R.A.SMITH
& ASSOCIATES, INC.

IROGAMI LAKE MANAGEMENT PLAN

Irogami Lake Management District
Waushara County, Wisconsin

Project No.: 1937600-261

June 2, 1995

R.A.SMITH
& ASSOCIATES, INC.

June 2, 1995

Mr. William J. Downie, Chairman
Irogami Lake Management District
Route 2, Box 95
Wautoma, WI 54982

Re: Irogami Lake Management Plan

Dear Mr. Downie:

I am pleased to submit to you the final Irogami Lake Management Plan. I trust that this report will be your guide for lake management activities now and into the future. I applaud your efforts to maintain and preserve the integrity and quality of Irogami Lake and its natural environment. I wish you the best of luck in implementing this plan. If I can be of further assistance, please feel free to contact me.

Sincerely,
R. A. SMITH & ASSOCIATES, INC.

Mark Doneux

Mark J. Doneux
Environmental Scientist

cc: Tim Rasman, WDNR, Lake Michigan District

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Construction Services
Environmental
Public Works
Site Development
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Transportation
Water Resources

SUMMARY

R. A. Smith and Associates prepared a feasibility study addressing the current concerns of the Irogami Lake Management District. In-lake monitoring was conducted, watershed inventories were updated, and management alternatives were re-examined under current lake conditions. Recommendations for management alternatives have also been considered.

CHAPTER 1

INTRODUCTION

Location and Description

Irogami Lake is a 288 acre lake located in central Waushara County, 3 miles east of the City of Wautoma, in the Towns of Marion and Mount Morris (See Figure 1). The lake has a maximum depth of 8 feet, with a mean depth of 2.5 feet. The watershed including Irogami Lake is 962 acres.

Background

As a shallow body of water, Irogami Lake experiences dense populations of rooted aquatic plants. In 1981, a study of the lake was conducted under Wisconsin's Inland Lake Renewal Program and submerged aquatic plant cover was estimated at more than 50% (WDNR, 1983). In 1983 the Wisconsin Department of Natural Resources prepared a feasibility study and reviewed lake management alternatives addressing the control of rooted aquatic plants; however, no recommendations were made for a course of action.

Scope and Objectives

The proposed study includes three components; in-lake monitoring, an updated watershed inventory, and preparation of a lake management plan. Water quality analysis was constructed in order to identify changes since the 1983 WDNR report and to predict future trends of the lake. An inventory of the watershed drainage area and nonpoint sources of pollution was constructed to isolate changes from the earlier study by the WDNR. Also, with the realignment of STH 21, new proposals for lake management alternatives, their feasibility, and costs have been prepared.

WAUSHARA CO.

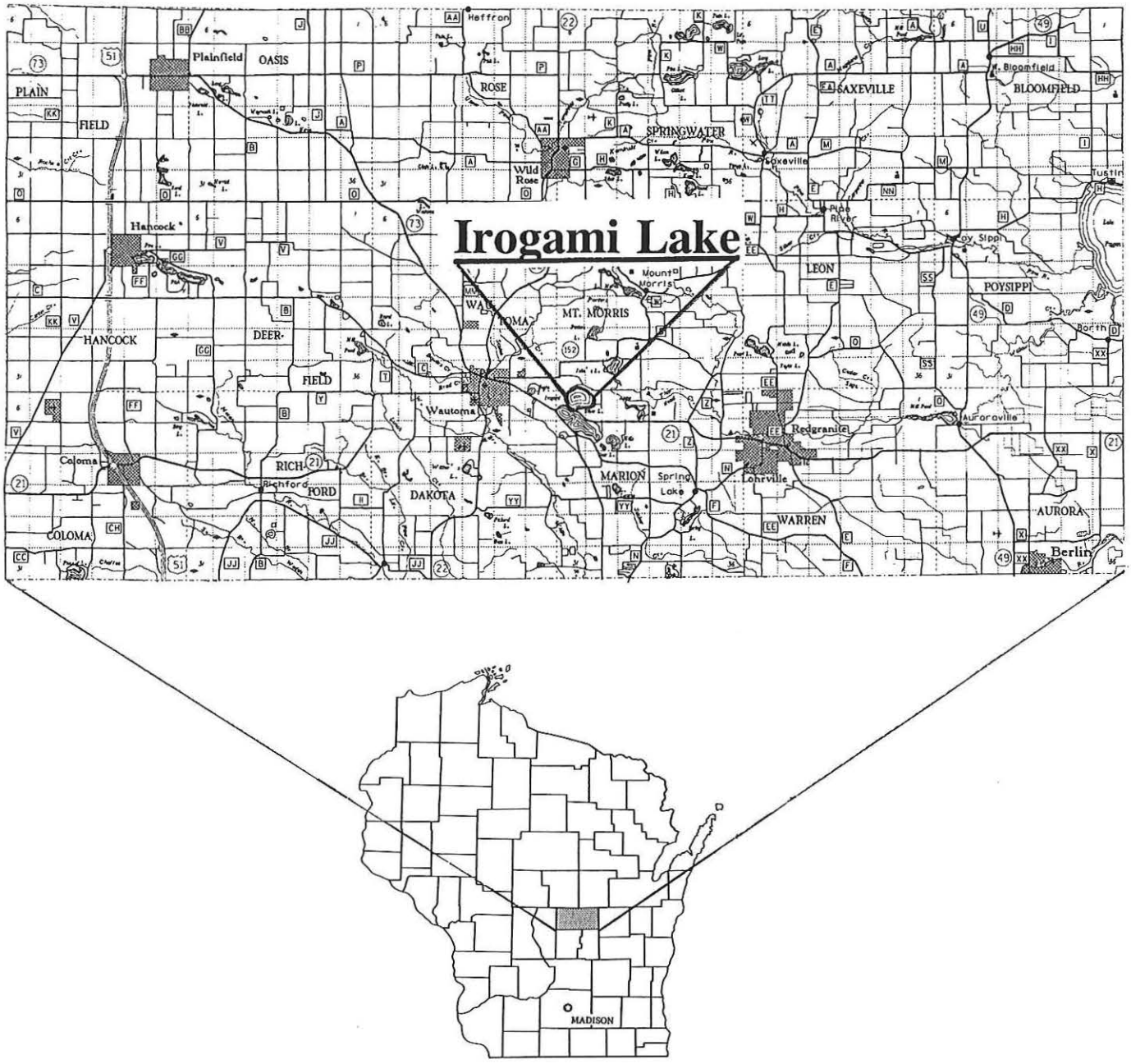

FIGURE 1	Source: Wis. Dept. of Transportation Waushara County Map not to scale
Irogami Lake Management District Waushara County, Wisconsin	
PROJECT LOCATION MAP	

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CHAPTER 2

WATERSHED STUDY AREA

Watershed Area

The Irogami Lake watershed area consists of approximately 674 acres, divisible into two subbasins relating to Direct and Indirect drainage systems. The corresponding acreage in these subbasins is as follows.

Subbasin (Direct)	273.5
Subbasin (Indirect)	400.5
Total	**674.0**

These sub-basins are important in distinguishing surface water runoff components and in locating areas of concern within the watershed. Figure 2 outlines the Irogami watershed and the corresponding subbasins.

