AUGUST 2002

Draft Environmental Assessment

MAINTENANCE DREDGING
GRAVING DOCK TURNING BASIN AND
BERTHING AREAS 15 & 16
SAN JUAN HARBOR , PUERTO RICO

U.S. Army Corps
of Engineers
JACKSONVILLE
DISTRICT

MAINTENANCE DREDGING
GRAVING DOCK TURNING BASIN AND
BERTING AREAS 15 & 16
SAN JUAN HARBOR, PUERTO RICO

PRELIMINARY FINDING OF NO SIGNIFICANT IMPACT

I have reviewed the Environmental Assessment (EA) for the proposed action. This Finding incorporates by reference all discussions and conclusions contained in the Environmental Assessment enclosed hereto. Based on information analyzed in the EA, reflecting pertinent information obtained from agencies having jurisdiction by law and/or special expertise, I conclude that the proposed action will not significantly impact the quality of the human environment and does not require an Environmental Impact Statement. Reasons for this conclusion are in summary:

a. The proposed action includes maintenance dredging of the Graving Dock Turning Basin and Berthing Areas 15 & 16 in San Juan Harbor, Puerto Rico. The dredged material will be placed in one or two artificial depressions located in the San José Lagoon.

b. The proposed action would not jeopardize the continued existence of any threatened or endangered species or adversely impact any designated "critical habitat".

c. Measures to eliminate, reduce, or avoid potential adverse impacts to fish and wildlife resources would be implemented.

d. Puerto Rico water quality standards will be met. A water quality certification will be obtained from the Puerto Rico Environmental Quality Board.

e. The proposed project will be consistent with the Puerto Rico Coastal Zone Management Program.

f. No known significant historic resources will be directly affected by this project. Coordination with the State Historic Preservation Office (SHPO) will determine the projects effect on historic properties.

g. Economic benefits will be accrued.

h. Measures to eliminate, reduce, or avoid potential impacts to environmental resources include the following: (1) The standard manatee protection measures would be followed for all water based activities, (2) The pipeline would be aligned in a manner to avoid adversely affecting mangroves.

_____ _____

James G. May
Colonel, U.S. Army
District Engineer

Date

DRAFT
ENVIRONMENTAL ASSESSMENT
ON
MAINTENANCE DREDGING
GRAVING DOCK TURNING BASIN AND
BERTHING AREAS 15 & 16
SAN JUAN HARBOR, PUERTO RICO

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1 PROJECT PURPOSE AND NEED

1.1 PROJECT AUTHORITY.

Work is authorized under PL-99-662, November 1986 and re-authorized in 1996 under PL-104-303.

1.2 PROJECT LOCATION.

San Juan Harbor is located on the northeast coast of the island of Puerto Rico. The Graving Dock Turning Basin and Berths 15 and 16 are located northeast of the Graving Dock Channel (Figure 1, vicinity map and plan view).

1.3 PROJECT NEED OR OPPORTUNITY.

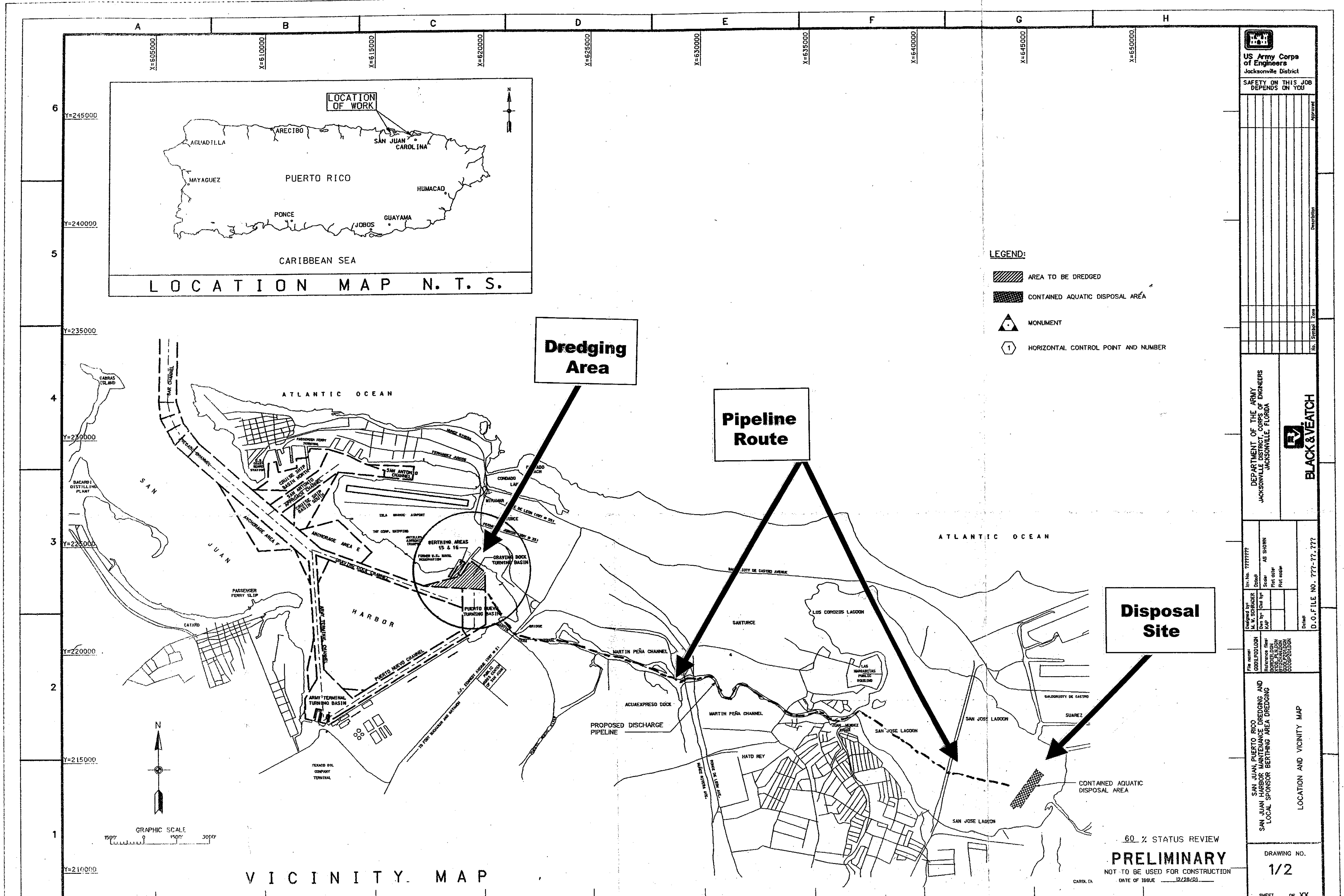
Periodic dredging is required to maintain adequate navigation depths. Surveys indicate sufficient shoaling to justify maintenance.

1.4 RELATED ENVIRONMENTAL DOCUMENTS.

In response to a request from the Puerto Rico government, studies of the authorized San Juan Harbor Federal Navigation project were completed and improvements were proposed in a Survey Report dated 1974. A Final Environmental Impact Statement (FEIS) was filed in 1976. A Phase I General Design Memorandum and S-EIS were prepared in 1982. An Environmental Assessment was prepared in1994 for project changes to the Phase I GDM design.

1.5 SCOPING AND ISSUES.

The following issues were identified during scoping and by the preparers of this Environmental Assessment to be relevant to the proposed action and appropriate for detailed evaluation: (1) water quality degradation, especially in regards to turbidity and sediment contaminants; (2) potential damage to Essential Fish Habitat, particularly to mangroves and soft bottom; and (3) deleterious effect to benthos.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CONTAINED AQUATIC DISPOSAL AREA
GRAPHIC SCALE
VICINITY MAP
60 % STATUS REVIEW
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION
DATE OF ISSUE 12/28/01
US Army Corps of Engineers
Jacksonville District
SAFETY ON THIS JOB DEPENDS ON YOU
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
BLACK & VEATCH
SAN JUAN, PUERTO RICO
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DRAWING NO.
1/2
SHEET OF XX

FIGURE 1

1.6 PERMITS, LICENSES, AND ENTITLEMENTS.

The work will require authorization from the Commonwealth of Puerto Rico's Environmental Quality Board (Water Quality Certificate). The project will also require determination of consistency with the Puerto Rico Coastal Management Program and concurrence of the Puerto Rico Planning Board with this determination. Refer also to section 4.35, Compliance with Environmental Requirements.

2 ALTERNATIVES

The alternatives section is the heart of this EA. This section describes in detail the no-action alternative, the proposed action, and other reasonable alternatives that were studied in detail. Then based on the information and analysis presented in the sections on the Affected Environment and the Probable Impacts, this section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a clear basis for choice among the options for the decision maker and the public.

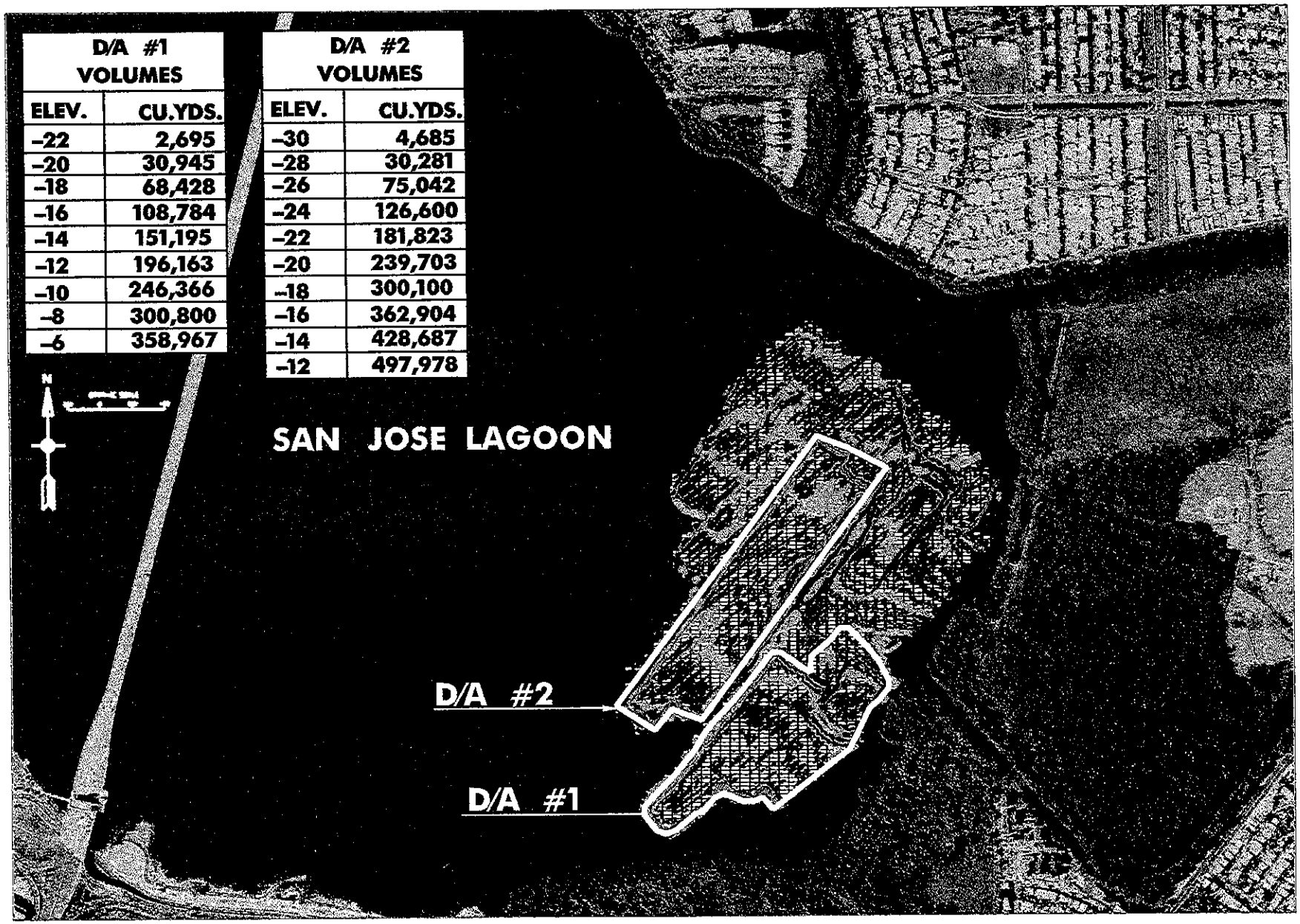
2.1 DESCRIPTION OF ALTERNATIVES.

2.1.1 DREDGING ALTERNATIVE

The proposed dredging alternative includes maintenance dredging and deepening the Graving Dock Turning Basin and adjacent Berthing Areas 15 and 16, to a depth of 33 feet (mlw) plus 1 foot allowable overdepth. The maintenance dredging and deepening would include the excavation of approximately 300,000 cubic yards of material from an approximately 50-acre area. The material to be removed consists of sandy, clayey silts with traces of shell. Bioassay testing results indicate the sediments within the turning basin and berthing area show traces of contaminants. Refer to sections 3.8 and 4.12 for more information concerning these sediments. The dredging method would be hydraulic excavation and pipeline pumping, via the Martín Peña Channel, of all dredged material into one or more existing artificial depressions within the San José Lagoon. A maximum 50 ft. wide corridor would be needed for placement of the floating pipeline through the Martín Peña Channel. The precise route along which the pipeline and booster pumps would be located has not been determined at this stage.

2.1.2 SUBAQUEOUS CONTAINED AQUATIC DISPOSAL (CAD) SITE

This alternative includes placing the 300,000 cubic yards of dredged material into an artificial depression in the San José Lagoon bottom. There are two deep depressions at the eastern end of the San José Lagoon which have been evaluated for conversion to a subaqueous contained aquatic disposal (CAD) site. These sites are designated as Disposal Area #1 and Disposal Area #2 (Figure 2). Based on studies performed by the U.S. Army Corps of Engineers Waterways Experiment Station (WES), these depressions have sufficient capacity for placement of the material and cap if filling operations and rates are controlled to allow for adequate sedimentation and consolidation to occur (see Appendix D, CAD Design). Clean material from maintenance dredging in San Juan Harbor would be used to cap the CAD pit. A minimum cap thickness of 1.75 feet would be used.



SAN JUAN HARBOR O&M DISPOSAL AREAS

FIGURE 2

2.1.3 NO ACTION ALTERNATIVE (STATUS QUO)

With this alternative, no maintenance dredging, deepening or disposal operations would occur. Sediment would continue to accumulate making the project eventually too shallow to be safely navigated. Additionally, the contaminated material would remain in the San Juan Harbor.

2.2 PREFERRED ALTERNATIVE(S)

The preferred alternative is to dredge and deepen the Graving Dock Turning Basin and adjacent Berths, 15 and 16. The material would be disposed in an artificial depression located in the San José Lagoon.

2.3 ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION

In the past, maintenance dredged material from the San Juan Harbor has been placed in the Ocean Dredged Material Disposal Site (ODMDS). This option was not considered due to presence and level of contaminants. Upland disposal was not regarded feasible due to the high cost and general unavailability of suitable nearby uplands.

2.4 COMPARISON OF ALTERNATIVES

Table 1 lists alternatives considered and summarizes the major features and consequences of the proposed action and alternatives. See section 4.0 Environmental Effects for a more detailed discussion of impacts of alternatives.

Table 1: Summary of Direct and Indirect Impacts

ALTERNATIVE ENVIRONMENTAL FACTOR	Dredging and Pipeline Placement	San José Lagoon Artificial Depressions (CAD Sites)	No Action Status Quo
PROTECTED SPECIES	No impact with implementation of standard protection measures for manatees.	No impact expected.	No impact.
HARD GROUND	No impact expected.	No impact expected.	No impact.
FISH AND WILDLIFE RESOURCES	No significant adverse impacts are anticipated.	No significant adverse impacts are anticipated.	No impact.
VEGETATION	No SAV would be impacted by project activities. Providing for a maximum 50-ft. pipeline corridor may have an impact on mangroves along the Martín Peña Channel.	No SAV would be impacted by project activities.	No impact.
WATER QUALITY	Temp. increase in turbidity and suspended sediments at dredging site.	Short-term degradation of water quality due to turbidity.	No impact.
HISTORIC PROPERTIES	No impact expected.	No impact expected.	No impact.
RECREATION	No impact expected.	No impact expected.	No impact.

ALTERNATIVE ENVIRONMENTAL FACTOR	Dredging and Pipeline Placement	San José Lagoon Artificial Depressions (CAD Sites)	No Action Status Quo
AESTHETICS	Minor short-term impact due to construction activities.	Minor short-term impact due to construction activities.	No impact.
NAVIGATION	Improve navigation safety.	No impacts expected.	Navigation safety would not be improved.
ECONOMICS	Increase in economics for the port area.	No impact.	Potential decrease in economics for the port area.
ESSENTIAL FISH HABITAT	No significant impact expected.	No significant impact expected.	No impact.

3 AFFECTED ENVIRONMENT

The Affected Environment section succinctly describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision to be made. It does not describe the entire existing environment, but only those environmental resources that would affect or that would be affected by the alternatives if they were implemented. This section, in conjunction with the description of the "no-action" alternative forms the base line conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

3.1 GENERAL ENVIRONMENTAL SETTING

Federal Navigation projects have been authorized in San Juan Harbor since 1917. Over the years, deepening and improving the existing channels has taken place to accommodate newer and larger ships using the port. Marine traffic in the project area consists of cruise ships, commercial, pleasure, and small recreational vessels.

The San José Lagoon is located northeast of the San Juan Harbor. The lagoon is divided into two segments, the Los Corozos Lagoon to the northwest and San José Lagoon to the southeast. These waterbodies have a surface area of approximately 1,129 acres. The two lagoons have no direct outlets to the Atlantic Ocean. Most of the shoreline of the San José Lagoon is forested with mangroves, but the western and southwestern banks have been filled for the construction of housing. Water exchange between the San Juan Bay and San José Lagoon is limited by sedimentation and the accumulation of debris in the Martín Peña Channel (SJBEP, 2000). The Martín Peña Channel is approximately 3.75 miles in length and ranges in width from 6-feet to over 400-feet with an average depth of 4-feet.

3.2 VEGETATION

3.2.1 SUBMERGED VEGETATION

Submerged aquatic vegetation (SAV) beds consisting of algae and seagrasses are documented to occur in San Juan Bay. However, benthic maps from NOAA's website at http://sag1.nos.noaa.gov/Website/PuertoRico/viewer.htm, indicate that there are no SAV communities present in the proposed dredging and disposal areas.

3.2.2 MANGROVE STANDS

Although once mangrove-lined along its entire southern shoreline, San Juan Bay retains little mangrove coverage due to filling or dredging for maritime commerce (USACE, 1994). There are no mangrove stands in or immediately adjacent to the areas proposed for dredging. A narrow strip of mangroves still exists along the Martín Peña Channel. Mangrove stands are also present along the shoreline of the San José Lagoon.

3.3 THREATENED AND ENDANGERED SPECIES

Brown pelicans may occasionally be observed resting on taller mangrove trees lining the western San José Lagoon. Manatees may be encountered in the San Juan Harbor.

3.4 HARDGROUNDS

Coral communities and related habitats are found within the San Juan Bay outlet. However, hardgrounds are not expected to be found within or adjacent to the dredging and disposal areas.

3.5 FISH AND WILDLIFE RESOURCES

San Juan Bay has lost most of its wildlife habitat such as mudflats, marshes, and mangroves to development. However, isolated mudflats and narrow strips of mangroves still exist along the Martín Peña Channel.

3.6 ESSENTIAL FISH HABITAT

Mangroves and soft bottom coastal lagoons may be present in the project area and are categories of EFH. Maps from the San Juan Bay Estuary Program and NOAA's website at http://sag1.nos.noaa.gov/Website/PuertoRico/viewer.htm, indicate that there are no other benthic communities present in the proposed dredging and disposal areas.

3.7 WATER QUALITY

Water quality would not be adversely impacted by this project, and Commonwealth water quality standards would be met. Short-term increases in turbidity are expected during the dredging operations phase of the project. However, the system would re-establish itself as a productive part of the overall ecosystem. No long-term surface water quality problems would result.

3.8 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

During the period May 4-16, 1999, 37 sample stations in the San Juan Harbor, Puerto Rico, were sampled as part of the 1999 Evaluation of Dredged Material for Ocean Disposal. This evaluation considered potential material from maintenance dredging and from harbor expansion and was reported to the U.S. Army Corps of Engineering in the form of a Final Report For San Juan Harbor, Puerto Rico 1999 Evaluation Of Dredged Material For Ocean Disposal, Delivery Order 0031, Contract DACW17-97-D-0001, October 1999 Volumes I and II. Submitted by PPB Environmental Laboratories, Inc. 6821 S. W. Archer Road, Gainesville, FL 32608.

Analytical results for sediments shows that trace metal results were consistent with earlier studies. Heavy metals were present in the sediments at low to moderate levels. Pesticides and PCBs were either below detection or present at low levels.

Analytical results for elutriates shows trace metals were all either below detection or present at low levels. These results indicate that those trace metals present in the sediments are rather tightly bound to the sediment particles and do not readily migrate into the water column when subjected to mechanical agitation and mixing. There was no movement of pesticides or PCBs from the sediment into the water column, as all elutriates were below detection for all pesticides and PCBs.

Bioaccumulation tests with clams and worms indicated that trace metals did not accumulate in the tissues either. Mercury and silver were below detectable levels. Arsenic, cadmium, chromium, copper, and lead, were either below detection or found at low levels. Statistical analysis showed that no site had significantly higher arsenic, cadmium, chromium, copper, lead, mercury, silver, or zinc than the reference site. Similarly, pesticides and PCBs did not show elevated levels.

Food and Drug Administration (FDA) action levels for metals, pesticides, and PCBs in fish and shellfish for human food range from 0.3 to 1.0 ppm, wet weight basis. Even the highest levels found in the organisms exposed to sediment from San Juan Harbor are 1 to 2 orders of magnitude below the FDA levels. The overall purpose of the proposed project is to prevent and minimize present and future impacts to humans, wildlife and the aquatic environment.

3.9 AIR QUALITY

No atmospheric emissions of controlled substances would occur as a result of project activities, except those normally generated from engines used by dredge, towboat and other machinery. All applicable regulations of the EQB would be complied with.

3.10 NOISE

Ambient noise around the project area is typical to that experienced in harbor environments. The immediate environment surrounding the Martín Peña Channel is moderately noisy. Residences are spaced closely, and traffic on nearby roads includes heavy tractor-trailers, city buses, and commercial trucks (USACE, 2001).

