LAKE AND WATERSHED ASSESSMENT

AND MANAGEMENT RECOMMENDATIONS REPORT,

VOLTZ LAKE,

NEAR TREVOR, WISCONSIN

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I. SCOPE OF STUDY

Applied Ecological Services, Inc. (AES) was retained by the Voltz Lake Management District to conduct a watershed study and non-point pollution source audit and to assist in land-use planning and the design of management and monitoring programs for Voltz Lake, near Trevor, Wisconsin (see Appendix 1, Site Location Map).

This study involved several major tasks including prework and checkpoint meetings, aerial photograph and historical documentation procurement, field surveys, modelling of point and non-point pollution sources within the watershed, preparation of lake and watershed management recommendations, development of maps, and sediment analysis. This report follows the seven step approach as proposed.

AES has been aware of the problems of this lake and nearby lakes. Lakes in the region are showing signs of eutrophication. Nutrient loading and sediment buildup are the main concerns. Findings and management recommendations to improve the overall quality of the lake follow.

II. HISTORICAL BACKGROUND

Voltz Lake is a small shallow lake located in the Town of Salem, Kenosha County, Wisconsin and constitutes a very small portion of the Fox River watershed (Appendix 1). The lake consists of a deep basin with marshy lobes in the northwest and south part of the lake. The wetland edges and wetlands in the Voltz Lake watershed were identified by the Wisconsin Wetland Inventory (Appendix 1). The marsh areas are shallow and were deepened perhaps 2-3 feet by installation of a dam (actually the levels of the outlet stream seems to have been raised to construct a road subgrade) which raised water levels. The exact date of this is uncertain. In 1921, Bill Daly recalled a small wooden bridge in the present location of the road/dam.

Based on interviews (Ms. Ama Glechner and Mr. Bill Daly), there is uncertainty on whether the lake was officially dammed. Nevertheless interviewed people suggested aquatic vegetation such as lily pads have increased 90%; fishing in the lake is difficult to impossible, especially using a motor boat, because of the dense aquatic vegetation.

Both parties suggested an algal (green coloration) bloom was annually associated with fertilization of farm fields on the west side of the lake. Land-uses have been about the same in the last 15-17 years. Most newer homes that have been built were not lake shore homes. According to the people interviewed most existing lake shore homes were built 20-30 years ago. The homes were sewered in 1978, based on the recollection of the interviewed persons.

Voltz Lake is natural in origin being a kettle lake occupying a depression formed by melting of a glacial ice block buried in outwash sand and gravel deposits lying on the edge of the terminal moraine. Maximum depth of Voltz Lake was 24 feet, mean depth, 7 feet, and volume 361.9 acre-feet (DNR 1970).

Unchanneled runoff to Voltz Lake occurs from the east and there are four intermittent channels which drain land to the north and from the south. The lake's source of water is primarily from run-off with little coming from an unmeasured groundwater supply.

Two soil types dominate the border of Voltz Lake. Morley silt loam dominates the western shore while Ashkum silty clay loam dominates much of the rest of the border (See Appendix 2). Both soils have limitations for development, being poorly drained and having severe erosion potential.

Aquatic plants are growing in extensive mats within the lake's marsh lobes. Unlike the basin, the marsh lobes are very shallow and warm, ideal conditions for aquatic plant growth. Dominant species identified are curly leaf pondweed (Potamogeton crispus and other Potamogeton species), water milfoil (Myriophyllum), coontail (Ceratophyllum), water lily (Nymphaea spp.), Elodea (Elodea canadensis), and cattail (Typha sp.).

Dominant shoreline plants include cattail, reed canary grass, and iris.

Aquatic vegetation has been removed mechanically several times in the past, however, because the lake is so shallow and fertile, the effect, as in most other lakes, is not lasting.

Since installation of the sanitary sewer system (and elimination of lakeshore home septic systems) it would be expected that the nutrient contribution from the septic discharge would have been eliminated or decreased. The problem of accelerated eutrophication in the lake continues to be a serious problem suggesting other contributors within the watershed.

III. METHODS AND RESULTS

The following narrative gives procedures and findings for the major tasks undertaken in this study.

LAKE SEDIMENT STUDY

One 18 January 1991 a 2-person team cored the lake in 29 locations to determine the depth, nature, and extent of sediment within the lake (see Appendix 3, Attachments 1 and 2). This coring allowed us to categorize similar sediment and water depth zones throughout the lake.

Voltz Lake has several areas of shallow water and considerable sediment depth (see Appendix 3, Attachment 2). In the southern marsh lobe 15 cores were taken. Water depths ranged from 3 to 6 feet and sediment depth ranged from 1 to more than 8 feet. The sediment was a very black muck. Seven cores were taken surrounding the deep basin. Sediment depths ranged from 2-6 feet and water depth ranged from 3 to 12 feet. The sediment was a peaty muck. Seven cores were taken in the northwestern marsh basin. Sediment depths ranged from 1 to greater than 8 feet and water depth ranged from 3.5 to 6 feet.

SEDIMENT CHEMISTRY STUDY

Sediment samples taken from the lake were consolidated into four composite samples (see Appendix 3, Attachments). These samples were sent to Illinois Natural History Survey laboratory for testing. Tests were performed for selected trace elements and selected macro and micronutrients, and trace elements.

Comparison of historic water quality data from 1966 (Kenosha Co., 1977) with recent sediment data suggests the following:

1. Recent sediment analysis suggested most previous water samples had lower trace elements in the water column. This is a typical difference between water and substrate chemical analysis. Levels of some elements such as Calcium (Ca) were comparable in water and sediment samples at 20,000 - 30,000 parts per million.

