FEASIBILITY STUDY PHASE III - RECYCLING, REUSING AND/OR REHANDLING BALTIMORE HARBOR DREDGED MATERIALS

JUNE 10, 1985

KIDDE CONSULTANTS, INC.
1020 CROMWELL BRIDGE ROAD
BALTIMORE, MARYLAND 21204

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OUTLINE OF
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BALTIMORE HARBOR DREDGED MATERIALS

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1. INTRODUCTION AND SUMMARY

1.1 Introduction

This Feasibility Study Phase III presents a final conceptual design of a facility to effect the environmentally safe placement and disposal of dredged material from Baltimore Harbor.

The need for this study was first stated in a report (Technical Report No. 1, Technical Appendix A1.1) submitted in September of 1979 by the Federal Highway Administration and the Interstate Division for Baltimore City (IDBC), Maryland State Highway Administration to supplement the Final Environmental Impact Statement (EIS) of April 1976 for the Fort McHenry Tunnel Project. This study later became a requirement for EIS approval, and the study was authorized by the Federal Highway Administration.

Numerous investigations have indicated that the dredged sediments originating within the confines of the Harbor are contaminated with heavy metals, chemical compounds, and organic and biological debris. As in other polluted harbors throughout the nation, the heavy metal and chemical contamination is the direct result of years of accumulation from effluent discharges into the harbor from waterfront facilities and other sources within the watershed. Although, in recent years, the polluted discharges have been greatly reduced, the heavily contaminated bottom sediments have remained since the harbor is not exposed to strong tidal flushing.

The Port of Baltimore faces a critical problem related to an economically and environmentally sound way of disposing of dredged sediments. Past practice was to either cast the spoil overboard or place it within a containment area and create fast land. Both of these methods pose potential environmental problems, especially in light of the State of Maryland's current restrictions on disposing of Baltimore Harbor spoil outside the harbor area. Overboarding resuspends many of the pollutants currently resting on the bottom. The use of coastal or upland sites such as inactive mines or quarries presents the problems of potential groundwater pollution, along with citizen opposition.

It should be understood that any method and/or facility for reuse/rehandling will be expensive. These costs must not be compared with today's disposal costs, which are still based upon diked disposal areas being available within the legal boundaries of the harbor. The disposal and rehandling costs derived in this report must instead be balanced against the overall economic impact of a total prohibition of any dredging in Baltimore Harbor. A scenario exists which says that within a short time there will be no diked disposal areas available, and the facility described herein may be the only alternative to cessation of dredging.

1.2 Study Description (Phase I, II, and III)

1.2.1 Phase I

The Phase I study and report were prepared in several phases. This method was used so that all alternatives could initially be considered. Later as work progressed, the less desirable methods and processes were eliminated by a series of screening meetings.

Since previous studies had produced vast amounts of work regarding sediment volumes, pollution levels, and general character of the spoil material, it was decided to make maximum use of this previous work. Therefore, no additional field investigations or lab work were performed. Intensive study of the available literature was used to characterize the sediments in an overview manner. The characterization is a condensation of previous work by others.

The initial phase of the process design was a literature search to identify all processes that were thought to be feasible. An initial screening was conducted, and those processes and treatment methods that were not appropriate were removed from future consideration.

After the initial screening, those processes that still appeared to be feasible from a technical standpoint were investigated. The number of units, space requirements and operating costs were compiled for a second screening based upon cost factors.

A final system was then selected for use in conceptual site studies. The IDBC was originally required by the U.S. Army Corps Permit to investigate the feasibility of locating the facility at two potential sites. These sites were the Canton/Seagirt disposal site and the disposal area at Marley Neck. However, since the Canton/Seagirt site was subsequently designated by the State as a container transfer and storage site, the conceptual site studies were done only with reference to Marley Neck.

The results of Phase I were summarized in a report entitled "Feasibility Study Phase I: Recycling, Reusing and/or Rehandling Dredged Materials," dated August 1984, and prepared for the U.S. Department of Transportation, the Federal Highway Administration and the Interstate Division of Baltimore City.

1.2.2 Phase II

The work performed under Phase II consisted of the establishment of design criteria including minimum acreage, number and type of treatment systems, transportation accessibility requirements and environmental criteria.

Process flow diagrams were prepared for the required treatment processes showing all handling and processing operations.

Using the process flow diagrams, equipment was selected and a preliminary conceptual site plan of a complete rehandling facility was prepared including: operational layout (including receiving and offloading, dewatering, densification, stockpiling, and waste disposal), modes of transport to and from the facility, and environmental controls and facilities necessary to decontaminate the dredge material and treat any water being returned to the harbor to a suspended solids concentration of 400 ppm or less. This is the maximum allowable level allowed by law.

1.2.3 Phase III

Phase III of the study encompassed the production of this draft report, summarizing the previous two Phases, and including copies of the drawings prepared as part of Phase II.

1.3 Process Description and Summary

The report on Phase I of this study identified a technology potentially capable of safely handling and disposing of large quantities of contaminated dredged material.

Past records of maintenance dredging operations were evaluated, and an estimated yearly production of 825,000 cubic yards was established. An additional 200,000 cubic yards of storage was provided at the site.

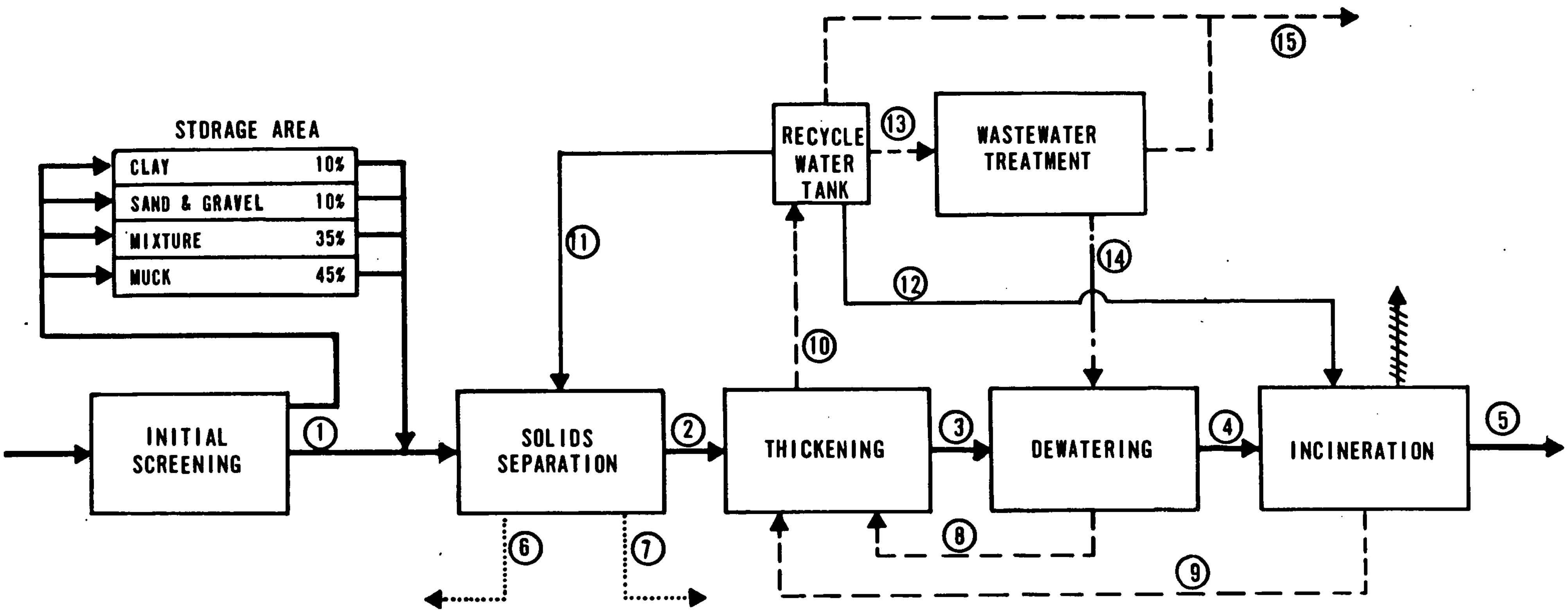
An overall process flow schematic for the final conceptual design is shown on Plate #1. A mass balance for the process appears in Figure 1-1. Throughout the plant, covered conveyors would be used to transport the dredge material to the various stages of processing. Material flow thru the treatment stages is defined in the individual chapters. The stages in the process are as follows.

1.3.1 Delivery and Unloading: Dredged material would arrive at the facility by barge. An offshore structure is proposed to dock the barges and offload the muck. A mobile crane with clamshell bucket will transfer the dredged material into a receiving hopper.

1.3.2 Initial Screening: All incoming material would be screened thru an inclined vibrating grizzly at the bottom of the receiving hopper to remove solid debris larger than 12".

Material smaller than 12" would drop through the grizzly into chutes and be conveyed to the stockpiles or solids separation system, as appropriate. The material 12" or larger will be stockpiled alongside the screen until manually removed.

PROCESS MASS BALANCE



LEGEND

PROCESS LINE ————

WASTEWATER — — —

SAND & GRAVEL ··········

WATER ————

GAS

SLUDGE -·-·-·-

STREAM FLOW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SOLIDS (TPH)	216	184	194	194	194	16	16	9.5	0.13	---	---	---	---	---	---
LIQUIDS (TPH)	324	1437	1097	129	---	4.4	40	935	12.5	1284	1226	12.5	---	---	2537
% SOLIDS	40	11	15	60	100	79	29	1	1	0	0	0	---	---	---
GALS/MIN	1346	5820	4584	804	---	18	159	3745	50	5131	4900	50	---	---	181

FIGURE 1-1

About 10% of the total dredged material is estimated to be clay. A portion of the clay will be in lumps larger then 12 inches. This material should be manually removed from the oversize stockpile and marketed if sufficient quantities are uncovered.

1.3.3 Solids Separation: All dredged material which will go through the plant for further processing must first pass through the solids separation system in order to remove particles larger than 1/16". Particles of this size could damage downstream processing equipment.

The solids separation equipment will separate sand and gravel from silts and organic material. To reclaim and treat the former materials, a standard sand and gravel plant is proposed. The equipment will clean and wash the raw material and segregate it into sand and gravel stockpiles that have market demand.

The silts and organic material remaining after the sand and gravel have been separated out are characterized as muck. Within the muck are heavy metals in fairly high concentrations. In order for this material to be reused, the heavy metals must be immobilized to prevent the material from being classified as a hazardous waste. This will be discussed further in the incinerator chapter.

1.3.4 Thickening and Dewatering: Prior to incineration, it is important to remove as much water as possible from the material to be treated. The wetter the material going to incineration, the greater will be the fuel requirements. Water removal will take place in two stages, thickening (using a lamella gravity settler/thickener) and dewatering (using a series of high compression belt filter presses).

1.3.5 Incineration: The decontamination system that appears best suited for this application is a rotary kiln incineration process developed by the Dutch. This is the only system with a proven record for the capacity needed for this operation.

1.3.6 Water Treatment/Recycle: The final major process system is that of water treatment/recycle. State of Maryland regulations require that any effluent discharged into Baltimore Harbor shall contain less than 400 ppm suspended solids. Such a level of treatment would be provided in inclined plate settling tanks. From these tanks the clarified water is collected and recycled to the solids separation and incinerating systems, thus keeping the facility's water consumption to a minimum.

1.4 Report Organization

Chapter 2 of this report deals with the sediment characterization from the standpoint of sediment types and pollution levels. Chapter 3 establishes the design assumptions and criteria that are used throughout the process design.

The various stages of the treatment process are described in Chapters 4 through 9.

Potential uses and disposal sites for end products are discussed in Chapter 10, and environmental issues and problems are covered in Chapter 11. Chapter 12 presents the study's results and conclusions and Chapter 13 follows with a cost estimate for the completed dredged material recycling operation.

2. SEDIMENT AND POLLUTION CHARACTERIZATION

2.1 Sediment Characterization

In attempting to characterize the dredge material that would be coming to this facility, one encounters two problems. First there is a large amount of diverse information available in the form of soil borings for recent construction projects such as the Key Bridge and the I-95 Tunnel crossing. The second problem is that the wide geographical area encompassed by the study makes it difficult to synthesize that information into a single characterization.

2.1.1 Characterization of the Upper Sediments (0 to 15 ft. depth)

A 1979 report by Roy F. Weston entitled "The Technical and Economic Feasibility of Producing Beneficial Products from Baltimore Harbor Dredge Spoil" presented a "Composite Curve for Organic Silt (Bay Muck)" which was based upon more than 200 samples obtained by Associated Engineers in 1969. This curve indicates that the material normally found in the top 10 to 15' is primarily in the silt and clay sizes. Our own review of the many borings and our discussions with MPA and IDBC staff indicate that the majority of the sediments to be removed and processed would be classified as muck or silty clay. Since most of the expected dredge material will be from maintenance dredging of these recent deposits, we estimate that fully 70% of the yearly volume will be this fine grained muck with water contents in the 120-200% range.

2.1.2 Characterization of Underlying Sediments

In an effort to characterize the remaining material which underlies the muck, we also reviewed the many borings available. This review, however, did not indicate any uniformity. Instead, we observed the presence of stiff clays, sands and gravel. In this case we feel that characterization of this material should be based upon an understanding of the overall harbor geological phenomena rather than a synthesized curve.

The sediments underlying the Baltimore Harbor and Channels generally consist of a series of wedged shaped deposits which dip and thicken to the southeast. Sediments within elevation -50 to -60 have generally been identified as belonging to Recent, Pleistocene and Cretaceous Geological Age. Recent deposits at the mudline of the Baltimore Harbor generally consist of black, very soft clayey silts or silty clays with decomposed organics and petroleum residue. These bottom sediments are very recent, and may represent deposition since earlier dredging of Maryland Channels. Beneath these black materials is generally a soft, organic gray silty clay which is believed to represent the surface of natural material predating previous dredging.

