CARY MILLPOND
WAUPACA COUNTY

FEASIBILITY STUDY RESULTS;

MANAGEMENT ALTERNATIVES

2nd Rough Draft.

By

Office of Inland Lake Renewal

Wisconsin Department of Natural Resources

1980

CARY POND

INTRODUCTION

The management alternatives presented in this report were developed from data collected during the Cary Pond study from 1977 to 1978. The purpose of this feasibility study was to gather information on the physical, biological and chemical characteristics of the lake and its watershed. This data was then used to assess the present and possible future water resource potentials. The components of the study included analyses of the water quality, the aquatic plant populations, and determination of the type and quantities of soft sediments accumulated in the pond.

The purpose of this report is to present management alternatives to the Cary Pond Lake District that are designed to improve or maintain the usefulness of the lake. In developing these alternatives consideration was given to the lake's current trophic status, nutrient budget, and characteristics of the inlet stream. The future of the pond and the management alternatives selected will be dependent upon the desired uses and values of the pond as perceived by the Lake District. Any plans must conform to local, state and federal constraints.

DESCRIPTION OF AREA

Cary Pond is located in the City of Waupaca in Waupaca County. It is an impoundment of the Crystal River. It is uncertain when the dam was constructed but the first recorded inspection was in 1915. It was known as the Felt Mill Dam and owned by the Cary Manufacturing Company. Since then it has been owned by the Jorgensen Manufacturing Company, Cary Manufacturing Company, and today the dam is owned by the Shanack Foundry and Machine Company. From available records it appears that little has been done to the dam in the way of structural improvements, and an inspection report in 1971 recommended some dam repair.

Table 1 lists the morphometric characteristics of the pond and the watershed size, and Figure 1 is a map of the pond. The soils of the watershed are comprised predominantly of sandy and silty loams and overlay glacial drift deposits of 100 to 200 feet in thickness. These outwash plains were formed during the recession of the Cary ice sheet during the Pleistocene Glaciation (10,000-14,000 years ago). The glacial outwash in the area consists of a 15 to 100 feet thick sequence of medium to coarse-grained sand with gravel lenses and overlies 50 feet of glacial till, which in turn rests on granite bedrock.

The watershed is 33,280 acres although the area directly drained is 2,500 acres (Figure 2). Most of this area is a mixture of agricultural and wood lands with only a small area being in urban development. The landscape consists of gently rolling hills with a maximum elevation of 160 feet above the level of the pond. Little Hope Pond ~~is~~ has an elevation only 20 feet ~~above~~ higher than Cary Pond even though it is 5.5 miles upstream.

The Crystal River originates as an outflow of Long Lake in the Rainbow Chain of Lakes and flows through Junction Lake and Little Hope Pond prior to entering Cary Pond. The soil in the watershed is porous, allowing for rapid infiltration of rain. The steep slopes are wooded, as is the river bank. In the stretch of river between Cary and Little Hope Ponds only two minor erosion areas were evident and these were just below Little Hope Pond. Any runoff problems above this area would be ameliorated by Little Hope Pond. The water quality of the river is good and the river above Cary Pond is classified as a Class II trout stream. In general, the watershed is in good condition. Efforts in the watershed should be primarily aimed at protecting the existing conditions to prevent nutrient runoff and erosion.

The most aesthetically objectionable problem in Cary Pond is the profusion of macrophytes, both emergent and submergent, accompanied by filamentous algae. Table 2 gives a list of macrophytes found in Cary Pond during the study. Figure #3 is a map of their distribution. The only area where these are not a problem is in the channel where the water current restricts their growth. Elodea canadensis (american waterweed) and filamentous algae dominate in June with lesser populations of Ceratophyllum demersum (coontail) and Potomogeton zosteriformis (flatstem pondweed). In August these macrophytes and filamentous algae are still dominant, especially E. canadensis. Herbicide application records indicate that macrophytes have been a problem in the past (Table 3).

