation
2C15	Field Investigation of the Functional Use of Vegetation to Filter and Remove Contaminants from Existing Dredged Material Disposal Areas	EEL, WES	Jan 77	25,000	Active; to be combined with 2D01
2C16	Containment Area Design to Maximize Effectiveness of Confined Disposal Areas	Brian J. Gallagher and Company, Elmgrove, WI	Jun 77	75,221	Active
2C17	Public Information Brochure Regarding Land Planning Principles and Landscape Design Concepts for Confined Dredged Material Disposal Facilities	Roy Mann Associates, Cambridge, MA	Jan 77	9,984	Brochure in press
2C18	<i>Containment Area Sizing - Synthesis Report</i>	EEL, WES	Dec 77	20,000	Planning
4A16A	Performance of Containment Areas Filled with Dredged Material	Massachusetts Inst. of Technology, Cambridge, MA	Dec 76	99,500	Draft report being reviewed
5E01	Landscaping Concept Development for Confined Dredged Material Disposal Sites	Roy Mann Associates, Cambridge, MA	Apr 75	44,289	Final report published: CR D-75-5

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(Sheet 4 of 11)

Work Units		Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 2D: Confined Disposal Area Effluent and Leachate Control					
2D01	Physical and Chemical Characterization of Contaminated Dredged Material Influent, Effluents, and Sediments in Confined Upland Disposal Areas	EEL, WES	Jan 77	\$134,000	Final report in preparation
2D02	A Study of Leachate from Dredged Material in Upland Disposal Sites and/or in Productive Uses	SCS Engineers, Long Beach, CA	Sep 77	153,094	Active
2D03	Physical and Chemical Monitoring of River Sediments and Water and Confined Disposal Area Dredged Material Influent, Effluents, and Sediments During High-Solids Dredging of a PCB Spill	EPA Region X, Seattle, WA Seattle District, CE	May 76	17,012	Completed; data input to 2D01
2D04	Characterization of Confined Disposal Area Influent and Effluent Particulate and Petroleum Fractions	Univ. of Southern California, Los Angeles, CA	Dec 76	32,708	Completed; data input to 2D01
2D05	Physical and Chemical Characterization of Dredged Material Sediments and Leachates in Confined Land Disposal Areas	Univ. of Southern California, Los Angeles, CA	Oct 77	159,012	Active
Task 3B: Upland Disposal Concepts Development					
3B01	A Study of Dredged Material Transport Systems for Inland Disposal and/or Productive Use Concepts	General Research Corp., McLean, VA	Sep 77	137,092	Draft report being reviewed
3B02	Feasibility of Inland Disposal of Dredged Material: Literature Review	SCS Engineers, Long Beach, CA	Apr 77	43,473	Final report in preparation
Task 4A: Marsh Development					
4A01	Study of Identification of Relevant Criteria and Survey of Potential Application Sites for Artificial Habitat Creation	Coastal Zone Resources Corp., Wilmington, NC	Jul 74	86,438	Final report published: CR D-76-2, Vol I and II
4A03	State-of-the-Art Survey and Evaluation of Marsh Plant Establishment Techniques	University of Michigan, Ann Arbor, MI	Jul 74	24,967	Final report published: CR D-74-9, Vol I and II
4A04A	Productivity of Minor Marsh Grass Species and Their Substrate Selective Properties (Atlantic Coast Area)	Univ. of Georgia Marine Institute, Sapelo Island, GA	Dec 76	211,559	Final draft report in review
4A04B, 4A06	Productivity of Minor Marsh Grass Species (Gulf Coast Area) and Physiological Response of Marsh Plants to Environmental Stress	Dept. of Marine Sciences, Louisiana State University, Baton Rouge, LA	Sep 76	263,277	Completed; report in press
4A05	Modeling of Ecological Succession and Production in Estuarine Marshes	Dept. of Environmental Sciences, Univ. of Virginia, Charlottesville, VA	May 76	188,646	Final report received
4A07	Concept Development and Economic and Environmental Compatibility Analysis of Underwater and/or Floating Dredged Material Retaining and Protective Structures	EEL, WES	Jun 74	51,159	Report will be revised in 4A07A
4A07A	Development and Design Concepts for In-Water Retaining and/or Protective Structures for Marsh Development	U. S. Army Coastal Engineering Research Center, Ft. Belvoir, VA	Nov 77	63,700	Active
4A08	Development of Guidelines for Material Placement in Marsh Creation	Center for the Environment and Man, Inc., Hartford, CT	Jan 75	62,884	Final report published: CR D-75-2
4A09	Design and Establish Salt Marsh Ecosystem Simulation (Includes: Pregermination Requirements and Establishment Techniques in Salt Marsh Vegetation)	EEL, WES	Jun 74	253,100	Complete; report in press
4A10	Branford Harbor (Connecticut) Field Study				
4A10A	Methods for Material Confinement at Branford Harbor Marsh Development Site	Massachusetts Inst. of Technology, Cambridge, MA	Nov 74	2,350	Completed; no formal report planned
4A10B	Technical Assistance for Branford Harbor Systems	Massachusetts Inst. of Technology, Cambridge, MA	Feb 75	9,625	Completed; no formal report planned
4A10C	Assessment of Preoperational Environmental Conditions at the Branford Harbor Marsh Development Site	Marine Sciences Institute, University of Connecticut, Groton, CT	Jun 76	170,700	Final draft report in review
4A10D	Marsh Grass Seed Collection Storage and Testing	Environmental Concern, Inc., St. Michaels, MD	Apr 76	4,200	Completed; IWD D-77-1
4A10E-H	Documentation of Political and Social Factors Affecting the Branford Harbor Project: A Plan of Study	Dr. Fred Grupp, Storrs, CT Ms. Sue Richardson Vicksburg, MS	Nov 76	9,805	Completed; IWD D-77-5

