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Appendix A

Dredged Material Disposal Plan
Delaware River Main Stem and Channel Deepening Project

DREDGED MATERIAL DISPOSAL PLAN
DELAWARE RIVER MAIN STEM AND CHANNEL DEEPENING PROJECT

DREDGED MATERIAL DISPOSAL PLAN, 1992 to 2009

This appendix presents the current dredged material disposal plan for Delaware River Main Channel Deepening project and summarizes how it has evolved since the 1992 Feasibility Study as subsequent phases of investigation and reporting were completed. The reports that document the evolution of the dredged material disposal plan for the project include:

- Final Interim Feasibility Study and Environmental Impact Statement (February 1992)
- Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement (July 1997)
- Comprehensive Economic Reanalysis Reports (December 2002, February 2004)

The disposal plan presented in each of the above documents is summarized in sequence in this appendix.

Final Interim Feasibility Study and Environmental Impact Statement (February 1992)

The Philadelphia District completed the "Main Channel Deepening Final Interim Feasibility Study and Environmental Impact Statement" in February 1992. In that document, the following dredged material estimates were presented:

Initial construction (new work) dredging: 50,100,000 cubic yards (50.1 MCY)
Annual O&M dredging for the 40-ft channel: 5.4 MCY/yr
Incremental maintenance dredging for 45-ft project: 756,000 CY/yr
Total annual O&M dredging for the 45-ft channel: 6.2 MCY/yr

The 1992 Feasibility Study investigated the use of existing Federal upland disposal areas without acquisition of any new sites because existing sites were well distributed along the length of the main channel and had potential to minimize project costs. However, this option was eliminated as it would have significantly reduced the useful life of existing Federal sites, given the quantity of new work and O&M dredging estimated at the time for the 45-ft channel project.

The 1992 report recommended the construction of three new upland disposal facilities (Site 17-O, Site 15-D and Raccoon Island) and continued use of existing upland disposal facilities used for the project in Reaches AA-D (Delaware River). The recommended plan for Reach E (Delaware Bay) included a combination of beneficial use (wetland/island creation) and sand stockpiling for future local use.

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Delaware River Main Channel Deepening Project, Supplemental Environmental Impact Statement (July 1997)

A Supplemental Environmental Impact Statement for the project was issued in July 1997. Dredged material estimates in the SEIS were:

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Initial construction (new work) dredging: 33,000,000 CY
Annual O&M dredging for the 40-ft channel: 4.9 MCY/yr
Incremental maintenance dredging for 45-ft project: 1,119,000 CY/yr
Total annual O&M dredging for the 45-ft channel: 6.0 MCY/yr

Section 2 of the SEIS presented the disposal requirements anticipated for each reach, as presented in the following paragraphs.

Reach A (from the upstream project limit to and including Billingsport Range). "Approximately 153,000 CY of material are dredged from these channel ranges on an annual basis. This material is dredged for both the Delaware River, Philadelphia to the Sea project, and the Delaware River at Camden project. This material is currently placed in a single upland disposal area located at National Park, New Jersey. This site has a capacity of about 3.2 million CY to a dike height of 50 feet. With the current rate of usage, this elevation would be reached in the year 2007. Raising the dike further could add an additional 3.3 million CY of capacity, and extend the life of the site to 2027. In order to continue maintenance dredging activities for the full 50-year term of the study period, an additional disposal area will be required in the vicinity of Reach A."

Reach B (Tinicum Range to and including Cherry Island Range). Approximately 2,400,000 CY of material are dredged from Reach B on an annual basis. This material is currently placed in three dredged material disposal sites. These Federal sites are Pedricktown North and Pedricktown South, and the adjacent Oldmans site which is leased. These sites currently have a combined capacity of 21.3 million CY to a dike height of 50 feet. Replacement sites would be needed by the base year if dikes at the Federal sites are not raised and if the Oldmans lease cannot be extended beyond the current expiration date of 1996. Raising the dikes further could add an additional 36.5 million CY of capacity, and extend the life of this complex to 2030. A new site would be required by the year 2030 assuming that dike raising continues."

Reach C (Deepwater Range to and including New Castle Range). Approximately 2,000,000 CY of material are dredged from Reach C on an annual basis. This material is currently placed in two Federal sites, Penns Neck and Killcohook. These sites have a disposal capacity of 42.3 million CY to a dike height of 50 feet. Based on current usage, fill would reach that elevation in year 2014. Raising the dikes further would add an additional 48.7 million CY of capacity and extend the lives of these sites throughout the planning period. As such, there is sufficient dredged material disposal capacity in Reach C to conduct maintenance dredging activities for the full term of the study period, assuming dike raising continues."

