FRIENDS
OF THE LAKE

Problems facing Lake Lillinonah

Prepared by George Knocklien, consultant to Lake Lilillinonah Authority

Lake Lillinonah is a large deep lake by Connecticut standards, at 1,600 acres it is the second largest water body in the state, and with 100 feet of depth at the southern end near the dam it is also one of the deepest. The lake is fed by several rivers of which the Housatonic River is the largest. The Housatonic River drains an area that is roughly 1,400 square miles in size and includes parts of the Berkshires in Massachusetts, and a small part of the Taconic region in New York State. In addition the lake is fed by the Shepaug River that drains the towns of Litchfield and Bantam, and the Still River which flows north from the Danbury area. Together these rivers carry enough water to replace all the water in the lake about one every 13 days.

This inflowing water is the natural resource that provides for continued hydroelectric power generation at the Shepaug dam that impounds Lake Lillinonah. However, this inflowing water also carries a significant quantity of nutrients, sediments, and woody debris into the lake each year. The nutrients are plant fertilizers that promote the growth of both algae and weeds in the lake. The sediments settle to the bottom and are gradually filling in the lake, and the woody debris clogs the surface of the lake causing hazardous boating conditions.

The two plant nutrients, phosphorus and nitrogen, are accumulate in the river waters from several sources; discharge from municipal sewage treatment plants, erosion from agricultural fields, storm water runoff, and from the atmosphere. The affects on the lake from these high levels of nutrients in the inflow water are compounded by two aspects, 1) the large water volumes of the rivers, and 2) the long sinuous shape of the lake. The first aspect means that the rivers carry large quantities of nutrients into the lake, especially during storms when the rivers are full. The second aspect means that the nutrients either settle to the bottom to become incorporated into the sediments or are utilized by plants with very little of reaching the dam to be discharged out of the lake.

The high level of nutrients, primarily phosphorus but nitrogen is also a problem, is the cause of severe algae bloom on the lake. These blooms are composed of tiny, microscopic, single celled plants that reproduce at rates that are dependent on the quantity of nutrients in the water. The higher the phosphorus levels the faster the cell division rates. During the summer in Lake Lillinonah the warm water temperatures combine with high phosphorus levels to cause massive growths of algae that cause algae blooms. These blooms are manifest in two ways, 1) the water becomes green, and surface mats are formed. These mats are collections of floating algae cells that have died and are in the process of decomposing. The mats generally turn white or gray and release putrid odors as they decompose. Typically the mats are found first in the Lovers Leap area of the lake and then move slowing southward in the lake toward the dam.

The relationship between phosphorus and the growth of algae can be seen by the following set of empirical relationships. The first graph shows spring phosphorus concentration and summer chlorophyll, while the second graph shows the relationship between chlorophyll and water clarity as measured by the Secchi disk.

FRIENDS
OF THE LAKE

Empirical relationships are made by collecting field data from many lakes over the course of a few years then combined to find similarities between them. Chlorophyll is the photosynthetic pigment used by algae (actually all plants use chlorophyll which is why they are all green). Chlorophyll measurements are simply assays of the quantity of algae in the water. The Secchi disk is an 8 inch round disk with alternating black and white quadrants on the face. It is lowered into the water until no longer visible marking the Secchi disk depth. It is a simple way to measure the clarity of the water. Water clarity is generally a function of how many algae cells are in the water.

The first graph shows the relationship between increasing total phosphorus and chlorophyll is logarithmic in nature. However it is clear that as phosphorus increases so does algae biomass, here represented by chlorophyll. The second graph shows that as the chlorophyll concentration in the water increases the water become more turbid as shown by decreasing Secchi disk depth. Again there is a distinct non-linear relationship between the two. Above chlorophyll concentrations of about 5 mg/m^3 (also ppb or parts per billion, or μg/L micrograms per liter) there is sufficient algae growth to cause loss of water clarity. The first graph shows that in order to have chlorophyll below 5 mg/m^3 the phosphorus concentration needs to be below about 12 ppb. This indicates that in order for algae growth potential to lessen the in-lake concentration of phosphorus needs to be decreased to levels below at least 15 ppb. Currently the phosphorus level in Lake Lillinonah runs between 8 and 280 ppb.

