Potential Water Quality Impacts

If water quality contaminants reach surface waters or groundwater, the potential water quality impacts can include the following:

- drinking water impairment, if nitrogen as either nitrate (NO_3) or nitrite (NO_2) are present at levels above health-based risk values in drinking water, which may adversely affect health
- nutrient enrichment of surface waters
- sedimentation due to eroding soils
- toxicity to aquatic life

Each potential impact is discussed below.

Drinking Water Impairment

The presence of nitrogen as either nitrate (NO_3) or nitrite (NO_2) at levels above health-based risk values in drinking water may adversely affect health. MCLs established by EPA are 10 mg/L for nitrate and 1 mg/L for nitrite. Phosphorus contamination of drinking water has not been directly linked to human health problems, although increased levels may affect water taste and odor and, in some cases, enhance the growth of toxic algae. MCLs have been established for some pesticides or pesticide constituents in drinking water, such as glyphosphate.

Although drinking water impairment from golf course management activities is possible, research indicates that this is uncommon. Seventeen studies (36 golf courses) were reviewed by Cohen et al. (1999) and were incorporated into a detailed data review. A total of 16,587 data points from pesticide, metabolite, solvent, and NO_3 analyses of surface water and ground water were reviewed. Approximately 90 organics were analyzed in the surface water database and approximately 115 organics in the ground water database. The results of the analysis indicated that widespread and repeated water quality impacts by golf courses were not observed at the golf course study sites. None of the authors of the individual studies concluded that toxicologically significant impacts were observed, although health advisory levels, MCLs, or maximum allowable concentrations were occasionally exceeded.

Nutrient Enrichment

Nutrient enrichment of surface waters is widespread across the state of New York in large part because of the prevalence of sources of phosphorus and nitrogen, including the following:

- municipal wastewater treatment plant discharges
- urban runoff from impervious surfaces such as parking lots, rooftops and roads
- agricultural activities
- flow from inadequate onsite septic systems
- home lawn and other fertilization practices
- atmospheric deposition

Nutrient enrichment can lead to eutrophication, the process by which a body of water acquires a high concentration of nutrients, which promotes excessive growth of algae (called algal blooms). As the algae die and decompose, oxidation of the organic matter and respiration by the decomposing organisms can deplete dissolved oxygen in the water, in turn causing the death of aquatic organisms such as fish and invertebrates.

Although both phosphorus and nitrogen must be managed to prevent eutrophication, nitrogen is the higher priority for marine environments, while phosphorus is more important in fresh waters. In Long Island Sound, nitrogen fuels the growth of excessive amounts of planktonic algae. In the Sound, the eutrophication process results in hypoxia (very low levels of dissolved oxygen in the water column) each summer, especially in the western half of Long Island Sound. In marine systems, the eutrophication process can also alter the habitat for submerged aquatic vegetation and marine life, reducing the size and diversity of the ecosystem and fisheries. Some algal blooms, often referred to as red or brown tides, can also be toxic to crustaceans, fish, and humans. In freshwaters, phosphorus fuels the growth of excessive amounts of algae that also results in reduced amounts of dissolved oxygen available to freshwater aquatic organisms. Phosphorus levels of 0.035 to 0.10 mg/L have been linked with increased levels of algal growth in rivers, lakes, and estuaries.

In addition to excessive algae growth, nutrient enrichment can contribute to the excessive growth of vascular aquatic plants. Excessive aquatic plant growth can alter the aquatic plant community, deplete oxygen, impact fish communities, restrict recreational use, and cause odors during die off.

For more information, see:

- NYSDEC "Nutrient Loadings and Eutrophication" fact sheet: http://www.dec.ny.gov /docs/water_pdf/top10nutloading.pdf
- NYSDEC "Aquatic Weeds and Invasive Species" fact sheet: www.dec.ny.gov /docs/water_pdf/top10invasives.pdf
- EPA Nutrient Pollution web page: http://epa.gov/nutrientpollution/

Sedimentation

Sedimentation is the process whereby water that is carrying sediments from eroding soil slows long enough to allow soil particles to settle out. The smaller the particle, the longer it stays in suspension. Larger, heavier particles such as gravel and sand settle out sooner than smaller, lighter particles such as clay (which may stay in suspension for long periods and cause water turbidity).

The effects of sedimentation are generally site specific and depend on a number of variables including sediment grain size and type, and hydrological conditions; water quality impacts can include increased turbidity, impairment of aquatic habitats, and filling in of water bodies. In addition, sediments can also affect water quality if they contain other contaminants such as organic matter, nutrients, pesticides, or other chemicals. Sedimentation is only likely to occur on golf courses during construction and major renovations when soils are disturbed.

Toxicity to Aquatic Life

Pesticides applied to golf courses can be harmful to fish and wildlife. Herbicides used to control weeds can be transported to ponds and streams where they can be harmful to aquatic vegetation and

algae. Insecticides, including some of the products used for adult mosquito control, also tend to be toxic to fish and aquatic life, and if transported off treated areas by runoff, fish and invertebrates in adjacent waters can be harmed. Fortunately, turf tends to hold water and retard runoff, greatly reducing the pesticide load transported to adjacent water bodies, particularly compared to pesticide treatments on bare ground or agricultural fields. To ensure the protection of aquatic life and compliance with pesticide regulations as described in the Regulatory Framework section of this web site, close attention should be paid to all of the instructions listed on the pesticide label. Carefully following label instructions is the best way to insure that a pesticide application will not be harmful to fish and wildlife.