Pleistocene deposits appear as soft to stiff micaceous sandy silts and clays with gravel pockets, or as compact sands and gravel. The Pleistocene period was accompanied by lowering and raising of sea levels; by cutting of deep stream and river channels indenting the underlying Cretaceous sediments, and by subsequent filling of these channels with Pleistocene outwash materials. These actions have resulted in irregular or discontinuous strata in subsurface profiles. Pleistocene deposits consisting of stiff to hard clay with gravel and ironstone have been encountered in the east and northwest channels above elevation -55. Similarly, Pleistocene sand, gravels and cobbles have been reported in the Curtis Bay channel within depths of interest.

The older Cretaceous deposits, despite forming the base for the younger overlying sediments, outcrop in the extreme northwest corner of the Baltimore Harbor as a result of erosion and deposition patterns. The Cretaceous deposits include the Patapsco, Raritan, and Patuxent formations and can be characterized as either very compact silty or clayey sand; stiff to hard plastic clay; or very compact sand and gravel. In addition to reported out-croppings in the northwest harbor area, hard Cretaceous Raritan clay rises above elevation -50 in the Fort McHenry Channel section.

A literature search was conducted of the numerous subsurface investigation programs performed in the Baltimore Harbor and channel areas. This subsurface information was found to be in general agreement with that reported in the geological publications.

2.1.3 Conclusion

In summary, the major portion of dredge material to be delivered to the facility will be muck with a high moisture content. This material is estimated to be 70% of the annual dredging. The remaining 30% is estimated to consist of stiff clays and granular materials in the sand and gravel range each comprising one half of the 30%. These parameters will be used to prepare the process design. To aid in further understanding the properties of the material and also to do a conceptual mass balance we have defined an assumed moisture content and unit weight of the major soil types. It should be understood that these are approximations and the final plant capacity should have enough flexibility to accommodate the variation one can expect when processing material from the different areas within the harbor.

2.2 Chemical and Pollutant Characterization

2.2.1 Type of Pollutants

Analyses of contaminants found in samples of sediments from various Baltimore Harbor and channel locations are contained in many previous reports. These analyses have indicated the presence of trace heavy metals in significant quantities, often in excess of current EPA limits.

These metals include Arsenic (As), Cadmium (Cd), Chromium (total Cr and hexavalent CrVI), Copper (Cu), Lead (Pb), Mercury (Hg), and Zinc (Zn). Organically related parameters such as Total Volatile Solids (TVS), Chemical Oxygen Demand (COD) and Total Kjeldahl Nitrogen (TKN) also have exceeded EPA limits by factors of 2 or more. These parameters reflect the poor dissolved oxygen content of the lower layers of water within the harbor near the water-sediment interface. Oil and grease have been detected in significant quantities in harbor sediments. Trace organics such as Chlordane, DDT, Kepone, Mirex and PCB's have also been detected.

2.2.2 Distribution of Pollutants

A review of data sources and analyses reveals that the upper five to ten feet of sediment generally contain the highest levels of pollutants. Materials in this zone are soft, recently formed, and subject to movement by tidal actions. Conversely, materials below the upper ten feet are relatively firmer and not subject to tidal action. These latter materials were deposited prior to industrial development in Baltimore, and any contaminants found within the layer either occur naturally or result from leaching from the upper layer.

Certain locations have higher indicated levels of toxicity than others. Highly industrialized areas indicate higher levels of pollutants than urban areas. Curtis Bay Channel, Colgate Creek, Bear Creek and portions of the Inner Harbor have indicated the highest concentrations of pollutants. A report, entitled "Evaluation of the Problem Posed by In-Place Pollutants in Baltimore Harbor and Recommendation of Corrective Action" (EPA 440-15-77-015b), prepared by Trident Engineering Association, Inc. in September 1977, deals with this in depth and presents a comprehensive picture of the distribution of pollutants. Also the May 1976 EPA report entitled "Identifying and Prioritizing Locations for the Removal of In-Place Pollutants" points out many highly polluted locations and the wide range of contaminants found.

2.2.3 Conclusion

Again, as was the case with grain size characterization, no single overall generalization can be made regarding the chemical properties of the contaminated sediments over such a widespread area of study and range of values. There will be some degree of uncertainty regarding how many of these contaminants behave during the various decontamination processes considered.

For the purposes of conceptual process design, it was concluded that the heavy metal particles and other pollutants which are of concern are bonded to the silty particles consisting of muck, and are not associated to a significant degree with sand and gravel or stiff clays. This is justified on the basis that sand, gravel, and stiff clay deposits are generally found beneath the level at which significant pollution occurs.

3. PROCESS DESIGN ASSUMPTIONS

3.1 Sediment Volume

3.1.1 General Introduction

In order to establish unit sizes for equipment and production rates for dewatering and decontaminating processing, an estimate of annual dredging rates was established. It is understood that in any particular year the quantity of dredge material produced may be above or below this estimate, and appropriate stockpile areas must be included at the site. In addition, dredge permits may have to be scheduled in order not to exceed the facility capacity.

The area to be considered as a source of dredge material for this study is that designated as Baltimore Harbor under Section 8-1602 of the Annotated Code of Maryland, which was passed in 1975. Specifically, this area is all of the Patapsco River west of a line from North Point to Rock Point. This area is of significance in this study because the state law prohibits any open water disposal of dredge material from Baltimore Harbor in the Chesapeake Bay.

Within the study area, dredge material now comes from several jurisdictional sources and is in turn disposed of at different sites. The three jurisdictional dredging sources are Federal, State and Private.

The Federal activity relates to the dredging of main channels and anchorages and will be disposed of at the now approved Hart Miller Island site. No discussion or consideration of those quantities is included in this report.

The State dredging pertains only to channels and turning basins connecting the State owned marine terminals to the main Federal channels. This State generated material is currently being disposed of at the Masonville site.

The third source of dredge material is from private sector dredging of individual channels and turning basins.

As the Masonville site and other sites within the harbor become filled, both State and private sector material may have to be processed by the proposed facility.

In attempting to estimate and project future dredge quantities, we have used source material from various agencies such as the Baltimore District Corps of Engineers, the Maryland Port Administration, the Maryland State Water Resources Administration and several private dredging companies. Additionally, we have met with staff members from Maryland Port Administration and Interstate Division for Baltimore City to review the conflicting information from various literature sources. These discussions provided insight into the reliability of past projections, and they provided valuable guidance in preparing the projections used in this report.

3.1.2 State of Maryland Dredging

The State of Maryland is responsible for dredging those channels in Baltimore Harbor which connect the Federal Channels to state owned marine terminals including Dundalk Marine Terminal, and state owned facilities such as Hawkins Point and Leading Point.

The Maryland Port Administration's Engineering Department prepared a Summary of MPA Dredging 1958-1975. Data from the period 1975-1981 was obtained by examining construction permits issued by the Department and completed by them. There was no state dredging in 1980 or 1981. Total new work for the 1958-1981 period was estimated to be 7,427,300 C.Y. Total maintenance work was estimated to be 1,825,000 C.Y. These calculations are from a draft copy of this report being proposed by Maryland Port Administration, and represent the best available information from literature at this time.

The projected quantities for 1982 - 2001 from that document indicate an average volume per year of 380,000 C.Y. While it is recognized that not all of this material will have to be handled by the proposed facility, a conservative approach indicates that we consider this full value.

3.1.3 Private Sector Dredging

Private Sector Dredging includes both maintenance and new work projects around piers and private company marine facilities. Private dredging is expected to be the main source of material to be handled at the new facility.

3.1.3.1 Maryland Port Administration Estimate

Again, the best available information from literature is the draft report being prepared by the Maryland Port Administration. That informal document shows an average of 820,000 C.Y. per year over the 20 year period. The projections were adjusted for statistical purposes by the MPA.

3.1.3.2 Contractor's Estimates

Another estimate considered is opinions obtained from the two main private dredging contractors in Baltimore Harbor. Langanfelder and Sons and McLean Contracting Company were interviewed, and both expressed opinions that an estimate of 1,000,000 C.Y. per year average over the next 20 years would be reasonable.

3.1.3.3 Summary of Estimates - Private Sector Dredging

Estimate I - MPA DATA	820,000 CY/YEAR
Estimate II CONTRACTORS' ESTIMATE	1,000,000 CY/YEAR

State Dredging

MPA Estimate	380,000 CY/YEAR

In the private sector dredging, more weight should be given to Estimate I as it represents past historical trends. As discussed earlier, not all State dredging may be destined for the new facility over the next 20 years as this is dependent on the filling of their present disposal sites. However, it seems likely some of the State materials may be directed to the new facility.

Additional consultations with MPA regarding historical records indicate 600,000 cy/yr average over the past 30 years. Of this composite number approximately 70% or 420,000 cy/yr was for maintenance dredging.

3.1.4 Conclusion

All of those suggested volumes have been discussed with staff from IDBC in an attempt to arrive at the best consensus estimate possible for this study. The results of this discussion produced the following criteria:

Average Capacity: 750,000 cu yd/yr
Excess Capacity: 10% (For maintenance outage)
Storage Capacity: 200,000 cu yd
Operation: 8 hr/day, 5 days/week
Total Nominal Facility Capacity: 825,000 cu yd/yr

These conditions then indicate a nominal facility capacity of 825,000 cu yd/yr plus storage. All systems have been sized using this volume. The schedule of operation was determined by economic factors; facility hours of operation could be increased if it were necessary to handle an especially large load.

3.2 Material Characteristics

3.2.1 Overall Character of Material

The following estimates and assumptions will be used as design criteria for the proposed facility:

70% - Muck

15% - Sand and Gravel

15% - Clay

3.2.2 Character of Delivered Loads

Even though the abovementioned overall character of the material may be valid over an entire year, the current methods of dredging will not deliver uniform segregated material to the site. Locations and depth of dredging operations and normal mixing will produce a variable feed stock. After considering the possible combinations that could occur it was decided to base the plant process design on the following distribution of delivered loads. It is understood that segregated stockpiling will be necessary to prevent further mixing of the limited amount of clean clay with muck, sand or gravel that could arrive. In addition, muck will be stockpiled separately from the mixture of muck, sand and gravel due to differences in the types of containment and conveying equipment required. Following are the percentages of the total dredge amount as stockpiled:

45% - Muck along

10% - Lump stiff clay alone

45% - Mixture of muck, sand and gravel, clay

3.2.3 Distribution of Pollutants

For decontamination and treatment purposes it has been assumed that heavy metals and organic pollutants are bound to the -200 mesh materials. This is a valid assumption since the larger materials (lump clay, sand and gravel) were formed prior to the deposition of such pollutants into the bay.

3.3 Site

A 3,520,000 SF site at Marley Neck, just south of the Francis Scott Key Bridge on Baltimore's Harbor, was chosen for the proposed facility. This site, shown on Plate #2, is easily accessible by both barge and truck. A rail line runs just west of the site providing access to non-local markets should future need arise. A site plant of the proposed facility is shown on Plate #3.

A barge offloading device will be located on the east end of the site occupying approximately 67,500 SF. A clamshell crane mounted on a deck barge will unload the incoming dredged material transferring it to a receiving hopper. Objects with diameters larger than 12 inches will be removed by a grizzly in the receiving hopper and stockpiled in this area until trucks haul them to a local disposal site.

West of the barge unloading device are the material stockpiles. Six stockpiles of diked earth will have the capacity to store 200,000 CY of dredged material. Muck clay and mixtures of muck with sand, gravel and clay will be stored separately. The stockpiles occupy a 976,000 SF area.

The solids separation system and finished product stockpiles occupy 36,550 SF area as shown. The solids separation system extracts the sand and gravel and processes it into marketable products. It consists of two triple deck screens, a log washer, a classifying tank and screw classifiers for sand and conveyors. The system will produce specification gravel and sand. The finished product stockpiles will have the capacity to store a 20 day production supply of sand and gravel.

The water treatment system will consist of six steel Lamella Gravity Settlers/Thickeners (LGSTs) covering an area of 3413 SF. The LGSTs should reduce the suspended solids to 400 ppm. A rectangular clarifier, however, has been designed should secondary treatment be needed. It can be constructed at a later date just west of the material stockpiles.

The dewatering building will house six Parkson Corporation model 3500 - 4X Magnum^{R} belt filter presses. These presses will handle the 4500 gpm flow of muck from the LGSTs and decrease the water content in this flow from 87 to 40 percent.

The decontamination or detoxification system will be constructed on the northwest corner of the site. This system, occupying approximately 12,000 SF will incinerate the muck's organic pollutants at 1700°F. Products will include soil, gases of air, water vapor and incinerated organics, and dust from the bag filter.

4. DREDGING, UNLOADING, INITIAL SCREENING AND STOCKPILING

4.1 Current Dredging Methods

Until the early 1970's, maintenance dredging was conducted by the Army Corps of Engineers' owned and operated hopper dredges. The use of hopper dredges ceased in the early 1970's largely because the submarine, open water, disposal procedures were being conducted at shallow water disposal sites.

Current dredging practice within the harbor is clamshell bucket and barge. For the purpose of this study, no change from the present dredging or transportation mode is contemplated.

4.2 Barges

Mud or sand scow/barges are the current methods used. Under normal operation, a 5-cyd bucket dredge can load three 500-cyd barges in a 10-hour day for a daily production of 1,500 cyd. The offloading operation may be accomplished at an average rate of 250 cy/hr and a maximum of 400 cy/hr. To prevent delays, sufficient room has been provided at the unloading facility to allow two full barges to dock end to end. The unloading facility is shown on Plate #4.

