THE MAGOTHY RIVER INDEX FOR 2007
Long version of the summary presented on February 20, 2008

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The Magothy River Association's "Magothy River Index" is an assessment of the aquatic health of the tidal river for communication to the residents of the watershed, produced annually by the MRA since 2003. It summarizes what we know about the status of **vital habitats** and **water quality** in the Magothy in the previous year, based (for water quality) on monitoring done by MRA volunteers. We also summarize the ongoing and planned habitat restoration and protection actions in the watershed, and conclude with a section on what we can do to help the Magothy.

This is the long version of the 4-page summary that I presented on February 20, 2008, and it includes the following sections:

1. SUMMARY and DETAILS FOR 2001-2007, same as what I presented on Feb. 20, using water quality data from 2001-2007 from 12 sampling sites, and SAV mapping results
2. INDEX DETAILS 1992-2007--Similar Magothy water quality and SAV results for more years from fewer (5) sampling sites, which were reported in a poster on Feb. 20. A new section on possible salinity effects was added that was not on the poster.
3. OTHER FACTORS NOT INCLUDED IN THE INDEX
    a. Vital habitats that lack annual data (wetlands, shorelines, etc.)
    b. Water Quality Factors sampled by MRA, requiring lab analysis
    c. Other Water Quality Factors sampled by the MRA (bacteria, nontidal aquatic health)
4. ONGOING MRA ACTIONS TO HELP THE MAGOTHY
    a. Oyster restoration
    b. SAV restoration
5. WHAT WE CAN DO TO HELP THE MAGOTHY

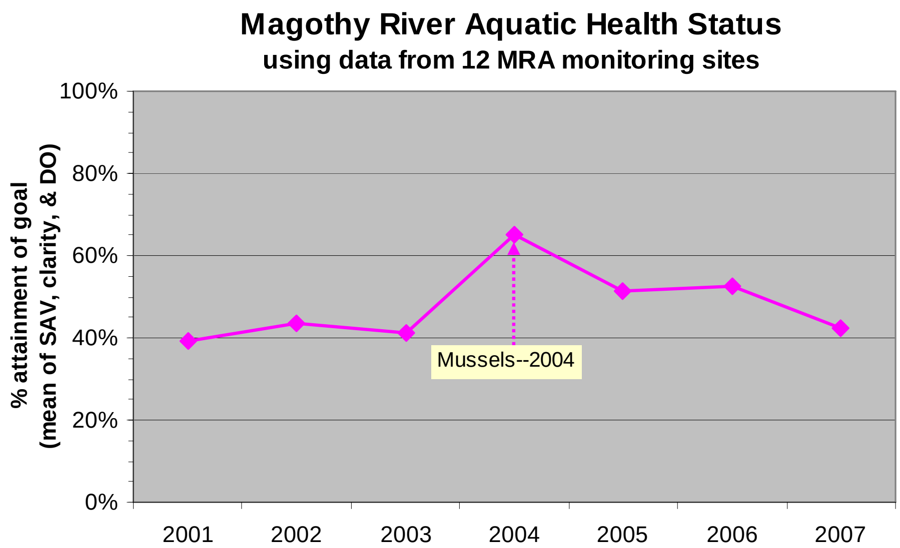
MAGOTHY RIVER INDEX FOR 2007:
Submerged Aquatic Vegetation (SAV), Water Clarity, & Dissolved Oxygen (DO)

The three factors used in the 2007 Index are divided into two categories: (1) Vital Habitats (measured factor is Submerged Aquatic Vegetation or SAV) and (2) Water Quality (measured factors are water clarity, as measured by Secchi depth and dissolved oxygen or DO). For both Vital Habitats and Water Quality, we compared monitoring results to an established Chesapeake Bay Program (CBP) goal. The attainment of that goal for that factor was expressed as a percentage of the goal; 100% (maximum) means the goal was met.

SUMMARY for 2001-2007

The mean Magothy aquatic health status for the last seven years (based on SAV, clarity, and DO status**)** is shown in Fig. 1. **The 2007 value (42%) is the lowest value since 2003**. The dark false mussels that filtered so much water in 2004-05 probably accounted for the improved status in those years, when SAV, water clarity, and DO all improved (see Table 1 and Fig. 3 below).

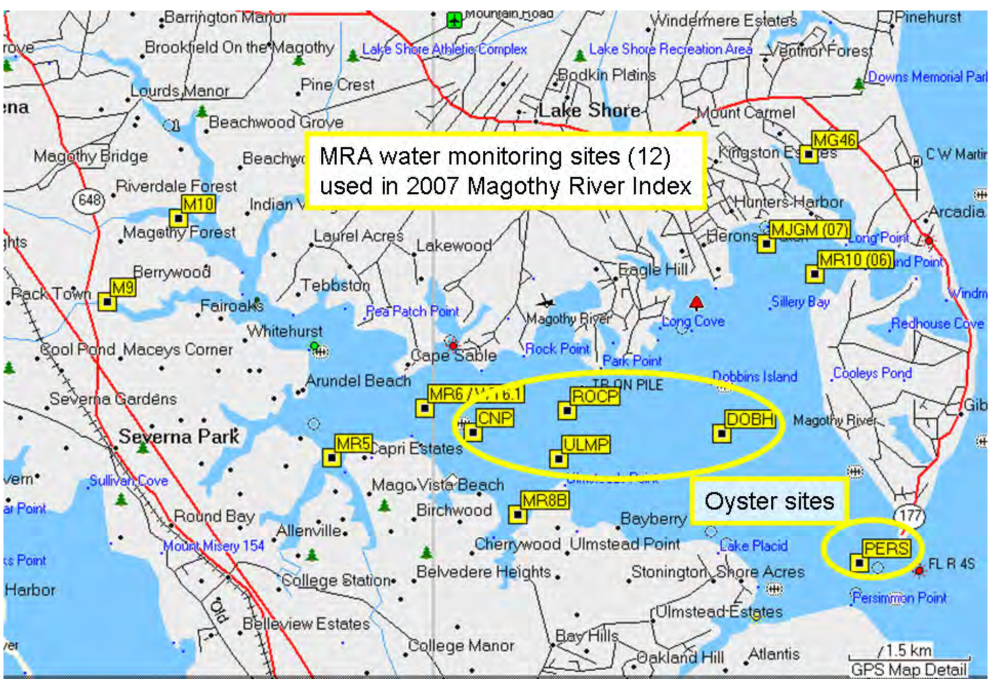
Figure 1. Magothy River aquatic health status, 2001-2007. Dark false mussels appeared in 2004.



INDEX DETAILS: 2001-2007

The monitoring sites sampled by Magothy River Association volunteers in 2007 are shown in Fig. 2. The volunteers from 2001-2007 included myself, helped by Conner & Vicki Lines (3 sites), Bill & Barbara Kobett (1 site), and Dick Carey (8 sites). All sites were sampled at least twice a month. We thank the Chesapeake Bay Trust for several grants to the MRA to help cover monitoring costs.

Figure 2. Sampling sites used in Magothy River Index, 2007, showing the 5 oyster restoration sites.



