## PSEGESPEnvDocsPEm Resource

**From:** Fetter, Allen
**Sent:** Wednesday, May 06, 2015 10:36 AM
**To:** PSEGESPEnvDocsPEm Resource
**Subject:** FW: [EXTERNAL] Response to NMFS questions (UNCLASSIFIED)
**Attachments:** NMFS Response 042415.doc

-----Original Message-----
From: Bonner, Edward E NAP [mailto:Edward.E.Bonner@usace.army.mil]
Sent: Tuesday, April 28, 2015 4:14 PM
To: Fetter, Allen
Cc: Bellacima, Bryan P NAP; Jenkins, William H NAP
Subject: FW: [EXTERNAL] Response to NMFS questions (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Allen,
The attached is relative to the questions/issues raised by the National Marine Fisheries Service. I have not had a chance to review it yet but I wanted to forward it for your information and use.

Ed Bonner

-----Original Message-----
From: Gary Bickle [mailto:gbickle@akrf.com]
Sent: Friday, April 24, 2015 2:02 PM
To: Bonner, Edward E NAP
Cc: James.Mallon@pseg.com; David.Robillard@pseg.com; Jeffrey Pantazes
Subject: [EXTERNAL] Response to NMFS questions

Ed,

Per our previous discussions, please find attached our response to the NMFS data requests. The attached document has all of the information requested except for the Mason's Point Wetland Mitigation Plan. We are putting finishing touches on that plan and simply need to cover a few open items. We should have that to you by COB on Monday.

Please review the attached information and let us know if you think it covers the appropriate needs. Once you have reviewed we can then discuss how to proceed with finalizing the product.

Appreciate your help and assistance on this matter. As always feel free to contact me anytime on my cell if there are questions

Have a good weekend

Gary

Gary L. Bickle
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**Technical Response Memo**

**Response to National Marine Fisheries Service (NMFS) Request for Information**

**DRAFT (4/24/15)**



The United States Nuclear Regulatory Commission (USNRC) has prepared a Draft Environmental Impact Statement (EIS) for the potential new plant at the PSEG Site. In the fall of 2014, the NRC held public meetings in New Jersey and Delaware to solicit comments on the DEIS. At some time following the issuance of a Final EIS and the USNRC Early Site Permit (ESP), PSEG will select a reactor technology and prepare an application for a technology-specific Combined Operating License (COL). During the COL application review period, the USNRC will prepare a Supplemental EIS to address either: (1) specific data that was not available at the time the Final EIS for the ESP was prepared, or (2) new and significant information. At that time there will be additional opportunities for the public and resource agencies to provide inputs to the USNRC related to the construction of a new nuclear plant at the PSEG Site.

This technical memo addresses the comments received by the USACE from the National Marine Fisheries Service (NMFS). The NMFS comments included inquiries related to dredging impacts, potential effects on threatened and endangered species (specifically Atlantic sturgeon, shortnose sturgeon, and sea turtles), shoreline development, and wetland mitigation. Those issues are addressed in this technical memo and attachments. Based on the data and information provided, including a more detailed analysis of the potential impacts, PSEG believes that the potential new plant at the PSEG Site will not have a substantial and unacceptable impact on the aquatic resources of national importance in the Delaware Estuary / River and will not result in more than minor detrimental effects to endangered species.

The comments / questions listed below were provided by the USACE and represent the information that the USACE has requested from PSEG to address the NMFS comments.

**1. Identify amount (acreage) of wetland impacts inside and outside the diked areas.**

The acreage of wetland impacts within the diked areas that comprise the United States Army Corps of Engineer (USACE) and the PSEG Confined Disposal Facilities (CDFs) is 71.75 acres. Of this, 18.80 acres are located within the diked PSEG-owned CDF and 52.95 acres are within the USACE CDF (per USACE Jurisdictional Determination dated February 24, 2014 – See Figure 3 of the attached Mitigation Plan).

2. **Provide depth info in action areas. If > 2m, it is deepwater and there is no conversion of habitat. If depth < 2m, then PSEG is converting from a shallow water habitat to a deepwater habitat (which would warrant mitigation).**

The depth of the action areas for dredging associated with the new units is a minimum of 10 feet (3.05 meters) relative to Mean Low Water (MLW). The only areas within the action acres that are shallower than 3.05 meters comprise the existing bulkhead and rock dike that form the western boundary of Artificial Island. These areas are artificially placed rock, and not native Delaware Estuary sediments (NOAA Chart 12311). No conversion of shallow water habitat to deep water habitat will occur as part of the project.

3. **The NMFS comment letter of November 12, 2014 (sent to the US Nuclear Regulatory Commission) requests specific information, including:**

   **A. Best Management Practices (BMPs) for In-Water work**
   - **Environmental windows**
     - **Dredging**
       - **Use of closed environmental bucket dredge**
     - **Pile-driving**
   - **Use of cofferdams**
   - **Use of turbidity curtains**
   - **Use of NMFS-approved observers**
   - **Stormwater management to minimize impacts**

For practical reasons related to the transport of dredged material to the authorized CDFs at the PSEG Site and the adjacent Artificial Island USACE CDF, PSEG intends to dredge open waters using hydraulic suction dredges. In its November 12, 2014 comment letter to the USNRC, the NMFS expressed concerns about a variety of dredging methods and potential effects to listed species:

> "*Sturgeon and sea turtles can be killed by hopper dredges; sturgeon are also vulnerable to entrainment in cutterhead dredges and capture in bucket/clamshell dredges. Additionally, the turbidity associated with dredging can affect listed species and their prey. Dredging and other benthic disturbances can also result in the reduction in available prey*."

Although there is some concern that hydraulic dredges may entrain or entrap listed species, the proposed use of a hydraulic dredge would serve to reduce turbidity and sedimentation associated with dredging and would limit the extent of impacts on aquatic resources by minimizing the duration of in-water activity. Thus, while a technology such as an environmental hopper dredge may be less likely to be *directly* injurious to listed species, this method trades direct impacts for increased work duration, increased turbidity, and additional (or double) handling of the material for disposal. In addition, it is expected that some dredging will be coincident with the pile driving activities described above – sturgeon avoiding the near-field areas ensonified by pile driving sounds would not be susceptible to

dredge impacts. Nevertheless, suction/hydraulic dredging could entrain or impinge juvenile fish, fish larvae, and eggs during certain times of the year. To address this potential impact, resource management agencies have established specific-windows during which in-water work is permitted. PSEG will adhere to the seasonal in-water timing restrictions that are imposed by the USACE and NJDEP for dredging and other in-water work.

