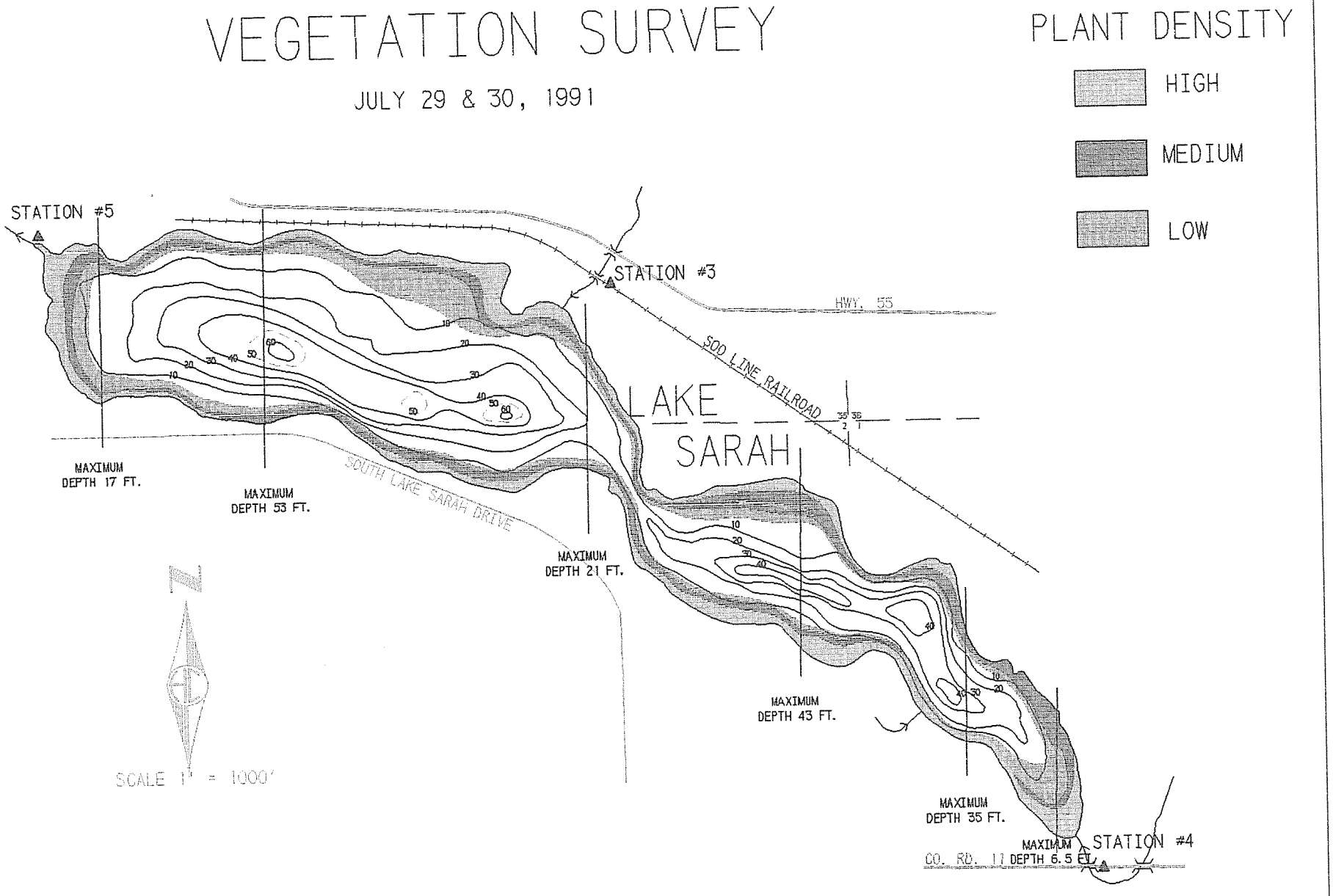
Figure 8


VEGETATION SURVEY
JULY 29 & 30, 1991
PLANT DENSITY
HIGH
MEDIUM
LOW
STATION #5
STATION #3
HWY. 55
SOO LINE RAILROAD
LAKE SARAH
SOUTH LAKE SARAH DRIVE
MAXIMUM DEPTH 17 FT.
MAXIMUM DEPTH 53 FT.
MAXIMUM DEPTH 21 FT.
MAXIMUM DEPTH 43 FT.
MAXIMUM DEPTH 35 FT.
MAXIMUM
CO. RD. 11 DEPTH 6.5 FT.
STATION #4
SCALE 1" = 1000'

In the spring of 1991, five to ten acres of Eurasian watermilfoil were treated with 2,4-D. In the fall of 1991, 17 to 18 acres were treated with 2,4-D and another six to seven acres were treated with Garlon 3A. The Garlon appeared to have no affect, but the 2,4-D treated area showed some control. However, in 1992 an estimated 95 to 100 acres of the lake was found to have Eurasian watermilfoil infestations. The lake association continues to work on managing the large infestation.