3.11 AESTHETIC RESOURCES

San Juan Bay, San José Lagoon, as well as the interconnecting Martín Peña Channel, are all part of the San Juan Bay Estuary system. However, visual aesthetic resources found at San Juan Harbor are not of significant value. Commercial harbor activities are the main use of the harbor.

3.12 RECREATION RESOURCES

Within the San José Lagoon, recreational fishing is enjoyed by many sportfishers. San José Lagoon is part of the San Juan Bay Estuary Program.

3.13 NAVIGATION

San Juan Harbor is the 17th largest port facility in the world and the most important port in Puerto Rico. Federal Navigation projects have been authorized in San Juan Harbor since 1917. Over the years, deepening and improving the existing channels has taken place to accommodate newer and larger ships using the port. Marine traffic in the project area consists of cruise ships, commercial, pleasure, and small recreational vessels.

3.14 HISTORIC PROPERTIES

This project will be fully coordinated with the Puerto Rico State Historic Preservation Officer (SHPO). If required, cultural resource investigations will be conducted to identify and evaluate historic properties within the project area.

4 ENVIRONMENTAL EFFECTS

This section is the scientific and analytic basis for the comparisons of the alternatives. See table 1 in section 2.0 Alternatives, for summary of impacts. The following includes anticipated changes to the existing environment including direct, indirect, and cumulative effects.

4.1 GENERAL ENVIRONMENTAL EFFECTS

Dredging and deepening the Graving Dock Turning Basin and adjacent Berths 15 & 16, would improve navigation safety for vessels. Impacts to the existing environment due to construction activities are considered minimal.

4.2 VEGETATION

4.2.1 SUBMERGED VEGETATION

Impacts to bottom vegetation are not expected by project construction activities.

4.2.2 MANGROVES

Providing a 50-foot pipeline corridor through the Martín Peña Channel may impact fringing mangroves. However impacts should be minor since the pipeline would be aligned in a manner to avoid adversely affecting mangroves.

4.3 THREATENED AND ENDANGERED SPECIES

Dredging and disposal would not adversely affect species under the jurisdiction of the USFWS or NMFS. Protective measures would be taken during dredging activities to ensure the safety of manatees. Telephone conversation records from July 1, 2002 with NMFS indicate that there would be no effect to endangered or threatened species under their jurisdiction.

4.4 HARDGROUNDS

Hardgrounds are not expected to be found within or adjacent to the dredging and disposal areas. Therefore, no impact is expected.

4.5 FISH AND WILDLIFE RESOURCES

The benthic areas within the turning basin and berthing areas are subject to constant sedimentation. Dredging the project area would result in minor impacts to benthos. The dredged areas should quickly recolonize with benthic organisms from adjacent

dissolved oxygen levels should stabilize to 4 mg/l. Water temperature, pH, salinity, and conductivity should not change from present existing conditions. Once the dredged material is removed from dredging areas then leaching of PCBs and PAHs would not be present in the water and benthos in the area.

4.12 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

There will be a Spill Contingency Plan for HTRW. Removing the contaminated dredge material from the dredge site would stop the leaching of heavy metals, PCBs and PAHs into the water. Placing the dredged material in the CAD pits in the San José Lagoon with a 12 inch cap would ensure the contaminated material would not leach contaminates into the water. The current anoxic conditions found in the CAD pit will improve due to the raising of the levels of the pits to a more normal lagoon depth. Monitoring of the water around the CAD would ensure that the contaminated material is not leaching out.

4.13 AIR QUALITY

The short-term impact from emissions by construction equipment associated with the project would not significantly impact air quality. Air pollution standards of the Commonwealth and all Federal emission and performance laws and standards, including the U.S. Environmental Protection Agency's Ambient Air Quality Standards would be met.

4.14 NOISE

With the implementation of the proposed action there would be a temporary increase in the noise level during construction. All equipment and dredge/barges, boats, and tugs used on this project would be equipped with mufflers or other noise abatement devices. Due to the length of the pipeline, there would be several booster pumps positioned along the pipeline route. Any booster pumps would be located at least 300-feet from any residential development. To minimize the effects of noise, booster pumps would be fitted or equipped with mufflers or other noise control features.

4.15 NAVIGATION

Navigation safety would be improved by the proposed project activities.

4.16 CUMULATIVE IMPACT

Cumulative impact is the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Maintenance dredging of the San Juan Harbor has provided a positive stimulus for adjacent regional economies resulting in growth and development. No adverse cumulative impacts are expected.

4.17 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.17.1 IRREVERSIBLE

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. The energy and fuel used during construction would be an irreversible commitment of resources.

4.17.2 IRRETRIEVABLE

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. Benthic organisms within the dredging areas would be impacted during construction. However, these organisms are expected to quickly recolonize the disturbed areas.

4.18 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

There may be short-term degradation of water quality due to turbidity caused by dredging and dredged material disposal operations.

4.19 INDIRECT EFFECTS

An indirect effect of the proposed project would be using the dredged material to fill in one or more of the artificial depressions in San José Lagoon. Material used from this project and future dredging projects would fill the depressions to the original level of the lagoon bottom.

4.20 ENVIRONMENTAL COMMITMENTS

The U.S. Army Corps of Engineers and contractors commit to avoiding, minimizing or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications:

4.20.1 Protection of Fish and Wildlife Resources

The Contractor shall keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife. Species that require specific attention along with measures for their protection shall be listed in the Contractor's Environmental Protection Plan prior to the beginning of construction operation.

4.20.2 Endangered Species Protection

1. The Contractor shall instruct all personnel associated with the project of the potential presence of manatees and the need to avoid collisions with manatees.

2. All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Sanctuary Act of 1978. The Contractor may be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.

3. Siltation barriers shall be installed and shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be monitored regularly to avoid manatee entrapment. Barriers shall not block manatee entry to or exit from essential habitat.

4. All vessels associated with the project shall operate at "no wake/idle" speeds at all times while in water where the draft of the vessel provides less than four feet clearance from the bottom and that vessels shall follow routes of deep water whenever possible.

5. If a manatee is sighted within 100 yards of the project area, all appropriate precautions shall be implemented by the Contractor to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. If a manatee is closer than 50 feet to moving equipment or the project area, the equipment shall be shut down and all construction activities shall cease. Construction activities shall not resume until the manatee has departed the project area.

6. Collision and or injury to a manatee should be reported to the U.S. Fish and Wildlife Service.

7. Temporary signs concerning manatees shall be posted prior to and during construction/dredging activities. All signs are to be removed by the Contractor upon completion of the project.

8. If nighttime construction occurs, lights must be in place that illuminates a 100-foot radius around the construction site.

4.21 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

4.21.1 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled and this Environmental Assessment has been prepared. The project is in compliance with the National Environmental Policy Act.

4.21.2 ENDANGERED SPECIES ACT OF 1973

During the scoping process with National Marine Fisheries Service and the U.S. Fish and Wildlife Service, no endangered species or habitat was identified within the project area (refer to Appendix C, pertinent correspondence). The project will be in compliance with this act.

4.21.3 FISH AND WILDLIFE COORDINATION ACT OF 1958

This project has been coordinated with the U.S. Fish and Wildlife Service (USFWS) during the scoping process. A Coordination Act Report (CAR) is not required for this project. This project is in full compliance with the Act.

4.21.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

(PL 89-665, the Archeology and Historic Preservation Act (PL 93-291, and executive order 11593)
This project has been coordinated with the State Historic Preservation Office during general scoping. The project is in full compliance at this stage.

4.21.5 CLEAN WATER ACT OF 1972

All Federal and Commonwealth water quality standards will be met. A Section 404 (b) evaluation is included in the EA.

4.21.6 CLEAN AIR ACT OF 1972

This project is being coordinated with the U.S. Environmental Protection Agency (EPA) and is in compliance with Section 309 of the Act. This EA will be forwarded to EPA for their review.

4.21.7 COASTAL ZONE MANAGEMENT ACT OF 1972

A determination of consistency with the Coastal Zone Management Plan of Puerto Rico will be made and submitted to the Planning Board, in accordance with Puerto Rico Federal Consistency Regulations.

4.21.8 FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this project. This act is not applicable.

4.21.9 WILD AND SCENIC RIVER ACT OF 1968

No designated Wild and Scenic river reaches would be affected by project related activities. This act is not applicable.

4.21.10 MARINE MAMMAL PROTECTION ACT OF 1972

Incorporation of the safe guards used to protect threatened or endangered species during dredging and disposal operations would also protect any marine mammals in the area, therefore, this project is in compliance with the Act.

4.21.11 ESTUARY PROTECTION ACT OF 1968

The San Juan Bay, San José Lagoon and the interconnecting Martín Peña Channel are all part of the San Juan Bay Estuary (SJBE) system. The project was coordinated with the SJBE program office during general scoping. This EA will be forwarded to the SJBE program for their review.

4.21.12 FEDERAL WATER PROJECT RECREATION ACT

There is no recreational development proposed for maintenance dredging or disposal. Therefore, this act does not apply.

4.21.13 FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

The project has been coordinated with the National Marine Fisheries Service (NMFS) during general scoping. This EA will be coordinated with NMFS.

4.21.14 COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These acts are not applicable.

4.21.15 RIVERS AND HARBORS ACT OF 1899

The proposed work would not obstruct navigable waters of the United States. The project is in full compliance.

4.21.16 ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project will be coordinated with the National Marine Fisheries Service and will be in compliance with the act.

4.21.17 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

This project will be coordinated with the U.S. Fish and Wildlife Service and the Puerto Rico Department of Natural and Environmental Resources by circulation of this EA.

4.21.18 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

Early in the study, it was determined that materials proposed for dredging were not eligible for offshore ocean disposal. The disposal activities addressed in this EA will be evaluated under Section 404 of the Clean Water Act.

4.21.19 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Coordination of this EA constitutes initial consultation with the National Marine Fisheries Service (NMFS) under provisions of this Act. Based on analysis discussed in this EA, the Corps has determined that the proposed action would not adversely affect the essential habitat of species managed under this Act.

4.21.20 E.O. 11990, PROTECTION OF WETLANDS

No wetlands would be affected by project activities. This project is in compliance with the goals of this Executive Order.

4.21.21 E.O. 11988, FLOOD PLAIN MANAGEMENT

The project is in the base flood plain (100-year flood) and has been evaluated in accordance with this Executive Order.

4.21.22 E.O. 12898, ENVIRONMENTAL JUSTICE

The proposed action would not result in adverse health or environmental effects. Any impacts of this action would not be disproportionate toward any minority. The activity does not (a) exclude persons from participation in, (b) deny persons the benefits of, or (c) subject persons to discrimination because of their race, color, or national origin. The activity would not impact "subsistence consumption of fish and wildlife".

4.21.23 E.O. 13089, CORAL REEF PROTECTION

No coral reef or coral reef organism would be impacted by this project.

4.21.24 E.O. 13112, INVASIVE SPECIES

Invasive species would not be impacted by project activities. This E.O. is not applicable.

5 LIST OF PREPARERS

5.1 PREPARERS

Preparer	Discipline	Role
Yvonne Haberer	Biologist	Principal Author
Olice Carter	Environmental Engineer	HTRW & Water Quality
Thomas Birchett	Archaeologist	Historic Properties

5.2 REVIEWERS

Ivan Acosta, Team Leader, Environmental Branch, Special Projects Section.

6 PUBLIC INVOLVEMENT

6.1 SCOPING

A scoping letter dated June 4, 2002 was coordinated for this action. Scoping letters were mailed to appropriate government agencies, interested parties and non-governmental organizations.

6.2 AGENCY COORDINATION

Any agency coordination letters can be found in Appendix C.

6.3 LIST OF RECIPIENTS

A complete mailing list of the parties receiving a copy of the scoping letter is included with the letter in Appendix C.

6.4 COMMENTS RECEIVED AND RESPONSE

Copies of comments received during the scoping process are in Appendix C.

REFERENCES

Conde-Costas, Carlos. 1987. Laguna San Jose Bathymetric and Water Quality Survey, Puerto Rico: U.S. Geological Survey Administrative Report. 10 p.

Cushing, Bradford S. 1998. Falling Short of the Mark, The Limits of Dredging as a Feasible Technology for Contaminated Sediment Removal. Water Environment and Technology, June 1998, p. 61-66.

Palermo, Michael R. 1997. Contained Aquatic Disposal of Contaminated Sediments in Subaqueous Borrow Pits. Technical Report, U.S. Army Corps of Engineers Experiment Station, Vicksburg, MS.

San Juan Bay Estuary Program. 2000. Comprehensive Conservation and Management Plan for the San Juan Bay Estuary. U.S. Environmental Protection Agency 420 pp.

U.S. Army Corps of Engineers. 2001. Project Design Report and Environmental Impact Statement for the Dredging of Cano Martin Pena. 55 p. plus appendices, plates.

U.S. Army Corps of Engineers. 1994. General Reevaluation Report and Environmental Assessment for San Juan harbor. 50 p. plus appendices, plates.

U.S. Fish and Wildlife Service. 1993. Fish and Wildlife Coordination Act Report for San Juan Harbor. 16 pp.

APPENDIX A - SECTION 404(B) EVALUATION

SECTION 404(b) EVALUATION

MAINTENANCE DREDGING
GRAVING DOCK TURNING BASIN AND
BERTHS 15 & 16
SAN JUAN HARBOR, PUERTO RICO

I. Project Description

a. Location. The Graving Dock Turning Basin and Berths 15 & 16 are located northeast of the Graving Dock Channel in San Juan Harbor, Puerto Rico.

b. General Description. The proposed plan calls for dredging and deepening the Graving Dock Turning Basin and adjacent Berths 15 & 16. The dredging method would be hydraulic excavation and pipeline pumping, via the Martín Peña Channel, into one or more artificial depressions within the San José Lagoon. A maximum 50' wide corridor would be needed for floating pipeline placement through the Martín Peña Channel.

c. Authority and Purpose. Work is authorized under PL-99-662, November 1986 and re-authorized in 1996 under PL-104-303.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. The material to be removed consists of sandy, clayey silts with traces of shell. Bioassay testing results indicate the sediment within the proposed dredging areas show traces of contaminants.

(2) Quantity of Material. 200,000 to 300,000 cubic yards.

(3) Source of Material. Material would be removed from the turning basin and berths 15 & 16.

e. Description of the proposed Discharge Site.

(1) Location. One of two artificial depressions located in the San José Lagoon.

(2) Size. Disposal Area #1 at –6 ft. elevation has the capacity to hold approximately 358,997 cubic yards of material. Disposal Area #2 at –12 ft. has the capacity to hold approximately 497,978 cubic yards of material.

(3) Type of Site. Artificial depression.

(4) Type of Habitat. Softbottom coastal lagoon.

(5) Timing and Duration of Discharge. Models performed by WES show different rates of duration of discharged dredged material. With the proposed 12" pipeline it is recommended that the operating times be 8-hours per day during the first two weeks to promote efficient clarification during the initial part of the filling period. It is estimated that it would take 6-months to 1-year to complete project.

f. Description of Disposal Method. Dredged material would be hydraulically pumped to the disposal site

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. For disposal area #1, elevation changes range from –6 ft. to -22 ft. For disposal area #2, elevation changes range from –12 ft. to –30 ft.

(2) Sediment Type. The material to be removed consists of sandy, clayey silts with traces of shell. Bioassay testing results indicate the sediment within the proposed dredging areas show traces of contaminants.

(3) Dredge/Fill Material Movement. Using the 12" pipeline the average velocity of the dredge material would be 15 feet per second.

(4) Physical Effects on Benthos. Dredging and disposal activities would result in minor impacts to benthos. The areas should quickly recolonize with benthic organisms from adjacent similar habitats.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. There would be a temporary increase in water turbidity during dredging and deposition of the dredged due to the resuspension of fine sediments in the water column.

(2) Current Patterns and Circulation. For both the dredge site and disposal site the areas of concern are located inside a harbor for the dredge site and inside a lagoon for the disposal site. Both sites show minimal water patterns and circulation is not a factor due to non access to ocean wave patterns due to the connecting channel being restricted with debris and silt.

(3) Normal Water Level Fluctuations and Salinity Gradients. Salinity ranges were from 32.2 to 38.2 ppt and the range for conductivity was 47.5 to 57.4 mmhos. Minimal water level fluctuations inside harbor only due to daily tides.

c. Suspended Particulate/Turbidity Determinations. There would be a temporary increase in water turbidity during dredging and deposition of the dredged material due to the resuspension of fine sediments in the water column.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. There would be a temporary increase in water turbidity during deposition of the dredged material in the San José Lagoon due to resuspension of fine sediments. The conditions are expected to return to normal after construction.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. There would be a temporary increase in suspended fine particles in the water column, and temporary decreases in light penetration.

(b) Dissolved Oxygen. The fine particulates from the harbor bottom include organic matter, and dissolved oxygen concentrations may temporarily be lowered.

(c) Toxic Metals, Organics, and Pathogens. During the period May 4-16, 1999, 37 sample stations in the San Juan Harbor, Puerto Rico, were sampled as part of the 1999 Evaluation of Dredged Material for Ocean Disposal. Heavy metals were present in the sediments sampled at the Graving Docks Turning Basin at low to moderate levels. Pesticides and PCBs were either below detection or present at low levels. Analytical results for sediments can be found in Section 3.8 of the EA.

(d) Aesthetics. No effect.

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. There would be no long-term effect on the bay or lagoon productivity as a result of the construction activities.

(b) Suspension/Filter Feeders. There would be no long-term adverse impact to suspension/filter feeders.

(c) Sight Feeders. There would be no long-term adverse impact to sight feeders.

d. Contaminant Determinations.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. None expected.

(2) Effects on Benthos. None expected.

(3) Effects on Nekton. None expected.

(4) Effects on the Aquatic Food Web. None expected.

(5) Effects on Special Aquatic Sites.

(a) Hardground and Coral Reef Communities. None expected.

(b) Sanctuaries and Refuges. None.

(c) Wetlands. None expected.

(d) Mud Flats. None expected.

(e) Vegetated Shallows. None expected.

(f) Riffle and Pool Complexes. None.

(6) Endangered and Threatened Species. There would be no impacts expected on any threatened or endangered species.

(7) Other Wildlife. None expected.

(8) Actions to Minimize Impacts. There will be a Spill Contingency Plan for HTRW. Removing the contaminated dredge material from the dredge site would stop the leaching of heavy metals, PCBs and PAHs into the water. Placing the dredged material in the CAD pits in the San José Lagoon with a 12 inch cap would ensure the contaminated material would not leach contaminates into the water. The current anoxic conditions found in the CAD pit will improve due to the raising of the levels of the pits to a more normal lagoon depth. Monitoring of the water around the CAD would ensure that the contaminated material is not leaching out.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Not applicable.

(2) Determination of Compliance with Applicable Water Quality Standards. The discharge to fill the artificial depressions will comply with applicable standards.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. No effect.

(b) Recreational and Commercial Fisheries. Possible temporary impact on recreational fishing in the immediate area of construction.

(c) Water Related Recreation. Possible temporary impact on water related recreation in the immediate area of construction.

(d) Aesthetics. Temporary reduction in aesthetics during construction due to the presence of dredge equipment.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No effect.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. No adverse cumulative impacts are expected.

h. Determination of Secondary Effects on the Aquatic Ecosystem. There may be short-term degradation of water quality due to turbidity caused by dredging and disposal operations. This may have a temporary impact to the aquatic ecosystem.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The San Juan Harbor Graving Docks Turning Basin and Berths 15 and 16 maintenance dredging will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

e. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

f. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

APPENDIX B - COASTAL ZONE MANAGEMENT CONSISTENCY

APPENDIX C - PERTINENT CORRESPONDENCE

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DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

JUN 04 2002

To Whom It May Concern:

The Jacksonville District, U.S. Army Corps of Engineers, is gathering information to define issues and concerns that will be addressed in an Environmental Assessment (EA) being prepared for maintenance dredging in San Juan Harbor, San Juan, Puerto Rico. As shown on the enclosed location and vicinity map, San Juan Harbor is located on the northeastern coast of Puerto Rico.

The proposed maintenance dredging areas that will be addressed in the EA include the Graving Dock Turning Basin and Berthing Areas 15 and 16 (see enclosure for the dredging area location). Approximately 300,00 cubic yards of material would be dredged from the proposed areas.

The sediments in the Graving Dock Turning Basin and adjacent Berthing Areas, 15 and 16, have been determined to be contaminated with heavy metals, polyaromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Therefore, the dredged material will be disposed in a Contained Aquatic Disposal (CAD) facility. The dredging plan includes hydraulic dredging and pipeline pumping, via the Martin Pena Canal, of all dredged material into one or more existing CAD pits within the San Jose Lagoon (see enclosure for pipeline route and disposal site).

We welcome your views, comments and information about environmental and cultural resources, study objectives and any suggested improvements. Letters of comment or inquiry should be

addressed to the letterhead address to the attention of Ms. Yvonne Haberer, Planning Division, Environmental Branch and received by this office within thirty (30) days of the date of this letter. Ms. Haberer can also be reached at 904-232-1701.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, Florida 33702
(727) 570-5317, FAX 570-5300

June 20, 2002 F/SER4:LC

James C. Duck
Chief, Planning Division
Jacksonville District
U.S. Army Corps of Engineers
PO Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Duck:

The National Marine Fisheries Service (NMFS) has received your June 4, 2002, letter concerning the preparation of an Environmental Assessment (EA) for maintenance dredging in the San Juan Harbor, San Juan, Puerto Rico. You have requested our views, comments, and information about cultural and environmental resources, study objectives, and suggested improvements.

Based on the information contained in your cover letter, only maintenance dredging activities proposed for the area of the Graving Dock Turning Basin and Berthing Areas 15 and 16 will be addressed in the EA. Because dredging and harbor improvements are planned throughout the San Juan Harbor as part of the San Juan Harbor Federal Navigation Project (SJHFNP), the NMFS believes that the project scope should be expanded. We suggest that a single EA be prepared that includes all activities planned within the San Juan Harbor that could affect Essential Fish Habitat (EFH) or fishery species managed by the NMFS or the Caribbean Fishery Management Council. For instance, the map included with your cover letter indicates that a pipeline will be constructed to pump dredged sediments from the Graving Dock Turning Basin and Berthing Areas 15 and 16 to a site in the San José Lagoon through the Martín Peña Channel. The Martin Pena Channel and San Jose Lagoon are lined by mangroves. Mangroves and soft bottom coastal lagoons are categories of EFH. Maps from the San Juan Bay Estuary Program and NOAA's National Ocean Service indicate that other categories of EFH, such as seagrass beds and macroalgal plains are present in the harbor area where further dredging activities are planned based on the Limited Reevaluation Report recently prepared by the Jacksonville District Corps of Engineers (COE).