2. Macronutrient analysis suggested:
   a. Phosphorus levels in sediment and water were comparable (1966 vs. 1991) and ranged from 580-838 parts per million.
   b. Nitrogen values and percent and parts per million were moderate to high in recent sediment chemistry analysis.

WATER AND SEDIMENT YIELD SIMULATIONS

This task has taken data produced by previous tasks and used this to assess erosion problem zones and nutrient sources using the ARMSED watershed computer models (USA-CERL 1989) (see Appendix 4). A land-use cover map is included in Appendix 4 which show existing vegetation types.

The procedure for this task involved several steps. First, the watershed and sub-watershed boundaries were delineated using a U.S. Geological Survey 7.5 minute topographic map. Boundaries were confirmed by field surveys. The sub-watersheds were then divided into units of planes and sub-watersheds. Areas of each sub-watershed and their sub-units, channel length, channel slope, over-land slope, and over-land flow length were all measured and calculated using a polar planimeter and a swiss measuring wheel. This, and data from previous tasks were entered into the ARMSED watershed modeling computer program. The findings with an overview of land-use within the watershed follow.

Voltz Lake has a contributing watershed of about 246.3 acres. The watershed is about 37% woodland (91.1 acres), 42% agricultural (103.4 acres), and 21% residential (51.7 acres). The soils are mostly Morley Silt loams with Ashkum silty clay loams along the drainage ways.

Most of the residential areas are along the western shoreline and drain directly into the lake. Woodlands are primarily north of the lake and drain through intermittent drainage ways. About 34% of the agricultural area (83.7 acres) is located along the eastern lake shore. The remaining agricultural area is located at the upper regions of small watersheds. Storm water from the agricultural area to the south drains through a wetland before reaching the lake.

The watershed can be divided into 9 subwatershed areas (see Appendix 4, Figure 1). Subwatershed 1 was 100% woodland. Subwatershed 5 was 100% agricultural. Subwatershed 8 was 100% residential. These three subwatersheds were used to simulate the relative contribution of water and sediment from each of the three types of land-uses. Areas and cover conditions for all of the subwatersheds are shown in Table 1.

TABLE 1. Subwatershed area and percent land cover type

SUBWATERSHED	AREA (ac)	COVER CONDITIONS
1	23.8	100% Woodland
2	48.7	60% Woodland 40% Fields
3	59.7	50% Woodland 35% Fields 15% Residential
4	10.1	60% Fields 40% Residential
5	27.8	100% Fields
6	30.3	30% Woodland 70% Fields
7	12.9	60% Fields 40% Residential
8	26.6	100% Residential
9	6.4	100% Residential
TOTAL	246.3	

Water and sediment yield simulations were made using the ARMSED model. A two-year, six-hour storm was used.

The results indicate that water yield is lowest for the woodlands and highest for the agricultural lands. The sediment yield results are dramatically different. No sediment is generated from the residential areas and very little from the woodlands. The agricultural areas, under conditions of 10% ground cover, contribute sediment at the rate of about 0.3 tons/acre for the test storm event. Assuming a similar sediment contribution from all agricultural areas, a two-year, six-hour rainfall would deliver about 31 tons of sediment to the lake. However, some of the sediment from agricultural areas in the upper portions of the small watershed would be deposited along the drainage ways, especially when the drainage passes through a wetland. Some of this could continue to flush with each storm event into the lake.

The results also indicate that, of the water yield, about 52% comes from agricultural lands, 30% from woodlands and 18% from residential areas.

In summary, the agricultural areas along the shoreline are the primary contributors of sediment. These areas, along with the other fields within the watershed are the primary source of sediment. Channel locations also contribute to this yield and many channel areas are severely eroded. Sediment from the woodlands and residential areas is negligible bur may increase in the future as ground cover vegetation deteriorates in these locations.

WATERSHED ASSESSMENT

The watershed was investigated on several occasions for stream bank erosion, wetland restoration potential, and tilled agricultural field problem areas and to understand the watershed has or is likely to change. Problems areas were noted and identified on a map (see Appendix 5, Figure 1). We have included our management recommendations for these areas to help reduce sediment and nutrient entry into the lake.

Watershed modeling studies revealed that the percentages of cover of each land-use or vegetation type have remained virtually unchanged since 1937. The acreage of developed homesites has increased slightly but represents a negligible percentage of the total watershed.

While land-use types have remained unchanged, the nature and quality of the native vegetation in remnant oak savanna and wetlands has changed significantly. Surveys in surrounding oak savanna suggest that documented regional trends (Haney and Apfelbaum 1990) are also occurring locally in savanna remnants. Invasion into the canopy and understory has produced an overstocked tree canopy and dense shrub and sapling layer. A concurrent reduction in the cover, density and frequency of ground cover vegetation has occurred as shade density has increased. Often severe erosion has been reported in these destabilized and degrading savanna systems. Degradation of savanna systems has been identified in some studies as a principal reasons for sediment loading into adjacent wetlands and other down gradient ecological systems.

Investigations on the availability of useful data on past cropping systems and rotations including herbicide and pesticide use revealed little useful information. Discussions with owners of the previous Happ Vegetable farms suggested that over their many years of vegetation production, so many year to year changes in crops and herbicides, pesticides and fertilizers occurred that no coherent record of use exists. No other data pertinent to this subject was found.

Existing land-uses and waterbody practices are projected to represent the future uses in the Voltz Lake watershed. The lake is primarily used by residents for recreation using small boats; primarily for fishing and recreational boating. It is believed that few non-residents use the lake system for similar purposes. The lake homeowners expressed no desire for additional or redirected use of the lake. They would like it to be improved for existing use.

IV. DISCUSSIONS

Voltz Lake has been showing signs of water quality changes that are generally associated with nutrient enrichment and siltation. The process of lake enrichment has proceeded to the point of concern. Most landowners now realize that the enrichment problem, often manifested by aquatic weed problems, has become undesirable.

