RR5 Lake Santa Fe
Metamora IL 61548
August 3, 1995

Bruce Muench, Biologist
19121 Beck Road
Marengo IL 60152

Bruce,

This letter is a follow-up to our telephone discussion on August 2nd regarding your recent inspection of Lake Santa Fe and your conversations with George Schlink on the day of the inspection. As I mentioned to you on the phone, Mr. Schlink reported to the board of directors that you told him that your recommendation was going to be to add 200 grass carp to our lake to solve our problems. As you requested I am sending you this letter to ask specific questions for your written response prior to finalization of your official report. The questions that I would like you to respond to are:

1. Did you or will you recommend adding 200 grass carp to our lake to control our algae problem?

2. Will grass carp, in any number, effectively control algae ?

3. If grass carp are not effective at controlling algae will you have alternate recommendations of actions that we could take to control the algae in our lake ? When will you present us with those recommendations ?

4. What is the current level of aquatic vegetation in our lake and is it of such a nature that it could expand rapidly and "overcome" the lake ?

5. Have there been any findings from your studies that would indicate that there are serious problems or rapidly changing conditions that would require urgent action ?

Thank you for your response to these questions. I plan to distribute copies of this inquiry with your return answers attached to the board members as soon as possible.

Regards,

J. Michael Miles

J. Michael Miles
President, Lake Santa Fe Management Corp.

August 4, 1995

Michael Miles, Pres.
Lake Santa Fe Management Corp.
R.R. 5, Lake Santa Fe
Metamora, Illinois 61548

Dear Mr. Miles:

I got your fax with the five questions in good shape this morning and will address them in the order you gave:

1. In my experience with grass carp in a number of lakes in northern Illinois, I have not found them to be effective in the control of filamentous algae. As a consequence, I would not recommend stocking grass carp in any lake with the objective of controlling filamentous (or plankton) algae.

2. See above.

3. Perhaps the most effective method of temporarilly controlling filamentous algae in a lake like yours is with the use of a mixture of ortho-diquat and cutrine. I emphasize "temporary" because controlling algae with chemicals would be a maintenance effort, perhaps as often as every three weeks during the warm weather period.

In my final report, I will offer some alternatives to the use of chemicals in the effort to reduce algae. These are <u>not</u> certain ways to eliminate algae, but are alternatives for your consideration.

As a caveat, I have been in the position where one of the duties I had was to apply chemicals for the control of aquatic plants. This period of time was from 1954 to 1993.

4. Currently, Lake Santa Fe has relatively little in the way of rooted, submergent aquatic plants in the two inspections I have conducted. There is a little leafy pondweed and Najas, primarilly in the upper part of the lake, and some sago pondweed growing right next to shore, where sunlight can get to it, in areas like the beach. As for filamentous algae, on July 20th, it extended offshore in a band of from five to ten feet wide in areas of sunlight. It was not growing in areas of tree shade.

There are no doubt several species of algae involved in your lake and they will change as the season progresses. As long as the sunlight penetration in the water is relatively good (40 inches is relatively good), and you have adequate nitrogen and phosphorus present, you will have algae growth, both in the water and on the bottom. One big asset you have going for you in your lake is that most of your lake is deep, i.e., over eight feet deep. This means that there is not much of the bottom that sunlight can penetrate to and stimulate the growth of aquatic plants;, therefore you are not going to be "overwhelmed" with rooted, submergent aquatic plants in your lake.

Plankton algae, on the other hand, can grow anywhere in the lake where there is sunlight - shoreline or middle of the lake. It is always present in a healthy lake to some extent and is a primary producer of dissolved oxygen and food for aquatic animals. Filamentous algae, on the other hand, usually originates in shallow water. However, it may drift to anywhere in the lake, depending on wind strength and direction. It does not have as much value as plankton algae to the health of a lake. In lakes where there is an abundance of rooted, submergent aquatic plants, there is usually little filamentous algae.

5. As lakes age, they become more fertile. As they become more fertile, the expression of aquatic plants (or algae) becomes more pronounced. This is because elements for fertility accumulate in the lake both from the watershed and from matter which enters directly on the surface of the lake. Smaller, shallow lakes with large watersheds do this more rapidly than large lakes with proportionately smaller watersheds.

My answer to this question is, "Yes, your lake is changing with age." The changes will not be rapid, unless something happens to increse the sedimentation rate or nutrient inflow to your lake. Perhaps one urgent question is the resolution of any faulty septic tanks or fields in your residences, especially if that field is located on the downward slope to the lake. Very high nutrient contributions can come from sources like this. Consultation with your county Soil and Water Conservation District regarding the condition of the watershed to your lake should also be done.