The major emergent species in Lake Sarah was *Typha* sp. (cattail). Stands of cattail up to several feet thick line the shoreline in the less used areas. Specifically, the areas near the outlet and a large part of the shoreline of the upper basin has dense stands of cattails. Lake residents complain that at times these cattails break off in floating bogs and float to their shoreline where they, if they are not removed fairly quickly, take root and grow.

Purple loosestrife (*Lythrum salicaria*) was found at the lake edge on one property. It appeared to be there as a decorative part of a landscaped area of the yard. The lake association president was notified. She notified the property owners that the plant should be removed before it spreads.

The DNR conducted a visual macrophyte assessment as part of their fisheries survey on June 26-28, 1991. The report stated that about 10% of the lake surface is covered by emergent vegetation, including *Typha* species (cattail), *Sagittaria latifolia* (Arrowhead), *Scirpus acutus* (Bulrush), *Phalaris arundinacea* (reed canarygrass) and *Polygonum amephibium* (Smartweed). The most abundant was *Typha latifolia* (See Appendix 2). The DNR also concluded that plants were found at a maximum depth of 8 feet. Submergent plants found in abundance were, *Ceratophyllum demersum* (coontail) and *Potamogeton pectinatus* (sago pondweed).

2.2.6 Phytoplankton

Phytoplankton samples were collected from October 1990 - October 1991 from the upper basin of Lake Sarah. Forty-eight different genera were identified throughout the sampling period. The general progression of algal phyla observed was a change from dominance of greens and yellow-greens to blue-greens from spring to summer (Figure 9). Blue-greens were dominant from mid June through mid September. Chlorophyll *a* concentrations were substantially lower in October 1990 compared to October 1991. Blue-green algal blooms occurred in June - September as evidenced by high chlorophyll *a* concentrations with dominance by blue-green algae genera.