Federally-managed species known to occur within the San Juan Bay, Martín Peña Channel, and San José Lagoon include horse eye jack, schoolmaster, gray snapper, dog snapper, lane snapper, doctorfish, and yellowtail snapper. Of these species, juvenile and adult schoolmaster and gray snapper are known to utilize mangroves. Further, the entire Federal navigation project, including the area to be dredged and the disposal site for the dredged material, are located within the San Juan Bay Estuary system. Estuaries have been designated as EFH Habitat Areas of Particular Concern

due to their susceptibility to human-induced degradation, ecological importance, or location in an environmentally stressed area. Thus, the EA should discuss in detail the potential direct, indirect, and cumulative impacts to EFH due to harbor improvements and port operations throughout the area affected by the SJHFNP.

Due to the importance of fishery resources within San Juan Bay, the NMFS is concerned about the proposal to construct a pipeline through Martín Peña Channel to the San José Lagoon and the disposal of dredged material. The EA should provide details of pipeline construction, including anticipated impacts to the mangrove forest, as well as alternatives, if any, for transporting the dredged material to the disposal site. In addition, to our knowledge, there is no Contained Aquatic Disposal facility within the San Jose Lagoon. Thus, the EA should provide details regarding the methods of minimizing turbidity, confining contaminated sediments dredged from the area of the Graving Dock Turning Basin and Berthing Areas 15 and 16, and alternatives for upland disposal of contaminated sediments.

Mitigation plans for unavoidable impacts to EFH should be included in the EA. Past correspondence from the COE described in-bay mitigation consisting of the construction of a dredged material island for the portion of the Federal navigation project. That project also included the dredging of the Graving Dock Channel and Puerto Nuevo Channel. It is our understanding that dredging activities have taken place, but no in-bay mitigation was performed. If this mitigation is no longer planned, the COE should develop new mitigation strategies.

In summary, to satisfy the EFH consultation provisions of the Magnuson-Stevens Fishery Conservation and Management Act specified in 50 CFR 600.920 of the final rule, the EA should include details of the entire SJHFNP, including all planned deepening and maintenance dredging; an evaluation of the impacts of the project on EFH, managed species, and associated species by life history stage; Federal agency's views regarding the effects of the action on EFH; and proposed mitigation. In addition to the EFH consultation requirement, the Federal action agencies must consult with NMFS's Protected Resources Division (PRD) on the potential effects of the proposed action on threatened and endangered species. The NMFS's PRD biologist for the project area is Mr. Eric Hawk, who may be reached at the letterhead address or at 727-570-5312.

We appreciate the opportunity to provide these comments.

Questions related to the proposed project and marine fishery resource issues should be directed to Dr. Lisamarie Carrubba in our Cabo Rojo, Puerto Rico, office at 787/851-3700.

Sincerely,

Andreas Mager, Jr.
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June 18, 2002

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Re: Scoping for the San Juan Harbor Graving Dock Turning Basin Maintenance Dredging

Dear Mr. Duck:

The Corps is requesting comments and concerns for the proposed dredging of the Graving Dock Turning Basin and Berthing Areas 15 & 16 in San Juan Bay. The sediments in this area have been identified as being contaminated with metals, PAH's, and PCB's. The Corps is proposing to dispose of these sediments in a Contained Aquatic Disposal (CAD) facility located in San Jose Lagoon. To our knowledge such a facility does not exist. If the Corps is going to construct such a facility the EA must cover all aspects. From the information provided it seems that the Corps is proposing to use existing depressions in San Jose Lagoon as their CAD facility. These depressions were created by dredging operation in the past and have left anoxic depressions well below the natural bottom of the lagoon.

The current plan is to hydraulicly dredge the contaminated sediments and pipe them to the CAD pits. There is no mention as to how these sediments will be contained in the pits. This issue needs to be throughly discussed in the EA. San Jose Lagoon is part of the San Juan Estuary Program and is an estuarine lagoon system. The fishery resources of the lagoon are used by artesanal and recreational fishermen making confinement of the sediments during pumping and disposal critical. Although not mentioned in the letter, we assume that the sediments would be contained in some form of geotube like material prior to disposal in the pits.

The Service has always endorsed the filling of the pits in San Jose Lagoon for environmental reasons. However, the project description is not clear on the methodology to be used other than pumping it to the site. Our other concern involves the actual pumping operation. Will the placement of the pipeline require additional removal of mangroves from Caño Martin Peña, will staging areas or other temporary facilities require access to Caño Martin Peña? There will have to be a contingency plan in the event of a pipeline rupture and discharge of contaminated sediments into Caño Martin Peña and surrounding wetlands.

Since the San Juan Bay maintenance project has been ongoing for such a long period of time, and seems to be constantly changing, we recommend that the Corps consider formally re-coordinating this project with the federal resource agencies. The impression is that this project is being carried out in a piecemeal fashion and that over all project impacts are being lost.

Thank you for the opportunity to comment on this action, if you have any questions please contact Felix Lopez of my staff at 787 851-7297 ex 26.

Sincerely,

James P. Oland
Field Supervisor

fhl
cc:
DNER, San Juan
COE, Planning, San Juan
EPA, San Juan
NMFS, Lajas
SJBE, San Juan

GRAVING DOCK

ESTADO LIBRE ASOCIADO DE PUERTO RICO
OFICINA DE LA GOBERNADORA
JUNTA DE CALIDAD AMBIENTAL

21 de junio de 2002

DADA: 2082-02

James C. Duck
Jefe, División de Planificación
Cuerpo de Ingenieros
del Ejército de los Estados Unidos
Avenida Fernandez Juncos # 400
San Juan, Puerto Rico 00901-3299

ASUNTO: DRAGADO DE MANTENIMIENTO
BAHIA DE SAN JUAN
SAN JUAN, PUERTO RICO

Estimado señor Duck:

El Cuerpo de Ingenieros del Ejército de los Estados Unidos (COE por sus siglas en inglés), está en el proceso de preparar una Evaluación Ambiental (EA) para el dragado de mantenimiento de la Bahia de San Juan. El área de dragado propuesta incluye los muelles 15 y 16, así como el área de viraje frente a éstos, los cuales se ha determinado que contienen sedimentos contaminados con metales pesados, hidrocarburos poliaromáticos (PAHs) y bifenilos policlorinados (PCB). Aproximadamente 300,000 yardas cubicas de sedimento serán dragadas de las áreas antes mencionadas y dispuestas mediante bombeo por tuberías a través del Caño Martín Peña, hasta una o mas fosas existentes para disposición de material contenido en bidones (CAD por sus siglas en inglés), en la Laguna San José.

Esta Junta no tiene objeción alguna a la preparación de la EA, siempre que la misma cumpla con las disposiciones del Reglamento de la Junta de Calidad Ambiental para el Proceso de Presentación, Evaluación y Trámite de Documentos Ambientales.

Agradecemos su cooperación para mantener y conservar la calidad de nuestro ambiente.

Cordialmente,

Fernando Guzmán Esquilín
Director Interino
Area de Asesoramiento Científico

(Translation 3 Jul 2002, by e. Jiménez)

COMMONWEALTH OF PUERTO RICO
OFFICE OF THE GOVERNOR
ENVIRONMENTAL QUALITY BOARD

June 21, 2002 DADA-2082-02

James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
400 Fernandez Juncos Avenue
San Juan, Puerto Rico 00901-3299

Attention: Mr. Esteban Jiménez

Subject: MAINTENANCE DREDGING
SAN JUAN HARBOR
SAN JUAN, PUERTO RICO

Dear Mr. Duck:

The U.S. Army Corps of Engineers (COE) is preparing an Environmental assessment (EA) for the maintenance dredging of San Juan Harbor. The proposed dredging area includes piers 15 and 16, as well as the turning basins in front of these piers, which have been determined to contain sediments contaminated with heavy metals, polyaromatic hydrocarbons (PAH) and polychlorinated biphenols (PCB). Approximately 300,000 cubic yards of sediment will be dredged from the above mentioned areas and sent by means of a pipeline through Caño Martín Peña to one or more of the existing submerged depressions or sinkholes for the deposition of material contained in drums (CAD) in San José Lagoon.

This Board has no objection to the drafting of an EA as long as this complies with the Regulations of the Environmental Quality Board (EQB) for the Process of Presentation, Evaluation, and Transaction of Environmental Documents

We appreciate your cooperation in maintaining and conserving the quality of our environment.

Cordially,

Fernando Guzmán Esquilín
Acting Director
Scientific Advisory Area

Box 11488
Santurce, Puerto Rico o Telephone 787-767-8181

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES

06 AGO 2002

Mr. James C. Duck
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr Duck:

Environmental Assessment
San Juan Harbor and Berthing Area Maintenance Dredging

This is in response to your request of information, concerns, views, etc. for the development of the Environmental Assessment for the San Juan Harbor Graving Dock Turning Basin and Berthing Areas 15 and 16 Maintenance Dredging.

SJU

The Department of Natural and Environmental Resources, as partner of the San Juan Bay Estuarine Program met with personnel from the Program's office and identified some of the issues that we consider important for the assessment. Most of these issues are already part of the Waterways Experiment Station (CE) experience, as gathered in the publication "Contained Aquatic Disposal of Contaminated Sediments Subaqueous Borrow Pits" by Michael R. Palermo (1997). Hence, we emphasize the following themes, among others, to be addressed from the environmental point of view:

1. Selection of deposition site and number of CADS
2. Effect of water depth at deposition site
3. Benefit of interim caps for minimizing erosion
4. Biological and cultural resources
5. Effects of design, construction, and operation of CADS on environment
6. Effect of types of pipeline placements and order of placements of contaminated sediments
7. Monitoring of all components: biological, chemical, physical, health safety

P.O. BOX 9066600 PTA. DE TIERRA STATION, SAN JUAN, P.R 00906-6600
PHONE (787) 724-8774 FAX. 723-4255

8. Pipeline installation controls, surveillance for leaks, etc.
9. Dredging techniques at the harbor

Should you have any further inquiries, please contact Eng. José M. Lebrón Lastra, Assistant Administrator for the Mineral and Water Resources Area at (787) 725-3856.

Cordially,

Salvador Salas-Quintana
Secretary

JMLL/LSBC/lsbc

COMMONWEALTH OF PUERTO RICO
PUERTO RICO ELECTRIC POWER AUTHORITY

SAN JUAN, PUERTO RICO

CABLE ADRESS
PREPA

P.O. Box 364267
San JUAN, PUERTO RICO 00936-4267

July 19, 2002

Mr. James C. Duck, Chief
Planning Division
Department of the ARMY
P O Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

San Juan Harbor Maintenance Dredging, San Juan, Puerto Rico

We are responding to your letter of June 4, 2002, requesting for comments on the above project.

The Puerto Rico Electric Power Authority (PREPA) is planning to construct a 115 kV underground transmission line in the Metropolitan Area. This line will be installed along thirty miles across the Municipalities of Bayamón, Cataño, Guaynabo, San Juan and Toa Baja.

The line will connect thermoelectric plants and key substations and transmission center facilities in the Metropolitan Area to improve the electrical system reliability, especially during hurricane seasons. The funds for this project will be provided by the Federal Emergency Management Agency (FEMA).

This project will be constructed as described below:

1. Phase I- from Monacillo Transmission Center to Hato Rey TC

2. Phase II – from Hato Rey TC to San Juan Steam Plant, including Martín Peña GIS, Viaducto Transmission Center and Isla Grande Transmission Center.

3. Phase III- from San Juan Steam Plant to Palo Seco Steam Plant and from Palo Seco Steam Plant to Bayamón Transmission Center.

4. Phase IV- from Bayamón Transmission Center to Monacillo Transmission Center.

On the phase II, the underground transmission line will cross the Martín Peña Canal, near the San Juan Central Park and Kennedy Avenue. We included the preliminary drawings to ensure that PREPA's project will not interfere with your project.

If you need additional information on this project, please contact Eng. Milagros Calixto at 787-772-6654.

Sincerely,

Edwin Rivera Serrano
Engineering Director

Enclosures 21

c Ms. Yvonne Haberer, Environmental Branch

PUERTO RICO
Compañía de Turismo

July 10, 2002

Mr. James C. Duck
Chief
Planning Division Department of the Army
Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

DREDGING IN SAN JUAN HARBOR

Dear Mr. Duck:

According to your letter dated June 4, 2002, the US. Army Corps of Engineers is gathering information to define issues and concerns that will be addressed in an Environmental Assessment being prepared for maintenance dredging in San Juan Harbor.

Two important activities of Puerto Rico's economy are located at San Juan Harbor: the main cruise ship docking facilities of the Island, where almost one million cruise ship passengers arrive each year; and the main shipping port, where almost all the merchandise being exported from or imported to the Island by sea is handled.

For the above mentioned reasons, the Puerto Rico Tourism Company has not objection to this project as it considers the importance of and our interest in the conservation of the service capacity of the Port of San Juan.

Cordially yours,

Carlos Negrón-Roche
Director
Planning

CN/smv

Apartado Postal 902-3960, San Juan, Puerto Rico 00902-3960 • Teléfono: (787) 721-2400 Fax: (787) 722-6352

CN 078-04495
REV. 1/01

COMMONWEALTH OF PUERTO RICO
PUERTO RICO ELECTRIC POWER AUTHORITY
SAN JUAN, PUERTO RICO

www.prepa.com

PO Box 364267
San Juan, Puerto Rico 00936-4267

July 2, 2002

Mr. James C. Duck, Chief
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

RE: Dredging in San Juan Harbor
San Juan. Puerto Rico

Reference is made to your letter of June 4, 2002, in which the Puerto Rico Electric Power Authority (PREPA) is requested to comment on the project "Dredging in San Juan Harbor".

PREPA is planning to install an underground 115 kv power line that will pass, at some point, over the Martín Peña Canal. This project, sponsored by the Federal Emergency Management Agency, is on planning stage at this time. For this reason, its very important for PREPA, to know exactly, the date on which the dredging will be initiated and how much time it will take in order to coordinate our efforts with those of your Agency.

Another important issue for PREPA is the impact of the project on the quality of surrounding waters. Contaminants such as heavy metals, polychlorinated byphenyls and hydrocarbons are usually trapped and stabilized within the sediments. The dredging process may release the contaminants from the sediment matrix allowing them to enter the water column. Once in the water column, the contaminants can be transported to locations far from the project site. PREPA's San Juan Thermoelectric Plant's cooling water intake is located south of the proposed project. The discharge of cooling water is permitted under the National Pollutant Discharge Elimination System.

If you need additional information regarding this matter, please contact Eng. Jaime A. Plaza, Head, Environmental Protection and Quality Assurance Division, at (787) 289-4959.

Cordially,

Héctor M. Alejandro, Director
Planning and Environmental Protection

Proyecto Península de Cantera
¡Nuestro Orgullo!

July 1, 2002

Miss Ivonne Hoberer
Planning Division
Department of the Army
Jacksonville District Corp of Engineers
Box 4970 Jacksonville, Florida 32232-0019

Dear Miss Hoberer:

Reference is made to your letter dated June 04, 2002, in which you request our comments in relation to the propose maintenance dredging in the San Juan Harbor, San Juan, Puerto Rico.

The project consist of the dredging of 300,000 cubic yards of contaminated material to be disposed in a Contained Aquatic Disposal (CAD) facility in to one or more existing CAD pits inviting the San José Lagoon.

The Peninsula de Cantera Project is surrounded by the north by the Los Corozos Lagoon, by the east the San José Lagoon, by the south by the Martin Peña Canal and by the east by the Barbosa Avenue. Be cause of its location our Project consider the San José Lagoon and the Martín Peña Canal as a Natural Resource and in our long term planning the intensive recreational uses of both is contemplated.

Our project is also participating with the Puerto Rico Department of Public Works and PR Highway Authority in the proposed channeling of the Martín Peña Canal from the San José Lagoon to the Muñoz Rivera Ave in Hato Rey. In various meetings we have discussed the possibility to dispose the dredging material from the Martín Peña Canal into the existing CAD pits within the San José and Los Corozos Lagoons. We suggest to evaluate the capacity of the CAD pits in both lagoons to determine if both dredgings can be dispose in the Lagoons.

Angel J Colon
Development Coordinator

cc: Lyvia Rodríguez – PR Highway Authority

COMPAÑÍA PARA EL DESARROLLO INTEGRAL DE LA PENINSULA DE CANTERA
PO Box 7187, San Juan, PR 00916-7187 • Tel. (787) 268-3138/728-7641 • Fax: (787) 727-0278/728-7658

ADMINISTRACION DE TERRENOS
ESTADO LIBRE ASOCIADO DE PUERTO RICO

02 JUL 2002

Mr. James C. Duck
Chief, Planning Division
Environmental Branch
Department of the Army
Jacksonville District Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

SUBJECT: ISSUES DEFINITIONS FOR THE ENVIRONMENTAL ASSESSMENT FOR MAINTENANCE DREDGING OF THE GRAVING DOCK TURNING BASIN AND BERTHING AREAS 15 AND 16 IN THE SAN JUAN HARBOR, SAN JUAN, PUERTO RICO

We acknowledge receipt of your letter dated June 4, 2002, describing the subject project and requesting our comments on the proposed action. After review of the documents, we inform that no property presently owned by the Puerto Rico Land Administration (PRLA) is located inside the maritime enclave of the project. The dredging operation will improve the vessels traffic inside the San Juan Harbor.

Nonetheless the above, the proposed action to dispose of highly contaminated dredged material inland raises some concerns. First, pumping the sediments a relatively large distance through a meandering and highly shallow inland water course as the Martin Peña Channel, will place the banking areas at risk of contamination at possible pump and pipeline breaks and/or disruptions. Second, the Contained Aquatic Disposal (CAD) device is not described in your letter. But even though a high degree of safe-proofing may be achieved with the CAD system, not that high a volume of hazardous wastes as the one proposed (300,000 cyds.) shall be placed in a ecologically sensitive area as the San Jose Lagoon. If the CAD system permits, the hazardous wastes may be disposed of in deeper waters in the ocean.

If you have any questions concerning this letter, please do not hesitate to contact Mr. Juan L. García Uriarte, Engineer Director at (787) 753-9300 extension 226.

Sincerely,

Juan Vaquer Castrodad
Executive Director

PO BOX 363767 • SAN JUAN, PR 00936-3767 • #171 AVE. CARLOS CHARDON, SUITE 101 • SAN JUAN, PR 00918-0903 • T. 753-9300 • F. 250-7150 • WWW.TERRENOS.PRSTAR.NET

United States Department of Agriculture | Forest Service | International Institute of Tropical Forestry
Tel: (787) 766-5335 | P.O. Box 25000 San Juan PR 00928 Fax: (787) 766-6263

File Code: 1900
Date: June 25, 2002

Ivonne Haberer
Planning Division
Environmental Branch
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Ms. Haberer:

This is in response to a request from your office for information concerning the Environmental Assessment for maintenance dredging of San Juan Bay. We recognize the importance of San Juan Bay for Puerto Rico and the United States and have no objections to the maintenance dredging. However, we are concerned about the level of expenditures that the US government invests in maintenance dredging while also investing in activities upstream that produce excessive sedimentation, increases maintenance costs, and forces the federal government to invest huge quantities of money for maintenance activities such as this dredging. Accordingly, we recommend an economic analysis of the cost/benefits of all federal activities on the San Juan Bay watershed with a view of coordinating activities that would save money to taxpayers in the United States.

For example, the Army Corps of Engineers constantly approves projects that involve burying stream channels (for construction) and redirecting water flows through culverts that are of questionable effectiveness in the context of our tropical conditions. Thanks to these--and many other developments subsidized by federal funds (for example for infrastructure or with regulations that allow less rigorous environmental constraints on constructions activities in Puerto Rico)--the water flows to the San Juan Bay during storm periods are sediment-laden to a degree that is manifold what would be naturally expected. So, the federal and commonwealth governments subsidize the construction industry by facilitating its infrastructure, eliminating accountability for environmental protection, and picking up the tab for removing the high sediment and pollution loads that accumulate on San Juan Bay (and in fact all throughout the coast of Puerto Rico). On a long-term basis, the federal government is allowing for the over-development of Puerto Rico and making this development dependent on the federal treasury. Puerto Rico has no resources to assume the incredible financial burden of maintaining such a vulnerable infrastructure.

As we pour more money into this system, it is wise to analyze the direction it is heading and the consequences of no action.

I look forward to your analysis, and thank you for allowing us to comment.

Sincerely,

ARIEL E. LUGO
Director

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
Caribbean Area State Office
P.O. Box 364868
San Juan, PR 00936-4868
Tel. 787-766-5206
Fax. 787-766-5987

June 5, 2002

Mr. James C. Duck
Planning Division
Environmental Branch
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Duck:

SUBJECT: DEA FOIA- San Juan Harbor Federal Navigation Project, San Juan, PR

After a thorough review of above named EA report, we have no environmental concerns to express.

For more information please contact Félix A. Latorre, Water Resources Planning Specialist, at (787) 766-5206, Ext. 234.

Sincerely,

JUAN A. MARTÍNEZ
Director

San Juan Bay Estuary Program

August 7, 2002

Ms. Yvonne Haberer
Planning Division – Environmental Branch
Jacksonville District
US Army Corps of Engineers
P.O. Box 4970
Jacksonville, Fl 32232-0019

Dear Ms. Haberer:

This letter is in response to the US Army Corps of Engineers (USACE) request for information, related to the scoping of the Environmental Assessment for the San Juan Harbor Graving Dock Turning Basin & Berthing Areas 15 and 16 Maintenance Dredging Project. The San Juan Bay Estuary (SJBE) Program Office met with personnel from the PR Department of Natural and Environmental Resources (DNER) to discuss which information should be presented in the Environmental Assessment (EA). The SJBE Program recommends that the following issues be included as part of the EA:

1. Dredging: The EA should discuss which measures will be implemented to reduce sediment resuspension and contaminant bioavailability during dredging operations at the Graving Dock Turning Basin & Berthing Areas 15 and 16. Among these, the EA should mention which type of hydraulic dredge (i.e. cutterhead dredge, horizontal auger dredge) will be used, since the amount of sediments lost during dredging operations, due to the space between the cutterhead and the pump suction head, will vary depending on the type and the production rate of the hydraulic dredge system employed. Other operational controls that can be considered to reduce sediment and pollutant resuspension, and that can be part of the discussion, include: the placement of silt curtains; reducing cutterhead rotation speed; slowing dredgehead movement; increasing suction rate; and, slowing the movement and placement of spud piles and swing anchors.

