Running Head: Lake Conservation

Lake Conservation on Big Cedar Lake

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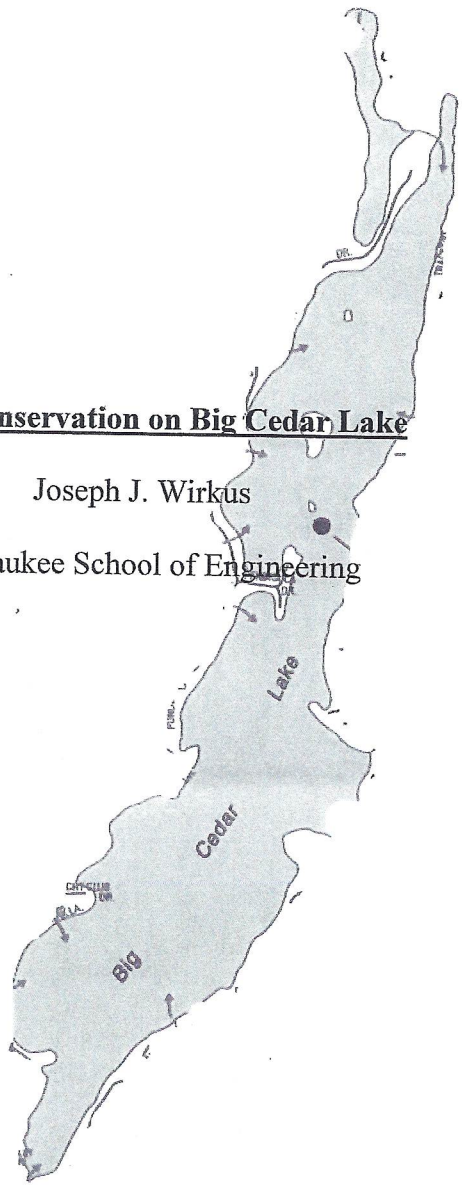

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Table of Contents

Abstract

Lake Conservation seeks to preserve a natural body of water and all the benefits it holds. Within I have covered a general background of major types of pollutants such as phosphorus, mercury, arsenic and metals and how each one pertains to inland lake conservation. Also, I have covered several methods of reducing pollutants in a lake such as retention ponds and dredging. Throughout I have used as a specific example, Big Cedar Lake. Located in Washington County, Wisconsin, it is a perfect example of a lake with a governing district as well as an active Conservation Foundation. The statistics used throughout are mostly results of studies carried out by those organizations in cooperation with the Wisconsin Department of Natural Resources. A brief and general recommendation on how to proceed with the explored conservation methods is given and could apply to lakes similar in situation to Big Cedar Lake.

Introduction

In the interest of preserving for the future, the health of a body of water, the prevention of pollution as well as management of current problems is the focus of lake conservationists and the organizations they create. In 1972, the Clean Water Act, under United States Code Title 33, Chapter 26, called for the cleanup and maintenance of lakes and other bodies of water to preserve aquatic life and sustain recreational human activity. Methods of cleaning up various forms of pollution from silt, sediment, undesirable plant growth, and heavy metal and other toxic water contaminants, have been carried out with success for quite a number of years since the act. Consequently, several unexpected obstacles have been encountered during the first cleanup endeavors and many lessons

have been learned. More natural control methods such as retention ponds and conservatories are used to prevent pollution from reaching a lake and preserve beauty and ecosystem integrity, while dredging is being considered, in cooperation with proper prevention and care to prolong the health and beauty of the lake and support human recreation.