Other BMPs for dredging, including cofferdams and turbidity curtains, are expected to be impractical for the project location due to the high ambient turbidity concentrations (Artificial Island is at or near the turbidity maximum in the Delaware Estuary - PSEG 1999, Cook at al 2006), strong currents, and the need for other vessels to transit the area. Finally, the construction of the new units will employ appropriate soil erosion and sediment control measures to prevent stormwater from impacting aquatic resources.

**B. Pile driving and acoustic analyses**

- **Types**
  - **steel**
  - **concrete**
  - **wood**
- **Number**
  - **sheet piles**
  - **pipe piles**
- **Size**
  - **length of sheet piles**
  - **diameter of pipe piles**
- **Installation**
  - **time of year**
  - **days per week**
  - **hours per day**
  - **drive time per pile**
  - **single or multiple piles driven at one time**
  - **types of substrate**
  - **water depths where pile driving would occur (bathymetry)**
  - **vibratory hammer or impact hammer**
    - **vibrate**
    - **impact — implementation of noise attenuation systems**
    - **ramp up or soft start method warning strikes**

Relevant piling data are summarized in Table 1.

To facilitate USACE and NMFS review of these data, PSEG has also assessed the acoustic footprint of pile installation so that its potential impact to aquatic fish and other listed species (e.g., sea turtles) can be readily evaluated.

To assess the potential effects of underwater noise generated during impact pile driving, relevant information from Table 1 was compiled to identify appropriate representative data

for acoustic propagation in the marine environment. Critical input parameters included pile size and composition (e.g., concrete, steel, etc.), method of driving (e.g., vibratory versus impact), and distance at which acoustic data were collected. The California Department of Transportation (Caltrans) has developed a compendium of acoustical data associated with various pile driving projects, and direct analogs to the anticipated piling for the new unit were identified (Caltrans 2012).

PSEG used acoustical data from representative pile-driving studies, along with expected blow counts, to develop estimates of underwater-noise isopleths for the Peak Sound Pressure Level ($SPL_{peak}$), Cumulative Sound Exposure Level ($SEL_{cum}$), and Behavioral Root Mean Square Sound Pressure Level ($SPL_{rms}$). These were populated into each unique pile installation scenario into the NMFS's Pile Driving Calculations spreadsheet model (provided to PSEG by the USACE). The NMFS model calculates the distance within which the NMFS-established underwater noise criteria are exceeded.

The criteria for fish are as follows:

206 dB re: 1μPa $SPL_{peak}$,
187 dB re: 1μPa$^2$·s $SEL_{cum}$, and,
150 dB re: 1μPa $SPL_{rms}$.

For estimates of the $SPL_{peak}$ and $SPL_{rms}$ noise isopleths, the model assumes that 150 dB is the effective quiet level, and applies a Practical Spreading Loss model following the equation:

$TL = 15*\log(R_1/R_0)$, where:

TL = Transmission loss, and
$R_1/R_0$ = The ratio of measured sound pressure levels at two distances from a reference source.

This analysis preserved NMFS model's default transmission loss constant at 15, which is the conservative value when site-specific transmission loss has not been measured. In estimating the size of the noise isopleth for the 187 dB re: 1μPa$^2$·s $SEL_{cum}$, the model explicitly account for the number of pile driving strikes per day, which are included as a variable for calculating Cumulative SEL and Behavioral RMS distances. Table 2 presents these data for the PSEG proposed piling scenarios that are detailed in Table 1. Project location and type of construction, as well as the distance from the source to the hydrophone for the representative acoustic data used in the analysis are also presented in Table 2.

Based on the NMFS model, the 206 dB $SPL_{peak}$ is only exceeded immediately adjacent to pile driving activity. For all expected pile driving activity (in-water vibratory driven steel sheet piles, land-side impact driven steel pipe piles, and marsh plain driven concrete causeway piles), the maximum extent of the SPL 206 dB $SPL_{peak}$ is within only 3.9 meters (13 feet) of the source.

For the 187 dB $SEL_{cum}$, the distance from the source for the proposed causeway within which the criterion is exceeded is 216 meters (709 feet); however, this distance includes

mostly vegetated marsh plain and shallow marsh creeks which are not habitat for Atlantic or shortnose sturgeon. For the “worst case” scenario (8,000 strikes per day for land-side 14” steel pipe cooling tower pilings), the maximum distance in the Delaware River within which the 187 dB $SEL_{cum}$ is exceeded in the Delaware River is 431 meters (1,414 feet). This is 12.8% of the width of the Delaware River at Artificial Island (Figure 1). The isopleths presented in Figure 1 are conservative in that they assume sound is radiated from the entire project area rather than from a more localized area of construction (where much smaller, circular isopleth bands would be expected).

The “worst case” scenario analyzed above is highly conservative with respect to potential impacts to either Atlantic or shortnose sturgeon. First, the “worst case” 187 dB $SEL_{cum}$ distance was projected from the shoreline into the Delaware River – in practice, most of these land-side piles will be driven at a greater distance landward of the shoreline, serving to attenuate sound and reduce the distance into the river into which the SEL criterion is exceeded. In addition, recent analysis and a NMFS Biological Opinion for the New NY Bridge (to replace the existing Tappan Zee Bridge) indicates that for Atlantic and shortnose sturgeon, behavioral responses to in-water pile driving sounds causes these species to avoid underwater noise from impact pile driving, which makes it less likely that sturgeon would be exposed to 187 dB $SEL_{cum}$ (NMFS 2012).