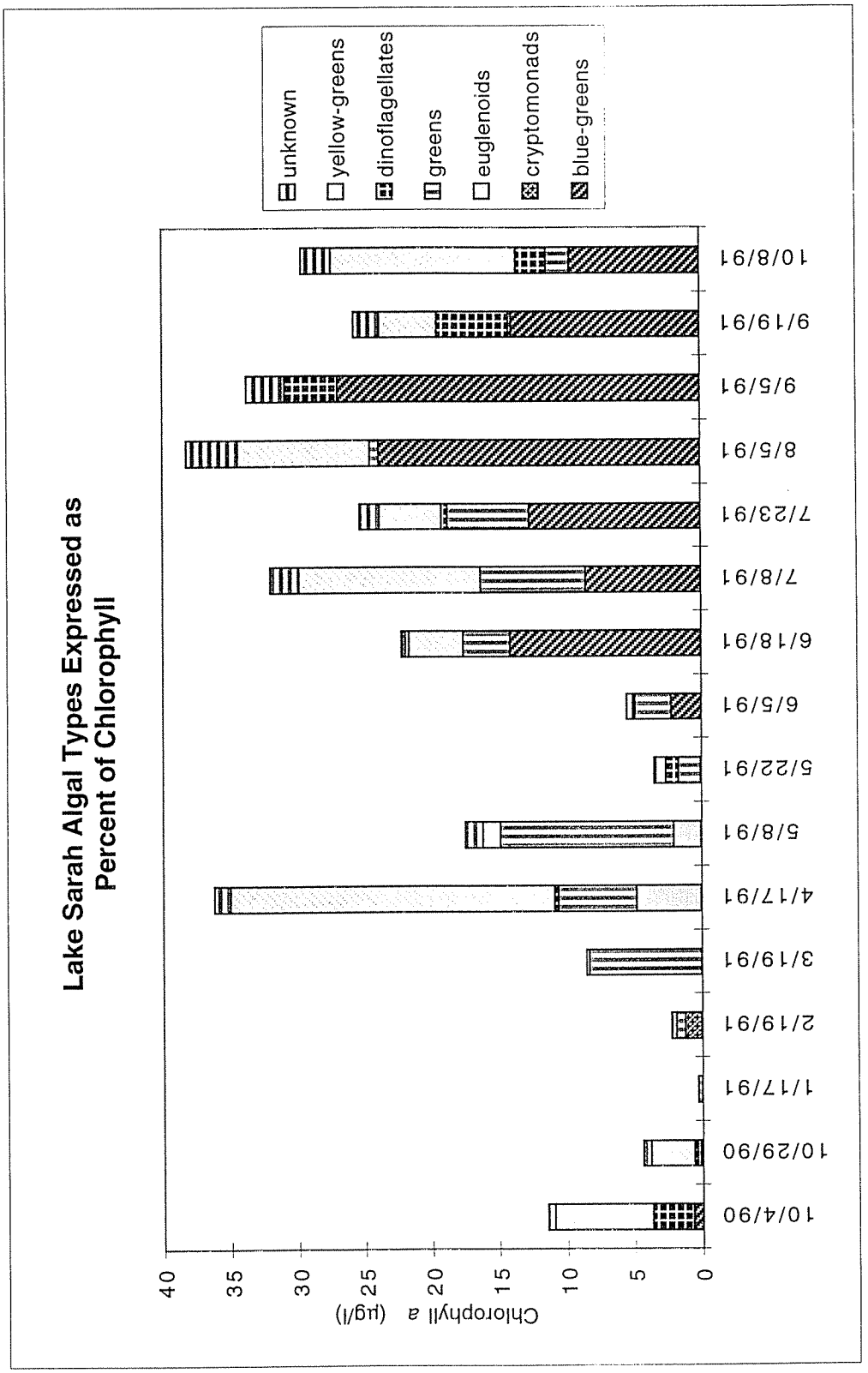


Figure 9. Phytoplankton

2.2.6 Zooplankton

Zooplankton samples were collected from October 1990 - October 1991 from the upper basin of Lake Sarah. Zooplankton biomass peaked in October 1990 and May and June of 1991. A smaller peak was observed in September. Three Daphnia species, *Daphnia retrocurva*, *Daphnia pulex* and *Daphnia galeata mendotae*, were dominant (Figure 10a). Chlorophyll *a* concentrations corresponded to the peaks and falls in the number of Daphnia species. A low chlorophyll *a* concentration in May and early June was found when zooplankton numbers were at their highest for 1991. Chlorophyll *a* concentrations were higher in July and the first half of August when zooplankton counts were down (Figure 10b). The data indicate that zooplankton are controlling algal blooms to some extent in Lake Sarah.

2.2.7 Water level

The water level fluctuates substantially in Lake Sarah mainly due to beaver activity. The beavers dam the outlet every year. They have been trapped in the past and the dam removed. However, they return each year to rebuild. High water and shoreline erosion is a problem. One resident on the southeast end of the lake has flooding problems. The garage floor and much of the yard is below the 100 year flood elevation. The former resort area also experienced flooding. Lake levels have been higher than the 100 year flood elevation in recent years and are often above the ordinary high water mark (OHW).