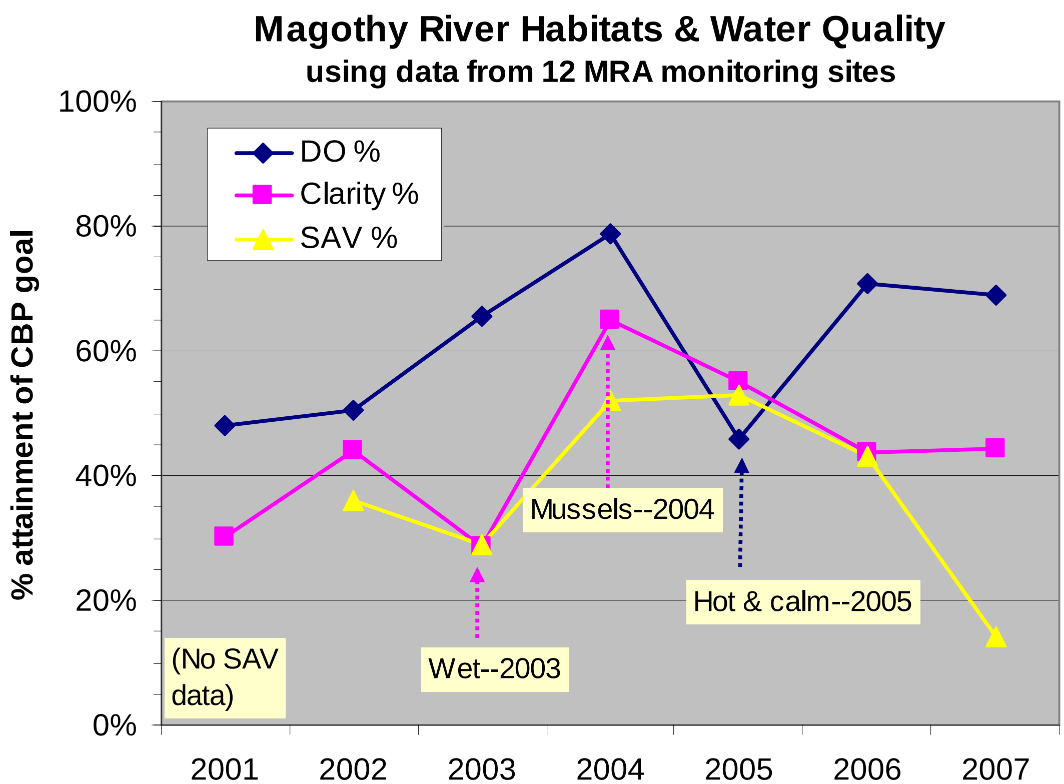
Monitoring from 2001-2007 showed the following changes in habitat and water quality status (shown below in Table 1 and Fig. 3):

- **Vital habitats**
  - Submerged Aquatic Vegetation (SAV) area in the Magothy peaked in 2004-05, and then declined in 2006 and 2007. The 2007 Magothy SAV area, 83 acres, was the lowest area mapped since 1995; which was shortly after Magothy SAV started coming back in 1993. The CBP SAV goal for the Magothy is 579 acres.
- **Water quality**
  - The CBP **water clarity** goal in the Magothy is Secchi depth > 0.97 meters, which should allow SAV growth. Water clarity status declined in 2003 when a wet year followed several years of drought, **peaked in 2004-05** when dark false mussels were abundant, and declined in 2006-07 after the mussels died back. We think the larvae of the small, native mussels were washed into the river by the storm surge from Hurricane Isabel, but they could not maintain their high levels after 2004.
  - The CBP **dissolved oxygen** goal in the Magothy is DO > 5 mg/l through the whole water column. DO status rose in 2004 when mussels were abundant, dipped in 2005 when the summer was hot and calm, and then recovered to earlier levels. Warmer water holds less oxygen, and breezes mix oxygen into surface waters.
- **Mean status of all three factors (Fig. 1 and Table 1)**
  - This peaked in 2004, when clarity & SAV area were up, and was lower before and after that year. **The low mean aquatic health status in 2007 (42%) shows that we all need to do more to help improve the Magothy's health.** See the last page of this report for suggestions for what we can do.

Table 1. MAGOTHY RIVER INDEX components, 2001-2007, using data from 12 sites.

Factor	What	2001	2002	2003	2004	2005	2006	2007
(1) Submerged Aquatic Vegetation (SAV)	% of CBP goal (579 ac)	No data	36%	29%	52%	53%	43%	**14%**
(2) Water clarity, all sites	% of Secchi above SAV goal (0.97 m)	30%	44%	28%	65%	55%	44%	**44%**
(3) Dissolved Oxygen (DO) > 5 mg/l, all sites	% of DO > 5.0 mg/l, surface to bottom	48%	50%	65%	79%	46%	71%	**69%**
(4) Mean status, all 3 factors	Mean of SAV, clarity, & DO	39%	44%	41%	**65%**	51%	52%	**42%**
(5) Weather, episodic events	Rainfall, hurricanes, etc.	Dry	Very Dry	**Wet**, Isabel (Sept)	Avg. then Wet, **Mussels**, Ivan (Sept)	Avg., **calm & hot**	Dry spring, wet summer	**Normal spring, dry summer**

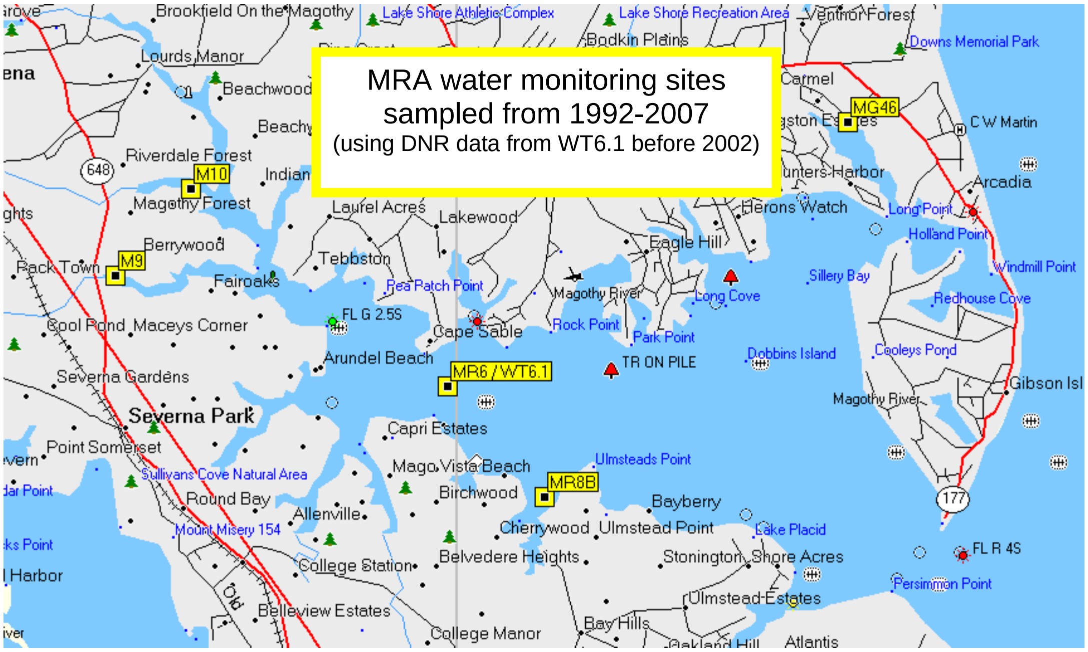
Figure 3. Recent changes in habitat & water quality status at Magothy sites (2001-2007). See text and Table 1 above for explanation of the events noted on the graph.