2. Transport of Dredged Material: The proposed project will involve pumping of all dredged material through a pipeline along the entire length of the Martín Peña Channel and most of the San José Lagoon, to its final disposal into an artificial depression in the lagoon's bottom. This depression will be converted to a contained aquatic disposal (CAD) facility. The EA should describe the precise route along which the pipeline and booster pumps would be located, including information such as if these will be supported by floats or submerged on the bottom of the Martín Peña Channel and the San José Lagoon, or routed over land along the fringes of these water bodies. We recommend that the USACE consider the placement of the pipeline over land, on the segment along the southern edge of the eastern half of the Martín Peña Channel. The pipeline would be limited to the north by the mangroves fringing the Channel and by a jogging trail and unmantained green areas to the south. On several sites along this

400 Fdez. Juncos Ave.,
2nd. Floor,
San Juan, P.R.,
00901-3299
Tel. (787) 725-8162

route, some wood and zinc dwellings are found, but these are scheduled for removal as part of the proposed dredging works for the Martín Peña Channel. The USACE should coordinate with the PR Highway Authority and the Municipality of San Juan the timeframe for the relocation of these structures, which would also include all of those east of the Barbosa Avenue fringing the Channel and that belong to the Israel and Bitumul communities, as well as any possible conflicts with the construction of the new Barbosa Avenue Bridge.

We believe the EA should also discuss which measures will be in place to reduce the possibility of pipeline leakage, such as employing pipeline leak-tight joints and connectors, as well as those remedial actions that would be taken to correct and mitigate any accidental sediment spills. The EA should present what measures will be implemented to avoid the escape of sediments if there is a need to disassemble a pipeline or booster pump for flushing, in case these become clogged or suffer any malfunction.

3. Selection of Disposal Site: The EA should discuss which alternatives were evaluated for the disposal of the dredged material, and the rationale for the selection of the artificial depression located on the southeast corner of the San José Lagoon. We recommend that the EA consider the artificial depression found at the northwest embayment of the San José Lagoon, known also as Los Corozos Lagoon, as an alternative for a disposal site. This depression has a maximum depth of approximately 28 feet and has a more regular, "cup" shape, possibly making it more suitable for its conversion into a CAD, than the one that has been preliminarily selected. The recommended site at Los Corozos Lagoon would be closer to the dredging area at the San Juan Bay, requiring approximately 1,000 meters less of pipeline to transport the dredging material for disposal. The volumetric capacity of Los Corozos Lagoon depression would have to be calculated, to determine if this site would be suitable to dispose of all of the approximately 300,000 cubic yards of material that would be dredged from the proposed areas.

   Finally, the EA should provide information about the benthic flora and fauna, and any other biological resources found in the water column, in the area that is finally selected for the disposal of the dredged material. A Benthic Assessment Study was performed by the National Marine Fisheries Service (NMFS) on behalf of the SJBE Program, to determine the spatial distribution of benthic communities, the area extent, the species composition and their density within the SJBE. The information provided in this study could be useful for the characterization of the benthic organisms that might be affected by the proposed dredging and CAD creation activities. The final report of this study will be available for spring 2003. The SJBE Program Office has also other reports documenting the environmental condition (i.e. water and sediment quality) and the biological resources (i.e. zooplankton, nekton, macrobenthos) of the San Juan Bay and the San José and Los Corozos lagoons, which can be available to the USACE for review upon request.

4. Cap Design: The EA should provide detailed information regarding the thickness, characteristics and the source of the material for capping the proposed CAD, including a description on how it will be placed to assure the isolation of the contaminated sediments from the benthic and aquatic environment, and how its long term integrity would be maintained or guaranteed. Thus, the cap should be designed to account for bioturbation,

erosion, consolidation and long term chemical isolation. The performance criteria related to cap design must be tied to suitable design objectives that the cap is intended to meet. The EA should justify the final cap design by providing information derived from laboratory analysis that test for cap material consolidation and isolation effectiveness, and modeling studies that evaluate its erosion potential and the settlement of the dredged material.

5. Disposal of Dredged Material: The contaminated materials must be placed in the selected CAD pit, so that water column impacts from releases of contaminants during placement are acceptable. Available field data on conventional open water disposal operations indicates that the total amount of dredged material dispersed in the upper water column and transported long distances from the placement area is one (1) to five (5) percent of the original mass of material.[1] Therefore, the EA should present a thorough discussion of the measures that will be implemented to reduce sediment resuspension and dispersion, including but not limited to: placement method (i.e. diffusers); placement of silt curtains; placement of dredged material into geosynthetic fabric containers (GFCs); sheetpiles and floating booms; as well as which factors were considered for the selection of these or any other measures evaluated.

   The sediments to be dredged from the Graving Dock Turning Basin & Berthing Areas 15 and 16 are contaminated with heavy metals, polyaromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). The EA should present the specific concentrations at which these pollutants were found in the sediments and their exceedance over established standards. The EA should account for the possible temporary increase in the volatilization of some of these contaminants from the water column to the air during the deposition of the dredged material. In the case of PCBs, volatilization involves desorption from the suspended solids phase, diffusion through the water column, and transport through the water-air interface. The extent of volatilization would depend on the magnitude of resuspension, concentration and vapor pressure of PCBs, and prevailing temperature and wind. We recommend that an air-monitoring program be considered for implementation, to test for those pollutants that could volatilize, since between 40% to 50% of the PCBs entering the water column can volatilize during dredging activities.[2] Finally, we recommend that USACE defines in the EA the location of a mixing zone for the proposed disposal activities, defined as the point of compliance with water quality standards or biological standards tied to the potential water column release associated with placement operations at the disposal site.

6. Monitoring: The EA should discuss a monitoring program designed to measure the effects of sediment resuspension on the dredging site and the disposal area, to ensure compliance with prevailing water quality standards and those set by the proposed project. Monitoring should be provided before, during and following the placement of the contaminated materials and final cap, to insure that water column dispersion is within acceptable limits and that an effective cap has been constructed. Palermo, M. R., 1997, recommends that monitoring to assure that the placement of dredged material occurs as designed, includes water column sampling, baseline conditions, post-contaminated material placement, interim, and post cap

[1] Palermo, M. R., 1997. *Contained Aquatic Disposal of Contaminated Sediments in Subaqueous Borrow Pits.* Presented at Western Dredging Association XVIII Annual Meeting, 29 Jun - 2 July 1997, Charleston, S.C.

[2] Cushing, B. S., 1998. *The limits of dredging as a feasible technology for contaminated sediment removal.* Water Environment & Technology, June 1998.

material placement precision bathymetric surveys, as well as sediment profile image (SPI) surveys. Long term monitoring may include sequential bathymetric and SPI surveys or diver inspected settling plates to determine changes in material thickness, surface sediments chemistry samples, sediment and pore water chemistry profiles from cores, sediment physical structure from cores, benthic community structure, and contaminant tissue concentrations of resident benthic species. A monitoring program to avoid any impacts over species of concern, such as federally endangered species, should be implemented as part of the proposed project. We recommend that the same protocol used for the Phase II of the San Juan Harbor Deepening and Blasting Activities Project be followed. Manatees have been observed on a regular basis on the San Juan Bay and in the Puerto Nuevo River Channel, the latest located in the vicinity of the proposed dredging site.

Thank you for the opportunity to comment on this action. If you have any questions, please do not hesitate to contact me or Mr. Mario Tacher and Mr. Luis Jorge Rivera Herrera from my staff, at 787-725-8162, or by e-mail at Mario.Tacher@saj02.usace.army.mil, or Luis.J.Rivera-Herrera@saj02.usace.army.mil.

Cordially,

Agustín F. Carbó Lugo, Esq.
Executive Director

MTR/LJRH/ljrh

c: Mr. Gerardo Irizarry, Department of Environmental Management, Municipality of Carolina
Mrs. Giovanna Fuentes, Chair, Implementation Committee, SJBE Partnership, DNER
Mr. James P. Oland, Field Supervisor, US Fish and Wildlife Service
Mr. José Soto, Life Scientist, US Environmental Protection Agency
Mr. Julio A. Toro Mc. Cown, Technical Assistant, Deputy Secretary for Planning, DNER
Mrs. Lourdes Bernier, Technical Assistant, Water & Mineral Resources Area, DNER
Mrs. Ivonne Santiago, Director, Water Quality Area, PR Environmental Quality Board
Dr. Michael Szendrey, Chair, Scientific & Technical Advisory Committee, SJBE Partnership
Arq. Roberto Alsina, Executive Director, Department of Urbanism, Municipality of San Juan
Mr. Ramón Lloveras, Esq., Chair, Board of Directors, SJBE Partnership

COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF EDUCATION

AREA FOR PLANNING AND EDUCATIONAL DEVELOPMENT

July 11, 2002

Mr. James C. Duck
Chief, Planning Division
Department of the Army
Jacksonville District of Engineers
P. O. Box 4970
Jacksonville, Florida 32232 - 0019

Attention: Mrs. Ivonne Haberer
Planning Division
Environmental Branch

Dear Mr. Duck:

We received your letter, regarding the Environmental Assesment being prepared for maintenance dredging in San Juan Harbor, San Juan, Puerto Rico.

We consider this a very important proyect in this area and have our endorsement under the following conditions:

- The access to any school along the route should not be affected.
- The teaching – learning process would not be affected.
- Materials being dredged from the proposed areas will not affect the health of the school community.

Cordially,

Ángel L. Canales Encarnación
Acting Assistant Secretary

ALCE/ar/aeg

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COMMONWEALTH OF PUERTO RICO

HIGHWAY AND TRANSPORTATION AUTHORITY

July 30, 2002

Mr. James C. Duck
Chief, Planning Division
Department of The Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

ENVIRONMENTAL ASSESSMENT (EA) FOR MAINTENANCE DREDGING IN SAN JUAN HARBOR, PUERTO RICO

Dear Mr. Duck:

Reference is made to your letter dated June 4, 2002, related to this matter.

At present the Construction Improvement Program of this Authority includes the following projects in the reference area:

1. AC-000140 – Geometric Improvement on PR-1, Muñoz Rivera Expressway, from Km 5.4 with Intersection PR-2 to Martín Peña Channel, Km 7.9.

2. AC-100209 – Improvements to Muñoz Rivera Expressway and Access to Miramar Marine Front, Included an Overpass from Muñoz Rivera Expressway to Miraflores and Villa Verde Streets, Pavement Rehabilitation, Geometric and Bridges Improvements.

3. AC-100217 – Bridge Replacement #675, Km 7.85 Over Martín Peña Channel.

4. AC-002528 – Bridge Replacement #185, Km 8.0 Over Martín Peña Channel, Alternatives Study.

5. AC-002721 – Bridge Replacement #87, Over Martín Peña Channel, PR-27, Km 2.4.

The reference project should be coordinated with our projects. For additional information please contact the Design Area at 787-721-8787, extention 1401, or our Office of Highway Systems at 787-721-8787, extention 1512.

Cordially,

Irma M. García
Director
Planning Area

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APPENDIX D – CAD DESIGN, REPORT BY USACE WES

Revised San Juan CAD Design – Calculation of CAD Pit Parameters for Hydraulic Dredging with Pipeline Discharge into Disposal Area #2

An investigation of the cap design was performed for the confined aquatic disposal (CAD) of the unsuitable dredged material from the Graving Dock area of the San Juan Harbor into Disposal Area #2 in the San Jose Lagoon, using "clean" material from the Cruise Ship Basin for the cap. The original calculations for pit 2 were revised in order to provide a range of possible dredging parameters. The range of parameters studied within this investigation is shown below in Table 1. The original in situ sediment volume estimate is 200,000 cubic yards, although larger volumes could be anticipated due to shoaling and overdredge, and thus volumes up to 300,000 cu. yd were included. Due to the long distance from the dredging site to the pit and the associated use of booster pumps, production (effective pumping time) will be significantly reduced. Production rates are expected to be as low as 35%, achieving at most 50%. As with the original calculations, it is assumed that a submerged diffuser will be used to provide 90% or better hydraulic efficiency, thereby reducing the area required for clarification. A submerged diffuser will also allow better placement of material and will reduce sediment dispersion in the water column.

Table 1. Range of Dredging Parameters Investigated

In-Situ Volume cu yd.	Dredge Sizes (in.)	Average Pipeline Velocities (fps)	Production Rates (%)	Solids Content (g/l)
200,000	16	10	35 %	95
225,000	18	12	50 %	115
250,000	21	15		135
300,000	24			
	27			
	30			

Due to volume limitations within the pit, the dredging parameters must be limited such that the material is confined below the pit lip at –12 ft elevation. Typically, determination of the elevation over time is computed/modeled using the Primary Consolidation, Secondary Compression, and Desiccation of Dredged Fill (PSDDF) model which takes into consideration the initial fill volume computed from laboratory compression settling data (SETTLE program) and the void ratio vs. effective stress and permeability relationships generated from curve-fitted laboratory consolidation tests (REDUCE program). However, in this instance, the PSDDF model did not appear to correctly model the process, since the model predicted far less consolidation than that observed during laboratory testing. This occurred because PSDDF is more suited to model long-term consolidation, rather than short-term processes where there is minimal initial effective stress. Furthermore, the permeability vs. void ratio relationship for the Graving Dock sediment that was originally generated by the curve-fitting program, REDUCE, predicted much lower permeabilities than those observed in the laboratory. The correlation generated by REDUCE appeared incorrect for the fine-grained sediment in the range of higher void ratios. Therefore, instead, one point was hand-calculated for a large void ratio, then the remaining values were linearly estimated between that point and the lower void ratios (from the oedometer range of values which appeared to be correct).

Therefore, an alternative method was used to estimate the filling and consolidation of the unsuitable and capping dredged material for this project. For the short-term, the compression settling equations were used to make predictions about the filling and consolidation over the range of dredging parameters. These predictions include the initial volume and elevation of unsuitable material upon filling, the required initial cap thickness (assuming a final cap thickness of 1.75 ft), the maximum elevation of material (immediately after cap placement), and the unsuitable and cap material thicknesses at 6 months (or 1 year, depending on time to fill). The 1.75-ft minimum cap thickness was based on the following assumptions for individual thickness components:

- 1 ft to account for bioturbation,

- 0.25 ft (post-consolidation) for operational considerations (thickness variation), and
- 0.5 ft to account for chemical isolation.

No thickness component for erosion was included, as net deposition is expected to occur rather than erosion. Note also that a 7-day waiting period between cap placement and placement of the unsuitable material was assumed and strongly recommended to allow the unsuitable material to gain strength prior to placing the cap.

From these calculations, the maximum dredging solids output (kg/day) to avoid overfilling the pit can be determined for each in situ sediment volume. Results (Figure 1) show the maximum solids output to avoid filling above the –12 ft pit lip is approximately 9.928, 4.171, 1.972 and 0.605 million kg/day respectively for each investigated in situ sediment volume (200,000, 225,0000, 250,000, 300,000 cu. yd.). Table 2 shows the range of examined dredging parameters with the associated solids output in kg solids per day. Note that the solids contents of the unsuitable (Graving Dock) and cap material (Cruise Ship Basin) are different, with Graving Dock having 419.07 kg/ in situ cu. yd., and Cruise Ship Basin 507.23 kg/in situ cu. yd. These values can be used to obtain the dredging rates in terms of in situ cu yd. per day. Table 3 shows the estimated maximum elevation (top of cap immediately after cap placement) that would be incurred with the range of dredging parameters and in situ sediment volumes. The dredging time associated with each dredging rate and in situ volume is plotted in Figure 2. The tables in Appendix 1 give a more detailed summary of the compression settling calculations. A number of different combinations of dredging parameters would be appropriate to meet the volume limitations, and selection should be made based on dredge solids output that meet the volume limitations as well as dredge availability and associated economics.

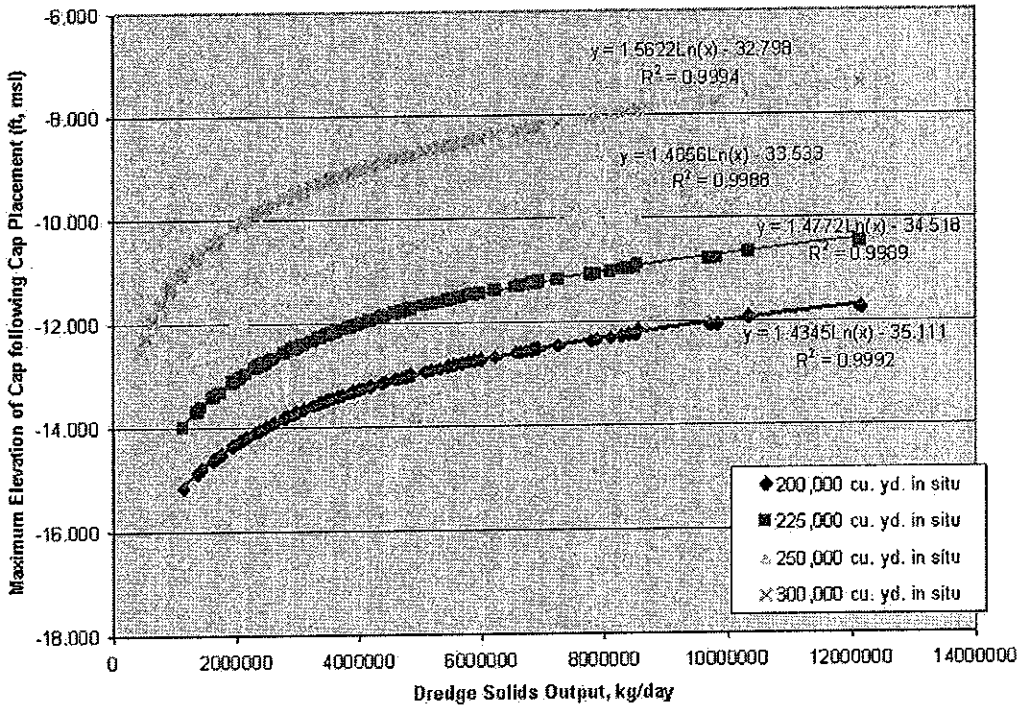

Figure 1. Maximum predicted pit elevations produced by various dredging production rates and in situ sediment volumes

Long-term consolidation for several dredging scenarios was modeled with PSDDF, using the 6-month (or 1 year) unsuitable and cap material thicknesses generated from the compression settling equations. Note that the permeability relationships were modified from the erroneous values generated by

REDUCE. The PSDDF results (Figure 3) predict that the material will completely consolidate within 15 to 20 years.

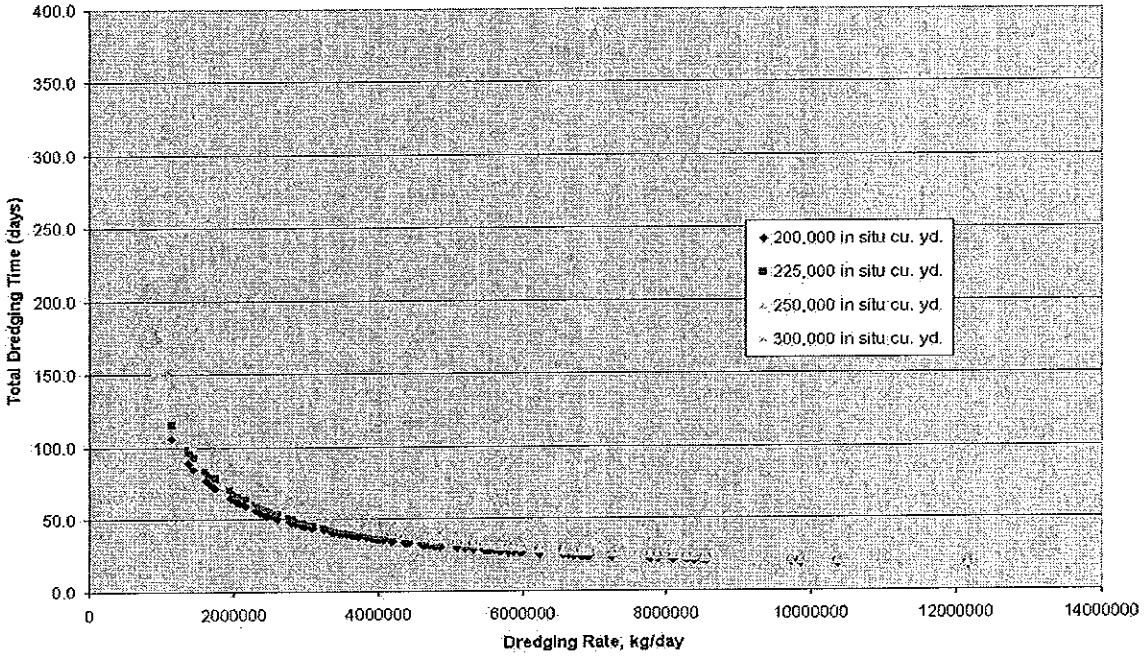

Figure 2. Total Dredging Duration depending on Dredging Rate and In Situ Volume (including time to dredge, 7-day waiting period, and time to cap).

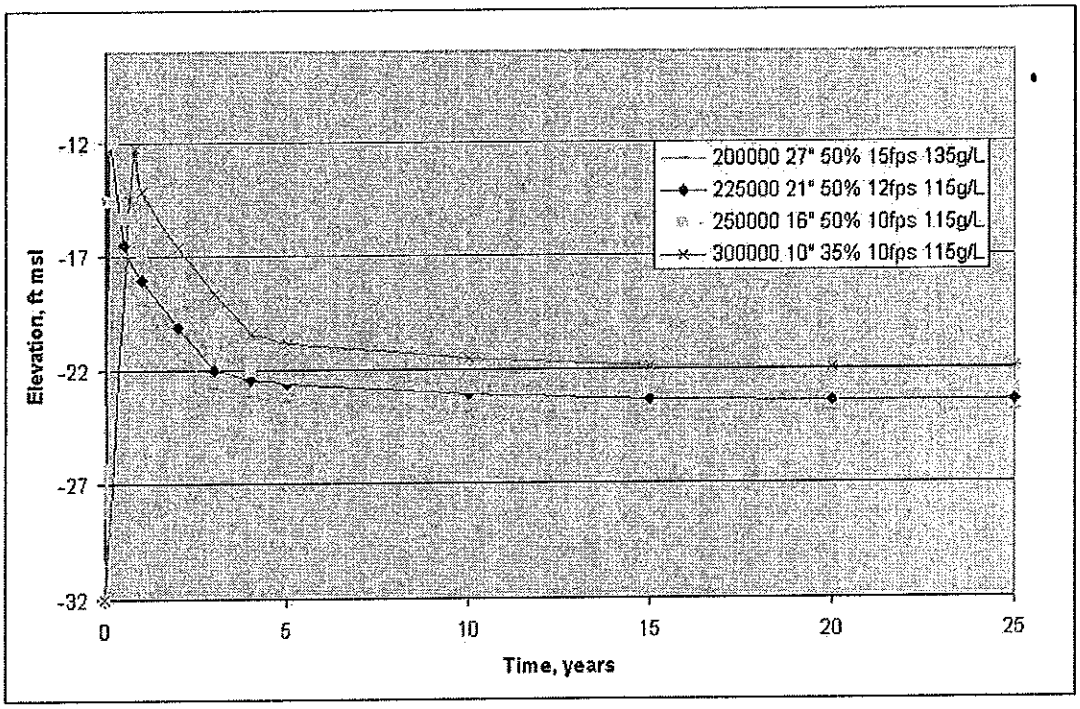

Figure 3. Predicted elevation of Graving Dock dredged material and cap over time for several dredging scenarios

It is important to point out some weaknesses of the methods used that give way to a low level of confidence in the results. First, the compression settling equations are derived from the laboratory column settling tests which were performed on just one sample each of the Graving Dock, Cruise Ship Basin and Deep Draft Anchorage materials. The same is true of the laboratory consolidation tests. These samples may or may not be representative of each of the dredging areas. In order to get a feel for the variability of sediments in the harbor, the compression settling calculations were performed substituting the Deep Draft Anchorage and Cruise Ship Basin compression settling coefficients in place of the Graving Dock properties. Comparison of the maximum predicted cap elevations showed the elevations to vary by an average of 1 ft., and at most 1.37 ft between the properties of the three harbor sediments. The elevations predicted by the Graving Dock material properties fell between that of the other two sediments.

