Four lakes (Cook, Fish, Mill Pond and Weaver) were sampled by the Commission in 1988 (figure 2). Lake morphometry, watershed area and land use data are summarized for each lake in Table 1. Land uses with potentially adverse effects on water quality include, row crops, commercial, industrial and medium and high density residential uses. These land uses are classified as deleterious uses in the Elm Creek watershed plan. Land uses with potentially positive effects on water quality include grasslands, wetlands, woods and parks. These uses are classified as sustaining uses.

Water quality parameters monitored in 1988 are summarized in Table 2. Cook, Fish and Weaver were sampled monthly from May through September. Analyses of lake samples for nitrogen compounds were conducted in May and August. Alkalinity and chloride analyses were conducted in May. All other parameters were monitored or analyzed monthly. The Mill Pond was sampled monthly from June through September. Alkalinity, chloride and nitrogen analyses were done once in June. All other parameters were monitored or analyzed monthly.

The maximum Secchi disk transparency occurred in May in Weaver Lake and in June for Cook Lake and the Mill Pond. The maximum Secchi disk transparency did not occur until July in Fish Lake. Minimum transparency occurred in July in Weaver Lake and in August in the Mill Pond. Cook and Fish Lakes had their lowest transparencies in September (figure 3). Secchi disk transparency is a measure of water clarity. Higher Secchi disk transparency indicates greater water clarity. Cook, Fish and Weaver Lakes had similar mean and median Secchi disk transparencies (figure 4). All three lakes had average and median values in excess of 6 feet. Weaver Lake had the highest median value (7.0 feet). The Mill Pond had the lowest mean and median values for transparency with both measures less than 1.5 feet.

The concentration of chlorophyll a in Cook Lake peaked in May and was lowest in June. The Mill Pond also had its lowest concentration in June but the peak concentration occurred in July. Fish and Weaver Lakes had their lowest concentrations in May. Fish Lake had its peak concentration in September and Weaver Lake had its highest concentrations of chlorophyll a in July and August (figure 5). Chlorophyll a is a photosynthetic pigment found in all green plants. The concentration of chlorophyll a is a measure of algal abundance. The Mill Pond had the highest and Weaver Lake the lowest mean and median concentrations of chlorophyll a (figure 6). The relationships between concentrations of total phosphorus and chlorophyll a, trophic state and lake use are presented for comparison in table 7.

Cook and Fish Lakes had their maximum concentrations of total phosphorus in September. Cook Lake had its lowest concentration of total phosphorus in June but Fish Lake had its lowest concentrations in June and July. The Mill Pond had it highest concentration of total phosphorus in July and its lowest concentration in June. The concentration of total phosphorus in Weaver Lake peaked in May and was lowest in June (figure 7). Phosphorus is a chemical element that is essential for plant growth. Concentrations of total phosphorus indicate the maximum growth potential for algae in a lake and may be used to classify a lake's trophic status. The Mill Pond had the highest mean and median concentrations of total phosphorus. Cook Lake had the lowest median concentration and Weaver Lake the lowest mean concentration (figure 8).

Temperature profiles showed that Cook, Fish and Weaver Lakes were weakly stratified

on May 12. Fish and Weaver were strongly stratified June through August. Cook and Fish Lakes were virtually isothermal by September 21 but Weaver Lake remained weakly stratified on this date (figures 9-11). Profiles for the Mill Pond are not shown due to its lack of depth. pH and dissolved oxygen profiles reflect the pattern of thermal stratification in the individual lakes (figures 12-17). pH was uniform throughout the epilimnion or tended to peak deep in the epilimnion due to photosynthesis. Dissolved oxygen concentrations mirrored temperature profiles with a rapid decrease in dissolved oxygen below the thermocline during stratification and nearly uniform dissolved oxygen concentrations during isothermal conditions. Specific conductance varied seasonally in all lakes but did not demonstrate a consistent variation with depth except in Weaver Lake (figures 18-20).

Mean Secchi disk transparency in Cook Lake declined slightly in 1988 compared to 1986 but the difference is not significant (figure 21). Mean concentrations of chlorophyll a increased over three fold from approximately 5 to 17 mg m^{-3} (figure 22) and mean concentrations of total phosphorus declined by approximately 40% (figure 23). This apparent anomaly will be discussed in a subsequent section of this report.

Mean Secchi disk transparency in Fish Lake also declined in 1988 compared to transparencies in 1986 and 1987 (figure 24). The 1986 transparency is the highest of record. The difference between 1987 and 1988 is not significant. The 1988 mean Secchi disk transparency is near the median of all mean values since 1980. The mean concentration of chlorophyll a and total phosphorus also declined in 1988 (figures 25-26). The decline in mean concentrations of total phosphorus was more pronounced than the decline in the mean concentration of chlorophyll a. The 1988 mean concentration of chlorophyll a is below the median mean concentration observed since 1980. The 1988 mean concentration of total phosphorus is near the median (1980-88) value.

Mean Secchi disk transparency and mean concentration of total phosphorus in the Mill Pond were lower in 1988 than in 1985 (figure 27, 29). Mean chlorophyll a was higher in 1988 than in 1985 (figure 28).

