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DIVISION OF ENVIRONMENT
COEUR D'ALENE OFFICE

WATER QUALITY SUMMARY

HAYDEN LAKE, IDAHO

PREPARED BY
IDAHO DEPARTMENT OF HEALTH AND WELFARE
Division of Environment

June, 1977

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Areawide Waste Treatment Management Planning Grant from the U. S.
Environmental Protection Agency.

HAYDEN LAKE

INTRODUCTION

Hayden Lake is located three miles north of Coeur d'Alene, Idaho, in Kootenai County. The lake has a surface area of 3,800 acres and a maximum depth of 190 feet. The major tributaries to the lake are Hayden Creek, Mokins Creek, Yellowbanks Creek, and Avondale Lake outlet. Only Hayden Creek flows year round. The single surface outlet flows only during spring high water. Most of the lake outflow is via subsurface seepage into the Rathdrum aquifer. Eighty percent (80%) of the 41,000 acre watershed is forest land administered by the U. S. Department of Agriculture, Forest Service, and the State of Idaho. Agricultural development within the watershed is minimal. Residential development around the lake is extensive and recreational use is heavy during the summer months. The lake is used as a source of drinking water for six public and numerous private water systems.

TROPHIC LEVEL

The available data indicate that Hayden Lake should be considered oligotrophic; however, various bays on the lake vary from mesotrophic to eutrophic. Areas such as Mokins Bay, O'Rourke Bay and Windy Bay have dense submerged and emergent macrophytic growth. The shallow north end of the lake experiences heavy growth of submerged and emergent aquatic plants. This shallow area reportedly was once meadowland prior to the

raising of the lake level in 1911. Eutrophic conditions in the various bays is believed to be exacerbated by domestic and recreational development adjacent to the lake shoreline.

WATER QUALITY

Bacteriological data collected from Hayden Lake by the Idaho Department of Health and Welfare (IDHW), Division of Environment, indicate a water quality condition that can be described as generally good. In some cases total coliform numbers have been shown to be greatly variable (Appendix B, Table I). High counts appear to be associated with high density shoreline development and recreation areas. High fecal coliform numbers have not been demonstrated in Hayden Lake. The highest fecal counts recorded by the IDHW have not exceeded 41/100 ml.

Hayden Lake is classified A₁ in the Idaho Water Quality Standards. Shoreline waters of the State (i. e. within 100 feet of shore), are, however, expected to conform with A₂ standards which read:

- a. Total coliform concentrations where associated with a fecal source(s) to exceed a geometric mean of 240/100 ml., nor shall more than 20 percent of total samples during any 30-day period exceed 1000/100 ml. (as determined by multiple-tube fermentation or membrane filter procedures and based on not less than 5 samples for any 30-day period).
- b. Fecal coliform concentrations to exceed a geometric mean of 50/100 ml., nor shall more than 10 percent of total samples during any 30-day period exceed 200/100 ml.; or greater than 500/100 ml. for any single sample.

Fecal coliforms recovered from Hayden Lake have never been shown to exceed the A₂ standard. Total coliform numbers where associated with a fecal source have also never been demonstrated by the IDHW to exceed the A₂ standard for shoreline waters. (see Appendix B, Table I; Appendix C, Table I).

During the summer of 1975 the Panhandle Health District conducted bacteriological sampling of waters from Honeysuckle Beach, the major public swimming area on Hayden Lake. A total of 20 samples were collected on separate days from July through September, 1975. Less than one-half (9 of 20) showed the presence of fecal coliform organisms and in no case did the numbers of total or fecal coliforms exceed the Idaho Standard for shoreline waters (class A₂).

Mineral and nutrient samples collected on Hayden Lake since 1972 by the IDHW have, at times, shown higher levels of ammonia-nitrogen than anticipated. During surveys conducted in August, 1973 (Appendix D, Table I) shoreline samples collected at five lake stations showed ammonia-nitrogen levels which approached or exceeded recognized organic pollution levels of 0.2 mg/l. Concentrations ranged from 0.164 to 0.247 mg/l and were collected at stations adjacent to shoreline development. Subsequent surveys by the IDHW have not measured shoreline ammonia-nitrogen (or other nutrient levels) although midlake levels have been measured and have not been shown to exceed 0.2 mg/l (Appendix C, Table 2; Appendix E, Tables I-V).

Nitrate-nitrogen concentrations in Hayden Lake have been shown to be generally low. (An exception to this occurred on August 23, 1973, (Appendix D, Table II), when samples collected at five lake stations were shown to approach or exceed the algal bloom potential level of 0.3 mg/l. Since nitrite-nitrogen levels were, in all cases, less than 0.0003 mg/l, the high nitrate levels are believed to be a result of lab error. Samples recently collected from midlake stations in 1975 and 1976 have consistently shown concentrations of nitrate-nitrogen to be less than 0.1 mg/l.

Mineral and nutrient data collected in 1975 from Hayden Lake by the IDHW and the EPA showed varied results. IDHW data collected on July 6, 1975, showed moderate levels of orthophosphate phosphorus and total phosphorus at three midlake stations (Appendix C, Table II), while EPA data collected on three other occasions showed low levels of ammonia, $\text{NO}_2 + \text{NO}_3$ -nitrogen, orthophosphate phosphorus, and total phosphorus at three different midlake stations (Appendix E). The reason(s) for these differences are not clear, but could be related to differences in sample sites and in the dates of sample collection.

Total phosphorus concentrations measured at midlake stations in Hayden Lake have generally been shown to be low. Only one midlake station sampled in 1976 was shown to exceed the algal bloom potential level of 0.05 mg/l. All other stations sampled in 1976 ranged from less than 0.01 mg/l to 0.04 mg/l (Appendix E).

Low dissolved oxygen concentrations have not been demonstrated at midlake stations on Hayden Lake. During 1975, dissolved oxygen levels below 8.4 mg/l were not observed in the hypolimnion.

POINT AND NON POINT POLLUTION

No point sources of pollution are known to exist within the watershed. Non-point pollution sources in the watershed are related to domestic, recreational, agricultural, and silvicultural activities, and the construction related to these activities.

In 1976, the Panhandle Health District conducted a shoreline survey of lots with dwellings adjacent to the lake. Five hundred and eighty-four (584) individual sub-surface disposal systems (cesspools, privys, septic tanks with drainfield, drywell or adsorption bed) were found to be located an average distance of 115 horizontal feet from the lake. Also, 59% of those lots surveyed were shown to have subsurface rock (within six feet of surface). The total potential nutrient contribution to the lake from these systems has recently been calculated to be 12.0% of the annual total phosphorus, and 10.9% of the total nitrogen, (EPA, 1977).

Since 80% of the watershed consists of forested land, activities taking place on these lands (mining, recreation, road construction, logging, etc.) necessarily have a major potential for impacting the lake. The extensive ongoing construction of domestic dwellings around the lake combined

with existing sewage disposal systems adjacent to the lake also has a major potential for lake impact. It is anticipated that any additional construction activities or surface disturbances within the watershed (housing, roads, logging, farming, etc.) will add to the present nutrient loading of the lake unless best management practices (BMP) are strictly adhered to. The present non-point nutrient loading from minor tributaries and the immediate watershed has been calculated (EPA, 1977) at 24.1% of the total phosphorus loading, and 22.7% of the total nitrogen loading to Hayden Lake.

