Port of New York and New Jersey
Feasibility Analysis for a Dredged Material
Public Processing Facility

Potential Dredged Material Storage Facilities and Their Impact on Public Processing Facility Economic Modeling
Summary Report

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EXECUTIVE SUMMARY

The economic benefits of constructing a Public Processing Facility (PPF) to handle dredged material from New York and New Jersey Harbor (Harbor) have been under consideration by regional dredged material managers for the last decade. Interest in investigating the feasibility of constructing such a facility arose out of concerns of the Regional Dredging Team (RDT) that privately developed processing facilities alone may not remain economically viable or sustainable in the long-term.

The United States Army Corps of Engineers, New York District (NYD), in conjunction with the PPF Subgroup of the RDT, is evaluating the feasibility and economic costs/benefits of a Harbor-wide PPF to support all types of proposed dredging in the Port of New York and New Jersey (Port). An Economic Model Summary Report, completed in March 2006, evaluated relative costs and benefits for various combinations of PPF attributes in an effort to define the facility that would be both cost effective and meet the needs of the Port stakeholders. The Optimum Model developed by the PPF Subgroup consisted of a single PPF sized to process 1.5 million cubic yards of fine-grained silty dredged material annually for beneficial reuse and placement at upland sites that are typically brownfields. It required approximately 20 acres of land adjacent to the Harbor for material receipt, processing and offsite transportation and also provided space for a future Remedial Material processing facility as well as a small amount (25,000 cubic yards) of storage.

The 25,000 cubic yards of storage for unprocessed dredged material that was included in the facility modeled in the Optimum Model added some operational flexibility to the facility. Adding significantly larger amounts of storage (e.g., from 250,000 cubic yards to as much as 1.5 million cubic yards), may provide even greater operational flexibility, may stabilize the flow of dredged material to processing, and may allow dredging and processing to become more independent operations. By allowing dredged material processing to become more independent of specific dredging projects, a large storage facility may also allow processors to provide a steadier, more predictable flow of uniformly processed material to placement sites.

Construction and operation of any large storage facility as an additional component in the PPF will add more costs to the Harbor-wide PPF. Results of the modeling indicate this cost increase could range from 5% to as much as 24% depending on the type and volume of the storage facility. However, those new costs may be offset if other cost components in the management of dredged material can be reduced as a result of the storage. Providing predictable volumes of material for long periods of time so that long-term operations can be assured, removing constraints and reducing risks for dredgers and processors by decoupling dredging and processing, and allowing steady delivery of uniform material to placement sites are among the potential benefits that may be derived from a storage facility. These and other benefits from the storage facility have the potential to lower other cost components in the overall PPF operation, leading to a lower overall cost. Sensitivity analyses of model assumptions for the various cost components indicate there may be the potential for cost savings of 20% to 30%.

The economic model developed in the Economic Model Summary Report of March 2006 was used in this follow-on Report to evaluate the additional costs anticipated as a result of providing various amounts and types of storage. Facilities storing from 250,000 cubic yards up to 1.5 million cubic yards of in channel material were considered. An in-water confined disposal facility (CDF), an upland pit CDF, an upland bermed CDF, and a nearshore CDF were the types of storage facilities evaluated. Increases in cost as a result of providing storage were evaluated as an added component in an Updated Optimum PPF Model so that the relative cost of each storage facility and volume, with various scenarios, could be evaluated and compared. Space requirements for the various sized facilities were also estimated so that the potential for sites within the Harbor could be investigated.

Adding storage increased overall PPF modeled costs from 5% to 24%. In terms of the cost per in channel cubic yard of material processed through the Updated Optimum PPF annually, this was an increase of from \$3.36 to \$13.00 per cubic yard over the base cost without storage. Space requirements for the various storage facilities ranged from as little as 8 additional acres of space to almost 120 acres.

Cost components within the model (e.g., percent profit, general management and administrative costs, recovery of capital costs, long-term contracted costs for processing materials, long-term maintenance costs) can potentially be reduced if storage facilities reduce risks to dredgers, processors and placement operations; ensure long term operations; and allow predictable material management. The resulting reductions in these cost components would reduce overall costs to process material through the Updated Optimum PPF, including the storage facility. Modeling suggests the cost reduction could be as much as 20% to 30% below the base costs of the Updated Optimum PPF Model. If a 20% to 30% reduction in costs can be achieved by adding one of the lower cost storage options, than the storage facility would contribute to lower overall cost. Further evaluation of the concept may be warranted if suitable areas within the Harbor are identified where a storage facility could be developed.

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ABBREVIATIONS AND COMMONLY USED TERMS

CY	Cubic Yard
DMMP	Dredged Material Management Plan
FGSM	Fine-Grained Silty Material
FWENC	Foster Wheeler Environmental Corporation
G&A	General and administrative overhead
Harbor	New York and New Jersey Harbor
HARS	Historic Area Remediation Site
HDP	New York/New Jersey Harbor Deepening Project
MCY	Million Cubic Yards
NYD	United States Army Corps of Engineers, New York District
PANY/NJ	Port Authority of New York/New Jersey
pcf	Pounds per cubic foot
Port	Port of New York and New Jersey
PPF	Public Processing Facility
RDT	Regional Dredging Team
RM	Remedial Material
SM	Sandy Material
SRC	Stiff Red Clay
USACE	United States Army Corps of Engineers

1.0 INTRODUCTION

Dredged material management and placement is one of the biggest challenges facing ports in the United States today. As our coastal and harbor areas continue to grow in population, competition for use of waterfront property and adjacent harbor and ocean waters increases. By restricting the use of waterfront property and adjacent waters, this development increases the complexity of managing dredged material in an environmentally appropriate and economically feasible manner. Greater sensitivity and knowledge of the potential adverse effects of dredged material that contains certain contaminants adds additional challenges to finding environmentally appropriate dredged material placement alternatives in older urban ports like the Port of New York and New Jersey (Port) (USACE, 2003).

Significant quantities of material dredged annually from New York and New Jersey Harbor (Harbor) are no longer suitable for use in the remediation of the old ocean placement site now referred to as the Historic Area Remediation Site (HARS). Projections of future maintenance dredging estimate that quantities in excess of one to two million cubic yards (MCY) per year will require alternate placement sites. In addition, large volumes of dredged material will be generated in the next ten years in association with the New York/New Jersey Harbor Deepening Project (HDP) with a significant percentage requiring alternate placement sites.

During the last decade, regional dredged material managers have considered the economic benefits of constructing a Public Possessing Facility (PPF) to handle material unsuitable for HARS placement as an alternative to utilizing existing privately developed facilities (USACE, 2006a). The Economic Modeling Summary Report (USACE, 2006c) evaluated several alternative PPF arrangements encompassing the range in dredged material types and volumes that might be processed based on projections identified in the NYD's 2006 Dredged Material Management Plan (DMMP) update.

Based on the attributes and costs of the alternatives evaluated, an Optimum PPF was formulated. Using conservative assumptions for the various cost components, a cost of $43.12/CY was modeled for the Optimum PPF. These costs could be lowered significantly if less conservative assumptions regarding the various cost components were made. However, uncertainty as to a consistent flow of material through the system on a week to week and year to year basis may not warrant less conservative cost assumptions. Reducing the uncertainty as to the annual volume of dredged material may reduce overall costs for a PPF. Providing storage is among the alternatives to consider that may reduce the uncertainty and is evaluated in this Report.

2.0 ECONOMIC MODEL & OPTIMUM MODEL SELECTION

The economic model used in the March 2006 Economic Model Summary Report was based on models completed for the PANY/NJ (FWENC, 2001 & 2002) and used costs developed in those reports updated in 2004-05 for inflation. The economic model considered each of the steps in managing the dredged material. Screening level costs were developed for each of the major management steps for dredged material, including: offloading, processing, transporting, and placing the material. For each step, annual costs were estimated for recovering capital investment, labor, management, maintenance, and material and equipment. Costs to recover capital investment in infrastructure were also included, as well as an estimate of profit. To account for the current level of uncertainty, contingency was added to each step of the process.

All screening level prices were conservative estimates, so that the resulting overall costs would more likely overestimate total costs as well as cost/cubic yard (CY) rather than underestimate them. Because the model results were being used to compare the relative costs of different alternatives and scenarios, the conservative bias did not affect the relative comparison. Details of additional assumptions used are provided in the March 2006 Economic Modeling Summary Report.

Based on the outcomes from four Alternatives, including various scenarios, an Optimum Model was developed in the March 2006 Report in consultation with the PPF Subgroup of the RDT. The Optimum Model provided the general parameters for a PPF that could satisfy the long term needs of the Port in an economical and sustainable manner. It also provided general guidelines for the facility requirements, the type and amount of necessary real estate, and the required infrastructure. The Optimum Model, discussed below, provides the basis for the Storage Models developed and considered in this Report

The Optimum Model considered one PPF that processes 1.5 MCY of fine-grained silty material (FGSM) annually during the eight month dredging period. The FGSM is stabilized, transported offsite to placement sites, and placed. Truck transportation to nearby placement sites was presumed to be the initial mode of offsite transport. Provisions were included for barge transport and space was provided for rail transport. Space was also included for eventual development of a Remedial Material (RM) processing facility (facilities).

Long-term projections of maintenance dredging requirements (USACE, 2006b) indicate that at least 1.5 MCY of FGSM will need to be dredged annually. Projected annual volumes are generally greater than 1.5 MCY and average over 2 MCY. However, there is some uncertainty associated with these projections. Sizing the PPF to operate at 1.5 MCY would ensure it operates at design capacity, thereby minimizing the cost/CY. Management of the flow of maintenance material and coordination of individual projects would be required to maintain a steady flow. The PPF can be designed with a certain degree of flexibility in processing rates so as to accommodate some variations in daily volumes.

Provisions for eventual processing of RM were included in the Optimum Model PPF by providing additional real estate. While a full-scale, cost effective means of processing large volumes RM into a product for beneficial reuse and sale has not been demonstrated, there are a number of promising technologies being developed and evaluated. A facility that could process RM has the potential to lower overall costs of the PPF, especially if a portion of the FGSM could be diverted to the facility and converted into a saleable product.

It was concluded the Optimum Model PPF could benefit from a modest (several days production) storage area. Modest storage would allow for small surges or ebbs in the delivery of dredged material without interrupting the processing operations. Short term shut down of the processing operations would also not effect the rate of dredging if a modest storage area were available.

The Optimum Model assumed the PPF could be sited at a central location and includes PPF supplied scows to transport the dredged material to the facility. Dredged material is assumed processed by the addition of cement once it arrives at the PPF. At the level of detail of the model, processing costs per in channel CY by either in-barge or pug mill mixing are roughly equivalent. Barge transportation of the mixed product in PPF supplied scows would favor in-barge mixing. Pug mill mixing may be more cost effective with a truck or rail transportation alternative. More detailed design is needed to identify the preferred mode of processing as well as the preferred additives. An optimized processing operation could result in significant overall savings to the operation of the PPF.

To develop the Optimum Model PPF, 20 acres of land would be required adjacent to the water. Approximately 1,500 feet of wharf space would be needed, allowing space for processing of scows and loading or unloading for shipment. Extra wharf space would also be provided for receipt and shipping of RM once the RM facility is developed. A 300-foot wide area would be provided adjacent to the wharf for equipment operations. One or two rail spurs could also be developed in this area for rail transportation offsite.

In addition to the 10 acres adjacent to the 1,500-foot wharf, it was assumed there was a two acre area available for development of a RM facility and that an additional eight acres were available for upland storage of unprocessed RM, processed RM, and unprocessed FGSM material or some combination of these. RM processing is likely to be a year round operation, so a certain amount of storage would be required for both the unprocessed and processed material. In addition, space for FGSM storage would add flexibility to the PPF operation and might help to reduce overall costs if FGSM could be processed through the RM for sale.

In the short term, the most likely mode of transportation of the processed material was assumed to be by truck. Placement sites remain available within a relatively short distance (<25 miles) and might still have capacity when the PPF is operational. Barge transportation was also considered a viable option, especially in light of the substantial transportation savings if a site accessible by barge could be identified.

Placement would most likely be at individual brownfield sites in the near term. Multiple sites would likely be used during the next five to ten years. Although specifics of each brownfield site closure would vary, the economics of brownfield development suggests it would be necessary to pay a fee to place material at these sites. A fee of $5.00/delivered CY seemed a reasonable estimate of the fee that would be charged. This would be in addition to the costs to physically unload, place and work the material at each site. While placement of the material would be done by the developer, it is assumed those costs would be passed on to the PPF.

Average costs to load, transport, offload and place the processed dredged material, including the tipping fee, was estimated by the Optimum Model in the March 2006 Report to be $18.84/CY. When barges were used, the average cost to load, transport, offload and place, including tipping fee, was almost half as costly ($13.80/CY) as compared to when trucks were used ($23.87/CY).

Assumed conditions for the Optimum Model are provided in more detail in Appendix A. Table 1 summarizes the annual cost estimate by major categories and provides the total annual cost, approximately $64.7 million, and the cost/CY of in channel material processed, $43.12.

3.0 UPDATED OPTIMUM PPF MODEL – NO STORAGE BASE CASE

The economic model used in the March 2006 PPF Report was also used for this Report. Modifications to the basic model were made so that storage alternatives capable of storing large volumes (hundreds of thousand cubic yards) of dredged material could be evaluated. As discussed in Section 2.0, the economic model uses conservative costs, but because the same conservative costs are used for all alternatives, the model provides a sound basis for comparing the relative cost of an alternative and various scenarios. This economic model also provides a sound basis for viewing the relative cost increase to be expected if, in addition to the base operating facilities, storage is included in the PPF. Changes to the underlying assumptions of the model, based on the potential savings that may result from storage, can then be made. This provides a mechanism for viewing potential cost savings resulting from the storage alternative and an opportunity to evaluate whether the storage alternative could lead to overall cost reductions in the operations of the PPF.

In order to provide a sound base model PPF against which the various storage alternatives and scenarios could be compared, the Optimum Model PPF discussed in Section 2.0 was updated. This Updated Optimum Model better reflects changes in costs and conditions since the March 2006 study was completed.

Since the objective of this Report is to evaluate the impact of storage on the PPF, including storage in the base model used for comparison was not appropriate. Similarly, providing space for RM processing may be of value if a PPF is developed, but those requirements and costs should not be included in the base model used for comparison of storage alternatives. These components of the March 2006 Optimum Model PPF were removed in the Updated Optimum Model PPF.

Barge transportation was included for half of the processed dredged material leaving the Optimum Model PPF. When that model was being developed, prospects of a placement site(s) accessible by barge were promising and including barge transportation significantly lowered modeled costs. Because those prospects have dimmed and trucking of most material processed from a PPF is a more likely scenario, the Updated Optimum Model PPF assumes all transportation of processed material to placement sites is by truck.

Costs for the Optimum Model PPF were developed in late 2004 and early 2005. While all costs used are considered conservative, reviewing and updating them to reflect costs in 2006 was undertaken for this Report.