Lake Conservation

Lake Conservation organizations seek to plan and carry out the care of a body of water and its surrounding land. A prime example of a lake community with an increasingly influential conservation organization is Big Cedar Lake in Washington County, Wisconsin. Big Cedar Lake is a center for recreational activity such as fishing, swimming, skiing, and boating and is the largest of all the lakes in Washington County. It is also a good example of a lake in need of increasing care and attention in the coming years, if it is to be preserved, for the sake of both nature and human recreation. The Big Cedar Lake Protection and Rehabilitation District was founded in 1974 to govern and maintain the operations of the lake (SEWRPC Vol. 1, 2001). A separate organization, the Cedar Lakes Conservation Foundation, works closely with the District in collecting grants, funding projects, and acquiring important land (SEWRPC Vol. 1, 2001). Both organizations are concerned with improving the existing condition of the lake through water quality management, pollution and sediment removal, and other conservation methods. Between 1976 and 1978 the first extensive study on Big Cedar Lake and its surrounding water shed was carried out to provide information to be used in future conservation and management of the lake (BCLPRD Summary, 1994).

Non-Point Source Water Pollution

In lakes surrounded by high terrain or developed urban or agricultural land, storm water runoff is a threat to aquatic ecosystem health. Water enters a lake from the surrounding land in cases where the land is inclined towards the lake. The boundary marking this surrounding land is called the watershed. Silt, or fine dirt from gravel roads or farmland within a lake's watershed, is dissolved and carried by rainwater into the lake. Silt causes lake water to become temporarily unclear or cloudy but eventually settles to the bottom of the lake and remains there. Over time accumulation of silt on the bottom of the lake produces an undesirable soft "muck" covering on the existing sand, and causes the lake to shallow, only slightly, over many years. More importantly, the sediment on the bottom of the lake provides a sink in which harmful or toxic chemicals are deposited and accumulate over time (Burzynski, 2001).

Silt or sediment, while temporarily clouding the water in a lake, carries with it other substances that can cause the nutrient level of a lake to change. In 1991, approximately 238 tons of sediment was deposited in Big Cedar Lake from runoff on the surrounding watershed (Kuphal, 1991). In 1995, 669 total tons of sediment was reported (SEWRPC Vol. 1, 2001). Of the 669 tons of sediment estimated to have entered Big Cedar in 1995, a reported 45.8 pounds of copper, and 176.3 pounds of zinc were present (SEWRPC Vol. 1, 2001). While metals are present in storm water runoff, the majority of pollution comes from phosphorus contained in agricultural land where there is an abundance of exposed soil that is easily eroded. Runoff from residential land equipped with leaking onsite sewage disposal systems, contains high levels of phosphorus from

human waste as well. A typical dairy cow can produce as much as 27 pounds of phosphorus each year through solid excrement, 13 times as much as a human (BCLPRD Summary, 1994). A properly functioning sewage system reduces the amount of phosphorus released by a factor of 10 as compared to the human sewage being left untreated, making community involvement in monitoring residential sewage systems imperative (BCLPRD Summary, 1994). Upon entering into a lake ecosystem, nutrients such as phosphorus and nitrogen affect the trophic status or nutrient level of the water and are oftentimes indicated by excessive plant or algae growth (SEWRPC Vol. 1, 2001) (Burzynski, 2003). Generally, a lake can be described as oligotrophic, mesotrophic, or eutrophic under a measurement system known as the Trophic Status Index (TSI) (SEWRPC Vol. 1, 2001). An oligotrophic lake is a lake with very low nutrient levels and poor aquatic life, while a eutrophic lake is one with high levels of nutrients showing excessive weed growth and an overabundance of algae (SEWRPC Vol. 1, 2001). According to a study performed in 1995, Big Cedar Lake was classified as a mesotrophic lake containing moderate nutrients, and supports a healthy fish and aquatic plant habitat suitable for recreational activities (SEWRPC Vol. 1, 2001). In terms of phosphorus alone, however, Big Cedar was then considered oligotrophic for its relatively low level of phosphorus. In 1995 it was reported that the annual phosphorus load to Big Cedar was about 2340 pounds, 1690 pounds or 72% of which was from rural or agricultural sources while 400 pounds or 14% was from urban areas within the watershed (SEWRPC Vol. 1, 2001). In a later study by the Wisconsin Department of Natural Resources, reported in 2001, Big Cedar Lake was considered closer to being eutrophic according to the TSI measured, and showed signs of undesirable aquatic plant growth and some algae bloom

in certain areas (Burzynski, 2001). The trophic status of Big Cedar Lake has risen recently as algae blooms have occurred consecutively in 2001 and 2002. A rise in the trophic status of a lake such as Big Cedar is undesirable, as excessive weed growth might hinder recreational activities and threaten healthy aquatic animal habitats.