Land Use, Soils and Hydrology

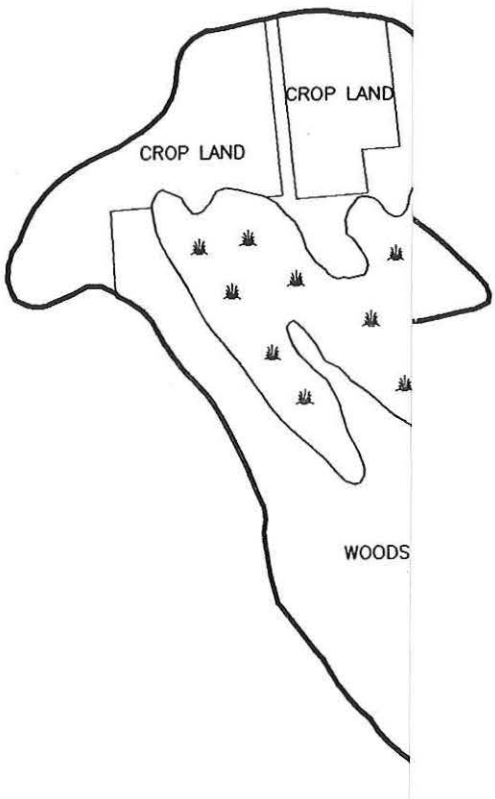
Each subbasin was delineated for specific quantification of land parameters required for water quality analysis. These parameters include functional land use, slopes, and soils. The parameters are described as follows:

LAND USE

In classifying sub-basins, the "Direct" drainage basin refers to the area contributing overland flow to Irogami Lake, "Indirect" refers to the land area contributing subsurface water or groundwater to Irogami Lake.

Land use in the two subbasins is further delineated using surface characteristics. The six categories identified in the Irogami Lake watershed include: Woodland, Cropland, Residential, Wetland, Gravel Pit and Water. Table 1 indicates the acreage which corresponds with each land type, within each subbasin. Each land use category was defined using a combination of current aerial photographs and Wisconsin wetland inventory maps, along with field verification. The acreage corresponding to each land use type was then totalled for each subbasin. The subbasins are defined as follows: 1 -Direct subbasin, 2 - Indirect subbasin. These acreages correspond closely with the 1983 feasibility study conducted by the Wisconsin Department of Natural Resources.

OUNDARIES FOR IROGAMI LAKE



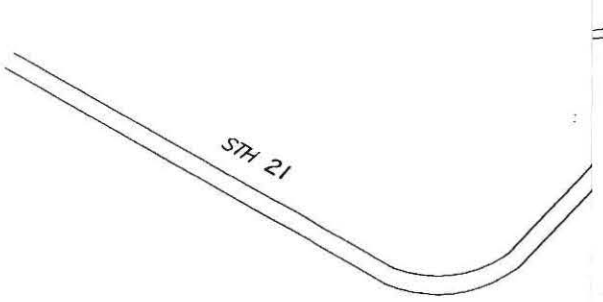


Figure 2

R.A.SMITH & ASSOCIATES, INC.	*Engineering driven by vision*	414-786-1777 FAX 786-0826 16745 W. Bluemound Rd, Suite 301 Brookfield, WI 53005-5938	
IROGAMI LAKE			
WAUSHARA, COUNTY			
WATERSHED & LANDUSE BOUNDARIES			
SCALE: 1" = 400'		JOB NO. 93760-0-342-342	DATE: 9/2/94
DESIGNED BY:	DRAWN BY: N.E.T.	CHECKED BY:	
REVISED: 12/8/94			SHEET OF

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TABLE 1

Irogami Lake Watershed Land Use

	LAND USE (acres)						
Subwatershed	**Woodland**	**Cropland**	**Residential**	**Wetland**	**Gravel Pit**	**Water**	**Total**
1	131.4	64.2	64.7	11.1	0.0	2.1	273.5
2	190.0	159.1	4.8	37.8	7.9	0.9	400.5
Total	321.4	223.3	69.5	48.9	7.9	3.0	674.0

SOILS AND HYDROLOGY

The predominant soil type in the watershed is Richford Loamy Sand (50%). Secondary soil types include Boyer Loamy Sand (20%), Plainfield Sand (10%), and Houghton Muck (5%). Figure 3 outlines the soil types. The soils and their corresponding hydrology are described in more detail below.

Richford Series

"The Richford series (Rf-) consists of somewhat excessively drained soils on outwash plains and stream terraces. These soils formed in loamy and sandy outwash deposits. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. Slope ranges from 0 to 20 percent."[1] Depth to the water table is typically greater than six feet. The native vegetation is coniferous forest consisting of jack pine, red pine and eastern white pine.

Plainfield Series

"The Plainfield series (Pf-) consists of excessively drained and moderately well drained soils on outwash plains, stream terraces, and moraines. These soils formed in sand and permeability is rapid. Slope ranges from 0 to 30 percent."[1] Depth to the water table is typically greater than six feet. The native vegetation is coniferous forest, similar to the Richford series.

Boyer Series

"The Boyer series (By-) consists of well drained soils on outwash plains and moraines. These soils formed in sandy and loamy deposits over sand or gravelly sand. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Slope ranges from 2 to 20 percent."[1] Depth to the water table is typically greater than six feet. The native vegetation is forest consisting of red pine, white spruce, jack pine, green ash and Norway spruce.

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[1]United States Department of Agriculture, Soil Conservation Service. Soil Survey of Waushara County, Wisconsin, September 1989.

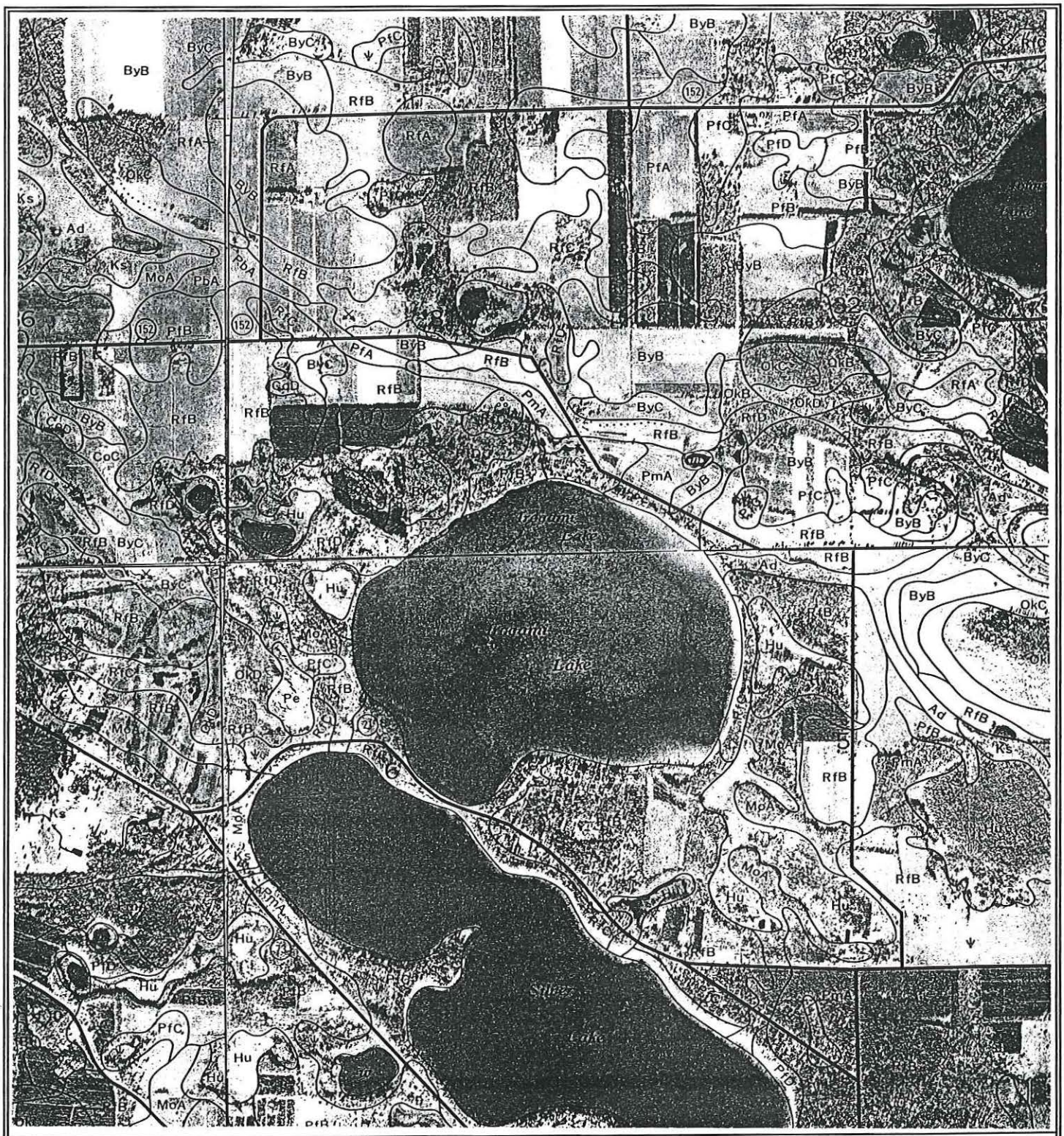

FIGURE 3	Source: U.S.D.A., Soil Conservation Service, Soil Survey for Waushara County Scale: 1:20,000
Irogami Lake Management District Waushara County, Wisconsin	R.A.SMITH & ASSOCIATES, INC. *Engineering driven by vision* 414-786-1777 FAX 786-0826 16745 W. Bluemound Rd, Suite 301 Brookfield, WI 53005-5938
SOILS MAP	

