George Lake Rehabilitation & Protection District
Planning Grant #1006-1

Updated Feasibility Study
Core Sample Results
Water Usage Ordinance

Submitted to the Department of Natural Resources
Dennis Bloomquist, Project Chairperson

Final Report Compiled by Marianne Giannis
6/30/94

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Section One - Grant Application Process

Summary - *The purpose of this 1991 Wisconsin Lake Management Planning Grant #1006-1 is listed below:*

A) Updating of plan developed from 1978 Feasibility Study with new cost data and verification of original findings.
B) Determination of whether the original disposal sites for sediment are still available along with lab and field tests of sediments and the disposal sites.
C) Publication and dissemination of the plan to district residents, data reporting format to be worked out in consultation with Bob Wakeman, DNR district contact.
D) Legal advice to draft a lake usage ordinance for the District.

WISCONSIN LAKE MANAGEMENT PLANNING GRANT AWARD #1006-1

GEORGE LAKE, KENOSHA COUNTY

I. Background & Chronology

II. Sediment Testing Methodology & Results

III. Lake Usage

IV. Conclusions & Next Steps

V. Grant Costs

I. In 1978 the George Lake Inland Lake Rehabilitation & Protection District engaged Environmental Resource Assessments of Madison, WI and Aquatic Biologists of Fond Du Lac, WI to conduct a feasibility study of the Lake and to make an analysis of options available. The study addressed the Watershed as to Nutrient loading, Precipitation, Surface Water Monitoring, and Water quality. No parcel by parcel survey was taken nor recommendations made as to ways to diminish nutrient & sediment inflow to the lake at the source. The conclusion was that, although the inflow was low during the drought at the time of the samplings, "the construction of a small siltation basin in the swamps that feed the two inlets would remove a considerable proportion of the sediment and nutrients from these waters before they enter the lake." The study further addressed Ground Water as to Levels, Water Quality, Dissolved Oxygen and Temperature, and Permeability. Although Phosphorus levels were noted as "moderately high" especially at one of the sites, and that the lake was a "perched lake" (ground water enters the lake only during the early spring when surface water is also entering the lake. During the rest of the year lake water apparently is recharging the ground water system.), no problems requiring action to protect the lake or public health were noted. The study further addressed Inlake as to Water Chemistry, Dissolved Oxygen, Transparency, Chlorophyll a, Diurnal Variations, Sediment Studies, Bacteriological Studies, and a Macrophyte Survey. The lake was found to be "basic and hard" with moderate to high phosphorus levels in the water and the report commented that "Much of the phosphorus is not readily available for the plant and algae growth and it may be that some of it is precipitating with calcium carbonate to become incorporated into the sediments." Dissolved oxygen levels were determined to be "very good" but subject to wide swings in seasonal variation. Transparency was low attributed to silt and algae. There was an algae bloom during the testing period and chlorophyll a levels reacted normally. No Diurnal variations were noted. The sediment studies were restricted to a mapping of the sediment layer and determining its characteristics and volume. It was determined that the lake contained 315 acre feet of flocculent sediment and 599 acre feet of consolidated sediment for a total of 914 acre feet of sediment. No chemical analysis of the sediments was undertaken due to budget constraints. The bacteriological studies found no fecal colonies in either the lake or well samples. The machrophyte study identified heavy infestation with as much as 58% of the surface water having dense growth.

A discussion of alternative lake management techniques identified "weed cutting, chemical control, dredging, siltation basins and sewer extensions." note (All dwellings in the immediate area (but not the entire watershed) are now connected to sewers).

At each annual meeting a general discussion as to the next year's weed control program has taken place. As the method of weed control has been a contentious issue with chemical, weed cutting, and doing nothing having all been tried over the years, and that this item was the largest expenditure in the annual budget, it was determined at the 1990 meeting to explore a more or less permanent solution to the problem.

A review of the 1978 feasibility study determined that, because of costs, an evaluation of the chemical composition of the sediment was not carried out and that to evaluate the feasibility and costs of any sediment removal program this information was critical. In August 1990 the annual meeting therefore approved the application for a Planning Grant from the Wisconsin DNR be made to determine the toxic qualities of the sediment to update and further the knowledge base of the lake. The chronology of the grant request is contained in exhibit A.

II. Sediment Testing Methodology & Results

After DNR approval of the methodology, sites, and chemicals to be tested, Aquatic Biologists was selected as low bidder for the project from among seven firms solicited with firm quotations from two. Core samples were taken through the ice at the four designated locations in March of 1991. The samples were analyzed by ENVIROSCAN of Rothschild, WI and the results are incorporated in exhibit b. We are advised that all samples showed levels below or far below RCRA limits. The conclusion drawn therefore is that should dredging be determined to be economically feasible, the chances of a dredging permit being denied because of sediment contamination is extremely low and that the contents of this analysis should serve as the basis for "sediment analysis" in any application for a dredging permit.

III. Water Usage

No funds were required for the preparation of the lake usage ordinances as originally requested due to previous arrangements for legal review and the extension of the issue past the grant deadline. Three proposed ordinances have been

prepared and will be presented to the electors at a special meeting in April 1990 called specifically for the purpose of resolving the issue.

IV. Conclusions & Next Steps

The primary purpose of the grant application has been satisfied by the taking, evaluating, and recording of the chemical contents of the lake sediment within the agreed DNR guidelines. The results indicate that the possibility of being allowed to remove and dispose of sediment is an addition to surrounding farmland disposal is plan. The dredging project explored in the original study calls for approximately 11% removal of the lake sediments. Discussions with contractors has pointed out that the removal of sediments out to a 15 foot sand bottom would increase the dredging costs by as much as 50% due to the use of a self contained hydraulic process rather than a cable supported hydraulic system required for deeper dredging. In the opinion of this commissioner, the dredging option is of little value without an in place watershed siltation management plan. Bids were not solicited to determine actual costs. Conversations with contractors produced ranges from $200,000 to as much as $500,000 to remove the approximately 150 acre feet of sediment contained from the shoreline in front of dwellings and public areas to a depth of 15 ft. As the need for a watershed management plan was determined to be necessary prior to undertaking any sediment removal project, the payment of fees for in-depth analysis and bids on sediment removal were determined to be premature. The use of sediment removal as a solution to the excessive macrophyte problem should therefore await the results and implementation of a sediment control plan for the watershed as it may not considered a viable economic alternative if current sedimentation rates are continued after dredging. Frankly the lake would simply fill in again prior to the payback for the dredging project.

V. Grant Costs

Aquatic Biologists $4,500

Core sampling and sediment sample analysis.

Copying & Mailing of Report (Estimated 15 pages X .075 X 300 copies X $1.00 each mailing costs = $708)

Bank Fees $100 less interest $64.96 net $35.04

Costs $4,500 + $708 + $35.04 = $5,243.04

State Share 75% = $4,051.31

Lake Share 25% = $1,017.31

Prepared: D. W. Silbernagel
Commissioner - George Lake District
March 1, 1982

Section Three - Core Samples

Summary - *Core samples were taken to determine if hazardous levels of metals and pollutants are present in the lake's sediment. If present, dredging would not be an available option for aquatic weed control, improving water quality, and deepening the lake. The disposal of removed sediments to a local farm field cannot be done if there are metals and other pollutants present in amounts exceeding DNR limits. The test results showed that no levels exceeded the DNR limits and dredging still remains to be an option for George Lake.*

Testing Procedures

Core samples were taken by Aquatic Biologists, inc. 313957 Summit Court, Fond du Lake, Wisconsin 54935 (414) 921-6827 The samples were tested by Enviroscan 303 West Military Road, Rothschild, Wisconsin 54474 (715) 359-7226. All analyses were done in accordance with EPA methods (EPA- 600/4-79-020, March 1983 or SW-846, Third Edition

Location & Date of Core Samples

Core samples were taken in March 1991 at four locations of the lake.
These locations are marked on Map 3-9

A) At inlet to lake in three feet of water. No hard bottom found as indicated on map.
B) Located in northeast bay.
C) Deepest area in George Lake.
D) Located in front of dam

Samples were taken only to 15' with the intention that if dredging was considered, a partial removal of sediment down to 15' would be 50% less than dredging down to the hard bottom at 30'-32'.

Items Tested

Refer to pages 3-2 to 3-7 for test results.
Samples were tested for :

Arsenic
Barium
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Nickel
Selenium
Zinc
Mercury
TOC
Cyanide
Tot. Grease/Oil
Kjeldahl N
Ammonia N
Nitrate N
Nitrite N
Total Solids
Total Ash
Settleability

ANALYTICAL REPORT

ENVIROSCAN

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

CUST NUMBER: GEORGE LAKE
SAMPLED BY: Client
DATE REC'D: 03/06/91
REPORT DATE: 04/02/91
APPROVED BY: KMC KMC

	Units	Detection Limit	101-12-1CC
Arsenic	µg/g	8.5	11.9
Barium	µg/g	0.42	107.
Cadmium	µg/g	0.42	X
Chromium	µg/g	0.85	7.75
Copper	µg/g	2.1	29.1
Iron	µg/g	0.42	17,443.
Lead	µg/g	6.4	55.9
Manganese	µg/g	0.42	792.
Nickel	µg/g	1.3	13.0
Selenium	µg/g	13.	X
Zinc	µg/g	0.42	80.4
Mercury	µg/g	0.085	X
TOC	µg/g	-	402.
Cyanide	µg/g	0.85	1.67
Tot. Grease/Oil	µg/g	13.0	225.
Kjeldahl N	µg/g	296.0	9,789.
Ammonia N	µg/g	191.0	1,089.
Nitrate N	µg/g	14.	X
Nitrite N	µg/g	14.	X
Total Solids	%	100.	23.6
Total Ash	%	100.	80.6

Analytical No.: 47051

X = Analyzed but not detected.
Results calculated on a dry weight basis.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

ANALYTICAL REPORT

ENVIROSCAN

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

CUST NUMBER: GEORGE LAKE
SAMPLED BY: Client
DATE REC'D: 03/06/91
REPORT DATE: 04/02/91
APPROVED BY: KMC

	Units	Detection Limit	101-11-1AC	101-11-2AG
Arsenic	µg/g	7.8	X	7.33
Barium	µg/g	0.44	48.4	69.8
Cadmium	µg/g	0.39	X	X
Chromium	µg/g	0.87	7.98	11.7
Copper	µg/g	2.2	14.7	21.3
Iron	µg/g	0.44	13,949.	55,556.
Lead	µg/g	5.8	11.0	X
Manganese	µg/g	0.44	181.	583.
Nickel	µg/g	1.3	11.5	20.1
Selenium	µg/g	12.0	12.9	X
Zinc	µg/g	0.44	45.8	67.9
Mercury	µg/g	0.073	X	X
TOC	µg/g	-	184.	161.
Cyanide	µg/g	0.87	1.61	1.92
Tot. Grease/Oil	µg/g	13.0	964.	653.
Kjeldahl N	µg/g	305.0	4,837.	8,225.
Ammonia N	µg/g	196.0	191.	436.
Nitrate N	µg/g	12.	X	X
Nitrite N	µg/g	12.	X	X
Total Solids	%	100.	22.9	25.9
Total Ash	%	100.	77.6	78.4
Analytical No.:			47045	47046

X = Analyzed but not detected.
Results calculated on a dry weight basis.

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

3-3

ANALYTICAL REPORT

ENSCAN

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

CUST NUMBER: GEORGE LAKE
SAMPLED BY: Client
DATE REC'D: 03/06/91
REPORT DATE: 04/02/91
APPROVED BY: KMC

	Units	Detection Limit	101-11-38C	101-11-48G
Arsenic	µg/g	8.7	X	10.0
Barium	µg/g	0.49	91.7	116.
Cadmium	µg/g	0.53	X	X
Chromium	µg/g	1.1	4.69	X
Copper	µg/g	2.4	9.71	9.64
Iron	µg/g	0.49	4,854.	5,529.
Lead	µg/g	7.9	X	X
Manganese	µg/g	0.49	457.	637.
Nickel	µg/g	1.5	6.80	7.37
Selenium	µg/g	16.	X	X
Zinc	µg/g	0.49	25.1	29.3
Mercury	µg/g	0.12	X	X
TOC	µg/g	-	385.	200.
Cyanide	µg/g	0.97	3.73	3.10
Tot. Grease/Oil	µg/g	15.0	82.8	860.
Kjeldahl N	µg/g	340.0	2,282.	11,391.
Ammonia N	µg/g	218.0	732.	1,057.
Nitrate N	µg/g	17.	X	X
Nitrite N	µg/g	17.	X	X
Total Solids	%	100.	20.6	19.0
Total Ash	%	100.	80.2	70.4
Analytical No.:			47047	47048

X = Analyzed but not detected.
Results calculated on a dry weight basis.

3-4

ANALYTICAL REPORT

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

CUST NUMBER: GEORGE LAKE
SAMPLED BY: [illegible]
DATE REC'D: 03/06/91
REPORT DATE: 04/02/91
APPROVED BY: KMC

	Units	Detection Limit	101-11-SDC
Arsenic	µg/g	4.6	X
Barium	µg/g	0.26	87.6
Cadmium	µg/g	0.26	X
Chromium	µg/g	0.51	1.76
Copper	µg/g	1.3	2.82
Iron	µg/g	0.26	2,371.
Lead	µg/g	3.8	X
Manganese	µg/g	0.26	533.
Nickel	µg/g	0.77	5.20
Selenium	µg/g	7.7	X
Zinc	µg/g	0.26	6.84
Mercury	µg/g	0.051	X
TOC	µg/g	-	195.
Cyanide	µg/g	0.51	0.425
Tot. Grease/Oil	µg/g	7.7	86.5
Ejeldahl N	µg/g	179.	2,615.
Ammonia N	µg/g	115.	197.
Nitrate N	µg/g	8.2	X
Nitrite N	µg/g	8.2	X
Total Solids	%	100.	39.1
Total Ash	%	100.	93.1
Analytical No.:			47049

X = Analyzed but not detected.
Results calculated on a dry weight basis.

Analyses conducted in accordance with Enviroscan Quality Assurance Program.