I hope to have the final copy of my report finished in about three weeks. To whom should I send it? All my primary contact has been with Scott Blinkenstaff. I presume it is alright to send him a copy of this letter.

Sincerely,

Bruce Muench

Bruce Muench, Biologist
19121 Beck Road
Marengo, Illinis 60152

In my conversation with Mr. Schlink, I said if one were interested in the use of grass carp to control rooted, submergent aquatic plants, I would recommend the stocking of from 15 to 20 grass carp per surface acre of the lake. I emphasized to him that they would not control filamentous algae.

****** MEETING ANNOUNCEMENT******

LAKE SANTA FE BOARD OF DIRECTORS MEETING

TUESDAY SEPTEMBER 5, 1995

7:00 PM

WORTH TOWNSHIP HALL

Please attend the September board of directors meeting to hear the special lake algae/vegetation committee summary of our hired biologist's final report (attached) and to hear the explanation of why directors Schlink, Luschen, and Nikola persist in acting in direct opposition to the biologists stated recommendations by stocking 200 grass carp in the lake at an expense of approximately $1500 to the shareholders.

Also at this meeting there will be a presentation by officers from the Woodford Co. Sheriff's Department on the Neighborhood Watch Program.

1995

Final Lake Study Report

Lake Santa Fe

by

Bruce Muench, Biologist

August 19, 1995

Introduction

In October of 1994, I sent a proposal for the study of Lake Santa Fe to Scott Blinkenstaff of the homeowners association. Mr. Blinkenstaff also sent me the results of some lake monitoring data collected in 1993 and '94, for background information.

In February of 1995, Mr. Blinkenstaff sent me a map of the lake in preparation to my attending a meeting of lake homeowners, which was held also in February. My previous proposal for study was approved in March.

The first period of field study was completed on April 27, 1995. A preliminary report of this initial study was sent to Mr. Blinkenstaff on both May 9, and June 13, 1995.

Algae samples were sent to me in mid-June and I sent a letter in response to Messers Blinkenstaff and Miles, dated June 16th. The second field sampling was completed on July 20, 1995.

A letter was faxed to me by Mr. Miles on August 3rd, concerning mostly aquatic plants and grass carp. I responded to this on August 4th.

This final report will present a summary of all data collected in my two field sampling trips, in addition to my evaluation and implications of this data.

Methods and materials

A secchi disc was used for water transparency measurements. Dissolved oxygen and water temperature were examined with a Sentry III electrical meter. The pH was measured with a Rascher/Betzold color comparitor. Deep water samples were collected with a Kemerer bottle on a measured cord. Water depth and sediment thickness were measured with a calibrated steel rod.

All other water chemistry samples were taken to Daily Analytical Laboratories in Peoria, where they were analyzed using standard methods for water examination.

Results and discussion

Transparency (visibility)

The visibility within water is an indication of the extent that sunlight can penetrate the water column. It is an important measurement because it provides information about the depth that aquatic plants can grow. The transparency of a lake is also a part of the esthetic appearance of a lake. Water transparency is considered adequate for sight-feeding fish, like bass and bluegills, if it exceeds 20 inches. For esthetic purposes, lake water is considered alright if it is over 44 inches.

The two transparency measurements on Lake Santa Fe were 62 inches on April 27th and 40 inches on July 20th. This is quite similar to what was found by the volunteer lake monitor in 1993 and '94. These readings are both relatively good and imply that rooted, submergent plants can probably grow to a depth of at least six feet in the lake. Water color was greenish on both dates, meaning that plankton algae was suspended in the water. Lakes with poor transparency (high turbidity) do not have much in the way of aquatic plant growth.

Aquatic plants and algae

Observations of the rooted, submergent aquatic plants and of algae in the lake were made on each of the two visits. On April 27th, plants did not yet show much growth. Leafy pondweed was apparent in small amounts in shallow water in the upper end of the lake and along the shoreline. The filamentous algae present at this time was Spirogyra, which also was not abundant.

By July 20th, plant growth was further progressed. Leafy pondweed was joined by Najas, and sago pondweed. The first two species were growing sparsely out to a depth of about six feet and the sago was confined to along the shore and was evident along the beach. Filamentous algae was present along about 50% of the shoreline, both floating and on the bottom. It was not present where there was tree shade. It is likely that a sucession of different species of algae takes place as the season progresses. Small duckweed plants were also seen floating on the surface near the downwind shore.

Other shoreline plants seen were willows and crown vetch along the faces of the dam. Deciduous trees covered about half of the shoreline.

Dissolved oxygen and water temperature

A profile of the dissolved oxygen and temperature in the water column can be found in Figure 1 for each of the sampling dates. The contrast is significant. On April 27, dissolved oxygen did not get below 5 mg/L until it was deeper that 21 feet. Water temperature was not stratified, in that there was only 3°F change from two feet to 22 feet.

