
EFFECTS OF MEETING HOUSE GOLF CLUB UPON EDGARTOWN GREAT POND

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SUMMARY

Edgartown Great Pond is one of the most important and sensitive aquatic resources on Martha's Vineyard. Severe water quality problems occurred in 1993. The onset of these problems indicated that the Pond may be balanced on a very precarious edge. Further increases in nitrogen inputs could cause a recurrence of the 1993 oyster die-off and algal blooms. Other forms of stress, such as an increase in the toxic conditions caused by pesticides, could reduce the ability of the Pond ecosystem to recover from recurrences of algal blooms and other water quality problems.

While these factors cause Edgartown Great Pond to be extremely vulnerable, they do not mean that the watershed is unsuitable for a golf course. Martha's Vineyard residents could enjoy the benefits offered by both a golf course and a high quality Edgartown Great Pond if the course can be designed so it does not exceed key Pond protection criteria. However, the analysis presented in this report shows that the proposed Meeting House Golf Club would exceed Pond protection criteria.

Nitrogen

The Martha's Vineyard Commission proposed interim nitrogen loading limits to reduce the likelihood of a recurrence of the 1993 algal blooms. When applied to the 200-acre Meeting House site, the interim limits would allow for the release of 520 kilograms of nitrogen per year. Using the Commission's assumptions, the most optimistic estimate shows that the Meeting House golf course would release 537 kilograms of nitrogen per year to the Pond. Less optimistic estimates put the golf course nitrogen release in the range of 718 to 1,400 kilograms per year.

Alternate uses of the site would release far less nitrogen. If the site is developed as a residential project then nitrogen loads would be just 193 kilograms per year. If preserved as Conservation then nitrogen releases would plummet to a mere 22 kilograms per year. Again, these estimates are based upon the same assumptions the Commission employed in drafting the interim loading limits.

Pesticides

The applicant has proposed using a maximum of 38 pesticides on the Meeting House golf course. Four of these pesticides have a *very high* relative toxicity to aquatic life and six have a *high* relative toxicity.

The U.S. Environmental Protection Agency (EPA) has established specific aquatic life protection criteria for only one of these 38 pesticides - the insecticide chlorpyrifos. Without aquatic life protection criteria it is very difficult to evaluate the effect of a pesticide (or any other substance) upon an aquatic ecosystem.

The applicant's estimate of chlorpyrifos releases shows that the EPA aquatic life protection criteria will be exceeded throughout 25% of Edgartown Great Pond. In Mashacket Cove the criteria will be exceeded by a factor of three. These exceedances do not include the concerns identified by Dr. Adel Shirmohammadi. If Dr. Shirmohammadi is correct then pesticide releases from the golf course (and, therefore, aquatic life protection criteria exceedances) could be much higher.

While the proposed golf course does pose a substantial threat to the quality of Edgartown Great Pond, it is possible that a redesign combined with more effective Best Management Practices

(BMPs) would reduce the threat to an acceptable level. But a far more accurate pesticide model is crucial to determining if a redesign-BMP mix is available which will prevent pesticides from exceeding aquatic life protection criteria. Before the search for this mix can be initiated, the pesticide model deficiencies identified by Dr. Shirmohammadi must be resolved.

It has been proposed that monitoring will prevent any unforeseen, adverse effects upon Edgartown Great Pond. This assumes that it is possible to conduct a monitoring program that will catch problems earlier enough to initiate corrective action. Given the extremely close proximity of the golf course to the Pond and Coves, by the time a problem is detected it may be too late to take corrective action.

Alternate uses of the 200-acre site pose far less of a threat to the Pond. Presently about 9 kilograms of pesticides are applied on the site each year. If the site becomes a golf course then pesticide application rates will increase to 1,200 kilograms per year. If the site is developed as residential then pesticide applications would total just 2.3 kilograms per year. As pesticide application rates diminish so does the potential for harm.