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Work Units		Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 4A: Marsh Development (Continued)					
4A10I	Design and Cost Estimate for Construction of Containment Areas	EEL, WES	Aug 77	\$ 50,000	Active
4A10J	Maintenance Dredging Project, Branford Harbor, CT, Final Environmental Impact Statement	New England Division, CE	Nov 75	NA	Completed; IWD D-77-16
4A10K	Branford Harbor Marsh Development: Summary Report	EEL, WES	Sep 77	NA	Active
4A11 James River (Virginia) Field Study					
4A11A	Soils Exploration and Testing, James River Marsh	Soil and Material Engineers, Inc., Raleigh, NC (through the Norfolk District)	Dec 74	30,331	Completed; IWD D-77-6
4A11B	Dike Design, James River Site	Dr. Robert Y. K. Cheng, Old Dominion Univ., Norfolk, VA (through the Norfolk District)	Dec 74	4,820	Completed; IWD D-77-6
4A11C	Preoperational Assessment, James River Site	Virginia Institute of Marine Science, Gloucester Point, VA (through Norfolk District)	Jan 75	10,725	Completed; to be Appendix B to site report
4A11D	Preoperational Assessment, James River Site	Old Dominion Univ., Norfolk, VA (through the Norfolk District)	Dec 75	9,805	Completed; to be combined with 4A11G
4A11F	Technical and Administrative Support by Norfolk District for the James River Project	Norfolk District, CE	Jan 77	55,000	Completed; IWD D-77-12
4A11G	Sediment and Water Chemistry Investigation at the James River Habitat Development Site, James River, VA	Old Dominion Univ., Norfolk, VA (through the Norfolk District)	Oct 76	80,209	Draft report being reviewed; to be Appendix A to site report
4A11H	Pollutant Mobilization Studies at the Windmill Point Habitat Development Site, James River, Virginia	Old Dominion Univ., Norfolk, VA	Oct 77	105,872	Active*
4A11I	Ecological Studies at the Windmill Point Marsh Development Site, James River, Virginia	Virginia Institute of Marine Science, Gloucester Point, VA	Oct 77	210,600	Active*
4A11J	Propagation of Vascular Plants at the Windmill Point Marsh Development Site, James River, Virginia	Environmental Concerns, Inc., St. Michaels, MD	Oct 75	49,556	Completed; no formal report planned
4A11K	Assessment of Acute Impacts on the Macrobenthic Community at the Windmill Point Marsh Development Site, James River, Virginia	Virginia Institute of Marine Science, Gloucester Point, VA	Sep 76	31,939	In press; to be Appendix E to site report
4A11L	<i>Organohalide Study at the Windmill Point Marsh Development Site</i>	<i>Contract</i>			<i>Being advertised</i>
4A11M	<i>Windmill Point Marsh Development: Site Report</i>	EEL, WES			<i>Being planned</i>
4A12 Buttermilk Sound (Georgia) Field Study					
4A12A	Buttermilk Sound Marsh Development: Site Report	University of Georgia, Athens, GA	Jan 78	303,530	Active
4A13 Bolivar Peninsula (Texas) Field Study					
4A13A	Topographic Survey of Bolivar Peninsula Habitat Development Site	Galveston District, CE	Sep 74	7,000	Completed; incorporated into 4A13H
4A13B	Development of Soil Sampling and Testing Plans for the Bolivar Peninsula Site	Galveston District, CE	Jun 74	22,000	Completed; incorporated into 4A13H
4A13C	Inventory and Assessment of Hydrology and Water Chemistry at the Bolivar Peninsula Site	U. S. Geological Survey, Houston, TX	Jul 77	28,380	Final report in review; to be Appendix A to site report
4A13D	An Inventory and Assessment of the Aquatic Biota at the Bolivar Peninsula Site	National Marine Fisheries Service, Galveston, TX	Jul 77	62,656	Final report in review; to be Appendix B to site report
4A13E	An Inventory and Assessment of the Terrestrial Flora, Fauna, and Sediment Chemistry at the Bolivar Peninsula Site	Texas A&M University, College Station, TX	Jul 77	51,823	Draft report in review; Appendix C to site report
4A13F	Propagation of Vascular Plants and Post Propagation Monitoring of the Botanical, Soils, Aquatic Biota, and Wildlife Resources, Bolivar Peninsula Site	Dept. of Range Science, Texas A&M University, College Station, TX	Nov 77	370,793	Active
4A13G	Plans and Specifications for Site Construction, Bolivar Peninsula Site	Galveston District, CE	Dec 75	16,000	Completed; incorporated with 4A13H
4A13H	Sampling and Testing of Sediments, Bolivar Peninsula Site	Galveston District, CE	Aug 75	6,000	Completed; IWD D-77-13

