

CESAJ-CO-ON (11-2-240a)
PN-SJH-136

Findings of Compliance Concerning Maintenance
Dredging Operations at San Juan Harbor,
San Juan, Puerto Rico

D. O. Files

CE-SAJDE

Hanson/tc/3729

1. This Findings of Compliance has been prepared in accordance with the Guidelines on "Specification of Disposal Sites for Dredged or Fill Materials" (40 CFR Parts 227 - 228 and 33 CFR 209.145). Appendix A is the Factual Determination (Atch 1). Appendix B is the Section 103 Evaluation prepared for the San Juan Harbor (Atch 2).

2. The selected disposal alternative complies with the requirements of the Guidelines. There are no other suitable disposal alternatives currently available for material dredged from San Juan Harbor.

3. Determinations and Findings. I have reviewed the project files, Environmental Assessment, and offshore ocean disposal evaluation. The offshore ocean disposal alternative will present:

- a. no unacceptable adverse effects to the marine ecosystem;
- b. no significant damage to wetlands; and
- c. no unacceptable adverse effects on human health.

SIGNED: Robert L. Herndon

2 Atchs

ROBERT L. HERNDON
Colonel, CE
Commanding

PH Hanson/CESAJ-CO-ON
AS Aspin/CESAJ-CO-ON
W Wilton/CESAJ-CO-0
D DiChiara/CESAJ-CO-A
TG Gren/CESAJ-CO
B Burns/CESAJ-DX
B Brown/CESAJ-DD
H Herndon/CESAJ-DE

APPENDIX A

FACTUAL DETERMINATION
MAINTENANCE DREDGING WITH OFFSHORE OCEAN
DISPOSAL OPERATIONS OF SAN JUAN HARBOR
SAN JUAN, PUERTO RICO

Introduction. This evaluation is prepared in accordance with the requirements found in 40 CFR 230 (Subpart B - paragraph 230.11).

a. Physical substrate impact determinations. The proposed ocean disposal site has been used in the past for disposal of similar material from San Juan Harbor. The shoal material, predominantly silty clay with a trace of sand, has been evaluated under Section 103 and found suitable for ocean disposal. Disposal should not result in any serious adverse impacts on the existing disposal area substrate.

b. Water circulation, fluctuations, and salinity impacts. Not significant.

c. Suspended particulate/turbidity determinations. Short-term adverse impacts will result from increased levels of turbidity from discharge operations. Turbidity plumes are expected to be located in the vicinity of the point of discharge. Temporarily reduced photosynthetic rates accompanied by lower water quality can be expected during project operations. These effects will be short-term with ambient conditions returning shortly after completion of the project.

d. Contaminant impact. The disposal material is predominantly silty clay with a trace of sand. Material of this composition is more likely to contain contaminants than predominantly sandy material. The results of bioassays performed in 1984 on sediment samples from San Juan Harbor are listed in the Section 103 report. Under the guidelines established by the EPA, the bioassays showed the material to be ecologically acceptable for ocean disposal and that contaminant impact would not be significant.

e. Aquatic ecosystem and organism determinations. Short-term minor effects will result, both individually and collectively, on the structure and function of the aquatic ecosystem and its organisms.

f. Proposed disposal site determinations. The EPA interim-approved ocean disposal area is specified in the Environmental Assessment (EA). No mixing zone requirements have been established for this disposal site. Alternative disposal areas, besides ocean disposal, are not available.

g. Determinations of cumulative effects on the aquatic ecosystem. The cumulative effects on the aquatic ecosystem by the ocean disposal operations of this project should be minimal.

h. Determination of secondary effects on the aquatic ecosystem. No secondary effects on the aquatic ecosystem have been identified.

APPENDIX B

SAN JUAN HARBOR, PUERTO RICO
MAINTENANCE DREDGING
SECTION 103
OCEAN DISPOSAL EVALUATION REPORT

1. Description of Action. Approximately 613,000 cubic yards of predominantly silty clay shoal material will be dredged from the navigation channels and turning basins at San Juan Harbor and disposed of in an EPA interim ocean disposal site.

2. Description of Disposal Area. The disposal area is an EPA-designated interim ocean disposal area located approximately 1.5 nautical miles north of San Juan Harbor in the Atlantic Ocean at coordinates:

<u>Latitude</u>			<u>Longitude</u>			<u>Latitude</u>			<u>Longitude</u>		
<u>Deg</u>	<u>Min</u>	<u>Sec</u>	<u>Deg</u>	<u>Min</u>	<u>Sec</u>	<u>Deg</u>	<u>Min</u>	<u>Sec</u>	<u>Deg</u>	<u>Min</u>	<u>Sec</u>
18	30	10 N	66	09	31 W	18	30	10 N	66	08	29 W
18	31	10 N	66	08	29 W	18	31	10 N	66	09	31 W

The site has an approximate area of one square nautical mile and depths in excess of 600 feet.