3-5

ANALYTICAL REPORT

ENVIROSCAN

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

CUST NUMBER: GEORGE LAKE
SAMPLED BY: Client
DATE REC'D: 03/06/91
REPORT DATE: 04/02/91
APPROVED BY: KMC

	Units	Detection Limit	101-11-6DG
Arsenic	µg/g	5.7	X
Barium	µg/g	0.32	106.
Cadmium	µg/g	0.32	X
Chromium	µg/g	0.63	1.48
Copper	µg/g	1.6	3.80
Iron	µg/g	0.32	1,802.
Lead	µg/g	4.8	X
Manganese	µg/g	0.32	630.
Nickel	µg/g	0.95	3.17
Selenium	µg/g	9.5	X
Zinc	µg/g	0.32	7.92
Mercury	µg/g	0.06	X
TOC	µg/g	-	145.
Cyanide	µg/g	0.63	0.570
Tot. Grease/Oil	µg/g	9.5	47.5
Kjeldahl N	µg/g	222.	2,934.
Ammonia N	µg/g	143.0	255.
Nitrate N	µg/g	10.	X
Nitrite N	µg/g	10.	X
Total Solids	%	100.	31.6
Total Ash	%	100.	92.6

Analytical No.: 47050

X = Analyzed but not detected.
Results calculated on a dry weight basis.

3-6

All analyses conducted in accordance with Enviroscan Quality Assurance Program.

SETTLEABILITY

Sample #	101-11 1AC	101-11-2AG	101-11-3BC	101-11-4BG	101-11-5DC	101-11-6DG	101-12-1CC
Analytical #	47045	47046	47047	47048	47049	47050	47051
Time (Mins.)	Milliliters Settled						
0	0	0	0	0	0	0	0
10	16	6	4	6	4	7	4
25	23	10	7	10	12	19	4
45	28	14	10	12	18	25	7
65	30	16	11	13	20	29	7
95	30	18	13	13	20	31	8
1010	32	20	17	14	32	38	8
1190	32	20	17	14	32	38	8

Samples prepared with 1:1 mix with lake water as requested.

REQUEST FOR SERVICES

303 W. MILITARY RD. ROTHSCHILD, WI 54474 1-800-338-SCAN

CLIENT INFORMATION

Name: James A Gohlen
Company: Aquatic Biologists Inc.
Address: N-693 Pine Rd
Brokaw, WI 54414
Phone: (715) 499-3001
P.O. # / Project #: George Lake
Quote / Reference #:
Note: Terms and conditions printed on back apply.

Turnaround Time
☒ Normal
☐ Rush
Date Needed: 3 weeks April 1st
(Preapproved by Lab)

Sample Type (Check all that apply)
☐ Groundwater
☐ Wastewater
☐ Soil
☐ Solid Waste
☐ Oil
☒ Other: Sediment Samples

Sample Handling
☒ Nonhazardous ☒ Refrigerate
☐ Flammable ☐ Work in Hood
☐ Skin Irritant ☐ Wear Gloves
☐ Highly Toxic
☐ Other (specify)

ANALYTICAL REQUESTS
(use separate sheet if necessary)

LAB USE ONLY	DATE	TIME	No. of Containers COMP	No. of Containers GRAB	SAMPLE ID	As, Ba, Cd, Cr, Cu, Fe, Pb, Mn	Ni, Se, Zn	Hg, TOC	TKN, Ammonia, Nitrate, Nitrite	% Solids, Vol Solids, SETTLEABILITY	REMARKS
08047045 ✓	3-4-91	15:30	X		101-11-1AC	X	X	X	X	X	2 liters
08047046 ✓		15:30		X	101-11-2AG	X	X	X	X	X	2 liters
08047047 ✓		17:30	X		101-11-3BC	X	X	X	X	X	2 liters
08047048 ✓		17:30		X	101-11-4BG	X	X	X	X	X	1 liter
08047049 ✓		18:40	X		101-11-5DC	X	X	X	X	X	2 liters
08047050 ✓		18:40		X	101-11-6DG	X	X	X	X	X	1 liter
08047051 ✓		19:30	X		101-12-1CC	X	X	X	X	X	2 liters
	3-5-91	--		X	101-13-1	(For Settleability)					3 liters

AQUATIC

CHAIN OF CUSTODY RECORD

SAMPLERS (Signature): James A Gohlen

RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)
James A Gohlen	3/6/91	
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED BY (Signature)
RELINQUISHED BY (Signature)	DATE/TIME	RECEIVED FOR LABORATORY BY (Signature): James L. Sulkowski — DATE/TIME: 3/6/91 2:55 pm

Del'v (Hand) Comm.
Ship. Cont OK? Y N N/A
Rec'd Refrig ? Y N N/A
Seals OK? Y N N/A
Samples leaking? Y N N/A
Comments.

3-8

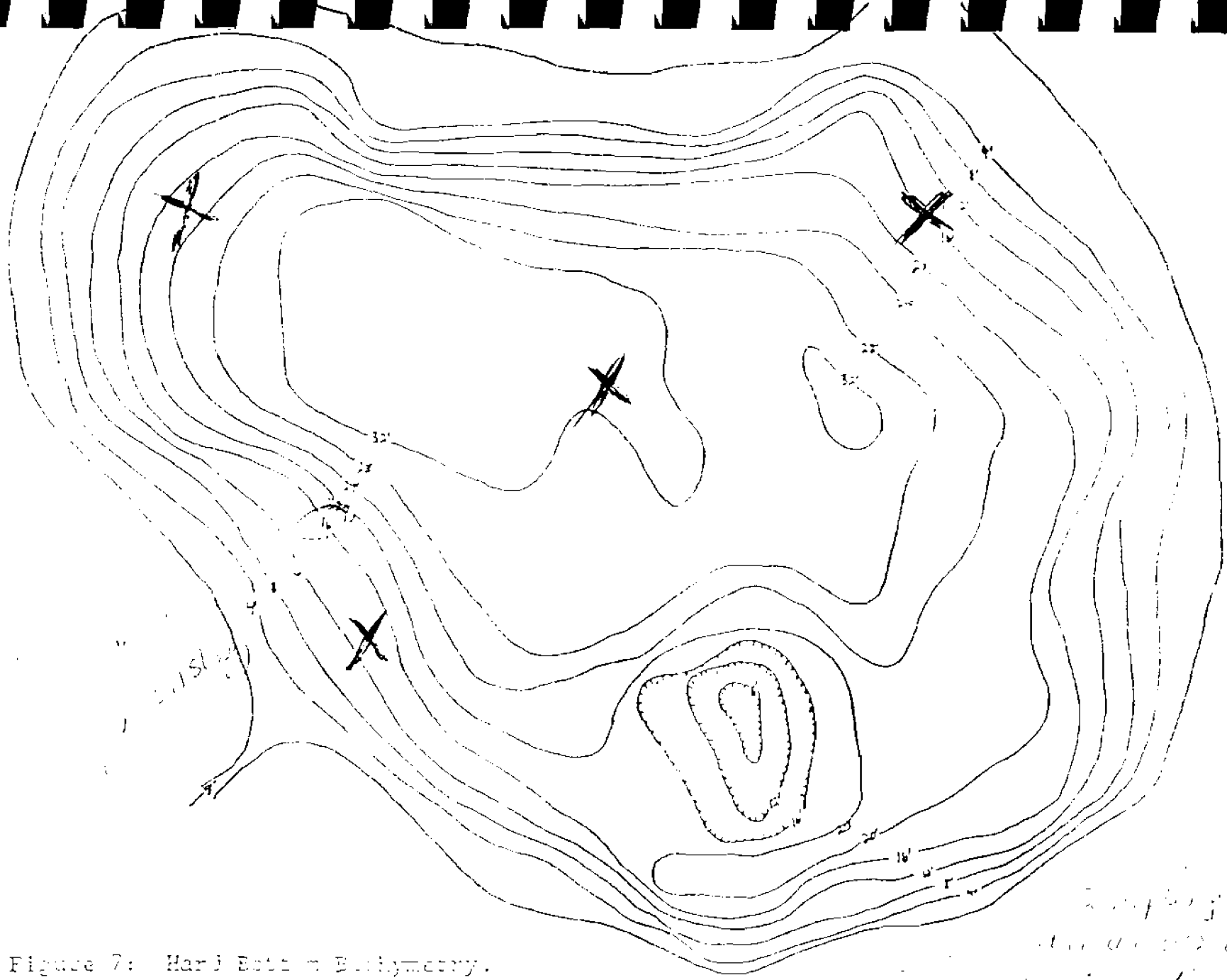

Figure 7: Hard Bott m Bathymetry.

ENVIROSCAN

April 2, 1991

Aquatic Biologists, Inc.
N-643 Pine Road
Birnamwood, WI 54414

Attn: Jim Goheen

Re: GEORGE LAKE

Please find enclosed the analytical results for the sample received March 6, 1991.

All analyses were done in accordance with EPA Methods (EPA-600/4-79-020, March, 1983 or SW-846, Third Edition). The results are reported on a dry weight basis.

The chain of custody documents are enclosed.

If you have any questions about the results, please call. Thank you for using Enviroscan Corp. for your analytical needs.

Sincerely,

Enviroscan Corp.

Karla M. Coenen

Karla M. Coenen
Analytical Chemist

3-10

501 West Midway Road Rothschild WI 54474 (715) 359-7211
An Affiliate of the Black Clawson Co.

Aquatic Biologists, inc.
Specialists in Lake & Pond Management Services & Supplies

313957 Summit Court
Fond du Lac, WI 54935
(414) 921-6827

Kathi Kramasz
Water Management Specialist
Wis. Dept. of Natural Resources
Box 12436
Milwaukee, WI 53212

April 4th, 1991

Dear Kathi,

Here are the results from George Lake sediment tests (File ref: 3500) conducted by Aquatic Biologists, Inc. and Envirosean. Sample numbers correspond to the following sites.

101-11-1AC Composite sample, 3ft to 13ft 9in, site A
101-11-2AG Grab sample @ 13ft 9in to 15ft 8in, site A

101-11-3BC Composite sample, 6ft to 15ft, site B
101-11-4BG Grab sample, 15ft to 18ft, site B

101-12-1CC Grab sample, 14ft to 17 ft, site C *

101-11-5DC Composite sample, 5ft to 10ft 2in, (hard bottom) site D
101-11-6DG Grab sample, 12 ft 2in to 14 ft, in hard bottom, site D

* no grab sample taken due to depth deeper than planed dredging.

Site A --- At inlet to lake in three feet of water. No hard bottom found as indicated on map.

Site B --- Located in northeast bay.

Site C --- Deepest area in George Lake.

Site D --- Located in front of dam.

If you have any questions about the results or methods of obtaining the samples, please give me a call.

Sincerely,

James A. Goheen

James A. Goheen
Aquatic Biologists, Inc.

715-449-3001

3-11

ENVIROSCAN

September 18, 1991

Aquatic Biologists, Inc.
N-643 Pine Rd.
Birnamwood, WI 54414

Attn: Jim Goheen

Re: GEORGE LAKE

Recently, you requested that samples from the George Lake project be analyzed for arsenic in a TCLP extract. In reviewing the data from our report of April 2, 1991, it seems that this request would be a waste of time and resources. Sample 101-12-1CC (Analytical No. 47054) had the highest arsenic detect at 11.8 mg/kg (ppm) on a dry weight basis. Since the sample was only 23.6% solids this equates to 2.8 mg/kg on a received basis.

11.8 mg/kg (dry wt.) X 0.236 = 2.78 mg/kg (wet wt.)

Since the TCLP extraction involves a twenty-fold dilution (75 grams to 1500 ml) of the wet sample and assuming that all the arsenic present is leached, the maximum concentration of arsenic in the leachate can only be 0.139 mg/l.

2.78 mg/kg X 1/20 = 0.139 mg/l

This is far below the RCRA limit of 5.0 mg/l and therefore non-hazardous based on arsenic content.

Today, I discussed this to Mr. Ken Hein of the Wisconsin DNR and he agreed. He requested that you submit the above information and calculations to satisfy the request of Mr. Rob McLennan dated June 28, 1991. If you have any further questions or if I can be of further help, please call.

Sincerely,

Enviroscan Corp.

James R. Salkowski

James R. Salkowski
Laboratory Manager

3-12

363 West Military Road Rothschild, WI 54474 (715) 359-7211
An Affiliate of the Black Clawson Co.

Aquatic Biologists, inc.

313957 Summit Court
Fond du Lac, WI 54935
(414) 921-6827

Specialists in Lake & Pond Management, Services & Supplies

Robert McLennan — Oct. 2nd, 1991
Wisconsin Department of Natural Resources
P.O. Box 12436
Milwaukee, WI 53212

Dear Robert,

We have been asked to take care of the additional testing of sediment samples for the George Lake Association. In reviewing the request for a TCLP leachate extraction with the chief chemist at enviroscan it was his opinion that the testing would not be necessary. We then talked to Ken Hein and confirmed that the testing would not be required. I am forwarding a letter from Jim Salkowski of Enviroscan explaining the reasons that he discussed with Ken Hein.

If there are any further questions regarding this issue please give me a call.

Sincerely,

James A. Goheen
Aquatic Biologists, Inc.

715-449-3001

cc: Dennis Bloomquist

3-13

Bloomquists'
P O. Box 541 — Bristol, WI 53104

R. A. Smith & Assoc. Inc.
17400 W. North Ave.
Brookfield, Wi. 53004

1-10-91

Dear Messrs. Doneux, Johnson:

Re: George Lake Rehabilitation Plan
Request for Proposal

I am writing to you upon direction of the Board of the George Lake Inland Lake Rehabilitation & Protection District. We have been advised by the Wisconsin Department of Natural Resources that our application for a planning grant has been approved. (See attachment grant #1006-1)

In accordance with the grant request (copy of funding request also enclosed), we are specifically interested in updating a 1978 lake study (summary of which is enclosed) which recommended a dredging operation alternative be undertaken along with other sediment restriction procedures. More specifically, we are interested in engaging the services of a professional consultant to assist us in 1. determining the proper methodology acceptable to the DNR in sampling the sediment of both the lake and the disposal sites. 2. arrange for the taking of the referenced samples, 3. interpretation of the findings of the State Lab with regards its impact on the dredging plan.