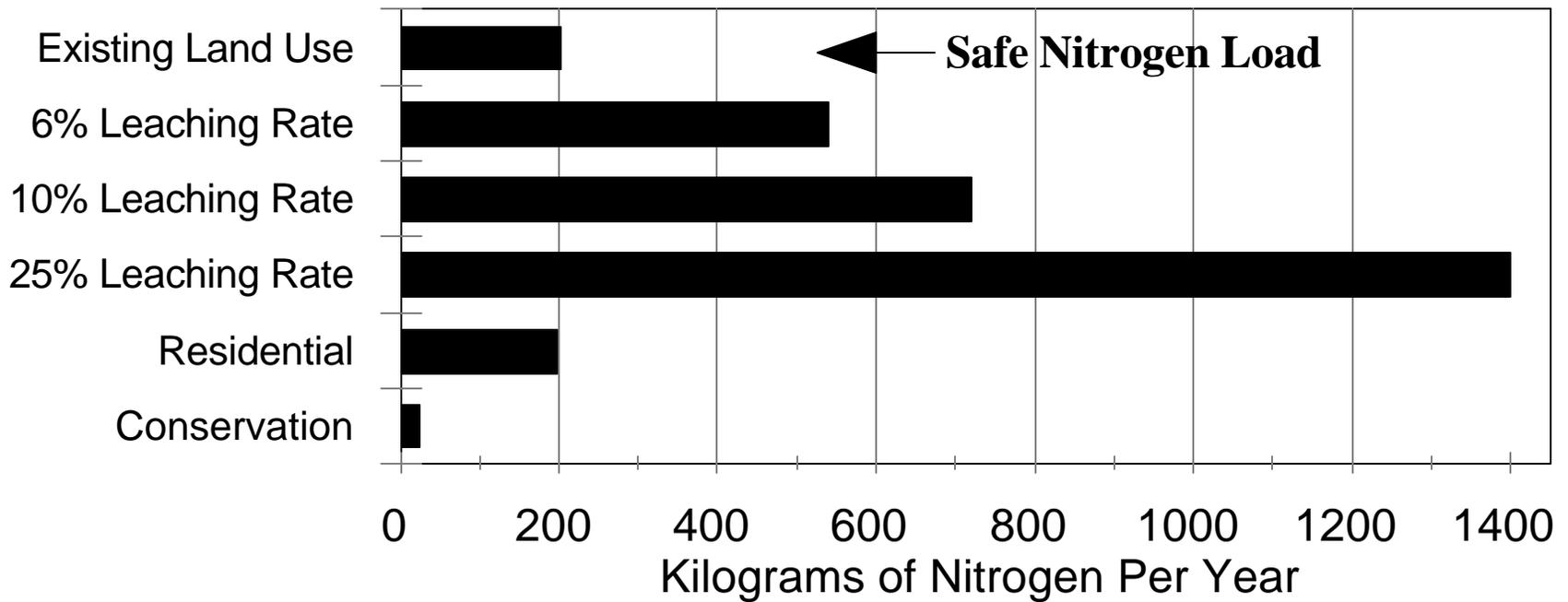
In summary, the Meeting House Golf Club (as proposed) will clearly have an adverse effect upon the environmental quality of Edgartown Great Pond. Alternate uses of the site would have a favorable environmental effect by reducing nitrogen releases and by reducing pesticide application rates.

NITROGEN & EDGARTOWN GREAT POND

Following is a review of key points essential to understanding the relationships between Edgartown Great Pond, nitrogen, the Meeting House Golf Club proposal, and alternate uses of the site.