3. Description of Material. The material is predominantly silty clay with traces of sand.

4. Environmental Testing Results.

a. Sediments from seven locations in San Juan Harbor were subjected to liquid-phase bioassays, and bioaccumulation tests following Federal guidelines as published in the EPA/COE Implementation Manual.

b. Mean survival of organisms exposed to the 100 percent suspended particulate phase for 96 hours was:

<u>Results</u>	<u>Species</u>
93.3 - 100.0%	grass shrimp
96.7 - 100.0%	mysids
99.0 - 96.7%	Atlantic silversides

Mean survival of all species exposed to the control was 90 percent. Survival of all species exposed to dredged material from each station was equal to or greater than control survival. Therefore, no significant differences exist among survival of any test organism exposed to the control and 100 percent suspended particulate phase of dredged material. The calculation of LC50 values and limiting permissible concentration (LPC) values are not necessary.

c. Mean survival of organisms exposed to the solid phase for 10 days was:

<u>Results</u>	<u>Species</u>
86 - 94%	brown shrimp
96 - 100%	hard clams
87 - 93%	sandworms

Mean survival of organisms exposed to the control sediment for 10 days was:

<u>Results</u>	<u>Species</u>
91%	brown shrimp
97%	hard clams
90%	sandworms

Analysis of the survival data for the three species indicate that the survival of organisms exposed to the solid phase of dredged material was not significantly less (0.05 probability level) than survival of organisms exposed to control material.

d. Concentrations of mercury, cadmium, PCB's, and aliphatic and aromatic petroleum hydrocarbons in organisms exposed to the solid phase of dredged material were examined for bioaccumulation. A statistical analysis of the data indicate that the concentrations of mercury, cadmium, PCB's, and aromatic petroleum hydrocarbons exposed to the solid phase of dredged material were not significantly higher (0.05 probability level) than concentrations in control organisms. Concentrations of aliphatic petroleum hydrocarbons in tissues of sandworms exposed to dredged material from station 1 were significantly higher than concentrations in organisms exposed to control sediment. The maximum mean concentration of these hydrocarbons was within the range of baseline levels for most organisms. The probability of harmful accumulation of petroleum hydrocarbons in the human food chain is judged to be negligible as the compound does not have the potential to magnify in the upper levels of the ecological food chain. Sandworms exposed to dredged material from stations 2-7 and brown shrimp and hard clams exposed to dredged material from all seven stations did not exhibit elevated levels of aliphatic petroleum hydrocarbons.

5. Need for Ocean Disposal. Alternatives to the selected disposal area include upland sites or other ocean disposal areas not approved by the EPA. There are no suitable upland sites within economic transporting distance of the project area and the material is unsuitable for beach disposal. The ocean disposal site chosen is approved for use by the EPA.

6. Environmental Impacts.

a. Esthetics. Temporary turbidity caused by disposal activities could be esthetically displeasing.

b. Recreation Resources. The proposed action is not expected to adversely affect recreation resources.

c. Commercial Marine Resources. No adverse impacts are expected.

d. Navigation. Implementation of the proposed action will have a positive effect on navigation by maintaining the authorized project depths, thus alleviating navigation hazards and insuring the economic viability of Puerto Rico's largest port.

e. Mineral Resources. No impact expected.

f. Water Quality. A temporary reduction in water quality may occur at the disposal site but applicable water quality standards will be met.

g. Historical and Archeological Resources. No adverse impacts are expected.

h. Endangered Species. No impacts are expected.

7. Determinations and Findings. I have reviewed the project files, Environmental Impact Assessment, and the ocean disposal evaluation report. The proposed ocean disposal will present:

a. no unacceptable adverse effects on human health and no significant damage to the resources of the marine environment;

b. no unacceptable adverse effects on the marine ecosystem;

c. no unacceptable adverse persistent or permanent effects due to the dumping of the particular volumes or concentrations of these materials; and

d. no unacceptable adverse effects on the ocean for other uses as a result of direct environmental impact.

SIGNED: Robert L. Herndon

ROBERT L. HERNDON
Colonel, CE
Commanding

VJ/Hanson/CESAJ-CO-
3729 1/20
Ashton/CESAJ-CO-0
Hutton/CESAJ-CO-
DiChiara/CESAJ-C
TDA Gren/CESAJ-CO
Burns/CESAJ-DX
Brown/CESAJ-DD
Herndon/CESAJ-DE



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232
April 29, 1985

Construction-Operations Division
Public Notice No. SJH-136

PUBLIC NOTICE

TO WHOM IT MAY CONCERN: The District Engineer, Jacksonville District, U. S. Army Corps of Engineers, proposes to perform maintenance dredging pursuant to Section 404 of the Clean Water Act of 1977. This federal project is being evaluated and coordinated pursuant to 33 CFR 209.145.

Comments regarding the application should be submitted in writing to the District Engineer at the above address within 30 days from the date of this notice. Any person who has an interest which may be affected by the disposal of this dredged material may request a public hearing. The request must be submitted in writing to the District Engineer within 30 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

If you have any questions concerning this application, you may contact Ms. Glisel Torres of this office, telephone (904) 791-1133.

WATERWAY & LOCATION: San Juan Harbor, Puerto Rico

PROJECT AUTHORIZATION: River and Harbor Act of July 3, 1958, and House Document 38, 85th Congress, 1st Session.

WORK AND PURPOSE: The work will consist of removing approximately 1.2 million cubic yards of shoal material to provide the following harbor project depths:

Graving Dock Basin	30-ft. depth
Army Terminal Channel	36-ft. depth
Army Terminal Turning Basin	36-ft. depth
Puerto Nuevo Channel & Turning Basin	32-ft. depth

The maintenance dredging and disposal operation will be performed by hopper dredge. The material will be disposed of in an EPA interim ocean disposal site located at 18° 30' 10"N; 66° 09' 31"W; 18° 30' 10"N; 66° 08' 29"W; 18° 31' 10"N; 66° 08' 29"W; 18° 31' 10"N; 66° 09' 31"W. The interim disposal site has an approximate area of one square mile. Depths at the site exceeds 600 ft. Previous historical uses of the site include the disposal of dredge material obtained from areas within the San Juan Harbor, in conjunction with both federal channel dredging projects and nonfederal dredging. At least 4.3 million cubic yards of material have been dumped at the site since 1974. No known evidence of significant adverse impacts have resulted from this previous disposal activities. The proposed dredged material is predominantly silty clay with traces of sand.