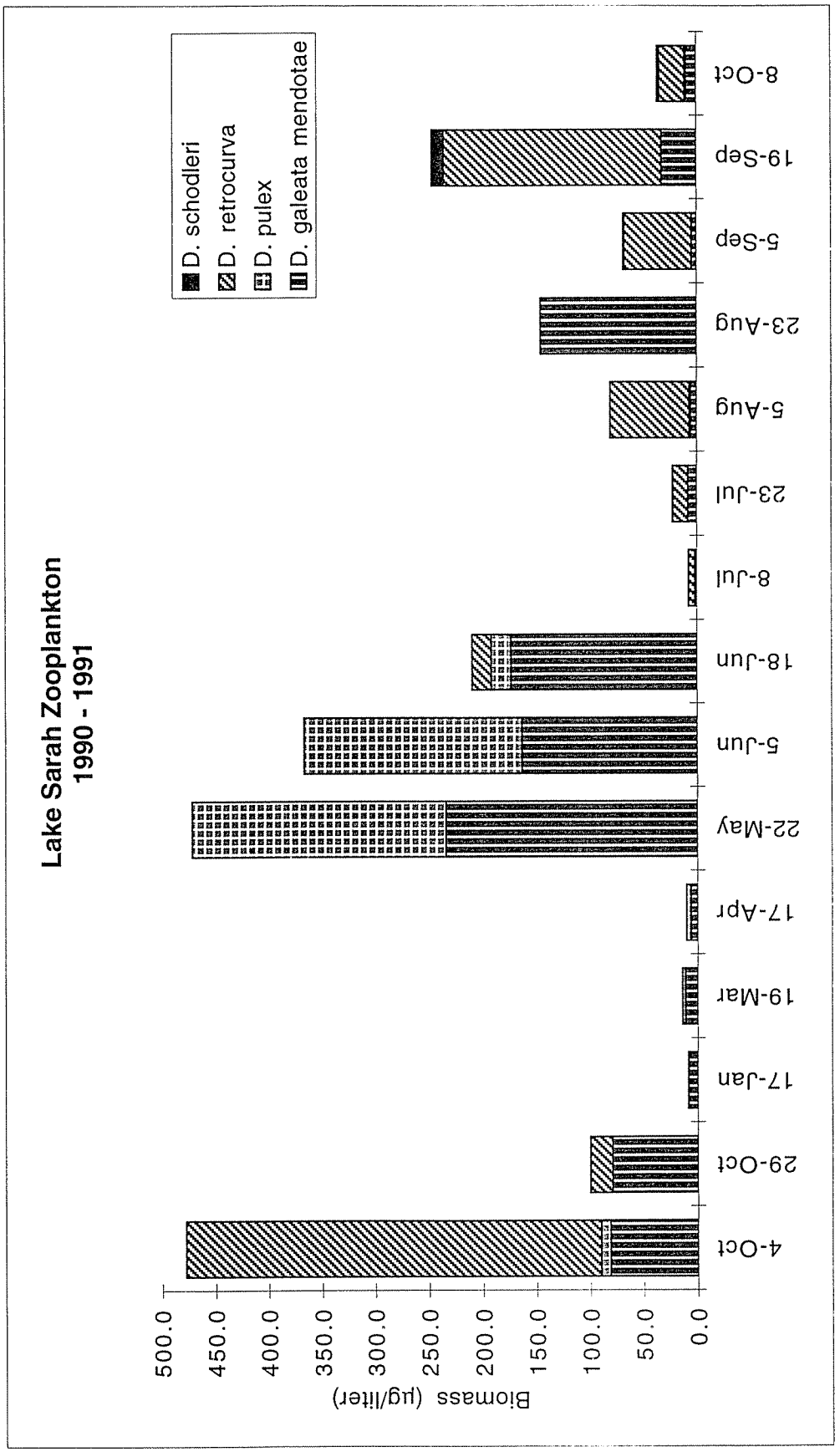


Figure 10a. Zooplankton Biomass

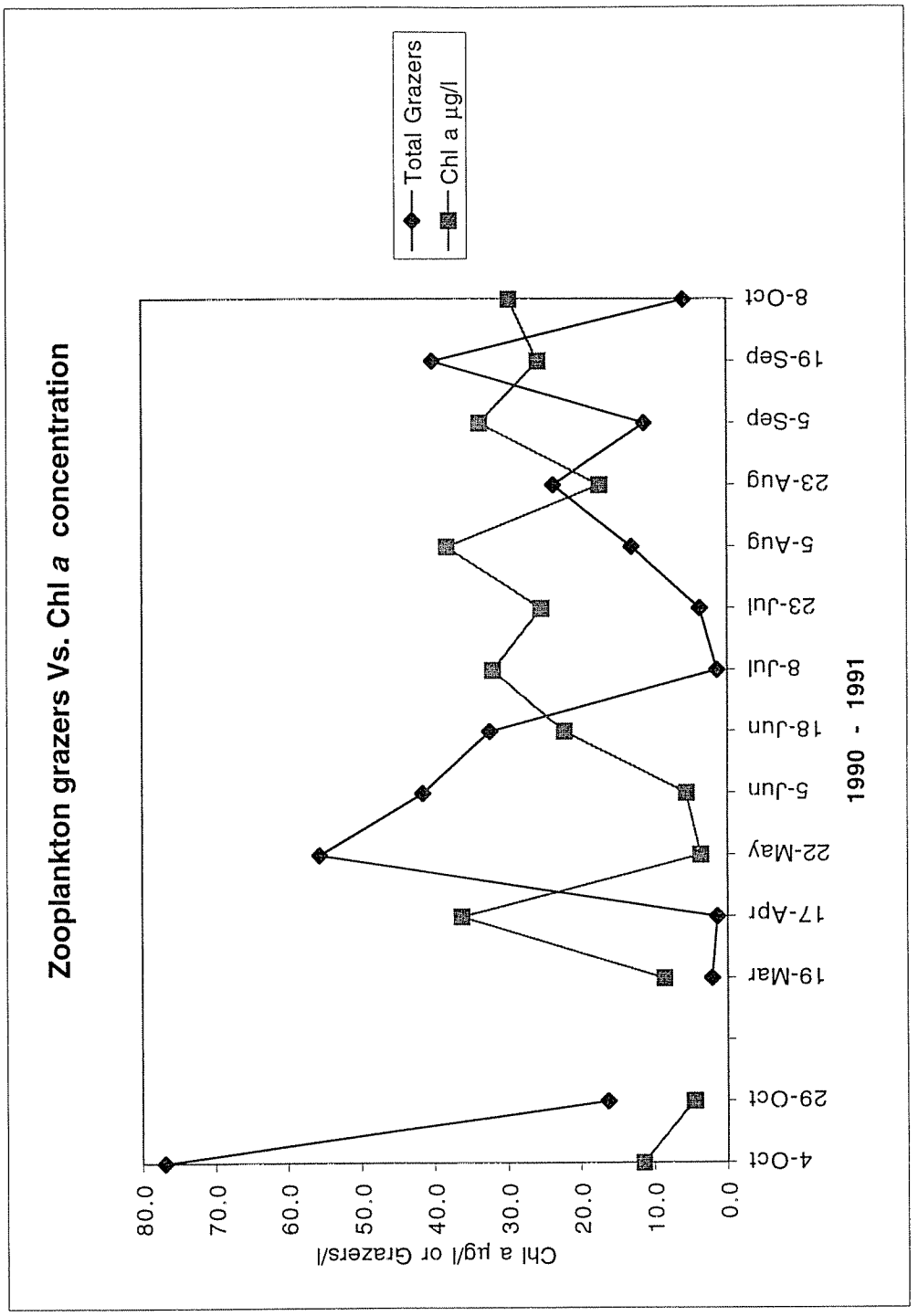


Figure 10b. Zooplankton Grazers vs. Chl *a* Concentration

2.3 Watershed Assessment

2.3.1 Watershed characteristics

Watershed area:lake area ratio: 6.9:1 (excluding lake area)

Table 8. Subwatershed Areas

Seven subwatersheds	Size (acres)	Size (km^2)
subwatershed 1 (Loretto Creek)	1,259 acres	4.7 km^2
subwatershed 2	454 acres	1.8 km^2
subwatershed 3 (Dance Hall Creek)	2,289 acres	9.0 km^2
subwatershed 4	252 acres	1.0 km^2
subwatershed 5	48 acres	0.2 km^2
subwatershed 6	191 acres	0.8 km^2
subwatershed 7	105 acres	0.4 km^2
Total area	4,608 acres	17.9 km^2

The watershed of Lake Sarah drains an area that is primarily agriculture. Land use percentages for the watershed are listed in part 2.1.1, Existing Land Uses. The agricultural area consists of 70 % cropland and 25% grassland and pasture. Six animal feedlots were identified within the watershed. These feedlots are small but located in areas where runoff of nutrients and soils from the feedlot to a ditch or the lake is probable. The primary crops are corn, soybeans and alfalfa. Many of the former type 1 and 2 wetlands have been drained and are being farmed. Much of this land is used for producing hay. Although the horse lots are small, they tend to be lacking vegetation more than cattle sites.

2.3.2 Agricultural watershed assessment

The agricultural area of the community makes up 60 percent of the land use. Seventy percent of the agricultural land is cropland, 25 percent is grassland/pasture and 5 percent is farmsteads/feedlots. Primary crops grown in the watershed are soybeans, corn, alfalfa and hay. The most commonly used pesticides in the area are Round-up, Alachlor, Atrazine and 2,4-D.