In the case of the New NY Bridge on the Hudson River, technical analyses conducted as part of the assessment of underwater noise impacts to sturgeon and evaluated by NMFS in its Biological Opinion (2014) provided adequate support for NMFS to rely only on the 206 dB $SPL_{peak}$ criterion (i.e., the area ensonified by 206 dB or greater) for estimating incidental take of Hudson River sturgeon, and did not consider the cumulative criterion. Based on project-specific data, NMFS determined that sturgeon will avoid pile driving and will therefore not remain in proximity during active pile driving long enough to accumulate sufficient sound energy to reach the cumulative criterion. The recognition was supported by project-specific pile driving noise measurements and a study of acoustically tagged Atlantic sturgeon that was conducted in the project vicinity during a pre-construction pile demonstration project

A Pile Installation Demonstration Project (PIDP) that was conducted following the predictive impact analysis for the New NY Bridge project indicated that the spatial extent of pile-driving noise with noise attenuation in place was considerably smaller than that projected by prior modeling. As a result, empirical noise data measured during the PIDP were used to recalculate potential sturgeon take (NMFS BO 2014). Results showed that fewer sturgeon were detected during pile driving activity, and stayed in the area for a less time during pile driving than during silent control periods. Moreover, the short amount of time spent by sturgeon in the vicinity of pile driving suggests that those sturgeon were unlikely to have reached the cumulative sound exposure criterion. These results suggest that sturgeon avoid areas ensonified by impact pile-driving and do not remain nearby long enough to experience physiological effects. Thus, this study provided empirical evidence for NMFS to conclude that the $SPL_{peak}$ criterion is the best metric for assessing the potential impacts of pile-driving noise on sturgeon and other fish species in the project vicinity. The NY State Department of Environmental Conservation (DEC) also relied on these analyses using the peak criterion to develop allowable sturgeon take for their incidental take permit.

The $SEL_{cum}$ criterion would not be expected to affect Atlantic or shortnose sturgeon in the Delaware River near the new unit construction. The $SEL_{cum}$ zone does not form an up-river/downriver migration or movement barrier because it only extends to a maximum of 12.8% of the River’s width, and sturgeon have exhibited a documented behavioral avoidance response to pile driving sounds that makes it unlikely that they will be exposed to noise levels as great as 187 dB $SEL_{cum}$.

For the 150 dB $SPL_{rms}$ criterion (considered by NMFS to be the threshold at which fish may begin to avoid underwater noise), the zone within which this criterion is exceeded for the causeway piles extends up to 1,165 meters (3,825 feet) from the source. For the causeway, this zone comprises mostly vegetated marsh plain and shallow marsh creeks, as well as a shallow (<2’ at MLW) Delaware River embayment east of Artificial Island.[1] For vibratory shoreline steel sheet pile installation at Artificial Island, the zone of RMS exceedance extends out to 74 meters (243 feet) from the source into the Delaware River. For the “worst case” land-side cooling tower pilings, the RMS criterion is exceeded out to 2,000 meters (6,562 feet) from the source into the Delaware River. This represents 47% of the river width at this location (Figure 1). The “worst case” is conservative in that it assumes all pile driving would occur along the shoreline, but in practice, most pilings would be a substantial distance from the shoreline (to landward). While Atlantic and shortnose sturgeon exhibit active behavioral avoidance to pile driving sounds, the Behavioral RMS zone does not represent a blockage to upriver/downriver movement or migration in light of the large portion of the river that would fall below the effective quiet level of 150 dB.

**C. Vessels**

- **Types and dimensions used for installation activities (causeway, barge slip, intake and discharge installation)**
  - **Crane, construction, and material barges**
  - **hopper scows**
  - **workboats**
  - **tugboats**
- **Draft of vessels**
  - **navigational clearance (i.e., depth of water and draft of the vessel)**
- **Speed of vessels**
- **Duration of vessel traffic**
- **Number of vessel trips to and from Federal navigational channel**

Relevant data on the projected construction-related vessel traffic are presented in Table 3.

To facilitate USACE and NMFS review of these data, PSEG has assessed the potential for vessel collisions/strikes and vessel-related underwater noise to adversely affect Atlantic sturgeon, shortnose sturgeon, or other listed aquatic species (e.g., sea turtles).

[1] Neither Atlantic nor shortnose sturgeon would be expected to frequent the relatively shallow Alloway Creek or its tributaries – as such, causeway activities should not affect these species.

First, in order to assess how the project's increase in vessel traffic during the construction period compares to routine Delaware River shipping traffic (in terms of number of trips), the Maritime Exchange for the Delaware River and Bay (MEDRB) Delaware River Ports Vessel Arrival Statistics Annual data were queried for the period of 2007 through 2014. These data include the number of revenue trips for commercial traffic and associated tugboats, but do not include data on private vessels not engaged in commerce, support/pilotage vessels, military vessels, ferries, fishing vessels, etc. The MEDRB data for the reporting period are summarized in Table 4.

The mean number of annual trips taken by commercial vessels in the Delaware River for the period analyzed is 4,485 (+/- 1 standard deviation of 419), with a maximum number of trips reported as 5,274 and a minimum number of trips reported as 4,096. The estimated number of annual trips for the PSEG New Unit project is approximately 300 to 310. The incremental increase is well within the range of routine maritime commerce on the River, and is also within one standard deviation of routine traffic volume. Therefore, based simply on the number of trips, no statistically significant increase in sturgeon collision/strikes would be anticipated above background levels.

Second, to assess the probability of project-related vessel traffic to approach within one-meter of the river bottom (the depth at which the bottom-oriented sturgeon spend the majority of time), the deepest draft vessels (those approaching two feet from the bottom at MLW) were evaluated based on local tide data to determine the frequency at which their hulls or propellers could be in the near-bottom zone. A query of NOAA tide data for the Reedy Point, Delaware gage (Station No. 8551910), referenced to local MLW elevation, is presented in Figure 2. Figure 2 also shows (relative to MLW) the depth of the deepest draft project vessels – that is, within two feet of the bottom plus one foot to account for the one-meter, or approximately three feet, sturgeon impact depth. In terms of percent of the time, and discounting operational factors that affect vessel movement into and out of the project area, the temporal distribution of the tidal elevations suggest that vessels could be within one meter of the bottom in the project area approximately 27% of the time.