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Work Units		Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 4A: Marsh Development (Continued)					
4A131-4A13J	Construction, Maintenance, and Repair of Site Bolivar Peninsula	Galveston District, CE	Dec 76	\$274,600	Active
4A13K	<i>Bolivar Peninsula Marsh and Upland Habitat Development: Site Report</i>	EEL, WES			<i>Being planned</i>
4A14	Grays Harbor (Washington) Field Study				
4A14A	Preliminary Survey, Rennie Island Site, Grays Harbor	Seattle District, CE	Jun 75	2,300	Completed; IWD D-77-14
4A14B	Preparation of Work Statements for the Rennie Island Marsh Creation Site	Coastal Ecosystems Management, Fort Worth, TX	Dec 74	1,243	Completed; IWD D-77-7
4A14C	Baseline Study and Literature Review	Fisheries Research Institute, Univ. of Washington, Seattle, WA	Jan 76	18,412	Completed; in press; to be Appendix A to summary report
4A14D	Rennie Island Marsh Development: Summary Report	EEL, WES	Sep 77	--	Final draft in review
4A15	Heavy Metal Uptake by Marsh Grasses (Phase I)	EEL, WES	Jun 76	87,000	Final report published: TR D-76-5
4A15A	Heavy Metal Uptake by Marsh Grasses (Phase II)	EEL, WES	Mar 77	144,178	Active
4A16	Prediction of a Stable Elevation for Marshes Created from Dredged Material	Massachusetts Inst. of Technology, Cambridge, MA	Dec 75	99,000	Completed: IWD D-77-15
4A17	Dyke Marsh Demonstration Area, Feasibility Study	EEL, WES	Apr 76	30,000	Final report published: TR D-76-6
4A17A	Detailed Design - Dyke Marsh Demonstration Area, Virginia	EEL, WES	Dec 76	96,000	Completed; in press
4A18	Pond No. 3 Marsh Demonstration, San Francisco, CA	San Francisco District, CE	Aug 77	50,350	Active
4A18A	Monitoring, Pond No. 3 Marsh Demonstration Area, San Francisco, CA	San Francisco Bay Marine Research Center, San Francisco, CA	Oct 77	33,000	Active
4A18B	<i>Pond No. 3 Marsh Demonstration Area: Site Report</i>	EEL, WES	Dec 77		<i>Planned</i>
4A19	Marsh Development, Apalachicola Bay, FL	Environmental Systems Service of Tallahassee, Inc., Tallahassee, FL	Oct 77	8,490	Active
4A20	Productivity of Marsh Plants, Pacific Coast	Dr. R. W. Rountree Syracuse, NY	Sep 77	11,800	Active
4A21	Influence of Seed Storage and Germination Conditions on the Viability and Germination of Selected Marsh Plant Species	Washington State University, Pullman, VA	Dec 77	16,987	Active
4A22	<i>Marsh Plant Productivity on Natural Habitats and Dredged Material: A Synthesis</i>	EEL, WES	Jul 78		<i>Being planned</i>
4A23	<i>Engineering Considerations and Cost Effectiveness of Habitat Development on Dredged Material: A Synthesis</i>	EEL, WES	Mar 78		<i>Being planned</i>
4A24	<i>Marsh Plant Establishment on Dredged Material: A Synthesis</i>	EEL, WES	Jul 78		<i>Being planned</i>
4A25	Recent and Planned Marsh Establishment Work Throughout the Contiguous United States	Environmental Concern, Inc., St. Michaels, MD	Feb 77	10,000	Final report published: CR D-77-3
4A26	Field Testing of Rapid Bioassay Technique for Marsh Development	Univ. of Georgia, Athens, GA	Oct 77	9,850	Active
Task 4B: Terrestrial Habitat Development					
4B01	Identification and Assessment of Modes, Needs, Benefits, and Constraints of Habitat Enhancement	Hittman Associates, Columbia, MD	Jun 75	83,854	Completed: IWD D-77-3
4B04	Nott Island (Connecticut) Field Study				
4B04A	Preoperational Data Collection and Monitoring of Dredged Material Disposal, Nott Island Habitat Development Site	Marine Sciences Institute, University of Connecticut at Groton, Groton, CT	Sep 75	25,131	Draft report being reviewed
4B04B	Technical Liaison, Nott Island Habitat Development Site	Connecticut Dept. of Environmental Protection, Hartford, CT	Jul 76	1,900	Completed; no report planned
4B04C	Growth of Selected Plant Species on Dredged Material	Cooperative Ext. Service, Univ. of Connecticut, Storrs, CT	Jan 76	75	Completed; IWD D-77-8

