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MEMORANDUM

SUBJECT: Explanation of New Bedford Harbor (NBH) Operational Monitoring Approaches

FROM: William Nelson, Ph.D.

TO: Dave Lederer, NBH Remedial Project Manager

In response to your request for an explanation of the current remedial dredging operational monitoring criteria (i.e., turbidity based), I think it is very important to understand not only the rationale for that criterion, but also the evolution of all operational dredge monitoring programs since the Pilot Dredging Study in the late 1980's. I will keep the historical perspective brief here; however, for a more detailed perspective, I have also attached PDF versions of two peer-reviewed manuscripts describing both the Pilot Study and Hot Spot monitoring programs.

In the late 1980's, prior to selecting dredging as a remedial option in NBH, there was a valid concern that any dredging might cause significant negative impacts elsewhere in the harbor, principally due to PCB contaminant transport from the upper harbor (UH) to both the lower harbor (LH) and outer harbor (OH). A real-time monitoring program was designed and implemented to monitor PCB toxicity and transport to ensure that any problems were both localized and short-term (please see attached Pilot Study paper). From this pilot study we learned that dredging could be done safely if the proper monitoring controls were instituted, including the appropriate physical, chemical, and biological testing, as well as a real-time feedback loop between dredge contractors and Federal and State managers.

The second major remedial dredging monitoring activity was conducted during the "Hot Spot" removal (i.e., PCB concentrations > 4,000 ppm). Due to the extraordinarily high PCB sediment concentrations, there was again a valid concern that significant impacts could result from dredging. The Hot Spot monitoring program also demonstrated that any negative effects were both localized and short-term in nature (please see attached Hot Spot paper). These two initial remedial monitoring programs included extensive physical measurements of total suspended solids (TSS), quantification of both dissolved and particulate PCB concentrations, and numerous toxicity tests to ensure that any impacts due to remedial dredging were limited. This level of monitoring was both very expensive and labor intensive; therefore, we looked at the data comprehensively to determine if some of the tests were redundant, the sampling frequency too high, etc.

Based on this evaluation, we determined that if TSS levels were maintained at low concentrations (quantified as nephelometric turbidity units, NTU's) close to the remedial operations (e.g., dredging, debris removal, etc.), PCB water column concentrations and toxicity were also low and contaminant transport was minimal. In contrast, when TSS levels were elevated, negative impacts (e.g., toxicity) were observed. The end result of this analysis was that a tiered monitoring approach could be used, where simple TSS measurements (i.e., NTU's) were conducted in close proximity to any operation. If TSS levels were low, the operation proceeded; however, high TSS levels triggered notification of managers, water collections were made for chemical and toxicity testing, and the operation either halted or modified.

This approach worked effectively for several of the subsequent small scale pilot projects (e.g., Pre-Design Field Test) and was implemented for the full scale UH dredging that began in 2004. In subsequent years, the monitoring plan has been modified accordingly based on dredging location, sediment PCB concentrations, etc. For example, the original remedial monitoring plan for the 2009 dredging and debris removal operations in upper NBH was at best complicated and at times, unwieldy. In previous operations, the goal was to restrict toxic impacts and resuspended contamination to the immediate area of the dredge, while preventing redistribution of contaminants to cleaner areas north of Wood St. and south of the Coggeshall St. Bridge. This was relatively easy because dredging was limited to one small area; however, in 2009 there are multiple dredge areas in the upper harbor with different PCB concentrations, various removal operations in each (i.e., sediment and debris), time restrictions due to water depth, etc. Therefore, a simpler, yet still effective, approach was implemented to accomplish the same goals.

A previous criterion of 50 NTU's 300' from the dredge was based on historical observations in other remedial operations that demonstrated that this turbidity level rarely if ever had adverse biological effects, so it was adopted as a "protective" concentration. In 2009, a new dose-response test was conducted (see attached toxicity test report file) with freshly collected resuspended upper harbor sediment (7/22/09) and showed that concentrations as high as 110 NTU's had no significant toxic effect in the *Arbacia* test or the Mysid test. Further, there was still 88% fertilization in the *Arbacia* test at 190 NTUs, indicating no biologically relevant impacts. Based on the totality of these data, it was reasonable to reassess the old NTU criterion level and increase it from 50 to 100, which is still in place to date. This modification was less restrictive on the operation but still "protective," as defined by the toxicity tests.

The most important data set to document the protectiveness of the monitoring approaches to date is the Long-Term Monitoring PCB sediment data (Figure 1). These data show a steady decline in PCB concentrations throughout the harbor and no significant transport of PCBs away from dredging areas (e.g., from the Upper Harbor (UH) to the Lower Harbor (LH) to the Outer Harbor (OH)) over time. Further, as a result of all the dredging activities since the Hot Spot operation in 1995, the benthic community has shown a significant increase in quality, as measured by the EMAP Benthic Index (Figure 2). Collectively, this information demonstrates that removal of PCB contaminated sediments in NBH can be done effectively and without significant harm to the environment, therefore, a continuation of this approach is warranted for future dredging operations.