INDEX DETAILS: 1992-2007

Volunteer water monitoring was done in the Magothy at fewer sites for a longer period, and those results are presented here. The monitoring sites sampled by Magothy River Association volunteers from 1992- 2007 are shown in Fig. 4. The volunteers from 1992-2000 included myself, helped by Dan Zivi, Bill Kobett, and others (3 sites), and Bill & Barbara Kobett (1 site). All sites were sampled at least once a month from April-October. I used DNR data from WT6.1 before 2002. We thank the Chesapeake Bay Trust for several grants to the MRA to help cover monitoring costs.

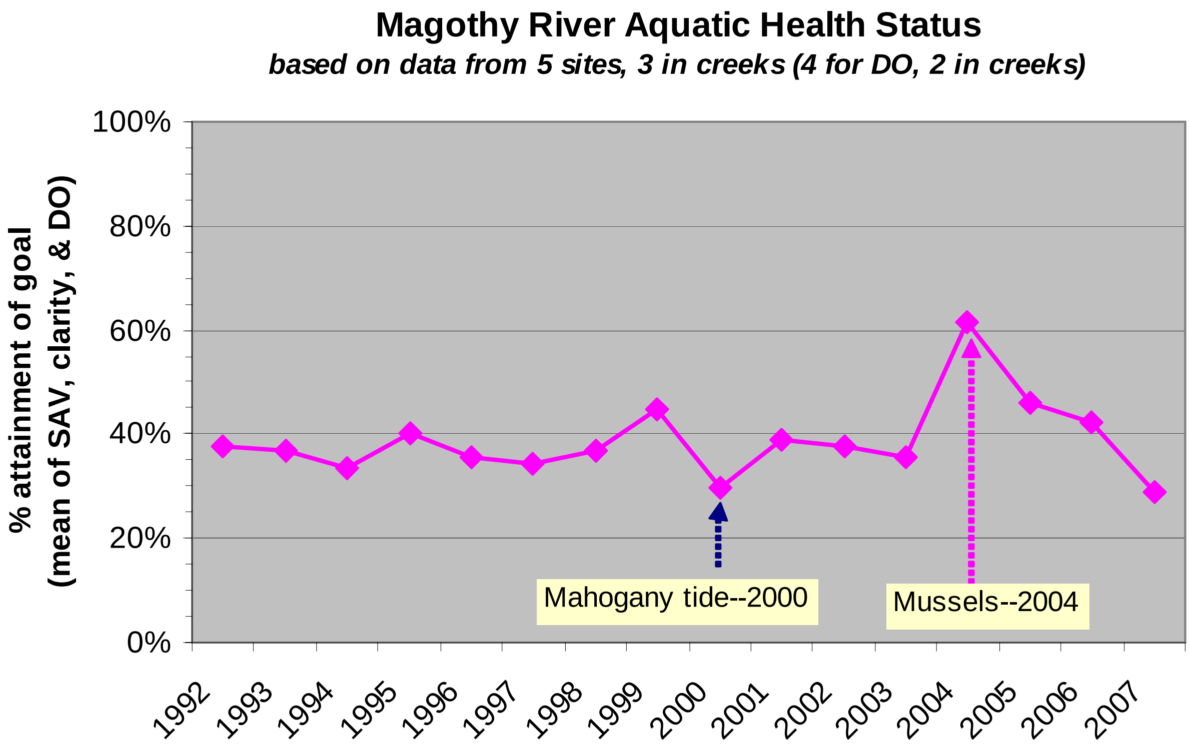
Figure 4. Sampling sites used in Magothy River Index over a longer period, 1992-2007.



Monitoring from 1992-2007 showed the following changes in habitat and water quality status (shown below in Fig. 5 for the mean of all factors and Fig. 6 for each factor):

- **Mean status of all three factors (Fig. 5 and Table 2)**
    - This peaked in 2004 at 61% during the mussel explosion (three of the creeks monitored had huge mussel populations) when clarity & SAV area were up, and was lower before and after that year. The next to the lowest score (30%) was in 2000 when the Magothy had an intense mahogany tide (red-brown algae bloom) in April and May, and the highest score in 2004 was. The lowest mean aquatic health status was in 2007 (29%). This was lower than the 42% status reported above because data from fewer sites were used, and the predominantly creek sites used here tend to have worse water quality than mainstem sites, except in 2004. See the last page of this report for suggestions for what we can do to improve the Magothy's aquatic health.
    -
- **Vital habitats (Fig. 6 and Table 2)**
    - Submerged Aquatic Vegetation (SAV) area in the Magothy was first mapped in 1993, dropped in 2000, **peaked in 2004-05 during the dark false mussel explosion**, and then declined in 2006 and 2007 (Fig. 6). The 2007 Magothy SAV area, 83 acres, was the lowest area mapped since 1995; which was shortly after Magothy SAV started coming back in 1993. The CBP SAV goal for the Magothy is 579 acres.

Figure 5. Magothy River aquatic health status, 1992-2007. Dark false mussels appeared in 2004.



- **Water quality (Fig. 6 and Table 2)**
    - The CBP **water clarity** goal in the Magothy is Secchi depth > 0.97 meters, which should allow SAV growth. Water clarity status at these sites declined in 1994, 1996 (both wet years), **2000 (mahogany tide)**, and in 2003 when a wet year followed several years of drought, **peaked in 2004** when dark false mussels were abundant, and declined in 2005-07 after the mussels died back. We think the larvae of the small, native mussels were washed into the river by the storm surge from Hurricane Isabel, but they could not maintain their high levels after 2004. There was no change in clarity status after the two creeks I sample were dredged in 1996-1997.
    - The CBP **dissolved oxygen** goal in the Magothy is DO > 5 mg/l through the whole water column. **DO status dropped in 1997** when two of the creeks I sample were dredged and thus the bottom sample became deeper; deeper waters are farther from the oxygen at the surface and tend to have lower DO. DO status rose in 2004 when mussels were abundant, dipped in 2005 when the summer was hot and calm, and then recovered to earlier levels. The 2005 dip resulted because warmer water holds less oxygen, and breezes mix oxygen into surface waters.

- **Related water quality factor: Salinity**
    - Although not part of the report card because it has no goal, changes in salinity probably affect Magothy SAV area. These are discussed, and shown in Fig. 7 and Table 2, below.

Figure 6. Longer-term changes in habitat & water quality status at Magothy sites (1992-2007). See text above for explanation of the events noted on the graph.