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Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status	
Task 4B: Terrestrial Habitat Development (Continued)					
4B04D	Plot Establishment and Preoperational Data Collection (Experimental Control of <i>Phragmites communis</i>)	Connecticut College, New London, CT	Sep 77	\$ 4,750	Active
4B04E	Monitoring of Dredged Material Disposal and Reclamation Study, Nott Island, Connecticut	Connecticut College, New London, CT	Nov 77	34,367	Active*
4B04F	Post Propagation Monitoring of Flora and Fauna at Nott Island	Connecticut College, New London, CT	Jan 78	36,680	Active*
4B04G	<i>Nott Island Upland Habitat Development: Site Report</i>	EEL, WES	Mar 78		Being planned
4B05 Miller Sands (Oregon) Field Study					
4B05A	Subsurface Exploration, Miller Sands Habitat, Columbia River	Portland District, CE	Jan 75	6,000	Completed; IWD D-77-9
4B05B	Preparation of Work Statements, Miller Sands Island, Columbia River	Coastal Ecosystems Management, Fort Worth, TX	Dec 74	1,243	Completed; IWD D-77-10
4B05C	Baseline Biological Inventory and Assessment of the Aquatic Environs of the Miller Sands Habitat Development Site	National Marine Fisheries Service, Seattle, WA	Dec 75	38,500	Completed; combined with 4B05L
4B05D	Inventory and Assessment of Existing Environmental Conditions at Miller Sands Island in the Lower Columbia River, Oregon - Terrestrial Fauna and Flora	Woodward-Clyde Consultants, Portland, OR	Nov 75	38,926	Final draft in review; to be Appendix C to site report
4B05E	Inventory and Assessment of Existing Environmental Conditions at Miller Sands Island in the Lower Columbia River, Oregon - Physical and Chemical	Oregon State University, Corvallis, OR	Oct 75	52,689	Final draft in review; to be Appendix A to site report
4B05F	Pilot Study of Propagation of Marsh Plants at Miller Sands Island in the Lower Columbia River, Oregon	Wave Beach Grass Nursery, Florence, OR	Jan 76	9,817	Completed; IWD D-77-2
4B05G	Propagation of Vascular Plants	Wave Beach Grass Nursery, Florence, OR	Dec 77	85,439	Active
4B05H	Trapping of Nutria at Miller Sands	Jack Rogers, Corvallis, OR	Sep 77	33,360	Active
4B05I	Post Propagation Monitoring of Wildlife Resources at Miller Sands Habitat Development Site, Columbia River, Oregon	Oregon State University, Corvallis, OR	Dec 77	39,855	Active*
4B05J	Aquatic Biology Investigation at Miller Sands Habitat Development Site, Columbia River, Oregon	National Marine Fisheries Service, Seattle, WA	Oct 77	80,000	Active*
4B05K	Post Propagation Monitoring of Botanical and Soil Resources at Miller Sands, Columbia River, Oregon	Washington State University, Pullman, WA	Dec 77	160,559	Active*
4B05L	Post Operational Aquatic Biology at Miller Sands Habitat Development Site	National Marine Fisheries Service, Seattle, WA	Dec 76	45,072	Combined with 4B05C
4B05M	<i>Miller Sands Marsh and Upland Habitat Development: Site Report</i>	EEL, WES	Mar 78		Being planned
4B06	Establishment of Marsh Grasses on Dredged Material	EEL, WES	Jun 76	255,571	Final report published: TR D-77-2
4B07	The Biology and Control of the Common Reed, <i>Phragmites communis</i>	Louisiana Tech University, Ruston, LA	May 75	1,750	Draft report being reviewed
4B08	<i>Terrestrial Habitat Plant Selection</i>	Contract			Being advertised
4B09	<i>Upland Plant Propagation on Dredged Material: A Synthesis</i>	EEL, WES	Jul 78		Being planned
5B01	Regional Identification of Species Affected by Dredging/Disposal Operations	MESL, WES	Jun 76	43,700	Completed; no formal report planned
5B02	Assessment of Species' Habitat Requirements and Responses of Populations to Habitat Conditions	MESL, WES	Jun 76	59,000	Completed; no formal report planned
5B03	Study of Successional Patterns of Plants and Animals at Upland Disposal Areas	Coastal Zone Resources Corp., Wilmington, NC	Sep 75	101,887	Final report published: CR D-77-2, Vol I and II
5B04	Review and Examination of Disposal Area Filling Techniques and Rates to Identify Nonconflicting Wildlife Enhancement Alternatives	Dames and Moore, San Francisco, CA	Jul 74	87,014	Final draft report in review
Task 4C: Land Improvement Concepts					
4C01	Use of Dredged Material to Reclaim Strip-Mined Land: A Preliminary Investigation	U. S. Bureau of Mines (Morgantown Energy Research Center), Morgantown, WV	Apr 76	5,000	Completed; no formal report planned

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Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status	
Task 4C: Land Improvement Concepts (Continued)					
4C02	A Feasibility Study of Dredged Material Use in Conjunction with Solid Waste Management	Environmental Engineering Div., EEL, WES	Aug 77	\$ 34,000	Final draft being reviewed
4C03	Potential of Dredged Material as an Agricultural Soil and/or Amendment	Agricultural Research Service, North Central Region, St. Paul, MN	Dec 77	209,400	Active
4C04	<i>Strip Mine Field Demonstration</i>	<i>Contract</i>			<i>Being planned</i>
Task 4D: Products Development					
4D01	A Feasibility Study of Lawn Sod Production and/or Related Activities in Dredged Material Disposal Sites	Arthur D. Little, Inc., Cambridge, MA	Oct 74	39,566	Final report published: CR D-75-1
4D02	Investigation of Mariculture as an Alternative Use of Dredged Material Containment Areas	Dow Chemical Co., Midland, MI	Aug 77	94,572	Draft report being rewritten
4D03	Demonstration of Marine Shrimp Culture in an Active Dredged Material Containment Area	Dow Chemical Co., Midland, MI	Sep 77	133,526	Active
Task 4E: Aquatic Habitat Development					
4E01	Literature Survey of Seagrasses	Univ. of Virginia, Charlottesville, VA	Aug 77	28,963	Active
4E02	Grassbed Development, St. Joseph Bay, Florida	Dr. Ronald Phillips Bellevue, WA	Dec 77	4,815	Active
Task 4F: Island Habitat Development					
4F01A	Survey of Critical Bird Nesting and Migration Areas of the Great Lakes, and Comparison of Dredged Material and Natural Island Breeding Sites	U. S. Fish and Wildlife and Northwestern Michigan College, Traverse City, MI	Nov 77	58,000	Active
4F01B	Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in Texas	Texas A&I Univ., Kingsville, TX	Jan 78	84,383	Active
4F01C	Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in Florida	Seabird Research, Inc., Tampa, FL	Jan 78	59,122	Active
4F01D	Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey	Manomet Bird Observatory, Manomet, MA	Jan 78	87,724	Active
4F01E	Use of Dredged Material Islands by Colonial Seabirds and Wading Birds (Pacific Coast)	John Graham & Co., Seattle, WA	Dec 77	52,736	Active
4F01F	Use of Dredged Material Islands by Colonial Seabirds and Wading Birds (Upper Mississippi)	EEL, WES	Oct 77	10,000	Active
4F02	A Comparison of Plant Succession and Bird Utilization on Diked and Undiked Dredged Material Islands in the North Estuaries	Univ. of North Carolina, Wilmington, NC	Jan 78	94,721	Active
4F03	<i>Dredged Material Island Establishment and Disposal Methodology: A Synthesis</i>	<i>EEL, WES</i>	<i>Mar 78</i>		<i>Being planned</i>
Task 5A: Dredged Material Densification					
5A01	Methodology for Dredged Material Reclamation and Drainage	Dames and Moore, San Francisco, CA	Nov 73	55,858	Final report published: CR D-74-5
5A02	Laboratory Study of Dredged Material Slurry Water Loss Due to Mechanical Agitation	EEL, WES	Sep 75	49,235	Completed; no formal report planned
5A03	State-of-the-Art Survey and Evaluation of Current Physical, Mechanical, and Chemical Dewatering and Densification Techniques	SPL, WES	Sep 75	57,117	Final report published: TR D-77-4
5A04	A Laboratory Study to Determine the Variables that Influence the Electro-Osmotic Dewatering of Dredged Material	KMA Research Institute, Phoenix, AZ	Mar 76	96,828	Completed; no formal report planned
5A05	A Laboratory Study of Aeration as a Feasible Technique for Dewatering Fine-Grained Dredged Material	Environmental Engineering Consultants, Inc., Stillwater, OK	Jun 76	49,265	Final report published: CR D-76-10
5A06	Feasibility Study of General Crust Management as a Technique for Increasing Capacities of Dredged Material	Texas A&M Univ., College Station, TX	Jun 76	53,529	Draft report being reviewed
5A07	Feasibility of Frost Action for Densification of Dredged Material	CRREL	Apr 76	64,965	Draft report being reviewed
5A08	Mobile (Alabama) Field Study	EEL, WES	Dec 76	91,000	Active*
5A09	Feasibility Study of Consolidating Fine-Grained Dredged Material with Windmill-Powered Vacuum Well Points	EEL, WES	Dec 76	126,000	Active*

