Final

US Army Corps
of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/ENVIRONMENTAL
DOCUMENTATION (SP-7)

FINGER LAKES

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 5
UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

MAY 1990

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INTRODUCTION

FOCUS

The study effort documented herein assesses the biological problems associated with Finger Lakes and seeks possible solutions.

AUTHORITY

The authority for this report is provided by Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The proposed project which is discussed in detail in the main body of this report would be funded and constructed under this authorization. This report includes an integrated environmental assessment, preliminary Section 404(b)(1) evaluation, and draft Finding of No Significant Impact.

Section 1103 of the Water Resources Development Act of 1986 is summarized as follows:

> Section 1103. UPPER MISSISSIPPI RIVER PLAN
>
> (a)(1) This section may be cited as the Upper Mississippi River Management Act of 1986.
>
> (2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of the Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system....The system shall be administered and regulated in recognition of its several purposes.

(e)(1) The Secretary, in consultation with the Secretary of the Interior and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, is authorized to undertake, as identified in the Master Plan -

(A) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement....

A design memorandum (or implementation document) did not exist at the time of the enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the Upper Mississippi River System Environmental Management Program (UMRS-EMP) in January 1986. The U.S. Fish and Wildlife Service (USFWS), Region 3, and the five affected States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addendums.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addendums led to an examination of the Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Master Plan, completed by the Upper Mississippi River Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below.

a. (First Annual Addendum). The Master Plan report...and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. For habitat projects, the main eligibility criterion should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan; i.e., the sedimentation of backwaters and side channels of the UMRS. Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance....

b. (Second Annual Addendum).

(1) The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:

- backwater dredging
- dike and levee construction
- island construction
- bank stabilization
- side channel openings/closures
- wing and closing dam modifications
  - aeration and water control systems
  - waterfowl nesting cover (as a complement to one of the other project types)
  - acquisition of wildlife lands (for wetland restoration and protection) Note: By letter of 5 February 1988, the Office of the Chief of Engineers directed that such projects not be pursued.

(2) A number of innovative structural and nonstructural solutions which address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects which include such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and recommended only after consideration of system-wide effects.

PROJECT SELECTION PROCESS

Under the EMP authority, the following procedures were followed in selecting this project for inclusion and eventual study.

Projects are nominated for inclusion in the District's habitat program by the respective State natural resource agency or the U.S. Fish and Wildlife Service (USFWS) based on agency management objectives. To assist the District in the selection process, the States and USFWS agreed to utilize the expertise of the Fish and Wildlife Work Group (FWWG) of the Channel Maintenance Forum (CMF) to consider critical habitat needs along the Mississippi River and prioritize nominated projects on a biological basis. The FWWG consists of biologists responsible for managing the river for their respective agency. Meetings were held on a regular basis to evaluate and rank the nominated projects according to the biological benefits that they could provide in relation to the habitat needs of the river system. The ranking was forwarded to the CMF for consideration of the broader policy perspectives of the agencies involved. The CMF submitted the coordinated ranking to the District and each agency officially notified the District of its views on the ranking. The District then formulated and submitted a program which is consistent with the overall program guidance as described in the UMRS-EMP General Plan and Annual Addendums and supplemental management guidance provided by the North Central Division.

Projects consequently have been screened by biologists closely acquainted with the river. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available is being used to optimize the habitat benefits created at the most suitable locations. Through this process, the Finger Lakes project was recommended and supported as capable of providing significant habitat benefits.

Finger Lakes was identified by the Minnesota Department of Natural Resources at the outset of the UMRS-EMP as one of their highest priority habitat projects. After consideration of CMF recommended priorities, the public interest in the project, the value of the resource, and the opportunity for rehabilitation/enhancement, the Finger Lakes project was ranked number 1 on a listing of the St. Paul District's top 20 projects in 1987. Based on that priority, funds were made available to begin study on the project in fiscal year 1988.

PARTICIPANTS AND COORDINATION

Participants in project planning included the Upper Mississippi River Wildlife and Fish Refuge and the Region 3 Office of the U.S. Fish and Wildlife

Service, the Minnesota and Wisconsin Departments of Natural Resources, and the St. Paul District, Corps of Engineers. The U.S. Fish and Wildlife Service was a cooperating agency throughout the process as defined by the Council on Environmental Quality Regulations for implementing the National Environmental Policy Act (40 CFR 1500-1508). Meetings of the study participants were held at the project site and other locations to discuss project objectives and designs. During various stages of project development, coordination was supplemented by correspondence between the agencies.

PROJECT LOCATION

Finger Lakes are located on the Minnesota side of the Mississippi River in pool 5 immediately below the dike for lock and dam 4. The project area is within the Upper Mississippi River Wildlife and Fish Refuge and is located in Wabasha County, Minnesota. Buffalo County is the adjoining county in Wisconsin. The nearest communities are Alma, Wisconsin, which lies immediately opposite the five Finger Lakes; Kellogg, Minnesota, which is about 5 miles to the southwest; and Wabasha, Minnesota, which is approximately 5 miles to the northwest. The closest major metropolitan areas are the Twin Cities (Minneapolis and St. Paul), Minnesota, which are 70 miles to the northwest, and La Crosse, Wisconsin, which is 50 miles to the southeast. (See plates 1 and 2 for a location map and study area map, respectively.)

PROJECT SCOPE

The overall purpose of this project is rehabilitation, enhancement, and maintenance of diverse backwater habitat for fish (primarily centrarchids). Following construction of the lock and dam system in the 1930's, the five Finger Lakes were formed essentially as they are seen today. Within the present lake system, there are periods of low dissolved oxygen (D.O.) conditions in portions of the lakes. Although existing conditions within the backwater complex indicate that habitat conditions are generally good, continued D.O. problems in these areas are a limiting factor affecting fish populations within the lakes. (This problem is discussed in detail in later sections of this report.)

All project features have been studied and designed with the purpose of improving dissolved oxygen conditions in the existing Finger Lakes system. This was achieved by the following general procedure. First, the water resources in the vicinity were identified and related to the habitat problems (present and future) in the area. This information was then used to develop and evaluate a number of potential plans to address these problems. From this array, the best design was selected and further defined in sufficient detail to allow for a recommendation to proceed with plans and specifications and eventual construction.

FISH AND WILDLIFE MANAGEMENT OBJECTIVES IN THE PROJECT AREA

Fish and wildlife management goals and objectives for the area fall under those more broadly defined for the Upper Mississippi River Wildlife and Fish Refuge as a whole (Upper Mississippi River National Wildlife and Fish Refuge Environmental Impact Statement/Master Plan, 1988, U.S. Fish and Wildlife Service, Department of the Interior, North Central Regional Office, St. Paul, Minnesota). The management objective that most directly applies to the project area is:

Fisheries and Aquatic Resources

+ Maintain and enhance, in cooperation with the States, the habitat of fish and other aquatic life on the Upper Mississippi River.

Because the project area is within the Upper Mississippi River Wildlife and Fish Refuge, this management objective, together with additional input from State and Federal agency natural resource managers, was used to guide development of specific project objectives (presented in a subsequent section of this report).

EXISTING CONDITIONS

PHYSICAL SETTING

Pool 5 is part of the Upper Mississippi River system which was created by the construction of lock and dam 5. The entire pool is 14.6 river miles in length, extending from river mile (R.M.) 738.1 to 752.7. The Finger Lakes are in the extreme upper part of pool 5 and are located immediately below the lock and dam 4 dike. These lakes (from west to east) are known as Clear Lake, Lower Peterson Lake, Third Lake, Second Lake, and First Lake and are collectively referred to as Finger Lakes. Although the lakes vary somewhat in size, each generally extends from R.M. 752 to 752.7. Lower Peterson Lake, Clear Lake, and Third Lake flow into an area known as Schmokers Lake, and then all join an intertwined backwater system.

In addition to the dike to the north, the immediate study area is bounded on the east by the main channel of the Mississippi River, on the south by bottomland/slough areas which stretch to the Zumbro River and beyond, and on the west by the Minnesota mainland. The entire study area is comprised of 525 acres of backwater lakes, ponds, sloughs, and bottomland hardwoods. The five Finger Lakes make up about 130 acres of this area.

WATER RESOURCES

Prior to construction of the pool 4 and pool 5 lock and dam systems, the study area consisted of running sloughs, marshes, and floodplain forest. At that time, two defined, continuous flow channels existed. (These were in areas which are now known as Lower Peterson Lake and Third Lake.) Following inundation, water levels rose, converting the marsh/slough areas and part of the floodplain downstream of the dam into the five Finger Lakes and connecting sloughs that are in existence today. On the west, upstream of the lock and dam 4 system, a large body of water was formed. This is currently referred to as Peterson Lake. Plate 3 shows the area as it appeared pre- and post-construction of the dam. As part of the lock and dam 4 system, a 5,500-foot-long dike was constructed which extends from the Minnesota main shoreline to the spillway of the dam. This dike has a top elevation at elevation 678.0

feet mean sea level (msl) which is equivalent to a 100-year flood event. Upon construction of this entire lock and dam system, the area upstream of the dike was essentially eliminated as a direct water source to the downstream lakes. The dike has not been overtopped since its creation. Therefore, in the past 50 years, fresh flows have been able to directly enter all five lakes only during high flows on the Mississippi River and/or the Zumbro River when water passing through the dam flowed overland downstream of the dam or when water from the Zumbro River flowed back into the lakes. Like the rest of the Upper Mississippi River system, the project area experiences annual high water which occurs most frequently in March and April. The primary source of floodwaters is spring snowmelt combined with the increased precipitation that can occur during these months.

In the mid 1960's, the lack of fresh flows into the area downstream of the dike was improved somewhat with the placement of a single culvert through the dike. This 48-inch-diameter corrugated metal pipe (CMP) connects Peterson Lake with Lower Peterson Lake. It is the only source of fresh water into the Finger Lakes at low river stages. The culvert construction was accomplished through Corps operation and maintenance efforts under the authority of the Rivers and Harbors Act dated July 3, 1930. The work was done in order to reestablish some inflow into the Finger Lakes backwaters along an existing slough which had been cut off by construction of the dike. Depending upon local flow conditions as well as beaver activity in the area, the water entering Lower Peterson Lake may also spread into Third Lake and Clear Lake at higher stages. The amount of flow through the culvert depends on the difference in water level across the dike; however, the average flow provided is about 80 cubic feet per second (cfs). At low stages, there is a single outlet for the five Finger Lakes that is located approximately 4,600 feet downstream of the dike and follows a meandering course before outletting to the main river channel. Second Lake is currently isolated from the system because of beaver activity which has blocked the outlet from the lake.

The five Finger Lakes comprise a 132-acre backwater lakes complex. Average water depths range from 2 to 4 feet, with Clear Lake and First Lake being at the more shallow end of this depth range. Although Second Lake is generally shallow, it has a hole about 7 to 8 feet deep. Shallow depths combined with limited flow through four of the five lakes result in some areas having periods of D.O. deficiency which limits productivity and population diversity. These conditions occasionally result in fish kills, particularly in winter. Lower Peterson Lake is the only lake that does not develop these adverse conditions, because of the culvert through the dike at the head of the lake.

GEOLOGY/SOILS/SEDIMENT

Geology - At the Alma, Wisconsin - Kellogg, Minnesota location, the river flows through a large bedrock valley almost 6 miles across and 600 feet deep. Bedrock is 200 to 300 feet beneath the valley's present alluvial floor. Glacial meltwaters scoured the original valley, greatly enlarging its size, but since glacial times the river has rapidly diminished in size. Now the river occupies only a small portion of its valley and deposits clays, silts, sands, and gravels on its bed and margins. Numerous oxbow lakes, meanders, side channels, and sloughs are evidence of the low gradient of the present valley floor. In addition, gravel terraces are well developed parallel to the river. They are a very good groundwater source for local wells. Springs are common at the base of the terraces.

The plateau adjacent to the valley is a uniform upland, thinly mantled by till and loess, and dissected by sharp, canyon-like valleys which extend several miles from the main valley. Cambrian era, marine sandstones comprise the bedrock of the study area. Uppermost is found the Ironton and Galesville sandstones. Both of these members are medium to coarse grained quartz rock, with the Ironton being slightly more silty. Moderate amounts of water may be obtained from these units, and their approximate combined thickness is 50 feet. Beneath the Ironton-Galesville lies the Eau Claire sandstone. This unit consists of interbedded sandstone, siltstone, and shale. The Eau Claire member retards vertical water movement and does not yield much water of its own. The average thickness is about 120 feet. Below the Eau Claire sandstone lie the Mt. Simon sandstone and the Simon-Hinckley aquifer. This is a medium to coarse grained rock and is one of the best water producing zones in the area. Unit thickness can be in excess of 200 feet. Municipal water for the village of Kellogg, Minnesota, is derived from a 10-inch well, 300 feet deep, situated in the Mt. Simon sandstone.

Soils - No borings have been taken for this project. However, three borings through the dike were recently taken for another project and can be used for analysis here. A soil profile dating from the original dike construction was also consulted.

The three borings (85-5M, 85-6M, and 85-7M) were taken in 1985 and are spread from the lock and dam 4 storageyard to 330 feet west of the existing 48-inch CMP culvert. They show 16 to 19 feet of sand dike fill over a foundation of fluvial sands, with some scattered silt and clay layers. The dike material is a poorly graded sand with 2 to 5 percent fines. The foundation sands were similar and contained 2 to 6 percent fines. Plate 4 shows the logs of these three borings.

Review of the existing boring data indicates that settlement due to construction of any proposed pipes through the dike would not be anticipated. Any consolidation should have taken place shortly after construction of the dike in the 1930's. Silts that had originally overlain the foundation sands were excavated and sidecast downstream of the dike during construction. These spoil piles are still evident.

Sediment - Survey data in the study area consists of flowage easement survey data taken prior to construction of the lock and dam system and limited bathymetric data taken in 1989. These show that both increases and decreases in lake bed elevations have occurred since inundation in the 1930's. The overall average elevation in First, Third and Clear Lakes does not appear to have changed substantially. Second Lake's bottom elevation shows decreases where Lower Peterson Lake has increased by about 1 foot.

It is difficult, however, to thoroughly assess these noted changes in the area, given the lack of historic information. Aside from errors inherent in attempting to compare such sparse data, changes could be attributed to sediment deposition and scour within the system. There are a number of methods by which sediment could enter the current Finger Lakes system. These include transport of suspended sediment through the culvert at the upstream end of Lower Peterson Lake, diffusive transport of suspended sediment to the lakes caused by rising water stages on the Mississippi River, and advective transport caused by lateral overland flow of water during floods on the Mississippi River or Zumbro River. Calculations done, using existing information on the study area, indicate that neither rising river stages nor overland flow from the Mississippi River appears to introduce significant sediment to the area. Not enough information is available to determine the contribution via the Zumbro River or the culvert. (See Appendix A for a more detailed explanation of sedimentation in the area.) It should be noted that, given the average increase in bottom elevations in Lower Peterson Lake, it would appear that the culvert constructed in the 1960's could be responsible for some of the sediment deposition in this lake.

NATURAL RESOURCES

Vegetation - The plant community of the project area is typical of Upper Mississippi River habitats, consisting of floodplain forests and backwater sloughs. The most common tree species present include silver maple, river birch, cottonwood, and willow with an understory generally dominated by poison ivy. Aquatic vegetation is abundant and diverse and includes coontail, sago pondweed, curly-leaf pondweed, river pondweed, greater duckweed, lesser duckweed, watermeal, Canada waterweed, mud plantain, white and yellow water lily, and yellow lotus. Marsh areas are dominated by sedge with a scattering of cattail and bulrush.

Fish and Wildlife - Fish habitat in the Finger Lakes complex is considered to be superior from many standpoints. The area provides spawning and rearing habitat for a wide variety of species including largemouth bass, bluegill, crappie, sauger, walleye, catfish, carp, buffalo, and forage fish. Structure in the form of downed trees throughout the area provides excellent shelter for such species as largemouth bass, bluegill, and crappie. The large areas of marsh habitat, when flooded, provide highly suitable spawning habitat for northern pike.

The project area has a diverse wildlife community. Wildlife most commonly found in the area include muskrat, mink, beaver, raccoon, fox, wading birds and a wide variety of songbirds. These backwater areas also provide good to excellent conditions for waterfowl, especially surface feeding species such as mallard, teal, shoveler, and wood duck.

Threatened and Endangered Species - The following federally listed threatened or endangered species may occur in pool 5 of the Upper Mississippi River: bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and Higgins' eye pearly mussel (*Lampsilis higginsi*). There is no designated critical habitat for these species in the project area. The peregrine falcon has been reintroduced at a site just north of Alma, Wisconsin. Success has been limited due to problems with high mortality of the young, mainly from predation by owls. Occasional sightings of this species occur in the project area, especially during spring and fall migration. Bald eagles are fairly common along the Mississippi River. Of primary value to bald eagles is their use of the river as a migration corridor and as a wintering area. No active eagle nests are present in the immediate project area. However, the U.S. Fish and Wildlife Service has indicated that an eagle nest was recently discovered approximately 1.25 miles south of the dike. The Higgins' eye pearly mussel is not known to inhabit the reach of the river where the project area is located. In addition, the silty substrate and the lack of flows in the project area do not provide suitable habitat for this species.

CULTURAL RESOURCES

In accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, the National Register of Historic Places has been consulted. As of 1 November 1989, there is one site on or determined eligible for the Register in the immediate project area - lock and dam 4. Pool 5 contains at least 34 known historic sites and 40 archaeological sites on the lands bordering the pool. There are no known sites in the immediate project area other than lock and dam 4.

SOCIOECONOMIC RESOURCES

The shoreline surrounding the lakes is used for recreational purposes, primarily by seasonal inhabitants. The dike is used extensively for various activities such as fishing, hunting access, and bird watching. The area immediately to the west is comprised of the only privately owned residences in the vicinity. There are approximately 30 cabin sites, primarily seasonal, on the west shore of Clear Lake.

RECREATIONAL RESOURCES

Recreation in the Finger Lakes is limited primarily to fishing and waterfowl hunting. A pedestrian path along the lock and dam 4 dike provides access to the lakes and to the main channel of the river. A commercial fishing float below the lock and dam adjacent to the main channel is also used by anglers. A small walk-on public access and a parking lot are located near the west end of the dike. There is limited boat access from the main channel through the winding backwater which serves as the outlet for the Finger Lakes. A private unimproved boat access is located on the west shore of Clear Lake. Fishing on the Finger Lakes takes place primarily on Clear Lake, Lower Peterson Lake, and Third Lake.

FUTURE WITHOUT PROJECT CONDITIONS

HISTORICALLY DOCUMENTED CHANGES IN HABITAT

Historical data on the habitat conditions of the Finger Lakes complex is somewhat limited. Brown Survey maps indicate that, prior to the construction of lock and dam 4, what is now known as Finger Lakes existed as a series of running backwater sloughs and marshes. It is assumed that the mix of open water, aquatic vegetation (both submerged and emergent), and underwater structure from downed trees provided excellent year-round fish habitat. The construction of the dike cut off freshwater inflow to the system. Due to the shallow depths of the lakes, the lack of direct water flow into the lakes has resulted in periods of depressed oxygen levels during the summer and winter. It is unknown if low dissolved oxygen was a problem in this area prior to the construction of the lock and dam. However, given the shallowness of the system, it is likely that it was a periodic problem. Being the most isolated of the five lakes, Second Lake has experienced periodic fish kills. It is assumed that limited fish kills have occurred in all of the lakes at one time or another since the construction of the dike. This occurrence is dependent on whether the fish are able to egress from a given lake in any given year before unsuitable conditions develop. The Minnesota Department of Natural Resources conducted D.O. surveys in 1963 and 1964 in Clear, Lower Peterson, and Third Lakes and documented the presence of a winter sag in D.O. levels. Clear Lake appeared to have the least decline in D.O. levels, presumably due to the presence of springs in this lake.

In 1965, the single culvert was placed through the dike at Lower Peterson Lake which provides a flow of approximately 80 cfs. This action resulted in Lower Peterson Lake being available as fish habitat on a year-round basis. Surveys of D.O. levels in all of the Finger Lakes in 1975, 1976, and 1977 indicated that, with the exception of Lower Peterson Lake, the Finger Lakes complex experienced winter D.O. sags. Again, Clear Lake did not appear to have as severe a problem as the other lakes without flow. A 1977 fisheries survey of the Finger Lakes by the Minnesota Department of Natural Resources indicated that a more abundant and diverse fish population was present in Lower Peterson Lake than in the other four lakes, presumably due to the freshwater flow.

Additional D.O. surveys were conducted by the Minnesota Department of Natural Resources from December 1988 to March 1989. First, Second, and Third Lakes showed the biggest decline in D.O. levels over this time period. Clear Lake also experienced D.O. declines but not to the extent of the other three lakes. (Information on the D.O. data can be found in the technical appendix at the end of this report.)

No data is available to document summer D.O. conditions. However, given the shallow nature of the lakes, the large amount of aquatic vegetation present, and the lack of flows, it is reasonable to assume that unsuitable habitat conditions develop in selected areas of these lakes during late summer. This assumption is supported by observations of area fishery managers who note the decline in fishing pressure on most of the lakes in the complex in late summer, with the exception of Lower Peterson Lake.

EXISTING HABITAT DEFICIENCIES

Habitat deficiencies must be viewed in the context of the desired conditions or management goals for a particular area. What may be viewed as a deficiency for one species may be excellent habitat for another. Because the project goal is to maintain and improve habitat for fish, and centrarchids in particular, the discussion of habitat deficiencies is focused in this direction. A variety of habitat suitability models for several species of centrarchids, published by the U.S. Fish and Wildlife Service, were used as a source of information for the following discussion.

In general, optimal riverine habitat for centrarchids includes low velocity or lentic waters with greater than 25 percent littoral area. Deeper water areas are preferred for overwintering and as a retreat from summer heat. Dissolved oxygen requirements are similar to those of most warmwater species in that concentrations greater than 5 milligrams per liter (mg/l) are considered optimal while levels below 1 mg/l are likely to be lethal. Cover in the form of submerged logs and vegetation is important, especially for juveniles and small adults.