The proposed transportation of this dredged material for the purpose of dumping it in ocean waters will be evaluated to determine that the proposed dumping will not unreasonably degrade or endanger human health, welfare, or amenities or the marine environment, ecological system, or economic potentialities. In making this determination, the criteria established by the Administrator, EPA, pursuant to Section 102(a) of the Marine Protection, Research, and Sanctuaries Act of 1972 shall be applied. Bioassays were performed on the materials to be dredged, and it meets the requirements for ocean disposal.

a. Impact on Natural Resources: A final Environmental Impact Statement (EIS) was filed with the Council of Environmental Quality (CEQ) on April 11, 1975. The statement was coordinated with interested agencies and organizations as required by the National Environmental Policy Act of 1969. All comments received were incorporated in the final EIS.

b. Historical Resources: The National Register of Historic Places and the latest supplement to the Register was consulted. No resources have been listed in the Register that may be affected by the project's operations. Existing historical, archeological, and cultural resources within the work area will be so designated by the Corps and precautions taken to preserve all such resources as they existed at the time they were located. If during construction activities the Corps observes unusual items that might have historical or archeological value, such observations shall be reported as soon as practicable.

c. Fish and Wildlife Resources: Construction activities will be kept under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife. The surveillance, management, and control will be performed by either Corps or Contractor depending upon who is performing the work. Contract work is under the supervision of the Corps.

d. Threatened or Endangered Species. The Corps or Contractor will monitor and instruct all personnel associated with the construction of the project about the presence of manatees and/or sea turtles in the area and the need to avoid collisions. All vessels associated with the project will be required to operate at "no wake" speeds at all times while in shallow waters, or channels, where the draft of the boat provides less than 3 feet clearance of the bottom. Boats used to transport personnel will be shallow-draft vessels, preferably of the light-displacement category, where navigational safety permits. Vessels transporting personnel between the landing and the dredge shall follow routes of deep water to the extent possible. The Corps or Contractor will brief their personnel concerning the civil and criminal penalties for harming, harassing, or killing manatees and/or sea turtles, which are protected under the Endangered Species Act and the Marine Mammal Protection Act. The Corps or Contractor will be held responsible for any manatee and/or sea turtles harmed, harassed, or killed as a result of the construction of the project. The Corps or Contractor will keep a log detailing all sighting, collisions, damage, or killing of manatees and/or sea turtles which have occurred during the maintenance dredging period. Any collision with a manatee and/or sea turtle resulting in death or injury to the animal shall be reported immediately to the Corps' Environmental Resources Branch for Contractor work and to the Fish and

Wildlife Service (Mayaguez, Puerto Rico) for Corps' work for investigations so the appropriate course of action can be taken. Following project completion, the Corps will submit a report summarizing the above incidents to the U. S. Fish and Wildlife Service.

e. Ecological Examination of Dredged Material Proposed for Oceanic Discharge. An examination of the dredged material proposed for ocean disposal was undertaken to assess the potential for creating significant undesirable effects due to constituents within the harbor sediments. Specific prohibitions have been established for ocean disposal of certain materials which would cause unacceptable adverse effects on human health and the marine environment. Restrictions have been set for the ocean disposal of sediments which contain constituents whose presence may be environmentally damaging. Dredged material from San Juan Harbor does not contain high level radioactive waste, materials produced or used for radiological, chemical, or biological warfare, or persistently inert material which may interfere with legitimate uses of the ocean. A determination of compliance with criteria established for toxicological and bioaccumulative impacts was sought by performing bioassays and bioaccumulation tests.

1. Summary of Testing Procedures and Materials. Seven sampling stations were chosen in San Juan Harbor to obtain sediment samples for analyses. At each station, one subsample was separated for bioassay testing and two subsamples for chemical analyses. All the subsamples were maintained, prepared, and analyzed in accordance with the methods outlined in the manual, Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material into Ocean Waters (U.S. EPA and U.S. Army CE, 1977). Species used in the suspended particulate phase bioassays were the Atlantic silverside (Menidia menidia), mysid (Mysidopsis bahia), and the grass shrimp (Palaemonetes pagio). Species utilized in the solid phase bioassays were the brown shrimp (Penaeus aztecus aztecus), hard clam (Mercenaria mercenaria), and sandworm (Nereis virens). Tissue samples were analyzed for two metals, cadmium (Cd) and mercury (Hg) according to methods described by EPA (1979) and Goldberg (1976). Other tissue samples were analyzed for three types of organics, polychlorinated biphenyls (PCBs), aliphatic petroleum hydrocarbons, and aromatic petroleum hydrocarbons according to procedures described by EPA (1971) and the U.S. Food and Drug Administration (1977). The bioassay and bioaccumulation results were statistically interpreted using techniques recommended by the EPA and Army CE manual cited above. The data sets were evaluated by Cochran's test to determine the homogeneity of data variances when necessary. For homogeneous variances, a parametric one-way analysis of variance (ANOVA) and, when warranted, the Student-Newman-Keuls' test were used to determine if significant differences existed between control organisms and test organisms. In all the statistical tests, a determination of significant or nonsignificant difference was made at the 95% confidence level.

2. Results and Discussions. The following results and statistical analyses were obtained from tests performed on samples taken from San Juan Harbor (Tables 1-8).