Reach D (Reedy Island Range to the lower end of Liston Range). Approximately 226,000 CY of material are dredged from Reach D on an annual basis. This material is currently placed in the Federal dredged material disposal site on Artificial Island. The Artificial Island site has a capacity of 15.8 million CY to a dike height of 50 feet. By raising the dikes further, an additional 4.9 million CY of capacity would be gained. There is sufficient dredged material disposal capacity to maintain the navigation channel in Reach D for the entire 50-year study period and beyond.

Reach E (lower end of Liston Range to natural deep water in Lower Delaware Bay). Approximately 370,000 CY of material are dredged from Reach E every five years. This material is currently placed in an overboard disposal site designated as Buoy 10. Buoy 10 is located approximately six miles northwest of Cape May Point, NJ. Sufficient capacity exists at the Buoy 10 site to continue maintenance dredging activities within Reach E for more than the 50-year study period.

Based on the capacity requirements identified above and changes in site availability that occurred subsequent to the 1992 Feasibility Study, the 1997 SEIS recommended that site 17-G be added in Reach A to replace 17-O (which was subject to concerns about cultural resources), and three new sites (15-D, 15-G, and Raccoon Island) be added in Reach B. Overall, there was no change in disposal capacity of the four new sites recommended in the SEIS compared to the three sites recommended in the 1992 Feasibility Study.

For Reach E, the 1997 SEIS identified four beneficial use sites that would receive dredged material from the initial dredging phase of the project: Kelly Island (wetland restoration); Egg Island Point (wetland restoration); L-5 (sand stockpile offshore of Broadkill Beach); and MS-19 (sand stockpile offshore of Slaughter Beach).

Comprehensive Economic Reanalysis Reports (December 2002 and February 2004)

In December 2002 and again in February 2004 the District prepared Comprehensive Economic Reanalysis Reports (CERRs) for the 45-ft project. As part of these reports further refinements were made to the Disposal Plan based on more recent and accurate surveys, updated new work and O&M dredging quantities, updated survey datums for the project, and changes in site availability.

The 2002 CEER provided the following estimated dredging quantities:

Initial construction (new work) dredging: 26,012,000 CY
Annual O&M dredging for the 40-ft channel: 3.5 MCY/yr
Incremental maintenance dredging for 45-ft project: 862,000 CY/yr
Total annual O&M dredging for the 45-ft channel: 4.3 MCY/yr

With regard to the previous disposal plan presented in the 1997 SEIS, Site 17-G was no longer available and it was eliminated from further consideration. Additionally, the sand stockpile locations in Reach E were eliminated based on environmental concerns raised during the 1997

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SEIS process. Instead, sand would be placed directly onto Broadkill Beach as part of the initial 45-ft project dredging in Reach E.

CURRENT DISPOSAL PLAN (2009)

The current disposal plan for new work dredging of the 45-ft project plus 50 years of O&M dredging utilizes only existing Federal disposal areas, and does not require acquisition of new disposal sites. Several factors contribute to this situation.

- Site 15-D is no longer available, thus two of the four new sites recommended in the 1997 SEIS can not be utilized. Eliminating the acquisition of new sites is consistent with Corps policy to avoid and/or minimize adverse impacts in planning and implementing new projects.
- Total estimated dredged material quantities (new work plus 50 years of O&M) have declined from 375 MCY in 1992; to 321 MCY in 1997; to 242 MCY in 2002[1]; to 232 MCY in 2009. Consequently, projections of required disposal capacity presented in the 1992 EIS and 1997 SEIS have been reduced accordingly.
- The decrease in new work dredging quantity estimates between 1992 and 2009 results from four principal sources.
    - Improved hydrographic survey technology that provides much higher resolution mapping of the channel
    - Dredging in the navigation channel by non-Federal interests to obtain upland fill material
    - Natural scour (deepening) in parts of the navigation channel
    - Revised tidal datums to reflect measured sea level rise since the 1950-period when previous tidal datums were established
- The Water Resources Development Act of 1996 eliminated the need for non-Federal sponsors to provide disposal capacity for navigation projects without regard to whether adequate capacity to meet project objectives already existed.