Voltz Lake is moderately developed and has a moderate demand for recreational use. Fishing and swimming opportunities have declined due to the aquatic weed problem and siltation.

Weeds are considered a problem when they cover more than 25% of the lake's surface. They can hinder many types of recreational uses of a lake. An overabundance of undesirable aquatic weeds can also provide a hiding place for many small fish thereby increasing their chances for overpopulation and stunting. Undesirable aquatic vegetation utilizes nutrients in the water that could otherwise go into the production of desirable microscopic plants called phytoplankton. An excess of aquatic growth can further offset a delicate balance between the dynamic physical and biological elements in the lake system. The decomposition of dense weed beds can also lead to winterkill of fishes during the ice cover period when oxygen availability is depleted in the water column.

Aquatic weeds are common in fertile lakes and ponds. Drainage from barnyards, septic tanks, fertilized lawns, and fertilized farmland contribute to the fertility of the water when this drains into a lake. Shallow, clear, warm water is conducive to weed growth.

The lake has become dominated by certain undesirable aquatic weed species mentioned previously. Most of the weeds are submersed aquatic plants. These plants are rooted in the bottom substrates form dense colonies, and have foliage growing to the water surface. These plants grow entirely underwater and may be found growing in depths of 8-10 feet.

Heavy siltation is also a problem in the lake. This silt contributes to the weed problem by providing adsorbed nutrients and fills areas hindering recreational opportunities. The primary source of recent and continued sediment is from tilled agricultural fields and stream bank erosion.

Once in the lake, sediments from sources in the watershed, get swept with wind and wave action and becomes distributed throughout the lake, although initially deposited locally. The turnover of the lake in the spring and fall can also re-distribute sediments and nutrients.

Watershed and lake management must be coordinated in conjunction for effective improvement and control of weed and siltation problems. Management recommendations and alternatives follow.

V. MANAGEMENT SUGGESTIONS AND ALTERNATIVE ANALYSIS

AES has developed various management alternatives. We emphasize the methods which are both effective and ecologically sound.

WATERSHED MANAGEMENT

Watershed management focuses on the entire system rather than simply on the symptoms of the problem as identified in Voltz Lake. This is the key to developing a sound lake management plan. In order for long-term management plans to be successful, watershed management is the most critical element in an overall lake management plan.

From our own observations, mapping of land-cover types, speaking with residents, studying historical land-uses, and computer modelling, we have identified specific watersheds that would be expected to contribute to significant nutrient and sediment problems. Management attention needs to be focused on these areas. Streambank stabilization, wetland restoration, stream and lake buffer zones, increasing the practice of no-till farming, and control of fertilizer and pesticide use would be components of a watershed management program.

The key to preventing sediments and suspended solids from entering the lake system is to establish and maintain stabilized soils with grass vegetation and by allowing crop residue to remain on erodible agriculture fields. Clearly, upland management[1] and stabilization of buffers between agricultural land-uses, housing developments, and the lake or streams will reduce sediment entry into lakes. Suspended solids typically carry nutrients such as phosphorus and potassium which can lead to algae blooms and excessive rooted aquatic vegetation. These can be trapped upstream of the lakes which would mean less sediment and less nutrient enrichment in the lakes. Most of the stream banks are eroding and also provide a continual source of sediment.

[1]Within the watershed of Voltz lake, currently, at least one subdivision is under construction (Arboretum Woods, Appendix 5; Figure 9). This subdivision occupies the previous Happ Vegetable Farm. Several other areas of farm ground are present in the Voltz Lake watershed and are potential sites for development. It is currently not known if development plans exist for these areas.

STREAM AND DITCH BANK STABILIZATION

Stream and ditch bank stabilization is a practice which will help reduce sediment loads entering the lakes. The stream channels have been examined and included are specific areas which should be concentrated on (See Appendix 5, Figure 1). The most serious erosion problem appears to be on the stream channel entering the northern end of the lake. Bank instability leads to erosion of the bank during high water flow conditions. Bank instability exacerbated by the invasion of undesirable trees such as box elders, willows, and cottonwoods along with various shrubs and decline of shoreline stabilizing grasses which cannot survive in the dense shade when trees and shrubs invade. Examples of bank stabilization practices follow.

RIPRAP

Riprap consists of natural rock or quarry stone that is placed on stream banks. Before placement of rocks, trees along the banks are removed, and the banks are usually graded if the slope is too irregular or too steep. A bed of gravel or porous filler material may be placed between the bank and riprap blanket to allow seepage but still prevent erosion of the bank material.

Hand placement of riprap is one method of installation. Stones are usually laid in a more or less definite pattern usually resulting in a smooth surface.

We don't recommend riprap along stream banks for four main reasons: 1. Can be time and labor intensive, 2. Cost, 3. Not very aesthetically desirable, and 4. Doesn't allow for a diverse population of plant and animal species. We recommend the following method.

TREE REMOVAL AND GRASS PLANTING

Streambank stabilization is best accomplished by removing or selective pruning of some trees, saplings, and shrubs along banks, often followed by grading, and seeding the banks with a grass/forb mix.

The trees and shrubs present on much of the stream banks create too much shade for many species of grasses to survive. An effective method of removal of these trees is by cutting near ground level with chainsaws and the application of the herbicide Garlon to the cut stump.

Short-lived annual grasses (i.e. annual rye grass, barnyard grass) can be used to provide initial stabilization of banks before the slower growing native grasses establish and stabilize. Native grasses that provide essential stream bank stabilization in partially shady areas include wild rye (Elymus villosa, E. virginicus), wood reed (Cinna arundinacea), bottlebrush grass (Hystrix patula), and cutgrasses (Leersia oryzoides, L. virginicus). Native grasses which grow better in sunny areas include manna grasses (Glyceria grandis, G. striata) and cordgrass (Spartina pectinata). Wildflowers would include green headed coneflower (Ratibida laciniata) and cup plant (Silphium perfoliatum). (also see Appendix 5, Figure 8). We caution that such species as reed canary grass would be undesirable because of its aggressive and persistent nature.