Please feel free to contact me to discuss this any of this information.

Fig. 1 Spatial distribution of the interpolated sediment PCB concentration data for the upper harbor (UH), lower harbor (LH), and outer harbor (OH) segments, for each of the five long-term monitoring collections. The number to the right of each segment is the surface-weighted average PCB concentration for that segment. Spatially, within a collection year, each segment is significantly different from each other for all five collections. Temporally, within a segment, each mean PCB concentration was compared to the 1993 baseline, with values that are significantly higher shown in red, values not different in black, and significantly lower values shown in green.

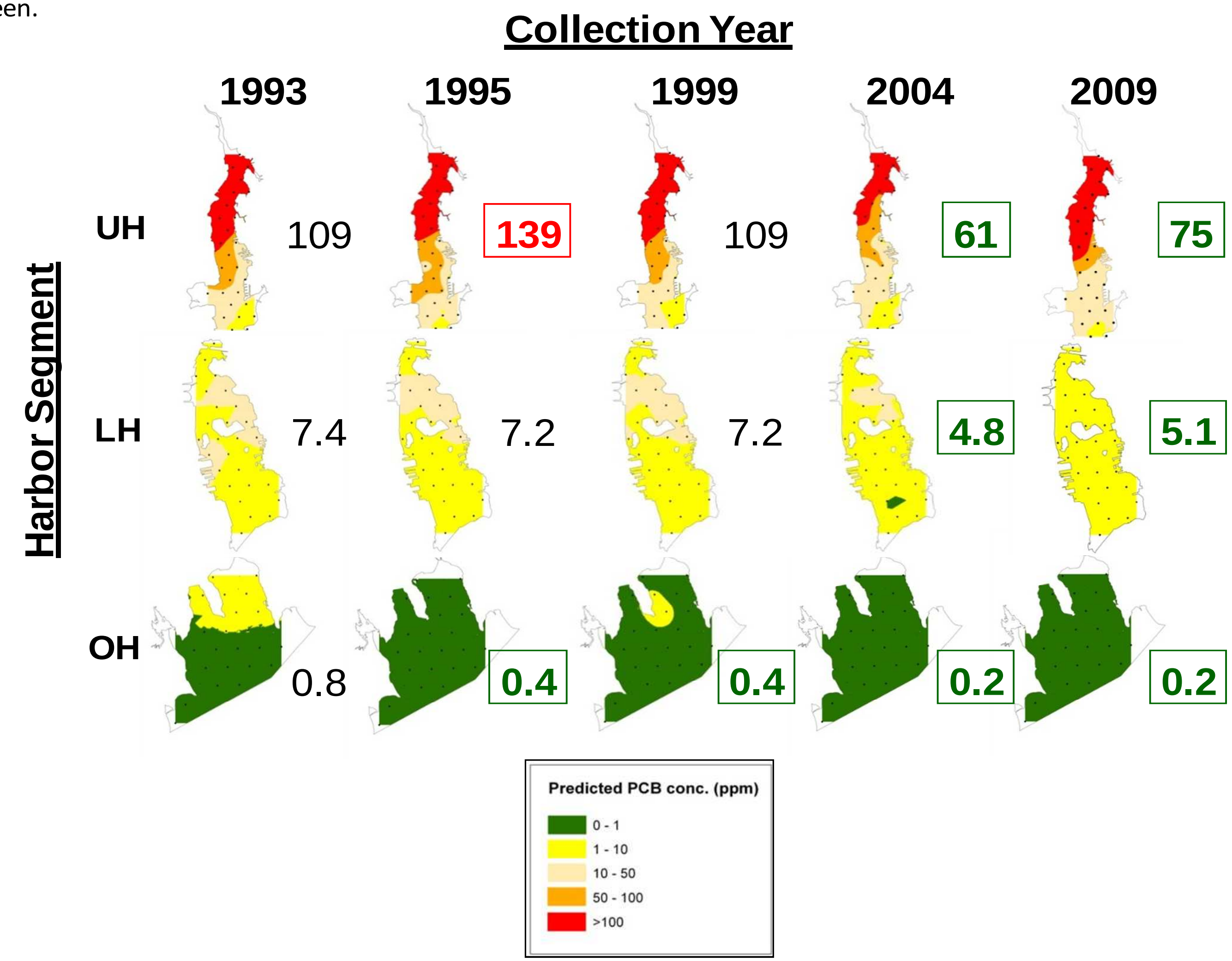

Fig. 2 Bar graph showing the mean EMAP Benthic Index value for each harbor segment (UH, LH, OH) and collection year. Positive values indicate a "good" benthic community, while negative values are considered "impaired." Spatially, within a collection year, there was a significant difference among harbor segments. Temporally, when compared to the 1993 baseline collection, there was a significant increase* in benthic condition in the LH and OH segments in the 2009 collection.