We anticipate the following schedule: Feb.-Mar. 1991 selection of consultant, Apr.-May methodology determination and sampling, Jun.-Jul. lab work & analysis, Aug. incorporation of results into study and dissemination. We would appreciate your reply by 2-1-91 on whether you would be interested in participating with us in this project and based on the above, an estimate of your costs.

We are available to discuss this with you. Please contact Messrs. Nolan (414-857-2440), Bloomquist (414-857-2737), Mallman (414-857-7279). Please direct correspondence to Mr. Tim Nolan 18627 102nd Str. Bristol, Wi. 53104.

D. W. Bloomquist
10135 195th Ave.
Bristol, Wi. 53104

3-14

Bloomquists'
P.O. BOX 541 BRISTOL, WI 53104
414/857-2737
To Order Merchandise 1-800-279-0835

Aquatic Biologists, Inc. 1/30/91
Jim Goheen
N-643 Pine Road
Birnamwood, Wi. 54414

Re: George Lake Planning Project-Kenosha County

Per our meeting this week with you Messrs. Mallman, Nolan and myself I would offer the following:

A. Per our original RFB we are most interested in completing the study performed by your company in the late 70's whereby the feasibility study made a number of recommendations and/or alternatives to our continuing phosphate and siltation problems. In order to complete the study we require your bid for services to include: 1. determine with the DNR the proper methodology to use in taking and analyzing core samples of the lake sediment and proposed disposal sites to conform with the requirements of any future dredging project which was one of the alternatives in the original study. 2. performance of the core sampling and analyzation in conformance with the DNR guidelines with the specific requirement that the results are acceptable to the Wisconsin DNR as the basis for a "OK to dredge or NO dredge" decision as it applies to the question of sediment content and disposal requirements.

B. We would also be interested in your updating the original study with a new mapping of the lake as to the contour of the "hard bottom" and the present dept of sediment throughout the lake for comparison with the 78 study. This request is within the scope of the 90-91 Planning Project, however, we feel it is separate from the written specifications outlined in A above and therefore should be treated separately.

We therefore would ask that any bid from your company be presented to the board of the George Lake PILP&R District and include a response to only A above, only B above and the cost of A & B done at the same time. Per a recent telephone conversation, I will meet with you and the DNR in Milwaukee at 10:30AM in Milwaukee Feb. 6th.

D. W. Bloomquist (Treas.) George Lake PILP&RD

cc: Messrs. Nolan, Mallman, Hafferkamp

3-16

Aquatic Biologists, inc.
313957 Summit Court
Fond du Lac, WI 54935
(414) 921-6827
Specialists in Lake & Pond Management Services & Supplies

ACCOUNT/P.O. GEORGE LAKE

DREDGING PROJECT, SEDIMENT SAMPLING

THIS AGREEMENT, IS MADE BETWEEN AQUATIC BIOLOGISTS, INC., LOCATED AT 313957 SUMMIT COURT, FOND DU LAC, WISCONSIN 54935 (HEREINAFTER CALLED "ABI") AND George Lake Public Inland Lake Protection and Rehabilitation District, (HEREINAFTER CALLED "CUSTOMER"), FOR AND IN CONSIDERATION OF THE MUTUAL COVENANTS HEREIN CONTAINED, THE PARTIES HERETO AGREE AS FOLLOWS:

1. AGREEMENT: ABI HEREBY AGREES TO PROVIDE SERVICES FOR THE PURPOSE OF SEDIMENT SAMPLING GEORGE LAKE FOR THE BENEFIT OF THE CUSTOMER, AND THE CUSTOMER HEREBY ACCEPTS SUCH SERVICES IN THE WATER AREA DESCRIBED AS FOLLOWS: GEORGE LAKE, KENOSHA COUNTY, WISCONSIN.

2. TERM OF AGREEMENT. THE TERM OF THIS AGREEMENT SHALL COVER THE START OF THE SERVICE AND CONTINUE UNTIL COMPLETION OF SEDIMENT SAMPLING, AND THE SUBMISSION OF SAMPLE DATA TO THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES, MILWAUKEE OFFICE.

3. SERVICES PROVIDED: ABI SHALL SUPPLY ALL NECESSARY LABOR, MATERIALS, EQUIPMENT, AND TECHNICAL ADVICE IN PROVIDING SEDIMENT SAMPLING SERVICE TO CUSTOMER. CUSTOMER SHALL PROVIDE A SUITABLE BOAT LAUNCHING SITE OR LAKE ACCESS DURING THE WINTER AND PAY FOR ANY APPLICABLE LAUNCHING FEES IF NECESSARY.

4. COST AND TERMS OF PAYMENT: THE COST TO THE CUSTOMER ON SERVICES SUPPLIED BY ABI SHALL BE 50% DOWN WITH PURCHASE ORDER OR PROJECT INITIATION AND 50% DUE NO LATER THAN 10 DAYS FOLLOWING COMPLETION OF AGREEMENT. TOTAL COST AS AGREED $4500.00.

5. PERMIT: NOT APPLICABLE

6. LIABILITY: ABI IS RESPONSIBLE FOR ITS OWN PERSONNEL DURING THE TERMS OF AGREEMENT.

7. WARNING SIGNS: NOT APPLICABLE.

8. CUSTOMER AUTHORIZATION: CUSTOMER REPRESENTS AND WARRANTS THAT THIS AGREEMENT HAS BEEN DULY AUTHORIZED BY THE CUSTOMER, AND THAT THE PERSONS EXECUTING THIS AGREEMENT HAVE THE AUTHORITY TO EXECUTE THIS AGREEMENT ON THE CUSTOMER'S BEHALF.

9. LIMITED WARRANTY: NOT APPLICABLE

3-18

10. MISCELLANEOUS: THIS AGREEMENT SHALL BE CONSTRUED UNDER AND IN THE COURTS OF THE STATE OF WISCONSIN. THIS AGREEMENT CONSTITUTES THE ENTIRE UNDERSTANDING BETWEEN THE PARTIES, AND IT MAY BE AMENDED ONLY IN WRITING BY THE PROPERLY AUTHORIZED REPRESENTATIVES, SUCCESSORS, AND ASSIGNS. THIS AGREEMENT SHALL WORK FOR THE BENEFIT OF AND BE BINDING UPON THE PARTIES HERETO, THEIR RESPECTIVE PERSONAL REPRESENTATIVES, SUCCESSORS, AND ASSIGNS.

IN WITNESS WHEREOF, THE PARTIES HEREUNTO ACCEPT THE TERMS AND CONDITIONS OF THE ABOVE, SIGNED

THIS 28th DAY OF February, 1991

FOR AQUATIC BIOLOGISTS, INC.

FOR GEORGE LAKE PILP&RD

Pd 2250.00

Check #1

3/4/91

STRAND
ASSOCIATES, INC

910 West Wingra Drive
Madison, Wisconsin 53715
(608) 251-4843

January 29, 1991

George Lake Inland Lake
Rehabilitation and Protection District
18627 102nd Street
Bristol, Wisconsin 53104

Attention: Mr. Tim Nolan

Re: George Lake Rehabilitation Plan
Request for Proposal

Dear Mr. Nolan:

Thank you for the opportunity to submit a proposal for the above referenced project. We are interested in working with the District on the lake rehabilitation project. However, in speaking with you and with Mr. Robert Wakeman of the Department of Natural Resources, it is our understanding that the scope of the sampling effort and the sample analysis has not been determined. Therefore, we do not feel comfortable submitting a proposal for this work.

The DNR indicated to us that the scope of the sampling effort would be determined according to Chapter NR 347 of the Wisconsin Administrative Code, which contains criteria for dredging projects. These requirements were updated in 1989 and include sampling and analysis requirements for compounds which could include up to 29 pesticides, herbicides, heavy metals, PCBs, and other compounds. Some of the analyses may be waived by the department based on previously submitted data. However, even if some of the analytical requirements were waived, the analytical costs for this project could still be quite high. Labor and equipment costs for sampling could vary considerably and exceed those budgeted by the District, depending on the sampling frequency required by the DNR to meet NR 347.

We are sorry that we are unable to submit a proposal at this time. We would be very happy to submit a proposal once the DNR has determined the scope of the sampling effort. If you have any questions, please do not hesitate to call.

Sincerely,

STRAND ASSOCIATES, INC.

Jane M Carlson

Jane M. Carlson
Project Engineer

3-20

001-972/JMC

STRAND
ASSOCIATES, INC

910 West Wingra Drive
Madison, Wisconsin 53715
(608) 251-4843

February 15, 1991

George Lake Inland Lake
Rehabilitation and Protection District
c/o Bloomquist's
10135 195th Avenue
Bristol, Wisconsin 53104

Attention: Mr. Dennis Bloomquist

Re: George Lake Rehabilitation Plan
Proposal for Sample Collection and Analysis

Dear Mr. Bloomquist:

The purpose of this letter is to follow up our recent telephone conversation regarding our proposed fee for the sediment sampling project. We propose to perform four cores to an average depth of eight feet, with samples retained every two feet for laboratory analysis. The analyses performed on each of the sixteen samples would be as described in the February 12, 1991 letter from Kathi Kramasz of the Department of Natural Resources (DNR). Our fee would include sediment sampling at the four locations shown in the DNR's letter, laboratory analysis of a maximum of sixteen samples, and preparation of a report documenting the methods used and the results of the sediment analyses. Ten copies of the report would be provided to the Lake District.

Our proposed fee for the above described scope of work is as follows:

Labor (field and office)	$5,200
Laboratory Fees	7,600
Equipment and other expenses	1,300
TOTAL	$14,100

The proposed fee would not be exceeded unless there is a change of scope agreed to by both parties or unless additional samples need to be analyzed. If more than sixteen samples need to be analyzed, for instance if there are many distinct stratifications in the sediments, additional sample analyses will be billed at $475 each.

This proposal does not include costs for sampling soils at the dredge disposal site or preparation of a permit application for dredging. We will be happy to

provide costs for these items if you wish. If you have any questions, please call. I will be in the office for much of the day Sunday if questions come up during your meeting.

Sincerely,

STRAND ASSOCIATES, INC.

Jane Carlson

Jane M. Carlson

cc: Michael Doran, P.E., SAI
001-972

3-22

STRAND
ASSOCIATES INC

Engineering driven by vision.
17400 West North Avenue
Brookfield, Wisconsin 53045-4496
414-786-1777 Fax 414-786-0826

Richard A. Smith, PE, President
Paul A. Johnson, PE
James W. Nicholson, PE
George F. Glocka, R.L.S.
Donald A. Yecke, M.A.
Steven R. Berg, PE
William C. Radle, PE
John C. Mills, PE
Gregory A. Kunz, R.L.S.

R. A. Smith & Assoc., Inc.
Engineers ■ Planners ■ Surveyors ■ Inspectors

March 4, 1991

Mr. Timothy Nolan
George Lake Protection and Rehabilitation District
18627 102nd Street
Bristol, WI 53104

Re: Proposal for Professional Services

Dear Mr. Nolan:

I apologize for not getting back to you earlier regarding the sediment sampling and analysis for your project. If you have not yet selected a consultant, I invite you to review our proposal.

The contents of this proposal letter spell out the Scope of Services to be provided, the proposed Completion Schedule, the Professional Fees, and the Assumptions under which this proposal is being made. If the terms of this proposal meet with your approval, we ask that you sign in duplicate and return one original to our office. If you have any questions, please feel free to call us.

I. PROJECT NAME: Lake Grant Sediment Sampling.

II. DESCRIPTION OF SERVICES TO BE PERFORMED:

1. Determine the proper methodology acceptable to the Department of Natural Resources in sampling the sediment of both the lake and the disposal sites.

2. Arrange for the taking of referenced samples.

3. Take samples and submit them to the State Laboratory for analysis.

4. Interpret the findings with regards to its impacts on the dredging plan.

III. COMPLETION SCHEDULE:

Work to be completed by August 1, 1991.

IV. PROFESSIONAL FEES:

2-23

1. Fees To Be Received: A lump sum of $2,000.00.

2. Frequency of Invoicing: Invoices shall be issued monthly. Payment is required within 30 days. The delivery of services or work products may be withheld if payment is not kept current.

3. As would any prudent business, we retain full lien rights, as described in Attachment A, which is hereby made a part of this Proposal.

V. ASSUMPTIONS:

The determination of our fees is based on the following set of assumptions. Deviations from these assumptions may result in an adjustment of the proposed fees:

1. The terms of this proposal are valid for 120 days from the date of this eetter.

2. Lab costs are not included.

3. Soil compaction testing is not included.

4. Additional or extended services beyond those specifically described in the Scope of Services shall constitute extra work.

Sincerely,
R. A. SMITH & ASSOCIATES, INC.
ENGINEERS - PLANNERS - SURVEYORS

Paul A. Johnson, P.E.
Director of Water Resources

ktm:0-1-940

Accepted By:

_____
Signature

_____
Printed Name

_____
Date

Engineering driven by vision.
7100 West North Avenue
Brookfield Wisconsin 53045-4396
414-786-1777 Fax 414-786-0826

R. A. Smith & Assoc., Inc.
Engineers ■ Planners ■ Surveyors ■ Inspectors

Mark J. Doneux
Environmental Specialist

3-24

Attachment A

Notice of Retention of Lien Rights

AS REQUIRED BY THE WISCONSIN LIEN LAW, R. A. SMITH & ASSOC., INC. HEREBY NOTIFIES OWNER THAT PERSONS OR COMPANIES FURNISHING LABOR FOR ENGINEERING OR SURVEYING SERVICES FOR THE CONSTRUCTION ON OWNER'S LAND, MAY HAVE LIEN RIGHTS ON OWNER'S LAND AND BUILDING IF NOT PAID. THOSE ENTITLED TO LIEN RIGHTS, IN ADDITION TO THE UNDERSIGNED, ARE THOSE WHO GIVE THE OWNER NOTICE WITHIN 60 DAYS AFTER THEY FIRST FURNISH LABOR OR MATERIALS FOR THE CONSTRUCTION. ACCORDINGLY, OWNER PROBABLY WILL RECEIVE NOTICES FROM THOSE WHO FURNISH LABOR OR MATERIALS FOR THE SURVEYING OR ENGINEERING SERVICES, AND SHOULD GIVE A COPY OF EACH NOTICE RECEIVED TO THE MORTGAGE LENDER, IF ANY. R. A. SMITH & ASSOC., INC. AGREES TO COOPERATE WITH THE OWNER AND THE OWNER'S LENDER, IF ANY, TO SEE THAT ALL POTENTIAL LIEN CLAIMANTS ARE DULY PAID, IF APPLICABLE.