Houghton Series

"The Houghton series (Hu) consists of very poorly drained soils on outwash plains and moraines. These soils formed in more than 51 inches of organic material. Permeability is moderately slow to moderately rapid. Slope is 0 to 1 percent."[1] Depth to the water table typically ranges from one foot deep to a foot above the ground surface. The period for high water tables occurs through the months of September to June. The native vegetation is northern white-cedar, green ash and common ninebark.

Soils classifications are coded using a system of letters and numbers. The first two letters are an abbreviation of the soil name. The third letter, always capitalized, indicates relative slope. If only two letters are present, the land is typically level or nearly level in slope. The final number in the map symbology designates levels of erosion. The number "2" indicates moderately eroded soil, "3" severely eroded.

Environmentally Sensitive Areas

ERODIBLE SOILS AND STEEP SLOPES

The critical soil in the Irogami watershed is the Richford Loamy Sand with slopes varying from 12 to 20 percent (classified as RfD), located on the northwest side of the lake. The majority of these steep sloped soils lie on the border between the Direct and Indirect drainage basins. The steep slopes and terraces are generally wooded and have undergone minimum erosion. Clearing of woodlands would, however, create a strong potential for soil movement.

WETLANDS

Forty-nine acres of wetlands lie in the Irogami Lake watershed, with 37.8 acres lying in the Indirect subbasin and 11.1 acres in the Direct subbasin. These areas vary from small Aquatic Beds (A3/W0H) of Duckweed and Emergent/Wet Meadows (E2H) of cattails on the western edge of the drainage basin, to Wet Meadows (E1K) of varying sizes bordering the eastern edge of the lake. (See Figure 4 for details of wetland locations). Wetlands are often areas of groundwater recharge and can be very sensitive to human impact.

Wetland classes are established using vegetation, hydrology and existing geology of a particular site. A typical classification may have up to four identifiers (E1Ka) with the first identifying the class (Wet meadow); the second signifying the subclass (Persistent); the third, a hydrologic modifier (Wet soil, Palustrine); and the last, a special modifier (Abandoned cropland). Further details of Irogami Lake wetland classifications are listed in the appendix. Wetland inventory maps are available from the Wisconsin Department of Natural Resources Bureau of Planning.

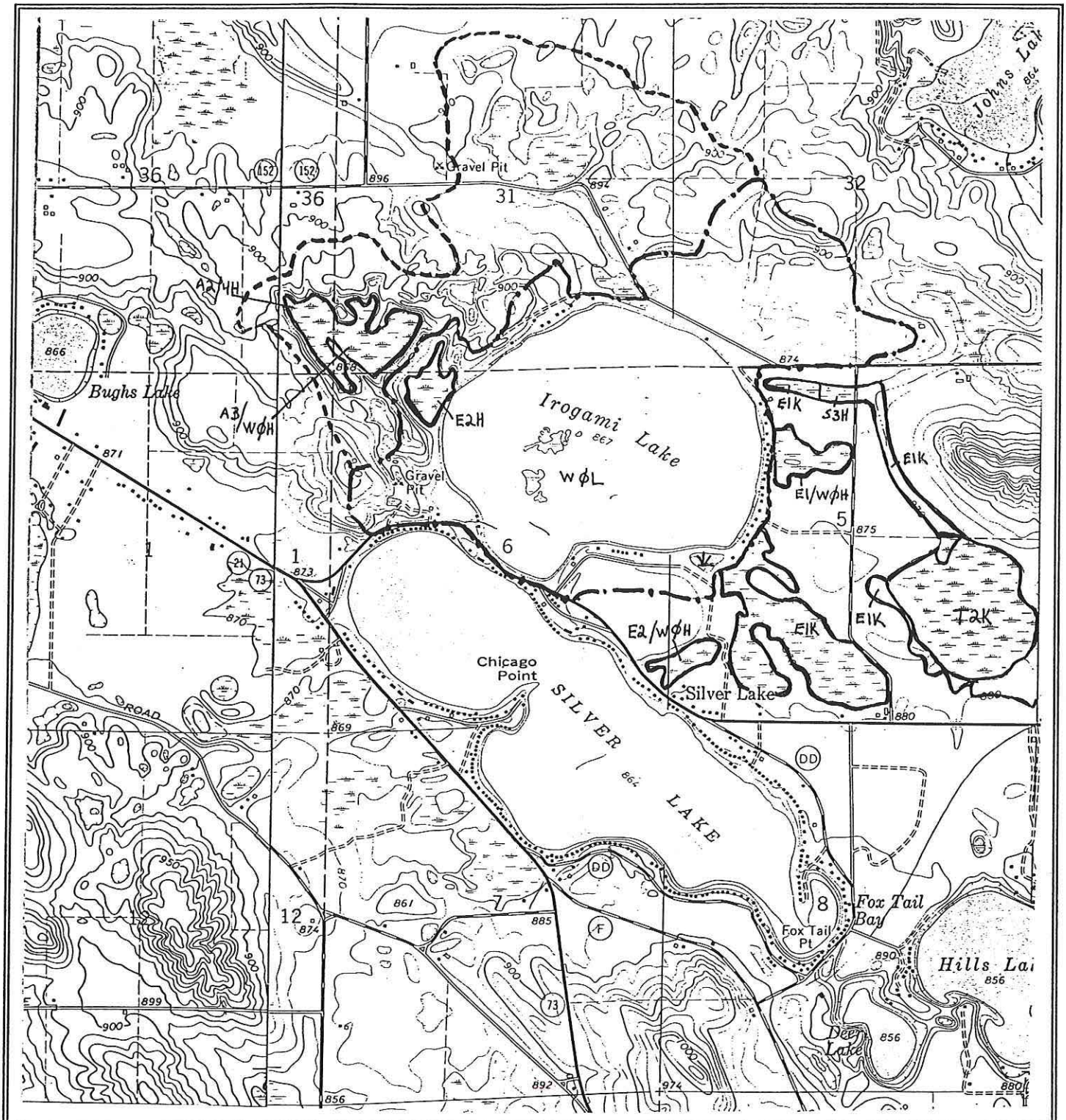

FIGURE 4	Source: 1979 WDNR Wisconsin Wetlands Inventory Maps for Waushara County, T19 R10E, T19 R11E, T18 R10E, T18 R11E. Scale: Approximately 1"=2000'
Irogami Lake Management District Waushara County, Wisconsin	
WETLANDS INVENTORY MAP	R.A.SMITH & ASSOCIATES, INC. *Engineering driven by vision* 414-786-1777 FAX 786-0826 16745 W. Bluemound Rd, Suite 301 Brookfield, WI 53005-5938

CHAPTER 3

WATER QUALITY ANALYSIS

Factors of Influence

Two basic nutrients, phosphorus and nitrogen, can dramatically affect the quality of water. Phosphorus and nitrogen concentrations are associated with algae content, water clarity, dissolved oxygen concentrations, and fish populations. Both nutrients originate from a variety of sources, including soil erosion, septic systems, and surface runoff. Various tests have been conducted to interpret the affect these nutrients have had on Irogami Lake.