Reproduction and food are not considered to be limiting factors in the Finger Lakes. Adequate spawning habitat is available, and high water fertility (nutrients) and the abundant aquatic vegetation provide for sufficient food resources.

The seasonal depletion of dissolved oxygen in the Finger Lakes complex is considered to be the primary limiting factor (habitat deficiency). While the lack of more extensive deepwater habitat for thermal refuge may be somewhat limiting, it is not considered to be a critical factor.

Construction of the dike for lock and dam 4 effectively cut off water flow to the Finger Lakes area. While the Finger Lakes complex provides good fisheries habitat, the usability of much of the area is seasonal and limited because of dissolved oxygen depletion during the summer and winter. Some areas may be unsuitable for fish habitation for up to 6 months of the year.

In 1965, the culvert was constructed through the dike at the head of Lower Peterson Lake in an effort to correct the problem. The culvert provides a freshwater flow of up to 80 cfs. Although the culvert did not alleviate the problems for the entire Finger Lakes complex because of flow patterns, it has eliminated D.O. problems in Lower Peterson Lake.

As dissolved oxygen levels in First Lake, Second Lake, Third Lake, and Clear Lake periodically sag to critical levels, fish in these areas move to oxygenated areas provided by flow from the culvert at Lower Peterson Lake. This forced movement from preferred habitat may cause high mortality, due to predation, a change in the availability of food, or exposure to colder waters, for some of the species affected. Frequently, escape routes from D.O. depleted areas are blocked by conditions such as ice buildup or beaver dams, resulting in fish kills.

Dissolved oxygen depletion does not appear to be as frequent a problem in Clear Lake, apparently because it has a more abundant groundwater source than the other lakes in the complex.

ESTIMATED FUTURE HABITAT TYPES AND DISTRIBUTION

It is expected that the current habitat conditions of the project area would be maintained if a rehabilitation project is not implemented. The area will continue to provide seasonal periods of excellent habitat for fish, as well as occasional fish kills due to dissolved oxygen depletion during the summer and winter. Existing conditions will continue to limit fish productivity and population diversity in some areas of the Finger Lakes complex.

PLANNING CRITERIA AND CONSTRAINTS

Finger Lakes is part of the Upper Mississippi River Wildlife and Fish Refuge. The proposed project does not conflict with the goals of the Refuge Master Plan. The Upper Mississippi River Land Use Allocation Plan prepared by the St. Paul District, Corps of Engineers shows that the study area is owned either by the Corps or the U.S. Fish and Wildlife Service. The entire area is managed by the U.S. Fish and Wildlife Service. The land use allocation for a majority of the lands in the study area is for wildlife management. Minor exceptions occur on land along the main river channel, where small portions are designated as recreational area or for project operation use, and the dike itself, which is also currently designated as a project operations area.

There were several hydrologic constraints in developing alternatives for this project. Any solution designed for this area included consideration of the following criterion: All alternatives needed to be evaluated with respect to their effects on the integrity of the dike for lock and dam 4.

Alternatives for providing freshwater flow to the four lakes concentrated on providing adequate flow to the targeted areas and minimizing operation and maintenance costs. Hydrologic investigations coupled with biological judgment and operation and maintenance considerations were used to help identify the flow required to meet the desirable D.O. levels (5 mg/l or greater) needed for any proposed design.

Debris accumulation at the culvert inlets is a concern. At Lower Peterson Lake, the most recent solution has been to install a slanted trash gate over the entrance to the culvert. However, problems with debris accumulation still occur, and periodic removal of debris from the trash gate is required. Inlet locations or debris control designs that would reduce this problem were investigated.

In addition to debris accumulation, the presence of numerous beaver in the area must be taken into consideration when designing a flow system. Other factors to be analyzed when refining the selected design are safety and security.

No inlet (culvert or siphon) should be placed such that flow would pass through the wetland located on the upstream side of the dike north of Second Lake. This is required, in order to preserve the integrity of this existing high quality ecosystem.

PROJECT OBJECTIVES

The overall goal of this project is to increase the amount of available fish habitat on a year-round basis in the Finger Lakes by stabilizing D.O. levels throughout the complex. The ability to maintain D.O. levels of greater than 5 mg/l would alleviate current problems in the Finger Lakes complex. An increase in the amount of available habitat would increase the productivity and diversity of the existing fishery resource.

PLAN FORMULATION

The principal purpose of plan formulation is to develop a plan that would provide the best use, or combination of uses, of water and land resources to meet the established project objectives. In the Finger Lakes study, causal factors associated with the defined objectives were identified. These were described previously in the "Future Without Project" section of this report. Alternative solutions to the problem were then assessed. A summary of this alternative evaluation is presented below. Design efforts centered around achieving the desired project objectives with low first costs and yet minimal maintenance requirements.

ALTERNATIVES CONSIDERED

Several alternatives that might meet the identified project objectives were considered. These included a no-action alternative, as well as several structural solutions. The proposed alternatives are described below. Included is a discussion of the ability of each alternative to meet the project objectives and, where practical, an estimated cost for the proposed solution.

Development of Design Criteria - Water quality investigations determined that a flow of at least 10 cfs was required into each of the remaining lakes to maintain a D.O. level of 5 mg/l. This flow was calculated based strictly on past winter D.O. monitoring activities, limited bathymetric information, and estimated lake volumes. It is probable that the primary culvert design for a flow of 10 cfs would not be adequate under certain conditions to maintain a D.O. level of 5 mg/l. Without extensive bathymetric information, inflow and outflow determinations for each of the lakes, and more extensive winter and summer D.O. monitoring, a more precise calculation of minimum flows required to maintain a D.O. level of 5 mg/l is not possible. This minimal 10 cfs flow was used near the onset of the plan formulation process to develop and evaluate alternative designs.

Many assumptions were used in predicting the flows required to maintain adequate D.O. levels in the Finger Lakes. Due to these assumptions, there can be a great variability in the required flows for each lake to maintain adequate D.O. levels. The oxygen depletion rate assumed is an important factor in determining the required flow to each lake. The oxygen depletion rate is actually a variable rate and depends on the current lake conditions. Decay rates can slow when the available oxygen is limited or the oxygen demanding materials settle to the bottom. The inflow of water can resuspend the oxygen demanding materials and supply them with the oxygen required to drive the reactions. This can result in much higher decay rates than were seen during the winter study period. If this occurs, increased flow rates would be required to overcome the higher decay rates. The assumptions used should be conservative; however, the reaction of the environment is very hard to predict using the limited data available during the study. Another assumption was that the supply water above the dike maintained at least 6 mg/l D.O. during the period that flow is required to the lakes. If the D.O. level falls below this, greater flows would be required. It is recommended that a monitor or monitors be placed at inlet locations to determine if adequate D.O. is available above the dike throughout the winter. Concerns also arose over installation of a culvert capable of passing only a maximum flow of 10 cfs. If any blockage of the culvert occurred, this would result in inadequate flows being delivered to the lake in question.

A culvert currently exists between Peterson Lake and Lower Peterson Lake. The 48-inch-diameter culvert supplies an average flow of 80 cfs to Lower Peterson Lake. Prior to the culvert installation in 1965, similar problems were experienced as in the other Finger Lakes. During the winter of 1988-89, the Minnesota Department of Natural Resources monitored the D.O. of the Finger

Lakes. D.O. levels in Lower Peterson and Schmokers Lakes were high throughout the year, usually with D.O. levels above 10 mg/l, while all the other lakes experienced depressed D.O. levels at some time during the winter. Due to the sampling results on Peterson and Schmokers Lakes, it is reasonable that the same type of culvert plan on a smaller scale would maintain adequate D.O. levels in the other lakes since their volumes are much smaller than that of Lower Peterson and Schmokers Lakes.

To meet the project objectives, it is imperative that the project be designed with enough flexibility to ensure the ability to meet the stated goals under a variety of conditions. Due to blocking problems, freezing, and design assumptions, it appeared advisable to increase the required culvert size to near 50 cfs to maintain operational flexibility. Based on the above considerations, and after consultation with area resource managers, a culvert with a design capacity flow of 50 cfs was selected as the preferred design.

No Action

With this alternative, no project would be implemented using Federal funds. Specific details of future conditions with no action have been described in previous sections; therefore, they will not be reiterated in this section. (In particular, refer to the "Estimated Future Habitat Types and Distribution" section on page 16.)

Siphons

The lifting of water over the dike into the downstream lakes by siphonic action was considered. Interest in this option arose because of a perceived potential for a major reduction in construction costs with considerable difference in operation and maintenance requirements. It was felt that considerable cost savings should result because no dewatering should be required for this option during construction. (The pipe would need to be buried as it crosses the dike but not below the water line as would be needed for a gravity flow culvert system.)

A literature search was performed in an attempt to find a situation in which a siphon was used in a fashion similar to the one suggested at Finger Lakes. There was no case history for this type of system. Generally, siphons such as this are used only to reduce the apparent head seen by a pump and, in this situation, are not capable of running without the pump in operation. Air regulated siphonic spillways are sometimes used in low head applications. In these instances, however, they are seen as a way of getting increased flow over a weir in a flood event and not as a means of continually transporting water over a dike. While there are no case histories for such systems, the following reservations surfaced with regard to this alternative:

a. A siphonic line must be essentially airtight and remain so for the life of the project. Once the seal in the pipe is broken, the siphon no longer functions effectively. The frequency of this occurring should be minimal. However, since the pipeline for the siphon would be buried where it crosses the dike, any leakage in the pipe itself could be costly and inconvenient to repair.

b. If a single, larger pipe were used to provide siphonic flows to an individual lake, it would be very difficult to design an operating system that would consistently be able to provide water over a wide range of flows.

c. The entrance to the siphonic system would be placed several feet below the low control pool elevation. With this system, although the siphon would still be susceptible to plugging, the frequency of this occurring should be reduced with the more deeply submerged entrance. Because the pipe would be deeper in the water, however, it would be more difficult to clean once it became plugged.

d. Bends in the pipe would make visual inspection very difficult and help trap any debris brought up inside the pipe.

e. As with a culvert, partial blockage of the siphon pipe would reduce the efficiency of the operation. Unlike a culvert, occlusion of greater than 50 percent of the opening would likely result in loss of the siphonic action.

f. Winter operation should function as well as in the summer, once the system was operating. However, if the prime were lost, it could be difficult to restart because of the freezing conditions that exist at the interface of the air and water within the pipe.

g. Because the siphon must be primed in order to start it, more human intervention would be required.

Interest in this option originally surfaced primarily because it was felt that the installation costs and future operation and maintenance duties would be significantly less than for a culvert option. However, the only potential first cost savings with this alternative, as compared to a culvert option, would be the dewatering costs. Currently, this cost savings is estimated at approximately $20,000 per culvert. This savings would be more than offset by pump, gate valve and air relief valve installation, and design costs. With regard to future operation and maintenance, although pipe cleanout would probably be less frequent with this type of design (and other potential problems mentioned above that could occur with a siphon system would be rare), the actions required to maintain a functional system would be much more difficult and expensive. For these reasons, the siphon system was dropped from further consideration.

<u>Culverts</u>

A number of alternative culvert designs were considered for getting flow into the four remaining lakes. A description of each follows.

<u>Culvert Alternative 2A:</u> This alternative consisted of culverts through the dike into Clear Lake, Third Lake, and Second Lake. A ditch/culvert system running from the main channel of the Mississippi River into First Lake would be constructed immediately below lock and dam 4, in order to provide flows to this lake. Plate 5a shows a plan view of this option. Field measurements have shown that there is little, if any, head differential between the Mississippi River below dam 4 and First Lake. Therefore, the required minimum flow of 10 cfs during the late summer and in the winter would not occur under this plan. Furthermore, increased flows into the other lakes from the

proposed culverts could actually generate flow out of First Lake into the river with this plan. For these reasons, it was concluded that this option is not hydraulically feasible, and it was not analyzed further.

Culvert Alternative 2B: For this alternative, the flow through the existing culvert into Lower Peterson Lake would be split between all five Finger Lakes by means of a network of pipes. (The movement of water by ditches, instead of pipes, into the individual lakes was also assessed. This was not pursued in depth, however, because it was apparent that it would not be possible to produce a hydraulic design using an open ditch system that would guarantee adequate flow to each of the lakes. Essentially the same sorts of difficulties with an open ditch system that were encountered with alternative 2A - head differential between the main channel and First Lake - would also apply in this instance.) The location of the proposed pipe network is shown on plate 5b. All outlets would be controlled by slide gates. At the onset of plan formulation, a preliminary cost estimate was performed based on the very minimum expected flow requirement (10 cfs). With this scenario, the estimated total project cost for this alternative was $888,000. Increased expenditures for this alternative were due primarily to the cost of larger pipes that would be needed to transport water the entire length of the system, high first construction costs due to the necessity of running the pipeline through long stretches of open water, and the cost of providing fill to serve both as an adequate bedding on which to lay pipe and as cover to prevent upheaval of the pipe system.

Culvert Alternative 2C: This alternative consisted of a single gate well structure located in the dike north of First Lake near the main channel. Flow would enter the gate well via a single culvert and be distributed to First and Second Lakes via two culverts exiting the gate well. Clear Lake and Third Lake would be supplied with flows by single culvert systems, installed immediately upstream of each of these individual lakes. Using the 50 cfs flow criterion, the estimated cost of supplying all four lakes was $790,000. For the locations of these proposed features, see plate 5c.

Culvert Alternative 2D: For this alternative, a culvert or ditch would connect Lower Peterson Lake and Clear Lake, in place of a culvert through the dike into Clear Lake as proposed in alternative 2C. The remaining three lakes would be supplied by a system that was selected as the best of the remaining viable alternatives presented above. The location of the proposed ditch feature for Clear Lake is shown on plate 5d. Field measurements have shown that there is little or no head differential between Lower Peterson Lake and Clear Lake. Therefore, as with the other suggested ditch systems, the required flow cannot be assured under this plan. For this reason, it was concluded that this alternative is not hydraulically feasible, and it was not analyzed further.

Wells

There is approximately 200 to 300 feet of Mississippi River alluvium over Cambrian and Precambrian rock. The bedrock stratigraphy in the river valley is as follows:

Ironton-Galesville aquifer (may be eroded)
Eau Claire sandstone (not a good water producer)
Mt. Simon-Hinckley aquifer (typically produces flowing wells)

Flowing wells are known to be present in the Kellogg area, although no recent data is available. These wells typically have been in the 350 gallons per minute (gpm) flow range. Based on this information and general knowledge on wells, a very optimistic flow from a typical single 6-inch-diameter well would be less than 1 cfs (1 cfs = 449 gpm). A more reasonable flow estimate would be 200 gpm (0.45 cfs). The possibility of drilling into an artesian system is problematical. However, it is estimated that a depth of approximately 500 feet would be required to reach a flow in the 200 to 400 gpm range. The approximate cost of the drilling operation was estimated to be $29,000 per well (this does not include mobilization and demobilization, access, and aeration structure costs). It would take numerous wells to reach the 50 cfs design flow. Because of the high cost of implementing the full project, as well as the inability to assure that the drilling operation would be successful, this option was not pursued.

Alternative Selection

The "no-action" alternative represented the condition of Finger Lakes in 50 years if the existing trends continued. With the implementation of any of the proposed alternatives, there would be a positive change in habitat conditions when compared to the "no action" alternative. It was apparent that, given technical feasibility, each of the alternatives could offer essentially the same amount of habitat improvement for the Finger Lakes. The siphon system was eliminated from consideration because first costs were comparable to (if not more expensive than) the cheapest culvert option; operation and maintenance tasks were more difficult, albeit potentially less frequent; and the system would not operate effectively over a wide range of flows. Wells were also dropped from further analysis due to their high cost and questionable success. With regard to the four culvert options, only two (Culvert Alternatives 2B and 2C) could offer assurances that the required design flows would enter the Finger Lakes system. Between these two remaining viable culvert systems, Culvert Alternative 2C was the least costly. It was, therefore, the plan selected.

SELECTED PLAN OF ACTION

Project Features

The selected plan of action consists of the construction of 3 separate gate well/culvert systems that would supply flows into the Finger Lakes. Clear Lake and Third Lake would have individual gate well/culvert systems located immediately upstream of each lake. Clear Lake would have a 36-inch-diameter reinforced concrete pipe (RCP) extending 300 feet from upstream of the dike to a point beyond which water could flow by gravity into Clear Lake. Water running into this lake would exit the culvert into a wetland upstream of the main body of Clear Lake. No ditching would be required to bring flows directly into the lake from this point. Third Lake would also be supplied by a 36-inch-diameter RCP. Because of the existing topography downstream of the dike in the vicinity of Third Lake, only a 170-foot-long culvert would be required to supply flows to the lake. The remaining two lakes, Second and

First, would be supplied by separate parallel culvert systems which would pass through a common gate well structure in the dike. The culvert to First Lake would be 42 inches in diameter with an overall length of 350 feet. Field inspection of the area and review of aerial photography indicate that from this point onward water would naturally flow into First Lake. To supply flows to Second Lake, a 48-inch-diameter pipe would be required, extending a distance of about 860 feet. Some ditching would be needed at the entrance to the First and Second Lakes culverts in order to assure that adequate flows would reach this system. Additional ditching may also be required at the culvert outlets to assure proper flow to these two lakes. Material would be sidecast to create a berm next to the ditch. A final determination will be made during plans and specifications. Table 1 contains a summary of culvert sizes, lengths, and invert elevations. See plates 6 and 7 for a plan view and typical cross section of the recommended design.

All culvert systems were designed for the minimum winter head loss conditions that could be expected. The gated culverts will allow for flexibility of operation between 0 and 50 cfs, including the ability to close individual culverts completely, if necessary. The variation in culvert sizes between the lakes compensates for friction losses due to pipe lengths, thereby providing the maximum design flow.

Table 1 - Culvert Data for the Finger Lakes

Lake	Culvert Diameter	Culvert Length	Inlet Invert	Outlet Invert
Clear Lake	36 inches	300 feet	663.3	660.0
Third Lake	36 inches	170 feet	662.5	660.0
Second Lake	48 inches	860 feet	659.0	659.0
First Lake	42 inches	350 feet	659.0	659.0
Gate Well Inlet	48 inches	50 feet	660.0	659.0

Features that are common to all of the gate well/culvert systems include the control mechanism, erosion/scour protection, and debris control structures. Within each gate well/culvert system, a sluice gate would be installed to control flow into that particular Finger Lake.

Every attempt would be made to return the same riprap that is currently present on the dike as part of the construction activities. No increase in depth of riprap on the dike is anticipated as a result of construction of the gate well/culvert systems. Downstream of the pipes, riprap protection would also be put in place in order to provide erosion protection due to high flows from the culverts. This erosion protection would typically be a horizontal blanket of riprap. Design of the horizontal blankets is shown on plate 8. Where field conditions make use of a horizontal blanket impractical, a preformed scour hole lined with riprap may be substituted at the culvert outlets. This design is shown on plate 9. A final determination on the appropriate type of erosion protection will be made during plans and specifications.

A field investigation of the existing debris protection at the inlet to the Lower Peterson Lake culvert has shown that the present design requires a higher than desirable amount of maintenance. The very small grate spacing causes an accumulation of small debris at the inlet, resulting in a matting effect that greatly reduces inflow capacity. After investigating several alternatives, a new design has been selected for potential recommendation. This is a debris deflector of triangular plan with an apex angle of 20 degrees. The purpose of this structure would be to deflect large debris to either side of the inlet, while allowing debris not capable of blocking the protected culvert to pass. Plate 10 shows the proposed design.

During the detailed studies, it was determined that the placement of the culvert which would provide adequate flows into Third Lake could be completed under the authority of the Rivers and Harbors Act dated July 3, 1930. Construction could be accomplished through operation and maintenance efforts, because prior to inundation, this lake (just as Lower Peterson Lake) was a defined running slough which was cut off through placement of the lock and dam system. This being the case, it is recommended that this feature not be constructed under UMRS-EMP authority. Coordination with the operation and maintenance elements within the St. Paul District indicates that an effort would be made to ensure that the construction of a culvert into Third Lake would be done concurrently with the Habitat Rehabilitation and Enhancement Program (HREP) proposed action. By sharing mobilization and demobilization, this consolidation should provide a cost savings for both construction efforts.

Construction Methods

Based on current information, the following is offered as the likely method of construction for this project. Installation of the gate well/culvert systems would basically entail excavation of the existing dike, installation of the proposed gate well/culvert system, and replacement of the dike materials. Dewatering of the area would be required prior to commencement of the proposed construction. Sheetpile cofferdams would be put in place at the points along the dike where the culverts were to be constructed. Following placement of the cofferdams, the water level within the cofferdams would be removed with point wells. The original dike would be excavated, the gate well/culvert structures constructed, and the dike replaced. Efforts would be made to reuse material taken from the dike for its reconstruction.

Riprap required for scour protection would come from existing quarries in the area. Fill for construction would most likely come from existing dredged material disposal sites in the vicinity of the project. Access to the construction site would be along the dike or via Peterson Lake on the upstream side of the dike.

Real Estate Requirements

The construction features of this project are located just upstream of the Finger Lakes. This area is part of the Upper Mississippi Refuge which is managed by the U.S. Fish and Wildlife Service for wildlife. It is owned in fee title by the Federal Government, either through the U.S. Fish and Wildlife Service or the Corps of Engineers. Although the dike through which the culverts would be placed has a current land use designation for project operations, its underlying purpose is for fish and wildlife management purposes. Appropriate agreements, therefore, would be made with the U.S. Fish and Wildlife Service to place the culverts in the refuge. Agreements with the U.S. Fish and Wildlife Service would also be needed for construction and future operation and maintenance of this structure.

Estimated Future Habitat Conditions with the Project

The effects of the project are discussed in more detail in the following environmental effects section. In general, the proposed action would improve 113 acres of aquatic habitat in the Finger Lakes complex by making this amount of habitat available as suitable fish habitat on a year-round basis. This number includes the culvert to Third Lake where 27 acres would be affected. This, in turn, would result in increased productivity and diversity of the existing fish population.