In order for these stabilization projects to be successful and remain effective, management of these areas is critical. Management would involve prescribed burning and often periodic mowing of uplands. Both of these practices would prevent the woody vegetation from re-establishing and would promote desirable grass and forb species. The grasses and forbs which would be planted are adapted to fire, while most of the invading species are not, thus fire promotes desirable native vegetation.

Burning can often be done once a year, typically in the spring, for the first three years and once every 2-3 years thereafter. Mowing should be done in years the areas were not burned or in the first and second year while native vegetation is establishing. Mowing to a height of 8-10" is typically recommended.

Stream bank stabilization is a complex and often difficult task yet would be desirable. Cost sharing for such projects is often available from U.S. Soil Conservation Service and U.S. Agricultural Stabilization Services (see Appendix 5, Figure 2).

BUFFER ZONE ESTABLISHMENT

A minimum 50-75 foot section of land set aside between active agricultural fields and the lake is very desirable in protecting the quality of the lake. This buffer strip acts as a sediment filter and controls erosion. The buffer could be seeded with native prairie grasses and wildflowers using a Truax drill. Buffering the lake would require agreements with the landowner. This could be accomplished by working closely with the landowner and the Soil Conservation Service (see Appendix 5, Figure 1 and Appendix 8).

TILLED UPLAND

One of the major contributors of silt and nutrients into the lake are the tilled agricultural fields within the watershed, the field to the east. The highly erodible soils present especially require conservation practices by farmers to prevent excess erosion.

Terracing, contour farming, and conservation tillage are accepted conservation practices to reduce erosion. We recommend one or all of these practices be implemented on the agricultural fields. This will require consultation with the land owners and the Soil Conservation Service.

FERTILIZER APPLICATION TO AGRICULTURAL FIELDS

The source of the majority of nutrients reaching the lakes is from fertilizers applied to tilled agricultural uplands. Fertilizers applied to tilled uplands normally become adsorbed to soil particles. Nutrients such as phosphorus and potassium are slow to move through the soil remaining near the surface for a period of time. When a storm event occurs these soil particles containing nutrients become dislodged and are suspended within the water flow, ultimately reaching a stream and then the lakes.

The increased practice of no-till farming, stream buffer zones, and wetland restorations will prevent much of this nutrient rich sediment from reaching the lake, but we also recommend agreements be made with area farmers on amount, type, and timing of fertilizers applied to their fields. Reduced fertilizer rates, slow release fertilizers, more incorporation of fertilizers into the soil, and fall application are all techniques which could be used by farmers to reduce nutrient loss to water flow. The Soil Conservation Service should be contacted regarding this.

LAWN APPLIED FERTILIZERS BY LAKE RESIDENTS

An agreement should be made with lake residents to reduce the amount of fertilizer, especially fertilizer containing phosphorous (P) and potassium (K), which is applied to lawns. Lawn applied fertilizers are often washed into lake.

A typical fertilizer applied to lawns is 10-10-10. This fertilizer contains 10% each of nitrogen, phosphate, and potash. According to many studies, lawn grass is normally just deficient in nitrogen, not P or K. It is not necessary to apply P or K on most lawns. These two nutrients are the major stimulants for aquatic weeds and algae. If fertilizers are applied only limited amounts of nitrogen fertilizers should be applied. Limited nitrogen use especially use of organically bound fertilizers may significantly reduce the nutrient load.

WETLAND MANAGEMENT

Wetlands are one our most valuable habitats. Some of the more important functions of wetlands are that they can harbor a vast array of plant and animal species and can filter sediment and nutrient rich water before it enters lake and streams.

Most of the wetlands within the watershed are degraded and of moderately low quality being dominated by the southeast Asian reed canary grass (Phalaris arundinacea) and cattail (Typha sp.). These plant species produce a monoculture throughout the wetland which is highly undesirable. A "leaky" system results because they are so low in diversity. A variety of plants is one of the keys in the filtering capacity of a wetland as well as being attractive to more species of wildlife.

The effectiveness of the wetlands could be greatly increased if wetland management practices are implemented. We have marked areas on a map (see Appendix 5, Figure 1) where management is recommended.

Cattails and reed canary grass invade much of the wetlands in North America. Management may be desirable where ecosystem disruption favors these species. Their control can be very difficult (Appendix 6, Attachments 1 and 2). Prescribed burning has had varying effectiveness. A burning program along with water level maintenance (see Appendix 5, Figure 3) is probably the best approach to eradication and control of these species.

Both species are very difficult species to eradicate (Appendix 6). Herbicides such as "RODEO" have been used effectively to kill this plant. However, seeds of this species will germinate from the substrates and again establish dense vegetative cover. Use of prescribed burning has had varying effectiveness. If wetland vegetation is damp, burning is often unsuccessful. The best burns occur when vegetation is dry and substrates are damp or dry. This allows fire to damage the shallow rhizomes and consume most of the above-ground biomass. If this is done in sequential years, control of canary grass can be achieved. Removal of canary grass allows suppressed plants (e.g., sedges, wetland grasses, and wildflowers) to begin growth. Reed canary grass can be repeatedly suppressed by the burning, but it will not be completely eliminated. Eventually, desirable plants will begin to flourish and further suppress canary grass. Several (3-5) years of burning are required to achieve this trend.

