

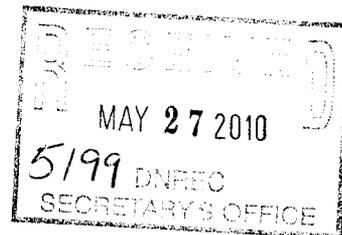


DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
WANAMAKER BUILDING, 100 PENN SQUARE EAST  
PHILADELPHIA, PENNSYLVANIA 19107-3390

May 21, 2010

Executive Office

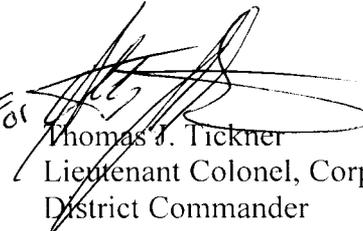
Mr. Collin P. O'Mara, Secretary  
State of Delaware  
Department of Natural Resources and Environmental Control  
89 Kings Highway  
Dover, Delaware 19901



Dear Secretary O'Mara:

As promised in my letter dated May 7, 2010, enclosed please find responses to the comments provided by the Department of Natural Resources and Environmental Control (DNREC) on April 22, 2010 pertaining to the information submitted by the Corps for the Delaware River Main Channel Deepening Project. The responses and information provided reflect the coordination that has occurred between the Corps' technical staff and their respective counterparts at DNREC since our meeting on May 4, 2010. I would like to thank your staff for their assistance.

Sincerely,

*For*   
Thomas J. Tickner  
Lieutenant Colonel, Corps of Engineers  
District Commander

Enclosure

**USACE Responses to  
DNREC Comments Provided April 22, 2010**

**May 21, 2010**

On March 12, 2010, the U.S. Army Corps of Engineers, Philadelphia District (Corps) submitted to the Delaware Department of Natural Resources and Environmental Control (DNREC) materials that would be required in conjunction with the submission of an application for a State of Delaware Subaqueous Lands and Wetlands Permit for applicable portions of the Delaware River Main Channel Deepening Project. In a letter dated April 22, 2010, DNREC provided initial review comments on the information submitted by the Corps. The Corps' responses to DNREC's comments are provided below. Additional information provided as attachments are denoted by superscripts and listed at the end of the document.

**OVERVIEW OF ECONOMICS RELATED COMMENTS**

The letter of April 22, 2010 raised several issues regarding the project's benefits and performance. The first set of issues is with regard to whether changing the physical dimensions of the channel will allow different vessels and or commodities to call on the region's ports, with potential secondary impacts. The deepening of the Federal channel to 45 feet will not cause the fleet and mix of commodities to change but will allow them to be utilized more efficiently. Of course, there is the possibility that a different commodity or vessel type could come to the region at some time in the future but such an occurrence is uncertain, and not the basis of the economic evaluation of the project.

The second set of issues refers to the recent Government Accountability Office (GAO) report and any potential issues identified. In this regard, it is important to note what GAO recommended, and then to understand the regulatory basis of the analysis presented. The GAO report pointed out that the recent recession may have changed some of the Corps analysis of the future trends associated with the cargoes calling on the benefitting facilities and thereby recommended that the Corps review these potential changes to enhance the certainty of the project's benefits predicted over the 50-year project life. The Assistant Secretary of the Army for Civil Works (ASA CW), in her March 25, 2010 response to the GAO draft report, concurred with the GAO report conclusions. ASA(CW) stated that, "The Corps will perform an updated quantitative assessment of the impact of relevant market and industry trends on the previously projected project benefits. The updated assessment will augment the qualitative port assessment previously provided by the Corps for consideration during the development of the GAO draft report". Based on the 2010 qualitative assessment provided to GAO as well as the Corps' prior Comprehensive Reanalysis, it is expected that the economic assessment will confirm project justification. GAO also concluded that the Corps' 2002/2004 reanalysis was responsive to their previous concerns and that the Corps has addressed these concerns effectively.

Following are responses to all DNREC comments, including economics related topics, as appropriate, as well as an explanation of the Corps' regulatory requirement associated with the economic analyses of Federal projects.

## COMMENTS AND RESPONSES

### 1. Water Quality

(Section 4.7.1.1 of the Regulations Governing the Use of Subaqueous Lands)

The Division of Water Resources evaluated the data provided concerning toxics in the sediments of the main navigation channel and non-channel areas. This includes a review of a draft set of data from the Partnership for the Delaware Estuary provided to the Department in late February as well as a preliminary analysis of samples collected from the deepening project that began in March according to updated protocols agreed to by the Corps and the Department. As a result, our evaluation indicates a low potential for water quality impacts associated with toxics released as a result of deepening the main channel within Delaware waters.

However, as indicated in more detail in Section 3 below, the Department remains concerned that spur channels and berthing areas that may be deepened to take advantage of a deeper main channel are under-characterized with regard to toxics and potential impacts, and may have the potential for toxicity concerns. We believe this issue falls within the category of secondary impacts associated with the deepening project; and as such, this issue should be addressed as part of a complete Subaqueous Lands Permit Application. The Application should be supplemented with the information to characterize the water quality impacts from dredging these areas.

**Response:** *For the on-going Reach C deepening work, the Philadelphia District has worked with DNREC (Dr. Richard Greene) to develop water quality monitoring scopes for both disturbance of sediment at the point of dredging and the discharge of effluent from the Killcohook confined disposal facility. This monitoring is continuing and will provide valuable data that can be used to assess water quality impacts associated with the deepening project. This type of monitoring will also be implemented for other Reaches of the project that are within or immediately upstream of Delaware State waters. Concerns related to deepening of spur channels and berthing areas are discussed below (see response to comment #3, Lateral Access Channels).*

### 2. Sensitive Fisheries

(Sections 4.7.1.2, 4.7.1.4, and 4.7.5.5 of the Regulations Governing the Use of Subaqueous Lands)

The Division of Fish and Wildlife reviewed the Application and identified multiple questions requiring additional information.

*Sturgeon*—New data related to early stage Atlantic sturgeon has come to light that indicates that the 2005 sturgeon study vastly underestimated sturgeon use of the Marcus Hook anchorage and Tinicum Island area in the wintertime. Mitigation measures proposed by the Corps will likely be ineffective with juvenile sturgeon during wintertime. Therefore, further

coordination and modification of the proposed blasting windows and mitigation measures may be necessary. The Application should be updated to reflect any changes agreed-upon.

**Response:** *The current rock removal plan for the channel in the vicinity of Marcus Hook, PA is to dredge the area first to remove as much rock as possible before blasting. The intent is to minimize the amount of blasting required. The Philadelphia District recognizes that sturgeon, including juvenile Atlantic sturgeon, utilize this area year round and it is not possible to time dredging or rock blasting activities to avoid their presence. The District will work with DNREC to develop a plan to monitor and/or relocate sturgeon from the work area. As suggested by Dr. Dewayne Fox, the District will contact Dr. Douglas Clarke, Program Manager for the Corps' Dredging Operations Technical Support group at the Engineering Research and Development Center's Environmental Laboratory, to request assistance. Dr. Clarke has experience with protection of threatened and endangered species during dredging projects, including work with sturgeon.*

*Sandbar shark—We reviewed the Corps' description of methods to minimize impacts to sandbar sharks and believe that further coordination with the Department, the U.S. Fish and Wildlife Service, and National Marine Fisheries Service is necessary. The Department's Division of Fish and Wildlife remains concerned about protection of sandbar sharks because the sandbar shark population has declined precipitously during the planning period for this project and the sandbar shark has become the subject of recent intensive management efforts. The lower Delaware Bay is the most important annual pupping habitat, from May 15-July 15, for this shark on the Atlantic coast. As such, we would like to discuss ways to modify the dredge cutter head to protect adults that might be attracted to it as they would be to a chum slick, and request more information about the Corps' plans to protect juveniles using time of year restrictions.*