Except for Hayden Creek, the other major tributaries to Hayden Lake have been studied little. The U. S. Geological Survey has conducted chemical and bacteriological sampling on Hayden Creek since 1966. Data from these years are variable although they do indicate the presence of relatively high nutrient concentrations in the stream at various times of the year (Water Resources Data for Idaho, U.S.G.S., 1966 through 1975).

TREND 1965 TO 1976

Little data exists with which to identify a trend in the water quality of Hayden Lake. Bacteriological data collected since 1972 does, at times, indicate high total coliform levels in those areas where high density development has occurred. Further shoreline development can be expected to increase these bacterial levels. The limited data collected to date do not, however, confirm this.

LIMITING NUTRIENTS

Algal growth potential studies were conducted on Hayden Lake in 1975 by the Environmental Protection Agency's National Eutrophication Survey (NES) and in 1976 by the IDHW. Composite samples were collected through the euphotic zone from three midlake stations on April 4, and September 10, 1975 and on March 29, June 8, August 24, and November 11, 1976. Algal growth responses showed the waters of Hayden Lake to be phosphorus limited on all the above dates except March 29, 1976. Nitrogen limitation was noted on this date. No toxic or other limiting factors were identified. A final NES report by EPA is due in mid 1977.

MONITORING/RESEARCH HISTORY

The first reported studies on Hayden Lake were conducted in 1948 by the Idaho Department of Fish and Game (Appendix A). Parameters tested at that time included temperature, dissolved oxygen, hardness, and alkalinity. A limited survey was conducted in 1959 by the Department which compiled some chemical and physical data (Appendix B).

The IDHW, Division of Environment, commenced surveys of Hayden Lake in 1972. Samples were collected for mineral, chemical, and bacteriological analyses (Appendix C). On July 7, 1975 a shoreline bacteriological survey was conducted and samples for mineral and nutrient analysis were collected at midlake stations (Appendix D). In the past, surveys conducted

by the IDHW appear to have been somewhat sporadic while sample stations have tended to vary from one survey to the next. More recently the IDHW has begun quarterly monitoring of midlake stations in order to identify long term trends in the water quality of Hayden Lake.

On April 4, and September 10, 1975, the EPA surveyed the lake for algal growth potential (AGP). Chemical and nutrient data were collected from the lake and tributaries and are available from STORET data retrieval.

Additional AGP studies were conducted in 1976 by the IDHW. Monthly monitoring of the lake tributaries commenced in April, 1976, and will conclude in August, 1977. This monitoring is expected to produce data to assist in calculating a lake nutrient balance.

The U. S. Geological Survey has conducted water quality sampling on Hayden Creek since 1964. A wide range of parameters are determined on samples collected at a gaging station located 0.3 miles downstream from the confluence of the creek's east and north forks (Water Resources Data for Idaho, U.S.G.S., 1966 through 1975).

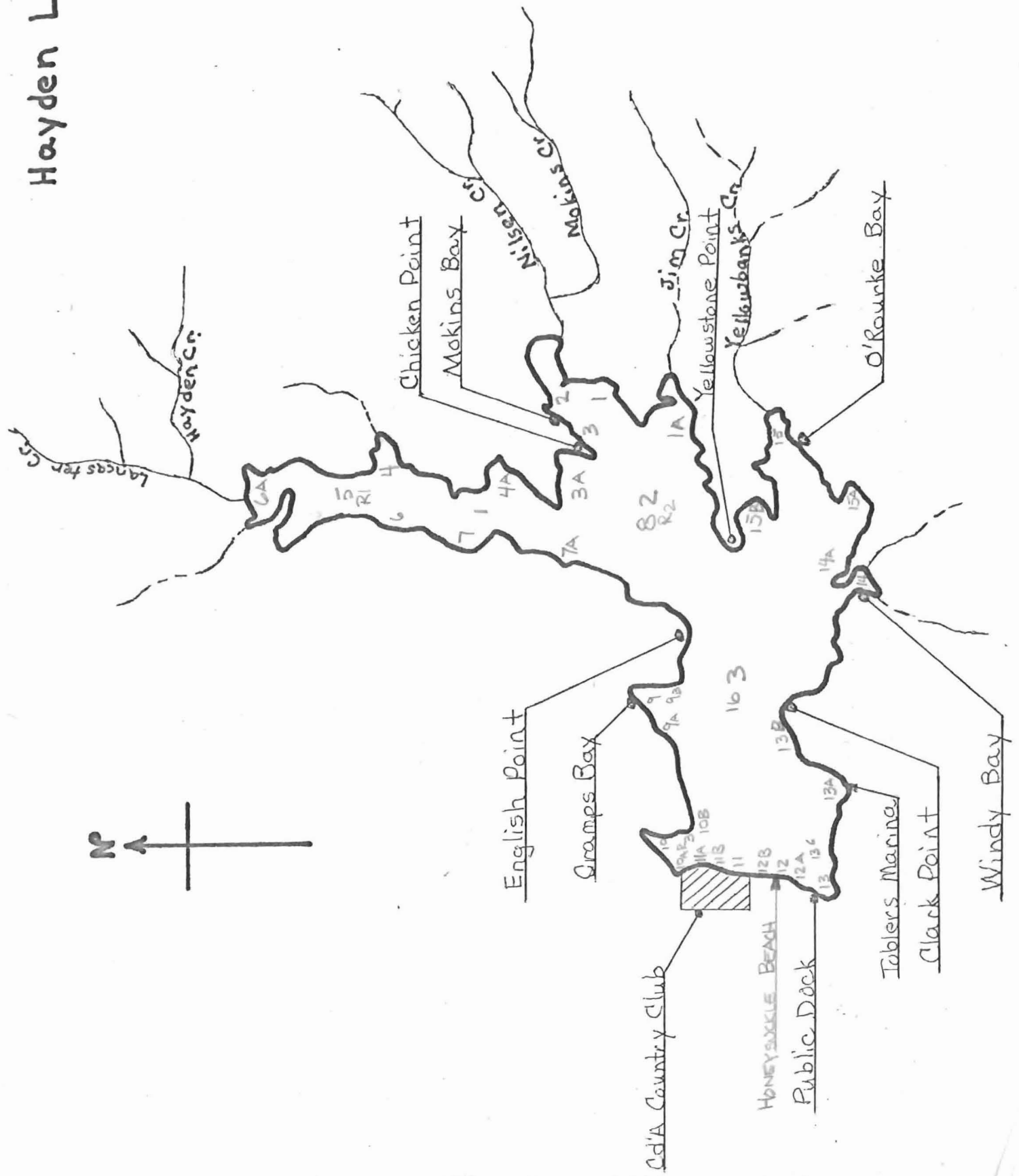
ADDITIONAL DATA NEEDS

Shoreline monitoring of high density developed and developing areas is deemed necessary in order to better assess the impact on the lake of these activities. Mineral, nutrient, and bacteriological analyses

should be conducted on a regular basis during the summer months at suspected problem areas. Estimates of the relative loadings from each of the non-point source contributors in the watershed should be calculated for purposes of planning and abatement strategy.