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	Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 5A: Dredged Material Densification (Continued)					
5A10	Development of Capillary Enhancement Devices for Dewatering Fine-Grained Dredged Material	SPL, WES	Feb 76	\$ 65,000	Active*
5A11	Feasibility of Injecting Fine-Grained Sand Slurry into Dredged Material	SPL & EEL, WES	Jun 76	15,000	Completed; no report planned
5A12	Acquisition of Meteorological Data for On-going Dredged Material Research Studies at the Mobile Test Site	MESL, WES	Mar 77	49,200	Active*
5A13	Containment Area Management as a Means of Promoting Densification of Fine-Grained Dredged Material	EEL, WES	Dec 76	50,000	Active
5A14	Mechanical Stabilization of Fine-Grained Dredged Material by Periodic Mixing in of Dried Surface Crust	MESL, WES	Dec 76	33,000	Active*
5A15	Field Evaluation of Slurry Densification by Underdrainage Techniques	SPL, WES	Jun 77	225,000	Active*
5A16	Development of Dewatering Alternatives Manual for the Mobile District	Mobile District, CE	Jun 77	25,000	Active
5A17	Field Demonstration of Electro-Osmotic Dewatering of Fine-Grained Dredged Material Slurry	Mobile District, CE	May 77	85,000	Active
5A18	Vegetative Dewatering Field Demonstration	Dauphin Island Sea Lab, Dauphin Island, AL	Mar 77	44,000	Active*
5A19	Development of Containment Area Sizing Methodology Considering Effects of Dredged Material Dewatering	EEL, WES	Aug 77	45,000	Active
5A20	Implementation of Task 5A Technology	SPL, WES	Sep 77	81,000	Active
5A21	Task 5A Design Alternatives Development	EEL, WES	Feb 78	35,000	Active
Task 5C: Disposal Area Reuse					
5C01	Concept Development for Appurtenant Containment Area Facilities for Dredged Material Separation, Drying, and Rehandling	Hittman Associates, Columbia, MD	Feb 74	94,968	Final report published: CR D-74-6
5C01A	Concept Development...-Field Evaluation	Hittman Associates, Columbia, MD	Nov 74	10,587	Completed; no formal report planned
5C02	Classification and Determination of Engineering and Other Physical Characteristics of Dredged Material	EEL, WES	Mar 76	94,424	Final report being reviewed
5C03	Systems Cost Analysis of Confined Disposal Practices	CERL ^B	Feb 76	75,000	Completed; no report planned
5C04	Study of Regional Landfill and Construction Material Needs in Terms of Dredged Material Characteristics and Availability	Green Associates, Inc., Towson, MD	Jul 74	66,793	Final report published: CR D-74-2, Vol I and II
5C05	Development of Procedures for Selecting and Designing Reuseable Dredged Disposal Sites	Acres American, Inc., Buffalo, NY	Apr 77	90,000	Active. Report will be basis of synthesis report.
5C06	Investigation of Legal, Policy, and Institutional Constraints Associated with Dredged Material Marketing and Land Enhancement	American Technical Assistance Corp., McLean, VA	Mar 74	56,653	Final report published: CR D-74-7
5C07	Feasibility Study of Vacuum Filtration Systems for Dewatering Dredged Material	Ryckman/Edgerly/Tomlinson and Associates, St. Louis, MO	Jun 77	78,531	Active
5C08	Identification of Alternative Power Sources for Dredged Material Disposal Operations	Naval Construction Battalion Center, Engineering Laboratory, Port Hueneme, CA	Feb 77	86,000	Active
5C09	Survey of Districts for Needs and Areas of Potential Application for Disposal Area Reuse	EEL, WES	Sep 77	46,710	Active
5C10	Physical Properties Investigation of in situ WES Lake Dredged Material	EEL, WES	Sep 77	1,000	Active
5C11	Development of Methodology for Designing Fine-Grained Dredged Material Sedimentation Basins	EEL, WES	Sep 77	97,000	Active
Task 5D: Disposal Area Land Use Concepts					
5D01	Socio-Economic Aspects of Dredged Material Disposal: Creation of Waterfront Recreational Opportunities in Urbanized Areas	Dept. of Environmental Sciences, University of Virginia, Charlottesville, VA	Oct 75	163,817	Final report published: CR D-76-6