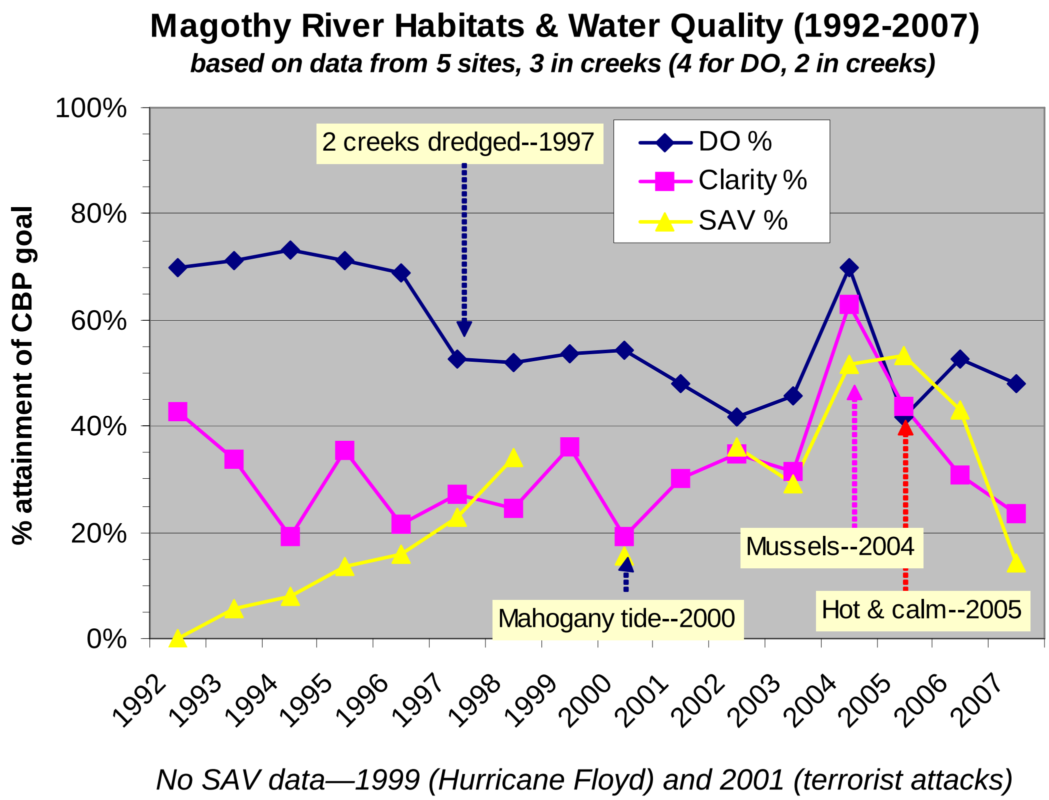


Table 2. MAGOTHY RIVER INDEX components, 1992-2007, using data from 4-5 sites, plus mean bottom salinity from one site (MR8B, Forked Creek) near SAV.

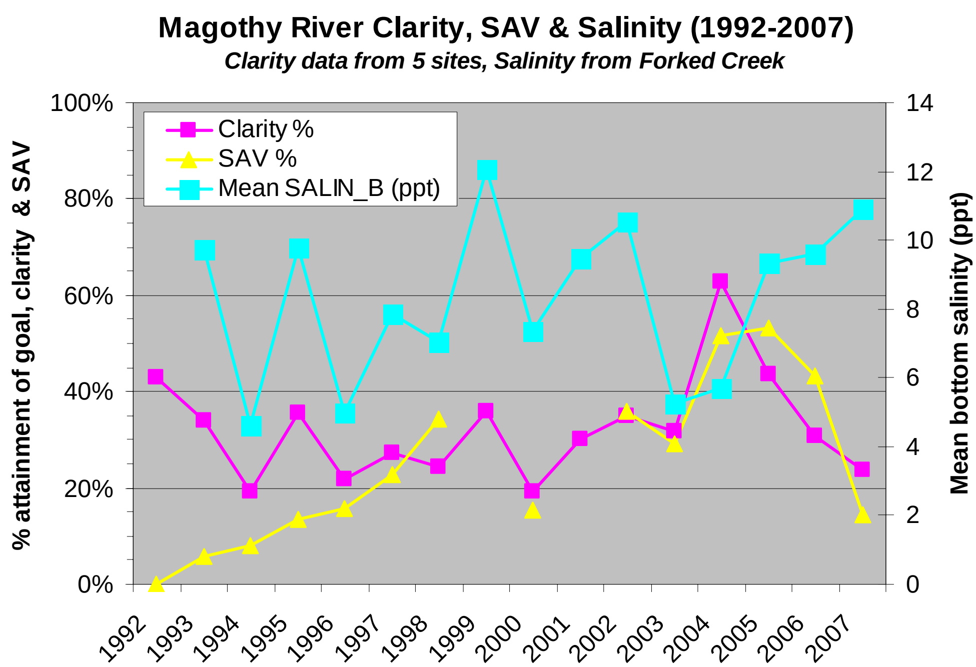
Year	DO %	Clarity %	SAV %	MEAN	SAL_B mean (ppt)	NOTES
1992	70%	43%	0%	38%	No data	
1993	71%	34%	6%	37%	9.7	Dry
1994	73%	19%	8%	33%	4.6	Wet
1995	71%	35%	14%	40%	9.8	Dry
1996	69%	22%	16%	35%	5.0	Wet
1997	53%	27%	23%	34%	7.9	Average
1998	52%	25%	34%	37%	7.0	Wet spring
1999	54%	36%	No data	45%	12.1	Highest mean salinity (dry)
2000	54%	19%	16%	30%	7.4	Mahogany tide; average
2001	48%	30%	No data	39%	9.5	Dry
2002	42%	35%	36%	38%	10.5	Dry (3rd highest salinity)
2003	46%	32%	29%	35%	5.2	Wet; Isabel in Sept
2004	70%	63%	52%	61%	5.7	Dark false mussel peak; wet
2005	42%	44%	53%	46%	9.4	Hot, calm summer; dry
2006	53%	31%	43%	42%	9.6	Dry
2007	48%	24%	14%	29%	10.9	2nd highest mean salinity (dry)

Possible Salinity Effects: 1992-2007

The preceding sections assumed that water clarity is the main factor that affects SAV area, and that is generally true. However, in unusually wet or dry years, extreme salinity values can favor some SAV species over others. That is especially true in the Magothy because our river (like our neighbor across the Bay, the Chester) is at the lower salinity range of the mesohaline zone, and thus it has some of the southernmost populations of SAV species that are usually only found in tidal fresh and oligohaline waters (mean salinity from 0-5 ppt). These species near the upper end of their salinity range here include wild celery (*Vallisneria americana*), common water weed (*Elodea canadensis*) and slender pondweed (*Potamogeton pusillus*). We also have some of the northernmost populations of SAV species that are more common in higher salinity, including sago pondweed (*Stuckenia pecti*nata) and widgeongrass (*Ruppia maritima*). Thus, one might expect that Magothy SAV area might stay about the same as salinity changed, if lower salinity species were replaced by higher salinity species in drought years, and vice versa in wet years. This does occur to some extent, with an apparent expansion of common waterweed and wild celery in wet (low salinity) years, and an expansion of sago pondweed in dry (high salinity) years. However, there is no guarantee that this species shift will occur, nor that the area lost will match the area gained.

Looking at the Magothy mean bottom salinity from 1993-2007 (Table 2 and Fig. 7), we see that 2007 had the highest mean bottom salinity (10.9 ppt) since 1999, which was another dry year (that ended with Hurricane Floyd). The salinity means used data from one site in Forked Creek (MR8B) because it is the only monitoring site adjacent to SAV beds. The changes in salinity suggest that high salinity may have been one of the causes of the 2007 drop in SAV area. Based on 2007 ground surveys I did, there did not seem to be the same expansion of sago pondweed beds that occurred in some past dry years. There may also be effects from consecutive years of low or high salinity, as well as salinity effects on other Magothy organisms. For example, the low salinity in 2003-2004 probably helped SAV area to increase in 2004-05, and also helped the dark false mussels to expand.

Figure 7. Longer-term changes in SAV & clarity status, and mean bottom salinity, at Magothy sites (1992-2007).



OTHER FACTORS NOT INCLUDED IN THE INDEX

These factors were not included in the Index because they either (1) lack annual data, or (2) are not being sampled by other local watershed groups. The MRA worked to make its 2007 Index as consistent as possible with those planned by other groups, using the data we had available.