Fulfilled Goals with the Project

During the plan formulation phase of the study, the primary objective of the project was identified as maintaining a minimum D.O. level of 5 mg/l throughout the Finger Lakes complex on a year-round basis. This goal would be realized through construction of this entire project. Improvement of D.O. in the Finger Lakes system should lead to increased use of the area by fish throughout the year. The projected measurable accomplishments of the proposed plan are presented in table 2.

Table 2 - Measurable Goals and Accomplishments of the Proposed Plan

Goal	Project Accomplishment	Potential Enhancement Feature	Unit of Measure	Enhancement Potential: Present	Enhancement Potential: Future Without	Enhancement Potential: Future With
Improve aquatic habitat	Maintain an adequate DO level year-round	Culverts	Mg/l	<5 at certain times of year	<5 at certain times of year	>5 year-round
			Lack of winter kills	Periodic winter kills	Same as present condi- tions	No winter kills

ENVIRONMENTAL EFFECTS

An environmental assessment has been conducted for the proposed action, and a discussion of the impacts on habitat conditions follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in the environmental impacts matrix (table 3) were reviewed and considered in arriving at the final determination. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation was prepared (attachment 3). Application has been made to the State of Minnesota regarding water quality certification under Section 401 of the Clean Water Act. The Finding of No Significant Impact (attachment 2) will be signed after the public review period has elapsed, any issues have been resolved, and the water quality certification has been obtained.

As stated previously, the culvert into Third Lake will not be constructed under UMRS-EMP authorities. It is planned that the construction of a culvert into Third Lake would be done concurrently with the proposed action. Therefore, in order to consolidate environmental documentation and review, this assessment and the accompanying 404(b)(1) evaluation address the placement of all of the culverts through the dike.

Relationship to Environmental Requirements

The proposed action would comply with all applicable Federal environmental laws, executive orders, and policies, and State and local laws and policies including the Clean Air Act, as amended; the Clean Water Act of 1977; the Endangered Species Act of 1973, as amended; the Land and Water Conservation Fund Act of 1965, as amended; the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969, as amended; the Fish and Wildlife Coordination Act of 1958, as amended; the Farmland Protection Policy Act of 1981; Executive Order 11988 - Floodplain Management; and Executive Order 11990 - Protection of Wetlands.

TABLE 3

IMPACT ASSESSMENT MATRIX

NAME OF PARAMETER	MAGNITUDE OF PROBABLE IMPACT						
	<----- INCREASING BENEFICIAL IMPACT			NO APPRECIABLE EFFECT	INCREASING ADVERSE IMPACT ----->		
A. SOCIAL EFFECTS	SIGNIFICANT	SUBSTANTIAL	MINOR		MINOR	SUBSTANTIAL	SIGNIFICANT
1. Noise Levels					X		
2. Aesthetic Values					X		
3. Recreational Opportunities			X				
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth & Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenues				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity				X			
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality				X			
2. Terrestrial Habitat					X		
3. Wetlands				X			
4. Aquatic Habitat		X					
5. Habitat Diversity and Interspersion		X					
6. Biological Productivity		X					
7. Surface Water Quality					X		
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Hist & Historic Archeological Values				X			

Natural Resources

The proposed action would improve the fish habitat conditions of 113 acres of the Finger Lakes complex by making this amount of habitat accessible on a year-round basis. In order to better quantify the habitat benefits of the proposed action, the U.S. Fish and Wildlife Service's Habitat Evaluation Procedure (HEP) was used. HEP utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing existing HU's to HU's expected to be gained with a proposed action, the outputs can be quantified.

It was determined that all of the three major alternative categories considered (siphons, wells, and culverts) could meet the objectives of providing adequate flows to maintain D.O. levels in the Finger Lakes system. Therefore, the comparative benefits of all the alternatives are considered to be equal, with the only determining factors of selection being technical feasibility and cost. Therefore, the HEP evaluation results are presented only for the selected alternative.

Several centrarchid species models (largemouth bass, bluegill, crappie) were reviewed in an initial evaluation of HSI values. According to the models, D.O. is the variable which, if it is considered to be the most limiting factor, is used to determine the HSI. An onsite meeting was held with personnel from participating Federal and State agencies. Some of the personnel present were resource managers for the project area. It was the consensus of the evaluation team that from a physical standpoint, with the exception of depth, habitat conditions in the project area were considered to be excellent. The only identified limiting factor was seasonal availability of habitat within the system due to D.O. sags.

Based on the above information, the following assumptions were used in completing the HEP evaluation:

1. From a physical standpoint, habitat conditions in the Finger Lakes

system are near optimum, with an HSI of 0.9.

2. Dissolved oxygen depletion is the primary limiting factor and seasonal D.O. sags limit habitat availability in portions of the complex for up to 6 months of the year.

3. D.O conditions in Lower Peterson Lake are not limiting, and D.O. conditions in Clear Lake are not as degraded as in First, Second, and Third Lakes.

4. Based on the assumptions stated above, the HSI values for the individual lakes were calculated to be:

(a) Lower Peterson Lake - HSI = 0.9
(b) Clear Lake - HSI = 0.6
(c) First, Second, and Third Lakes - HSI = 0.4

5. Improved D.O. levels in the Finger Lakes system will maintain year-round availability of habitat throughout the complex and raise the HSI of the entire system to 0.9.

Based on the above assumptions, an analysis comparing existing HU's available in the Finger Lakes system to HU's available with the project is presented in table 4.

Table 4 - HEP Evaluation for Finger Lakes (1)

Lake Name	Acres	Existing (Future Without) HSI	Existing (Future Without) HU's	Future With HSI	Future With HU's	HU's Gained
Lower Peterson	19	0.9	17.1	0.9	17.1	0.0
Clear	27	0.6	16.2	0.9	24.3	8.1
First Lake	31	0.4	12.4	0.9	27.9	15.5
Second Lake	28	0.4	11.2	0.9	25.2	14.0
Third Lake	27	0.4	10.8	0.9	24.3	13.5
TOTAL	132		67.7		118.8	51.1

(1) Habitat units reported are average annual habitat units.

The evaluation indicates that the proposed project would result in a net gain of 51 average annual habitat units, or a 75-percent increase in the habitat value of the area (HU's Gained/HU's Existing).

Construction of the project would result in some short-term disturbance impacts resulting from vegetation clearing and earthmoving. Overland culvert alignments on the downstream side of the dike would result in the loss of approximately 3 acres of woods.

The proposed action would result in short-term decreases in water quality because of temporary localized increases in turbidity during construction.

No State listed or federally listed threatened or endangered species would be adversely affected by the project. The proposed activities would have no effect on the eagle nest located approximately 1.25 miles south of the dike.

Recreation and Aesthetic Values

The proposed action would result in minor recreation benefits to the Finger Lakes area. Many species of fish would be attracted to the culvert outlets, thereby providing excellent angling opportunities at these locations.

Short-term negative impacts to recreation activities would occur during project construction because pedestrian access to the area would be restricted.

Cultural Resources

Lock and dam 4 has been determined to be eligible for the National Register of Historic Places. However, the Corps historian and the State Historic Preservation Office have agreed that the dike is a noncontributing element to the National Register-eligible structure and that the integrity of the National Register-eligible structure would not be affected. No other site areas would be disturbed.

Socioeconomic Resources

The proposed action would have no appreciable effects from a social standpoint. There would be minor inconveniences from construction noise and related aesthetic considerations.

PROJECT REQUIREMENTS

OPERATION AND MAINTENANCE

Operation and maintenance (O&M) requirements for this HREP plan would be limited to work associated with the culvert systems for Clear, First, and Second Lakes. Generally, it is anticipated that maintenance actions would include bimonthly inspection of the culverts during the operating season, monthly cleanout of debris that accumulates at the upstream end of each of the culverts, twice yearly removal of beaver dams, and minor maintenance (oiling and lubrication) of the three sluice gates. No dike repair would be required by the U.S. Fish and Wildlife Service for this project. This would continue to be a responsibility of the Corps through its operation and maintenance branch, as it has been in the past. Operation responsibilities for the HREP plan would be confined to lowering and raising the sluice gates as desired in order to maintain adequate flows into the three lakes during low flow periods. It has been recommended that the gates be closed during high flow periods in the spring in order to limit the entrance of sediment laden waters at that time. The projected average annual estimated O&M cost of this project, over the 50-year project life, is shown in table 5. With five culvert systems in place along the lock and dam 4 dike, two (at Lower Peterson Lake and Third Lake) will be operated and maintained by the Corps and three (at First, Second, and Clear Lakes) will be operated and maintained by the U.S. Fish and Wildlife Service. An O&M manual detailing operation and maintenance requirements at the three HREP-EMP lakes would be prepared by the Corps during the plans and specifications phase of this project. Development of the manual would be coordinated with the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources.

Table 5 - Estimate of Annual Operation and Maintenance [1] Costs

Item	Cost
Inspection and reporting (2 times/month)	$2,000
Debris removal (1 time/month) [2]	5,800
Beaver dam removal	2,000
Operation of the control structure (4 times/year)	700
Total annual cost [3]	$10,500

NOTE: (1) Maintenance has been calculated only for what is considered to be the 6-month summer/fall operating season of the gate well/culvert system. Although flows will continue through the winter, little or no maintenance should be required during that time.

(2) Costs shown above reflect the assumption that the work required for debris removal could be done with boats currently available to the U.S. Fish and Wildlife Service. Costs associated with alleviating problems due to beaver activity have also been included.

(3) Costs for operation and maintenance would total $525,000 over a 50-year project life.

PERFORMANCE EVALUATION

Monitoring plans for project evaluation purposes were designed to directly measure the degree of attainment of the selected project objectives. Therefore, for each objective, an evaluation plan was developed. These are described below and also presented in table 6. The general parameter to be measured for each objective follows:

<u>Project Objective</u>: Maintain a D.O. level of 5 ppm throughout the Finger Lakes complex on a year-round basis.

<u>Evaluation</u>: Annual monitoring of the D.O. levels would be conducted in each of the lakes during the critical winter and late summer months. It is anticipated that the availability of an additional 86 acres of habitat (113 with the construction of a culvert into Third Lake) on a year-round basis would result in an increase in productivity and diversity of the existing fishery resource. This increased fish presence would not be monitored as a part of postproject evaluation efforts of the Corps. However, information gathered by local resource agencies, such as fish surveys or angling success, would be used. Periodic fish surveys would be scheduled to monitor this population change.

Table 6 - Postconstruction Measurements

Goal	Project Accomplishment	Unit of Measure	Monitoring Plan	Monitoring Interval	Projected (1) Cost per effort
Improve aquatic habitat	Maintain an adequate DO level throughout the year	Mg/l	DO measurements	Annually (1) for first 5 years; once every 5 years thereafter	$5,000
		Lack of winter kills	Observation	Annually	Negligible

(1) Annually reflects several sampling efforts throughout the year.

COST ESTIMATE

A cost estimate for the EMP project features is shown below. Quantities and unit costs may be revised during final design and construction. A detailed (baseline) estimate for each culvert system can be found on plates 11a and 11b. (The projected cost for Third Lake is given on plate 11c.)

Table 7 - Cost Estimate for the Selected Plan

Item	Cost (1)
First and Second Lakes	$380,000
Clear Lake	113,000

Subtotal	493,000
Engineering and design (2)	158,000
Supervision and administration	54,000

TOTAL	$705,000

(1) Costs for construction of a gate well/culvert system at Third Lake are not shown above. These are estimated to be $126,000 at Third Lake, constructed under Corps Operation and Maintenance authority and funding.

(2) This does not include prior allocations of $80,000 for general design (planning).

Annualized first costs, using first construction costs and general design expenditures (based upon a 50-year economic life and an 8-7/8 percent discount rate), would amount to $63,500. With the addition of annual operation and maintenance costs as indicated above, the total average annual costs are estimated to be $74,000. An incremental analysis of the cost effectiveness of providing increased flows to each lake was conducted (plate 12). A detailed discussion of how the Habitat Units were derived for this evaluation is presented in the Environmental Effects portion of this report. The analysis shows that, on a Cost/Habitat Unit basis, Third Lake is the most cost effective to improve, while First and Second Lakes are slightly more costly. Clear Lake is the least cost effective of the four lakes to improve. Overall, however, the relative cost of improving each lake does not differ significantly. Therefore, it is recommended that improved flows be provided to each of the four lakes.

PROJECT IMPLEMENTATION

DIVISION OF PLAN RESPONSIBILITIES

The responsibilities of plan implementation and construction would fall to the Corps of Engineers as the lead Federal agency. After construction of the project, annual operation and maintenance of the completed project would be the responsibility of the U.S. Fish and Wildlife Service. Should rehabilitation of the Finger Lakes project which exceeds the annual maintenance requirements be needed (as a result of a specific storm or flood event), this would be the responsibility of the Corps. Performance evaluation which includes monitoring of physical/chemical conditions and some limited biological parameters (observations of fish kills in this instance) would be a Corps responsibility. (Attachment 5 contains a draft copy of the formal agreement that delineates the above responsibilities which would be entered into by the Corps of Engineers and the U.S. Fish and Wildlife Services.)

COST APPORTIONMENT

Construction - The construction activities and habitat improvement would be conducted on the Upper Mississippi River National Wildlife and Fish Refuge. Therefore, in accordance with Section 906(e)(3), first costs for construction would be 100-percent Federal and would be borne by the Corps of Engineers.

Operation and Maintenance - After construction of the project, annual management and maintenance operations would be conducted by the U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service would assure that non-Federal operation and maintenance responsibilities were in conformance with Section 906(e) of the Water Resources Development Act of 1986. The non-Federal sponsor is the Minnesota Department of Natural Resources. Specific operation and maintenance features would be defined in a project O&M manual which would be prepared by the Corps and coordinated with the involved agencies during the plans and specifications phase of this project.

STEPS PRIOR TO PROJECT CONSTRUCTION

Funds for plans and specifications can be provided by the Office of the Chief of Engineers (OCE), prior to approval of the project by the Assistant Secretary of the Army (Civil Works), upon a recommendation from Civil Works Planning after OCE staff review of the final report.

PUBLIC INVOLVEMENT AND COORDINATION

The proposed project has been coordinated with the Minnesota Department of Natural Resources and the U.S. Fish and Wildlife Service (attachment 4). Coordination has been completed with the Minnesota State Historic Preservation Officer (SHPO), the State Archaeologist, and the National Park Service. The SHPO concurred with a no effect determination for the project.

This report will be sent to interested citizens and the following agencies:

<u>Federal</u>

Federal Highway Administration
Department of Transportation
Environmental Protection Agency
U.S. Coast Guard
U.S. Fish and Wildlife Service
U.S. Geological Survey
National Park Service
Soil Conservation Service
Advisory Council on Historic Preservation
Department of Energy
Department of the Interior

State of Minnesota

Department of Energy, Economics, and Development

Department of Agriculture

Department of Health

Department of Natural Resources

Department of Transportation

Pollution Control Agency

State Archaeologist

State Historic Preservation Officer

Water Resources Board

Department of Administration

State Planning Agency

Water and Soils Resources Board

State of Wisconsin

Department of Natural Resources

County

Wabasha County Board of Commissioners

RECOMMENDATIONS

I have weighed the accomplishments to be obtained from this control structure construction project against its cost and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the proposed project is a justified expenditure of Federal funds. I recommend approval of the Finger Lakes for habitat rehabilitation and enhancement at pool 5 in Wabasha County, Minnesota. The total estimated construction cost of the project is $705,000, which amount would be a 100-percent Federal cost according to Section 906(e)(3) of Public Law 99-662. I further recommend that funds be allocated, as soon as possible, for preparation of plans and specifications and subsequent construction.

Roger L. Baldwin
Colonel, Corps of Engineers
District Engineer

Attachments:

1. Plates:
    - 1 - Location Map
    - 2 - Study Area Map
    - 3 - Pre- and Post-Lock and Dam Construction
    - 4 - Boring Logs
    - 5 a-d - Plan Views of Culvert Alternatives
    - 6 - Selected Plan - Plan View
    - 7 - Selected Plan - Typical Cross Section
    - 8 - Horizontal Blanket Protection Design
    - 9 - Scour Hole Protection Design
    - 10 - Debris Protection Design
    - 11 a-c - Baseline Cost Estimates
    - 12 - Incremental Analysis
2. Finding of No Significant Impact
3. Section 404(b)(1) Evaluation Report
4. Correspondence
5. Memorandum of Agreement

REFERENCES

Edwards, E.A., D.A. Krieger, M. Bacteller, and O.E. Maughan. 1982. Habitat suitability index models: black crappie. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.6, 25pp.

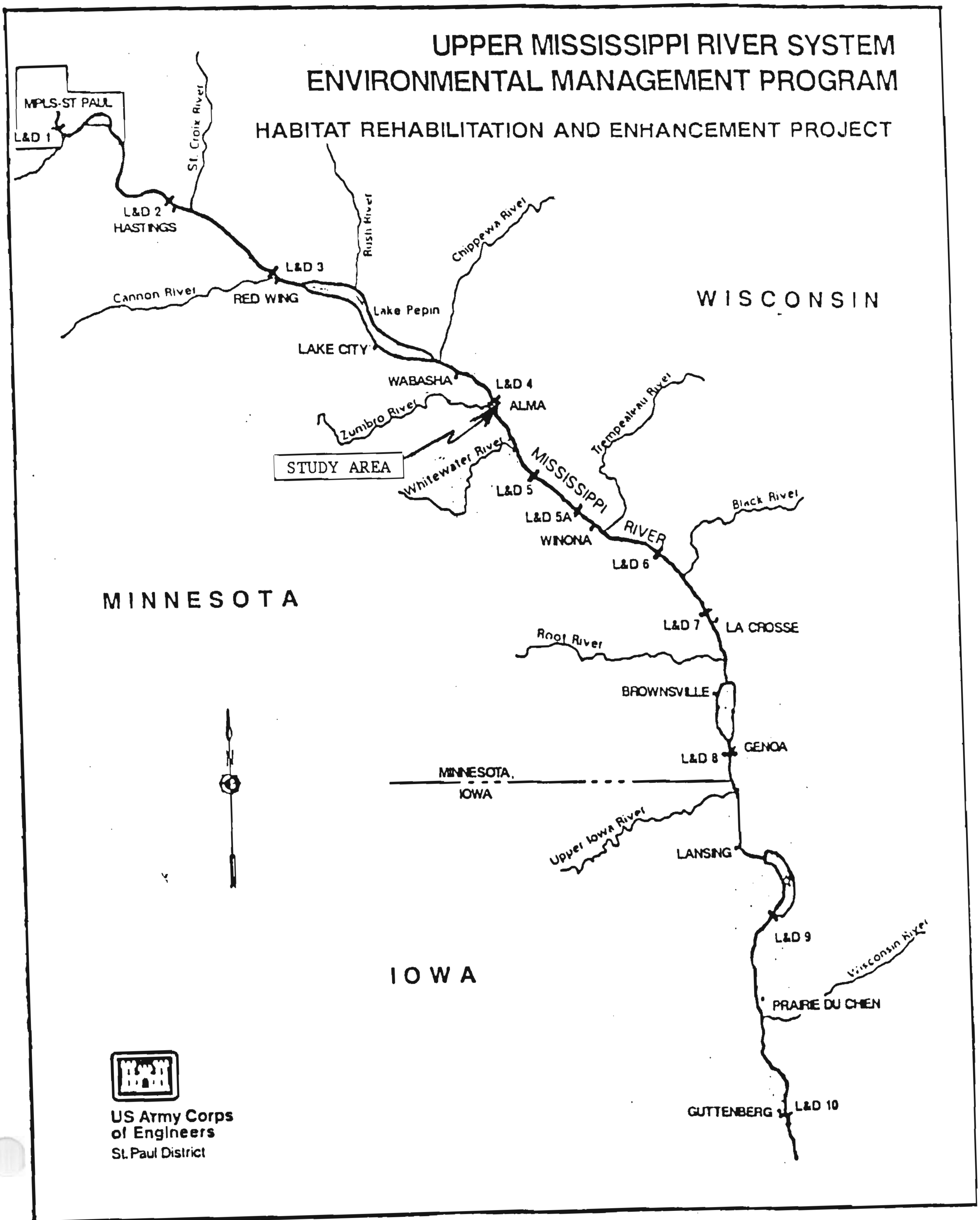
Palesh, G. and D. Anderson, 1990. Modification of the habitat suitability index model for the bluegill (Lepomis macrochirus) for winter conditions for the Upper Mississippi River backwater habitats. St. Paul Dist., Corps of Eng. 8pp.

Stuber, R.J., G. Gebjart, and O.E. Maughan. 1982. Habitat suitability index models: bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8, 26pp.