4.3 Unloading Systems

4.3.1 General

Once at the offloading site, clamshell bucket offloading will be used for the transfer of the dredged material. The other methods considered included: (a) slurry pump-out systems (rejected because of the large amount of water required, and resultant water treatment problems), and (b) bottom dump barges and a rehandling basin (rejected because of space limitations and possible environmental problems).

4.3.2 Clamshell Bucket Offloading

Barge offloading will be conducted through the medium of a clamshell crane mounted on a deck barge. In this procedure, the operator systematically offloads from one end until the heavier end tips and the barge's content slides toward the heavy end. A hydraulic wench system is provided to move the barge along the piers to facilitate the unloading operation.

The offloaded material will be deposited in a receiving hopper for initial screening.

4.3.3 Spill and Erosion Protection

Both spillage of dredged material and site erosion due to stormwater runoff could cause contaminated material to become resuspended in the harbor's waters. Several measures have been taken to prevent this.

First, the dock will be provided with a curb. This will keep material spilled during unloading from reaching the water. To prevent pollution due to erosion, the site will be diked and seeded. The planted grass will decrease the amount of soil erosion that occurs, and dikes will cause runoff to flow inland rather than into the harbor. Finally, all runoff will be collected and processed through the wastewater treatment system before being discharged.

4.4 Initial Screening

Initial screening of dredge material prior to sorting and stockpiling is needed for the removal of solid debris such as steel bars and angles, chain, steel cable, water-logged timbers and the like which dredgers report as being extensive at certain locations within the harbor.

Removal of this material will be accomplished by the use of a screening device on the receiving hopper. The device, called an inclined vibrating grizzly, consists of a series of bars, screens, or rods placed beneath the receiving chute to screen out large items (larger than 12") that may damage the downstream conveying system or processing machinery. The large debris removed in this manner is collected in a hopper and set aside for appropriate disposal. If large clay lumps are separated out at this time, they should be separated from the trash and reclaimed. The dredged material smaller than 12" will fall through the grizzly into chutes and be loaded onto a conveyor, which will transport it to designated stockpiles or directly to the plant for processing.

4.5 Sorting and Stockpiling

4.5.1 Sorting

It is understood that the dredge material received will not be a continuous homogeneous flow of material. Depending on where in the harbor dredging is taking place and to what depth one is dredging, a variety of materials or mixtures could be recovered. It is anticipated that the majority of the material will be pure muck or muck mixed with some amounts of sand, gravel, or clay. Also, there could be loads of clean clay.

4.5.2 Stockpiling

The 200,000 cy stockpile area is to be subdivided into three separate areas as follows:

a) clean clay

b) muck only

c) muck mixed with clay, sand or gravel

The clean clay will be stockpiled until sufficient quantities have been accumulated, then recycled and used off-site.

Muck only will be stockpiled separately from muck mixed with sand and gravel because of differences in the material characteristics. Muck flows and tends to dry along the top, leaving a crust which retains the internal water. Sand and gravel are easy to reclaim and easy to dry.

The muck will be stockpiled and then fed through the solids reclamation apparatus. Although significant amounts of sand and gravel will not be found in the muck, this processing is necessary to ensure that particles larger than 1/16" are screened out before reaching the belt filter press, which could be damaged by such particles. Because it is felt that muck will be the largest part of the total plant feed, this stockpile area will also act as storage when the plant is shut down for repairs.

The remaining stockpile area will be for the mixture of muck, sand, gravel and clay. This material will first be processed through the sand/gravel unit to separate and recover the sand and gravel. After screening, the sand and gravel can be used off-site. The remaining muck will then be processed through a series of dewatering stages and then fed into the decontamination facility.

4.6 Belt Conveyor Systems

The transportation of dredged material from the proposed offloading area to the proposed storage and treatment areas will require a belt conveyor system. The conveyors should be 42 inch wide, troughed conveyors, with a 16° maximum angle of inclination and 200 fpm maximum speed. Transfer of the materials will be with diversion conveyors thru trippers or plows. The practical aspects of the system have been proven at the Maryland Port Authority disposal site at Masonville. Conventional off the shelf equipment is available and can be easily site adapted.

4.6.1 Weighing

At various points during the handling and treatment process it may be advisable to maintain continuous on-line monitoring of the weight, or quantity, of the material being transported to the various units. Weighing can be accomplished by a mechanical weighing system. Use of a weighing system is necessary to develop a daily record of the plant's throughput.

5. SOLIDS SEPARATION

5.1 General

Although the solids separation system includes sand and gravel processing equipment, its primary function is to screen out all particles large enough to cause damage to downstream equipment. The belt filter press, part of the dewatering system, can be damaged by particles larger than 1/16". It is therefore essential that all materials passing through the plant, even if characterized as "muck only" be processed through the solids separation system.

The material removed from Baltimore Harbor is believed to be predominently less than 2 inches in size, consisting of clay, silt, organics, sand, gravel, metal, and other miscellaneous materials. The proposed solids separation system is designed to separate out the sand and gravel and to process them into salable products. The remaining silt, clay, etc. will be dewatered and detoxified.

Sand and gravel operations are in existence throughout the world. Standard practice at such plants is to crush the boulders, screen the material and wash it of any impurities, and size the final product to various specifications. The technology involved in such an operation is straightforward and varies in complexity depending upon the final product required.

5.2 Plant Capacity

An estimated 825,000 cubic yards per year of dredge material will pass through the solids separation system. This material has been assumed to have a weight of 2700 lbs. per cubic yard. The total yearly throughput is therefore 1,113,750 tons.

Plant operation was assumed to be 5 days a week, 8 hours a day. On this basis, the hourly flow to the plant would therefore be 400 cubic yard (535 tons). Total production capacity of sand and gravel is estimated to be 32 tons per hour, which is a rate representative of a small sand and gravel operation. The foregoing estimate was based on an estimated muck or fine-grained silt content of 70%. If the muck content decreases, the production capacity of the equipment will increase.

The proposed plant was designed to produce 2 types of sand (for instance, specification mason sand and specification concrete sand), but it could be converted to producing 3 spec sands simultaneously with only minor modifications. The plant also includes a gravel processing system to provide clean, washed gravel in two sizes. These products would be comparable to those sold at local sand and gravel plants, such as Genstar. The going rates paid by distributors for the products range from $4.00 to $6.00 per ton. The $4.00 value is used in Chapter 13 as a part of the cost evaluation.

The initial capital cost is higher for a sand and gravel plant that produces specification products then for one that doesn't. However, the market value of a cleaned and graded specification sand is much higher then that of an ungraded product. For the purpose of this report, the more costly system with the highest potential pay back will be used.

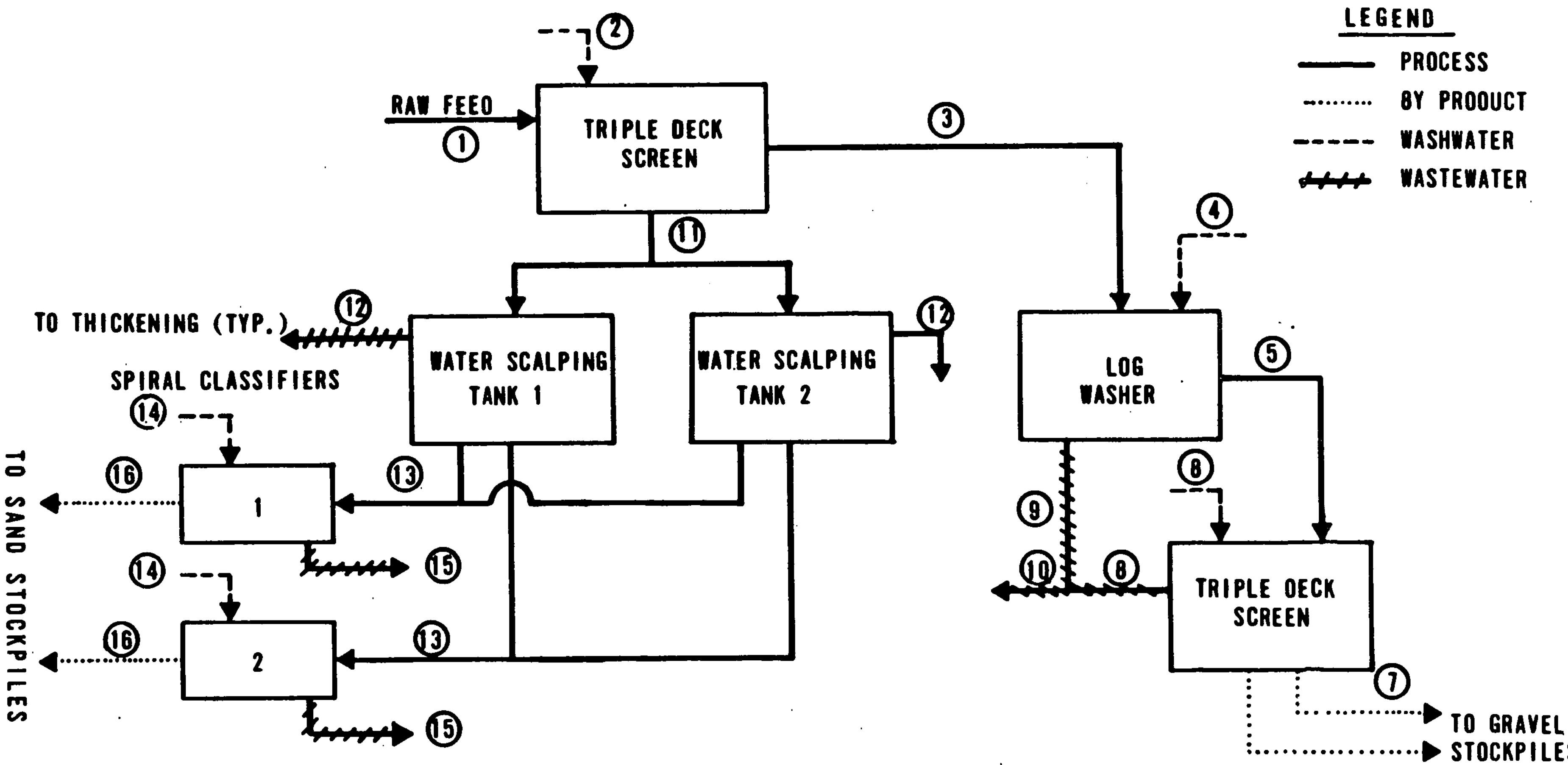
5.3 Plant Process

The solids separation system of the proposed facility uses equipment standard in conventional sand and gravel plants. It comprises the following major pieces of equipment, all of which are off-the-shelf items:

1. Triple Deck Screens
2. Classifying Tanks (Water Scalping Tanks)
3. Screw Classifiers
4. Log Washers
5. Conveyors

A schematic of the solids separation system is shown on Plate #5, and a mass balance of the process is depicted in Figure 5-1. Plate #'s 6 and 7 show the system's layout. A general description of the process follows:

SOLIDS SEPARATION
MASS BALANCE



STREAM FLOW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SOLIDS (TPH)	216	0	49	0	19	0	16	3	29	32	167	136	31	0	15	16
LIQUID (TPH)	324	1000	0	125	13	75	4	83	113	196	1325	927	397	25	358	40
% SOLIDS	40	0	100	0	61	0	79	4	21	14	11	13	7	0	4	29
GALS/MIN	1296	4002	0	500	50	300	18	333	451	783	5295	3706	1589	100	1430	159

5.3.1 Separation into Sand and Gravel

In the first stage of the solids separation process, the dredged material is fed to a triple deck, inclined vibrating screen (Triple Deck Screen #1). With the help of wash bars, the material is separated into 3 streams: (1) materials 2-1/4" and greater are screened out and discarded; (2) materials between 2-1/4" and 3/16" are screened out and routed to the gravel processing system; (3) materials which fall through the screens are routed to the sand processing system.

5.3.2 Gravel Processing

The gravel at this stage contains lump clay. A log washer (a tank in which materials are agitated by heavy-duty rotary blades) is required to break the clay into small particles that may be more easily washed from the gravel. After being processed in the log washer, the gravel is free of most contaminants. However, a final grading and washing is required to insure a clean product. Therefore, the material is then run thru a triple deck inclined screen (Triple Deck Screen #2), which separates the gravel into several size ranges while washing slimes and small dirt. The final product is then conveyed to stockpiles for final distribution and use.

5.3.3 Sand Processing

Material passing thru the initial triple deck screen's lower deck contains muck and sand. To produce specification sands, this material must be graded and cleaned. A classifying tank is used for this purpose. The tank is a compartmented, horizontal, flow thru tank with outlets spaced along the bottom for removing the settled product. The principle of operation is that the distance the sand particles will be carried before they settle on the bottom of the tank is inversely related to the size of the particles. The heavier, (i.e. larger mesh) particles settle closest to the inlet, followed by the next smallest, ranging through the colloidal particles, which will not settle. The classifying tank produces a desired size assortment by controlling the operation of valves spaced at intervals along the tank bottom. The percentage of time each valve is open corresponds to the percentage of a certain size material required for the specification sand.

The sands flow from the classifying tank into either of two screw classifiers, where the material is washed and dewatered. (A third screw classifier may be added if it is desired to produce three types specification sand.) From the screw classifiers, the sands are conveyed to sand stockpiles.

5.4 Wash Water

The washing stages occuring throughout the sand and gravel operation generates a large amount of dirty water. This will be routed through the Water Treatment Process and recycled for reuse in the sand and gravel washing processes.