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	Work Units	Contractor or Mode of Conduct	Scheduled Completion of Work	Funding Level	Status
Task 5D: Disposal Area Land Use Concepts (Continued)					
5D02	Case Studies and Comparative Analyses of Issues Associated with Productive Land Use at Dredged Material Disposal Sites	Energy Resources Company, Inc., Cambridge, MA	Aug 77	\$297,381	Active
5D03	Productive Land Use of Dredged Material Containment Areas: International Literature Review	Beeman/Benkendorf, Portland, OR	Sep 77	29,097	Final report in revision
5D04	Evaluation of Laws and Regulations Impacting the Land Use of Dredged Material Containment Areas	Science Applications, La Jolla, CA	Oct 77	73,050	Active
5D05	<i>Determination of the Value of Land and Associated Benefits Created by Dredged Material Containment</i>	<i>Contract</i>			<i>Proposals being evaluated</i>
5D06	<i>Guidelines for Productive Land Use Concepts</i>	<i>Contract</i>			<i>Being planned</i>
Task 6B: Treatment of Contaminated Dredged Material					
6B01	Assessment of Chemical, Physical, and Biological Processes for Treatment of Dredged Material	JBF Scientific Corporation, Burlington, MA	Apr 74	41,900	Completed; no formal report planned
6B02	Laboratory Treatability Studies of Polluted Dredged Material	EEL, WES	Jun 74	125,772	Final report published: TR D-76-2
6B05	An Evaluation of Oil and Grease Contamination Associated with Dredged Material - Engineering Aspects	Engineering-Science, Inc., Austin, TX	Jun 76	74,537	Draft report being reviewed
6B06	Research Study of Oxygenation of Dredged Materials	JBF Scientific Corporation, Burlington, MA	Feb 77	99,850	Draft report being reviewed
6B07	Flocculation as a Means for Water-Quality Improvement from Disposal of Dredged Material in Confined Areas	Univ. of Southern California, Los Angeles, CA	Apr 77	112,580	Draft report being reviewed
6B08	Development and Application of Design and Operational Procedures for Coagulation of Dredged Material Slurries and Diked Area Effluents	EEL, WES	Jul 77	74,700	Active
6B09	Field Verification of the Functional Use of Vegetation to Remove Contaminating Constituents of Effluents from Dredged Material Disposal Areas	Dr. H. L. Windom, Savannah, GA	Jul 77	76,560	Draft report being reviewed
Task 6C: Turbidity Prediction and Control					
6C01	Laboratory Study Related to Predicting the Turbidity-Generation Potential of Sediments to be Dredged	Walden Research Division of ABCOR, Inc., Wilmington, MA	Jul 77	110,206	Draft report being reviewed
6C02	Field Investigation of the Nature, Degree, and Extent of Turbidity Generated by Open-Water Pipeline Disposal Operations	State University of New York, Stony Brook, NY	Jan 78	192,863	Active
6C03	Investigation of Techniques for Reducing Turbidity Associated with Present Dredging Procedures and Operations	John Huston, Inc., Corpus Christi, TX	Oct 75	49,280	Final report published: CR D-76-4
6C04	Assessment of Chemical Flocculants and Friction-Reducing Agents for Application in Dredging and Dredged Material Disposal	SPL, WES	Mar 74	33,430	Completed; no formal report planned
6C06	Analysis of Functional Capabilities and Performance of Silt Curtains	JBF Scientific Corporation, Wilmington, MA	Jun 77	123,281	Draft report being reviewed
6C07	A Field Study of Fluid Mud Dredged Material: Its Physical Nature and Dispersion	Virginia Institute of Marine Science, Gloucester Pt., VA	Jul 77	164,989	Active
6C08	An Evaluation of the Submerged Discharge of Dredged Material Slurry During Pipeline Dredged Operations	JBF Scientific Corporation, Wilmington, MA	Jun 77	83,073	Active
6C09	Laboratory Investigation of the Dynamics of Mud Flows Generated by Open-Water Pipeline Disposal Operations	JBF Scientific Corporation, Wilmington, MA	Jul 77	90,142	Active
Task 9A: Research Results Application					
9A01	Information Dissemination and Technology Transfer System for the Dredged Material Research Program	Teknekron, Inc., Washington, DC	Sep 76	146,783	Final report published: CR D-77-1, Vol I and II

Table 1
DMRP TASKS PROVIDING SIGNIFICANT INPUT
TO THE IMPLEMENTATION MANUAL

Evaluation Category*	DMRP Task
Liquid Phase Chemical Tests	1C Effects of Dredging and Disposal on Water Quality
	1E Pollution Status of Dredged Material
Water-Quality Criteria	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material
Initial Mixing	1A Aquatic Disposal Field Investigations
	1B Movements of Dredged Material
	1E Pollution Status of Dredged Material
Bioassay	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material
Suspended Particulate Bioassay	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material
Solid Phase Bioassay	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material
Initial Mixing	1A Aquatic Disposal Field Investigations
	1B Movements of Dredged Material
	1E Pollution Status of Dredged Material
Bioaccumulation	1A Aquatic Disposal Field Investigations
	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material
Trace Contaminants	1A Aquatic Disposal Field Investigations
	1C Effects of Dredging and Disposal on Water Quality
	1D Effects of Dredging and Disposal on Aquatic Organisms
	1E Pollution Status of Dredged Material

* From Figure 1.