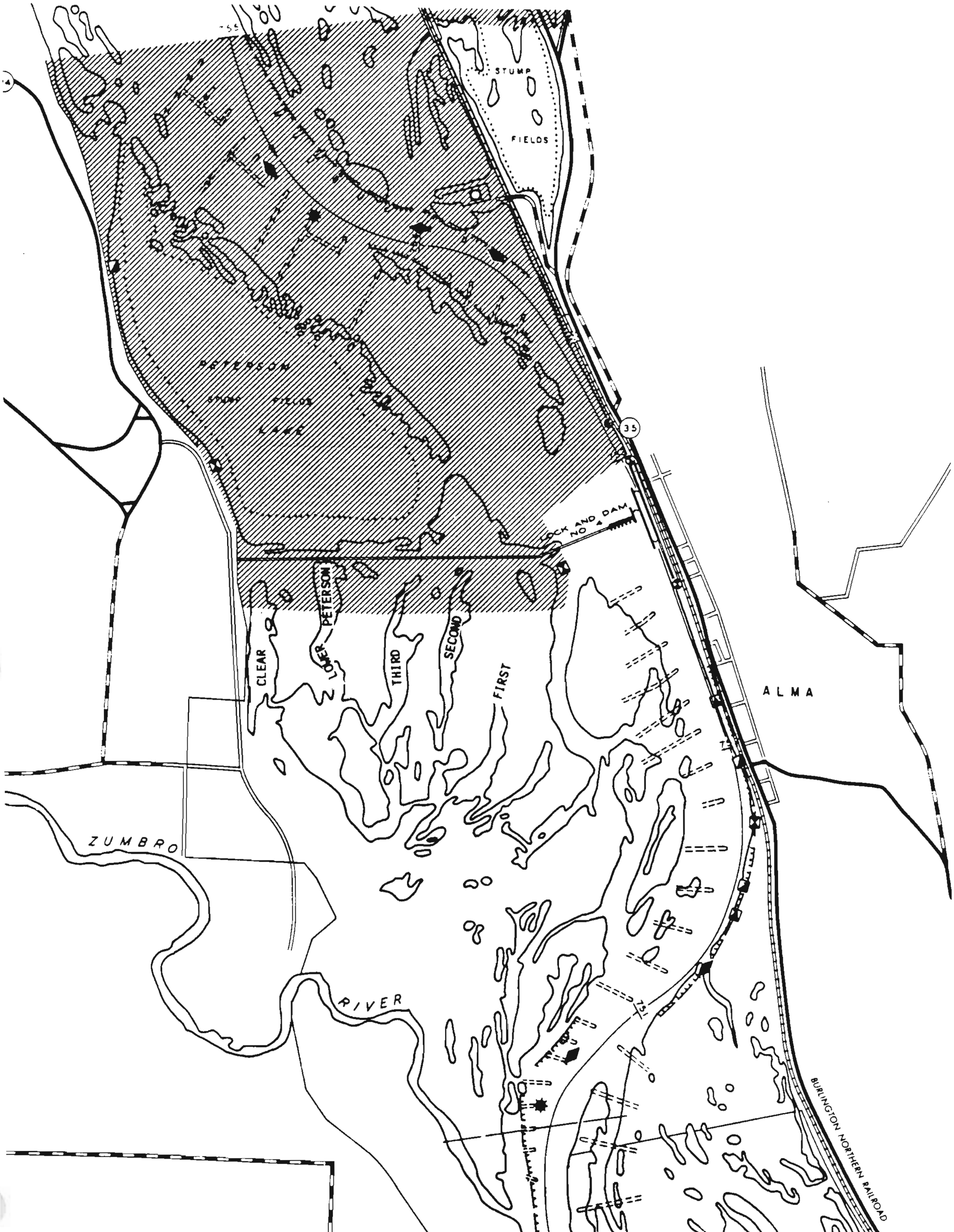
Stuber, R.J., G. Gebjart, and O.E. Maughan. 1982. Habitat suitability index models: largemouth bass. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.16, 33pp.

Attachment 1

Plates 1-12

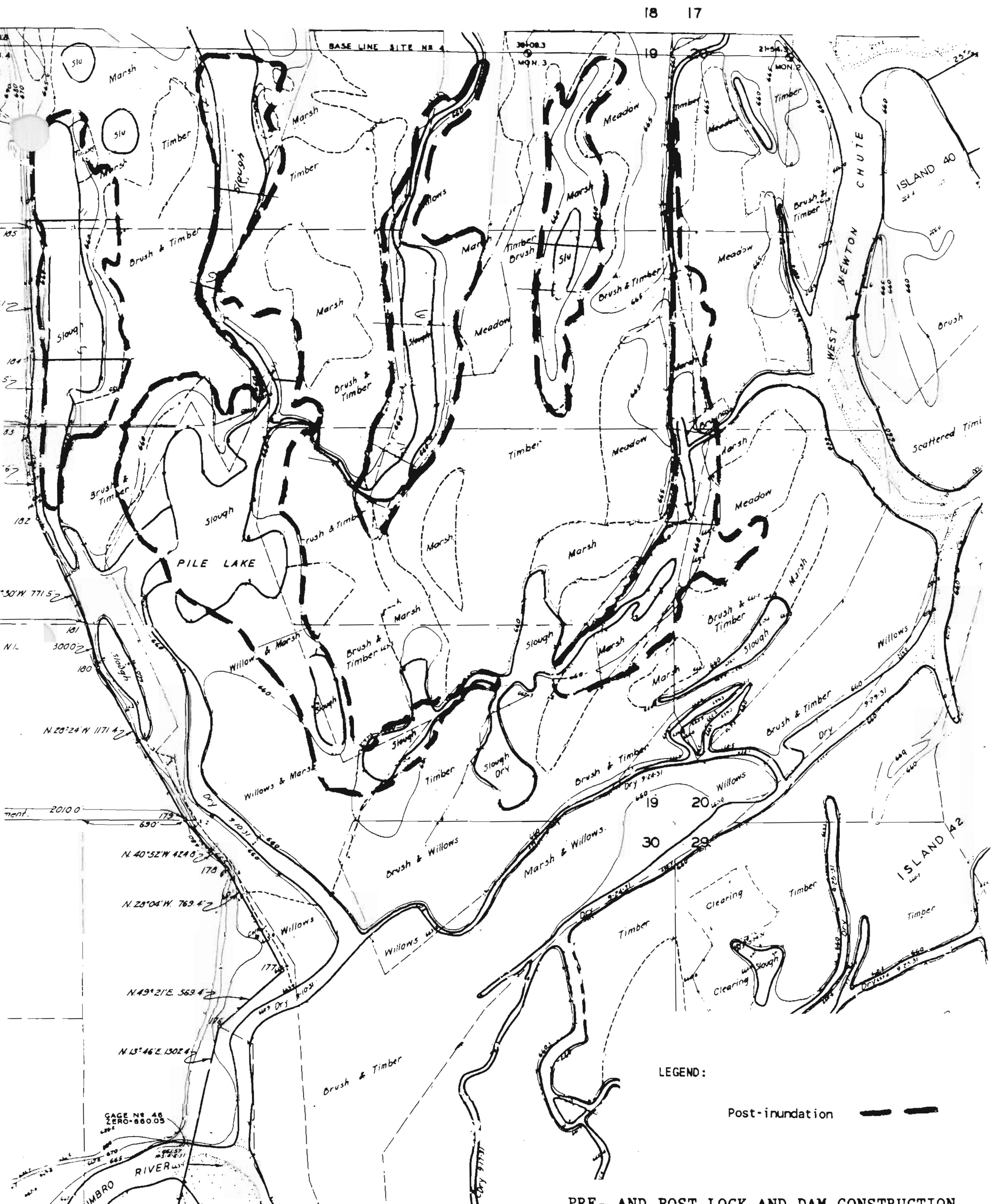


LOCATION MAP



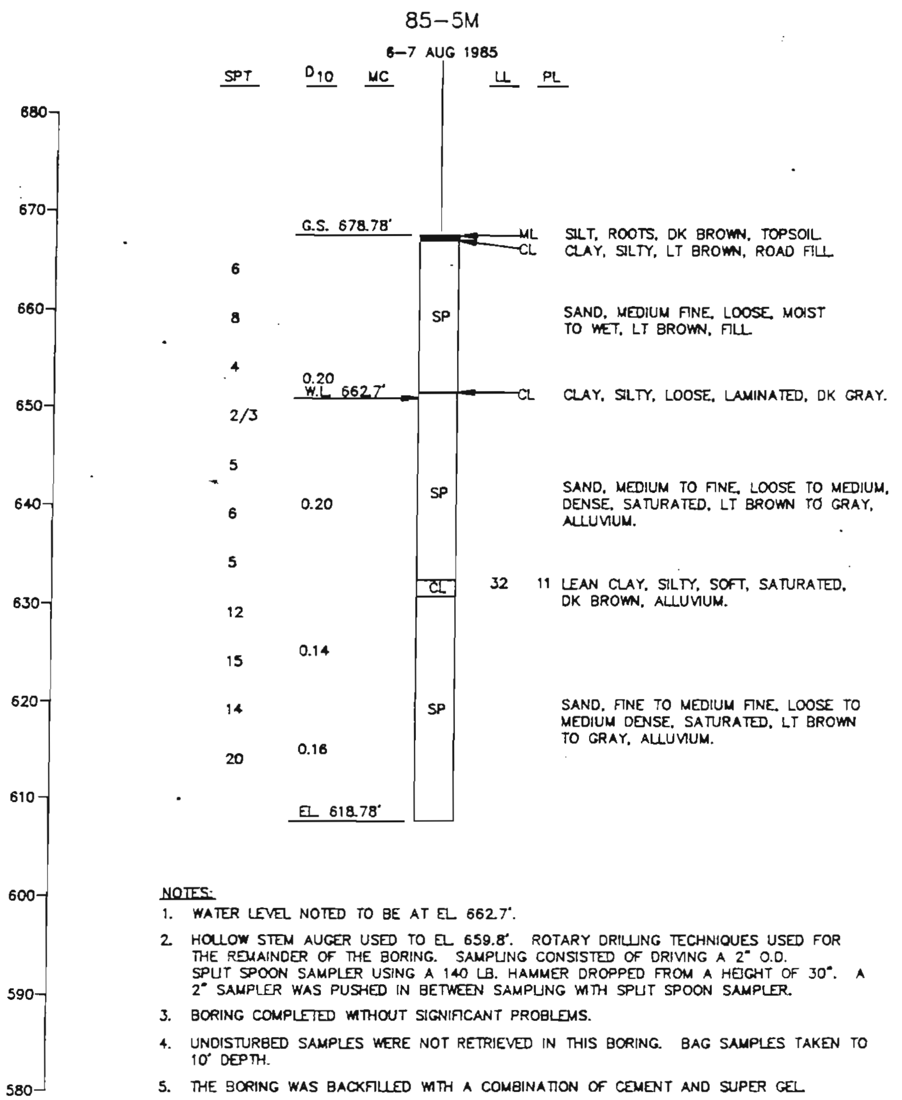
STUDY AREA MAP

Plate 2

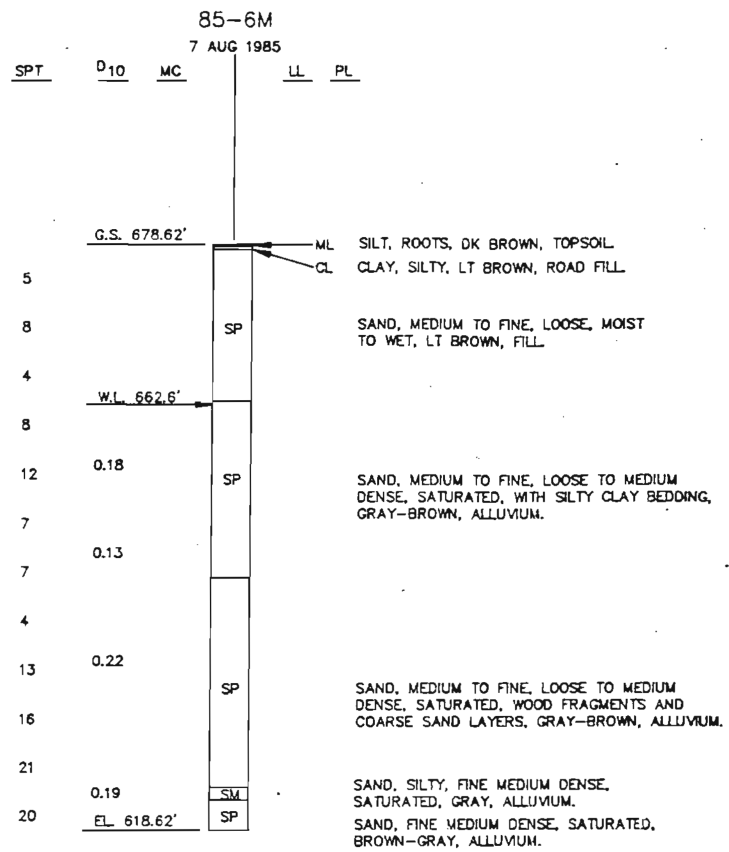


PRE- AND POST-LOCK AND DAM CONSTRUCTION

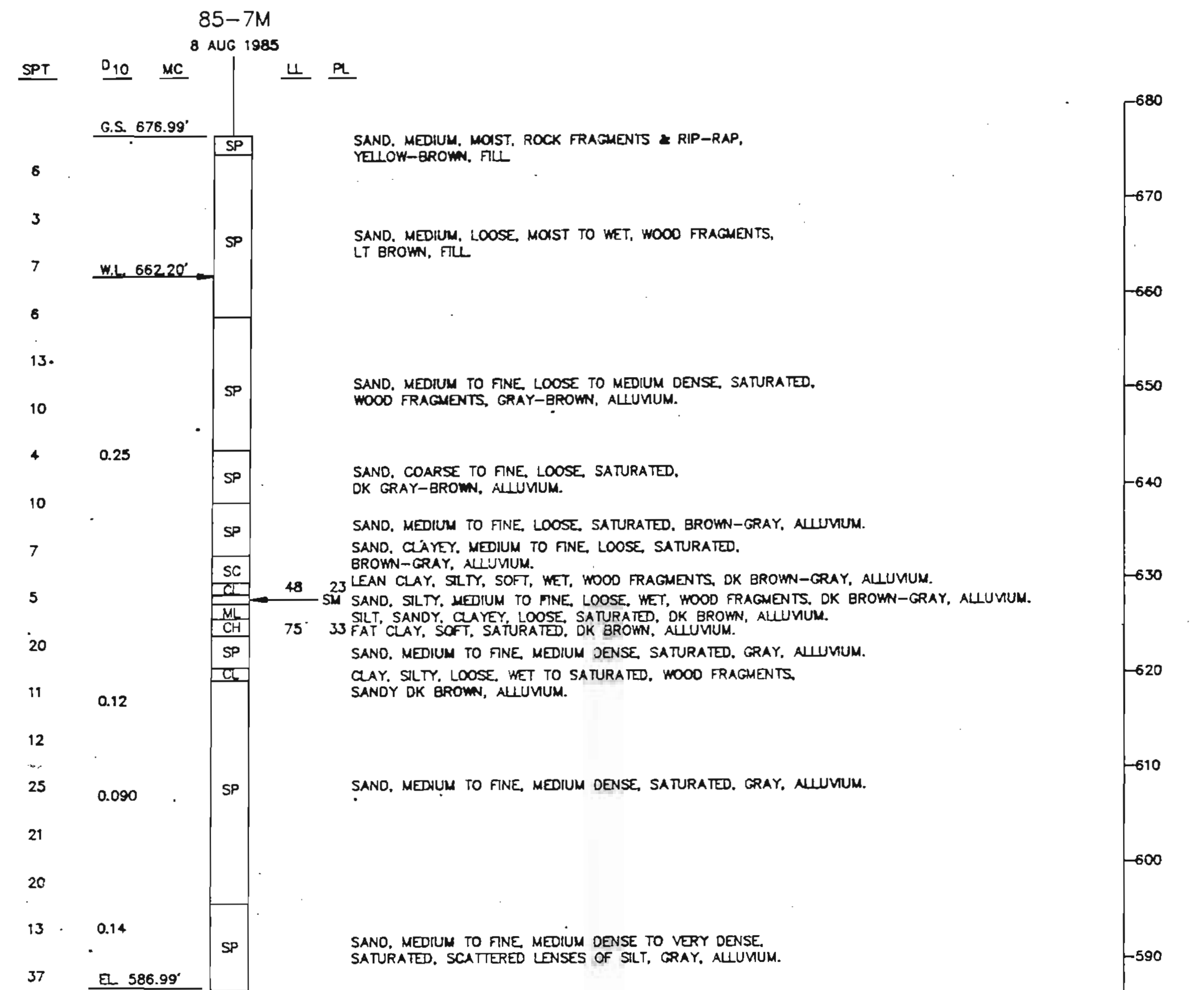
Plate 3



NOTES:
1. WATER LEVEL NOTED TO BE AT EL. 662.7'.
2. HOLLOW STEM AUGER USED TO EL. 659.8'. ROTARY DRILLING TECHNIQUES USED FOR THE REMAINDER OF THE BORING. SAMPLING CONSISTED OF DRIVING A 2" O.D. SPLIT SPOON SAMPLER USING A 140 LB. HAMMER DROPPED FROM A HEIGHT OF 30". A 2" SAMPLER WAS PUSHED IN BETWEEN SAMPLING WITH SPLIT SPOON SAMPLER.
3. BORING COMPLETED WITHOUT SIGNIFICANT PROBLEMS.
4. UNDISTURBED SAMPLES WERE NOT RETRIEVED IN THIS BORING. BAG SAMPLES TAKEN TO 10' DEPTH.
5. THE BORING WAS BACKFILLED WITH A COMBINATION OF CEMENT AND SUPER GEL.
6. BORING LOCATED 6.5' SOUTH OF DIKE ℄ 1800' FROM BORING #85-6M.



NOTES:
1. WATER LEVEL NOTED TO BE AT EL. 662.6'.
2. HOLLOW STEM AUGER USED TO EL. 659.7'. ROTARY DRILLING TECHNIQUES USED FOR THE REMAINDER OF THE BORING. SAMPLING CONSISTED OF DRIVING A 2" O.D. SPLIT SPOON SAMPLER USING A 140 LB. HAMMER DROPPED FROM A HEIGHT OF 30". A 2" SAMPLER WAS PUSHED IN BETWEEN SAMPLING WITH THE SPLIT SPOON SAMPLER.
3. BORING COMPLETED WITHOUT SIGNIFICANT PROBLEMS.
4. UNDISTURBED SAMPLES WERE NOT RETRIEVED IN THIS BORING. BAG SAMPLES TAKEN TO 5' DEPTH.
5. THE BORING WAS BACKFILLED WITH A COMBINATION OF CEMENT AND SUPER GEL.
6. BORING LOCATED 6.5' SOUTH OF DIKE ℄ 59.5', 284° AZMUTH FROM 11TH TELEPHONE POLE FROM MAIN GATE.



NOTES:
1. WATER LEVEL NOTED TO BE AT EL. 662.2'.
2. HOLLOW STEM AUGER USED TO EL. 665.0'. ROTARY DRILLING TECHNIQUES USED FOR THE REMAINDER OF THE BORING. SAMPLING CONSISTED OF DRIVING A 2" O.D. SPLIT SPOON SAMPLER USING A 140 LB. HAMMER DROPPED FROM A HEIGHT OF 30". A 2.5" SAMPLER WAS PUSHED IN BETWEEN SAMPLING WITH THE SPLIT SPOON SAMPLER.
3. BORING COMPLETED WITHOUT SIGNIFICANT PROBLEMS.
4. UNDISTURBED SAMPLES WERE NOT RETRIEVED IN THIS BORING.
5. THE BORING WAS BACKFILLED WTIH A COMBINATION OF CEMENT AND SUPER GEL.
6. BORING LOCATION SHOWN ON SITE PLAN.

SYMBOL	DESCRIPTION	DATE	APPROVAL

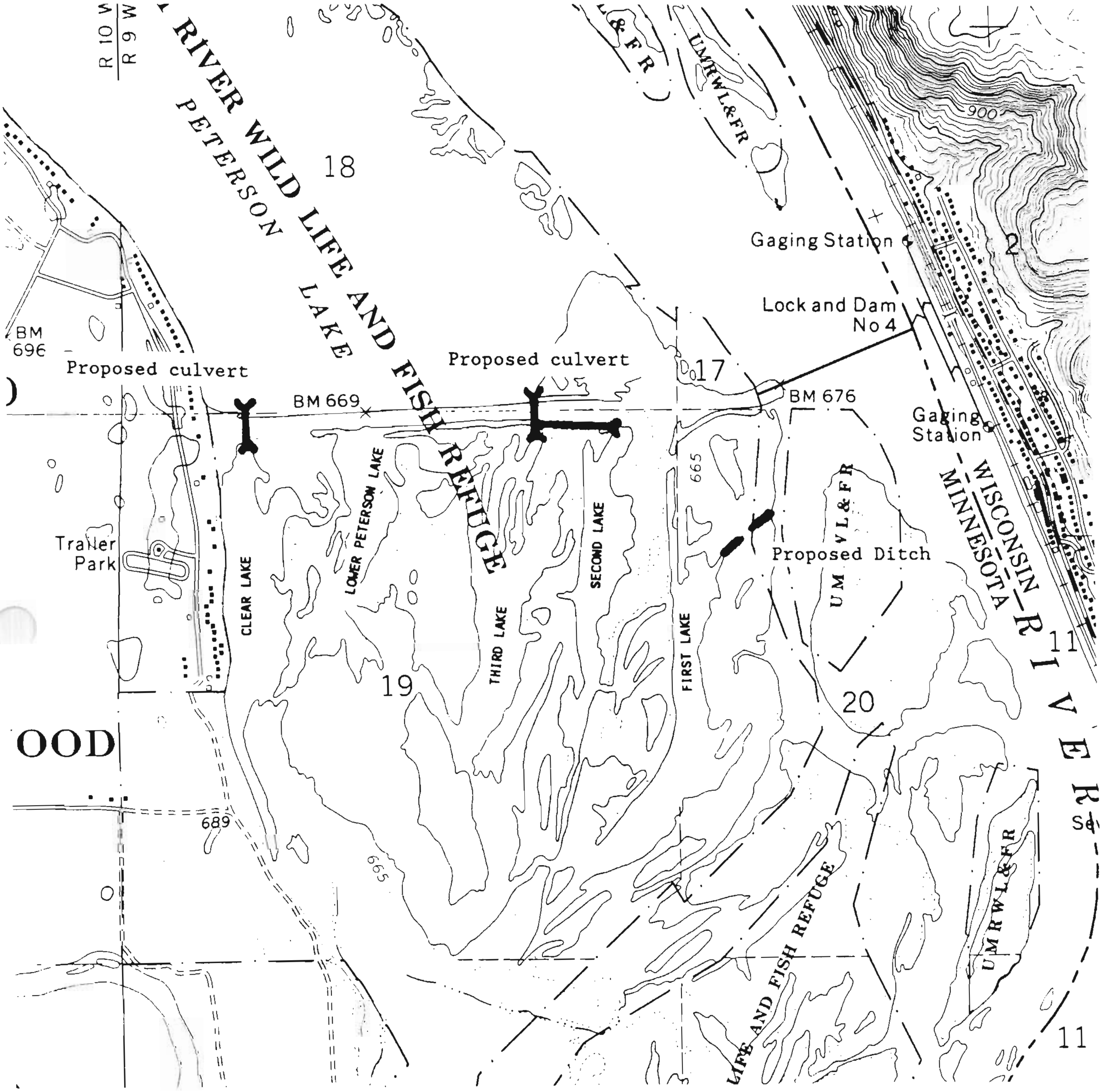
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