- A. Edgartown Great Pond experienced severe water quality problems in 1993, which were attributed to excessive nitrogen inputs.
- B. These problems included the die-off of oysters, reduced water clarity, loss of eelgrass, and algae blooms.
- C. To prevent a further decline in Pond quality an interim nitrogen loading limit of 15,513 kilograms per year was recommended in the Martha's Vineyard Commission report *Edgartown Great Pond: Nutrient Loading & Recommended Management Program*, dated November 1998.
- D. The Commission's report calculated present nitrogen loading to be 10,327 kilograms per year.
- E. The Commission's report recommended limiting nitrogen loadings to the Pond to 15,513 kilograms per year.
- F. The Commission's report showed that at a moderate rate of growth future development could occur in the watershed without degrading the quality of Edgartown Great Pond.
- G. Following this page is a graph labeled Figure 1. The graph shows how the Commission's recommended moderate growth rate scenario would apply to the 200-acre Meeting House Golf Club site. The data presented in Figure 1 is based upon tables appearing in Appendix A of this report. These tables were computed using the same assumptions presented in the Commission's report.
- H. The safe nitrogen load from the 200 acre site is 520 kilograms per year. If development causes the nitrogen load from this site to exceed 520 kilograms, then the likelihood of future water quality problems in the Pond increases.
- I. Figure 1 shows that the existing land use releases 201 kilograms of nitrogen to the Pond each year. Most of the existing nitrogen load comes from the 13 acres of cropfields on the site.
- J. The next bar in Figure 1 is labeled "6% Leaching Rate." The applicant assumed that 6% of the 5,600 kilograms of fertilizer nitrogen applied on the golf course would leach into the Pond. Other sources of nitrogen from the project will include the proposed wastewater treatment plant discharge with a minor addition from the forests, grasslands, and wetlands remaining on the site. After combining all three sources (fertilizer, wastewater, forest-

Figure 1: Nitrogen Loadings & Land Use
Meeting House Golf Club Site



grassland), Figure 1 shows that the entire Meeting House Golf Club project would release 537 kilograms of nitrogen into the Pond each year or 17 kilograms above the safe level. The loadings shown in Figure 1 for the golf course is for the period beginning 10 years after the course is built. For the first 10 years nitrogen contaminated groundwater will be pumped onto the course. A portion of this nitrogen will be removed and thereby prevented from entering Edgartown Great Pond. Therefore, during the first 10 years the Meeting House Golf Club will be releasing less nitrogen to the Pond than is shown in Figure 1. But for decades afterwards, when the contaminated groundwater is exhausted, the loadings will be as shown in Figure 1.

- K. The “10% leaching rate” bar uses the nitrogen loss anticipated for another proposed golf course - the Vineyard Golf Club. The site of this project adjoins the Meeting House Golf Club site. The scientists who drafted the Vineyard Golf Club report assumed 10% nitrogen fertilizer leaching rate, not the 6% assumed for the Meeting House project. This reflects the considerable uncertainty among scientists with respect to nitrogen leaching rates. If the Vineyard Golf Club scientists are right, then the Meeting House Golf Club would release more than 700 kilograms of nitrogen into Edgartown Great Pond or 180 kilograms above the safe level.
- L. The Cape Cod Commission assumes that 25% of the fertilizer nitrogen applied to a golf course will leach to the water table. While the scientific community appears united that 25% is too high, it is also logical that the Cape Cod Commission would chose this figure. A 25% leaching rate builds in the margin of safety which is frequently necessary when dealing with the imprecise sciences of watershed modeling and Pond ecology. If the Cape Cod Commission is right then the Meeting House Golf Club would release nearly 1,400 kilograms of nitrogen to the Pond each year or nearly three times the safe loading.
- M. The second to last bar in Figure 1 is marked “Residential.” Under the Residential land use alternative 40 houses would be built on the site. At this level of development the site would release 193 kilograms of nitrogen per year. By eliminating the 13 acres of cropfield on the site, residential development would cause a slight reduction in nitrogen releases when compared to the existing land use.
- N. The Residential alternative would also release only 40% of the nitrogen discharged from the Meeting House Golf Club, assuming of course that the 6% fertilizer leaching rate is correct. If the higher leaching rates assumed by the Vineyard Golf Club scientists or the Cape Cod Commission are correct, then the Residential alternative would release just 14% to 28% of the golf course nitrogen load.
- O. The last alternate land use examined in Figure 1 is *Conservation*. The Commission’s report recommended preserving a minimum of 165 acres of forest and grassland within the watershed of Edgartown Great Pond. Each acre of forest and grassland releases about a tenth of a kilogram of nitrogen to the Pond each year. Therefore, conserving the entire 200 acres through easement or