Vital habitats that lack annual data

Tidal and non-tidal wetlands: These are important habitats for fish and wildlife, although they are not monitored regularly. Wetlands once made up about 7.5% of the area of the watershed, which we used as our interim goal. They now cover 2% of the watershed, based on National Wetlands Inventory (NWI) data from 1989, so **currently wetlands are 27% of this goal.** Wetlands area from additional years (1988, 1991, 1993, and 2001) may be available soon based on satellite images, if this is funded by the Chesapeake Bay Program.

Forested nontidal stream buffers: These buffers improve water quality and provide wildlife habitats. In 1997 (the latest year with data), **23% of Magothy streams** had at least a 100 foot wide forested buffer, also called a riparian forested buffer. Our goal is for 100% of streams to have forested buffers, and you can help the Magothy reach this goal by planting trees along streams that lack them (see last page of report).

Forested tidal shoreline buffers: This came from the watershed survey done by MD DNR in 2004. Our goal is 100%. They estimated that **68%** or 52 miles of the tidal shoreline they surveyed had a forested buffer at least 50 feet wide. If you live on the water, you can help the Magothy reach this goal by planting trees along shorelines that lack them (see last page of report).

Unaltered tidal shoreline (not bulkhead or riprap): This also came from the watershed survey done by MD DNR in 2004. Our goal is 100%. They estimated that **35%** of all tidal shorelines were unaltered.

Water Quality Factors sampled by MRA, requiring lab analysis

I measured 4 other water quality factors from surface samples over 1993-2007 at 2-3 sites (we sampled several more sites from 1993-1998). The other factors we measured are **Total suspended solids (TSS)**, **Dissolved inorganic nitrogen (DIN)**, **Chlorophyll *a* (CHLA), and Dissolved Inorganic Phosphorus (DIP)**. All of these factors require field filtration of water samples, shipping frozen samples to a lab, and lab analysis. The Chesapeake Bay Trust paid for the shipping and lab expenses for most of those years, while the Environmental Protection Agency paid them for a few years. The same factors were also measured at the state sampling site, WT6.1 (see Fig. 4 for location), and those results are included here for comparison.

The MRA decided to stop measuring these factors in 2008 because they are not being sampled by other groups at tidal sites, and thus do not fit in a consistent report card format. In addition, although these factors were monitored because research showed they affected SAV growth, subsequent research has shown that water clarity is more important to SAV growth than any of these factors. It would also be too expensive and time-consuming to sample them at more sites, which would be needed to use them to help assess aquatic health. MRA volunteer Carl Treff started a new monitoring program, “Creek Watchers” in 2008 to get water clarity, salinity, and temperature data from many more Magothy sites, and dissolved oxygen data at selected sites. Data from that program will be used in the Magothy River Index for 2008.

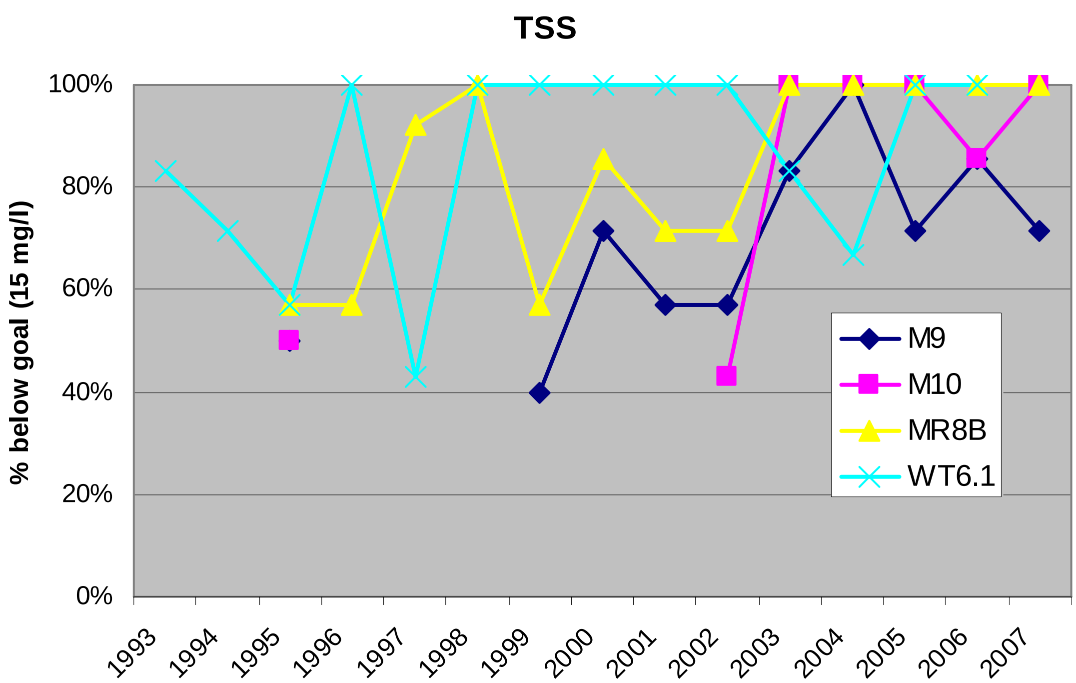
For all of these factors, attainment was calculated using the same method used for the field parameters, the % of observations better than the goal. In past Magothy reports, attainment was measured using the median (50th percentile) compared to a goal. Attainment over 100% was possible using the old method, but not using the new method.

Total Suspended Solids (TSS)

Site comparisons: The TSS status at the state site, WT6.1, was similar to that at the MRA sites, except in 1999-2002 when WT6.1 had 100% and the other sites had lower status (Fig. 8). The TSS status at WT6.1 went down in 2003-2004, at the same time it went up in Old Man and Cattail creeks.

Year comparisons: TSS goal attainment was highest in the upper creeks (Old Man and Cattail) in 2003-2004. Surprisingly, both were high rainfall years, which tend to have more runoff and thus worse total suspended solids levels. We think the TSS status in Cattail Creek (M9) improved in 2004 due to filtration by dark false mussels, which removed solids from the water. Attainment of the goal got worse at Cattail Creek in 2005-2007 but stayed about the same at the Old Man (M10) and Forked (MR8B) creeks in those years. In 2005-2007 there were both fewer mussels (and thus less filtration) but also less rainfall (and thus less runoff) compared to 2003-2004. (Fig. 8)

Figure 8. Total Suspended Solids (TSS) status by year at 3 MRA sampling sites and 1 state (MD DNR) sampling site, WT6.1, 1993-2007. Data represent % of samples < 15 mg/l.