**Response:** *The Delaware River Basin Fish and Wildlife Management Cooperative has not recommended any hopper dredging restrictions for protection of the sandbar shark. The Cooperative has recommended restricting hopper dredging from 1 June through 31 March for protection of Atlantic sturgeon and overwintering blue crab. Restrictions are also recommended for work along the shoreline from 15 April to 15 September from the mouth of the bay to River Mile 12 for protection of sandbar shark. The restricted shoreline includes the Broadkill Beach portion of the project. To best meet these competing restrictions, dredging for the Broadkill Beach portion of the project was scheduled to take place between 1 April and 30 June. To protect sandbar shark during this period, the plan was to float the dredge pipe to avoid disruption of sandbar shark movements and to stockpile sand above mean high water from 15 April to 15 September. After 15 September, sand was to be graded below mean high water to widen the beach. As discussed at a May 13, 2010 project coordination meeting that included Mr. Jerry Pasquale of the Philadelphia District's Environmental Resources Branch, Dr. Dewayne Fox and staff members with DNREC, it was decided that a more acceptable time of year for construction of the Broadkill Beach project is 15 September to 15 December. Dredging and shoreline work during this time would avoid any impacts to the sandbar shark, the sand tiger shark, the horseshoe crab and local residents and vacationers utilizing the beach during the summer months. According to Dr. Fox, dredging at this time would not impact Atlantic sturgeon, as his data show*

*they are not using this area at this time of year. The Philadelphia District will coordinate this change with NMFS and also work with DNREC to develop a dredging plan that minimizes impacts to overwintering blue crab during the month of December (i.e. schedule dredging in December in areas least utilized by blue crab).*

*Sea Turtles*—The 2009 Environmental Assessment does not adequately address the potential impact to sea turtles and makes inaccurate statements about sea turtle use and abundance in the Delaware Estuary. The Corps does not appear to be undertaking all Reasonable and Prudent Measures (RPMs) to minimize impacts to sea turtles from dredging activities, as identified in the National Marine Fisheries Service Biological Opinion, which states on page 67: "Sea turtles are likely to occur in Delaware Bay from May through mid-November each year with the largest numbers present from June through October of any year (Stetzar 2002). The Delaware Estuary is an important foraging area for sea turtles and an important developmental habitat for juvenile sea turtles, particularly loggerheads. The areas to be dredged and the depths preferred by sea turtles do overlap, suggesting that if suitable forage was present, loggerheads and Kemp's ridleys may be foraging in the channel areas where dredging will occur." Additional comments and concerns regarding sea turtles are included as an attachment to this letter. Please revise the permit Application to include more detail regarding measures that will be implemented to minimize sea turtle impacts.

**Response:** *The information provided to DNREC includes the National Marine Fisheries Service 2009 Biological Opinion for the Main Channel Deepening Project. The Philadelphia District is committed to implementing all reasonable and prudent measures outlined in the Biological Opinion for the protection of sea turtles. These measures include the use of a rigid sea turtle deflector on any hopper dredge working in Reaches D and E between 1 May and 15 November and placement of NMFS-approved observers on board hopper dredges for 100 percent of this time period with at least 50 percent monitoring coverage on a daily basis. The additional comments provided as an attachment are addressed separately.*

#### Environmental Windows

*Blue Crab*—Pages 4 and 6 of the Corps' July 24, 2009, response letter provide contradictory information regarding blue crab impact avoidance. Page 4 states that windows for blue crabs will be observed from mile 32 south to the mouth of the Bay, but Page 6 of the same letter indicates that windows will not be met below mile 32 or for any work at Kelly Island or Broadkill Beach. Please provide clarification of this issue.

**Response:** *The construction schedule submitted met the recommended dredging restriction for protection of overwintering blue crab from the mouth of the bay to River Mile 32. Recommended competing restrictions that could not be met were a restriction on hopper dredging for the months of June, July and August for protection of Atlantic sturgeon and a restriction on shoreline work from 15 April to 15 September for protection of horseshoe crab and sandbar shark. Based on discussions at a May 13, 2010 project coordination meeting, it was decided that a more acceptable time of year for construction of the Broadkill Beach project is 15 September to 15 December (see*

above). This schedule includes dredging during the first two weeks of the recommended overwintering blue crab window. The Philadelphia District will coordinate this change with NMFS and work with DNREC to develop a dredging plan that minimizes impacts to overwintering blue crab during the month of December (i.e. schedule dredging in December in areas least utilized by blue crab).

### 3. Secondary and Cumulative Impacts

(Sections 4.7.3 and 4.7.5.4 of the Regulations Governing the Use of Subaqueous Lands)

#### Lateral Access Channels

The navigation channels and/or berthing areas associated with the Port of Wilmington, the Delaware City Refinery, the Sunoco Refinery, Oceanport Industries, General Chemical, Delmarva Power and Light, the Logan Generating Station, and the DuPont Edgemoor and Chambers Works facilities have been omitted from consideration as potential future access channels or berthing areas located in Delaware waters that should be assessed for secondary impact evaluation. These facilities should be included as part of the Subaqueous Lands Permit Application secondary impact analysis. Full sediment characterization, water quality effects of initial construction and maintenance, and ongoing dredged material management for maintaining deeper depths should be addressed. This also will affect the Department's evaluation of the cost-benefit analysis, as it is difficult to assert any potential benefits to the State of Delaware or its industries without also assessing the secondary impacts of constructing and maintaining new access to the deeper navigation channel.

**Response:** *The appropriate benefiting facilities have been included in the project benefit/cost analysis and associated impacts. The Delaware River Deepening project will generate benefits to the following nine facilities: Packer Avenue Marine Terminal, Beckett Street Terminal, four Sunoco refineries (located in PA and NJ), Valero, Conoco Phillips, and the Magellan LP Terminal; of these facilities, only Magellan is in Delaware. A portion of the Sunoco Marcus Hook Refinery is within Delaware State waters, and Conoco Philips is approximately 3/4 of a mile upstream of the Delaware State line. The remaining facilities are in the vicinity of Philadelphia (see the attached map of benefiting facilities from the 45 foot improvements<sup>1</sup>).*

*Because these facilities (except Magellan LP) would be required to deepen their access channels/berthing areas to 45 feet, in order to realize project benefits, they are considered associated features of the project, and all associated costs for the non-federal berth(s) or access channel improvements for these benefiting facilities have been included in the benefit-cost analysis.*

*With regard to Magellan LP (formerly Delaware Terminals), note that they are planning to establish a berth on a naturally deep section of the Delaware River to access the existing 40 foot federal shipping channel, and have been evaluating two alternative berths, independently of the deepening project, as stated by a company representative to GAO in January 2010 (see March 2010, GAO-10-420 report). Since construction of the berth is not dependent on implementation of the 45-foot project, no (berth) costs are included as part of the associated project costs.*

*Additionally, the Delaware River at that location is naturally deeper than 45 feet, so no additional dredging from 40 to 45 feet is necessary in order to realize benefits.*

*Based on numerous comprehensive project economic evaluations (also see response to comment #6), none of the other facilities listed in comment #3 Lateral Access Channels, have been identified as project beneficiaries and as such have not been included in the benefit to cost ratio.. Therefore there is no rational economic basis to postulate that they will dredge their access channels/berthing areas to 45 feet. One of the listed facilities, Oceanport Industries LLC, does handle bulk shipments, such as salt. However, the berth is maintained at only 35 feet (MLW), and the vessel movements at the company's dock would not benefit from a deepened Delaware River federal channel. The Delaware City Refinery and Port of Wilmington facilities (the latter located on the Christina River) are also constrained by access channels with less than 40 foot channel depths. General Chemical, Delmarva Power and Light, the Logan Generating Station, and the DuPont Edgemoor and Chamber Works facilities have not reported waterborne commerce.*

*The only facilities in the vicinity of Delaware State waters that will benefit from the Main Channel Deepening Project are the Sunoco Marcus Hook and ConocoPhillips refineries. Two sediment cores were collected in each area. The cores were divided in to eight sediment samples based on observed sediment stratification and analyzed using bulk sediment procedures. Concentrations of contaminants in these samples were within the range of contaminant concentrations from samples collected in the Federal channel. This data was provided in a report entitled: Black & Veatch Waste Science, Inc. 1996, Results of Berthing Area Vibracore Sampling Along the Delaware River from Beckett Street Terminal in Camden, NJ to Sun Oil Refinery in Marcus Hook, PA, Prepared for USACE, Philadelphia District, Contract No. DACW61-94-D-0013 Task Order Nos. 0005, 0006, & 0009. Metals data from these eight samples are being evaluated following the procedure provided in: Greene, Rick, 2010, An Evaluation of Toxic Contaminants in the Sediments of the Tidal Delaware River and Potential Impacts Resulting from Deepening the Main Navigation Channel in Reach C. The results of this analysis will be provided within a week.*

#### Updated Salinity Model

(Sections 4.7.1.3 and 4.7.1.4 of the Regulations Governing the Use of Subaqueous Lands)

The model submitted with the current Application has not been updated since the Department's previous review of the April, 2009 EA. Our review at that time expressed concerns about the model. The Corps' July 24, 2009, letter indicates that additional sea level rise scenarios have been added as model runs but does not address the Department's underlying concerns about the model itself. More detailed questions and concerns have been included as an attachment to this letter. Please update the model to address these concerns.