In order to demonstrate that the 45-ft project can be successfully accomplished without addition of new upland disposal sites, the following methodology was applied to each Reach of the project:

1) Identify estimated quantity of dredged material to be dredged during initial construction plus 50 years of maintenance

2) Identify existing disposal site or sites to be utilized

3) Identify remaining capacity for each existing disposal site based on size of disposal site and projected maximum dike elevation; and

[1] Analysis of project O&M dredging data from 1976 to 2008 indicates a downward trend in the amount of material dredged in the Delaware River in order to maintain the 40-ft project.

4) Determine adequacy of identified disposal site or sites to accommodate estimated dredged quantities after accounting for bulking and shrinkage.[2]

The current new work dredging quantity estimate for the 45-ft project is approximately 16 MCY. The incremental O&M quantity for the 45-ft project over the 50 year project is estimated at approximately 43 million CY (860,000 CY per year). Table 1 represents the quantity of material to be placed at each upland site as estimated in the 1992 EIS versus the current 2009 plan. Figure 1 shows the historic summary of the O&M dredging quantity for the existing 40-ft project for Fiscal Years 1976 through 2007. It is noted that that there were several iterations of the disposal plan including during the 1997 SEIS and the 2002 and 2004 Economic Reanalyses. The incremental maintenance column details the quantity of dredged material estimated to be placed over and above the O&M requirements of the existing 40 ft project over a 50-year period of analysis. The incremental quantity estimated to be dredged over 50 years is approximately equivalent to ~12 years of maintenance under the existing 40 ft project.

2009 Capacity Analysis of Existing Federal Disposal Sites

In the following reach-by-reach summary of quantities, the term "50 years maintenance" refers to the total volume of dredged material estimated. Figure 2 displays the referenced disposal sites.

Reach A/A-A

Dredged material (initial construction + 50 years maintenance) = 8,194,000 CY
(Quantity includes 1,294,000 for initial construction and incremental O&M)
Disposal site(s) to be utilized: ***National Park***
Current dike elevation at ***National Park***: +35
Ultimate dike elevation at ***National Park*** to contain dredged material +60
Capacity remaining after initial construction + 50 years maintenance 787,200 CY

Reach B

Dredged material (initial construction + 50 years maintenance) = 110,532,200 CY
(Quantity includes 15,881,500 for initial construction and incremental O&M)
Disposal site(s) to be utilized: ***Pedricktown North, Oldmans, Pedricktown South***

Current dike elevation at ***Pedricktown North***: +42
Ultimate dike elevation at ***Pedricktown North*** to contain dredged material +76
Capacity remaining after initial construction + 50 years maintenance 2,267,900CY

Current dike elevation at ***Oldmans***: +36

[2] Bulking is a factor that represents the increased volume of unconsolidated dredged material initially placed in a confined upland disposal facility. Shrinkage is the factor that represents the decreased volume of dredged material after subsequent consolidation and compaction within the disposal facility.

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Ultimate dike elevation at ***Oldmans*** to contain dredged material +66
Capacity remaining after initial construction + 50 years maintenance 4,610,400 CY

Current dike elevation at ***Pedricktown South***: +45
Ultimate dike elevation at ***Pedricktown South*** to contain dredged material +75
Capacity remaining after initial construction + 50 years maintenance 3,277,900CY

Reach C

Dredged material (initial construction + 50 years maintenance) = 73,255,000 CY
(Quantity includes 11,555,000 for initial construction and incremental O&M)
Disposal site(s) to be utilized: ***Killcohook 1,2,3 and Penns Neck***

Current dike elevation at ***Killcohook 1***: +35
Ultimate dike elevation at ***Killcohook 1*** to contain dredged material +65
Capacity remaining after initial construction + 50 years maintenance +10,000,000CY

Current dike elevation at ***Killcohook 2***: +50
Ultimate dike elevation at ***Killcohook 2*** to contain dredged material +50
Capacity remaining after initial construction + 50 years maintenance +10,000,000 CY

Current dike elevation at ***Killcohook 3***: +46
Ultimate dike elevation at ***Killcohook 3*** to contain dredged material +46
Capacity remaining after initial construction + 50 years maintenance +3,000,000 CY

Current dike elevation at: ***Penns Neck*** +30
Ultimate dike elevation at ***Penns Neck*** to contain dredged material +60
Capacity remaining after initial construction + 50 years maintenance +1,390,600 CY

Reach D

Dredged material (initial construction + 50 years maintenance) = 14,750,400 CY
(Quantity includes 7,249,000 for initial construction and incremental O&M)
Disposal site(s) to be utilized: ***Reedy Point South, Artificial Island***

