MEMORANDUM FOR RECORD 3 March 2005

SUBJECT: Chesapeake Bay Sediment Transport Modeling

1. A Study "Evaluation of Suspended Solids Transport and of Living Resource Interactions in the Chesapeake Bay System" has been initiated and the first review meeting was held in Anapolis Maryland on 11 and 12 January 2005. Presentations were made on the work done to date on the project and on the planned modeling work. Ongoing work included data collection and physical process description for sub-model modules. What follows are comments on the sediment model and field data collection presentation made at the review meeting and on notes from a sediment brainstorming session conducted on 23 February 205 (provided by Sung-Chan Kim, ERDC).

2. The sediment transport model module is to be developed within the water quality model. The purpose of the sediment model is to provide data for calculating water clarity. Since salinity fields as well as flow fields will be passed to the WQM from the hydrodynamic model, this coupling should work fine (in the case of Chesapeake) since suspended sediment concentrations SSC are too low to generate appreciable density feedback to the flow regime. A sediment budget for the bay having sufficient detail to guide model development needs to be located or developed. Fine sediments are the most important sediment component to consider. Shoreline erosion is to be included. Riverine inputs of course will be included. Should the internal cycling of sediment by dredging and disposal be included in the model?

3. Decisions will be made soon on what sediments constituents are to be transported, and represented in the bed, and on the bed structure. According to the brainstorming session, three particle classes are being considered: un-flocculated and flocculated inorganics, and algal-sediment flocs. Sand would be excluded. Carl Friedrichs has made water column measurements with a LISST particle/aggregate sizer that uses near-forward laser-light scattering principles. Measurements with the LISST need careful quality control by direct examination of suspended material, comparison of volume concentrations from the LISST to simultaneous mass concentration measurements, and to independent size measurements. Near-surface bubbles can affect LISST measurements. Very little LISST data has been published in proportion to the number of instruments out there. Documentation of the field work has not yet been developed or reviewed.

4. It is not clear to me how un-flocculated and flocculated inorganics would be defined. Floc size measurements from previous studies indicate that continuous floc spectra occur under

cohesive component). Therefore, I don't immediately see the rationale for representing un-flocculated and flocculated inorganics (silts and clays) in the model.

5. The sediment components represented in the model should be observable quantities. Boundary conditions must be developed for the model, and model results validated to field measurements. How much data on un-flocculated and flocculated inorganic data will be available? How will these components be represented in the bed? Inorganic dispersed particle size data are the most widely available sediment characteristic.

6. The bed module will be important to calculating realistic suspension concentrations. Sediments undergo cyclic erosion and deposition and have very long residences in a system like the Chesapeake, and erosion characteristics depend on conditions at the bed surface. The brainstorm session discussed a fluff layer residing above a active layer. The fluff layer maybe 2 mm thick depending of the local deposition history. It is composed of newly deposited sediments and generally a larger fraction of organics than in the bed. It is more easily eroded than the bed and might be completely dispersed back into the water column during high-energy events. The active layer is nominally 10 cm thick and identified with the bioturbated zone. At some sites such layers might be fairly uniform. At other sites where deposition is more intense, the active layer might be stratified. Erodibility depends strongly on solids content of the bed surface, as well as grain size, organic content, clay mineralogy, etc. Sediment bed erodibility tends to be in quasi-equilibrium with local shear stresses so that high velocity zones are less erodible than low velocity zones. In order to respond correctly to changes in sediment input, sediment components will need to be conserved in the bed and interact with erodibility parameters in a realistic way.

7. The sediment measurement and model development team for the Chesapeake study is very experienced and resourceful. They have made a good start on a very difficult task and I have no doubt that an excellent product will result from their efforts.

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