Port of New York and New Jersey
Feasibility Analysis for a Dredged Material
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) has 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 Regional Dredging Team, 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). This Economic Model Summary Report (Report) marks the initial step in the evaluation process. This Report evaluates relative costs and benefits for various combinations of PPF attributes in an effort to define the facility that would be both cost effect and meet the needs of the Port stakeholders.

The economic model developed in this Report is based on the understanding that a PPF for dredged material will not be authorized for construction unless it is cost-effective. The economic model made it possible to evaluate the cost effects of changing dredged material volumes, PPF location, material types processed, transportation methods, types of processing, equipment, and predictability of dredged material supply, for various PPF scenarios.

Four initial alternative scenarios for the PPF were developed. They encompassed the range in dredged material types and volumes that might be processed through a PPF based on projections identified in the NYD's 2006 Dredged Material Management Plan (DMMP) Update. Conservative estimates of the annual costs to process dredged material through the facility(ies) were developed so that the cost ranges for the alternatives could be compared. Estimated costs were reported as the cost/cubic yard of in situ dredged material as well as total annual costs. These costs covered management and processing of the dredged material from delivery to the PPF through final placement at an upland location or sale of the processed product.

Based on the projected outcomes of the four alternatives, the PPF Subgroup developed an Optimum Alternative. Formulation of the Optimum Alternative was achieved through incremental adjustments in various PPF attributes, which resulted in differences in cost. The Subgroup then analyzed these cost changes and in turn modified PPF attributes until the optimal cost-to-benefit ratio was identified. The Optimum Alternative consists of a single PPF sized to process 1.5 million cubic yards of fine-grained silty dredged material annually. This type of dredged material is most commonly found in maintenance dredging. Processing will consist of stabilization to make the material suitable for upland placement and beneficial use at brownfield sites and for other similar applications. While trucking from the PPF to the beneficial use site is anticipated in the initial years of PPF operation, provisions are proposed for barge transportation due to the significant cost savings associated with barge transportation. Rail access to the site is also needed so that upland sites, inaccessible by water and distant from the Port, can be considered for beneficial use.

The Optimum PPF would also provide space for the eventual development of the facility to process more highly contaminated sediments associated with remedial dredging projects. While a viable, cost-effective treatment process has not yet been demonstrated on a large-scale, a number of promising technologies are under development. When such a technology is available to process more highly contaminated dredged material into a salable product, it could be sited at the PPF. If this new technology could also process a portion of the maintenance dredging material into a saleable product, overall costs for the PPF could be significantly reduced through sale of the product.

The model concluded that approximately 20 acres of land would be required adjacent to the Harbor to develop the Optimum PFF. A central location would be preferable, such as Newark Bay, so that the site would be easily accessible to most dredging projects, but sites further removed from the center of the Harbor could also be considered if space were more affordable and more able to meet the optimum site requirements.

Formulation of this Economic Model was the first phase in evaluating the feasibility of a PPF for the Port of New York and New Jersey. The PPF attributes identified in the Optimum Alternative will now be used as a guide in evaluating available alternative locations for the PPF in the Port and as a baseline for further economic analyses during the next phase of the project.

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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). Interest in investigating the feasibility of constructing such a facility arose out of concern that privately developed processing facilities may not be economically viable or sustainable in the long-term once the HDP is complete, or when various large real estate developments projects (e.g., landfills and brownfields) exhaust their capacity for dredged material.

It is anticipated that the development of a Harbor-wide dredged material PPF could resolve some of the unpredictability in the supply of dredged material through any one facility, which could result in substantial cost savings. Costs savings could be realized by: 1) designing a facility with adequate dredged material storage capacity to facilitate continuous and unimpeded operations, and 2) maximizing the volumes of dredged material to be processed at one facility, to reduce stabilization and transportation costs.

If a Harbor-wide PPF achieved these cost savings while producing an ample, reliable supply of usable dredged material, upland placement of dredged material for beneficial uses could become an economically preferred alternative. The potential also exists for a PPF to reduce costs to the point where dredging would become economically feasible for small quantity generators that cannot currently afford to conduct necessary dredging.

The PPF would be accessible to all in the Port, accepting dredged material from both Federal and state channels and private berthing facilities. The facility would be designed to complement privately operated dredged material processing endeavors, not to compete directly with them. The facility would process non-HARS material, typically a fine-grained silty material that fails the current criteria for placement at the HARS. In addition, the facility might process other types of material including fine-grained silty material that would be suitable for placement at the HARS, sandy material that may or may not be HARS suitable, stiff red clay that will be removed as part of the HDP and remedial materials associated with environmental dredging projects within the Harbor.

The United States Army Corps of Engineers, New York District (NYD), in conjunction with a wide range of Port stakeholders including the Port Authority of New York and New Jersey (PANY/NJ), the New Jersey Office of Maritime Resources, the New Jersey Department of Environmental Protection, the New York Department of Environmental Conservation and the United States Environmental Protection Agency, is evaluating the feasibility and economic costs/benefits of a Harbor-wide PPF to support all types of proposed dredging in the Port. This Economic Model Summary Report (Report) marks the initial step in the evaluation process. This Report evaluates relative costs and benefits for various combinations of PPF attributes in an effort to define the facility that would be both cost effect and meet the needs of the Port stakeholders. The economic model developed in this Report is based on the stakeholders' understanding that a PPF for dredged material will not be authorized for construction unless it is cost-effective. The economic model made it possible to evaluate the effects to cost of increasing the volume and predictability of dredged material processed for various PPF scenarios.

2.0 ECONOMIC MODEL ALTERNATIVES DEVELOPMENT

The economic model developed to evaluate different possible scenarios for a PPF is based on models completed for the PANY/NJ (FWENC, 2001 & 2002) and uses costs developed in those reports updated 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 needed 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.

Each alternative was developed in consultation with the PPF Subgroup of the RDT. The PPF Subgroup, lead by the NYD, consisted of various stakeholders from the Port community who were also active in the development of the 2006 update of the DMMP for the Port. Several iterations of each PPF alternative described below were developed, reviewed and refined by the PPF Subgroup as they reached a consensus regarding the general components of each of the alternatives presented in the following sections.

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) 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.

In all of the Alternatives considered in this Report's economic model, costs for dredging were not included. It is assumed that each dredging project will continue to be bid and awarded following existing procedures and protocols. Adding dredging costs will not affect the relative comparison of the various PPF alternatives. Transportation of dredged material from the dredging site to the PPF and scow return to the dredging site were also assumed to be the responsibility of the dredging firm and included within the cost of dredging.

For all of the Alternatives developed, it was assumed that all scows used to deliver the mechanically dredged material to the PPF were provided by the PPF. Purchase of scows was a capital expenditure included in each Alternative. Capital cost recovery, maintenance, and management of the scows increased overall annual cost by roughly $3.50/CY. Capital expenditure for tangible equipment such as scows was judged by the PPF Subgroup to be a reasonable type of public contribution to the PPF.

Having uniformly sized scows arriving at the PPF would simplify handling of the scows and standardize operations that take place within or from the scows such as dewatering, mixing, offloading and reloading. Standardization was assumed to improve handling efficiencies and thereby reduce PPF handling costs. Allowing dredging firms to use scows bought and maintained by the PPF was also assumed to reduce the cost that would be charged by the dredging firms for the dredging. Potential dredging cost savings/CY were not quantified. Removing the scow costs from each Alternative would have a similar impact on overall cost/CY for each Alternative, keeping relative comparative costs similar.

Model results for the overall cost of processing dredged material (excluding dredging) were in the $40-$55/CY range, 30 to 40% higher than the $29-$42/CY cost (including dredging) cited in the DMMP for processing and placing HARS unsuitable materials (USACE, 2006a).

In order to allow for an examination of each of the individual cost assumptions, the models were set up so that individual costs could be varied and the impact of that change on the overall costs of each or all alternatives could be seen. As reported below, as the more conservative cost assumptions are modified to more aggressive assumptions, cost/CY drops significantly. Under the most aggressive of assumptions, overall cost falls into the $20-$30/CY range.

To provide a consistent basis for comparison among each alternative and scenario and between the individual management steps within an alternative, annual costs were also developed for each CY of material dredged and processed. Since percent solids in a cubic yard of dredged material, and consequently its weight, changes as it moves through the processing and management chain, costs were normalized to an *in situ* or in channel cubic yard of dredged material.

Table 1 provides a listing of the assumptions used in each of the models. Specific steps in each model are illustrated in Appendix A, where details of the Base Model are provided.

Table 1
Assumptions Used in Cost Estimates for Processing Dredged Material Through a PPF

Type of Dredged Material	Varied among Alternatives
Number of Days of Operation Annually	210 to 312 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	4,762 to 14,286 CY
Annual volume of in channel material dredged	1,000,000 to 3,000,000 CY
Decanted Dredged Material	
Solids content of decanted dredged material, delivered	37.5% - 81.1 pcf
Daily volume delivered for processing	5,316 to 15,947 CY
Annual volume delivered for processing	1,116,283 to 3,348,852 CY
Percent debris >4"	0.5% to 0.05% of daily volume
Disposal cost of debris	$110 ton
Stabilized FGSM Dredged Material	
Solids content of stabilized dredged material	45.5% - 84 pcf
Daily volume of stabilized dredged material	5,089 to 10,178 CY
Daily tonnage of stabilized dredged material	5,771 to 11,541 tons
Annual volume of stabilized dredged material	1,068,699 to 2,137,399 CY
Annual tonnage of stabilized dredged material	1,211,809 to 2,423,619 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	$57/hour
Supervision personnel	$86/hour
Cement for Stabilizing Decanted FGSM Dredged Material	
Percent cement added	8%
Cost for cement	$100/ton
Transportation	
Transportation distance	25 to 150 miles
Mode of transportation	Truck, barge and rail

3.0 BASE MODEL – ALTERNATIVE 1

The Fine-Grained Silty Material (FGSM) Base Model evaluated processing and placement of one MCY of material annually. One MCY is a modest percentage (<25%) of the total amount of annual maintenance and new work dredging anticipated within the timeframe of the HDP (USACE, 2006b) and is the smallest volume considered in this cost comparison study. Earlier economic comparisons completed for the PANY/NJ (FWENC, 2001 & 2002) indicated one MCY was a reasonable annual economical processing volume in terms of achievable and sustainable daily dredging, processing and placement rates, and the amount of capital equipment needed.

Only FGSM was considered in Alternative 1 – the FGSM Base Model. As reported in the DMMP (USACE, 2006a), much of the maintenance dredged material and some of the new work dredging will be FGSM. While a small portion of this material may be suitable for use at the HARS, most will not be suitable and will require upland placement. Smaller maintenance projects may also elect upland placement if testing costs exceed cost savings from placement at the HARS.

For the FGSM Base Model, only one PPF was considered and operations were limited to the approximately eight months during the year (June through January) when dredging is generally allowed throughout most of the harbor. The PPF was assumed to be centrally located so that it could receive material from projects throughout the harbor. No specific, suitable location(s) were identified or evaluated. The costs developed in the model do not include any real estate costs nor do they include any special geotechnical or environmental work that may be required to prepare the site for PPF construction.

To provide one MCY annually, approximately 4,800 CY of in channel material would need to be dredged and delivered daily during the eight-month operating period. Approximately 5,000 CY (5,800 tons) of stabilized material would be produced each day of operation.

The FGSM Base Model assumed that FGSM was stabilized for upland placement by in-barge mixing with cement following decanting of free water and debris removal. Capital equipment and labor needed for this operation were estimated. Earlier economic comparisons completed for the PANY/NJ (FWENC, 2002) indicated that, at the level of detail in these economic comparisons, pug mill mixing costs were not significantly different from in-barge mixing costs. While there may be a significant difference in the actual costs when a final PPF is sited and a final process is designed, for these comparisons the costs/CY is roughly comparable for either process. For the Base Model, this processing cost was estimated at $19.16/CY.

Similarly, the assumed use of cement at 8% by wet weight of dredged material may not be the most cost effective stabilizing approach for the actual facility operation, but is a sufficient estimate for these comparisons. Actual percentages of stabilizing agents will vary depending on the characteristics of the FGSM and the placement site requirements. Other additives such as coal fly ash, lime kiln dust, or cement kiln dust may prove to be more economical. Opportunities exist for significant reductions in costs once actual projects and placement sites are identified.

Portside infrastructure for the FGSM Base Model was estimated assuming that an eight-acre linear parcel roughly 1,000 feet long could be identified along the Harbor waterfront. Other arrangements are possible, including locating significant portions of the infrastructure on piers. However, to process almost 5,800 tons (5,000 CY) of stabilized material daily, there would need to be room for simultaneous work in three scows as well as space for processed dredged material to be loaded onto trucks for offsite transport.

For the FGSM Base Model, truck transportation to a placement site 25 miles from the PPF was assumed. Subcontracted, leased and PPF owned trucking were evaluated and subcontracted transportation provided the least cost option at $15.41/CY. The placement site was assumed to charge a tipping fee of $5/CY of stabilized material delivered ($5.35/in channel CY). Additionally, the cost to place and compact the stabilized material was assumed to be a cost passed on to the PPF. Overall cost for loading, transportation and placement, including the tipping fee, was estimated to be $22.73/CY.

Assumed conditions for the FGSM Base Model are provided in more detail in Table 2. Table 3 summarizes the annual cost estimate by major categories and provides the total annual cost, approximately $46.5 million, and the cost/CY of in channel material dredged, $46.46/CY. Material processing is estimated to be the single most costly step in the overall process, with transportation to the placement site the second most costly.

Table 4 evaluates the relative impact of individual assumptions on the overall cost/CY. The alternate assumption is given below the base assumption used in the model; all other factors remained unchanged from the initial FGSM Base Model.

Volume of material processed through the PPF can have a significant impact on the cost/CY when the flow of material is significantly less than the designed capacity. A 50% reduction in the flow of material is estimated to increase the processing cost/CY by 25% because capital costs are spread over fewer yards of material.

The volume of additive (cement) needed for stabilizing the dredged material and the tipping fee can significantly influence costs (±10%). Cost for the additives is a significant factor and provides opportunities for cost reductions. Lowering management general and administrative costs (G&A) and extending or eliminating capital costs recovery also provides opportunities for overall cost reduction. Other factors affect price and in combination may lower overall cost significantly.

Table 5 evaluates the potential reduction in overall cost/CY from a combination of alternate assumptions. Assumptions used for the initial case of the Base 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. Under the most optimistic of circumstances, processing and placement cost/CY could be reduced by more than half to under $23/CY. A more realistic cost is probably found in the middle of Table 5, in the range of $30/CY.

Table 2

Assumptions Used for Model Development

Alternative 1 – Fine-Grained Silty Material (FGSM) Base Model

1. Material dredged and processed

- 1 MCY of in channel FGSM dredged annually.
- Dredging and processing from June through January (35 weeks or 210 days).
- 4,800 CY of in channel FGSM dredged daily.
- 5,300 CY of decanted FGSM processed daily.

- ❖ DMMP projected quantities for FGSM - summary statistics
  - ➢ Maintenance dredging
  - o >1 MCY annually 2005-2014 and beyond.
  - o 2005-2014, Ave. 1.7 MCY, Max. 2.5 MCY, Min. 1.1 MCY.
  - o After 2014, Ave. 2.3 MCY, Max. 3.2 MCY, Min. 1.5 MCY.
  - o Based on DMMP summary of maintenance dredging projects with FGSM, 10 to 20 of these projects would be undertaken annually.
  - ➢ Harbor Deepening Project dredging
  - o >1 MCY annually 2005-2012 except 2007 and 2010.
  - o 2005-2012, Ave. 1.5 MCY, Max. 3.0 MCY, Min. 0.2 MCY.
  - o No deepening material after 2012.
  - o Based on DMMP summary of new work deepening projects with FGSM, 2 to 4 projects undertaken in most years.

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.
- Oversight of upland placement.

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.

Table 2, continued

- Newark Bay is the assumed location of the FGSM Base 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 cost of dredging.
- All scows for transport of dredged material from 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 18 scows, approximately 2,000 CY each, are supplied by the PPF.
- Decant water is pumped out at the PPF.

4. Receipt and processing at the PPF

- Dredger delivers an average of 4 scows daily to the PPF. Scows are moored to pile dolphins to begin processing.
- Decant water is pumped to one of two 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 52 tons daily.
- Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head. Cement added at 8% by weight or 462 tons daily.
- Scows are moved to pile dolphins to allow material to begin initial cure.
- Scows are returned to the wharf for offloading by an excavator.
- Dock space is required for 4 scows (debris removal, mixing, offloading, extra space).
- Pile dolphins are needed for an additional 8-10 scows (scows being dewatered, scows curing, empty scows to be returned to dredging site, decant water scows).

5. Portside Infrastructure

- 1,000 feet of wharf space is needed to accommodate 4 scows.
- 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 (1 acre).
- 20 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 at 200 feet from the wharf).

Table 2, continued

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.
    - Infrastructure for loading is included in portside infrastructure.

7. Transportation

    - Processed material is placed at a site that is within 25 miles of the PPF facility.
    - Subcontracted trucks deliver 4 truck loads each of material to the placement site daily.

8. Placement

    - Trucks deliver processed material 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.