We recommend the following:

1) Begin a program of prescribed burning in the wetlands (see Appendix 5, Figure 3). Burn these areas annually for 3-5 years in the fall or summer of the year when vegetation is erect and calorically at peak and when the wetlands are the driest. Fall burning compromises winter cover for wildlife in the short-term but is the quickest way to create healthy wetland systems. Monitoring will indicate if desirable species establish after management. Introduction of seed, tubers, or rhizomes of species will accelerate restoration; this will be necessary if the system

does not respond well to burning (see Appendix 5, Figure 3).

2) Installation of water control structures to maintain water levels at a level where vegetation is in saturated or inundated soils.

If these methods are followed in wetland areas specified wetlands will be enhanced which in turn will help improve the condition of the lake. A higher diversity of plant life will attract more wildlife making the areas more aesthetically pleasing. Methods of vegetation control follow.

VEGETATION CONTROL IN WETLANDS

Vegetation control techniques that improve the filtering capabilities and wildlife habitat of wetlands would be desirable in locations specified (see Appendix 5, Figure 1). Improvements include the creation of openings in vegetation, removal of rank vegetation, encouragement of new sprouting, and freeing new plantings from competition. Weed-choked marshes are of only limited value to wildlife but some overgrown stages must be maintained because they provide shelter and escape cover. The removal of undesirable growth provide openings, creates additional "edge", and increase desirable species. Woody plants or any tall overstory may have to be removed or thinned to allow a new vegetation community to develop. A diverse community of vegetation also allows the wetland to be the most efficient at filtering out nutrients, sediments, or other pollutants before entering the lakes. Also, water must be maintained at a level where the soil is permanently inundated or saturated. Following are different techniques to control or remove marsh or upland vegetation.

CHEMICAL CONTROL

The use of chemicals for vegetation control in wetland management is an outgrowth of the development of herbicides for agricultural purposes. Many herbicides have been developed specifically to control vegetation that is considered a nuisance by other interests, but these plant species are often valuable to wildlife.

A herbicide list (see Appendix 5, Figures 4 and 5) has been included. These herbicides have been found to be effective on three plant types or habitat classifications: 1) emergent - moist soil vegetation; 2) aquatic grasses; and 3) shoreline, ditchbank, and upland vegetation. We recommend any use of herbicides be very judicious and applied by trained and licensed applicators.

MECHANICAL CONTROL

The use of mechanical equipment is a common method of controlling vegetation, especially on upland sites. A factor limiting the use of weed mowing equipment is the inability to operate in wet areas. Conventional heavy equipment techniques are presented here for upland vegetation removal, and equipment adaption for mechanical vegetation control in wetland areas.

BURNING

Controlled burning is an economical method for vegetation management and reduction that is widely used in habitat restoration (see Appendix 5, Figure 3).

Warm, bright days when the humidity is between 25 and 40% are considered best for burning. Burning should not begin until the dew is off the vegetation. Wind speed should be less than 20 mph and wind direction should be steady.

Burns in late summer or early fall are considered best because all nesting of waterfowl and other birds is completed. Burning in winter or early spring can be successful, except in areas with a heavy snow cover; however, the burn produced at this time of year is usually not as clean as that in late summer or fall. Sparsely vegetated marshes or uplands cannot be effectively burned.

Watershed management will require a cooperative effort with the Department of Natural Resources, Soil Conservation Service, landowners, and lake residents.

These alternatives should be implemented in coordination. A combination of different techniques is probably the best alternative. Each management method would check the other making each more efficient and thus more effective.

LAKE MANAGEMENT

Due to the heavy siltation and the nutrient rich sediments involved which have spurred weed infestation, it is obvious to AES a direct method of sediment removal would need to be implemented in order to deepen the lake and make conditions less conducive to weed growth. Since, however, dredging is not economically feasible the lake will have to be managed as a shallow lake.

WEED CONTROL

The infestation of the lake by various weed species, mainly Eurasian water milfoil (*Myriophyllum* spp.), white water lily (*Nymphaea* sp.), and coontail (*Ceratophyllum* sp.) has led the management district to begin investigation of possible actions which could be taken to gain control of the weed problem. Weeds hinder fishing quality, inhibit boating opportunities, and can cause major fish kills.

Aquatic plants require light, nutrients, and water for vigorous growth, just like terrestrial plants. Aquatic plant growth is usually accelerated by chemical nutrient impact to lakes and ponds. These increases are most often a result of human activities such as run-off of lawn fertilizers, sewage, feed lot run-off, phosphate detergents, etc. This process is called eutrophication, which means over-feeding.

The only long-lasting cure is to bring waste discharge, disruptive land-uses and other nutrient sources under control. But the necessary alteration of the surrounding human community can take many years and in some instances may be impossible. In the meantime herbicidal treatment and/or mechanical and non-mechanical harvesting of weeds are two types of band-aid approaches to consider in contending with algae and weed problems (see Appendix 6).

Chemical control involves the application of herbicides which will kill or suppress the plants. The advantage of this method is that it is normally very effective in killing the plants and does produce good short-term results. Some of the disadvantages include: the suppression of desirable native vegetation, harmful environmental effects, and the dead vegetation which remains on the bottom of the lake and can cause fish kills due to the high biochemical oxygen required by their decomposition. Oxygen levels can be depleted to levels below those required by various species of fish, resulting in death to a large number of fish.

Herbicides affect both plant and animal communities. They may kill aquatic invertebrates, which are vital for fish and waterfowl food. Chemical groups may drift into areas not needing control such as wildlife areas in both lakes. Ingredients in some herbicides such as copper sulfate, may accumulate in sediments, limiting future dredging options because of restrictions on disposing of contaminated wastes and areas may be closed to swimming, fishing or other uses for a few days, weeks, or even an entire year, depending on the chemical used.