**Response:** *The DNREC comment above was expanded upon in the attachment to the 22 April 2010 DNREC letter. Detailed salinity modeling comments and questions from Bartholomew Wilson (provided as an attachment to the 22 April 2010 DNREC letter) are addressed point-by-point below.*

### Sediment Budget Impacts

(Section 4.7.1.6 of the Regulations Governing the Use of Subaqueous Lands)

The Department remains concerned about the effect of the deepening on sediment delivery to adjacent marshes as well as shallow water habitat and shoals within the Delaware River and Bay. The Department continues to seek additional information to address this issue. Please provide to the Department additional information to address the long-term effects of the deepening on the estuary.

**Response:** *The DNREC comment above was expanded upon in the attachment to the 22 April 2010 DNREC letter. Detailed sediment budget comments and questions from Bartholomew Wilson (provided as an attachment to the 22 April 2010 DNREC letter) are addressed point-by-point below.*

### Changes to Ship Traffic

Specifically, the Corps should address whether the increased channel depth will allow or encourage use by different vessel types than those currently using the channel, which may pose new or increased environmental or public safety risks.

**Response:** *A deeper channel will allow vessels to more efficiently apportion vessel operating costs over the same magnitude of tonnage, resulting in transportation savings. The largest vessels in the fleet, crude oil tankers, will continue to carry the same amount of imported crude, since vessel capacity is not the sole determinant of cargo volume, to the Big Stone Beach anchorage (located in the naturally deeper water in the lower Delaware Bay). The Coast Guard allowance for sailing drafts of the tankers into the anchorage is 55 feet. Lightering requirements will be reduced for these tankers with the channel deepening, which will lessen the number of barge trips required to carry crude to the refineries upriver. Also, a deeper channel depth will allow current dry bulk and container vessels to carry more cargo as well as allow more effective use of the vessel charter market. For example, dry bulk vessels would be able to move up from the 60,000-70,000 DWT class to a deeper design draft class of 80,000 DWT with the deepened channel. So, overall, the total vessel and barge traffic through the Delaware River port system will be less with the 45 foot deepening as compared to the traffic for the existing 40 foot channel depth.*

## **4. Operational Concerns**

### Economic Loading

The Corps' July 24, 2009, letter states that economic loading will not be employed for any portion of the project. Can you confirm that economic loading will not be used in the reaches proposed for hopper dredging (Reaches D and E)? If economic loading is to be utilized, additional assessment of potential water quality effects will be required.

**Response:** *Confirmed. Project construction does not include the use of economic loading.*

### Rock Removal

(Section 4.6.7 of the Regulations Governing the Use of Subaqueous Lands)

The Department consistently has requested all rock that results from the blasting operations near Marcus Hook, regardless of size or whether it has been sorted, be beneficially reused in Delaware waters. However, it does not appear that the Corps intends to provide this material as requested. Further consultation with the Department's Fisheries Section is requested.

***Response:** Investigation of the feasibility of using rock for beneficial use resulted in findings that specific rock size was indeterminable due to the likely pulverization of most of the rock during blasting. A mixture of rock, cobbles, gravel, sand, and mud would be excavated either prior to or following the blasting and loaded on to barges. The feasibility of placing this material in open water is precluded by the variation in material expected. After the rock is excavated and stockpiled on shore, a determination of its suitability and the economics of using it for beneficial use can be made. It is likely that the cost of remanding, separating, and transporting this material will exceed the cost of commercially available supplies.*

### Air Quality Conformity

(Section 4.7.1.5 of the Regulations Governing the Use of Subaqueous Lands)

The Corps is attempting to demonstrate general conformity for nitrogen oxides (NO<sub>x</sub>) by offsetting direct NO<sub>x</sub> emissions through the purchase of Emission Reduction Credits (ERCs). The Corps submitted to the Department a March 4, 2010, letter that indicated the Philadelphia Regional Port Authority (PRPA) has “*acquired the necessary NO<sub>x</sub> emission reduction credits (ERCs) to construct the project.*” Attached to that letter was a February 26, 2010, letter from PRPA stating the PRPA “*hereby dedicates the acquired credits for the exclusive use in connection with the project for the duration of the initial project construction,*” and that identified a total of 873.72 NO<sub>x</sub> credits; 37 from Delaware, 755.72 from New Jersey, and 81 from Pennsylvania.

Delaware has validated that the 37 Delaware ERCs obtained from Lafarge are valid, and are surplus to Delaware's ozone and fine particulate matter SIPs (reference DE SIP FOR ATTAINMENT OF THE 8-HOUR OZONE NAAQS, Reasonable Further Progress and Attainment Demonstration, June 2007, Page 27; and DE SIP FOR ATTAINMENT OF THE PM<sub>2.5</sub> ANNUAL NAAQS, Attainment Demonstration, January 3, 2008, Page 55). These 37 ERCs are now used as emission offsets, and are no longer available for sale, trade, or future use.

Additional information and documentation from the Corps is requested as follows:

- 266.1 tons per year of credits are identified as having been created in Cumberland County, NJ. Cumberland County, NJ is outside the PM<sub>2.5</sub> non-attainment area boundary and

therefore not eligible to satisfy the conformity requirements. Please explain how the Corps plans to satisfy the shortfall.

**Response:** *In the Corps Statement of Conformity, dated 30 December 2009, the Corps committed to purchasing 607 tons per year of NOx ERCs to satisfy the maximum annual rate of emissions estimated for the project. As noted in your comment, 873.72 tons of NOx credits were actually obtained. Of these, 607.62 tpy were generated in dual NOx/PM 2.5 nonattainment areas. Therefore, there is no shortfall.*

- Certification/documentation that the PA and NJ credits are surplus to those states ozone and fine particulate matter SIPs. This is necessary as Delaware is part of multi-state ozone and fine particulate matter nonattainment areas.

**Response:** *All of the credits purchased for the Delaware River Main Channel Deepening Project NOx ERCs were identified on their respective state's registry systems or confirmed by the Philadelphia Regional Port Authority's (PRPA) broker as being valid and available for sale or trade, and thus not bound by state SIPs. Attached is confirmation from the Pennsylvania Department of Environmental Protection (PADEP) for the transfer of the 81 tons of credits purchased from Exelon to the PRPA for the Delaware River Main Channel Deepening Project.<sup>2</sup> As of the date of this letter, we are still awaiting responses from NJDEP on the transfer documentation (other than administrative clarifications on one of the purchases). The Corps will provide those confirmations to DNREC once they are available.*

- Documentation that demonstrates the PA and NJ credits are now used as emission offsets and are no longer available for sale, trade, or future use.

**Response:** *In the attached letter from PADEP, the Bureau of Air Quality, commits the 81 tpy of emissions purchased from Exelon by the PRPA to be used for the Delaware River Main Channel Deepening Project. Additionally, in Amendment No. 1 to the Project Partnership Agreement between the Department of the Army and Philadelphia Regional Port Authority for construction of the Delaware River Main Stem and Channel Project (attached), Article XXII, Paragraph C states.<sup>3</sup>*

*The Non-federal Sponsor shall dedicate and pledge the Emission Reduction Credits (hereafter the "ERCs") identified on the ERC Log as set forth in exhibit "A" for use on the project to satisfy the requirements of the Clean Air Act as determined by the Project's Final Statement of Conformity dated December 30, 2009. The Non-Federal Sponsor shall continue to dedicate ERCs that the Government determines to be required for the Project. The Non-Federal Sponsor shall not transfer, pledge, or otherwise encumber the ERCs for any other purpose unless the Government authorizes such change in writing. The non-Federal Sponsor may dedicate additional ERCs to the Project for purposes of regulatory compliance upon receiving written approval from the Government to revise the ERC Log.*

*With respect to future use, upon completion of the project, any remaining offset value of the ERCs dedicated to the project will be managed in accordance with the respective state's ERC program.*

## **5. Updated Dredge Material Disposal Plan**

(Section 4.6.7 of the Regulations Governing the Use of Subaqueous Lands and Section 12.0 of the Wetlands Regulations)

The Department has significant concerns about the Kelly Island project and use of this site for dredged material disposal from the main channel deepening project. The concerns are focused on the significant changes that have occurred at the site as a result of erosion over the intervening years, as well as the quality of the geophysical sediment data that the Corps has provided to date. The fine grained quality of the sand material to be used may be poorly suited for the intended purpose, making it unlikely that the project can provide the habitat needed for horseshoe crabs or shorebirds and potentially results in a more degraded habitat condition rather than an improved one. If a dike should fail, the sediment load could be catastrophic to the adjacent oyster beds. The shoreline has eroded back to the point where it is no longer feasible to use this project to protect the Port Mahon public ramp. And with sea level rise considerations, the Department is concerned that a project constructed under current conditions will become harder to maintain over time.