Point Source Water Pollution

Point source pollution is a type of pollution that can be located, and for the most part, eliminated. An example of point source pollution would be a construction site or malfunctioning residential septic system, both of which contribute phosphorus. It could also be as simple as a sunken vehicle in the lake contributing hydrocarbons or iron, an electric battery containing mercury, lead, or cadmium that has been improperly disposed of, or a corroded water pipe contributing dissolved iron or copper (EPA, 2003). Mercury is a naturally occurring element but is also produced in large quantities by paper manufacturers and coal burning power plants (WDNR, 2003). The air pollution produced by these facilities settles onto the surface water of surrounding lakes and eventually accumulates at the bottom. There, Mercury is chemically converted by various bacteria into an easily ingestible form, subsequently being consumed by fish and other aquatic creatures along with anything they eat. Biomagnification is the process by which Mercury is accumulated at a greater rate higher on the food chain, making it a concern for people who consume fish (EPA, 2003). Humans consume fish and the mercury they contain, and are prone to health risks, especially expectant mothers and children (WDNR, 2003). Because of this danger the Wisconsin DNR lowered the allowable limit as of the

year 2000 for fish mercury contamination, subsequently placing widespread fish consumption advisories across the state (WDNR, 2003).

Herbicides are chemicals used to control unwanted weed growth in a lake. Between the years 1950 and 1969 approximately 179,164 pounds of an herbicide called Sodium Arsenite was used to control weed growth in Big Cedar Lake and was the third highest amount of Sodium Arsenite administered to any Wisconsin lake in those years, topped only by Pewaukee and Okauchee Lakes (SEWRPC Vol. 1, 2001). Sodium Arsenite is a source of the harmful element Arsenic. In some forms, arsenic becomes dissolved in water and is poisonous to humans. An additional 21,440 pounds of Copper Sulfate between the years 1950 and 1969, and 42 pounds of 2,4-D between the years 1985 and 1987, were used on the lake as herbicides as well (SEWRPC Vol. 1, 2001). Substances like Sodium Arsenite and Copper Sulfate are no longer used because their potential toxic effects have since been recognized. While point sources of pollution can be for the most part, controlled or eliminated, non-point sources must be dealt with on a much larger basis.

Prevention and Retention Ponds

Storm water abatement basins, commonly known as retention ponds, are manmade ponds designed to eliminate harmful sediment from non-point sources of pollution.. A retention pond is set up in an area where water normally flows directly into a lake in a region of the watershed where sediment contribution is heavy. A retention pond filters water first by collecting the water in a series of deep connected pools, allowing the sediment to settle to the bottom, and finally by releasing the clarified water

to the lake via a gate or dam. A typical pond is preceded or surrounded by a culvert lined with rocks to aid in the filtering of the water. Similarly, many drainage and residential areas without a pond may be landscaped with rocks or grassland to filter the water during its course into the lake. Retention ponds can improve the quality of the water flowing into the lake and are especially effective during periods of heavy rain. A typical retention pond was installed on the northwest shore of Big Cedar Lake in a subbasin in which approximately 6.5 tons of sediment is contributed per year (Kuphal, 1991). This particular pond is built on land, like other ponds surrounding Big Cedar, on land acquired by the Cedar Lakes Conservation Foundation. It has a series of three relatively shallow pools that filter the runoff from the subbasin where it is built. It is monitored regularly and maintained by the Protection and Rehabilitation District. Sediment that collects in the bottom of a pond never reaches a lake but is periodically removed by a process called dredging, by which it is simply removed by a vacuum apparatus and transported to a remote location for disposal or beneficial use of some type. Dredging is also used to clean out the bottom of an entire lake when the shallowing depths hinder recreational activities or destroy a natural habitat.