Furthermore, the settling column test is performed at a smaller thickness (6 ft) than the pit fill depth (> 15 ft), and the larger thickness may contribute to more settling due to the greater weight of material or possibly less consolidation due to increased drainage path length.

Due to the level of uncertainty, it is strongly recommended that a factor of safety be incorporated. For instance, one may consider choosing a dredge size and other parameters such that the maximum predicted elevation allows at least 1 foot or more space below the pit lip. Upon selecting a solids output, it should be stressed to the contractor to avoid excessive volumes by abiding by the given flowrate restrictions and limiting overdredge to the extent possible. It is recommended that the dredged material volume be minimized through the use of negative incentives to the contractor. It is also suggested that the filling process be closely monitored such that adjustments can be made if necessary. Furthermore, a contingency plan should be in place to account for any excess volumes.

Table 2. Solids output generated by a range of dredging parameters, kg/day

Dredge Size (in.):	10	12	16	18	21	24	27	30
35% Production								
10 fps, 95 g/L	443,688	638,911	1,135,841	1,437,549	1,956,664	2,555,643	3,234,485	3,993,192
10 fps, 115 g/L	537,096	773,418	1,374,966	1,740,191	2,368,593	3,093,673	3,915,430	4,833,864
10 fps, 135 g/L	630,504	907,926	1,614,090	2,042,833	2,780,523	3,631,703	4,596,374	5,674,536
12 fps, 95 g/L	532,426	766,693	1,363,009	1,725,059	2,347,997	3,066,771	3,881,383	4,791,830
12 fps, 115 g/L	644,515	928,102	1,649,959	2,088,229	2,842,312	3,712,407	4,698,516	5,800,637
12 fps, 135 g/L	756,605	1,089,511	1,936,908	2,451,399	3,336,627	4,358,044	5,515,649	6,809,443
15 fps, 95 g/L	665,532	958,366	1,703,762	2,156,324	2,934,996	3,833,464	4,851,728	5,989,788
15 fps, 115 g/L	805,644	1,160,127	2,062,449	2,610,286	3,552,890	4,640,509	5,873,145	7,250,796
15 fps, 135 g/L	945,756	1,361,889	2,421,135	3,064,249	4,170,784	5,447,554	6,894,561	8,511,804
50% Production								
10 fps, 95 g/L	633,840	912,730	1,622,630	2,053,642	2,795,234	3,650,918	4,620,693	5,704,560
10 fps, 115 g/L	767,280	1,104,883	1,964,237	2,485,987	3,383,705	4,419,533	5,593,471	6,905,520
10 fps, 135 g/L	900,720	1,297,037	2,305,843	2,918,333	3,972,175	5,188,147	6,566,249	8,106,480
12 fps, 95 g/L	760,608	1,095,275	1,947,156	2,464,370	3,354,281	4,381,102	5,544,832	6,845,472
12 fps, 115 g/L	920,736	1,325,860	2,357,084	2,983,185	4,060,446	5,303,439	6,712,165	8,286,624
12 fps, 135 g/L	1,080,864	1,556,444	2,767,012	3,501,999	4,766,610	6,225,776	7,879,498	9,727,776
15 fps, 95 g/L	950,760	1,369,094	2,433,946	3,080,462	4,192,851	5,476,377	6,931,040	8,556,840
15 fps, 115 g/L	1,150,920	1,657,325	2,946,355	3,728,981	5,075,557	6,629,299	8,390,207	10,358,280
15 fps, 135 g/L	1,351,080	1,945,555	3,458,765	4,377,499	5,958,263	7,782,221	9,849,373	12,159,720

Table 3. Elevation of Top of Cap (immediately after placement, maximum)

200,000 cu yd. In situ Volume						
Dredge Size (in.):	16	18	21	24	27	30
35% Production						
10 fps, 95 g/L	-15.17	-14.81	-14.34	-13.94	-13.59	-13.29
10 fps, 115 g/L	-14.88	-14.52	-14.05	-13.66	-13.32	-13.02
10 fps, 135 g/L	-14.63	-14.28	-13.81	-13.42	-13.09	-12.80
12 fps, 95 g/L	-14.89	-14.53	-14.07	-13.67	-13.33	-13.03
12 fps, 115 g/L	-14.60	-14.24	-13.78	-13.39	-13.06	-12.77
12 fps, 135 g/L	-14.36	-14.00	-13.55	-13.16	-12.84	-12.55
15 fps, 95 g/L	-14.55	-14.19	-13.73	-13.35	-13.01	-12.72
15 fps, 115 g/L	-14.26	-13.91	-13.45	-13.07	-12.75	-12.47
15 fps, 135 g/L	-14.02	-13.67	-13.23	-12.85	-12.54	-12.27
50% Production						
10 fps, 95 g/L	-14.62	-14.27	-13.81	-13.42	-13.08	-12.79
10 fps, 115 g/L	-14.33	-13.98	-13.53	-13.14	-12.82	-12.53
10 fps, 135 g/L	-14.09	-13.74	-13.29	-12.92	-12.60	-12.33
12 fps, 95 g/L	-14.35	-13.99	-13.54	-13.16	-12.83	-12.53
12 fps, 115 g/L	-14.06	-13.71	-13.26	-12.89	-12.57	-12.29
12 fps, 135 g/L	-13.82	-13.48	-13.04	-12.67	-12.37	-12.09
15 fps, 95 g/L	-14.01	-13.66	-13.22	-12.84	-12.51	-12.17
15 fps, 115 g/L	-13.73	-13.38	-12.95	-12.59	-12.27	-11.94
15 fps, 135 g/L	-13.49	-13.16	-12.73	-12.38	-12.07	-11.76

225,000 cu yd. In situ Volume						
Dredge Size (in.):	16	18	21	24	27	30
35% Production						
10 fps, 95 g/L	-14.00	-13.62	-13.13	-12.71	-12.35	-12.04
10 fps, 115 g/L	-13.69	-13.32	-12.83	-12.42	-12.07	-11.76
10 fps, 135 g/L	-13.44	-13.06	-12.58	-12.18	-11.84	-11.54
12 fps, 95 g/L	-13.71	-13.33	-12.85	-12.44	-12.08	-11.78
12 fps, 115 g/L	-13.40	-13.03	-12.55	-12.15	-11.81	-11.51
12 fps, 135 g/L	-13.15	-12.78	-12.31	-11.91	-11.58	-11.29
15 fps, 95 g/L	-13.35	-12.98	-12.50	-12.10	-11.76	-11.46
15 fps, 115 g/L	-13.05	-12.68	-12.21	-11.82	-11.49	-11.20
15 fps, 135 g/L	-12.80	-12.44	-11.98	-11.60	-11.27	-11.00
50% Production						
10 fps, 95 g/L	-13.43	-13.06	-12.58	-12.17	-11.83	-11.53
10 fps, 115 g/L	-13.13	-12.76	-12.29	-11.89	-11.56	-11.27
10 fps, 135 g/L	-12.87	-12.51	-12.05	-11.66	-11.34	-11.06
12 fps, 95 g/L	-13.14	-12.77	-12.30	-11.91	-11.57	-11.27
12 fps, 115 g/L	-12.84	-12.48	-12.02	-11.63	-11.31	-11.02
12 fps, 135 g/L	-12.59	-12.24	-11.78	-11.41	-11.10	-10.82
15 fps, 95 g/L	-12.79	-12.43	-11.97	-11.59	-11.25	-10.91
15 fps, 115 g/L	-12.50	-12.14	-11.70	-11.33	-11.00	-10.68
15 fps, 135 g/L	-12.25	-11.91	-11.47	-11.11	-10.80	-10.49

Table 3. Elevation of Top of Cap (immediately after placement, maximum) (continued)

250,000 cu yd. In situ Volume								
Dredge Size:	10	12	16	18	21	24	27	30
35% Production								
10 fps, 95 g/L	-14.46	-13.86	-12.91	-12.52	-12.03	-11.60	-11.24	-10.93
10 fps, 115 g/L	-14.14	-13.54	-12.60	-12.21	-11.72	-11.31	-10.96	-10.65
10 fps, 135 g/L	-13.88	-13.28	-12.34	-11.96	-11.47	-11.07	-10.72	-10.42
12 fps, 95 g/L	-14.16	-13.56	-12.61	-12.23	-11.74	-11.32	-10.97	-10.66
12 fps, 115 g/L	-13.84	-13.24	-12.30	-11.92	-11.44	-11.04	-10.69	-10.39
12 fps, 135 g/L	-13.58	-12.98	-12.04	-11.67	-11.20	-10.80	-10.46	-10.17
15 fps, 95 g/L	-13.79	-13.19	-12.25	-11.87	-11.39	-10.99	-10.64	-10.35
15 fps, 115 g/L	-13.48	-12.87	-11.94	-11.57	-11.10	-10.71	-10.38	-10.09
15 fps, 135 g/L	-13.21	-12.61	-11.69	-11.32	-10.86	-10.48	-10.16	-9.88
50% Production								
10 fps, 95 g/L	-13.87	-13.27	-12.33	-11.95	-11.47	-11.06	-10.71	-10.41
10 fps, 115 g/L	-13.56	-12.95	-12.02	-11.65	-11.17	-10.78	-10.44	-10.15
10 fps, 135 g/L	-13.29	-12.69	-11.77	-11.40	-10.93	-10.55	-10.22	-9.94
12 fps, 95 g/L	-13.57	-12.97	-12.03	-11.66	-11.19	-10.79	-10.45	-10.15
12 fps, 115 g/L	-13.25	-12.66	-11.73	-11.37	-10.90	-10.52	-10.19	-9.90
12 fps, 135 g/L	-12.99	-12.39	-11.48	-11.12	-10.67	-10.30	-9.98	-9.70
15 fps, 95 g/L	-13.20	-12.60	-11.68	-11.32	-10.86	-10.47	-10.14	-9.81
15 fps, 115 g/L	-12.89	-12.29	-11.38	-11.03	-10.58	-10.21	-9.89	-9.57
15 fps, 135 g/L	-12.62	-12.03	-11.14	-10.79	-10.36	-10.00	-9.68	-9.38

300,000 cu yd. In situ Volume								
Dredge Size:	10	12	16	18	21	24	27	30
35% Production								
10 fps, 95 g/L	-12.58	-11.97	-11.02	-10.63	-10.14	-9.72	-9.36	-9.04
10 fps, 115 g/L	-12.26	-11.65	-10.71	-10.33	-9.84	-9.42	-9.06	-8.75
10 fps, 135 g/L	-11.99	-11.38	-10.45	-10.07	-9.59	-9.18	-8.82	-8.51
12 fps, 95 g/L	-12.27	-11.66	-10.72	-10.34	-9.85	-9.44	-9.08	-8.76
12 fps, 115 g/L	-11.95	-11.35	-10.41	-10.04	-9.56	-9.15	-8.79	-8.48
12 fps, 135 g/L	-11.69	-11.08	-10.16	-9.79	-9.31	-8.90	-8.55	-8.25
15 fps, 95 g/L	-11.90	-11.29	-10.36	-9.99	-9.51	-9.10	-8.74	-8.43
15 fps, 115 g/L	-11.58	-10.98	-10.06	-9.69	-9.21	-8.81	-8.46	-8.16
15 fps, 135 g/L	-11.32	-10.72	-9.80	-9.44	-8.97	-8.57	-8.23	-7.93
50% Production								
10 fps, 95 g/L	-11.98	-11.38	-10.44	-10.06	-9.58	-9.17	-8.82	-8.50
10 fps, 115 g/L	-11.66	-11.06	-10.13	-9.76	-9.29	-8.88	-8.53	-8.23
10 fps, 135 g/L	-11.40	-10.80	-9.88	-9.51	-9.04	-8.64	-8.30	-8.00
12 fps, 95 g/L	-11.68	-11.08	-10.15	-9.78	-9.30	-8.90	-8.55	-8.23
12 fps, 115 g/L	-11.36	-10.76	-9.85	-9.48	-9.01	-8.61	-8.27	-7.96
12 fps, 135 g/L	-11.10	-10.51	-9.60	-9.23	-8.77	-8.38	-8.04	-7.74
15 fps, 95 g/L	-11.31	-10.71	-9.80	-9.43	-8.96	-8.56	-8.21	-7.87
15 fps, 115 g/L	-10.99	-10.41	-9.50	-9.14	-8.68	-8.29	-7.94	-7.61
15 fps, 135 g/L	-10.73	-10.15	-9.25	-8.90	-8.44	-8.06	-7.72	-7.40

Appendix 1. Compression Settling Results for a Range of Dredging Properties

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between Unsuitable and Cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
200000	16	10	95	35	7	1.75	1135841	2710.36	2239.31	73.79	24.57	105.36	-17.58	-18.40	3.23	-15.17
200000	16	10	115	35	7	1.75	1374966	3280.96	2710.74	60.96	20.42	88.37	-17.32	-18.18	3.30	-14.88
200000	16	10	135	35	7	1.75	1614090	3851.56	3182.17	51.93	17.48	76.41	-17.10	-18.00	3.37	-14.63
200000	16	12	95	35	7	1.75	1363009	3252.43	2687.17	61.49	20.59	89.08	-17.34	-18.19	3.30	-14.89
200000	16	12	115	35	7	1.75	1649959	3937.15	3252.89	50.80	17.11	74.91	-17.07	-17.97	3.38	-14.60
200000	16	12	135	35	7	1.75	1936908	4621.88	3818.61	43.27	14.65	64.92	-16.85	-17.80	3.44	-14.36
200000	16	15	95	35	7	1.75	1703762	4065.54	3358.96	49.19	16.59	72.78	-17.03	-17.94	3.39	-14.55
200000	16	15	115	35	7	1.75	2062449	4921.44	4066.11	40.64	13.79	61.43	-16.76	-17.73	3.47	-14.26
200000	16	15	135	35	7	1.75	2421135	5777.35	4773.26	34.62	11.81	53.43	-16.54	-17.55	3.53	-14.02
200000	16	10	95	50	7	1.75	1622630	3871.94	3199.01	51.65	17.39	76.04	-17.10	-17.99	3.37	-14.62
200000	16	10	115	50	7	1.75	1964237	4687.09	3872.49	42.67	14.45	64.13	-16.83	-17.78	3.45	-14.33
200000	16	10	135	50	7	1.75	2305843	5502.23	4545.96	36.35	12.38	55.73	-16.61	-17.61	3.51	-14.09
200000	16	12	95	50	7	1.75	1947156	4646.33	3838.81	43.04	14.58	64.62	-16.84	-17.79	3.44	-14.35
200000	16	12	115	50	7	1.75	2357084	5624.51	4646.99	35.56	12.12	54.68	-16.58	-17.58	3.52	-14.06
200000	16	12	135	50	7	1.75	2767012	6602.68	5455.16	30.29	10.38	47.67	-16.35	-17.41	3.59	-13.82
200000	16	15	95	50	7	1.75	2433946	5807.91	4798.52	34.44	11.75	53.18	-16.53	-17.55	3.54	-14.01
200000	16	15	115	50	7	1.75	2946355	7030.63	5808.73	28.45	9.77	45.22	-16.26	-17.35	3.62	-13.73
200000	16	15	135	50	7	1.75	3458765	8253.35	6818.95	24.23	8.37	39.60	-16.03	-17.18	3.69	-13.49
200000	18	10	95	35	7	1.75	1437549	3430.30	2834.12	58.30	19.55	84.86	-17.26	-18.13	3.32	-14.81
200000	18	10	115	35	7	1.75	1740191	4152.47	3430.78	48.16	16.25	71.42	-17.00	-17.92	3.40	-14.52
200000	18	10	135	35	7	1.75	2042833	4874.64	4027.44	41.03	13.92	61.95	-16.78	-17.74	3.46	-14.28
200000	18	12	95	35	7	1.75	1725059	4116.36	3400.95	48.59	16.39	71.98	-17.01	-17.93	3.39	-14.53
200000	18	12	115	35	7	1.75	2088229	4982.96	4116.94	40.14	13.62	60.76	-16.75	-17.71	3.47	-14.24
200000	18	12	135	35	7	1.75	2451399	5849.56	4832.93	34.19	11.67	52.86	-16.52	-17.54	3.54	-14.00
200000	18	15	95	35	7	1.75	2156324	5145.45	4251.19	38.87	13.21	59.08	-16.70	-17.68	3.49	-14.19
200000	18	15	115	35	7	1.75	2610286	6228.70	5146.17	32.11	10.98	50.09	-16.43	-17.47	3.57	-13.91
200000	18	15	135	35	7	1.75	3064249	7311.95	6041.16	27.35	9.41	43.76	-16.21	-17.31	3.63	-13.67
200000	18	10	95	50	7	1.75	2053642	4900.43	4048.75	40.81	13.85	61.66	-16.77	-17.73	3.47	-14.27
200000	18	10	115	50	7	1.75	2485987	5932.10	4901.12	33.71	11.51	52.23	-16.50	-17.53	3.55	-13.98
200000	18	10	135	50	7	1.75	2918333	6963.77	5753.49	28.72	9.86	45.58	-16.27	-17.36	3.61	-13.74
200000	18	12	95	50	7	1.75	2464370	5880.51	4858.50	34.01	11.61	52.62	-16.51	-17.54	3.54	-13.99
200000	18	12	115	50	7	1.75	2983185	7118.52	5881.34	28.10	9.65	44.75	-16.24	-17.33	3.62	-13.71
200000	18	12	135	50	7	1.75	3501999	8356.52	6904.18	23.93	8.27	39.20	-16.02	-17.17	3.69	-13.48
200000	18	15	95	50	7	1.75	3080462	7350.64	6073.12	27.21	9.36	43.57	-16.20	-17.30	3.64	-13.66
200000	18	15	115	50	7	1.75	3728981	8898.15	7351.68	22.48	7.78	37.26	-15.93	-17.11	3.72	-13.38
200000	18	15	135	50	7	1.75	4377499	10445.65	8630.23	19.15	6.67	32.81	-15.70	-16.95	3.79	-13.16

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
200000	21	10	95	35	7	1.75	1956664	4669.02	3857.56	42.84	14.51	64.34	-16.84	-17.79	3.45	-14.34
200000	21	10	115	35	7	1.75	2368593	5651.97	4669.68	35.39	12.06	54.45	-16.57	-17.58	3.52	-14.05
200000	21	10	135	35	7	1.75	2780523	6634.92	5481.79	30.14	10.33	47.47	-16.34	-17.41	3.59	-13.81
200000	21	12	95	35	7	1.75	2347997	5602.82	4629.07	35.70	12.16	54.86	-16.58	-17.59	3.52	-14.07
200000	21	12	115	35	7	1.75	2842312	6782.36	5603.61	29.49	10.11	46.60	-16.31	-17.38	3.60	-13.78
200000	21	12	135	35	7	1.75	3336627	7961.91	6578.15	25.12	8.66	40.78	-16.08	-17.22	3.67	-13.55
200000	21	15	95	35	7	1.75	2934996	7003.53	5786.34	28.56	9.81	45.36	-16.27	-17.35	3.62	-13.73
200000	21	15	115	35	7	1.75	3552890	8477.96	7004.51	23.59	8.15	38.74	-16.00	-17.15	3.70	-13.45
200000	21	15	135	35	7	1.75	4170784	9952.38	8222.69	20.10	6.98	34.08	-15.77	-17.00	3.77	-13.23
200000	21	10	95	50	7	1.75	2795234	6670.03	5510.80	29.98	10.28	47.26	-16.34	-17.40	3.60	-13.81
200000	21	10	115	50	7	1.75	3383705	8074.24	6670.97	24.77	8.55	40.32	-16.06	-17.20	3.68	-13.53
200000	21	10	135	50	7	1.75	3972175	9478.46	7831.13	21.10	7.32	35.42	-15.84	-17.04	3.75	-13.29
200000	21	12	95	50	7	1.75	3354281	8004.03	6612.96	24.99	8.62	40.61	-16.08	-17.21	3.67	-13.54
200000	21	12	115	50	7	1.75	4060446	9689.09	8005.16	20.64	7.17	34.81	-15.81	-17.02	3.76	-13.26
200000	21	12	135	50	7	1.75	4766610	11374.15	9397.36	17.58	6.14	30.72	-15.58	-16.87	3.83	-13.04
200000	21	15	95	50	7	1.75	4192851	10005.04	8266.20	19.99	6.95	33.94	-15.76	-16.99	3.77	-13.22
200000	21	15	115	50	7	1.75	5075557	12111.36	10006.45	16.51	5.78	29.29	-15.49	-16.81	3.86	-12.95
200000	21	15	135	50	7	1.75	5958263	14217.69	11746.70	14.07	4.95	26.02	-15.26	-16.67	3.94	-12.73
200000	24	10	95	35	7	1.75	2555643	6098.31	5038.44	32.80	11.21	51.00	-16.46	-17.50	3.56	-13.94
200000	24	10	115	35	7	1.75	3093673	7382.17	6099.17	27.09	9.32	43.41	-16.19	-17.30	3.64	-13.66
200000	24	10	135	35	7	1.75	3631703	8666.02	7159.89	23.08	7.98	38.06	-15.96	-17.13	3.71	-13.42
200000	24	12	95	35	7	1.75	3066771	7317.97	6046.13	27.33	9.40	43.73	-16.20	-17.30	3.64	-13.67
200000	24	12	115	35	7	1.75	3712407	8858.60	7319.00	22.58	7.82	37.39	-15.93	-17.11	3.72	-13.39
200000	24	12	135	35	7	1.75	4358044	10399.22	8591.87	19.23	6.69	32.93	-15.71	-16.95	3.79	-13.16
200000	24	15	95	35	7	1.75	3833464	9147.47	7557.67	21.86	7.58	36.44	-15.89	-17.08	3.73	-13.35
200000	24	15	115	35	7	1.75	4640509	11073.25	9148.75	18.06	6.30	31.36	-15.62	-16.89	3.82	-13.07
200000	24	15	135	35	7	1.75	5447554	12999.03	10739.84	15.39	5.40	27.78	-15.39	-16.75	3.89	-12.85
200000	24	10	95	50	7	1.75	3650918	8711.87	7197.78	22.96	7.94	37.90	-15.96	-17.13	3.71	-13.42
200000	24	10	115	50	7	1.75	4419533	10545.95	8713.10	18.96	6.60	32.57	-15.69	-16.94	3.80	-13.14
200000	24	10	135	50	7	1.75	5188147	12380.03	10228.42	16.16	5.66	28.81	-15.46	-16.79	3.87	-12.92
200000	24	12	95	50	7	1.75	4381102	10454.25	8637.33	19.13	6.66	32.79	-15.70	-16.95	3.79	-13.16
200000	24	12	115	50	7	1.75	5303439	12655.14	10455.72	15.80	5.54	28.34	-15.43	-16.77	3.88	-12.89
200000	24	12	135	50	7	1.75	6225776	14856.03	12274.10	13.46	4.74	25.21	-15.20	-16.63	3.96	-12.67
200000	24	15	95	50	7	1.75	5476377	13067.81	10796.66	15.30	5.37	27.67	-15.38	-16.74	3.90	-12.84
200000	24	15	115	50	7	1.75	6629299	15818.93	13069.65	12.64	4.47	24.11	-15.10	-16.57	3.99	-12.59
200000	24	15	135	50	7	1.75	7782221	18570.04	15342.63	10.77	3.82	21.59	-14.88	-16.44	4.06	-12.38