Past and Present In-Lake Water Quality Data

Over ten years have elapsed since the last Irogami Lake watershed study, allowing for data comparison and possible analysis of Irogami Lake trends. Table 2 categorizes the changes which have occurred in phosphorus loading of the lake. As indicated, total loads vary by 11.7 lbs/year. This is partly attributable to the elimination of septic lines entering the lake and partly due to the change in land use over the last decade. Crop acreage has declined over the last ten years, but an increase in use of fertilizer may account for the consistency of phosphorus loading from agriculture. Residential acreage has almost tripled in the last decade and so has the corresponding phosphorus loading. Overall, estimates of phosphorus loading have been reduced by 14%. This is a positive sign for the Lake district.

TABLE 2

Total Phosphorus

Source	1983 lbs./year	Percent	1994 lbs./year	Percent
Agriculture	73	44	68.1	45
Forest	12.4	8	8.1	5
Residential	6.5	4	16.9	11
Wetlands	1.0	1	1	1
Precipitation	54.7	33	57.9	38
Septic Tanks	16.1	10	0	0
Total	163.7	100	152.0	100

Nutrient Loading

In order to properly interpret and plan for the water quality future of the lake, Eutromod software was used. Table 3 indicates the information which was input into the Eutromod system along with other measured variables to properly evaluate the Irogami Lake watershed and water quality conditions. The input data in Table 3, are the specific characteristics of the Irogami watershed.

The resulting land acreages, when analyzed with the model, give the results indicted in Table 4. As indicted, the majority of Phosphorus and Nitrogen entering the lake come from the agricultural acreage. In examining the total watershed, the Phosphorus and Nitrogen contribution is 8.5 and 10.5 times greater from cropland, even though woodland covers more acreage. This is typical for agricultural lands due to the continual fertilizing and working of the soils. It should also be noted that simple precipitation can be a significant contributor to nutrient loading.

TABLE 3

Irogami Lake Eutromod Input Data

	Total Combined Watershed	Subbasin 1 Direct
TROPHIC MODEL INPUT		
Loading Period	365 days	365 days
Lake Volume	1668 acre-feet	1668 acre-feet
Lake Surface Area	288 acres	288 acres
UNCERTAINTY MODEL INPUT		
Area of Watershed	674 acres	273.5 acres
Annual Unit Runoff	4.35 inches/year	4.35 inches/year
Lake Surface Area	288 acres	288 acres
Annual Precipitation	29.44 inches/year	29.44 inches/year
AREA LAND USE	**Acres**	**Acres**
Woodland	321.4	131.4
Cropland	223.3	64.2
Residential	69.5	64.7
Wetland	48.9	11.1
Gravel Pits	7.9	0
Water	1.3	2.1

Trophic State

Trophic state is a second type of water quality indicator. Three categories; oligotrophic, mesotrophic, and eutrophic, are defined according to a lake's nutrient and clarity levels. Irogami Lake can be categorized as mesotrophic (see Figure 5). This trophic state typically supports a wide range of fish with moderate weed conditions.

Irogami Lake

1993-1994 Trophic State Index

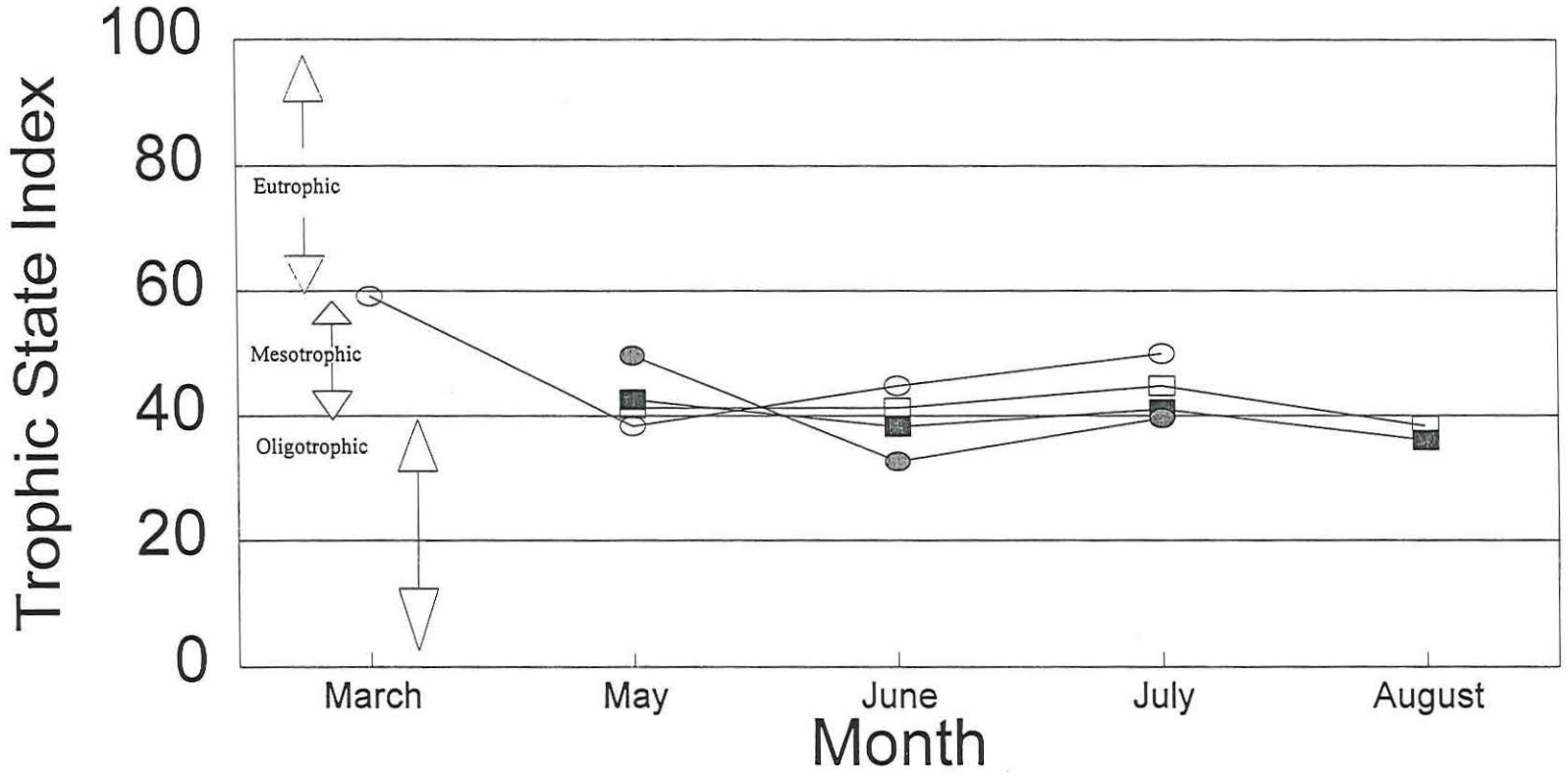

Figure 5

Source: R.A. Smith & Assoc., Inc.1994

TROPHIC STATUS INDICATORS

The average Total Phosphorus content of Irogami Lake as measured throughout 1993 and 1994 is.0196 mg/l. This is categorized as good to very good on a water quality index scale. (Adapted from Lillie and Mason, 1983). (Table 5).

Chlorophyll "a" measures algae content and contributes to the trophic status of Irogami Lake. Two years of collected data average 2.99 ug/l, classified as high clarity for a mesotrophic lake.

Secchi disc, a measure of water clarity, is constant at six feet (lake bottom) which indicates good water clarity.