TABLE 3

HISTORICAL HERBICIDE APPLICATIONS

ld be placed with other Tables

Year	Herbicide	Amount	Area Treated
1957	Arsenic	720 lbs.	15 acres
1958	Arsenic	1272 lbs.	11.8 acres
1976	Diquat	10 gal.	6 acres
1977	Diquat	8 gal.	6 acres

During the study period water clarity was good. The Secchi disc was visible to the bottom (4-5 feet) from April through October. Chlorophyll a values were low, averaging 3 mg/m^3 and the maximum value was 7 mg/m^3 in July. This indicates that floating (planktonic) algae were of little problem.

Hydrologic and Nutrient Budget

Rainfall during the study period was 20 percent higher than normal implying that more material may have entered the lake this year than would in most years. The amount of material entering the lake was calculated assuming the inflow volume to be equivalent to the measured outflow volume. This should be a safe assumption given the short hydraulic retention time (less than 12 hours). Because of the relatively high volume flows entering Cary Pond, other nutrient contributors such as groundwater, precipitation, and overland flow were considered negligible.

During the study period the average flow ~~volume~~ was 82 cfs, indicating a hydraulic residence time of 6-7 hours although at low flow ~~conditions~~ this may be extended to 11 hours. This short residence time indicates that plantonic algae should not be a problem except perhaps in the protected bays.

Table 4 gives the nutrient and suspended solids budget for Cary Pond during the study period. Of the three measured parameters (phosphorus, nitrogen, and solids) only phosphorus was retained within the pond on an annual basis. Calculations from the data collected by the consultant indicate that five percent of the phosphorus was retained within the pond. The rest (or an amount equalling 95 percent of the incoming amount) left the pond via the outflow. More nitrogen and solids left the pond than entered during the study. While there are errors inherent in these calculations, these results ~~may~~ indicate that the volume of sediment in the pond may NO LONGER BE INCREASING. ~~not increase further, i.e. the pond get any shallower, because at times of high flows some sediment is washed from the pond.~~

A mathematical model, designed to estimate the infilling rate of an impoundment like Cary Pond, predicts that this pond should trap little sediment entering with the river because of its small size. This agrees with the results observed during the study year.

This analysis will not be true of the basin between state highway 49 and Riverside Drive (shaded area in Figure ~~2~~ 1). This area receives little benefit from current action and is probably continuing to become shallower.

MANAGEMENT ALTERNATIVES

The following management alternatives have been proposed to give the Lake District a starting point from which to implement a plan for Cary Pond. These alternatives are not, however, all-inclusive and the District should consider their needs and priorities in concluding a final lake management plan.

Drawdown

A well-planned drawdown of the pond could have two beneficial effects. One would be the consolidation of some of the pond's flocculent, organic sediment. The pond would be permanently deepened by six inches or more. Sediment consolidation resulting from a drawdown would be relatively permanent since once compacted, the sediments tend not to expand. The second would be the temporary control of some of the ~~submergent~~ weed species. ~~As a general rule,~~ floating leafed plants are susceptible to control by drawdown. ~~Specifically Ceratophyllum demersum is well controlled. Elodea canadensis is controlled very little and Potomegeton zosteriformis which reproduces vegetatively and via seeds is not well controlled but it is not likely to expand under periodic drawdown.~~ Weed control which might result would be relatively temporary. Periodic drawdown, perhaps every 3 to 5 years, could help for a time, but, eventually, drawdown resistant weed species could replace those which are susceptible. Certain emergent species such as the cattails have the potential to benefit from drawdown. Normally, however, to increase their range they need wet areas exposed for longer than just over the winter period. Recommended time for drawdown would be overwinter. Refilling of the pond in the spring would be short, requiring less than a week's time. The depth of drawdown might be dependent upon such limitations as the capabilities of the dam, but, in general, the greater the drawdown the greater the potential for consolidation.

The advantages of drawdown include: 1) low cost, 2) sediment consolidation and 3) the opportunity for a general cleanup of the lake bottom, such as stump removal and bulkhead repair. The disadvantages of drawdown include: 1) elimination of water based recreation during drawdown period, 2) increased growth of emergent and drawdown resistant plant species, 3) not a permanent solution and 4) results are somewhat unpredictable--may control excessive growth for several years or may be relatively ineffective.