July 20th, on the other hand, the water essentially ran out of dissolved oxygen at nine feet of depth. Significant temperature change also occurred at nine to 18 feet with water temperatures dropping from 78

to 53°F. This is called the "thermocline". At this time, fish could not live below ten feet deep.

Water was entering and discharging from the lake in small amounts on both sampling dates.

Fecal coliform bacteria and pH

Water samples for fecal coliform bacteria were taken on both sampling dates at the surface sampling location off the beach. Fecal coliform bacteria originate in the digestive tract of warm-blooded animals, like waterfowl, farm animals, pets and humans. High numbers of these bacteria (above 200/100 ml) may indicate fresh pollution and unsatisfactory conditons for swimming. In both of the seasonal samples of Lake Santa Fe, the fecal coliform bacteria were less than 15/100 ml, suggesting at these dates the water quality was satisfactory for body contact.

The pH (acidity/alkalinity) of the surface water varied only from 8.7 to 8.8. This is on the alkaline side, as are most of our lake waters. About the only implication of this high pH is that the lake is productive and that in mid-day, plant growth is making the pH higher. In a lake which is being treated chemically, higher pH water requires more chemical to achieve the same effect.

Nutrients

Two nutrients which are primarily responsible for excessive growth of algae and other aquatic plants are nitrogen and phosphorus. Tests were taken in both shallow and deep (20 ft. plus) water on both dates for ammonia nitrogen, nitrate/nitrite nitrogen and total phosphorus. When a lake stratifies in the summer, nitrogen and phosphorus frequently become higher in the deep water below the thermocline. Values below are given in mg/L.

4/27/95

	Ammonia nitrogen	Nitrate/nitrite nitrogen	Total phosphorus
surface	0.5	0.21	0.04
deep	0.5	0.31	0.05

7/20/95

surface	0.5	0.02	0.03
deep	0.6	0.02	0.13

Ammonia nitrogen comes mostly from decomposition of organic material which is occurring within the lake, while nitrate nitrogen comes mainly from ground water seepage. Nitrite nitrogen amounts are usually insignificant in lakes in this area. The amount of nitrogen compounds

found in Lake Santa Fe are not high, but are sufficient to support growth of aquatic plants.

Total phosphorus is also sufficient to stimulate growth of plants in lakes when over 0.02 mg/L. All samples of phosphorus in the lake were slightly above this level and in deep water on July 20th, was relatively high. This is usually the case in Illinois lakes which stratify in the summer and have no oxygen in deep water. This high phosphorus is sealed off from the shallow water to some extent, because the thermocline's density layer prevents mixing of deep and shallow water.

Sediment

Sediment on the bottom of a lake can come from two sources: outside the lake and inside the lake. Outside sources are mainly the watershed from which the runoff water flows off upstream lands; inside sources are the decomposition of aquatic plants in the lake and erosion of the lake's shoreline. Leaf fall from trees around the lake may also be a source of eventual sediment, plus what people may inadvertently throw into the water themselves, such as grass clippings.

I measured the sediment thickness in the lake from the upper end by the road, out to a water depth of 13 or 14 feet, by lot 7. It became apparent that most of the sediment deposition was in the uppermost end of the lake, out to a depth of about ten feet of water (Figure 2). This upper end is where soils carried in from the watershed stream and die-back of aquatic plants would most likely occur. It also represents a sort of "bank" of nutrients for the lake.

Average sediment depth above (upstream) of Blinkenstaff's dock is about 30 inches, where water depth runs between three and ten feet deep. Beyond this, sediment thickness is averaging less than five inches in water of 7½ to 14 feet deep. Eventually, the upper end of the lake, above the island, may be difficult to use with a boat because of sediment deposits. However, most of the sediment deposited in your lake likely happend in the first five or six years after its construction, when roads and houses were being built, the dam was new and soil was exposed to rain runoff. Although minor erosion can be found on banks next to the lake now (Figure 2), it is not nearly so significant.

What I saw of the agricultural land above the lake did not look bad in 1995. Much of it appeared to be in Conservation Rerserve Land.

Overview and management options

1. Water transparency is good, both for fish and esthetic purposes. It is also clear enough to grow aquatic plants. Use of a chemical dye, like Aquashade (trade name), may inhibit sunlight sufficiently to retard some growth of plants. This dye is non-active, meaning it does not affect other water quality parameters and it imparts a definite bluish color to the water, which some people may like and others may not. It would require treatment of the lake at one gallon per acre, about every three weeks from

May through August. It is easy to apply from a boat by just running it off the side going lengthwise down the lake. I have never used it with the objective of controlling plants, only in reflection ponds for beauty. I'm certain some plant and algae growth would occur even with its application.