Weaver Lake had a slightly lower mean Secchi disk transparency in 1988 than in 1987 (figure 30). Although the decline in transparency is small the mean concentration of chlorophyll a was significantly higher in 1988 than in 1987 (figure 31). 1987 was the lowest mean concentration of chlorophyll a on record. Mean concentration of total phosphorus (figure 32) declined in 1988 even though chlorophyll a had increased.

Weaver Lake had the best overall water quality in 1988 but the water quality in Cook and Fish Lakes was very similar to Weaver Lake. Mean Secchi disk transparencies in Cook and Weaver differed by only 0.1 foot although median transparency was 0.7 foot higher in Weaver Lake. Fish Lake had a higher mean concentration of total phosphorus (42 mg m^{-3}) than either Weaver (22 mg m^{-3}) or Cook (26 mg m^{-3}) but this higher concentration did not result in markedly higher algal abundance. Weaver Lake had the lowest mean concentration of chlorophyll a (13 mg m^{-3}) but mean chlorophyll a in Cook and Fish was not much higher (17 mg m^{3}). The Mill Pond had the poorest water quality of the lakes monitored in 1988.

Cook Lake demonstrated an unusual pattern with a slight decline in transparency but a marked increase in algal abundance as indicated by concentrations of chlorophyll a. A decrease in total phosphorus accompanied the increase in chlorophyll a which is also

unusual. Weaver Lake displayed a similar pattern of slightly lower transparency, increased chlorophyll and lower total phosphorus although the changes in chlorophyll and total phosphorus were not as large on a relative basis as the changes in Cook Lake.

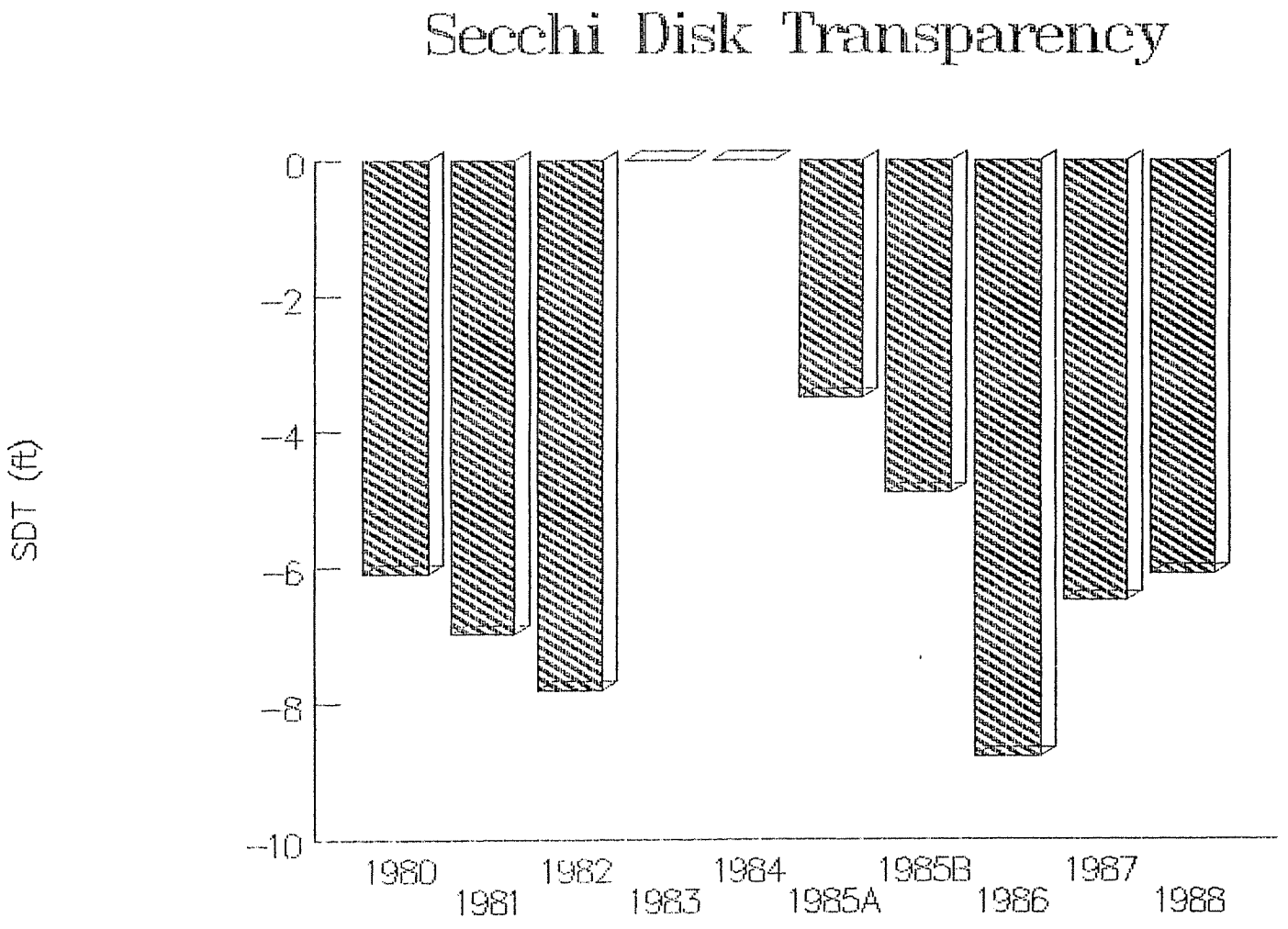
This pattern can be explained if the percentage of total phosphorus attributed to algae was higher in Cook and Weaver in 1988 than in previous years. The lack of runoff in 1988 could result in less non-algal particulate matter and hence non-algal phosphorus in the surface waters of these lakes. Less non-algal particulate matter would also improve transparency and could mitigate the reduced transparency due to increased algal abundance. Lack of runoff would also explain the higher chlorophyll concentrations observed in the Mill Pond in 1988. Algal abundance in the Mill Pond has always been less than expected based on available phosphorus due to the stream like character of the Mill Pond. Algae were simply flushed out before they could utilize all the available phosphorus. The low flows in 1988 allowed the algae to attain a higher population density due to a longer residence time.