A permit would be required from the Department of Natural Resources (DNR) District Office at Green Bay to implement this alternative.

Sediment Coverings

At the present time, the DNR is conducting an evaluation of various artificial bottom coverings. Until this evaluation is complete, this alternative must be considered experimental in nature and the effectiveness of this technique is unproven. Preliminary results indicate that most types are ineffective for macrophyte control. However, one type, Aquascreen[R] seems to be somewhat effective in controlling weed growth although filamentous algae will grow on top of the screening. The material is put down in the spring after the weeds have been allowed to grow for a short time (approximately one month). The screen is weighted to help push the plants to the sediment surface. The sinking of the material requires about one week during which time it must not be disturbed. In the fall this material would be removed from the pond and stored overwinter. This material works best in limited areas along the shore.

Bottom coverings have several positive benefits including: 1) reduction of macrophyte growth by elimination of suitable substrate, 2) control of macrophytes at less cost than physical removal of sediments and 3) establishment of areas suitable for recreational use, e.g., swimming, fishing and boating.

The cost of the material alone is about 25 cents per square foot or $10,900 per acre. This cost is approximate depending upon quantity bought and shipping. This material may be laid down from a boat and rocks used as weights.

Aquatic Plant Control by Herbicides or Harvesting

The objective of these alternatives is to reduce the aquatic plant population to tolerable levels, thereby improving recreational opportunities.

Herbicide treatment is a commonly used, effective approach for control of aquatic weeds. All weed species in the lake could be controlled chemically, although effective control will probably require using more than one herbicide. Some of the disadvantages of herbicide treatments include: 1) the treatment has to be repeated annually, and probably more than once per summer, 2) the treated and dying weeds settle to the bottom resulting in an increased oxygen demand during decomposition and organic sediment accumulation, and 3) only near shore (shallow) areas can be treated effectively.

Anyone conducting chemical control of an aquatic nuisance must obtain a permit from the DNR in accordance with Wisconsin Administrative Code Section NR 107.

Weed harvesting is another common method used to reduce plant abundance and maintain open water areas. There are two variations to this method. One method involves a cutter and a push bar which simply cuts the weeds and ~~does not collect them~~ pushes them toward shore where manual collection would be necessary. Wisconsin statutes require ~~however~~ that cut weeds be removed. A cutter and push bar machine can be obtained commercially for approximately $3,500. A collection system and transport to disposal area ~~would~~ could add substantially to the cost.

The other variation is to use a weed harvesting system. ~~consisting of a harvester, transport barge and shore conveyor.~~ This system has an advantage over the cutter and push bar system in that it cuts, collects and delivers the weeds to a shore station. A small weed harvesting system can be obtained commercially for $10,000 to $15,000.

It may be possible to rent a harvester or hire a company to periodically harvest ~~your~~ LAKE weeds. It may also be possible to purchase a harvester with another community and share usage of the machine. One problem with this is that both communities may want to use the harvester at the same time.

Harvesting has several advantages over herbicides, including: 1) discrete areas can be treated anywhere in the lake, 2) plant biomass and nutrients are removed from the lake, and 3) all species present will be controlled. Retreatment will still be required annually, and adequate control may necessitate cutting an area 2-3 times each summer. The primary disadvantages compared with herbicides include initially higher equipment costs, and the need to remove and dispose of the harvested material. In addition, a small harvester can only clear a couple of acres per day.

Dredging

Dredging all or part of Cary Pond, while probably the most expensive, is also the most permanent alternative. This involves physically removing the bottom sediments. This would increase the depth of the pond and eliminate, at least temporarily, the severe aquatic plant problem.

Various amounts of sediment could be removed depending upon the longevity required and cost limitations. Dredging the whole pond to hard bottom (the depth at which weeds could be expected to be retarded) would require the removal of 130,000 cubic yards of sediment. Following this the maximum water depth would be 10 feet with the mean depth being 5 feet. Hydraulic residence time would be increased to 20 hours but washout should be sufficient to minimize any floating algal problems. Although it is difficult to determine the sediment infilling rate the life expectancy of this action would be in the neighborhood of 35 years.