2. Rooted, submergent aquatic plants are present in the lake because environmental conditions (nutrients and transparency) are suitable for their growth. They were not abundant in the lake in 1995. Although their growth and abundance may have been restricted to some extent in the six or seven years after stocking grass carp, these fish are having no effect on these plants at present as it has been too long since their last stocking. The rooted, submergent aquatic plants have value to the ecology of the lake and they should not be eliminated (Figure 3). Because these plants will grow to a depth of about seven feet in your lake, dredging deeper than that will restrict their area (e.g. upper end of the lake)

3. A clear distinction should be made between rooted aquatic plants and algae. Both produce oxygen and food for fish, but one may be desirable and the other not, depending upon their relative abundance. When rooted, underwater plants are abundant, usually algae is not. The reason for this is because the nutrients are tied up in the rooted plants and are not available to the algae. Filamentous algae was not especially abundant either time I visited the lake, although I understand this is a matter of controversy among land owners.

If partial control of filamentous algae is absolutely necessary, it can be temporarily controlled with chemicals, such as a mixture of Ortho-Diquat and Cutrine, a commercial copper compound. However, this treatment will also kill the rooted, submergent plants at the same time. Lake water restrictions after the application of this chemical combination is 1 day no swimming and 14 days no use for irrigation. A licensed applicator must apply the chemical. I have used this combination many times over the past 35 years and it is effective, however, it is <u>temporary</u> in that the algae will reappear in a matter of a few weeks requiring re-treatment.

Phosphorus is the limiting nutrient in the plant growth in your lake. What I found in 1995, was similar to what you found in 1993. Reduction of this essential nutrient, may be achieved by application of alum (aluminum sulfate) as a slurry to the lake. The alum binds with the phosphorus, sealing it at the sediment/water interface and robs algae of some of its needed stimulus. I have used this approach in about fifteen different smaller lakes with varying degrees of success. It requires application of about 1000 lbs of alum, as a slurry, per surface acre of water, although there is a formula which determines the exact amount to use in a given lake. There are no water use restrictions to my knowledge after application.

Correction of any faulty septic systems around the lake would be an initial order of business in nutrient control. Examination of systems by the appropriate county agency would be the first step. Examination of the watershed leading into the lake should also take place. Any agricultural runoff from unprotected fields, or from livestock confinement areas, should be treated with up-to-date management practices. Contact Resource

Conservationist Tina Calvetti and District Conservationist Sharon Hartzold of Woodford County for assistance.

Grass carp should not be used as an attempt to control filamentous algae. Of all the lakes and ponds I have come across with grass carp, I have encountered only one (a golf course pond) where these fish controlled all the aquatic plants, including algae. Filamentous algae has to be the lowest plant on their priority order of "things to eat". If you need to ask questions of someone other than myself and Mr. Herndon (DNR), ask Mr. Mike Cochran, who for a long time was the state regulator of grass carp stocking in Illinois. His address is 700 S. 10th Street, Havana, Illinois 62644. Examination of the fish population was not a part of my study plan, however I did see one very large, dead grass carp and one alive.

Were it a matter of trying to control leafy pondweed or Najas, I would recommend grass carp stocking, however you have only a small amount of these plant species in 1995.

4. One manner of regulating sediment influx from the watershed, and to a certain extent nutrient input, is by creating a instream preimpoundment above the lake. If large enough, this would settle out some of the soil par ticles before they could enter the upper end of the lake. Phosphorus can be attached to these soil particles. I am not an engineer, but I would think it would require a settling pond of at least an acre in size to do the job. I imagine it would require purchasing the appropriate land, so the expenses may be considerable. Measurement of sedimentation rate in this pond and periodic dredging would likely be required.

As it is, the main body of Lake Santa Fe has more than adequate depth.

5. Your lake stratifies and loses its oxygen in deep water, probably from June through mid-September. Other lakes in northern Illinois, like White Oak, that are deep also do the same thing, so this is an expected phenomenon. Although it does tend to restrict the area in which fish can live in the warmest time of year, there is not much to be concerned about with this situation. I would not recommend the installation of an aeration system to destratify the lake. I would only recommend aeration if the lake had experienced periodic suffocation of fish, then I would suggest running an aerator from December through March. Because you have no history of fish kill, to my knowledge, forget it for now.

A national expert in the value of aeration lives in Peoria and works for the State Water Survey. His name is Dr. Raman Raman. I am giving him the water chemistry profile of your lake and he is going to review the information, along with that of White Oak Lake. Give him a month or two and then call him: Ill. State Water Survey, P. O. Box 697, Peoria, Il. 61652, ph. 309/671-3196. I have already had a phone conversation with him.