The Toxic Dangers of Dredging

Dredging is considered with great caution by lake conservationists because while it may only need to be done once in a lifetime, the less often dredging is done the better, according to the conservation community. Dredging a lake involves selecting critical areas of the lake where sediment buildup needs to be removed. However, care must be taken in selecting these areas, as many locations contain contaminated sediment from

runoff, and more seriously, point sources of pollution such as herbicides. When a lake is dredged, there is a very likely chance that arsenic, mercury, and a variety of other accumulated toxins like Polychlorinated Biphenyls (PCB's) will be stirred up and reincorporated into the ecosystem (Burzynski, 2001) (EPA, 2003). Evaluation of candidate sites for dredging is done by the Department of Natural Resources many times in cooperation with the Army Corps of Engineers to carry out the procedures and safe disposal (EPA, 2003).

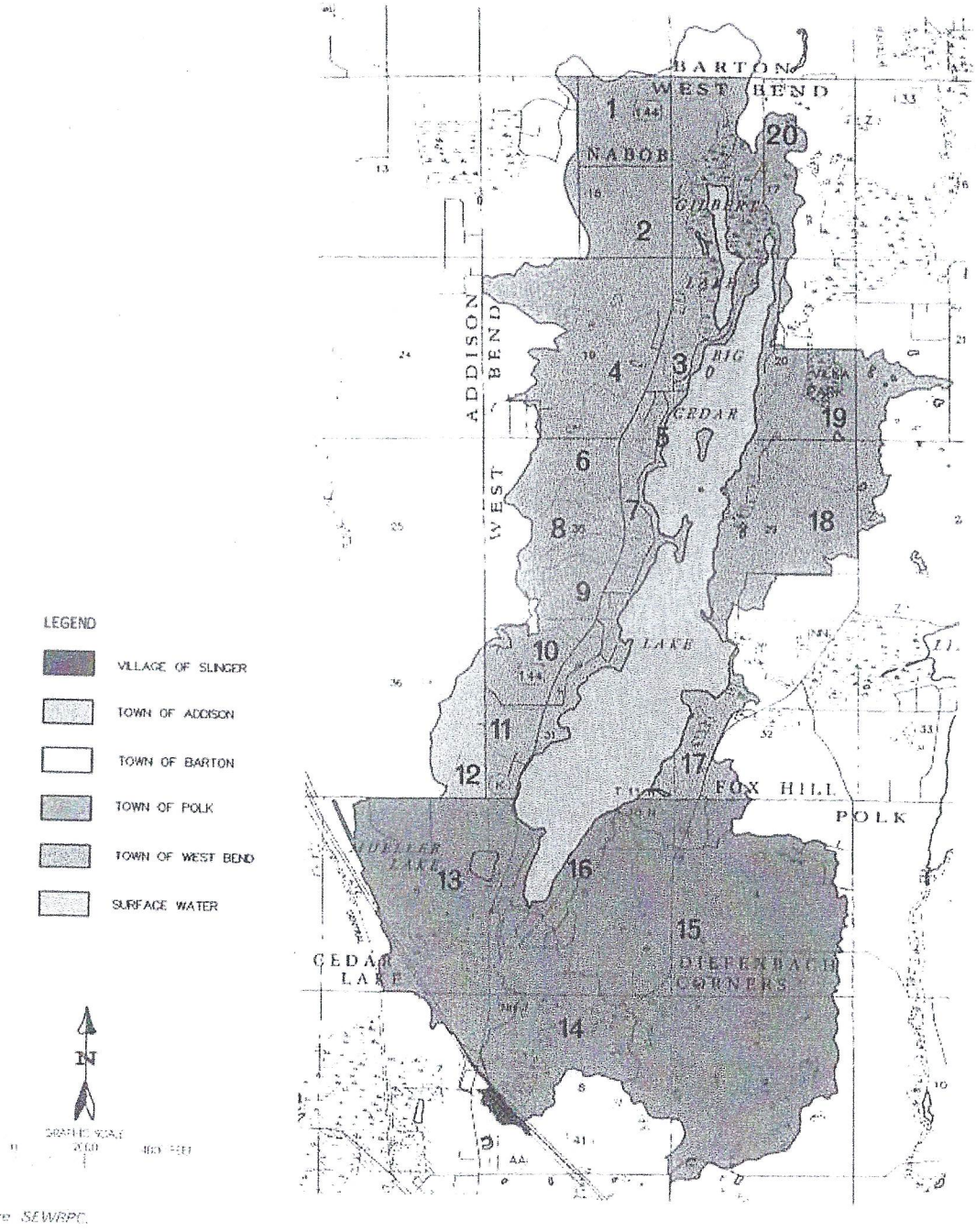
Future Outlook

Two locations in particular on Big Cedar Lake are in future management plans by the Protection and Rehabilitation District and include land acquired by the Cedar Lake Conservation Foundation. One, on the west shore, referred to as Subbasin 8, includes a new retention pond that has been completed as of Autumn 2002 and also includes future plans to raise the elevation of West Lake Drive in that same area (SEWRPC Vol.2, 2001). The second area of interest, Subbasin 1 is north of the lake located in between Gilbert Lake, which is connected to Big Cedar Lake on the north end, and State Highway 