Table 1. Results of analyses of liquid phase samples formulated with sediment from San Juan, Puerto Rico, and the artificial seawater used to formulate the liquid phase

Sample	Constituent (ug/l)							Petroleum hydrocarbons	
	Arsenic	Cadmium	Lead	Nickel	Mercury	Zinc	PCBs	Aliphatic	Aromatic
	Station 1	3.8	<0.1	<1	3.8	<0.1	20	<0.01	<0.1
Station 2	6.1	<0.1	<1	3.1	<0.1	21	<0.01	<0.1	<0.1
Station 3	<1.0	<0.1	<1	3.1	<0.1	13	<0.01	<0.1	<0.1
Station 4	4.1	<0.1	<1	12	<0.1	12	<0.01	<0.1	<0.1
Station 5	7.5	<0.1	<1	10	<0.1	12	<0.01	<0.1	<0.1
Station 6	4.8	<0.1	<1	11	<0.1	34	<0.01	<0.1	<0.1
Station 7	2.1	<0.1	<1	4.6	<0.1	9.5	<0.01	0.2	<0.1
Artificial seawater	<1.0	<0.1	<1	<3	<0.1	135	<0.01	<0.1	<0.1

Table 2. Results of analyses of sediment samples from San Juan Harbor, Puerto Rico, and the control sediment used in solid phase bioassays

Sample	Constituent (ug/g)			Petroleum hydrocarbons	
	Cadmium	Mercury	PCBs	Aliphatic	Aromatic
	Station 1	<0.52	0.34	0.03	57.5
Station 2	<0.63	0.44	0.01	47.7	3.4
Station 3	<0.62	0.61	0.06	182.8	19.4
Station 4	<0.52	0.48	0.14	53.9	11
Station 5	<0.50	0.20	0.01	17.8	4.6
Station 6	<0.54	0.43	0.04	66.4	9.1
Station 7	<0.60	0.53	0.24	132	14.4
Control sediment	<0.50	<0.004	<0.01	0.6	0.6

Table 3. Survival of grass shrimp, *Palaemonetes pugio*, mysids, *Mysidopsis bahia*, and Atlantic silversides, *Menidia menidia*, exposed for 96 hours to 100% suspended particulate phase of dredged material and a control

Organism	Repli- cate	Number of survivors							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Grass shrimp	1	9	10	10	10	9	10	10	9
	2	8	9	10	8	9	10	10	10
	3	10	9	10	10	10	10	10	10
	Mean	9.00	9.33	10.00	9.33	9.33	10.00	10.00	9.67
Percent survival		90.0	93.3	100.0	93.3	93.3	100.0	100.0	96.7
Mysids	1	9	10	10	10	10	10	10	9
	2	9	10	10	10	9	10	10	10
	3	9	9	9	10	10	10	10	10
	Mean	9.00	9.67	9.67	10.00	9.67	10.00	10.00	9.67
Percent survival		90.0	96.7	96.7	100.0	9.67	100.0	100.0	96.7
Atlantic silversides	1	9	9	10	9	8	10	10	10
	2	8	10	10	10	9	10	10	9
	3	10	9	9	9	10	8	9	10
	Mean	9.00	9.33	9.67	9.33	9.00	9.33	9.67	9.67
Percent survival		90.0	93.3	96.7	93.3	90.0	93.3	96.7	96.7

Table 4. Survival of brown shrimp, *Penaeus aztecus aztecus*, hard clams, *Mercenaria mercenaria*, and sandworms, *Nereis virens*, exposed for 10 days to the solid phase of dredged material and control sediment

Organism	Repli- cate	Number of survivors							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Brown shrimp	1	19	16	15	18	20	19	20	16
	2	17	18	18	16	18	17	18	17
	3	18	19	19	15	20	20	19	20
	4	18	16	17	20	20	17	16	18
	5	19	20	18	17	16	19	16	19
	Mean	18.2	17.8	17.4	17.2	18.8	18.4	17.8	18.0
Percent survival		91.0	89.0	87.0	86.0	94.0	92.0	89.0	90.0
Hard clams	1	20	20	20	20	19	18	20	19
	2	20	17	20	20	19	20	20	20
	3	17	19	20	20	20	20	20	20
	4	20	20	19	20	20	20	20	19
	5	20	20	20	20	20	20	20	19
	Mean	19.4	19.2	19.8	20.0	19.6	19.6	20.0	19.4
Percent survival		97.0	96.0	99.0	100.0	98.0	98.0	100.0	97.0
Sandworms	1	18	16	17	17	16	19	17	15
	2	16	17	17	18	19	18	18	16
	3	18	16	19	20	17	18	19	19
	4	18	20	18	20	16	17	17	18
	5	20	18	20	18	19	19	20	19
	Mean	18.0	17.4	18.2	18.6	17.4	18.2	18.2	17.4
Percent survival		90.0	87.0	93.0	93.0	87.0	91.0	91.0	87.0

Table 5. Statistical analyses of survival of brown shrimp, *Penaeus aztecus aztecus*, hard clams, *Mercenaria mercenaria*, and sandworms, *Nereis virens*, exposed for 10 days to the solid phase of dredged material and control sediment

Organism	Treatment	Cochran's test for homogeneity of variances of survival data			Parametric one-way analysis of variance (ANOVA) of survival data
		Mean	Variance	C(cal) ^a	F(cal) ^b
Brown shrimp	Control	18.2	0.7	0.18 ns	0.53 ns
	Station 1	17.8	3.2		
	Station 2	17.4	2.3		
	Station 3	17.2	3.7		
	Station 4	18.8	3.2		
	Station 5	18.4	1.8		
	Station 6	17.8	3.2		
	Station 7	18.0	2.5		
Hard clams	Control	19.4	1.8	0.35 ns	0.67 ns
	Station 1	19.2	1.7		
	Station 2	19.8	0.2		
	Station 3	20.0	0.0		
	Station 4	19.6	0.3		
	Station 5	19.6	0.8		
	Station 6	20.0	0.0		
	Station 7	19.4	0.3		

Table 5. Continued.