These changes in the March 2006 Optimum Model PPF to the Updated Optimum Model PPF provide a base case to use in this Report for evaluating storage alternatives that better reflects the

Table 1
Optimum Model - March 2006 Report
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8,656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
4,328 tons of Material by Truck
4,328 tons of Material by Barge
78 tons >4" Debris Removed for Landfill Disposal Daily

Component in Overall Processing and Transportation		Total Annual Costs		Cost/CY of In Channel Material	% of Total Cost
Scow Fleet	$	5,253,466	$	3.50	8%
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$	29,314,733	$	19.54	45%
Portside Facilities Infrastructure	$	1,860,968	$	1.24	3%
20 acres needed for this facility[2]		*1,500*	*feet of wharf space*		
Loading, Transportation, and Placement by Truck	*$*	*17,900,850*	*$*	*23.87*	*28%*
Loading, Transportation, and Placement by Barge	*$*	*10,353,511*	*$*	*13.80*	*16%*
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$	28,254,361	$	18.84	44%
Total	$	64,685,028	$	43.12	

[1] Screening level pricing for comparison only among alternatives.
[2] Cost of real estate not included.

Table 1
Optimum Model - March 2006 Report
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Component	Capital or Infrastructure Costs w/o Contingency	Contingency 15% of Capital Costs	Annual Cost Recovery Capital (5 yr) & Infrastructure (10 yr)	Annual O & M 5% of Capital Cost	Annual Operations	Annual Costs[2] w/o G&A or Profit	G&A 15% of Annual Cost	Profit/ Cost of Money 10% of Annual Cost	Tipping Fee	Total Annual Costs
Scow Fleet	$ 14,445,000	$ 2,166,750	$ 3,322,350	$ 830,588	$ -	$ 4,152,938	$ 622,941	$ 477,588	$ -	$ 5,253,466
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 6,819,191	$ 1,022,879	$ 1,568,414	$ 392,103	$ 21,213,185	$ 23,173,702	$ 3,476,055	$ 2,664,976	$ -	$ 29,314,733
Portside Facilities Infrastructure	$ 12,449,409	$ 1,867,411	$ 1,471,121	$ -	$ -	$ 1,471,121	$ 220,668	$ 169,179	$ -	$ 1,860,968
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 4,319,507	$ 553,426	$ 776,137	$ 194,034	$ 3,899,130	$ 15,999,301	$ 2,399,895	$ 1,839,920	$ 8,015,245	$ 28,254,361
Total	$ 38,033,106	$ 5,610,466	$ 7,138,021	$ 1,416,725	$ 25,112,315	$ 44,797,061	$ 6,719,559	$ 5,151,662	$ 8,015,245	$ 64,683,528
Cost/CY In Channel Material			$ 4.76	$ 0.94	$ 16.74	$ 29.86	$ 4.48	$ 3.43	$ 5.34	$ 43.12

[1] Screening level pricing for comparison only among alternatives.
2 Annual costs include capital (5 year) or infrastructure (10 year) cost recoveries, O&M, and facility operations.

actual case with no storage. The changed model also provides a better basis for evaluating each storage alternative and the various scenarios.

Table 2 gives a summary of the assumptions used in the Updated Optimum Model PPF and Appendix B provides a more detailed description of the updated model. Table 3 provides a cost summary of the annual costs of the Updated Optimum Model PPF. Overall cost per in channel CY increased by $10.80 from $43.12 for the March 2006 Optimum Model to $53.92/CY. Small savings were realized by elimination of the 25,000 CY of storage and the space for the RM processing facility(ies) and the associated infrastructure and operational costs. These savings were negated by general increases in costs from 2004-05 to 2006. However, the biggest factor in the 25% increase in cost/CY is the change from only 50% truck transportation to 100% truck transportation. Loading, transportation and placement with truck transportation was almost twice as costly in the Optimum Model as loading, transportation and placement by barge.

Space requirements for the Updated Optimum Model PPF also changed because of the elimination of the modest storage facility and the RM facility. Space requirements were reduced from 20 acres to only 8 acres.

Storage alternatives and the various scenarios developed in the following sections of this Report are compared to the Updated Optimum PPF cost of $53.92/CY and the Updated Optimum PPF space requirements of 8 acres.

Table 4 illustrates the impact of individual model assumptions on overall cost/CY. Specific cost factors and their assumed value can change overall cost/CY by 10% or more. The storage alternatives discussed in the following sections increase base PPF costs; however, having material in a storage facility and readily available to processing facilities may allow a number of the individual cost components to be reduced.

Table 5 illustrates the potential reduction in overall cost/CY from a combination of alternate assumptions for the various cost components. Assumptions used for the initial case of the Updated Optimum Model were selected to be conservative (tending to produce a higher cost). Less conservative assumptions are made in a step-wise fashion in Table 5, generally from most likely to less likely to occur. A storage facility may increase the likelihood that a less conservative assumption (lower cost component) is, in fact, realistic. Under the most optimistic of circumstances, processing and placement cost/CY could be reduced by almost half to under $29/CY for the Updated Optimum PPF with No Storage. If a storage facility could make the less conservation assumptions about cost components more realistic then the reduced overall cost may make a storage facility a sound investment.

Table 2
Assumptions Used in Cost Estimates for Processing Dredged Material through the Updated Optimum PPF Model

Type of Dredged Material	Fine-Grained Silty Material (FGSM)
Number of Days of Operation Annually	210 days
In Channel Material	
Solids content of in channel material to be dredged	40.8% - 83.2 pcf
Daily volume of in channel material dredged	7,143 CY
Annual volume of in channel material dredged	1,500,000 CY
Decanted Dredged Material	
Solids content of decanted dredged material, delivered	37.5% - 81.1 pcf
Daily volume delivered for processing	7,973 CY
Annual volume delivered for processing	1,674,426 CY
Percent debris >4"	0.5% of daily volume
Disposal cost of debris	$125 ton
Stabilized FGSM Dredged Material	
Solids content of stabilized dredged material	45.5% - 84 pcf
Daily volume of stabilized dredged material	7,634 CY
Daily tonnage of stabilized dredged material	8,656 tons
Annual volume of stabilized dredged material	1,603,049 CY
Annual tonnage of stabilized dredged material	1,817,714 tons
Cost Factors	
General cost factor for installation	2.5 times unit costs
Contingency	15.0 % of capital cost investment
Transportation contingency	5% of capital cost investment
Tipping fee	$5 per CY of stabilized material
Recover capital costs over	5 years
Recover infrastructure capital cost over	10 years
Annual maintenance material, percent of total capital costs	5%
Management G&A overhead	15%
Profit	10%
Labor	
Union labor	$63/hour
Supervision personnel	$88/hour
Cement for Stabilizing Decanted FGSM Dredged Material	
Percent cement added	8%
Cost for cement	$125/ton
Transportation	
Transportation distance	within 25 miles
Mode of transportation	Truck

Table 3
Updated Optimum PPF Model - No Storage
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8,656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
8,656 tons of Material by Truck
78 tons >4" Debris Removed for Landfill Disposal Daily

Component in Overall Processing and Transportation	Total Annual Costs	Cost/CY of In Channel Material	% of total Cost
Scow Fleet	$ 5,516,139	$ 3.68	7%
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,213,481	$ 23.48	44%
Portside Facilities Infrastructure	$ 1,130,428	$ 0.75	1%
8 acres needed for this facility[2]	*1,000*	*feet of wharf space*	
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 39,022,818	$ 26.02	48%
Total	**$ 80,883,866**	**$ 53.92**	

[1] Screening level pricing for comparison only among alternatives
[2] Cost of real estate not included

Table 3

UPDATED OPTIMUM PPF MODEL - NO STORAGE

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Component	Capital or Infrastructure Costs w/o Contingency	Contingency 15% of Capital Costs	Annual Cost Recovery Capital (5yr) & Infrastructure (10 yr)	Annual O & M 5% of Capital	Annual Operations	Annual Costs[2] w/o G&A or Profit	G&A 15% of Annual Cost	Profit/ Cost of Money 10% of Annual Cost	Tipping Fee	Total Annual Costs
Scow Fleet	$ 15,167,250	$ 2,275,088	$ 3,488,468	$ 872,117	$ -	$ 4,360,584	$ 654,088	$ 501,467	$ -	$ 5,516,139
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 7,678,450	$ 1,151,768	$ 1,766,044	$ 441,511	$ 25,629,189	$ 27,836,744	$ 4,175,512	$ 3,201,226	$ -	$ 35,213,481
Portside Facilities Infrastructure	$ 7,770,598	$ 1,165,590	$ 893,619	$ -	$ -	$ 893,619	$ 134,043	$ 102,766	$ -	$ 1,130,428
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 3,029,827	$ 454,474	$ 696,860	$ 174,215	$ 3,543,840	$ 24,511,915	$ 3,676,787	$ 2,818,870	$ 8,015,245	$ 39,022,818
Total	$ 33,646,125	$ 5,046,919	$ 6,844,990	$ 1,487,843	$ 29,173,029	$ 57,602,862	$ 8,640,429	$ 6,624,329	$ 8,015,245	$ 80,882,866
Cost/CY In Channel Material			$ 4.56	$ 0.99	$ 19.45	$ 38.40	$ 5.76	$ 4.42	$ 5.34	$ 53.92

[1] Screening level pricing for comparison only among alternatives

[2] Annual costs include capital (5 year) or infrastructure (10 year) cost recoveries, O&M, and facility operations

Table 4
Changes in Cost with Alternate Assumptions
Updated Optimum PPF Model - No Storage

	Cost/CY of In Channel Material	Percent Change in Cost/CY
Processing Capacity of 1.5 MCY[1]	**$53.92**	
Capital Cost Recovery over 5 Years	**$53.92**	
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)	$48.90	-9%
Capital Cost Recovery Increased from 5 Years to 10 Years	$51.41	-5%
No Capital Cost Recovery on Scows	$49.94	-7%
Infrastructure Cost Recovery over 10 Years	**$53.92**	
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (By Others)	$53.17	-1%
Infrastructure Cost Recovery Increased from 10 Years to 20 Years	$53.55	-1%
Management G&A at 15%	**$53.92**	
Management G&A Reduced from 15% to 7.5%	$50.75	-6%
Management G&A Reduced from 15% to 5%	$49.70	-8%
Profit at 10%	**$53.92**	
Profit Reduced from 10% to 7.5%	$52.82	-2%
Profit Reduced from 10% to 5%	$51.71	-4%
Capital Cost Contingency at 15%	**$53.92**	
Capital Cost Contingency Reduced from 15% to 10%	$46.16	-14%
Captial Cost Contingency Reduced from 15% to 5%	$45.86	-15%
General Cost Factor for Installation as 2.5 times Capital Cost	**$53.92**	
General Cost Factor for Installation Reduced from 2.5 to 2	$53.81	0%
General Cost Factor for Installation Reduced from 2.5 to 1	$53.59	-1%

Table 6, continued
Changes in Cost with Alternate Assumptions
Updated Optimum PPF Model - No Storage

	Cost/CY of In Channel Material	Percent Change in Cost/CY
Annual Maintenance Costs of 5%	**$53.92**	
Annual Maintenance Costs Reduced to 2.5%	$53.30	-1%
Annual Maintenance Costs Increased to 10%	$55.18	2%
Stabilize with 8% Cement	**$53.92**	
Reduce Cement from 8% to 5%	$48.17	-11%
Increase Cement from 8% to 10%	$57.75	7%
Cement Cost of $125 per ton	**$53.92**	
Cement Cost Reduced 15% to $106.25	$51.62	-4%
Union Labor Rate of $63	**$53.92**	
Union Labor Rate Reduced 10% to $56.70	$53.44	-1%
Supervisor Labor Rate of $88	**$53.92**	
Supervisor Labor Rate Reduced 10% to $79.20	$53.77	0%
Original Staffing	**$53.92**	
Staffing Reduced by 10%	$53.14	-1%
Dump Truck Subcontract Rate of $1,100	**$53.92**	
Dump Truck Lease Rate Reduced 10% to $990	$52.23	-3%
Tipping Fee of $5/CY Stabilized Material ($5.35/In Channel CY)	**$53.92**	
Double Tipping Fee to $10	$59.27	10%
Reduce Tipping Fee to $2.50	$51.25	-5%
Reduce Tipping Fee to $1.00	$49.65	-8%
Remove Tipping Fee	$48.58	-10%

1. **Assumption from Base Model with Cost/CY**
2. Alternate Assumption with Resulting Cost/CY and % Change

Table 5
Reduced Cost Estimate with Modified Assumptions
Updated Optimum PPF Model - No Storage

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions	**$53.92**	
Modified Assumptions		
Management G&A Reduced from 15% to 7.5%	$50.75	$3.17
No Management G&A on Capital Costs	$50.54	$0.21
Profit Reduced from 10% to 7.5%	$49.51	$1.03
Capital Cost Recovery Increased from 5 Years to 10 Years	$47.32	$2.19
Infrastructure Cost Recovery Increased from 10 Years to 20 Years	$46.97	$0.35
Capital Cost Contingency Reduced from 15% to 10%	$46.81	$0.16
General Cost Factor for Installation Reduced from 2.5 to 2	$46.76	$0.05
Annual Maintenance Costs Reduced to 2.5%	$46.19	$0.57
Cement Quantity for Stabilization Reduced from 8% to 5%	$40.94	$5.25
Cement Cost Reduced by 15% to $106.25	$40.06	$0.88
Tipping Fee Reduced to $2.50/CY of Stabilized Material Placed	$37.39	$2.67
Dump Truck Subcontracted Rate Reduced by 10% to $990	$35.84	$1.55
Union Labor Rate Reduced by 10% to $56.70	$35.40	$0.44
Supervisor Labor Rate Reduced by 10% to $79.20	$35.27	$0.13
Staffing Reduced by 10%	$34.62	$0.65
Management G&A Reduced from 7.5% to 5%	$33.93	$0.69
Profit Reduced from 7.5% to 5%	$33.21	$0.72
Captial Cost Contingency Reduced from 10% to 5%	$33.08	$0.13
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (Provided by Others)	$32.78	$0.30
Capital Cost Recovery Reduced from 5 years to No Recovery (Provided by Others)	$30.88	$1.90
Tipping Fee Reduced to $1.00/CY of Stabilized Material Placed	$29.28	$1.60
No Tipping Fee	$28.21	$1.07

4.0 STORAGE ALTERNATIVES

The earlier studies (Foster Wheeler, 2001 & 2002 and USACE, 2006c) modeling the costs of processing and placing dredged material and the relative impact of the various cost components showed that a consistent flow of dredged material at or near the design capacity of the processing facility had the largest potential to impact the cost/CY. An increase in the overall volume of material being processed, as long as there was additional capacity in the system, had a modest effect on cost/CY, reducing cost slightly (by 1% to 2%). A drop in the volume of material processed below the design capacity raised cost/CY by as much as 20 to 25%, depending on the shortfall of material for processing.

Maintaining a consistent flow of dredged material, both on a week to week basis during the processing period and on a year in and year out basis, appears to be the single most important factor controlling the processing and placement costs. A facility that could store unprocessed dredged material could act as a buffer between dredging operations and processing operations. If, for a number of reasons, dredging within the Harbor ceased for several weeks or several months, material in the storage facility could be made available for processing, avoiding the significant increases in overall cost/CY that are incurred when there is a shortfall in material for weeks or months.

Storage may also offer a number of other benefits to the overall dredging, processing, and upland placement of dredged materials from the Harbor. Dredging rates would be less constrained by the maximum rate at which the material could be processed. If dredging rates exceeded the capacity of the processing facility(ies), the excess material could be placed in storage. This increases the potential for multiple dredging projects during the same time frame; larger, more cost effective dredging equipment; and dredging rates optimized to reduce dredging costs. In addition, processing slowdowns and delays at a processing facility would not effect the dredging since material could be diverted to the storage facility. The increased flexibility and assurance of no delays in the operations offered to the dredging firms may translate into lower dredging costs and overall savings.