Figure 1. Phosphorus Chlorophyll relationship. (Dillon and Rigler 1974)

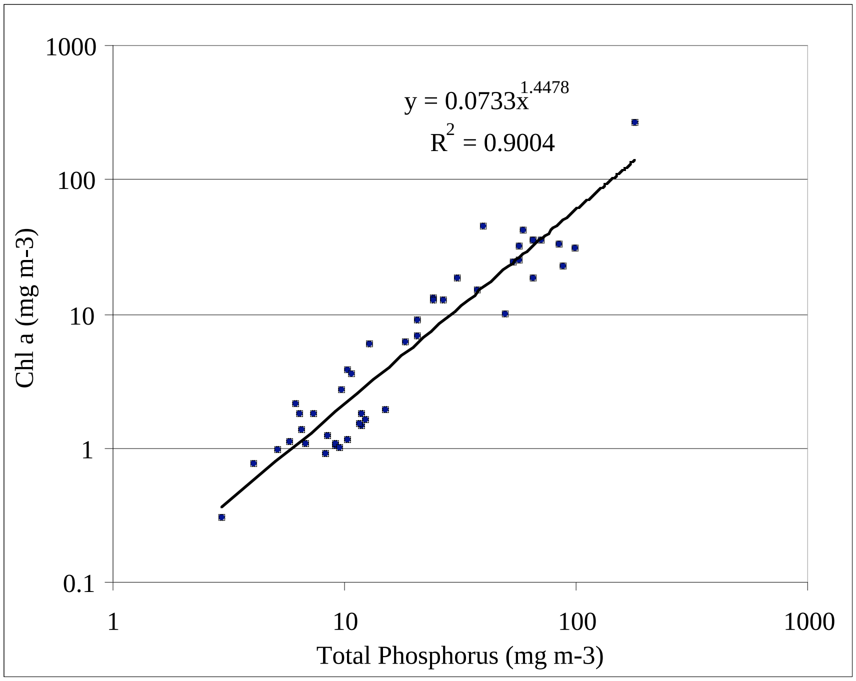
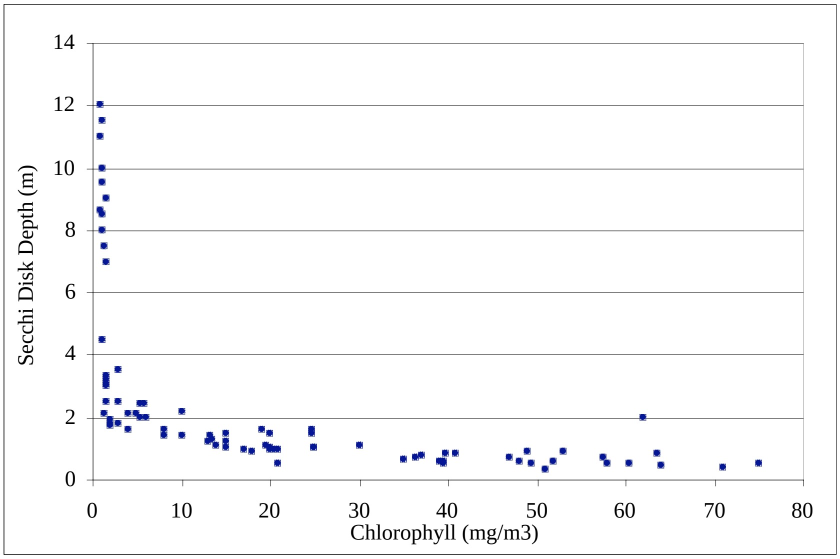