The distribution of biologically important substances in lakes is affected by differences in water density that can impede mixing of surface and bottom waters. Water density varies with temperature. Temperature profiles in lakes indicate the degree of thermal stratification or layering present at the time of sampling. Profiles of temperature (density), pH, specific conductivity and dissolved oxygen in Cook, Fish and Weaver Lakes showed variability seasonally and with depth. Specific conductance was least affected by changes in depth. All lakes demonstrated reduced concentrations of dissolved oxygen in deeper waters during summer. Low concentrations of dissolved oxygen in deep waters are typical of eutrophic lakes.

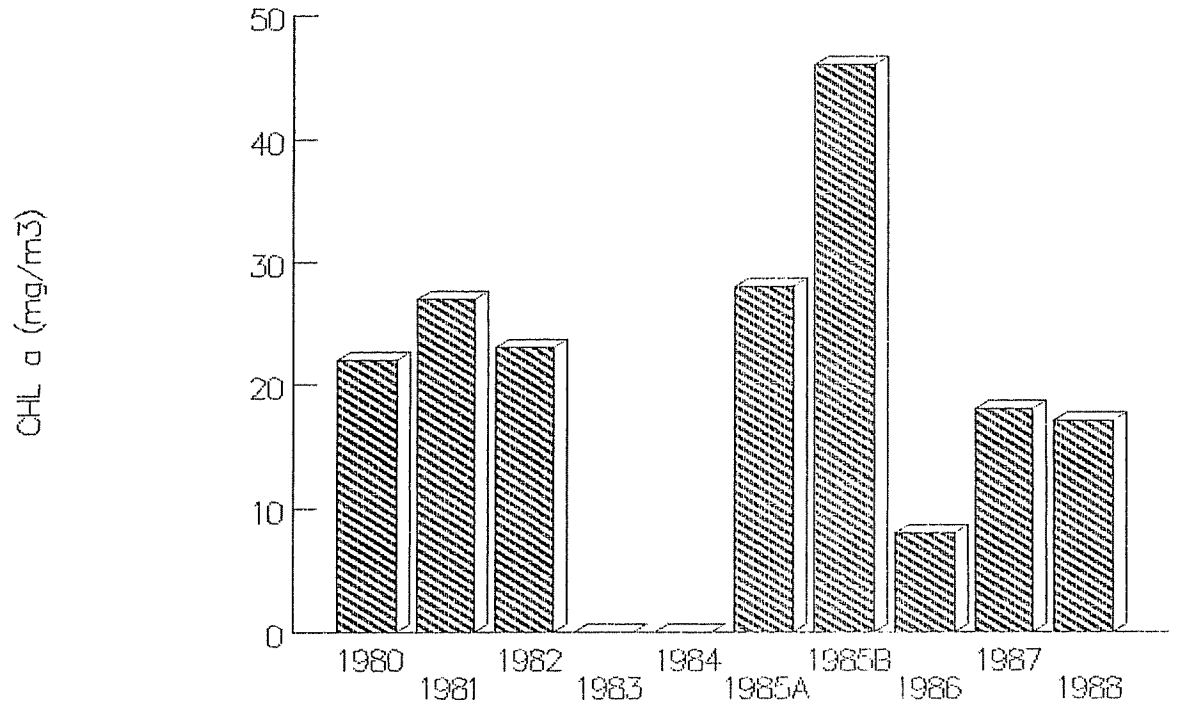
LAKE: FISH LAKE

PARAMETERS		SDT ft	CHL mg/M3	TP mg/M3	NO3 mg/M3	NO2 mg/M3
MEAN (May - Sept)	Epilimnetic	6.1	17	42	25	10
STANDARD DEVIATION		1.4	6	22	25	5
MEAN (May - Sept)	Hypolimnetic	*	*	123	50	5
STANDARD DEVIATION		*	*	121	77	8