Table 3
Fine-Grained Silty Material (FGSM) - Base Model
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,000,000 CY In Channel Material Dredged Annually
5,089 CY Stabilized Material Processed Daily (FGSM - In-Barge)
5,771 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
52 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[3]
Scow Fleet	$	3,502,311	$	3.50	8%
Addition of Stabilizing Agents at Portside (In-Barge Mixing)	$	19,161,563	$	19.16	41%
Portside Facilities Infrastructure	$	1,066,601	$	1.07	2%
8 acres needed for this facility[2]		*1,000*	*feet of wharf space*		
Portside Loading to Dump Truck	$	762,832	$	0.76	2%
Transportation - Subcontracted	$	15,407,700	$	15.41	33%
Transportation - Leased	$	19,306,157	$	19.31	
Transportation - Purchased	$	19,195,970	$	19.20	
Placement Cost PLUS Tipping Fee	$	6,557,287	$	6.56	14%
Total with Subcontracted Transportation	$	46,458,293	$	46.46	
Total with Leased Transportation	$	50,356,750	$	50.36	
Total with Purchased Transportation	$	50,246,564	$	50.25	

[1] Screening level pricing for comparison only among alternatives.
[2] Cost of real estate not included.
[3] Assuming total is with cheapest transportation.

Table 3, continued

Fine-Grained Silty Material (FGSM) - Base Model

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	$ 9,630,000	$ 1,444,500	$ 2,214,900	$ 553,725	$ -	$ 2,768,625	$ 415,294	$ 318,392	$ -	$ 3,502,311
Addition of Stabilizing Agents at Portside (In-Barge Mixing)	$ 5,102,102	$ 765,315	$ 1,173,483	$ 293,371	$ 13,680,627	$ 15,147,481	$ 2,272,122	$ 1,741,960	$ -	$ 19,161,563
Portside Facilities Infrastructure	$ 7,331,850	$ 1,099,778	$ 843,163	$ -	$ -	$ 843,163	$ 126,474	$ 96,964	$ -	$ 1,066,601
									$ -	
Portside Loading to Dump Truck	$ 925,040	$ 138,756	$ 212,759	$ 53,190	$ 337,080	$ 603,029	$ 90,454	$ 69,348	$ -	$ 762,832
Transportation - Subcontracted	$ -	$ -	$ -	$ -	$ 12,180,000	$ 12,180,000	$ 1,827,000	$ 1,400,700	$ -	$ 15,407,700
Transportation - Leased	$ -	$ -	$ -	$ -	$ 15,261,784	$ 15,261,784	$ 2,289,268	$ 1,755,105	$ -	$ 19,306,157
Transportation - Purchased	$ 2,144,000	$ 107,200	$ 1,715,200	$ 428,800	$ 10,779,480	$ 15,174,680	$ 2,276,202	$ 1,745,088	$ -	$ 19,195,970
Placement Cost PLUS Tipping Fee	$ 343,580	$ 51,537	$ 79,023	$ 19,756	$ 860,740	$ 959,519	$ 143,928	$ 110,345	$ 5,343,495	$ 6,557,287
Total with Subcontracted Transportation	$ 13,702,572	$ 3,499,886	$ 4,523,329	$ 920,041	$ 27,058,447	$ 32,501,817	$ 4,875,273	$ 3,737,709	$ 5,343,495	$ 46,458,293
Cost/CY In Channel Material			$ 4.52	$ 0.92	$ 27.06	$ 32.50	$ 4.88	$ 3.74	$ 5.34	$ 46.46
Total - Leased Transportation	$ 23,332,572	$ 3,499,886	$ 4,523,329	$ 920,041	$ 30,140,231	$ 35,583,601	$ 5,337,540	$ 4,092,114	$ 5,343,495	$ 50,356,750
Total - Purchased Transportation	$ 25,476,572	$ 3,607,086	$ 6,238,529	$ 1,348,841	$ 25,657,927	$ 35,496,497	$ 5,324,475	$ 4,082,097	$ 5,343,495	$ 50,246,564

[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
Fine-Grained Silty Material (FGSM) - Base Model

	Cost/CY of In Channel Material	Percent Change in Cost/CY
Processing Capacity of 1 MCY[1]	**$46.46**	
Processing Capacity of 0.5 MCY with No Changes to Equipment or Personnel[2]	$58.23	25%
Processing Capacity of 1.5 MCY by Increasing Equipment	$45.51	-2%
Processing Capacity of 1.5 MCY by Increasing to Two 8-Hour Shifts	$45.58	-2%
Capital Cost Recovery over 5 Years	**$46.46**	
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others) *	$41.80	-10%
Capital Cost Recovery Increased from 5 Years to 10 Years**	$44.13	-5%
No Capital Cost Recovery on Scows	$43.66	-6%
* for Base Model purchased transportation becomes most cost effective ($40.63)		
** for Base Model purchased transportation becomes most cost effective ($44.10)		
Infrastructure Cost Recovery over 10 Years	**$46.46**	
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (By Others)	$45.39	-2%
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$46.10	-1%
Management G&A at 15%	**$46.46**	
Management G&A Reduced from 15% to 7.5%	$43.78	-6%
Management G&A Reduced from 15% to 5%	$42.88	-8%
Profit at 10%	**$46.46**	
Profit Reduced from 10% to 7.5%	$45.52	-2%
Profit Reduced from 10% to 5%	$44.59	-4%
Capital Cost Contingency at 15%	**$46.46**	
Capital Cost Contingency Reduced from 15% to 10%	$46.16	-1%
Captial Cost Contingency Reduced from 15% to 5%	$45.86	-1%
General Cost Factor for Installation as 2.5 times Capital Cost	**$46.46**	
General Cost Factor for Installation Reduced from 2.5 to 2	$46.34	0%
General Cost Factor for Installation Reduced from 2.5 to 1	$46.09	-1%

Table 4, continued
Changes in Cost with Alternate Assumptions
Fine-Grained Silty Material (FGSM) - Base Model

	Cost/CY of In Channel Material	Percent Change in Cost/CY
Annual Maintenance Costs of 5%	**$46.46**	
Annual Maintenance Costs Reduced to 2.5%	$45.88	-1%
Annual Maintenance Costs Increased to 10%	$47.62	2%
Stabilize with 8% Cement	**$46.46**	
Reduce Cement from 8% to 5%	$41.85	-10%
Increase Cement from 8% to 10%	$49.55	7%
Cement Cost of $100 per ton	**$46.46**	
Cement Cost Reduced 15% to $85	$44.62	-4%
Union Labor Rate of $57	**$46.46**	
Union Labor Rate Reduced 10% to $51	$46.16	-1%
Supervisor Labor Rate of $86	**$46.46**	
Supervisor Labor Rate Reduced 10% to $77	$46.36	0%
Original Staffing	**$46.46**	
Staffing Reduced by 10%	$46.17	-1%
Dump Truck Subcontract Rate of $1,000 for 100% Dump Truck	**$46.46**	
Dump Truck Lease Rate Reduced 10% to $900 for 100% Dump Truck	$44.92	-3%
Tipping Fee of $5/CY Stabilized Material ($5.35/In Channel CY)	**$46.46**	
Double Tipping Fee to $10	$51.80	11%
Reduce Tipping Fee to $2.50	$43.79	-6%
Reduce Tipping Fee to $1.00	$42.18	-9%
Remove Tipping Fee	$41.11	-12%

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
Fine-Grained Silty Material (FGSM) - Base Model

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions (see Table 2)	**$46.46**	
Modified Assumptions		
Management G&A Reduced from 15% to 7.5%	$43.78	$2.68
No Management G&A on Capital Costs	$42.40	$1.38
Profit Reduced from 10% to 7.5%	$41.56	$0.84
Capital Cost Recovery Increased from 5 Years to 10 Years	$39.58	$1.98
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$39.28	$0.30
Capital Cost Contingency Reduced from 15% to 10%	$39.12	$0.16
General Cost Factor for Installation Reduced from 2.5 to 2	$39.06	$0.06
Annual Maintenance Costs Reduced to 2.5%	$38.56	$0.50
Cement Quantity for Stabilization Reduced from 8% to 5%	$34.40	$4.16
Cement Cost Reduced by 15% to $85	$33.35	$1.05
Tipping Fee Reduced to $2.50/CY of Stabilized Material Placed	$30.64	$2.71
Dump Truck Subcontracted Rate Reduced by 10% to $900	$29.33	$1.31
Union Labor Rate Reduced by 10% to $51	$29.06	$0.27
Supervisor Labor Rate Reduced by 10% to $77	$28.97	$0.09
Staffing Reduced by 10%	$28.74	$0.23
Management G&A Reduced from 7.5% to 5%	$28.46	$0.28
Profit Reduced from 7.5% to 5%	$27.86	$0.60
Captial Cost Contingency Reduced from 10% to 5%	$27.73	$0.13
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (Provided by Others)	$27.19	$0.54
Capital Cost Recovery Reduced from 5 years to No Recovery (Provided by Others)	$25.49	$1.70
Tipping Fee Reduced to $1.00/CY of Stabilized Material Placed	$23.86	$1.63
No Tipping Fee	$22.78	$1.08

3.1 BASE MODEL – SCENARIOS

Two scenarios were developed for the FGSM Base Model. In both scenarios, the volume of material processed during the eight-month dredging period was increased by 0.5 MCY to 1.5 MCY or 7,200 CY of in channel dredged material delivered for processing daily. In one case, this was accomplished by increasing the amount of processing equipment but maintaining a 10 hour/day, 6-day/week work schedule. In the other case, the amount of capital equipment was estimated to remain roughly the same, but capacity was increased by operating two 8-hour shifts, 6 days/week. For both scenarios, the overall cost/CY decreased slightly (2%), but total costs for each scenario were essentially equal. Table 4 presents the results of these two scenarios.

4.0 YEAR-ROUND MODEL – ALTERNATIVE 2

This Alternative also evaluated processing and placement of one MCY of FGSM annually, but operations are assumed to take place continuously throughout the year. To maintain operations during those periods when dredging is not allowed, upland storage is provided. Several scenarios are also considered in this case including dredging and processing sandy material, storage in vessels, and various transportation options.

It is assumed that one million in channel CY of FGSM is delivered to the Year-Round PPF in PPF supplied scows during the eight-month dredging period of June through January. The majority of the material is processed by in-barge mixing when it is delivered to the PPF. A portion of this material is transported by truck to an upland storage facility. When dredging is not underway, stored material is excavated from the upland storage facility and returned for in-barge processing. Stabilization is accomplished by adding 8% by wet weight cement.

Portside infrastructure land requirements for the Year-Round Model must be increased by roughly 12 acres to provide for upland storage in a diked facility. The storage facility is sized to hold the volume of material (about 250,000 CY) needed to sustain processing during the four months when dredging is not occurring. The upland storage would also provide additional flexibility to the PPF during the dredging season. If dredging rates exceed the processing capacity, material could still be delivered and moved into storage and dredging production rates would not be effected. Or if dredging ceased for a short period during the dredging season, processing could continue by drawing on material in storage.

In-barge annual processing cost/CY for the Year-Round Model increases as compared to the processing cost for the Base Model by $2.57/CY (13%). More equipment, mainly subcontracted trucks, is required to move material to and from the upland storage area and more personnel hours are required for the year round operation. Equipment needed for the actual in-barge processing remains essentially the same as in the Base Model, while infrastructure annual costs increase by roughly 50% or $0.50/CY to account for the cost (excluding real estate costs) of providing the diked upland storage facility. While operational flexibility is gained by adding upland storage, cost/CY increases. In addition, real estate requirements more than double from 8 acres in the Base Model to 20 acres in this model.

The Year-Round Model assumes transportation from the PPF is accomplished by barge and that the placement site is nearby, within 25 miles. Because the placement site is nearby, the in-barge mixed material can remain in the scows and is only offloaded once, at the placement site. The model assumes the placement site has pre-existing infrastructure for receipt of the scows, but equipment to offload the scows, offloading, local transportation to the placement site and placement are costs the PPF must bear. It is also assumed that a $5/delivered CY tipping fee is charged by the placement site.

These optimistic transportation assumptions minimize transportation costs compared to the Base Model. The transportation cost, including loading, unloading, placement and tipping fee, for the barge transportation in the Year-Round Model is $12.31/CY as compared to $22.73/CY for the Base Model where trucks are used, a decrease of almost 50%. This results in an overall cost/CY of $39.11/CY for the Year-Round Model as compared to $46.46 for the Base Model. However, if truck transportation to a nearby site (<25 miles) rather than barge transportation is assumed, overall costs would be on the order of $50/CY, about 8% above the Base Model cost.

Table 6 provides more details on the assumed conditions used in the Year-Round Model while Table 7 provides details on the cost components. Table 8 provides a summary of the impact of varying individual assumptions on the overall costs. Trends are similar to those seen in the Base Model. Similar trends are also seen in Table 9 where assumptions are changed to less conservative ones in a stepwise fashion and cost/CY is reduced by up to 50% under the most optimistic circumstances.

4.1 YEAR-ROUND MODEL – SCENARIOS

Several scenarios were run on the Year-Round Model to look at cost implications. Assumptions used for the Year-Round Model remained the same except for the changes in the scenario that are discussed in the following Sections.

4.1.1 Sandy Material (SM) Scenario

The Sandy Material (SM) Scenario considered processing SM through the PPF in addition to the base flow of FGSM. SM is dredged as part of channel maintenance from several channels and averages approximately 250,000 CY annually. Additionally, significant quantities (MCYs) of SM will be dredged as part of the HDP. For the SM Scenario, it was assumed that 250,000 CY would be processed through the PPF annually.

Under this scenario, the SM would be delivered to the PPF in PPF supplied scows. Due to the sandy character of the SM, it was assumed to be uncontaminated and suitable for decanting and offloading to a stockpile area with no/minimal processing. The sand could then be sold from the stockpile area and would be transported offsite by the purchaser. Based on the anticipated characteristics of the sand, which are geotechnically poor when compared to other sources of sand, a sale value of $3.88/ton was estimated with all transportation costs borne by the purchaser.

Additional infrastructure would be needed to add SM handling to the PPF, including increased wharf space and stockpile area. Rehandling equipment dedicated to the SM would be needed as

Table 6

Assumptions Used for Model Development

Alternative 2 – Fine-Grained Silty Material (FGSM) Year-Round Model

with

Sandy Material Scenario
Ship Storage Scenario
Transportation Scenarios

1. Material dredged and processed

- 1 MCY of in channel FGSM dredged annually.
- Dredging from June through January (35 weeks or 210 days).
- Processing for 52 weeks (312 days).
- 4,800 CY of in channel material dredged daily.

❖ DMMP projected quantities for FGSM - summary statistics
  - ➢ Maintenance dredging
  - o >1 MCY annually 2005-2014 and beyond.
  - o 2005-2014, Ave. 1.7 MCY, Max. 2.5 MCY, Min. 1.1 MCY.
  - o After 2014, Ave. 2.3 MCY, Max. 3.2 MCY, Min. 1.5 MCY.
  - o Based on DMMP summary of maintenance dredging projects with FGSM, 10 to 20 of these projects would be undertaken annually.
  - ➢ Harbor Deepening Project dredging
  - o >1 MCY annually 2005-2012 except 2007 and 2010.
  - o 2005-2012, Ave. 1.5 MCY, Max. 3.0 MCY, Min. 0.2 MCY.
  - o No deepening material after 2012.
  - o Based on DMMP summary of new work deepening projects with FGSM, 2 to 4 projects undertaken in most years.

Sandy Material (SM) Scenario

- 0.25 MCY of in channel SM dredged annually for handling through PPF.
- Dredging from June through January.
- No processing is required, only stockpiling and sale of SM.

❖ DMMP summary statistics for SM
  - ➢ Maintenance dredging
  - o 2005 and beyond - Ave. 0.25 MCY; Max. 0.7 MCY; Min. 0.
    - ▪ East Rockaway Inlet – 0.2 MCY/cycle
    - ▪ Jamaica Bay – 0.35 MCY/cycle
    - ▪ Main Ship Channel – 0.35 MCY/cycle
    - ▪ Sandy Hook Channel – 0.1 MCY/cycle
    - ▪ All of this SM typically used for beach nourishment

Table 6, continued

- Harbor Deepening Project dredging
  - 2005-2014, Ave. 1.8 MCY, Max. 4.6 MCY, Min. 0.3 MCY.
  - No deepening material after 2014.

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.
- Oversight of upland placement.

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 the FGSM Year-Round 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 cost of dredging.
- All scows for transport of dredged material from 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 18 scows, approximately 2,000 CY each, are supplied by the PPF.
- Decant water is pumped out at the PPF.

Sandy Material (SM) Scenario

- Five additional scows for transporting the SM to the PPF are supplied by the PPF.

4. Receipt and processing at the PPF

- Dredger delivers an average of 4 scows daily to the PPF. Scows are moored to pile dolphins to begin processing.
- Decant water is pumped to one of two holding scows. After holding scows are filled, they sit for 24 hours to allow for settlement before the decant water is discharged overboard.

Table 6, continued

- 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 52 tons daily.
- Three scows daily (approximately) for the dredging period are processed with in-barge mixing [3,875 CY].
  - Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head.
  - Scows sit overnight for curing before being offloaded by an excavator.
- One scow daily (approximately) is offloaded to storage [1,200 CY] during the dredging period.
  - Decanted, raked and unprocessed FGSM is offloaded to trucks and taken to the upland storage area.
- One to two scows daily are loaded with stored dredged material during the non-dredging period and processed by in-barge mixing [2,500 CY].