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
200000	27	10	95	35	7	1.75	3234485	7718.17	6376.78	25.91	8.93	41.84	-16.13	-17.25	3.66	-13.59
200000	27	10	115	35	7	1.75	3915430	9343.05	7719.26	21.41	7.42	35.83	-15.86	-17.06	3.74	-13.32
200000	27	10	135	35	7	1.75	4596374	10967.93	9061.74	18.23	6.36	31.59	-15.63	-16.90	3.82	-13.09
200000	27	12	95	35	7	1.75	3881383	9261.81	7652.14	21.59	7.49	36.08	-15.87	-17.07	3.74	-13.33
200000	27	12	115	35	7	1.75	4698516	11211.66	9263.11	17.84	6.23	31.06	-15.60	-16.88	3.83	-13.06
200000	27	12	135	35	7	1.75	5515649	13161.52	10874.09	15.20	5.33	27.53	-15.37	-16.74	3.90	-12.84
200000	27	15	95	35	7	1.75	4851728	11577.26	9565.17	17.28	6.04	30.31	-15.55	-16.85	3.84	-13.01
200000	27	15	115	35	7	1.75	5873145	14014.58	11578.89	14.27	5.02	26.29	-15.28	-16.68	3.93	-12.75
200000	27	15	135	35	7	1.75	6894561	16451.90	13592.61	12.16	4.30	23.46	-15.05	-16.54	4.00	-12.54
200000	27	10	95	50	7	1.75	4620693	11025.96	9109.69	18.14	6.33	31.47	-15.62	-16.90	3.82	-13.08
200000	27	10	115	50	7	1.75	5593471	13347.22	11027.51	14.98	5.26	27.25	-15.35	-16.72	3.91	-12.82
200000	27	10	135	50	7	1.75	6566249	15668.47	12945.34	12.76	4.51	24.27	-15.12	-16.58	3.98	-12.60
200000	27	12	95	50	7	1.75	5544832	13231.16	10931.62	15.12	5.31	27.42	-15.36	-16.73	3.90	-12.83
200000	27	12	115	50	7	1.75	6712165	16016.66	13233.02	12.49	4.41	23.90	-15.09	-16.56	3.99	-12.57
200000	27	12	135	50	7	1.75	7879498	18802.17	15534.41	10.64	3.78	21.42	-14.86	-16.43	4.07	-12.37
200000	27	15	95	50	7	1.75	6931040	16538.94	13664.53	12.09	4.28	23.37	-14.99	-16.52	4.01	-12.51
200000	27	15	115	50	7	1.75	8390207	20020.83	16541.27	9.99	3.56	20.55	-14.72	-16.37	4.10	-12.27
200000	27	15	135	50	7	1.75	9849373	23502.71	19418.01	8.51	3.05	18.56	-14.49	-16.25	4.18	-12.07
200000	30	10	95	35	7	1.75	3993192	9528.61	7872.57	20.99	7.28	35.27	-15.83	-17.04	3.75	-13.29
200000	30	10	115	35	7	1.75	4833864	11534.63	9529.95	17.34	6.06	30.40	-15.56	-16.86	3.84	-13.02
200000	30	10	135	35	7	1.75	5674536	13540.66	11187.33	14.77	5.19	26.96	-15.33	-16.71	3.91	-12.80
200000	30	12	95	35	7	1.75	4791830	11434.33	9447.08	17.49	6.11	30.60	-15.57	-16.86	3.83	-13.03
200000	30	12	115	35	7	1.75	5800637	13841.56	11435.94	14.45	5.08	26.53	-15.30	-16.69	3.92	-12.77
200000	30	12	135	35	7	1.75	6809443	16248.79	13424.80	12.31	4.35	23.66	-15.07	-16.55	4.00	-12.55
200000	30	15	95	35	7	1.75	5989788	14292.91	11808.85	13.99	4.93	25.92	-15.24	-16.66	3.94	-12.72
200000	30	15	115	35	7	1.75	7250796	17301.95	14294.93	11.56	4.10	22.65	-14.97	-16.50	4.03	-12.47
200000	30	15	135	35	7	1.75	8511804	20310.98	16781.00	9.85	3.51	20.35	-14.74	-16.37	4.11	-12.27
200000	30	10	95	50	7	1.75	5704560	13612.30	11246.53	14.69	5.16	26.86	-15.32	-16.70	3.91	-12.79
200000	30	10	115	50	7	1.75	6905520	16478.05	13614.22	12.14	4.29	23.43	-15.04	-16.54	4.01	-12.53
200000	30	10	135	50	7	1.75	8106480	19343.79	15981.90	10.34	3.68	21.02	-14.82	-16.41	4.08	-12.33
200000	30	12	95	50	7	1.75	6845472	16334.76	13495.83	12.24	4.33	23.57	-15.01	-16.53	4.00	-12.53
200000	30	12	115	50	7	1.75	8286624	19773.66	16337.06	10.11	3.60	20.71	-14.74	-16.38	4.09	-12.29
200000	30	12	135	50	7	1.75	9727776	23212.55	19178.29	8.62	3.08	18.70	-14.51	-16.26	4.17	-12.09
200000	30	15	95	50	7	1.75	8556840	20418.45	16869.79	9.80	3.50	20.29	-14.41	-16.27	4.11	-12.17
200000	30	15	115	50	7	1.75	10358280	24717.07	20421.32	8.09	2.91	18.00	-14.15	-16.14	4.20	-11.94
200000	30	15	135	50	7	1.75	12159720	29015.69	23972.86	6.89	2.49	16.38	-13.92	-16.04	4.28	-11.76

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
225000	16	10	95	35	7	1.75	1135841	2710.36	2239.31	83.01	25.29	115.30	-16.42	-17.22	3.22	-14.00
225000	16	10	115	35	7	1.75	1374966	3280.96	2710.74	68.58	21.05	96.62	-16.15	-16.98	3.29	-13.69
225000	16	10	135	35	7	1.75	1614090	3851.56	3182.17	58.42	18.04	83.46	-15.92	-16.79	3.35	-13.44
225000	16	12	95	35	7	1.75	1363009	3252.43	2687.17	69.18	21.22	97.40	-16.16	-16.99	3.29	-13.71
225000	16	12	115	35	7	1.75	1649959	3937.15	3252.89	57.15	17.67	81.81	-15.89	-16.76	3.36	-13.40
225000	16	12	135	35	7	1.75	1936908	4621.88	3818.61	48.68	15.15	70.83	-15.66	-16.58	3.43	-13.15
225000	16	15	95	35	7	1.75	1703762	4065.54	3358.96	55.34	17.13	79.47	-15.84	-16.73	3.38	-13.35
225000	16	15	115	35	7	1.75	2062449	4921.44	4066.11	45.72	14.26	66.98	-15.57	-16.50	3.45	-13.05
225000	16	15	135	35	7	1.75	2421135	5777.35	4773.26	38.95	12.23	58.18	-15.34	-16.32	3.52	-12.80
225000	16	10	95	50	7	1.75	1622630	3871.94	3199.01	58.11	17.95	83.06	-15.91	-16.78	3.36	-13.43
225000	16	10	115	50	7	1.75	1964237	4687.09	3872.49	48.00	14.95	69.95	-15.64	-16.56	3.43	-13.13
225000	16	10	135	50	7	1.75	2305843	5502.23	4545.96	40.89	12.82	60.71	-15.41	-16.37	3.50	-12.87
225000	16	12	95	50	7	1.75	1947156	4646.33	3838.81	48.43	15.07	70.50	-15.65	-16.57	3.43	-13.14
225000	16	12	115	50	7	1.75	2357084	5624.51	4646.99	40.00	12.55	59.55	-15.38	-16.35	3.51	-12.84
225000	16	12	135	50	7	1.75	2767012	6602.68	5455.16	34.08	10.76	51.84	-15.15	-16.17	3.57	-12.59
225000	16	15	95	50	7	1.75	2433946	5807.91	4798.52	38.74	12.17	57.91	-15.34	-16.31	3.52	-12.79
225000	16	15	115	50	7	1.75	2946355	7030.63	5808.73	32.00	10.14	49.14	-15.07	-16.10	3.60	-12.50
225000	16	15	135	50	7	1.75	3458765	8253.35	6818.95	27.26	8.69	42.95	-14.84	-15.92	3.67	-12.25
225000	18	10	95	35	7	1.75	1437549	3430.30	2834.12	65.59	20.16	92.76	-16.08	-16.93	3.31	-13.62
225000	18	10	115	35	7	1.75	1740191	4152.47	3430.78	54.18	16.79	77.97	-15.81	-16.70	3.38	-13.32
225000	18	10	135	35	7	1.75	2042833	4874.64	4027.44	46.16	14.39	67.55	-15.58	-16.51	3.45	-13.06
225000	18	12	95	35	7	1.75	1725059	4116.36	3400.95	54.66	16.93	78.59	-15.82	-16.71	3.38	-13.33
225000	18	12	115	35	7	1.75	2088229	4982.96	4116.94	45.15	14.09	66.25	-15.55	-16.49	3.46	-13.03
225000	18	12	135	35	7	1.75	2451399	5849.56	4832.93	38.46	12.09	57.55	-15.33	-16.30	3.52	-12.78
225000	18	15	95	35	7	1.75	2156324	5145.45	4251.19	43.73	13.67	64.40	-15.51	-16.45	3.47	-12.98
225000	18	15	115	35	7	1.75	2610286	6228.70	5146.17	36.12	11.38	54.50	-15.24	-16.23	3.55	-12.68
225000	18	15	135	35	7	1.75	3064249	7311.95	6041.16	30.77	9.76	47.53	-15.01	-16.05	3.62	-12.44
225000	18	10	95	50	7	1.75	2053642	4900.43	4048.75	45.91	14.32	67.24	-15.58	-16.51	3.45	-13.06
225000	18	10	115	50	7	1.75	2485987	5932.10	4901.12	37.93	11.93	56.86	-15.31	-16.29	3.53	-12.76
225000	18	10	135	50	7	1.75	2918333	6963.77	5753.49	32.31	10.23	49.54	-15.08	-16.11	3.60	-12.51
225000	18	12	95	50	7	1.75	2464370	5880.51	4858.50	38.26	12.03	57.29	-15.32	-16.30	3.53	-12.77
225000	18	12	115	50	7	1.75	2983185	7118.52	5881.34	31.61	10.02	48.62	-15.05	-16.08	3.61	-12.48
225000	18	12	135	50	7	1.75	3501999	8356.52	6904.18	26.93	8.59	42.52	-14.82	-15.91	3.68	-12.24
225000	18	15	95	50	7	1.75	3080462	7350.64	6073.12	30.61	9.71	47.32	-15.00	-16.05	3.62	-12.43
225000	18	15	115	50	7	1.75	3728981	8898.15	7351.68	25.29	8.09	40.37	-14.73	-15.85	3.70	-12.14
225000	18	15	135	50	7	1.75	4377499	10445.65	8630.23	21.54	6.94	35.48	-14.51	-15.68	3.77	-11.91

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
225000	21	10	95	35	7	1.75	1956664	4669.02	3857.56	48.19	15.00	70.19	-15.65	-16.56	3.43	-13.13
225000	21	10	115	35	7	1.75	2368593	5651.97	4669.68	39.81	12.49	59.30	-15.37	-16.34	3.51	-12.83
225000	21	10	135	35	7	1.75	2780523	6634.92	5481.79	33.91	10.71	51.62	-15.15	-16.16	3.58	-12.58
225000	21	12	95	35	7	1.75	2347997	5602.82	4629.07	40.16	12.60	59.75	-15.39	-16.35	3.51	-12.85
225000	21	12	115	35	7	1.75	2842312	6782.36	5603.61	33.17	10.49	50.66	-15.12	-16.14	3.59	-12.55
225000	21	12	135	35	7	1.75	3336627	7961.91	6578.15	28.26	9.00	44.26	-14.89	-15.96	3.65	-12.31
225000	21	15	95	35	7	1.75	2934996	7003.53	5786.34	32.13	10.17	49.30	-15.07	-16.10	3.60	-12.50
225000	21	15	115	35	7	1.75	3552890	8477.96	7004.51	26.54	8.47	42.01	-14.80	-15.90	3.68	-12.21
225000	21	15	135	35	7	1.75	4170784	9952.38	8222.69	22.61	7.27	36.87	-14.57	-15.73	3.75	-11.98
225000	21	10	95	50	7	1.75	2795234	6670.03	5510.80	33.73	10.66	51.39	-15.14	-16.16	3.58	-12.58
225000	21	10	115	50	7	1.75	3383705	8074.24	6670.97	27.87	8.88	43.74	-14.87	-15.95	3.66	-12.29
225000	21	10	135	50	7	1.75	3972175	9478.46	7831.13	23.74	7.61	38.35	-14.64	-15.78	3.73	-12.05
225000	21	12	95	50	7	1.75	3354281	8004.03	6612.96	28.11	8.95	44.06	-14.88	-15.96	3.66	-12.30
225000	21	12	115	50	7	1.75	4060446	9689.09	8005.16	23.22	7.46	37.68	-14.61	-15.76	3.74	-12.02
225000	21	12	135	50	7	1.75	4766610	11374.15	9397.36	19.78	6.39	33.18	-14.39	-15.60	3.81	-11.78
225000	21	15	95	50	7	1.75	4192851	10005.04	8266.20	22.49	7.23	36.72	-14.57	-15.72	3.76	-11.97
225000	21	15	115	50	7	1.75	5075557	12111.36	10006.45	18.58	6.02	31.60	-14.30	-15.54	3.84	-11.70
225000	21	15	135	50	7	1.75	5958263	14217.69	11746.70	15.83	5.16	27.99	-14.07	-15.39	3.91	-11.47
225000	24	10	95	35	7	1.75	2555643	6098.31	5038.44	36.90	11.61	55.51	-15.27	-16.26	3.54	-12.71
225000	24	10	115	35	7	1.75	3093673	7382.17	6099.17	30.48	9.67	47.15	-15.00	-16.04	3.62	-12.42
225000	24	10	135	35	7	1.75	3631703	8666.02	7159.89	25.96	8.30	41.26	-14.77	-15.87	3.69	-12.18
225000	24	12	95	35	7	1.75	3066771	7317.97	6046.13	30.75	9.75	47.50	-15.01	-16.05	3.62	-12.44
225000	24	12	115	35	7	1.75	3712407	8858.60	7319.00	25.40	8.12	40.52	-14.74	-15.85	3.70	-12.15
225000	24	12	135	35	7	1.75	4358044	10399.22	8591.87	21.64	6.97	35.60	-14.51	-15.69	3.77	-11.91
225000	24	15	95	35	7	1.75	3833464	9147.47	7557.67	24.60	7.88	39.47	-14.69	-15.82	3.72	-12.10
225000	24	15	115	35	7	1.75	4640509	11073.25	9148.75	20.32	6.56	33.88	-14.42	-15.62	3.80	-11.82
225000	24	15	135	35	7	1.75	5447554	12999.03	10739.84	17.31	5.63	29.93	-14.20	-15.47	3.87	-11.60
225000	24	10	95	50	7	1.75	3650918	8711.87	7197.78	25.83	8.25	41.08	-14.76	-15.87	3.69	-12.17
225000	24	10	115	50	7	1.75	4419533	10545.95	8713.10	21.34	6.87	35.21	-14.49	-15.67	3.78	-11.89
225000	24	10	135	50	7	1.75	5188147	12380.03	10228.42	18.17	5.90	31.07	-14.27	-15.52	3.85	-11.66
225000	24	12	95	50	7	1.75	4381102	10454.25	8637.33	21.52	6.93	35.45	-14.51	-15.68	3.77	-11.91
225000	24	12	115	50	7	1.75	5303439	12655.14	10455.72	17.78	5.77	30.55	-14.24	-15.49	3.86	-11.63
225000	24	12	135	50	7	1.75	6225776	14856.03	12274.10	15.15	4.95	27.09	-14.01	-15.35	3.94	-11.41
225000	24	15	95	50	7	1.75	5476377	13067.81	10796.66	17.22	5.60	29.82	-14.19	-15.46	3.88	-11.59
225000	24	15	115	50	7	1.75	6629299	15818.93	13069.65	14.22	4.66	25.88	-13.92	-15.29	3.96	-11.33
225000	24	15	135	50	7	1.75	7782221	18570.04	15342.63	12.12	4.00	23.11	-13.70	-15.15	4.04	-11.11

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
225000	27	10	95	35	7	1.75	3234485	7718.17	6376.78	29.15	9.27	45.42	-14.93	-16.00	3.64	-12.35
225000	27	10	115	35	7	1.75	3915430	9343.05	7719.26	24.08	7.72	38.80	-14.66	-15.79	3.72	-12.07
225000	27	10	135	35	7	1.75	4596374	10967.93	9061.74	20.51	6.62	34.13	-14.44	-15.63	3.80	-11.84
225000	27	12	95	35	7	1.75	3881383	9261.81	7652.14	24.29	7.78	39.08	-14.68	-15.80	3.72	-12.08
225000	27	12	115	35	7	1.75	4698516	11211.66	9263.11	20.07	6.48	33.55	-14.41	-15.61	3.81	-11.81
225000	27	12	135	35	7	1.75	5515649	13161.52	10874.09	17.10	5.56	29.65	-14.18	-15.46	3.88	-11.58
225000	27	15	95	35	7	1.75	4851728	11577.26	9565.17	19.43	6.29	32.72	-14.36	-15.58	3.82	-11.76
225000	27	15	115	35	7	1.75	5873145	14014.58	11578.89	16.05	5.23	28.29	-14.09	-15.40	3.91	-11.49
225000	27	15	135	35	7	1.75	6894561	16451.90	13592.61	13.68	4.49	25.16	-13.87	-15.26	3.98	-11.27
225000	27	10	95	50	7	1.75	4620693	11025.96	9109.69	20.41	6.59	33.99	-14.43	-15.63	3.80	-11.83
225000	27	10	115	50	7	1.75	5593471	13347.22	11027.51	16.86	5.48	29.34	-14.16	-15.44	3.89	-11.56
225000	27	10	135	50	7	1.75	6566249	15668.47	12945.34	14.36	4.70	26.06	-13.94	-15.30	3.96	-11.34
225000	27	12	95	50	7	1.75	5544832	13231.16	10931.62	17.01	5.53	29.54	-14.17	-15.45	3.88	-11.57
225000	27	12	115	50	7	1.75	6712165	16016.66	13233.02	14.05	4.61	25.65	-13.90	-15.28	3.97	-11.31
225000	27	12	135	50	7	1.75	7879498	18802.17	15534.41	11.97	3.95	22.91	-13.68	-15.14	4.05	-11.10
225000	27	15	95	50	7	1.75	6931040	16538.94	13664.53	13.60	4.47	25.07	-13.82	-15.24	3.99	-11.25
225000	27	15	115	50	7	1.75	8390207	20020.83	16541.27	11.24	3.72	21.96	-13.55	-15.08	4.08	-11.00
225000	27	15	135	50	7	1.75	9849373	23502.71	19418.01	9.57	3.19	19.76	-13.33	-14.96	4.16	-10.80
225000	30	10	95	35	7	1.75	3993192	9528.61	7872.57	23.61	7.58	38.19	-14.64	-15.77	3.73	-12.04
225000	30	10	115	35	7	1.75	4833864	11534.63	9529.95	19.51	6.31	32.81	-14.37	-15.58	3.82	-11.76
225000	30	10	135	35	7	1.75	5674536	13540.66	11187.33	16.62	5.41	29.03	-14.14	-15.43	3.89	-11.54
225000	30	12	95	35	7	1.75	4791830	11434.33	9447.08	19.68	6.36	33.04	-14.38	-15.59	3.81	-11.78
225000	30	12	115	35	7	1.75	5800637	13841.56	11435.94	16.26	5.30	28.55	-14.11	-15.41	3.90	-11.51
225000	30	12	135	35	7	1.75	6809443	16248.79	13424.80	13.85	4.54	25.39	-13.89	-15.27	3.98	-11.29
225000	30	15	95	35	7	1.75	5989788	14292.91	11808.85	15.74	5.14	27.88	-14.06	-15.38	3.92	-11.46
225000	30	15	115	35	7	1.75	7250796	17301.95	14294.93	13.00	4.28	24.28	-13.79	-15.21	4.01	-11.20
225000	30	15	135	35	7	1.75	8511804	20310.98	16781.00	11.08	3.67	21.74	-13.57	-15.08	4.08	-11.00
225000	30	10	95	50	7	1.75	5704560	13612.30	11246.53	16.53	5.38	28.91	-14.13	-15.42	3.89	-11.53
225000	30	10	115	50	7	1.75	6905520	16478.05	13614.22	13.65	4.48	25.14	-13.86	-15.25	3.98	-11.27
225000	30	10	135	50	7	1.75	8106480	19343.79	15981.90	11.63	3.84	22.47	-13.64	-15.12	4.06	-11.06
225000	30	12	95	50	7	1.75	6845472	16334.76	13495.83	13.77	4.52	25.30	-13.84	-15.25	3.98	-11.27
225000	30	12	115	50	7	1.75	8286624	19773.66	16337.06	11.38	3.76	22.14	-13.57	-15.09	4.07	-11.02
225000	30	12	135	50	7	1.75	9727776	23212.55	19178.29	9.69	3.22	19.92	-13.35	-14.97	4.15	-10.82
225000	30	15	95	50	7	1.75	8556840	20418.45	16869.79	11.02	3.66	21.68	-13.32	-15.00	4.09	-10.91
225000	30	15	115	50	7	1.75	10358280	24717.07	20421.32	9.10	3.04	19.15	-13.05	-14.86	4.18	-10.68
225000	30	15	135	50	7	1.75	12159720	29015.69	23972.86	7.75	2.61	17.36	-12.82	-14.75	4.26	-10.49