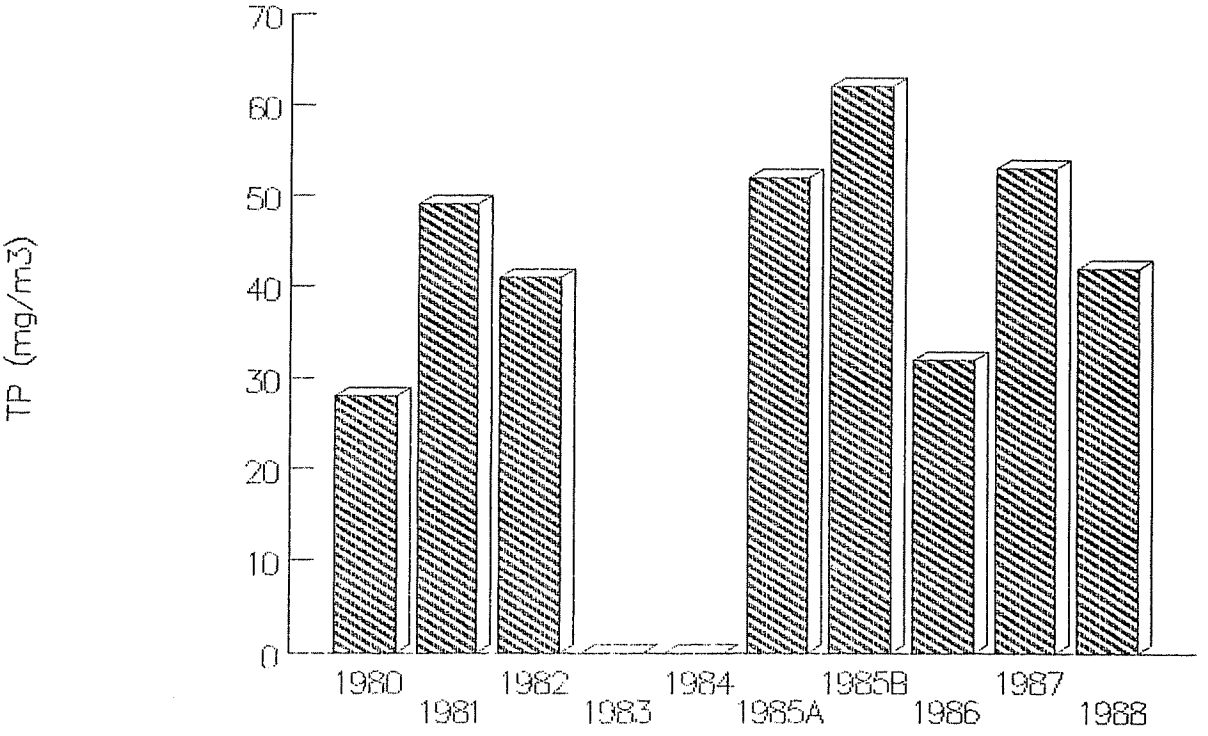
PARAMETERS		NH3 mg/M3	TKN mg/M3	TN mg/M3	ALK mg/L	CL mg/L
MEAN (May - Sept)	Epilimnetic	138	1655	156	32	32
STANDARD DEVIATION		96	955	*	*	*
MEAN (May - Sept)	Hypolimnetic	535	754	159	3	32
STANDARD DEVIATION		1040	1114	*	*	*