Sandy Material (SM) Scenario

- Dredger delivers 1 scow daily or every other day to the PPF in scows holding approximately 2,000 CY.
- Because of “clean” sandy properties, the scow is taken directly to the wharf for decanting and offloading.
- SM is offloaded to a conveyor, then to a radial stacker, and finally to the storage area.
- Any excess water drains by gravity and that drainage water is allowed to return to harbor with no treatment.

5. Portside Infrastructure

- 1,000 feet of wharf space is needed to accommodate 4 scows.
- 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 (1 acre).
- 12 acres of upland diked storage are required for storage of FGSM.
- Total space required is approximately 20 acres.
- 20 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).

Sandy Material (SM) Scenario

- A total of 1,500 feet of wharf and 24 acres of space are needed.

Table 6, continued

Ship Storage Scenario

- Use 5 Great Lakes ore or grain ships holding 50,000 CY each for storage of the FGSM.
- Ships moored offshore of the PPF.
- Ships are loaded from scows with decanted and raked dredged material during the dredging period.
- Ships are unloaded to scows for processing during non-dredging periods.

6. Portside loading

- Barge transport all processed material to a nearby placement site within 25 miles of the PPF facility.
- Because the FGSM is processed in the scows, there is no need to rehandle the processed material prior to transport or provide additional rehandling infrastructure.
- Use the scows that have already been provided by the PPF for transportation.
- Consequently, NO additional scows are needed for barge transportation to the nearby placement site.

FGSM Transportation Scenario 1

- Transport half of the material by truck and transport the other half by barge (see barge notes above).
- Excavator removes mixed and partially cured material from a scow and places it onto a conveyor.
- Conveyor moves 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.

FGSM Transportation Scenario 2

- Transport all of the material by train.
- Excavator removes mixed and partially cured material from a scow and places it onto a conveyor.
- Conveyor moves material to a dump hopper that weighs and dumps the material into the rail cars.
- Additional portside infrastructure is provided for rail operations of 40-50 car trains with leased cars.
- An additional 10 acres is needed for rail car marshalling & loading.

Table 6, continued

Sandy Material (SM) Scenario

- SM is loaded by the PPF for transport offsite.
- All SM is transported offsite by others as part of the material purchase.
- SM is sold at $3.88/ton.

7. Transportation

- One to three scows are moved daily by a PPF supplied tug.
- Scows are taken to a nearby placement site.

FGSM Transportation Scenarios

- Placement sites are within 50 miles.
- Subcontracted trucks can deliver 2 loads each daily.
- A 40–50 car train is dispatched every 1 to 2 days.
- Scows are taken to a nearby placement site.

Sandy Material (SM) Scenario

- SM is transported offsite by others.

8. Placement

- Processed material is offloaded from scows into trucks at the offloading facility.
- Offloading facilities are in place for scow offloading.
- Trucks deliver the material to a placement site within 5 miles of the offloading facility 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 a $5.00 tipping fee per CY of material delivered.

FGSM Transportation Scenarios

- Truck and rail placement sites are at different locations.
- Rail cars are offloaded to trucks.
- Placement then follows the placement procedures outlined above.

Table 7
Fine-Grained Silty Material (FGSM) - Year-Round Model
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,000,000 CY In Channel Material Dredged Annually
3,875 CY Stabilized Material Processed Daily (FGSM - In-Barge)*
4,394 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily*
52 tons >4" Debris Removed for Landfill Disposal Daily
* Quantity of material transported during the majority of year (i.e. not during fish window shutdown).

Component in Overall Processing and Transportation	Total Annual Costs	SM Total Annual Costs	FGSM Total Annual Costs	TOTAL Cost/CY of In Channel Material
Scow Fleet	$ 3,502,311	$ -	$ 3,502,311	$ 3.50
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 17,926,193	$ -	$ 17,926,193	$ 26.63
Addition of Stabilizing Agents to FGSM at Portside (In-Barge) during Fish Window Shutdown	$ 3,802,799	$ -	$ 3,802,799	$ 11.63
Portside Facilities Infrastructure	$ 1,568,055	$ -	$ 1,568,055	$ 1.57
20 acres needed for this facility[2]		*1,000 feet of wharf space*		
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 12,305,971	$ -	$ 12,305,971	$ 12.31
Total	$ 39,105,329	$ -	$ 39,105,329	$ 39.11
Total with SM Scenario - 1.25M CY	$ 41,807,435	$ 2,533,211	$ 39,274,223	$ 33.45
22 acres needed for this facility[2]		*1,500 feet of wharf space*		
SM - 0.25 MCY Processed and Sold at $3.88/ton				$ 10.13
FGSM - 1 MCY Processed				$ 39.27
Total with 50% Truck & 50% Barge Scenario	$ 56,600,947	$ -	$ 56,600,947	$ 56.60
Total with 100% Rail Scenario	$ 58,502,269	$ -	$ 58,502,269	$ 58.50
Total with Ship Storage Scenario	$ 39,435,524	$ -	$ 39,435,524	$ 39.44

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

Table 7, continued

Fine-Grained Silty Material (FGSM) - Year-Round Model

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	$ 9,630,000	$ 1,444,500	$ 2,214,900	$ 553,725	$ -	$ 2,768,625	$ 415,294	$ 318,392	$ -	$ 3,502,311
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 5,102,102	$ 765,315	$ 1,173,483	$ 293,371	$ 12,704,050	$ 14,170,904	$ 2,125,636	$ 1,629,654	$ -	$ 17,926,193
Addition of Stabilizing Agents to FGSM at Portside (In-Barge) during Fish Window Shutdowr	$ -	$ -	$ -	$ -	$ 3,006,165	$ 3,006,165	$ 450,925	$ 345,709	$ -	$ 3,802,799
Portside Facilities Infrastructure	$ 10,068,385	$ 1,510,258	$ 1,239,569	$ -	$ -	$ 1,239,569	$ 185,935	$ 142,550	$ -	$ 1,568,055
									$ -	
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 2,132,147	$ 208,627	$ 271,595	$ 67,899	$ 2,356,440	$ 5,503,934	$ 825,590	$ 632,952	$ 5,343,495	$ 12,305,971
Total	$ 26,932,633	$ 3,928,700	$ 4,899,548	$ 914,995	$ 18,066,655	$ 26,689,197	$ 4,003,380	$ 3,069,258	$ 5,343,495	$ 39,105,329
Cost/CY In Channel Material			$ 4.90	$ 0.91	$ 18.07	$ 26.69	$ 4.00	$ 3.07	$ 5.34	$ 39.11
Total with SM Scenario	$ 34,081,412	$ 5,178,769	$ 6,416,445	$ 1,194,250	$ 19,343,320	$ 29,762,015	$ 4,464,302	$ 3,422,632	$ 4,158,485	$ 41,807,435
Cost/CY In Channel Material			$ 5.13	$ 0.96	$ 15.47	$ 23.81	$ 3.57	$ 2.74	$ 3.33	$ 33.45
Total with 50% Truck & 50% Barge Scenario	$ 28,201,253	$ 4,118,993	$ 5,191,330	$ 987,940	$ 20,582,455	$ 38,005,425	$ 6,077,959	$ 4,659,768	$ 5,343,495	$ 56,600,947
Cost/CY In Channel Material			$ 5.19	$ 0.99	$ 20.58	$ 38.01	$ 6.08	$ 4.66	$ 5.34	$ 56.60
Total with 100% Rail Scenario	$ 37,147,911	$ 5,253,539	$ 6,276,163	$ 1,144,447	$ 15,710,215	$ 33,535,071	$ 6,303,412	$ 4,832,616	$ 5,343,495	$ 58,502,269
Cost/CY In Channel Material			$ 6.28	$ 1.14	$ 15.71	$ 33.54	$ 6.30	$ 4.83	$ 5.34	$ 58.50
Total with Ship Storage Scenario	$ 29,862,025	$ 4,368,109	$ 5,160,571	$ 914,995	$ 18,066,655	$ 26,950,220	$ 4,042,533	$ 3,099,275	$ 5,343,495	$ 39,435,524
Cost/CY In Channel Material			$ 5.16	$ 0.91	$ 18.07	$ 26.95	$ 4.04	$ 3.10	$ 5.34	$ 39.44

[1] Screening level pricing for comparison only among alternatives.

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

Table 8
Changes in Cost with Alternate Assumptions
Fine-Grained Silty Material (FGSM) - Year-Round Model

	YEAR ROUND MODEL	
	Cost per Cy of In Channel Material	**Cost Change per CY**
1 MCY FGSM with NO SM[1]	**$39.11**	
1 MCY FGSM and 0.25 MCY SM[2]	**$33.45**	**-14%**
SM Resale Price of $3.88	**$33.45**	
Reduce SM Resale Price by 50% to $1.94	$33.92	1%
Increase SM Resale Price by 50% to $5.82	$32.97	-1%
Increase SM Resale Price to Break-Even: $12.17	$31.42	-6%
Capital Cost Recovery over 5 Years	**$39.11**	
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)	$34.48	-12%
Capital Cost Recovery Increased from 5 Years to 10 Years	$36.79	-6%
No Capital Cost Recovery on Scows	$36.30	-7%
Infrastructure Cost Recovery over 10 Years	**$39.11**	
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (By Others)	$37.54	-4%
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$38.58	-1%
Management G&A at 15%	**$39.11**	
Management G&A Reduced from 15% to 7.5%	$36.90	-6%
Management G&A Reduced from 15% to 5%	$36.17	-8%
Profit at 10%	**$39.11**	
Profit Reduced from 10% to 7.5%	$38.34	-2%
Profit Reduced from 10% to 5%	$37.57	-4%
Capital Cost Contingency at 15%	**$39.11**	
Capital Cost Contingency Reduced from 15% to 10%	$38.79	-1%
Captial Cost Contingency Reduced from 15% to 5%	$38.47	-2%
General Cost Factor for Installation as 2.5 times Capital Cost	**$39.11**	
General Cost Factor for Installation Reduced from 2.5 to 2	$39.02	0%
General Cost Factor for Installation Reduced from 2.5 to 1	$38.86	-1%
Annual Maintenance Costs of 5%	**$39.11**	
Annual Maintenance Costs Reduced to 2.5%	$38.50	-2%
Annual Maintenance Costs Increased to 10%	$40.32	3%

Table 8, continued
Changes in Cost with Alternate Assumptions
Fine-Grained Silty Material (FGSM) - Year-Round Model

Stabilize with 8% Cement	**$39.11**	
Reduce Cement from 8% to 5%	$34.50	-12%
Increase Cement from 8% to 10%	$42.12	8%
Cement Cost of $100 per ton	**$39.11**	
Cement Cost Reduced 15% to $85	$37.27	-5%
Union Labor Rate of $57	**$39.11**	
Union Labor Rate Reduced 10% to $51	$38.73	-1%
Supervisor Labor Rate of $86	**$39.11**	
Supervisor Labor Rate Reduced 10% to $77	$38.96	0%
Original Staffing	**$39.11**	
Staffing Reduced by 10%	$38.74	-1%
100% Transportation by Barge	**$39.11**	
100% Transportation by Rail Car	**$58.50**	**50%**
50% Transportation by Dump Truck and 50% Transportation by Barge	$56.60	45%
100% Transportation by Dump Truck	**$69.93**	**79%**
Dump Truck Subcontract Rate Reduced 10% to $900 for 100% Dump Truck	$66.74	-5%
Rail Car Haul Cost of $1,010 for 100% Rail Car	**$58.50**	
Rail Car Haul Cost Reduced 10% to $909 for 100% Rail Car	$57.07	-2%
Rail Car Haul Cost Increased 10% to $1,111 for 100% Rail Car	$59.93	2%
Rail Car Lease Rate of $570 for 100% Rail Car	**$58.50**	
Rail Car Lease Rate Reduced 10% to $513 for 100% Rail Car	$58.34	0%
Including Transportation Infrastructure	**$58.50**	
Remove Transportation Infrastructure (Provided by Others)	$57.92	-1%
Tipping Fee of $5/CY Stabilized Material ($5.35/In Channel CY)	**$39.11**	
Double Tipping Fee to $10	44.45	14%
Reduce Tipping Fee to $2.50	36.43	-7%
Reduce Tipping Fee to $1.00	34.83	-11%
Remove Tipping Fee	33.76	-14%

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

Table 9
Reduced Cost Estimate with Modified Assumptions
Fine-Grained Silty Material (FGSM) - Year-Round Model

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions (see Table 6)	**$39.11**	
Revised Assumptions		
Management G&A Reduced from 15% to 7.5%	$36.90	$2.21
No Management G&A on Capital Costs	$36.37	$0.53
Profit Reduced from 10% to 7.5%	$35.67	$0.70
Capital Cost Recovery Increased from 5 Years to 10 Years	$33.70	$1.97
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$33.26	$0.44
Capital Cost Contingency Reduced from 15% to 10%	$33.09	$0.17
General Cost Factor for Installation Reduced from 2.5 to 2	$33.05	$0.04
Annual Maintenance Costs Reduced to 2.5%	$32.54	$0.51
Cement Quantity for Stabilization Reduced from 8% to 5%	$28.39	$4.15
Cement Cost Reduced 15% to $85	$27.34	$1.05
Tipping Fee Reduced to $2.50/CY of Stabilized Material Placed	$24.63	$2.71
Dump Truck Subcontracted Rate Reduced 10% to $900	$24.20	$0.43
Union Labor Rate Reduced 10% to $51	$23.85	$0.35
Supervisor Labor Rate Reduced 10% to $77	$23.72	$0.13
Staffing Reduced by 10%	$23.43	$0.29
Management G&A Reduced from 7.5% to 5%	$23.04	$0.39
Profit Reduced from 7.5% to 5%	$22.57	$0.47
Captial Cost Contingency Reduced from 10% to 5%	$22.43	$0.14
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (Provided by Others)	$21.63	$0.80
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)	$19.92	$1.71
Tipping Fee Reduced to $1.00/CY ofStabilized Material Placed	$18.30	$1.62
Remove Tipping Fee	$17.22	$1.08

well as additional scows. Processing the SM through the PPF would be significantly less expensive than processing the FGSM, but the economic comparison model indicated there would still be a net cost of $10.13/CY for processing SM. The model indicated that a sale value of $12.17/ton would be required for the SM operation to break-even.

While the cost/CY to process and handle the 1.25 MCY of material through the enlarged PPF (1 MCY FGSM and 0.25 MCY SM) would be $5.66/CY less under this scenario than in the case of the base Year-Round Model, this is only because the cost to handle the SM is less than to process and place the FGSM. Total annual costs of this scenario would be greater than the base Year-Round Model by about $2.7 M. Adding SM to the PPF does not reduce overall costs. Because of the low sale price estimated for the sand, increasing the volume of SM handled through the PPF to reflect the larger volumes available during the HDP was not evaluated since it seemed unlikely to reduce overall costs. While this analysis indicates including SM as part of the PPF is does not improve the PPF economics, this analysis does not indicate there is no economic value to the SM material. Under other circumstances, using the SM material upland may have value beyond the value it contributes to the remediation of the HARS. If such opportunities are identified, they should be evaluated on their own merit.

4.1.2 Ship Storage Scenario

The upland dredged material storage facility included in the base Year-Round Model allows processing to continue when dredging is not allowed and also provides surge capacity during the dredging period. However, the economic comparison indicates that storage increases processing costs as compared to the Base Model, and that holds true without factoring in the high cost of the required additional real estate. Waterborne storage is a storage option that would significantly reduce the real estate requirement.

Large ore and grain carriers used on the Great Lakes have been taken out of service and may be available for purchase. New Jersey Office of Maritime Resources is sponsoring a demonstration project where one of these vessels will store on the order of 50,000 CY of dredged material for processing by various vendors (S. Douglas, personal communication, 2005). Five of these vessels, moored offshore of the PPF or at a nearby mooring location, would provide roughly the same storage capacity as the upland facility in the base Year-Round Model.

To evaluate this scenario, it was assumed that five large ore/grain ships would be available and could be purchased and transported to the harbor for $750,000 each. No cost information was located to verify this cost, which was based on the reported cost associated with the NJ Maritime project. The cost for mooring facilities for ships of this size was estimated to be an additional $350,000 for each ship. Mooring facilities for at least one ship would be at/offshore of the PPF. The other ships could be moored at some other location and towed to the PPF by the PPF tug for loading or offloading as needed.

While purchase of the ships and construction of the mooring facilities is more expensive than development of the diked upland storage facility, less additional equipment is needed to load and offload the storage vessels. The economic comparison indicates (Table 7) this scenario is only

$0.33/CY more than the base Year-Round Model case, or essentially equal. Innovative on-water storage options, with the less demanding real estate needs, may be one means of providing some degree of storage, especially to dampen short-term surges in delivery of dredged material.

4.1.3 Transportation Scenarios

Two transportation scenarios were also considered. Under one case, only half of the material was taken to the nearby placement site by barge. The other half was trucked in subcontracted trucks to a different placement site 50 miles from the PPF. The second scenario assumed no nearby placement site accessible by barge was available and all material was taken to a placement site 50 miles from the PPF by rail.