R. A. SMITH & ASSOC., INC.

Bloomquists'
P.O. BOX 541 BRISTOL, WI 53104
414/857-2737
To Order Merchandise 1-800-279-0835

Ms. Kathi Krasmasz
Water Management Specialist
Wisconsin Department of Natural Resources
PO Box 12436
Milwaukee, WI 53212

cc: Bob Wakeman

4/9/91 Re: George Lake Planning Grant DNR # 1006-1

Talked to Jim Goheen of Aquatic Biologists at the recent Lake Conference and received a copy of the lab report from the sediment sampling. As we have a Quarterly Lake meeting coming up April 26th, I would like to report to the membership on our progress to date. Frankly, reporting the analysis numbers means little although I am sure they will be happy to hear there was no mercury in the samples.

As consistent with our Planning Grant award we need to know whether the presence of those chemicals found would require that any sediments be processed further prior to disposal or are they within limits for farm use at the nearbye site. This is the part of the original 1978 plan that was never completed and a major portion of the DNR Planning Grant Funds are being used to find out. We still have to sample the site, but can't do that until we have an interpretation of the lab analysis. We would certainly welcome any other comments you may have regarding the analysis. Things such as "normal or abnormal levels of a particular chemical" for a small lake draining 1900 acres of farmland. "Possible? high level of copper probably due to years of copper sulfate use for algae control". (Don't know anything about chemistry so don't know if that is true or not, but would help to have some comments like that for the report to the electors.) We would consider any of these anecdotal and accept them as mearly possibilities as I understand further study would be required to arrive at hard conclusions on why we have what we have.

Thanks for your help and would certainly understand if 4-26 is too soon to receive the DNR's interpretation of the sample analysis.

Thanks,

3-24

D. W. Bloomquist Treasurer
George Lake Public Inland Lake Protection & Rehabilitation District

Section Four - Updated Feasibility Study

Summary - *A Feasibility Study was conducted in 1978 to review various methods of controlling problem aquatic weeds and improving water quality. Alternative lake water quality plan elements reviewed included: livestock waste control, rural land management practices, construction erosion control practices, low cost urban land management practices, total diffuse source control, macrophyte harvesting, aeration, sediment covering, and dredging.*

As part of this Grant, the 1978 Feasibility Study was updated to reflect new water quality data collected since 1978, additional accumulation of sediment from 1977 and 1989 (soil conservation practices were instituted in much of the watershed in 1989), new regulations since 1978 regarding the disposal site of sediment, and estimated 1991 costs of dredging and disposal.

Study Information

The 1978 Feasibility Study was conducted by Environmental Resource Assessments, 2828 Regent Street, Madison, Wisconsin 53705, (608) 233-1234. The final report analyzing the study and reviewing management alternatives for George Lake was done by SEWRPC. Refer to 4-2. SEWRPC updated the feasibility study in November 1992. Refer to 4-9

Dredging Feasibility

The 1978 SEWRPC report states that "the long-term maintenance of water quality in George Lake requires that the recommended level of nutrient input reductions be achieved" but "if nutrient loadings are reduced, the sediments which have been deposited on the lake bottom may continue to provide a suitable bottom substrate and nutrient source for excessive macrophyte growth and may release nutrients to the water body, resulting in continued poor water quality."

According to the updated report, "the impact of dredging on water clarity is not clear--dredging may increase clarity by limiting the area of lake bottom that is subject to wind- or fish-induced sediment resuspension; or dredging may have little effect or even diminish clarity as algal growth replaces macrophyte growth." . "This is of more import in terms of a limited or partial dredging option than in terms of a large-scale dredging of the waterbody which would place most of the lake bottom beyond the depth of plant colonization."... "For this reason, a partial or limited dredging of the lake should be concentrated in areas of two to six feet in depth along the northern, eastern, and western shores of the Lake to maximize aquatic plant growth."

The updated study concludes that "while dredging is an expensive operation in the short-term, the dredging of George Lake is likely to have long-term effects which will extend the life of the Lake well into the next century. This management option should continue to be considered by the George Lake District Commissioners and electors when compiling the management plan for George Lake."

Disposal Site

A local farm located north of the Lake is a possible disposal site for removed sediment. Further study would be necessary to insure that all DNR restrictions for sediment disposal are met. Refer to Map 4-18 for location of possible disposal site. Further study of this disposal site and considerations for other disposal sites were considered too premature at this time.

Estimated Costs

The capital cost of dredging the lake to an average depth of 15 feet was expected to range from $0.8 to 2.4 million in 1978. 1991 estimates for a partial dredging is "about $1.5 million, or through the purchase of a hydraulic dredge which, amortized over a 20-year period, might cost $20,000 per year plus $10,000 in operational expenses, resulting in a total cost of about $150,000 plus permitting fees and disposal costs for a large-scale dredging completed over a five-year period, assuming that the machine is sold or leased thereafter for an amount equal to the $20,000 per year repayment cost."

Alternatives

The 1991 SEWRPC study offers three alternatives besides partial dredging or doing nothing at all.

Alternative One -Shore-based Dredging

The major shortcomings of this alternative are the limited (50 to 100 foot) reach to the dragline, bucket, and the access requirement along the lake shore. Both could be mitigated by drawing down the lake to the level extant prior to the construction of the low-head dam-- that is about three feet." However, "the sediment character of the shoreline area was muck, which may limit this access, at least until sufficient material is removed to expose a hard bottom, and limit the efficiency of the dragline method of dredging. "Other environmental impacts associated with such a drawdown would have to be examined further."

Alternative Two -Acquisition of an Hydraulic Dredge

The purchase of a small hydraulic dredge would reduce costs and would be "more convenient to District residents than a 'round-the-clock' contract operation." The estimated capital cost is between $150,000 and $250,000 with yearly operating costs estimated at between $10,000 and $20,000.

Alternative Three -Aquatic Plant Management

This option could be implemented through the purchase of a mechanical weed harvester, which the District has done since the 1991 SEWRPC Updated Report. "Give that the nonpoint source sediment load to the Lake has been significantly reduced through the adoption of integrated nutrient and pest management practices and conservation tillage practices on the agricultural lands to the west of the Lake, this option may have some merit as the rate of sedimentation may have been reduced. However, the Lake would remain a relatively shallow waterbody and require continued maintenance to control aquatic plant growth."

George Lake is a 59 acre lake located in the Town of Bristol in Kenosha County. The lake drains to the Dutch Gap Canal. Certain geomorphological characteristics of George Lake are set forth in Table 1, together with the approximate 1975 resident-population of the direct tributary watershed and a brief description of lake water quality conditions. Map 1 presents a graphic summary of 1975 land use and cover conditions in the lake watershed. Most of the urban land in the tributary watershed area as shown on Map 1 is served by sanitary sewers although an estimated 56 privately-owned onsite sewage disposal systems--15 of which are located in areas covered by soils which are limited or severely limited for the use of such systems--remain in operation in the watershed area.

As indicated in Table 2, the existing major phosphorus loadings to the lake are estimated to originate from livestock operations, rural land runoff including agriculture and runoff from construction activities with all sources contributing about 2,203 pounds of phosphorus annually. Also as indicated in Table 2, urban land uses are expected to increase by about twofold under planned year 2000 land use conditions with an extension of the sanitary sewer service area. The estimated annual total phosphorus load to the lake under anticipated 2000 condtiions is 2,088 pounds. Unless reduced by the implementation of nonpoint source control measures, phosphorus loadings from livestock, rural land and construction activities may be expected to continue to be the primary sources of phosphorus to the lake under anticipated year 2000 conditions. The estimated steady-state total pnosphorus concentration during spring overturn under existing and anticipated year 2000 conditions, as estimated from the water quality simulation model is 0.24 mg/l and 0.18 mg/l, respectively. The Commission recommends a level of 0.02 mg/l of total phosphorus for the prevention of excessive aquatic plant growth.

Table 1

GEOMORPHOLOGICAL AND WATER QUALITY CHARACTERISTICS OF GEORGE LAKE

Surface Area	59	acres
Direct Tributary Drainage Area	1,911	acres
Shoreline		miles
Depth		
Maximum	16	feet
Mean	6.4	feet
Volume	389.4	acre-feet
1975 Population of Direct Tributary Watershed[a]	460	persons

General Existing Water Quality Conditions: Occasional algae blooms; dense macrophyte growth; high nutrient concentrations.

[a]The population of the direct tributary watershed is estimated by assuming an average of 3.68 persons per dwelling unit.

Source: SEWRPC.

Table 2

ESTIMATED PHOSPHORUS LOADS TO GEORGE LAKE, KENOSHA COUNTY
FOR
EXISTING AND ANTICIPATED YEAR 2000 CONDITIONS

Source	Existing 1975			Anticipated 2000[a]		
	Extent	lbs/year	Percent	Extent	lbs/year	Percent
Urban Land	120 acres	43	2.0	338 acres	78	3.7
Construction Activities	9 acres	396	18.0	9 acres	396	19.0
Septic Systems	56 systems	43	2.0	44 systems	43	2.1
Rural Land	1,782 acres	464	21.1	1,265 acres	314	15.0
Livestock	186 animal units	1,228	55.6	186 animal units	1,228	58.8
Atmospheric	59 acres surface water	29	1.3	59 acres surface water	29	1.4
Total	--	2,203	100.0	--	2,088	100.

[a] Assumes that the sanitary sewer service area is extended, as recommended in the point source element for the Des Plaines River Subregional Area, but that no diffuse source controls are implemented.

Source: SEWRPC

Analysis of Alternatives

Existing and anticipated year 2000 pollutant loadings may be expected to result in total phosphorus concentrations in George Lake which exceed the phosphorus level estimated to be necessary to maintain water quality suitable for recreational use and for the maintenance of warm water fish and aquatic life. Measures to control livestock waste contributions appear to be the most cost-effective way to substantially reduce phosphorus loadings to the lake. In addition to the proposed extension in sewer service area, livestock waste control and construction erosion control; measures to reduce rural land runoff of pollutants by 50 percent--through the implementation of basic conservation practices; and stream protection measures, which include minimum rural land management practices; low-cost urban diffuse source control measures--including public education programs, litter and pet waste control, restricted fertilizer and pesticide application, and critical area protection; and septic tank system management, which is also necessary for the preservation of public health and the maintenance of drinking water supplies, should achieve the 90 / percent reduction in phosphorus loadings required to satisfy the water quality objectives. Extensive urban diffuse source pollution control measures, such as improved street sweeping, catch basin cleaning, leaf collection by vacuum sweepers, improved street maintenance and refuse collection, and material storage and runoff control, are generally not required in the George Lake drainage area.

The estimated steady-state total phosphorus concentration in George Lake indicates that the lake has been receiving excessive phosphorus loadings. If nutrient loadings are reduced, the sediments which have been deposited on the lake bottom may continue to provide a suitable bottom substrate and nutrient source for excessive macrophyte growth and may release nutrients to the water body, resulting in continued poor water quality. If this problem is confirmed through further local study, the application of lake restoration or rehabilitation procedures should be considered, in addition to the above diffuse source controls. Appropriate restor-

ation measures may include dredging, sediment covering, aeration, and nutrient inactivation. The feasibility of these measures would have to be assessed in a preliminary engineering study. Additional management measures, such as macrophyte harvesting, may be used to temporarily control the macrophyte growth which may interfere with the recreational use of the lake. It should be emphasized, however, that the long-term maintenance of water quality in George Lake requires that the recommended level of nutrient input reductions be achieved.

The provision of extended sanitary sewer service to the lake watershed would involve a total capital cost over the period of 1980-2000 of $434,000 with an average annual operation and maintenance cost of $18,300. The 50-year present worth cost of sanitary serer service, useful in comparing the long-term costs of alternative control measures is $607,000 with an equivalent annual cost of $38,400. The application of diffuse source management measures to control livestock waste contributions; control construction erosion; reduce urban land runoff pollutant loads through public education programs, litter and pet waste control, restricted fertilizer and pesticide applications, and critical area protection; and reduce rural land runoff pollutant loads to George Lake by about 50 percent through basic conservation practices and stream protection measures including minimum rural land management practices, would entail a total capital cost of about $449,000, and an average operation and maintenance cost of about $10,000. The total 50-year present worth cost of these diffuse source control measures, is $472,400 with an equivalent annual cost of $29,700. The estimated capital cost for implementation of inlake protection and/or rehabilitation measures ranges from $5,000 to $799,400. Cost estimates for alternative pollution control measures are presented in Table 3.

TCS/pdp
7/6/78

CALCULATED ANNUAL TOTAL PHOSPHORUS LOAD TO LAKE GEORGE

Detail 1975 Land Use

Source	Extent	TP	% TP
Row Crop	886.84	226.00	10.26
Woodland	231.96	75.07	3.41
Grain	46.60	12.12	0.55
Hay	173.42	44.86	2.04
Other Open Land	443.42	105.74	4.80
Commercial	10.00	9.06	0.41
Low Res.	81.72	19,98	0.91
Med. Res.	26.87	12.95	0.59
Hi Res.	1.00	0.90	0.01
Construction	8.79	395.55	17.96
Atmospheric	59	29.50	1.34
Livestock	186	1,227.60	55.72
Septic	15/58	43.43	1.97
Total	—	2,202.76	100

General 2000 Land Use

Source	Extent	TP	% TP
Row	809.35	206.38	9.89
Other Open	455.27	108.11	5.18
Low Res.	338.21	77.08	3.69
Construction	8.79	395.55	18.95
Atmospheric	59.0	29.50	1.41
Livestock	186	1,227.60	58.80
Septic	15/44	43.43	2.08
Total	—	2,087.65	100

NOTES:

Atmospheric, livestock, and septic system loads are not simulated.