DESIGNED BY:
DRAWN BY: LS
CHECKED BY:
SUBMITTED BY:
CHIEF BRANCH
CHIEF BRANCH

DESIGN ANALYSIS REPORT-MISSISSIPPI RIVER
LOCK & DAM NO. 4, ALMA, WISCONSIN
STABILITY ANALYSIS-LOCK 4
BORING LOGS: 85-5M THROUGH 85-7M

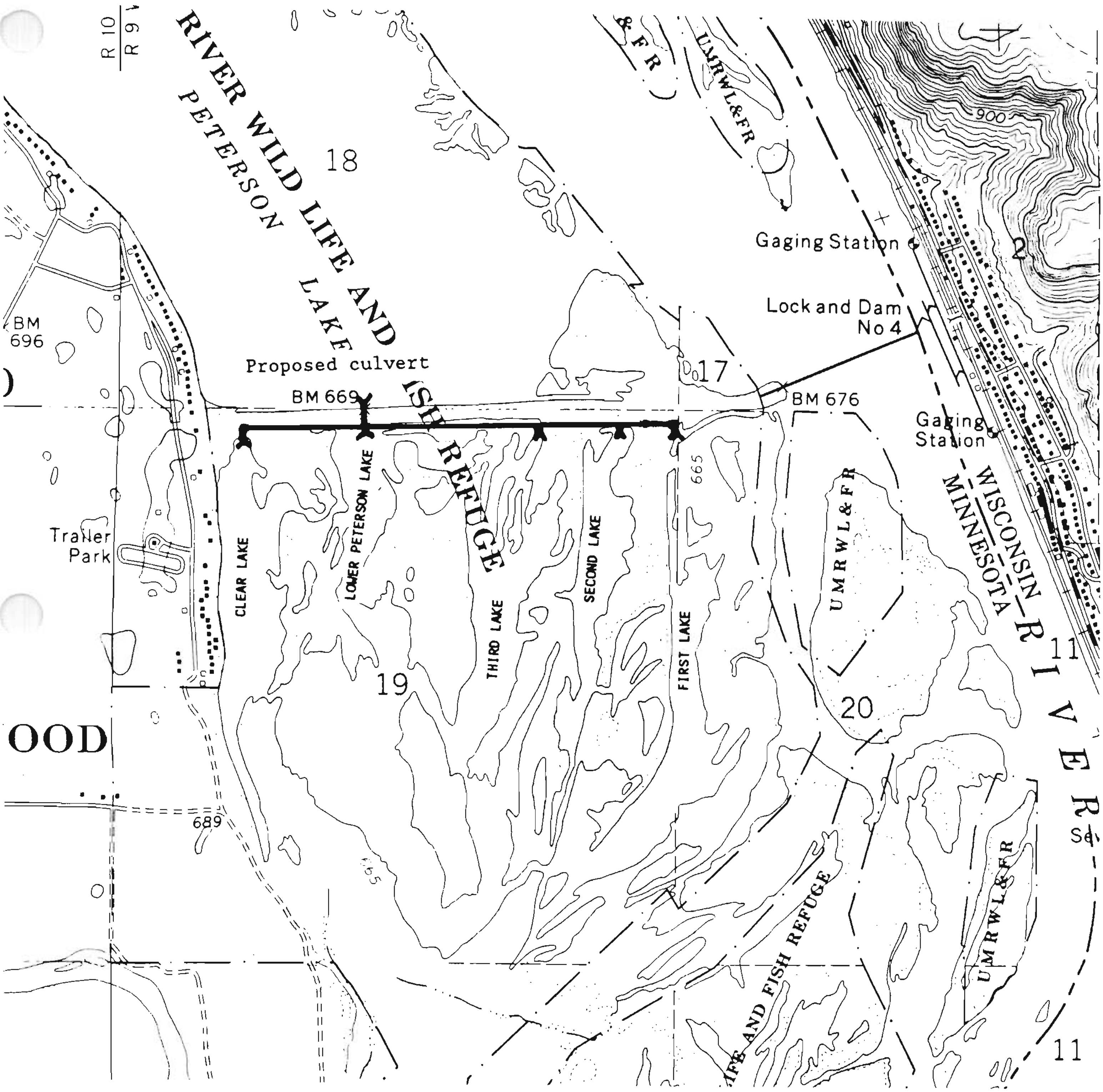
APPROVED BY:
CHIEF ENGR. DIVISION
DATE:

SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET OF
Plate 4

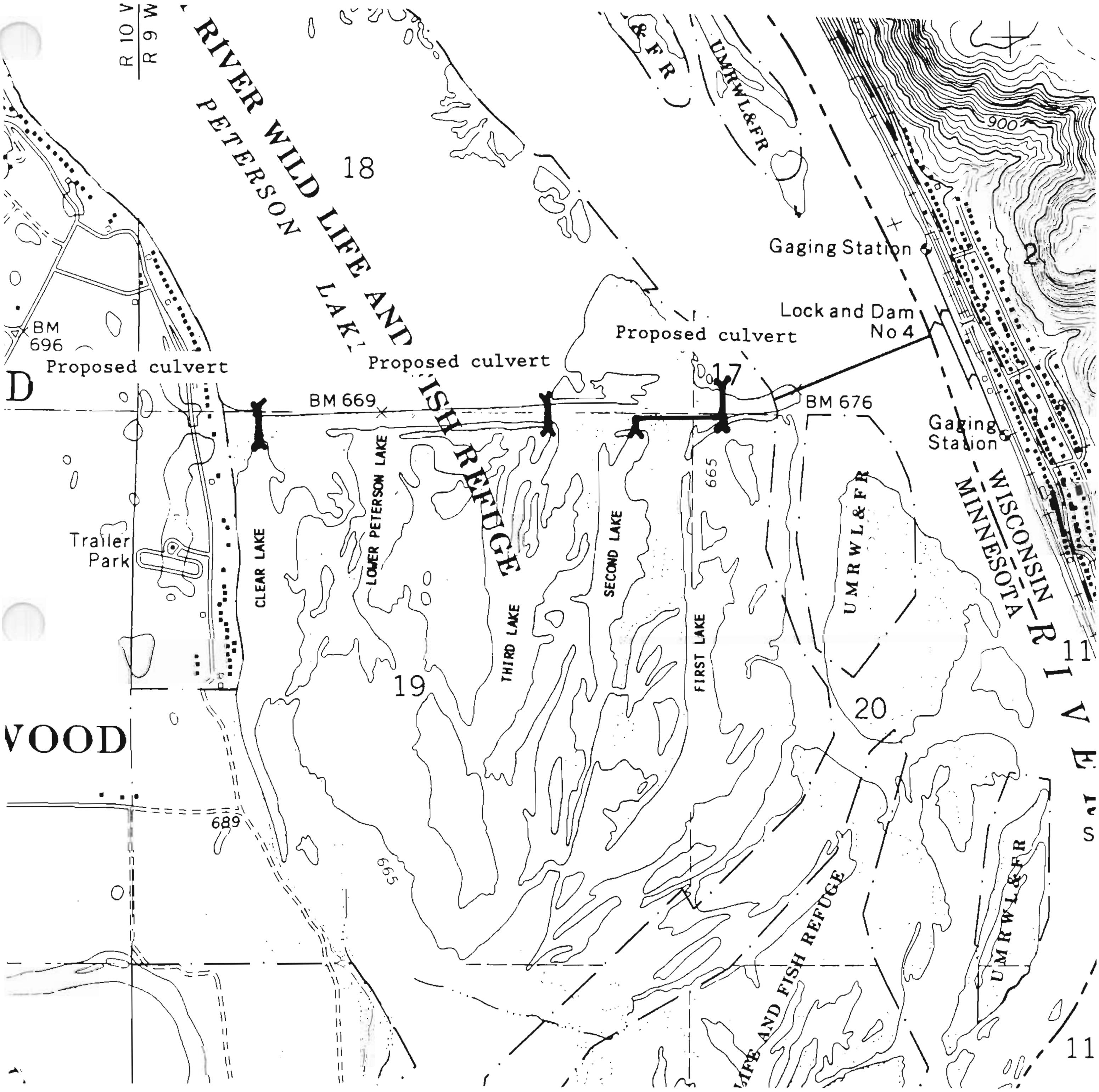


PLAN VIEW
CULVERT ALTERNATIVE 2A

Plate 5a

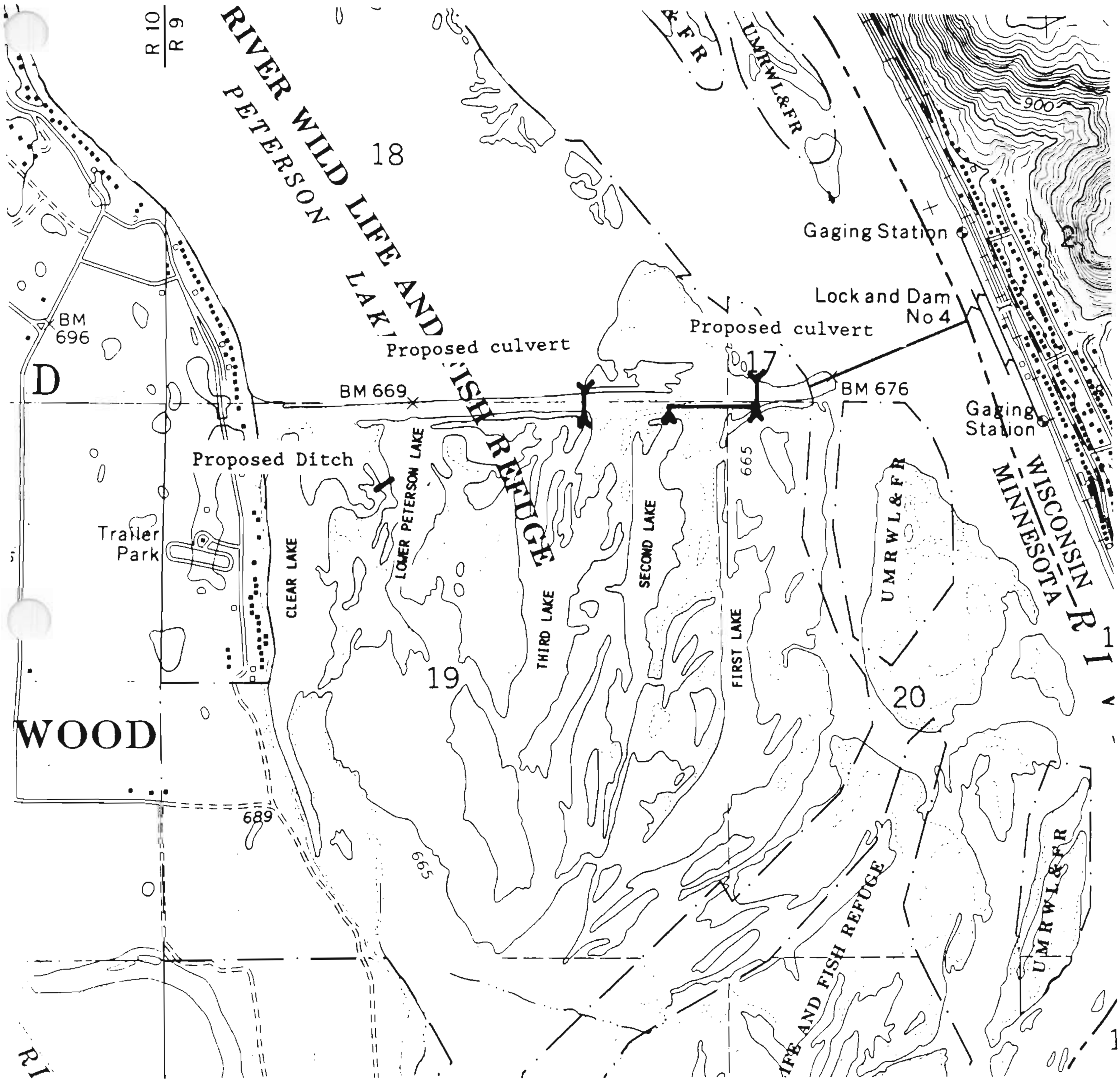


PLAN VIEW
CULVERT ALTERNATIVE 2B



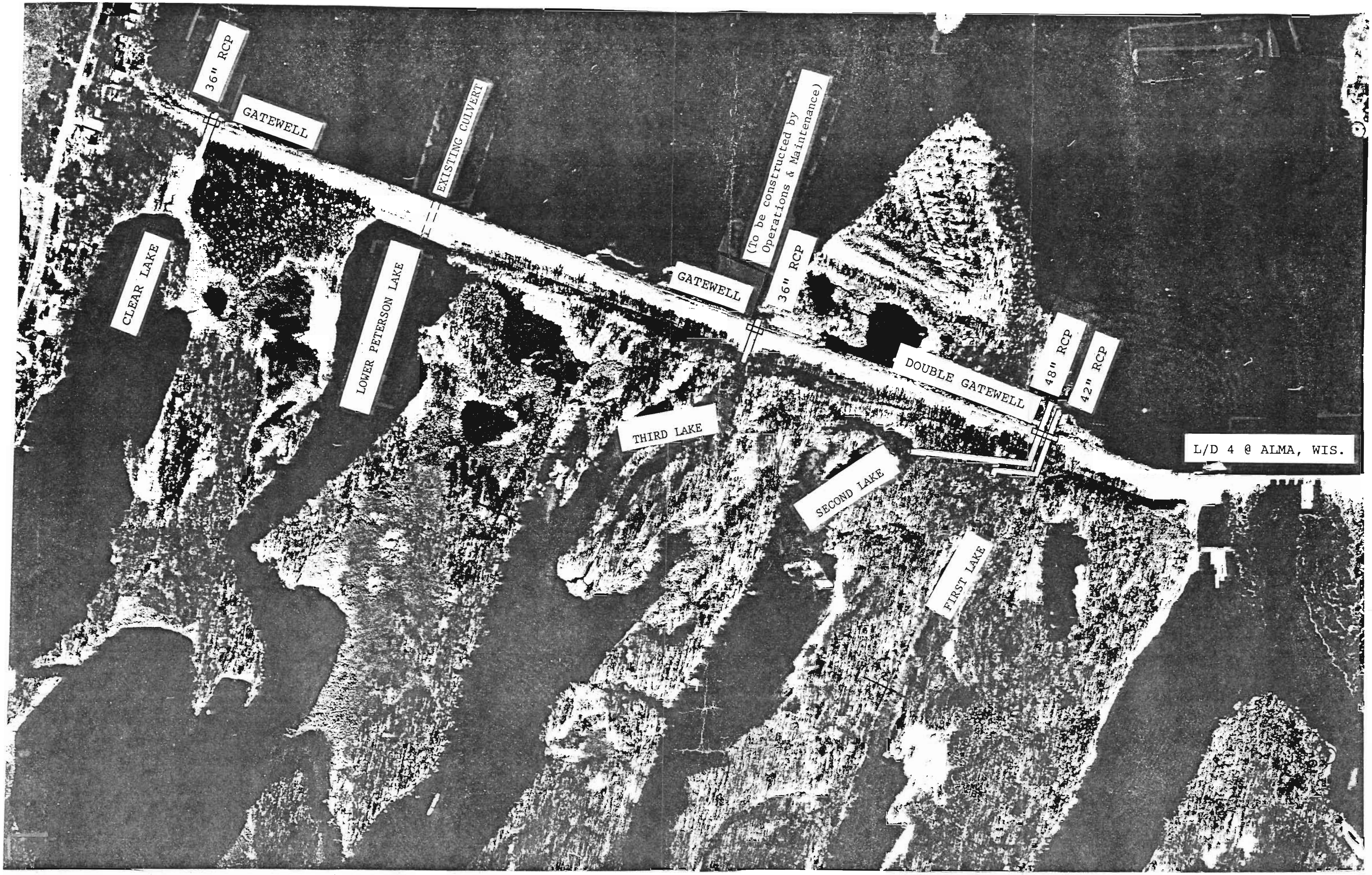
PLAN VIEW
CULVERT ALTERNATIVE 2C

Plate 5c

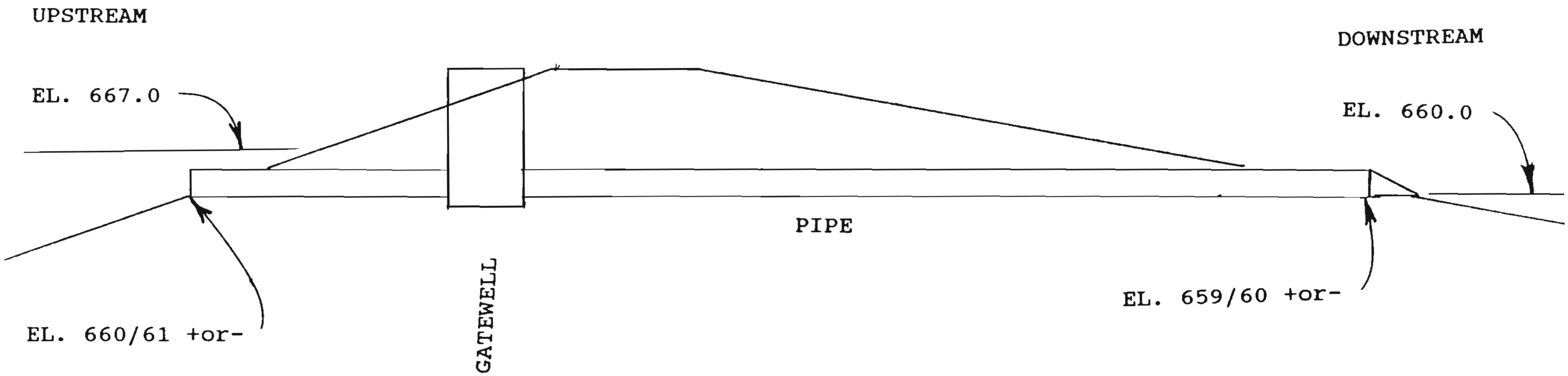


PLAN VIEW
CULVERT ALTERNATIVE 2D

Plate 5d



PLAN VIEW
RECOMMENDED PLAN



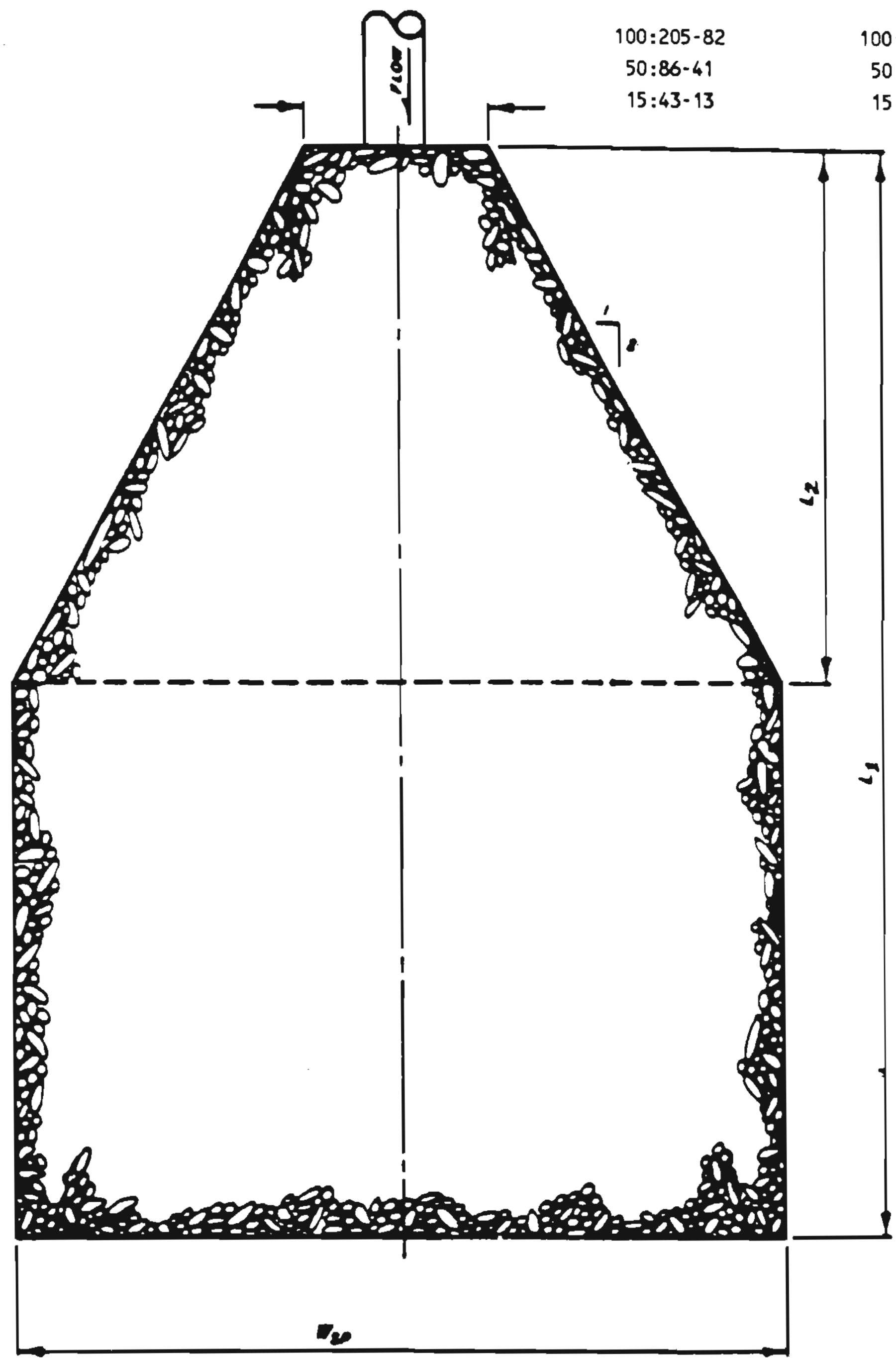
FINGER LAKES

TYPICAL GATEWELL/PIPE INSTALLATION

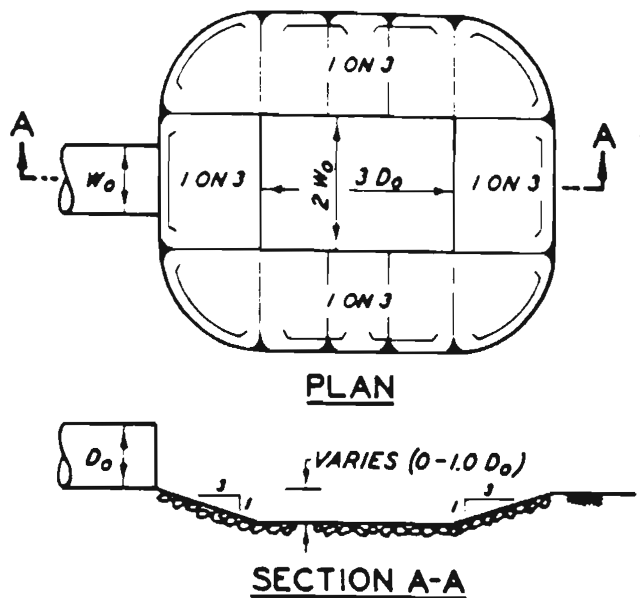
Location	Discharge (cfs)	Outlet Diameter (inches)	Velocity (ft/sec)	W50 Size (pounds)	Thickness (inches)	Gradation (see below)	WO	L1	L2	WSP
First Lake	50	42	7.8	40	24	B	11	39	23	34
Second Lake	50	48	8.8	85	36	E	12	46	30	42
Third Lake	50	36	8.6	70	30	C	9	39	29	30
Clear Lake	50	36	8.6	70	30	C	9	39	29	30