144 in the Town of West Bend. This subbasin contributes 26.4 tons of sediment per year to Gilbert Lake and Big Cedar Lake (Kuphal, 1991). This plan involves the installation of three small retention ponds in the subbasin tributary to Gilbert Lake and its wetlands as well as the future installation of a public nature conservatory and walking trails (SEWPC Vol. 2, 2001).

Conclusions and Recommendations

Big Cedar Lake is a hub of community and state recreation activity as well as a fine example of a clean, healthy Wisconsin Lake. Pollution to the lake, monitored regularly since 1974 and the beginning of the conservation movement here, has proved to be mild compared to other lakes. Recent algae blooms have some concerned that the lake's nutrient level may be on the rise, however, and most agree care must continue in monitoring the lake. Current retention pond installments must be properly maintained to ensure their effectiveness and future installments must be carried out in the proper areas around the lake. Community involvement in the conservation effort should include prudent construction or landscaping ventures as well as proper disposal of harmful chemicals or materials. Furthermore, when all necessary retention basins have been implemented, the lake should be dredged in specific locations determined by the Department of Natural Resources. With the lake safely dredged, properly protected and monitored, most sources of pollution should be able to be controlled, allowing for healthy recreational use of the lake.

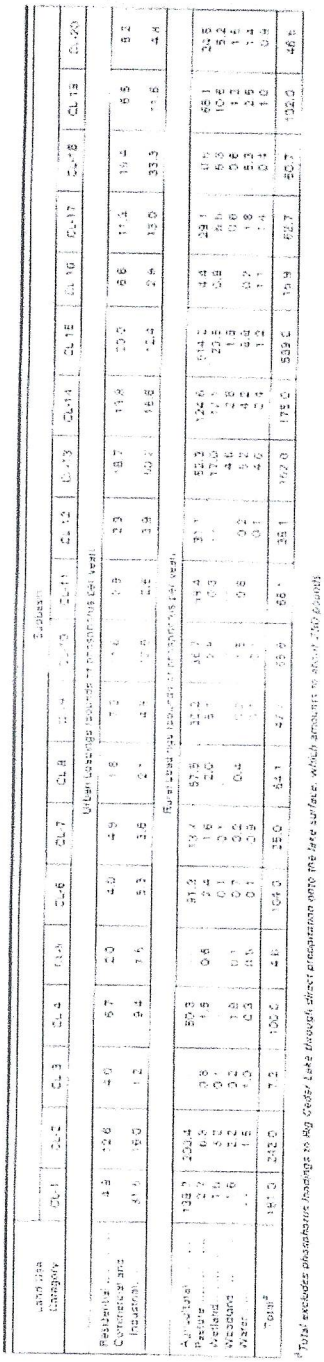
Fig. A- Map of Big Cedar Lake and Surrounding Watershed