Another alternative would be to only dredge the area between state highway 49 and Riverside Drive (Figure 1). This would involve removing 3,500 cubic yards and would give a maximum depth of 6 feet in this area.

Following dredging, aquatic plants would gradually move back but their abundance should be limited by the marginal substrate. As silt and organic material from the Crystal River moved into Cary Pond the relative abundance of plants will increase. The rate at which the pond would fill up, however, would be relatively slow.

Either mechanical excavation or hydraulic dredging could be used to remove sediment. If drawdown and sufficient drying out of the sediments is possible, removal of sediment from the lake bed could be done by earthmoving equipment. This type of mechanical excavation is less complicated and ~~probably~~ might be less costly than hydraulic dredging. If mechanical excavation is possible, the sediment removed can be stock-piled or used as fill. Consequently, adequate disposal sites are generally available.

Hydraulic dredging involves a cutterhead and pump to remove sediments. This type of dredging generally requires a number of holding ponds, out of the floodway, to settle out the dredged material. Usually dikes have to be constructed to create holding ponds. Thus a common problem with hydraulic dredging is finding adequate upland disposal sites. ~~An unavoidable side effect of hydraulic dredging is the turbidity created in the impoundment by the dredge's cutterhead.~~

Either type of dredging requires a permit under Chapter 30, Wisconsin Statutes, and approval by the U.S. Army Corps of Engineers. A dredging permit would require that any water returned to the river or impoundment ~~be "visually clear."~~ meet certain standards. This means that if the dredging alternative is selected, further investigation on settling rates of solids in a sediment-water mixture will be necessary. Additional analyses of chemical composition of the sediments would also be required. Various factors influence dredging costs including project size, method of removal, type of material to be dredged, distance to disposal sites and availability of contractors. Unit costs on current dredging projects range from 1.5 to 2.0 dollars per cubic yard of material removed. Thus dredging all of Cary Pond to hard bottom would cost between $200,000 and $260,000.

Leave As Is

Waupaca is surrounded by many high quality lakes; Mirror and Shadow Lakes are within the city limits. Therefore, one alternative would be to leave Cary Pond as it is. The pond seems to have reached an equilibrium with the Crystal River, i.e. it is not filling in further, therefore it should not get shallower with the possible exception of the area shaded in Figure 1.

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Any management alternative selected by the lake district that requires Department of Natural Resources permits and/or more than $25,000 of state funds will be evaluated by completion of an Environmental Impact Assessment (EIA). The EIA will provide an opportunity for public review and comment on its findings and will determine the need for an Environmental Impact Statement (EIS). If the EIA demonstrates that the selected management alternative will significantly affect the quality of the human environment, the Department will prepare an EIS prior to project approval.

11/5/80
djc

TABLE 1
BASIC CHARACTERISTICS FOR CARY POND

Surface Area	26 acres
Maximum Depth	6 feet
Mean Depth	1.8 feet
Volume	45 acre-feet
Direct Drainage Basin	2,500 acres
Average Water Residence Time	6-7 hours

TABLE 2
A SPECIES LIST OF MACROPHYTES IDENTIFIED IN CARY POND IN 1978

SPECIES	COMMON NAME
Ceratophyllum demersum	coontail
Elodea canadensis	American waterweed
Heteranthera dubia	water stargrass
Myriophyllum ~~exalbescens~~ sp.	water milfoil
Nuphar ~~advena~~ sp.	yellow water lily
Nymphaea ~~tuberosa~~ sp.	white water lily
Potamogeton amplifolius	large leaf pondweed
P. pectinatus	sago pondweed
~~P. pusillus~~	~~small pondweed~~
P. Richardsonii	claspingleaf pondweed
P. Robbinsii	Robin's pondweed
P. zosteriformis	flatstem pondweed
Potamogeton sp. (unknown)	
Zanichellia palustris	horned pondweed
Lemna minor	duckweed

...re are emergents?