Table 4

WATER QUALITY MANAGEMENT ALTERNATIVES FOR GEORGE LAKE IN KENOSHA
NONPOINT POLLUTION LOADING REDUCTION RECOMMENDATIONS AND ALTERNATIVE REHABILITATION MEASURES

Number Designation	Alternative Plan Element Description	Estimated Cost Total Capital (1980-2000)	Estimated Cost Average Annual Operation & Maintenance	Economic Analysis: Present Worth (1975-2025) Capital	Present Worth (1975-2025) Operation & Maintenance	Present Worth (1975-2025) Total	Equivalent Annual (1975-2025) Capital	Equivalent Annual (1975-2025) Operation & Maintenance	Equivalent Annual (1975-2025) Total	Anticipated Effectiveness	Total Phosphorus Reduction in Excess of Annual Loading Goal (kg/yr)
a	Sanitary Sewer Service	(1975-2000) 430,000	1,300	328,000	279,000	607,000	20,700	17,700	38,400	Protect public health and drinking water supplies; reduce nutrient concentrations.	--
1	Septic Tank System Management	--	--	--	--	--	--	--	--	Reduce Nutrient concentrations, prevent the stimulation of excessive macrophyte and algae growth: improve recreational use potential, protect public health and drinking water supplies.	
2	Livestock Waste Control [f]	16,400	1,400	12,200	16,400	28,600	800	1,000	1,800		
4	Rural Land Management Practices and Streambank Protection [d]	17,200	4,400	12,800	94,000	66,800	800	3,400	4,200		
5	Construction Erosion Control Practices [e]	415,800	1,000	312,100	96,700	408,800	19,800	1,400	21,200		
6	Low Cost Urban Land Management Practices	0	600	0	8,200	8,200	0	600	600		
--	Additional Urban Land Management Practices	Not Required		Not Required			Not Required				
-	Total Diffuse Source Control	449,400	10,000	337,100	135,300	472,400	21,400	6,300	29,700		90
7	Macrophyte Harvesting [g]	37,200	2,200	27,900	87,000	109,000	1,800	7,200	9,000	Control excessive macrophyte growth; aesthetic enhancement; improve recreational use potential	Minimal additional reduction
8	Total Aeration	5,000	100	3,700	1,600	5,300	300	100	300	Prevent anaerobic conditions (lack of oxygen) in the hypolimnion.	No additional reduction
9	Nutrient Inactivation [h]	3,900	--	4,400	--	4,400	--	300	300	Accelerate lake improvement prevent release of nutrient from sediment, remove nutrients from water body.	No additional reduction
--	Sediment Covering [i,k]	116,200	--	90,200	--	88,300	5,600	--	7,600	Accelerate lake improvement prevent release of nutrients from sediment, reduce suitable plant substrate	No additional reduction
-	Dredging [j]	799,400	--	597,400	--	597,400	37,900	--	37,900	Deepen lake, reduce macrophyte growth	No additional reduction

a. The cumulative percent reduction in phosphorus loadings is in addition to sanitary sewer service, as recommended in the point source element for the Des Plaines River Subregional area.

Sanitary sewer costs presented above include treatment plant and major trunk sewer costs. This cost--and the required level of treatment--is dependent on surface water quality requirements. Costs represent the estimated cost of wastewater treatment and trunk sewer facilities for the Bristol-George Lake sewer service area prorated based upon the population of the lake watershed to the total sewered population of the service area. Local hook-up and operation and maintenance costs, which are not primarily dependent on surface water quality, are not presented above. The estimated expenditures for local hook-up and operation and maintenance in the George Lake drainage basin include a capital cost over the period of 1975-2000 of $ 34,000 ; an average annual operation and maintenance cost of $ 2,100 ; and a total 50-year present worth cost of $ 312,800 .

b. Proper maintenance and replacement of the remaining septic tank systems is recommended to help improve the water quality of George Lake. However, because septic tank systems management is an existing function necessary for the preservation of public health and the maintenance of drinking water supplies, this cost is not included in the water quality management plan. The estimated expenditures for septic system management in the George Lake drainage basin include a capital cost over the period of 1980-2000 of $ 67,500 , an average annual operation and maintenance cost of $ 1,500 , and a total 50-year present worth cost of $ 87,600 .

c. Rural land management practices necessary to achieve a 50 percent reduction in rural diffuse source pollutant loads which includes costs for minimum urban land management practices.

d. Cost estimated to control erosion from the estimated 5 acres of land estimated to be annually undergoing construction activity in the George Lake watershed.

e. Cost estimated to dredge lake to an average depth of 15 feet. Existing average depth is 6.6 feet.

f. Cost estimated to cover the entire lake bottom with sand, clay, plastic, or other suitable material.

g. Cost for nutrient inactivation is for treating the entire lake with aluminum.

h. Cost estimated to aerate about 25 acres of the lake.

i. Cost estimated to harvest macrophytes from the 40 acres of George lake subject to excessive macrophyte growth.

j. Costs may be higher depending upon lake physiography.

k. If adequate livestock waste control is determined following a field inspection by soil conservation representatives, the above cited control costs may be substantially reduced or eliminated.

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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November 25, 1992

Ms. Marianne D. Giannis, Commissioner
George Lake Inland Lake Rehabilitation
and Protection District
18627 102nd Street
Bristol, Wisconsin 53104

Dear Ms Giannis:

Pursuant to your letter request of October 23, 1992, Commission staff have reviewed and up-dated the probable costs associated with the dredging of George Lake located in the Town of Bristol, Kenosha County.

The accumulation of fine silts and the proliferation of aquatic plants in the lake basin has reduced the recreational and aesthetic utility of George Lake, creating continued concern among lake residents and visitors over the state of the water body. As early as 1978, the George Lake District participated in the Wisconsin Inland Lake Renewal Program, and a draft lake management plan was compiled by the Wisconsin Department of Natural Resources and the Southeastern Wisconsin Regional Planning Commission following investigations undertaken by the firm of Environmental Resource Assessments of Madison, Wisconsin. Although this plan was never completed, due to the cancellation of the Inland Lake Renewal Program initiative by the State Legislature, information about the proposed plan was widely disseminated at the time via the local media and through public hearings and lake district meetings, and, therefore, became well-known to George Lake residents. As a result, various elements of the plan--including the dredging option--continued to be discussed by the George Lake District electors. Thus, with the initiation of the Wisconsin Lakes Program in the late 1980s, the George Lake District applied for, and received, a Wisconsin Lake Management Planning Grant in August 1990 to up-date and complete the draft plan. Sediment quality investigations carried out during 1991 by the firm of Aquatic Biologists, Inc. of Fond du Lac, Wisconsin, in association with the firm of Enviroscan Inc. of Rothschild, Wisconsin, confirmed that the lake sediments were non-hazardous.

Subsequently, the Commission staff was requested to review and revise the estimated costs of the dredging options identified in the draft lake management plan. Based upon the Commission staff review, the following information and comments are offered for your consideration:

PRIMARY DATA SOURCES

To gain an understanding of the originally proposed plan and related water

4-10

quality issues associated with George Lake, information was gathered by the Commission staff on the watershed geography, environmental corridors, soils, and water and sediment chemistry. Much of this information was used in the preparation of the Final Report on the George Lake Study, Kenosha County, Wisconsin, Environmental Resource Assessments, June 1978, for the George Lake District; the unpublished draft lake management plan dated September 1979; a summary report prepared by R. A. Smith & Associates dated July 1983; and various files held by the Wisconsin Department of Natural Resources--Madison and Southeast District-Milwaukee--and the Southeastern Wisconsin Regional Planning Commission.

DESCRIPTION OF EXISTING AND HISTORIC FINDINGS

The surface water drainage area boundaries of George Lake are shown on the map attached hereto as Exhibit A. The study area is located in the eastern portions of Sections 20 and 29, Township 1 North, Range 21 East, Town of Bristol. There are three subbasins within this watershed which contribute runoff to the lake as identified in SEWRPC Panning Report No. 30, A Regional Water Quality Management Plan for Southeastern Wisconsin--2000, Volume 2, Alternative Plans.

The Regional Planning Commission has delineated primary environmental corridors within the area which occupy about 30 percent of the watershed, as shown on Exhibit A and identified in SEWRPC Community Assistance Planning Report No. 131, A Park and Open Space Plan for Kenosha County. In addition, shoreland and floodplain boundaries have been delineated by the Commission staff for the Lake. Much of the residential development surrounding the Lake--accounting for about 20 percent of the watershed area--lies within the shoreland area, while most of the floodplain area lies below the Lake adjacent to the Dutch Gap Canal. Most of the surrounding lands--almost 50 percent of the watershed--have been designated as prime agricultural lands as identified in SEWRPC Community Assistance Planning Report No. 126, A Development Plan for Kenosha County, Wisconsin, Volume 1, Inventory Findings.

George Lake is a 59-acre lake draining to the Dutch Gap Canal in the Des Plaines River watershed. The Lake is a kettle lake formed as the result of glaciation. It is located in an area of silty clay till of low--type C--permeability and is surrounded by extensive areas of marsh. In the early 1900s, water levels in the Lake were stabilized and raised through the construction of a low head, three-foot dam at the lake outlet to the Dutch Gap Canal.

The lake bottom substrate is comprised primarily of organic muck with some portions--about 10 percent of the shoreline length--being comprised of sand and marl deposits. These sediment deposits were found to be up to 20 feet in thickness during surveys conducted in 1977 by the firm of Environmental Resource Assessments. This resulted in an estimated volume of about 910 acre-feet--or about 1,400,000 cubic yards--of accumulated sediments, of which about 310 acre-feet are flocculent and about 600 acre-feet are consolidated

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Comparison of the 1952 bathymetric map prepared by the Wisconsin Conservation Department (Exhibit B) and the 1977 map prepared by the firm of Environmental Resource Assessments following the sediment survey (Exhibit C) suggests that the lake depth diminished by between two and four feet during the 25-year period, while the lake surface area had decreased from 70 acres to under 60 acres during the same period. The maximum depth of the lake had been reduced from over 16 feet in 1952 to about 12 feet in 1977. This reduced depth has probably contributed to the heavy infestations of the rooted aquatic plants Myriophyllum spicatum (milfoil) and Nymphaea tuberosa (white water lily) throughout much--about 60 percent--of the lake (Exhibit D).

To control such infestations, extensive and partial dredging options were identified in the aforereferenced 1979 draft lake management plan. Under the extensive dredging option, the entire volume of accumulated sediment was proposed for removal, increasing the mean depth of the lake--calculated as the ratio between lake volume and surface area--from just over 6 feet to about 15 feet. This would increase the maximum depth of water in the lake basin to about 36 feet. Under the partial dredging option, about 93 acre-feet--or about 150,000 cubic yards--or about 10 percent of the total sediment was proposed for removal from those areas adjacent to the populated portions of the shoreline. This would be unlikely to increase the maximum depth of water in the lake basin. The costs of these programs were estimated at between $200,000 and $1.5 million in 1979.

Dredge spoil disposal was planned at a site located about 2,500 feet--approximately one-half mile--from the lake center near the intersection of the south section line of Section 20, Township 1 North, Range 21 East and USH 45. Construction of a confined disposal facility was proposed on the site of an existing wetland immediately west of USH 45.

EVALUATION OF PRESENT (1992) DREDGING COSTS

In reevaluating the potential costs of dredging George Lake, the Commission staff have taken cognizance of several modifying factors affecting the cost calculation. These factors include:

1. The continued accumulation of sediment in the lake between the bathymetric study of 1977 and the institution of soil conservation practices in large portions of the watershed in 1989.

2. The maximum depth of colonization of the nuisance aquatic plants.

3. The need for selection of a disposal site meeting the more stringent siting criteria promulgated by the State since the completion of the previous studies.

4. The increased costs associated with the operation of dredging equipment.

These considerations are examined in more detail below.

Sediment Accumulation

In 1975, public sanitary sewers were installed in the Lake George area. In addition, the U. S. Department of Agriculture, Soil Conservation Service and the Kenosha County Land Conservation Department report that soil conservation practices have been instituted in the western portions of the lake watershed. These actions have significantly reduced the quantities of sediment and contaminants reaching George Lake, and would improve the long-term usefulness of any dredging project.

However, the soil conservation practices have only been instituted relatively recently--since 1989--in the history of the Lake. In addition, other sediment sources, such as decaying aquatic vegetation, have continued to contribute sediment. Thus, it was assumed that an additional sediment accumulation of one to three feet was deposited in the lake basin since the last bathymetric survey in 1977. Such an assumption results in an additional accumulation of about 40 acre-feet of sediment--estimated from the nomogram provided by the firm of Environmental Resource Assessments--bringing the total amount of dredgable material in the Lake to approximately 950 acre-feet--or about 1,550,000 cubic yards. The maximum depth of the Lake under these undredged conditions would be about 11 feet. In fact, Aquatic Biologists, Inc., reported a depth of 14 feet at the time of their sediment sampling in April 1991. While the reasons for this discrepancy are unclear--being possibly related to such factors as the fluctuating water surface, poorly defined sediment-water interface, and measurement technique used--the Commission staff have assumed the larger, more conservative sediment volume estimate to be applicable in the calculation of dredging costs.

Aquatic Plant Considerations

As the depth of water in a lake decreases, more of the lake bottom becomes exposed to light and conditions that are conducive to plant growth, and the infestation of aquatic plants worsens, further reducing recreational access to, and aesthetic enjoyment of, the waterbody. Previous data from George Lake indicated that plant growth was confined to waters of less than five feet deep. This is consistent with the calculated maximum depth of plant colonization based on a Secchi disc transparency of two feet.