Some farmers in the area spread the Metropolitan Waste Control Commission (MWCC's) nutralime on their cropland. Information provided by Hennepin Extension Service showed that the nutralime was high in phosphorus. Some of the property on which the nutralime was applied is tiled directly to the lake. In 1991, the Hennepin Conservation District (HCD) office received a complaint of a cloud of turbidity in the lake. Upon inspection it was noted that the large plume of soils with a milky color due to the nutralime, was coming through the tile line which drained a field on the south side of the lake. This field a recent application of nutralime.

Most of the agricultural land in the watershed has been tiled or ditched. An extensive ditch system can be found in the upper part of the watershed connecting to what is known as Dance Hall Creek or Rush Creek. There are no maps of the tile systems in the watersheds. It is believed that much of the area is ditched, tiled or both. A couple of tile lines have been located. The drainage area of one includes a feedlot. Because of the extensive ditching and tiling in the project area, many of the type 1 and 2 wetlands have been lost. These are the wetlands that are most susceptible to agricultural drainage. These drained wetlands are used for pasture and for cropping/haying.

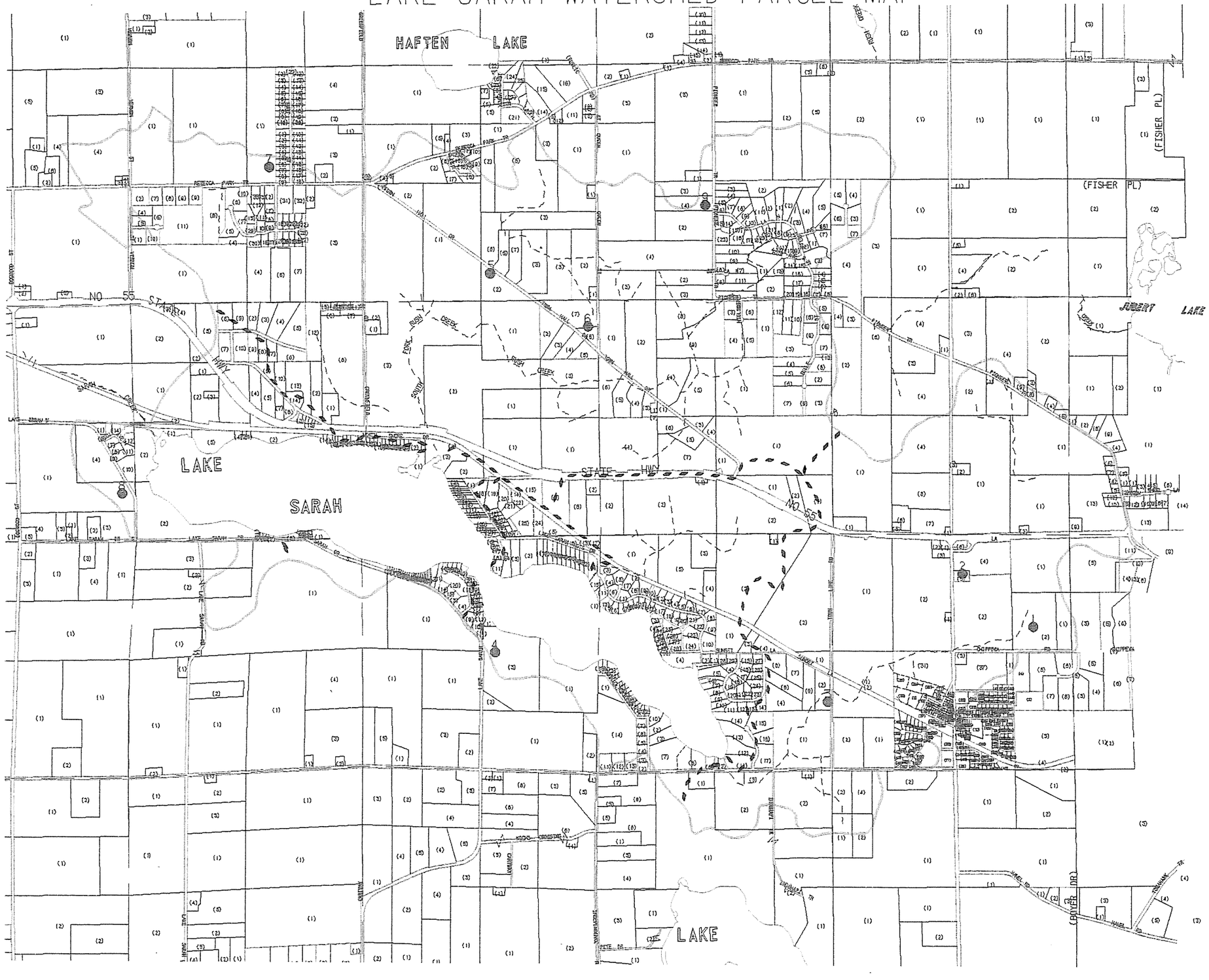
There are eight feedlots within the project area (Table 9 and Figure 11). Two of these feedlots drain directly to the lake. The feedlot on the south side of the lake has approximately 40-45 dairy cows. The cows are not fenced off and freely roam into the lake. Drainage from the feedlot flows into a pond on site which is connected to the lake by a large culvert. The culvert is set partly below lake level so water exchange occurs back and forth between the lake and the pond. In 1985, the MPCA informed the owner that a pollution problem existed. Assistance was requested from the HCD. HCD designed a system to correct the pollution problem, primarily by plugging the culvert and installing a vegetated filter strip with a concrete spreader box. No enforcement action was initiated against the landowner and the pollution problem continued. Several contacts with the MPCA occurred in 1990-1993 to request resolution of the problem. In November, 1993, the MPCA contacted the landowner to resolve the pollution problem. In 1994, the landowner notified the MPCA that he had resolved the problem by plugging the culvert.

