

## TOWN LAKE (AKRON, INDIANA)

All lakes undergo a process of dying as they slowly fill-in with sediment and plant life. This process is called eutrophication. The trophic condition of a lake is a measure of how fast a lake is dying. The goal of lake management is to slow the eutrophication process to as close to a natural rate as possible (a rate which would occur if people's use of the land did not accelerate it abnormally).

During wet weather, the combined sewer system in Akron overflows to Town Lake. Town Lake is a 21 acre glacial lake in the Tippecanoe River watershed. Akron began a study last summer to determine how the town's CSO discharge affects water quality in the lake and in the Tippecanoe River watershed. The study also wanted to determine whether there is a cost-effective way to treat the discharge using constructed wetland technology.

The lake study, using data collected August 4, 1999, determined that Town Lake was highly eutrophic (abnormally enriched with phosphorus and nitrogen nutrients which cause algae blooms and rapid lake deterioration). Phosphorus and nitrogen levels in the lake were five to ten times higher than in a normally aging lake. The Indiana Department of Environmental Management uses a trophic index ranging from 0 to 75 to classify lake water quality. Town Lake's index value was 61, which puts it in the upper 10% of all lakes in the state for rapid aging and deteriorating water quality.

|                          | Measured Value  | Maximum Eutrophy Points | Actual Eutrophy Points |
|--------------------------|-----------------|-------------------------|------------------------|
| Total Phosphorus         | 0.87 mg/l       | 5                       | 4                      |
| Soluble Phosphorus       | 0.60 mg/l       | 5                       | 4                      |
| Organic Nitrogen         | 7.2 mg/l        | 4                       | 4                      |
| Nitrate                  | <0.1 mg/l       | 4                       | 1                      |
| Ammonia                  | 3.5 mg/l        | 4                       | 4                      |
| Dissolved Oxygen         | 96%             | 4                       | 0                      |
| % surface saturation     |                 |                         |                        |
| Dissolved Oxygen         | 100%            | 4                       | 0                      |
| % water column aerobic   |                 |                         |                        |
| Secchi Disk Depth        | 1.5 feet        | 6                       | 6                      |
| Light Transmission 3 ft. | 33%             | 4                       | 3                      |
| Phytoplankton            | 900,000/liter   | 25                      | 25                     |
| Dominant Group           | bluegreen algae | 10                      | 10                     |
| <b>Total Points</b>      |                 | <b>75</b>               | <b>61</b>              |

Several samples of "first flush" water from the CSO discharge have been collected and

analyzed. The nutrient concentrations in the discharge were very high and could easily account for most of the loading of pollutants associated with Town Lake's low water quality.

|                                | 8/4/99 | 4/7/00 | 4/21/00 | Average |
|--------------------------------|--------|--------|---------|---------|
| Rainfall (inches)              | 0.8    | 0.8    | 2.0     |         |
| Total Phosphorus (mg/l)        | 0.46   | 1.77   | 1.80    | 1.34    |
| Total Ammonia (mg/l)           | 0.78   | 5.50   | 0.79    | 2.36    |
| Nitrate + Nitrite (mg/l)       | 0.28   | 0.20   | 5.85    | 2.11    |
| Total Kjeldahl Nitrogen (mg/l) | 4.94   | 46.2   | 8.78    | 20.0    |

A bacteriological test of the 4/7/00 CSO sample gave the following results:

|                 |   |
|-----------------|---|
| Total coliforms | 1.7 million colony-forming units per 100 ml |
| <u>E. coli</u>  | 1.2 million colony-forming units per 100 ml |

The lake eutrophication model EUTROMOD developed at Duke University predicts the following changes in water quality under three different scenarios:

|                              | Pristine Conditions<br>100% forested watershed | Present Conditions<br>With CSO discharge | Present Conditions<br>Without CSO discharge |
|------------------------------|--|--|---|
| Phosphorus<br>Load kg/yr     | 26   | 870                                      | 590   |
| Nitrogen<br>Load kg/yr       | 490  | 17000                                    | 12000                                       |
| Algal<br>Chlorophyll<br>ug/l | 3  | 50                                       | 40  |
| Carlson<br>Trophic<br>Index  | 43<br>mesotrophic                              | 71<br>hypereutrophic                     | 66<br>eutrophic                             |

These results show that eliminating nutrient inputs from the CSO discharge, though not returning Town Lake to pristine conditions, will reduce phosphorus loading by 20%, nitrogen loading by 30%, algae concentrations by 20%, and slow down the "hypereutrophic" aging the lake is experiencing now. Based on predictions from Eutromod and on present water quality data in Town Lake, the following CSO discharge water quality goals are desirable to slow down the eutrophication process to a more natural rate:

|                         |      |
|-------------------------|------|
| Total Phosphorus (mg/l) | 0.10 |
| Total Ammonia (mg/l)    | 0.50 |

|                                |      |
|--------------------------------|------|
| Nitrate + Nitrite (mg/l)       | 0.50 |
| Total Kjeldahl Nitrogen (mg/l) | 0.50 |

From a bacteriological standpoint, 235 E. coli cfu/100 ml is a reasonable discharge goal.

A constructed wetland wastewater treatment system was built to help the Town of Akron meet these water quality goals. The wetland was built in the autumn of 2001. Commonwealth Biomonitoring planted 20,000 plugs of five species of wetland plants in a 4 acre area excavated near the town's park:

|                      |                                     |
|----------------------|-------------------------------------|
| prairie cordgrass    | ( <i>Spartina pectinata</i> )       |
| fowl mannagrass      | ( <i>Glyceria striata</i> )         |
| wool grass           | ( <i>Scirpus cyperinus</i> )        |
| three-square bulrush | ( <i>Scirpus pungens</i> )          |
| softstem bulrush     | ( <i>Scirpus tabernaemontanii</i> ) |