Similarly, placement sites would have increased predictability as to the amount and quality of the processed dredged material they would be receiving. With a long-term, steady supply of processed material, it may be possible to enter into long-term contracts at more attractive rates for the PPF. Placement sites could plan and meet schedules for placement volumes. Increased predictability and flexibility for placement may also translate into lower overall costs.

4.1 Storage Operations

While the storage operations would be part of the overall PPF concept for dredged material management within the Harbor, for this Report operation of the storage facility is assumed to be independent of the dredging operations as well as the processing and upland placement activities. Any equipment, infrastructure and staff needed to operate the storage facility is dedicated to the storage facility. Capital equipment and infrastructure cost recovery, administrative costs, profit and other cost components are also specific to the storage facility. Although the storage facility would be part of the overall PPF management operations, potential cost savings from shared resources are not considered in this Report.

However, since storage would be a component within the overall PPF management operations, this Report assumes PPF managers would be able to control the flow of dredged material so that material would go directly from the dredging site to the processing facility(ies) when and where processing capacity was available. Material would only go to the storage facility when dredging rates exceeded overall available processing capacity.

Similarly, removal or mining of material from the storage facility would not be underway as long as dredging was meeting the needs of the processing facility(ies). Mining from storage would only take place when there was no dredging underway or when dredging rates were lower than available processing capacity. Unlike dredging, there would be no periods when removal of material from storage would be prohibited. Consequently, dredged material processing and placement could be year round operations.

Dredged material would be delivered to the storage facility or processing facility(ies) in PPF supplied scows by the dredging firms. Storage operations or processing operations would take control of the loaded scow and provide the dredger with an empty scow to take back to the dredging site. Scows would be offloaded as required into the storage facility by the storage operation.

When material from storage was needed by the processing facility(ies), storage operations would mine the stored dredged material, place it into PPF scows and deliver it to the processing facility.

4.2 Storage Volumes

Two main factors were considered in developing the storage alternatives, storage capacity of the facility and the physical layout/location of the facility.

The Optimum Model included 25,000 CY of storage, slightly less than a weeks worth of material for processing based on an assumed processing rate of 7,143 in channel CY daily. While this modest amount of storage added some flexibility, it was not clear that it was sufficient to offer overall savings to the PPF. Significantly larger volumes are likely needed to result in significant savings due to a storage facility.

Four storage volumes were considered in this Report: 250,000 CY; 500,000 CY; 1,000,000 CY; and 1,500,000 CY. These volumes are in channel cubic yards. Because of bulking, the physical arrangement of the storage facilities was sized to hold decanted cubic yards of dredged material, a larger volume by approximately 12% (see Table 2).

These volumes were selected based on the assumed typical annual volume of material through the PPF, around 1,500,000 CY, and the processing rate of the Optimum PPF. A stored volume of 250,000 in channel CY would provide enough material for roughly six weeks of processing. Increased dredging rates caused by overlapping contracts, short periods of no dredging due to sequencing of contracts or prolonged inclement weather, short interruptions in processing and similar surges or ebbs in the flow of material could be accommodated with this volume of storage. With the smallest volume, the size of the storage facility would be the least, requiring the least amount of space, and it could be built and operated at the lowest cost.

A stored volume of 500,000 in channel CY provides enough material for 12 weeks of processing at the Optimum PPF rate and allows longer periods of overlap, no dredging or no processing than the 250,000 CY option. It would also support year round processing at a daily rate of 4,808 in channel cubic yards daily as compared to the 7,143 in channel cubic yards daily of the Optimum PPF (approximately 30% less daily). A smaller, optimized processing operation may lower costs.

A stored volume of 1,000,000 in channel CY provides sufficient material for significant interruptions in dredging or processing while the largest volume, 1,500,000 in channel CY would provide sufficient storage for no dredging or no processing for a full year. While these larger volumes will add greater flexibility and provide more assurance that dredging and processing can proceed independently, they also require larger areas for development and have higher initial construction costs.

4.3 Storage Facilities

Four potential storage facility physical layouts were considered. Each of the four storage facilities was sized to hold the four volumes being considered. Finally, several scenarios were developed for the construction or operation of some of the facilities. Costs to build, operate and then close the storage facilities were developed and added to the costs of the Updated Optimum PPF.

4.3.1 In-Water Confined Disposal Facility (CDF) Pit

Conceptually, the layout of the in-water CDF pit storage facility would be similar to the Newark Bay Confined Disposal Facility. The Newark Bay CDF was constructed in Newark Bay in the late 1990's in response to the need for a disposal site during the transition from managing dredged material at the ocean disposal site to the upland placement of material not suitable for placement as capping material at the HARS.

Water depth in the area of the in-water CDF pit was assumed to be 10 feet, providing sufficient draft for dredge scows. A 20-foot layer of soft sediments was assumed to overly a 75-foot thick layer of stiff clay. The storage area was constructed by excavating a circular pit through the soft sediments and into the stiff clay. It was assumed that slopes in the soft sediments were 3:1 while slopes in the stiff clay could be 1.5:1, similar to the actual construction of the Newark Bay CDF. A 25-foot wide bench was assumed at the transition from the soft sediments to the stiff clay. Fifteen feet of clay was left at the bottom of the pit to act as a barrier between the stored sediments and the underlying bedrock, eliminating any regional groundwater concerns. The soft sediments were assumed unsuitable for use at the HARS, requiring upland placement. The clay was assumed to be suitable for use as capping material at the HARS, allowing HARS placement.

To control turbidity as material is being placed into the pit and as material is being excavated from the pit, it was assumed the maximum elevation of the stored dredged material was at five feet below the surrounding bottom elevation of -10 feet. Based on this general geometry, the overall area of the in-water CDF pit varied from 6.0 acres for 250,000 in channel CY of storage to 21.9 acres for storage of 1,500,000 in channel CY.

To support operations of the CDF such as mining and monitoring, a shore-side support facility independent of the processing facility(ies) was assumed. To provide dock and upland space for mining support vessels, monitoring vessels, work scows, and maintenance activities, a two acre site was assumed.

Cost recovery for construction of the storage facility and supporting infrastructure was assumed to occur over 20 years. Once the useful life of the storage facility was reached, it was assumed that the facility was closed by filling with dredged material and capping with a five foot sand cap leaving the closed elevation at the same elevation as the surrounding bottom. Table 6 summarizes the basic physical features and provides a conceptual cross section of the in-water CDF pit.

In the initial case for the in-water CDF pit storage facility, the model assumed PPF supplied scows delivered dredged material to the CDF. Once there, the material was mechanically offloaded from the scows and deposited into the storage cell. When material was mined (removed) from the in-water CDF pit, it was mechanically dredged and placed into PPF supplied scows for delivery to the processing facilities.

4.3.1.1 In-Water CDF Pit Scenarios

Several scenarios were run for the in-water CDF pit storage case. For the 1,000,000 CY and 1,500,000 CY storage facilities, annually removing all of the material may not be a typical operational cycle. During most years, it is more likely that only a portion of the material would be mined. For the first scenario, it was assumed that in a typical year, only 500,000 CY was cycled through the CDF, reducing mining operations during those years.

It may be possible to deliver dredged material to the in-water CDF pit in dump scows rather than in the PPF supplied scows envisioned as part of the overall processing operations. In this scenario, dump scows would be positioned in the central portion of the CDF and then they would open and dump the dredged material into the CDF. No offloading by clamshell or bucket loader would occur.

Environmental concerns regarding turbidity associated with placing material into the CDF and removing material from the CDF may necessitate more stringent turbidity control than envisioned in the base case. Three turbidity control scenarios were considered: 1) heavy duty, full depth turbidity curtains surrounding the facility, 2) an earthen and riprap enclosure berm to elevation +5 surrounding the facility with turbidity curtains at the entrance and 3) steel sheeting to +5 encircling the facility with turbidity curtains at the entrance. Table 7 summarizes the physical features of the in-water CDF pit and the various scenarios considered.

Table 6

In-Water CDF Pit - Base Case
(Newark Bay CDF)

- Based on NBCDF design of 2001
- Water depth at CDF — 10 feet
- Thickness of soft sediments — 20 feet
- Thickness of underlying clay — 75 feet
- Thickness of clay in CDF — 60 feet
- Minimum freeboard to control turbidity — 5 feet
- No additional turbidity control required
- Circular in plan view
- Close by filling with dredged material
- Five foot sand cap over dredged material

Storage Volume (In Channel CY)	Diameter (feet)	Area (acres)
250,000	578	6.0
500,000	728	9.6
1,000,000	940	15.9
1,500,000	1,102	21.9

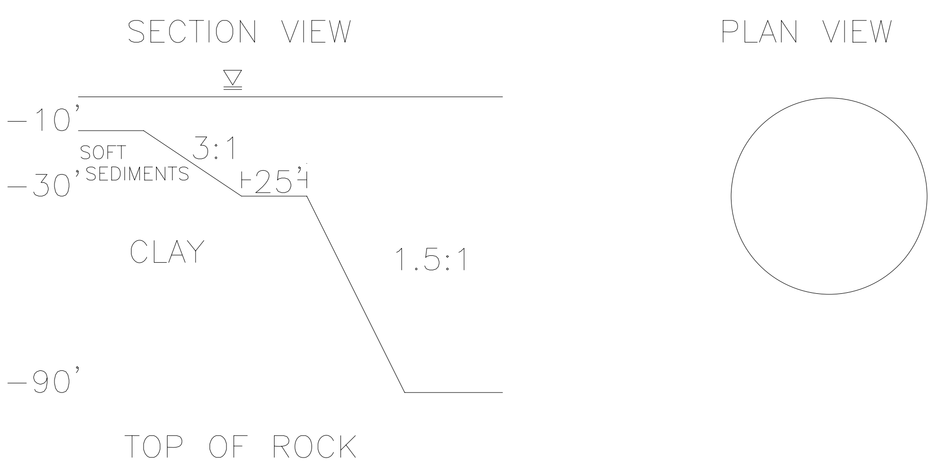


Table 7
In-Water CDF Pit

In-Water CDF Pit

Storage Volume (In-Channel CY)	Diameter of Storage Area (feet)	CDF Storage Surface Area (acres)	Soft Sediment for Disposal (CY)	Clay for Disposal (CY)	Closure Sand (CY)
250,000	578	6.0	142,801	181,207	42,394
500,000	728	9.6	241,936	386,981	69,141
1,000,000	940	15.9	426,694	811,753	118,105
1,500,000	1,102	21.9	603,126	1,242,088	164,334

In-Water CDF Pit with Full Depth Turbidity Curtain

Storage Volume	Diameter of Storage Area	CDF Storage Surface Area	Soft Sediment for Disposal	Clay for Disposal	Closure Sand	Turbidity Curtain	
						Length	Area
(In-Channel CY)	(feet)	(acres)	(CY)	(CY)	(CY)	(feet)	(sq. ft.)
250,000	588	6.2	142,801	181,207	42,394	2,032	30,480
500,000	738	9.8	241,936	386,981	69,141	2,550	38,255
1,000,000	950	16.3	426,694	811,753	118,105	3,283	49,244
1,500,000	1,112	22.3	603,126	1,242,088	164,334	3,843	57,642

In-Water CDF Pit with Earthen Enclosure Berm

Storage Volume	Diameter of Storage Area	Storage Surface Area	Soft Sediment for Disposal	Clay for Disposal	Enclosure Berm		Closure Sand	Turbidity Curtain	
					Sand	Riprap		Length	Area
(In-Channel CY)	(feet)	(acres)	(CY)	(CY)	(CY)	(CY)	(CY)	(feet)	(sq. ft.)
250,000	792	11.3	142,801	181,207	51,968	7,828	0	300	4,500
500,000	942	16.0	241,936	386,981	63,938	9,493	0	300	4,500
1,000,000	1,154	24.0	426,694	811,753	80,850	11,843	25,413	300	4,500
1,500,000	1,316	31.2	603,126	1,242,088	93,770	13,636	56,928	300	4,500

In-Water CDF Pit with Steel Sheeting Enclosure

Storage Volume	Diameter of Storage Area	Storage Surface Area	Soft Sediment for Disposal	Clay for Disposal	Closure Sand	Steel Sheeting		Turbidity Curtain	
						Length	Area	Length	Area
(In-Channel CY)	(feet)	(acres)	(CY)	(CY)	(CY)	(feet)	(sq. ft.)	(feet)	(sq. ft.)
250,000	598	6.4	142,801	181,207	42,394	1,729	77,790	300	4,500
500,000	748	10.1	241,936	386,981	69,141	2,200	98,996	300	4,500
1,000,000	960	16.6	426,694	811,753	118,105	2,866	128,967	300	4,500
1,500,000	1,122	22.7	603,126	1,242,088	164,334	3,375	151,869	300	4,500

4.3.2 Upland CDF Pit

Rather than developing the CDF pit described in 4.2.1 in the Harbor (in-water), it may be possible to develop it adjacent to the Harbor at an upland location. Conceptually this storage facility is similar to the in-water CDF pit except that the initial upland elevation of the facility is assumed to be at +15. A 45-foot layer of soft sediments was assumed to overly a 75-foot thick layer of stiff clay. The storage area was constructed by excavating a circular pit through the soft sediments and into the stiff clay. Another geometry could be used but would require additional space. It was assumed that slopes in the soft sediments were 3:1 while slopes in the stiff clay could be 1.5:1. A 25-foot wide bench was assumed at the transition from the soft sediments to the stiff clay. Fifteen feet of clay was left at the bottom of the pit to act as a barrier between the stored sediments and the underlying bedrock. Due to the relatively low permeability of the clay and the soft sediments, and because of the location adjacent to the Harbor, the assumption was made that the potential groundwater contamination was not a significant concern that needed to be addressed.

The soft sediments were assumed suitable for use at an upland placement site similar to those receiving processed dredged material. The clay was assumed to be suitable for use as capping material and could be excavated and placed for a cost similar to clay handling for the in-water case.

To prevent material overflow from the upland pit, it was assumed the maximum elevation of the stored dredged material was at three feet below the surrounding upland elevation of 15 feet. To control access to the facility and CDF pit, a 100-foot buffer surrounding the CDF pit was assumed. Based on this general geometry, the overall area of the upland CDF pit facility varied from 11.1 acres for 250,000 in channel CY of storage to 28.2 acres for storage of 1,500,000 in channel CY.

Support facilities for the upland CDF pit would be required, but could be developed within the 100-foot buffer. Consequently, no other area would be needed. Stormwater management by solids settlement only with direct discharge was assumed acceptable, and any odors from the upland site were assumed insignificant and acceptable.

Cost recovery for construction of the storage facility and supporting infrastructure was assumed to occur over 20 years. Once the useful life of the storage facility was reached, it was assumed that the facility was closed by filling with dredged material and capping with a three foot sand cap leaving the closed elevation at the same elevation as the upland. Table 8 summarizes the basic physical features and provides a conceptual cross section of the upland CDF pit.