APPENDIX A

Hayden Lake



MIDLAKE CHEMICAL AND PHYSICAL PARAMETERS*

HAYDEN LAKE, IDAHO

August, 1948

| | Dissolved Oxygen | Temperature °F | Hardness | Alkalinity |
|----------|---------------------|-------------------|----------|------------|
| Surface | 9.5 ppm | 73 | 48 ppm | 64 ppm |
| 26 feet | 7.5 | 52 | | |
| 50 feet | 5.0 | -- | | |
| 75 feet | 5.0 | -- | | |
| 100 feet | 4.7 | 42.5 | | |
| 200 feet | 4.7 | 42.5 | | |

Most abundant plankton forms noted were Diaptomus and Cyclops.

* Data from the Idaho Department of Fish and Game.

APPENDIX B

WATER QUALITY SURVEY

HAYDEN LAKE

David Johann

DEPARTMENT OF HEALTH AND WELFARE
Environmental Services Division
Coeur d'Alene, Idaho

WATER QUALITY SURVEY

HAYDEN LAKE

David Johann

This is a collection of water quality information obtained by Environmental Services beginning in 1972 until August 1974. Limited information during 1959, obtained from Idaho Fish and Game, is in Appendix B. United States Geological Survey. Water Resources Division, has available information on Hayden Creek, a major tributary since 1966.

Hayden Lake is located five miles northeast of Coeur d'Alene in T 51N, R 3W, and has a surface area of about 3,800 acres. The watershed contains about 41,000 acres, of which about 80% is forested and in public ownership by USFS and Idaho State Lands. Agricultural development is limited to the feeding and grazing of cattle and some hay crops. Residential development around the lake is very extensive, with many year round homes along the western half of the shoreline.

The lake is used for recreational purposes and as a water reservoir for numerous private and six public water systems.

The residences around the lake are served by individual subsurface sewage disposal systems. Soil types, or the lack of soil and the slope makes the shoreline unsuitable for subsurface disposal. It seems inevitable that nutrient enrichment is occurring due to leaching from the domestic sewage.

Rooted, submerged plants grow in the shallow areas of the bays with emergent aquatic plants predominating in Mokins Bay and the upper segment of the lake north of sites 6 and 4. The upper portion of the lake is very shallow, six feet or less, and was formerly a hay meadow prior to raising of the lake level in 1911. Emergent vegetation in these areas form almost a solid mat in late August.

The upper portion of the lake has received excessive nutrient enrichment over the years due to the dumping of cow manure into the water by the operators of a cattle ranch located at the head of the bay. This practice ceased in 1973 due largely to the efforts of the Panhandle Health District.

Major tributaries are Yellow Banks, Mokins and Hayden Creek, and Avondale Lake outlet. Hayden Creek is the only year round flowing creek. Avondale Lake is a six acre, shallow, eutrophic pond completely surrounded by private development. The outlet enters Hayden Lake on an intermittent basis. The water level in Hayden Lake is artificially controlled and the outlet which flows intermittently feeds a ground water recharge area just west of the spillway.

A water quality survey was conducted on April 3 with the assistance of Steve Hurst, Panhandle Health District, and again on July 7 with the assistance of Scott Anderson, summer aide. Twenty five sample sites for coliform density analysis and four locations for physical and chemical analysis were established for monitoring of water quality.

Coliform bacteria densities show considerable variation between sample periods and between years (Tables 1 and 3). In August, 1972, only 50% of the samples showed evidence of coliforms, yet 85% of the positive samples exceeded the recommended standard of 50 per 100/ml, and 50% exceeded the 200 per 100/ml for a single sample period.

During sample periods in 1973, 81% of the sites had coliform densities exceeding 50 per 100/ml, and 26% exceeding 200 per 100/ml.

April and July sample periods in 1974 showed coliform densities of greater than 50 per 100/ml in about 12% of the sites. Yet in August, the Class A standard was exceeded in 65% of the sites.

Site 13A, during the August sample period, had a total coliform density too numerous to count from a 5 ml sample filtered. This site is near the only commercial marina on the lake. The shoreline in this area also has a high density residential development.

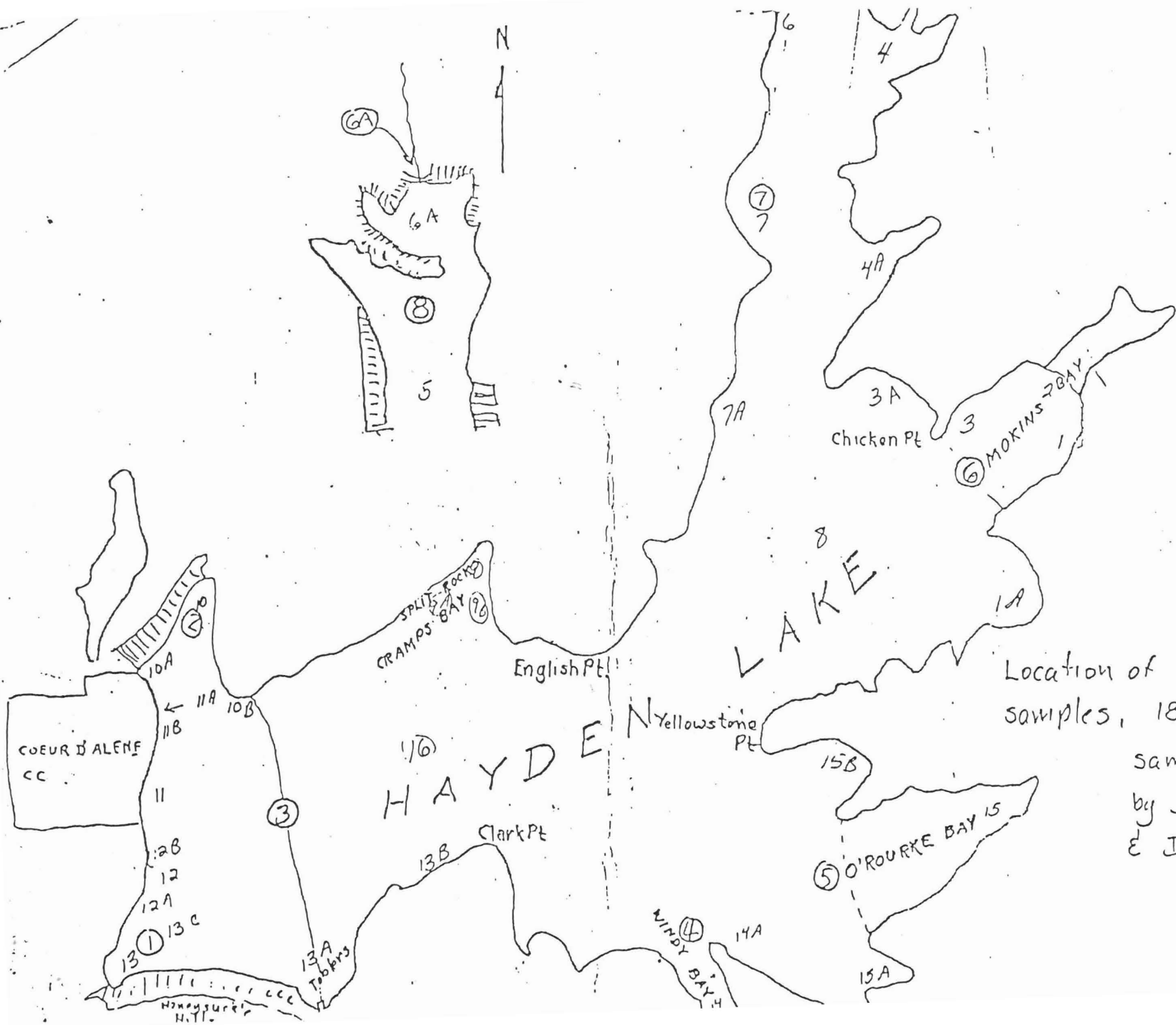
The high coliform densities in 1973 led to the posting of Honeysuckle Public Beach to alert the public of the potential health hazard. The low water level and exceptionally warm weather certainly contributed to the consistently high counts during the summer.