The Department offers to work with the Corps to identify other potential sites where beneficial reuse of dredged material can occur in Delaware. One possibility may be restoration of the interior marshes within Bombay Hook National Wildlife Refuge. Toward that end, and in order to supplement the Corps' limited geophysical data, the Department is undertaking its own mapping of the sediments in the portion of the main channel that would have been used for the Kelly Island project and is hopeful that the information can be utilized in choosing and designing an alternative beneficial reuse site. The Department requests that the Corps pursue an alternative beneficial re-use project and supplement its Application with a conceptual project plan.

**Response:** *The concerns raised by DNREC over the use of Kelly Island as a beneficial use site have been addressed since publication of the 1997 SEIS. To address DNREC concerns, many changes to the original design were made. The original stacked geotube design, with a 20 foot-width footprint was abandoned for a more stable 200 foot-width beach structure comprised of sand with a buried geotube. The revised footprint averages over 600 feet wide at its base. At the root of DNREC's current concern is the eroding shoreline at the proposed site and its impact on the design. The shoreline along Kelly Island has retreated between 150 and 400 feet since 1998; however, the alignment of the shoreline has remained essentially the same. Although the spit at the southern end of the project has been completely eroded, the design of the proposed beach/wetland structure is unaffected by the shoreline erosion. We contend that the loss of the spit and its impact on protection of the Mahon River boat ramp is not relevant to the intended "ecosystem restoration" purpose of the Kelly Island site. It was anticipated that the detailed layout of the project would occur immediately prior to construction, in the plans and specifications phase of the project. Given the scale of erosion, the geotechnical data and design*

*assumptions for the beach, groins, and wetland creation are still valid. Only the horizontal position of the project needs to be adjusted landward to accommodate the continued shoreline retreat that Kelly Island has experienced since 1997. In addition, since the spit has eroded, the proposed geotube protection of the spit is no longer necessary.*

*During the design of the project, twenty-nine channel vibracores were collected in the Delaware River and gaps in channel sedimentation quality were covered by a geoacoustic survey of the channel. Only three cores were taken in 1991 in the channel area proposed for Kelly Island borrow. Since that time, additional cores were collected in the channel in 1995, 1997, 1999, 2001, and 2005. A total of 27 additional cores were collected in the area now being proposed as the source of sediment to construct the Kelly Island beneficial use site, in addition to five cores within the borrow limits for the planned Egg Island Point ecosystem restoration feature. There are now a total of 35 cores in the channel characterizing the sediments to be used for construction. The typical sediment size (D50) for the sand to be used in the construction of Kelly Island is between 0.2 and 0.4 mm (medium to medium-fine sand), which will provide both a stable beach and suitable horseshoe crab habitat.*

*In order to address concern for a catastrophic failure, which we deemed to be more likely with the stacked geotube design, a sand dike was designed with twelve 300 foot-long timber groins to limit the alongshore movement of sand. The behavior of the structure was modeled under both storm and non-storm conditions to determine where and how much the sand would migrate over time. The results of this investigation are included in Appendix B ("Modeling Efforts/Hydraulics Analysis") of the May 1996 Design Memorandum. The study indicated that the historic erosion at Kelly Island would be greatly slowed and that the sand migration would not negatively impact the oyster beds. In addition, the likelihood of a catastrophic failure was mitigated by the dike/beach design, which included 5,000 lineal feet of buried geotube, serving as a last line of defense in case of unforeseen erosion. Once the low and high marshes were established, any failure would be inherently less than what is occurring at the site on an annual basis. Another factor limiting the possibility of a negative environmental impact is that the original design was conceived to contain almost 1 million CY of fine grain sediment. However, the additional vibracores and greatly improved survey techniques reduced that quantity to a total of approximately 55,000 CY. The fine-grained sediments will be placed within the 2.4 million CY sand structure and covered with 5 to 6 feet of additional sand, significantly reducing the possibility of a release of fine grained sediment.*

*The structure will be constructed with a top elevation of +10 which is 4 to 5 feet higher than the marsh it will protect. Historic sea level rise is a phenomenon that may have contributed to the well-documented retreat of Kelly Island (and other) fringing marsh shoreline on Delaware Bay. Likewise, the continued historic or potentially accelerated rate of sea level rise may impact the entire estuary shoreline in the future. However the impact of continued sea level rise on the proposed sand dike containment structure at Kelly Island is not deemed sufficient to compromise the intended function and durability of this feature of the project.*

*With respect to DNREC's offer to work with the Corps to identify other beneficial use sites in the bay, note that the 45 foot project was Congressionally authorized with beneficial use of dredged material for Kelly Island and Egg Island Point only. As such, the Corps may work with DNREC*

*to modify and adjust the design for Kelly Island to accommodate the wishes of the department and the Refuge, but has no authority to change the location. The only alternative to the construction of the Kelly Island Wetland Restoration project is to construct Egg Island Point in New Jersey, which at this time has been deferred due to a lack of adequate sand from the proposed channel deepening.*

*Another possibility (subject to future Congressional appropriations) is to pursue investigation of other sites under separate authority. Currently, a Reconnaissance study for beneficial use of dredged material is in progress under the General Investigations (GI) program. The purpose of the Reconnaissance study is to determine the Federal interest to conduct a detailed feasibility level study, to determine the scope of such study (cost & schedule), and to identify if there is a non-Federal sponsor willing to cost share (50-50) in the feasibility effort. In the near future, we will be coordinating the preliminary findings of our Reconnaissance study with DNREC and other regional stakeholders, and we look forward to positive responses. Alternatively, a smaller beneficial use project may be initiated under Section 204 of the Continuing Authorities Program (CAP); however, similar to the GI effort, a non-Federal cost sharing partner is needed.*

## **6. Cost Benefit Ratio**

(Section 4.6.8 of the Regulations Governing the Use of Subaqueous Lands)

The Department is required to consider the public benefits of a project versus the public detriments. The U.S. Government Accounting Office recently released an updated cost-benefit analysis on the proposed project; however, this analysis was limited in scope. In 2004, the Corps provided an economic analysis as part of its permit Application. The 2008 and 2009 Economic Updates revised the project benefit estimates of the 2004 study to reflect the current price level and discount rate, but did not provide sufficient information for the department to conduct a thorough analysis. For example, while the 2004 economic analysis and subsequent updates did review certain commodity growth rates and provided limited sensitivity analyses, they did not contain any substantive market analyses or include information regarding changes to current or projected industry conditions, such as impacts to crude oil and containerized cargo—two of the project's main benefiting categories. Please submit any additional information that will assist the Department in its economic review.

**Response:** *GENERAL. Federal water resources projects constructed by the Corps of Engineers, along with those of the Bureau of Reclamation, Natural Resources Conservation Service, and the Tennessee Valley Authority, are based on the Principles and Guidelines (P&G) which was approved by President Reagan in 3 February 1983, and adopted by the Water Resources Council. Accordingly, plan formulation and economic analyses performed for this Congressionally authorized project, starting with the feasibility phase, and continuing into the subsequent Preconstruction Engineering & Design phase updates. All of these, the 2002-2004 Comprehensive Economic Reanalysis and Supplemental Reports, etc, adhere to the methodologies prescribed in the P&G, and the National Economic Development (NED) objective as defined in the P&G.*

*The Corps' Engineer Regulation ER 1105-2-100, Planning Guidance Notebook (available at the following link: <http://140.194.76.129/publications/eng-regs/er1105-2-100/toc.htm>), incorporates the P&G, and further expands and details the methodologies used by the Corps to investigate and implement water resource projects. Federal projects under the P&G, are formulated to reasonably maximize net national benefits. Contributions to **National Economic Development (NED)** outputs) are defined as increases in the net value of the national output of goods and services. As such, benefits are evaluated and maximized from the national perspective, and not on a state by state basis. For deep-draft navigation benefits, the standard procedure for transportation cost reduction benefits (quantifies the reduction in transportation costs to benefiting commodities from the channel improvement. This was the procedure that was applied in the economic analysis of the Delaware River Channel Deepening project. Using these principles, the portion of NED outputs (benefits) that are expected to accrue within DE include \$464,000 of Average Annual Benefits (AAB) at the Magellan LP facility, ecosystem restoration benefits from restoring 120-140 acres at Kelly Island (of which about 60 acres will be wetlands, and the rest a sandy beach for Horseshoe Crab habitat), and annualized beneficial use cost savings of \$617,000 by placing sand at Broadkill Beach for hurricane and storm damage reduction purposes.*