When applied to the deepest draft vessels (from Table 3), of the projected 195 deep draft annual trips in the project area, only 53 could occur close enough to the bottom to physically contact sturgeon. In practice, this estimate is very conservative since the deepest draft vessels typically are used for the delivery of the largest, heaviest (and extremely high value / long lead time) power plant components (e.g., reactor vessels, steam generators, reactor heads, steam turbines, etc.). Delivery of these critical components necessitates extreme conservatism on the part of vessel operators and will be timed to coincide with high tides to avoid vessel grounding. They would also occur during calm weather to facilitate maneuvering, and vessels typically will be travelling slowly to maintain precise control. As such, the likelihood of any sturgeon strikes from the deeper draft vessels is low.

Finally, with respect to noise radiated from the construction vessels, a plausible upper bound has been established based on a literature review. McKenna et al. (2012) provide source sound pressure levels for a number of vessels, and these researches also included Peak SPL dB, SEL, and RMS data for container ships, bulk carriers, and tankers of various sizes and various speeds. As an upper limit, the highest source level (1-meter) Peak SPL

associated with a 298 meter (977 foot) container ship traveling at 11.7 m/s (22.7 knots) was 188.1 dB. Source levels for this large vessel are well below the NMFS Peak SPL criterion of 206 dB, and are only slightly above the Cumulative SEL criterion of 187 dB. When assessed using the NMFS spreadsheet model, the radius of the Behavioral RMS criterion of 150 dB for this ship is around 340 meters, or 1,118 feet. The radius for operating tugboats would be substantially smaller. For example, Mazzuca (2001) provides source levels for a 25 meter (82 foot) tugboat pulling an empty barge between 145 and 170 dB (depending on frequency band). These levels are well below the NMFS Peak SPL and Cumulative SEL levels, and when assessed using the NMFS spreadsheet model, exhibit a maximum Behavioral RMS (150 dB) zone of only 10.9 meters (36 feet). Along with a visual assessment of pile driving sounds, Figure 1 includes a visual assessment of vessel related sounds for a large, relatively fast container ship, as well as a (hypothetical) tugboat more similar to those that would be used for project construction.

**D. Dredging**

- **Mechanical and/or Hydraulic — what each would involve; need separate descriptions for each kind of technology**
- **Description of dredge operations and material management, including mitigative measures (for turtles/sturgeon)**

For practical reasons related to the transport of dredged material to authorized CDFs at the site, PSEG intends to dredge open waters using hydraulic suction dredges. In its November 12, 2014 comment letter to the USNRC, the NMFS expressed concerns about a variety of dredging methods and potential effects to listed species:

> "*Sturgeon and sea turtles can be killed by hopper dredges; sturgeon are also vulnerable to entrainment in cutterhead dredges and capture in bucket/clamshell dredges. Additionally, the turbidity associated with dredging can affect listed species and their prey. Dredging and other benthic disturbances can also result in the reduction in available prey*."

Although there is some concern that hydraulic dredges may entrain or entrap listed species, the proposed use of a hydraulic dredge would serve to reduce turbidity and sedimentation associated with dredging and would limit the extent of impacts on aquatic resources by minimizing the duration of in-water activity. Thus, while a technology such as an environmental hopper dredge may be less likely to be *directly* injurious to listed species, this method trades direct impacts for increased work duration, increased turbidity, and additional (or double) handling of the material for disposal. In addition, it is expected that some dredging will be coincident with the pile driving activities described above; hence sturgeon avoiding the near-field areas ensonified by pile driving sounds would not be susceptible to dredge impacts. Nevertheless, suction/hydraulic dredging could entrain or impinge juvenile fish, fish larvae, and eggs during certain times of the year. To address this potential impact, resource management agencies have established specific-windows during which in-water work is permitted. PSEG will adhere to the seasonal in-water timing restrictions that are imposed by the USACE and NJDEP for dredging and other in-water work.

4. **USACE needs PSEG "mitigation plan" per 2008 Rule, public lands (coastal wetlands) for mitigation measures (Mason's Point property).**

PSEG has developed a preliminary mitigation plan for the Mason's Point impoundment, located in Elsinboro Township, Salem County, NJ (Attachment 1). The mitigation plan continues to be advanced, and when PSEG moves closer to selecting a reactor technology and refining impacts to regulated resources, the mitigation plan will also be refined as new data are collected and analyzed.

5. **Land Use description in ER does not include open water, but this term is used in other ER sections. Need resolution of what impacts are occurring in open water, and where this open water occurs. Are the small marsh creeks (tidal drainage) that may be filled on site as described in the ER in fact part of the wetland impacts?**

The use of the term "open water" within the ER included areas of intertidal shallows and small tidal marsh creeks. Because these areas are intertidal, their official designation in terms of impact areas were in the wetland calculations and are inclusive to the total wetland impact number.

For clarification purposes, the area in the vicinity of the proposed 4,495 foot bulkhead was also considered to be intertidal and was consequently included within the wetland impact area. Accordingly, the only open water fill areas per the ESP included standing waters within CDF areas of the proposed site.

**References**

California Department of Transportation (CalTrans). 2012. Compendium of Pile Driving Sound Data. Prepared by: Illinworth & Rodkin, 505 Petaluma Blvd. South, Petaluma, CA 94952. Contact: James Reyff

Cook, T. L., C.K. Sommerfield, K. Wong. 2006. Observations of tidal and springtime sediment transport in the upper Delaware Estuary. Estuarine, Coastal, and Shelf Science. 27: 235 – 246

Mazzuca L.L. 2001. Potential Effects of Low Frequency Sound (LFS) from Commercial Vessels on Large Whales. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Marine Affairs, University of Washington 2001. Program Authorized to Offer Degree: School of Marine Affairs

McKenna, M.F., D. Ross, S. M. Wiggins, and J.A. Hildebrand. 2012. Underwater radiated noise from modern commercial ships. J. Acoust. Soc. Am. 131 (1), January 2012. Pp. 92 – 103.

National Marine Fisheries Service (NMFS). 2014. Biological Opinion for the Tappan Zee Bridge Replacement Project. NER2014-11317. September 23, 2014.

PSEG Nuclear LLC (PSEG). 1999. Application for Renewal of NJPDES Permit No. 0005622, submitted to NJDEP March 4, 1999.