Organism	Treatment	Cochran's test for homogeneity of variances of survival data			Parametric one-way analysis of variance (ANOVA) of survival data
		Mean	Variance	C(cal) ^a	F(cal) ^b
Sandworms	Control	18.0	2.0	0.20 ns	0.53 ns
	Station 1	17.4	2.8		
	Station 2	18.2	1.7		
	Station 3	18.6	1.8		
	Station 4	17.4	2.3		
	Station 5	18.2	0.7		
	Station 6	18.2	1.7		
	Station 7	17.4	3.3		

^aThe value for C(cal) is compared to C(tab), which equals 0.39 for 0.05 probability level, k = 8, and v = 4. Variances are considered to be homogeneous (ns) if C(cal) ≤ C(tab). Otherwise, variances are considered to be heterogeneous (*).

^bThe value for F(cal) is compared to F(tab), which equals 2.31 for 0.05 probability level, numerator df = 7, and denominator df = 32. Mean survival of organisms is considered to be nonsignificantly different (ns) if F(cal) ≤ F(tab). Otherwise, the difference is considered to be significant (*).

Table 6. Concentrations of mercury (Hg), cadmium (Cd), PCBs, aliphatic petroleum hydrocarbons, and aromatic petroleum hydrocarbons in tissues of brown shrimp, Penaeus aztecus aztecus, that survived 10-day exposure to the solid phase of dredged material and control sediment

		Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
Chemical	Repli- cate	Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Mercury	1	0.037	0.035	0.062	0.045	0.033	0.025	0.029	0.029
	2	0.032	0.035	0.035	0.031	0.024	0.026	0.023	0.029
	3	0.030	0.030	0.029	0.027	0.037	0.039	0.039	0.040
	4	0.038	0.028	0.032	0.033	0.039	0.026	0.035	0.025
	5	0.041	0.025	0.047	0.036	0.042	0.025	0.037	0.032
	Mean	0.036	0.031	0.041	0.034	0.035	0.028	0.033	0.031
Cadmium	1	0.021	0.026	0.016	0.016	0.023	0.011	0.010	0.018
	2	0.025	0.036	0.022	0.012	0.016	0.017	0.015	0.018
	3	0.038	0.038	0.024	0.024	0.023	0.033	0.015	0.018
	4	0.017	0.025	0.014	0.021	0.013	0.020	0.062	0.045
	5	0.021	0.015	0.015	0.012	0.013	0.012	0.031	0.019
	Mean	0.024	0.028	0.018	0.017	0.018	0.019	0.027	0.024
PCBs	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 6. Continued.

		Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
Chemical	Repli- cate	Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Aliphatic petroleum hydrocarbons	1	0.4	<0.15	<0.15	<0.15	1.8	<0.15	<0.15	0.3
	2	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	3	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	4	19.2	<0.15	<0.15	<0.15	<0.15	2.2	<0.15	<0.15
	5	<0.15	<0.15	<0.15	<0.15	3.6	8.2	<0.15	<0.15
	Mean	4.01	<0.15	<0.15	<0.15	1.17	2.17	<0.15	0.18
Aromatic petroleum hydrocarbons	1	<0.15	<0.15	1.1	<0.15	<0.15	<0.15	<0.15	0.6
	2	<0.15	4.1	<0.15	<0.15	<0.15	<0.15	0.5	0.4
	3	<0.15	<0.15	<0.15	0.8	<0.15	<0.15	0.3	<0.15
	4	9.1	<0.15	<0.15	<0.15	<0.15	2.4	<0.15	<0.15
	5	<0.15	<0.15	1.4	<0.15	<0.15	<0.15	<0.15	0.5
	Mean	1.94	0.94	0.59	0.28	<0.15	0.60	0.25	0.36

^aData sets in which mean tissue concentration in organisms exposed to dredged material for any station is higher than mean concentration in control organisms are enclosed by boxes. Statistical analyses of the enclosed data sets appear in Table 9.

Table 7. Concentrations of mercury (Hg), cadmium (Cd), PCBs, aliphatic petroleum hydrocarbons, and aromatic petroleum hydrocarbons in tissues of hard clams, *Mercenaria mercenaria*, that survived 10-day exposure to the solid phase of dredged material and control sediment

Chemical	Repli- cate	Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Mercury	1	0.010	0.010	0.019	0.008	0.015	0.009	0.015	0.015
	2	0.013	0.007	0.014	0.008	0.010	0.009	0.014	0.014
	3	0.013	0.009	0.013	0.009	0.015	0.009	0.014	0.013
	4	0.020	0.008	0.013	0.005	0.013	0.011	0.014	0.012
	5	0.014	0.024	0.009	0.015	0.015	0.013	0.015	0.011
	Mean	0.014	0.012	0.014	0.009	0.014	0.010	0.014	0.013
Cadmium	1	0.12	0.14	0.18	0.11	0.17	0.27	0.18	0.16
	2	0.25	0.15	0.16	0.18	0.16	0.23	0.11	0.15
	3	0.14	0.19	0.09	0.15	0.15	0.15	0.13	0.15
	4	0.28	0.11	0.15	0.23	0.17	0.12	0.14	0.18
	5	0.16	0.17	0.10	0.13	0.15	0.14	0.18	0.19
	Mean	0.19	0.15	0.14	0.16	0.16	0.18	0.15	0.17
PCBs	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	5	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Mean	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 7. Continued.

Chemical	Repli- cate	Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Aliphatic petroleum hydrocarbons	1	<0.15	<0.15	<0.15	<0.15	1.8	<0.15	<0.15	0.3
	2	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	3	0.4	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	4	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	5	1.3	0.8	<0.15	3.7	3.6	<0.15	<0.15	<0.15
	Mean	0.43	0.28	<0.15	0.86	1.17	<0.15	<0.15	0.18
Aromatic petroleum hydrocarbons	1	0.4	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
	2	0.2	<0.15	0.4	<0.15	4.5	<0.15	5.0	<0.15
	3	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	0.6	<0.15
	4	0.3	<0.15	0.4	<0.15	<0.15	<0.15	<0.15	<0.15
	5	1.1	0.3	0.2	0.4	0.4	<0.15	0.8	<0.15
	Mean	0.43	0.18	0.26	0.19	1.07	<0.15	1.34	<0.15

^aData sets in which mean tissue concentration in organisms exposed to dredged material for any station is higher than mean concentration in control organisms are enclosed by boxes. Statistical analyses of enclosed data sets appear in Table 9.