*Detailed descriptions of the aforementioned economic benefits are included in the 2002-2004 Comprehensive Economic Reanalysis Report (2002)<sup>4</sup> and Supplemental Report (2004).<sup>5</sup> Economic updates of the project were subsequently completed in April 2008, and again in December 2009.<sup>6</sup> These two updates (while not intended to be another comprehensive reanalysis) verified the previous detailed economic analyses conducted in 2002-2004 through review of trends from published commodity data for the Delaware River port system.*

*TONNAGE CONSIDERATIONS: For the purpose of reducing uncertainties inherent in long term projections, the standard, approach for deep-draft navigation analyses, from a national perspective, is to apply the judgment that the magnitude of tonnage through a waterway or port will not be specifically changed from channel improvements. For the Comprehensive Economic Reanalysis Report and Supplemental Report (2002-2004) decision documents for this project, an External Independent Review was conducted by a panel that was designated by the Corps' HQ Director of Civil Works. The three-member panel, comprised of two university professors from academia and a private industry expert in navigation economics, reviewed and approved the expectation of no induced tonnage from the channel deepening.*

*The Delaware River 45-foot project has therefore been evaluated based on the parameter of no induced tonnage. Any increase in the amount of tonnage through the port over the project life will be an equivalent amount for either the existing 40 or 45 foot improved channel depth conditions, and would be predicated on the performance of the U.S. economy.*

*In summary, economic justification of the 45 foot channel depth improvement is not dependent and will not necessitate any expansion of port facilities. The project's navigation benefits are based upon transportation cost savings from more efficiently managing vessel operating costs. The future volume of cargo passing through the Delaware River port system is determined by macroeconomic factors that are not affected in any measureable way by the channel depth. The purpose of the deepening project is to make it possible to handle the total volume of cargo, existing and projected future, in a more efficient way. This efficiency takes the form of increased loading*

*of some vessels in the benefiting fleet. With the deeper channel, fewer total vessel calls will be required.*

*The GAO report, GAO-10-420, "DELAWARE RIVER DEEPENING PROJECT" (March 2010) was neither limited nor cursory, and was developed by GAO after an intensive audit review period by the agency from March 2009 to March 2010. As stated by GAO in its final report, "The Corps' reanalysis addressed many of the limitations GAO had identified in 2002 in the Delaware River deepening project's original economic analysis by using more recent information to correct invalid assumptions and outdated data, recalculating benefits and costs to correct miscalculations, and accounting for some of the economic uncertainty associated with the project. For example, the Corps revised its benefit estimates for transportation cost savings related to such commodities as crude oil, containerized cargo, and steel slabs. In addition, as GAO recommended, the Corps had independent experts review the reanalysis".*

*More recently and in response to the March 2010 GAO report, the ASA(CW) concurred with the GAO report conclusions, and stated that the "The Corps will perform an updated quantitative assessment of the impact of relevant market and industry trends on the previously projected project benefits. The updated assessment will augment the qualitative port assessment previously provided by the Corps for consideration during the development of the GAO draft report".*

## **Main Channel Deepening Project**

Natural Heritage and Endangered Species Program, Delaware Division of Fish and Wildlife  
Edna Stetzar, Biologist/Environmental Review Coordinator

### Summary of sea turtle concerns regarding the Environmental Assessment (EA) and the Biological Opinion (BO):

1) The EA does not adequately address potential impacts to sea turtles in the two short paragraphs included and there is no literature cited to support information used in the assessment. The National Marine Fisheries Service (NMFS) BO cites many research papers and reports but does not have a literature cited section at the end of the document.

**Response:** *The National Marine Fisheries Service has Federal jurisdiction over threatened and endangered sea turtles and the Philadelphia District formally consulted with the Service pursuant to Section 7 of the Federal Endangered Species Act. The Service's 2009 Biological Opinion regarding the Main Channel Deepening Project is their professional position on the likely impacts that project construction will have on sea turtles. The Philadelphia District concurs with the Biological Opinion and is committed to implementing all reasonable and prudent measures identified by the Service.*

2) The US Army Corps of Engineers (ACOE) is not implementing 'Reasonable and Prudent Measure #5 as **required** by NMFS in the Biological Opinion. NMFS requires observer coverage every day that dredging is occurring in reaches D & E (Page 108 NMFS BO). The ACOE is proposing observer coverage primarily only on a bi-weekly basis (Page 135 of the EA). NMFS requires 12 hours on, 12 hours off coverage. ACOE is proposing to use 6 hours on, 6 hours off.

**Response:** The Environmental Assessment was completed in April 2009 and reports the level of hopper dredge monitoring required under the previous National Marine Fisheries Service Biological Opinion for dredging within the boundaries of the Philadelphia District. The Philadelphia District is committed to implementing all reasonable and prudent measures identified by the Service in their July 2009 Biological Opinion, including sea turtle observer coverage every day a hopper dredge operates in Reaches D and E between 1 May and 15 November. Reasonable and prudent measure #5 requires observation of at least 50 percent of hopper dredge loads and gives an example of 12 hours on and 12 hours off. An observation schedule of 6 hours on and six hours off would provide the same 50 percent coverage over a 24-hour period.

3) The EA incorrectly states that sea turtles only occasionally enter the Delaware Estuary (page 75), when in fact they are regular annual migrants.

**Response:** *Agree that sea turtles are regular annual migrants. Sea turtles are also discussed in the 1997 SEIS at 10-28 and 10-29. As noted in our other responses relevant to sea turtle concerns, NMFS has evaluated the impacts on sea turtles resulting from project construction as the consulting agency under the Endangered Species Act..*

4) The authorized level of take (20 turtles including initial deepening and 10 years of maintenance) for this project is based on take levels in 7 previous dredging operations that may not be comparable to the current dredging operation in scope and timing. In addition, there is insufficient data on sea turtle spatial distribution and annual trends in abundance, so the allowable take level was not based on current population trends or status. These 7 projects were spread out over a span of 13 years as follows: 1 project in 1993, 1 project in 1994, 1 project in 1995, 2 projects in 2005 and 1 project in 2006. Three of these projects took place in October or November while the current proposal includes hopper dredging in reach E from April to July in 2011 and April to August in 2012. Peak abundance is unknown, but turtles may be more abundant during the summer months than they are in October and November and therefore the current proposal may take more turtles than predicted. Dredging operations prior to 1995 required only 25% observer coverage, with observers working one week, then off the next. Take levels could have been underestimated for the 1993 and 1994 projects. NMFS states in the BO (Page 71) “...It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. In addition, NMFS acknowledges in the BO “The areas to be dredged in Reaches D and E are part of the summer developmental habitat of juvenile sea turtles as well as foraging areas. Sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters.”

**Response:** *The sea turtle take statement was determined by the National Marine Fisheries Service with the best available information. Any sea turtle take will be immediately reported to the Service and the circumstances will be investigated to determine if any additional measures can be taken to increase sea turtle protection.*

5) Data quantifying the current level of sea turtle mortality from anthropomorphic activities is insufficient to reliably predict or estimate the additive impacts this project could have on the population.

**Response:** *The National Marine Fisheries Service has Federal jurisdiction over threatened and endangered sea turtles and the Philadelphia District formally consulted with the Service pursuant to Section 7 of the Federal Endangered Species Act. The Service's 2009 Biological Opinion regarding the Main Channel Deepening Project is their professional position on the likely impacts that project construction will have on sea turtles. The Philadelphia District concurs with the Biological Opinion and is committed to implementing all reasonable and prudent measures identified by the Service.*

6) The EA does not address the potential for the project to impact sea turtle foraging and migratory habitat (research indicates that sea turtles cue into channel habitat). On Page 67 of the BO, NMFS acknowledges the importance of the Delaware Estuary to sea turtles ‘...sea turtles are likely to occur in Delaware Bay from May through mid-November each year with the largest numbers present from June through October of any year (Stetzar 2002). The Delaware Estuary is an important foraging area for sea turtles and an important developmental habitat for juvenile sea turtles, particularly loggerheads.’ ‘The areas to be dredged and the depths preferred by sea turtles

*do overlap, suggesting that if suitable forage was present, loggerheads and Kemp's ridleys may be foraging in the channel areas where dredging will occur.'*

***Response:*** *As required by the National Marine Fisheries Service, hopper dredges working in Delaware Bay between 1 May and 15 November must be equipped with a rigid deflector draghead or a rigid sea turtle deflector attached to the draghead. NMFS-approved sea turtle observers will be on board working hopper dredges every day during this period to monitor for any sign of a sea turtle take. Any sea turtle take will be immediately reported to the Service and the circumstances will be investigated to determine if any additional measures can be taken to increase sea turtle protection.*

7) The BO is based on limited data and the EA does not acknowledge the need for baseline data on sea turtle occurrence and distribution within the Delaware Estuary. This type of information is important for predicting sea turtle activity within the area of impact and how the activity will impact the population within the Estuary.