6. The fecal coliform bacteria tests I conducted show the water to be satisfactory. If you're not already doing it you should have the beach

water sampled in the same fashion four or five times during the summer to be sure the water quality maintains itself and that swimming is safe.

7. I suggest you control the growth of willows and any other trees which volunteer on the faces of your dam. Tree roots can undermine the road and perforate the dam, possibly causing leakage. This depends upon how good a seal was established in the intial construction of the dam. Also, check the condition of the spillway and 12 inch diameter steel outlet pipe periodically to be certain no cracks or damage occurs. Most damage happens when the ice goes out in the springtime. Bank erosion along the dam face is negligible, because the rock rip-rapping there extends from above the surface to two feet below normal water line. Shoreline erosion in the upper lake (Figure 2) should also be attended to with appropriate rip-rapping. Some of these eroded areas are quite steep and may require anchoring the riprap horizontally back into the bank in order to keep it in place. Riprap should extend from three feet above the lake's surface to three feet below (Figure 4).

An excellent source of erosion control information is the magazine: Land and Water, 900 Central Avenue, Suite 21, P. O. Box 1197, Ft. Dodge, Iowa 50501.

8. In summary, from the viewpoint of a biologist, Lake Santa Fe appeared to be in good overall condition both in April and July of 1995. In reviewing fishery biologist Wayne Herndon's report for October of 1994, the fish population was strong on largemouth bass, but weak on bluegills. The latter may be a result of too little rooted, submergent aquatic plants which would provide food and habitat for this species. Mr. Herndon notes this in his report of October 13, 1994. I did see some abandoned bluegill spawning nests in shallow water on July 20th.

Figure 1. Dissolved oxygen & temperature profile, Lake Santa Fe, 4/27/95 and 7/20/95.

4/27/95

* Water Depth (ft.)	Dissolved oxygen (mg/L)	Temperature (°F)
2	10.8	50
4	11.1	50
6	11.3	50
8	11.3	50
10	11.2	50
12	11.0	50
14	10.7	50
16	10.5	50
18	8.4	48
20	5.1	47
22	2.5	47

Surface pH = 8.7

Water transparency = 62 inches

* See Figure 2 for water sampling location.

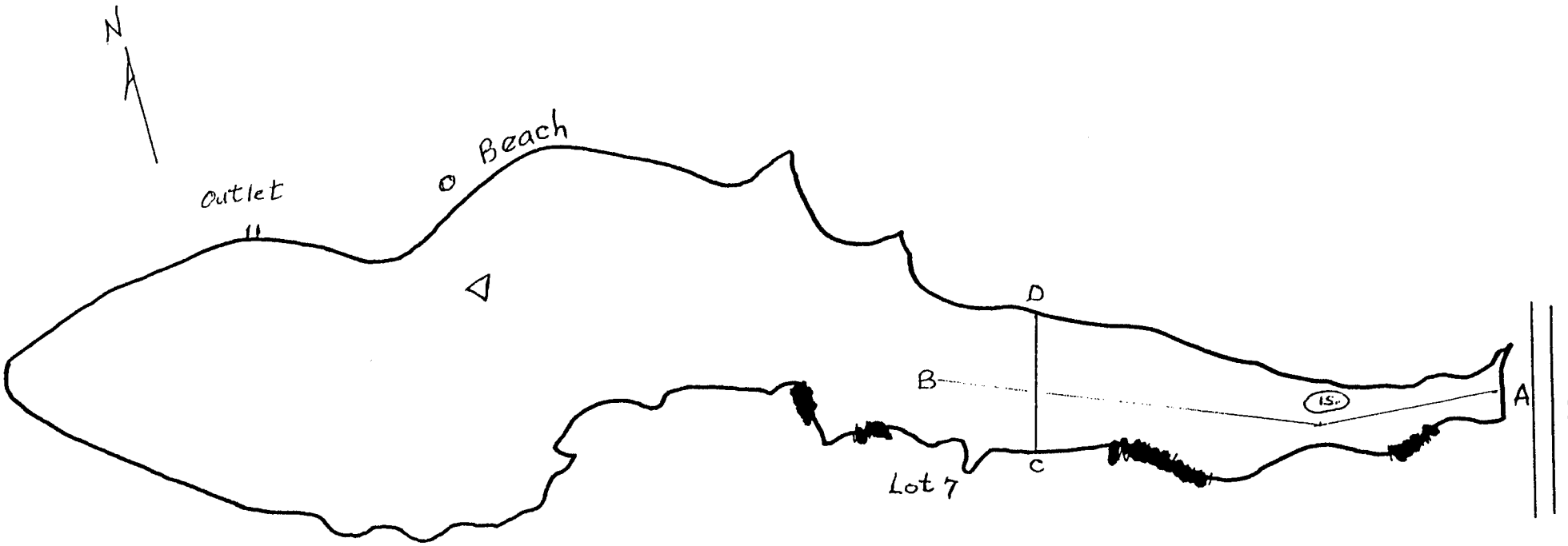
7/20/95

2	8.6	78	
4	9.0	78	
6	8.9	79	
8	6.7	78	
10	1.9	72	
12	0.6	66	thermocline
14	0.2	60	
16	0.0	57	
18	0.0	53	
20	0.0	52	
22	0.0	52	
24	0.0	52	