Table 9. Lake Sarah Watershed Feedlot Inventory

Site #	Animal type	Number A.U.	% cover Feedlot area	% cover Pasture	Feedlot Area (sq. ft.)	Distance from Creek/lake	Water type	Water Access	Runoff Treatment
1	cattle	8	<10	50	17000	200	Loretto Creek	?	no
2	horses	6			1500				no
3	cattle								no
4	Dairy cows	20				0	lake	yes	pond
5	cattle	35				0	ditch/tile	yes	no
	swine	0.8	0	90		0	ditch/tile	yes	no
6	horses	2	50		52500				no
7	horses	5					ditch		
8	cattle	8	20	20	15000	1000	ditch/lake	no	
9	horses	3	50		4500		ditch/wetland	yes	
10	horses					100	wetland/lake	yes	no

Figure 11

LAKE SARAH WATERSHED PARCEL MAP



LEGEND

- FEEDLOT
- WATERSHED BOUNDARY
- SUB-WATERSHED BOUNDARY
- CREEK LINE

Loading from the feedlot in 1991 was estimated based upon estimates of manure production and phosphorus concentration. Dairy cattle produce approximately 40-115 lbs of manure each day. The phosphorus content of this manure ranges from 0.036 to 0.102 lbs/day. Approximately 40 dairy cows are held in the feedlot. Some of this phosphorus is deposited directly to the lake as the cattle have access to the water. Additional phosphorus enters the lake from overland runoff across the feedlot which is sloped down to the lake. A holding pond on the property catches some of the runoff. However, the pond is connected to the lake via a culvert. Water exchange occurs through the culvert into the lake. The pond also receives milkhouse waste. A 1987 sample showed a phosphorous content of the milk house waste of 6.3 mg/l. Estimates of approximately 290 gallons (1100 liters) of milkhouse drainwater enters the pond each day. Using a phosphorus concentration of 6.3 mg/l, the milkhouse waste would amount to 2.5 million milligrams of phosphorus (2.5 kg) per year. This waste is no longer entering the lake.

The feedlot on the west side of the lake is across Lake Sarah Road from the lake. Runoff from this small feedlot is carried through a culvert under the road. It is filtered somewhat as it runs overland through an open grassed field prior to entering the lake.

2.3.3 Urban watershed assessment

There is no land use in the area that would be classified as urban. However, rural residential development is present. At the time of the study, there were approximately 210 homes around the lake. About 20-30 additional homes are located near the lake, but do not have lakeshore. About half of Loretto is within the watershed. Several business and industries are located in Loretto and along Highway 55 in Medina. Commerical areas, dwellings and roads comprise approximatley 20% of the watershed area.

One of the main sources of pollutants to Lake Sarah from the residential areas is construction site erosion. Since the watershed is undergoing development, erosion of soils into ditches, tiles and creeks flowing to Lake Sarah may occur when the soil is disturbed for construction of roads, commerical/ industrial development and residential development.