Current dike elevation at ***Reedy Point South***: +25
Ultimate dike elevation at ***Reedy Point South*** to contain dredged material +25
Area will only be used for initial dredging

Current dike elevation at ***Artificial Island***: +20
Ultimate dike elevation at ***Artificial Island*** to contain dredged material +50
Capacity remaining after initial construction + 50 years maintenance 1,800,200 CY

Reach E

Dredged material (initial construction only) = 4,081,700

Kelly Island - dredged sand/silt required for beneficial use construction = 2,483,000
Egg Island - deferred due to reduction in dredged material quantities
Broadkill Beach – dredged sand required for beach nourishment = 1,597,700

Total dredged material utilized at ***Kelly Island and Broadkill Beach*** = 4,081,700

CONCLUSIONS

There is sufficient capacity at existing Federal upland disposal sites to construct the 45-ft project in Reaches A/AA, B, C, and D and then maintain the project for at least 50 years. In Reach E, all of the dredged material from the construction of the 45-ft project can be utilized for beneficial use projects at Kelly Island and Broadkill Beach. Sufficient capacity exists at the Buoy 10 disposal site to handle all maintenance dredging quantities generated in Reach E.

There is a cost saving associated with constructing and maintaining the 45-ft project without the three new disposal sites at Raccoon Island, 15-D, and 15-G.

Eliminating new disposal sites eliminates all environmental impacts associated with the development and utilization of those sites. Due to the decrease in initial and projected maintenance quantities, the ultimate projected elevations for all of the federal disposal areas are at or below those predicted in the feasibility phase, despite a larger quantity of material being placed in some of the areas. The ultimate dike heights required in 2009 are all less than or equal to those contemplated in the 1992 EIS. This is because the capacity analysis performed prior to 1992 was based on existing dike heights at that time. This was accomplished by finding the highest existing point in the dike and using that elevation as the given elevation for the entire dike. In many cases this single point elevation was higher than the average dike elevation and thus resulted in an underestimation of available disposal area capacity. In addition, some of the areas have been totally rebuilt since 1992 and others have had material removed for beneficial uses, thus contributing to the available capacity. The current dike elevations and capacity analysis are based on updated topographic mapping and the 2007 disposal area inspection report. This has provided more accurate dike heights and disposal capacity information than was available in 1992. Overall, available capacity in 1992 was greater than what was calculated at that time. This under-calculation of capacity in 1992 allows for more dredged material in a disposal area without the need to raise dikes beyond what was originally contemplated.

Overall, constructing the 45-ft project utilizing existing Federal disposal sites only is both feasible and cost-effective. At the same time, it will eliminate all environmental impacts associated with construction and utilization of new disposal sites and substantially reduce the overall environmental impact of the project.

The projections in the 1992 EIS and 1997 SEIS that additional disposal capacity would be needed to complete the 45-ft project were based on estimated dredging quantities that are no longer valid. Further, given the continuing downward trend in maintenance dredging quantities and the increasing opportunities for and emphasis on beneficial use of dredged material it is unlikely that there will be a need for additional upland disposal capacity beyond the 50 year period of analysis for the 45-ft project.

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TABLE 1. DELAWARE RIVER DEEPENING - 1992 vs 2009 - DRAFT DISPOSAL AREA ANALYSIS

Reach	Disposal Area	1992			2009			
		1992 Authorized Plan Initial Quantity Cubic Yards	1992 Authorized Plan, 50 Year Maintenance Quantity Cubic Yards 1/	Estimated Dike Elevation for Initial Quantity and 50 Year Total Maintenance	2009 Initial Quantity Cubic Yards	2009 Incremental Maintenance Quantity 45ft Project Cubic Yards 2/	2009 Total 50 Year Maintenance Quantity Cubic Yards 3/	Estimated Dike Elevation for Initial Quantity and 50 Year Total Maintenance
A-A	National Park		6,469,600	+70 Feet	994,000	300,000	7,200,000	+60 Feet
A	17G		8,690,400					
	17O	7,626,000						
B	15G		13,966,000					
	Pedricktown North		33,378,400	+76 Feet	2,717,300	4,128,000	45,408,000	+76 Feet
	Oldmans		9,696,000	+66 Feet	1,671,400	1,982,000	21,452,000	+66 Feet
	Pedricktown South		33,428,400	+78 Feet	1,942,843	3,440,000	37,840,000	+75 Feet
	15D	11,400,000	58,437,200					
Rock	Fort Mifflin				77,000			
C	Killcohook		94,389,600	+84 Feet	1,905,000	5,200,000	46,700,000	+65 Feet
	Penns Neck		30,470,400	+70 Feet	0	4,450,000	24,650,000	+60 Feet
	Raccoon Island	8,020,000						
D	Reedy Point South	4,270,000		+30 Feet	994,100			+25 feet
	Artificial Island		19,980,000	+70 Feet	1,654,800	4,600,000	9,000,000	+50 Feet
	Reedy North	4,000,000			0			
E	Kelly Island				2,483,000			
	Broadkill Beach				1,597,700			
	Egg Island Point				0			
	Buoy 10	14,870,000	15,850,000			19,000,000	23,600,000	
	L5							
	MS19							
	Totals	50,186,000	324,756,000		16,037,143	43,100,000	215,850,000	