Table 8. Concentrations of mercury (Hg), cadmium (Cd), PCBs, aliphatic petroleum hydrocarbons, and aromatic petroleum hydrocarbons in tissues of sandworms, *Nereis virens*, that survived 10-day exposure to the solid phase of dredged material and control sediment

Chemical	Repli- cate	Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Mercury	1	0.013	0.013	<0.002	0.013	0.007	0.002	0.007	0.020
	2	0.017	0.013	0.005	0.011	0.011	0.020	0.007	0.013
	3	0.013	0.015	0.003	0.024	0.009	0.011	0.012	0.008
	4	0.005	0.020	0.014	0.007	0.012	0.007	0.022	0.019
	5	0.006	0.015	0.014	0.018	0.022	0.029	0.007	0.024
	Mean	0.011	0.015	0.008	0.015	0.012	0.014	0.011	0.017
Cadmium	1	0.055	0.044	0.028	0.027	0.017	0.032	0.061	0.059
	2	0.017	0.032	0.028	0.051	0.047	0.020	0.023	0.038
	3	0.028	0.037	0.044	0.040	0.043	0.041	0.046	0.023
	4	0.071	0.051	0.040	0.037	0.050	0.026	0.038	0.019
	5	0.048	0.031	0.031	0.029	0.046	0.053	0.021	0.028
	Mean	0.044	0.039	0.034	0.037	0.041	0.034	0.038	0.033
PCBs	1	0.02	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01
	2	0.02	0.01	0.01	0.01	0.02	<0.01	<0.01	<0.01
	3	0.01	<0.01	0.02	0.02	<0.01	0.01	<0.01	0.02
	4	0.01	<0.01	0.01	<0.01	<0.01	0.01	<0.01	0.03
	5	0.02	<0.01	0.02	0.01	0.01	0.02	<0.01	0.02
	Mean	0.02	0.01	0.01	0.01	0.01	0.01	<0.01	0.02

Table 8. Continued.

Chemical	Repli- cate	Concentration of chemical constituent in tissues (ug/g, wet weight) ^a							
		Control	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7
Aliphatic petroleum hydrocarbons	1	4.5	2.0	4.1	2.5	5.4	3.9	<0.15	4.6
	2	3.0	2.5	4.0	7.5	4.5	5.0	5.1	4.8
	3	1.4	24.3	5.4	5.7	<0.15	2.9	<0.15	6.3
	4	2.3	11.3	6.9	4.4	7.7	4.9	<0.15	10.0
	5	2.8	16.4	4.6	2.9	4.9	7.3	<0.15	5.2
	Mean	2.8	11.3	5.0	4.6	4.5	4.8	1.1	6.2
Aromatic petroleum hydrocarbons	1	2.1	0.3	1.3	0.3	1.3	0.2	<0.15	0.6
	2	2.4	0.4	1.3	0.9	5.3	0.3	0.5	1.8
	3	0.5	0.1	0.7	0.3	<0.15	0.3	0.3	3.3
	4	0.4	0.1	0.6	0.6	0.3	0.3	<0.15	3.3
	5	2.1	0.6	1.4	0.4	0.3	1.0	<0.15	3.0
	Mean	1.5	0.3	1.1	0.5	1.5	0.4	0.2	2.4

^aData sets in which mean tissue concentration in organisms exposed to dredged material for any station is higher than mean concentration in control organisms are enclosed by boxes. Statistical analyses of enclosed data sets appears in Table 9.

Table 9. Continued.

Chemical constituent	Organism	Treatment	Mean	Variance	C(cal) a	F(cal) b	Difference from control mean c	LSD	χ^2 (cal) d	U(cal) e	Parametric		one-way analysis of variances	
											Cochran's test for homogeneity of variances of chemical data	one-way analysis of variance (ANOVA) of chemical data	Student-Newman-Keuls' multiple range test	(ANOVA) of chemical data (Kruskal and Wallis' test)
Mercury	Sandworms	Control	0.011	0.0000262	0.34 ns	1.00 ns								
		Station 1	0.015	0.0000082										
		Station 2	0.008	0.0000353										
		Station 3	0.015	0.0000433										
		Station 4	0.012	0.0000337										
		Station 5	0.014	0.0001157										
		Station 6	0.011	0.0000425										
Station 7	0.017	0.0000397												
Aliphatic petroleum hydrocarbons	Sandworms	Control	2.8	1.285	0.37 nsf	4.14*	—	0.8						
		Station 1	11.3	89.735			0.9*	0.8						
		Station 2	5.0	1.435			0.4 ns	0.8						
		Station 3	4.6	4.240			0.4 ns	0.8						
		Station 4	4.5	7.532			0.2 ns	0.7						
		Station 5	4.8	2.680			0.4 ns	0.8						
		Station 6	1.1	4.900			—	0.8						
Station 7	6.2	4.942			0.6 ns	0.8								
Aromatic petroleum hydrocarbons	Sandworms	Control	1.5	0.935	0.63*									
		Station 1	0.3	0.045										
		Station 2	1.1	0.143										
		Station 3	0.5	0.065										
		Station 4	1.5	4.794										
		Station 5	0.4	0.107										
		Station 6	0.2	0.024										
Station 7	2.4	1.395												

The value for C(cal) is compared to C(tab), which equals 0.39 for 0.05 probability level, k = 8, and v = 4. Variances are considered to be homogeneous (ns) if C(cal) < C(tab). Otherwise, variances are considered to be heterogeneous (*).