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
250000	10	10	95	35%	7	1.75	443688	1058.73	874.73	236.13	64.25	307.39	-16.67	-17.32	2.87	-14.46
250000	10	10	115	35%	7	1.75	537096	1281.63	1058.88	195.06	53.47	255.54	-16.41	-17.08	2.93	-14.14
250000	10	10	135	35%	7	1.75	630504	1504.52	1243.04	166.17	45.84	219.01	-16.18	-16.87	2.99	-13.88
250000	10	12	95	35%	7	1.75	532425	1270.48	1049.68	196.78	53.92	257.70	-16.42	-17.09	2.93	-14.16
250000	10	12	115	35%	7	1.75	644515	1537.95	1270.66	162.55	44.89	214.44	-16.15	-16.84	3.00	-13.84
250000	10	12	135	35%	7	1.75	756604	1805.42	1491.64	138.47	38.50	183.97	-15.92	-16.63	3.05	-13.58
250000	10	15	95	35%	7	1.75	665532	1588.10	1312.09	157.42	43.53	207.95	-16.10	-16.80	3.01	-13.79
250000	10	15	115	35%	7	1.75	805644	1922.44	1588.33	130.04	36.25	173.29	-15.83	-16.55	3.08	-13.48
250000	10	15	135	35%	7	1.75	945756	2256.78	1864.56	110.78	31.10	148.87	-15.61	-16.35	3.14	-13.21
250000	10	10	95	50%	7	1.75	633840	1512.48	1249.61	165.29	45.61	217.90	-16.17	-16.86	2.99	-13.87
250000	10	10	115	50%	7	1.75	767280	1830.89	1512.69	136.55	37.98	181.53	-15.90	-16.62	3.06	-13.56
250000	10	10	135	50%	7	1.75	900720	2149.31	1775.77	116.32	32.58	155.90	-15.68	-16.41	3.12	-13.29
250000	10	12	95	50%	7	1.75	760608	1814.97	1499.54	137.74	38.30	183.05	-15.91	-16.63	3.06	-13.57
250000	10	12	115	50%	7	1.75	920736	2197.07	1815.23	113.79	31.90	152.69	-15.64	-16.38	3.13	-13.25
250000	10	12	135	50%	7	1.75	1080864	2579.17	2130.92	96.93	27.37	131.30	-15.42	-16.18	3.19	-12.99
250000	10	15	95	50%	7	1.75	950760	2268.72	1874.42	110.19	30.94	148.14	-15.60	-16.34	3.14	-13.20
250000	10	15	115	50%	7	1.75	1150920	2746.34	2269.04	91.03	25.78	123.81	-15.33	-16.10	3.21	-12.89
250000	10	15	135	50%	7	1.75	1351080	3223.97	2663.65	77.54	22.13	106.67	-15.10	-15.89	3.27	-12.62
250000	12	10	95	35%	7	1.75	638910	1524.58	1259.61	163.98	45.27	216.25	-16.16	-16.85	2.99	-13.86
250000	12	10	115	35%	7	1.75	773418	1845.54	1524.79	135.46	37.69	180.16	-15.89	-16.60	3.06	-13.54
250000	12	10	135	35%	7	1.75	907925	2166.50	1789.97	115.39	32.33	154.73	-15.66	-16.40	3.12	-13.28
250000	12	12	95	35%	7	1.75	766692	1829.49	1511.53	136.65	38.01	181.66	-15.90	-16.62	3.06	-13.56
250000	12	12	115	35%	7	1.75	928101	2214.65	1829.75	112.88	31.66	151.55	-15.63	-16.37	3.13	-13.24
250000	12	12	135	35%	7	1.75	1089510	2599.81	2147.97	96.16	27.17	130.33	-15.41	-16.17	3.19	-12.98
250000	12	15	95	35%	7	1.75	958366	2286.87	1889.42	109.32	30.71	147.03	-15.59	-16.33	3.14	-13.19
250000	12	15	115	35%	7	1.75	1160127	2768.31	2287.19	90.31	25.59	122.89	-15.32	-16.09	3.21	-12.87
250000	12	15	135	35%	7	1.75	1361888	3249.76	2684.96	76.93	21.96	105.89	-15.09	-15.88	3.27	-12.61
250000	12	10	95	50%	7	1.75	912729	2177.97	1799.44	114.79	32.17	153.96	-15.66	-16.39	3.12	-13.27
250000	12	10	115	50%	7	1.75	1104883	2636.49	2178.27	94.82	26.81	128.63	-15.39	-16.15	3.19	-12.95
250000	12	10	135	50%	7	1.75	1297036	3095.01	2557.10	80.78	23.00	110.78	-15.16	-15.95	3.25	-12.69
250000	12	12	95	50%	7	1.75	1095275	2613.56	2159.33	95.65	27.03	129.68	-15.40	-16.16	3.19	-12.97
250000	12	12	115	50%	7	1.75	1325859	3163.79	2613.93	79.02	22.53	108.55	-15.13	-15.92	3.26	-12.66
250000	12	12	135	50%	7	1.75	1556444	3714.01	3068.53	67.31	19.33	93.65	-14.90	-15.72	3.33	-12.39
250000	12	15	95	50%	7	1.75	1369094	3266.95	2699.17	76.52	21.85	105.37	-15.08	-15.88	3.28	-12.60
250000	12	15	115	50%	7	1.75	1657324	3954.73	3267.41	63.22	18.21	88.43	-14.81	-15.64	3.35	-12.29
250000	12	15	135	50%	7	1.75	1945555	4642.51	3835.66	53.85	15.63	76.48	-14.59	-15.45	3.41	-12.03

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
250000	16	10	95	35	7	1.75	1135841	2710.36	2239.31	92.24	26.11	125.35	-15.35	-16.11	3.20	-12.91
250000	16	10	115	35	7	1.75	1374966	3280.96	2710.74	76.20	21.76	104.96	-15.08	-15.87	3.28	-12.60
250000	16	10	135	35	7	1.75	1614090	3851.56	3182.17	64.91	18.68	90.59	-14.85	-15.67	3.34	-12.34
250000	16	12	95	35	7	1.75	1363009	3252.43	2687.17	76.87	21.94	105.81	-15.09	-15.88	3.27	-12.61
250000	16	12	115	35	7	1.75	1649959	3937.15	3252.89	63.50	18.29	88.79	-14.82	-15.65	3.35	-12.30
250000	16	12	135	35	7	1.75	1936908	4621.88	3818.61	54.09	15.70	76.79	-14.59	-15.45	3.41	-12.04
250000	16	15	95	35	7	1.75	1703762	4065.54	3358.96	61.49	17.74	86.23	-14.77	-15.61	3.36	-12.25
250000	16	15	115	35	7	1.75	2062449	4921.44	4066.11	50.80	14.79	72.59	-14.50	-15.38	3.44	-11.94
250000	16	15	135	35	7	1.75	2421135	5777.35	4773.26	43.27	12.70	62.97	-14.28	-15.19	3.50	-11.69
250000	16	10	95	50	7	1.75	1622630	3871.94	3199.01	64.57	18.58	90.15	-14.84	-15.67	3.34	-12.33
250000	16	10	115	50	7	1.75	1964237	4687.09	3872.49	53.34	15.49	75.83	-14.57	-15.44	3.42	-12.02
250000	16	10	135	50	7	1.75	2305843	5502.23	4545.96	45.44	13.30	65.74	-14.35	-15.25	3.48	-11.77
250000	16	12	95	50	7	1.75	1947156	4646.33	3838.81	53.81	15.62	76.43	-14.59	-15.45	3.41	-12.03
250000	16	12	115	50	7	1.75	2357084	5624.51	4646.99	44.45	13.02	64.47	-14.32	-15.22	3.49	-11.73
250000	16	12	135	50	7	1.75	2767012	6602.68	5455.16	37.86	11.18	56.04	-14.09	-15.04	3.56	-11.48
250000	16	15	95	50	7	1.75	2433946	5807.91	4798.52	43.04	12.63	62.68	-14.27	-15.19	3.50	-11.68
250000	16	15	115	50	7	1.75	2946355	7030.63	5808.73	35.56	10.53	53.09	-14.01	-14.97	3.58	-11.38
250000	16	15	135	50	7	1.75	3458765	8253.35	6818.95	30.29	9.04	46.33	-13.78	-14.79	3.65	-11.14
250000	18	10	95	35	7	1.75	1437549	3430.30	2834.12	72.88	20.86	100.74	-15.01	-15.82	3.29	-12.52
250000	18	10	115	35	7	1.75	1740191	4152.47	3430.78	60.21	17.39	84.59	-14.74	-15.58	3.37	-12.21
250000	18	10	135	35	7	1.75	2042833	4874.64	4027.44	51.29	14.92	73.21	-14.52	-15.39	3.43	-11.96
250000	18	12	95	35	7	1.75	1725059	4116.36	3400.95	60.73	17.53	85.26	-14.76	-15.59	3.37	-12.23
250000	18	12	115	35	7	1.75	2088229	4982.96	4116.94	50.17	14.62	71.79	-14.49	-15.36	3.44	-11.92
250000	18	12	135	35	7	1.75	2451399	5849.56	4832.93	42.74	12.55	62.29	-14.26	-15.18	3.51	-11.67
250000	18	15	95	35	7	1.75	2156324	5145.45	4251.19	48.59	14.18	69.76	-14.44	-15.33	3.46	-11.87
250000	18	15	115	35	7	1.75	2610286	6228.70	5146.17	40.14	11.82	58.96	-14.17	-15.11	3.53	-11.57
250000	18	15	135	35	7	1.75	3064249	7311.95	6041.16	34.19	10.15	51.34	-13.95	-14.93	3.60	-11.32
250000	18	10	95	50	7	1.75	2053642	4900.43	4048.75	51.02	14.85	72.87	-14.51	-15.38	3.44	-11.95
250000	18	10	115	50	7	1.75	2485987	5932.10	4901.12	42.14	12.38	61.52	-14.24	-15.16	3.51	-11.65
250000	18	10	135	50	7	1.75	2918333	6963.77	5753.49	35.90	10.63	53.53	-14.02	-14.98	3.58	-11.40
250000	18	12	95	50	7	1.75	2464370	5880.51	4858.50	42.51	12.48	62.00	-14.26	-15.17	3.51	-11.66
250000	18	12	115	50	7	1.75	2983185	7118.52	5881.34	35.12	10.41	52.53	-13.99	-14.96	3.59	-11.37
250000	18	12	135	50	7	1.75	3501999	8356.52	6904.18	29.92	8.94	45.85	-13.76	-14.78	3.66	-11.12
250000	18	15	95	50	7	1.75	3080462	7350.64	6073.12	34.01	10.10	51.11	-13.94	-14.92	3.60	-11.32
250000	18	15	115	50	7	1.75	3728981	8898.15	7351.68	28.10	8.42	43.51	-13.68	-14.71	3.69	-11.03
250000	18	15	135	50	7	1.75	4377499	10445.65	8630.23	23.93	7.22	38.16	-13.45	-14.55	3.76	-10.79

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
250000	21	10	95	35	7	1.75	1956664	4669.02	3857.56	53.54	15.55	76.09	-14.58	-15.44	3.42	-12.03
250000	21	10	115	35	7	1.75	2368593	5651.97	4669.68	44.23	12.96	64.20	-14.31	-15.22	3.49	-11.72
250000	21	10	135	35	7	1.75	2780523	6634.92	5481.79	37.68	11.13	55.81	-14.09	-15.03	3.56	-11.47
250000	21	12	95	35	7	1.75	2347997	5602.82	4629.07	44.62	13.07	64.69	-14.32	-15.23	3.49	-11.74
250000	21	12	115	35	7	1.75	2842312	6782.36	5603.61	36.86	10.90	54.76	-14.06	-15.01	3.57	-11.44
250000	21	12	135	35	7	1.75	3336627	7961.91	6578.15	31.40	9.36	47.76	-13.83	-14.83	3.64	-11.20
250000	21	15	95	35	7	1.75	2934996	7003.53	5786.34	35.70	10.57	53.27	-14.01	-14.97	3.58	-11.39
250000	21	15	115	35	7	1.75	3552890	8477.96	7004.51	29.49	8.81	45.30	-13.74	-14.76	3.66	-11.10
250000	21	15	135	35	7	1.75	4170784	9952.38	8222.69	25.12	7.57	39.69	-13.52	-14.60	3.73	-10.86
250000	21	10	95	50	7	1.75	2795234	6670.03	5510.80	37.48	11.07	55.55	-14.08	-15.03	3.56	-11.47
250000	21	10	115	50	7	1.75	3383705	8074.24	6670.97	30.96	9.23	47.20	-13.81	-14.82	3.64	-11.17
250000	21	10	135	50	7	1.75	3972175	9478.46	7831.13	26.38	7.93	41.30	-13.59	-14.65	3.71	-10.93
250000	21	12	95	50	7	1.75	3354281	8004.03	6612.96	31.23	9.31	47.54	-13.83	-14.83	3.64	-11.19
250000	21	12	115	50	7	1.75	4060446	9689.09	8005.16	25.80	7.76	40.56	-13.56	-14.62	3.72	-10.90
250000	21	12	135	50	7	1.75	4766610	11374.15	9397.36	21.98	6.66	35.64	-13.34	-14.46	3.79	-10.67
250000	21	15	95	50	7	1.75	4192851	10005.04	8266.20	24.99	7.53	39.51	-13.51	-14.59	3.74	-10.86
250000	21	15	115	50	7	1.75	5075557	12111.36	10006.45	20.64	6.27	33.92	-13.25	-14.40	3.82	-10.58
250000	21	15	135	50	7	1.75	5958263	14217.69	11746.70	17.58	5.38	29.97	-13.02	-14.25	3.89	-10.36
250000	24	10	95	35	7	1.75	2555643	6098.31	5038.44	40.99	12.06	60.05	-14.20	-15.13	3.53	-11.60
250000	24	10	115	35	7	1.75	3093673	7382.17	6099.17	33.87	10.05	50.92	-13.94	-14.91	3.61	-11.31
250000	24	10	135	35	7	1.75	3631703	8666.02	7159.89	28.85	8.63	44.48	-13.71	-14.74	3.67	-11.07
250000	24	12	95	35	7	1.75	3066771	7317.97	6046.13	34.16	10.14	51.30	-13.95	-14.92	3.60	-11.32
250000	24	12	115	35	7	1.75	3712407	8858.60	7319.00	28.22	8.45	43.67	-13.68	-14.72	3.68	-11.04
250000	24	12	135	35	7	1.75	4358044	10399.22	8591.87	24.04	7.26	38.30	-13.46	-14.55	3.75	-10.80
250000	24	15	95	35	7	1.75	3833464	9147.47	7557.67	27.33	8.20	42.53	-13.64	-14.68	3.70	-10.99
250000	24	15	115	35	7	1.75	4640509	11073.25	9148.75	22.58	6.83	36.41	-13.37	-14.49	3.78	-10.71
250000	24	15	135	35	7	1.75	5447554	12999.03	10739.84	19.23	5.86	32.10	-13.15	-14.33	3.85	-10.48
250000	24	10	95	50	7	1.75	3650918	8711.87	7197.78	28.70	8.59	44.28	-13.71	-14.74	3.68	-11.06
250000	24	10	115	50	7	1.75	4419533	10545.95	8713.10	23.71	7.16	37.86	-13.44	-14.54	3.76	-10.78
250000	24	10	135	50	7	1.75	5188147	12380.03	10228.42	20.19	6.14	33.34	-13.22	-14.38	3.83	-10.55
250000	24	12	95	50	7	1.75	4381102	10454.25	8637.33	23.91	7.22	38.13	-13.45	-14.55	3.76	-10.79
250000	24	12	115	50	7	1.75	5303439	12655.14	10455.72	19.75	6.02	32.77	-13.19	-14.36	3.84	-10.52
250000	24	12	135	50	7	1.75	6225776	14856.03	12274.10	16.83	5.16	28.99	-12.96	-14.21	3.91	-10.30
250000	24	15	95	50	7	1.75	5476377	13067.81	10796.66	19.13	5.84	31.97	-13.14	-14.33	3.86	-10.47
250000	24	15	115	50	7	1.75	6629299	15818.93	13069.65	15.80	4.86	27.67	-12.87	-14.15	3.94	-10.21
250000	24	15	135	50	7	1.75	7782221	18570.04	15342.63	13.46	4.17	24.63	-12.64	-14.01	4.02	-10.00

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
250000	27	10	95	35	7	1.75	3234485	7718.17	6376.78	32.39	9.64	49.03	-13.88	-14.87	3.62	-11.24
250000	27	10	115	35	7	1.75	3915430	9343.05	7719.26	26.76	8.03	41.79	-13.61	-14.66	3.71	-10.96
250000	27	10	135	35	7	1.75	4596374	10967.93	9061.74	22.79	6.90	36.69	-13.39	-14.50	3.78	-10.72
250000	27	12	95	35	7	1.75	3881383	9261.81	7652.14	26.99	8.10	42.09	-13.62	-14.67	3.70	-10.97
250000	27	12	115	35	7	1.75	4698516	11211.66	9263.11	22.30	6.75	36.05	-13.36	-14.48	3.79	-10.69
250000	27	12	135	35	7	1.75	5515649	13161.52	10874.09	18.99	5.80	31.79	-13.13	-14.32	3.86	-10.46
250000	27	15	95	35	7	1.75	4851728	11577.26	9565.17	21.59	6.55	35.14	-13.31	-14.45	3.80	-10.64
250000	27	15	115	35	7	1.75	5873145	14014.58	11578.89	17.84	5.46	30.30	-13.04	-14.26	3.89	-10.38
250000	27	15	135	35	7	1.75	6894561	16451.90	13592.61	15.20	4.68	26.88	-12.82	-14.12	3.96	-10.16
250000	27	10	95	50	7	1.75	4620693	11025.96	9109.69	22.67	6.86	36.54	-13.38	-14.49	3.78	-10.71
250000	27	10	115	50	7	1.75	5593471	13347.22	11027.51	18.73	5.72	31.45	-13.11	-14.31	3.87	-10.44
250000	27	10	135	50	7	1.75	6566249	15668.47	12945.34	15.96	4.91	27.86	-12.89	-14.16	3.94	-10.22
250000	27	12	95	50	7	1.75	5544832	13231.16	10931.62	18.89	5.77	31.66	-13.12	-14.32	3.86	-10.45
250000	27	12	115	50	7	1.75	6712165	16016.66	13233.02	15.61	4.80	27.41	-12.85	-14.14	3.95	-10.19
250000	27	12	135	50	7	1.75	7879498	18802.17	15534.41	13.30	4.12	24.42	-12.62	-14.00	4.03	-9.98
250000	27	15	95	50	7	1.75	6931040	16538.94	13664.53	15.12	4.66	26.78	-12.77	-14.10	3.96	-10.14
250000	27	15	115	50	7	1.75	8390207	20020.83	16541.27	12.49	3.88	23.37	-12.50	-13.94	4.06	-9.89
250000	27	15	135	50	7	1.75	9849373	23502.71	19418.01	10.64	3.33	20.97	-12.27	-13.82	4.13	-9.68
250000	30	10	95	35	7	1.75	3993192	9528.61	7872.57	26.24	7.89	41.12	-13.58	-14.64	3.72	-10.93
250000	30	10	115	35	7	1.75	4833864	11534.63	9529.95	21.67	6.57	35.25	-13.32	-14.45	3.80	-10.65
250000	30	10	135	35	7	1.75	5674536	13540.66	11187.33	18.46	5.64	31.10	-13.09	-14.30	3.87	-10.42
250000	30	12	95	35	7	1.75	4791830	11434.33	9447.08	21.86	6.63	35.49	-13.33	-14.46	3.80	-10.66
250000	30	12	115	35	7	1.75	5800637	13841.56	11435.94	18.06	5.52	30.59	-13.06	-14.27	3.88	-10.39
250000	30	12	135	35	7	1.75	6809443	16248.79	13424.80	15.39	4.74	27.12	-12.83	-14.13	3.96	-10.17
250000	30	15	95	35	7	1.75	5989788	14292.91	11808.85	17.49	5.36	29.85	-13.01	-14.24	3.90	-10.35
250000	30	15	115	35	7	1.75	7250796	17301.95	14294.93	14.45	4.46	25.91	-12.74	-14.07	3.99	-10.09
250000	30	15	135	35	7	1.75	8511804	20310.98	16781.00	12.31	3.83	23.14	-12.51	-13.94	4.06	-9.88
250000	30	10	95	50	7	1.75	5704560	13612.30	11246.53	18.37	5.61	30.98	-13.08	-14.29	3.87	-10.41
250000	30	10	115	50	7	1.75	6905520	16478.05	13614.22	15.17	4.68	26.85	-12.81	-14.12	3.96	-10.15
250000	30	10	135	50	7	1.75	8106480	19343.79	15981.90	12.92	4.01	23.94	-12.58	-13.98	4.04	-9.94
250000	30	12	95	50	7	1.75	6845472	16334.76	13495.83	15.30	4.72	27.02	-12.79	-14.11	3.96	-10.15
250000	30	12	115	50	7	1.75	8286624	19773.66	16337.06	12.64	3.93	23.57	-12.52	-13.95	4.05	-9.90
250000	30	12	135	50	7	1.75	9727776	23212.55	19178.29	10.77	3.37	21.14	-12.29	-13.83	4.13	-9.70
250000	30	15	95	50	7	1.75	8556840	20418.45	16869.79	12.24	3.82	23.06	-12.30	-13.87	4.06	-9.81
250000	30	15	115	50	7	1.75	10358280	24717.07	20421.32	10.11	3.18	20.29	-12.02	-13.73	4.16	-9.57
250000	30	15	135	50	7	1.75	12159720	29015.69	23972.86	8.62	2.72	18.34	-11.77	-13.62	4.24	-9.38