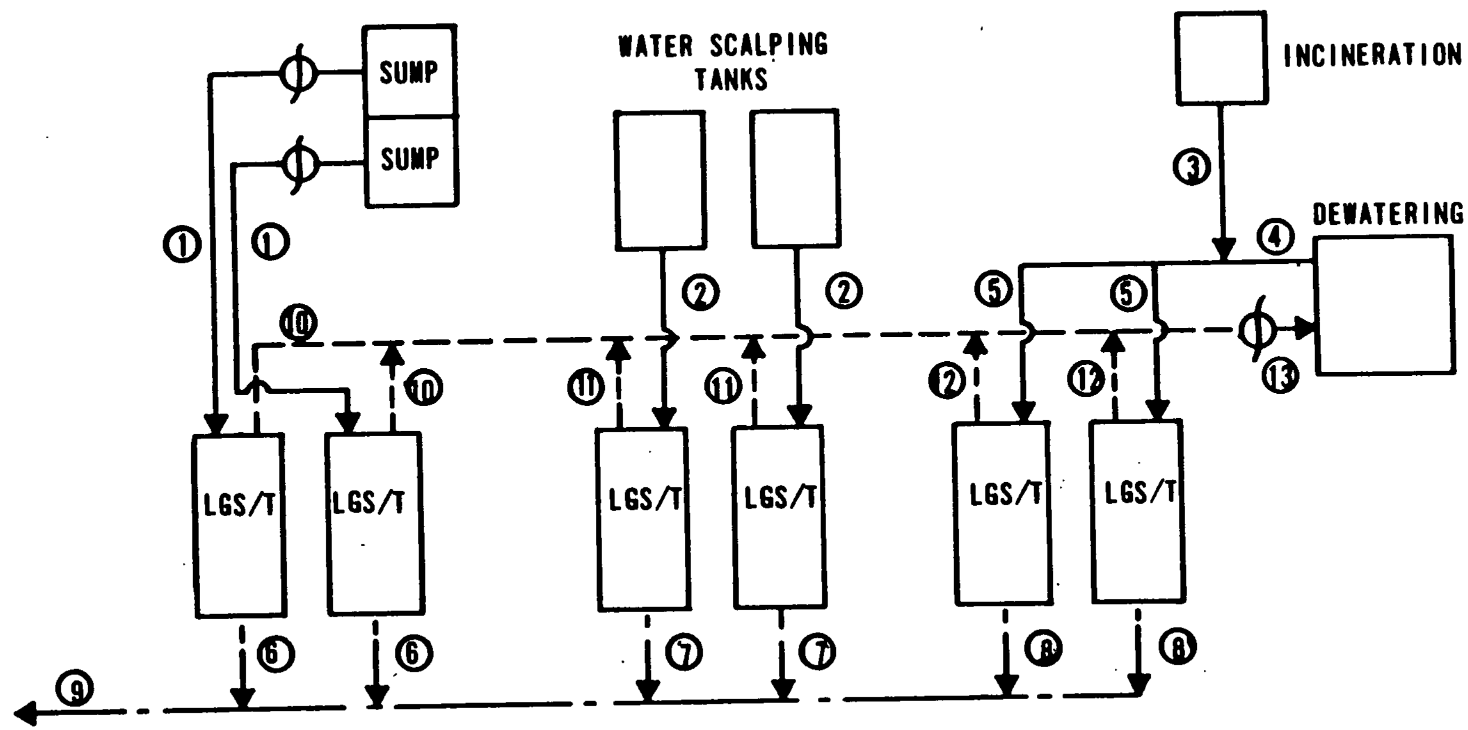
6. DEWATERING AND DENSIFICATION PROCESSES

The ultimate goal of dewatering and densification processes is to remove the maximum possible amount of water from the dredged material, thus reducing the eventual cost of decontamination. In the proposed plant, densification will be accomplished by mechanical means. A mass balance of the dewatering system appears in figure 6-1. Layouts of the dewatering building and LGS/Ts appear on plates #8 and #6 respectively.

6.1 In-Transit Dewatering

Depending on the type of dredged material, some dewatering will take place in transit. This will be the case primarily with sand/gravel loads. The free water can be pumped out of the barge and passed through the water treatment system for the removal of any suspended solids.

THICKENING MASS BALANCE



LEGEND

INCOMING SLURRY ————

THICKENED SLUDGE — — — —

CLARIFIED WATER — - ——

STREAM FLOW	1	2	3	4	5	6	7	8	9	10	11	12	13
SOLIDS (TPH)	26	66.7	.13	7.9	4	---	---	---	---	26	67	4	193
LIQUID (TPH)	280	446	12.5	779	3956	123	67	373	1126	147	378	22	1095
% SOLIDS	8.5	13	1	1	1	---	---	---	---	15	15	15	15
GALS/MIN	1107	1853	50	3117	1584	489	269	1490	4500	617	1584	94	4590

FIGURE 6-1

6.2 Mechanical Dewatering System

The separation of solids from water when bulk quantities of materials and fluids are involved has been successfully accomplished by municipal wastewater sludge dewatering industries for many years.

6.2.1 Lamella^R Gravity Settler/Thickener (LGS/T)

LSG/Ts are used extensively in the coal washing, aggregate processing, and mineral mining industries where the removal of heavy solids is required. The Marley Neck facility will utilize six Parkson 3250/55 LGS/Ts to treat 9700 gpm of wastewater and to thicken the sludge continuing on for further treatment.

A lamella gravity settler/thickener consists of a large rectangular tank containing a series of plates angled from 45° to 55°. The slurry is fed into the thickener through a bottomless feed box. Below the feed box the material is distributed over the plates. The clarified liquid flows upward and out of the unit, while the solids settle on the plates and slide downward into a sludge hopper. A low amplitude vibrating pack increases compression in the hopper. The solids are then pumped to the dewatering building.

6.2.3 Belt Filter Press

A belt filter press dewaters material by pressing it between a double moving set of belts. The belt press operates in two basic stages, the draining and the pressing stage. Initially, the feed material is fed into a flocculator. A flocculant is added to the mixtures, causing the formation of flocs, or agglomerations of particles, that are captured by the belt. The mixture then flows into the feed box and onto a drainage screen.

In the drainage screen, the majority of free water is drained off. Next, the muck is sandwiched between an upper and lower screen and is subjected to increasing pressure (compression). In some press designs, the muck can be subjected to a very high compression pressure area. The high pressure is generated by flat belts that press uniformly across the surface of the final dewatering roller.

The dewatered cake is removed from the screens by "doctor" blades. The screens are then washed and travel back continuously to the head of the press.

The system is used extensively for severe duty applications in the coal, pulp and paper, mining, and chemical processing industries.

A major belt filter press manufacturer, Parkson Corporation, Fort Lauderdale, Florida recommends using six model 3500-4x Magnum^{R} belt presses to handle the estimated 4600 gpm and 13% solids concentration flow from the LGS/Ts. This recommendation was made on the basis of a 7 day/week, 16 hr/day operation schedule.

A 16 hr/day operation is also economically advantageous in the incineration plant. The incineration process heats the soil to as high as 1600°F, and whenever this process is shut down, large quantities of recyclable energy (heat) are lost. Therefore, a longer operation schedule would account for considerable savings.

7. DECONTAMINATION METHODS

Two types of contaminants can be found in material dredged from Baltimore's harbor; organic compounds and heavy metals. Organic contaminants are most easily separated from soil by incineration. Heavy metals, however, are a hazardous product not easily immobilized, and therefore difficult to eliminate. Present day legislation is very strict regarding the disposal of hazardous wastes and if a treatment process cannot immobilize the metals, then a suitable hazardous waste disposal site must be found.

Processes originally considered to remove these pollutants included solvent extraction, high gradient magnetic separation (HGMS), digestion, solution mining (leaching) and incineration. These processes were evaluated to determine if they could successfully neutralize heavy metals. How effectively the process could handle a high water content (40% by weight) and a large amount of fines were also important considerations. (Approximately 80% by weight of the muck's dry solids are assumed to have a diameter of less than 50 ccm).

The most promising system appears to be a rotary kiln incineration process called Ecotherm, developed by the Dutch corporation Volker Stevin. This system is the only one known which has successfully treated soils contaminated with heavy metals. The Volker Stevin plant, using this incineration process found that heavy metals could be immobilized and bound to the soil at sufficiently high temperatures. A plan of this process is shown on plate #9.

7.1 System Description

Volker Stevin studied the Baltimore Harbor problem and presented several modified incineration systems. Since in the past their system has been used to decontaminate soil and earth, changes to their original design were necessary. Earth, unlike muck, does not have such a large amount of fines and it's water content is usually no greater than 15 percent. Conversely, the muck will have a large amount of -200 mesh material and upon reaching the incineration facility, a 40 percent water content.

Parallel and counter current flow rotary kiln processes were considered. The parallel flow system has the material and hot gases traveling through the kiln in the same direction. The counter current flow kiln have the gases and material moving in opposite directions. Volker Stevin recommended the parallel flow system along with such modifications as mixing gravel with the muck and adding a second rotary kiln and special settlement chamber to the process. The gravel is added to prevent lumping and sticking of the wet muck which could cause bad heat transfer and frequent equipment breakdowns. The second rotary kiln was added to minimize the risk of particles being carried away by exhaust gases without having reached the temperature necessary to decontaminate them. Finally, the settlement chamber was added to further reduce the number of particles entering the gas stream.

The system description is as follows: The muck mixed with gravel is fed into the first rotary kiln and the moisture content is reduced to approximately 15%. It then enters the second kiln where the evaporation process is completed. The purified soil and gravel then leave the kiln and are separated by means of a sieve. Both material streams are fed into a mixer where they are moistened and quenched. The gravel is recycled and fines escaping the mixer with the vapor produced are removed by washing and sedimentation.

Gases generated in the rotary kiln contain evaporated pollutants and fines. These gases are fed through a cyclone to remove dust and next through an after-burner where organic contaminants are incinerated at 1700°F. The hot clean exhaust gas then passes through a heat exchanger and venturi scrubber before being emitted through a stack.

7.2 Heavy Metals

Volker Stevin, after investigating the requirements for decontaminating Baltimore Harbor's dredged material, concluded that their process could not, at the present time, be modified to immobilize the heavy metals found. Volker Stevin and CSO, and environmental consultant in the Netherlands, are however working together on a process to decontaminate material dredged near Rotterdam. The process will incinerate organics and immobilize heavy metals in a ceramic compound which can be used in place of fill or gravel. It is therefore believed a process will be available within the next 5 to 10 years.

This leaves 2 options. First, the project can be abandoned but Baltimore, due to limited diked disposal areas, may in the future have to discontinue dredging. The second option is to build the plant and stockpile the incinerated soil containing heavy metals until future treatment methods are developed. After being treated by the proposed facility, the volume of contaminated material will be greatly reduced requiring smaller storage facilities.

8. REHANDLING AND HAULING

8.1 Stockpiling

As mentioned in Chapter 4, a 200,000 CY stockpile area will have the capacity to separately store three types of dredged material. The area will consist of six earthern, diked, open air chambers. Each dike will have a 3:1 slope. All diked areas will be formed in such a way that no cut or fill material need be hauled from or to the site. Since the Marley Neck site was formed with dredged material, a liner to prevent leaching is not required. The storage area is shown on plate #10.

A conveyor system like the one described in Section 4.6 will usually transport dredged material from the clamshell bucket offloading device, through the stockpiles directly to the treatment area. If, however, clay is being unloaded or there is a backup in the system, the material can be transferred to smaller conveyors which will drop it onto the stockpiles. Material movement and reclamation will be by means of front end loaders. Each diked area will have 2 hoppers and 2 conveyors to transport the material back to the unloading conveyor belt. This belt will move the material to either the sand and gravel operation.

Four finished product stockpiles, two for sand and two for gravel will be situated on either side of the sand and gravel processing equipment. At a production rate of 64 tons/day or 900 CF/day, each stockpile will have a 20 day storage capacity. Material will reach the stockpiles, each consisting of a concrete pad with concrete retaining walls on 3 sides, by conveyor. Material and finished product stockpiles are shown on plates #10 and #6 respectively.

8.2 Truck Hauling

8.3 Rail Hauling

Due to a prosperous local sand and gravel market, it is not believed rail hauling will be required. A rail line does, however, cross the west end of the site, and future installation of a spur would be relatively simple. This spur may also be installed if a disposal site accessible by train is found for hazardous wastes.

9. WATER TREATMENT/RECYCLE

A composite flow of 9715 gpm with a 1% solids concentration will be clarified by 6 Lamella Gravity Settlers/Thickeners. If a need for secondary treatment becomes evident, a rectangular clarifier will be constructed to process the wastewater before it is discharged.

Extracted solids, containing a large amount of water, will be pumped to the dewatering building. Most of the clarified water will be recycled through the separation and incineration systems. That not needed will be released into the harbor.

9.1 Primary Wastewater Treatment

Primary wastewater treatment will utilize Lamella Gravity Settlers/Thickeners (LGS/Ts). These settlers consist of a series of steel plates angled from 45° to 55°. Wastewater, treated with a flocculant to provoke agglomeration of the suspended solids, enters the unit and flows in a horizontal direction across the plates. Solids settle on the plates and the supernatant moves upwards to exit through orifice holes. The solids slide down the plates and into a sludge hopper. Flow emitted from the hopper will have a 15 to 20 percent solids concentration.

The Marley Neck facility will employ six Parkson Corporation model 3250/55 LGS/Ts. They will be above grade, packaged units of steel construction with separate mixer-flocculator modules. Each LGS/T measures 22 ft. high and including the flocculator covers 385 SF. The LGS/Ts are shown on plate #6.