# Table 1 – Projected Pilings by Type, Material, Size, Number, and Location for the PSEG New Unit

**PSEG Power / Nuclear - New Plant at PSEG Site** **Piling Details**

| | | Causeway (Note 6) | Intake Structure | Haul Road Bulkhead | Haul Road Deadmen | Cooling Towers (2) | Office Structures (Note 9) | Support Structures (Note 10) | Switchyards and Electrical Substations (Note 11) | Concrete Batch Plant | Pump Houses, Auxiliary Boiler, and Other Yard | Caissons (7) (Note 7) | Cofferdams for Outfall and StormDrains | Main Powerblock Excavation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of Piles** | | 1000 | 650 | 2400 | 2400 | 6000 | 1000 | 1000 | 500 | 75 | 250 | 1200 | 320 | 4500 |
| **Pile Type (Notes 1 to 4)** | | Concrete | Sheeting | Sheeting | Sheeting | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Sheeting | Sheeting | Sheeting |
| **Diameter/Size** | | 30" x 30" | N/A | N/A | N/A | 14" | 14" | 14" | 14" | 14" | 14" | N/A | N/A | N/A |
| **Sheeting linear feet** | | N/A | 1200 LF | 4500 LF | 4500 LF | N/A | N/A | N/A | N/A | N/A | N/A | 2200 LF | 600 LF | 8500 LF |
| **Driven Length (ft)** | | 100 | 75 | 50 | 15 | 120 | 120 | 120 | 120 | 120 | 120 | 50 | 25 | 125 |
| **Type of Hammer** | | Impact | Vibratory | Vibratory | Vibratory | Impact | Impact | Impact | Impact | Impact | Impact | Vibratory | Vibratory | Vibratory |
| **Distance to Water (feet)** | | Note 8 | N/A | N/A | 22 | 1100 | 3500 | 1100 | 2400 | 775 | 110 | N/A | N/A | 225 |
| **Substrate (Surface, Lower)** | | Holocene Silt/Organic, Sand | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels | Fill, Sand, Gravels |
| **Water Depth (MLW)** | | 0 - 12' | 12 | 12 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 15 | 12 -15 | N/A |
| **Installation Details** | | | | | | | | | | | | | | |
| **Driving Timeframe** | | Days | Days | Days | Days | Days | Days | Days | Days | Days | Days | Days | Days | Days |
| **Hours/week** | | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| **Piling Limitations** | | No Limit | 3/1 - 6/30 Exclusion | 3/1 - 6/30 Exclusion | No Limit | No Limit | No Limit | No Limit | No Limit | No Limit | No Limit | 3/1 - 6/30 Exclusion | 3/1 - 6/30 Exclusion | No Limit |
| **Number of Rigs** | | 2 | 1 | 2 | 2 | 4 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 4 |
| **Drive Time per Pile** | | .5hr | 12 LF/hr | 12 LF/hr | 30 LF/hr | 0.75 | 2 | 2 | 2 | 2 | 2 | 12 LF/hr@ | 30 LF/hr | 30 LF/hr |
| **Blows per Pile** | | 125 - 275 | Vibratory | Vibratory | Vibratory | 400^ | 400^ | 400^ | 400^ | 400^ | 400^ | Vibratory | Vibratory | Vibratory |
| **Piles per Day** | | 20 | 120LF/d | 240LF/d | 600LF/d | 20 | 8 | 8 | 8 | 4 | 4 | 120LF/d | 600LF/d | 1200LF/d |
| **Blows per Day** | | 5500 | | | | 8000 | 3200 | 3200 | 3200 | 3200 | 3200 | | | |
| **Mitigating Measures** | | Additional Cushioning (see Note 4) | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 | See Note 5 |

**Notes**

1 Steel pipe piles are 14" diameter, concrete filled. They are nominally driven to an approximate depth of 120' for permanent facilities. This is based on the criteria used for Hope Creek construction.
2 Steel pipe piles for temporary facilities (i.e batch plant, some construction support facilities, etc.) may be driven to shallower depths depending on load and soil characterisitics.
3 Sheet piles will be one of the following sections and (widths): PZ 35 (22.64 inches), PZC 26 (27.88 inches, or AZ 25 (24.80 inches). The number of sheet piles conservatively uses 22.64 inch (1.89 feet) width piles.
4 Concrete piles are driven with additional cushioning to reduce pile head damage; this also reduces sound energy transfer. Concrete piles are prestressed / precast.
5 Sound reduction techniques will be evaluated during contracting based on pile type, substrate conditions, etc. and will be implemented as appropriate
6 Causeway design per Gannett Fleming structure evaluation. No. of piles may be reduced in final design.
7 Caissons are 20 feet in diameter
8 Causeway pier locations as noted in USACE Section 10/404 application. Most are in open marsh excepting crossing of Alloway Creek where there will be two open water piers.
9 Office structures includes both temporary and permanent offices, change houses, first aid facilities etc.
10 Support structures includes warehousing and laydown, various yard buildings that house testing labs, welding shops, materials staging facilities and fabrication buildings.
11 Two switchyards are included in the design. A-Frames, Equipment Racks and Transformer Foundations are piled.