purchase would reduce nitrogen loads from the site to just 22 kilograms per year, which is 10% of the nitrogen released from the existing land use and 2% to 4% of the golf course loading rate..

- P. In summary, even the most optimistic golf course scenario - the 6% leaching rate - would cause the site to exceed the limit recommended in the Commission's report.
- Q. The Residential alternative would have far less impact on the fragile ecology of the Pond.
- R. Both the Residential and Conservation alternatives would have a favorable effect on the Pond by reducing nitrogen releases below that presently coming from the 200-acre site.
- S. Clearly, the golf course alternative would have a far less favorable impact upon the environmental quality of Edgartown Great Pond when compared to either the Residential or Conservation alternative.
- T. Because of the less favorable effect on environmental quality, the golf course would negatively affect the value of properties within view of Edgartown Great Pond.¹ In addition to causing an economic loss to these property owners, the golf course would also adversely affect those who seek out the Pond for recreational or commercial fishing, boating, and other pursuits.

PESTICIDES & EDGARTOWN GREAT POND

- A. In Table VI-1, of Part 2 of the applicant report, *Management Plan & Risk Assessment for the Proposed Meeting House Golf Club*, 38 pesticides are listed for use.
- B. The 38 pesticides are assigned to four groupings - herbicides, insecticides, fungicides, and plant growth regulators.
- C. Of these four pesticide groupings the insecticides have the highest relative toxicity to aquatic life (*see Table VI-1 in the applicant's report*).
- D. Table 1, following this page, lists the nine insecticides proposed for use at the Meeting House Golf Club.

¹ Several studies have shown that a noticeable decline in the appearance of a water body or a loss of sport fishing quality lowers the value of nearby properties by 10% or more. These studies are: *The effect of water quality on rural nonfarm residential property values*, American Journal of Agricultural Economics, Aug 79, 529-534, and *The effects of San Francisco Bay water quality on adjacent property values*, Journal of Environmental Management (1989) 27, 263-274.