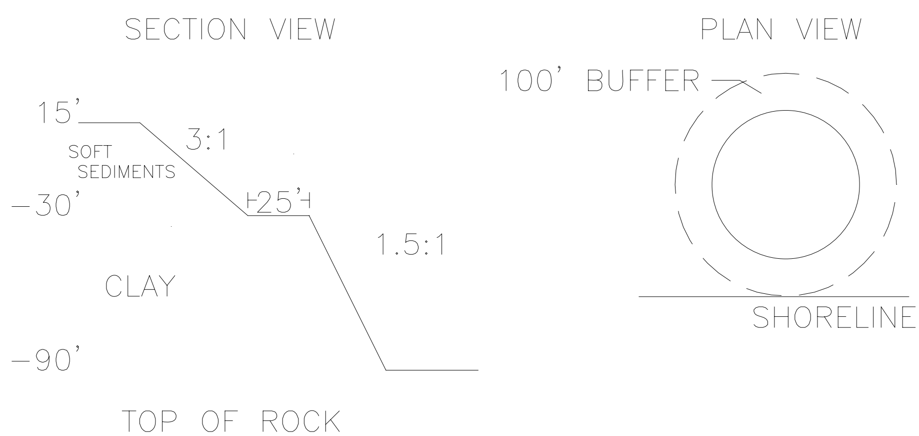
In the initial case for the upland CDF pit storage facility, the model assumed PPF supplied scows delivered dredged material to an offloading/loading facility adjacent to the CDF. Once there, the material was offloaded from the scows and transferred to the upland CDF via conveyors. When material was mined (removed) from the upland CDF pit, it was mechanically dredged, conveyed to the loading area and placed into PPF supplied scows for delivery to the processing facilities.

Table 8

Upland CDF Pit – Base Case

• Use In-Water CDF Pit Design	
• Ground Elevation at CDF	15 feet
• Thickness of soft surface materials	45 feet
• Thickness of underlying clay	75 feet
• Thickness of clay in CDF	60 feet
• Minimum freeboard to prevent overflow	3 feet
• No groundwater control required	
• Circular in plan view	
• Buffer surrounding pit	100 feet
• Close by filling with dredged material	
• Three foot clean fill cap over dredged material	
• Stormwater management - settling and direct discharge	

Storage Volume (In Channel CY)	Diameter (feet)	Area w/buffer (acres)
250,000	586	11.1
500,000	724	15.4
1,000,000	910	22.2
1,500,000	1,050	28.2



4.3.2.1 Upland CDF Pit Scenarios

Several scenarios were developed for the upland case. Because the upland CDF pit is assumed to be adjacent to the Harbor, connecting it to the Harbor by a channel may be possible. Once connected, then PPF scows could be taken into the pit for offloading and loading as in the in-water CDF pit case. An access channel with sloped earthen sidewalls developed from the harbor into the pit and a steel sheeted channel were considered as two scenarios.

While connecting the upland pit to the harbor will allow direct access to the pit by scows, it will also lower the maximum elevation to which dredged material can be placed. To maintain sufficient draft, it was assumed the maximum elevation for the dredged material in the storage facility would be –10 feet. With a lower maximum elevation for storage, a larger area is needed to reach the desired storage volumes. Areas requirements increase on the order of 30% (see Table 9).

Developing a lock in the access channel will allow water levels in the upland CDF to remain higher than in the Harbor, will allow dredged material to be stored at a higher elevation and will reduce area requirements below the requirements of the first two scenarios. This was the third scenario considered.

As with the in-water CDF pit case, upland CDF pit scenarios could have also been developed for reduced annual mining volumes for the larger capacity storage facilities and for using dump scows once the facility was linked to the harbor. Because the cost changes would be of a similar order of magnitude as for the in-water case (see Section 5), these scenarios were not pursued for the upland CDF pit storage facility.

4.3.3 Upland Bermed CDF

Upland confined disposal facilities are typically developed by building containment berms or dikes rather than excavating deep pits. The third storage facility considered was a traditional upland CDF developed by building berms to hold the dredged material.

Conceptually, the upland bermed CDF would be adjacent to the Harbor with the outer toe of the berm 100 feet away from the edge of the water. The initial upland ground elevation was assumed to be at +15 feet. Earthen berms 25 feet tall with 3:1 slopes were assumed surrounding the containment area(s). At the berm crest elevation of +40, a width of 20 feet was assumed, allowing space for truck passage. To provide some of the material for berm construction and to increase storage, it was assumed that the interior of the CDF could be excavated to an elevation of +7.5.

Concern for potential groundwater contamination from the CDF was assumed negligible due to its location adjacent to the Harbor. Stormwater management by simple solids settlement and direct discharge was assumed acceptable, and any odors from the upland site were assumed insignificant and acceptable.

Table 9
Upland CDF Pit

Basic Upland CDF Pit

Storage Volume (In-Channel CY)	Diameter of Storage Area (feet)	CDF Storage Surface Area (acres)	CDF Area with 100' Buffer (acres)	Soft Sediment for Disposal (CY)	Clay for Disposal (CY)	Closure Sand (CY)
250,000	586	6.2	11.1	248,722	58,776	26,991
500,000	724	9.5	15.4	427,557	176,795	41,948
1,000,000	910	14.9	22.2	747,481	441,045	67,366
1,500,000	1,050	19.9	28.2	1,048,027	719,599	90,481

Upland CDF Pit with Sloped Channel Access to Harbor

Storage Volume (In-Channel CY)	Diameter of Storage Area (feet)	CDF Storage Surface Area (acres)	CDF Area with Buffer & Channel (acres)	Soft Sediment for Disposal (CY)	Clay for Disposal (CY)	Closure Sand (CY)
250,000	702	8.9	15.5	419,812	153,526	46,783
500,000	848	13.0	20.6	655,307	339,543	66,531
1,000,000	1,054	20.0	29.1	1,082,498	728,563	100,723
1,500,000	1,210	26.4	36.6	1,479,923	1,121,723	131,545

Upland CDF Pit with Sheeted Channel Access to Harbor

Storage Volume (In-Channel CY)	Diameter of Storage Area (feet)	CDF Storage Surface Area (acres)	CDF Area with Buffer & Channel (acres)	Soft Sediment for Disposal (CY)	Clay for Disposal (CY)	Closure Sand (CY)	Steel Sheeting Length (feet)	Steel Sheeting Area (sq. ft.)
250,000	702	8.9	15.1	414,812	153,526	45,227	420	31,500
500,000	848	13.0	20.3	650,307	339,543	64,976	420	31,500
1,000,000	1,054	20.0	28.8	1,077,498	728,563	99,168	420	31,500
1,500,000	1,210	26.4	36.3	1,474,923	1,121,723	129,989	420	31,500

Upland CDF Pit with Lock Access to Harbor

Storage Volume (In-Channel CY)	Diameter of Storage Area (feet)	CDF Storage Surface Area (acres)	CDF Area with Buffer & Channel (acres)	Soft Sediment for Disposal (CY)	Clay for Disposal (CY)	Closure Sand (CY)	Steel Sheeting Length (feet)	Steel Sheeting Area (sq. ft.)
250,000	638	7.3	13.1	319,971	95,442	37,855	735	55,125
500,000	780	11.0	17.8	518,786	243,648	55,426	735	55,125
1,000,000	972	17.0	25.2	869,684	555,964	84,781	735	55,125
1,500,000	1,120	22.6	31.9	1,204,572	884,533	111,800	735	55,125

To prevent material overflow from the upland bermed CDF, it was assumed the maximum elevation of the stored dredged material was at two feet below the berm crest elevation of 40 feet. To provide access for equipment to remove/mine the material, access ramps interior to the CDF with 1:10 slopes were assumed. To control access to the facility, a 25-foot buffer surrounding the CDF away from the waterside was assumed. The 100-foot setback along the waterside provided space for material transfer and other support activities. Based on this general geometry, the overall area of the upland bermed CDF facility varied from 18.5 acres for 250,000 in channel CY of storage to 96.2 acres for storage of 1,500,000 in channel CY.

Cost recovery for construction of the storage facility and supporting infrastructure was assumed to occur over 20 years. Once the useful life of the storage facility was reached, it was assumed the facility was closed by removing the berms and all dredged material. With 35 foot tall berms, the filled CDF would be a significant feature on the upland landscape. Additionally, it would contain unprocessed dredged material that might present a concern at some future time. For these reasons, closure included removal of the berms and dredged material and restoration of the ground elevation to +15 with clean fill. Table 10 summarizes the basic physical features and provides a conceptual cross section of the upland CDF pit.

The model assumed PPF supplied scows delivered dredged material to an offloading/loading facility adjacent to the CDF. Once there, the material was offloaded from the scows and transferred to the upland CDF via trucks. When material was mined (removed) from the upland CDF pit, it was mechanically excavated, loaded into trucks, taken to the loading area and placed into PPF supplied scows for delivery to the processing facilities.

4.3.4 Nearshore Bermed CDF

The fourth storage facility type considered was a nearshore bermed or diked CDF. This facility would be developed adjacent to the shoreline and dredged material would be contained by earthen/riprap berms. Water depths at the CDF were assumed to average 10 feet. Earthen berms with riprap protection reaching an elevation of +35 feet were assumed. Width of the berm crest was 20 feet, allowing truck passage.

To prevent material overflow, it was assumed the maximum elevation of the stored dredged material was at two feet below the berm crest elevation of +35 feet. To provide access for equipment to remove/mine the material, access ramps interior to the CDF with 1:10 slopes were assumed. Groundwater, stormwater and odor were assumed to be insignificant concerns. Based on this general geometry, the overall area of the nearshore bermed CDF facility varied from 18.6 acres for 250,000 in channel CY of storage to 111.3 acres for storage of 1,500,000 in channel CY.

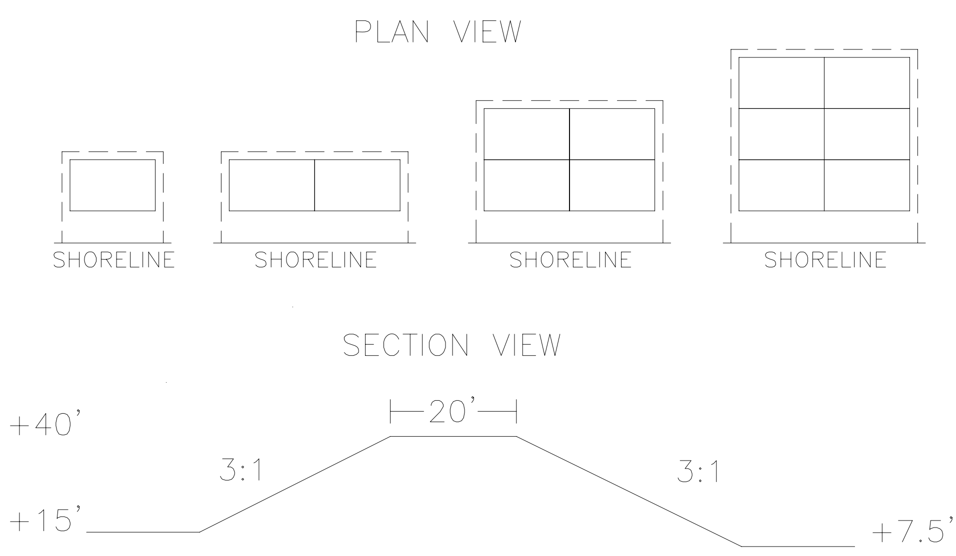
To support operations of the CDF such as material offloading and mining, a shore-side support facility independent of the processing facility(ies) was assumed. To provide dock and upland space for mining support vessels, work scows, and maintenance activities, a two acre site was assumed.

Table 10

Upland Bermed CDF

• Adjacent to Harbor and set back	100 feet
• Ground Elevation at CDF	15 feet
• Depth of Excavation	7.5 feet
• Height of berm above ground elevation	25 feet
• Berm crest elevation	40 feet
• Minimum freeboard to prevent overflow	2 feet
• 1:10 access ramps into CDF for mining	
• Maximum reach for mining approximately	100 feet
• No liner required & no odor management	
• 25 ft. buffer on edges except for 100 ft. setback	
• Close by removing all dredged material and berms	
• Stormwater management - settling and direct discharge	

Storage Volume (In Channel CY)	Width (feet)	Length (feet)	Area w/buffer (acres)
250,000	618	1,034	18.5
500,000	618	2,100	36.1
1,000,000	1,268	2,100	66.2
1,500,000	1,918	2,100	96.2



Cost recovery for construction of the storage facility and supporting infrastructure was assumed to occur over 20 years. Once the useful life of the storage facility was reached, it was assumed that the facility was closed by filling with dredged material and capping with a two foot sand cap. Table 11 summarizes the basic physical features and provides a conceptual cross section of the nearshore bermed CDF pit.

The model assumed PPF supplied scows delivered dredged material to an offloading/loading facility adjacent to the CDF. Once there, the material was offloaded from the scows and transferred into the nearshore bermed CDF by truck. When material was mined (removed) from the nearshore bermed CDF, it was mechanically excavated, taken to the loading area and placed into PPF supplied scows for delivery to the processing facilities.

5.0 UPDATED OPTIMUM PPF MODEL WITH STORAGE OPTIONS

The storage alternatives described in Section 4.0 were added to the Updated Optimum PPF Model described in Section 3.0 and costs with the storage alternative for each of the storage volume options were modeled. Annual costs per cubic yard were modeled using the base assumptions for the Updated Optimum PPF Model as discussed above. Equipment and material costs, installation costs, labor costs, administrative costs, profit, and other cost components remained the same conservative values for all of the storage alternatives discussed below. Only cost recovery for the storage facility differed. The 20 year period assumed for the storage facility construction cost recovery was greater than the 10 year infrastructure recovery and the 5 year capital equipment recovery periods used.

Each storage alternative adds extra steps in the management of the dredged material and therefore, additional costs. Consequently, all of the modeled alternatives discussed below have higher overall costs per cubic yard than does the Updated Optimum PPF Model. The discussions that follow in this Section allow for a comparison of the various storage alternatives in terms of potentially more costly or less costly approaches.

While adding storage adds to the base cost in every instance, storage alternatives may allow some of the cost components such as capital cost recovery, administration or profit to be lowered. Section 6.0 discusses potential savings that may be realized as a result of including a storage alternative within a Harbor-wide PPF management system.

5.1 In-Water CDF Pit

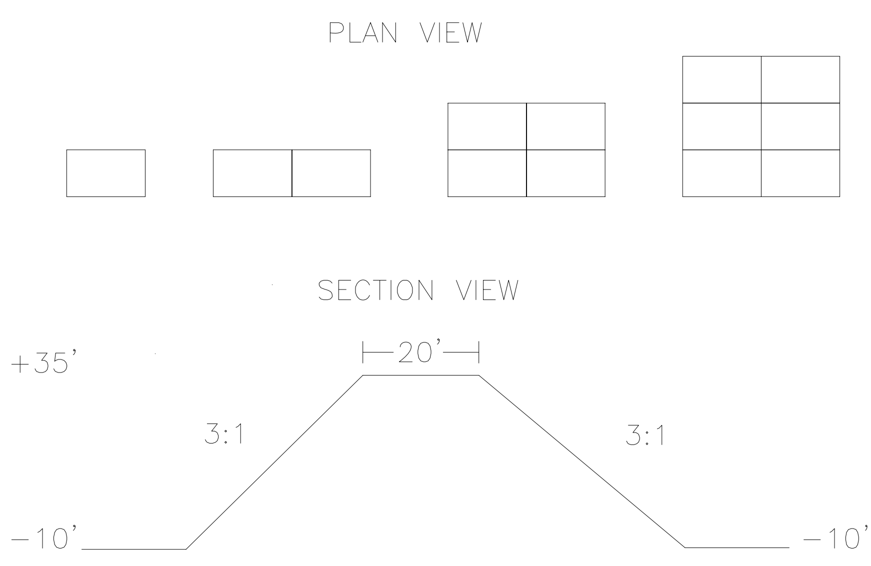
The base in-water CDF pit model assumes that dredged material is delivered by the dredger to the storage facility in PPF scows and is offloaded mechanically. While delivery rates and delivery times would likely vary if this facility were built, the assumption was made that material would be delivered at a relatively consistent rate during the 35-week dredging period from June through January. In the case of the 250,000 CY and 500,000 CY storage alternatives, it was assumed the material was generally mined during the 16 week period from January through May when dredging is restricted in much of the Harbor. Consequently, processing and placement was

Table 11

Nearshore Bermed CDF

- Adjacent to shoreline
- Water Depth at CDF averages 10 feet
- Height of berm above bottom 45 feet
- Berm crest elevation 35 feet
- Minimum freeboard to prevent overflow 2 feet
- 1:10 access ramps into CDF for mining
- Maximum reach for mining approximately 100 feet
- No liner required & no odor management
- Two foot cap of clean fill over dredged material to close
- Stormwater management - settling and direct discharge

Storage Volume (In Channel CY)	Width (feet)	Length (feet)	Area (acres)
250,000	686	1,178	18.6
500,000	686	2,388	37.1
1,000,000	1,404	2,388	74.2
1,500,000	2,122	2,388	111.3



assumed to extend for an additional 8 weeks under the 250,000 CY alternative and to be year-round for the 500,000 CY alternative.