***Response:*** *Since 1992, the Philadelphia District has employed sea turtle monitors on all hopper dredges working in Delaware Bay and along the Atlantic Ocean coast within District boundaries between June and November. Reported sea turtle takes during this period of time were considered by the National Marine Fisheries Service in the development of their 2009 Biological Opinion for the Main Channel Deepening Project. The Philadelphia District concurs with the Biological Opinion and is committed to implementing all reasonable and prudent measures identified by the Service.*

**Delaware River Main Stem & Channel Deepening Project**  
Bartholomew Wilson P.G., Environmental Scientist IV  
Delaware Coastal Program, Delaware Department of Natural Resources and Environmental  
Control

**Summary of Issues regarding the updated salinity model presented in: Delaware Wetlands and Subaqueous Lands Permit Application (the Application) for deepening the Delaware River Federal Navigation Channel, April 2009 Environmental Assessment, and 2007 Delaware Estuary Salinity Model.**

*Note – Jeff Gebert of USACE/Philadelphia District and Bart Wilson of DNREC discussed these comments and responses by phone on 7 May 2010.*

Q) To assess the validity of the modeled results, we would like to view results of model calibrations that have been conducted using newer existing data (a current low flow condition, updated boundary conditions to match flow data, and updated bathymetry).

**Response:** It is not apparent what additional value would be added from modeling a “current low flow condition” since any current low flow condition (not defined in the comment) is not as severe a test of low flow conditions as the 1964-65 drought of record. The 1964-65 drought of record is the scenario adopted by DRBC for planning for extreme low-flow conditions. This scenario was used and represents the worst case condition for low-flow periods. A full discussion of results and conclusions of the salinity modeling is presented in Section 5 (“Hydrodynamic and Salinity Modeling”) of the 1997 SEIS. An abbreviated extract from Section 5 of the SEIS follows: “deepening the existing navigation channel from 40 feet to 45 feet will result in salinity (chlorinity) increases in the Philadelphia area during a recurrence of the drought of record. However, the increases will not have an adverse impact on water supply. The present DRBC drought management plan, including reservoir storage added since the drought of record, prevents the intrusion of ocean salinity into the Philadelphia area in excess of existing standards. With the deepened channel and a recurrence of the drought of record, the maximum 30-day average chlorinity at RM 98 is about 150 ppm.”

Q) Boundary conditions based upon 1965 data, where available, and Upper Chesapeake watershed based upon 1992-1993 data. Several datasets used for boundary; how does this effect reliability? How reliable is the 1965 boundary dataset?

**Response:** When ideal boundary condition data sets do not exist, it is necessary to adopt the “next best” appropriate data set for use in the model. For the 1965 simulation, there were no available observed Chesapeake Bay boundary condition data sets for temperature and salinity. The Chesapeake Bay temperature boundary conditions (at Annapolis) were adopted from observed 1992-1993 data, and the salinity boundary conditions were synthesized from 1964-65 Susquehanna inflow data. We deem this to be an appropriate and acceptable approach (a pragmatic, realistic “proxy”) when the ideal data sets do not exist. Based on the above, we conclude that the 1965 data set is “reliable”.

Q) Much better salinity and temperature data today than 1996; how does this affect reliability of model?

**Response:** Having “much better” salinity and temperature today compared to what was available when the model was being developed and improved is an inevitable occurrence. This has been driven by an expanded awareness of the need to monitor various environmental parameters, as well as an expanded network of gages and monitoring instruments, many of which can now provide real-time or near real-time data via the Internet. However, the availability of newer and/or better data does not directly affect the “reliability” of the model. The modeling work to date has been coordinated with other agencies, including DNREC, in terms of the scenarios to be simulated and the locations at which data were saved.

Q) Projections based upon 1996 to 2040 interval. What is the change in consumptive use since 1996? Are there updated predictions of consumptive use for the next 50 years?

**Response:** Consumptive use is a parameter monitored and forecast by Delaware River Basin Commission (DRBC). DRBC’s 1996-2040 consumptive use forecasts were applied in the model. Model results to date indicate that DRBC projected changes in consumptive use lead to relatively insignificant changes in salinity distribution compared to other changes, including sea level rise and the Delaware River 45 foot Deepening Project. Therefore, additional updated scenarios of consumptive use are not warranted in any model analysis.

Q) Utilize precipitation predictions outlines by Ray Najjar (2007), Pennsylvania State University, in Climate Change: “Climate simulations of major estuarine watersheds in the Mid-Atlantic region of the United States”.

**Response:** The USACE hydrodynamic-salinity model does not use precipitation data as a boundary condition. The model incorporates the effects of precipitation in the form of freshwater inflows at selected locations within the model domain.

Q) All modeled results based upon 5 ft deepening, but actual deepening is 6 ft or 7 ft with the overdraft . Are there changes in the model that would result from a more representative post-replenishment bathymetric condition (i.e. overdraft depth)?

**Response:** The existing project was authorized by Congress as a “40 foot Mean Lower Low Water (MLLW”) channel. The deepening project is authorized as a “45 ft MLLW” channel. The authorized depth is the nominal depth which the Corps is obligated to maintain in the interest of safe and efficient navigation. When the Corps performs dredging, there is an increment of “allowable overdepth” dredging, typically 1 foot, which is the tolerance for payment to dredging contractors. Ongoing new work dredging of the 45 ft channel in Reach C (between Wilmington and the C&D Canal) includes required dredging to 47 feet along 8,000 feet of channel in the New Castle range. This section is only a portion of the 60,000 linear feet of new work dredging in Reach C, the balance of which is required to 45 ft. Both 45 and 47 ft zones include a 1 ft

allowable over depth. New work dredging to 47 feet in the New Castle range is necessary because of the normal high shoaling rate that occurs there. It would not be useful or realistic to modify the model bathymetric grid to reflect what is in effect a localized, transient deepening to 47 feet.

Q) Used 1996 bathymetry for existing conditions grid, while the model used 1965 bathymetry. There are significant differences in 1965 to 1996 bathymetry between river miles ~20 to 70, and 100 to 130. How does this bathymetric difference affect the comparison between the existing conditions and modeled results?

**Response:** 1965 bathymetry was utilized with observed 1965 inflows and salinity/chlorinity data for the model calibration phase. Once the model was acceptably calibrated to reproduce observed 1965 salinity distribution, the newer (1996) bathymetric data set was used in production runs of the model to assess salinity impacts of channel deepening under a range of inflow conditions.

Q) How does the 1965 and 1996 bathymetry data compare to the 2007 bathymetry?

**Response:** Detailed questions on this topic are addressed individually below.

Q) What bathymetric data was used for area outside of channel?

**Response:** The 1996 Corps of Engineers bathymetric data set covered the area outside the channel. These surveys are referred to as “shore-to-shore” surveys. South of the limit of the 1996 shore-to-shore surveys in Delaware Bay, the latest available NOS hydrographic survey data were used.

Q) Model dominantly looks at in-channel changes, with no mention of out of channel changes or effects. The 1996 data was collected for the in-channel reaches.

**Response:** Model results for salinity time series were principally saved for locations in the navigation channel. However, at River Miles 27, 38 and 43 in Delaware Bay, salinity data were saved at shallower locations on both the east and west sides of the channel. These data were presented in the 1997 SEIS, Section 5, “Hydrodynamic and Salinity Modeling”.

Q) Salinity Re-Validation of the Delaware Bay and River 3D Hydrodynamic Model (2007): “The modifications consisted of changing the planform numerical grid to better represent the Delaware Bay and River navigation channel and re-constructing the water depth file representing existing conditions using bathymetry data from 1996.”