The impact of dredging on water clarity is not clear--dredging may increase clarity by limiting the area of lake bottom that is subject to wind- or fish-induced sediment resuspension; or dredging may have little effect or even diminish clarity as algal growth replaces macrophyte growth. The Commission staff assumed a marginal net improvement in Secchi disc transparency based upon data contained in Wisconsin Department of Natural Resources Report No. PUBL-WR-233 90, Wisconsin Self-Help Monitoring Program With Specific Data from 1986-1988. This is of import more in terms of a limited or partial dredging option than in terms of a large-scale dredging of the waterbody which would place most of the lake bottom beyond the depth of plant colonization. For this reason, a partial or limited dredging of the lake should be concentrated

in areas of two to six feet in depth along the northern, eastern, and western shores of the Lake to maximize access and minimize aquatic plant growth. Based on the 1977 bathymetric survey, this would involve dredging in a band of between 150 and 350 feet from shore, and removing about 100 acre-feet--about 160,000 cubic yards--of sediment.

Confined Disposal Facility Site Selection

While the previous reports anticipated disposal of the dredge spoils in a wetland site within one-half mile of the lake, subsequent changes in wetland preservation regulations would negate such an option, especially as the selected site is located within an area designated as shoreland in terms of Chapter NR 117 of the Wisconsin Administrative Code. Although the Commission staff have not undertaken a confined disposal facility siting review in connection with this assessment, it would appear that the next nearest spoil disposal site would be one mile or more away from the lake center.

Dredging Costs: Hydraulic Dredging

Given the foregoing constraints, it is the opinion of the Commission staff that hydraulic dredging would be the most suitable dredging methodology given the distance off-shore to be dredged--which is beyond the reach of shore-based draglines--and the composition of the sediments--highly organic silt and muck --to be removed. This methodology also lends itself to the use of booster pumps to transfer dredged materials to the disposal site without the need for intermediate environmental exposure. Although the sediment to be removed is non-hazardous, it is very likely that it will be initially malodorous due to its high--over 80 percent--organic content.

Accordingly, siting, operating, spoil disposal and associated costs of dredging using an hydraulic dredge may be expected to range from $7 to $10 per cubic yard, $2 to $5 of which represents the cost of removal of the sediments from the lake, while the balance represents the costs of siting, disposal of the spoils, permitting, and associated costs. This would suggest that the cost of a large-scale dredging of George Lake, that removed some 1,550,000 cubic yards of accumulated silt, would approach $15 million. The cost of a partial or limited dredging that would remove 160,000 cubic yards of spoil would approach $1.5 million. While lower cost estimates have been obtained by the George Lake District--for limited shoreland dredging (Commissioner D. W. Bloomquist, in litt., March 1992)--these may not have included the additional costs of permitting, spoil disposal, and other associated costs.

ALTERNATE DREDGING OPTIONS

Based on the findings of the previous investigations, and the additional evidence provided above, it would appear that dredging remains a potentially sound management option for George Lake. Removal of the accumulated terrestrial soils and other sediments from the Lake could significantly improve the utility and aesthetic appeal of the waterbody. Given the high cost of the

hydraulic dredging process, however, the Commission staff examined other techniques for deepening the waterbody. Two cost-saving options were identified in addition to the "do nothing" option.

Alternative 1 - Shore-based Dredging

Use of a shore-based dragline to undertake sediment removal operations should result in a substantial savings over the use of an hydraulic dredge, as the equipment necessary to accomplish this activity should be available locally--reducing the siting costs associated with an hydraulic dredge. The major shortcomings of this alternative are the limited--50- to 100-foot--reach of the dragline bucket, and the access requirement along the lake shore. Both could be mitigated by drawing down the lake to the level extant prior to the construction of the low-head dam--that is by about three feet. This may permit access by the mechanical equipment along the newly exposed lake shore and could "extend" the reach of the dragline into the Lake to between the four-foot and six-foot depth contours under full supply conditions. The 1978 report prepared by the firm of Environmental Resource Assessments did, however, note that the sediment character of the shoreline area was muck, which may limit this access, at least until sufficient material is removed to expose a hard bottom, and limit the efficiency of the dragline method of dredging. While such an operation may permit accomplishment of the same degree of sediment removal as the limited or partial dredging option described above, the Lake would have to be drawn down for several seasons. Other environmental impacts associated with such a drawdown would have to be examined further.

Alternative 2 - Acquisition of an Hydraulic Dredge

The George Lake District may wish to consider obtaining a small hydraulic dredge. This would permit the District to undertake sediment removal operations at lower operating costs than would be possible if such services were hired in on a contract basis. While the capital costs of such an option are relatively high--between $150,000 and $250,000--some of this cost may be offset by the subsequent re-sale of the equipment at the conclusion of the project or the leasing of the equipment to other lake districts having need of such equipment. This would also enable the George Lake District to undertake the dredging of the waterbody in accordance with a locally-determined timetable, which may prove more convenient to District residents than a "round-the-clock" contract operation. Operating costs may be expected to approximate $10,000 to $20,000 per year depending on factors such as the number of volunteer operators, number of hours worked, the need for spare parts and maintenance, and insurance costs.

Alternative 3 - Aquatic Plant Management

Access and aesthetics could be enhanced using alternative methodologies--aquatic plant management, for example, could be accomplished using a harvester as proposed in the aquatic plant management plan submitted to the Wisconsin Waterways Commission. Given that the nonpoint source sediment load to the Lake has been significantly reduced through the adoption of integrated nutrient and pest management practices and conservation tillage practices on the agricultural lands to the west of the Lake, this option may have some merit as

the rate of sedimentation may have been reduced. However, the Lake would remain a relatively shallow waterbody and require continued maintenance to control aquatic plant growth. The advantage of aquatic plant harvesting is that it removes the plant biomass that contributes to the organic portion of the sediment load to the Lake. The cost of an aquatic plant harvester would be about $75,000--of which 50 percent may be subsidized by the Wisconsin Waterways Commission--and the annual operating costs between $10,000 and $15,000. Disposal costs, including the lease or purchase of a dump truck, would be in addition to the aforementioned costs. Harvesting requires operation into the foreseeable future, so that, in the longer term, the costs to the District may be similar.

PERMITS REQUIRED

Dredging requires both Federal--U.S. Army Corps of Engineers--and State--Wisconsin Department of Natural Resources--permitting under Section 404 of the Federal Clean Water Act and Chapter 30 of the Wisconsin Statutes, respectively, while return flows from the confined disposal facility will be subject to a Wisconsin Pollution Discharge Elimination System permit under Chapter 147 of the Wisconsin Statutes. Applications for these and any other applicable permits should be made, at least six months in advance, through the Wisconsin Department of Natural Resources, Bureau of Water Regulation and Zoning, Southeast District Office, P. O. Box 12436, Milwaukee, WI 53212-0436. Permit fees are based on the cost of the project and range from $60 to $75. Permits must be obtained before any dredging or disposal of dredged materials takes place.

CONCLUSIONS

Dredging remains a potentially viable option for the management of George Lake, and offers a long-term option for controlling the growth of aquatic plants within the lake basin. Estimates of sediment loading to the lake have ranged up to two inches per year--based on a four-foot sediment accumulation in the lake between 1952 and 1977. However, institution of agricultural conservation measures in the watershed since 1989 have likely significantly reduced this load to less than 0.5 inches per year--based on estimates made by the U.S. Department of Agriculture, Soil Conservation Service, and Kenosha County Land Conservation Department. Such a reduction in sediment loading reenforces the potential effectiveness of dredging as a lake management option.

The cost of whole-lake, large-scale dredging using contract dredging services may approximate $15 million, based on an estimate of $10 per cubic yard--inclusive of permitting, siting, disposal and associated costs. This cost could be reduced by conducting a partial dredging at a cost of about $1.5 million, or through the purchase of a hydraulic dredge which, amortized over a 20-year period, might cost $20,000 per year plus $10,000 in operational expenses, resulting in a total cost of about $150,000 plus permitting fees and disposal costs for a large-scale dredging completed over a five-year period,

assuming that the machine is sold or leased thereafter for an amount equal to the $20,000 per year repayment cost.

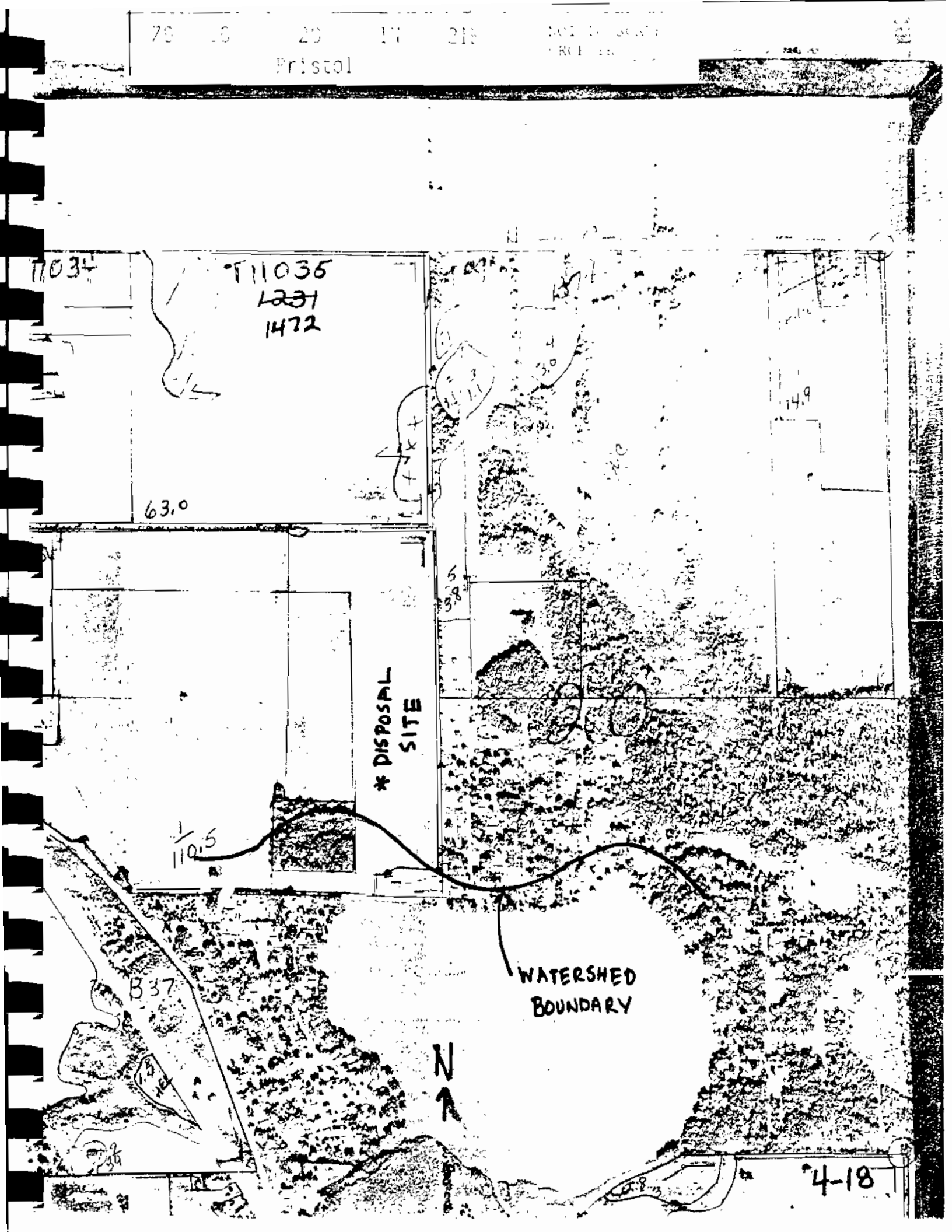
In short, while dredging is an expensive operation in the short-term, the dredging of George Lake is likely to have long-term effects which will extend the life of the Lake well into the next century. This management option should continue to be considered by the George Lake District Commissioners and electors when compiling the management plan for George Lake.

We trust that the information hereby provided will be helpful to you in your further consideration of this matter. Should you have any questions concerning the information herein provided, please do not hesitate to call.

Sincerely,

Kurt W. Bauer
Executive Director

KWB/ib
Giannis.JAT
Enclosures
cc: Mr. George E. Melcher, Kenosha County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4-18

Section Five - Water Usage Ordinance

Summary - *Three options of a boating ordinance were presented to the April 1992 George Lake Rehabilitation District Meeting. A vote of all residents present at the meeting was taken to determine which option would be pursued. Option Two received the most votes. The legality of the existing ordinance, Chapter 10, (refer to Section 5-11 to 5-14) was questionable since it did not allow water-skiing and did not address jet-skiing. A water usage ordinance that would accommodate the recreational use by all residents was desired.*

The George Lake Water Usage Committee (Chairman Dan Hometer, Members: Dennis Bloomquist, Time Nolan, Greg Spinner, Keith Wehr), in cooperation with the Town of Bristol, and following the guidelines provided by the DNR, developed the following water usage ordinance. The ordinance was put into effect on July 12, 1993. Refer to Section 5-3 to 5-8 for the new Water Usage Ordinance, Chapter 11.

Proposed Water Usage Ordinances

Option 1 - Eliminates all water skiing, jet skiing etc. Requires a slow-no-wake at all times.

Option 2 - Regulates recreational uses such as water skiing and jet skiing to specified hours only.

Option 3 - Regulates slow-no-wake times and bans recreational uses such as water skiing and jet skiing.

A sole ordinance to regulate water traffic, boating and water sports upon the waters of George Lake, Kenosha County, Wisconsin and prescribing penalties thereof.

The Town Board of the Town of Bristol, Wisconsin do ordain as follows:

Section 1. Intent
The intent of this ordinance is to provide safe and healthful conditions for the enjoyment of aquatic recreation consistent with public rights and interest and the capability of the water resources.

Section 2. Applicability and Enforcement.
The provisions of this ordinance shall apply to the waters of George Lake within the jurisdiction of the Town of Bristol. The provisions of ordinance shall be enforced by the officers of the Town of Bristol.

Section 3. State Boating and Safety Laws Adopted.
State Boating laws as found in ss. 30.50 to 30 71 are adopted by reference and are superseded by provisions of this ordinance when these are more restricted.