TABLE 4

Irogami Lake Eutromod Model Results

	Total Watershed		**Direct Watershed**	
Trophic	Phosphorus	Nitrogen	Phosphorus	Nitrogen
State				
Prediction	lb/year	lb/year	lb/year	lb/year
Method				
Agriculture	68.13	2189.29	19.58	628.26
Forest	8.06	203.09	3.27	67.01
Urban	16.93	126.97	15.11	113.31
Feedlots	0	0	0	0
Precipitation	57.92	193.05	57.92	193.05
Septic Tanks	0	0	0	0
Point Sources	0	0	0	0
Total	**151.04**	**2712.4**	**95.88**	**1001.63**

TABLE 5

Irogami Lake Actual Water Quality Results

	1993 & 1994	
Total Phosphorus (mg/l)	Chlorophyll a (ug/l)	Secchi Depth (meters)
0.0196	2.99	1.83

Eutromod analysis of these same variables was also conducted, with similar results (Table 6). Eutromod computations for prediction purposes are more conservative and therefore, variations between predicted and actual results are present. These predictions, however, are very useful in determining future changes in the water quality situation. The Eutromod TSI, or Trophic State Index, of 53.92 for the total watershed reaffirms Irogami's position as a mesotrophic lake.

TABLE 6

Irogami Lake Eutromod Predicted Lake Trophic Status
Predicted Lake Trophic State Variables

		Predicted Lake Trophic State Variables					
Total Phosphorus (mg/l)		Chlorophyll a (ug/l)		Secchi Depth (meters)		TSI	
Total	Direct	Total	Direct	Total	Direct	Total	Direct
0.0234	0.0225	14.83	15.25	1.40	1.49	53.92	53.55

DISSOLVED OXYGEN

Oxygen content of water is a key component for survival of aquatic organisms. Oxygen solubility depends on temperature, with lower temperatures allowing greater oxygen holding capacity. Continual mixing of water with air is essential for water bodies to maintain oxygen levels and consequently, winter ice cover reduces dissolved oxygen by reducing air/water interaction. Through photosynthesis, plants produce oxygen during daylight hours and use oxygen (via respiration) during evening hours. Generally, fish require a minimum of 3 mg/l of dissolved oxygen, however, some species need over 5 mg/l for survival. Typical dissolved oxygen levels for Irogami Lake for summer months are shown in Table 7, all quite sufficient for a strong fish habitat. However, a common problem in shallow Wisconsin lakes

is winter depletion of oxygen due to a high snow cover and inability of aquatic plants to photosynthesize. Although late spring and summer oxygen levels are sufficient, March values (Table 7) indicate an oxygen level of 3 mg/l, borderline for fish survival in Irogami Lake. In fact, any time snow cover is greater than 4 inches, this problem is likely to develop. Various approaches can be taken to minimize this problem, as discussed in the alternatives section of this report.

TABLE 7

Temperature and Dissolved Oxygen Profile 1993 and 1994

1994	April 19		June 15		July 11		August 17	
Depth (feet)	**Temp. (C)**	**DO (mg/l)**	**Temp. (C)**	**DO (mg/l)**	**Temp. (C)**	**DO (mg/l)**	**Temp.(C)**	**DO (mg/l)**
Surface	12.0	7.0	26.5	8.4	23.5	9.6	22.5	10.9
2	12.0	7.0	26.2	8.2	23.3	9.7	22.5	11.5
4	12.0	6.9	26.1	8.6	23.3	9.7	22.2	11.6
6	12.0	7.0	26.1	8.6	23.5	9.8	22.2	11.6
1993	**May 12**		**June 23**		**July 27**		**August 25**	
Surface	20.9	9.6	22.5	9.2	23.8	8.2	27.0	9.2
2	20.9	9.6	22.5	9.2	23.8	8.2	27.0	9.2
4	20.9	9.5	22.5	9.2	23.8	8.2	27.0	9.2
6	20.9	9.5	22.5	9.2	23.8	8.1	26.0	9.2

Eutromod Predictions - 1994 versus 2003

To illustrate typical urbanization of the "Irogami" community over the next decade, the Eutromod model was adjusted to demonstrate a land use shift. As indicted in Table 8, the proposed changes reduced agricultural land by approximately half, with 20 percent placed in woodland and 80 percent being split between residential and commercial development. With these changes incorporated, there is a 16 percent reduction in total phosphorus loading and a 39 percent reduction in nitrogen loading. Trophic State Index drops to 52.7 from 53.9. The lake classification remains in the mesotrophic category, but water quality would improve slightly under these conditions.

TABLE 8

Irogami Lake Eutromod Model Results
Eutromod Results

		Total Watershed				
		1994		2003		
Trophic		Phosphorus	Nitrogen	Phosphorous	Nitrogen	
State						
Prediction		lb/yr	lb/yr	lb/yr	lb/yr	
Method						
	Acres			Acres		
Agriculture	223.3	68.13	2189.29	99.8	30.58	1001.05
Woodland	321.4	8.06	203.09	346.3	8.69	234.45
Residential	69.5	16.93	126.97	120.3	20.34	152.75
Commercial	0	0	0	49.4	8.35	62.71
Precipitation	0	57.92	193.05	0	57.92	193.05
Septic Tanks	0	0	0	0	0	0
Total		**151.04**	**2712.4**		**125.88**	**1644.01**

CHAPTER 4

RECOMMENDATIONS

Possible Inlake Alternatives

Four alternatives have been developed in consideration of management plans. Criteria used in selecting the best alternative include:

1. Will the hydrologic cycle be significantly altered?
2. Is the solution economically feasible?
3. Will the intended alternative minimize environmental impact?
4. Will the alternative solve the outlined concerns?

ALTERNATIVE 1 - MAINTAIN EXISTING CONDITIONS

Since the lake currently has good water clarity and sufficient oxygen for good fish habitat, this is the most economical alternative. Maintaining the current conditions will not alter the hydrologic cycle or have any dramatic impact on the environment. It will not, however, eliminate the sporadic winter fish kills.

ALTERNATIVE 2 - WEED HARVESTING

Regular removal of aquatic species located in the western and central portion of the lake would improve the recreational environment. Harvesting of submergent species throughout the summer months will reduce boater/skier interference and begin to reduce the percent of years with winter fish kill. Small harvesters may be acquired for $15,000 to $20,000. Additional operating costs must be considered for individuals to operate the equipment and to remove the plant material. Weed harvesting is economical, and because of the ability to be selective, minimizes environmental impact.

ALTERNATIVE 3 - WINTER AERATION

The largest threat to sport fishing in Irogami Lake is the periodic winter fish kills due to low oxygen content. Artificial aeration and resulting lake mixing would aide in preventing oxygen depletion. Aeration options include diffused aeration, mechanical sprayers, pump-chute systems, and mechanical impeller-aspirator systems. The air diffusion method consists of an air compressor, electric motor and a weighted air line placed in the deepest section of the lake. Small air bubbles rise from the pipeline and a turbulent air-water mixture is established. This type of system is the most popular and is used on lakes of various sizes and depths. Depending on the system, initial costs may range from $1,000 to $50,000 with operating costs extending from $30 to $3,000 per month. Satisfactory results have been obtained in lakes of similar depth and acreage as Irogami.

Mechanical sprayers driven by electric motors consist of an underwater impeller which propels water into an umbrella-shaped spray several feet above the lake surface. Initial system costs run approximately $2,000 to $4,000 with operating costs being $60 to $80 per month.

Pump-chute systems consist of a pump, pipeline and a lakeside chute with baffles. Water is pumped from the lake to the chute with aeration occurring as water passes over the baffles and plunges back into the lake. Cost estimates include $3,000 to $4,000 start-up and $150 to $1,000 per month for operation.

Aspirator systems, including the Aire-O2, consists of an electric motor-driven shaft with a subsurface impeller. The impeller draws air down a hollow shaft and propels the water and air into the lake to keep an area ice-free. Aeration then takes place through the air-water boundary. Initial costs are approximately $4,000 with operating costs running about $90 per month. Results vary depending on lake depth and surface area kept open.

All aeration systems will keep some portion of Irogami Lake open during the winter months and therefore, may affect recreational lake use.