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
300000	10	10	95	35	7	1.75	443688	1058.73	874.73	283.36	67.94	358.30	-14.83	-15.42	2.85	-12.58
300000	10	10	115	35	7	1.75	537096	1281.63	1058.88	234.08	56.68	297.76	-14.56	-15.17	2.91	-12.26
300000	10	10	135	35	7	1.75	630504	1504.52	1243.04	199.40	48.69	255.09	-14.33	-14.96	2.97	-11.99
300000	10	12	95	35	7	1.75	532426	1270.48	1049.68	236.13	57.15	300.28	-14.57	-15.18	2.91	-12.27
300000	10	12	115	35	7	1.75	644515	1537.95	1270.66	195.06	47.68	249.75	-14.30	-14.93	2.97	-11.95
300000	10	12	135	35	7	1.75	756605	1805.42	1491.64	166.17	40.97	214.14	-14.08	-14.72	3.03	-11.69
300000	10	15	95	35	7	1.75	665532	1588.10	1312.09	188.90	46.26	242.16	-14.26	-14.88	2.99	-11.90
300000	10	15	115	35	7	1.75	805644	1922.44	1588.33	156.05	38.61	201.66	-13.99	-14.63	3.05	-11.58
300000	10	15	135	35	7	1.75	945756	2256.78	1864.56	132.93	33.17	173.11	-13.77	-14.43	3.11	-11.32
300000	10	10	95	50	7	1.75	633840	1512.48	1249.61	198.35	48.45	253.80	-14.33	-14.95	2.97	-11.98
300000	10	10	115	50	7	1.75	767280	1830.89	1512.69	163.85	40.43	211.28	-14.06	-14.70	3.04	-11.66
300000	10	10	135	50	7	1.75	900720	2149.31	1775.77	139.58	34.74	181.32	-13.84	-14.49	3.09	-11.40
300000	10	12	95	50	7	1.75	760608	1814.97	1499.54	165.29	40.77	213.06	-14.07	-14.71	3.03	-11.68
300000	10	12	115	50	7	1.75	920736	2197.07	1815.23	136.55	34.03	177.57	-13.81	-14.46	3.10	-11.36
300000	10	12	135	50	7	1.75	1080864	2579.17	2130.92	116.32	29.24	152.56	-13.58	-14.26	3.16	-11.10
300000	10	15	95	50	7	1.75	950760	2268.72	1874.42	132.23	33.01	172.24	-13.76	-14.42	3.11	-11.31
300000	10	15	115	50	7	1.75	1150920	2746.34	2269.04	109.24	27.56	143.79	-13.50	-14.18	3.18	-10.99
300000	10	15	135	50	7	1.75	1351080	3223.97	2663.65	93.05	23.68	123.74	-13.27	-13.98	3.24	-10.73
300000	12	10	95	35	7	1.75	638911	1524.58	1259.61	196.78	48.08	251.86	-14.31	-14.94	2.97	-11.97
300000	12	10	115	35	7	1.75	773418	1845.54	1524.79	162.55	40.13	209.68	-14.05	-14.69	3.04	-11.65
300000	12	10	135	35	7	1.75	907926	2166.50	1789.97	138.47	34.48	179.95	-13.83	-14.48	3.10	-11.38
300000	12	12	95	35	7	1.75	766693	1829.49	1511.53	163.98	40.46	211.44	-14.06	-14.70	3.04	-11.66
300000	12	12	115	35	7	1.75	928102	2214.65	1829.75	135.46	33.77	176.23	-13.80	-14.45	3.10	-11.35
300000	12	12	135	35	7	1.75	1089511	2599.81	2147.97	115.39	29.02	151.42	-13.57	-14.25	3.16	-11.08
300000	12	15	95	35	7	1.75	958366	2286.87	1889.42	131.18	32.76	170.95	-13.75	-14.41	3.12	-11.29
300000	12	15	115	35	7	1.75	1160127	2768.31	2287.19	108.37	27.35	142.72	-13.49	-14.17	3.19	-10.98
300000	12	15	135	35	7	1.75	1361889	3249.76	2684.96	92.31	23.51	122.82	-13.26	-13.97	3.25	-10.72
300000	12	10	95	50	7	1.75	912730	2177.97	1799.44	137.74	34.31	179.05	-13.82	-14.47	3.10	-11.38
300000	12	10	115	50	7	1.75	1104883	2636.49	2178.27	113.79	28.64	149.43	-13.55	-14.23	3.17	-11.06
300000	12	10	135	50	7	1.75	1297037	3095.01	2557.10	96.93	24.62	128.55	-13.33	-14.03	3.23	-10.80
300000	12	12	95	50	7	1.75	1095275	2613.56	2159.33	114.79	28.88	150.66	-13.57	-14.24	3.16	-11.08
300000	12	12	115	50	7	1.75	1325660	3163.79	2613.93	94.82	24.11	125.93	-13.30	-14.00	3.24	-10.76
300000	12	12	135	50	7	1.75	1556444	3714.01	3068.53	80.78	20.72	108.50	-13.08	-13.80	3.30	-10.51
300000	12	15	95	50	7	1.75	1369094	3266.95	2699.17	91.83	23.39	122.22	-13.26	-13.96	3.25	-10.71
300000	12	15	115	50	7	1.75	1657325	3954.73	3267.41	75.86	19.53	102.39	-12.99	-13.73	3.32	-10.41
300000	12	15	135	50	7	1.75	1945555	4642.51	3835.66	64.62	16.79	88.41	-12.76	-13.53	3.38	-10.15

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
300000	16	10	95	35	7	1.75	1135841	2710.36	2239.31	110.69	27.90	145.59	-13.51	-14.19	3.18	-11.02
300000	16	10	115	35	7	1.75	1374966	3280.96	2710.74	91.44	23.30	121.73	-13.25	-13.96	3.25	-10.71
300000	16	10	135	35	7	1.75	1614090	3851.56	3182.17	77.89	20.02	104.91	-13.03	-13.76	3.31	-10.45
300000	16	12	95	35	7	1.75	1363009	3252.43	2687.17	92.24	23.49	122.73	-13.26	-13.97	3.25	-10.72
300000	16	12	115	35	7	1.75	1649959	3937.15	3252.89	76.20	19.61	102.81	-12.99	-13.73	3.32	-10.41
300000	16	12	135	35	7	1.75	1936908	4621.88	3818.61	64.91	16.86	88.76	-12.77	-13.54	3.38	-10.16
300000	16	15	95	35	7	1.75	1703762	4065.54	3358.96	73.79	19.03	99.82	-12.95	-13.69	3.33	-10.36
300000	16	15	115	35	7	1.75	2062449	4921.44	4066.11	60.96	15.89	83.84	-12.68	-13.46	3.41	-10.06
300000	16	15	135	35	7	1.75	2421135	5777.35	4773.26	51.93	13.65	72.58	-12.45	-13.28	3.47	-9.80
300000	16	10	95	50	7	1.75	1622630	3871.94	3199.01	77.48	19.92	104.40	-13.02	-13.75	3.31	-10.44
300000	16	10	115	50	7	1.75	1964237	4687.09	3872.49	64.01	16.63	87.64	-12.75	-13.52	3.39	-10.13
300000	16	10	135	50	7	1.75	2305843	5502.23	4545.96	54.52	14.30	75.82	-12.52	-13.33	3.45	-9.88
300000	16	12	95	50	7	1.75	1947156	4646.33	3838.81	64.57	16.77	88.34	-12.76	-13.53	3.38	-10.15
300000	16	12	115	50	7	1.75	2357084	5624.51	4646.99	53.34	14.00	74.34	-12.49	-13.31	3.46	-9.85
300000	16	12	135	50	7	1.75	2767012	6602.68	5455.16	45.44	12.04	64.47	-12.26	-13.12	3.53	-9.60
300000	16	15	95	50	7	1.75	2433946	5807.91	4798.52	51.65	13.59	72.24	-12.44	-13.27	3.47	-9.80
300000	16	15	115	50	7	1.75	2946355	7030.63	5808.73	42.67	11.34	61.01	-12.16	-13.05	3.55	-9.50
300000	16	15	135	50	7	1.75	3458765	8253.35	6818.95	36.35	9.75	53.10	-11.93	-12.87	3.62	-9.25
300000	18	10	95	35	7	1.75	1437549	3430.30	2834.12	87.46	22.34	116.79	-13.19	-13.90	3.27	-10.63
300000	18	10	115	35	7	1.75	1740191	4152.47	3430.78	72.25	18.65	97.90	-12.92	-13.67	3.34	-10.33
300000	18	10	135	35	7	1.75	2042833	4874.64	4027.44	61.54	16.03	84.57	-12.69	-13.48	3.40	-10.07
300000	18	12	95	35	7	1.75	1725059	4116.36	3400.95	72.88	18.80	98.68	-12.93	-13.68	3.34	-10.34
300000	18	12	115	35	7	1.75	2088229	4982.96	4116.94	60.21	15.70	82.91	-12.66	-13.45	3.41	-10.04
300000	18	12	135	35	7	1.75	2451399	5849.56	4832.93	51.29	13.49	71.78	-12.43	-13.26	3.48	-9.79
300000	18	15	95	35	7	1.75	2156324	5145.45	4251.19	58.30	15.23	80.54	-12.62	-13.41	3.42	-9.99
300000	18	15	115	35	7	1.75	2610286	6228.70	5146.17	48.16	12.72	67.88	-12.34	-13.19	3.50	-9.69
300000	18	15	135	35	7	1.75	3064249	7311.95	6041.16	41.03	10.93	58.96	-12.11	-13.01	3.57	-9.44
300000	18	10	95	50	7	1.75	2053642	4900.43	4048.75	61.22	15.95	84.17	-12.69	-13.47	3.41	-10.06
300000	18	10	115	50	7	1.75	2485987	5932.10	4901.12	50.57	13.32	70.89	-12.41	-13.25	3.48	-9.76
300000	18	10	135	50	7	1.75	2918333	6963.77	5753.49	43.08	11.44	61.53	-12.18	-13.06	3.55	-9.51
300000	18	12	95	50	7	1.75	2464370	5880.51	4858.50	51.02	13.43	71.44	-12.43	-13.26	3.48	-9.78
300000	18	12	115	50	7	1.75	2983185	7118.52	5881.34	42.14	11.21	60.35	-12.15	-13.04	3.56	-9.48
300000	18	12	135	50	7	1.75	3501999	8356.52	6904.18	35.90	9.63	52.53	-11.91	-12.86	3.62	-9.23
300000	18	15	95	50	7	1.75	3080462	7350.64	6073.12	40.81	10.87	58.69	-12.10	-13.00	3.57	-9.43
300000	18	15	115	50	7	1.75	3728981	8898.15	7351.68	33.71	9.08	49.79	-11.81	-12.79	3.65	-9.14
300000	18	15	135	50	7	1.75	4377499	10445.65	8630.23	28.72	7.80	43.52	-11.56	-12.62	3.72	-8.90

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(In situ cu yd/day)	(In situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
300000	21	10	95	35	7	1.75	1956664	4669.02	3857.56	64.25	16.70	87.95	-12.75	-13.53	3.39	-10.14
300000	21	10	115	35	7	1.75	2368593	5651.97	4669.68	53.08	13.94	74.02	-12.48	-13.30	3.46	-9.84
300000	21	10	135	35	7	1.75	2780523	6634.92	5481.79	45.22	11.98	64.20	-12.25	-13.12	3.53	-9.59
300000	21	12	95	35	7	1.75	2347997	5602.82	4629.07	53.54	14.05	74.60	-12.49	-13.31	3.46	-9.85
300000	21	12	115	35	7	1.75	2842312	6782.36	5603.61	44.23	11.73	62.97	-12.22	-13.09	3.54	-9.56
300000	21	12	135	35	7	1.75	3336627	7961.91	6578.15	37.68	10.08	54.76	-11.98	-12.91	3.60	-9.31
300000	21	15	95	35	7	1.75	2934996	7003.53	5786.34	42.84	11.38	61.22	-12.17	-13.06	3.55	-9.51
300000	21	15	115	35	7	1.75	3552890	8477.96	7004.51	35.39	9.50	51.89	-11.89	-12.84	3.63	-9.21
300000	21	15	135	35	7	1.75	4170784	9952.38	8222.69	30.14	8.17	45.31	-11.64	-12.67	3.70	-8.97
300000	21	10	95	50	7	1.75	2795234	6670.03	5510.80	44.98	11.92	63.90	-12.24	-13.11	3.53	-9.58
300000	21	10	115	50	7	1.75	3383705	8074.24	6670.97	37.16	9.95	54.11	-11.96	-12.90	3.61	-9.29
300000	21	10	135	50	7	1.75	3972175	9478.46	7831.13	31.65	8.55	47.20	-11.71	-12.72	3.68	-9.04
300000	21	12	95	50	7	1.75	3354281	8004.03	6612.96	37.48	10.03	54.52	-11.97	-12.91	3.61	-9.30
300000	21	12	115	50	7	1.75	4060446	9689.09	8005.16	30.96	8.38	46.34	-11.68	-12.70	3.69	-9.01
300000	21	12	135	50	7	1.75	4766610	11374.15	9397.36	26.38	7.20	40.57	-11.43	-12.53	3.76	-8.77
300000	21	15	95	50	7	1.75	4192851	10005.04	8266.20	29.98	8.13	45.11	-11.63	-12.66	3.70	-8.96
300000	21	15	115	50	7	1.75	5075557	12111.36	10006.45	24.77	6.78	38.55	-11.33	-12.46	3.79	-8.68
300000	21	15	135	50	7	1.75	5958263	14217.69	11746.70	21.10	5.82	33.93	-11.06	-12.30	3.86	-8.44
300000	24	10	95	35	7	1.75	2555643	6098.31	5038.44	49.19	12.97	69.17	-12.37	-13.21	3.49	-9.72
300000	24	10	115	35	7	1.75	3093673	7382.17	6099.17	40.64	10.83	58.47	-12.09	-13.00	3.57	-9.42
300000	24	10	135	35	7	1.75	3631703	8666.02	7159.89	34.62	9.31	50.93	-11.85	-12.82	3.64	-9.18
300000	24	12	95	35	7	1.75	3066771	7317.97	6046.13	40.99	10.92	58.92	-12.11	-13.01	3.57	-9.44
300000	24	12	115	35	7	1.75	3712407	8858.60	7319.00	33.87	9.12	49.98	-11.82	-12.79	3.65	-9.15
300000	24	12	135	35	7	1.75	4358044	10399.22	8591.87	28.85	7.83	43.68	-11.57	-12.62	3.72	-8.90
300000	24	15	95	35	7	1.75	3833464	9147.47	7557.67	32.80	8.84	48.64	-11.77	-12.76	3.66	-9.10
300000	24	15	115	35	7	1.75	4640509	11073.25	9148.75	27.09	7.38	41.47	-11.47	-12.56	3.75	-8.81
300000	24	15	135	35	7	1.75	5447554	12999.03	10739.84	23.08	6.34	36.42	-11.21	-12.39	3.82	-8.57
300000	24	10	95	50	7	1.75	3650918	8711.87	7197.78	34.44	9.26	50.70	-11.84	-12.81	3.64	-9.17
300000	24	10	115	50	7	1.75	4419533	10545.95	8713.10	28.45	7.73	43.18	-11.55	-12.61	3.72	-8.88
300000	24	10	135	50	7	1.75	5188147	12380.03	10228.42	24.23	6.64	37.87	-11.29	-12.44	3.79	-8.64
300000	24	12	95	50	7	1.75	4381102	10454.25	8637.33	28.70	7.79	43.49	-11.56	-12.62	3.72	-8.90
300000	24	12	115	50	7	1.75	5303439	12655.14	10455.72	23.71	6.50	37.21	-11.26	-12.42	3.80	-8.61
300000	24	12	135	50	7	1.75	6225776	14856.03	12274.10	20.19	5.59	32.78	-10.99	-12.25	3.88	-8.38
300000	24	15	95	50	7	1.75	5476377	13067.81	10796.66	22.96	6.31	36.27	-11.20	-12.38	3.82	-8.56
300000	24	15	115	50	7	1.75	6629299	15818.93	13069.65	18.96	5.26	31.23	-10.85	-12.19	3.91	-8.29
300000	24	15	135	50	7	1.75	7782221	18570.04	15342.63	16.16	4.52	27.68	-10.60	-12.04	3.98	-8.06

In Situ Volume	Dredge Size	Average Pipeline Velocity	Solids Concentration	Production	Time between unsuitable and cap	Minimum Cap Thickness	Solids Output	Unsuitable Material Average Solids Output	Cap Material Average Solids Output	Time to dredge unsuitable material	Time to Cap	Total Days to Fill	Elevation of Unsuitable Material at end of disposal	Elevation of Unsuitable Material at End of Capping	Cap Thickness at end of capping	Top of Cap at end of capping
(cu. yd.)	(inches)	(fps)	(g/L)	(%)	(days)	(ft)	(kg/day)	(in situ cu yd/day)	(in situ cu yd/day)	(days)	(days)	(days)	(ft, msl)	(ft, msl)	(ft)	(ft, msl)
300000	27	10	95	35	7	1.75	3234485	7718.17	6376.78	38.87	10.38	56.25	-12.03	-12.95	3.59	-9.36
300000	27	10	115	35	7	1.75	3915430	9343.05	7719.26	32.11	8.67	47.78	-11.74	-12.74	3.67	-9.06
300000	27	10	135	35	7	1.75	4596374	10967.93	9061.74	27.35	7.45	41.80	-11.49	-12.57	3.74	-8.82
300000	27	12	95	35	7	1.75	3881383	9261.81	7652.14	32.39	8.74	48.13	-11.75	-12.75	3.67	-9.08
300000	27	12	115	35	7	1.75	4698516	11211.66	9263.11	26.76	7.29	41.05	-11.45	-12.54	3.75	-8.79
300000	27	12	135	35	7	1.75	5515649	13161.52	10874.09	22.79	6.27	36.06	-11.19	-12.38	3.82	-8.55
300000	27	15	95	35	7	1.75	4851728	11577.26	9565.17	25.91	7.08	39.99	-11.40	-12.51	3.77	-8.74
300000	27	15	115	35	7	1.75	5873145	14014.58	11578.89	21.41	5.90	34.31	-11.09	-12.31	3.85	-8.46
300000	27	15	135	35	7	1.75	6894561	16451.90	13592.61	18.23	5.07	30.31	-10.81	-12.15	3.92	-8.23
300000	27	10	95	50	7	1.75	4620693	11025.96	9109.69	27.21	7.41	41.62	-11.48	-12.56	3.74	-8.82
300000	27	10	115	50	7	1.75	5593471	13347.22	11027.51	22.48	6.18	35.66	-11.17	-12.36	3.83	-8.53
300000	27	10	135	50	7	1.75	6566249	15668.47	12945.34	19.15	5.31	31.46	-10.90	-12.20	3.90	-8.30
300000	27	12	95	50	7	1.75	5544832	13231.16	10931.62	22.67	6.24	35.91	-11.18	-12.37	3.82	-8.55
300000	27	12	115	50	7	1.75	6712165	16016.66	13233.02	18.73	5.20	30.93	-10.86	-12.18	3.91	-8.27
300000	27	12	135	50	7	1.75	7879498	18802.17	15534.41	15.96	4.47	27.42	-10.58	-12.03	3.99	-8.04
300000	27	15	95	50	7	1.75	6931040	16538.94	13664.53	18.14	5.05	30.19	-10.77	-12.14	3.93	-8.21
300000	27	15	115	50	7	1.75	8390207	20020.83	16541.27	14.98	4.21	26.19	-10.43	-11.96	4.01	-7.94
300000	27	15	135	50	7	1.75	9849373	23502.71	19418.01	12.76	3.61	23.38	-10.14	-11.81	4.09	-7.72
300000	30	10	95	35	7	1.75	3993192	9528.61	7872.57	31.48	8.51	46.99	-11.71	-12.72	3.68	-9.04
300000	30	10	115	35	7	1.75	4833864	11534.63	9529.95	26.01	7.10	40.11	-11.41	-12.51	3.76	-8.75
300000	30	10	135	35	7	1.75	5674536	13540.66	11187.33	22.16	6.10	35.26	-11.14	-12.35	3.83	-8.51
300000	30	12	95	35	7	1.75	4791830	11434.33	9447.08	26.24	7.16	40.40	-11.42	-12.52	3.76	-8.76
300000	30	12	115	35	7	1.75	5800637	13841.56	11435.94	21.67	5.97	34.65	-11.11	-12.33	3.84	-8.48
300000	30	12	135	35	7	1.75	6809443	16248.79	13424.80	18.46	5.13	30.59	-10.84	-12.17	3.92	-8.25
300000	30	15	95	35	7	1.75	5989788	14292.91	11808.85	20.99	5.80	33.79	-11.05	-12.29	3.86	-8.43
300000	30	15	115	35	7	1.75	7250796	17301.95	14294.93	17.34	4.84	29.17	-10.72	-12.10	3.95	-8.16
300000	30	15	135	35	7	1.75	8511804	20310.98	16781.00	14.77	4.15	25.92	-10.43	-11.95	4.02	-7.93
300000	30	10	95	50	7	1.75	5704560	13612.30	11246.53	22.04	6.07	35.11	-11.13	-12.34	3.84	-8.50
300000	30	10	115	50	7	1.75	6905520	16478.05	13614.22	18.21	5.06	30.27	-10.81	-12.15	3.92	-8.23
300000	30	10	135	50	7	1.75	8106480	19343.79	15981.90	15.51	4.35	26.86	-10.52	-12.00	4.00	-8.00
300000	30	12	95	50	7	1.75	6845472	16334.76	13495.83	18.37	5.11	30.47	-10.80	-12.15	3.92	-8.23
300000	30	12	115	50	7	1.75	8286624	19773.66	16337.06	15.17	4.26	26.43	-10.46	-11.97	4.01	-7.96
300000	30	12	135	50	7	1.75	9727776	23212.55	19178.29	12.92	3.66	23.58	-10.17	-11.83	4.09	-7.74
300000	30	15	95	50	7	1.75	8556840	20418.45	16869.79	14.69	4.14	25.83	-10.25	-11.89	4.02	-7.87
300000	30	15	115	50	7	1.75	10358280	24717.07	20421.32	12.14	3.45	22.59	-9.89	-11.73	4.11	-7.61
300000	30	15	135	50	7	1.75	12159720	29015.69	23972.86	10.34	2.96	20.30	-9.58	-11.59	4.19	-7.40