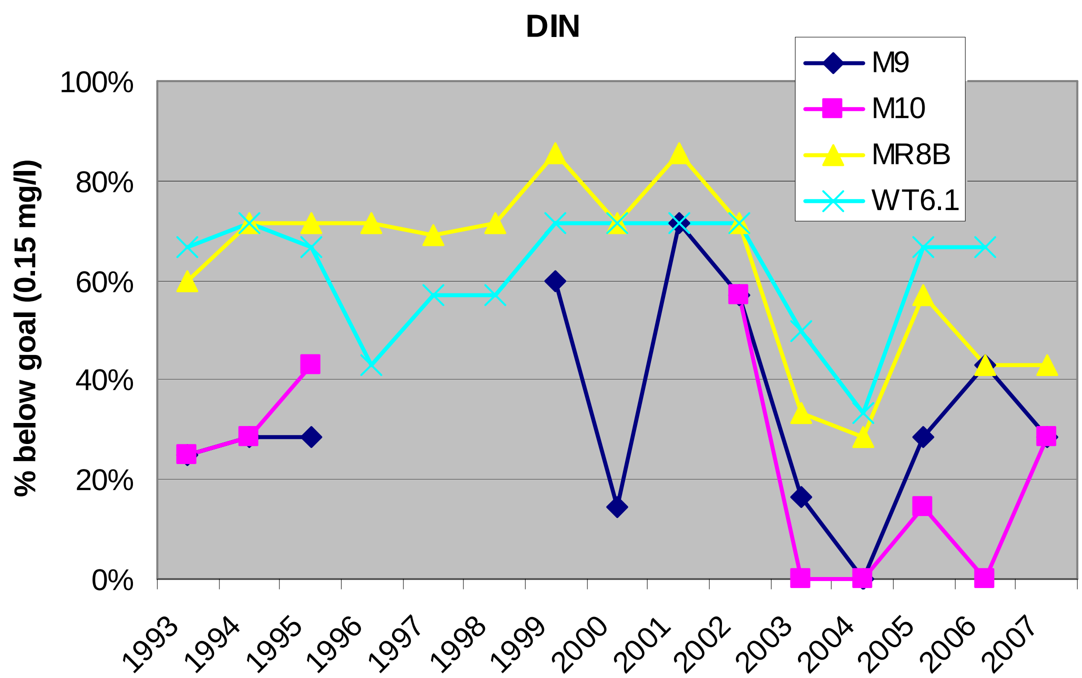


Dissolved Inorganic Nitrogen (DIN)

Site comparisons: The DIN status for the state site (WT6.1) was usually similar to that at MRA site MR8B, which is near the mainstem of the river (Fig. 9). The two upper creek sites (M9 and M10) usually had the worst DIN status, and are closer to nontidal DIN inputs than the other two sites.

Year comparisons: DIN status was worse in 2003 and 2004, which were wet years, than in 2001-2002, which were drought years, at all four Magothy sites (Table 3 and Fig. 9). This is the expected pattern. DIN is generally more affected by changes in rainfall than most other water quality parameters, partly because one of its components, nitrate, can be abundant in both runoff (from air pollution, lawn fertilizer, etc.) and ground water (partly from nitrate from septic tanks). High rainfall flushes more ground water into the river, and also reduces the residence time of water in areas such as wetlands where denitrification (natural nitrogen removal) occurs. Worse DIN levels can fuel algae blooms. It's also possible that DIN levels got worse in the creeks in 2004 because the dark false mussels removed some of the phytoplankton, which use DIN as they grow. DIN status improved by most sites in 2005-2007 compared to 2004, presumably because there was less rainfall in those years, except for Old Man Creek in 2006.

Figure 9. Dissolved Inorganic Nitrogen (DIN) status by year at 3 MRA sampling sites and 1 state (MD DNR) sampling site, WT6.1, 1993-2007. Data represent % of samples < 0.15 mg/l.



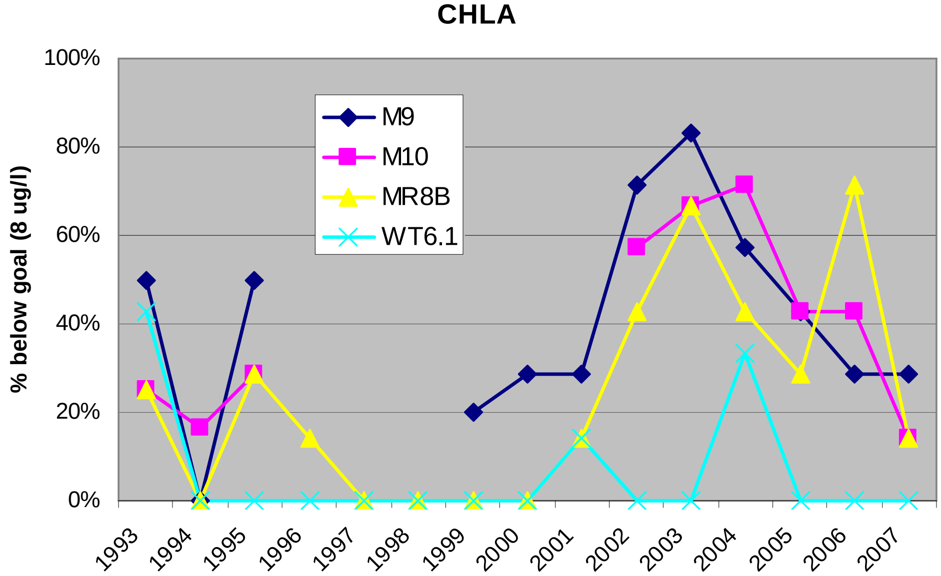
Chlorophyll *a* (CHLA)

Site comparisons: CHLA status at the state site, WT6.1, was similar to that found at the MRA sites in seven years (1993-1994, 1997-2000, and 2004) but in the other eight years, status at WT6.1 was much lower than at the MRA sites (Fig. 10).

Reasons for these CHLA site differences in about half of the years sampled are not known. The CHLA methods were different (WT6.1 used spectrophotometric methods at MDHMH while MRA data used fluorometric methods at CBL & VIMS), but that does not seem to be the cause. MRA volunteers sampled CHLA at the state site from 1993-1996, and comparison of those data by month to the state data from the same site collected within the same week showed that 7 of the 8 paired samples had good agreement, and the one that did not had high values, which tend to have lower agreement.

Year comparisons: CHLA status in the Magothy was best (over 60%) in 2002-2004 at M9 and M10 and in 2003 at MR8B, and got slightly worse after that at all three sites, except status went up again in 2006 at MR8B (Fig. 10). Since these chlorophyll *a* improvements started in 2002-2003 before the increase in dark false mussels in 2004, and because 2004 (when mussels were at their peak) did not have the best chlorophyll *a* status, the increased filtration by the mussels may not have been a major cause of those improvements (see below for further discussion).

Figure10. Chlorophyll *a* status by year at 3 MRA sampling sites and 1 state (MD DNR) sampling site, WT6.1, 1993-2007. Data represent % of samples < 8 ug/l.

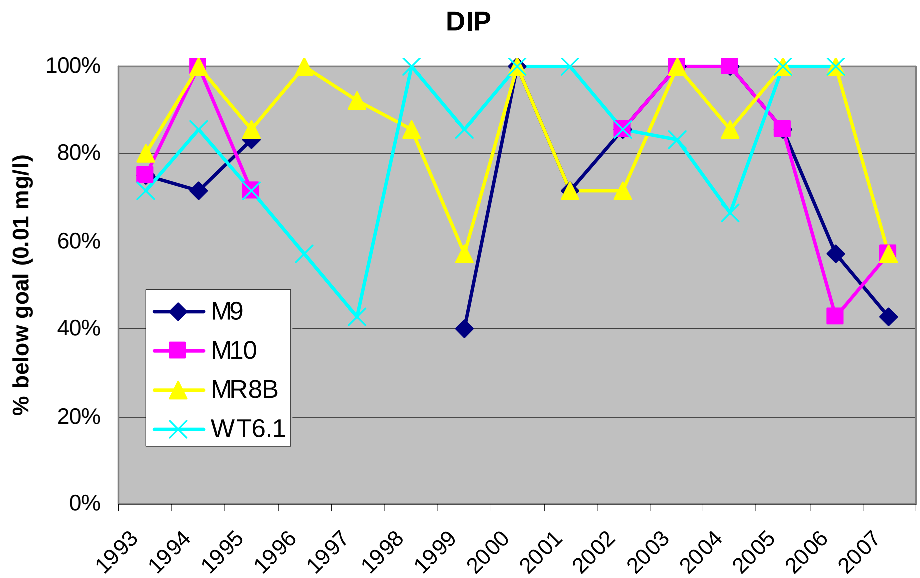


Dissolved Inorganic Phosphorus (DIP)

Site comparisons: DIP status at the state site (WT6.1) was usually similar to that at MRA sites (Fig. 11).