Rip gradations (pct. lighter by weight/weight limits in pounds)

B	C	E
100:205-82	100:400-160	100:691-276
50:86-41	50:169-80	50:292-138
15:43-13	15:84-25	15:146-43

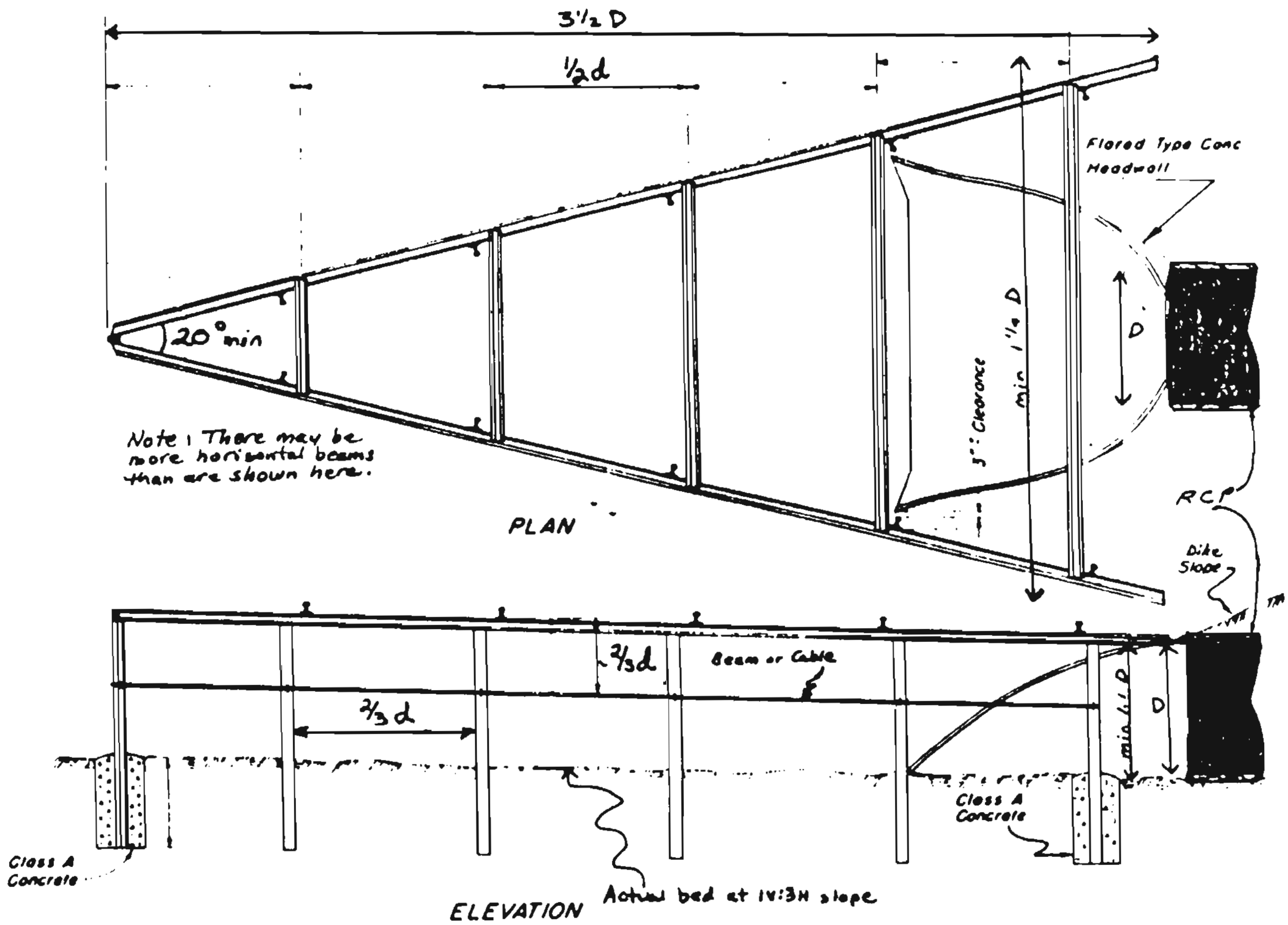


HORIZONTAL BLANKET PROTECTION DESIGN



Preformed scour hole

Location	Inlet Diameter (inches)	Deflector Length (feet)	Deflector Width (feet)	Minimum Height Above Invert (feet)	(1) Space Between Side Beams (inches)	(1) Space Between Top Beams (inches)
First Lake	42	12.25	4.50	4.00	28	21
Second Lake	48	14.00	5.00	4.50	32	24
Third Lake	36	10.50	3.75	3.50	24	18
Clear Lake	36	10.50	3.75	3.50	24	18



DEBRIS DEFLECTOR

Note Scales Variable

D - inlet diameter
d - diameter of smallest pipe in multiple pipe system
(= D for single culvert)

DEBRIS PROTECTION DESIGN

********BASELINE ESTIMATE********

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	PERCENT	REASON
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	MOBILIZATION AND DEMOBILIZATION	JOB	1	5,000.00	5,000	1,000	20%	1
06.3.3.B	DITCH EXCAVATION	CY	3000.0	2.00	6,000	2,000	33%	1,2,3
06.3.3.B	CLEARING AND GRUBBING	ACRE	2.0	2,000.00	4,000	1,000	25%	1,2,3
06.3.3.B	DEWATERING (COFFERDAMS)	JOB	1	8,000.00	8,000	4,000	50%	3
06.3.3.B	DEWATERING (WELLS)	LF	150	50.00	8,000	2,000	25%	1,2,3
06.3.3.B	PIPE THROUGH DAM (42" DIA.)	LF	100	95.00	10,000	2,000	20%	1,2,3
06.3.3.B	PIPE THROUGH DAM (48" DIA.)	LF	100	105.00	11,000	3,000	27%	1,2,3
06.3.3.B	PIPE DOWNSTREAM OF DAM (42" DIA.)	LF	250	165.00	41,000	8,000	20%	1,2,3
06.3.3.B	PIPE DOWNSTREAM OF DAM (48" DIA.)	LF	760	175.00	133,000	27,000	20%	1,2,3
06.3.3.B	GATEWELL	JOB	1	24,000.00	24,000	5,000	21%	2,3
06.3.3.B	SLUICE GATE W/OPERATOR (42")	JOB	1	18,000.00	18,000	4,000	22%	2,3
06.3.3.B	SLUICE GATE W/OPERATOR (48")	JOB	1	20,000.00	20,000	4,000	20%	2,3
06.3.3.B	42" DIA. BEND	EA	1	1,000.00	1,000	1,000	100%	2,3
06.3.3.B	48" DIA. BEND	EA	1	2,000.00	2,000	1,000	50%	2,3
06.3.3.B	42" TRASH RACK	EA	1	3,000.00	3,000	1,000	33%	2,3
06.3.3.B	48" TRASH RACK	EA	1	3,000.00	3,000	1,000	33%	2,3
06.3.3.B	SCOUR HOLE	EA	2	4,000.00	8,000	2,000	25%	2,3
06.3.3.B	CHANNEL EXCAVATION , UPSTREAM OF DAM	JOB	1	5,000.00	5,000	1,000	20%	2,3
30.-.-.-	ENGINEERING AND DESIGN	JOB	1	90,000	90,000	18,000	20%	1
31.-.-.-	SUPERVISION AND INSPECTION	JOB	1	33,000	33,000	6,000	18%	1
	SUBTOTAL CONSTRUCTION COSTS				433,000			
	SUBTOTAL CONTINGENCIES		21.7%			94,000		
	TOTAL					527,000		

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. UNIT PRICE UNKNOWNS
3. UNKNOWN SITE CONDITIONS

310 70

NOTES

1. EXTENSIONS ARE ROUNDED TO THE NEAREST $1,000

*********BASELINE ESTIMATE*********

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	PERCENT	REASON
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	MOBILIZATION AND DEMOBILIZATION	JOB	1	5,000.00	5,000	1,000	20%	1
06.3.3.B	CLEARING AND GRUBBING	ACRE	0.5	2,000.00	1,000	1,000	100%	1,2,3
06.3.3.B	DEWATERING (COFFERDAMS)	JOB	1	8,000.00	8,000	4,000	50%	2,3
06.3.3.B	DEWATERING (WELLS)	LF	150	50.00	8,000	2,000	25%	1,2,3
06.3.3.B	PIPE THROUGH DAM (36" DIA.)	LF	150	80.00	12,000	3,000	25%	1,2,3
06.3.3.B	PIPE DOWNSTREAM OF DAM (36" DIA.)	LF	150	150.00	23,000	5,000	22%	1,2,3
06.3.3.B	GATEWELL	JOB	1	13,000.00	13,000	3,000	23%	2,3
06.3.3.B	SLUICE GATE W/OPERATOR	JOB	1	12,000.00	12,000	3,000	25%	2,3
06.3.3.B	TRASH RACK	EA	1	3,000.00	3,000	1,000	33%	2,3
06.3.3.B	SCOUR HOLE	JOB	1	4,000.00	4,000	1,000	25%	2,3
30.-.-.-	ENGINEERING AND DESIGN	JOB	1	42,000	42,000	8,000	19%	1
31.-.-.-	SUPERVISION AND INSPECTION	JOB	1	13,000	13,000	2,000	15%	1
	SUBTOTAL CONSTRUCTION COSTS				144,000			
	SUBTOTAL CONTINGENCIES		23.6%			34,000		
	TOTAL					178,000		

89 24

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. UNIT PRICE UNKNOWNS
3. UNKNOWN SITE CONDITIONS

NOTES

1. EXTENSIONS ARE ROUNDED TO THE NEAREST $1,000

********BASELINE ESTIMATE********

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	PERCENT	REASON
06.-.-.-	FISH AND WILDLIFE FACILITIES							
06.3.3.-	HABITAT AND FEEDING FACILITIES							
06.3.3.B	MOBILIZATION AND DEMOBILIZATION	JOB	1	5,000.00	5,000	1,000	20%	1
06.3.3.B	CLEARING AND GRUBBING	ACRE	0.5	2,000.00	1,000	1,000	100%	1,2,3
06.3.3.B	DEWATERING (COFFERDAMS)	JOB	1	8,000.00	8,000	4,000	50%	2,3
06.3.3.B	DEWATERING (WELLS)	LF	170	50.00	9,000	2,000	22%	1,2,3
06.3.3.B	PIPE THROUGH DAM (36" DIA.)	LF	170	80.00	14,000	3,000	21%	1,2,3
06.3.3.B	GATEWELL	JOB	1	13,000.00	13,000	3,000	23%	2,3
06.3.3.B	SLUICE GATE W/OPERATOR	JOB	1	12,000.00	12,000	3,000	25%	2,3
06.3.3.B	TRASH RACK	EA	1	3,000.00	3,000	1,000	33%	2,3
06.3.3.B	SCOUR HOLE	JOB	1	4,000.00	4,000	1,000	25%	2,3
30.-.-.-	ENGINEERING AND DESIGN	JOB	1	24,000	24,000	4,000	17%	1
31.-.-.-	SUPERVISION AND INSPECTION	JOB	1	8,000	8,000	2,000	25%	1
	SUBTOTAL CONSTRUCTION COSTS				101,000			
	SUBTOTAL CONTINGENCIES		24.8%			25,000		
	TOTAL					126,000		

69 19

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. UNIT PRICE UNKNOWNS
3. UNKNOWN SITE CONDITIONS

NOTES

1. EXTENSIONS ARE ROUNDED TO THE NEAREST $1,000

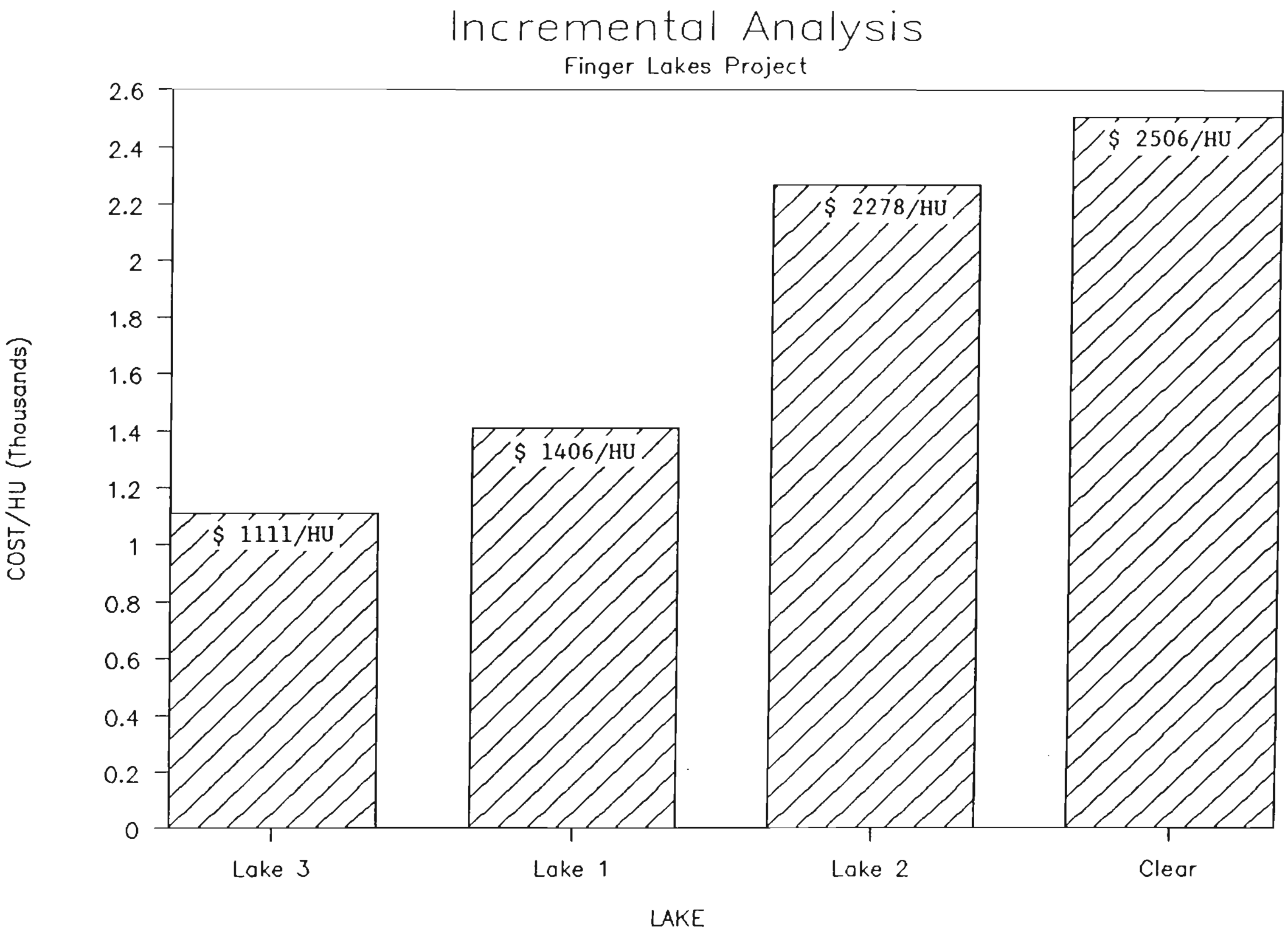


Plate 12 NOTE: Average Annual Cost divided by Units Gained = COST/HU

Attachment 2

Finding of No Significant Impact

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1421 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-1479

REPLY TO
ATTENTION OF

Environmental Resources Branch
Planning Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act, the St. Paul District, Corps of Engineers has assessed the impacts of the following project.

FINGER LAKES REHABILITATION
POOL 5, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

The intent of the proposed project is to improve fish habitat in the Finger Lakes complex by reducing periods of low dissolved oxygen levels. The proposed project involves the placement of culverts through the dike for Lock and Dam 4 to provide freshwater flows to this backwater lake complex. This Finding of No Significant Impact is based on the following factors: the proposed project would have minor and short-term impacts on wildlife resources; the project would have beneficial impacts on fishery resources, the project would have no impact on the cultural environment; the project would have minor and short-term impacts on the social environment; the project would have no impacts on the aesthetic/recreation environment; and continued coordination will be maintained with appropriate State and Federal agencies.

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the environment. Therefore, an environmental impact statement will not be prepared.

9 MAY 90
Date

for Roger L. Baldwin LTC, EN
Colonel, Corps of Engineers
District Engineer

Attachment 3

Section 404(b0(1) Evaluation Report

SECTION 404(b)(1) EVALUATION
FINGER LAKES
POOL 5, UPPER MISSISSIPPI RIVER
WABASHA COUNTY, MINNESOTA

I. PROJECT DESCRIPTION

A. Location and Background - The Finger Lakes are located on the Minnesota side of the Mississippi River in pool 5 immediately below the dike for lock and dam 4, in Wabasha County, Minnesota. These lakes (from west to east) are known as Clear Lake, Lower Peterson Lake, Third Lake, Second Lake, and First Lake. Although the lakes vary somewhat in size, generally each extends from river mile (R.M.) 752 to 752.7. In addition to the dike to the north, the immediate project area is bounded on the east by the main channel of the Mississippi River, on the south by bottomland/slough areas, and on the west by the Minnesota mainland. The project area lies within a 525-acre backwater complex comprised of backwater lakes, ponds, sloughs, and bottomland hardwoods. The five Finger Lakes make up about 130 acres of this area (see plates 1 and 2 of the main report).

Prior to construction of the pool 4 and pool 5 lock and dam systems in the 1930's, the area consisted of running sloughs, marshes, and floodplain forest. Following inundation, water levels rose, converting the marsh/slough areas and part of the floodplain into the five Finger Lakes and connecting slough that are in existence today. The construction of the dike cut off freshwater inflow into the system. Due to the shallow depths of the lakes, the lack of freshwater flow into the lakes has resulted in periods of depressed oxygen levels during the winter and summer months which occasionally results in fish kills. In 1965, one culvert was placed through the dike at Lower Peterson Lake which provides a flow of approximately 80 cfs. This action resolved the dissolved oxygen (D.O.) problems in Lower Peterson Lake.

The overall purpose of the proposed project is the rehabilitation, enhancement, and maintenance of diverse backwater habitat for fish. This would be accomplished by providing freshwater flow to the remaining four lakes in the Finger Lakes system by placing culverts through the dike with a design capacity of delivering 50 cfs to each lake. Providing these flows would maintain dissolved oxygen levels in the Finger Lakes complex at or above 5 milligrams per liter (mg/l).

B. General Description - The proposed plan consists of the construction of three separate gate well/culvert systems which would supply flows into the Finger Lakes. Clear Lake and Third Lake would each have individual gate well/culvert systems located immediately upstream of the lake. Clear Lake would have a 300-foot-long, 36-inch-diameter reinforced concrete pipe (RCP), extending from just upstream of the dike to a point below the dike where water would flow by gravity into Clear Lake. Third Lake would also be supplied by a 36-inch culvert through the dike, which would be 170 feet in length. First Lake and Second Lake would be supplied by separate parallel culvert systems which would pass through a common gate well structure in the dike. The culvert to First Lake would be a 42-inch-diameter RCP with a length of 350 feet. The culvert to Second Lake would be a 48-inch-diameter RCP with a length of 850 feet. Some ditching may be required at the head of both of these lakes. Excavated material would be sidecast to create a berm along the ditch. The culverts for Clear, Second, and First Lakes would be covered with fill on the downstream side of the dike to prevent heaving.

Riprap would be placed at the outlet of the culverts to provide scour protection. This would be in the form of either a horizontal blanket or a preformed, riprap lined scour hole (plates 8 and 9 of the main report).

A triangular debris deflector would be placed over the inlet to each culvert. Plate 10 shows the proposed design.

Sheetpile cofferdams would be required on the upstream side of the dike to install the culverts through the dike.

C. Authority and Purpose - Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) provides authorization and appropriations for an environmental management program for the Upper Mississippi River System that includes fish and wildlife habitat rehabilitation and enhancement. The culverts for Clear, Second, and First Lakes would be funded and constructed under this authority.