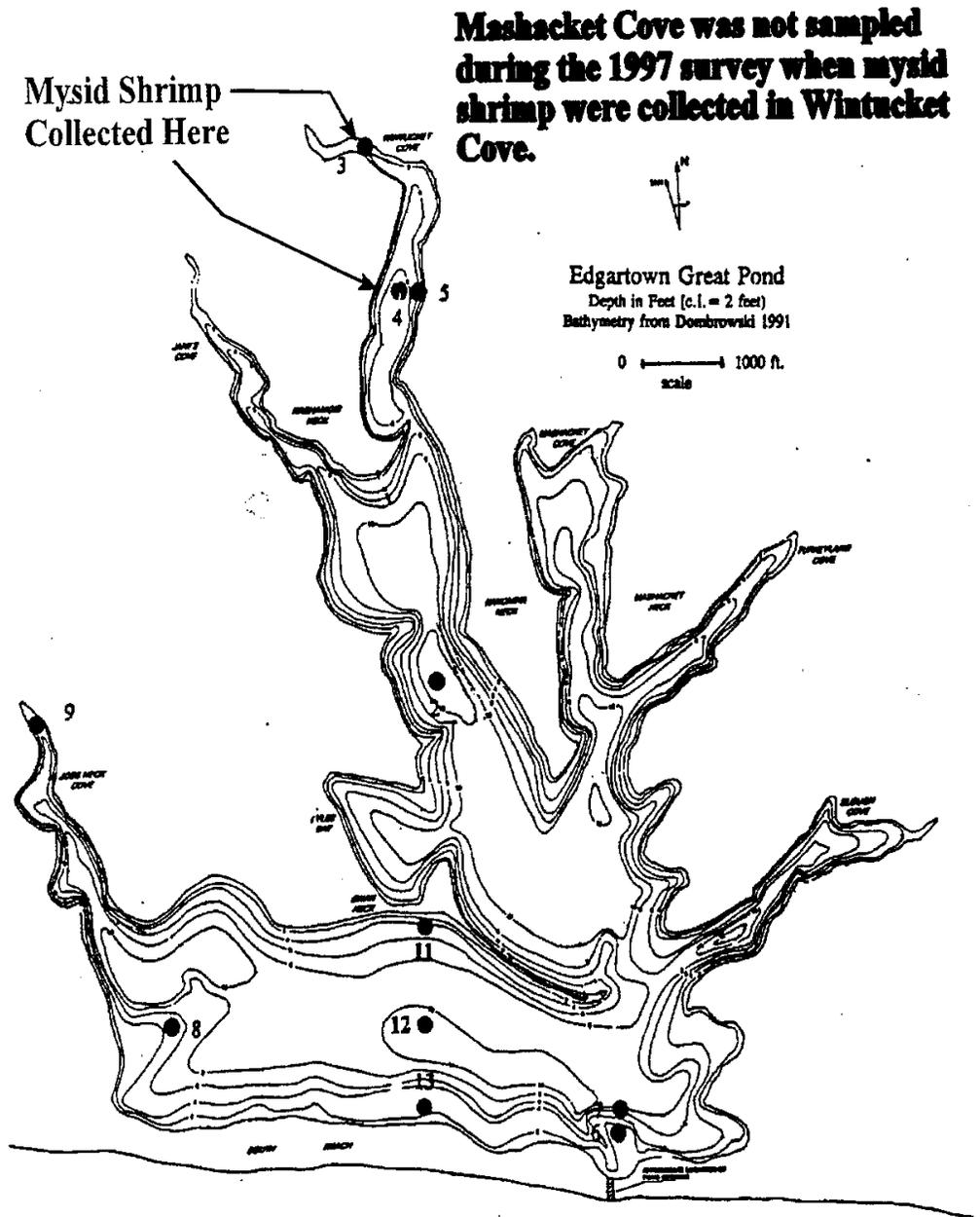
Table 1: Insecticides Proposed for Use at Meeting House Golf Club

Insecticide	Aquatic Life Relative Toxicity	EPA Saltwater Aquatic Life Protection Standard (parts per billion)
Azadirachtin	Not Applicable	Not Applicable
<i>Bacillus thuringiensis</i>	Not Applicable	Not Applicable
Chlorpyrifos	Very High	0.0056
Cyfluthrin	Very High	None Established
Halofenozide	?	None Established
Imidacloprid	Very High	None Established
Parasitic nematodes	Not Applicable	Not Applicable
Potassium salts of fatty acids	Not Applicable	Not Applicable
Spinosad	Not Applicable	Not Applicable

Data presented in this table was derived from Table VI-1, in *Part 2: Water Quality Risk Assessment and Rare/Endangered Species Protection Measures*. EPA saltwater aquatic life protection standards were obtained from *Part IV, Environmental Protection Agency National Water Quality Criteria*, which appeared in the Thursday, December 10, 1998 edition of the *Federal Register*.