9.2 Water Recycling System

All water used in the plant, 4900 gpm at peak operation, will flow into a 8,3600 CF receiving chamber. From here three 50 HP, 2000 gpm centrifugal pumps will recycle it into the processing system. Screen filters which can be cleaned by backwashing, will precede the pumps preventing damage from suspended solids. A low water cut off mechanism will halt pump operation when the level in the receiving chamber falls to 5 feet, and an overflow weir will maintain a maximum water level of 12 feet. The quantity of city water entering this chamber will be controlled by a manually operated valve.

Excess water in the system will escape over the weir and flow through 24 inch pipe directly into the Harbor. If water tests determine the suspended solids count to be over 400 ppm consistently, a secondary clarifier will be built. A flocculation chamber for this clarifier will already have been constructed within the receiving chamber. Water may be directed into it and on to the clarifier by opening a sluice gate.

9.3 Secondary Wastewater Treatment

A 45,600 CF secondary clarifier has been designed as a safety precaution. This clarifier will not be constructed as the LGS/Ts alone should reduce the suspended solids to the required level. If during operation a need for secondary treatment becomes evident, the settling tank will be built to treat water intended for release into the harbor. Water being recycled to the incineration or solids separation processes will not receive secondary treatment.

The water receiving chamber just south of the material stockpiles will contain a 2200 CF flocculation chamber and outlet pipes intended for the clarifier. The clarifier itself, can be constructed adjacent to this receiving chamber.

Overflow weirs will maintain the water level in the clarifer at 10'. As the wastewater flows through, the solids will settle to the bottom. These solids will periodically be removed from the clarifier by a truck with a suction unit and bladder. The solids will be transported to the dewatering building for further treatment.

9.4 Chemical Requirements

Both previously discussed water clarification systems rely on particle sedimentation. If particles with diameters as small as a few microns were allowed to settle on their own, required water retention times would be so large as to render most systems impractical. Therefore, a flocculant is added to the wastewater to provoke particle agglomeration and thus accelerate the settlement rate.

Flocculation chambers will proceed both the LGS/Ts and, if it is built, the clarifier. A polymer flocculant may be required at 1 or 2 ppm to provoke agglomeration in wastewater entering the LGS/Ts. If the clarifier is built, another chemical or polymer flocculant may be added to the wastewater to induce settlement here.

10. POTENTIAL USES AND DISPOSAL SITES FOR END PRODUCTS

10.1 Clay

10.2 Sand and Gravel

At peak operation, the proposed facility will produce 64 tons each of specification sand and gravel. A local market with prices ranging from $4.00 to $6.00 per ton has been confirmed by local sand and gravel manufacturers.

10.3 Soil and Fly Ash

The Ecotherm proces= will, through incineration, process muck into an organically free soil and produce fly ash. These products, classified as hazardous wastes due to the presence of heavy metals, must either be stockpiled on site or hauled to an approved disposal area.

Fly ash and as much as 815 tons of soil may be produced daily. At this rate, the present site will not have the capacity to store the products of incineration formed in one year. If the output is stockpiled on site, construction of a large concrete building with an impervious liner will be necessary. No other hazardous waste disposal areas are known at the present time.

The Dutch company Volker Stevin is working in conjunction with an environmental consultant, CSO, on a process to immobilize heavy metals in a ceramic-like compound. A preliminary study indicated the end products' properties would be such that they could be substituted for gravel, fill and split. The final design of this process will take at least another year.

10.4 Untreated Muck and Dredged Material

If a decision is made not to construct the incineration plant, untreated muck, a hazardous waste, must be stockpiled or disposed of at an approved site. 595,000 CY of muck will be produced annually. Furthermore, if the material is not processed at all, that is if clay, sand and gravel are not removed, 850,000 CY of hazardous waste will be dredged each year. Again, there is not sufficient space to store the products produced in one year on site.

11. ENVIRONMENTAL OVERVIEW

11.1 Role of the Regulatory Agencies

State government is at different times applicant, regulatory authority and contractor on dredging projects in Chesapeake Bay. These roles are variously assumed by the Maryland Port Administration, the Board of Public Works, and the Department of Natural Resources. State agencies do not adhere directly to their formally designated roles on dredging/disposal projects, but often function by informal interagency agreements. The actual roles and responsibilities of these agencies should be clarified to provide a recognized focal point of management.

The State is legally designated "local interest", responsible for providing disposal areas for dredging projects in the Baltimore Harbor and it's approaches, and in the connecting channels to the C&D approach. The Philadelphia District Corps of Engineers is responsible for selecting acceptable disposal sites for the C&D Canal and western approach. However, the State has both an economic interest in maintaining the Canal at authorized depths, and the responsibility for maintaining environmental quality during maintenance and improvement operations. The State is required by State Law to perform such monitoring (Natural Resources Article (9-1413-1). At this time only federal dredging projects receive the level of scrutiny specified in the monitoring legislation. However, nonfederal dredging and disposal operations of large magnitude may also cause significant environmental impact and should be monitored.

The study area is also within the jurisdiction of the State of Maryland's newly passed law governing environmental protection in the Chesapeake Bay's Critical Areas. This law designates certain areas of lands and waters to be included in the Chesapeake Bay Critical Area, subject to exclusion of certain types of land after certain findings are made. This legislation has been passed by Maryland's Senate Bill No. 664 (41 r 2441, Chapter 794).

11.2 Project Location

The proposed site lies on the south shore of the Patapsco River, bounded approximately by the Kennecott Refinery to the north, B.G.&E.'s Brandon Shores Power Plant to the south, and Fort Smallwood Road to the west. The entire site is located in Anne

Arundel County, just south of the Baltimore City-Anne Arundel County line. The Baltimore and Ohio Railroad bisects the site in approximately a north-south direction.

11.3 Proposed Development

The proposed facilities are located towards the northeast quadrant of the site (See ____________). The Materials Stockpile area is approximately 1300' x 800', the Solids Separation area is approximately 250' x 300', the Dewatering Building is approximately 100' x 100' and the Incineration Facility about 300' x 300'. The stockpile area has a capacity of 200,000 cubic yards.

11.4 Environmental Inventory

11.4.1 Air Quality

As mandated by the Clean Air Act of 1970, the Environmental Protection Agency promulgated the National Ambient Air Quality Standards (NAAQS) that define both primary and secondary levels of air quality for major pollutants. Primary standards define levels of air quality which are necessary, with an adequate margin of safety, to protect public health. Secondary standards are designed to protect the public welfare from any adverse effects on human comfort and enjoyment, and to protect animals, vegetation, materials and visibility. The NAAQS and the State of Maryland's ambient air quality standards are listed in Table 1. The Clean Air Act Amendments of 1977 directed each State to determine the NAAQS attainment status of each of its Air Quality Control Regions (AQCR) or their subareas. The project site is located in the Metropolitan Baltimore Intrastate (MBI) AQCR which includes Baltimore City and Anne Arundel, Baltimore, Carroll, Harford and Howard Counties. The air quality and attainment status designations for the various pollutants are as follows:

- Total Suspended Particulates (TSP) - There are many different sources of particulates, including combustion smoke, ash and dust. The site lies within the attainment area for TSP.

- Photo Chemical Oxidants - Ozone constitutes a regional problem attributed primarily to volatile organic compound emissions from automobiles, stationary sources, and subsequent atmospheric standards. Violations were recorded in both 1980 and 1981.

TABLE 1

Ambient Air Quality Standards

	National	
	Primary	Secondary
Secondary Sulfur Dioxide		
Annual Arithmetic Mean, ug/m^3	80	
24-Hour Maximum[a], ug/m^3	365	
3-Hour Maximum[a], ug/m^3		1,300
Particulate Matter		
Suspended		
Annual Geometric Mean, ug/m^3	75	60
24-Hour Maximum[a], ug/m^3	260	150
Carbon Monoxide		
8-Hour Maximum[a], mg/m^3	10	
1-Hour Maximum[a], mg/m^3	40	
Nitrogen Dioxide		
Annual Arithmetic Mean, ug/m^3	100	
Photo Chemical Oxidants		
1-Hour Maximum[b], ug/m^3	235	
Lead		
Three Month Average, ug/m^3	1.5	

a - Not to be exceeded more than once per year

b - Not to be exceeded on more than one day per year (averaged over 3 years)

Source: Maryland Air Quality Data Report 1984

- **Sulfur Dioxide** - Fossil fuel-fired power plants are the major sources of SO_2. Significant SO_2 levels may be found several miles from their source. The MBI AQCR is designated as meeting the standards.

- **Nitrogen Dioxide** - Nitrogen dioxide (NO_2) is generally formed in the atmosphere from the nitric oxide (NO) emitted by vehicular traffic, power plants and other combustion sources. The entire State of Maryland is designated as meeting the nitrogen dioxide standard.

- **Carbon Monoxide** - The MBI AQCR is designated as meeting the carbon monoxide standards. Carbon monoxide levels vary markedly with location since they are highly dependent upon proximity to major roadways and parking areas. While there are no monitors recording carbon monoxide levels near the site, it is likely the levels are being exceeded near major traffic arteries due to heavy volume and congestion.

- **Lead** - Ambient concentrations of leads are predominantly caused by emissions from gasoline-powered mobile sources due to the lead content in gasoline. Emissions from stationary sources also contribute to ambient concentrations of lead. At the present time, all areas of Anne Arundel County are considered to be attaining the Federal lead standard. In addition, EPA has approved Maryland's State Implementation Plan (SIP) for controlling lead emissions.

As required by the 1977 Clean air Act Amendments, the State of Maryland submitted a State Implementation Plan (SIP) to EPA in January 1979. The SIP provides for the implementation, maintenance and enforcement of the NAAQS in each AQCR within the State.

11.4.2 Noise Levels

Although detailed information in the study area was not available, the present rail and road system, the jet aircraft activity, and the industrial activities add noticeably to the noise element near these facilities. Careful control of both new facilities and development near these facilities will serve to mitigate against additional noise intrusion.

11.4.3 Surface Water

11.4.4 Groundwater

Anne Arundel County relies almost entirely on groundwater for its water supply needs, except for the northernmost portion of the County (the Glen Burnie Service Area) which is supplied partly with water purchased from Baltimore City. Also, according to studies conducted by the U.S. and Maryland Geological Surveys, the County's future water supply demand can be met easily from the three major water producing formations in the County: the Magothy, the Patapsco and the Patuxent formations.

11.4.5 Major Water Bodies

The Chesapeake Bay receives water from a basin of 64,170 square miles. Stream-gaging stations measure the fresh water input of approximately 80 percent of the land drainage area. There are over 50 tributary rivers with varying geo-chemical and hydrologic characteristics contributing fresh water to the Chesapeake Bay. The largest river basin on the east coast of the United States, the Susquehanna, drains 42 percent of the Bay basin. The Potomac River drains 22 percent of the Bay basin, while the Rappahannock - York - James System drains about 24 percent. The Chesapeake Bay represents an ancient drainage system, the predecessor of the present

Susquehanna River, which was "drowned" when the northeastern portion of the continent became down tilted toward the end of the Pliocene epoch (about 15 million years ago). As sea level changed during the following Pleistocene epoch, the ancient drainage system was modified further.

The mean tidal fluctuation in Chesapeake Bay is small, generally between one and two feet. Saline water intrusion is highest along the eastern side of the estuary due to the influence of Coriolis Force (a force caused by the earth's rotation which deflects water masses clockwise in the Northern hemisphere). Surface salinities range from 30 parts per thousand (p.p.t.) inside the mouth of the Bay to near zero at the north end of the Bay and in the tributaries of the Bay. Salinity variations constitute the most significant physical parameter influencing the circulation dynamics of the estuary. The ebb and flood of the tides are the most readily perceptible water movements in the Bay. Average maximum tidal current range from 0.5 knots to over 2 knots. The tidal currents supply necessary energy for the mixing of ocean and fresh water. Tidal currents, being oscillatory by nature, do not function as a mechanism for the net transport of water, suspended solids, or dissolved material. Within the Bay proper, its major tributaries, there is superimposed on the tidal currents, a nontidal, two layered circulation pattern that provides a net seaward flow in the upper layers of the Bay, and flow up the estuary in deeper layers.

During the winter, the Bay is high in dissolved oxygen content. With spring and higher water temperatures, the dissolved oxygen content decreases. Surface values stay near saturation while in deeper water the dissolved oxygen content becomes significantly less because of increasing oxygen demands, decreasing temperature, and vertical mixing. Through the summer, lower layers become oxygen deficient in the headwaters and smaller tributaries. By early fall, vertical mixing takes place, and the oxygen content at all depths begins to steadily increase until there is almost uniform distribution of oxygen.

Water quality as a whole in Chesapeake Bay is good. Several tributaries, however, are seriously degraded: notably the Potomac and James Rivers, and Baltimore Harbor in the Patapsco River. Probably the most extensive water quality studies in Baltimore Harbor were made by Garland (1952); Stroup, Poritchard and Carpenter (1961); and Wilson (1970).

Garland studied primarily salinity and temperatures and presented conclusions that flushing characteristics were based primarily on meteorological tides, and that local fresh water produced very little flushing. Stroup et al. determined that a three layered density-driven system exists in Baltimore Harbor, with an inflow of Bay water at the surface and at depths (in the navigation channel) and an outflow from the harbor at mid-depth. Due to the dynamic density-controlled two-layer circulation pattern of Chesapeake Bay, there is a net outflow of low salinity water at the surface and a net inflow of high salinity water on the bottom. As water in Chesapeake Bay freshens in springtime as a result of high Susquehanna River discharges, water in Back and Middle Rivers (and many other small tributaries) remain more saline and more dense than Bay waters. Since the more dense water sinks below water of lesser density, there is an outflow of water from the river to the Bay along the bottom, and a corresponding inflow of fresher water at the surface in order to equalize water levels.

As the water in Chesapeake Bay becomes saltier in autumn as a result of reduced flow in the Susquehanna River, the tributaries remain fresher than the Bay.