For the 1,000,000 CY and 1,500,000 CY alternatives, year-round processing was also assumed. In order for the 1,000,000 CY or the 1,500,000 CY to be placed into storage and removed from storage annually, periods of intense dredging activity followed by periods of no dredging during the 35-week dredging period would be required. While this assumption may be less realistic on a year in and year out basis, it was used for development of the base costs. If such large swings in dredging rates were never likely to occur, then there would be no need for the larger storage facilities. One of the scenarios discussed below address the case where only some of the storage capacity of the larger facilities is used on a routine annual basis.

Table 12 presents the modeled costs for dredged material processing and placement using an in-water CDF pit of various capacities for storage. The major components in modeling the costs are presented in the Table along with the total annual costs and cost per cubic yard of in channel material. The per cubic yard cost components of the storage facility - construction, operation and closure - are based on the total annual in channel cubic yards managed through the PPF, 1,500,000 CY.

As seen in Table 12, the cost component for the PPF Scow Fleet varies somewhat among the storage facility sizes and differs slightly from the Updated Optimum PPF Model. These small changes are due to changes in the size of the scow fleets required. Fewer scows are needed for year-round processing; however, as the volume of material into and out of storage grows, the size of the fleet also grows. If the PPF did not supply scows, overall PPF costs for managing the dredged material would be lowered. However, scows would still be needed and their costs would likely be reflected in the price for dredging.

Modeled costs for processing and for loading, transporting and placing the material also vary slightly with storage facility size, reflecting modest changes in capital equipment and labor due to the longer processing period. However, modeled costs remain similar to the modeled costs of the Updated Optimum PPF Model.

As would be expected, modeled construction costs increase as the capacity of the facility increases from an annual cost of $1.1 million to an annual cost of $4.9 million. Because these storage facilities could be used for an extended period of time (tens of years), cost recovery was extended over 20 years. The relatively modest annual cost therefore represents a significant initial investment for construction, ranging from an estimated $17.6 million for the 250,000 CY facility to $76.9 million for the 1,500,000 CY facility.

Model construction costs per in channel cubic yard also need to be viewed within the context of the 20 year cost recovery period. They also are based on the overall quantity of material moving through the PPF management system annually, 1,500,000 CY, not on the number of cubic yards the facility stores. If the annual construction costs were spread only over the cubic yards stored, then the annual cost per in channel cubic yard of material stored in the 250,000 CY in-water CDF pit would be $4.45/CY. This costs drops to $3.78 for the 500,000 CY facility, $3.39 for the 1,000,000 CY facility and $3.24 for the largest facility.

Table 12

Updated Optimum PPF Model - In-Water CDF Pit Storage

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8.656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
8.656 tons of Material by Truck
78 tons >4" Debris Removed for Landfill Disposal Daily

	250,000 CY Storage		500,000 CY Storage		1,000,000 CY Storage		1,500,000 CY Storage	
Component in Overall Processing and Transportation	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material
Scow Fleet	$ 5,311,838	$ 3.54	$ 4,903,235	$ 3.27	$ 5,516,139	$ 3.68	$ 6,129,044	$ 4.09
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,580,078	$ 23.72	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]	*1,000 feet of wharf space*							
Loading, Transportation by Truck, Placement	$ 39,575,003	$ 26.38	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
In-Water CDF Pit Storage Facility Construction	$ 1,112,476	$ 0.74	$ 1,889,642	$ 1.26	$ 3,392,683	$ 2.26	$ 4,860,696	$ 3.24
Storage Cell Operations	$ 3,829,372	$ 2.55	$ 3,997,307	$ 2.66	$ 4,216,203	$ 2.81	$ 6,264,337	$ 4.18
Storage Cell Closure	$ (431,712)	$ (0.29)	$ (944,283)	$ (0.63)	$ (1,936,525)	$ (1.29)	$ (2,935,008)	$ (1.96)
Total	$ 86,151,125	$ 57.43	$ 85,914,492	$ 57.28	$ 87,257,091	$ 58.17	$ 90,387,659	$ 60.26
Percent increase in cost over Updated Optimum PPF Model		6.5%		6.2%		7.9%		11.8%
Scenario - Annual Mining only 500,00 CY		$ 57.43		$ 57.28		$ 57.62		$ 57.93
Percent change to In-Water CDF Pit Storage		0.0%		0.0%		-1.0%		-3.9%
Scenario - Dump Scows used to deliver material to storage		$ 56.21		$ 56.29		$ 56.63		$ 57.10
Percent change to In-Water CDF Pit Storage		-2.1%		-1.7%		-2.6%		-5.2%
Scenario - Heavy Duty Turbidity Curtain for Turbidity Control		$ 57.67		$ 57.52		$ 58.49		$ 60.71
Percent change to In-Water CDF Pit Storage		0.4%		0.4%		0.5%		0.8%
Scenario - In-Water Berm for Turbidity Control		$ 57.49		$ 57.34		$ 58.24		$ 60.34
Percent change to In-Water CDF Pit Storage		0.1%		0.1%		0.1%		0.1%
Scenario - Steel Sheeting Wall for Turbidity Control		$ 57.83		$ 57.76		$ 58.80		$ 61.00
Percent change to In-Water CDF Pit Storage		0.7%		0.8%		1.1%		1.2%
Upland support area requirements, acres		2		2		2		2
In-Water CDF area, acres		6.0		9.6		15.9		21.9
Total Updated Optimum PPF Model - No Storage		$ 53.92		$ 53.92		$ 53.92		$ 53.92

[1] Screening level pricing for comparison only among alternatives
[2] Cost of real estate not included

Storage cell operation costs also increase as the size of the storage facility increases. Annual costs to operate the 250,000 CY facility or the 500,000 CY facility are similar because the basic heavy equipment needed for the smaller facility can also accommodate the larger flow of material. In these cases, cost of the capital equipment is recovered over five years. Modest increases in costs for operations are modeled for the 1,000,000 CY facility. When 1,500,000 CY are managed annually, capacity of the basic equipment need is exceeded and significant additional capital investment in equipment is required.

As with construction costs, the cost/CY presented in Table 12 for storage cell operations reflects the annual flow of material through the PPF. On the basis of the number of in channel yards stored, the annual cost/CY for operation of the 250,000 CY storage facility is $15.32. The cost/CY of stored in channel material drops to $7.99 for the 500,000 CY facility, $4.22 for the 1,000,000 CY in-water CDF pit, and $4.18 for the 1,500,000 CY facility.

Closure of the in-water CDF pit is assumed to generate a "credit" for the overall PPF operations. When the pit is closed, it is filled with dredged material and then capped with five feet of clean sand to return the bottom elevation to that of the surrounding Harbor bottom. While there is a cost to place the closure sand, the dredged material placed during closure does not need to be processed, transported or place upland. Therefore those costs are avoided. For the PPF model, those avoided costs are treated as a credit. The avoided costs are spread over 20 years in the model as are the construction costs. The annual credit from closure is presented in Table 12 along with the annual credit/CY based on the 1,500,000 CY of material managed by the PPF annually. Based on the capacity of the storage facility, the annual credit/CY of in channel material storage in the 250,000 CY facility would be $1.73. This increases to $1.89/CY for the 500,000 CY facility, $1.94/CY for the 1,000,000 CY facility and $1.96/CY for the largest facility.

Total annual costs for the Updated Optimum PPF Model with in-water CDF pit storage as modeled range from $86.2 million to $93.4 million or from $57.43/CY to $60.26/CY (see Table 12). When compared to the Updated Optimum PPF Model, this is an increase in costs of 6.2% to 11.8%. The model results suggest the 500,000 CY sized facility is the least costly to develop, operate and close, but modeled costs for both the 250,000 CY and the 1,000,000 CY capacity facilities are comparable given the many model uncertainties.

Relative to the Updated Optimum PPF Model, adding an in-water CDF pit storage facility increases overall costs to manage the dredged material. The increase ranges from approximately 6% to approximately 12%. Based on the sensitivity analyses of the Updated Optimum PPF Model presented in Tables 4 and 5, less conservative assumptions for the various cost components can lower cost/CY significantly more than 10%. If including storage in the PPF management system makes the less conservative cost assumptions more likely, than the additional cost may be justifiable.

5.1.1 In-Water CDF Pit Scenarios

Five different scenarios were modeled for the in-water CDF pit storage alternatives to see if changes in operation or construction would significantly impact the costs of storage or the overall cost to manage the dredged material through the PPF system.

5.1.1.1 Annual Mining of only 500,000 In Channel CY

Although there have been years in the past when little or no dredging occurred as well as years when dredging volumes were much higher than typical, those years are unusual. For most years, the annual volume of material dredged would be within several 100,000's of cubic yards of the 1,500,000 CY quantity and the rate of dredging during the 35 week dredging period would be relatively steady. Having a storage facility sized to hold 1,000,000 CY or 1,500,000 CY may be advantageous in those unusual years of very little or very high dredging. However, it seems unlikely that a storage facility with this larger capacity would be filled and emptied on a routine annual basis. It is more likely that a smaller volume would move in and out on an annual basis in most years with the larger swings in storage only occurring during unusual years.

For this scenario, it was assumed a maximum of 500,000 in channel CY were placed into and mined out of the in-water CDF pit on a typical annual basis. For the 250,000 CY and 500,000 CY capacity storage facilities, annual costs and cost/CY remain unchanged from the base in-water CDF pit case. While construction cost and closure credit for the 1,000,000 CY and 1,500,000 CY facilities also remain unchanged, operation costs are reduced when only 500,000 CY cycle through annually. Overall cost for the 1,000,000 CY capacity facility drops by 1% when compared to the base in-water CDF pit (see Table 12). The cost is reduced by almost 4% for the 1,500,000 CY capacity facility although it still remains the most costly to develop, operate and close.

5.1.1.2 Dump Scow Material Delivery

When HARS suitable material is dredged, it is typically placed into bottom dump scows that are towed to the HARS where they are opened to dump all of the material into the ocean and onto the HARS. With an in-water CDF pit, material taken to the pit could be delivered in a similar manner. The dump scow would be filled and towed to the in-water CDF pit where the load would be dropped into the storage cell. No offloading equipment would be required, eliminating that operational cost.

Not all of the 1,500,000 CY of material dredged could be placed into the dump scows. A significant amount would continue to go from the dredging site directly to the processing site and PPF supplied scows might continue to be the most cost effective delivery vessel. PPF scows would also be needed for the material as it was mined from the storage facility. However, fewer PPF supplied scows would be required, lowering overall material management cost. Dump scows may be more efficient for the dredging firms, and it was assumed the dredging firm would provide the dump scows needed at no cost to the PPF and without increasing their cost to dredge.

Under this scenario, overall cost for the PPF management system dropped by 1.7% to 5.2% when compared to the PPF management system with the base in-water pit operation (see Table 12). Overall cost remained higher than in the Updated Optimum PPF Model by between 4.3% and 5.9%.

5.1.1.3 Turbidity Control with Heavy Duty Turbidity Curtains

Dropping dredged material into the in-water CDF pit and dredging material from the in-water CDF pit may create turbidity even if best management practices are used to minimize turbidity. If these turbidity levels have the potential to reach unacceptable levels, then controls beyond best management practices may be required. Encircling the in-water CDF pit with a turbidity curtain to contain any turbidity is one scenario evaluated.

In this scenario, a heavy duty, full depth turbidity curtain is assumed to encircle the pit offset 10 feet from the edge of the pit. The curtain would be secured with pilings and anchors and would be opened and closed in one area as scows moved into and out of the in-water CDF pit. Additional operations would be required to maintain and manage the curtain. It was also assumed the curtain would not have a robust life and would be replaced completely every 2.5 years.

As shown in Table 12, overall costs increased for each of the capacity options by 0.4% to 0.8% under this scenario. The footprints of these facilities would also increase slightly with the turbidity control at 10 feet beyond the pit edge. Footprint increase would range from 0.4 acres (6.6%) for the 250,000 CY capacity facility to 0.8 acres (3.6%) for the 1,500,000 CY capacity facility.

5.1.1.4 Turbidity Control with an In-Water Berm

Rather than encircling the in-water CDF pit with a turbidity curtain requiring frequent maintenance, management and replacement, the in-water CDF pit could be encircled with a berm or dike that reached above the water, isolating the in-water pit and containing any turbidity generated during material placement or dredging. An opening in the berm would allow scows to move in and out and a much shorter full depth turbidity curtain at the opening could control turbidity there.

For this scenario, it was assumed that interior toe of the berm was set back from the edge of the pit by 10 feet and that the crest of the berm was at +5 feet, slightly above Higher High Water. The riprap and sand in the berm were assumed suitable for use as closure materials once the useful life of the facility had been reached.

Under these assumptions, overall costs increased modestly. A 0.1% increase is seen over the base in-water CDF pit case for each capacity option (Table 12). While the increase in cost is modest, the berm will significantly increase the footprint of the facility. The overall footprint of the 250,000 CY capacity facility will increase by almost 90% to 11.3 acres. For the 1,500,000 CY in-water CDF pit, the footprint will increase by not quite 10 acres to 31.2 acres. The footprints of the 500,000 CY and 1,000,000 CY facilities will increase by 67% to 16.0 acres and by 51% to 24.0 acres respectively.

5.1.1.5 Turbidity Control with Steel Sheeting

The final scenario considered steel sheeting surrounding the in-water CDF pit with an access channel through the sheeting wall for the scows. The sheeting would be setback from the edge of the pit by 10 feet and would extend to an elevation of +5. Turbidity curtains at the channel entrance would be in place to full contain any turbidity. When the CDF was closed, the sheeting would be pulled and removed.

Under this scenario, overall costs increased by between 0.7% and 1.2% (Table 12). Additional area requirements are the same as in the heavy duty turbidity curtain case.

5.2 Upland CDF Pit

The base upland CDF pit model assumes that dredged material is delivered to a shoreline facility where it is mechanically offloaded and then conveyed by conveyors to the nearby upland facility and dumped into the pit. As in the in-water CDF pit case, delivery to the upland CDF pit is assumed to be at a relatively steady pace throughout the 35 week dredging period and mining is assumed to extend the dredge material processing period to year round. When material is removed from the upland CDF pit in the base case, it is excavated mechanically and transferred by conveyors to the shoreline facility where it is loaded into PPF scows.

Material movement in PPF scows, material processing, transportation and placement in the upland CDF pit case are the same as in the in-water CDF pit case and costs remain the same as shown in Table 13.