Sites 9 through 13A are in the vicinity of the most concentrated developments.

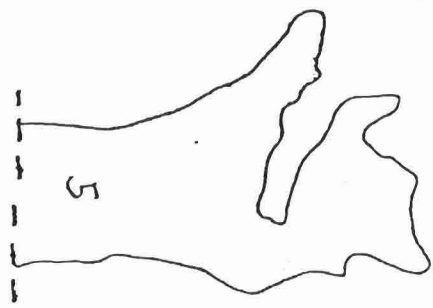
The heavy metal concentrations during 1973 are in Table 4. The higher lead level at site 5 in October is unexplainable.

Secchi disk transparency varies from 0.8 meters to 7.5 meters during April. The readings in the northern and eastern portions of the lake are much lower. These areas are where the tributaries enter and are also the areas most affected by wave action. In July, the secchi transparency was 9 meters at all deep water stations.

Chemical conditions in Tables 2 and 2A show expected seasonal variation but no real significant annual change. The concentration of $N-NH_3$, $N-NO_3$, and $O-PO_4$ in the surface waters are average for oligotrophic lakes in Northern Idaho. Variables in the collection, preservation and analysis, up until recently, make it difficult to compare chemical data between years.



Location of water samples, 18 May 73
 sampling con:
 by D. Johann
 & D. Troy.



HAYDEN INTAKE

A
B
C

GOCOUR D'ALENE
C C

outlet

HAYDEN

CRAMPS BAY

CHICKEN PT

MOKINS BAY

DORRANCE BAY

WINDY BAY

Clark Pt.

Tobler

13

13C

12

11

10

10B

9

16

13B

7A

7

10

4

8

LAK E

19

HA

15A

TABLE 1

COLIFORM DENSITIES IN HAYDEN LAKE DURING SAMPLE

| YEAR | MONTH | SAMPLE SITES | | | | | | | | | | | | | |
|------|----------|--------------|----|-----|-----|-----|----|-----|-----|-----|----|------|------|------|-----|
| | | 1 | 1A | 2 | 3 | 4 | 4A | 5 | 6 | 7 | 7A | 8 | 9 | 10 | 10B |
| 1972 | Aug. | 60 | | 430 | 80 | 100 | | 400 | 760 | 260 | | 0 | 0 | 0 | |
| 1973 | Oct. 17, | 116 | - | 48 | 460 | 168 | | 192 | 40 | 28 | - | 1220 | 1770 | 1660 | 540 |
| | Fecal | 41 | | | | | | 2 | | | | < 2 | | | |
| | Oct. 30, | 50 | - | 150 | 110 | 70 | 60 | 80 | 30 | 290 | 60 | 100 | 80 | 220 | 80 |
| | Fecal | 2 | | | | | | < 2 | | < 2 | | | < 2 | | |
| 1974 | April | 0 | 0 | 54 | 8 | 20 | 4 | 102 | 64 | 26 | 12 | 8 | 2 | 6 | |
| | July | 24 | - | - | - | - | - | 74 | - | 8 | - | 4 | 22 | - | |
| | Fecal | 0 | | | | | | 0 | | 0 | | 0 | 0 | | |
| | Aug. | 80 | 0 | 60 | 20 | 40 | | 0 | 80 | 80 | | 60 | 20 | 20 | |
| | Fecal | | | 0 | | | | | | 0 | | | | | |

NOTE: Fecal coliform densities for April 1974 were 0 at all sites.

TABLE 2

CHEMICAL AND PHYSICAL CONDITIONS IN HAYDEN LAKE D

| SITE | MO/YEAR | TEMP. | TURB- IDITY | pH | TOTAL SOLIDS | NH ₃ | NO ₃ | NO ₂ | O-PO ₄ | CL |
|------|--------------|-------|----------------|-----|-----------------|-----------------|-----------------|-----------------|-------------------|----|
| 5 | Aug., 1972 | 20.3 | 3 | 7.6 | 100 | 0.1 | 0.3 | - | 0.18 | <2 |
| | Aug., 1973 | 21 | 3 | 8.6 | 64 | 0.1 | 1.1 | <0.001 | 0.04 | 3 |
| 5 | Oct. 17, '73 | 11.5 | 3 | 7.7 | - | 0.1 | 0.3 | 0.001 | <0.01 | 4 |
| 5 | Oct. 30, '73 | | 2 | 7.6 | 68 | 0.1 | 0.4 | <0.001 | <0.01 | 3 |
| 5 | Apr., 1974 | 4 | 5 | 6.9 | 84 | <0.01 | 0.5 | 0.002 | 0.01 | 4 |
| 5 | July, 1974 | | 4.5 | 7.2 | 38 | <0.01 | <0.01 | <0.001 | <0.01 | 6 |
| 8 | Aug., 1972 | 22 | 1 | 7.8 | 92 | <0.1 | 0.1 | - | 0.05 | <2 |
| 8 | Oct. 17, '73 | 12 | 3 | 7.9 | 64 | 0.1 | 0.3 | <0.001 | <0.01 | 4 |
| 8 | Oct. 30, '73 | | 2 | 8.0 | 64 | <0.1 | 0.4 | <0.001 | <0.001 | 3 |
| 8 | Apr., 1974 | 4 | <1 | 7.2 | 64 | 0.03 | 0.4 | 0.001 | <0.01 | 2 |
| 8 | July, 1974 | | 3.5 | 7.4 | 28 | <0.01 | 0.02 | 0.001 | <0.01 | 10 |