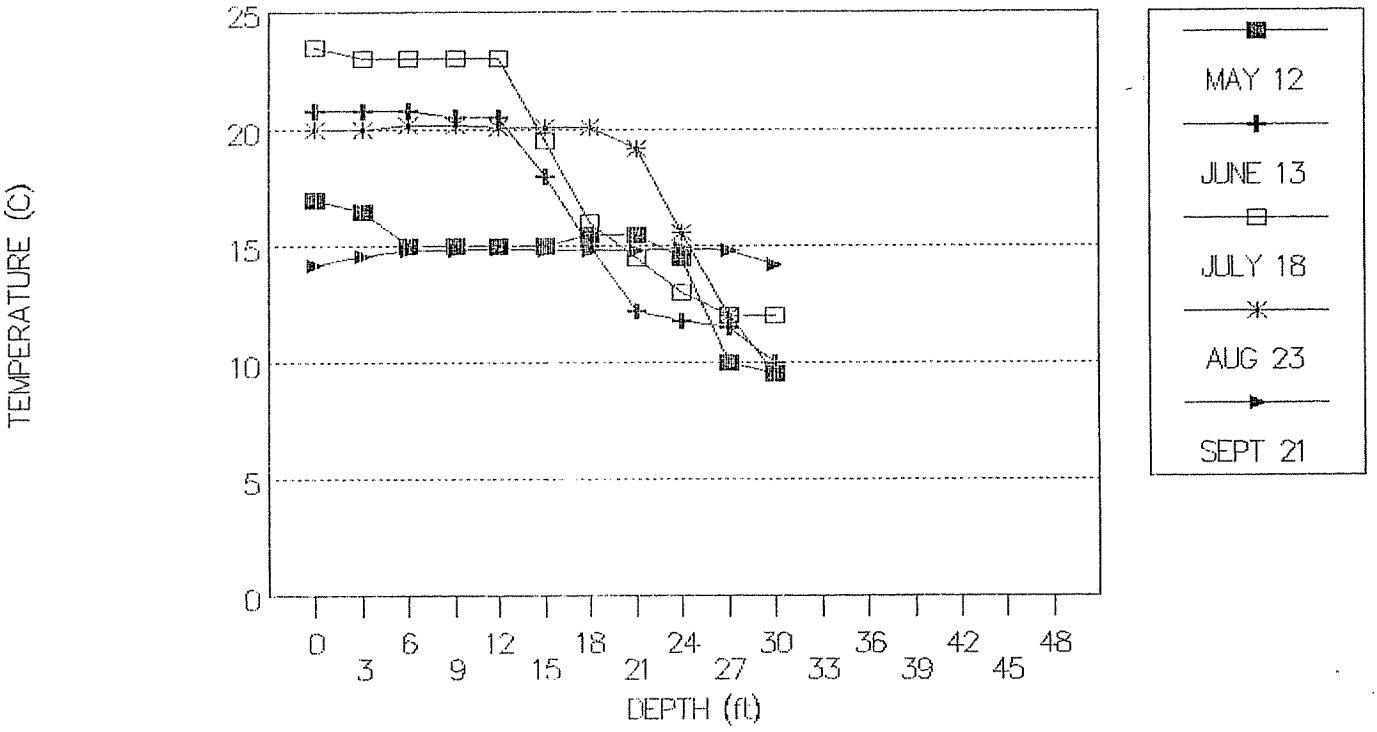
Chlorophyll a



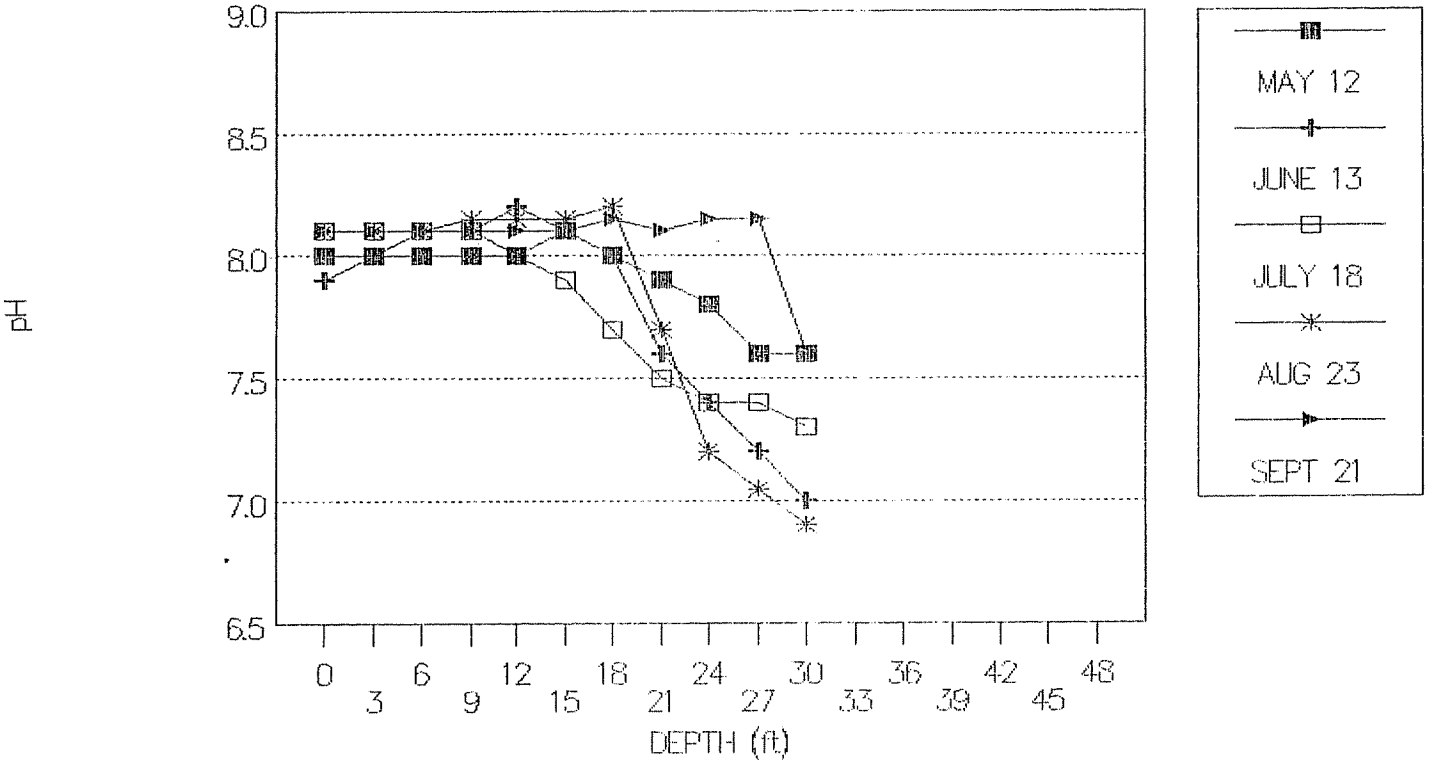
Total Phosphorus



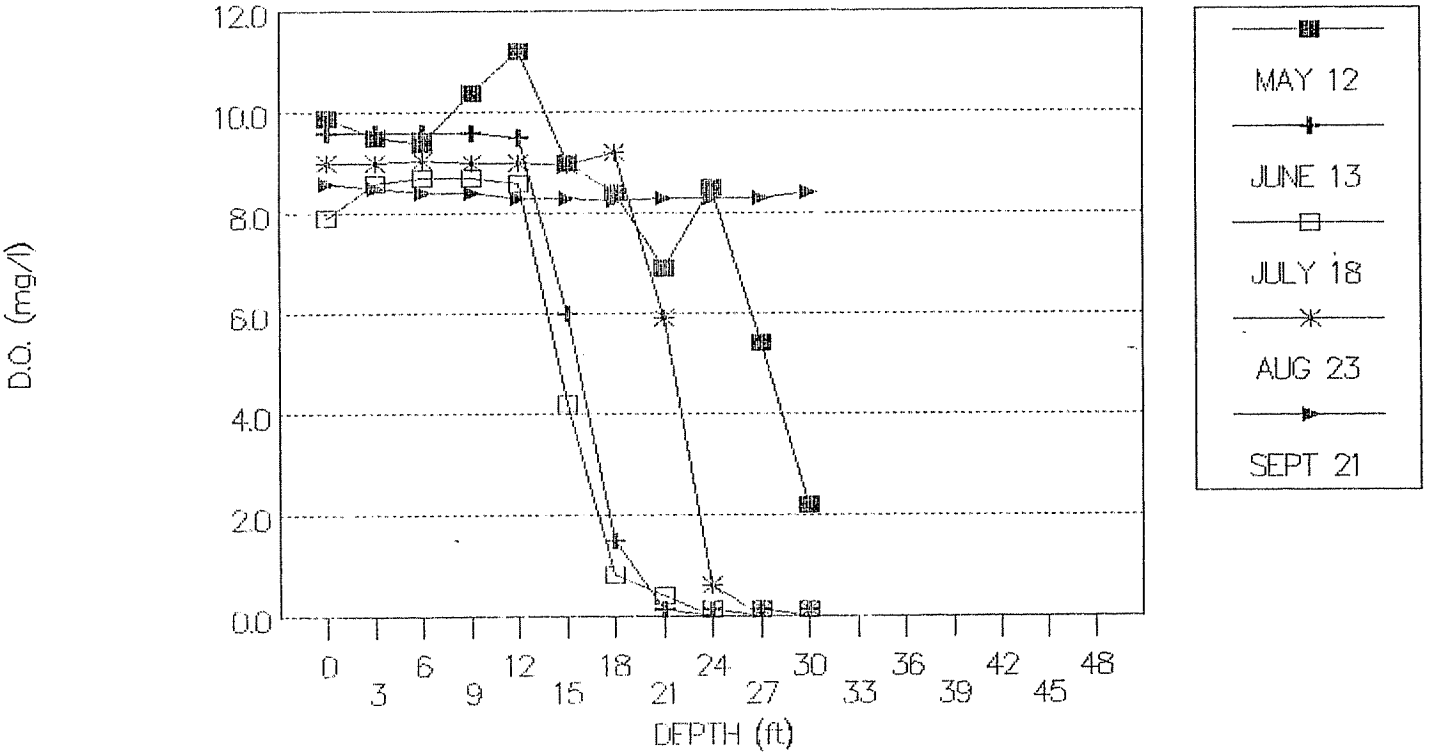