The culvert for Third Lake would be constructed under the authority of the Rivers and Harbors Act dated July 3, 1930, as part of the operation and maintenance program for lock and dam 4.

D. General Description of Dredged or Fill Material

1. General Characteristics of Material - The culverts would be reinforced concrete pipe. The debris structures would be constructed of angle iron or similar materials. Bedding for the foundation of some of the culverts would be sand or gravel. The fill for covering the culverts would be clean random fill. Rock fill would be either graded riprap or quarry run rock.

2. Quantity of Material - The quantities of the various fill materials are as follows: Random fill - 10,000 cubic yards, culverts - 1,700 linear feet, rock fill - 500 cubic yards, bedding - 15,000 cubic yards, sheet pile for cofferdams - 2,000 square feet.

3. Source of Material - The rock would be obtained from approved quarries in the vicinity of the project. Bedding would be obtained from a local source. Earth fill may be obtained from existing spoil banks on the downstream side of the dike or from dredged material disposal sites located in the vicinity of the project.

E. Description of the Proposed Discharge Sites

1. Location - The proposed fill activities would take place along the dike for lock and dam 4 in the vicinity of Clear Lake, Third Lake, Second Lake, and First Lake.

2. Size - An area about 60 feet wide would be disturbed at each point on the dike where the culvert would be placed. The routing of the culverts to each of the lakes would require the disturbance of approximately 3 acres of floodplain forest. Scour protection at each of the culvert outlets would affect a 50-foot by 50-foot area in each lake. Approximately 800 lineal

feet of lake bottom on the upstream side of the dike would be temporarily disturbed by the placement and removal of the cofferdams. A total of about 100,000 square feet would be affected by the fill activities. About 10 percent of this area is normally under water.

3. Type of Site - The majority of the fill activities would take place in a bottomland hardwood type of setting, typical of backwater areas common to this stretch of the Upper Mississipi River. Riprap placement for scour protection from culvert discharges would take place in a lacustrine setting.

4. Types of Habitat - The discharge sites are a mixture of terrestrial and aquatic habitat. The Finger Lakes area is wooded, with silver maple, river birch, cottonwood, and willow being the predominant tree species present. The soil is a combination of sand and silt. The Finger Lakes complex provides good habitat for a wide variety of fish.

5. Timing and Duration - Subject to approval, construction could begin in the spring of 1991. The proposed work would take approximately three months to complete.

F. Description of Disposal Method - The material would be placed with heavy equipment working on the dike and in the bottomland areas. The cofferdams would be placed using equipment operating off of work barges.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope - Substrate slope would not be changed appreciably, as the culvert routes would generally follow existing gradients. Substrate elevation at the culvert outlets may be minimally raised by the placement of riprap to provide scour protection. Substrate slope and elevation on the upstream side of the dike would not be changed appreciably as the cofferdams would be temporary and would be removed after construction.

2. Sediment Type - Sediment in the proposed fill area is primarily silt and silty sand.

3. Dredged/Fill Material Movement - The rock fill material would be sufficiently large so as to preclude any movement during placement. The culverts and attendant fill material would be placed in the predominantly dry environment of bottomland hardwoods. Therefore, no movement of fill material is expected.

4. Physical Effects on Benthos - The project would have no appreciable effects on benthos in the project area. Benthos living in the area where riprap would be placed for scour protection would be killed by material placement. Benthic organisms should rapidly recolonize the area. Production should increase due to the increased habitat diversity and increased surface area provided by the rock fill. Benthos on the riprap facing of the dike would be disturbed during culvert placement through the dike. These areas would be recolonized after construction.

5. Actions Taken to Minimize Impacts - No special actions would be taken to minimize impacts.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water

a. Salinity - Not applicable.

b. Water Chemistry - Minimal impacts are expected.

c. Clarity - Some minor, short-term decreases in clarity would occur with the proposed fill activities. There would be no long-term effects on water clarity

d. Color - The proposed fill activities would have no impact on water color.

e. Odor - The proposed fill activities would have no impact on water odor.

f. Taste - The proposed fill activities would have no impact on water taste.

g. Dissolved Gas Levels - The proposed fill activities would have an impact on dissolved gas levels. Placement of the culverts would allow flows to be directed into the lakes. This action would maintain dissolved oxygen levels at or above 5 mg/l.

h. Nutrients - The proposed fill activities would have no significant impact on nutrient levels in the water.

i. Eutrophication - The proposed fill activities should have no impact on the level or rate of eutrophication of the water.

j. Temperature - The proposed fill activities would have no significant impact on water temperature.

2. Current Patterns and Circulation

a. Current Patterns and Flow - Installation of the culverts would introduce flows of up to 50 cfs into each of the four lakes. This activity would improve the water quality of these backwater lakes. The other fill activities would have no effect on current patterns and flows.

b. Velocity - The proposed fill activities would not cause an increase in the river's velocity.

c. Stratification - The proposed fill activities would have no effect on the development of stratified conditions in the river.

d. Hydrologic Regime - The proposed fill activities would have no significant impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed fill activities would have no effect on normal water level fluctuations.

4. Salinity Gradient - Not applicable.

5. Actions Taken to Minimize Impact - Placement of fill material would be done by mechanical means during periods of low water.

C. Suspended Particulate/Turbidity Determinations - Placement of the culverts and riprap and the installation and removal of the cofferdams may result in some minor, temporary increases in turbidity during project construction. Levels of turbidity would return to normal after construction.

D. Contaminant Determinations - The fill material would be clean rock, earth fill, corrugated metal pipe, and sheet pile and would not introduce contaminants into the aquatic system. Neither the material nor its placement would cause relocation or increases of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on Plankton - No effect expected.

2. Effects on Benthos - Some minor losses of benthos could result during the placement of the cofferdams and riprap for the scour protection at the culvert outlets. However, these losses would be offset with recolonization of the area after construction was completed.

3. Effects on Nekton - Introduction of flow into these backwater lakes would improve year-round fish habitat by decreasing periods of low dissolved oxygen. Such conditions are expected to improve fish productivity and diversity in these areas.

4. Effects on Aquatic Food Web - No significant or long-term effects on the aquatic food web are expected.

5. Effects on Special Aquatic Sites - No effects on such sites are expected.

6. Threatened or Endangered Species - No federally-listed or State-listed threatened or endangered species would be affected by the proposed action.

7. Other Wildlife - Some temporary disturbance to wildlife would result from equipment operations during construction. Since vegetation impacts would be restricted to the culvert placement and riprap areas, actual displacement of wildlife would be minor.

8. Actions Taken to Minimize Impacts - No actions are required because of the lack of impacts associated with the proposed action.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination - Not applicable. The material would not be dispersed.

2. Determination of Compliance with Applicable Water Quality Standards - The fill would be uncontaminated material obtained from approved sources, which should insure that State water standards would not be violated because of project-related activities.

3. Potential Effects on Human Use Characteristics - The proposed action would result in no adverse effects on municipal or private water supplies; recreational or commercial fisheries; or water related recreation, aesthetics, parks, national historic monuments, or similar preserves.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - Implementation of the proposed action would cause no significant cumulative impact on the aquatic ecosystem.

H. Determination of Secondary Effects on the Aquatic Ecosystem - No significant secondary effects would be expected.

III. FINDINGS OF COMPLIANCE

The proposed fill activity would comply with the Section 404(b)(1) guidelines of the Clean Water Act. No significant adaptations to the Section 404(b)(1) guidelines were made for this evaluation. Several alternatives were considered which might meet the project objectives of decreasing periods of low dissolved oxygen in the Finger Lakes complex. The other alternatives considered were no action, the use of siphons to transfer water over the dike, drilling artesian wells to introduce flows, and a variety of culvert designs. These designs were not selected because they were either more expensive or technically infeasible.

The proposed fill activities would comply with all State of Minnesota water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed activity would have no adverse impacts on human health or welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. No significant adverse effects on aquatic ecosystem diversity, productivity and stability, or on recreational, aesthetic, and economic values would occur.

On the basis of this evaluation, I specify that the proposed placement of sheet pile for the construction of cofferdams and the placement of culverts, clean fill, and riprap to provide water to the Finger Lakes complex comply with the requirements of the guidelines for discharge or placement of fill material.

9 MAY 90
Date

for [signature] LTC, EN
Roger L. Baldwin
Colonel, Corps of Engineers
District Engineer

Attachment 4

Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FEDERAL BUILDING, FORT SNELLING
TWIN CITIES, MINNESOTA 55111

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

FWS/ARW-SS

AUG 8 1990

Colonel Roger L. Baldwin
District Engineer
U. S. Army Engineering District, Saint Paul
1421 U. S. Post Office and Custom House
Saint Paul, Minnesota 55101-1479

Dear Colonel Baldwin:

The U.S. Fish and Wildlife Service (Service) has reviewed the Definite Project Report (March 1990) for the Finger Lakes Habitat Rehabilitation and Enhancement Project. This project, located in Pool 5 of the Mississippi River, is proposed under the Water Resources Development Act of 1986 (Public Law 99-662) as part of the Upper Mississippi River System Environmental Management Program.

The Finger Lakes project has been coordinated with the Service and we approve and support the project as planned and described in the Definite Project Report. The Service agrees with the preferred alternative described in the Environmental Assessment. A copy of the refuge compatibility statement as required by the National Wildlife Refuge administration Act has been provided.

The Service will assure that operation and maintenance requirements of the project will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986. The Service will perform the operation and maintenance requirements for this project in accordance with the policies stated in the Fourth Annual Addendum.

We look forward to our continued cooperative efforts in developing habitat rehabilitation and enhancement projects under the Environmental Management Program.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
500 LAFAYETTE ROAD, ST. PAUL, MINNESOTA 55155-4037

OFFICE OF THE COMMISSIONER

DNR INFORMATION
(612) 296-6157

Celebrate MINNESOTA 1990

June 19, 1990

Col. Roger Baldwin, District Engineer
St. Paul District
Corps of Engineers
1135 U.S. Post Office and Customs House
St. Paul, MN 55101

Dear Col. Baldwin:

The Minnesota Department of Natural Resources supports the Environmental Management Program Habitat Rehabilitation and Enhancement Project at Finger Lakes in Upper Pool 5 of the Mississippi River.

Upon completion and final acceptance of this project by the Corps of Engineers and the U.S. Fish and Wildlife Service, the Department agrees to cooperate with the Fish and Wildlife Service and the Corps of Engineers to ensure that operation, maintenance and any mutually agreed upon rehabilitation as described in the Definite Project Report will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986.

Yours truly,

By Steven G. Thorne, Deputy

Joseph N. Alexander
Commissioner

United States Department of the Interior

TAKE PRIDE IN AMERICA

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL AFFAIRS
230 S. DEARBORN, SUITE 3422
CHICAGO, ILLINOIS 60604

ER-90/324

May 4, 1990

Colonel Roger L. Baldwin
District Engineer
U.S. Army Engineer District
St. Paul
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

Dear Colonel Baldwin:

The Department of the Interior has reviewed the Definite Project Report and Environmental Documentation for the Finger Lakes Project in Wabasha County, Minnesota and concurs with the recommended plan.

Thank you for the opportunity to provide comment.

Sincerely,

Sheila Minor Huff

Sheila Minor Huff
Regional Environmental Officer

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

DNR INFORMATION (612) 296-6157   500 LAFAYETTE ROAD • ST. PAUL, MINNESOTA • 55155-40

Celebrate MINNESOTA 1990

May 3, 1990

Roger L. Baldwin, Colonel
Department of the Army
St. Paul District, Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

Re: Finger Lakes Habitat Rehabilitation/Enhancement Project
Definite Project Report and Environmental Assessment

Dear Colonel Baldwin:

The Minnesota Department of Natural Resources (DNR) has completed a review of the above-referenced project documents. The DNR has had extensive involvement in this project including providing comments on the preliminary draft of the Definite Project Report and Environmental Assessment. Our only additional comment is that a DNR Protected Waters Permit or an amendment to an existing Protected Waters Permit will be required for the project.

If you require additional information from the DNR, please contact Cheryl Heide from my staff at 296-9228.

Sincerely,

Thomas W. Balcom

Thomas W. Balcom, Supervisor
Natural Resources Planning and Review Services

c. Bill Johnson
Steve Colvin
Tom Lutgen
Bonita Eliason
Steve Johnson

900202-1

Minnesota Pollution Control Agency
520 Lafayette Road, Saint Paul, Minnesota 55155
Telephone (612) 296-6300

Celebrate MINNESOTA 1990

April 13, 1990

Colonel Roger L. Baldwin
District Engineer
St. Paul District
U.S. Army Corps of Engineers
1421 U.S. Post Office & Custom House
St. Paul, Minnesota 55101-9808

Dear Colonel Baldwin:

RE: Finger Lakes Enhancement Project
Draft Definite Project Report/Environmental Assessment
Pool 5, Upper Mississippi River

This is in response to your letter to the Minnesota Pollution Control Agency (MPCA) dated March 26, 1990. In that letter you requested a Water Quality Certification or waiver pursuant to the provisions of Section 401 of the Clean Water Act, for the project referenced above. The selected plan of action consists of a proposal to construct three separate culvert systems, with gate wells, that would supply flows into the Finger Lakes. The culverts would be gated to allow flexibility of operation between 0 and 50 cubic feet per second. The culverts were sized to compensate for friction losses due to pipe lengths at given slope and flow velocities. The project goal is to maintain and improve habitat for fish, centrarchids in particular, by controlling the seasonal depletion of dissolved oxygen in the Finger Lakes complex.

The MPCA waives certification of the referenced project, since the project should have only minor, temporary water quality impacts and the overall project should be beneficial to water quality in the Finger Lakes area. While we have not been involved in development of the design specifications, the MPCA fully supports the concept of enhancing the water quality in the Finger Lakes. We hope that the proposed effort will meet the intended water quality and habitat goals for the project.

This letter does not approve activities beyond those specified above. It does not waive your responsibility to obtain any other permits or approvals which may be required by other state or federal laws nor does it grant any right to violate personal or property rights.

If you have any questions regarding our position on these projects, please feel free to contact me or Mr. Louis Flynn of my staff at (612) 297-3364.

Sincerely,

Barbara Lindsey Sims
for Gerald L. Willet
Commissioner

GLW:jae

cc: Mr. Ron Nargang, Minnesota Department of Natural Resources
Mr. Robert F. Welford, U.S. Fish and Wildlife Service
Mr. Bill Franz, U.S. Environmental Protection Agency, Chicago, IL

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

Celebrate MINNESOTA 1990

PHONE NO. (612) 345-3331

FILE NO.

Mississippi River System Management Team
Route 2 Box 230
Lake City, MN 55041-9015

March 19, 1990

Mary Schommer
St. Paul District
U.S. Army Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, MN 55101-1479

Dear Ms. Schommer:

As Mississippi River Coordinator for the Minnesota Department of Natural Resources I would like to be sure that the Corps understands that we fully support the Finger Lakes HREP (Habitat Rehabilitation and Enhancement Project) in Pool 5 of the river.

Our biologists have coordinated with your agency during the Problems and Appraisal Report and Definite Project Report phases, and will continue to coordinate with the Corps during the construction and evaluation phases as well.

We have provided the Corps with written and verbal comments regarding design concerns and report comments, suggestions for project improvements and with background data and overview for use in planning and design.

Sincerely,

Steven P. Johnson
Mississippi River System Coordinator

United States Department of the Interior

TAKE PRIDE IN AMERICA

FISH AND WILDLIFE SERVICE

ST. PAUL FIELD OFFICE (ES)
50 Park Square Court
400 Sibley Street
St. Paul, Minnesota 55101

IN REPLY REFER TO

SPFO

December 8, 1989

Mr. Robert Whiting
Environmental Resources Branch
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

Dear Mr. Whiting:

This is in response to your December 1, 1989 letter concerning potential impacts on federally endangered or threatened species from the proposed Finger Lakes project located immediately below the dike at Lock and Dam 4 on the Upper Mississippi River near Alma, Wisconsin. The project is proposed for implementation under the Environmental Management Program.

Based on information contained in your above referenced letter and the nature of the proposed project, its location, and the habitat requirements of the federally threatened bald eagle (Haliaeetus leucocephalus), endangered Higgins' eye pearly mussel (Lampsilis higginsi) and peregrine falcon (Falco peregrinus), we support your determination that the proposed project will not affect federally listed endangered or threatened species. This precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended. Should this project be modified or new information indicates listed species may be affected, consultation with this office should be reinitiated.

These comments have been prepared under authority of and in accordance with provisions of the Endangered Species Act of 1973, as amended.

Sincerely,

James L. Smith

James L. Smith
Assistant Field Office Supervisor

cc: WI Dept. of Natural Resources, Madison
WI Dept. of Natural Resources, LaCrosse
MN Dept. of Natural Resources, St. Paul
MN Dept. of Natural Resources, Lake City

Upper Mississippi River National
Wildlife and Fish Refuge
Established 1924
Compatibility Study
Finger Lakes Rehabilitation

Establishment Authority:

Public Law No. 268, 68th Congress, The Upper Mississippi River Wildlife and Fish Refuge Act.

Purpose for Which Established:

"The refuge shall be established and maintained (a) as a refuge and breeding place for migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, and (b) to such extent as the Secretary of Agriculture may by regulations prescribe, as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and (c) to such extent as the Secretary of Commerce may by regulations prescribe a refuge and breeding place for fish and other aquatic animal life."

Description of Proposed Use:

The proposal is a Habitat Rehabilitation and Enhancement project authorized by the Water Resource Development Act of 1986 (Pub. L. 99-662). The proposed plan would allow for gravity water flow into the Finger Lakes area which is located in Minnesota in Pool 5 just south of the Lock and Dam 4 dike. The project will include the construction of three separate gatewell/culvert systems in the dike. Clear Lake's structure would include a 300-foot-long, 36-inch-diameter reinforced concrete pipe (RCP), extending from just upstream of the dike to a point below the dike. Third Lake would also be supplied by a 36-inch culvert through the dike, which would be 170 feet in length. First Lake and Second Lake would be supplied by separate parallel culvert systems which would pass through a common gatewell structure in the dike. The culvert to First Lake would be a 42-inch-diameter RCP 350 feet long and the culvert to Second Lake would be a 48-inch-diameter RCP 850 feet long.

The overall purpose of the proposed project is the rehabilitation, enhancement, and maintenance of diverse backwater habitat for fish. This would be accomplished by providing freshwater flow to the Finger Lakes system by placing culverts with a design capacity of delivering 50 cfs to each lake. This should maintain dissolved oxygen levels in the Finger Lakes complex at or above 5 mg/l.

Complete details of the project, including maps and engineering drawings, are contained in the draft report entitled, "Upper Mississippi River System Environmental Management Program Definite Project Report with Integrated Environmental Assessment (SP-7) Finger Lakes Habitat Rehabilitation and Enhancement, Pool 5, Upper Mississippi River, Wabasha County, Minnesota," prepared by the St. Paul District, Corps of Engineers.

Anticipated Impacts on Refuge Purposes:

As a result of the project the fish populations should increase. The above mentioned report contains detailed information on the project's impacts on fish.

Justification:

The proposed project works toward the accomplishment of the purposes and stated objectives of the refuge.

Determination:

The proposed project is compatible with purposes for which the refuge was established.

Determined by: ______________________ Refuge Manager 2/9/90 Date

Reviewed by: ______________________ 2/15/90 Date

Concurred by: Acting ______________________ Regional Director 2/27/90 Date

THE STATE HISTORICAL SOCIETY OF WISCONSIN

H. Nicholas Muller III, Director

816 State Street
Madison, Wisconsin 53706
608/262-3266

Octobr 3, 1989

Mr. Gary Palesh
Chief, Environmental Resources Branch
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

SHSW: 89-1343
RE: Restore Aquatic Habitat in Pool 4, Mississippi

Dear Mr. Palesh:

We have reviewed the materials that you submitted concerning the proposed habitat improvement projects in Pool 4 of the Mississippi River that were described in your letter of May 16, 1989.

As it appears that all work proposed will only affect newly created land/islands, we do not believe that the proposed undertakings would have any effect on properties that are listed in, or eligible for inclusion in, the National Register of Historic Places. Should other lands be affected, please let us know.

Sincerely,

Richard W. Dexter
Chief, Compliance and Archeology Section
DIVISION OF HISTORIC PRESERVATION

RWD:da
2096N

Attachment 5

Letter of Intent and Draft Memorandum of Agreement

MEMORANDUM OF AGREEMENT
BETWEEN
THE UNITED STATES FISH AND WILDLIFE SERVICE
AND
THE DEPARTMENT OF THE ARMY
FOR
ENHANCING FISH AND WILDLIFE RESOURCES
OF THE
UPPER MISSISSIPPI RIVER SYSTEM
AT THE
FINGER LAKES
WABASHA COUNTY, MINNESOTA

I. PURPOSE

The purpose of this Memorandum of Agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (FWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Finger Lakes separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP). All project lands are owned by the United States and are managed by the FWS as part of the Upper Mississippi River Wildlife and Fish Refuge.

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Finger Lakes project are 100 percent Federal, and all operation, maintenance, repair, and rehabilitation costs are to be cost shared 75 percent Federal and 25 percent non-Federal.

III. GENERAL SCOPE

The Finger Lakes project provides for the construction of individual controlled culvert systems into First, Second, and Clear Lakes. This would provide direct flows into these backwater lakes, thereby improving the dissolved oxygen in the Finger Lakes system. This should lead to increased use of the area by fish throughout the year.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction: Construction of the Project consists of installing three individual controlled culvert systems into the Finger Lakes area.

2. Major Rehabilitation: Any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the Definite Project Report and that is needed as a result of specific storm or flood events.

3. Construction Management: Subject to and using funds appropriated by the Congress of the United States, DOA will construct the Finger Lakes project as described in the Definite Project Report, Finger Lakes, Habitat Rehabilitation and Enhancement, dated May 1990, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The FWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If DOA encounters potential delays related to construction of the Project, DOA will promptly notify FWS of such delays.

4. Maintenance of Records: DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the Project to the extent and in such detail as will properly reflect total costs. DOA shall maintain such

books, records, documents, and other evidence for a minimum of three years after completion of construction of the Project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the FWS.