Overall average costs for transporting half of the material by barge and the other half by truck increases transportation (loading, transporting, placement and tipping fee) from the $12.31 of the base Year-Round Model to $29.80. Costs to barge half of the material increase by roughly 35% compared to the base Year-Round Model costs because capital costs must be spread over fewer yards. Costs to truck the other half of the material increase by almost 250% over barging costs in the base Year-Round Model.

Transporting all of the material by rail is slightly more costly (6%) than the truck and barge scenario. Rail transportation, including loading, placement and tipping fee, is twice as costly as barge transportation, but less than truck transportation. This scenario suggests that rail transportation begins to become cost competitive with truck transportation when the placement site is roughly 50 miles or further from the PPF site. However, additional acreage is needed for marshalling the rail cars.

Table 7 provides costs for both of the transportation scenarios. Developing a nearby placement site accessible by barge has the potential to result in significant long-term savings.

5.0 TWO FACILITIES MODEL – ALTERNATIVE 3

The third model developed for economic comparison considered two facilities each operating year-round and processing one MCY FGSM each. While no specific locations for the facilities were considered, it is likely they would be spaced away from each other with one in New York and one in New Jersey.

Two MCY is roughly 2/3rds of the annual volume of FGSM projected to be dredged when the HDP and routine maintenance dredging are underway through 2014 (USACE, 2006b). After the HDP is completed, routine maintenance dredging is projected to average slightly more than 2 MCY annually.

The model assumes FGSM is delivered to each PPF in PPF supplied scows and stabilized for upland placement by the addition of cement. For this model, it was assumed that both in-barge mixing and pug mill mixing were employed at each facility. Pug mill mixing was assumed to be the main mixing process and the mode employed throughout the year. In-barge mixing is employed only during the peak periods when dredging is ongoing and the pug-mill operation is at capacity. Material is also being moved to upland storage during the dredging period and then returned to the PPF for pug mill mixing during the four months when no dredging is occurring.

Processing costs for year-round processing in the Two Facilities Model increased above those developed in the Year-Round Model from $21.73 to $25.50, or roughly 17%. This indicates that there is no cost advantage to having two different modes of processing occurring at each facility. Increasing the capacity of a single process will be more cost effective. However, if two facilities are developed, there may be an advantage to having in-barge operations at one and pug mill operations at the other. This should be investigated in more detail if this alternative is carried forward.

This Model assumes processed material is transported by barge to a placement site approximately 100 miles away. Because of the longer transport distance and the pug mill processing of most of the material, the model assumes processed material is loaded into larger PPF supplied barges for the 100-mile trip. It still assumes the receiving facility has existing infrastructure for docking and offloading of the barges. Offloading, local transport to the placement site, and placement costs remain the responsibility of the PPF operations and the placement site is assumed to charge a $5.00/delivered CY tipping fee.

Under these assumptions, the costs to load, transport, offload and place the material, including the tipping fee, is estimated at $16.66/CY. This is a 35% increase over the barge transportation costs of the Year-Round Model, but indicates barge transportation remains very cost effective when compared to truck and rail. Identifying a site accessible by water that can accept large quantities of material may result in significant savings, even if that site is much further from the PPF than others accessible only by truck or rail.

Overall cost/CY for the Two Facilities Alternative is estimated to be $47.49, an increase of $8.38/CY over the Year-Round Alternative. As discussed above, this increase is due to dual mixing operations and a longer transportation distance. Total cost for the Two Facilities Alternative, processing 2 MCY annually, is almost $95 million as compared to $39 million for the Year-round alternative processing 1 MCY annually.

Table 10 provides a more detailed description of the assumed conditions of the Two Facilities Model and the various scenarios discussed below. Table 11 provides a cost breakdown of the various components. Tables 12 and 13 look at the impacts of single changes in assumptions and stepwise changes respectively. These changes are similar to the ones seen in the previous two models.

5.1 TWO FACILITIES MODEL – SCENARIOS

Several scenarios were run on the Two Facilities Model to examine the cost implications of changing conditions. Assumptions used remained the same except for the changes in the scenario. Details on each scenario are discussed below.

Table 10

Assumptions Used for Model Development

Alternative #3 – The Fine-Grained Silty Material (FGSM) Two Facilities Model

with

Sandy Material and Stiff Red Clay Scenario
Transportation Scenarios

1. Material dredged and processed

- 2 MCY of in channel FGSM dredged annually.
- FGSM is taken to each of the **TWO** PPFs in equal quantities.
- Dredging from June through January (35 weeks or 210 days).
- Processing at both facilities for 52 weeks (312 days).
- 9,500 CY of in channel material dredged daily.

❖ DMMP projected quantities for FGSM - summary statistics
    - >2 MCY for most years.
    - ➢ Maintenance dredging
    - >1.3 MCY annually 2005-2014 and beyond.
    - 2005-2014, Ave. 1.7 MCY, Max. 2.5 MCY, Min. 1.1 MCY.
    - After 2014, Ave. 2.3 MCY, Max. 3.2 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.
    - ➢ Harbor Deepening Project dredging
    - >1 MCY annually 2005-2012 except 2007 and 2010.
    - 2005-2012, Ave. 1.5 MCY, Max. 3.0 MCY, Min. 0.2 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.

Sandy Material (SM) Scenario

- 0.25 MCY of in channel SM dredged annually for handling through one PPF.
- Dredging from June through January.
- No processing required, only stockpiling and sale of SM.

❖ DMMP summary statistics for SM
    - ➢ Maintenance dredging
    - 2005 and beyond - Ave. 0.25 MCY; Max. 0.7 MCY; Min. 0.
        - East Rockaway Inlet – 0.2 MCY/cycle.
        - Jamaica Bay – 0.35 MCY/cycle.
        - Main Ship Channel – 0.35 MCY/cycle.
        - Sandy Hook Channel – 0.1 MCY/cycle.
        - All of this SM typically used for beach nourishment.

Table 10, continued

- ➢ Harbor Deepening Project dredging
  - 2005-2014, Ave. 1.8 MCY, Max. 4.6 MCY, Min. 0.3 MCY.
  - No deepening material after 2014.

Stiff Red Clay (SRC) Scenario

- 0.5 MCY of in channel SRC dredged annually for handling through one PPF.
- Dredging and processing from June through January.
- Processing (drying & discing) required so material can be stockpiled and sold.

- ❖ DMMP summary
  - SRC dredged as part of the Harbor Deepening Project only.
  - >0.5 MCY projected 2005-2012 except 2005 and 2008 - Ave. 0.7 MCY.
  - No SRC dredged after 2012.

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.
- Oversight of upland placement.

3. Dredging and transport to the two PPFs

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 and Staten Island are the assumed locations of the PPFs and are “central” to all dredging.
- Transportation of scows to the PPFs and return of scows to the dredge sites are included in the cost of dredging.
- All scows for transport of dredged material from dredging sites to the PPF are supplied by PPF.
- Additional scows needed to allow for processing activities are also supplied by the PPF.
- A total of 36 scows, approximately 2,000 CY each, are supplied by the PPF (18 scows for each PPF).
- Decant water is pumped out at the PPF.

Table 10, continued

Sandy Material (SM) Scenario

- Only one PPF will receive SM.
- Five additional scows for transporting the SM to the PPF are supplied by the PPF.

Stiff Red Clay (SRC) Scenario

- Only one PPF will receive and process SRC.
- Seven additional scows for transporting the SRC to the PPF are supplied by the PPF.

4. Receipt at PPFs and processing by both in-barge and pug mill mixing

- Dredgers deliver an average of 4 scows daily to each PPF. Scows are moored to pile dolphins to begin processing.
- At each PPF, decant water is pumped to one of two holding scows. After holding scows are filled, they sits 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.
- Two scows daily (approximately) are processed by pug mill mixing at each PPF.
  - Material is offloaded to a pug mill through a debris screen to remove debris.
  - Stored FGSM is processed when no FGSM is being dredged.
  - Cement is added to the material in the pug mill.
  - Material is stacked on the paved area for initial curing and is then loaded for transportation to the placement site.
- One scow daily (approximately) is processed with in-barge mixing at each PPF during the dredging period.
  - Debris >4" is removed from the dredged material by an excavator with a rake and placed dockside for disposal at a landfill.
  - Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head.
  - Scows sit overnight for curing before being offloading by an excavator.
- One scow daily (approximately) is offloaded to upland storage during the dredging period.
  - Decanted, unprocessed FGSM is offloaded to trucks and taken to the upland storage area.

Sandy Material (SM) Scenario

- Dredger delivers 1 scow daily or every other day to the one PPF accepting SM in scows holding approximately 2,000 CY.
- Because of "clean" sandy properties, scow is taken directly to the wharf for decanting and offloading.
- SM is offloaded to a conveyor, then to a radial stacker, and finally to the storage area.
- Any excess water drains by gravity and that drainage water is allowed to return to the harbor with no treatment.

Table 10, continued

Stiff Red Clay (SRC) Scenario

- Dredger delivers 2 scows daily to the one PPF accepting SRC in scows holding approximately 2,000 CY.
- Because of the stiff red clay properties, each scow is decanted in a manner similar to the FGSM before it goes to the wharf for offloading.
- SRC is offloaded to a conveyor, then to a radial stacker, and finally to a temporary storage area.
- Any excess water is allowed to drain by gravity and that drainage water is allowed to return to harbor with no treatment other than solids retention.
- SRC is moved to one of two 10-acre processing areas where it is worked with a disc to improve handling properties and to dry.
- Once the SRC has dried sufficiently, it is moved by front end loaders to the storage area for where it is sold.

5. Portside Infrastructure for each PPF

- 1,250 feet of wharf space is needed to accommodate 5 scows.
- 10 acres are required for site improvements; 300 feet of working space along the 1,250 feet of wharf plus space for 1 days production (1 acre).
- 12 acres of upland diked storage are required for storage of FGSM.
- Total space required for each PPF site is approximately 22 acres.
- 25 pile dolphins for scow tie-up.
- 35,000 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).

Sandy Material (SM) Scenario

- An additional 250 feet of wharf space is required for SM offloading.
- An additional 2 acres is required for storage and sale of SM.

Stiff Red Clay (SRC) Scenario

- SRC shares the additional SM wharf space.
- An additional 24 acres for discing, drying, storage and sale of SRC is required. (Two 10-acre plots for discing and drying, and one 4-acre plot for storage and sale).

6. Portside loading

- Barge transport all processed material to a placement site within 100 miles.
- Excavator loads the transport barges.
- Infrastructure for barge loading is included in portside infrastructure.
- PPF provides roughly 2,000 – 4,000 CY transport barges. These larger barges are in addition to the scows provided for other operations.

Table 10, continued

FGSM Transportation Scenario 1

- Transport half of the material by truck and half by barge (see barge notes above).
- Front end loader loads the material to trucks.
- Infrastructure for loading is included in portside infrastructure.

FGSM Transportation Scenario 2

- Transport all of the material by train.
- Conveyor moves material to a dump hopper that weighs and dumps the material into the rail cars.
- Additional portside infrastructure is provided for rail operations of 40-50 car trains with leased cars.
- An additional 10 acres is needed for rail car marshalling & loading at each site.

Sandy Material (SM) Scenario

- SM is loaded by the PPF for transport offsite.
- All SM is transported offsite by others as part of material purchase.
- SM is sold at $3.88/ton.

Stiff Red Clay (SRC) Scenario

- SRC is loaded by the PPF for transport offsite
- All SRC is transported offsite by others as part of material purchase.
- SRC is sold at $6.80/CY.

7. Transportation

- One to two barges are moved daily from each PPF by PPF supplied tugs to a placement site within100 miles.

FGSM Transportation Scenarios

- Placement sites are within 100 miles of a PPF.
- Subcontracted trucks can deliver only 1 load each daily.
- A 40-50 car train is dispatched from each PPF every 1 to 2 days.

SM and SRC Scenarios

- SM and SRC is transported offsite by others.

8. Placement

- Existing offloading facilities near the placement site are in place for barge offloading.
- Processed material is offloaded from barges into trucks at the offloading facility.
- Trucks deliver the material to a placement site within 5 miles of the offloading facility 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.

Table 10, continued

- 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 delivered.

FGSM Transportation Scenarios

- Truck, rail and barge placement sites at different locations.
- Rail cars are offloaded to trucks.
- Placement then follows placement procedures outlined above.

Table 11
Fine-Grained Silty Material (FGSM) - Two Facilities Model
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Total Material Quantities
2,000,000 CY In Channel Material Dredged Annually
2,750 CY Stabilized Material Processed Daily (FGSM - In-Barge)
5,000 CY Stabilized Material Processed Daily (FGSM - Pug Mill)
7,750 tons of FGSM Produced, Loaded, and Transported Daily*
104 tons >4" Debris Removed for Landfill Disposal Daily
* Quantity of material transported during the majority of year (i.e. not during fish window shutdown).

Component in Overall Processing and Transportation	Total Annual Costs	SM Total Annual Costs	FGSM Total Annual Costs	SRC Total Annual Costs	TOTAL Cost/CY of In Channel Material	% of Total Cost
Scow Fleet - for Two Facilities	$ 7,004,621	$ -	$ 7,004,621	$ -	$ 3.50	7%
In-Barge Addition of Stabilizing Agents to FGSM at Portside	$ 17,850,201	$ -	$ 17,850,201	$ -	$ 33.04	19%
Pug Mill Addition of Stabilizing Agents to FGSM at Portside	$ 33,141,214	$ -	$ 33,141,214	$ -	$ 22.70	35%
Portside Facilities Infrastructure #1	$ 1,830,755	$ -	$ 1,830,755	$ -	$ 1.83	2%
22 acres needed for facility #1 [2]		*1,250*	*feet of wharf space*			
Portside Facilities Infrastructure #2	$ 1,830,755	$ -	$ 1,830,755	$ -	$ 1.83	2%
22 acres needed for facility #2 [2]		*1,250*	*feet of wharf space*			
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 33,315,983	$ -	$ 33,315,983	$ -	$ 16.66	35%
Total	$ 94,973,531	$ -	$ 94,973,531	$ -	$ 47.49	
Total with SM & SRC Scenario	$ 99,292,906	$ 719,122	$ 95,359,937	$ 3,213,847	$ 36.11	
48 acres needed for facility #1 [2]		*1,750*	*feet of wharf space*			
22 acres needed for facility #2 [2]		*1,250*	*feet of wharf space*			
SM - 0.25 MCY Processed and Sold at $3.88/ton					$ 2.88	
FGSM - 1 MCY at Each Facility					$ 47.68	
SRC - 0.5 MCY Processed and Sold at $6.80/Dried CY					$ 6.43	
Total with 50% Truck & 50% Barge Scenario	$ 156,548,002	$ -	$ 156,548,002	$ -	$ 78.27	
Total with 100% Rail Scenario	$ 124,660,284	$ -	$ 124,660,284	$ -	$ 62.33	

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

Table 11, continued

Fine-Grained Silty Material (FGSM) - Two Facilities Model

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 - for Two Facilities	$ 19,260,000	$ 2,889,000	$ 4,429,800	$ 1,107,450	$ -	$ 5,537,250	$ 830,588	$ 636,784	$ -	$ 7,004,621
In-Barge Addition of Stabilizing Agents to FGSM at Portside	$ 9,916,795	$ 1,487,519	$ 2,280,863	$ 570,216	$ 11,259,752	$ 14,110,831	$ 2,116,625	$ 1,622,746	$ -	$ 17,850,201
Pug Mill Addition of Stabilizing Agents to FGSM at Portside	$ 13,822,183	$ 2,073,327	$ 3,179,102	$ 794,776	$ 20,352,711	$ 26,198,589	$ 3,929,788	$ 3,012,838	$ -	$ 33,141,214
Portside Facilities Infrastructure #1	$ 11,874,192	$ 1,781,129	$ 1,447,237	$ -	$ -	$ 1,447,237	$ 217,086	$ 166,432	$ -	$ 1,830,755
Portside Facilities Infrastructure #2	$ 11,874,192	$ 1,514,699	$ 1,447,237	$ -	$ -	$ 1,447,237	$ 217,086	$ 166,432	$ -	$ 1,830,755
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 9,714,628	$ 922,294	$ 2,689,344	$ 572,024	$ 9,332,160	$ 17,888,528	$ 2,683,279	$ 2,057,181	$ 10,686,995	$ 33,315,983
Total	$ 76,461,990	$ 10,667,968	$ 15,473,584	$ 3,044,465	$ 40,944,623	$ 66,629,672	$ 9,994,451	$ 7,662,412	$ 10,686,995	$ 94,973,531
Cost/CY In Channel Material			$ 7.74	$ 1.52	$ 20.47	$ 33.31	$ 5.00	$ 3.83	$ 5.34	$ 47.49
Total with SM & SRC Scenario	$ 91,507,490	$ 12,924,793	$ 18,341,816	$ 3,613,465	$ 43,592,433	$ 72,714,714	$ 10,907,207	$ 8,362,192	$ 5,710,021	$ 99,292,906
Cost/CY In Channel Material			6.67	1.31	15.85	26.44	3.97	3.04	2.08	36.11
Total with 50% Truck & 50% Barge Scenario	$ 76,705,316	$ 10,914,829	$ 15,214,524	$ 3,029,856	$ 92,229,263	$ 115,305,144	$ 17,295,772	$ 13,260,092	$ 10,686,995	$ 156,548,002
Cost/CY In Channel Material			7.61	1.51	46.11	57.65	8.65	6.63	5.34	78.27
Total with 100% Rail Scenario	$ 91,442,211	$ 12,493,958	$ 15,621,853	$ 3,067,143	$ 63,461,659	$ 90,097,461	$ 13,514,619	$ 10,361,208	$ 10,686,995	$ 124,660,284
Cost/CY In Channel Material			7.81	1.53	31.73	45.05	6.76	5.18	5.34	62.33

