

SUMMARY OF 2006 WATER QUALITY MONITORING RESULTS IN MILL & DIVIDING CREEKS AFTER MILL CREEK SEWAGE SPILL, MAGOTHY RIVER

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BACKGROUND

Three million gallons of raw sewage spilled into Mill Creek on the Magothy River, Chesapeake Bay, in Arnold, MD in December 2005 after a sewer line broke. About 1,700 cubic yards (CY) of sediment washed into the creek from a sinkhole around the sewer line break. Of this about 700 CY of sediment were removed from the pumping station and the nontidal flood plain soon after the spill, but about 900 CY of sediment reached the tidal portion of the creek and was not removed. The Anne Arundel County (MD) Department of Public Works asked the Magothy River Association to work with BayLand Consultants to design and implement a water quality monitoring plan for the nontidal and tidal portions of the creek to assess possible effects of the spill on the creek in 2006. This report gives the main findings from that study; a more detailed report with complete results is in preparation by BayLand.

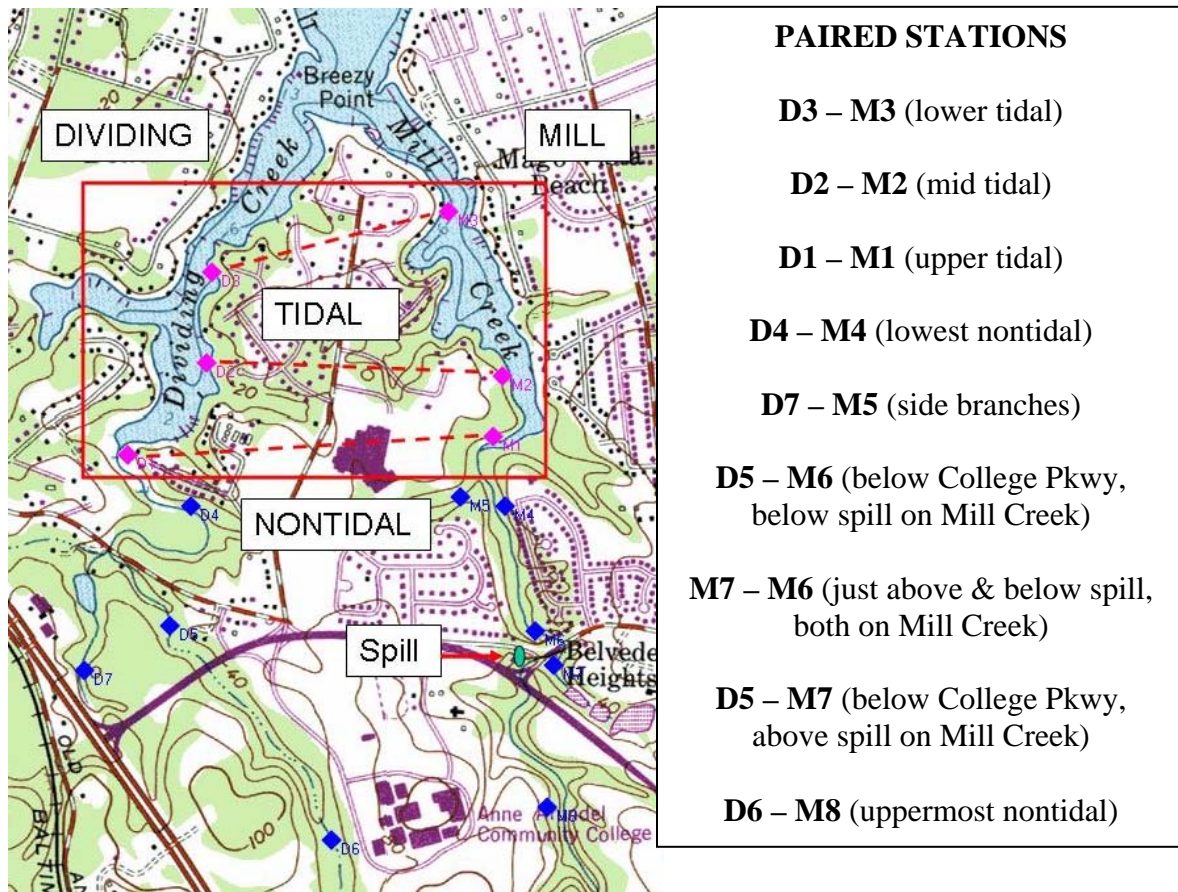
METHODS

Sampling design and data analysis: Mill Creek is adjacent to Dividing Creek; the two creeks share the same mouth and have similar watershed sizes and land uses, so Dividing Creek provided a control for the Mill Creek data. We developed a paired station monitoring design to compare data from each station in Mill Creek with a matched station in Dividing Creek. If Mill Creek consistently showed worse conditions than Dividing Creek for any parameters that could be affected by the sewage spill, the possibility that this difference was caused by the spill was investigated, and used in decision making about choosing responses to the spill.

Sample collection: Fifteen paired sampling stations were chosen, six in the tidal waters and eight in the nontidal portions of both creeks (Fig. 1). The tidal stations were all at piers. All the tidal stations were sampled in the same morning by teams of local volunteers, and all of the nontidal stations were sampled on the previous day by BayLand staff. Sampling dates were chosen beforehand and we sampled rain or shine, so some sampling dates fell during or just after a rain, and some did not. Some water quality parameters were measured in the field and some were measured from water samples that we collected and sent to a laboratory in Baltimore.