TABLE 2A
CHEMICAL AND PHYSICAL CONDITIONS IN HAYDEN LAKE DURI

| SITE | MONTH/YEAR | TEMP. | TURB- IDITY | pH | TOTAL SOLIDS | NH ₃ | NO ₃ | NO ₂ | O-PO ₄ | CI |
|------|---------------|-------|----------------|-----|-----------------|-----------------|-----------------|-----------------|-------------------|----|
| .0 | Aug., 1972 | 22 | 1 | 7.6 | 92 | 0.2 | 0.2 | - | 0.13 | < |
| 10 | Oct. 17, 1973 | 12 | 2 | 8.2 | 56 | 0.1 | 0.3 | 0.001 | 0.01 | |
| 10 | Oct. 30, 1973 | | 3 | 7.5 | 60 | 0.1 | 0.2 | < 0.001 | < 0.01 | |
| 10 | Apr., 1974 | 4 | < 1 | 7.1 | 56 | 0.07 | 0.5 | 0.001 | < 0.01 | |
| 10 | July, 1974 | - | - | - | - | - | - | - | - | |
| 16 | Aug., 1972 | 22 | 1 | 7.4 | 104 | 0.2 | 0.2 | - | 0.05 | |
| 16 | Aug., 1973 | 20 | 2 | 9.1 | 64 | 0.1 | 1.2 | < 0.001 | 0.01 | |
| 16 | Oct. 17, 1973 | 12 | 2 | 7.9 | 60 | 0.1 | 0.3 | < 0.001 | 0.02 | |
| 16 | Oct. 30, 1973 | | 3 | 7.6 | 56 | < 0.1 | 0.5 | < 0.001 | < 0.01 | |
| 16 | April, 1974 | 4 | < 1 | 7.1 | 96 | 0.1 | 0.5 | 0.001 | 0.04 | |
| 16 | July, 1974 | | 5 | 7.5 | 32 | < 0.01 | 0.03 | 0.001 | 0.01 | |

TABLE 3

SOME CHEMICAL AND BACTERIAL CONDITIONS IN THE VICINITY
OF THE INTAKE PIPE OF THE HAYDEN LAKE IRRIGATION DISTRICT IN
HAYDEN LAKE

| DATE | COLIFORM DENSITY 100 ML | FECAL | PH | TOTAL SOLIDS | NH ₃ | NO ₃ | CL | ALKALINITY | NA | K |
|-----------------|-------------------------------|-------|-----|-----------------|-----------------|-----------------|----|------------|-----|-----|
| August 23, 1973 | | | | | | | | | | |
| Surface | 24 | <1 | 8.4 | 68 | 0.1 | 1.5 | 4 | 40 | 1 | 0.1 |
| 10' | 56 | <1 | 8.8 | 72 | 0.1 | 1.4 | 4 | 40 | 2 | 0.4 |
| 20' | 60 | <1 | 8.3 | 68 | 0.1 | 1.5 | 2 | 36 | 1 | 0.2 |
| 30' | 40 | 1 | 8.4 | 64 | 0.1 | 1.6 | 2 | 40 | 1 | 0.1 |
| 40' | 64 | <1 | 8.5 | 64 | 0.2 | 1.6 | 3 | 32 | 1 | 0.2 |
| 50' | 32 | <1 | 8.4 | 60 | 0.1 | 1.4 | 3 | 40 | 1 | 0.1 |
| April 3, 1974 | | | | | | | | | | |
| Surface | 6 | 0 | 7.1 | 56 | 0.07 | 0.5 | 2 | 38 | 1.7 | 1.0 |
| 3' | 12 | 0 | 7.0 | 76 | 0.08 | 0.3 | 2 | 28 | 1.5 | 1.1 |
| 50' | 28 | 0 | 7.0 | 76 | 0.15 | 0.5 | 3 | 24 | 1.6 | 1.0 |
| 85' | 18 | 0 | 7.1 | 60 | 0.06 | 0.4 | 3 | 36 | 1.7 | 1.8 |
| July 7, 1974 | | | | | | | | | | |
| Surface | 4 | 0 | - | - | - | - | - | - | - | - |
| 25' | 118 | 0 | - | - | - | - | - | - | - | - |
| 74' | 22 | 0 | 7.5 | 24 | <0.01 | 0.02 | 4 | 24 | - | - |

LAKE SURVEY CARD

NAME Hayden Lake COUNTY Nebraska CATALOG REF. NO. III-4 PAGE 19

ALTIMUDE 2236 (survey datum) AREA 3800 acres LOCATION: SEC. _____ TWP. 51N R. 3W. S.M. 4

TRIBUTARIES Hayden and Hokin's creeks are the only important tributaries

OUTLET sinks in glacial till TRIB. TO Spring River Drainage

TYPE OF LAKE oligotrophic WATER LEVEL FLUCTUATION 22 ft. (normal) FT.

TYPE OF SHORELINE Forested (clay bluffs with rocky outcrops)

TYPE OF BOTTOM SHOAL mud, boulders, rubble, gravel DEEP ¹¹⁰ 230 feet or more
 pH 7.5 at surf. D.C. 25 at surf.

TYPE OF WATER: pH _____ ALKALINITY _____ TURBIDITY slight COLOR colorless

VEGETATION: TYPE AND ABUNDANCE waterweed, water lily, pondweed, buckwheat, and other common submergent aquatics are abundant in most shallow areas.

FISH FOOD: KIND AND ABUNDANCE Average productivity. Main bottom-food producing areas are overpopulated with terna

OTHER FISH From bullhead
Alabama squawfish, perch, etc.

DEGREE FISHED heavy for trout; light for other species

ACCESSIBILITY Adjacent to U. S. 95; a road which parallels the shoreline

SPAWNING AREAS arden and Jenkins creeks for trout.

PLANKTON HAULS (DATE) Summer 2.1 to 10 cc/ft. water; av. 5.5 cc. Planorbis & Cyclops
most abundant of zooplankton

GILL NET SETS (DATE) See "Cole and Leland on Squawfish" by Jensen and Platts in
most issue of Transactions of Amer. Fish. Soc. 1959

RECOMMENDATIONS Continue rainbow trout stocking program and squawfish eradication.
Visit shallows to eradicate perch. Treat trouts to eradicate resident populations
and reservoir with cutthroat trout.

REMARKS Dissolved oxygen (summer) 1.7 ppm at 3:00 p.m. -- 2.5 ppm (sat.) at surface
of water insects in streams -- 1 to 2 cc per square foot.
Water graph records (year round) available.

1959

APPENDIX C

HAYDEN LAKE SANITARY SURVEY, 1975
Division of Environment

A sanitary survey on Hayden Lake was conducted before, and near the end of, the 4th of July holiday. Purpose of the survey was to determine how increased recreation on the lake, and at shoreline cabins, affects the coliform densities in the surface water of the lake, which is a domestic water reservoir.

The first sample period was between 8:00 A.M. and 11:00 A.M. on July 3. Twenty eight (28) sample sites were chosen, and surface samples were taken at each site. The second sample period was between 8:00 A.M. and 12:00 noon on July 6, when all twenty eight sites were again sampled.

All samples were taken from the upper 12 inches of water, with sterile 100 ml glass bottles provided by the State Lab, and immediately placed in an iced cooler. All samples were processed at the State Lab in Coeur d'Alene by the Millipore filter method, within 6 hours of collection.

The map in Figure 1 shows the lake and sample sites.

Coliform densities were very low throughout both sample periods. Only 3 out of 28 samples showed growth during July 3, and one of these showed fecal growth. On July 6th, 50% of the samples showed growth ranging from 4 to TNTC, total coliforms. Fecal growth was nonexistent. Water temperature during both periods was 24.0 °C, in the upper 2 meters of water.

On July 6, two samples, 10 and 13, showed high coliform densities, when compared with other samples taken. While TNTC and 830 per 100 ml are relatively high, no fecal coliforms were associated. Both sample sites are located near high density shoreline development, with poor soil conditions for septic systems.

Samples for chemical analysis were taken in one liter nalgene bottles provided by the lab. Samples were placed on ice immediately after being taken and froze until analysis could be performed on 9 June 75 at the State Lab.