# Table 1 – Projected Pilings and Acoustic Data for the PSEG New Unit

**PSEG Power / Nuclear - New Plant at PSEG Site** **Piling Acoustic Analysis**

| | | Causeway | Intake Structure | Haul Road Bulkhead | Haul Road Deadmen | Cooling Towers (2) | Office Structures | Support Structures | Switchyards and Electrical Substations | Concrete Batch Plant | Pump Houses, Auxiliary Boiler, and Other Yard Buildings | Caissons (7) | Cofferdams for Outfall and StormDrains | Main Powerblock Excavation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Location** | | **Marsh and Creeks** | **In-Water** | **In-Water** | **Land** | **Land** | **Land** | **Land** | **Land** | **Land** | **Land** | **In-water** | **Land / In-water** | **Land** |
| **Pile Type** | | Concrete | Sheeting | Sheeting | Sheeting | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Steel Pipe | Sheeting | Sheeting | Sheeting |
| **Diameter/Size** | | 30" x 30" | N/A | N/A | N/A | 14" | 14" | 14" | 14" | 14" | 14" | N/A | N/A | N/A |
| **Acoustic Data Surrogate** | | 24" Octagonal Concrete - Impact (land) | 24" Steel Sheet - Vibratory (water) | 24" Steel Sheet - Vibratory (water) | 24" Steel Sheet - Vibratory (water) | 14" Steel Pipe - Impact (water) | 14" Steel Pipe - Impact (water) | 14" Steel Pipe - Impact (water) | 14" Steel Pipe - Impact (water) | 14" Steel Pipe - Impact (water) | 14" Steel Pipe - Impact (water) | 24" Steel Sheet - Vibratory (water) | 24" Steel Sheet - Vibratory (water) | 24" Steel Sheet - Vibratory (water) |
| **Peak dB** | **206** | 192 | 177 | 177 | 177 | 196 | 196 | 196 | 196 | 196 | 196 | 177 | 177 | 177 |
| **Cumulative SEL dB (<2cm)** | **183** | 174 | 163 | 163 | 163 | 170 | 170 | 170 | 170 | 170 | 170 | 163 | 163 | 163 |
| **Cumulative SEL dB (>2cm)** | **187** | 174 | 163 | 163 | 163 | 170 | 170 | 170 | 170 | 170 | 170 | 163 | 163 | 163 |
| **Behavior RMS dB** | **150** | 181 | 163 | 163 | 163 | 180 | 180 | 180 | 180 | 180 | 180 | 163 | 163 | 163 |
| **Distance of measurement** | | 10 m (land) | 10 m | 10 m | 10 m | 20 m | 20 m | 20 m | 20 m | 20 m | 20 m | 10 m | 10 m | 10 m |
| **Source** | | CALTRANS (Berth 22, Oakland) | CALTRANS (Berth 35/37, Oakland) | CALTRANS (Berth 35/37, Oakland) | CALTRANS (Berth 35/37, Oakland) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Richmond/SanRafael Bridge) | CALTRANS (Berth 35/37, Oakland) | CALTRANS (Berth 35/37, Oakland) | CALTRANS (Berth 35/37, Oakland) |
| **Effect Distances - Meters (NMFS Model)** | | | | | | | | | | | | | | |
| **Peak dB** | | 1 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 0 | 0 | 0 |
| **Cumulative SEL dB (<2cm)*** | | 398 | 74 | 74 | 74 | 431 | 431 | 431 | 431 | 431 | 431 | 74 | 74 | 74 |
| **Cumulative SEL dB (>2cm)*** | | 216 | 40 | 40 | 40 | 431 | 431 | 431 | 431 | 431 | 431 | 40 | 40 | 40 |
| **Behavior RMS dB** | | 1166 | 74 | 74 | 74 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 74 | 74 | 74 |
| **Effect Distances - Feet (NMFS Model)** | | | | | | | | | | | | | | |
| **Peak dB** | | 3 | 0 | 0 | 0 | 13 | 13 | 13 | 13 | 13 | 13 | 0 | 0 | 0 |
| **Cumulative SEL dB (<2cm) *** | | 1306 | 243 | 243 | 243 | 1414 | 1414 | 1414 | 1414 | 1414 | 1414 | 243 | 243 | 243 |
| **Cumulative SEL dB (>2cm) *** | | 709 | 131 | 131 | 131 | 1414 | 1414 | 1414 | 1414 | 1414 | 1414 | 131 | 131 | 131 |
| **Behavior RMS dB** | | 3825 | 243 | 243 | 243 | 6562 | 6562 | 6562 | 6562 | 6562 | 6562 | 243 | 243 | 243 |
| **Percent of River Width (Behavior RMS)** | | N/A | 2% | 2% | 2% | 47% | 47% | 47% | 47% | 47% | 47% | 2% | 2% | 2% |

* N/A Based on The New NY Bridge (Tappan Zee) NMFS Biological Opinion

Table 3 – Projected construction vessels by type, draft, and duration for the PSEG New Unit.

**PSEG Power / Nuclear - New Plant at PSEG Site** **Vessel and Dredging Details**

| | Bulk Material Delivery | Equipment Delivery | Work Craft | Work Craft | Work Craft | Work Craft | Dredges | Work Craft Causeway | Work Craft Causeway |
|---|---|---|---|---|---|---|---|---|---|
| **Vessel Type** | Scow Barge | Barge | Barge | Tugboat | Service | Crane Barge | Note 7 | Service and Tugboats | Barges and Cranes |
| **Material Quantities** | 9.8M Cubic Yards | Maximum load 1265 tons | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Vessel Capacity** | 3400 Cubic Yards | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **No. of Vessel Trips to / from Federal Channel** | 2900 | 200 | 25 | 250 | 250 | 250 | 6 (Note 7) | 30 (Note 8) | 15 (Note 8) |
| **Maximum Vessel Draft (See various Notes)** | 11 feet | 6 feet | 10 feet | 10.5 feet | 8 feet | 6 feet | 10 feet | 10 feet | 6 feet |
| **Navigational Clearance** | Minimum 2 feet at MLW | Minimum 7 feet at MLW | Minimum 7 feet at MLW | Minimum 2 feet at MLW | Minimum 4 feet at MLW | Minimum 7 feet at MLW | Minimum 7 feet at MLW | Minimum 2 feet at MLW | Minimum 7 feet at MLW |
| **Vessel Speed (Note 9)** | 1 to 7 knots | 1 to 7 knots | 4 to 7 knots | 4 to 7 knots | 4 to 7 knots | 4 to 7 knots | 4 to 7 knots | 4 to 7 knots | 4 to 7 knots |
| **Vessel Traffic Duration** | 3 to 5 years | 3 to 7 years | 3 to 7 years | 3 to 7 years | 3 to 7 years | 3 to 7 years | 3 to 7 years | 1 to 2 years | 1 to 2 years |
| **Annual Trips** | 145 | 28.6 | 3.6 | 35.7 | 35.7 | 35.7 | 0.9 | 15 | 7.5 |
| | | | | | | | | **Total** | **308** |