Data analysis: Data were analyzed by BayLand staff led by Duane Wilding, and by Peter Bergstrom of NOAA and the MRA. All results were reviewed by the Mill Creek Scientific Review Committee which includes local volunteers, AACC professors, and BayLand engineers and scientists and county environmental staff.

Figure 1. Map of the 15 sampling stations; tidal are magenta, nontidal are blue. The paired tidal stations are connected by dashed lines, nontidal pairs are not.



RESULTS AND DISCUSSION

Differences that could have resulted from the sewage spill: There were consistent differences in three parameters at one pair of tidal stations, M2 and D2 (the middle pair), that could have resulted from the sewage spill. The three differences where the results from D2 were consistently better than those at M2 were:

- **Water clarity** (turbidity tube depth, Fig. 2). This difference could have been caused by resuspension of sediments from the spill and the sinkhole that settled out near M2, which is near the upper end of the dredged channel in the creek
- **Total Phosphorus** (TP, Fig. 3). Sediment from the spill and the sinkhole that settled near M2 contained phosphorus, and thus could have raised TP levels at M2.
- **Bottom Dissolved Oxygen** (DO, Fig. 4). Sediment from the spill and the sinkhole that settled near M2 contained organic matter, and as this decomposed, it could have lowered the bottom DO at M2.

In all of the graphs below, medians (the 50th percentile) of April-November 2006 data are shown. Pairs of stations (Mill-Dividing) are arranged in spatial sequence from down the creek on the left to the upper watershed on the right. The pair(s) with consistent differences in the expected direction (Mill worse than Dividing) are circled. Bottom dissolved oxygen could only be measured at the lowest two pairs of tidal stations (the uppermost pair were too shallow).

Figure 2. Turbidity tube (clarity) medians by pairs of stations over April-November 2006.