Construction costs for the upland CDF pit are slightly less than construction costs for the in-water CDF pit. While the soft sediments from the upland pit require upland placement, the assumption was made that stabilization was not required as was assumed for the soft sediments from the in-water CDF pit. This lowered the modeled overall construction costs slightly but the initial investment to build the upland CDF pit remains significant. Construction costs for the upland CDF pit, including the needed shoreline support infrastructure, were estimated to range from $15.5 million for the 250,000 CY capacity facility to $72.6 million for the 1,500,000 CY facility.

Modeled costs for operation of the base case upland CDF pit are 50% to 80% higher than for the in-water CDF pit. Material going into the pit must be offloaded, transferred, conveyed and then placed while mined material must also be conveyed to the loading area and then loaded.

Closure of the upland pit CDF provides a slightly greater credit (10% to 20%) due to the smaller volume of closure sand required and upland placement of the closure sand.

Table 13

Updated Optimum PPF Model - Upland CDF Pit Storage

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8.656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
8.656 tons of Material by Truck
78 tons >4" Debris Removed for Landfill Disposal Daily

	250,000 CY Storage		500,000 CY Storage		1,000,000 CY Storage		1,500,000 CY Storage	
Component in Overall Processing and Transportation	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material
Scow Fleet	$ 5,311,838	$ 3.54	$ 4,903,235	$ 3.27	$ 5,516,139	$ 3.68	$ 6,129,044	$ 4.09
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,580,078	$ 23.72	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]	*1,000*	*feet of wharf space*						
Loading, Transportation by Truck, Placement	$ 39,575,003	$ 26.38	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Upland CDF Pit Storage Facility Construction	$ 983,147	$ 0.66	$ 1,829,146	$ 1.22	$ 3,300,996	$ 2.20	$ 4,588,742	$ 3.06
Storage Cell Operations	$ 5,645,520	$ 3.76	$ 7,145,380	$ 4.76	$ 7,402,605	$ 4.94	$ 11,172,306	$ 7.45
Storage Cell Closure	$ (528,332)	$ (0.35)	$ (1,078,335)	$ (0.72)	$ (2,161,360)	$ (1.44)	$ (3,240,579)	$ (2.16)
Total	**$ 87,741,324**	**$ 58.49**	**$ 88,868,017**	**$ 59.25**	**$ 90,126,972**	**$ 60.08**	**$ 94,718,104**	**$ 63.15**
Percent increase in cost over Updated Optimum PPF Model		8.5%		9.9%		11.4%		17.1%
Scenario - Channel Cut to Harbor to Allow Scow Access		$ 57.40		$ 57.19		$ 57.95		$ 59.89
Percent change to Upland CDF Pit Storage		-1.9%		-3.5%		-3.6%		-5.2%
Scenario - Steel Sheeted Channel Cut to Harbor		$ 57.53		$ 57.31		$ 58.07		$ 60.01
Percent change to Upland CDF Pit Storage		-1.7%		-3.3%		-3.4%		-5.0%
Scenario - Locks to Control Access to Upland Pit		$ 59.14		$ 58.88		$ 59.60		$ 60.87
Percent change to Upland CDF Pit Storage		1.1%		-0.6%		-0.8%		-3.6%
Updated Optimum PPF Model - No Storage		$ 53.92		$ 53.92		$ 53.92		$ 53.92

[1] Screening level pricing for comparison only among alternatives
[2] Cost of real estate not included

Due to the higher operating costs, each base case upland CDF pit increases costs to manage 1,500,000 CY through the PPF system annually more than costs are increased by the in-water CDF pit. Compared to the Updated Optimum PPF Model, costs increase by 8.5% and 17.1%.

5.2.1 Upland CDF Pit Scenarios

Operating costs of the upland CDF pit storage facility are significantly higher than for the in-water CDF pit because scows must be unloaded, material must be transferred to the upland pit and then the material must be placed into the pit. Mining material for delivery to the processing facility(ies) is also more costly since material must be excavated, transferred to the loading area and then loaded into scows. Connecting the upland CDF pit to the Harbor by a channel would be possible since it is assumed the facility is within 100 feet of the Harbor. If the CDF were connected to the Harbor, scows would have direct access, offloading and loading operations could be the same as for the in-water pit case, and overall costs may be lower.

However, if scows access the upland CDF pit directly, the maximum elevation for the stored dredged material must allow adequate draft for the scows. Instead of storing material to an elevation of +13, -10 is assumed to be the maximum elevation so that scows have a draft of at least ten feet. Since the bottom of the upland CDF pit is controlled by the depth to bedrock (see 4.2.2), the only way to provide the needed capacity at the lower maximum elevation is to increase the footprint of the upland CDF.

Three upland pit scenarios were developed. Each provided a direct link from the Harbor into the CDF pit so that the operating costs of the Upland CDF pit could be lowered.

5.2.1.1 Scow Access via Sloped Access Channel

The first scenario assumes an access channel is developed by excavation from the Harbor into the pit and that the sides of the channel are sloped back for stability. This layout will require more area for the channel but may be less costly to construct. As shown in Table 13, any increase in construction costs for developing the channel and the larger area required due to the lower maximum placement height of the stored material are clearly offset by the lower operating costs. As discussed in Section 4.2.1.1, the overall area of the upland CDF increased by as much as 30%. But overall costs drop between 1.9% to as much as 5.2% when compared to the base upland CDF pit case due to the operational savings.

5.2.1.2 Scow Access via a Sheeted Channel

Sheeting the sides of the access channel with steel sheet pile will reduce the overall area required for the channel while still allowing access to the pit from the Harbor. In this scenario, the sheeting extends to the elevation of the surrounding ground, +15 feet. Construction costs for the channel are greater than for the sloped channel, but overall costs are still less than for the base upland CDF pit case. Costs drop by 1.7% and 5% as shown in Table 13.

5.2.1.3 Scow Access via a Locked Channel

Providing direct access between the Harbor and the upland CDF pit lowers overall costs to manage the dredged material through the PPF system but significantly increases the acreage needed for the facility. As presented earlier in Table 9, aerial requirements for the 250,000 CY upland pit CDF increase from 11.1 to 15.5 acres, including the buffer, and requirements for the 1,500,000 CY capacity facility increases from 28.2 to 36.6 acres.

If water elevations within the upland CDF pit were maintained at a higher elevation, then the aerial requirements would be reduced but scow access would still be possible. This can be accomplished if the access channel is locked on either end. Scows could enter the lock directly from the Harbor, be lifted to the water elevation of the upland CDF pit, and pass through the second lock gate into the upland CDF pit. While building and operating the lock will be costly, it will eliminate much of the operating costs associated with offloading and then reloading material from the upland CDF pit.

Table 13 presents the modeled overall cost when there is scow access via a channel with a lock. While a lock increases the overall cost with a storage capacity of 250,000 CY, it does lower costs for the larger capacity options.

5.2.1.4 Additional Scenarios

A scenario where only 500,000 CY were moved into and out of the larger capacity upland CDF pits annually was not developed. However, based on the in-water CDF pit scenario evaluated, cost reductions on the order of 1% to 5% could be anticipated.

A dump scow scenario could have been developed with each scenario described above allowing direct access by scows into the upland CDF pit. Cost reductions on the order of 2% to 5%, similar to the in-water CDF pit scenario, would have been seen with dump scow scenarios.

5.3 Upland Bermed CDF Storage

The upland bermed CDF assumes that dredged material is delivered to a shoreline facility where the scows are decanted prior to offloading. The decanted dredged material is offloaded into dump trucks that transport the material to the upland CDF cell(s) and dump the material into the cell(s). As in the previous cases, delivery to the upland bermed CDF is assumed to be at a relatively steady pace throughout the 35 week dredging period and mining is assumed to extend the dredged material processing period to year round. When material is removed from the upland bermed CDF, it is excavated mechanically, loaded into dump trucks, transported to the shoreline facility, offloaded from the trucks and loaded into PPF scows.

PPF scows and material processing, transportation, and placement costs remain the same for this case as in the previous two storage cases. Table 14 presents these costs for the upland bermed CDF storage facility.

Table 14

Updated Optimum PPF Model - Upland Bermed CDF Storage

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8.656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
8.656 tons of Material by Truck
78 tons >4" Debris Removed for Landfill Disposal Daily

	250,000 CY Storage		500,000 CY Storage		1,000,000 CY Storage		1,500,000 CY Storage	
Component in Overall Processing and Transportation	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material	Total Annual Costs	Cost/CY of In Channel Material
Scow Fleet	$ 5,924,742	$ 3.95	$ 5,924,742	$ 3.95	$ 7,354,852	$ 4.90	$ 8,580,661	$ 5.72
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,580,078	$ 23.72	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]	*1,000 feet of wharf space*							
Loading, Transportation by Truck, Placement	$ 39,575,003	$ 26.38	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Upland Bermed CDF Storage Facility Construction	$ 454,039	$ 0.30	$ 855,090	$ 0.57	$ 1,359,665	$ 0.91	$ 1,722,060	$ 1.15
Storage Cell Operations	$ 4,986,129	$ 3.32	$ 6,607,505	$ 4.41	$ 9,880,719	$ 6.59	$ 13,029,068	$ 8.69
Storage Cell Closure	$ 367,486	$ 0.24	$ 510,321	$ 0.34	$ 743,375	$ 0.50	$ 976,429	$ 0.65
Total	$ 88,061,548	$ 58.71	$ 89,966,249	$ 59.98	$ 95,407,203	$ 63.60	$ 100,376,808	$ 66.92
Percent increase in cost over Updated Optimum PPF Model		8.9%		11.2%		18.0%		24.1%
Updated Optimum PPF Model - No Storage		$ 53.92		$ 53.92		$ 53.92		$ 53.92

[1] Screening level pricing for comparison only among alternatives
[2] Cost of real estate not included

Construction costs for the upland bermed CDF are the lowest of the four layouts considered. Annual cost/CY of in channel material range from \$0.30 to \$1.15 when spread over the 1,500,000 CY managed through the PPF system yearly. Construction costs for the storage facility and the shoreline support infrastructure needed for loading and unloading is estimated to range from \$7.2 million to \$27.2 million.

Modeled costs to operate the upland bermed CDF are comparable to costs for the base upland pit CDF case in the 250,000 CY and 500,000 CY cases and higher for the larger storage volume cases. Transportation between the unloading/loading site and the storage site by trucks or conveyors is similar in costs for the smaller volume cases, but conveying may help to lower costs in the case of the larger facilities when the larger amounts are moved annually.

Closure of the upland bermed CDF does not generate a credit to the overall PPF management system since it was assumed the CDF could not be closed in place. It was assume that closure would include removal of the berms and all dredged material and that the site would be returned to its original elevation and condition. Costs for closure ranged from \$0.24/CY to \$0.65CY of in channel material when spread over the 1,500,000 CY processed annually and the assumed 20 year useful life of the storage facility.

Although construction costs are estimated to be the lowest among the storage alternatives considered, closure costs negate those savings. When compared to the Updated Optimum PPF Model, including a upland bermed CDF adds 8.9% to 24.1% to the cost of managing dredged material through the PPF system.

5.3.1 Upland Bermed CDF Scenarios

As with the previous alternatives, cycling the entire 1,000,000 CY or 1,500,000 CY through the storage facility annually may not be typical annual operational case. Cycling only 500,000 CY annually may be more typical if the larger facilities are developed. Operational costs would drop to levels comparable to operational costs for the 500,000 CY case. The 1,000,000 CY sized facility would still increase costs over the Updated Optimum PPF Model, but by only approximately 13.9% as compared to 18%. The increase in costs of the 1,500,000 CY sized facility would be only 16.7% as compared to 24.1%.

Direct scow access to the facility through a lock is possible, but maintaining the elevation of the stored material as much as 15 feet below the elevation of the berms would greatly increase the area required. Since a large upland area is already required, 18.5 to 96.2 acres, a lock scenario seemed unreasonable to consider.

Hydraulic offloading and placement into the upland bermed CDF was another scenario considered. However, this would also require a much larger footprint for each upland bermed case to allow adequate settlement of suspended materials prior to discharge of the transport water back into the Harbor. Additionally, the increased water content of the placed material may make annual cycling infeasible. Cycling at a longer frequency would be possible and may even be advantageous if water content can be reduced sufficiently, but this would also require much larger footprints for the facilities. Developing facilities with footprints significantly larger than the base case were not considered likely.

5.4 Nearshore CDF Storage

The nearshore CDF assumes that dredged material is delivered to a bermed facility adjacent to the shoreline but offshore. The PPF scows are decanted prior to offloading, the decanted dredged material is offloaded into dump trucks that transport the material to the CDF cell(s) and dump the material into the cell(s). As in the previous cases, delivery to the nearshore CDF is assumed to be at a relatively steady pace throughout the 35 week dredging period and mining is assumed to extend the dredged material processing period to year round. When material is removed from the nearshore CDF, it is excavated mechanically, loaded into dump trucks, transported to the shoreline offloading/loading facility, offloaded from the trucks and loaded into PPF scows.

PPF scows and material processing, transportation, and placement costs remain the same for this case as in the previous two storage cases. Table 15 presents these costs for the upland bermed CDF storage facility.

Construction costs for the nearshore CDF are comparable to the in-water CDF pit. Annual cost/CY of in channel material range from $0.74 to $2.99 when spread over the 1,500,000 CY managed through the PPF system yearly. Construction costs for the storage facility and the shoreline support infrastructure needed for loading and unloading is estimated to range from $17.5 million to $71.0 million.

Modeled costs to operate the nearshore CDF are the same as the upland bermed CDF since the same operating parameters were assumed for each case.

Because the nearshore CDF is offshore and in an area not needed for navigation, it was assumed the nearshore CDF could be closed by leaving the dredged material in place after capping it with two feet of clean material. While this would leave a large area in the Harbor at an elevation of +35, it's more isolated location when compared to the upland bermed CDF may make this acceptable. By leaving the last round of stored dredged material in place, closure would generate an annual credit of $0.32/CY to $1.98/CY when spread over the 1,500,000 CY managed annually and the 20 year life of the facility. If closure in place were not allowed, then there would be an additional cost on the same order of magnitude as seen for the upland bermed CDF.

When compared to the Updated Optimum PPF Model, including a nearshore CDF adds 8.6 % to 22.6% to the cost of managing dredged material through the PPF system.