Year comparisons: DIP status was generally the best of all the lab parameters sampled in the Magothy by the MRA, usually between 70-100%, except status at the 3 MRA sites fell below 60% in 2006 and/or 2007. (Figure 11)

Figure 11. Dissolved Inorganic Phosphorus (DIP) status by year at 3 MRA sampling sites and 1 state (MD DNR) sampling site, WT6.1, 1993-2007. Data represent % of samples < 0.01 mg/l.



Mean status by factor by year: TSS, DIN, CHLA, & DIP

The mean status by factor by year was calculated and graphed in Fig. 12 to see if attainment by factor changed in similar ways over time. As seen in Figs. 7-10 above, in some cases the status for a particular factor varied quite a bit by monitoring site, but that variability is not shown here. Thus, changes that may have affected the whole river, such as rainfall, would be expected to have clearer effects in this graph than changes that affected some sites more than others, such as the dark false mussels in 2004. In the latter case, Cattail and Old Man creeks (M9 and M10) had more mussels filtering a smaller volume of water, so they would be expected to show more effects.

Figure 12. Mean status by factor by year for TSS, DIN, CHLA, and DIP, 1993-2007. The number of Magothy sites sampled per year varied from 2-4, except TSS in 1993-94 was only from WT6.1.

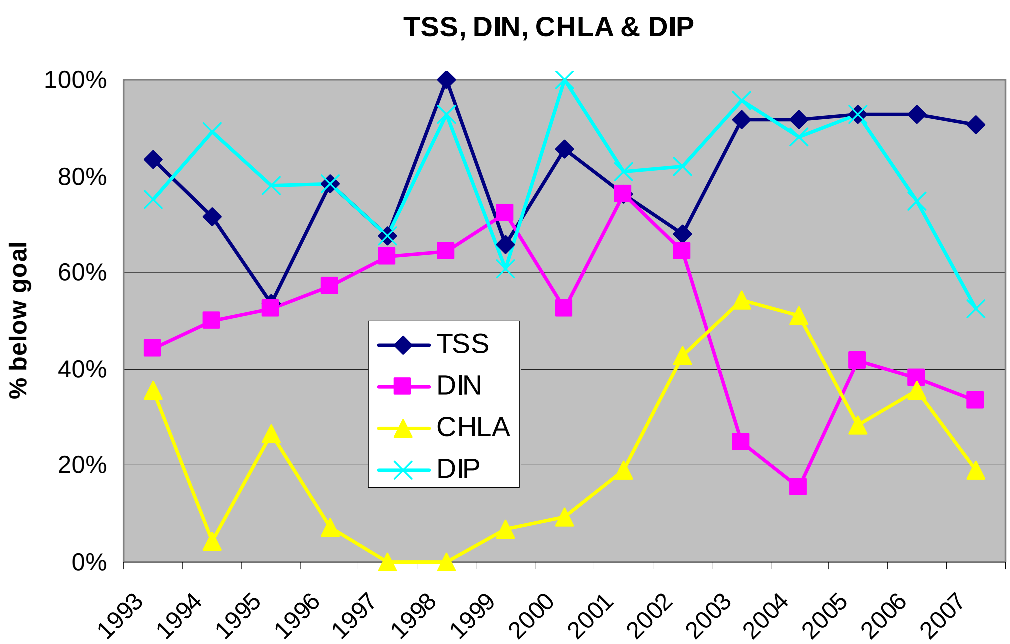


Fig. 12 shows some interesting patterns of changes over time. From 1993-2002, TSS and DIP had the best status, with DIN status improving to match theirs, even in wet years that normally increase DIN (such as 1996 and 1998). CHLA had the worst status over that period, improving in 2002. There were some marked changes in 2003, which was a wet year after several years of drought. In 2003, CHLA status continued to improve, DIN status got much worse (as expected during wet years), and TSS and DIP status improved. 2004 brought little change (although that was the year with the highest mussel populations), while 2005 (when the mussels died back and salinity rose, see Fig. 7) brought reversals for CHLA and DIN, and DIP status went down in 2006-07. TSS status stayed high through 2007.

These CHLA status improvements in 2002-2004 could be explained by the dark false mussels if they had started in 2004, when we noticed the mussels. Increased filtration could remove phytoplankton and thus reduce CHLA. However, the first mussels we noticed, in July 2004, were too small to have been present in 2003, and certainly not in 2002. Further investigation is needed to see what might have improved status CHLA from 2002-2004. TSS status improved at about the same time as CHLA (2003), but TSS status did not drop in 2005 as the mussels died, so it's also hard to argue that its changes were linked to the mussels.

Table 3. Status of Water Quality Factors using lab analysis sampled by the MRA, 1993-2007, based on the % of observations better than the goal, not on medians as in past reports. Sampling for TSS at MRA sites started in 1995, and Forked Creek (MR8B) was the only MRA site with results for all factors from all years. Means by year of each factor over all sites (not shown here for space reasons) were graphed in Fig. 12.

Water quality factor	Sampling site	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
DIN	M9	25%	29%	29%				60%	14%	71%	57%	17%	0%	29%	43%	29%
	M10	25%	29%	43%							57%	0%	0%	14%	0%	29%
	MR8B	60%	71%	71%	71%	69%	71%	86%	71%	86%	71%	33%	29%	57%	43%	43%
	WT6.1	67%	71%	67%	43%	57%	57%	71%	71%	71%	71%	50%	33%	67%	67%	
DIP	M9	75%	71%	83%				40%	100%	71%	86%	100%	100%	86%	57%	43%
	M10	75%	100%	71%							86%	100%	100%	86%	43%	57%
	MR8B	80%	100%	86%	100%	92%	86%	57%	100%	71%	71%	100%	86%	100%	100%	57%
	WT6.1	71%	86%	71%	57%	43%	100%	86%	100%	100%	86%	83%	67%	100%	100%	
TSS	M9			50%				40%	71%	57%	57%	83%	100%	71%	86%	71%
	M10			50%							43%	100%	100%	100%	86%	100%
	MR8B			57%	57%	92%	100%	57%	86%	71%	71%	100%	100%	100%	100%	100%
	WT6.1	83%	71%	57%	100%	43%	100%	100%	100%	100%	100%	83%	67%	100%	100%	
CHLA	M9	50%	0%	50%				20%	29%	29%	71%	83%	57%	43%	29%	29%
	M10	25%	17%	29%							57%	67%	71%	43%	43%	14%
	MR8B	25%	0%	29%	14%	0%	0%	0%	0%	14%	43%	67%	43%	29%	71%	14%
	WT6.1	43%	0%	0%	0%	0%	0%	0%	0%	14%	0%	0%	33%	0%	0%	
Notes		*Wet*	*Wet*	*Dry*	*Wet*	*Average*	*Wet*	*Dry*	*Average; Mahog. Tide*	*Dry*	*Dry*	*Wet*	*Wet, DFM*	*Few DFM*	*Dry*	*Normal then dry*

Key: DIN = Dissolved Inorganic Nitrogen; DIP = Dissolved Inorganic Phosphorus; TSS = Total Suspended Solids; CHLA = Chlorophyll *a*; M9 = Cattail Creek, M10 = Old Man Creek, MR8B = Forked Creek, (all 3 sampled by MRA); WT6.1 = Midriver (sampled by DNR, between North & South Ferry points). Mahog. Tide =mahogany tide (algae bloom), DFM = dark false mussels.