The more dense water flows in on the bottom, and the fresher, less dense water flows out at the surface.

Baltimore Harbor has historically been degraded by deposition of assorted wastes. Good fishing near the mouth of the harbor, and poor fishing within the harbor is due to waste discharges. In general, the pollutants affecting Baltimore Harbor are derived from municipal industrial and agricultural sources. Agricultural pollutants consist primarily of silt, fertilizer, insecticides, herbicides, and animal wastes. Industrial wastes contain a wide assortment of detrimental material ranging from sand and gravel wastes and heavy metals to complex chemical compounds and mine waste. Many of the latter waste types are toxic to both aquatic biota and man.

Municipal discharges contain human wastes and a huge panorama of household and industrial by products and often inject significant bacterial loads into the aquatic environment, contaminating both finfish and shellfish, making them potentially dangerous and therefore unfit for human consumption.

11.4.6 Ecosystems (Flora and fauna)

The Chesapeake Bay is one of the more important areas in North America for migrating and wintering waterfowl. The approximate numbers of waterfowl wintering in the upper Chesapeake region alone average about four percent of the entire continental population and about 23 percent of the Atlantic flyway population. Examples include the canvas back (Aythya nalisineria), Canada goose (Branta canadensis), black duck (Anas rubripes), and scamp (Aythya Spp.) make up more than half the average winter population. Other important species include the whistling swan (Cygnus Columbianus), mallard (Anas platyrhynchos), pintail (Anas acuta), American widgeon or baldpate (Mareea Americarra), and ruddy duck (Oxyura Jamaiceusis). Wintering populations require an adequate food supply (grains, emergent and submerged aquatic plants, finfish, and shellfish), cover and roosting and nesting areas. Comparatively small breeding population of dabbling ducks, primarily black ducks, remain in the area during late spring and summer.

Other birds common to the project area include American widgeon, teal (Anas Spp.), ringnecked duck (Aythya collaris), goldeneya (Bucephala clangula), red head, canvasback, bufflehead (*Glaucionetta albeola*), Canada goose, whistling swan, herring gull (*Larus argentatus*), ring billed gull (*Larus delawarensio*), laughing gull (*Larus atrieilla*), crow (*Coruus spp.*), red wing blackbird (*Agelaius phoeniceus*), sparrow (*Fringillidae*), and rails and galliuules (*Rallidae*).

Typical mammals which may be found around the project site include muskrat (*Ondatra zibethicus*), raccoon (*Pyocyon lotor*), otter (*Lutra canadensis*), mink (*Mustela vision*) and deer (*Odocsileus virginianus*), according to the Maryland Fish and Wildlife Administration.

Fishery resources in the tidal portion of the Patapsco River are of low value because of influence connected with urbanization of the area and previous construction activities. However, Chesapeake Bay contains a variety of high value fish and water-related wildlife resources. A recent report (USFWS, Bureau of Sport Fisheries and Wildlife, 1968) estimated average annual commercial finfish and shellfish harvest in the Bay for the period 1960-1964 to be approximately 320 million pounds with a value of $16.4 million. During this period, Chesapeake Bay tributaries provided about 6.7 percent of the total value United States commercial finfish harvest and 29.9 percent of the total shellfish (oysters, clams and crabs) harvest. In 1970, Virginia was the Nation's leading producer of blue crabs and Maryland lead the Nation in the production of oysters, soft-shell clams, and stripped bass. A variety of fresh water and marine finfish and shellfish found in the Bay included such species as menhaden (Brevoortia tyrannus), alewives (Alora pseudoharengus), American shad (Alosa Sapidissina), striped bass, spot (Leiostomos xanthurus), Atlantic croakers (Micropojon undulatus), seatrout (Cynoscion Spp.), flounders (Pleuronectiformes), blue fish (Pomatomus saltatrix), yellow perch (Perca flavesceus), white perch, sunfish (Lepomis Spp.), catfish (Tetalurus Spp., oysters, hard clams (Mercenaria mercenaria), soft shell clams and blue crabs. In addition, Chesapeake Bay is an important spawning and nursery area for valuable offshore fishes. The flora and fauna found on and near the study area are fairly typical of the upper Chesapeake Bay. Fish species observed by Ritchie (1970) in the Upper Chesapeake Bay are listed in Table 2. The list includes 13 freshwater species and 31 marine species, for a total of 44 fish species.

Of the 66 invertebrate species observed by Pfitzenmeyer (1970) in the Upper Chesapeake Bay, nine

TABLE 2

Common and scientific names of fish species collected in Upper Chesapeake Bay. Types of species: F = freshwater; M = marine; M&F = lives in both marine and freshwater. Brief description of each species's principal use of this area is included. Sp = spring, S = summer, W = winter (from Ritchie, 1970).

		Principal Usage of Area
* Alewife - Alosa pseudoharengus	M&F	Nursery
* American eel - Anguilla rostrata	M&F	Nursery & adult feeding (males only)
* American shad - Alosa sapidissima	M&F	Nursery
Atlantic croaker - Micropogon undulatus	M	Nursery; migrant feeding (S)
Atlantic herring - Clupea harengus harengus	M	Nursery; migrant feeding (S)
* Atlantic menhaden - Brevoortia tyrannus	M	Nursery; migrant feeding (S)
* Atlantic silverside - Menidia menidia	M	Spawning (Sp.) nursery
Atlantic sturgeon - Acipenser oxyrhynchus	M&F	Spawning (Sp.)
* Bay anchovy - Anchoa mitchilli	M	Spawning (Sp.) nursery, feeding (S)
Black drum - Pogonias cromis	M	Nursery; feeding (S)
* Blueback herring - Alosa aestivalis	M&F	Spawning (W); nursery
* Bluefish - Pomatomus saltatrix	M	Migrant feeding (S)
Bluegill - Lepomis macrochirus	F	Life resident
Brown bullhead - Ictalurus nebulosus	F	Life resident
* Butterfish - Peprilus triacanthus	M	Migrant feeding (S)
* Channel catfish - Ictalurus punctatus	F	Life resident
* Gizzard shad - Dorosoma cepedianum	M&F	Spawning (Sp.); nursery
* Golden shiner - Notemigonus crysoleucas	F	Life resident
* Hickory shad - Alosa mediocris	M	Spawning (Sp.); nursery
* Hogchoker - Trinectes maculatus	M	Life resident
Johnny darter - Etheostoma nigrum	F	Life resident
Mummichog - Fundulus heteroclitus	M&F	Life resident
Northern puffer - Sphoeroides maculatus	M	Migrant feeding (S)
Northern searobin - Prionotus carolinus	M	Migrant feeding (S)
* Oyster toadfish - Opsanus tau	M	Life resident
* Pumpkinseed - Lepomis gibbosus	F	Life resident
Scaled carp - Cyprinus carpio	F	Life resident
Silver hake - Merluccius bilinearis	M	Migrant feeding (S)
* Silver perch - Bairdiella chrysura	M	Nursery; migrant feeding (S)
Silvery minnow - Hybognathus nuchalis	F	Life resident

TABLE 2 (Continued)

		Principal Usage of Area
* Southern harvestfish - <u>Peprilus alepidotus</u>	M	Nursery; migrant feeding (S)
* Spot - <u>Leiostomus xanthurus</u>	M	Nursery (W); migrant feeding (S)
* Spotted hake - <u>Urophycis regius</u>	M	Nursery (W); migrant feeding (S)
* Spotted seatrout - <u>Cynoscion nebulosus</u>	M	Nursery (W); migrant feeding (S)
Spottail shiner - <u>Notropis hudsonius</u>	F	Life resident
* Striped bass - <u>Morone saxatilis</u>	M&F	Spawning (Sp.); nursery feeding
Summer flounder - <u>Paralichthys dentatus</u>	M	Migrant feeding (S)
* Weakfish - <u>Cynoscion regalis</u>	M	Nursery (W); migrant feeding (S)
* White catfish - <u>Ictalurus catus</u>	F	Life resident
White crappie - <u>Pomoxis annularis</u>	F	Life resident
* White perch - <u>Morone americana</u>	M&F	Life resident
* Winter flounder - <u>Pseudopleuronectes americanus</u>	M	Spawning (W); nursery
Yellow bullhead - <u>Ictalurus natalis</u>	F	Life resident
* Yellow perch - <u>Perca flavescens</u>	F	Life resident

* Fish taken near Hart and Miller Islands.

Source: The Northeast Regional Environmental Impact Study, Reference Document for the Health Effects of Air Pollution, U.S.D.E., November 1981.

species were found more commonly than any others during the 1966-1968 study period. These include the mollusks Macoma phenax, M. balthica, and Rangia cunneata; the arthropods Edotea triloba, Gammarus sp., Cyathura polila, and Leptocheisus plumulosus, the polychaete worms Theteromastus filiformis, and Scolecolepides viridis. Although oysters were formerly harvested above North Point towards Baltimore, and in the Bay near Hart and Miller Islands, there is no commercial fishery today. Blue crabs create an important recreational fishery.

The wetland vegetative types in the project area are classified by the Maryland Fish and Wildlife Administration as shrub swamp, and coastal shallow fresh marsh. Plants commonly found in this area include Olney three square (Scirpas Olenyi), narrow leaf cattail (Typhe augustifolia), big cord grass (Spartina cynosuroides), rosemallow (Hibiseus maschentos), reed (Phregmites communis), switchgrass (Paincum virgatum), spikerush (Eleocharis sp.), saltmarsh mallow (Kosleletzkya virginica), salt grass (Distichlis spicate), high tide bush (Iva frutescens), groundesel bush (Bacharis halmifolia), maple (Acer Spp.), poplar (Populus Spp.) willow (Salix Spp.), maple (Acer Spp.), poplar (Populu Spp.), willow oak (Querus phellos), sweetgum

(Liquidaube styuracifhia), ash (Fraxinus Spp.), loblolly pine (Pinus taeda), and elder (Alnus Spp.).

A potential role of the on site wetland area is biomass production. Although no productivity studies were conducted, their importance according to the State would rate low to moderate compared to the most productive types of wetlands. The principle reason for the low production is caused from the lack of daily tidal flooding to transport detritus material to the Bay. In many places along the shoreline, the wetlands are separated from estuarine waters by berms and only during storm and spring tidal action is material transported. As a result, most of the biomass produced remains in the wetlands.

Species of fish and wildlife threatened with extinction in the Chesapeake Bay Basin Study Area have been identified and classified by the committee on Rare and Endangered Species of the Bureau of Sport Fisheries and Wildlife. The following is a list of species with their status:

List of Species	Status
Bog Turtle	Rare
Maryland Darter	Endangered
Shortnose Sturgeon	Endangered

Delmarva Peninsula Fox Squirrel	Endangered
Southern Bald Eagle	Endangered
Eskimo Curfew	Endangered
Artic Peregrine Falcon	Endangered
Ipswich Sparrow	Rare
Osprey	Status undetermined
Eastern Pigeon Hawk	Status undetermined
Eastern Fox Snake	Status undetermined

11.4.7 Geology

The study area is adjacent to the Chesapeake Bay, which is one of the largest estuarine bodies of water in the world. It lies entirely within the Atlantic Coastal Plain in the Chesapeake Bay region which is underlain by a thick, wedge shaped series of sedimentary formations which strike northeast and dip gently toward the southeast. These "soft" rocks are composed of mostly unconsolidated beds of sands, clays, marls, and gravels, which range from Lower Cretaceous to recent in age. A summary of the Atlantic Coastal Plain formation is shown in Table 3. The thin edge of the wedge lies along the inner westernmost portion of the coastal plain, while the thick portion underlies the Atlantic Coast where information from deep drilling in the vicinity, shows the Coastal Plain Sediments to be in excess of 7,500

TABLE 3

GEOLOGIC FORMATIONS IN THE CHESAPEAKE BAY REGION

AGE	APPROXIMATE AGE (millions of years)	FORMATION
Recent		-
Pleistocene	2+	Pimlico Wicomico Sunderland
Pliocene	10	Brandywine Bryn Mawr
Miocene	27	Yorktown St. Mary's Choptank Calvert
Eocene	55	Nanjemoy Aquia
Upper Cretaceous	130	Monmouth Matawan Magothy Raritan Patapsco Arundel
Lower Cretaceous		Patuxent
------(UNCONFORMITY)		
Pre-Cambrian	1,500 - 3,500	Hard crystalline rocks, including granite, gneiss, schist, diorite, gabbro, and serpentine.

Source: The Northeast Regional Environmental Impact Study, Reference Document for the Health Effects of Air Pollution, U.S.D.E., November 1981.

feet thick. The basement upon which these sedimentary formations rest is composed of very ancient, predominantly pre-Cambrian, crystalline rocks upon which a prolonged pre-cretaceous erosion cycle produced a plained surface. The Chesapeake Bay represents an ancient drainage system which was "drowned" when the northeastern portion of the continent became downtilted toward the end of the Plicene epoch. Further modification was introduced by the rising and falling sea level upon a presumable stable land surface during the following Pleistocene glacial epoch.

Recurring stages of growth and depletion of the huge ice on the northern portion of the continent are believed to have caused recurring fluctuations in the Ocean's level of perhaps as much as 230 to 330 feet. Periods of glacial growth during which much of the Ocean waters were locked in the continental ice caps, were times of low sea level.

The interglacial periods were times of high sea level. The low water marks are now covered by the bay waters, but the high water levels, each slightly lower than the one preceding, remain as the elevated strand lines which bound the Pleistocene marine terraces.

In the past in the Baltimore area of the project numerous borings have been taken. The vast majority were taken to a depth of 50 feet or over. Most of the material was a silty, clay silt with small traces of sand at different locations.