The value for F(cal) is compared to F(tab), which equals 2.31 for 0.05 probability level, numerator df = 7, and denominator df = 32. Mean tissue concentrations are considered to be nonsignificantly different (ns) if F(cal) < F(tab). Otherwise, the difference is considered to be significant (*).

The difference between the treatment and control means (if treatment mean is larger than control mean) is compared to the least significant difference (LSD), which equals the tabulated significant difference (0.05 probability level) times the square root of the error mean square (calculated during the analysis of variance computation) divided by the number of replicates. Mean tissue concentrations are considered to be nonsignificantly different (ns) if the difference < LSD. Otherwise, the difference is considered to be significant.

The value for χ^2 (cal) is compared to χ^2 (tab), which equals 14.1 for 0.05 probability level, df = 7. Mean tissue concentrations are considered to be nonsignificantly different (ns) if χ^2 (cal) < χ^2 (tab). Otherwise, the difference is considered to be significant (*).

For each comparison (control mean versus larger treatment mean), the value of U(cal) is compared to U(tab) which equals 22.0 for 0.05 probability level, t = 2, and r = ∞. Mean tissue concentrations are considered to be nonsignificantly different (ns) if U(cal) < U(tab). Otherwise, the difference is considered to be significant.

Original data exhibited heterogeneous variances. Cochran's test and the parametric one-way analysis of variance were performed with transformed data (natural log of x+1).

For all seven stations, the survival rate of the grass shrimp, mysids, and Atlantic silversides exposed for 96 hours to 100% suspended particulate phase dredge material was found not to be significantly lower than the control organisms for the same period of time (Survival rates: 93.3 - 100% grass shrimp, 96.7 - 100% mysids, 90.0 - 96.7% Atlantic silversides, 90% control). Since the test organisms met or exceeded the survival rate of the control organisms, no statistical analysis of the results was necessary. The survival rate of the brown shrimp, hard clams, and sandworms exposed for 10 days to the solid phase of dredged material and to the control sediment was also not significantly different (Survival rates: 86.0 - 94.0% brown shrimp, 96.00 - 100.0% hard clams, 87.0 - 93.0% sandworms). The lack of significant difference between the survival of the test and control organisms for the suspended particulate phase and solid phase bioassays indicate the dredged material to be within the acceptable range for toxicological effects. It was therefore unnecessary to calculate the lethal concentration (LC50) and limiting permissible concentration (LPC). Tissues taken from surviving brown shrimp, hard clams, and sandworms did not contain significantly elevated concentrations of xenobiotic constituents (cadmium, mercury, PCBs, aliphatic and aromatic hydrocarbons) when compared to tissues from control organisms except in one case. In this case, a bioaccumulation test of sediment from Station 1 for aliphatic petroleum hydrocarbons in sandworms indicated a statistical potential for bioaccumulation. However, petroleum hydrocarbons do not biomagnify in concentration in the upper levels of the food chain and therefore have a negligible probability for harmful accumulation in the human food chain. Further, the maximum mean concentration of these hydrocarbons in sandworms is within the baseline range for most organisms. (Final Report, Ecological Evaluation of Proposed Oceanic Discharge of Dredged Material from San Juan Harbor, Puerto Rico; T. J. Ward and R. L. Boer, ENESCO, Inc., April 3, 1985). All the remaining samples yielded no statistical differences between the control and test organisms and therefore gave no indication of potential deleterious impact from disposal operations. It was unnecessary to calculate the limiting permissible concentration (LPC).

Based on the above results and the criteria established for oceanic discharge of dredged material, it is concluded that the material to be dredged from San Juan Harbor is ecologically acceptable for ocean disposal at the EPA designated site and should not pose any significant deleterious environmental impact.

APPLICABLE LAWS: The following laws are, or may be, applicable to the review of the proposed disposal sites and to the activities affiliated with this federal project:

1. Section 404 of the Clean Water Act of 1977 (PL 95-217) (33 U.S.C. 1344).
2. Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (PL 92-532) (33 U.S.C. 1413, 86 Stat. 1052).
3. Section 302 of the Marine Protection, Research, and Sanctuaries Act of 1972 (PL 92-532, 86 Stat. 1052).

4. The National Environmental Policy Act of 1969 (PL 91-190) (42 U.S.C. 4321-4347).

5. Sections 307(c)(1) and (2) of the Coastal Zone Management Act of 1972 (16 U.S.C. 1456(c)(1) and (2), 86 Stat. 1280).

6. The Fish and Wildlife Act of 1956 (16 U.S.C. 472a et seq).

7. The Migratory Marine Game-Fish Act of 1959 (16 U.S.C. 760c-760g).

8. The Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661-666c).

9. The Endangered Species Act of 1973 (PL 93-205) (16 U.S.C. 668aa-668cc-6, 87 Stat. 884).

10. The National Historic Preservation Act of 1966 (16 U.S.C. 470, 80 Stat. 915).

11. Section 313 of the Clean Water Act of 1977 (33 U.S.C. 1323, 82 Stat. 816).

DISSEMINATION OF NOTICE: You are requested to communicate the information contained in this notice to any other parties whom you deem likely to have an interest in this matter.