[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 12
Changes in Cost with Alterante Assumptions
Fine-Grained Silty Material (FGSM) - Two Facilities Model

	Two Facilities Model	
	Cost per Cy of In Channel Material	**Cost Change per CY**
2 MCY FGSM with NO SM or SRC[1]	**$47.49**	
2 MCY FGSM with 0.5 MCY SRC & 0.25 MCY SM at One Facility[2]	**$36.11**	**-24%**
SM Resale Price of $3.88	**$36.11**	
Reduce SM Resale Price by 50% to $1.94	$36.32	1%
Increase SM Resale Price by 50% to $5.82	$35.89	-1%
Increase SM Resale Price to Break-Even for SM: $6.24	$35.84	-1%
SRC Resale Price of $6.80	**$36.11**	
Reduce SRC Resale Price by 50% to $3.40	$36.80	2%
Increase SRC Resale Price by 50% to $10.20	$35.42	-2%
Increase SRC Resale Price to Break-Even for SM: $12.56	$34.94	-3%
Capital Cost Recovery over 5 Years	**$47.49**	
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)	$39.74	-16%
Capital Cost Recovery Increased from 5 Years to 10 Years	$43.62	-8%
No Capital Cost Recovery on Scows	$44.68	-6%
Infrastructure Cost Recovery over 10 Years	**$47.49**	
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (By Others)	$45.66	-4%
Infrastructure Cost Recovery Increased from 10 years to 15 years	$46.88	-1%
Management G&A at 15%	**$47.49**	
Management G&A Reduced from 15% to 7.5%	$44.74	-6%
Management G&A Reduced from 15% to 5%	$43.82	-8%
Profit at 10%	**$47.49**	
Profit Reduced from 10% to 7.5%	$46.53	-2%
Profit Reduced from 10% to 5%	$45.57	-4%
Capital Cost Contingency at 15%	**$47.49**	
Capital Cost Contingency Reduced from 15% to 10%	$47.03	-1%
Captial Cost Contingency Reduced from 15% to 5%	$46.58	-2%
General Cost Factor for Installation as 2.5 times Capital Cost	**$47.49**	
General Cost Factor for Installation Reduced from 2.5 to 2	$47.11	-1%
General Cost Factor for Installation Reduced from 2.5 to 1	$46.35	-2%

Table 12, continued
Changes in Cost with Alterante Assumptions
Fine-Grained Silty Material (FGSM) - Two Facilities Model

Annual Maintenance Costs of 5%	**$47.49**	
Annual Maintenance Costs Reduced to 2.5%	$46.44	-2%
Annual Maintenance Costs Increased to 10%	$49.60	4%
Stabilize with 8% Cement	**$47.49**	
Reduce Cement from 8% to 5%	$42.81	-10%
Increase Cement from 8% to 10%	$50.55	6%
Cement Cost of $100 per ton	**$47.49**	
Cement Cost Reduced 15% to $85	$45.65	-4%
Union Labor Rate of $57	**$47.49**	
Union Labor Rate Reduced 10% to $51	$46.90	-1%
Supervisor Labor Rate of $86	**$47.49**	
Supervisor Labor Rate Reduced 10% to $77	$47.31	0%
Original Staffing	**$47.49**	
Staffing Reduced by 10%	$46.97	-1%
100% Transportation by Barge	**$47.49**	
100% Transportation by Rail Car	**$62.33**	**31%**
50% Transportation by Dump Truck and 50% Transportation by Barge	$78.27	65%
Dump Truck Subcontract Rate of $1,000 for 100% Dump Truck	**$107.03**	**125%**
Dump Truck Lease Rate Reduced 10% to $900 for 100% Dump Truck	$100.77	-6%
Rail Car Haul Cost of $1,010 for 100% Rail Car	**$62.33**	**31%**
Rail Car Haul Cost Reduced 10% to $909 for 100% Rail Car	$60.92	-2%
Rail Car Haul Cost Increased 10% to $1,111 for 100% Rail Car	$63.74	2%
Rail Car Lease Rate of $570 for 100% Rail Car	**$62.33**	**31%**
Rail Car Lease Rate Reduced 10% to $513 for 100% Rail Car	$62.32	0%
Including Transportation Infrastructure	**$62.33**	**31%**
Remove Transportation Infrastructure (Provided by Others)	$61.75	-1%
Tipping Fee of $5/CY Stabalized Material ($5.35/In Channel CY)	**$47.49**	
Double Tipping Fee to $10	52.83	11%
Reduce Tipping Fee to $2.50	44.82	-6%
Reduce Tipping Fee to $1.00	43.21	-9%
Remove Tipping Fee	42.14	-11%

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

Table 13
Reduced Cost Estimate with Modified Assumptions
Fine-Grained Silty Material (FGSM) - Two Facilities Model

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions (see Table 10)	**$47.49**	
Revised Assumptions		
Management G&A Reduced from 15% to 7.5%	$44.74	$2.75
No Management G&A on Capital Costs	$44.12	$0.62
Profit Reduced from 10% to 7.5%	$43.24	$0.88
Capital Cost Recovery Increased from 5 Years to 10 Years	$39.94	$3.30
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$39.43	$0.51
Capital Cost Contingency Reduced from 15% to 10%	$39.18	$0.25
General Cost Factor for Installation Reduced from 2.5 to 2	$38.99	$0.19
Annual Maintenance Costs Reduced to 2.5%	$38.11	$0.88
Cement Quantity for Stabilization Reduced from 8% to 5%	$33.88	$4.23
Cement Cost Reduced 15% to $85	$32.83	$1.05
Reduce Tipping Fee to $2.50/CY of Stabilized Material Placed	$30.16	$2.67
Tug & Crew Rental Rate Reduced 10% to $2,700	$29.87	$0.29
Union Labor Rate Reduced 10% to $51	$29.28	$0.59
Supervisor Labor Rate Reduced 10% to $77	$29.10	$0.18
Staffing Reduced by 10%	$28.60	$0.50
Management G&A Reduced from 7.5% to 5%	$28.09	$0.51
Profit Reduced from 7.5% to 5%	$27.50	$0.59
Captial Cost Contingency Reduced from 10% to 5%	$27.30	$0.20
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (Provided by Others)	$26.38	$0.92
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)	$23.56	$2.82
Reduce Tipping Fee to $1.00/CY of Stabilized Material Placed	$21.95	$1.61
Remove Tipping Fee	$20.88	$1.07

5.1.1 Sandy Material (SM) and Stiff Red Clay (SRC) Scenario

This scenario considered adding both SM and SRC to the processing stream at one of the PPFs. Approximately 250,000 CY of SM would be handled as presented in the Year-Round Model SM Scenario. In addition, 500,000 CY of SRC would be processed.

As part of the HDP, glacially deposited stiff red clay will be excavated as dredging depths are extended below current channel depths and into virgin materials. Through 2012, more than 500,000 CY of SRC will be excavated during most years. The average annual volume is approximately 750,000 CY but it is projected to drop below 500,000 CY in two years. After 2012, no SRC will be dredged as SRC is not a component of any of the maintenance dredging materials

Under this scenario, SM would be received, handled and sold as described in the Year-Round Model scenario. The SM sale price is assumed to be $3.88/ton.

SRC would be delivered to the PPF in PPF supplied scows and standing water would be decanted from the scow. The SRC would be offloaded from the scow to a temporary storage area. It would then be moved to one of two 10-acre processing areas where it would be spread and worked with a disk and/or by equipment moving over the material. The SRC would be worked in this fashion to break up large clumps, improve handling properties, and promote drying. Once the material was drier and more workable, it would be removed to a storage area for sale.

In addition to the 20 acres needed for drying and working the SRC, four acres are assumed necessary for storage and sale for a total of 24 additional acres at the PPF receiving the SRC. Based on the properties of the SRC and a brief market survey of clay prices, it is estimated the SRC can be sold at $6.80/ton. This price assumes the purchaser will pick-up the SRC at the PPF. The PPF will load the SRC into trucks, but will not be responsible for delivery at the $6.80/ton price.

The cost to handle the SM is estimated by the cost comparisons to be $2.88/CY (see Table 11). The lower cost to handle the SM in this scenario than in the Year-Round Model reflects a different allocation of fixed, infrastructure and capital costs among the three materials being processed. However, the model still indicates there is a net cost to add SM to the PPF rather than a net benefit. Overall annual costs of the PPF would be greater, and slightly more real estate would be required.

The cost to process the SRC, $6.43/CY, is also modest when compared to the cost to process the FGSM, but the model indicates it is an additional cost. Overall annual costs for the PPF will increase if SRC is added. In addition, real estate required for the facility will more than double to almost 50 acres.

Handling SM and SRC at both PPFs was discussed among the PPF Subgroup but was not evaluated. It seemed unlikely to reduce overall costs. As discussed earlier, although including SM and SRC as part of the PPF does not improve PPF economics, this analysis does not imply there is no economic value to using either of these materials in some other context. Under other circumstances, the SM material may have value that justifies diverting the material onshore. Likewise, using the SRC for other specific project(s) such as closing a specific landfill may have significant merit. When opportunities are identified, they should be evaluated on their own merit.

5.1.2 Transportation Scenarios

Two transportation scenarios were also considered. Under one case, only half of the material was taken by barge to a placement site approximately 100 miles from the PPF. The other half was trucked in subcontracted trucks to a different placement site approximately 100 miles from the PPF. The second scenario assumed no placement site accessible by barge was available and all material was taken to a placement site approximately 100 miles from the PPF by rail.

Transporting half of the material by barge and the other half by truck increases overall transportation (loading, transporting, placement and tipping fee) from $16.66 to $47.45, an increase of 285%. Costs to barge half of the material increases by roughly 28% as compared to the base Two Facilities model because capital costs must be spread over fewer yards. Costs to truck the other half of the material increase by almost 440% to $73.63/CY as compared to costs in the base Two Facilities model. Developing a placement site(s) accessible by barge has the potential to result in long-term savings.

Transporting all of the material by rail is less costly (35%) than by truck and barge transportation. Rail transportation at $30.92/CY (loading, transporting, placement and tipping fee) remains more costly than barge, but significantly less than truck (almost 60% less). This scenario suggests that rail transportation would be the preferred mode when the placement site is on the order of 100 miles from the PPF and no barging options are available. Table 11 provides costs for both of the transportation scenarios.

6.0 FINE-GRAINED SILTY MATERIAL (FGSM) & REMEDIAL MATERIAL (RM) MODEL – ALTERNATIVE 4

This Alternative assumes two PPF facilities operating year-round. It assumes a total of 2.5 MCY of FGSM are processed through these two PPFs annually and upland storage is provided so that material is available during that portion of the year when dredging is generally not allowed. As in the Two Facilities Model, both in-barge and pug mill mixing are employed to stabilize the processed FGSM with cement prior to delivery for placement.

DMMP projections suggest 2.5 MCY or more of FGSM will be dredged in seven out of the next ten years when the HDP and maintenance dredging will be contributing material (USACE, 2006b). After 2014, 2.5 MCY or more of FGSM are projected to be dredged in about 37% of the years. In the other years, the quantity dredged will fall short of the designed PPF capacity of this Alternative, driving up cost/CY.

Of the 2.5 MCY of FGSM, this Alternative assumes 2 MCY would be processed by stabilization with cement by in-barge and pug mill mixing. This portion would be evenly divided between the two PPFs and processed as in the Two Facilities Model. The other 0.5 MCY would be diverted into the stream of material being processed through a Remedial Material (RM) facility located at one of the PPFs.

Following stabilization of the 2 MCY of FGSM, the product would be loaded into barges for transport and placement at a site approximately 100 miles from the Harbor. Because the FGSM material amounts and processing assumptions are the same as in Alternative 3, the cost for managing these 2 MCY in this Alternative is therefore identical to the cost in the base Two Facilities Model ($47.49/CY).

The FGSM & RM Model adds a facility at one of the PPF sites capable of processing RM and FGSM into a product for sale. In addition to the 0.5 MCY of FGSM diverted to the RM facility, the RM facility would receive another 0.5 MCY of RM annually, delivered in PPF supplied scows, so that the total quantity of material processed through the RM facility would be 1 MCY.

No DMMP projections are available as to the volume of RM that may be dredged annually. While some RM may be associated with maintenance dredging projects, the majority would come from environmental dredging projects developed to remove historically contaminated sediments found in the Harbor. While contaminants and contaminant levels will vary in the RM delivered to the RM facility, it is assumed for this Alternative that all delivered material can be processed to produce a material that can be sold.

The processed RM material would be combined with the FGSM processed through the RM facility to produce roughly 1.2 million tons of product annually. It was arbitrarily assumed by the PPF Subgroup that each in channel CY of FGSM and RM dredged for delivery and processing through the RM facility would be sold for a profit of $5.00. That is, a $5.00/CY profit would be realized and the rest of the sale price would account for all annual costs attributed to the RM facility, including delivery of the material, portside infrastructure, facility infrastructure, and operating costs.

Since no viable large-scale process has been demonstrated that is capable of producing a commercial product of this value, there is still a large amount of uncertainty associated with the RM processing facility. Consequently it was necessary to select a number of arbitrary costs, thought to be of the proper order of magnitude, for use in the economic comparison model. Construction of the RM facility, including all equipment and contingency was arbitrarily assumed to be $10 million. Annual maintenance was assumed to be twice as costly, at 10% of the total capital costs, as assumed for facilities' maintenance in the other models. Labor was assumed to be comparable to the labor modeled for the pug mill mixing operations. Costs for process chemicals, power, fuel and other expendables were also assumed to be comparable to costs for the stabilization processes.

Based on these admittedly arbitrary assumptions, the economic comparison model calculated a sale price for the product of $20.16/CY satisfying all of the conditions outlined above. It was assumed that the material processed through the RM facility would be stockpiled at the PPF after processing and then loaded into purchaser-supplied trucks for transport offsite. It was further assumed that the RM processing facility would require two acres for the facility, eight acres for storage of the material processed through the facility, and an additional six acres for storage of the FGSM to be processed when no FGSM dredging is underway. Total additional acreage needed for the RM facility was therefore estimated to be 16 acres.

The one MCY processed through the RM facility under the specified conditions would generate $5 million of profit annually, lowering the average overall cost to $30.20/CY for the 3 MCY yards processed through both PPFs.

Table 14 provides a more detailed description of the conditions of the FGSM & RM Model and the various scenarios discussed below. Table 15 provides a cost breakdown of the various components. The effects of changing assumptions were not evaluated for this Model, but are expected to be similar to the ones seen in the previous three models.

6.1 VALUE OF MATERIAL PROCESSED THROUGH RM FACILITY

To satisfy the arbitrary cost assumptions outlined above, the material processed through the RM facility would need to be sold for $20.16/CY, undelivered, and one MCY of the material would be sold annually. Based on existing prices for bulk construction materials such as sand, aggregates, and topsoil that are generally well below the $20/CY level, it seems unlikely the value of the processed product would demand the required sale price.

The Model also assumes the material going through the RM facility could be processed into a product with a significant value at a cost comparable to simply stabilizing FGSM. Since the material going through the RM facility will generally have physical properties similar to FGSM and chemical properties more challenging than FGSM, it is probably overly optimistic to assume it can be turned into a highly valued product at the same cost as simple stabilization.

It would appear that the Model over values the material processed through the RM facility. Processing will most likely be more expensive than modeled and the sale price of the finished product will most likely be less than modeled. The $5 million annual contribution to the overall costs of the two PPFs will not likely be achieved by adding a RM processing facility at one of the PPFs.

However, there is also value derived from the FGSM processed through the RM facility because that material does not need to be processed, transported and placed at the projected cost of $47.49/CY. If the 0.5 MCY of FGSM assumed processed through the RM facility by the model were instead processed through the stabilization management procedures, the additional cost would be approximately $23.8 M. Even if this 0.5 MCY were given away after processing through the RM facility (under the optimistic processing assumptions), there would be a net savings on the order of $7 million as compared to the cost of stabilizing, transporting and placing the material following the assumed stabilization management procedures.

Table 14

Assumptions Used for Model Development

Alternative #4 – The Fine-Grained Silty Material (FGSM) and Remedial Material (RM) Model

with

Transportation Scenarios

1. Material dredged and processed

Fine-Grained Silty Material (FGSM)

- 2.5 MCY of in channel FGSM dredged annually.
- FGSM is taken to each of **TWO** PPFs.
- Dredging from June through January (35 weeks or 210 days).
- Processing at both facilities for 52 weeks (312 days).
- 11,900 CY of in channel FGSM material dredged daily.
- 0.5 MCY FGSM diverted for RM processing at **ONE** PPF.

❖ DMMP projected quantities for FGSM - summary statistics
  - >2.5 MCY for 7 of 10 years 2005-2014.
  - >2.5 MCY 37% of years after 2014.
  - ➢ Maintenance dredging
  - 2005-2014, Ave. 1.7 MCY, Max. 2.5 MCY, Min. 1.1 MCY.
  - After 2014, Ave. 2.3 MCY, Max. 3.2 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.
  - ➢ Harbor Deepening Project dredging
  - 2005-2012, Ave. 1.5 MCY, Max. 3.0 MCY, Min. 0.2 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.