**Notes**

| | |
|---|---|
| **1** | Material Delivery barges will generally be rafted in groupings up to six. For mooring at the barge facility, they will be rafted in groupings up to 15. Material quantity based on 8,800,000 Cubic Yards of fill materials, 750,000 cubic yards of concrete aggregate, and 250,000 cubic yards of miscellanious bulk materials. |
| **2** | Equipment Delivery by water will consist of plant modules and large components (e.g. Reactor Vessel, Steam Generators, Turbine - Generator components, Heat Exchangers, and prefabricated modules |
| **3** | Material handling barges will be nominally up to 200' x 35' with a depth of 13'. Fully loaded the draft of these scow barges is 11 feet. Note that this size barge is not readily available in the Mid - Atlantic region and smaller materials barges (with shallower drafts) will potentially be used. Dredge depths in the barge unloading / transit area allow for at least 2 feet of clearance for the deepest draft barges at MLW. |
| **4** | Equipment barges will be nominally up to 250' by 72' with a depth of 16'. Fully loaded the draft of these barges, using the heaviest equipment / module, is less than 6 feet. The material handling barge draft governs. |
| **5** | The intake area dredging is for a 600' by 300' structure and approach area. The finished depth will be -19'10" or 17'2" below MLW elevation of -2'8". This is an average dredging depth of 1.5 feet over 31 acres or 225,000 cubic yards. |
| **6** | The barge facility dredging will average 4.5 feet depth reduction over 61 acres or 440,000 cubic yards. The finished depth will be -16'4" or 13'6" below MLW elevation of -2'8". |
| **7** | The types of dredges have not been determined and will be evaluted during final design. The use of hydraulic / cutterhead dredges is conservatively assumed based upon the proximity to the disposal areas on Artificial Island. The number of dredge trips is based on three dredges working for two separate work periods. |
| **8** | Causeway construction related vessel traffic is limited to work associated with the crossing of Alloways Creek. The number of trips is conservatively estimated at 15 for barges (with beams and cranes) and 30 for service and tugboats. |
| **9** | Speeds are noted after a vessel has left the Federal Navigation Channel. Speeds will slow to headway (1 to 2 knots) within 500 feet of the mooring / work areas for barges; speeds for tugboats and service craft will vary. |
| **10** | Tugboats vary in size; typically tugs range up to approximately 100' in length, 30' in beam, and have drafts up to approximately 10.5 feet. Tugboat drafts will be limited to provide a minimum of 2 feet clearance to the dredged bottom when operating. |
| **11** | Dredges vary in size, with registered lengths ranging from 160' to 270' with beams ranging from 41' to 65'. Drafts vary. Specific equipment will be determined during final design and contracting. |
| **12** | Work barges vary in size. They range up to approximately 300' in length with beams of up to 50'. Drafts vary but are usually generally shallow (5' to 10'). |
| **13** | Work and Service vessels also vary in size. The typical service vessel ranges from approximately 40' to 65' with beams up to 15' to 18'. Drafts are generally shallow at 5' to 8'. |

Table 4 – Reported Commercial Traffic in the Delaware River from 2007 through 2014

| Delaware River Maritime Traffic (Revenue Trips Only)* | | | |
|---|---|---|---|
| **2007** | Ships | 2663 | |
| | Tugs | 2611 | 5274 |
| **2008** | Ships | 2524 | |
| | Tugs | 2474 | 4998 |
| **2009** | Ships | 2196 | |
| | Tugs | 2174 | 4370 |
| **2010** | Ships | 2068 | |
| | Tugs | 2028 | 4096 |
| **2011** | Ships | 2196 | |
| | Tugs | 2171 | 4367 |
| **2012** | Ships | 2091 | |
| | Tugs | 2076 | 4167 |
| **2013** | Ships | 2171 | |
| | Tugs | 2133 | 4304 |
| **2014** | Ships | 2172 | |
| | Tugs | 2135 | 4307 |

***Source - Maritime Exchange for the Delaware River and Bay (MEDRB) Delaware River Ports Vessel Arrival Statistics Annual data**
**Does not include: Private vessels not engaged in commerce, support/pilotage vessels, military vessels, ferries, fishing vessels, etc.**

| | Mean | Minimum | Maximum | Project Trips/Year | **308** |
|---|---|---|---|---|---|
| | **Mean** | **Minimum** | **Maximum** | | **Project Increase over Mean** |
| | **4485** | **4096** | **5274** | | **4793** |
| | Delta | **-8.7%** | **17.6%** | | **6.9%** |