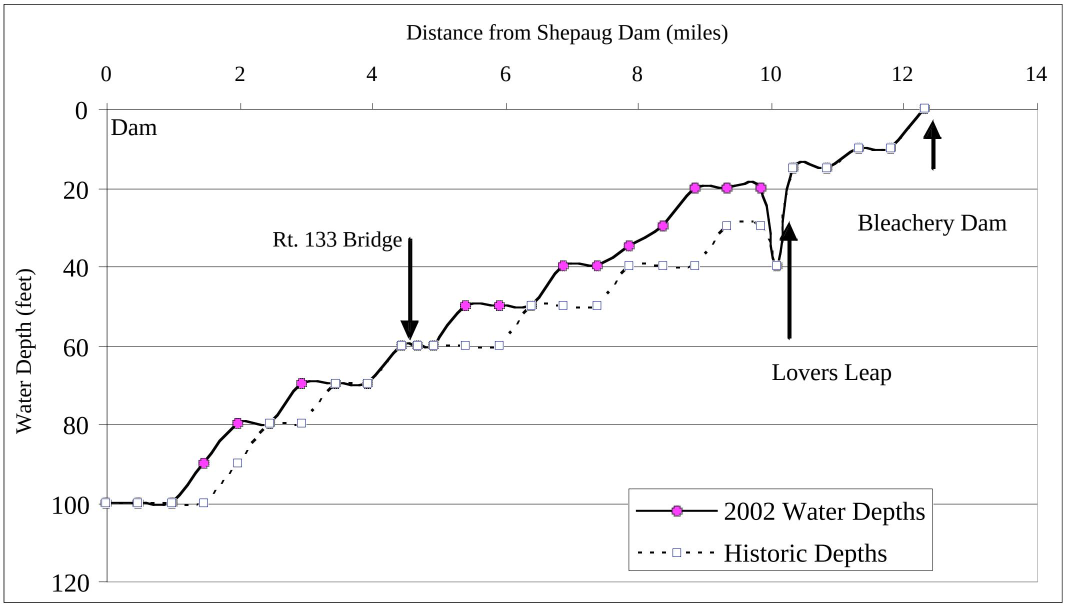
Figure 2. Relationship between Secchi Disk Depth and Chlorophyll concentration (Carlson 1977).

FRIENDS
OF THE LAKE



The second water quality aspect is the sediment in the inflow waters. These sediments are eroded from the drainage basin and carried by the inflow rivers, especially during high storm flows. The sediments begin to drop out of the water once the current stops, generally in the area of Lovers Leap for the Housatonic River, and below the Roxbury Boat ramp for the Shepaug River. The result of input of these sediments is a gradual decrease in water depth in the upstream reaches of the lake. The attached graph shows the change in water depth in the Housatonic arm of the lake.

Figure 3. Change in Water Depths in Lake Lillinonah Over Time.



The third major problem facing the lake is the accumulation of woody debris, logs, branches, sticks, and lumber. This material enters the lake from the Housatonic and Shepaug Rivers, and from wooded shoreline. Once in the lake it tends to collect in coves and bays and along the banks. The combination of the long sinuous shape of the lake and the fluctuating water level cause the debris to remain in the lake instead of being passed over the dam. Because the lake is about 12 miles long with several bends, coves and bays the debris can collect and remain in sheltered areas for years. Below Lovers Leap the water does not generally have much current so drifting logs don't seem to move much toward the dam. The fluctuation of lake levels also tends to either float debris off the bank during high water or beach it during lowering levels.

Each of these three problems has a different set of remedies requiring different implementations and corrective actions. To control the nutrients stricter

FRIENDS OF THE LAKE

discharge levels will likely be needed at the many sewage treatment plants in the Housatonic, Shepaug, and Still River basins. The sediments will probably be limited through the efforts of storm water management and best management practices for agricultural facilities. These two water quality aspects will also be improved by watershed wide construction and land use regulations and education. The debris problem may best be addressed by a collection and disposal program that implemented in the lake.