TABLE 4
ANNUAL SOLIDS, NITROGEN AND PHOSPHORUS BUDGET FOR CARY POND

	INFLOW	OUTFLOW	FLUX*
Solids	1.0×10^6 kg	1.1×10^6 Kg	-75,000 kg
Nitrogen	53,000 kg	57,000 kg	- 4,000 kg
Phosphorus	4,000 kg	3,800 kg	+ 200 kg

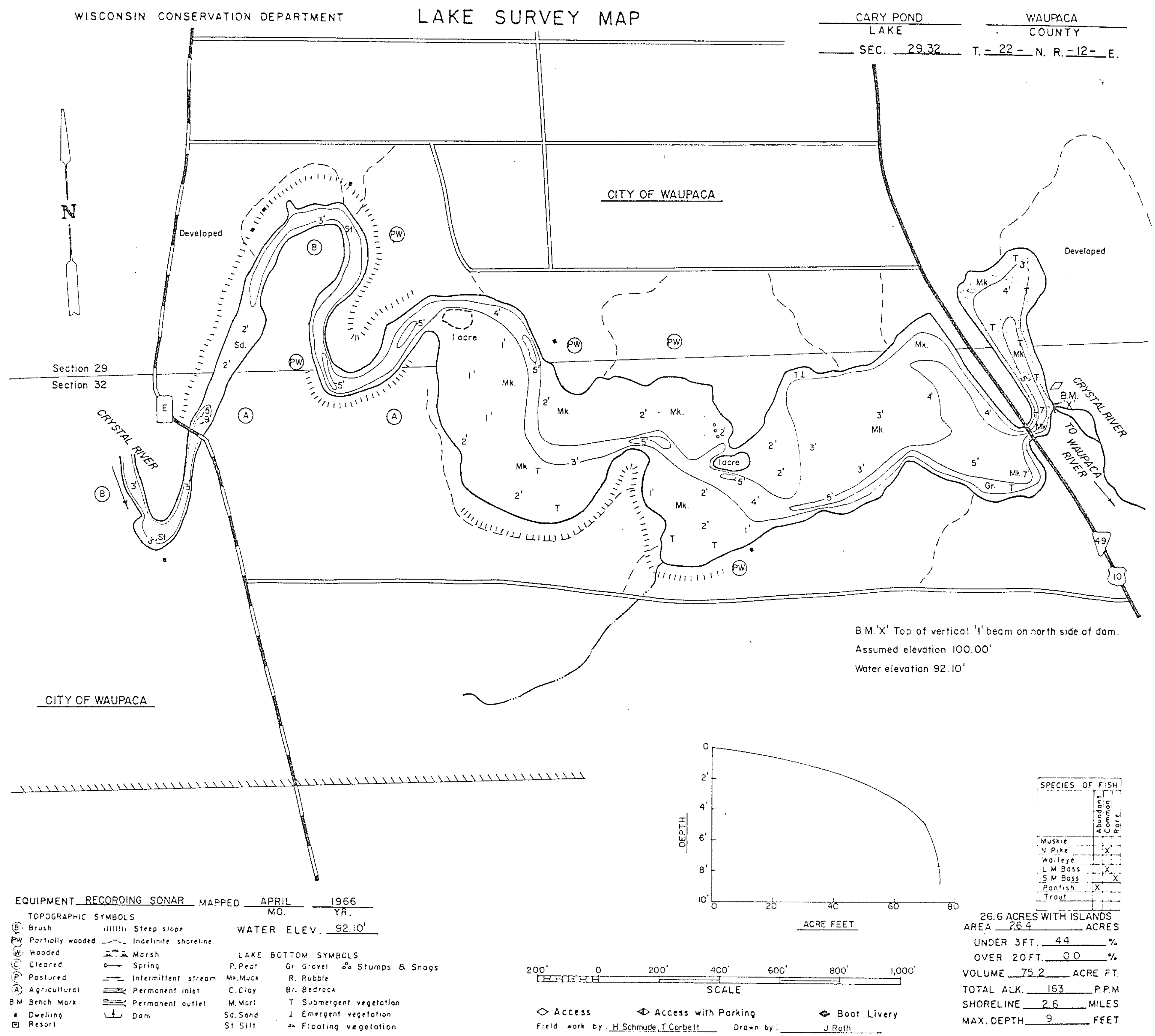

WISCONSIN CONSERVATION DEPARTMENT
LAKE SURVEY MAP
CARY POND LAKE
WAUPACA COUNTY
SEC. 29,32 T. - 22 - N. R. -12- E.
CITY OF WAUPACA
Developed
Section 29
Section 32
CRYSTAL RIVER
TO WAUPACA RIVER
1 acre
B.M. 'X' Top of vertical 'I' beam on north side of dam.
Assumed elevation 100.00'
Water elevation 92.10'
DEPTH
ACRE FEET
SPECIES OF FISH
Abundant
Common
Rare
Muskie
N. Pike
Walleye
L M Bass
S M Bass
Panfish
Trout
26.6 ACRES WITH ISLANDS
AREA 26.4 ACRES
UNDER 3FT. 44 %
OVER 20FT. 0.0 %
VOLUME 75.2 ACRE FT.
TOTAL ALK. 163 P.P.M.
SHORELINE 2.6 MILES
MAX. DEPTH 9 FEET
SCALE
Access
Access with Parking
Boat Livery
Field work by: H. Schmude, T. Corbett
Drawn by: J. Roth
EQUIPMENT RECORDING SONAR MAPPED APRIL MO. 1966 YR.
WATER ELEV. 92.10'
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
BM Bench Mark
Dwelling
Resort
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
LAKE BOTTOM SYMBOLS
P. Peat
Mk. Muck
C. Clay
M. Marl
Sd. Sand
St. Silt
Gr. Gravel
R. Rubble
Br. Bedrock
Stumps & Snags
T Submergent vegetation
Emergent vegetation
Floating vegetation