An alternative to planned aeration and purchase of equipment is winter monitoring of the dissolved oxygen content. A $800 to $1000 investment in a dissolved oxygen meter would allow the lake association to check fluctuating oxygen levels during the winter months. If the levels drop below 5 mg/l, the DNR can be contacted for appropriate courses of action.

ALTERNATIVE 4 - DREDGING

Large scale lake dredging would provide the most dramatic results in affecting the lake's vegetation. Removing several feet of soft sediment would temporarily eliminate rooted aquatics, increase lake depth, and possibly alter oxygen levels sufficiently to avoid winterkill. Such an undertaking, however, requires a significant expenditure and location of a disposal site for the dredged material. Removal of 3 feet of sediment from the entire lake would require 1.4 million cubic yards of dredge material @ $3.00 to $3.50 per cubic yard. The cost would be approximately $4.9 million.

It would not be necessary to remove that amount of material in order to produce effective results. Two other possibilities include dredging a 50 acre area or 30 acre area to a depth of 12 feet. The 50 acre dredging operation would remove 484,000 cubic yards of material at an estimated cost of $1.4 to $1.7 million, and the 30 acre operation would remove 290,400 cubic yards at an estimated cost of $870,000 to $1.0 million.

Dredging does require permitting and location of a proper disposal site for the excavated material. The long term effects of partial dredging of Irogami lake may also not be realized due to constant shifting of the soft bottom sediment.

Watershed Management Alternatives

RURAL LANDS MANAGEMENT

Soil Conservation Plans

According to the Eutromod simulations, agricultural lands contribute the majority of the phosphorus going into Irogami Lake. Because of this farm operators should incorporate conservation plans which would minimize erosion. If conservation plans are already in existence farmers must adhere to those plans.

Nutrient Management Plans

In addition to minimizing erosion from agricultural lands, it is also important to minimize the flow of excess nutrients from agricultural land to Irogami Lake. Farm operators should develop nutrient management plans which minimize the flow of excess nutrients leaving the farmland. Such plans specify when and how much manure should be spread on cropland.

Woodland and Wetland Preservation and Protection

Woodlands and Wetlands both provide positive water quality functions within the watershed. Woodlands are a stable land cover, producing little eroded sediment or nutrients in surface runoff. Currently woodlands constitute the largest proportion of land cover type in the watershed. It is important to inhibit the transformation of woodlands to residential or agricultural land use since this would have an adverse affect on the water quality of Irogami Lake.

Wetlands provide important water quality treatment within the watershed. The land in the indirect drainage basin drains into wetlands. These wetlands absorb and filter nutrients from surface runoff. It is important to preserve and protect these wetlands so this water quality treatment continues.

Construction Site Erosion Control

The nonpoint source pollution today may be agricultural runoff, however, tomorrow the likely problem will be construction site erosion. Development pressures are likely to continue to grow in this region. The Lake Management District, the Towns of Marion and Mount Morris and Waushara County need to work cooperatively to develop, administer and enforce a Construction Site Erosion Control Ordinance.

MONITORING AND ENFORCEMENT OF EXISTING ZONING AND LAND USE LAWS

Request Notification of Proposed Zoning or Land Use Changes

The Lake Management District should be notified of any proposed zoning or land use regulation changes by the local governments so that the district can respond with the best interest of the lake in mind.

Shoreland Zoning Protection

Waushara County currently has zoning ordinances pertaining to shoreland management and practices which protect water quality. It is important that shoreland property owners are knowledgeable of these ordinances and follow them.

Wetland Regulations

Shoreland wetlands (those within 1000 feet from the lake) are protected under the shoreland zoning ordinances of Waushara County. Other wetlands are protected under Chapter NR 103 of the Wisconsin DNR administrative code which sets water quality standards for wetlands.

Chapter 30 Permit Reviews

Construction or other types of alterations done in a navigable waterway are regulated in Chapter 30 of the Wisconsin State Statutes. Permits are required for a number of activities and must be reviewed. The Lake Management District should be notified by the appropriate personnel upon the review of any such permits for work taking place within the Irogami Lake watershed.

Army Corps of Engineers Public Notices

Likewise the Army Corp of Engineers regulates activities in navigable waterways and wetlands which require permits. The Lake Management District can request to be notified of any such permit requests within the Irogami Lake watershed.

INFORMATION AND EDUCATION

Newsletters

Newsletters put out by the Lake Management District can be a good way to distribute information about practices which would improve water quality such as shoreline management. Brochures describing appropriate land management practices could be inserted into the newsletter. Many such brochures are available from the University of Wisconsin-Extension. Newsletter distribution could extend to all residents of the watershed to help expand the community of people concerned about the water quality of Irogami Lake.

Demonstration Projects

Demonstration projects such as the planting of buffer strips between croplands and wetlands would be a good way to promote such practices among the residents of the watershed.

Riparian Land Use

The University of Wisconsin - Extension has good information on appropriate land management practices for protecting water quality. Many brochures are available. UW-Extension agents are also sometimes available for onsite visits.

APPENDIX A

Supplementary Recommendations
Implementation Plan
Implementation Schedule

R.A.SMITH
& ASSOCIATES, INC.

February 8, 1995

Mr. William Downie, Chairman
Irogami Lake Management District
Route 2, Box 95
Wautoma, WI 54982

Re: Irogami Lake Management Plan

Dear Bill:

This letter is to act as a summary of the previous Lake Planning Grant Advisory Committee meeting. At that meeting, I promised to send out a summary of our recommendations along with a copy of "Understanding Lake Data" published by the University of Wisconsin--Stevens Point. I recently received those documents and can now pass them along to you along with our recommendations summary.

RECOMMENDATIONS:

Water Quality Monitoring

Collect and evaluate water quality data from the Lake on an annual basis. These water samples should be taken for nutrients, Chlorophyll a, and other parameters through either a lake planning grant, the Long-Term Trends Monitoring Program or self initiative, as money allows. This data will help monitor trends in the Lake and help to gage success in the implementation phase of the Management Plan. The Lake District should find a volunteer for the "Self-Help Monitoring Program."

Information and Education Program

The Lake District should produce a semi-annual newsletter. This newsletter could include existing University of Wisconsin--Extension brochures on topics such as lawn care, maintaining natural shorelines, urban and rural runoff, etc. The newsletter could also serve as an advocate and advertisement for urban and rural water quality programs that are available to landowners.

Water Level Management

While improbable, the Silver Lake District should be requested to find an alternative outlet to their lake. Silver Lake has good water quality today; however, should that scenario change, Irogami Lake will be the unwilling recipient of any water quality problems that could manifest themselves in the future. As a minimum, Silver Lake should sample water entering, within, and leaving Irogami Lake when lake levels are such that the Irogami Lake outlet is in use. The Silver Lake District should follow-up with an assessment of the change in water quality when using the Irogami Lake outlet.

Dredging Referendum

A referendum or other similar vote should be conducted at the 1995 annual meeting of the Irogami Lake Management District. Dredging has been discussed as a potential solution for Irogami Lake. While water quality data does not support a dredging project, there may be other recreational or aesthetic reasons for dredging. The dredging issue must be resolved soon so that

414-786-1777
FAX 414-786-0826

16745 West
Bluemound Road
Suite 301
Brookfield,
WI 53005-5938

budgeting and coordination with the DOT project (STH 21) can be planned for. The dredging referendum would be to decide how the Lake District members would pay for a project and what kind of project would provide the greatest benefit. Dredging costs could range from $300,000 for a small scale project to over a million dollars for large scale project. Existing funding programs for dredging center around navigable channels and major lake rehabilitation projects and may not be applicable to Irogami Lake. Currently the DOT is prepared to provide assistance with a sediment disposal site. This opportunity will not always exist and should be formalized in writing with the DOT.