COORDINATION: This notice is being sent to, and coordinated with, the following agencies:

FEDERAL AGENCIES:

Field Supervisor, Fish & Wildlife Service, Mayaguez, PR
EPA, Region II, New York, NY
Southeast Regional Ofc, National Marine Fisheries Serv, St. Petersburg, FL

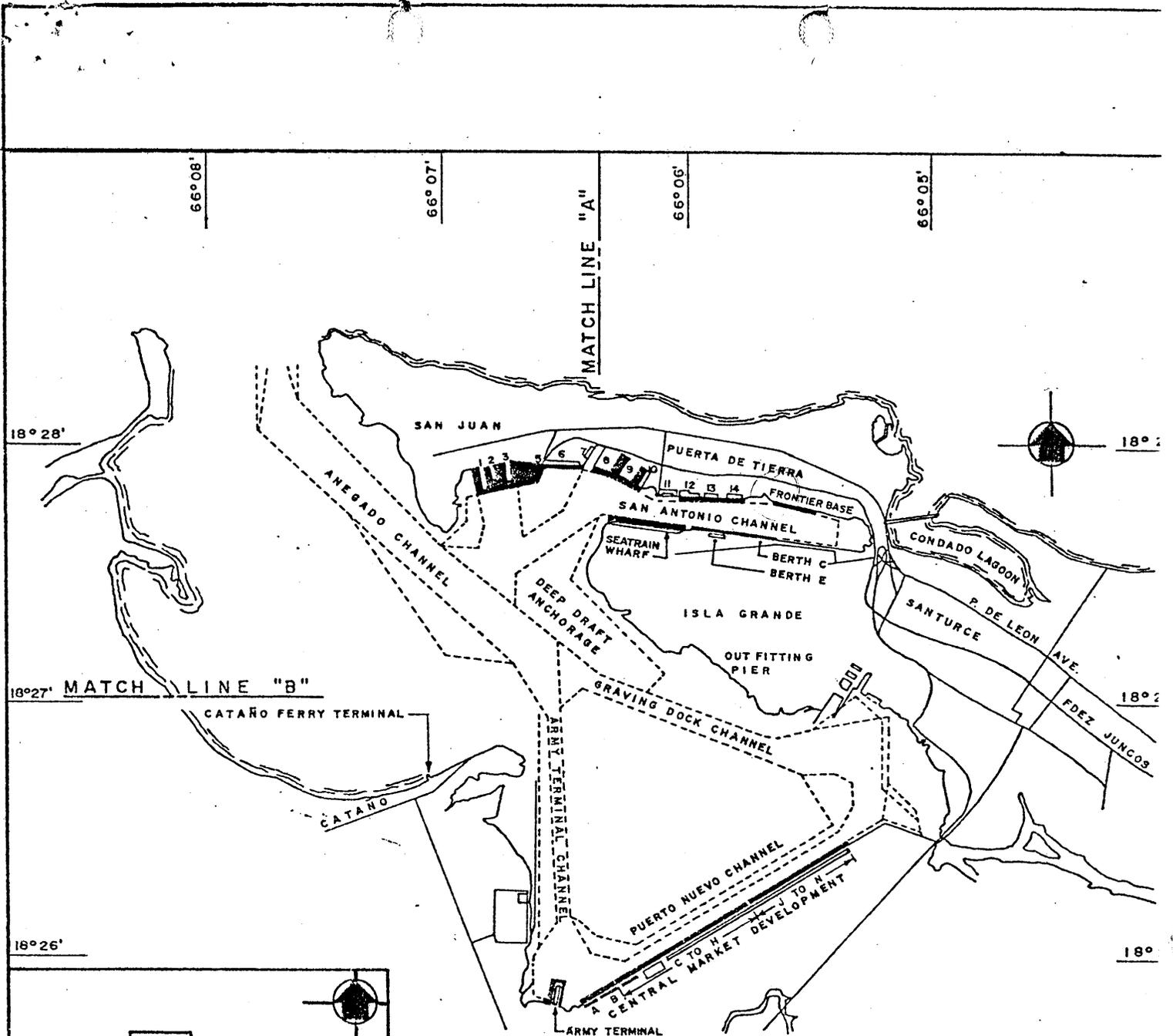
LOCAL GOVERNMENTS:

President, Environmental Quality Board, Santurce, PR
Executive Director, Ports Authority, San Juan, PR
Secretary, Dept of Natural Resources, San Juan, PR

FOR THE COMMANDER:



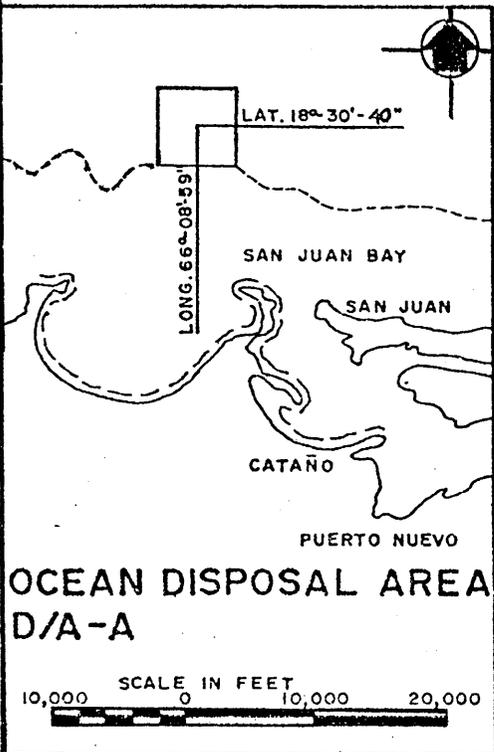
GAIL G. GREN
Chief, Construction-Operations Division



LOCATION PLAN

GRAPHIC SCALE

3,000 2,000 1,000 0 1,000 2,000 3,000



OCEAN DISPOSAL AREA
D/A-A

SCALE IN FEET
10,000 0 10,000 20,000

MAINTENANCE DREDGING
AT SAN JUAN HARBOR
SAN JUAN, PUERTO RICO

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
APRIL 1985