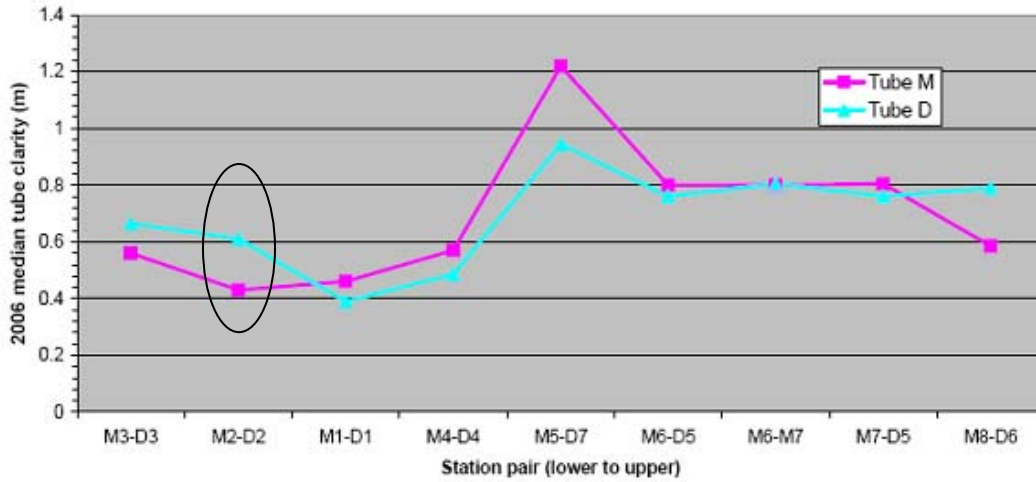


Figure 3. Total phosphorus medians by pairs of stations over April-November 2006.

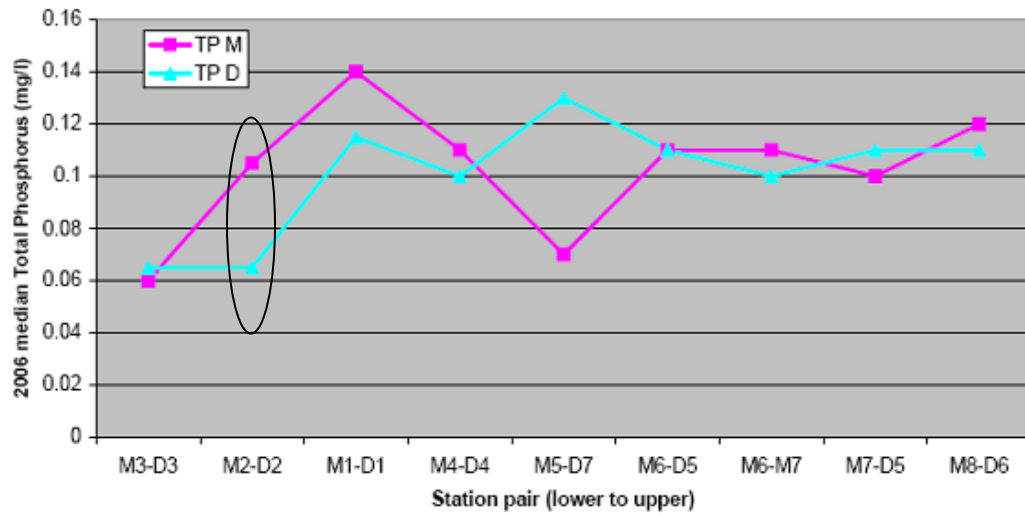
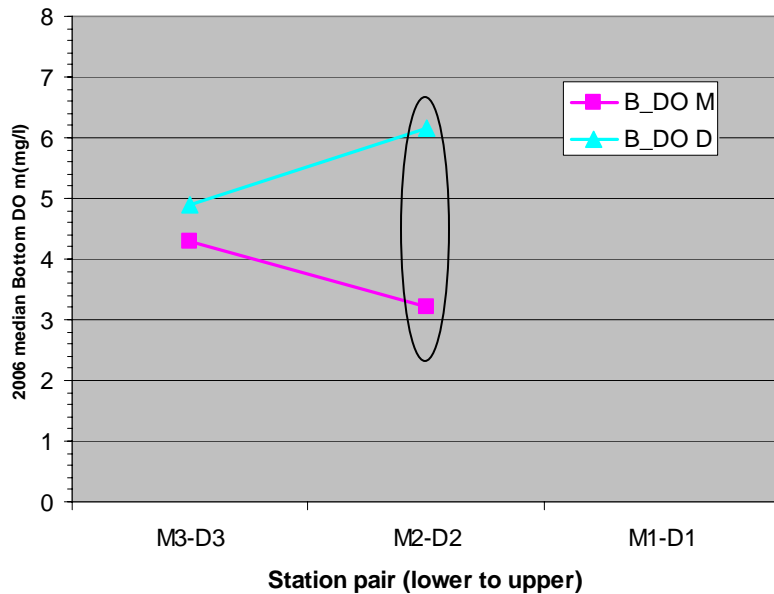