Section 4. Definitions in this Ordinance.

a) "Shore Zone" means all surface water within 100 feet of the shoreline.
b) "Swimming Zone" means an authorized area of water established by regulatory markers to designate a swimming area.
c) "Designated Anchorage" means an area of water established and marked as an anchorage by lawful authority.
d) "Public Access" means any access to the water by means of public property.
e) "Navigation Lawn" means an area designated by authorized aids to navigation.
f) "Slow-No-Wake" means that speed at which a boat moves as slowly as possible while still remaining steerage control.
g) "Public Boat Ramp" refers to the gravel access ramp on the lake.
h) "Water Skiing, Tubing,, Board Skiing" are recreational activities whereby a powered watercraft is utilized to tow (using ropes) a person(s) behind the craft.
i) "Jet Skiing" is a recreational activity whereby a powered personal water vehicle is utilized.

Section 5. Speed Restrictions.

Option 1 - Slow-no-wake speeds are required at all times.
Option 2 - Slow-no-wake speeds are required at all times:
a)Within the shore zone.
b)Within 100 feet of the designated swimming areas
Option 3 - Slow-no-wake speeds are required at all times:
a)Within the shore zone.
b)Within 100 feet of designated swimming areas.

Section 6. Boat Excluded Areas.

All boats are excluded from being within the designated swimming areas. Swimming areas designated by buoys are located at the north side of George Lake on 101st (100 feet wide beach zone) street and the east side at the foot of 103rd street (50 feet wide beach zone) and extend out into the lake for 150 feet.

Section 7. Water Skiing, Jet Skiing, Tubing.

Option 1 - These activities are prohibited on the waters of George Lake by virtue of the provisions of Section 5
Option 2 - Are restricted to the hours of 12.00 noon to 6:00 p.m daily.
Option 3 - Are not permitted on George Lake.

Section 8. Penalties.

a) Section 30.80 of Wisconsin Statutes are adopted by reference.
b) Penalties for violation of Sections 5., 6., 7., are $100 00 for first offense, $200.00 for each subsequent offense and are applicable to those persons(s) operating the water vehicle during the time of the offense.

Section 9. Severablility.

The provisions of this ordinance shall be deemed severable and it is expressly declared that the Town Board would have passed the other provisions of this provisions may be declared invalid. If any provision of this is held invalid, the remainder of the ordinance and the circumstances shall not be affected.

CHAPTER 11

AN ORDINANCE RELATING TO THE REGULATION OF WATER TRAFFIC, BOATING, WATER SPORTS AND PUBLIC BEACHES ON GEORGE LAKE

The Town Board of the Town of Bristol do ordain as follows: The Town Board of the Town of Bristol does hereby repeal Chapter 11 of the Ordinances of the Town of Bristol relating to water traffic, boating, water sports, and public beaches, and recreate Chapter 11 to read as follows.

SECTION 11.01

(a) INTENT. The natural waters and adjacent beaches located in the Town of Bristol are valuable natural resources and those portions of such waters and beaches which are owned by the public are threatened by overuse and by misuse. This Ordinance is intended to promote the health, safety and welfare of the public by placing reasonable regulations on the use of said waters and beaches to preserve their natural beauty and usefulness and to avoid conflicts of those members of the public enjoying said waters and beaches. This Ordinance is intended to be consistent with Chapter 30 of the Wisconsin Statutes governing navigable waters harbors and navigation, and with all valid administrative rules of the Department of Natural Resources for the State of Wisconsin, and with all applicable zoning regulations of Kenosha County, to the end that all interest may enjoy the aquatic recreation consistent with public rights, interest and capability of the water resource.

(b) INTERPRETATION, SEVERABILITY. This Ordinance shall be broadly interpreted to effectuate its stated intent and should any section, clause or provision of this Ordinance, be declared by the Court to be invalid, the same shall not effect the validity of this Ordinance as a whole or any part or section hereof, other than the part so declared invalid by a Court of competent jurisdiction.

5-3

(c) APPLICABILITY, ENFORCEMENT. The provisions of this Ordinance shall apply to the waters of GEORGE LAKE. The provisions of this Ordinance shall be enforced by law enforcement officers of the Town of Bristol, Kenosha County and State of Wisconsin

(d) PATROL BOATS The provisions of this Ordinance shall not apply to the operator of a duly authorized patrol boat when operated in the performance of duty, and sounding the required audible signal (siren) provided due regard is given to the safety of people in the vicinity.

SECTION 11.02 STATE BOATING AND WATER SAFETY LAWS ADOPTED.

(a) Wisconsin Statutes Sections 30.50 to 30.71 describing and defining regulations with respect to water traffic, boats, boating and related water activities and safety are hereby adopted by reference.

(b) ADDITIONAL DEFINITIONS.

(a) In addition to the definitions found in SECTION 11.02(a) and Section 30.50 Wis. Stats., the following definitions shall apply to this Ordinance:

(1) "Shore zone" means all surface water within 100 feet of the shoreline.

(2) "Swimming zone" means an authorized area marked by regulatory markers to designate a swimming area.

(3) "Designated anchorage" means an area of water established and marked as an anchorage by lawful authority.

(4) "Public access" means any access to the water by means of public property.

(5) "Navigation lane" means an area designated by authorized aids to navigation.

(6) "Public boat ramp" means the gravel access ramp located on the north side of 106th Street approximately 4/10 of a mile east of Highway 45.

5-4

SECTION 11.03 ADDITIONAL REGULATION.

(a) WATER SKIING LIMITED due to the shallow depth and limited acreage of GEORGE LAKE (59 acres) with fully developed shoreline fisherman and other recreational uses requiring slow moving boats, no person shall operate a motorboat towing a person on waterskis, aquaplane or similar device except during the hours of 12 noon until 6 p.m. daily.

(b) No person shall engage in waterskiing, aquaplaning or similar activity unless that person is wearing a Cost Guard approved Type 1, 2 or 3 personal flotation device

SECTION 11.04 SPEED RESTRICTIONS - SLOW-NO-WAKE No person shall operate a motorboat at a speed greater than slow-no-wake except during the hours of 12 noon until 6 p.m. daily.

SECTION 11.05 SWIMMING

(a) No person shall swim outside of the shore zone unless accompanied by a boat, attended by a competent observer.

(b) No person shall swim from any boat unless the boat is attended by a competent observer who is in the boat, and the swimmer shall stay within 25 feet of the boat.

(c) The following described area is hereby declared the swimming area, and shall be buoyed accordingly. The north and south lines of the public beach at 101st Street extend into the water for a distance of 200 feet and the east and west lines of the public beach at 192nd Avenue extend into the water for a distance of 200 feet.

SECTION 11.06 MOORING BUOYS, RAFTS AND PIERS

(a) MOORING BUOYS The use of mooring buoys is prohibited.

(b) SWIMMING AND DIVING RAFTS

(1) No person shall place or maintain any raft or platform on GEORGE LAKE more than 100 feet from the shoreline.

5-5

(2) Each raft shall have at least eighteen (18) inches above the water line, and not more than twelve (12) inches from each corner or projection, attached thereto a red reflector of not less than three (3) inches in diameter.

(c) PIERS

(1) No person shall construct or maintain a pier or boat lift which extends more than fifty (50) feet from the shoreline nor shall any person maintain a swimming and diving raft more than 100 feet from the shoreline.

(d) PROHIBITED IN PUBLIC AREAS

(1) No pier, swimming or diving raft shall be placed in waters of the extended boundaries of any street, fire lane or public park.

(e) REMOVAL OF RAFTS AND PIERS

(1 All piers, rafts or similar structures, and their supports, shall be removed from the waters on or before December 1, and remain out of the water until April 1 of the following year.

(2) In the event that such structures are not removed by December 1st, the Town, after notice to the riparian owner, may be remove the structures and the cost and expense of such removal shall be charged to the riparian owner. If such charges are not paid within thirty (30) days of the date of billing, a penalty of ten percent (10%) shall be added to such charges and the same shall constitute a lien on the property of the riparian owner and be inserted on the tax roll at the Town Office by the Town Clerk upon order by the Town Board.

SECTION 11.07 MARKING ICE FISHING SHELTERS

(a) No person shall place any ice fishing shanty, or similar structure, upon the ice of any lake, and leave it there unattended during hours of darkness, unless the shanty is marked with a bright orange reflectorized paint or tape at least three (3) inches wide,

5-6

applied in a continuous strip on all sides, not less than two (2) feet nor more than four (4) feet above the level of the ice.

SECTION 11.08 LITTERING

(a) No person shall place, throw or otherwise deposit any cans, bottles, debris, garbage, refuse, waste, sewage or effluent into or on the waters, ice or shores of GEORGE LAKE and any person who shall violate this section shall, upon conviction, pay the cost of removal in addition to any fine or forfeiture.

SECTION 11.09 MOTOR VEHICLES ON THE ICE

(a) No person shall operate any motor vehicle as (defined in Chapter 340.01 Wis. Stats.) on the ice of GEORGE LAKE at any time, except that a vehicle equipped with a snow plow may operate on the ice at their own risk for the purpose of snow plowing and such vehicle must be removed from the ice as soon as the vehicle has completed plowing the area.

SECTION 11.10 PUBLIC BEACHES

(a) There shall be two (2) public beaches on GEORGE LAKE located at 101st Street, immediately north of 192nd Avenue, and the fire lane on 103rd Street. Said public beaches shall be closed at ten (10:00) p.m. each night and remain closed until sunrise of the following day.

(b) No person shall enter, or remain, on the property or the adjacent water area of a public beach during the period of time that the beach is closed.

(c) No person shall allow a pet to be on any public beach area at any time.

11.11 PENALTIES AND FORFEITURES

(a) Any person convicted of violation of Section 11.02 of this Ordinance shall be subject to fines and forfeitures set forth in

5-1

Section 30.80, Wis. Stats., with references to imprisonment deleted. Uniform deposit and bail schedule established by Wisconsin Judicial Conference shall be applicable to citations issued under Section 11.02.

(b) The penalties for violation of any other section of this Ordinance shall, upon conviction, be subject to a fine or forfeiture of not less than $25.00 or more than $100.00 for the first offence, and not less than $50.00 or more than $200.00 for a second offence within one year of the first conviction. Deposits shall be as set forth in Chapter 12 (A) of the Municipal Code of Bristol.

(c) This Ordinance shall become effective upon posting in all public access points as required by Section 30.77(4) and Section 60.80 Wisconsin Statutes.

Enacted this 12 day of July 1993.

Audrey Van Slochteren
AUDREY VAN SLOCHTEREN, CHAIRPERSON

Gloria Bailey
GLORIA BAILEY, CLERK

5-0

Rocky

Rothrock & Kendall
19806 83rd Street
Bristol WI 53104

Re: George Lake Ordinance Revision to Chapter 11 Town of Bristol

The committee has reviewed the proposed ordinance contained in your correspondence of 5-29-92 and has the following comments.

1. The original proposal to the electorate covered the narrow issue of lake usage and the vote taken addressed that issue only. We did this as we were advised by the DNR that specific lakes within a jurisdiction could have different rules on lake usage under current statutes. Our intention was to adopt Wisconsin State law by reference except in the area of lake usage. We didn't plan on asking Bristol to change anything other than an addendum to chapter 11 (for George Lake only) which addressed the narrow issue of lake usage during the summer. Contained in Exhibit A attached. We were advised by the DNR to use the guidelines contained in the "ordinance writing" document also attached.

2. With that as background , the reconciling of a complete revamping of Chapter 11 to the narrow issue and addressing new changes to other issues required additional review.

COMMENTS:

a. 11.03 (b) Reference to Type of vest should default to Wisconsin statutes as Coast Guard approval of flotation wet suits with another type is imminent according to the trade papers. Do not restrict number of lines as helping youngsters learn many times requires additional skiers. Do not restrict boat patterns as we want to encourage strait runs which create significantly less dangerous wakes.

b. 11.04 (c) We currently have two swimming beaches with proposals for a third. They are at 101st & 192nd Ave., on the East side the terminus of 103rd into the lake and on the West side the terminus of 103rd into the lake. The latter two are 50 wide with the East side beach buoyed.

c. 11.05 (a) (1) We are not in favor of permits for rafts or piers. It seems if it ever became a problem we would have to address the issue. It seems like unnecessary town bookkeeping and for what we don't know. (b.) (1.) We believe it would be safe to have an

attended raft more than 100 feet from shore as it is necessary for some to go that far to get enough depth to dive. What we favor is to have no raft left out passed 100 feet unattended. (c.) (1.) 50 feet would again be better as some owners have to be out fifty feet for their boat to float in times of low water. (2.) March 15 would be a better date as ice out is usually the first week in March. (d) We are not in favor of mooring buoys at any time and as we have no one using them, we see no need for the reference. State law covers it and we see no need for the Town Clerk to have to provide permits.

d. 11.09 (a) previous reference to three public beaches although the third has not been developed we would encourage wording that included it as a future beach.

CHAPTER 10

BOATING ORDINANCE

TOWN OF BRISTOL

10.01 INTENT

The intent of this ordinance is to provide safe and healthful conditions for the enjoyment of aquatic recreation consistent with public rights and interest and the capability of the water resource.

10.02 APPLICABILITY AND ENFORCEMENT

The provisions of this ordinance shall apply to all of the waters of Lake Shangrila and Benet Lake located in the Town of Bristol and the Town of Salem; and to all other lakes in the Town of Bristol, Kenosha County, Wisconsin.

The provisions of this ordinance shall be enforced on Lakes Shangrila and Benet jointly by the officers of the Town of Bristol and the officers of the Town of Salem who are authorized to do so. On all other lakes in Bristol Town, the provisions of this ordinance shall be enforced by the officers of the Town of Bristol.

The provisions of this ordinance shall not apply to the operator of a duly authorized patrol boat when operated in the performance of duty, and if due regard is given to the safety of other persons in the vicinity.

10.03 DEFINITIONS

SHOREZONE: Shall mean the water area within 200 feet of the shoreline on any lake.

All other terms used in this ordinance shall have the definition set forth in Wisconsin Statutes Section 30.50.

10.04 STATE BOATING LAWS ADOPTED

All of the provisions of Wisconsin Statutes Sections 30.50 to 30.71, and 30.80, inclusive are herewith adopted by reference as though fully set forth herein.