Remedial Material (RM)

- 0.5 MCY of in channel RM dredged annually.
- Dredging of RM is possible year-round (52 weeks or 312 days).
- Processing occurs year-round.
- Dredge and process on average 1,600 CY of RM daily.

❖ DMMP projected quantities for RM
  - Virtually no RM is expected from “routine” projects covered in the DMMP projections.
  - RM will be from “environmental” dredging projects that have not yet been defined.

Table 14, continued

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.
- Special or additional requirements of “environmental” dredging projects.

3. Dredging and transport to the two PPFs

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.
- Costs of any special or additional dredging precautions potentially required for “environmental” dredging of RM is not included in the PPF model costs.
- Newark Bay and Staten Island are the assumed locations of the PPFs and are “central” to all dredging.
- One PPF receives 1 MCY of the FGSM annually. The other PPF receives 1.5 MCY of FGSM annually and 0.5 MCY of RM annually.
- Transportation of scows to the PPFs and return of scows to the dredge sites are included in the costs of dredging.
- All scows for transport of dredged material from the dredging sites to the PPFs are supplied by PPF.
- Additional scows needed to allow for processing activities are also supplied by PPF.
- A total of 52 scows, approximately 2,000 CY each, are supplied by the PPF (18 scows for one PPF and 34 for the other).
- Decant water is pumped out at the PPFs.

4. Receipt and processing at PPFs

- Dredgers deliver to the PPFs in scows holding approximately 2,000 CY. Scows are moored to pile dolphins to begin processing.
- At each PPF, FGSM decant water is pumped to one of two holding scows. After the holding scows are filled, they sits for 24 hours to allow for settlement before the decant water is discharged overboard.
- Decant water from RM is treated, if required, during RM processing activities

Table 14, continued

- Decanted scows are moved to the PPF wharf by a PPF tug and crew for processing.
- Two scows daily (approximately) are processed by pug mill mixing of FGSM at each PPF.
  - Material is offloaded to a pug mill through a debris screen to remove debris.
  - Stored FGSM is processed when no FGSM is being dredged.
  - Cement is added to the material in the pug mill.
  - Material is stacked on the paved area for initial curing and is then loaded for transportation to the placement site.
- One scow daily (approximately) is processed with in-barge mixing of FGSM at each PPF during the dredging period.
  - Debris >4" is removed from the dredged material by an excavator with a rake and placed dockside for disposal at a landfill.
  - Cement is pumped from a silo into the dredged material and mixed with an excavator with a mixing head.
  - Scows sit overnight for curing before being offloaded by an excavator.
- One scow daily (approximately) of FGSM is offloaded to upland storage during the dredging period.
  - Decanted, unprocessed FGSM is offloaded to trucks and taken to the upland storage area.
- Two scows daily (approximately) of FGSM offloaded for processing through RM facility during the dredging period.
  - Material is offloaded to truck and taken to storage during peak delivery periods.
  - Stored FGSM available for RM processing during the non-dredging periods.
- One to two scows daily of RM are offloaded year round for processing through RM facility.
  - RM processing (decontamination) includes offloading, processing, waste treatment, etc.
  - FGSM diverted to the RM facility is blended with RM to make one product.
  - No specific processing method is assumed. Costs for processing are assumed to be a similar order of magnitude to pug mill or in-barge mixing costs.
  - Final decontaminated product is suitable for sale.

5. Portside Infrastructure for each PPF

- 1,250 feet of wharf space is needed at one PPF and 1,500 feet at the other.
- 10 acres are required for site improvements; 300 feet of working space along the wharf plus space for 1 days FGSM production.
- 12 acres of upland diked storage are required for FGSM storage.
- 2 acres are required for a RM processing facility with an additional 8 acres for storage of processed RM and 6 acres for additional FGSM storage to feed RM processing year-round at one PPF.
- Total space required is 22 acres at one PPF and 38 acres at the second PPF.
- Pile dolphins for scow tie-up and dredging modified accordingly based on uses.

Table 14, continued

6. Portside loading

   - Barge transport all processed FGSM material.
     - Excavator loads transport barges.
     - Portside infrastructure for barge loading is included above.
     - PPF provides roughly 2,000 – 4,000 CY barges. These are in addition to scows provided for other operations.

   - All processed RM is transported offsite by others as part of the material purchase.
     - Processed RM is loaded by the PPF for transport offsite.
     - Processed RM is sold at $20.16/CY.

   FGSM Transportation Scenario 1
   - Transport half of the material by truck and half by barge 1/2 (see barge notes above).
   - Front end loader loads the material to trucks.
   - Infrastructure for loading included in portside infrastructure.

   FGSM Transportation Scenario 2
   - Transport all of the material by train.
   - Conveyor moves the material to a dump hopper that weighs and dumps the material into rail cars.
   - Additional portside infrastructure is provided for rail operations of 40-50 car trains with leased cars.
   - An additional 10 acres is needed for rail car marshalling & loading at each site.

7. Transportation

   - Processed RM is transported offsite by others.
   - Processed FGSM is transported in one to two barges daily from each PPF.
     - Moved by PPF supplied tugs to a placement site within 100 miles.

   FGSM Transportation Scenarios
   - Placement sites are within 100 miles of a PPF.
   - Subcontracted trucks can deliver only one load daily.
   - A 40-50 car train is dispatched from each PPF every 1 to 2 days.

8. Placement

   - Existing offloading facilities near the placement site are in place for barge offloading.
   - Processed material is offload from barges into trucks at the offloading facility.
   - Trucks deliver material to placement site within 5 miles of offloading and dump the material as directed.
   - No additional processing of the material is required at the placement site.

Table 14, continued

- 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 not the responsibility of the PPF operations, but 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.

FGSM Transportation Scenarios

- Truck, rail and barge placement sites at different locations.
- Rail cars are offloaded to trucks.
- Placement then follows placement procedures outlined above.

Table 15
Fine-Grained Silty Material (FGSM) & Remedial Material (RM) Model
Estimated Costs[1]
Summary

Dredged Material Stabilized with Admixtures

Total Material Quantities
3,000,000 CY In Channel Material Dredged Annually
2,750 CY Stabilized Material Processed Daily (FGSM - In-Barge)
5,000 CY Stabilized Material Processed Daily (FGSM - Pug Mill)
10,536 CY Stabilized Material Processed Daily (RM - Decontamination) Including 0.5M of FGSM Diverted
7,750 tons of FGSM Produced, Loaded, and Transported Daily*
156 tons >4" Debris removed for landfill disposal daily
*Quantity of material transported during the majority of year (i.e. not during fish window shutdown).

Component in Overall Processing and Transportati	Total Annual Costs	**FGSM** Total Annual Costs	**RM** Total Annual Costs	**TOTAL** Cost/CY of In Channel Material	% of Total Cost
Scow Fleet for Two Facilities	$ 10,117,786	$ 9,015,206	$ 1,102,579	$ 3.37	11%
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 17,850,201	$ 17,850,201	$ -	$ 33.04	20%
Addition of Stabilizing Agents to FGSM at Portside (Pug Mill)	$ 33,141,214	$ 33,141,214	$ -	$ 22.70	37%
Decontamination of RM at Portside	$ 14,322,133	$ 7,161,067	$ 7,161,067	$ 14.32	16%
Resale Offset for RM	$ (22,302,817)	$ (11,151,409)	$ (11,151,409)	$ (22.30)	-25%
Portside Facilities Infrastructure #1	$ 2,330,279	$ 1,941,899	$ 388,380	$ 1.17	3%
36 acres needed for facility #1[2]		*1,500*	*feet of wharf space*		
Portside Facilities Infrastruct	$ 1,830,755	$ 1,830,755	$ -	$ 1.83	2%
22 acres needed for facility #2[2]		*1,250*	*feet of wharf space*		
Transportation (Including Loading, Unloading, and Placement) PLUS Tipping Fee	$ 33,315,983	$ 33,315,983	$ -	$ 16.66	37%
Total	$ 90,605,536	$ 93,104,918	$ (2,499,383)	$ 30.20	
FGSM - 2 MCY Processed and 0.5 MCY Decontaminated and Sold at $20.16				$ 37.24	
RM - 0.5 MCY Decontaminated and Sold at $20.16				$ (5.00)	
Total with 3.5 MCY Scenario	$ 109,554,705	$ 112,055,374	$ (2,500,669)	$ 31.30	
36 acres needed for facility #12		*1,750*	*feet of wharf space*		
22 acres needed for facility #22		*1,500*	*feet of wharf space*		
FGSM - 2.5 MCY Processed and 0.5 MCY Decontaminated and Sold at $20.04				$ 37.35	
RM - 0.5 MCY Decontaminated and Sold at $20.04				$ (5.00)	
Total with 50% Truck & 50% Barge Scenario	$ 152,456,283	$ 154,955,665	$ (2,499,383)	$ 50.82	
FGSM - 2 MCY Processed and 0.5 MCY Decontaminated and Sold at $20.16				$ 61.98	
RM - 0.5 MCY Decontaminated and Sold at $20.16				$ (5.00)	
Total with 100% Rail Scenario	$ 120,292,289	$ 122,791,671	$ (2,499,383)	$ 40.10	
FGSM - 2 MCY Processed and 0.5 MCY Decontaminated and Sold at $20.16				$ 49.12	
RM - 0.5 MCY Decontaminated and Sold at $20.16				$ (5.00)	

Table 15, continued
Fine-Grained Silty Material (FGSM) & Remedial Material (RM) Model
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 for Two Facilities	$ 27,820,000	$ 4,173,000	$ 6,398,600	$ 1,599,650	$ -	$ 7,998,250	$ 1,199,738	$ 919,799	$ -	$ 10,117,786
Addition of Stabilizing Agents to FGSM at Portside (In-Barge)	$ 9,916,795	$ 1,487,519	$ 2,280,863	$ 570,216	$ 11,259,752	$ 14,110,831	$ 2,116,625	$ 1,622,746	$ -	$ 17,850,201
Addition of Stabilizing Agents to FGSM at Portside (Pug Mill)	$ 13,822,183	$ 2,073,327	$ 3,179,102	$ 794,776	$ 20,352,711	$ 26,198,589	$ 3,929,788	$ 3,012,838	$ -	$ 33,141,214
Decontamination of RM at Portside	$ 8,695,652	$ 1,304,348	$ 2,000,000	$ 1,000,000	$ 8,321,844	$ 11,321,844	$ 1,698,277	$ 1,302,012	$ -	$ 14,322,133
Resale Offset for RM	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (22,302,817)	$ (22,302,817)
Portside Facilities Infrastructure #1	$ 15,159,691	$ 2,273,954	$ 1,842,118	$ 276,318	$ -	$ 1,842,118	$ 276,318	$ 211,844	$ -	$ 2,330,279
Portside Facilities Infrastructure #2	$ 11,874,192	$ 1,781,129	$ 1,447,237	$ 217,086	$ -	$ 1,447,237	$ 217,086	$ 166,432	$ -	$ 1,830,755
Transportation (including loading, unloading, and placement) PLUS Tipping Fee	$ 10,369,472	$ 922,294	$ 2,288,094	$ 572,024	$ 9,332,160	$ 17,888,528	$ 2,683,279	$ 2,057,181	$ 10,686,995	$ 33,315,983
Total	$ 97,657,985	$ 14,015,571	$ 19,436,015	$ 5,030,068	$ 49,266,468	$ 80,807,397	$ 12,121,110	$ 9,292,851	$ (11,615,822)	$ 90,605,536
Cost/CY In Channel Material			$ 6.48	$ 1.68	$ 16.42	$ 26.94	$ 4.04	$ 3.10	$ (3.87)	$ 30.20
Total with 3.5 MCY Scenario	$ 111,153,200	$ 16,039,853	$ 22,158,929	$ 5,672,698	$ 56,848,645	$ 93,569,971	$ 14,035,496	$ 10,760,547	$ (8,811,309)	$ 109,554,705
Cost/CY In Channel Material			$ 6.33	$ 1.62	$ 16.24	$ 26.73	$ 4.01	$ 3.07	$ (2.52)	$ 31.30
Total with 50% Truck & 50% Barge Scenario	$ 97,520,725	$ 14,262,432	$ 19,377,580	$ 5,015,459	$ 100,769,508	$ 129,701,269	$ 19,455,190	$ 14,915,646	$ (11,615,822)	$ 152,456,283
Cost/CY In Channel Material			$ 6.46	$ 1.67	$ 33.59	$ 43.23	$ 6.49	$ 4.97	$ (3.87)	$ 50.82
Total with 100% Rail Scenario	$ 107,161,798	$ 15,841,560	$ 20,444,341	$ 5,052,746	$ 71,783,503	$ 104,275,186	$ 15,641,278	$ 11,991,646	$ (11,615,822)	$ 120,292,289
Cost/CY In Channel Material			$ 6.81	$ 1.68	$ 23.93	$ 34.76	$ 5.21	$ 4.00	$ (3.87)	$ 40.10

[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.

This analysis indicates there is significant "value" to an RM facility under this Alternative and any of the previously considered alternatives if the RM facility can convert FGSM to a product that does not need to be transported and placed at some cost to the PPF. Diverting some portion of the FGSM from transportation and placement by converting it into a product, even if that product has a low sale price, has a value and will lower the overall costs of managing the dredged material.

6.2 FGSM & RM MODEL – SCENARIOS

Several scenarios were run on the FGSM & RM Model to examine the cost implications of changing certain conditions. Assumptions remained the same except for the changes described below as part of each scenario.

6.2.1 Increased Volume Scenario

This scenario considers increasing the total volume of FGSM processed through the two PPFs to 3.5 MCY annually. Each PPF would process 1.25 MCY. The RM facility at one PPF would continue to process 0.5 MCY of FGSM and 0.5 MCY of RM as described in the base FGSM & RM Model.

Under this scenario, the overall cost/CY increases slightly from $30.20/CY to $31.30/CY. Although the cost/CY of stabilizing the 2.5 MCY, assuming the volume can be provided, does decrease under this scenario, the cost decrease in not sufficient to outweigh spreading the profit from the sale of the RM over more yards of material.

6.2.2 Transportation Scenarios

Two transportation scenarios were also considered. Under one scenario, half of the stabilized material was taken by barge to a placement site approximately 100 miles from the PPF. The other half of the stabilized material was trucked in subcontracted trucks to a different placement site approximately 100 miles from the PPF. The second scenario assumed no placement site accessible by barge was available and all stabilized material was taken to a placement site approximately 100 miles from the PPF by rail.

Results were similar to those reported for the Two Facilities Transportation Scenarios. Using trucks, even for only half of the material, significantly increases overall costs. Barge transportation can significantly lower overall costs, but if distant (>100 miles) placement sites inaccessible by barge are the only options, rail transportation would be the economically preferred transportation mode.

7.0 OPTIMUM MODEL – ALTERNATIVE 5

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

The Optimum Model considers one PPF that processes 1.5 MCY of 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 is presumed to be the initial mode of offsite transport. Provisions are made for barge transport and space is provided for rail transport. Space is also provided for eventual development of an 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 a certain level of 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.

SM was not included in the maintenance material to be processed through the optimum facility. Volumes of maintenance SM are generally small, much is already used beneficially, and processing SM through the optimum PPF will increase overall costs. While larger volumes are associated with the HDP, this is only a short-term source of material that would not subsidize the long-term operation of the PPF. Beneficial use of SM should be considered independent of the PPF project.

SRC was also excluded from the optimum PPF. While large volumes are associated with the HDP, this is only a short-term source of material, there would be a net cost to process and sell the SRC, and it would not subsidize the long-term operation of the PPF. Beneficial use of SRC should be considered independent of the PPF project.

Provisions for eventual processing of RM were included in the 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.

Operating two smaller facilities did not provide any savings, especially when real estate and portside infrastructure requirements were considered. Operating year-round also did not provide savings, especially when the cost of storage and real estate required for an upland storage area were factored in. The PPF could benefit from a modest (several days production) storage area, which could be provided upland or in a vessel(s). Modest storage would allow 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 assumes the PPF could be sited at a central location and includes PPF supplied scows to transport the dredged material to the facility. If the PPF must be located well away from the central areas of the Port, there might be additional cost to account for the increased transportation distances. However, any additional transportation costs should be weighed against real estate availability and costs. Similarly, if scows were not supplied by the PPF, overall costs as estimated for the optimum case would be reduced by $3.50/CY, but potential costs savings for the dredging would not be realized.

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. 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 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. The Optimum Model conservatively estimates processing costs at $19.54/CY of in channel material dredged.

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 provided, allowing space for processing of scows and loading or unloading for shipment. Extra wharf space would also be available for receipt and shipping of RM once the RM facility is developed. Arrangements other than one alongshore wharf may be possible, including piers, but space should be provided for simultaneous work on three to four scows as well as unloading or loading operations. 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 is assumed there is a two acre area available for development of a RM facility and that an additional eight acres are available for upland storage of raw RM, processed RM, and FGSM material. RM processing is likely to be a year round operation, so that 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 is 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 is also 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 seems 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, is estimated by the Optimum Model to be $18.84/CY. Barge transportation is estimated to be almost half as costly ($13.80/CY) as compared to truck transportation ($23.87/CY) to a nearby site. Identifying a site that could receive material by barge, even if it were some distance from the PPF, has the potential to significantly reduce overall costs/CY.