Mechanical or non-mechanical harvesting are the methods we recommend for short and long term aquatic weed control. Harvesting does have many advantages: it frees areas for immediate use, few plants are left to decay, and control can be directed at specific areas or used selectively to create channels. Harvested plants, with their nutrients, can be hauled to farms or gardens and used as mulch or compost.

Harvesters can have some negative effects on ecosystems by destroying habitat and removing insects and small fishes trapped in the vegetation. They may create turbidity and leave fragments to drift on shore. Shoreline clean-up using rakes and pitchforks, is often necessary with cutting and harvesting operations. The advantages of mechanical control of weeds far outweigh the harmful short and long-term effects which chemicals may have on an ecosystem.

Currently Voltz Lake employs the use of a mechanical weed cutter. The problem with this particular piece of equipment is that it does not have a conveying system to concurrently harvest the plants. With this machine the plants are simply cut and pushed to shore for removal, allowing cut plants to sink before reaching shore and re-root, perhaps compounding the weed problem.

Purchasing or leasing a mechanical cutter/harvester or possibly contracting with one of the several lake management companies to cut and harvest weeds on a regular basis are all viable options (see Appendix 6).

Hand harvesting, raking and use of a hand-held aquatic plant cutter are simple but highly effective techniques for the control of rooted and some floating plants, especially in front of individual piers or lots. Careful hand pulling and raking can remove roots as well as stems and leaves, thereby minimizing regrowth of the plants for several seasons. Since hand pulling may not be practical we recommend weed cutters.

A hand-held weed cutter is a device which is thrown out from shore or from a pier and then pulled in slowly, cutting the plants in its path as it is retrieved. These cutters are ideal for beach areas and around piers. They are labor and time intensive if used for larger areas.

Once the plants are pulled out or cut they will float to the surface and must be removed. If the cutter used does not have a rake for removal a net or chicken wire can be used to retrieve plants. Once removed the plants can serve as compost or as mulch. They make excellent soil conditioner and add to soil fertility.

Raking or hand harvesting are inexpensive methods to implement, and the tools required are fairly simple. Rakes/cutters vary in price from $50-100.00 (DNR 1988).

No permits are required for this method, but the law requires the removal of cut plants fragments.

With enough volunteer help non-mechanical harvesting can be an effective means of localized weed control. It does not however correct the cause of the problem (see Appendix 6).

ALGAE CONTROL

Filamentous algae, the type common in Voltz Lake, consists of long stringy, hairlike strands. Some of the green and brown scums may be slimy or cottony in appearance.

Copper sulfate is the cheapest chemical for the control of most types of algae. The most effective method of applying copper sulfate is in a solution and spraying it from a boat or shoreline. Copper sulfate crystals can be placed in a burlap bag and dragged behind a boat, but many of the small undissolved crystals will sink to the bottom where they are not effective. Crystalline copper sulfate is available in crystals the size of rock salt, fine crystals, flakes, or powder. The smaller the crystal the easier it is to dissolve in water. It is most effective when the water temperature is 60°F or above.

After the algae plants absorb the copper their color fades from green to grayish white, indicating that the plants are in the process of dying.

Copper sulfate can harm fish food organisms and fish reproduction. Copper sulfate is difficult to use properly. Its effects vary greatly depending on water hardness and other factors. In extremely soft water lakes, very little copper sulfate may kill the algae - but also kill some fish. In hard water, it may take much more copper sulfate to kill the algae, yet the danger to fish may be much less.

Sources of additional information for lake management are included in Appendices 7 and 8.

PUBLIC ACCESS INVESTIGATIONS

As an additional task AES investigated the potential for improved public access to Voltz Lake. Currently there is a public landing suitable for launching small boats and canoes, however, no parking for cars and boat-trailers is available. Improvements to the current landing and construction of a parking lot for a capacity of 5 car-trailers would allow for greater public use of the lake. Construction of a gravel or cement ramp at the lake access site would be an improvement.

Conclusions of the study are as follows:

1) The lake should have restricted access and should consequently not be significantly modified to improve access.

2) All lots along Voltz Lake within a reasonable distance from the existing lake access are not suitable for access or parking. The few remaining lots have wetland borders along the lake shoreline. We propose that these lots not be used because of the wetland modification that would be required for development of access.

3) The most practical and perhaps only feasible location for parking one to five vehicles (minimum size lot required under state standards of 2500 ft^2) and boat trailers would be an adjacent parcel of land to the north and east of the existing access (Appendix 9). During the study the land was used for agricultural purposes. The land is located directly north of platted lots with pin numbers 0.0130 and perhaps 0.0135 owned by Mengdbnck and Steven, respectively. Depending on placement, the parking area would be approximately 1000 feet from the lake access location (Figure). This land could be modified little if at all to provide seasonal parking. Perhaps simply planting the parking area to a dense growth of lawn or perhaps the farmer/owner could install a cover of grass/clover which is harvested for hay production.

4) No suggestions for major modification of the lake access location are proposed. Routine maintenance would be important including repair of road shoulder and road edge pavements in and peripheral to the access location. Signage to identify the access location and to provide rules for lake use would also be desirable.

5) Since the proposed sites exist in private lands, the lake district in conjunction with aid from the DNR would have to arrange use of (fee-simple title or perpetual easement) the land prior to construction. The DNR may provide up to 50 percent cost sharing for the land acquisition.

VI. CONCLUSIONS

Voltz Lake is undergoing an acceleration of the process of eutrophication. The influx of nutrients and sediment are causing excessive enrichment and silt loads which are undesirable aesthetically and recreationally. In order to correct these problems certain lake and watershed management alternatives need to be implemented and the state of the lake monitored to assess the effectiveness of each management technique.

