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Grand Lake Wetland Treatment System

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This is the first in a series of articles on alternative wastewater treatment systems in Minnesota.

Grand Lake is located 10 miles northwest of Duluth. The south shore of the lake was developed into small lots for cabins in the 1940's. Most of the cabins originally had no running water and outhouses. During the 1980-1990's, numerous cabins were expanded into year-round homes, with running water and modern indoor plumbing. The standard seepage bed, trench system, and mound system could not be used because of poor site conditions. The area consists of saturated peat soils with a water table at or near the surface much of the year.

The homeowners had no options available to them to solve their sewage problem using standard on-site systems. The lots were not only small with poor soils and spring flooding, but each home had its' own well for potable water. The original holding/septic tanks leaked, and on one lot, the mound was sinking into the underlying peat. The difficult soil conditions along the lakeshore presented a real challenge for treating the wastewater generated from these homes. Thus, a cluster system was pursued using "passive" wetland treatment technology.

By September 1995, a community wetland treatment system for 10 homes was largely constructed. The wetland was constructed on a small knoll of higher ground located in a wooded peatland about 500 ft inland from Grand Lake (Figure 1). The residents organized as a non-profit corporation and, in cooperation with the St. Louis County Health Department and the Natural Resources Research Institute (NRRI), consultants were hired to design the collection system and cluster wetland treatment system.

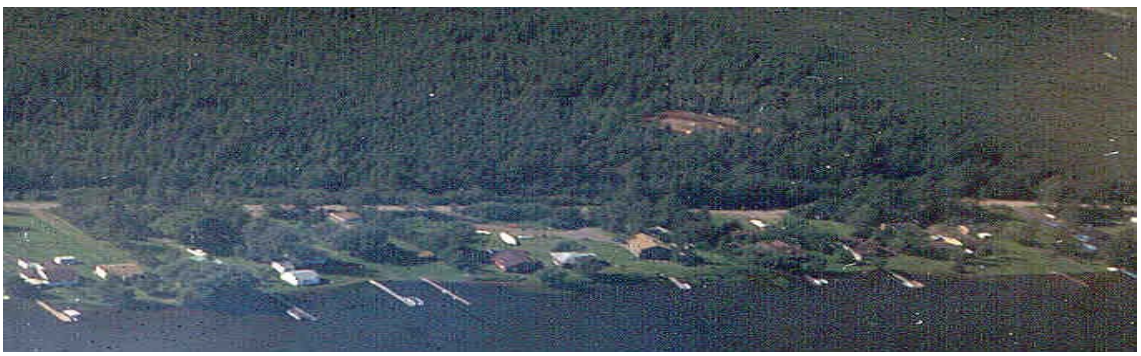

Figure 1. The cluster wetland treatment system for Grand Lake homes is located approximately 500 ft. inland from the lake (tan colored opening in the woods).

The homeowners were required to install new watertight septic and pump tanks. This was necessary to minimize the leakage of high groundwater into the tanks, which would easily overload the wetland treatment system. At the outlet of each septic tank, a screen was installed to prevent excess solids from entering the wetland. Each pump tank has a ½ h.p. effluent pump which pumps screened septic tank effluent (STE) to a common collection system. The collection system is a 2-inch pressure sewer (1,700 ft) constructed 6 ft deep along the road that conveys STE to the constructed wetland.

Figure 2. Construction activities included: placement of a liner, preparation of cattails for planting, placement of pea rock and planting cattails, and insulating it with mulch.

The wetland consists of a two-cell system, designed to treat 1,000 gallons per day. Wastewater enters the first cell of the wetland, lined with an impermeable membrane, filled with 24 inches of pea rock, and planted with cattails and other ornamental plants. This part of the system uses wetland vegetation to help treat the wastewater. The oxygenated root zone of these plants provides a suitable habitat for bacteria and other microorganisms that break down organic wastes, kill disease-causing organisms, and converts nitrogen to its' gaseous form (N_2) which is a harmless gas.

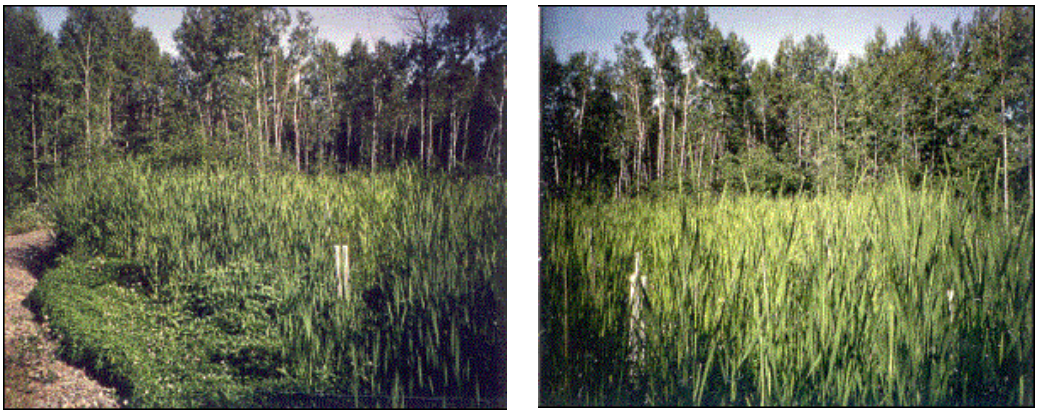

Figure 3. View of the cattails in cell-1 of the constructed wetland in June 1997.

The second cell of the system is unlined to provide for final polishing and subsurface dispersal of the wetland effluent. The wetland system was insulated each fall in the years 1995-97 with 12 inches of straw mulch to prevent it from freezing.

Figure 4. The two-cell wetland system at the start of the third growing season in June 1998. The dark feature between the two-cells is the control structure.

The estimated final cost for the wetland treatment system was $10,200-$11,400 per household. This cost included design of both the collection and wetland systems, land purchase, legal survey, legal and filing fees, construction of the collection system, installation of individual tanks and controls, and construction of the wetland system. The cost did not include road construction to the wetland, and the costs associated with the operation, maintenance and monitoring of the system.

The wetland system has performed adequately during the first 2-1/2 years of operation. The system did not freeze during the first three winters of operation, despite the record cold in 1996 when it hit

-40^{o}F. As expected, the wetland performed better during summers than during the winter months. The performance of the wetland is not expected to reach its full potential until the plants and their root systems have fully matured. NRRI scientists will continue to monitor flow, temperature, and treatment performance of the wetland through May 2001.

Figure 5. The Grand Lake wetland system at dusk during a typical Minnesota winter.

The Grand Lake wetland provides an example of how groups can successfully work together to solve a neighborhood sewage problem. The homeowners' organization has also accepted responsibility for the system and no major operational problems have occurred. Without a community-wide approach to solving this problem, minimally treated wastewater would have continued to discharge into Grand Lake, carrying with it pathogenic organisms, organic matter, nitrogen and phosphorus. Through this cooperative effort, the failing systems were removed from their yards and a functioning treatment system was placed in a "remote" location away from Grand Lake.

A copy of the report "Development of Alternative On-site Treatment Systems for Wastewater Treatment: A Demonstration Project for Northern Minnesota" that fully describes the project can be purchased by contacting the Natural Resources Research Institute-UMD at 800-234-0054.

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