Establish a Zoning and Permits Committee

A committee should be established to watch for and review local zoning and permit requests that could affect Irogami. This could, for example, be a major dairy expansion in the watershed, a new subdivision, or other regulated activities. The Irogami Lake Management District should have an informed and vocal presence with the units of government and agencies whose decisions could affect the water quality of Irogami Lake.

Purchase a Dissolved Oxygen Meter to Monitor In-Lake Winter Dissolved Oxygen Readings

To avoid future winter fish kills, the Irogami Lake Management District should purchase and operate a Dissolved Oxygen (D.O.) meter. This meter could be used to conduct weekly D.O. readings and alert the appropriate agencies if levels are dropping to dangerous levels. Fish kills have not been a major problem at Irogami Lake; however, this relatively inexpensive operation could act as an early warning mechanism to the Lake District.

Other general recommendations can be found in the draft Irogami Lake Management Plan. Please review the enclosed lake data guide, the draft plan and this summary letter. Please provide comments in writing to me by Friday, March 3, 1995, so I can review the comments before our March 18, 1995 meeting.

If you have any questions, please feel free to give me a call.

Sincerely,
R. A. SMITH & ASSOCIATES, INC.

Mark Doneux

Mark J. Doneux
Environmental Specialist

bth:93760-0-342-342
f:\wp\water\mjd\0208down.ltr

Enclosure

c: Dan and Joyce Wessley (with enclosure)
Mike and Michelle Karch (with enclosure)
Mary Anne Bolan (with enclosure)
Carolynn Hitchcock (with enclosure)
Baird Stouffer (with enclosure)
Jim Tetzlaff (with enclosure)
Gordon Krentz (with enclosure)
Tim Rasman, Wisconsin Department of Natural Resources, Green Bay (without enclosure)

IROGAMI LAKE - WATERSHED AND IN-LAKE MANAGEMENT PRACTICES IMPLEMENTATION PLAN

Management Practice	Priority	Unit Cost	Units	Practice Costs	Organization Involved In Implementation: Lake District	Landowner/ Renter/ Lessee	DNR Lakes Coordinator	DNR Fish/Wildlife Manager	UW-EX	Towns of Marion & Mount Morris	Waushara Co. Zoning Department	Waushara Co. Land Conservation Department
IN-LAKE MANAGEMENT ALTERNATIVES												
Water Quality Monitoring[1]	1	$300/yr	5 yrs	$1,500	✓		✓					
Water Level Monitoring/Mgt.	1	n/a		n/a	✓		✓					
Weed Harvesting[2]	2	$10,000	2	$20,000	✓		✓					
Dredging[3]	3	$300,000	1	$300,000	✓		✓	✓				
Aeration	4	$5,000	1	$5,000	✓			✓				
Winter Oxygen Level Monitoring[4]	4	$1,000	1	$1,000	✓			✓				
WATERSHED MANAGEMENT ALTERNATIVES												
Rural Lands Management[5]												
Soil Conservation Plans	3	n/a		n/a	✓	✓						✓
Nutrient Management Plans	2	n/a		n/a	✓	✓						✓
Wetland/Woodland Preservation	1	n/a		n/a	✓	✓		✓			✓	✓
Information and Education												
Newsletter	1	$500/yr	5	$5,000	✓		✓	✓	✓			✓
Demonstration Projects[5]	3	n/a		n/a	✓	✓		✓	✓			✓
Riparian Land Use	2	n/a		n/a	✓	✓		✓	✓	✓	✓	✓
Zoning and Permits Review[6]	1	n/a		n/a	✓	✓		✓		✓	✓	
TOTAL IMPLEMENTATION COSTS[7]				$4,000								

[1] Assumes no DNR funding is available. [2] Cost could vary based on area and frequency harvested. [3] Assumes minimum dredging program. [4] Requires acquisition of Dissolved Oxygen meter. [5] Cost share money may be available for implementation. [6] Does not include legal or technical fees that may be necessary to review permit or zoning requests. [7] Cost is for 5 years, one year would cost an average of $800.

w:\water\mjd\lakes\irog\implemnt.tab

IROGAMI LAKE IMPLEMENTATION SCHEDULE

IROGAMI LAKE MANAGEMENT DISTRICT

Activity	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
A. IN-LAKE MANAGEMENT ALTERNATIVES										
1. Water Quality Monitoring										
2. Water Level Monitoring and Management										
3. Weed Harvesting										
4. Dredging										
5. Aeration (1)										
6. Winter Oxygen Level Monitoring										
B. WATERSHED MANGEMENT ALTERNATIVES										
1. Soil Conservation Plans (2)										
2. Nutrient Management Plans (2)										
3. Wetland/Woodland Management (2)										
4. Newsletter										
5. Demonstration Projects (2)										
6. Riparian Land Use (2)										
7. Zoning and Permits Review										

Note: This is an anticipated schedule, assuming cooperation and access of data by all agencies involved. The schedule may also vary based upon work product review time by agencies.

(1) Aeration is not recommended at this time so no schedule was given.
(2) Conservation and nutrient plans, wetland/woodland management, Demonstration projects and riparian land use management would be scheduled as needed or when interest or need warranted action.

APPENDIX B

Wetland Designation Descriptions

WETLAND DESIGNATION DESCRIPTIONS

E1H	emergent/wet meadow, persistant, standing water, palustrine
S6	scrub/shrub, broad leaved evergreen
E2Hm	emergent/wet meadow, narrow leaved persistant, standing water, floating vegetated mats
W0L	open water, lake
A3	aquatic bed, rooted, floating
W0H	open water, palustrine
A2	floating aquatic bed
A4H	free floating aquatic bed, palustrine

APPENDIX C

WATER QUALITY DATA

DNR Lab ID #: ID09434900
Storet #: 703017
Account #: WR133
Route #: WR40

Lake: IROGAMI
County: WAUSHARA
Source: MIDDLE
Sample Depth: 3

Collected By: CLEARY
Collection Date: 5/12/93
End Date: 5/12/93
Time: 9:15
Time: 9:25

Date Received: 5/13/93
Time: 7:14

PARAMETER	MEASUREMENT	UNITS
Temperature Field	21	C
Dissolved Oxygen Field	9.6	MG/L
pH Field	8.4	SU
Secchi Depth	1.8	M
Cloud Cover %	0	%
Conductivity Field	215	UMHOS/CM
Calcium, ICP	26	MG/L
Chloride	2	MG/L
Chlorophyll A (Uncorrected)	3.4	UG/L
Color True	10	SU
Conductivity (At 25 Deg)	212	UMHOS/CM
pH (Lab)	8.29	SU
Alkalinity	101	MG/L
Hardness	110	MG/L
Iron, ICP	<.05	MG/L
Magnesium, ICP	12	MG/L
Manganese, ICP	<40	UG/L
Annonia, N	0.085	MG/L
Nitrate Plus Nitrite, N	0.116	MG/L
Total Kjeldahl Nitrogen	0.7	MG/L
Total Phosphorus, Persulfate	0.011	MG/L
Dissolved Phosphorus, Low	0.003	MG/L
Sodium, ICP	1	MG/L
Sulfate	8	MG/L
Total Solids	134	MG/L
Suspended Solids	<2	MG/L
Turbidity	0.8	NTU

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#10 of 16 on 07/09/93, unseen)

Id: 703017 Point/Well/..: Field #: Route: WR40
Collection Date: 06/23/93 Time: 10:20 County: 70 (Waushara)
End Date: 06/23/93 Time: 10:30
From: FISH (IROGAMI) LAKE - WISC. LAKE MGMT. PLAN GRANT PROG.
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 4 Feet
Account number: WR133 Collected by: CLEARY/SMITH & ASSOC
Date Received: 06/24/93 Labslip #: ID108645 Reported: 07/08/93

CHLOROPHYLL A UNCORRECTED	2.18	UG/L
TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.011	MG/L
DISSOLVED OXYGEN FIELD	9.2	MG/L
PH FIELD	8.5	SU
SECCHI DEPTH	6.0FT	M
CLOUD COVER %	0	%
CONDUCTIVITY FIELD	200	UMHOS/CM