10.05 SPEED RESTRICTIONS

No person shall operate a motorboat in excess of slow -no-wake speed:

a) within the shore zone on any lake at any time.

b) on any portion of any lake between the hours of 7:00 pm and 10:00 am.

10.06 WATER SKIING

No person shall operate a boat towing persons on waterskis, aquaplane, inflatable or similiar device; and no person shall engage in those activities:

a) when there are more than two persons being towed behind the boat at one time.

b) unless the boat is being operated in a counterclockwise direction around the lake.

c) unless each person being towed is wearing a USCG approved type 1, 2 or 3 personal floatation device.

d) on the waters of Lake George at any time.

10.07 SWIMMING

1. No person shall swim from any boat unless the boat is attended by a competent observer who is in the boat, and unless the swimmer stays within 25 feet of the boat.

2. No person shall swim outside of the shore zone unless accompanied by a boat, and the requirements in (1) are met.

10.08 SWIMMING AREAS ESTABLISHED

The following described areas are hereby declared swimming areas, and shall be buoyed according to the permit issued for that area.

1) (enter swim areas here).

2)

10.09 RACES, REGATTAS, SPECIAL EVENTS

No person shall direct or participate in any boat race, regatta, water ski meet or exhibition, or any other water sporting event, or any fishing contest or derby, unless the event has been authorized, and a permit issued, by the Town of Bristol. On Lakes Shangrila and Benet the authorization and permit shall be issued jointly by the Town of Bristol and the Town of Salem.

A permit issued under this section shall specify the area of water to be used, and the permittee may be required to place markers or buoys designating the specified area.

The permit may also grant a waiver of sections 10.05 and 10.06 to the permittee and any participants.

Boats and participants in any permitted area shall have the right of way within the marked area, and no person shall obstruct the area during the event, or interfere with the event, boats or participants.

10.10 PENALTIES

Any person violating the provisions of this ordinance for which a penalty is not otherwise specifically provided in State Statutes Section 30.80 shall forfeit not more than $50.00 for the first offense, and shall forfeit not more than $100.00 upon conviction of the same offense for a second or subsequent time within one year.

Section 6 - Conclusions

Dredging

According to the 1992 updated Feasibility Study from SEWRPC, that "while dredging is an expensive operation in the short-term, the dredging of George Lake is likely to have long-term effects which will extend the life of the Lake well into the next century. This management option should continue to be considered by the George Lake District Commissioners and electors when compiling the management plan for George Lake."

Discussions at District Meetings has changed the focus of weed control and sediment loading from dredging to mechanical harvesting and watershed management. Factors influencing these decisions include the high cost of a partial dredge ($1.5 million), the questionable results of a partial dredge, and the long-term affectiveness of the dredge.

Mechanical Harvesting

Alternatives in the 1992 SEWRPC report include mechanical weed harvesting as a viable option for George Lake The Lake District has pursued that option with the purchase of a weed harvester in 1993. The weed harvester was purchased through a 50/50 cost sharing program with the State of Wisconsin Waterways Commission

Sediment loading is estimated by SEWRPC to be at a rate of .5" per year due to improvements in the watershed since 1989. Much of the existing sediment in the lake is due to poor watershed practices before 1989 and an accumulation of dead plant material. A 1976-1977 study conducted by the District and DNR states that the increase in lake sediment was due to "the death and settlement of plant material to the lake's bottom, and by material carried directly by the inlet streams." A change from chemical control of problem aquatic weeds to mechanical harvesting will reduce the amount of additional sediment caused by decaying plant material.

Watershed Management

A 1993 Watershed Study conducted by Aron & Associates recommends that protection of the watershed's wetlands is needed to provide good filtration. Much of the wetlands have been degraded by invasions of purple loofestrife and lack of buffer strips surrounding the wetlands. The District has a purple loofestrive program to monitor and eliminate the plant from the wetlands There has been a reduction in loofestrife in treated areas. Areas in need of buffer strips are being identified. Cost sharing programs have been discussed with the Kenosha County Planning & Zoning, Pam Wallis, regarding a buffer strip on the north side of the lake by 101st street.

Education

Education of watershed residents is crucial to improving management practices. Newsletters and informational flyers from the U of W Extension Service and DNR have been including in District Mailings. The DNR publication "Life on the Edge" has been ordered for all lakefront residents and will be distributed by the District. A meeting of farmers in the watershed to discuss farming practices and their effect on the lake is being considered. Bristol Farms has implemented many farming practices that have reduced non-point source pollution and would be willing to host show these techniques to other farmers in our watershed.

Erosion Control

An erosion control ordinance that will protect the watershed and lake has been discussed by the District. Future discussion at District Meetings should determine if this should be pursued. The Town of Bristol currently has an erosion control ordinance for new construction but does cover changes in existing construction or the special needs of a lake.

Section 6 - Conclusions (cont.)

Water Use Ordinance

A water use ordinance that would address the needs of the recreational use of the lake, lake protection, and wildlife habitat was desired. The process in forming this ordinance included informal discussion of residents, formal discussions at District meetings, a volunteer committee to research ordinance requirements, three options presented to residents in a District mailing, and a special meeting held in April 1992.

Signs at the beaches and boat access as well as mailings and public meetings has informed residents and other lake users of the restrictions.

EXHIBIT B

SEC. 20
TOWNSHIP 21 E.
RANGE BRISTOL
TOWN KENOSHA
COUNTY
AREA 70 Acres
TOTAL SHORELINE
MAX DEPTH 18'
SCALE 1" = 200'
To U.S.H. 45
To U.S.H. 45
Sec. 20
Sec 31
Outlet to Dutch Gap Canal
1/4 Line
1/4 Line
Marsh Land
Ditch
Dam
Spike in base of oak tree
B.M. 4.7' above ice
DATE 2-5-52
SOURCE OF INFORMATION Soundings by W.C.D. Engineering Div.
SOUNDINGS 200' Grids
Sec 20
Sec 31
2
4
6
12
18
N

A-1

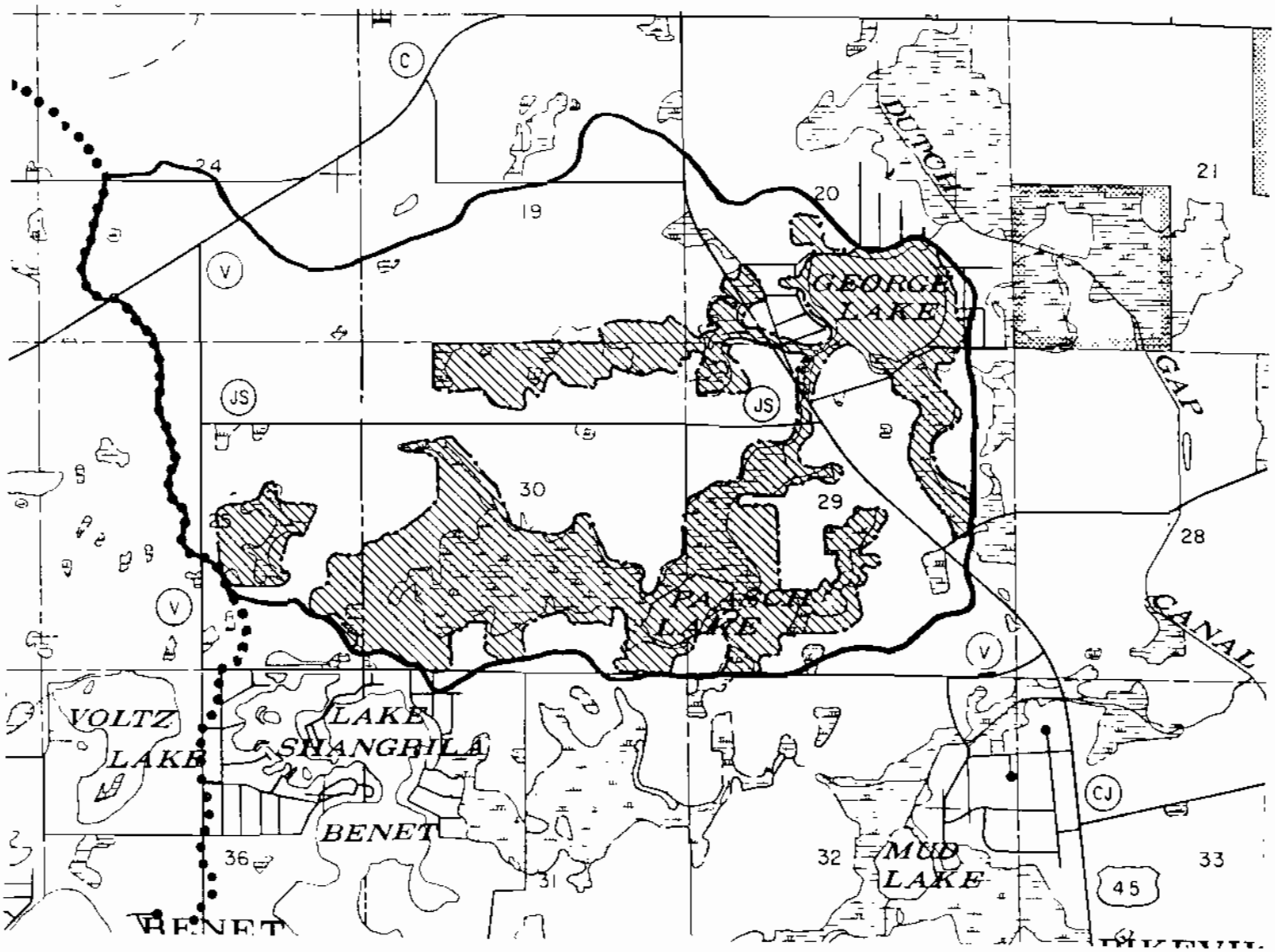


Exhibit A

PRIMARY ENVIRONMENTAL CORRIDORS WITHIN THE GEORGE LAKE WATERSHED

LEGEND

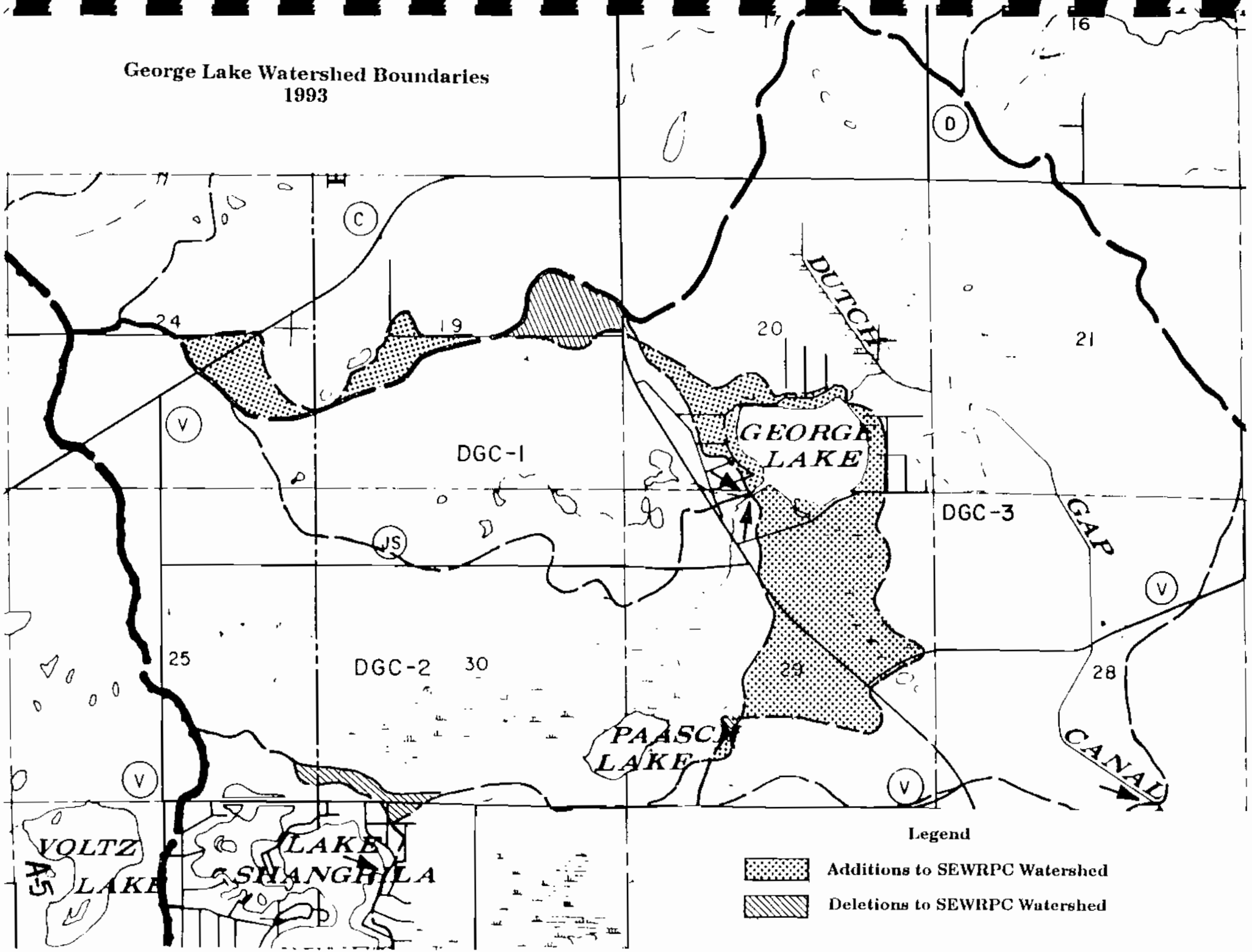
GEORGE LAKE WATERSHED BOUNDARY

PRIMARY ENVIRONMENTAL CORRIDOR

Source: SEWRPC.

GRAPHIC SCALE

0' 2000' 4000'


George Lake Watershed Boundaries
1993
DGC-1
DGC-2
DGC-3
GEORGE LAKE
PAASCH LAKE
LAKE SHANGRILA
VOLTZ LAKE
DUTCH GAP CANAL
Legend
Additions to SEWRPC Watershed
Deletions to SEWRPC Watershed