1/ Includes incremental maintenance between the 40 and 45 foot projects.
2/ Incremental maintenance quantity between the 40 foot and 45 foot project. These quantities are included in the total 50 year maintenance quantities.
3/ Total 50 year maintenance quantity for the 40 foot project and the incremental increase for the 45 foot project.

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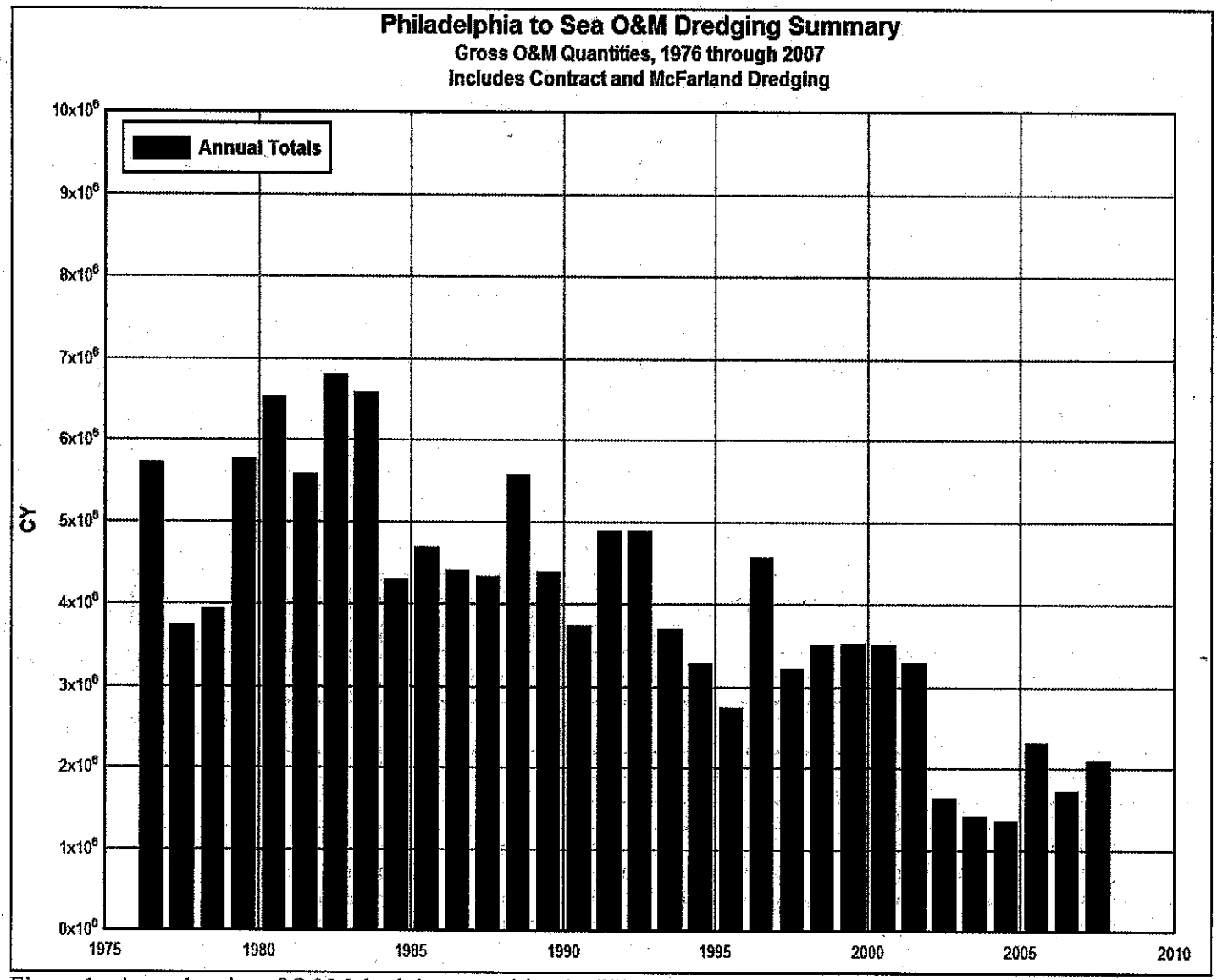

Figure 1. Annual series of O&M dredging quantities, by FY.