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#26 of 65 on 08/27/93, unseen)

Id: 703017 Point/Well/..: Field #: MIDDLE (3) Route: WR40
Collection Date: 07/27/93 Time: 09:00 County: 70 (Waushara)
End Date: 07/27/93 Time: 09:10
From: FISH (IROGAMI) LAKE
Description: WI LAKE MGMT. PLAN. GRANT PROG.
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 3 Feet
Account number: WR176 Collected by: CLEARY/RA SMITH ASSC
Date Received: 07/28/93 Labslip #: IE002943 Reported: 08/24/93

CHLOROPHYLL A UNCORRECTED	2.89	UG/L
TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.014	MG/L
TEMPERATURE FIELD	23.8	C
DISSOLVED OXYGEN FIELD	8.2	MG/L
PH FIELD	8.1	SU
SECCHI DEPTH	1.8	M
CLOUD COVER %	100	%

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#42 of 75 on 09/28/93, unseen)

Id: 703017 Point/Well/..: Field #: MIDDLE Route: WR40
Collection Date: 08/25/93 Time: 01:20 County: 70 (Waushara)
End Date: 08/25/93 Time: 01:40
From: FISH (IROGAMI) LAKE - WISC. LAKE MGMT. PLAN GRANT PROG.
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 3 Feet
Account number: WR176 Collected by: CLEARY/RA SMITH ASSC
Date Received: 08/26/93 Labslip #: IE005952 Reported: 09/27/93

CHLOROPHYLL A UNCORRECTED	1.74	UG/L
TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.009	MG/L
TEMPERATURE FIELD	26.0	C
DISSOLVED OXYGEN FIELD	9.2	MG/L
SECCHI DEPTH	1.8	M
CLOUD COVER %	20	%

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#36 of 50 on 03/28/94, unseen)

Id: 703017 Point/Well/..: Field #: MIDDLE Route: WR40
Collection Date: 03/02/94 Time: 11:45 County: 70 (Waushara)
End Date: 03/02/94 Time: 12:00
From: FISH (IROGAMI) LAKE
To: TIM RASMAN
DNR
GREEN BAY
Source: Surface Water
Sample depth: 3 Feet
Account number: WR204 Collected by: CLEARY - RA SMITH
Date Received: 03/03/94 Labslip #: IE019325 Reported: 03/25/94

TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.038	MG/L
TEMPERATURE FIELD	3.0	C
DISSOLVED OXYGEN FIELD	3.0	MG/L
CLOUD COVER %	0	%
TEMPERATURE	ICED	C

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#77 of 86 on 06/08/94, unseen)

Id: 703017 Point/Well/..: Field #: MIDDLE Route: WR40
Collection Date: 04/19/94 Time: 11:00 County: 70 (Waushara)
End Date: 04/19/94 Time: 11:30
From: FISH (IROGAMI) LAKE WISC LAKE PLANNING GRANT PROG
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 1 Feet
Account number: WR210 Collected by: MARK DONEUX
Date Received: 04/20/94 Labslip #: IE022951 Reported: 06/07/94

CALCIUM, ICP	31.	MG/L
CHLORIDE, AUTOMATED	3.5	MG/L
CHLOROPHYLL A UNCORRECTED	6.91	UG/L
COLOR TRUE PT-CO	10.	SU
CONDUCTIVITY (AT 25 DEG C)	258.	UMHOS/CM
PH, LAB	8.19	SU
ALKALINITY	127.	MG/L
HARDNESS, CALCULATION METHOD	130.	MG/L
IRON, ICP	<0.05	MG/L
MAGNESIUM, ICP	14.	MG/L
MANGANESE, ICP	<40.	UG/L
AMMONIA-N	0.154	MG/L
NITRATE PLUS NITRITE-N	0.097	MG/L
TOTAL KJELDAHL NITROGEN	0.6	MG/L
TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.009	MG/L
DISSOLVED PHOSPHORUS, LOW RANGE	ND (LOD=0.002 MG/L)	
SODIUM, ICP	2.	MG/L
SULFATE	8.	MG/L
TOTAL SOLIDS	162.	MG/L
SUSPENDED SOLIDS	3.	MG/L
TURBIDITY	0.8	NTU
TEMPERATURE FIELD	12	C
DISSOLVED OXYGEN FIELD	7.0	MG/L
PH FIELD	8.1	SU
SECCHI DEPTH	2.0	M
CLOUD COVER %	0	%
CONDUCTIVITY FIELD	254	UMHOS/CM
TEMPERATURE	ICED	C

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#144 of 177 on 07/20/94, unseen)

Id: 703017 Point/Well/..: Field #: Route: WR40
Collection Date: 06/15/94 Time: 12:40 County: 70 (Waushara)
From: IROGAMI - MIDPOINT ONLY
To: TIM RASMAN
DNR
GREEN BAY
Source: Surface Water
Sample depth: 3 Feet
Account number: WR204
Collected by: DONEUX;SMITH
Date Received: 06/16/94 Labslip #: IE030061 Reported: 07/19/94

CHLOROPHYLL A UNCORRECTED	*1.24	UG/L #1
analysis rejected		
TOTAL PHOSPHORUS, PERSULFATE, LOW LEVEL	0.014	MG/L
TEMPERATURE FIELD	27.9	C
DISSOLVED OXYGEN FIELD	8.4	MG/L
PH FIELD	8.8	SU
SECCHI DEPTH	1.92	M
CLOUD COVER %	30	%
TEMPERATURE	ICED	C

--- Footnotes ---
Remark #1: LOW ABSORBANCE, RESULT APPROXIMATE

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#21 of 41 on 08/26/94, unseen)

Id: 703017 Point/Well/..: Field #: Route: WR40
Collection Date: 07/11/94 Time: 13:00 County: 70 (Waushara)
From: IROGAMI - SURFACE WATER
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 3 Feet
Account number: WR225 Collected by: DONEUX/SMITH
Date Received: 07/12/94 Labslip #: IF001066 Reported: 08/25/94

CHLOROPHYLL A UNCORRECTED	*2.49	UG/L #1
analysis rejected		
TOTAL PHOSPHORUS	<0.02	MG/L
TEMPERATURE FIELD	23.7	C
DISSOLVED OXYGEN FIELD	9.7	MG/L
PH FIELD	8.9	SU
SECCHI DEPTH	6.0	FT.
CLOUD COVER %	40	%
TEMPERATURE	ICED	C

--- Footnotes ---
Remark #1: LOW ABSORBANCE, RESULT APPROXIMATE

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Environmental Science Section (608) 262-3458 DNR LAB ID 113133790
Inorganic chemistry (#55 of 158 on 10/19/94, unseen)

Id: 703017 Point/Well/..: Field #: SURF Route: WR40
Collection Date: 08/17/94 Time: 11:10 County: 70 (Waushara)
From: IROGAMI - SURFACE
To: TIM RASMAN
DNR Source: Surface Water
GREEN BAY Sample depth: 3 Feet
Account number: WR225 Collected by: DONEUX/RA SMITH
Date Received: 08/18/94 Labslip #: IF005767 Reported: 10/18/94

CHLOROPHYLL A UNCORRECTED	*1.47	UG/L #1
analysis rejected		
TOTAL PHOSPHORUS	*<0.02	MG/L #2
analysis rejected		
DISSOLVED PHOSPHORUS, LOW RANGE	**	MG/L #3
analysis rejected		
TEMPERATURE FIELD	22.5	C
DISSOLVED OXYGEN FIELD	11.5	MG/L
PH FIELD	9.1	SU
SECCHI DEPTH	1.83	M
CLOUD COVER %	0	%
CONDUCTIVITY FIELD	192	UMHOS/CM
TEMPERATURE	12	C

--- Footnotes ---
Remark #1: LOW ABSORBANCE, RESULT APPROXIMATE
Remark #2: HOLDING TIME EXCEEDED BY APPROX. 5 DAYS.
Remark #3: NO BOTTLE RECEIVED