Results of analysis are in table 2. There does not appear to be any significant difference in the reported values for tests performed on each sample other than turbidity. Site 6A, which has a value of 1.3 JTU compared with 4 JTU at other sites.

Overall, the nutrient concentration of the surface water sampled is very low.

TABLE I

TOTAL AND FECAL COLIFORM DENSITIES PER 100 ml FROM
SELECTED SITES ON HAYDEN LAKE

| SITE | JULY 3, 1975 | | JULY 6, 1975 | |
|------|--------------|-------|--------------|-------|
| | TOTAL | FECAL | TOTAL | FECAL |
| 13 B | 6 | 4 | 24 | 0 |
| 6 | 6 | 0 | 4 | 0 |
| 12 | 20 | 0 | 32 | 0 |
| 10 | 0 | 0 | TNTC | 0 |
| 9A | 0 | 0 | 4 | 0 |
| 9 | 0 | 0 | 8 | 0 |
| 16 | 0 | 0 | 8 | 0 |
| 7 A | 0 | 0 | 12 | 0 |
| 12 A | 0 | 0 | 52 | 0 |
| 3 | 0 | 0 | 8 | 0 |
| 7 | 0 | 0 | 8 | 0 |
| 12 B | 0 | 0 | 12 | 0 |
| 10 A | 0 | 0 | 12 | 0 |
| 13 | 0 | 0 | 830 | 0 |
| 13 A | 0 | 0 | 48 | 0 |

* Note: Total coliform densities are computed from a filtered 50 ml sample on July 3 sample period, and a 25 ml sample on July 6 sample period. Fecal coliform densities are computed from a 50 ml sample filtered each period.


David Johann
Environmental Quality Specialist

TABLE II

SOME CHEMICAL AND PHYSICAL CONDITIONS IN SURFACE WATERS
OF HAYDEN LAKE ON 6 JULY 1975

| Parameter | Sample Site * | | |
|-------------------|---------------|--------|-------|
| | 16 | 8 | 6A |
| Temperture | 22.5C | 22.5C | 24.5 |
| D.O. | 14 ppm | 14 ppm | 9 ppm |
| Turbidity (JTU) | 0.4 | .44 | 1.3 |
| pH | 8.2 | 8.1 | 8.2 |
| Total Solids | 11.9 | 12.2 | 16.5 |
| NH ₃ | .18 | .05 | .15 |
| NO ₃ | < .1 | < .1 | < .1 |
| NO ₂ | .001 | < .001 | .001 |
| O-PO ₄ | .04 | .04 | .03 |
| Sp. Cond. | 56 | 58 | 61 |
| Alkalinity | 28 | 28 | 32 |
| Chloride | 6.1 | 8.2 | 8.2 |
| Total-P | .07 | .02 | .04 |

Note * - Sample sites located in figure 1.



APPENDIX D

TABLE I

CHEMICAL AND PHYSICAL ANALYSES*

HAYDEN LAKE, IDAHO
August 7, 9, 13, 1973

| PARAMETER | STATION 1 | STATION 2 | STATION 3 | STATION 4 | STATION 5 |
|----------------------|-----------|-----------|-----------|-----------|-----------|
| | August 7 | August 7 | August 7 | August 13 | August 9 |
| Turbidity (J.T.U.) | 1.0 | 1.0 | 1.0 | --- | 1.0 |
| pH | 7.6 | 8.1 | 7.5 | 7.0 | 7.5 |
| Total Solids | 56 | 76 | 72 | 104 | 84 |
| Ammonia | 0.3 | 0.2 | 0.3 | 0.2 | 0.3 |
| Nitrate | 0.2 | 0.3 | 0.4 | 1.7 | 0.4 |
| Nitrite | <0.001 | <0.001 | <0.001 | --- | --- |
| Ortho-Phosphate | 0.01 | <0.02 | 0.01 | 0.09 | 0.08 |
| Chloride | 2 | 3 | 2 | 3 | 3 |
| Sp. Cond. (umhos/cm) | 40 | 56 | 54 | 80 | 55 |
| Alkalinity | 24 | 32 | 20 | 48 | 40 |
| Fe | 0.05 | 0.07 | 0.01 | 0.77 | 0.10 |
| Mn | 0.01 | 0.01 | 0.01 | 0.04 | --- |
| Na | 1 | 1 | 1 | 3 | 2 |
| K | <0.1 | <0.1 | 0.1 | 0.4 | 0.3 |
| Hardness | --- | --- | --- | 32 | 28 |
| Ca | --- | --- | --- | 11 | 6 |
| Mg | --- | --- | --- | 1 | 3 |
| Sulphate | --- | --- | --- | 3 | 2 |
| Suspended Solids | --- | --- | --- | 12 | --- |
| Volatile Solids | --- | --- | --- | 20 | --- |

* All results reported in mg/l (ppm) unless noted otherwise.

** See attached map for station locations.

TABLE II
CHEMICAL AND PHYSICAL ANALYSES*

HAYDEN LAKE, IDAHO
August 23, 1973

| | STATION A | | STATION B | | | | | STATION C | STATION D | STATION E |
|----------------------------|-----------|---------|-----------|--------|--------|--------|--------|-----------|-----------|-----------|
| | SURFACE | SURFACE | 10 ft | 20 ft | 30 ft | 40 ft | 50 ft | SURFACE | SURFACE | SURFACE |
| Temperature °C | 21.0 | 20.0 | 20.0 | 20.0 | 20.0 | 14.0 | 11.0 | 20.0 | 20.5 | 21.0 |
| Dissolved Oxygen | 8.1 | 8.0 | 8.0 | 8.1 | 7.6 | 6.2 | 6.6 | 8.2 | 8.2 | 8.3 |
| Turbidity (J.T.U.) | 3 | 3 | 5 | 3 | 2 | 2 | 2 | 2 | 4 | 3 |
| pH | 9.3 | 8.4 | 8.8 | 8.3 | 8.4 | 8.5 | 8.4 | 9.1 | 8.6 | 8.6 |
| Total Solids | 76 | 68 | 72 | 68 | 64 | 64 | 60 | 64 | 68 | 64 |
| Ammonia | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| Nitrate | 1.6 | 1.5 | 1.4 | 1.5 | 1.6 | 1.6 | 1.4 | 1.2 | 1.0 | 1.1 |
| Nitrite | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Ortho Phosphate | <0.01 | 0.05 | 0.03 | 0.06 | 0.03 | 0.03 | 0.05 | 0.01 | 0.03 | 0.04 |
| Chloride | 4 | 4 | 4 | 2 | 2 | 3 | 3 | 4 | 4 | 3 |
| Sp. Conductance (umhos/cm) | 60 | 50 | 52 | 51 | 52 | 50 | 48 | 52 | 51 | 49 |
| Alkalinity | 44 | 40 | 40 | 36 | 40 | 32 | 40 | 32 | 36 | 36 |
| Fe | 0.04 | <0.01 | 0.02 | 0.02 | <0.01 | 0.01 | 0.03 | 0.03 | <0.01 | 0.11 |
| Mn | 0.02 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | 0.02 | 0.01 | <0.01 | <0.01 |
| Na | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| K | 0.1 | 0.1 | 0.4 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.2 | 0.3 |