11.4.8 Transportation

11.4.8.1 Rail

Because of low rail transportation rates and excellent railroad facilities, the regional area that can reasonably be considered tributary to Baltimore includes the States of Ohio, Indiana, Illinois, Iowa, North Dakota, South Dakota, Nebraska, Kansas, Wisconsin, Michigan and Maryland, along with portions of New York, Kentucky, Delaware, Pennsylvania, Virginia, West Virginia and Missouri. This regional tributary area contains the large consuming centers of the middle west and widely diversified character. Baltimore is 50 to 200 miles closer to the midwest than any other North Atlantic port. The port of Baltimore is served by three trunk line railroads: the Chesapeake and Ohio/Baltimore and Ohio Railroad Company (C&O/B&O), the Penn

Central and the Western Maryland Railway.

The B&O operates principally in Maryland, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, and portions of Missouri, Michigan, New Jersey and New York. The C&O serves the same area as the B&O with the addition of Virginia and Kentucky. The Penn Central operates principally in Maryland, Pennsylvania, New York, Ohio, Indiana, Illinois, and Michigan, and into portions of Missouri, Kentucky, West Virginia, Virginia, Delaware, and Massachusetts. The Western Maryland Railway operates generally in Maryland, Pennsylvania and West Virginia.

The Baltimore and Ohio Railroad, which runs through the project site, is not expected to hinder the proposed project, and will provide easy rail access.

11.4.8.2 Motor Freight

Motor freight service available to the Port of Baltimore ranks among the most modern systems in the United States. High speed interstate highways connect the Baltimore area with other major transportation routes throughout the east coast. The John F. Kennedy Memorial Highway (I-95) connects Baltimore to the North with the New Jersey Turnpike. Interstate 95 also connects the Baltimore area with Washington, D.C. and other major metropolitan areas to the South. The Baltimore Harbor Tunnel and Baltimore Beltway presently provide the connecting links between the two sections of I-95. Interstate 83 connects Baltimore, to Harrisburg, Pennsylvania and to the Pennsylvania Turnpike. Interstate 70-N connects Baltimore with points in western Maryland and to the Pennsylvania Turnpike to the west. Beltways around Baltimore and Washington, D.C. allow rapid circumvention of these cities for goods destined for other areas. Maryland Route 3 connects Baltimore with U.S. Routes 50 and 301, providing ready access to Delaware and the Eastern Shore of Maryland and Virginia, via the William Preston Lane, Jr. Memorial Bridge over the Chesapeake Bay.

11.4.8.3 Air Freight

Foreign and domestic air transportation is available through the Baltimore-Washington International Airport, located within 10 miles of many of the Harbor facilities. Rapid access to the airport is provided by the Baltimore-Washington Parkway. The airport is in a position to serve the whole of the State of Maryland, a part of Central Pennsylvania, and the District of Columbia. In 1972, the airport handled over 100 million pounds of air freight, including more than 59 million pounds inbound and over 43 million pounds outbound. These figures are exclusive of express cargo and U.S. Postal Service shipments.

11.4.8.4 Area Shipping

Waterborne transportation connects Baltimore with major United States and Foreign ports. There exists a considerable volume of international shipping traffic which travels the waters of Baltimore Harbor. The Chesapeake Bay estuary includes two ports of national importance, Hampton Roads (which includes Norfolk & Newport News, Virginia) and Baltimore Harbor, Maryland.

Baltimore Harbor was the fourth largest port in the United States with 44,002,785 short tons of traffic, including 18 million short tons of imports (A short ton is 2000 lbs.). Baltimore is a major bulk commodity and general cargo port, the principal commodities being iron ore, coal, petroleum and grains. Baltimore Harbor contains over 90 general cargo piers and over 40 specialized piers receiving a wide variety of bulk materials in deep draft vessels. Coal is loaded for export principally at the Baltimore & Ohio Railroad pier in Curtis Bay. Petroleum products are received at 13 piers located throughout the Harbor, with the principal receiver being located on the east leg of the northwest branch.

Imports comprise about 90% of the prospective deep-draft commerce with steel-making ores and petroleum being the principal items. Baltimore Harbor is important both to a local and a regional tributary area. The local tributary area may be defined as the Baltimore Metropolitan Area, comprised of Baltimore City and Baltimore, Cecil, Howard and Anne Arundel Counties (as defined by the Bureau of the Census). The Metropolitan Area comprises of approximately 2050 manufacturing plants which employ about 209,700 workers or about 73% of the 287,600 persons employed in manufacturing operations in the state. The annual payroll of these plants is about $1,486,100,000. The industrial, commercial, and transportation complex making up the port of Baltimore, annually pours over $625 million into Maryland's economy while directly providing jobs for 62,138 Maryland residents. This is the primary economic impact of the port which generates, in turn, a total impact estimated at no less than $1.56 billion, representing 11.7 percent of Maryland's Gross State Product.

11.4.9 Aesthetics

11.5 <u>Environmental Assessment</u>

11.5.1 Air Quality

11.5.1.1 Equipment Emissions

State of the art air pollution control devices will be incorporated into the design of these facilities. Air quality in the study area is not expected to be degraded as a result of this project.

11.5.1.2 Fugitive Dust

Dust and particulates could emanate from traffic on roads, or from the stockpile area or from the transfer conveyor. This can easily be controlled by appropriate watering or spraying of these areas as applicable.

11.5.1.3 Odors

Odors expected from the overall disposal of dredged material and the processing facilities are expected to be minimal or non existent. Odors might occur in the dewatering building, but since it is an enclosed structure, odor control is feasible.

11.5.2 Noise Levels

The State of Maryland has enacted a policy to limit noise levels which in turn would protect the health, general welfare and property of the people of the state (Code of Maryland Regulations, Title 10, Health and Mental Hygiene, Subtitle 20, Chapter 101 - effective March 28, 1983).

Per these regulations, the following sound levels represent the standards for each general zoning district.

ENVIRONMENTAL NOISE STANDARDS

Zoning District	Level	Measure
Industrial	70 dB(A)	Leq
Commercial	64 dB(A)	Ldn
Residential	55 dB(A)	Ldn

where Leq = equivalent sound level, which is the level of time weighted, mean square, A-weighted sound pressure

Ld = the daytime average sound level

Ln = the nighttime average sound level

dB(A) = sound level in decibels determined by the A-weighting network of a sound level meter

In Maryland a person may not cause or permit noise levels which exceed those specified in the following table:

MAXIMUM ALLOWABLE NOISE LEVELS dB(A) FOR RECEIVING LAND USE CATEGORIES				
Effective Date	**Day/ Night**	**Industrial**	**Commercial**	**Residential**
Upon Adoption	Day	75	67	65
	Night	75	62	55

11.5.2.1 Equipment Noise

The industrial category of noise in the study area includes but is not limited to the Solids

Separation area, the Dewatering Building and the Incineration Facility. The design of these facilities would incorporate devices in each unit of the processing facilities that would dampen or reduce noise emanating from them. Because the industrial nature of adjacent lands allow levels of 75 dB(A), noise levels are expected to stay within the State of Maryland's permissible limits.

11.5.2.2 Vehicle Noise

All over the road trucks operating in Maryland have to be licensed by the State. Since these licensing requirements provide for devices to prevent excessive noise, the noise impact due to truck transportation is expected to be minimal.

11.5.3 Water Quality

11.5.3.1 Unloading Operations

During the unloading operations, the water quality in the area is not expected to be degraded. However, there would be some environmental effects due to turbidity generated at the unloading facility area.

11.5.3.2 Emergency Spills

The possibility of water pollution increases if, during a partial or total emergency spill, the suspended solids increase above 400 ppm. In areas of discharge other than to the receiving water, the danger arises of possible groundwater contamination.

11.5.3.3 Plant Discharge to Harbor

The overall discharge to the harbor from the treatment facilities is governed by the State and Environmental Protection Agency's NPDES (National Pollutant Discharge Elimination System) permit. The established criteria for this purpose is 400 ppm for suspended solids. At the present time this is the only parameter to be considered for preliminary design purposes. Should the need arise for more stringent requirements, a waste load allocation study for the harbor at the receiving site could easily be conducted to determine discharge limits.

11.5.4 Solid Waste Disposal

There are various kinds of solid wastes generated as a result of treatment of dredged sediments. These can be broken down into trash and junk, unmarketable portion and residue from processing facilities.

11.5.4.1 Trash and Junk

This portion, which cannot be processed at the site, would need to be disposed of or arranged to be landfilled. The metal portion could be sold as scrap after separation from the other trash by magnetic separation.

11.5.4.2 Unmarketable Portion

The unmarketable portion would also not be able to be disposed at the site. It would have to be hauled off to be disposed of at a remote site designated for this purpose, or it could be landfilled.

11.5.4.3 Residue

The liquid portions of these wastes could be recycled at the head of the plant. The solid residue could be either landfilled at designated locations or hauled off for disposal at a remote location.

11.5.5 Ecosystem

11.5.5.1 Wetlands (Tidal & Upland)

The areas immediately adjacent to the construction site would be modified by construction activities. The creation of slackwater areas above and below the construction site along the Maryland shore may favor the production of algal blooms, and they would be sediment traps due to reduced current velocities. At low flow in the summer months the algal bloom population in the backwater areas may not be any worse than in the main stem. Accumulation of sediment would change the suitability of the substrate for benthic organisms and could result in temporary changes in the species present. Other species might be attracted to the area because of high plankton production and still water, provided oxygen levels remain high.

11.5.5.2 Flora & Fauna

The operation of heavy construction equipment, temporary cofferdam construction, and rock blasting, could remove some vegetative biomass. The vegetation on the project site serves several eco system functions, which could be lost either permanently in areas of new buildings, or temporarily in areas to be restored. Permanent removal would contribute to the cumulative loss of riparian and natural habitats now occurring in the study area.

11.5.5.3 Rare & Endangered Species

Since no rare and endangered species are known to inhabit the site as residents, there should be no direct impacts on these species. Any construction activities (i.e. siltation) which could harm aquatic resources could secondarily affect bald eagles or peregrine falcons. (Major limiting factors, however, are pesticides in food chains.) Noise from blasting could temporarily affect rare or endangered birds feeding in the area by scaring them away.

11.5.5.4 Chesapeake Bay Critical Areas Legislation

The study area is located entirely within a designated Critical Area as defined by the State of Maryland. The Senate Bill No. 664 (14 r 2441) Chapter 794 was approved by the Governor of the State of Maryland on May 29, 1984. This bill designates certain areas of lands and waters to be included in the Chesapeake Bay Critical Area, subject to exclusion of certain types of land after certain findings are made. From June 1, 1984 with regard to any approval of a zoning amendment, variance, special exception, affecting any land or water area located within the initial planning area identified in Section 8-1807(A) of this subtitle, for which application is completed after that date, the approving authority of the local jurisdiction in rendering its decision to approve an application shall make specific findings that the proposed action shall have no adverse environmental effect in the area. There are various wetlands in the study area that need to be considered in this regard (See Table 4).

TABLE 4

The list of classified wetlands in the study area are shown in Figure ___. These can be further subdivided into the following:

TYPE		EXPLANATION			
		ECOLOGICAL SYSTEM	ECOLOGICAL SUBSYSTEM	CLASS	SUBCLASS
(i)	PFOIA	Palustrine	-	Forestic	1) Broad leaved deciduous 2) Needle leaved deciduous 3) Broad leaved evergreen 4) Needle leaved evergreen 5) Dead 6) Deciduous 7) Evergreen
(ii)	PEM5E	Palustrine	-	Emergent	Narrow leaved persistent seasonal saturated
(iii)	PEM1F	Palustrine	-	Emergent	Water regime, semipermanent
(iv)	POWF	Palustrine	-	Open water unknown bottom	Semipermanent
(v)	POWZH	Palustrine	-	Open water unknown bottom	Intermittently exposed/ permanent & permanent
(vi)	POWZ	Palustrine	-	Open water unknown bottom	Intermittently exposed/ permanent
(vii)	PEM5	Palustrine	-	Emergent	Narrow leaved persistent
(viii)	PEM5/1F	Palustrine	-	Emergent	Narrow leaved persistent, persistent semipermanent
(ix)	PEM1FH	Palustrine	-	Emergent	Persistent, semipermanent/ permanent
(x)	PEM1KFH	Palustrine	-	Emergent	Persistent, artificial, semipermanent, permanent
(xi)	POWKZFH	Palustrine	-	Open water unknown bottom	Artificial, intermittently exposed/permanent/semi-permanent
(xii)	E1UB4L	Estuarine	Subtidal	Unconsolidated bottom	Organic, subtidal
(xiii)	E2EM1P	Estuarine	Intertidal	Emergent	Persistent, irregular
(xiv)	E2B8P	Estuarine	Intertidal	Aquatic Bed-saturated	Eusaline, irregular
(xv)	E2FLN	Estuarine	Intertidal	-	Semipermanent subtidal regular

11.5.6 Access

The site is accessable by water, rail or highway.

11.5.6.1 Water

Barges will have access to the northeast quadrant of the study area where unloading will take place. This site is located just east of the stockpile area. Dredged material will be transported to the material stockpile area by transfer conveyor.

11.5.6.2 Rail

Towards the south westerly direction and to the west of the stockpile and processing area, access is possible to the Baltimore & Ohio Railroad. Rail access is therefore possible to a full network of railways in the United States.

11.5.6.3 Highway

To the south of the stockpile area is an access road. Access is thereby possible to Brandon Shores Road and Fort Smallwood Road. These roads are connected via other roads to Interstate 95 and 695, which also provide access to the Baltimore Washington Parkway.

