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LETTER AND COMMENTS FROM U S EPA REGION I REGARDING REVISED SEDIMENT TRANSPORT MODEL FOR GOULD ISLAND NS NEWPORT RI
2/13/2012
U S EPA REGION I

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION I**
5 Post Office Square, Suite 100
Boston, MA 02109-3912

February 13, 2012

Ms. Maritza Montegross
NAVFAC MIDLANT (Code OPNEEV)
Environmental Restoration
Building Z-144, Room 109
9742 Maryland Avenue
Norfolk, VA 23511-3095

Re: Revised Sediment Transport Model for Gould Island

Dear Ms. Montegross:

Thank you for the opportunity to review the revised Sediment Transport Model for Gould Island. Detailed comments are provided in Attachment A.

EPA consulted with Dr. Zeki Demirbilek at ERDC-CHL, a wave modeling expert and developer of CGWAVE, BOUSS-2D and CMS-Wave models, to review the wave modeling using CGWAVE described in this report. I have referenced his comments as '(Demirbilek, 2012)'. Dr. Demirbilek is willing to participate in a conference call with the Navy. He is also willing to review the input files used in the CGWAVE and STWAVE modeling and provide specific comments on the model setup and parameterization if desired. EPA believes that his input would be very valuable to the team

The wave-induced bed shear stresses reported in Table 7 seem too low for the simulated wave conditions in Stillwater Basin. Since the equations used to calculate wave-induced bed shear stresses were not included in the report, the values of these shear stresses could not be verified. As a result, it is not possible to review the reported conclusions from the sediment stability analysis described in Sec 7.4.

I look forward to working with you and the Rhode Island Department of Environmental Management toward the cleanup of Gould Island. Please do not hesitate to contact me at (617) 918-1385 should you have any questions or wish to arrange a meeting.

Sincerely,

Kymberlee Keckler, Remedial Project Manager
Federal Facilities Superfund Section

Attachment

cc: Pam Crump, RIDEM, Providence, RI
Deb Moore, NETC, Newport, RI
Bart Hoskins, USEPA, Boston, MA
Ken Finkelstein, NOAA, Boston, MA
Steven Parker, Tetra Tech-NUS, Wilmington, MA

## ATTACHMENT A

| Page | Comment |
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| Figure 1 | Correct the spelling of Atlantic Ocean. |
| Figures 12 – 15 | These feather diagrams are difficult to interpret and compare the measurements at the four ADCPs. Either add four panel current speed vs. time and current direction vs. time series plots, or replace the feather diagrams with the suggested time series plots. |
| p. 21, ¶3, last line | Change '(2010)' to '(2011).' |
| p. 27, §4.1, last line | Change 'finer estimation' to 'more detailed estimation.' |
| p. 27, §4.2.1, 1st sentence | Reference the previous wave modeling study. |
| Table 4 | The wave heights should be rounded to one decimal place. There is a lot of uncertainty associated with wave modeling over short model domains as in Narragansett Bay since wave generation and growth over such short fetches is not well understood (Demirbilek, 2012). |
| p. 31, §5 | The following comments on the CGWAVE modeling were provided by Dr. Demirbilek:<br><br>The period of wind-generated waves ranges from 6 to 25 seconds. The primary controlling factors are wind speed, fetch, width, and depth of water body. The shorter the wave period, the more difficult the modeling of short period waves becomes. This is mainly because of the very high resolution required with a phase-resolving wave model such as CGWAVE that are capable of representing a 5-second wave. CGWAVE is a Mild-Slope Equation (MSE) model. The mesh resolution controls accuracy of model results that include wave height and waves phase. By solving for the steady-state MSE, the wave period in CGWAVE remains constant. Also, there is no wind input in the MSE, so locally-generated wind growth cannot be modeled with CGWAVE. Nonlinear wave-wave interaction terms are not included in the MSE, so CGWAVE cannot simulate generation and growth of sub- and super-harmonics of a carrier wave. Incident waves are specified in input as wave height, period and direction. Only one set of wave parameters (H, T, theta) is prescribed, assuming a weak variation of waves along the semi-circular offshore boundary along all nodes. It is necessary to align the |

apex of semi-circle to coincide with the direction of incident waves. Only waves incident within -+ 20 deg of this primary direction should be simulated. For simulating incident waves with higher oblique angles, the semi-circular boundary should be re-oriented for modeling higher oblique waves. In general, for longer period waves, recommended grid resolution is 10-points per wavelength. For shorter period waves, greater resolution is required, and generally at least 20 to 30 points per wavelength. Wave reflection from land boundaries and structures is modeled y assigning a reflection coefficient to individual pieces of land and structures. Bottom friction is included.