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CONVENTIONAL DENSIFICATION TECHNIQUES TO INCREASE DISPOSAL AREA STORAGE CAPACITY

Scarcity of dredged material land disposal sites and limited storage capacities of sites have indicated that special priority must be given to the problem of improving containment areas. A study performed as Work Unit 5A03, "State-of-the-Art Applicability of Conventional Densification Techniques to Increase Disposal Area Storage Capacity," represents an essential step in research to develop and/or test promising techniques for increasing disposal area capacity and minimizing the number of new disposal areas. The study of dewatering/densification methodologies by the Soils and Pavements Laboratory

appropriate tasks are listed with the respective evaluation category from the *Federal Register*. Related research by the EPA was coordinated through the Technical Committee.

The Implementation Manual, however, is not intended to establish standards or rigid criteria and should not be interpreted in such a manner. Therefore, the document attempts to provide a balance between the technical state-of-the-art and routinely implementable guidance for using the procedures specified in the *Federal Register* and is expected to provide a continuity among the Corps Districts and the EPA's evaluation programs for Section 103 permit activities.

The Implementation Manual is particularly important for forming a foundation to be augmented by more meaningful and comprehensive evaluation procedures and guidelines as these evolve from current and future DMRP and EPA environmental research. Interagency coordination of the respective programs and the development of the joint agency procedures manual is being implemented by the EPA/CE Technical Committee on Criteria for Dredged and Fill Material. It is anticipated that the *Implementation Manual* will be updated routinely through this interagency committee as new and more implementable evaluation procedures are developed and verified. The *Implementation Manual* will remain in effect until publication of a new edition of the joint agency manual.

of WES makes an engineering evaluation of the applicability of conventional techniques used in soil mechanics and foundation engineering and by industries to dewater/densify large containment areas. No original research was conducted during this study. The results of the engineering evaluation were one basis for the selection of techniques to be evaluated further.

ENGINEERING PROPERTIES OF DREDGED MATERIAL

Dredged material varies from sands to silts and fine-grained plastic silty clays and clays. When it is deposited hydraulically, it has water contents after sedimentation which differ from those normally encountered in engineering practice. When dredged material is pumped into a confined disposal area, the

solids content may range from 7 to 25 percent by weight or water contents ranging from about 300 to 1300 percent because of such factors as the pipeline pumping system transport velocity, pump speed, and diameter and length of discharge lines. It is essentially saturated. The natural water content immediately after sedimentation is several times the Atterberg liquid limit (LL). After some surface drainage and drying has occurred, the limited data available suggest water content about equal to the LL. Once dredged material enters a confined disposal area, entrance and exit effects generally result in nonuniform deposition of materials over the entire area and varying soil properties. The settling velocity is influenced by environmental factors such as salinity, temperature, turbulence, and clay mineralogy.

If dredged material is left undisturbed, natural dewatering/densifying will occur to some extent. Dewatering (the removal of water from the soil) is a method for soil improvement which consolidates the soil. In fine-grained soils, dewatering results in the removal of part of the pore water and in reduction of pore pressure. It speeds up consolidation and is accompanied by an increase in strength and reduction in compressibility. In time, surface and base drainage effects some lowering of the groundwater level; a surface crust forms from desiccation; secondary compression effects develop; and consolidation occurs as the effective weight of soil above the lowered groundwater level increases from its submerged weight to its saturated weight. Placing dredged material in thin lifts and allowing natural drying to occur could reduce water contents to near the Atterberg plastic limit (PL).

DENSIFICATION TECHNIQUES

After some drainage has occurred and a crust has developed, some conventional densification treatments may be practical. For instance, loading (the temporary earth surcharge on the surface of a disposal area) is virtually impossible until after the disposal area has been somewhat drained and a surface crust has formed. Actual conditions of the site, as well as economics and the available time frame, will govern the appropriate method. Economically, dike raising is usually the lowest cost alternative for increased storage capacity. But dike raising is not always permissible or feasible, e.g., legal and environmental considerations; or the cost may be

relatively large because of the small size of the disposal area. So, alternate methods, which might include such techniques as loading, ponded water surcharges, surface vacuum mats, drainage, pumping, wellpoints, desiccation, or chemical treatments, must be found to dewater/densify containment areas.

PHYSICAL METHODS

Soil mechanics and foundation engineering use physical methods to reduce postconstruction settlements and increase shear strengths and bearing capacities of soft soils. Drainage techniques, for instance, can increase the storage capacity of disposal areas by accelerating soil stabilization and increasing the settlement. Various types of vertical drains, such as the Kjellman drain, are used for dewatering soft soils. The Kjellman drain consists of a cardboard sleeve which has small open channels that conduct water under pressure vertically to a drainage layer, with the cardboard acting as its own filter. The Geodrain, developed by the Swedish Geotechnical Institute, utilizes an inner piece of plastic with grooves that conduct water and is surrounded by an outer heavy paper that serves as a filter. Drainage techniques combining pumping with large vacuum pumps appear promising and most practicable where the quantity of water to be pumped is not large. The effectiveness of underlying drainage layers may be substantially increased if a partial vacuum in the drainage layer is maintained by vacuum pumps attached to or operated in conjunction with the groundwater lowering system. Drainage treatments may produce effective stresses as great as those produced by 5 to 10 ft of temporary surcharge loading. From this standpoint, drainage treatment concepts are efficient means of increasing the necessary effective stresses which cause densification in dredged material.