TEMPERATURE PROFILES



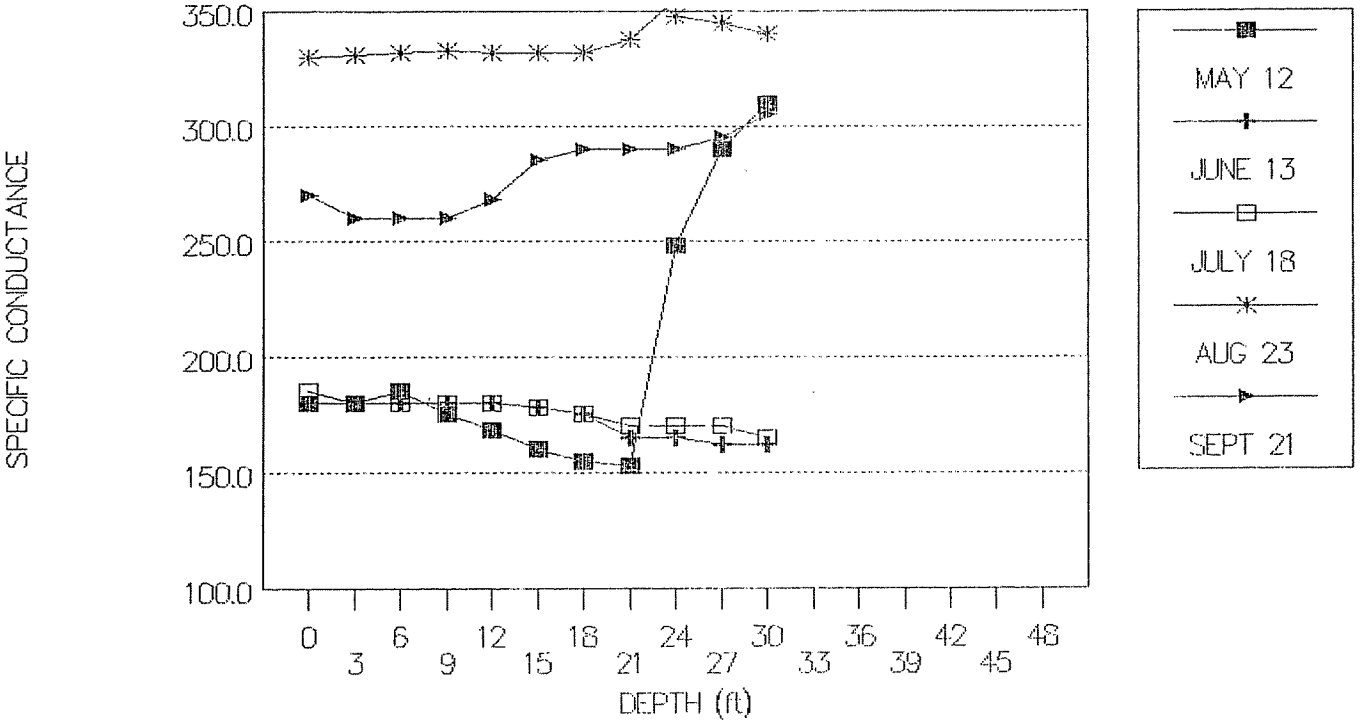
pH PROFILES



DISSOLVED OXYGEN PROFILES

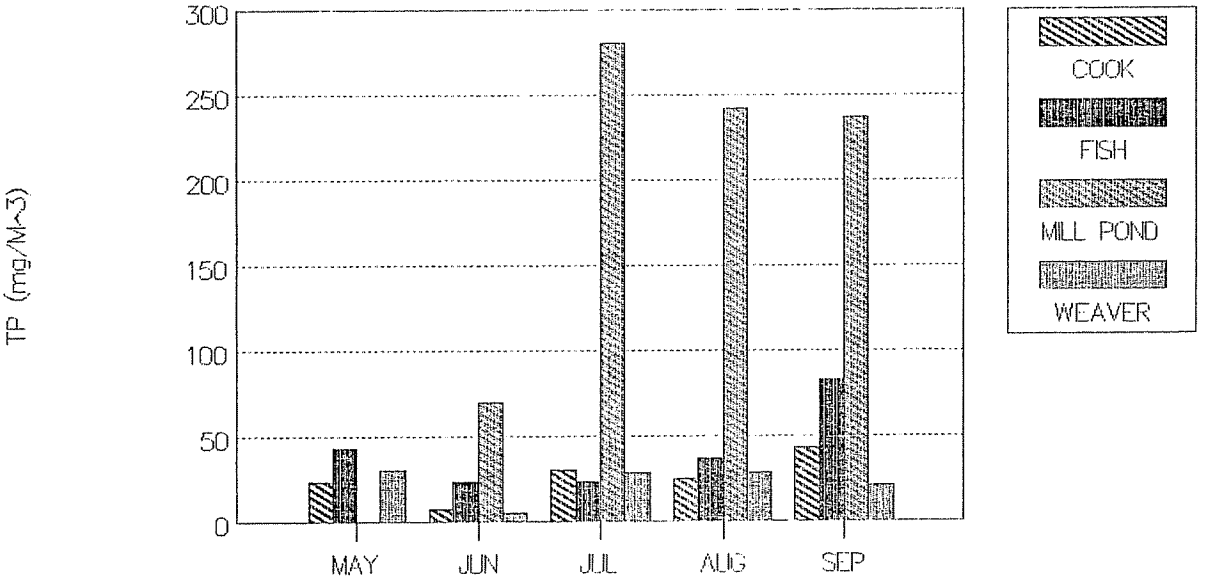


SPECIFIC CONDUCTANCE PROFILES