Lake management should consist of weed control and shoreline erosion control. For weed control we recommend mechanical or non-mechanical (hand) harvesting of weed species. Herbicides could be used in specific areas of severe weed infestation, however, we stress that the use of herbicides may have some adverse long-term effects on the lake ecosystem. Non-mechanical weed harvesting is time and labor intensive but offers excellent control in small areas. Voltz Lake will need to be managed as a shallow lake since dredging is probably not economically feasible. This will require regular harvesting of weeds or chemical application. It will be impossible to avoid recurring costs if weed control is desired. Dredging provides no greater benefit to long term weed management than a directed and focused weed management program. In shallow lakes, dredging often does not provide a lake weed solution.

Watershed management is essential for assisting in correcting and maintaining a quality lake ecosystem. Conservation practices by farmers, stream bank stabilization, and design of stream and lake buffer zones are recommended techniques for nutrient and sediment control. As stated there are areas within the watershed to concentrate on. These locations appear to be the main sediment and nutrient contributors. Nutrients are commonly carried on suspended solids within surface water flow. Agricultural fields are the main source. Farmers need to be aware of this problem and encouraged to cooperate in watershed improvement efforts. Lake Associations often find incentives can be provided to farmers to the benefit of cooperation and an improved lake system. Reduced fertilizer use and conservation practices would reduce the nutrient amount entering the lake. Lake residents also need to be aware that fertilizers applied to lawns can wash into the lakes thus contributing to the enrichment problem.

With proper ongoing management through a cooperative effort with watershed landowners, state agencies, and lake residents, Voltz Lake can return to a state which is more aesthetically pleasing and one which could provide for greater recreational opportunities than the present conditions permit.

A record of correspondence with Wisconsin Department of Natural Resources and others during finalization of this report are included in Appendix 10.

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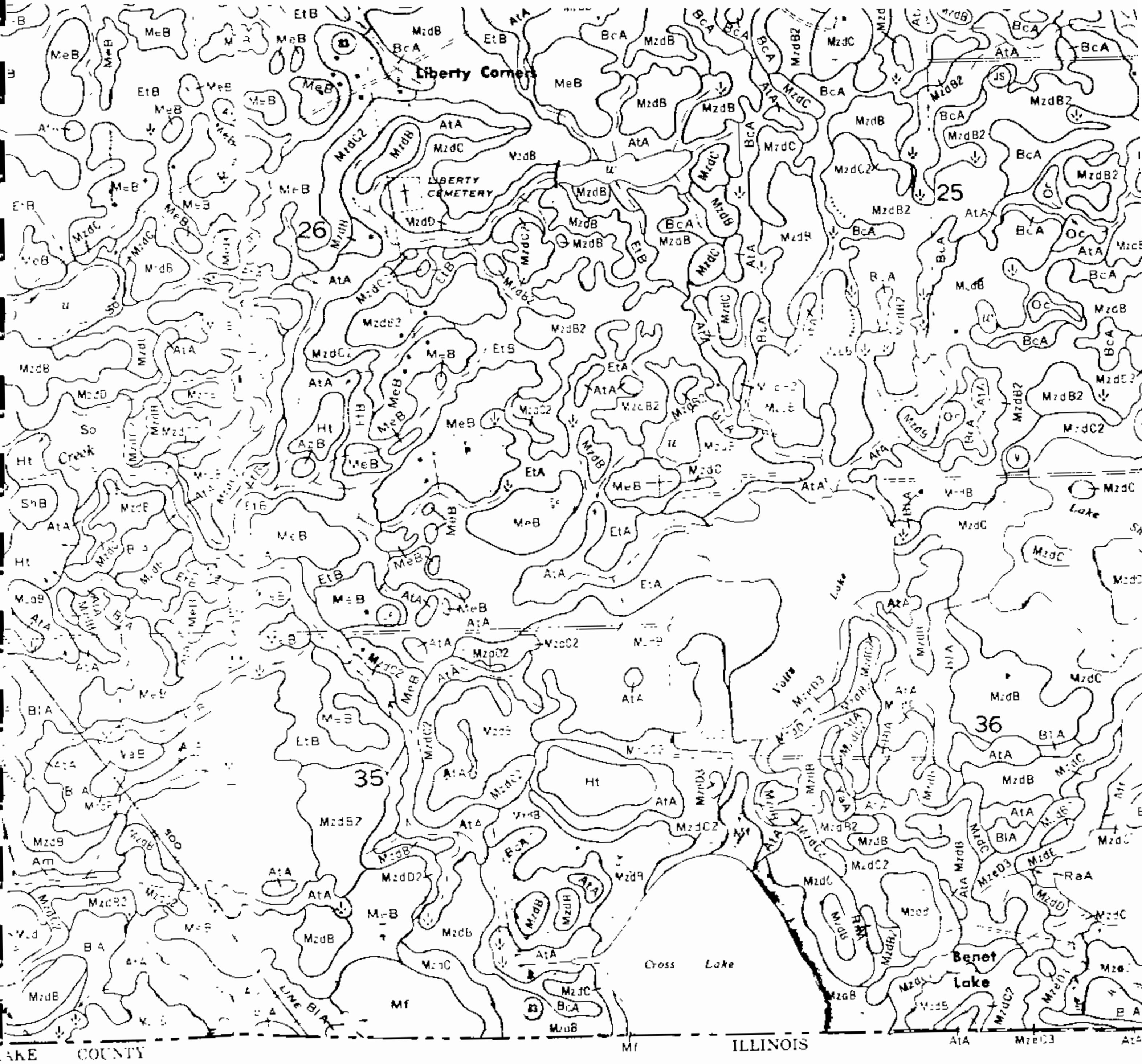
Wetland Inventory map.