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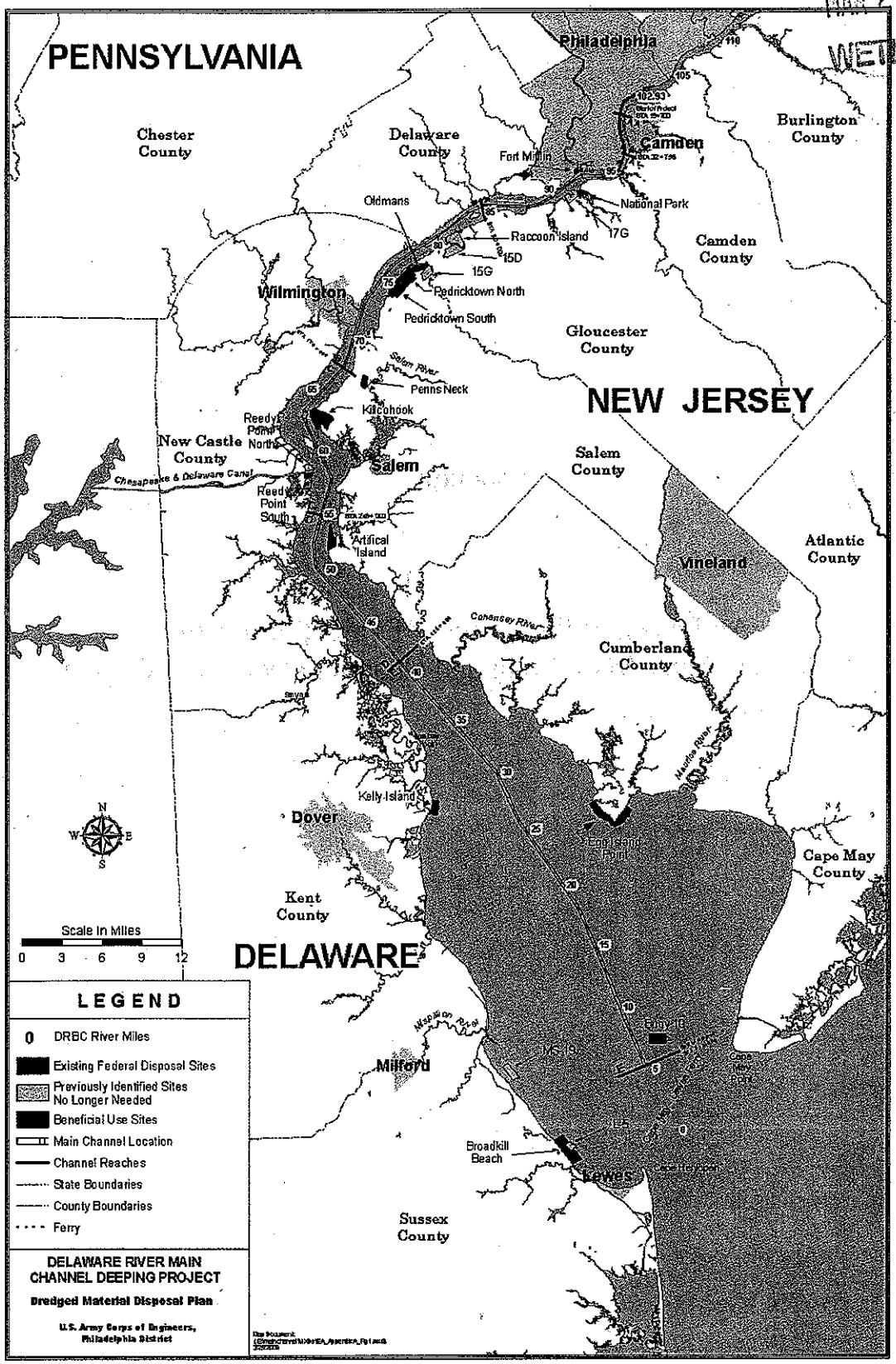

Figure 2. Disposal Site Map.