Assumed conditions for the Optimum Model are provided in more detail in Table 16 along with a discussion of the basis for selecting the assumed conditions. Table 17 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.

Table 18 evaluates the relative impact of individual assumptions on the overall costs. Table 19 presents the overall reduction in cost from a combination of revised assumptions. A cost of under $30/CY appears to be a realistic expectation if some of the more conservative assumptions can be relaxed or if the majority of the material to be placed can be transported by barge.

If a cost effective, full-scale means of processing large volumes of RM can be implemented as part of the PPF, overall costs for processing dredged material can be lowered substantially below the $30/CY estimate. Sale of the processed RM at a profit would help to subsidize the PPF. If some of the FGSM could be diverted into the RM processing stream and also sold for a profit, the PPF would receive an increased benefit because it would not incur the cost of processing, transporting, and placing the diverted FGSM.

Table 16

Assumptions Used for Model Development

Alternative #5 Optimum Model

1. Material dredged and processed

- 1.5 MCY of in channel FGSM dredged annually.
- Dredging and processing 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.

Basis for selection: 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.

- ❖ DMMP projected quantities for FGSM - summary statistics
  - ➢ Maintenance dredging
  - o 2005-2014, Ave. 1.7 MCY, Max. 2.5 MCY, Min. 1.1 MCY.
  - o After 2014, Ave. 2.3 MCY, Max. 3.2 MCY, Min. 1.5 MCY.
  - o Based on DMMP summary of maintenance dredging projects with FGSM, 10 to 20 of these projects would be undertaken annually.
  - ➢ Deepening dredging
  - o 2005-2012, Ave. 1.5 MCY, Max. 3.0 MCY, Min. 0.2 MCY.
  - o No deepening material after 2012.
  - o Based on DMMP summary of new work deepening projects with FGSM, 2 to 4 projects undertaken in most years.
  - ➢ Combined dredging volumes
  - o >1.5 MCY is projected annually but "management" and coordination of individual projects will be required to maintain a steady flow.

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.

Table 16, continued

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

Basis for selection: 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.

Basis for selection: 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).

Basis for selection: 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).

Basis for selection: 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.

<u>Basis for selection</u>: If 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.

<u>Basis for selection</u>: 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.

Table 16, continued

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.

Basis for Selection: 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.

Table 17
Optimum Model - Fine-Grained Silty Material (FGSM)
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 17
Optimum Model - Fine-Grained Silty Material (FGSM)
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
Loading, Transportation, and Placement by Truck	$ 1,268,620	$ 190,293	$ 291,783	$ 72,946	$ 1,378,060	$ 10,982,788	$ 1,647,418	$ 1,263,021	$ 4,007,623	$ 17,900,850
Loading, Transportation, and Placement by Barge	$ 3,050,887	$ 363,133	$ 484,354	$ 121,089	$ 2,521,070	$ 5,016,513	$ 752,477	$ 576,899	$ 4,007,623	$ 10,353,511
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 ifrastructure (10 year) cost recoveries, O&M, and facility operations.

Table 18

Changes in Cost with Alternate Assumptions

Optimum Model - Fine-Grained Silty Material

	Optimum Model Cost per CY of In Channel Material	Cost Change per CY
Processing Capacity of 1.5 MCY	**$43.12**	
Capital Cost Recovery over 5 Years[1]	**$43.12**	
Capital Cost Recovery Reduced from 5 Years to No Recovery (Provided by Others)[2]	$38.34	-11%
Capital Cost Recovery Increased from 5 Years to 10 Years	$40.73	-6%
No Capital Cost Recovery on Scows	$40.32	-6%
Infrastructure Cost Recovery over 10 Years	**$43.12**	
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (By Others)	$41.88	-3%
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$42.71	-1%
Management G&A at 15%	**$43.12**	
Management G&A Reduced from 15% to 7.5%	$40.66	-6%
Management G&A Reduced from 15% to 5%	$39.84	-8%
Profit at 10%	**$43.12**	
Profit Reduced from 10% to 7.5%	$42.26	-2%
Profit Reduced from 10% to 5%	$41.41	-4%
Capital Cost Contingency at 15%	**$43.12**	
Capital Cost Contingency Reduced from 15% to 10%	$42.81	-1%
Captial Cost Contingency Reduced from 15% to 5%	$42.50	-1%
General Cost Factor for Installation as 2.5 times Capital Cost	**$43.12**	
General Cost Factor for Installation Reduced from 2.5 to 2	$43.00	0%
General Cost Factor for Installation Reduced from 2.5 to 1	$42.75	-1%

Table 18, continued

Changes in Cost with Alternate Assumptions

Optimum Model - Fine-Grained Silty Material

Annual Maintenance Costs of 5%	**$43.12**	
Annual Maintenance Costs Reduced to 2.5%	$42.51	-1%
Annual Maintenance Costs Increased to 10%	$44.36	3%
Stabilize with 8% Cement	**$43.12**	
Reduce Cement from 8% to 5%	$38.52	-11%
Increase Cement from 8% to 10%	$46.18	7%
Cement Cost of $100 per ton	**$43.12**	
Cement Cost Reduced 15% to $85	$41.28	-4%
Union Labor Rate of $57	**$43.12**	
Union Labor Rate Reduced 10% to $51	$42.77	-1%
Supervisor Labor Rate of $86	**$43.12**	
Supervisor Labor Rate Reduced 10% to $77	$42.97	0%
Original Staffing	**$43.12**	
Staffing Reduced by 10%	$42.62	-1%
Dump Truck Subcontract Rate of $1,000 for 100% Dump Truck	**$43.12**	
Dump Truck Lease Rate Reduced 10% to $900 for 100% Dump Truck	$42.17	-2%
Tipping Fee of $5/CY Stabilized Materail ($5.35/In Channel CY)	**$43.12**	
Double Tipping Fee to $10	48.47	12%
Reduce Tipping Fee to $2.50	40.45	-6%
Reduce Tipping Fee to $1.00	38.85	-10%
Remove Tipping Fee	37.78	-12%

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

Table 19
Reduced Cost Estimate with Modified Assumptions
Optimum Model - Fine-Grained Silty Material

	Cost per CY of In Channel Material	Cost Reduction per CY
Original Assumptions (see Table 16)	**$43.12**	
Revised Assumptions		
Management G&A Reduced from 15% to 7.5%	$40.66	$2.46
No Management G&A on Capital Costs	$40.27	$0.39
Profit Reduced from 10% to 7.5%	$39.47	$0.80
Capital Cost Recovery Increased from 5 Years to 10 Years	$37.44	$2.03
Infrastructure Cost Recovery Increased from 10 Years to 15 Years	$37.09	$0.35
Capital Cost Contingency Reduced from 15% to 10%	$36.92	$0.17
General Cost Factor for Installation Reduced from 2.5 to 2	$36.86	$0.06
Annual Maintenance Costs Reduced to 2.5%	$36.33	$0.53
Cement Quantity for Stabilization Reduced from 8% to 5%	$32.13	$4.20
Cement Cost Reduced 15% to $85	$31.08	$1.05
Tipping Fee Reduced to $2.50/CY of Stabilized Material Placed	$28.41	$2.67
Dump Truck Subcontracted Rate Reduced 10% to $900	$27.53	$0.88
Barge Subcontracted Rate Reduced 10% to $2,700	$27.38	$0.15
Union Labor Rate Reduced 10% to $51	$27.06	$0.32
Supervisor Labor Rate Reduced 10% to $77	$26.92	$0.14
Staffing Reduced by 10%	$26.51	$0.41
Management G&A Reduced from 7.5% to 5%	$26.01	$0.50
Profit Reduced from 7.5% to 5%	$25.47	$0.54
Captial Cost Contingency Reduced from 10% to 5%	$25.33	$0.14
Infrastructure Cost Recovery Reduced from 10 Years to No Recovery (Provided by Others)	$24.71	$0.62
Capital Cost Recovery Reduced from 5 years to No Recovery (Provided by Others)	$22.93	$1.78
Reduce Tipping Fee to $1.00/CY of Stabilized Material Placed	$21.33	$1.60
Remove Tipping Fee	$20.26	$1.07

8.0 REFERENCES

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USACE. 2006a. Dredged Material Management Plan for the Port of New York and New Jersey, Implementation Report, 2005 Update. USACE, New York District, New York, NY.

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APPENDIX A
FINE-GRAINED SILTY MATERIAL – BASE MODEL

Assumptions for Fine-Grained Silty Material (FGSM) - Base Model

Number of days of operation annually	210	days		
Shutdown between February and May - operational 8 months @ 6 days per week = 35 weeks x 6 days = 210				
<u>DECANTED DREDGED MATERIAL</u>				
Solids content of decanted dredged material, in-barge	37.5%			
DAILY volume of decanted dredged material	5,316	CY		
ANNUAL volume of decanted dredged material	1,116,283	CY		
<u>DEBRIS > 4"</u>				
% debris > 4"	0.5%			
DAILY tonnage of debris > 4"	52			
Disposal cost per ton for debris > 4"	$110			
<u>TRANSPORTATION</u>				
Mileage to placement facility	25	miles		
Dump Truck	25	ton capacity		
Dump Truck, purchase price, used	$134,000	per truck		
Dump Truck, lease rate, monthly	$8,736	per truck		
Dump Truck, Subcontractor owned & operated (daily lump sum cost)	$1,000	per truck		
Fuel for Dump Truck, daily	$40	per truck		
Haul cost/truck/mile, leased/purchased	unlimited mileage with truck lease/purchase			
Tug & Crew Rental	$3,000	per 16-hr day		
<u>IN-CHANNEL MATERIAL TO BE DREDGED</u>				
Solids content of in-channel material to be dredged	40.8%			
DAILY volume of in-channel material to be dredged	4,762	CY		
ANNUAL volume of in-channel material to be dredged	1,000,000	CY		
<u>DREDGED MATERIAL @ 24 HOURS</u>				
Solids content of stabilized dredged material at 24 hrs	45.5%			
Weight of stabilized dredged material at 24 hrs	83.99	pcf		
DAILY volume of stabilized dredged material at 24 hrs	5,089	CY		
DAILY tonnage of stabilized dredged material at 24 hrs	5,771	ton		
ANNUAL volume of stabilized dredged material at 24 hrs	1,068,699	CY		
ANNUAL tonnage of stabilized dredged material at 24 hrs	1,211,809	ton		
<u>COST FACTORS</u>				
General cost factor for installation	2.5	times unit costs		
Contingency	15%	of capital cost investment		
Transporation Contingency	5%	of capital cost investment		
Tipping Fee	$5	per CY of stabilized material		
Recover Capital Costs over	5	years		
Annual Maintenance Material, % of **Total** Capital Costs	5%			
Infrastructure Cost Recovery over	10	years		
Management G&A Overhead	15%			
Profit	10%			
<u>LABOR</u>				
Union Labor Working				
@ $57/hr 10 hr/day	$57	per hour	$570	per day
Number of work days/person annually	210			
Union Labor Vacation				
@ $57/hr 8 hr/day	$57	per hour	$456	per day
Number of vacation days annually	15			
Supervision Personnel Working				
@ $86/hr 10 hr/day	$86	per hour	$860	per day
Number of work days/person annually	210			
Supervision Personnel Off-Season & Vacation				
@ $86/hr 8 hr/day	$86	per hour	$688	per day
Number of work days/person annually	85			

Assumptions for Fine-Grained Silty Material (FGSM) - Base Model

CEMENT FOR STABILIZING DECANTED/DREDGED MATERIAL AT PORTSIDE		
% cement added at portside	8%	
Cost for cement	$100	per ton
DAILY tonnage of cement added at portside	462	ton
FLY ASH FOR STABILIZING DECANTED/DREDGED MATERIAL AT PORTSIDE		
% fly ash added at portside	0%	
Cost for fly ash	$27	per ton
DAILY tonnage of fly ash added at portside	0	ton
EQUIPMENT COSTS, NEW		
Scow	$535,000	
Pump, 350 gpm	$48,879	
375 MH "CAT" Excavator w/Rake	$874,367	
Spare Rake	$26,500	
375 MH "CAT" Excavator w/Mixer	$932,667	
Spare Mixer	$85,000	
Silo	$59,741	
Feed & Discharge Systems	$41,058	
Dust Collector (In-Barge Mixing)	$135,775	
CAT 980 Front End Loader	$363,877	
IT28 CAT Front End Loader	$139,034	
Komatsu PC-1000 Excavator w/Bucket	$837,267	
Conveyor to Car Loadout	$97,758	
Oscillating Shuttle Conveyor	$59,741	
100 ton Dump Hoppers w/Support Structure	$514,479	
Load Out Cell and Instrumentation	$152,068	
Dust Collector	$43,448	
300 Ton Crane	$2,172,400	
988 Loader	$244,395	
IT38 CAT Front End Loader	$164,700	
Radial Stacker 36"x140'	$217,240	
D-5 Dozer	$138,200	
Site Water Truck	$40,680	
INFRASTRUCTURE COSTS		
Wharf Space (per foot)	$5,431	
Site Improvements for Facility (per acre)	$81,465	
Site Improvements for Transportation (per acre)	$81,465	
Dredging (per CY)	$38	
Pile Dolphins (each)	$5,431	

Fine-Grained Silty Material (FGSM) - Base Model

Estimated Costs[1]

Summary

Dredged Material Stabilized with Admixtures

Material Quantities
1,000,000 CY In Channel Material Dredged Annually
5,089 CY Stabilized Material Processed Daily (FGSM - In-Barge)
5,771 tons of FGSM Stabilized Material Produced, Loaded, and Transported Daily
52 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[3]
Scow Fleet	$	3,502,311	$	3.50	8%
Addition of Stabilizing Agents at Portside (In-Barge Mixing)	$	19,161,563	$	19.16	41%
Portside Facilities Infrastructure	$	1,066,601	$	1.07	2%
8 acres needed for this facility[2]		*1,000*	*feet of wharf space*		
Portside Loading to Dump Truck	$	762,832	$	0.76	2%
Transportation - Subcontracted	$	15,407,700	$	15.41	33%
Transportation - Leased	$	19,306,157	$	19.31	
Transportation - Purchased	$	19,195,970	$	19.20	
Placement Cost PLUS Tipping Fee	$	6,557,287	$	6.56	14%
Total with Subcontracted Transportation	$	46,458,293	$	46.46	
Total with Leased Transportation	$	50,356,750	$	50.36	
Total with Purchased Transportation	$	50,246,564	$	50.25	

[1] Screening level pricing for comparison only among alternatives.
[2] Cost of real estate not included.
[3] Assuming total is with cheapest transportation.

Fine-Grained Silty Material (FGSM) - Base Model

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	$ 9,630,000	$ 1,444,500	$ 2,214,900	$ 553,725	$ -	$ 2,768,625	$ 415,294	$ 318,392	$ -	$ 3,502,311
Addition of Stabilizing Agents at Portside (In-Barge Mixing)	$ 5,102,102	$ 765,315	$ 1,173,483	$ 293,371	$ 13,680,627	$ 15,147,481	$ 2,272,122	$ 1,741,960	$ -	$ 19,161,563
Portside Facilities Infrastructure	$ 7,331,850	$ 1,099,778	$ 843,163	$ -	$ -	$ 843,163	$ 126,474	$ 96,964	$ -	$ 1,066,601
									$ -	
Portside Loading to Dump Truck	$ 925,040	$ 138,756	$ 212,759	$ 53,190	$ 337,080	$ 603,029	$ 90,454	$ 69,348	$ -	$ 762,832
Transportation - Subcontracted	$ -	$ -	$ -	$ -	$ 12,180,000	$ 12,180,000	$ 1,827,000	$ 1,400,700	$ -	$ 15,407,700
Transportation - Leased	$ -	$ -	$ -	$ -	$ 15,261,784	$ 15,261,784	$ 2,289,268	$ 1,755,105	$ -	$ 19,306,157
Transportation - Purchased	$ 2,144,000	$ 107,200	$ 1,715,200	$ 428,800	$ 10,779,480	$ 15,174,680	$ 2,276,202	$ 1,745,088	$ -	$ 19,195,970
Placement Cost PLUS Tipping Fee	$ 343,580	$ 51,537	$ 79,023	$ 19,756	$ 860,740	$ 959,519	$ 143,928	$ 110,345	$ 5,343,495	$ 6,557,287
Total with Subcontracted Transportation	$ 13,702,572	$ 3,499,886	$ 4,523,329	$ 920,041	$ 27,058,447	$ 32,501,817	$ 4,875,273	$ 3,737,709	$ 5,343,495	$ 46,458,293
Cost/CY In Channel Material			$ 4.52	$ 0.92	$ 27.06	$ 32.50	$ 4.88	$ 3.74	$ 5.34	$ 46.46
Total - Leased Transportation	$ 23,332,572	$ 3,499,886	$ 4,523,329	$ 920,041	$ 30,140,231	$ 35,583,601	$ 5,337,540	$ 4,092,114	$ 5,343,495	$ 50,356,750
Total - Purchased Transportation	$ 25,476,572	$ 3,607,086	$ 6,238,529	$ 1,348,841	$ 25,657,927	$ 35,496,497	$ 5,324,475	$ 4,082,097	$ 5,343,495	$ 50,246,564

[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 BASE-0
Estimated Costs
Scow Fleet
Dredged Material Stabilized with Admixtures

Material Quantities

4,762 CY In-Channel Material transported daily

Capital Equipment

Quantity	Item	Unit Cost	Installation Cost	Total Cost
18	Scow	$ 535,000	$ -	$ 9,630,000
	14 scows needed + 2 extra for maintenance + 2 for decant water			
				$ 9,630,000
	Contingency of	15%		$ 1,444,500
	Estimated Capital Cost			$ 11,074,500

Note: Spare equipment rental not included

Annual Costs

Capital Costs Recovery Over	5 years	$ 2,214,900
Annual Maintenance Material (% of Total Capital Costs)	5%	$ 553,725
Annual Costs		$ 2,768,625
Management G&A Overhead	15%	$ 415,294
Annual Costs with G&A		$ 3,183,919
Profit	10%	$ 318,392
Total Annual Costs		$ 3,502,311

Table BASE-0

Estimated Costs

Scow Fleet

Dredged Material Stabilized with Admixtures

Processing Costs per Cubic Yard

Material Dredged	Annually		1,000,000	In-Channel CY
Annual Costs		$	3,502,311	
Cost/CY In-Channel Material Dredged		$	3.50	
Stabilized CY shipped	Annually		1,068,699	
Cost/stabilized CY shipped		$	3.28	
Stabilized tons shipped	Annually		1,211,809	
Cost/stabilized ton shipped		$	2.89	

Note: Dredging costs and transportation to the facility is not included.