5.4.1 Nearshore CDF Scenarios

Cycling the entire 1,000,000 CY or 1,500,000 CY through the storage facility annually may not be the typical annual operational case. Cycling only 500,000 CY annually may be more typical if the larger facilities are developed. Operational costs would drop to levels comparable to operational costs for the 500,000 CY case. The 1,000,000 CY sized facility would still increase

Table 15

Updated Optimum PPF Model - Nearshore CDF Storage

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,500,000 CY In Channel Material Dredged Annually
7,634 CY Stabilized Material Processed Daily (FGSM - In-Barge)
8.656 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
8.656 tons of Material by Truck
78 tons >4" Debris Removed for Landfill Disposal Daily

Component in Overall Processing and Transportation	250,000 CY Storage Total Annual Costs	250,000 CY Storage Cost/CY of In Channel Material	500,000 CY Storage Total Annual Costs	500,000 CY Storage Cost/CY of In Channel Material	1,000,000 CY Storage Total Annual Costs	1,000,000 CY Storage Cost/CY of In Channel Material	1,500,000 CY Storage Total Annual Costs	1,500,000 CY Storage Cost/CY of In Channel Material
Scow Fleet	$ 5,924,742	$ 3.95	$ 5,924,742	$ 3.95	$ 7,354,852	$ 4.90	$ 8,580,661	$ 5.72
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,580,078	$ 23.72	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]	*1,000 feet of wharf space*							
Loading, Transportation by Truck, Placement	$ 39,575,003	$ 26.38	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Nearshore CDF Storage Facility Construction	$ 1,109,186	$ 0.74	$ 2,075,070	$ 1.38	$ 3,354,123	$ 2.24	$ 4,490,996	$ 2.99
Storage Cell Operations	$ 4,986,129	$ 3.32	$ 6,607,505	$ 4.41	$ 9,880,719	$ 6.59	$ 13,029,068	$ 8.69
Storage Cell Closure	$ (480,247)	$ (0.32)	$ (992,246)	$ (0.66)	$ (1,984,493)	$ (1.32)	$ (2,976,739)	$ (1.98)
Total	$ 87,868,961	$ 58.58	$ 89,683,662	$ 59.79	$ 94,673,793	$ 63.12	$ 99,192,577	$ 66.13
Percent increase in cost over Updated Optimum PPF Model		8.6%		10.9%		17.1%		22.6%
Updated Optimum PPF Model - No Storage		$ 53.92		$ 53.92		$ 53.92		$ 53.92

[1] Screening level pricing for comparison only among alternatives
[2] Cost of real estate not included

costs over the Updated Optimum PPF Model, but by only approximately 13% as compared to 17.1%. The increase in costs of the 1,500,000 CY sized facility would be only 14.7% as compared to 22.6%.

Direct scow access to the facility through a lock is possible, but maintaining the elevation of the stored material as much as 15 feet below the elevation of the berms would greatly increase the area required. Since a large nearshore area is already required, 18.6 to 111.3 acres, a lock scenario seemed unreasonable to consider.

Hydraulic offloading and placement into the nearshore CDF was another scenario considered, but it was not evaluated in detail for the same reasons as discussed for the upland bermed CDF (Section 5.3.1)

6.0 STORAGE MODEL COMPARISIONS AND POTENTIAL SAVINGS

Adding any type of storage facility as an additional component of the PPF dredged material management system adds additional equipment, facilities, operations, labor, and management. If all other cost components of the PPF system remain the same, any type storage facility of any size will only add to the costs to manage dredged material. The additional cost varies with the type of storage facility, the volume of storage, and the amount of material cycled through the storage facility annually. Based on the model results presented in Section 5, the increase is costs can range from less than 5% to almost 25%.

Although any storage facility adds costs to the PPF management system, the storage facility also reduces risks to dredgers, processors and placement sites by ensuring adequate and consistently available flow of material for processing and a consistently available facility to receive material prior to processing. Ensuring this consistent availability of storage space and material for processing reduces uncertainty on the part of dredgers, processors and placement sites and may allow them to lower their costs. With lowered cost components, the overall savings may justify the addition of storage within the overall system

6.1 Storage Alternative Comparisons

Tables 16 through 19 provide modeled costs among the alternative layouts for each of the facility size options. For the in-water CDF pit and the upland CDF pit, the tables present the base case. For all sized facilities, the in-water CDF pit adds the smallest increase to the Updated Optimum PPF Model costs. The upland bermed CDF consistently increases costs by the largest amount.

Table 20 summarizes the cost increases among the various alternatives and facility volumes. It also presents the footprint each facility will occupy. This Table further illustrates that the in-water CDF pit will add the least costs to the PPF management system while requiring the smallest facility footprint. The footprint of the nearshore CDF is the largest, but only slightly larger than the upland bermed CDF. Costs increases for the nearshore CDF are slightly lower than costs increases for the upland bermed CDF which are the largest among the four alternative layouts.

Table 16

Updated Optimum PPF MODEL with 250,000 CY In Channel Storage
Estimated Costs[1]
Summary

Component in Overall Processing and Transportation	In-Water CDF Pit Total Annual Costs	In-Water CDF Pit Cost/CY of In Channel Material	Upland CDF Pit Total Annual Costs	Upland CDF Pit Cost/CY of In Channel Material	Upland Bermed CDF Total Annual Costs	Upland Bermed CDF Cost/CY of In Channel Material	Nearshore CDF Total Annual Costs	Nearshore CDF Cost/CY of In Channel Material
Scow Fleet	$ 5,311,838	$ 3.54	$ 5,311,838	$ 3.54	$ 5,924,742	$ 3.95	$ 5,924,742	$ 3.95
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,580,078	$ 23.72	$ 35,580,078	$ 23.72	$ 35,580,078	$ 23.72	$ 35,580,078	$ 23.72
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]	*1,000*	*feet of wharf space*	*1,000*	*feet of wharf space*	*1,000*	*feet of wharf space*	*1,000*	*feet of wharf space*
Loading, Transportation by Truck, Placement	$ 39,575,003	$ 26.38	$ 39,575,003	$ 26.38	$ 39,575,003	$ 26.38	$ 39,575,003	$ 26.38
Storage Cell Construction	$ 1,112,476	$ 0.74	$ 983,147	$ 0.66	$ 454,039	$ 0.30	$ 1,109,186	$ 0.74
Storage Cell Operations	$ 3,829,372	$ 2.55	$ 5,645,520	$ 3.76	$ 4,986,129	$ 3.32	$ 4,986,129	$ 3.32
Storage Cell Closure	$ (431,712)	$ (0.29)	$ (528,332)	$ (0.35)	$ 367,486	$ 0.24	$ (480,247)	$ (0.32)
Total	$ 86,151,125	$ 57.43	$ 87,741,324	$ 58.49	$ 88,061,548	$ 58.71	$ 87,868,961	$ 58.58
Percent increase in cost over Updated Optimum PPF Model		6.5%		8.5%		8.9%		8.6%

[1] Screening level pricing for comparison only among alternatives

Table 17

Updated Optimum PPF MODEL with 500,000 CY In Channel Storage

Estimated Costs[1]

Summary

Component in Overall Processing and Transportation	In-Water CDF Pit Total Annual Costs	In-Water CDF Pit Cost/CY of In Channel Material	Upland CDF Pit Total Annual Costs	Upland CDF Pit Cost/CY of In Channel Material	Upland Bermed CDF Total Annual Costs	Upland Bermed CDF Cost/CY of In Channel Material	Nearshore CDF Total Annual Costs	Nearshore CDF Cost/CY of In Channel Material
Scow Fleet	$ 4,903,235	$ 3.27	$ 4,903,235	$ 3.27	$ 5,924,742	$ 3.95	$ 5,924,742	$ 3.95
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]								
Loading, Transportation by Truck, Placement	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Storage Cell Construction	$ 1,889,642	$ 1.26	$ 1,829,146	$ 1.22	$ 855,090	$ 0.57	$ 2,075,070	$ 1.38
Storage Cell Operations	$ 3,997,307	$ 2.66	$ 7,145,380	$ 4.76	$ 6,607,505	$ 4.41	$ 6,607,505	$ 4.41
Storage Cell Closure	$ (944,283)	$ (0.63)	$ (1,078,335)	$ (0.72)	$ 510,321	$ 0.34	$ (992,246)	$ (0.66)
Total	$ 85,914,492	$ 57.28	$ 88,868,017	$ 59.25	$ 89,966,249	$ 59.98	$ 89,683,662	$ 59.79
Percent increase in cost over Updated Optimum PPF Model		6.2%		9.9%		11.2%		10.9%

[1] Screening level pricing for comparison only among alternatives

Table 18

Updated Optimum PPF MODEL with 1,000,000 CY In Channel Storage

Estimated Costs[1]

Summary

Component in Overall Processing and Transportation	In-Water CDF Pit Total Annual Costs	In-Water CDF Pit Cost/CY of In Channel Material	Upland CDF Pit Total Annual Costs	Upland CDF Pit Cost/CY of In Channel Material	Upland Bermed CDF Total Annual Costs	Upland Bermed CDF Cost/CY of In Channel Material	Nearshore CDF Total Annual Costs	Nearshore CDF Cost/CY of In Channel Material
Scow Fleet	$ 5,516,139	$ 3.68	$ 5,516,139	$ 3.68	$ 7,354,852	$ 4.90	$ 7,354,852	$ 4.90
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]								
Loading, Transportation by Truck, Placement	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Storage Cell Construction	$ 3,392,683	$ 2.26	$ 3,300,996	$ 2.20	$ 1,359,665	$ 0.91	$ 3,354,123	$ 2.24
Storage Cell Operations	$ 4,216,203	$ 2.81	$ 7,402,605	$ 4.94	$ 9,880,719	$ 6.59	$ 9,880,719	$ 6.59
Storage Cell Closure	$ (1,936,525)	$ (1.29)	$ (2,161,360)	$ (1.44)	$ 743,375	$ 0.50	$ (1,984,493)	$ (1.32)
Total	$ 87,257,091	$ 58.17	$ 90,126,972	$ 60.08	$ 95,407,203	$ 63.60	$ 94,673,793	$ 63.12
Percent increase in cost over Updated Optimum PPF Model		7.9%		11.4%		18.0%		17.1%

[1] Screening level pricing for comparison only among alternatives

Table 19

Updated Optimum PPF MODEL with 1,500,000 CY In Channel Storage
Estimated Costs[1]
Summary

Component in Overall Processing and Transportation	In-Water CDF Pit Total Annual Costs	In-Water CDF Pit Cost/CY of In Channel Material	Upland CDF Pit Total Annual Costs	Upland CDF Pit Cost/CY of In Channel Material	Upland Bermed CDF Total Annual Costs	Upland Bermed CDF Cost/CY of In Channel Material	Nearshore CDF Total Annual Costs	Nearshore CDF Cost/CY of In Channel Material
Scow Fleet	$ 6,129,044	$ 4.09	$ 6,129,044	$ 4.09	$ 8,580,661	$ 5.72	$ 8,580,661	$ 5.72
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79	$ 35,690,670	$ 23.79
Portside Facilities Infrastructure	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78	$ 1,174,070	$ 0.78
8 acres needed for this facility[2]								
Loading, Transportation by Truck, Placement	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14	$ 39,203,851	$ 26.14
Storage Cell Construction	$ 4,860,696	$ 3.24	$ 4,588,742	$ 3.06	$ 1,722,060	$ 1.15	$ 4,490,996	$ 2.99
Storage Cell Operations	$ 6,264,337	$ 4.18	$ 11,172,306	$ 7.45	$ 13,029,068	$ 8.69	$ 13,029,068	$ 8.69
Storage Cell Closure	$ (2,935,008)	$ (1.96)	$ (3,240,579)	$ (2.16)	$ 976,429	$ 0.65	$ (2,976,739)	$ (1.98)
Total	$ 90,387,659	$ 60.26	$ 94,718,104	$ 63.15	$100,376,808	$ 66.92	$ 99,192,577	$ 66.13
Percent increase in cost over Updated Optimum PPF Model		11.8%		17.1%		24.1%		22.6%

[1] Screening level pricing for comparison only among alternatives

Table 20

Storage Alternatives Summary - Additional Cost/CY and Facility Footprint

	250,000 CY Storage			500,000 CY Storage			1,000,000 CY Storage			1,500,000 CY Storage		
	Annual Cost/CY Through PPF System	Storage Area, acres	Support Area, acres	Annual Cost/CY Through PPF System	Storage Area, acres	Support Area, acres	Annual Cost/CY Through PPF System	Storage Area, acres	Support Area, acres	Annual Cost/CY Through PPF System	Storage Area, acres	Support Area, acres
In-Water CDF	$3.51	6.0	2	$3.36	9.6	2	$4.25	15.9	2	$6.34	21.9	2
Upland Pit CDF	$4.57	11.1	*	$5.33	15.4	*	$6.16	22.2	*	$9.23	28.2	*
Upland Bermed CDF	$4.79	18.5	*	$6.06	36.1	*	$9.68	66.2	*	$13.00	96.2	*
Nearshore CDF	$4.66	18.6	2	$5.87	37.1	4	$9.20	74.2	6	$12.21	111.3	6

* Support facilities within Storage Area footprint with Storage Area adjacent to the Harbor

	250,000 CY Storage			500,000 CY Storage			1,000,000 CY Storage			1,500,000 CY Storage		
	Annual Cost/CY Through PPF System	Percent Increase in Overall PPF System Costs	Annual Cost/CY of Storage	Annual Cost/CY Through PPF System	Percent Increase in Overall PPF System Costs	Annual Cost/CY of Storage	Annual Cost/CY Through PPF System	Percent Increase in Overall PPF System Costs	Annual Cost/CY of Storage	Annual Cost/CY Through PPF System	Percent Increase in Overall PPF System Costs	Annual Cost/CY of Storage
In-Water CDF	$3.51	6.5%	$21.06	$3.36	6.2%	$10.08	$4.25	7.9%	$6.38	$6.34	11.8%	$6.34
Upland Pit CDF	$4.57	8.5%	$27.42	$5.33	9.9%	$15.99	$6.16	11.4%	$9.24	$9.23	17.1%	$9.23
Upland Bermed CDF	$4.79	8.9%	$28.74	$6.06	11.2%	$18.18	$9.68	18.0%	$14.52	$13.00	24.1%	$13.00
Nearshore CDF	$4.66	8.6%	$27.96	$5.87	10.9%	$17.61	$9.20	17.1%	$13.80	$12.21	22.6%	$12.21

The upland pit CDF increases costs more than the in-water pit CDF and requires a larger footprint, but it’s footprint is significantly less than the upland or nearshore CDFs. As discussed in Section 5.2.1, scenarios linking the upland CDF to the Harbor lowered costs near to but not below the in-water pit CDF costs although a larger footprint would be required.

6.2 Potential Cost Reductions

With a storage facility acting as a buffer between dredging operations and processing operations, a consistent flow of dredged material to the processing operations can be assured. If, for a number of reasons, dredging within the Harbor ceased for several weeks or several months, material in the storage facility could be made available for processing, avoiding the significant increases in overall cost/CY that are incurred when there is a shortfall in material for weeks or months

Similarly, placement sites would have increased predictability as to the amount and quality of the processed dredged material they would be receiving. With a long-term, steady supply of processed material, it may be possible to enter into long-term contracts at more attractive rates for the PPF. Placement sites could plan and meet schedules for placement volumes. Increased predictability and flexibility for placement may also translate into lower overall costs.

When a consistent, long-term flow of dredged material has been ensured, long-term plans for processing and placement can be made, long-term contracts can be executed, capital equipment can be amortized over longer periods, more robust equipment can be afforded to reduce maintenance costs, and other cost components can be modified. Modifying (lowering) these costs components will reduce overall costs to the PPF system. If costs can be reduced sufficiently, overall costs with storage may be less than total costs modeled in the Updated Optimum PPF Model.

Table 21 presents the effects of modifying costs components on overall costs for the 500,000 CY in-water CDF pit storage facility as an example of how any of the storage alternatives might lead to reduced overall costs. The modified assumption is presented along with the modified cost/CY of in channel material. The modified assumptions are additive in a stepwise fashion.

Costs well below the Updated Optimum PPF Model total cost of $53.92/CY are achieved when only a few of the assumptions regarding cost components are less conservative. If all of the changes listed in Table 21 could reasonably be expected to result from the addition of the storage facility, overall costs would be reduced by over 30% as compared to the Updated Optimum PPF Model.