Given the above guidelines or rules-of-thumb, there are a number of concerns with the CGWAVE modeling described in the study report. A list of the concerns follows, with brief comment for each:

1. *Choice of semi-circular open boundary.* An East-West orientation is used for incident waves due from North and Northeast. If waves are from N and NE, semi-circle should be rotated such that its apex (the centerline) lies between N and NE.
2. *Grid resolution.* A 5-second wave is either a very short period wind-wave or ship-generated wake wave. Such waves would require a much finer mesh resolution than the mesh described in the report. Approximately 20-points per wave length would be required. For an average 8 meter depth in the basin, wave length is about 40 meters, requiring roughly the size of element within the semi-circle to be about 2 meters or less.
3. *Land boundary reflection coefficients.* The values used in this study assume nearly full reflection occurring from land boundaries. This is not the case. A simulation with no reflection should be done to check model solution and ensure results are acceptable. This should be followed by simulations by assigning more realistic values of reflection coefficients to different segments of land boundaries. Typical reflection from a rubble-mound jetty/breakwater is less than 30 percent. Except for short segments representing vertical wall structures, reflection of 90 plus percent is unrealistic.
4. *Incident wave input to CGWAVE.* To compare wave parameters calculated by STWAVE with CGWAVE would require some special considerations. This may require to run CGWAVE in the spectral mode (*e.g.,* use the incident wave spectra, but not H, T, theta values used for monochromatic waves). This may be done on high-

end PCs or on super-computers. Spectral input to CGWAVE requires special tools that are not available in SMS interface, so the user must prepare input based on spectral analysis, and such simulations are resource demanding. Alternatively, if CGWAVE has to be run in monochromatic wave mode, this then would require running STWAVE in an equivalent mono wave that requires converting the calculated spectral wave heights to $H_{rms}$ for comparison to CGWAVE calculated wave heights. Comparison between two models can be made only with CGWAVE solutions with zero reflection everywhere. Also, wind should not be used in STWAVE in simulations to be compared to CGWAVE.

5. *Bottom friction.* The incident wave height in the report is approximately 1 meter. A 5-second wave with this wave height will not break at 8 to 10 meter water depth in the basin. Therefore, bottom friction should be have no effect of these waves, and should be set to 0 in both models.
6. *Bottom shear stresses.* How were these were calculated? Provide the expression for calculation of bed velocity of waves and shear stress. What is the threshold critical shear stress value that determines sediment mobility? Also, percentile of grain size distribution will affect sediment mobility. These data should be provided in the report.

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| p. 37, §6, 3rd sentence | What is meant by "Receding waters from the upper Narragansett Bay were also simulated"? |
| p. 37, §6.1 | Is this a 3D model? Were the values of $z_o$ of 0.01 meter and 0.05 meter determined from calibration of the model? |
| p. 39, §6.3, ¶2, 2nd line | Change 'average 10-minute measured currents' to '10-minute averaged measured currents.' |
| Figure 28 | Was the value of $z_o$ adjusted in an attempt to improve model-data comparisons? |
| p. 40, §6.4.1 | Calculate absolute and relative bias to provid two other measures of goodness-of-fit between the data and model results. |
| p. 43, §6.4.2, ¶1, 3rd sentence | Delete 'depth-averaged.' |
| p. 48, §§7.2 & 7.3 | The equations used to calculate wave-induced bed shear stresses were supposed to be added to this report, but were not. |
| Table 7 | The bed shear stresses given for CGWAVE modeling in this |

table definitely seem *too* low. Since the equation used was not provided, these values could not be verified. Because of this, EPA's comments on the sediment stability analysis performed and discussed in Section 7.4 are not included herein and will be provided at a later date when the equations are made available.

For the $D_{50}$ and $D_{90}$ values given in Table 7, it is not appropriate to use the modified Shields Diagrams shown in Figures 32 and 33 to determine the critical shear stresses. All these diameters are in the clay to very fine silt size range where electrochemical surface forces control the particles' shear strength and not the force of gravity.