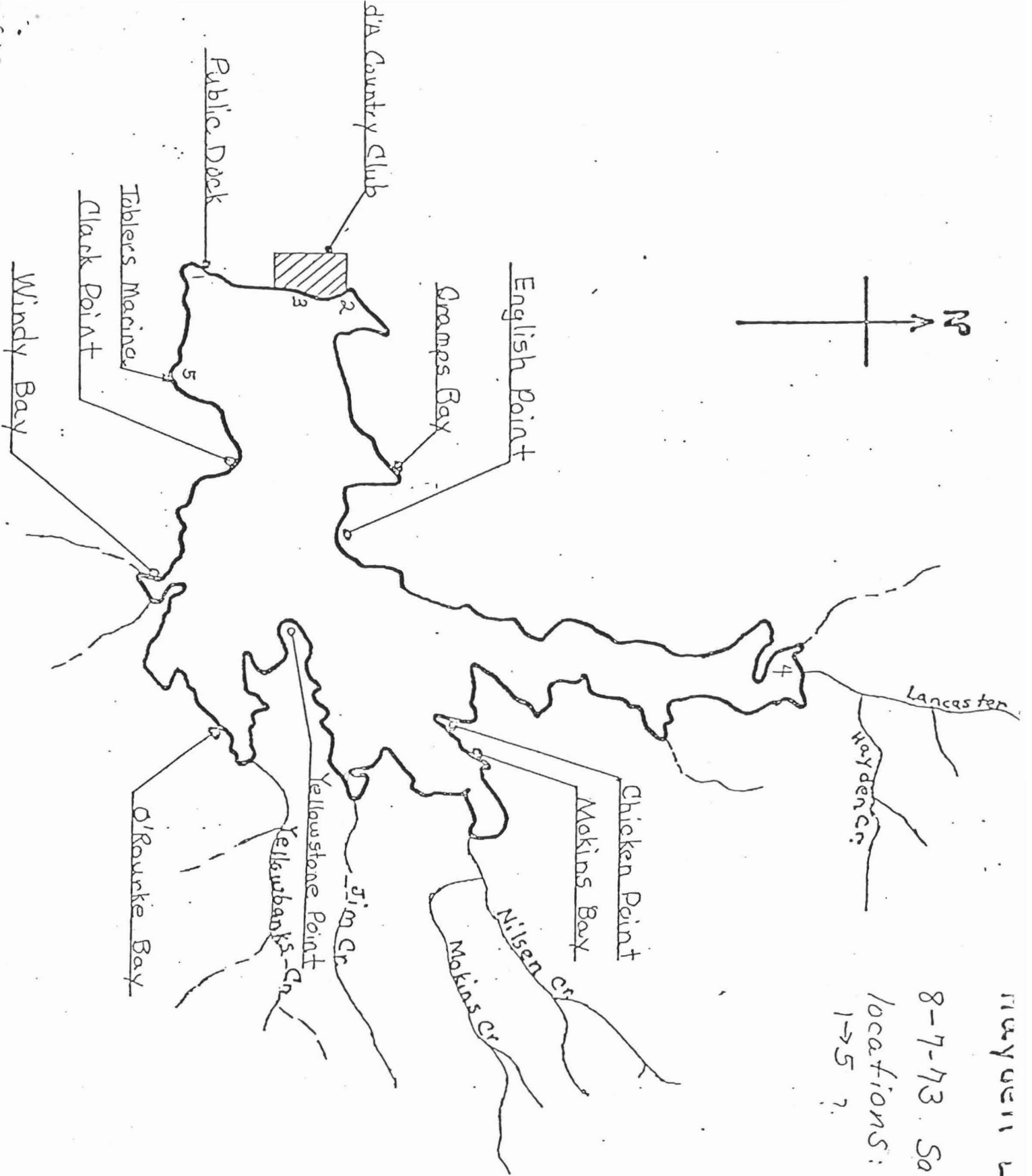
* All results reported in mg/l (ppm) unless otherwise noted.

** See attached map for station locations.

Maywell Cruise

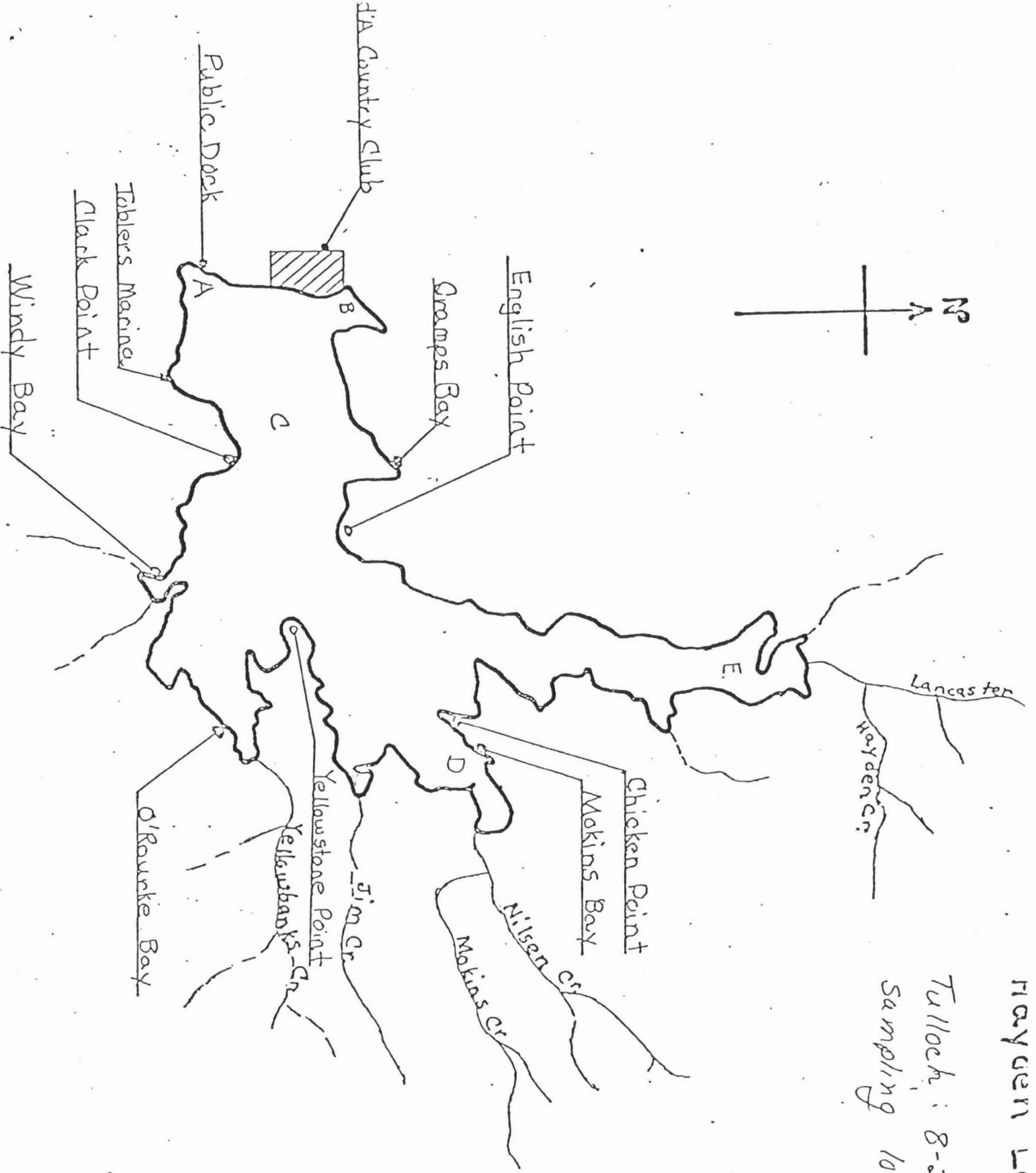
8-7-73 Sampling

locations: (J. Kimball)
1-5 ?