**Response:** Noted, concur. When the opportunity has been presented to revisit the model - in term of new scenarios to simulate and potentially improve the model’s ability to reproduce measured salinity data – we have done so. The 2007 modeling effort was just such an opportunity, and minor modifications to the model grid were consequently made.

Q) Wouldn't model become better representation of potential effect with a more comprehensive and detailed bathymetry that spans the entire study area.

**Response:** The existing model bathymetry grid does "span the entire study area". The bathymetric data used in the model was judged to be of sufficient spatial density and accuracy consistent with the grid cell size used in the model.

Q) Numerical bathymetric grid cells are very large, but the salinity results are presented to the thousands decimal place. Is this valued to the broad bathymetric grid? With advances in computing power, the numerical grid cell size needs to be greatly reduced to become better representation of actual and potential future conditions.

**Response:** Agree that salinity values could arguably have been truncated before publication of the report. However, there is no recommendation or conclusion in the report that critically relies on a reported third or fourth decimal place in any reported salinity value. Regarding grid cell size and "advances in computing power", we concur that if the modeling effort were being initiated today smaller grid cells could be accommodated. However, the grid modification or "advances in computer power" would not impact the essential findings of the work to date.

Q) What kinds of changes have occurred outside of the channel? The area on the tidal flats and marshes can bring about distortion in the tidal amplitude due to changes in water storage. This in turn affects sediment transport, salinity distribution, and estuarine morphology.

**Response:** The gridded model bathymetry reflects the actual surveyed bathymetry outside of the channel, as of the date of each survey. The hydrodynamic simulation features of the model incorporate the effects of varied bathymetry at the scale of the grid cells in terms of the three-dimensional (X, Y and Z) behavior of water, as well as for the transport of salinity. The model is not a sediment transport model, so direct evaluation of sediment transport impacts of deepening project is not possible.

Salinity Re-Validation of the Delaware Bay and River 3D Hydrodynamic Model (2007): "In addition, minor changes in bottom friction and horizontal diffusion coefficients were made during the process of forcing the model to better match observed values of salinity during 1965."

Q) Does this mean the coefficients were manipulated to match 1996 bathy with the 1965 flow? Excessive manipulation of model parameters reduces the reliability that the model results can actually be used to predict the future conditions.

**Response:** No. The adjustments to friction and diffusion were made for calibration runs that replicated hydrologic conditions and bathymetry that existed in 1965. Once the model calibration improvements were made, the calibration coefficients were not further adjusted for additional model runs.

Q) What would be the effect on salinity of IPCC rises in sea-level values? There needs to be a consideration of potential future effects that would result from the channel modification.

**Response:** The IPCC Fourth Assessment Report (2007) projects a range of potential eustatic SLR estimates by 2100 of between 0.18 and 0.59 meters. The recent (2009 to present) model work discussed at the 19 May 2010 briefing in the Philadelphia District office (DRBC was invited to attend) addressed the range of sea level rise scenarios of 1, 2, and 3 feet, which bracket the IPCC 2007 estimates. Sea level change appears to be a significantly larger driver of salinity impacts than does channel deepening. The USACE report on modeled sea level rise scenarios will be available within a month of the 19 May briefing.

Q) Only used 1.273 feet for modeled conditions. Use IPCC values of 0.5 m (1.640 ft) and 1.0 m (3.28 ft) for additional simulations to evaluate the future effects of the main channel deepening upon salinity intrusion in the upper estuary.

**Response:** See response immediately above.

Q) Salinity Re-Validation of the Delaware Bay and River 3D Hydrodynamic Model (2007): "The reason a sea level change of 1.273 ft per century has more impact than a channel deepening of 5 ft is because the sea level rise results in a greater increase of the entire cross-sectional area at the mouth of Delaware Bay, resulting in a greater increase of salt into the system from the ocean."

Q) Would the change in bathymetry amplify the effects of accelerated rates of sea-level impact upon salinity or would the effects of a 1.0 m rise greatly outweigh any variation or impacts based upon the channel deepening?

**Response:** Results from our present modeling indicate that salinity changes resulting from SLR scenarios of 1, 2, and 3 feet are all significantly larger than the salinity changes associated with deepening the Delaware River shipping channel to 45 feet. Modeling results do not indicate that changes in bathymetry due to deepening "amplify" the effects of SLR. However, the effects of SLR and channel deepening are "additive", so the impact of both together is greater than the impact of either alone.

Q) How is the 0.1 to 1 salinity concentration zone or upper limit of null zone (upper limit of Estuarine Turbidity Maximum (ETM)) going to react to the deepening? How far up river will it migrate under normal seasonal flow conditions?

**Response:** The modeling to date has not explicitly evaluated potential movement of the 0.1 or 1.0 ppt isohalines as a result of channel deepening. However, the modeling documented in the July 1997 SEIS did track the location of the 0.5 ppt isohaline, which is a useful proxy for the approximate center of the 0.1 to 1.0 ppt zone. Reference Table 5-6 on page 5-51 of the July 1997 SEIS (“Monthly Averaged Location of Selected isohalines, by River Mile”), which indicates that under the simulated monthly-averaged inflows from August through November, the 0.5 ppt isohaline advances on the order of 0 to 1 mile upstream, whether the monthly maximum or monthly average is considered.

Q) High-concentration core of the Estuarine Turbidity Maximum (ETM) is often present in the vicinity of Artificial Island. How far will the ETM migrate up river, under “normal conditions”, and how will the ETM movement affect sediment distribution and delivery to the sub-tidal flats and tidal wetlands within the Delaware River and Upper Delaware Bay?

See response immediately above.

Q) Massive sediment accumulation occurred on sub-tidal flats after the 1945 to 1960 channel deepening, because a greater fraction of tidal flow was concentrated in the deepened channel at the expense of flow over the adjacent flats (*Sommerfield, 2009 CERF Annual Meeting*). Will this trend become amplified or continue to increase because of even deeper channel? Will this result in increased rates of maintenance dredging because of higher rates of fine grained deposition in the navigational channel?

**Response:** We do not agree with the observation stated above regarding “massive sediment accumulation occurred on sub-tidal flats”. In this regard, see Figure 16 in the MS thesis of Dr. Sommerfield’s student David Walsh (“ANTHROPOGENIC INFLUENCES ON THE MORPHOLOGY OF THE TIDAL DELAWARE RIVER AND ESTUARY: 1877–1987”). Figure 16 is a contour map of bathymetric changes that occurred following the construction of the 40 ft navigation channel. Figure 16 and the text that accompanies it indicate that *scour*, rather than sediment accumulation, was the predominant change that occurred to sub-tidal area outside of the navigation channel.

Q) In the urban sector, where tidal flats are minimal, mud accumulated was primarily in the shipping channel. It is hypothesized that up estuary migration of the mud depocenter (since 1945) reflects landward movement of the estuarine null zone and turbidity maxima in response to intensified gravitational circulation, which was brought about by the deepened channel. Mud accumulation on tidal flats was reduced after 1987, but intense deposition persists in the shipping channel and necessitates widespread maintenance dredging to maintain the channels 45 ft depth (*Sommerfield, 2009 CERF Annual Meeting*).

**Response:** Comment noted, although this does not necessarily constitute agreement with all the characterizations presented above.

Q) Stated in Salinity Re-Validation of the Delaware Bay and River 3D Hydrodynamic Model (2007): “There is also a lateral salinity gradient present in the bay portion of the estuary, between the mouth and about RM 50, with higher salinities near the axis of the bay, and lower salinities on the east and west sides.”

**Response:** The sentence quoted above does not appear in the referenced document. However, the quoted text does appear in the Corps April 2009 “Delaware River Main Stem and Channel Deepening Project Environmental Assessment”. The text refers to the fact that on flood tides, the maximum upstream penetration of any isochlor tends to be greatest in the navigation channel, as would intuitively be expected given the deeper water along the channel axis. The model realistically reproduces the observation made in the comment.

Q) There is a confirmed increase in salinity on the Eastern side of the Upper Delaware Bay (Chris Sommerfield Ph.D. and Dave Bushek Ph.D., Personal Communications), due to Coriolis forces and up estuary gravitational circulation.

**Response:** Noted.

Q) Tidal pumping and gravitational circulation, in the lower estuary, cause flood-directed residual fluxes, which result in considerable variability between the channel and flanking sub-tidal shoals with respect to salinity and turbidity (Chris Sommerfield, GSA Annual Meeting 2006).

**Response:** Noted.

Q) So how do these confirmed variations in salinity and suspended sediments concentration affect the modeled salinity distribution, especially with respect to oyster grounds and the effect of higher salinities on oyster diseases?