Figure 1

Cary Pond Watershed
Waupaca County

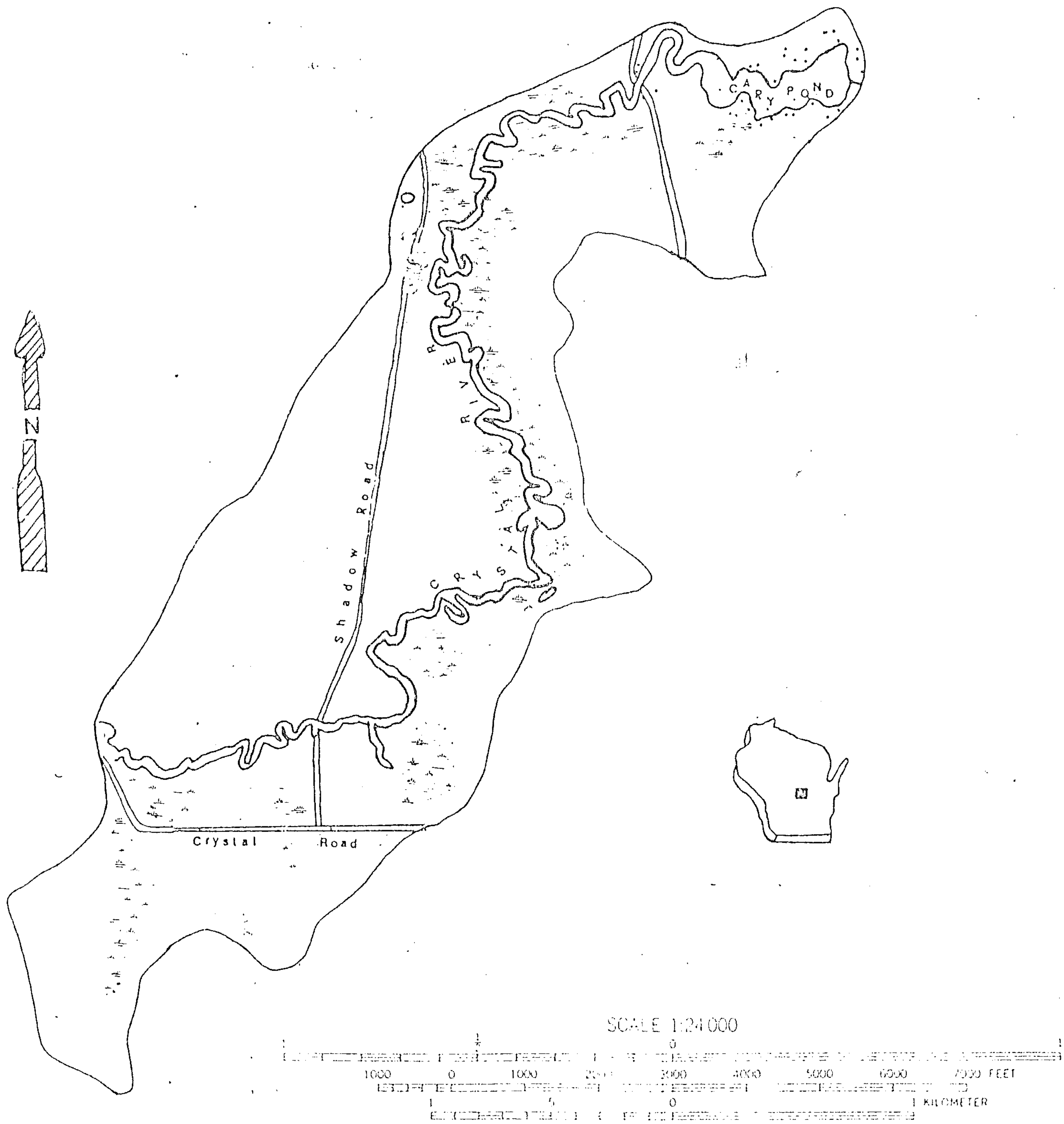
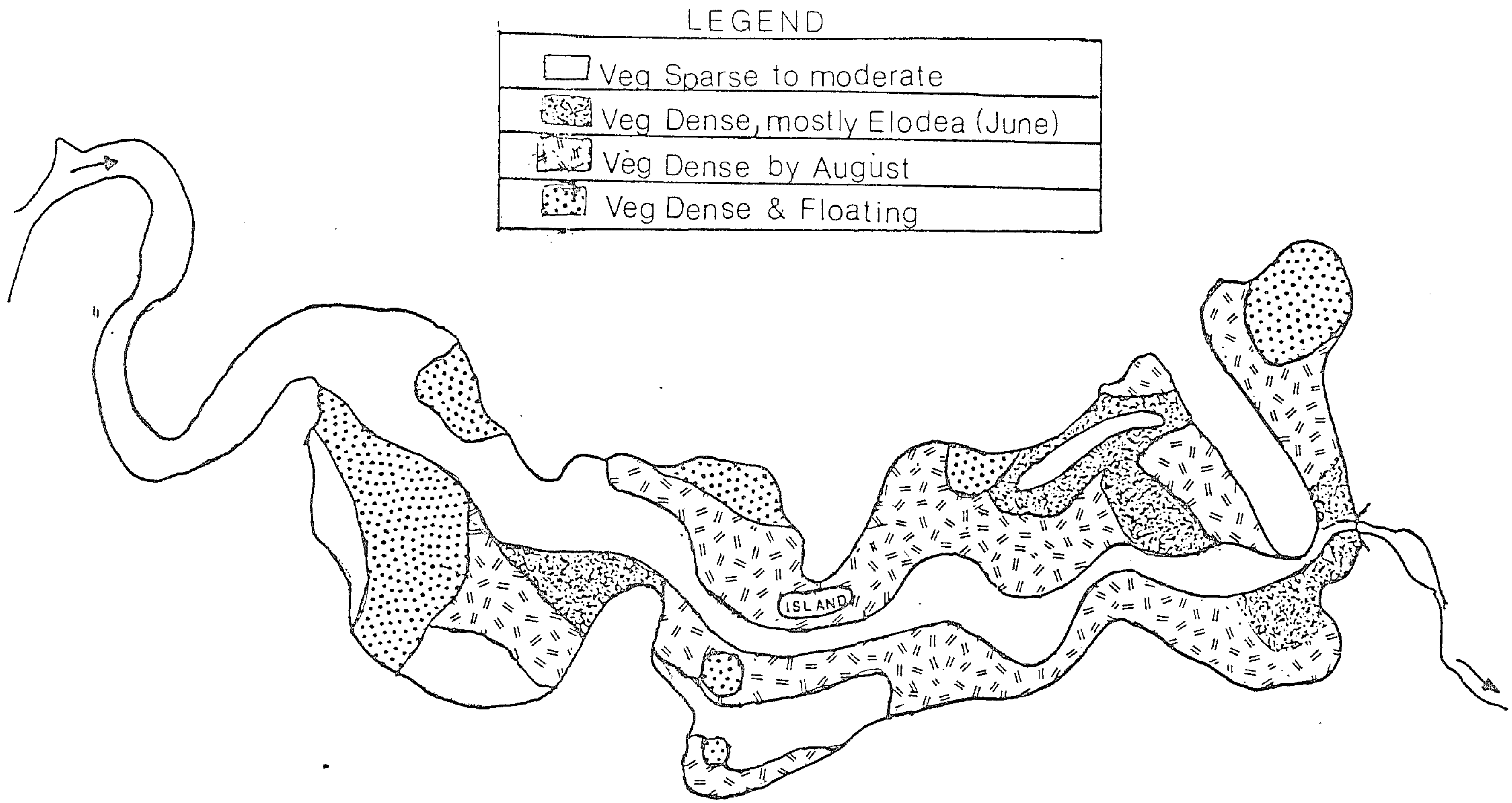