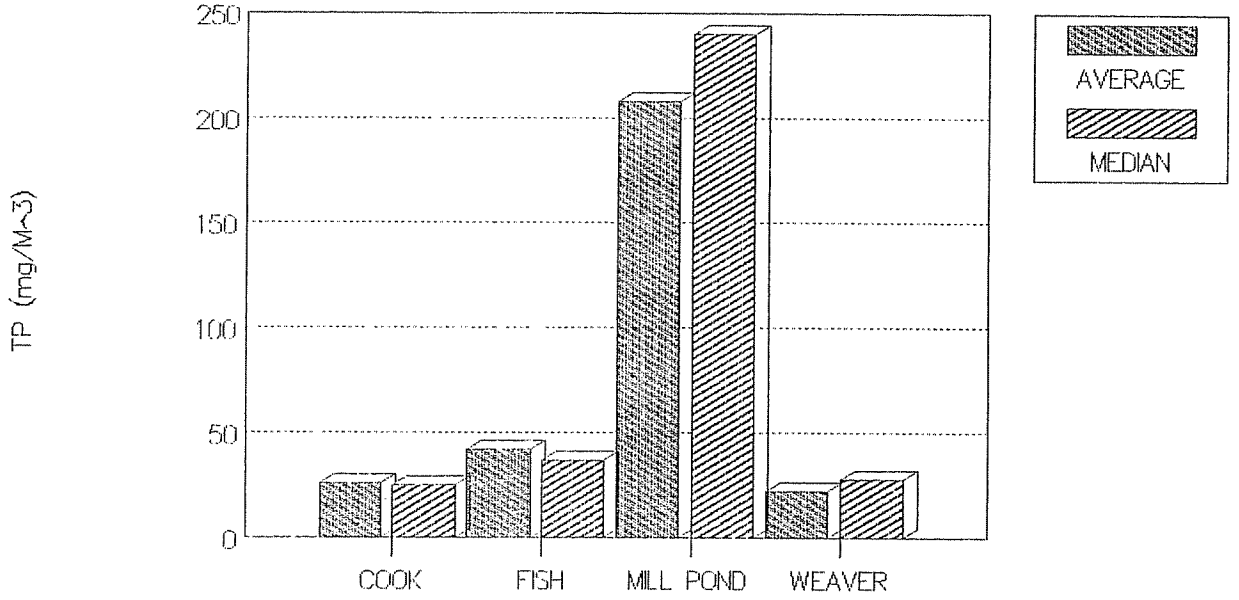
TOTAL PHOSPHORUS

1988



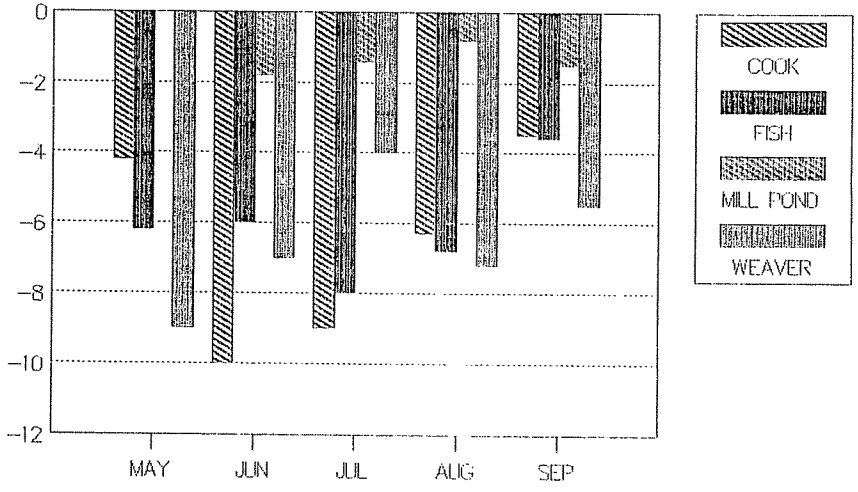
AVERAGE and MEDIAN TP

1988



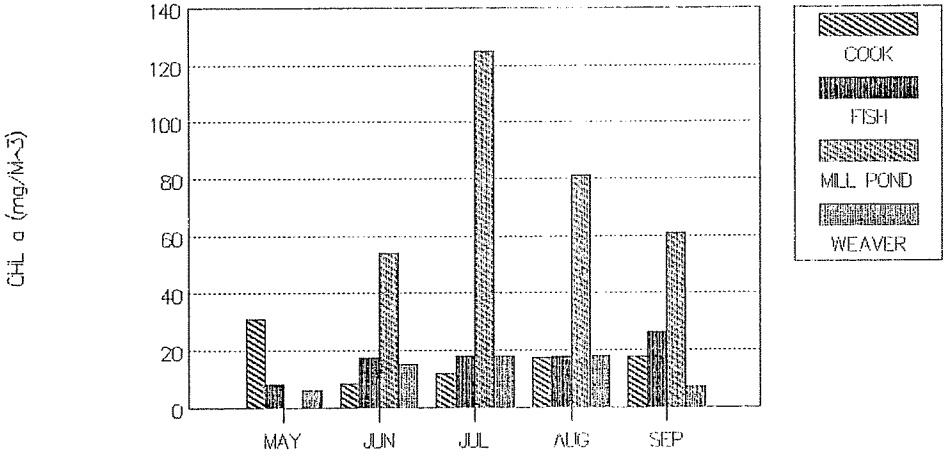