Other Water Quality Factors sampled by the MRA

Bacteria (enterococci) were only sampled at 4 Magothy swimming sites in 2007, and only 3 of those sites had enough data for analysis, after rain samples were excluded. That was not enough sites to report bacteria status for the river (other local watershed groups that report this have bacteria data from at least 8 sites per river). Bacteria data were collected at 6 tidal sites in Mill & Dividing creeks in 2006-2007 but they were part of a special study funded by Anne Arundel County Department of Public Works to assess the effects of the December, 2005 sewage spill in Mill Creek. They were not included in the Index due to possible effects from the sewage spill.

Nontidal aquatic health is assessed in three main ways:
(1) Measuring water quality, as we do to assess health of tidal waters
(2) Collecting and identifying benthic invertebrate animals (insects and other animals living on the bottom of streams).
(3) Assessing the quality of the physical habitats in nontidal streams.
Some assessments use more than one of these methods.

(1) Nontidal water quality is starting to be measured by some watershed groups, including the Chester and Patuxent River groups. It has not been sampled in the Magothy except as part of the special Mill & Dividing creek studies in 2006-2007. It is hard for volunteer groups to sample adequately since it is very affected by recent runoff.

(2) Benthic invertebrate sampling is much easier for volunteer groups because the animals integrate the effects of water quality over time. In spring 2002 and 2003, Magothy River Association (MRA) volunteers sampled 20 points on Magothy non-tidal tributary streams for benthic invertebrate animals. Maryland DNR staff analyzed the samples and rated their health by comparison to reference streams that had few human impacts and a diverse community of benthic animals living in them, nineteen of the 20 Magothy sites had "Poor" quality based on these samples. The one site rated "Fair" was on Magothy Branch (the non-tidal Magothy) above Lake Waterford. To see the data, go to http://mddnr.chesapeakebay.net/mbss/streamwaders.cfm and type "Magothy" in the box for "8 digit watershed name." Statewide, half of the small streams sampled by DNR were rated Poor, about a third were rated Fair, and the rest (11%) were rated Good. Thus, with 95% of our sites sampled rated Poor, the Magothy was much worse than the state average.

(3) Maryland DNR also supervised a Stream Corridor Assessment (SCA) of all nontidal Magothy streams in 2004. Rather than studying benthic invertebrates, the SCA located, photographed, and ranked any "problem areas" (such as serious erosion) on all of the walkable Magothy nontidal streams (49 stream miles total), looking mainly at physical habitat quality. It also included a tidal shoreline survey. Janis Markusic reported on both studies at the State of the Magothy meeting in February 2005; DNR's report is available as large PDF files by writing to sav2@magothyriver.org. The SCA ranked all of the subwatersheds as "Good," "Fair," or "Poor" by comparing them to relatively undisturbed reference watersheds. Fourteen of 22 (64%) of the subwatersheds were ranked in Poor condition. The rest (36%) were rated Fair; none were rated Good. Of these "fair" subwatersheds, Blackhole Creek, Kinder Branch, Grays Creek and Muddy Run were in the best condition. Cypress Creek**,** which includes North Cypress Branch, was identified as one of the highest priority subwatersheds for restoration, and a major effort is underway to restore North Cypress Branch.

WHAT WE CAN DO TO HELP THE MAGOTHY

Oyster restoration (including reef balls):
The MRA has done oyster restoration with our partners on five bars in the Magothy. Dick Carey is the lead on this activity. The MD Oyster Recovery Partnership planted 1.3 million spat on shell at Chest Neck Point (CNP) in 2001, and planted about 5 million spat on shell at that site and two others in 2006. The new Mary Jo Garreis Memorial (MJGM) reef was created in Sillery Bay in 2007 but has not yet been seeded. Since the Magothy is closed to oyster harvest, any oysters restored here will provide valuable water quality and habitat benefits. Reef balls have also been placed next to some oyster restoration sites, which provide fish habitat as well as oyster habitat.

SAV restoration:
The MRA started doing SAV restoration in the Magothy in 1998. We planted redhead grass every year from 2002-2005, first at the Grachur Club near Cockey Creek (2002-2003) and then off Sylvan View beach near Grays Creek and Little Island (2004-2005); and then we planted wild celery at a different site at the Grachur Club (2006-2007). All six of these planting projects had some survival for 1-3 years and had some plants spreading outside of the planted area. We plan to grow and plant wild celery elsewhere in the upper river in 2008. Carl Treff leads this activity with assistance from me and others.

WHAT WE CAN DO TO HELP THE MAGOTHY

- **Volunteer to help with water quality and other monitoring through Creek Watchers**. Contact Carl Treff at mracreekwatchers@yahoo.com .
- **Increase oyster reefs** to increase filtration capacity and fish habitat. You can do oyster gardening and help with oyster nurseries (oysterinfo@magothyriver.org), and do diving to support oyster restoration (diver@magothyriver.org).
- **Increase Submerged Aquatic Vegetation** (SAV) through planting to improve water quality and increase fish and shellfish habitat, contact Carl Treff at magothyriversavers@yahoo.com. (all spaces are full for 2008, however.) If you can help with **surveys of current SAV locations**, please contact Peter Bergstrom at sav2@magothyriver.org.
- **Plant trees along streams and shorelines that lack them** or have a narrow forested buffer. Trees absorb nitrogen, reduce air pollution, provide food and habitat to many animals, help stabilize shorelines, and shade homes and thus reduce energy cost.
- **If you have a septic system, keep it pumped out and in good repair.**
- Reduce your lawn area and your use of lawn fertilizer, and use native plants. **Fertilize your lawn (if necessary) only in the fall**, which is the best time for grass growth, and **avoid fertilizing in the sprin**g, when fertilizer runoff is more likely to cause algae blooms. **Don't put yard waste into the river, where it decomposes and lowers the dissolved oxygen.**
- **Reduce your use of vehicles and other internal combustion engines**. These add nitrogen to the air, much of which reaches the water. Car pool, combine trips, buy more fuel-efficient vehicles and four-cycle boat motors, and use electric or manual yard tools instead of gas tools.
- **Encourage nutrient best management practices,** including nutrient management by lawn care companies, and at horse farms and other farms in the watershed.
- **Minimize and when possible reduce the amount of pavement and other impervious surfaces in your yard,** since they increase runoff to the river. This can be done by using gravel or porous pavers for driveways and parking lots. **Install rain barrels, rain gardens, and other structures** to retain and improve the quality of runoff before it leaves your yard. See: http://www.arlingtonecho.org/rainbarrel.htm
- **Join the Magothy River Association: see** http://www.magothyriver.org/Who_We_Are.html or contact President Paul Spadaro at 410-647-8772 or president@magothyriver.org.
- Visit our web page (link above) and sign up for "News and Announcements" via email.