Figure 2



Macrophyte Communities in Cary Mill Pond

Figure 3:

File

CORRESPONDENCE/MEMORANDUM — STATE OF WISCONSIN

LMD Headquarters

Date: December 3, 1980 File Ref: 3120

To: Central Office (Russ Dunst ILR/4)

From: Tim Rasman

Subject: Cary Millpond - Waupaca County Management Plan

The district has several comments regarding the Cary Millpond management plan submitted by the Bureau of Inland Lake Renewal.

Our major concern involves the ramifications of drawdown. The outlet dam is used to generate electricity, reimbursing the local electric people will have to be considered in the total cost of this option. District water regulatory personnel submitted to Central Office on December 2, 1980 recommended water levels for Cary Millpond. Once agreement is reached, after the hearing process, any change in water level will have to be considered in the final management plan. Public input to this proposed water level change could take some time.

Concern about the adverse impacts of aquascreen should be expanded. The potential for disturbing spawning and nursery grounds by placing and removing the material should be mentioned. A permit under Chapter 30 may be needed to place the aquascreen.

The cost of chemically treating Cary Millpond for aquatic nuisance control should be mentioned under disadvantages.

TR:ds

cc: Ron Fassbender
Mike Primising
Walt Naab
Dave Hildreth

CORRESPONDENCE/MEMORANDUM — STATE OF WISCONSIN

Date: December 3, 1980

File Ref: 3560

To: Tim Rasman

From: R. L. Fassbender RLF

Subject: Cary Pond

Comments as follows:

p 5. Drawdown -

a. Selbig says sediment consolidation is not realistic for permanent results- remember his discussion on Machickanee Pond?

b. Drawdown may adversely affect H_20 Quality downstream-remember your concerns at Machickanee.

c. Foundry owner - Mike Shanek will not in all probability go for drawdown. He needs more power now than he can generate and has opposed our attempts to set water levels.

d. Permits would be required for Bulkhead Repair in addition to drawdown.

e. Cost may not be low if you have to pay Shanek for power.

p 6. Bottom Coverings

a. Permits required

b. What happens to food production, fish spawning, etc. with this stuff?

c. How do you swim on plastic nets?

p. 8.Dredging

a. You are still going to get weeds if mean depth is only 5'!!

b. Wetland disposal sites are out!

c. Solid waste and WPDES permits may be required for dredging because Arsenic was used in the 1950's.

d. COEngineers permits are required only for discharge into wetlands - not dredging per se!

e. Costs are way low if it must be put into some type of confined-engineered solid waste site.

Why don't they just mass produce these things and mail out to all lake districts. Only change would be cost of dredging on each project.