**Response:** The observations presented above in “i” and “ii” are referenced to personal communications and a conference presentation. . The observations cited with regard to salinity and suspended sediments are based on existing conditions that occur “naturally”, with the 40 foot navigation channel having been in place for almost 70 years. With the respect to impact to oysters, we have coordinated with Dr. Eric Powell of the Haskins/Rutgers Shellfish Lab during the Corps SEIS process (1995 through 1997). Specifically, Dr. Powell reviewed our conclusions with regard to modeled salinity impacts of the channel deepening project and concurred with our findings. .

### Summary of Issues regarding the Sediment Budget Impacts

Q) How is the 0.1 to 1 salinity concentration zone or upper limit of null zone (upper limit of Estuarine Turbidity Maximum (ETM)) going to react to the deepening? How far up river will it migrate under normal seasonal flow conditions?

This question was presented and addressed in the preceding section on salinity impacts.

Q) High-concentration core of the Estuarine Turbidity Maximum (ETM) is often present in the vicinity of Artificial Island. How far will the ETM migrate up river, under “normal conditions”, and how will the ETM movement effect sediment distribution and delivery to the sub-tidal flats and tidal wetlands within the Delaware River and Upper Delaware Bay?

This question was presented and addressed in the preceding section on salinity impacts.

Q) Massive sediment accumulation occurred on sub-tidal flats after the 1945 to 1960 channel deepening, because a greater fraction of tidal flow was concentrated in the deepened channel at the expense of flow over the adjacent flats (*Sommerfield, 2009 CERF Annual Meeting*). Will this trend become amplified or continue to increase because of an even deeper channel? Will this result in increased rates of maintenance dredging because of higher rates of fine grained deposition in the navigational channel?

This question was presented and addressed in the preceding section on salinity impacts.

Q) In the urban sector, where tidal flats are minimal, mud accumulated was primarily in the shipping channel. It is hypothesize that up estuary migration of the mud depocenter (since 1945) reflects landward movement of the estuarine null zone and turbidity maxima in response to intensified gravitational circulation, which was brought about by the deepened channel. Mud accumulation on tidal flats was reduced after 1987, but intense deposition persists in the shipping channel and necessitates widespread maintenance dredging to maintain the channels 45 ft depth (*Sommerfield, 2009 CERF Annual Meeting*).

This question was presented and addressed in the preceding section on salinity impacts.

Q) The movement of the fine grained sediment is clearly defined as; “At the tidal river-estuary transition zone, the residual flux was down estuary throughout the water column and dominated by advection, (i.e, river discharge and compensation flow for Stokes Drift). At the seaward limit of the ETM, the residual flux was controlled by river discharge and landward gravitational flow in the upper and lower water column, respectively; tidal pumping was subordinate at all times. Within the estuarine null zone, flux mechanisms were highly time dependant: advection and tidal pumping (particularly near the bottom) were of equal importance during typical flow conditions, but

down-estuary advection dominated during periods of extreme river discharge (Sommerfield, Yang, and Wong, 2007 ERF Annual Meeting) ”.

**Response:** Preceding is a statement quoted from a 2007 conference. No response necessary.

Q) How will the channel modification change the fluxes within the estuary and the relationship between the current locations of the ETM and the sediment routing and delivery to the intertidal and sub-tidal sediment sinks within the estuary?

**Response:** Quantitative understanding and measurement of sediment fluxes and mechanisms that transport and distribute fine-grained sediment are relatively new areas of scientific research within Delaware estuary. At present, there is only a cursory quantitative understanding of these processes, and we do not believe the state of the science is sufficiently advanced to permit a realistic quantitative assessment (prediction) of sediment flux changes associated with a 5-ft deepening of the navigation channel.

Q) What is the potential to increased wetland loss (especially in the Delaware River) resulting from tidal amplitude shifts from deepening?

**Response:** Based on our numerical hydrodynamic modeling, the deepened 45 foot channel will not contribute to increased tidal amplitudes. As such, we do not anticipate that there will be any impact on tidal wetlands due to tidal amplitude impacts.

Q) Increased amplitude in upper Bay and River tide will result in increased depth and duration of inundation in tidal wetlands. How will this effect tidal wetland loss in the estuary?

**Response:** The statement above presumes that tidal amplitudes will increase due to the channel deepening project. However, hydrodynamic model testing reported in the 1997 SEIS did not find a statistically significant increase in tidal range associated with the modeled 45 foot channel.

Q-i) Main Channel EA: “There is a well-documented historic loss of fringing wetlands on both the NJ and DE sides of the Bay extending back to at least 1900. There are also interior areas of formerly robust tidal wetlands that have reverted to shallow open water. To the present, no consensus has emerged as to the most important factor(s) causing or contributing to these losses. At a minimum, the observed rise in mean sea level over the past century is believed to have contributed to the loss, if only from the standpoint of sea level rise occurring more rapidly than vertical accumulation of sediment has occurred, leading to more frequent or permanent inundation of wetlands.”

**Response:** Comment noted.

Q) Does the increase in fringing wetland loss coincide with the increased commercial boat traffic, which would result in large amplitude and wavelength boat wakes eroding the shoreline?

**Response:** The loss of fringing wetlands along the shorelines of Delaware Bay has been occurring at least as far back as the 1800s, when only sailing vessels and relatively small powered vessels navigated the estuary channels. The various mechanisms that contribute to the loss of these fringing wetlands are poorly understood. The channel deepening project will not result in a statistically significant increase in boat wake energy at the shoreline, and we do not believe the deepening will exacerbate a real, but poorly understood problem. Also see the response presented previously in the section titled “Changes to Ship Traffic”.

Q) With deeper channels will commercial ship traffic speeds increase, thereby potentially increasing the occurrence and magnitude of waves that would result from boat wake?

**Response:** Vessels speeds with the deepened channel will not increase as the Delaware Bay and River pilots will employ the same procedures in moving the vessels as it currently exists under the current 40-foot project.

Q) Bathymetric change analysis indicates that the subtidal volume of the estuary from Trenton, NJ, to Bombay Hook, DE, increased by 17% between 1888 and 2001 (adjusted for sea-level rise). This increase is largely due to channel deepening during 1945-1960, a project that dredged the axial shipping channel to a uniform depth of 40' along its 200-km length. An immediate response to deepening was a 0.3-1.2 m increase in tidal range between Philadelphia and the head of tides at Trenton, and a 3-hr decrease in the time of tide propagation from mouth-to-head (*Sommerfield, 2009 CERF Annual Meeting*). What will be the effect of a 47 ft navigational channel be upon the tidal amplitude and time of tidal propagation within the estuary?

**Response:** Please refer to response above. The changes in tidal amplitude between Philadelphia and Trenton were not an “immediate response to [earlier] deepening” of the 40-foot channel in 1940’s. The tidal amplitude response was observed to have occurred gradually over several decades as the channel was deepened and other man-made modifications were made to the estuary’s shorelines.

Q) Channel Deepening would increase funneling effect due to increased water volume change, and decreased bottom friction because of deeper channel.

**Response:** Comment noted.

Q) Friction is greater in shallower water, so deeper channel reduces bottom interaction of water mass.

**Response:** Comment noted.

Q) The water column experiences more drag when H<sub>2</sub>O moving faster (high tide), than low tide (slower H<sub>2</sub>O movement). This should shift the shape of the tidal curve even more to further increase estuary flood dominance (under non-storm flow conditions).

**Response:** Based on hydrodynamic model testing of the 45 foot channel, the implied hydrodynamic effects cited above will have negligible impact on living and other resources of the estuary.

Q) It is well established within the literature that when it comes to deepening an estuaries the question is not if there will be a change in circulation but rather how much will be experienced. Here are some examples of studies that have documented the relationship between deepening of estuaries to changes in salinity, hydrodynamics, sediment transport, and erosion.

**Response:** Comment noted.

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List of Attachments

- <sup>1</sup> Map of Benefiting Facilities
- <sup>2</sup> Confirmation from PADEP for the transfer of ERCs from Exelon to PRPA
- <sup>3</sup> Amendment No. 1 to the Project Partnership Agreement
- <sup>4</sup> Delaware River Main Channel Deepening Project, Comprehensive Economic Analysis Report, December 2002
- <sup>5</sup> Delaware River Main Channel Deepening Project, Supplement to Comprehensive Economic Analysis Report, February 2004
- <sup>6</sup> Delaware River Main Channel Deepening Project, Economic Update for FY 2011 Budget, December 2009