Table 21
Reduced Cost Estimate with Modified Assumptions
Updated Optimum PPF Model - 500,000 CY In Channel In-Water CDF Pit Storage

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions	**$57.28**	
Modified Assumptions		
Management G&A Reduced from 15% to 7.5%	$53.85	$3.43
Profit Reduced from 10% to 7.5%	$52.73	$1.12
Capital Cost Recovery Increased from 5 Years to 10 Years	$50.32	$2.41
Infrastructure Cost Recovery Increased from 10 Years to 20 Years	$49.96	$0.36
Storage Facility Cost Recovery Increased from 20 Years to 30 Years	$49.79	$0.17
Capital Cost Contingency Reduced from 15% to 10%	$49.58	$0.21
General Cost Factor for Installation Reduced from 2.5 to 2	$49.52	$0.06
Annual Maintenance Costs Reduced to 2.5%	$48.95	$0.57
Cement Cost Reduced by 15% to $106.25	$46.85	$2.10
Tipping Fee Reduced to $2.50/CY of Stabilized Material Placed	$44.18	$2.67
Dump Truck Subcontracted Rate Reduced by 10% to $990	$42.63	$1.55
Union Labor Rate Reduced by 10% to $56.70	$42.13	$0.50
Supervisor Labor Rate Reduced by 10% to $79.20	$41.87	$0.26
Management G&A Reduced from 7.5% to 5%	$40.95	$0.92
Profit Reduced from 7.5% to 5%	$40.05	$0.90
Captial Cost Contingency Reduced from 10% to 5%	$39.88	$0.17
Tipping Fee Reduced to $1.00/CY of Stabilized Material Placed	$38.27	$1.61
No Tipping Fee	$37.21	$1.06

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Appendix A

Assumptions Used for Optimum Model

Appendix A

Assumptions Used for Optimum Model

Optimum Model PPF from Economic Modeling Summary Report March 2006

1. Material dredged and processed

- 1.5 MCY of in channel FGSM dredged annually.
- Dredging and processing through one facility from June through January (35 weeks or 210 days).
- 7,100 CY of in channel material dredged daily.
- 8,000 CY of decanted material processed daily.

- DMMP projected quantities for FGSM - summary statistics
    - Maintenance dredging
        - 2007-2016, Ave. 1.7 MCY, Max. 2.3 MCY, Min. 1.3 MCY.
        - After 2016, Ave. 2.2 MCY, Max. 2.8 MCY, Min. 1.5 MCY.
        - Based on DMMP summary of maintenance dredging projects with FGSM, 10 to 20 of these projects would be undertaken annually.
    - Deepening dredging
        - 2007-2012, Ave. 0.6 MCY, Max. 1.9 MCY, Min. 0 MCY.
        - No deepening material after 2012.
        - Based on DMMP summary of new work deepening projects with FGSM, 2 to 4 projects undertaken in most years.
    - Combined dredging volumes
        - >1.5 MCY is projected annually but "management" and coordination of individual projects will be required to maintain a steady flow.

DMMP projections indicate there will be sufficient material to allow this sized facility to operate at full capacity most years. Varying the number of shifts provides some flexibility regarding the weekly volume processed.

Operating two smaller facilities does not provide any savings, especially when real estate requirements are considered. Operating year-round also does not appear to provide significant savings when the cost of storage and the additional real estate for an upland storage area are factored in. Operating during the general harbor-wide fish shut-downs to meet the demands of specific dredging projects that might be allowed would still be possible.

2. "Supporting" activities

Costs for the following types of activities, required for any dredging project, are assumed to be the responsibility of the "owner" or "regulator" and are not included in the PPF costs.

- Engineering design.
- Sampling and analysis.

- Permitting.
- Contracting.
- Oversight during dredging.
- Monitoring of PPF operations and upland placement.

These activities are best accomplished by the entities responsible for the area to be dredged and the placement site and the regulation of these activities.

3. Dredging and transport to the PPF

All dredging is mechanical dredging with environmental controls and material is placed into dredge scows with no overflow allowed.

- Costs of dredging are **NOT** included in the PPF model costs.
- Newark Bay is the assumed location of Optimum Model PPF and is “central” to all dredging.
- Transportation of scows to the PPF and return of scows to the dredge site are included in the costs of dredging.
- All scows for transport of dredged material from the dredging sites to the PPF are supplied by the PPF.
- Additional scows needed to allow for processing activities are also supplied by the PPF.
- A total of 27 scows, approximately 2,000 CY each, are supplied by the PPF.
- Decant water is pumped out at the PPF.

Newark Bay is central to more of the maintenance dredging and has been the general location of these types of activities for a number of years. Real estate for a facility may be available in this generally central area.

By providing the scows, the facility has a standard scow to be working with/in and can process them most efficiently. Providing the scows may also lower the costs charged for the dredging and may address some of the contractual and liability issues. Capital expenditure for tangible equipment such as scows was determined to be a reasonable type of public contribution to the PPF.

4. Receipt and processing at PPF

- All material is processed by in-barge mixing. There are two 8-hours shifts daily when material is being delivered at the design rate of 8,000 decanted CY daily.
- Dredger delivers an average of 6 scows daily to the PPF. Scows are moored to pile dolphins to begin processing.
- Decant water is pumped to one of three holding scows. After holding scows are filled, they sit for 24 hours to allow for settlement before the decant water is discharged overboard.
- Decanted scows are moved to the PPF wharf by a PPF tug and crew for processing.

- Debris >4” is removed from the dredged material by an excavator with a rake and placed dockside for disposal at a landfill. Debris >4” is 0.5% of volume or 78 tons daily.
- Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head. Cement is added at 8% by weight or 692 tons daily.
- Scows are moved to the pile dolphins to allow the material to begin the initial cure.
- Scows are returned to the wharf for offloading by an excavator.
- Pile dolphins are needed for an additional 12-14 scows (scows being dewatered, scows curing, empty scows to be returned to dredging site, decant water scows).

At the level of detail of this estimate, processing costs per in channel cubic yard for the addition of stabilizing agents by either in-barge or pug mill are roughly equivalent. Providing for both types of operations at a single facility provides no distinct advantage and increases processing costs. Barge transportation of the mixed product in the PPF supplied barges favors in-barge mixing. Pug mill mixing may be more cost effective with a truck or rail transportation alternative. More detailed evaluation and design is needed to discriminate between systems or to identify other preferred modes of processing.

Stabilizing additives other than cement may lead to savings; but, for the level of detail in this estimate, quantifying those savings into the overall cost is not justified. During design, these issues must be addressed more fully because there is the potential for significant costs savings over the facility’s life.

5. Portside Infrastructure

- 1,500 feet of wharf space is needed to accommodate 6 scows; 3 being processed, 1 being “topped-off”, 1 with remedial material (RM), and 1 extra.
- 10 acres are required for site improvements; 300 feet of working space along the 1,500 feet of wharf plus space for 1 days production of in-barge stabilized material (1 acre).
- 2 acres for future RM processing.
- 8 acres of space for storage of FGSM and/or RM.
- An upland diked storage area for 50,000 CY of FGSM in half of the 8 acres.
- 25 pile dolphins for scow tie-up.
- 45,000 CY are dredged near the wharf (10 feet of dredging at the wharf face tapering to 0 feet of dredging 200 feet from the wharf).

Providing space for 6 scows allows flexibility in the use of the site to include dock space for transportation by barge and receipt of remedial material for processing. Within the 300 feet of space adjacent to the 1,500 feet of wharf, there is also potential space for one to two rail spurs for rail transportation of material offsite. Exact configuration of the waterfront component can be somewhat flexible based on available properties and offshore space for scow management.

Providing additional acreage for a future RM processing facility and for storage of FGSM and/or RM will provide flexibility for future operational approaches. Costs for dike construction to hold 50,000 CY are roughly equivalent to costs for ship storage in a large ore/grain ship.

6. Portside loading

- Excavator removes mixed and partially cured material from a scow and places it onto a conveyor.
- Conveyor moves the material to a radial stacker that stacks it on the pavement in the storage area.
- Front end loader loads the material to trucks.
- Conveyor to radial stacker to barge or scow top-off is also possible.
- Infrastructure for loading is included in portside infrastructure.
- Rail/rail loading infrastructure is not provided, but space is available.

It seems most likely the initial placement sites will be close enough to the harbor to make truck transportation economical. Barge transportation to a nearby location may also be realistic and would be significantly more cost effective than truck transportation. Including the flexibility to load/top-off barges provides the ability to capitalize on the significantly reduced costs of barge transportation. Rail transportation may become a realistic option as near-by placement sites are closed. However, since it is most likely a longer-term option, no loading facilities are considered at this time. Truck loading operations could be modified to accommodate some rail loading using the truck loading equipment.

7. Transportation

- Half of the material is transported by barge using PPF supplied scows.
- A placement site is located within 50 miles of the PPF that can accept barge transport material and that has existing offloading facilities.
- Half of the material is transported in subcontracted trucks.
- Placement sites for truck transported material average 25 miles from the PPF facility.
- Subcontracted trucks deliver 4 truck loads of material to the placement site daily.

Nearby placement sites accessible by truck and barge may be available in the near term. Trucking in the short term is the likely mode of transportation for 100% of the material. Barge transportation could potentially take a significant portion (>90%) in the near term, especially if a nearby site could accept this processed material. A 50/50 split may be a good approximation of the overall costs over the first 5 to 10 years of a PPF.

8. Placement

- Trucks deliver processed material directly to the placement site and dump the material as directed.
- Barges deliver the processed material to the offloading site where the material is offloaded to trucks and delivered to a placement site within 5 miles of offloading facility.
- No additional processing of the material is required at the placement site.
- Front end loader moves material within the placement location as necessary.
- Bulldozer scrapes and levels material.
- Equipment moving over placed material as well as continued curing achieves required compaction and strength.
- Placement costs, including barge offloading for the barge transportation, are not the responsibility of the PPF operations, but the PPF operator pays those costs to the placement site.
- Placement site fee covers costs of placement PLUS $5.00 tipping fee per CY of stabilized material delivered.

Individual brownfield closure sites are the most likely candidates for placement sites in the short term. Multiple sites will likely be used over the next 5 to 10 years. Individual developers of these sites will need to manage the delivered material to meet their site-specific requirements. This general approach provides a reasonable estimate of the level of effort and costs required.

The economics of these brownfield sites suggests it will be necessary to pay some type of fee to the developer in addition to paying the unloading and placement costs. While specifics regarding the fee will be subject to significant negotiations, $5.00 seems a reasonable order of magnitude fee to consider at this conceptual estimate level.

Appendix B

Updated Optimum PPF Model – No Storage

Appendix B

UPDATED OPTIMUM PPF MODEL – NO STORAGE

1. Material dredged and processed – No Change from March ’06 Optimum Model

- 1.5 MCY of in channel FGSM dredged annually.
- Dredging and processing through one facility from June through January (35 weeks or 210 days).
- 7,100 CY of in channel material dredged daily.
- 8,000 CY of decanted material processed daily.

❖ DMMP projected quantities for FGSM - summary statistics
  - ➢ Maintenance dredging
    - 2007-2016, Ave. 1.7 MCY, Max. 2.3 MCY, Min. 1.3 MCY.
    - After 2016, Ave. 2.2 MCY, Max. 2.8 MCY, Min. 1.5 MCY.
    - Based on DMMP summary of maintenance dredging projects with FGSM, 10 to 20 of these projects would be undertaken annually.
  - ➢ Deepening dredging
    - 2007-2012, Ave. 0.6 MCY, Max. 1.9 MCY, Min. 0 MCY.
    - No deepening material after 2012.
    - Based on DMMP summary of new work deepening projects with FGSM, 2 to 4 projects undertaken in most years.
  - ➢ Combined dredging volumes
    - >1.5 MCY is projected annually but “management” and coordination of individual projects will be required to maintain a steady flow.

2. “Supporting” activities – No Change from March ’06 Optimum Model

Costs for the following types of activities, required for any dredging project, are assumed to be the responsibility of the “owner” or “regulator” and are not included in the PPF costs.

- Engineering design.
- Sampling and analysis.
- Permitting.
- Contracting.
- Oversight during dredging.
- Monitoring of PPF operations and upland placement.

3. Dredging and transport to the PPF – No Change from March ’06 Optimum Model

All dredging is mechanical dredging with environmental controls and material is placed into dredge scows with no overflow allowed.

- Costs of dredging are **NOT** included in the PPF model costs.
- Newark Bay is the assumed location of Optimum Model PPF and is “central” to all dredging.

- Transportation of scows to the PPF and return of scows to the dredge site are included in the costs of dredging.
- All scows for transport of dredged material from the dredging sites to the PPF are supplied by the PPF.
- Additional scows needed to allow for processing activities are also supplied by the PPF.
- A total of 27 scows, approximately 2,000 CY each, are supplied by the PPF.
- Decant water is pumped out at the PPF.

4. Receipt and processing at PPF – No Change from March '06 Optimum Model

- All material is processed by in-barge mixing. There are two 8-hours shifts daily when material is being delivered at the design rate of 8,000 decanted CY daily.
- Dredger delivers an average of 6 scows daily to the PPF. Scows are moored to pile dolphins to begin processing.
- Decant water is pumped to one of three holding scows. After holding scows are filled, they sit for 24 hours to allow for settlement before the decant water is discharged overboard.
- Decanted scows are moved to the PPF wharf by a PPF tug and crew for processing.
- Debris >4" is removed from the dredged material by an excavator with a rake and placed dockside for disposal at a landfill. Debris >4" is 0.5% of volume or 78 tons daily.
- Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head. Cement is added at 8% by weight or 692 tons daily.
- Scows are moved to the pile dolphins to allow the material to begin the initial cure.
- Scows are returned to the wharf for offloading by an excavator.
- Pile dolphins are needed for an additional 12-14 scows (scows being dewatered, scows curing, empty scows to be returned to dredging site, decant water scows).

5. Portside Infrastructure

The amount of portside infrastructure is reduced. The Updated Optimum Model does not provide any space for storage or RM processing. Additionally, it assumes no offsite transport of processed material by barge so that dock space for this is not provided.

- 1,000 feet of wharf space is needed to accommodate 4 scows; 3 being processed and 1 extra.
- 8 acres are required for site improvements; 300 feet of working space along the 1,000 feet of wharf plus space for 1 days production of in-barge stabilized material (1 acre).

- No space for future RM processing.
- No space for storage of FGSM and/or RM.
- 25 pile dolphins for scow tie-up.
- 30,000 CY are dredged near the wharf (10 feet of dredging at the wharf face tapering to 0 feet of dredging 200 feet from the wharf).

6. Portside loading

Offsite transportation is by truck only so that no scow loading or topping-off is needed.

- Excavator removes mixed and partially cured material from a scow and places it onto a conveyor.
- Conveyor moves the material to a radial stacker that stacks it on the pavement in the storage area.
- Front end loader loads the material to trucks.
- Infrastructure for loading is included in portside infrastructure.
- Rail/rail loading infrastructure is not provided, but space may be available.

7. Transportation

All offsite transportation of processed material is by truck to sites within 25 miles.

- All of the material is transported in subcontracted trucks.
- Placement sites for truck transported material average 25 miles from the PPF facility.
- Subcontracted trucks deliver 4 truck loads of material to the placement site daily.
- A sufficient number of sites within 25 miles will be available over the life of the PPF.

8. Placement

All transportation is by truck.

- Trucks deliver processed material directly to the placement site and dump the material as directed.
- No additional processing of the material is required at the placement site.
- Front end loader moves material within the placement location as necessary.
- Bulldozer scrapes and levels material.
- Equipment moving over placed material as well as continued curing achieves required compaction and strength.
- Placement costs are not the responsibility of the PPF operations, but the PPF operator pays those costs to the placement site.
- Placement site fee covers costs of placement PLUS $5.00 tipping fee per CY of stabilized material delivered.