Figure 4. Bottom Dissolved Oxygen medians by pairs of stations over April-November 2006.



Unexpected differences in other parameters, probably not caused by the spill:

- **Total Nitrogen (TN)** levels were consistently higher in Mill Creek compared to paired stations in Dividing Creek, including pairs above the spill. This suggests that the spill was not a factor in these differences, since they persisted all year (nitrogen is not bound to sediment as much as phosphorus) and involved a station above the spill in Mill Creek.
- **Enterococci (bacteria)** were consistently worse at M2 than at D2, but it is unlikely that the spill could affect levels of short-lived bacteria several months later, so they must have had an ongoing source near M2. Enterococci also tended to be higher at nontidal than at tidal stations, suggesting wildlife and/or failing septic systems as sources (in both watersheds, most homes near the tidal creek are on public sewer while most homes in the headwaters are on septic systems).

Conclusion: It appears that some of the observed differences could have been caused at least in part by the sewage spill. These include the consistent differences at the middle pair of tidal stations (M2 & D2) in water clarity (turbidity tube and Secchi depths), total phosphorus (TP), and in bottom dissolved oxygen (DO). The total nitrogen and enterococci differences found were probably not caused by the spill.

Evaluation of potential watershed sources for the parameters with differences has started. For example, Mill Creek has about twice as many septic systems in its upper watershed as Dividing Creek, which could be a cause of the TN differences, although most of the septic systems are above our sampling stations. We also found that the TN levels we found in Mill Creek are more typical of levels found in the mainstem of the Magothy, while those in Dividing Creek are usually lower than those in the mainstem. Bacteria source tracking would be very useful in both watersheds, to try to identify and implement measures to reduce the bacteria levels.

The results are also being used to design and justify any proposed dredging of the upper reaches of Mill creek that got the most sediment from the sewage spill and the associated sinkhole. Removing these sediments should improve the water clarity, total phosphorus (TP), and bottom dissolved oxygen (DO), at M2 compared to D2. Some of the local volunteers who helped with the monitoring in 2006 will continue sampling the field parameters in 2007 to see if the differences we found in 2006 continue in 2007.

ACKNOWLEDGMENTS

We thank the local volunteers who helped with the tidal water quality monitoring, including the six pier owners who let us use them for sampling; the members of the project's Scientific Review Committee; and the Anne Arundel County Department of Public Works for funding the study. The volunteers who helped me with the monitoring included Sally Hornor, Dave Kemp, Vince Wheatley, Bob DeYoung, Mike and Trish Lehman, Dave & Stacey Hilder, Heather Millar, Patti Hanzook, Marjie Campbell, and Christine Almanza. The pier owners were Heather Millar, Juliet & Greg Page, and Bob & Mary Dudley on Mill Creek, and Richard & Roberta Allen, John & Carolyn Sabol, and Paul & Colleen Wood on Dividing Creek. The Scientific Review Committee included volunteers Juliet Page, Sally Hornor, Dave Kemp, Vince Wheatley, Bob DeYoung, John Sabol, and George Kerchner, as well as BayLand staff Keith Tate, Duane Wilding, Debbie Weller, and Kendra Scheminant, County DPW staff Ron Bowen, Chris Phipps, Merrill Plait, and Janis Markusic, County Health Dept. staff Kerry Topovski, and myself.