Hayden Lake

Tulloch: 8-23-73
Sampling locations A → E.



APPENDIX E

TABLE I
 CHEMICAL AND NUTRIENT ANALYSIS
 OF INTEGRATED DEPTH WATERS

HAYDEN LAKE, IDAHO*

April 4, 1975

| | Station 01 | Station 02 | Station 03 |
|--|------------|------------|------------|
| Temperature °C (surface) | ---- | 4.2 | 15.2 |
| Dissolved Oxygen (surface) | 11.8 | 11.6 | 8.6 |
| Secchi Disc (inches) | 214 | 348 | ---- |
| Conductivity (umhos/cm) | 35 | 33 | 43 |
| pH | 7.50 | 7.10 | 7.40 |
| Alkalinity | 28 | 22 | 31 |
| Ammonia (as N) | < 0.02 | 0.020 | < 0.020 |
| Total Kjeldahl Nitrogen (as N) | 0.30 | 0.800 | 0.200 |
| NO ₂ + NO ₃ (as N) | < 0.20 | 0.020 | < 0.020 |
| Ortho Phosphorus (as P) | 0.03 | 0.003 | 0.004 |
| Total Phosphorus (as P) | 0.015 | 0.013 | 0.007 |
| Chlorophyll <u>a</u> (ug/l) | 4.6 | 3.3 | 3.2 |

*Results expressed in mg/l (ppm) unless noted otherwise.

Data collected by the EDHW:

TABLE II
 CHEMICAL AND NUTRIENT ANALYSIS
 OF INTEGRATED DEPTH WATERS

HAYDEN LAKE, IDAHO*

March 29, 1976

| | Station 01 | Station 02 | Station 03 |
|--|------------|------------|------------|
| Temperature °C (surface) | 4.2 | 4.0 | 4.0 |
| Dissolved Oxygen (surface) | 11.4 | 10.9 | 11.0 |
| Secchi Disc (inches) | 215 | 390 | 351 |
| Conductivity (umhos/cm) | 52 | 50 | 51 |
| pH | 6.9 | 7.5 | 7.3 |
| Alkalinity | 32 | 28 | 32 |
| Ammonia (as N) | .01 | <.01 | .01 |
| Total Kjeldahl Nitrogen (as N) | .16 | .30 | .22 |
| NO ₂ + NO ₃ (as N) | <.1 | <.1 | <.1 |
| Ortho Phosphorus (as P) | .01 | .02 | <.01 |
| Total Phosphorus (as P) | .02 | .03 | .02 |
| Chlorophyll <u>a</u> (ug/l) | ---- | ---- | ---- |

*Results expressed in mg/l (ppm) unless noted otherwise.

Data collected by the IDHW.

TABLE III
 CHEMICAL AND NUTRIENT ANALYSIS
 OF INTEGRATED DEPTH WATERS

HAYDEN LAKE, IDAHO*

June 8, 1976

| | Station 01 | Station 02 | Station 03 |
|--|------------|------------|------------|
| Temperature °C (surface) | 16.1 | ---- | ---- |
| Dissolved Oxygen (surface) | ---- | ---- | ---- |
| Secchi Disc (inches) | 293 | 234 | ---- |
| Conductivity (umhos/cm) | 52 | 52 | 52 |
| pH | 7.4 | ---- | ---- |
| Alkalinity | 32 | 28 | 28 |
| Ammonia (as N) | .10 | .02 | .02 |
| Total Kjeldahl Nitrogen (as N) | 1.05 | .35 | .54 |
| NO ₂ + NO ₃ (as N) | < .1 | < .1 | < .1 |
| Ortho Phosphorus (as P) | .08 | .01 | < .01 |
| Total Phosphorus (as P) | .04 | .08 | .01 |
| Chlorophyll <u>a</u> (ug/l) | 1.0 | 0.6 | 0.5 |
| Total Solids | 41.5 | 45.6 | 44.3 |

*Results expressed in mg/l (ppm) unless noted otherwise.

Data collected by the IDHW

TABLE IV
 CHEMICAL AND NUTRIENT ANALYSIS
 OF INTEGRATED DEPTH WATERS

HAYDEN LAKE, IDAHO*

August 24, 1976

| | Station 01 | Station 02 | Station 03 |
|--|-----------------------------------|------------|------------|
| Temperature °C (surface) | 23.0 | 21.0 | 22.1 |
| Dissolved Oxygen (surface) | 9.8 | 9.5 | 9.7 |
| Secchi Disc (inches) | 273 | 390 | 390 |
| Conductivity (umhos/cm) | 52.3 | 52.3 | 52.3 |
| pH | 7.3 | 6.8 | 6.6 |
| Alkalinity | 32 | 32 | 40 |
| Ammonia (as N) | .05 | .06 | .03 |
| Total Kjeldahl Nitrogen (as N) | 0.7 | 1.3 | .5 |
| NO ₂ + NO ₃ (as N) | <.1 | <.1 | <.1 |
| Ortho Phosphorus (as P) | .01 | <.01 | .01 |
| Total Phosphorus (as P) | .02 | .01 | .02 |
| Chlorophyll <u>a</u> (ug/l) | 1.1 (composite of three stations) | | ---- |
| Total Solids | 45.3 | 45.3 | ---- |

*Results expressed in mg/l (ppm) unless noted otherwise

Dated collected by IDHW

TABLE V
 CHEMICAL AND NUTRIENT ANALYSIS
 OF INTEGRATED DEPTH WATERS

HAYDEN LAKE, IDAHO*

November 8, 1976

| | Station 01 | Station 02 | Station 03 |
|--|------------|------------|------------|
| Temperature °C (surface) | 11.0 | 11.0 | 11.0 |
| Dissolved Oxygen (surface) | 11.0 | 11.2 | 11.5 |
| Secchi Disc (inches) | 390 | 390 | 429 |
| Conductivity (umhos/cm) | 81 | 89 | 99 |
| pH | 7.3 | 7.2 | 7.1 |
| Alkalinity | 60 | 64 | 60 |
| Ammonia (as N) | 0.02 | 0.01 | 0.01 |
| Total Kjeldahl Nitrogen (as N) | 1.1 | 0.7 | 0.5 |
| NO ₂ + NO ₃ (as N) | <.1 | <.1 | <.1 |
| Ortho Phosphorus (as P) | .02 | .02 | .02 |
| Total Phosphorus (as P) | .02 | .02 | .03 |
| Chlorophyll <u>a</u> (ug/l) | ---- | ---- | ---- |

*Results expressed in mg/l (ppm) unless noted otherwise.

Data collected by the IDHW.