Surface pH = 8.8

Water transparency = 40 inches

Figure 2. Lake Santa Fe, Study of April 27, 1995.



Transects A - B and C - D
Water depth and sediment thickness

Areas of bank slumping and erosion

△ = Location of water sampling

○ = Emergency overflow

Bruce Muench

(Cont.) **Figure 2. Water Depth and Sediment Thickness, Lake Santa Fe, 4/27/95.**

Transect A - B See Figure 2. (previous page)

*Water depth (ft.)	Sediment (inches)	
3.0	30	
4.0	30	
5.0	30	
5.0	18	
5.0	30	
6.0	38	
5.0	9	
7.5	30	(past island)
9.0	28	
9.5	28	
9.5	35	
9.5	40	(Scott's dock)
10.0	28	
7.5	1	
7.0	1	
9.0	3	
11.0	12	
11.0	1	
14.0	14	
13.0	2	
13.5	5	

Transect C - D

9.5	23
14.5	13
16.0	--
11.0	18
10.0	3
7.5	4
2.0	2

* The lake was overflowing its spillway on this date.

Figure 3.

Bruce Muench
Lake Management Service
19121 Beck Road
Marengo, Illinois 60152

The Value of Aquatic Plants in Lakes

by

Bruce Muench, Biologist

In ponds and lakes in the midwest, aquatic plants are a natural and desireable growth which should appear voluntarily in a healthy body of water. Although aquatic plants may become extremely abundant in some lakes, this is usually a result of a combination of clear water and/or shallow depth. The depth to which rooted, submergent aquatic plants grow is limited by a certain minimum amount of sunlight which they require. As a rule of thumb, the depth to which these plants grow in lakes in northern Illinois is generally around seven feet or less, so if a lake is shallow and clear these plants may be very abundant. In artificial lakes and ponds, the distribution of aquatic plants can be controlled by making the body of water deeper than eight feet throughout most of its area.

There are many known benefits of aquatic plants in a lake:

1. They are a primary producer of dissolved oxygen, which not only is required by fish and other aquatic animals, but also which maintains a healthy lake condition in the presence of organic decomposition, thus they tend to "purify" the water.

2. Aquatic plants help to stabalize both the bottom of a lake and, if they are emergent, protect the shoreline by reducing the force of wave action upon the shoreline and embankment soils.

3. Rooted, submergent aquatic plants pick up and hold nutrients, nitrogen and phosphorus, which may be in solution in the water and thereby limit the growth of objectionable floating, filamentous algae.

4. Aquatic plants provide a habitat for aquatic insects and therefore these insects are more abundant in lakes where plants are present. The aquatic insects, like mayflies and dragonflies, are a primary source of food for fish and other larger aquatic animals.

5. Aquatic plants tend to make lake water clearer, due to their stabalizing influence on bottom and littoral soils.

6. Aquatic plants provide habitat and protective hiding areas for small fish, increasing their survival. The larger individuals of certain species of game fish prefer the diversity in the environment where there are aquatic plants to that where no plants are present.

Recognition of the important role of aquatic plants in lakes and ponds is required in order both that their presence be tolerated and also that effort and finances are not wasted upon control efforts which may not be meaningful and which may even harm the body of water (chemicals).