Table BASE-1

Estimated Costs

Addition of Stabilizing Agents at Portside (In-Barge Mixing)

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)

5,771 tons of Stabilized FGSM produced, loaded, and transported daily

52 tons >4" Debris removed for landfill disposal daily

Capital Equipment

Quantity	Item	Unit Cost	Installation Cost	Total Cost
1	Discharge Pump	$ 48,879	$ -	$ 48,879
4	Decant Water Pumps, 350 gpm	$ 48,879	$ -	$ 195,516
1	375 MH "CAT" Excavator w/ Rake	$ 874,367	$ -	$ 874,367
1	Spare Rake	$ 26,500	$ -	$ 26,500
4	Cement Silos	$ 59,741	$ 149,353	$ 836,374
2	Cement/Fly Ash Feed & Discharge Systems	$ 41,058	$ 102,646	$ 287,409
1	Dust Collector	$ 135,775	$ 339,438	$ 475,213
1	375 MH "CAT" Excavator w/ Mixer	$ 932,667	$ -	$ 932,667
1	Spare Mixer	$ 85,000	$ -	$ 85,000
	Front End Loaders			
1	CAT 980	$ 363,877	$ -	$ 363,877
1	IT28 CAT	$ 139,034	$ -	$ 139,034
1	Komatsu PC-1000 Excavator w/Bucket	$ 837,267	$ -	$ 837,267
				$ 5,102,102
	Contingency of	15%		$ 765,315
	Estimated Capital Cost			$ 5,867,417

Note: Spare equipment rental not included

Table BASE-1
Estimated Costs
Addition of Stabilizing Agents at Portside (In-Barge Mixing)
Dredged Material Stabilized with Admixtures

Annual Costs

	Capital Costs					
	Recovery Over		5	years	$	1,173,483
	Annual Maintenance Material					
	(% of Total Capital Costs)		5%		$	293,371
1	Tug with crew	$	3,000	per day		
			210	days/year	$	630,000
9	Union Operating Personnel					
	@ $57/hr 10 hr/day		210	days/year	$	1,077,300
	5 for equipment operation + 2 for pumps + 1 for silos + 1 spare = 9 operating personnel					
3	Union Maintenance Personnel					
	@ $57/hr 10 hr/day		210	days/year	$	359,100
	1 maintenance person for every ~2 pieces of equipment					
12	Union Personnel Vacation					
	@ $57/hr 8 hr/day		15	days/year	$	82,080
2	Supervision Personnel					
	@ $86/hr 10 hr/day		210	days/year		
	@ $86/hr 8 hr/day		85	days/year	$	478,160
	1 supervisor for every ~5 operating/maintenance person					
52	Tons Debris>4" for	$	110	per ton		
	landfill disposal daily		210	days/year	$	1,204,116
	Cement @		8%			
462	tons/day	$	100	per ton		
	for		210	days/year	$	9,694,471
	Power @ $150/day for		210	days/year	$	31,500
	Fuel @ $590/day for		210	days/year	$	123,900
	Annual Costs				$	15,147,481
	Management G&A Overhead		15%		$	2,272,122
	Annual Costs with G&A				$	17,419,603
	Profit		10%		$	1,741,960
	Total Annual Costs				$	19,161,563

Table BASE-1
Estimated Costs
Addition of Stabilizing Agents at Portside (In-Barge Mixing)
Dredged Material Stabilized with Admixtures

Processing Costs per Cubic Yard

Material Dredged	Annually		1,000,000	In-Channel CY
Annual Costs		$	19,161,563	
Cost/CY In-Channel Material Dredged		$	19.16	
Stabilized CY shipped	Annually		1,068,699	
Cost/stabilized CY shipped		$	17.93	
Stabilized tons shipped	Annually		1,211,809	
Cost/stabilized ton shipped		$	15.81	

Note: Dredging costs and transportation to the facility is not included.

Table BASE-2
Estimated Costs
Portside Facilities Infrastructure
Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)
5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Facilities Infrastructure Development Costs

Quantity	Item	Unit Cost		Total Cost
1,000	Wharf Space, ft. Four scows @ 250 ft per scow	$ 5,431		$ 5,431,000
8	Site Improvements, acre 8 acres for processing	$ 81,465		$ 651,720
30,000	Dredging, CY 3,000 yards for every 100' of wharf	$ 38		$ 1,140,510
20	Pile Dolphins, each	$ 5,431		$ 108,620
	Total			$ 7,331,850
	Contingency of	15%		$ 1,099,778
	Estimated Infrastructure Costs			$ 8,431,628

Notes: Intended as an Order of Magnitude estimate, actual cost can not be estimated until a specific site, site geotechnical conditions and specific processing operations are identified.
Any site remediation costs not included.
Site real estate costs not included.

Annual Costs

Infrastructure Costs Recovery Over	10	years	$ 843,163
Management G&A Overhead	15%		$ 126,474
Annual Costs with G&A			$ 969,637
Profit	10%		$ 96,964
Total Annual Costs			$ 1,066,601

Table BASE-2
Estimated Costs
Portside Facilities Infrastructure

Processing Infrastructrue Costs per Cubic Yard

Material Dredged	Annually		1,000,000	In-Channel CY
Annual Costs		$	1,066,601	
Cost/CY In-Channel Material Dredged		$	1.07	
Stabilized CY shipped	Annually		1,068,699	
Cost/stabilized CY shipped		$	1.00	
Stabilized tons shipped	Annually		1,211,809	
Cost/stabilized ton shipped		$	0.88	

Table BASE-3

Estimated Costs

Portside Loading to Dump Truck
Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)
5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Capital Equipment

Quantity	Item		Unit Cost		Installation Cost		Total Cost
1	IT38 CAT Front End Loader	$	164,700	$	-	$	164,700
1	Radial Stacker 36"x140'	$	217,240	$	543,100	$	760,340
						$	925,040
	Contingency of		15%			$	138,756
	Estimated Capital Cost					$	1,063,796

Annual Costs

Quantity	Item				Cost
	Capital Costs Recovery Over	5	years	$	212,759
	Annual Maintenance Material (% of Total Capital Costs)	5%		$	53,190
2	Union Operating Personnel @ $57/hr 10 hr/day 1 for front end loader operation + 1 for radial stacker = 2 total	210	days/year	$	239,400
2	Union Personnel Vacation @ $57/hr 8 hr/day	15	days/year	$	13,680
	Fuel @ $200/day for	210	days/year	$	42,000
	Power @ $200/day for	210	days/year	$	42,000
	Annual Costs			$	603,029
	Management G&A Overhead	15%		$	90,454
	Annual Costs with G&A			$	693,483
	Profit	10%		$	69,348
	Total Annual Costs			$	762,832

Table BASE-3
Estimated Costs
Portside Loading to Dump Truck
Dredged Material Stabilized with Admixtures

Portside Loading Costs per Cubic Yard

Material Dredged	Annually		1,000,000	In-Channel CY
Annual Costs		$	762,832	
Cost/CY In-Channel Material Dredged		$	0.76	
Stabilized CY shipped	Annually		1,068,699	
Cost/stabilized CY shipped		$	0.71	
Stabilized tons shipped	Annually		1,211,809	
Cost/stabilized ton shipped		$	0.63	

Table BASE-5A

Estimated Costs

Transportation - Subcontracted

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)

5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Daily Costs - Subcontractor Supplied Trucks

Quantity	Item	Unit Cost		Total Cost
58	Dump Truck Haul to Placement Site and Return	$ 1,000	per truck	$ 58,000
	Assumed that trucks can make 4 trips per 10-hour day to the placement facility.			
	Subtotal, Daily Cost			$ 58,000
	Shipping for	210	days annually	
	Subtotal, Annual Cost			$ 12,180,000
	Management G&A Overhead	15%		$ 1,827,000
	Annual Costs with G&A			$ 14,007,000
	Profit	10%		$ 1,400,700
	Total Annual Costs			$ 15,407,700

Transportation Costs/CY - Subcontractor Supplied Trucks

Material Dredged	Annually	1,000,000	In-Channel CY
Annual Costs			$ 15,407,700
Cost/cy In-Channel Material Dredged			$ 15.41
Stabilized CY shipped	Annually		1,068,699
Cost/stabilized CY shipped			$ 14.42
Stabilized tons shipped	Annually		1,211,809
Cost/stabilized ton shipped			$ 12.71

Table BASE-5B

Estimated Costs

Transportation - Leased

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)

5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Daily Costs - Leased Trucks

Quantity	Item	Unit Cost			Total Cost
58	Dump Truck Haul to	unlimited mileage with truck lease/purchase			
	Placement Site and Return	25	miles each way		
	Assumed that trucks can make 4 trips per 10-hour day to the placement facility.				
58	Daily Dump Truck Rental (8 month lease)	$ 332.80	per truck/ operating day	$	19,302
58	Fuel	$ 40	per truck/ operating day	$	2,320
	200 miles/day @ 10 miles/gallon @ $2/gallon				
	Subtotal, Daily Cost			$	21,622
	Shipping for	210	days annually		
	Subtotal, Annual Cost			$	4,540,704

Table BASE-5B

Estimated Costs

Transportation - Leased

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)
5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Annual Personnel Costs - Leased Trucks

	Annual Truck Maintenance			$	428,800
58	Union Operating Personnel				
	@ $57/hr 10 hr/day	210	days/year	$	6,942,600
	1 operator for each truck leased				
12	Union Maintenance Personnel				
	@ $57/hr 10 hr/day	210	days/year	$	1,436,400
	1 maintenance personnel per ~5 trucks				
70	Union Personnel Vacation				
	@ $57/hr 8 hr/day	15	days/year	$	478,800
6	Supervision Personnel				
	@ $86/hr 10 hr/day	210	days/year		
	@ $86/hr 8 hr/day	85	days/year	$	1,434,480
	1 supervisor for every ~10 operating/maintenance person				
	Estimated Annual Personnel Cost			$	10,721,080
	Estimated Annual Total Cost			$	15,261,784
	Management G&A Overhead	15%		$	2,289,268
	Annual Costs with G&A			$	17,551,052
	Profit	10%		$	1,755,105
	Total Annual Capital Costs			$	19,306,157

Transportation Costs per Cubic Yard - Leased Trucks

Material Dredged	Annually	1,000,000	In-Channel CY	
Annual Costs			$	19,306,157
Cost/CY In-Channel Material Dredged			$	19.31
Stabilized CY shipped	Annually			1,068,699
Cost/stabilized CY shipped			$	18.07
Stabilized tons shipped	Annually			1,211,809
Cost/stabilized ton shipped			$	15.93

Table BASE-5C

Estimated Costs

Transportation - Purchased

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)
5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Daily Costs - Purchased Trucks

Quantity	Item	Unit Cost			Total Cost
64	Dump Trucks Purchased, Used	$ 134,000		$	8,576,000
	Assumed that trucks can make 4 trips per 10-hour day to the placement facility.				
	Annual Capital Cost, Total			$	2,144,000
	Annual Cost per Truck			$	33,500

Annual Capital Costs - Purchased Trucks

58	Dump Truck Haul to	unlimited mileage with truck lease/purchase			
	Placement Site and Return	25	miles each way		
	Assumed that trucks can make 4 trips per 10-hour day to the placement facility.				
64	Daily Dump Truck Cost	$ 160	per truck/ operating day	$	10,210
	Shipping for	210	days annually		
	Subtotal, Annual Cost			$	2,144,000
	Contingency of	5%		$	107,200
	Estimated Annual Capital Cost			$	2,251,200

Table BASE-5C

Estimated Costs

Transportation - Purchased

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)

5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Annual Personnel Costs - Purchased Trucks

	Dump Truck Capital Cost Recovery Over		5	years	$	1,715,200
	Annual Truck Maintenance (% of Capital Cost)		5%		$	428,800
58	Union Operating Personnel @ $57/hr 10 hr/day 1 operator for each truck purchased		210	days/year	$	6,942,600
12	Union Maintenance Personnel @ $57/hr 10 hr/day 1 maintenance personnel per ~5 trucks		210	days/year	$	1,436,400
70	Union Personnel Vacation @ $57/hr 8 hr/day		15	days/year	$	478,800
6	Supervision Personnel @ $86/hr 10 hr/day @ $86/hr 8 hr/day		210 85	days/year days/year	$	1,434,480
	1 supervisor for every ~10 operating/maintenance person					
58	Fuel 200 miles/day @ 10 miles/gallon @ $2/gallon	$	40	per truck/ operating day	$	2,320
			210	days/year	$	487,200
	Estimated Annual Operating Cost				$	12,923,480
	Estimated Annual Total Cost				$	15,174,680
	Management G&A Overhead		15%		$	2,276,202
	Annual Costs with G&A				$	17,450,882
	Profit		10%		$	1,745,088
	Total Annual Costs				$	19,195,970

Table BASE-5C
Estimated Costs
Transportation - Purchased
Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)
5,771 tons of Stabilized FGSM produced, loaded, and transported daily

Transportation Costs per Cubic Yard - Purchased Trucks

Material Dredged	Annually	1,000,000	In-Channel CY	
Annual Costs			$	19,195,970
Cost/CY In-Channel Material Dredged			$	19.20
Stabilized CY shipped	Annually			1,068,699
Cost/stabilized CY shipped			$	17.96
Stabilized tons shipped	Annually			1,211,809
Cost/stabilized ton shipped			$	15.84

Table BASE-6

Estimated Costs

Placement Cost **PLUS** Tipping Fee

Dredged Material Stabilized with Admixtures

Material Quantities

5,089 CY Stabilized Material processed daily (FGSM - In-Barge)

Capital Equipment

Quantity	Item	Unit Cost	Installation Cost	Total Cost
1	IT38 CAT Front End Loader	$ 164,700	$ -	$ 164,700
1	D-5 Dozer	$ 138,200	$ -	$ 138,200
1	Site Water Truck	$ 40,680	$ -	$ 40,680
				$ 343,580
	Contingency of	15.0%		$ 51,537
	Estimated Capital Cost			$ 395,117

Table BASE-6
Estimated Costs
Placement Cost **PLUS** Tipping Fee
Dredged Material Stabilized with Admixtures

Annual Costs

	Capital Costs				
	Recovery Over	5	years	$	79,023
	Annual Maintenance Material				
	(% of Total Capital Costs)	5%		$	19,756
3	Union Operating Personnel				
	@ $57/hr 10 hr/day	210	days/year	$	359,100
	1 operator for each piece of equipment + 1 spare = 3 total				
1	Union Maintenance Personnel				
	@ $57/hr 10 hr/day	210	days/year	$	119,700
	1 maintenance person for every ~2 pieces of equipment				
4	Union Personnel Vacation				
	@ $57/hr 8 hr/day	15	days/year	$	27,360
1	Supervision Personnel				
	@ $86/hr 10 hr/day	210	days/year		
	@ $86/hr 8 hr/day	85	days/year	$	239,080
	1 supervisor for every ~5 operating/maintenance person				
	Power @ $50/day for	210	days/year	$	10,500
	Fuel @ $500/day for	210	days/year	$	105,000
	Annual Costs			$	959,519
	Management G&A Overhead	15%		$	143,928
	Annual Costs with G&A			$	1,103,447
	Profit	10%		$	110,345
5,089	Tipping Fee	$5	per stabilized CY		
		210	days/year	$	5,343,495
	Total Annual Costs			$	6,557,287

Table BASE-6
Estimated Costs
Placement Cost **PLUS** Tipping Fee
Dredged Material Stabilized with Admixtures

Costs per Cubic Yard

Material Dredged	Annually		1,000,000	In-Channel CY
Annual Costs		$	6,557,287	
Cost/CY In-Channel Material Dredged		$	6.56	
Stabilized CY shipped	Annually		1,068,699	
Cost/amended CY shipped		$	6.14	
Stabilized tons shipped	Annually		1,211,809	
Cost/amended ton shipped		$	5.41	