Ditching is also important in draining confined disposal areas. The Dutch employ the Amphirolo vehicle, which is propelled by rotating cylinders that have a spiral cutting edge. About 2 months after sedimentation and decanting of free water in dike-confined dredged material of about 1 m thick, the vehicles are used and leave ditches of about 10 cm deep. When the first layer has ripened* sufficiently, the process is repeated until

* Ripening: physical, biological, and/or chemical processes by which dredged material is converted to earth capable of containing or supporting animal and plant life.

the desired height of the dike is reached. Underdrains are sometimes used to accelerate consolidation. A similar but larger and more effective vehicle, the Riverine Utility Craft (RUC), has been evaluated by the DMRP.

Desiccation from improved surface drainage is one technique which is generally applicable in varying degrees and implies low-cost treatment. Engineering experience has shown that in a vegetative root system demand environment where normally consolidated soils were expected, subsoils were found to be preconsolidated by as much as 500 psf. The reduction of soil moisture content and the increased preconsolidation stress was of major benefit. Desiccation by vegetative desiccation may be of importance in increasing available disposal storage.

CHEMICAL DENSIFICATION METHODS

Chemical treatments used by the phosphate and aluminum industries were also evaluated to determine the potential application of these procedures to dredged material. Phosphate mining uses a washing process to produce a clay slurry waste product called slime, which is pumped into settling ponds constructed in the mined-out areas. The average solids concentration of the slime ranges from 2 to 6 percent by weight. Even though the industry reuses supernatant water released from the suspension as settling progresses, the settling process is quite slow and the large volumes of slurry exceed the volume of mined-out matrices. The phosphate industry has been studying ways to dewater slimes more rapidly for many years. In the late 1940's and early 1950's, the Tennessee Valley Authority conducted studies of various methods and found that while it was technically feasible to dewater the slime suspension to 50 percent solids by several different methods, the expense of applying any of the processes was significantly greater than that of storing in ponds. Waste products from the production of alumina, bauxite residue, have also undergone various studies to obtain increased consolidation and minimize land area required for storage. Chemical densification treatments at this time do not appear applicable for increasing disposal area storage capacity.

CONCLUSIONS AND RECOMMENDATIONS

Economics and actual environmental and engineering conditions at a disposal site will govern which technique is selected. While densification of disposal area soils to a water content about equal to the Atterberg LL is considered achievable by simple means, additional storage volume is more difficult to obtain. Properly designed soil treatments require laboratory tests, borings, experience, and judgment. Special problems and shortage of data and knowledge exist when analyzing dewatering/densification for dredged material in disposal sites. Consolidation properties that are regarded as constant in conventional soils engineering practice are variable when consolidation takes place over a large range in void ratios. Dredged material sedimentation and consolidation are a combined and continuous process unlike conditions in conventional engineering practice wherein only the consolidation phase is considered. Further, initial conditions are inadequately known. The effects of secondary compression during sedimentation and consolidation before start of densification treatment are considered to be of major importance in determining the initial water content and density of dredged material. Further research is recommended in several areas, to include not only laboratory research, but field tests as well.

The report was written by Mr. Stanley J. Johnson, Mr. Robert W. Cunny, Dr. Edward B. Perry, and Mr. Leslie Devay, all of the Soils and Pavements Laboratory, as a part of the DMRP Disposal Operations Project (Mr. Charles C. Calhoun, Jr., Project Manager), under DMRP Work Unit 5A03 (Dr. T. Allan Haliburton, DMRP Geotechnical Engineering Consultant, Work Unit Manager). Technical Report D-77-4 is currently available.

Supplemental information in the appendixes includes a description of dredged sediments, a general description of conventional densification techniques, and calculations for the economic evaluation of densification techniques.

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NEW LITERATURE

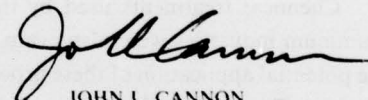
McCauley, J. E., et al., "Benthic Infauna and Maintenance Dredging: A Case Study," *Water Research*, Vol 11, 1977, pp 233-242.

Monitoring studies of a small maintenance dredging operation in Coos Bay, Oregon, showed that significant decreases of benthic infaunal abundance immediately after dredging extended at least 100 m from the site of actual dredging. The infauna readjusted to predredging conditions within 28 days in the dredged area and within 14 days in the adjacent areas. At the spoil site a similar decrease was followed by a 2-week recovery period. The authors suggest that an area subjected to maintenance dredging is also subjected to frequent disturbances from ship movements and other harbor activities and that the infauna is well adapted to this. Thus, maintenance dredging is a relatively normal event and should not be expected to have catastrophic effects.

Author's Abstract

NOTE: The DMRP regrets it cannot be a distributing agent for the new items of literature listed in this bulletin. All items presented are available at the time of listing from the publishing or issuing agency and requests for copies should be addressed to them. In many instances, only limited copies are available and the use of Interlibrary Loan or related services is encouraged.

This bulletin is published in accordance with AR 310-2. It has been prepared and distributed as one of the information dissemination functions of the Environmental Effects Laboratory of the Waterways Experiment Station. It is principally intended to be a forum whereby information pertaining to and resulting from the Corps of Engineers' nationwide Dredged Material Research Program (DMRP) can be rapidly and widely disseminated to Corps District and Division offices as well as other Federal agencies, State agencies, universities, research institutes, corporations, and individuals. Contributions of notes, news, reviews, or any other types of information are solicited from all sources and will be considered for publication as long as they are relevant to the theme of the DMRP, i.e., to provide through research definitive information on the environmental impact of dredging and dredged material disposal operations and to develop technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource. This bulletin will be issued on an irregular basis as dictated by the quantity and importance of information to be disseminated. Communications are welcomed and should be addressed to the Environmental Effects Laboratory, ATTN: R. T. Saucier, U. S. Army Engineer Waterways Experiment Station, P. O. Box 631, Vicksburg, Miss. 39180, or call AC 601, 636-3111, Ext. 3233.



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