- E. Of the nine insecticides listed in Table 1, three have a *Very High* relative toxicity to aquatic life. These three very highly toxic insecticides are: chlorpyrifos, cyfluthrin, and imidacloprid.
- F. The U.S. Environmental Protection Agency (EPA) has established aquatic life protection criteria for only one of these three very highly toxic insecticides. This insecticide is chlorpyrifos. In fact, of the 38 pesticides proposed for use on the Meeting House Golf Club, chlorpyrifos is the only one with an EPA established aquatic life protection criteria.
- G. Table 1 shows that the EPA criteria for protecting saltwater aquatic life from chlorpyrifos is 0.0056 parts per billion (ppb). This criteria appears in two publications: *Ambient Water Quality Criteria for Chlorpyrifos - 1986* and *Part IV, Environmental Protection Agency, National Recommended Water Quality Criteria, Federal Register, Thursday, December 10, 1998*. The *Federal Register* document contains EPA's official water quality criteria. The chlorpyrifos criteria presented in the *Federal Register* are based upon the findings presented in the *Ambient Water Quality Criteria* document. The *Federal Register* document is included in this report as Appendix B and *Ambient Water Quality Criteria for Chlorpyrifos - 1986* will be found in Appendix C.
- H. EPA's *Ambient Water Quality Criteria (page 7)* document shows that mysid shrimp are the most sensitive saltwater organisms to the insecticide chlorpyrifos. EPA's 0.0056 ppb saltwater chlorpyrifos criteria is based upon tests conducted on these shrimp. A typical mysid shrimp is pictured to the right. These crustaceans average about a half-inch long and are vitally important to the ecology of aquatic systems such as Edgartown Great Pond. Mysid shrimp serve as food for a number of other species, including fish with recreational and commercial value.
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- I. Figure 2, which follows this page, shows where mysid shrimp occur in Edgartown Great Pond. In their report *An Environmental Status Report on Edgartown Great Pond: Bottom Habitats and their Flora and Fauna (7/30/97 draft)*, Pratt and Gaines noted that the mysid shrimp (*Neomysis americana*) was present at two stations in Wintucket Cove very near the Meeting House Golf Club site. A copy of this report will be found in Appendix D.
- J. Since mysid shrimp are present in Edgartown Great Pond in the immediate vicinity of the Meeting House Golf Club site, the saltwater criteria (0.0056 ppb) is the appropriate value to use in judging whether the chlorpyrifos concentration caused by the golf course will harm the Pond ecosystem. In other words, Meeting House Golf Club will harm the aquatic ecosystem if it causes the chlorpyrifos concentration to exceed 0.0056 ppb at any location within Edgartown Great Pond or the Coves.
- K. Will the Meeting House Golf Club cause the chlorpyrifos concentration to exceed 0.0056 ppb in the Pond or Coves? The answer is Yes. In fact when viewed from three different

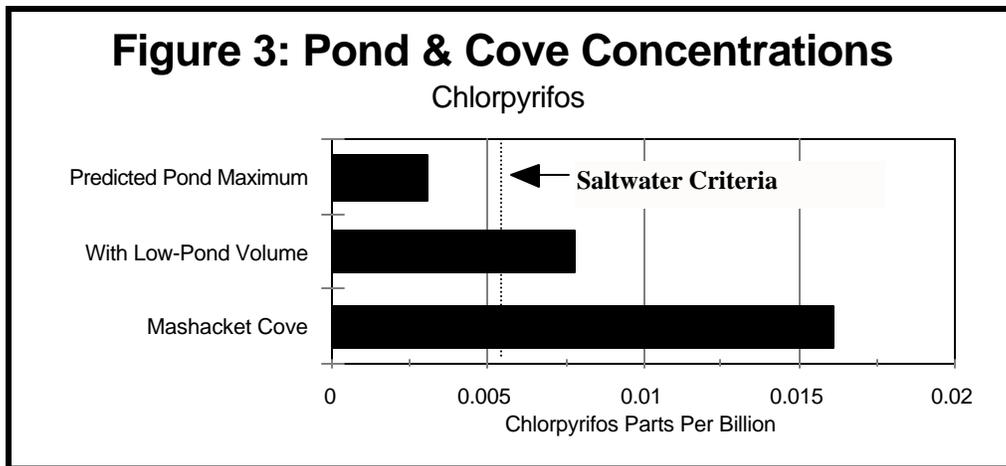
Figure 2: Mysid Shrimp Collection Sites



Atlantic Ocean
EPA's 0.0056 ppb saltwater chlorpyrifos standard resulted from the extreme sensitivity of mysid shrimp to this insecticide.

perspectives the data provided by the applicant's consultants shows that the 0.0056 ppb criteria will be exceeded.