Source: SEWRPC, 2001

Fig. B

PHOSPHORUS LOADINGS TO BIG CEDAR LAKE BY SUBBASIN: 1995



Source: SEWRPC, 2001

Fig. C

LAKES RECEIVING THE LARGEST AMOUNTS OF SODIUM ARSENITE AND COPPER SULFATE IN WISCONSIN FOR AQUATIC MACROPHYTE CONTROL: 1950-1969

Lake	County	Pounds of Herbicide
Sodium Arsenite		
Pewaukee	Waukesha	312,908
Okauchee	Waukesha	181,580
Big Cedar	Washington	179,164
Pine	Waukesha	129,877
Fowler	Waukesha	87,456[a]
Total	--	890,445[b]
Copper Sulfate		
Waubesa	Dane	256,174
Kegonsa	Dane	217,154
Chetek Chain	Barron	139,025
Pewaukee	Waukesha	125,454
Nepco	Wood	103,750
Wapogasset	Polk	102,740
Half Moon	Eau Claire	93,135
Delavan	Walworth	81,113
Monona	Dane	48,100
Menomin	Dunn	40,700
Okauchee	Waukesha	36,983
Little St. Germain	Vilas	28,400
Big Cedar	Washington	21,440
Mirror	Sauk	19,505
Geneva	Walworth	18,915
Delton	Sauk	18,650
Bear Trap	Polk	18,600
Pine	Waukesha	17,434
Whitewater	Walworth	14,970
Big Butternut	Polk	14,050
Total	--	1,416,292[c]

Source: SEWRPC, 2001

Glossary

2,4-D- an herbicide used to control weed growth in a lake or pond.

Algae- a naturally occurring plant life containing chlorophyll. Thrives suspended in open water causing cloudiness when present in excessive amounts.

Arsenic- an element toxic to humans. Found in the herbicide Sodium Arsenite.

Copper Sulfate- an herbicide used to control weed growth in a lake or pond.

Eutrophic- a general description of a lake with a high Trophic State Index. Contains a high level of nutrients characterized by excessive weed and algae growth.

Dredging- a process by which sediment deposits are extracted from the bottom of a lake or pond by a large vacuum apparatus, often then transported to a remote location.

Mercury- a metallic element found at the bottom of a lake or in water. Mercury accumulates in increasing amounts higher up the food chain and is eliminated from the human body extremely slow once ingested causing great health concerns. Caused by paper manufacturing and coal burning power plants as well as occurring naturally in small amounts.

Mesotrophic- a general description of a lake with a moderate Trophic Status Index. Contains a moderate or healthy amount of nutrients.

Non-Point Source Pollution- Pollution that cannot be traced to a single source or location and therefore cannot be easily cleaned or stopped.

Oligotrophic- a general description of a lake with a low Trophic Status Index. Contains a low level of nutrients.

PCB- polychlorinated biphenyls, substances similar to mercury in that they accumulate in increasing amounts higher up on the food chain and are resistant to break down in nature.

Point Source Pollution- Pollution that can be traced to a single source or location and can be cleaned up or eliminated.

Sediment- An accumulation of sand, dirt, or rocks in the bottom of a lake, compounded by silt and pollution of various forms present in storm water runoff.

Sodium Arsenite- an herbicide used to control weed growth in a lake or stream. A source of arsenic.

Subbasin- a division of a watershed in which a portion of the watershed is drained into a lake at a specific point. A watershed surrounding a lake consists of several subbasins.

Tributary- a stream or subbasin that contributes runoff into a standing body of water such as a lake or pond

Trophic Status- the nutrient level of the water in a lake measured by the presence of various substances, mainly phosphorus and nitrogen.

Trophic Status Index (TSI)- the measurement system used to measure the Trophic Status or nutrient level of a body of water.

Watershed- a region of land marked by an imaginary boundary inside which all storm water flows towards a lake or stream.

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