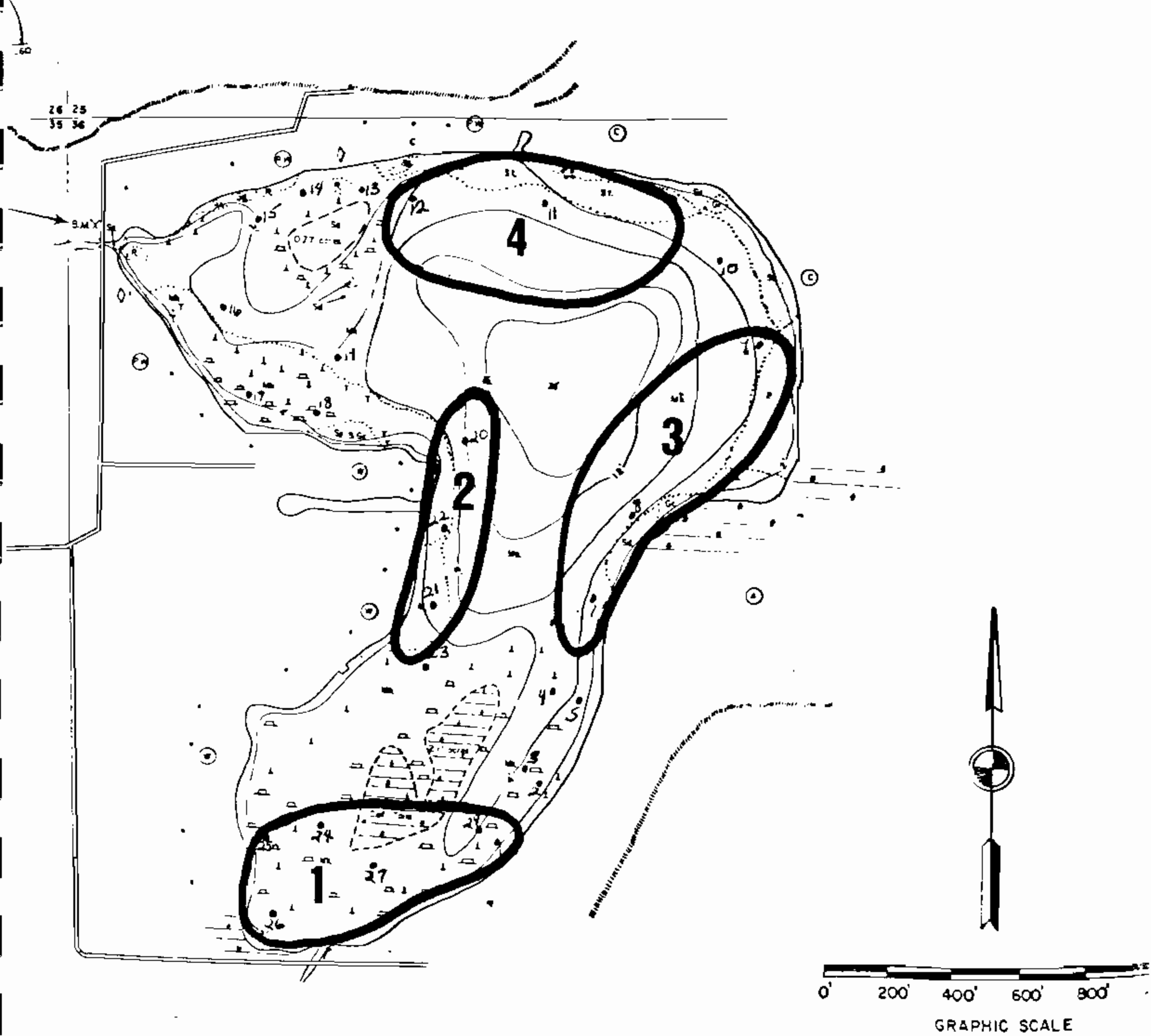
APPENDIX 2. Soils map and description for the Voltz Lake watershed.



Soils present within Voltz Lake watershed.

SYMBOL	SOIL UNIT	CHARACTERISTICS
MzdC	Morley Silt Loam	6-12% slope, moderate erosion, slow permeability
MzdD	Morley Silt Loam	12-20% slopes, found on ridges and knolls, severe erosion hazard
MzdB2	Morley Silt Loam	2-6% slope, eroded, low ridges, moderate erosion potential
MzdC2	Morley Silt Loam	6-12% slopes, eroded, ridges and knolls, moderate erosion potential
Mf	Marsh	Adjacent to lake, ponds, inundated with water at many times throughout year
AtA	Ashkum Silty Clay Loam	0-3% slopes, found on flats and drainageways, very poorly drained
B/A	Blount Silt Loam	1-3% slopes, found along drainageways and in depressions, poorly drained
MzeD3	Morley Soils	12-20% slopes, severely eroded, found on ridges
EtA	Elliot Silty Clay Loam	0-2% slopes, found along drainageways and in depressions, poorly drained
BcA	Beecher Silt Loam	1-3% slope, found along drainageways and in depressions, poorly drained
Oc	Ogden Muck	0-2% slopes, found in marshy areas, very poorly drained
YaA	Yahara Fine Sandy Loam	1-3% slopes, occupies flats, depressions, in lake-laid areas
RaA	Radford Silt	0-3% slopes, depression and wetlands that border eroded slopes, poorly drained
McB	Markham Silt Loam	2-6% slopes, on ridges and knobs, slight erosion hazard

APPENDIX 3. Attachment 1. Lake sediment sampling locations (sample number 1-29) and approximate location of composite samples 1-4.




Voltz Lake.
Codes used include:
G = Grass or alfalfa hay cover
F = Farmed (annual row crop)
R = Residential
S = Savanna woodland
W = Wetland
G
F
F
W
W
R
F
W
W wetland
streambank stabilization
buffer strip
farmland

Figure. Historic aerial photograph provided to Voltz Lake citizens. Date is August 12, 1937.