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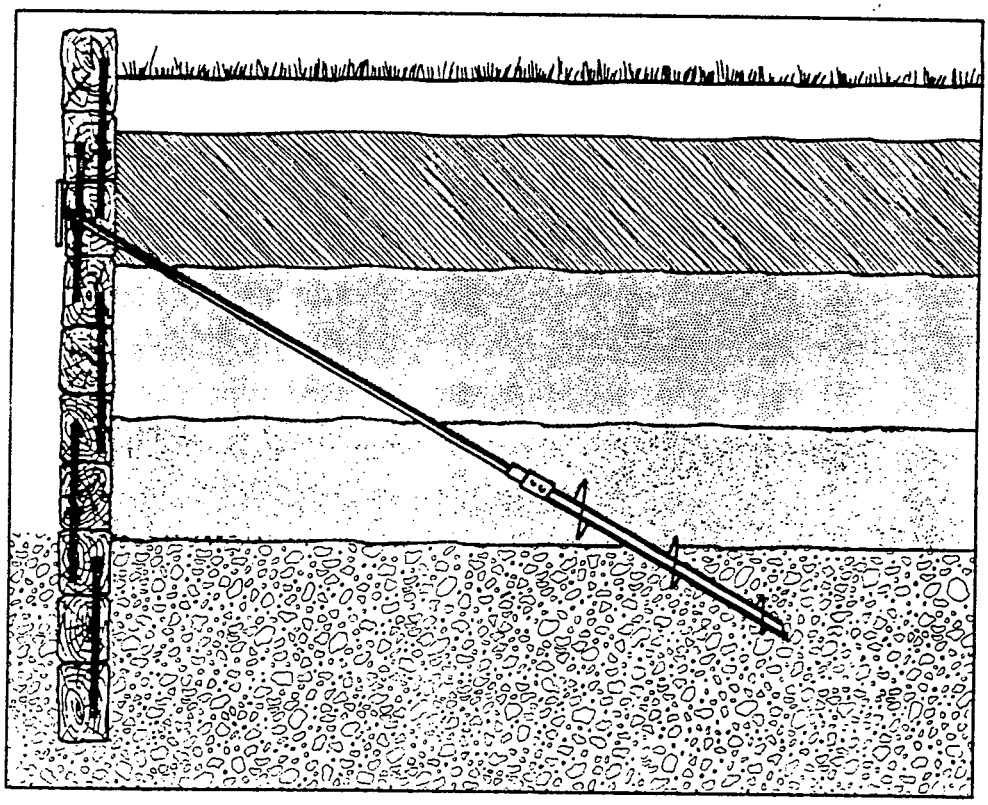

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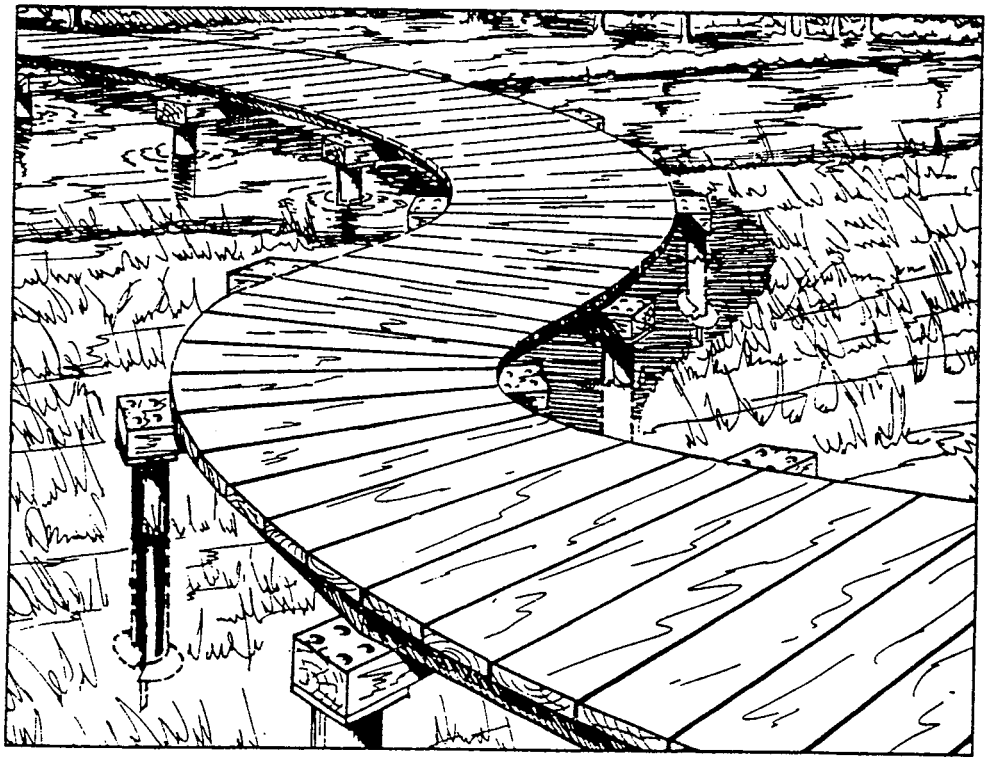

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For More Information, Circle #9

Dissolved Oxygen and Water Temperature

- Acceptability Criterion
  - Dissolved oxygen for fish population: Lower limit between 0.6 to 1.9 mg/L
- Measurements
  - See next page
- Comments
  - Water entering and discharging from the lake in small amounts on both visits
  - Fish could not live below 10 feet on July 20, 1995