| -1 S.D. | + 1 S.D. |
|---|---|
| **4066** | **4905** |

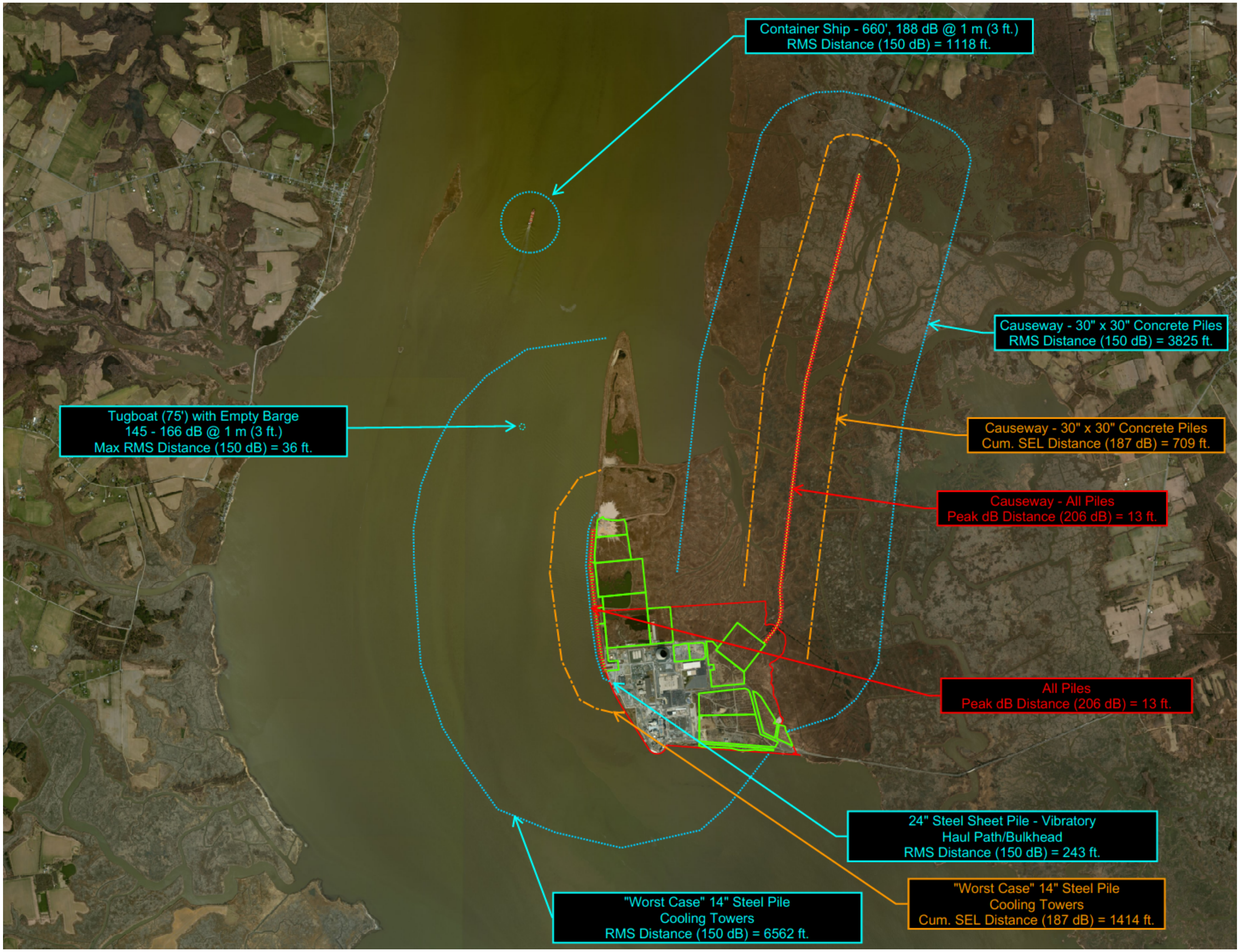


Figure 1 – Sound propagation for in-water and nearshore construction activities for PSEG's New Units.

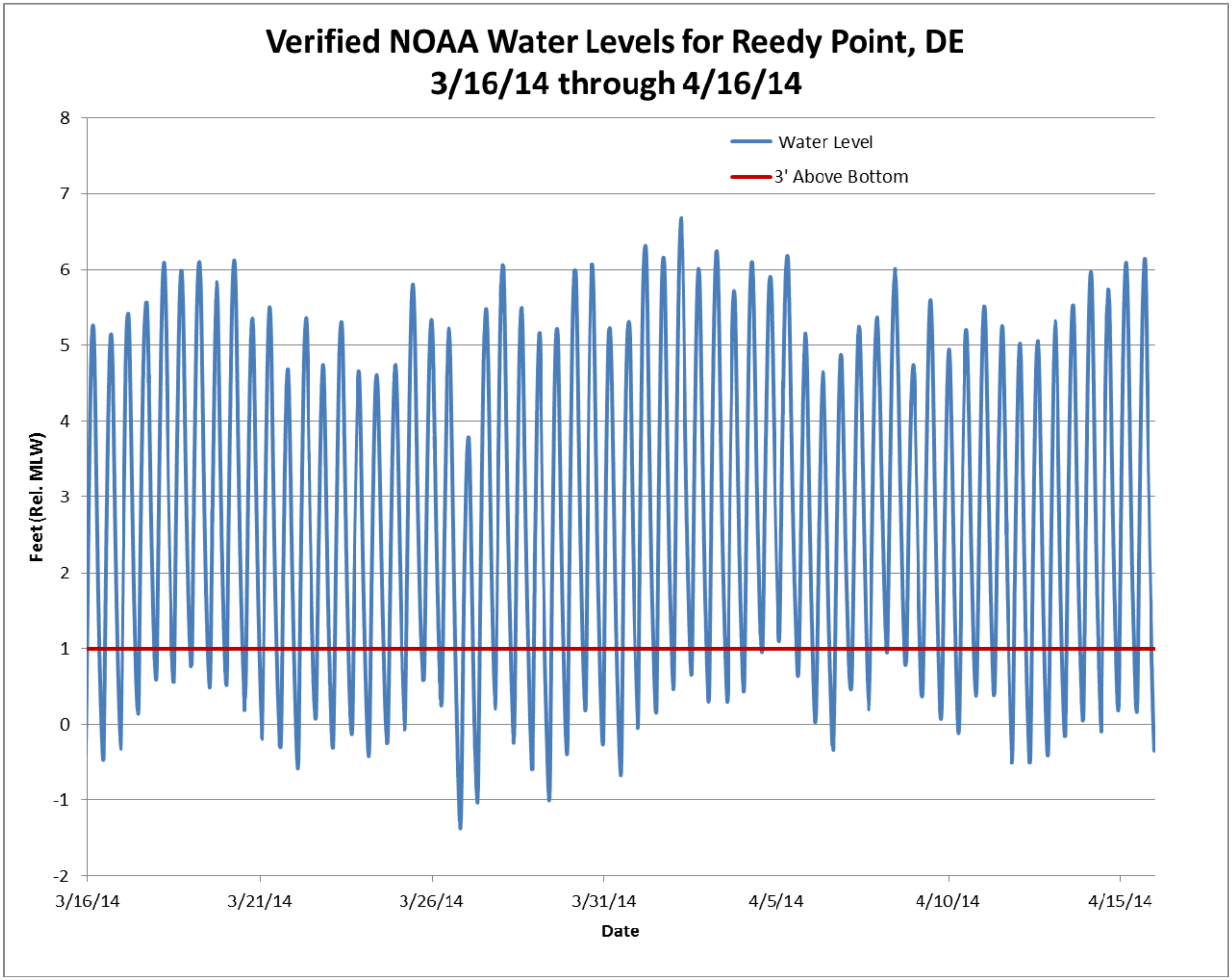


Figure 2 – Water levels relative to MLW. The red line indicates the project's deepest draft vessels within 3' (1 meter) of the bottom.