11.5.7 Aesthetics

11.5.7.1 Visual Impact (Land & Water)

The project site where the material is expected to be stockpiled is not expected to have any adverse visual impact. It has been sized into a 1300' x 800' area, making it fairly compact. The same is the case for the dewatering facility which is about 100' x 100' and the solids separation area which is about 250' x 300'. More over all the facilities including the unloading facility are lined up in series, making them visually acceptable in relation to the study area.

11.5.7.2 Buffers

There is plenty of room to the north, west and east of the proposed facilities. This would allow for enough buffer space between the project site and the Kennecot facility and the Brandon Shores Power Plant respectively. On the other hand, the area to the east of the site being the river, is already a buffer space.

11.5.7.3 Landscaping

The areas to the north, south and west of the project site have plenty of space to allow for tree lines in the buffer zones. Mounds can also be constructed to serve a two-fold purpose, by attenuating noise and for good aesthetics.

11.5.8 Security

The processing facilities are within an industrial zone. There is no history of any security problem associated with the location of the Kennecot and Brandon Shores Power Plant facilities, respectively. No security problems are anticipated for this project.

There is adequate space to erect a fence around the processing facilities, should any need arise for additional security. Signs designating safety hazards are expected to be clearly posted in applicable areas.

11.6 References

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12. CONCLUSIONS AND RECOMMENDATIONS

The Marley Neck facility has been designed to process 850,000 CY of dredged material per year. It is estimated that 15% of this material will be clay, 15% sand and gravel, and 70% muck.

The process will consist of several separate but interacting system: unloading and stockpiling, solid separation, water treatment, dewatering and detoxification (incineration). These systems will separate the dredged spoil into it's separate components, and wherever possible, process them into marketable products. End products of the system include sand, gravel and clay with commercial value, treated water which can be released into the harbor or recycled through the process, large objects extracted from the spoil which will be disposed of at a local disposal site, and soil and fly ash - both hazardous wastes due to the presence of heavy metals.

At the present time, no means exist to remove or immobilize heavy metals. The present site is not large enough to stockpile even a year's output of aggregate, and no hazardous waste disposal sites are known. This leaves three alternatives.

First, a decision not to create a hazardous waste, or not to build, may be made. Because all known diked disposal areas will soon be filled, however, Baltimore may in the future be forced to cease dredging. This would obviously have grave economic consequences. If dredging continues, an alternate method for disposing or storing 850,000 CY per year of dredged material will have to be found.

The second alternative is to build everything but the incineration system. This would allow the processing of sand, gravel and clay, but would not treat the contaminated muck. If this is done, 595,000 CY per year of hazardous waste will be produced. This waste will contain organic as well as heavy metal pollutants. The muck will have a water content of 40% and precautions must be taken to prevent stockpile leaching. Again, the present site is not large enough to provide storage for this muck.

The last alternative is to build the plant as designed. This would remove and treat all water from the muck and reduce the amount of hazardous waste to the smallest possible volume. Since heavy metal contamination is limited to the top five foot layer of the harbor bottom, the amount of hazardous waste could be even further reduced by dredging and processing this layer separately. This suggestion was made by AVECO Infrastructure Consultants in their "Narrative on Selective Dredging" completed in January of 1985.

If a decision's made to build the plant, we suggest a pilot plant be constructed first. This conservative approach would allow testing the process and monitoring quantities of flow on a small scale. A conservative approach would be the safest, since a similar plant has never been built.

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13. COST ESTIMATES

13.1 General

This chapter provides a preliminary cost estimate for the various processes described in Chapters 5 thru 9. Such items as conveyor systems, operation and maintenance costs, piping, access roads, fencing, and lighting are included in the latter sections of this chapter. Brand name equipment prices are used throughout the estimate. Other manufacturers, however, produce similar equipment which may be used with comparable results.

13.2 Site

The 55.8 acre site will be cleared and grubbed to allow erection of the facility.

Summary:

Clearing and Grubbing Site $203,700

13.3 Barge Off Loading

A 130' x 60' pier consisting of eleven concrete dolphins and a concrete deck will be constructed on the east end of the site. This pier will enable barges to access the off loading operation.

Off loading will be by the clamshell bucket method. A Mantowac 3900 tracked mobile crane with a 5 cy bucket and a 100 ft. beam was selected. This unit will be land based and powered by a cummins diesel engine.

Summary:

Pier Capital Cost	$285,200
Crane Capital Cost (with engine)	600,000
Transportation & Erection	50,000
Rip Rap Slope Protection	1,700
Hopper with Grizzly	50,000
TOTAL	$986,900

13.4 Dredged Material Storage Area

The dredged material containment area will have the capacity to store 200,000 cy of dredge material. Dikes with 3:1 slopes, will border the area and divide the stockpile into 6 smaller storage chambers.

This will allow loads of clay, muck and mixtures to be stored separatey. 6280 LF of dike will be required.

The total containment area, excluding dikes, covers 570,400 square feet. A 19' x 10' concrete apron in each stockpile will allow front end loaders to move the material into hoppers. These hoppers will in turn feed the dredge material back into the treatment system.

Summary:

Grading Storage Areas		$ 22,100
Grading Dikes		483,100
Aprons & Hoppers		18,000
	TOTAL	$523,200

13.5 Solids Separation System

The solids separation system will remove sand and gravel from the dredged material, wash it and classify it into various size categories. Two specification sands and gravels will be produced. With a local market value of approximately $4/ton and sand and gravel production estimated at 80,000 tons/year, revenues could reach $320,000. This income will help offset operational and maintenance expenses.

Sand and gravel products will be stored in (4) 64.5' x 54.5' finished material stockpiles. Each stockpile will consist of a concrete pad and 3 cast in place concrete retaining walls. From here it will be hauled by truck to local markets.

Summary:

Site Preparation	$ 150,000
Concrete Pad w/Footings	39,900
Equipment:	
(2) Cedarapids 6'x20' Triple Deck Steel Screens	
(2) Eagle 10'x40' Steel Classifying Tanks, Mark V Series	
(2) 44" x 32' Steel Fine Material Washers	
(1) Eagle 36" x 30' Steel Log Washer	
(4) Stockpille Conveyors	
Flumes	878,000
Shipment and Erection	420,000
Finished Material Stockpiles	210,700
TOTAL	$ 1,698,600

13.6 Thickening

The thickening system, composed of (6) Parkson 3250/55 LGS/Ts (Lamella Gravity Settlers/Thickeners) has a two fold purpose. First, it will reduce the wastewater's suspended solids to the required 400 ppm, and second, it will thicken the sludge continuing on to dewatering.

Slurry and contaminated water will flow to the thickeners from the following areas:

A) Solids separation system

B) Dewatering Building

C) Incineration System

Summary:

Concrete Pad 107' x 48'	$ 28,500
(6) Parkson 3250/55 LGS/Ts	930,000
TOTAL	$ 958,500

13.7 Dewatering

Dewatering will be accomplished with (6) Parkson model 3500-4x Magnum^R belt filter presses. These will reduce the muck's water content from approximately 85 to 40 percent. The presses will be housed in a 42' x 81' pre-engineered building.

Summary:

42' x 81' Pre-Engineered Building	$	52,000
Plumbing, HVAC, Electrical		34,200
Control Room		20,000
Poly Pack including:		
Mixing Tank		
Polymer Storage Tank		
Metering Pumps		50,000
(6) Parkson Model 3500-4x Magnum[R] Belt Filter Presses	$	2,000,000
	$	2.156.200

13.8 Incineration

The detoxification system, developed by the dutch company Volker Stevin, will eliminate organic pollutants by heating the muck to 950°F in two rotary kilns. Gases escaping these kilns will travel to an afterburner where they will be further incinerated at 1500° - 1600°F. Products of the process are detoxified soil, gases and wastewater.

Summary:

Equipment Capital Cost & Installation including:

(3) Feeders
(2) Rotary Kilns
(1) Sieve
(1) Mixer
(1) Conveyor to Recycle Gravel
(1) Cyclone
(1) Afterburner
(1) Heat Exchanger
(1) Ventilator

(1) Ventilator	
(1) Venturi Scrubber & Pump	
(1) Settlement Chamber	
Piping and Ductwork	$ 3,600,000
(1) Sludge Storage Hopper	82,300
Total	$ 3,682,300

13.9 Recycling and Secondary Wastewater Treatment

After leaving the LGS/Ts, all water used in the Marley Neck facility will flow to a concrete recycling chamber. From this chamber it will either be recycled, released into the harbor or, if the 400 ppm suspended solids requirement is not met in the LGS/Ts, sent on to the secondary clarifier for further treatment.

A 50' x 100' x 11' secondary clarifier has been designed adjacent to the recycling chamber. It may not be necessary to build this as the LGS/Ts should reduce the suspended solids to 400 ppm.

Summary:

Recycling Chamber Capital Cost including:

Concrete Construction	
Flocculation Chamber	
Overflow Weir	$ 91,700

Secondary Clarifier Capital Cost including:

Concrete Construction Overflow Weirs	89,500
	$181,200

13.10 Conveyors, Piping and Pumps

Cast iron and ductile iron pipes with diameters from 2 to 24 inches and conveyors with widths from 24 to 28 inches will be used to transport dredge material, slurry, muck, water, gravel, sand and clay throughout the plant. Several pumps will also be needed.

Summary:

I Conveyors Capital Cost Including:

Barge Offloading, 1900 LF of a 42" Belt	$ 1,045,000
48" Belts to and From Raw Material Stockpiles	1,561,950
30" Belt from Triple Deck Screen to Reject Pile	8,200
(2) 67' long, 36" wide Dewatering Transfer Conveyors	53,600
175' Long, 42" Wide Incineration Conveyor	96,250
SUBTOTAL	$ 2,765,000

II Piping Capital Cost Including:

Pipe to LGS/Ts from: Solids Separation	$ 5,310
Dewatering	7,400
Incineration	3,705
Pipe to Belt Filter Presses from LGS/Ts	6,825

Pipe to Receiving Chamber from LGS/Ts	42,250
Recycle Pipe to Solids Separation	48,750
Discharge Pipe from Secondary Clarifier & Receiving Chamber	12,090
City Water	246,050
SUBTOTAL	$ 372,380

III Pumps:

From Solids Separation to LGS/Ts

Slurry Vault including:

Excavation Concrete Construction Stairway	$ 64,700
(2) Slurry Tanks	13,500
(2) Rubber Lined Slurry Pumps 3000 gpm/ea	24,000
From Thickening to Dewatering (1) Rubber Lined Slurry Pump 4550 gpm, 15-20% Solids Concentration, Fully Enclosed	15,000
From Incineration to Thickening (1) Rubber Lined Slurry Pump 450 gpm, 1% Solids Concentration, Fully Enclosed	3,000

From Dewatering to Thickening

(1) Rubber Lined Pump Fully Enclosed	15,000
Subtotal	$ 161,600
Total	$3,299,000

13.11 Miscellaneous

The Marley Neck facility will also be equipped with maintenance and administration buildings. Interior lighting will be provided for these buildings and the dewatering building; exterior lights will be placed 150 feet apart where needed. Motor control centers and substations will also be provided. Heavy duty roads extending from Ft. Smallwood Road to the site will access the barge off loading operation, dredge material stockpiles and finished material stockpiles. A 6' high chain link fence will surround the site to discourage trespassing.

Administration & Maintenance Buildings:

(2) Concrete Slabs 50' x 50' (2) 50' x 50' Pre-Engineered Buildings Plumbing, HVAC & Electrical	$ 117,765

Electrical:

Interior Lighting for 3 Buildings Exterior Lighting Motor Control Centers Substation	500,000

Heavy Duty Access Road:

12' Wide, 11,500 LF 9" Gravel Base	191,150

Chain Link Fence with (2) Gates 5000 LF	48,400
TOTAL	$ 857,315

13.12 Operation and Maintenance Costs

O&M costs include yearly funds for water, electricity and workmen's wages. A front end loader will also be needed to distribute material within the stockpiles and to feed it back into the system.

Summary:

Capital Costs		
Front End Loader		$ 225,000
Yearly Costs		
Water		
Initial Cost		400
Yearly Cost		75,400
	Subtotal	$ 75,800
Electricity/Year	Subtotal	$ 118,300
Incineration O&M including: Repairs Insurance Fuel Depreciation		
	Subtotal	$5,420,000

Employees Wages/Yr - Including Benefits
(All Salaries Based on 5 Days/Week,
52 Wks/Yr Operation Schedule)

Operators:

(1) Front End Loader Operator

8 Hrs/Day	$ 40,000
(1) Dockside Supervisor - To Oversee Unloading Operation 8 Hrs/Day	40,000
(4) Operators - To Oversee Solids Separation, Thickening, Dewatering and Clarification 8 Hrs/Day	160,000
(2) Incineration Operators (2)8 Hrs/Day/3 Shifts	240,000
(2) Maintenance Personnel	80,000
(1) Administrative Person	60,000
Subtotal	$ 620,000
Yearly Total	$6,233,700

13.13 Summary

Costs for the Marley Neck Facility are totalled below:

Yearly Operation & Maintenance Costs

Water	$ 75,800
Electricity	118,300
Incineration O&M	5,420,000
Employees	620,000
Total	$ 6,233,700

Capital Costs

Sitework	$ 203,700
Barge Off Loading	986,900
Dredged Material Storage	523,200
Solids Separation System	1,698,600
Thickening	958,500
Dewatering	2,156,200
Incineration	3,682,300
Recycling & Secondary	

Wastewater Treatment	181,200
Conveyors, Piping & Pumps	3,299,000
Miscellaneous	857,300
Front End Loader	250,000
Subtotal	$ 14,797,000
Engineering (Design, Geotechnical, Survey) 10% of Subtotal	1,479,700
Contractors Overhead and Profit 15% of Subtotal	2,219,550
Contingencies 25% of Subtotal	3,699,250
	$ 22,195,500