SECCHI DISK TRANSPARENCY

1988



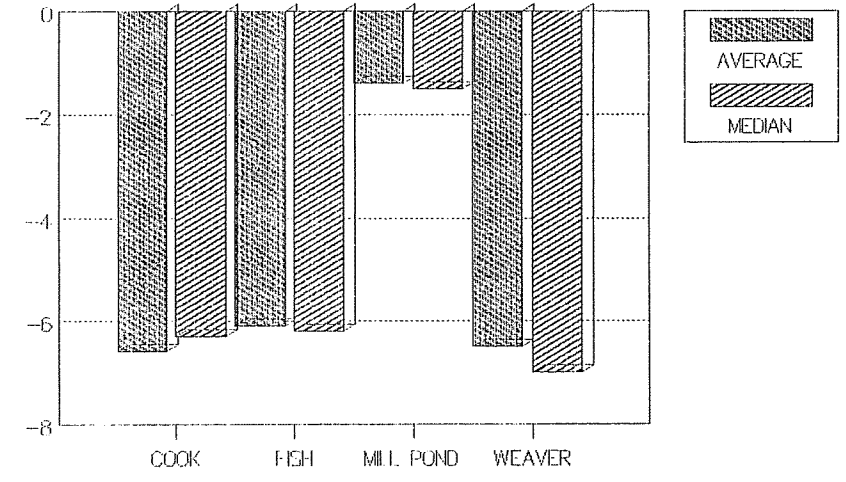
CHLOROPHYLL a

1988



AVERAGE and MEDIAN SDT

1988



AVERAGE and MEDIAN CHL a

1988