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*Waquoit Bay Watershed
Falmouth, Mashpee, Sandwich*

Association for
the Preservation
of Cape Cod

Waquoit Bay
National Estuarine
Research Reserve

Massachusetts
Department of Environmental
Management

CITIZENS FOR THE PROTECTION
OF WAQUOIT BAY, INC.
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Waquoit Bay, located on the southern shore of Cape Cod, and its watershed encompassing parts of Falmouth, Mashpee and Sandwich are the subjects of our concern (see Figure 1). Waquoit Bay, its watershed and estuaries encompass an area of approximately 20 square miles. The watershed extends from the mouth of Waquoit Bay to above Snake Pond in Sandwich, east to Jehu Pond in Mashpee and west to Ashumet Pond in Falmouth and Mashpee. Approximately 2.5 square miles of this area is surface water. The land area of the watershed crosses the political boundaries of Falmouth, Mashpee and Sandwich and encompasses the Waquoit Bay National Estuarine Research Reserve ("WBNERR") and a section of the Otis Air Force Base.

As you may be aware, disturbing trends are coming to light in Waquoit Bay based on research being conducted by scientists affiliated with the Waquoit Bay National Estuarine Research Reserve. These trends are the subject of this paper. Briefly they are:

- (1) declining water quality,
- (2) declining eelgrass beds,
- (3) declining species abundance, and
- (4) increasing incidence of "fish kills".

Mounting evidence indicates that these trends result primarily from land use in the watershed. The watershed consists of all land areas which drain into Waquoit Bay via streams and groundwater. What we dispose of in our drains, sinks and septic systems and what we apply to our lawns and gardens as fertilizers and pesticides enter the groundwater below.

Groundwater flows beneath the entire watershed and eventually empties into Waquoit Bay. Consequently, our land use practices affect not only Waquoit Bay but drinking water supplies and fresh water ponds as well. In addition, runoff from streets and other paved areas carries bacteria and other contaminants directly into ponds, rivers and Waquoit Bay. The effects of our current land use practices are already evident in Waquoit Bay. Let us examine each of the trends.

1: DECLINING WATER QUALITY

Waquoit Bay is clearly suffering from eutrophication, an increase in organic and mineral nutrients in the water. Nutrients discharged into a bay cause excessive algae growth ("blooms") which floats in the water ("microalgae") and forms thick mats on the bay floor ("macroalgae"). Algae reduces the clarity of the water and consequently the amount of light penetrating the water surface. Although algae photosynthesize during the day, producing oxygen, at night or on overcast days they respire, consuming large amounts of oxygen.

The decline in water quality due to eutrophication has a number of effects. For example, the decrease in water transparency impairs the ability of eelgrass to grow and may lead to a loss of eelgrass beds which are important habitats for a variety of finfish and shellfish. In addition, the decline in oxygen caused by blooms of algae makes it difficult for some species to live on the bay floor. In severe cases of oxygen depletion marine organisms are killed.

Figure 1: Land Use Types in the Waquoit Bay Watershed

The nutrient of greatest concern in coastal waters is nitrogen. Approximately 75% of the nitrogen entering Waquoit Bay is from septic systems including currently permitted Title 5 systems (see Figure 2). As presently designed, septic systems remove bacteria but are not capable of removing nitrogen. Fertilizers such as those placed on lawns are the second major source representing about 23% of the nitrogen entering the bay. Because the number of houses in the Waquoit Bay watershed has increased tenfold from 785 in 1938 to over 8000 by 1984 (the most recent estimate available), nitrogen loading is increasing. In terms of acreage, residential land use has increased from 9% (1055 acres) of the watershed to approximately 22% (2638 acres). A dramatic increase in macroalgae in waters adjacent to highly developed land areas signals that groundwater entering the estuaries is elevating nutrient levels. Figure 3 illustrates this phenomenon by comparing the growth rates of two species of macroalgae in 3 subestuaries of Waquoit Bay. Childs is densely developed, Sage Lot contains little development and Quashnet is in between in terms of housing density.

Figure 2: Sources of Nitrogen Entering a Shallow Coastal Bay on Cape Cod

Figure 3: Growth Rates of Macroalgae in 3 Subestuaries

The exact cause-and-effect relationship between land use development and the decline in water quality requires more detailed study. However, research to date shows a clear connection. Perhaps what is most alarming is that the full impact of nitrogen loading from existing septic systems has not yet been realized. Because of the length of the Waquoit Bay watershed and the flow rate of groundwater moving within it, nutrients in groundwater can take anywhere from a few months to over 30 years to reach coastal waters.

2: DECLINING EELGRASS BEDS

As water quality declines, habitats are altered. Eelgrass beds in Waquoit Bay are declining in size. In 1950, there were approximately 200 acres of eelgrass habitat. By 1987, 80% of the eelgrass beds were lost with only 40 acres remaining. Eelgrass beds are nursery habitats for a variety of finfish and shellfish.

Figure 4: Declining Eelgrass Beds

One agent contributing to the downturn in eelgrass acreage is the unusually large mass of algae which results from the decline in water quality caused by nutrient loading. Scientists have found that excessive nutrient loading leads to large blooms of algae which reduce the amount of light reaching the eelgrass and compete with eelgrass for nutrients. Microalgae floats in the water giving the bay a greenish tinge, while macroalgae forms large mats on the bay floor which occasionally float to the surface. Scientists have found dense macroalgal accumulations of one-to-two feet in only three feet of water in Waquoit Bay.

Damage to eelgrass is caused by boat propellers in shallow water. Propellers cut through beds causing entire plants to be uprooted. In addition, boat traffic suspends sediments. This reduces sunlight reaching eelgrass, resulting in a decreased growth rate. Furthermore, research indicates that the suspension of sediments leads to a decline in water clarity. This puts eelgrass under stress, making it more susceptible to the "wasting disease."

The wasting disease, which occurred in the early 1930s and nearly eliminated eelgrass beds in the North Atlantic, is believed to be caused by a slime-mold-like protist, *Labyrinthula*. After decades eelgrass beds recovered. In contrast, the current decline in eelgrass beds linked to eutrophication is unlikely to reverse unless steps are taken to reduce the amount of nutrients entering the bay.

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