- L. **First Perspective:** During testimony on behalf of the applicant, Dr. Stuart Cohen referenced his review of pesticide monitoring data for 17 golf courses. A copy of his trade journal paper, referenced during his presentation, will be found in Appendix E of this report. Dr. Cohen's paper shows that the maximum chlorpyrifos concentration measured in runoff from golf courses was 0.300 ppb or 54 times higher than the 0.0056 ppb criteria. The maximum chlorpyrifos concentration detected in golf course groundwater was 0.400 ppb or 71 times higher than the level deemed safe by EPA for water bodies such as Edgartown Great Pond. If chlorpyrifos had never been detected above 0.0056 ppb, then there would be little cause for concern. Unfortunately, this is not the case. Therefore it is not true that pesticide releases from golf course pose no threat to



the aquatic environment.

- M. **Second Perspective:** The applicant's consultants ran a model to determine the chlorpyrifos concentration after mixing with 25% of Edgartown Great Pond at "high-pond.". As shown in Figure 3, above, this exercise showed that the 96-hour chlorpyrifos concentration would be 0.003 ppb under these conditions. But this is a best-case scenario. To be conservative and to err on the side of full protection, the applicant should have assumed "low-pond" conditions. Under the low-pond scenario the chlorpyrifos concentration would be 0.0077 ppb or 38% higher than the 0.0056 ppb EPA criteria.

Before mixing with 25% of the low-pond volume runoff from the golf course will first mix with the waters of Mashacket Cove and Wintucket Cove. Most of the golf course will drain to Mashacket Cove. Mixing the same mass of chlorpyrifos in Mashacket Cove as was mixed with 25% of the high-pond volume results in a chlorpyrifos concentration of 0.0161 ppb or nearly three times the safe level. The calculations supporting the predicted chlorpyrifos concentrations will be found in Appendix F.

- N. **Third Perspective:** Appendix H of the applicant's report contains a table showing the chlorpyrifos concentration in runoff from greens and tees.

EPA's chlorpyrifos criteria is based upon maximum values that should not be exceeded more frequently than once every three years (*see page 17, in the Ambient Water Quality Criteria document in Appendix C of this report*). If the Edgartown Great Pond ecosystem were exposed to chlorpyrifos above 0.0056 ppb more frequently than once every three years then the mysid shrimp and other organisms supporting this ecosystem may not fully recover, which could cause a collapse of the system..

Table 2, following this page, summarizes the data presented in Appendix H of the applicant's report. Table 2 shows the maximum chlorpyrifos concentration for each three-year period presented in Appendix H of the applicant's report. Table 2 shows that the three-year maximum concentration in greens/tees runoff will average 0.2719 ppb or 49 times higher than the chlorpyrifos level which is safe for Mashacket Cove and other portions of the Pond.

During testimony it was asserted by the applicant's consultant that the greens/tees runoff would simply flow into adjoining forest and soak into the soil. This is not correct. Greens are constructed of highly permeable material. It takes as much or more rain to produce runoff from greens when compared to forest. In other words, all soil surfaces will be saturated by the time greens begin producing runoff. Therefore one should assume that the greens/tees runoff will reach Mashacket Cove and Wintucket Cove.

Table 2 also shows the volume of Mashacket Cove required to dilute each three-year maximum concentration to the 0.0056 ppb criteria. On average 3.5 acre-feet or about two acres of the Cove will exceed the 0.0056 ppb criteria.