Lake Santa Fe Special Committee

Special Committee Members:
- Bruce Wright
- George Schlink
- Brad Mead
- Scott Blickenstaff
- Dave Anderson

- Spring of 1995, unanimously recommended to Board to hire Bruce Muench.
- Board hired Bruce Muench
- First Field Study April 27, 1995
- Second Field Study July 20, 1995
- Bruce Muench's Final Report August 19, 1995

Bruce Muench's Report Details 6 Areas For Which He Tested

- Water Transparency
- Aquatic Plants and Algae
- Dissolved Oxygen and Water Temperature
- Fecal Coliform Bacteria and pH
- Nutrients
- Sediment

Water Transparency

- Acceptability Criterion
  - Sight Feeding Fish: 20 inches
  - Esthetics: 44 inches +
- Measurements
  - April 27, 1995: 62 inches
  - July 20, 1995: 40 inches
- Comments
  - Greenish water color on both dates due to Plankton Algae suspended in water

Aquatic Plants and Algae

- Acceptability Criterion
  - none defined
- Observations
  - April 27, 1995
    - Small Amounts of Leafy Pondweed in shallows
    - Spirogyra Filamentous Algae present, but not abundant
  - July 20,1995
    - Leafy Pondweed and Najas growing sparsely to depth of 6 feet
    - Sago Pondweed confined to shoreline
    - Filamentous Algae present along 50% of shoreline, both floating and on bottom
    - Duckweed seen floating on downwind shore
- Comments
  - It is likely that a succession of different species of Algae takes place as the season progresses

Fecal Coliform Bacteria and pH

- Acceptability Criterion
  - Fecal Coliform below 200/100ml for human contact
- Measurements
  - Fecal Coliform less than 15/100ml on both dates
  - Surface water between 8.7 and 8.8 pH
- Comments
  - The pH level is only pertinent if chemical treating of the lake is used as an option

Nutrients

- Acceptability Criterion
  - none defined
- Measurements
  - April 27, 1995
    - Ammonia nitrogen: .5mg/L surface and deep
    - Nitrate/Nitrite Nitrogen: .21mg/L surface and .31 mg/L deep
    - Total Phosphorus .04 mg/L surface and .05 mg/L deep
  - July 20, 1995
    - Ammonia nitrogen: .5 mg/L surface and .6 mg/L deep
    - Nitrate/Nitrite Nitrogen: .02 mg/L surface and deep
    - Total Phosphorus .03 mg/L surface and .13 mg/L deep
- Comments
  - There is enough nitrogen and phosphorus in Lake Santa Fe to support aquatic plants

Sediment

- Acceptability Criterion
  - none defined
- Measurements
  - See next page
  - Average depth of sediment from inlet to Blickenstaff's dock: 30 inches
  - Rest of lake with water depth between 7.5 and 14 feet: 5 inches
- Comments
  - Sediment near inlet end of lake is acting as nutrient "bank" for the lake
  - Most sediment in lake happened in the first 5 or 6 years after construction
  - Eventually inlet of lake will become difficult to navigate with a boat
  - Agricultural land above the lake appeared in good condition from a runoff standpoint

Bruce Muench's Final Report Aquatic Plants and Algae

- Do Not Use Grass Carp to Control Algae
- Water Transparency Recommendations
  - Dredge inlet deeper than 7 foot transparency level
  - Application of non-active water dye is a possibility (although never used for plant control)
- Nutrients
  - 1st step is to correct any faulty septic systems as found by county inspector
  - Dredge current sediment to remove nutrient "bank"
  - Apply Alum slurry to bind phosphorus in sediment
  - Examination of watershed by county personnel listed in report and encourage up-to-date practices for unprotected fields or livestock confinement areas

Bruce Muench's Final Report
A Biologist's Perspective on Rooted Aquatic Plants
From article written outside context of Lake Santa Fe Consultant

- They tend to purify the water
- Stabilize lake bottom, and if emergent, reduce wave force at shoreline
- Pick up and hold nutrients and thereby limit growth of filamentous algae
- Provide habitat for insects which are primary source of food for fish
- Tend to make water clearer by stabilizing lake bottom and shoreline
- Provide protection for smaller fish, increasing their survival

Bruce Muench's Final Report Dissolved Oxygen and Water Temperature

- Do not use aeration for lake destratification

Bruce Muench's Final Report
Fecal Coliform

- Test for fecal coliform 5 or 6 times during the swimming season at the beach area

Bruce Muench's Final Report Sediment

- Create larger pre-impoundment above the lake (by implication, maintain the current one)
- Control willows on dam
- Riprap erosion areas per Final Report
- Monitor Spillway condition