- O. Each of the three preceding perspectives shows that the quantity of the insecticide chlorpyrifos exported from the Meeting House Golf Club will be sufficient to degrade the quality of Edgartown Great Pond and its tributary coves. Two of these three perspectives are based upon the applicant's model predictions. During his testimony Dr. Adel Shirmohammadi explained why the model predictions could be serious underestimates. Thus the impact could be far greater.
- P. As previously stated, EPA has not established aquatic life protection criteria for the other 37 pesticides proposed for use at the Meeting House Golf Club. Three of these pesticides are rated as having *very high* toxicity to aquatic life according to Table VI-1 in the applicant's report. Another six pesticides have a *high* relative toxicity to aquatic life. A comprehensive evaluation of the environmental effects of the golf course must encompass all nine pesticides, at a minimum.

TABLE 2: CHLORPYRIFOS & MASHACKET COVE

Greens & Tees Runoff Impacts Only

Does not include fairway runoff, groundwater discharge or drift.

Three-Year Period	Maximum Chlorpyrifos Concentration ¹ (parts per billion)	Greens/Tees Runoff Depth ¹ (centimeters)	Runoff Volume ² (cubic feet)	Volume of Mashacket Cove Impacted ³ (acre-feet)
1965-1967	0.0202	0.0683	705	0.1
1968-1970	0.0278	0.8306	8,570	1.0
1971-1973	0.9988	0.0806	832	3.4
1974-1976	0.1590	2.295	23,681	15.4
1977-1979	0.4423	0.2188	2,258	4.1
1980-1982	0.0135	0.00527	54	0.0
1983-1985	0.1427	0.0474	489	0.3
1986-1988	0.3212	0.7830	8,079	10.6
1989-1991	0.5744	0.0118	122	0.3
1992-1994	0.0190	0.0127	131	0.0
Average	0.2719	0.4353	4,492	3.5

¹ Maximum concentration for each three-year period and the runoff depth was obtained from Appendix H, of *Part 2: Water Quality Risk Assessment and Rare/Endangered Species Protection Measures*

² Appendix G, of *Part 2: Water Quality Risk Assessment and Rare/Endangered Species Protection Measures*, shows that 7.22 acres of greens and tees would be located in the sub-basins draining to Mashacket Cove. The runoff depth in centimeters was converted to feet and multiplied by the number of square feet in 7.22 acres to compute greens-tees runoff volume.

³ The volume of Mashacket Cove impacted was computed by dividing the maximum chlorpyrifos concentration by the saltwater standard (0.0056 ppb) then multiplying the runoff volume to obtain cubic feet of water at or above the standard. This was then divided by 43,560 to obtain acre-feet of the Cove impacted.

- Q. The applicant’s model predictions also fail to consider pesticides released from other sources, such as the proposed Vineyard Golf Club. In addition to looking at all nine pesticides, a thorough environmental analysis must include all possible sources.

- R. While pesticide impacts may seem inevitable this is definitely not the case. It is possible that a golf course could be built on the Meeting House site without posing a significant threat to the Pond-Cove ecosystems. If the applicant can resolve the numerous deficiencies identified in Dr. Shirmohammadi’s critique of their pesticide model, it would then be possible to use the model to evaluate various alternative golf course layouts and Best Management Practices to find a mix which will prevent an exceedance of the chlorpyrifos criteria.

Alternate land use options pose far less of a threat to the quality of the Coves and the Pond. Figure 4, below, shows that under existing land use conditions about 9 kilograms of pesticides are applied on the 200-acre site each year. If the site were developed as residential then pesticide applications rates would drop to 2.3 kilograms per year, which is but a fraction of the 1,200 kilograms that would be applied to the golf course each year. The basis for these application rates will be found in Appendix G at the end of this report. Clearly the residential alternative results in a far lower rate of pesticide use on the site. This translates into far less potential for the movement of pesticides into the Coves and Pond.