B. FWS is responsible for:

1. Operation, Maintenance, and Repair: Upon completion of construction as determined by the District Engineer, St. Paul, the FWS shall accept the Project and shall operate, maintain, and repair the Project as defined in the Definite Project Report entitled "Finger Lakes, Habitat Rehabilitation and Enhancement," dated May 1990, in accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662.

2. Non-Federal Responsibilities: In accordance with Section 906(e) of the Water Resources Development Act, Public Law 99-662, the FWS shall obtain 25 percent of all costs associated with the operation, maintenance, and repair of the Project from the Minnesota Department of Natural Resources.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of no more than 50 years after initiation of construction of the Project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties:

FWS: Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

DOA: District Engineer
U.S. Army Engineer District, St. Paul
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-9808

VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

BY:

(signature)
ROGER L. BALDWIN
Colonel, Corps of Engineers
St. Paul District

Date ____________

THE U.S. FISH AND WILDLIFE SERVICE

BY:

(signature)
JAMES C. GRITMAN
Regional Director
U.S. Fish and Wildlife Service

Date ____________

FINGER LAKES REHABILITATION

POOL 5, UPPER MISSISSIPPI RIVER, MINNESOTA

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-7)

Appendix A

Sedimentation Analysis

Dissolved Oxygen Data

FINGER LAKES
DEFINITE PROJECT REPORT

APPENDIX A
SEDIMENTATION ANALYSIS

INTRODUCTION

Prior to construction of Lock and Dam 4, the Finger Lakes area was irregularly braided with open running sloughs, ponds, and floodplain forest areas. During normal low flows, Peterson Lake and Third Lake were the only two that had continuous delineated flowing channels running through them. The other three lake areas were permanent marshland which carried flow during high water events on the Mississippi. Both erosion and deposition of sediments occurred during various phases of annual hydrographs.

Construction of Lock and Dam 4 in the mid 1930's changed the characteristics of this area greatly. The Finger Lakes were cut off from upstream flows from the Mississippi River. Records show that overtopping of the Lock and Dam 4 dike has never occurred.

A 4 foot corrugated metal pipe with an upstream invert elevation of 662.0, was placed through the dike in 1967 and provides flow into Lower Peterson Lake. This culvert is the only source of upstream flow into the Finger Lakes and mainly affects Lower Peterson Lake. The other four lakes remain cut off from upstream flow.

The proposed project involves providing flow to all of the Finger Lakes via culverts through the Lock and Dam 4 dike. This should improve water quality in the Finger Lakes, but the sediment load to the lakes will also increase.

COMPARISON OF BATHYMETRIC DATA

Lake cross sections were obtained in 1988 in each of the 5 Finger Lakes. These cross sections were compared to the 1931 flowage surveys to determine changes in lake bottom elevations. Conditions in 1931 were based on contour lines and spot elevations on the flowage surveys. Water depths were not shown on these surveys so elevations representing 1931 conditions are somewhat questionable in places where standing or flowing water existed at the time of the flowage surveys. In Clear Lake the 1931 lake bottom elevations closely match the 1988 data indicating little if any sediment deposition. This might be expected since Clear Lake is isolated from external sediment inputs. The three cross sections taken in the upper half of Lower Peterson Lake show both increases and decreases in lake bottom elevations. In areas where flowage survey data exists (ie. areas that weren't inundated in 1931) the sediment deposits vary from 0 to 2 feet, with the average being about 1 foot. In First and Third Lakes the surveys also indicate both increases and decreases in lake bottom elevation. However, the net change in elevation appears to be close to zero. In Second Lake the average lake bottom elevation appears to have decreased 2 to 3 feet, although this anomaly is probably due to data errors. The reason for the great variation in the change of the lake bottoms isn't known. First, Second, and Third Lakes are much like Clear Lakes in that they are isolated from upstream sediment inputs, thus similar deposition patterns would have been expected. Obviously some error is introduced in trying to locate the surveyed cross sections on the flowage survey maps. This may account for the variation in results.

SEDIMENT SOURCES

Processes that could potentially transport sediment into Finger Lakes include diffusive transport of suspended sediment to the lakes caused by rising water stages on the Mississippi River, advective transport caused by lateral overland flow of water during floods on the Mississippi or Zumbro Rivers, and advective transport of suspended sediment through culverts at the upstream end of the lakes.

Rising river stages in pool 5 and Finger Lakes, caused by increasing river discharges, result in sediment laden water backing up into Finger Lakes. This process occurs on a seasonal time scale (ie. because of increasing river discharges during spring runoff) where fluctuations in stage may typically be 1 to 2 feet and on a daily time scale where fluctuations of less than 0.1 feet are more typical. Water backing up into Finger Lakes has a suspended sediment concentration approximately equal to the concentration in the Mississippi River. An analysis was performed to quantify sediment loading to Finger Lakes due to this process. Daily suspended sediment concentrations were obtained from the USGS gage at Winona, Minnesota. Daily changes in tail water elevation at Lock and Dam 4 were obtained from the DSS data base. To simplify the analysis it was assumed that all of the sediment entering Finger Lakes settles out. This gives a worst case scenario. Sediment accumulations were calculated using the following equation.

$$SH = SS * DH * .000062543 / SW$$

SH = the daily accumulation of sediment in Finger Lakes due to increases in stage, ft
SS = Suspended sediment concentration at Winona, mg/L
DH = the daily increase in water surface elevation in Finger Lakes, ft
SW = the specific weight of sediment deposits, pcf

On days when the stage at Lock and Dam 4 decreased from the previous days stage or remained the same, SH was set equal to zero. Annual sediment accumulation for the 10 year period 01 Jan 1976 through 31 Dec 1985, assuming a specific weight of 40 pounds per cubic foot was .0075 inches/year. Over a 55 year period (ie. the time period since lock and dam 4 was constructed) this would amount to .41 inches. Obviously this process is not a major contributor of sediment to Finger Lakes.

Flood events on the Mississippi River or the Zumbro River could result in direct advective transport of suspended sediment by overland flow. Because of data limitations on flow quantities during such events, this process can't be quantified. However, an examination of Lock and Dam 4 tailwater elevations for the 10 year period 01 Jan 1976 through 31 Dec 1985, showed very few events that would result in significant rises in tailwater elevation and subsequent overland flow to Finger Lakes. This time period doesn't include any major floods on the Mississippi River, but discharges were relatively high during this 10 year period.

Zumbro River flood flows can enter the Finger Lakes area when overbank breakouts flow north towards Finger Lakes. This occurs in the one mile reach of the Zumbro river upstream of the confluence with the Mississippi River main channel. Prior to 1909, the Zumbro River, upon entering the Mississippi River Valley, flowed north and south along an alluvial terrace and entered the main stem of the Mississippi River through the Robinson Lake area to the north and Weaver Bottoms to the south. A channelization project constructed by local interests in 1909 changed the course of the Zumbro River so that it entered the

Mississippi River downstream of the Finger Lakes area. This resulted in sediment laden flow entering the Finger Lakes area and causing sediment deposition. A comparison of aerial photographs from 1938 and 1989 indicate that deposition has occurred in the area between Finger Lakes and the Zumbro River. Based on field reconnaissance of the area granular material is usually found within 200 yards of the Zumbro River channel. However these gave way to clay and organic deposits further away from the Zumbro River. It appeared that a small amount of flow between the Zumbro River and the Finger Lakes area had occurred prior to a 21 March 1990 field trip. The recent peak discharge on the Zumbro River had occurred 10 days prior to this trip and was 5810 cfs. This discharge is a typical annual flood for the Zumbro River.

A flood control project constructed in the early 1970's increased the height of locally built levees and decreased the frequency and magnitude of overbank flow breakouts to the south. According to project documents, major breakout flow to the south occurred over the existing levees at discharges of 23,000 cfs which corresponds to the 6 year flood. Construction of the flood control project and the associated levee raises eliminated flow breakouts till a discharge of 48,000 cfs was exceeded. This corresponded to the 50 year flood. This has resulted in additional flow entering the Finger Lakes area for floods larger than 23,000 cfs. Additional sediment may enter the Finger Lakes area during these events, however they occur infrequently.

The sediment load into Finger Lakes through the culverts was analyzed using a suspended sediment load versus Mississippi River discharge relationship for the USGS gage at Winona, Minnesota (Tornes, 1986) and the discharge duration relationship (percentage of the time discharges are exceeded) for Lock and Dam 4. The USGS relationship is given below.

$$S = .00013 * Qr ** 1.62$$

S = sediment load, tons/day
Qr= total river discharge, cfs

The suspended sediment concentration at Winona was assumed to represent ambient river conditions at Lock and dam 4. It was also assumed that the concentration of suspended sediment at the culvert inlet is the same as ambient river conditions. In other words, inflows through the culverts to Clear, Lower Peterson, and Third Lakes haven't lost any of their sediment load to Upper Peterson Lake. This assumption clearly isn't true but will be made for analysis purposes. Given the discharge rating curve for Finger Lakes and the sediment discharge relationship for Winona, the total mass of sediment entering the lakes could be determined.

The trap efficiency of each of the Finger Lakes was found using the capacity inflow equation (Brune's method) shown below.

$$E = 100 * .97 ** [.19 ** \log (C/I)]$$

C = lake capacity, acre-ft
I = mean annual inflow, acre-ft

The capacity was determined using the cross sections obtained in 1988 and assuming a water surface elevation of 660.9. The inflow was determined for average annual Mississippi River discharge conditions and is approximately equal to the mean annual inflow for each culvert.

For existing conditions direct advective inflows only occur through the 4 foot culvert to Lower Peterson Lake . Discharges through this culvert were found using culvert nomographs and are the same for existing and proposed conditions. The total sediment load through this culvert was found to be 2200 tons/year. The trap efficiency of Lower Peterson Lake was found to be 18.2 percent and thus the amount of material retained in the lake is 400 tons. It should be noted that the capacity of Lower Peterson lake included the area now known as Schmoker's Lake. If this were spread out uniformly over the 78 acre lake and the specific weight of sediment was 40 pounds per cubic foot it would amount to .071 inches per year. Over a 23 year time span (the time span since the culvert was constructed) this would amount to 1.63 inches. As the cross section data for Peterson Lake indicates, sediment deposition has been greater than this, and has not been uniform. The non-uniformity may be due to the influence of lake bathymetry, lake geometry (bays), or aquatic vegetation. The calculation of a trap efficiency doesn't account for bays or areas of profuse vegetation that are isolated from direct advective transport. Typically what exists in backwater areas are two zones. The first of course are the channels and sloughs which have a low trap efficiency, and the second is the off-channel areas that have a high trap efficiency. Also, the trap efficiency calculated above is based on existing conditions geometry in Lower Peterson Lake, however the trap efficiency was undoubtedly higher before sediment started reducing lake volume. Thus as is the case in all backwater areas, the calculated trap efficiency doesn't always reflect the ability of backwaters to trap sediment.

For proposed conditions the discharge passing directly into Lower Peterson Lake through the culvert will remain unchanged. It was assumed that the proposed culverts were operated so that the discharge into each lake was 50 cfs for total river discharges less than approximately 70,000 cfs. For total river discharges greater than 70,000 cfs, culvert nomographs were used to determine culvert discharge. The total sediment load to the Finger Lakes will be 7247 tons annually under these conditions. This represents an increase of 5043 tons annually. If only the direct discharge to Lower Peterson Lake through the existing culvert is considered, the annual sediment deposition in lower Peterson would remain the same. However, there are inputs from Clear Lake and Third Lake to the southern half of Lower Peterson, and these may increase deposition in this area. The calculated trap efficiencies of the other lakes ranged from 3 to 6 percent. With these low trap efficiencies, the sediment deposition rate assuming uniform distribution over each of the lake areas range from .001 to .004 inches annually. Once again, these calculations don't include areas such as bays and areas with aquatic vegetation that have higher trap efficiencies. Actual deposition rates will probably be closer to those found in Lower Peterson Lake, however, since the average discharge through the gated culverts will be less than those in Lower Peterson, the deposition rates should be less. Because the intakes to First and Second Lakes are located closer to the navigation channel, the sediment load to these two lakes may be higher than the load to Third and Clear Lakes.

EFFECTS OF PROJECT ON UPPER PETERSON LAKE

Bathymetric data and measured discharges aren't available for Upper Peterson Lake so quantitative statements on the effects of the project on this lake are difficult to make. The additional flow and sediment load into Upper Peterson Lake depends on the operation of the proposed culverts to Clear and Third Lakes. The culvert inlets for First and Second Lake are not in Upper Peterson Lake so they will have no effect. If it is assumed that the culverts are operated to provide a maximum of 50 cfs to Clear and Third Lakes then an additional 100 cfs discharge will enter Upper Peterson Lake. The additional annual suspended sediment load associated with this is 2540 tons. If the trap efficiency of Upper Peterson is 100 percent the additional annual accumulation of sediment assuming a specific weight of sediment of 40 pounds per cubic foot would be .166 inches if uniformly distributed over the 261 acre lake. This would amount to 8.3 inches in 50 years. Of course, Upper Peterson Lake won't trap 100 percent of the sediment so the actual deposition rate will be less than .166 inches annually. Sediment that deposits in Upper Peterson will decrease deposition in Clear, Lower Peterson, and Third Lake.

FINE SEDIMENT EROSION

The erosion potential of existing lake sediments can be determined by comparing the bottom shear stress generated by flow velocities through the lakes to the critical shear stress of bottom sediments in the lake. The critical shear stress is defined as the shear stress above which sediment erosion will occur. The critical shear stress isn't known for Finger Lakes bottom sediments. While methods have been developed to determine this parameter, the erosion potential at Finger Lakes is further compounded by aquatic vegetation. The vegetation effects sediment erosion in two offsetting ways. Vegetation may act as a barrier to flows and help stabilize bottom sediments, thus reducing the potential for erosion. However, if vegetation creates a barrier to flows in some areas this will increase the amount of flow and the erosion potential through other areas. Even with these unknowns, a simplified determination of bottom shear stress in each of the Finger Lakes and comparison to typical critical shear stresses found in other water bodies will lend insight to the erosion potential in Finger Lakes.

One way to define the bottom shear stress is by the following equation.

$$Tb = p * Cf * v^{2}$$

Tb = bottom shear stress, psf
p = water density, slugs/cubic foot
Cf = friction coefficient
v = depth averaged velocity, fps

For hydraulically rough beds, Cf can be determined based on the Manning equation as follows:

$$Cf = n^{2} * g / [(h^{.333}) * 2.22]$$

n = Manning roughness coefficient
g = acceleration of gravity, ft/s**2
h = flow depth, ft

Values of critical erosion shear stress are given in table 1.

TABLE 1
Critical Shear Stress

Critical Shear Stress Tce, (psf)	Source of Information
.0125 .042 to .063	Waterways Experiment Station used these values in a study on Petenwell Reservoir on the Wisconsin River. .0125 psf was used to represent recent partially consolidated material (spec. wt. = 94 lbs/ft3). .042 to .063 psf is representative of older deposits with a higher degree of consolidation (spec. wt. = 119 lbs/ft3). (Memorandum for Record, 1988.).
.0125	Calibrated values used in 2-dimensional laterally averaged reservoir sediment transport model for Ft. Loudoun Reservoir on the Tennessee River in eastern Tennessee. (Hendrickson, J.S., Unpublished Thesis, 1988).
.0062	Calibrated values for numerical model study of sediment transport in Conway Estuary, Port of Brisbane, Great Britain (Cole and Miles, 1983).
.24 to 1.5	Field investigations of sediment erosion (Flaxmen, 1963).

Bed shear stress will be determined using discharges of 92 cfs into Lower Peterson Lake and 50 cfs into the other lakes. Based on the proposed project operation, these are the maximum discharges that will enter each lake. Velocities will be determined by the following equation.

$$V = Q / A$$

V = velocity in a cross section, fps
Q = discharge into each lake, cfs
A = cross sectional area of each lake, square feet

This implies that flow is uniformly distributed throughout a given cross section which certainly isn't true. However, this should lend insight on the erosion potential for existing lake sediments. Table 2 shows bottom shear stresses that would occur at the surveyed cross sections. A Manning n value of .04 and a water density of 1.9 slugs per cubic foot were used. A water surface elevation of 661.1 which corresponds to the average discharge in the river (29580 cfs) will be used for the depth and area calculations.

TABLE 2

Bottom Shear Stresses
Proposed Conditions

Lake	Inflow (cfs)	Cross section Area (ft2)	Flow Velocity (ft/s)	Average Depth (ft)	Friction Coefficient Cf	Bottom Shear Stress Tb (psf)
Clear	50	1037	.048	2.1	.018	.000079
		1168	.043			.000063
Lower Peterson	92	1380	.067	3.4	.015	.000128
		484	.190			.001029
		824	.112			.000358
First	50	745	.067	2.3	.017	.000145
		759	.066			.000141
Second	50	1499	.033	3.5	.015	.000031
		1520	.033			.000031
Third	50	1533	.033	3.0	.016	.000033
		1102	.045			.000062

Note:
1. The values of Cf were obtained from the Manning relationship. This applies to a hydraulically rough bed. If the bed were hydraulically smooth which is often true for beds of cohesive material (Ariathurai and Krone, 1976.) the Blazius or Karmen-Prandtl equations could be used. This would result in values of Cf somewhat lower than those above.

2. Cross sectional areas based on 1988 surveys.

A comparison of the bottom shear stresses in the above table to the critical shear stresses found in Table 1 indicates that wide spread erosion of bottom sediments will not occur. This doesn't mean that local scour won't occur. In fact, local scour is possible at the culvert outlets and anywhere there is a constriction in the flow. As mentioned previously this doesn't take into account the fact that aquatic vegetation may not allow the flow to spread out uniformly over the entire cross section area. For example, if the cross sectional area at the smallest section in Lower Peterson Lake were cut in half the resulting bottom shear stress would increase to .0041 psf. This is slightly below the lowest critical shear stress of .0062 psf used by Cole and Miles.

To generate velocities high enough for the bottom shear stress to exceed the critical shear stress relatively high culvert inflows are required. If it is assumed that the critical shear stress for Finger Lakes sediments is .0125, then the velocity required for the bottom shear stress to exceed this is quite high. In Clear Lake for instance, with a friction coefficient "Cf" of .018, the required velocity would be .604 fps and this would require a discharge of 600 to 700 cfs. If it is assumed that the critical shear stress for Finger Lakes sediments is .0062, then the velocity required for the bottom shear stress to exceed this in Clear Lake is .426 fps and this requires a discharge of 450 to 500 cfs. For average river discharge conditions of 29580 cfs, an eight foot culvert would be required to provide 450 cfs into Clear Lake. Obviously, trying to create a flow situation which results in erosion of Finger Lakes bottom sediments is way beyond the scope of this project.

SEDIMENTATION CONCLUSION

Lake cross sections obtained in 1988 indicate both increases and decreases in lake bed elevations as compared to the 1931 flowage surveys. Reasons for these variations, particularly in the decreases in elevation, aren't clear. Some error is introduced in locating the 1988 cross sections on the flowage surveys and in the lack of detailed data on the flowage surveys. Even with these problems, useful information was obtained by comparing the 2 surveys. In particular, it appears that little if any deposition has occurred in Clear Lake. Also, the cross sections show that the Lower Peterson Lake bottom has increased in elevation more than any of the other lakes. This increase varies but appears to average about 1 foot.

Several potential sources of sediment were analyzed to determine what the major sources of sediment to Finger Lakes are. Diffusive inflows due to rising river stages or lateral overland flow from the Mississippi River don't appear to contribute significant amounts to the total sediment load. One potential source that couldn't be quantified is overland flow during flood events on the Zumbro River. It appears that the Zumbro River could result in significant amounts of sediment entering the Finger Lakes area. It is difficult to explain why Lower Peterson Lake and Clear Lake, which are similarly located with respect to the Zumbro River, have such different deposition characteristics, however it may be due to local topographical features preventing flow from entering Clear Lake. The greater amount of deposition in Lower Peterson Lake seems to indicate that culvert discharges into Lower Peterson have contributed a significant amount of sediment. However, the sediment yield analysis for existing conditions results in an annual deposition rate in Lower Peterson Lake that is significantly lower than that shown by the field data. Part of the problem in determining the culvert sediment load, is in calculating a representative trap efficiency for Lower Peterson Lake. Even if the trap efficiency is 100 percent, however, the total sediment load through the culvert only accounts for about 8 inches of the 1 foot of deposition that has occurred in Lower Peterson. A reasonable explanation for this and the deposition that has occurred in areas of First and Third Lakes, might be that the 4 foot culvert is responsible for some of the deposition in Lower Peterson Lake but overland flow from the Zumbro River has also had an effect on deposition in Lower Peterson and the other Lakes.

Because of problems in predicting the trap efficiency of the lakes, the results of the proposed conditions analysis which show the very low trap efficiencies for Clear, First, Second, and Third Lakes are questionable. If the project is operated at maximum capacity, it will result in discharges in all the lakes like those that have existed in Lower Peterson for approximately 23 years. And this discharge has resulted in approximately 1 foot more net deposition in Lower Peterson than in any of the other Lakes. Based on this, the proposed culverts should be operated so that discharges into Finger Lakes are the minimum needed to provide improved aquatic habitat. During high flow events on the Mississippi River when sediment concentrations of river water are higher, the culvert gates should be closed. Discharges through the existing culvert to Lower Peterson Lake should be reduced also.

Discharges through the culverts, even if they are operated at maximum potential will not be sufficient to induce erosion of existing sediment deposits in Finger Lakes. The culvert sizes required to provide such discharges are not feasible for this project.

REFERENCES

GREAT 1, Study of the Upper Mississippi River, (1980). Vol. 4, "Sediment and Erosion."

Tornes, L.H. (1986). "Suspended Sediment in Minnesota Streams." U.S. Geological Survey, Water Resources Investigations Report 85-4312.

FINGER LAKES
DEFINITE PROJECT REPORT

APPENDIX A
DISSOLVED OXYGEN DATA

Finger Lakes
Dissolved Oxygen Samples

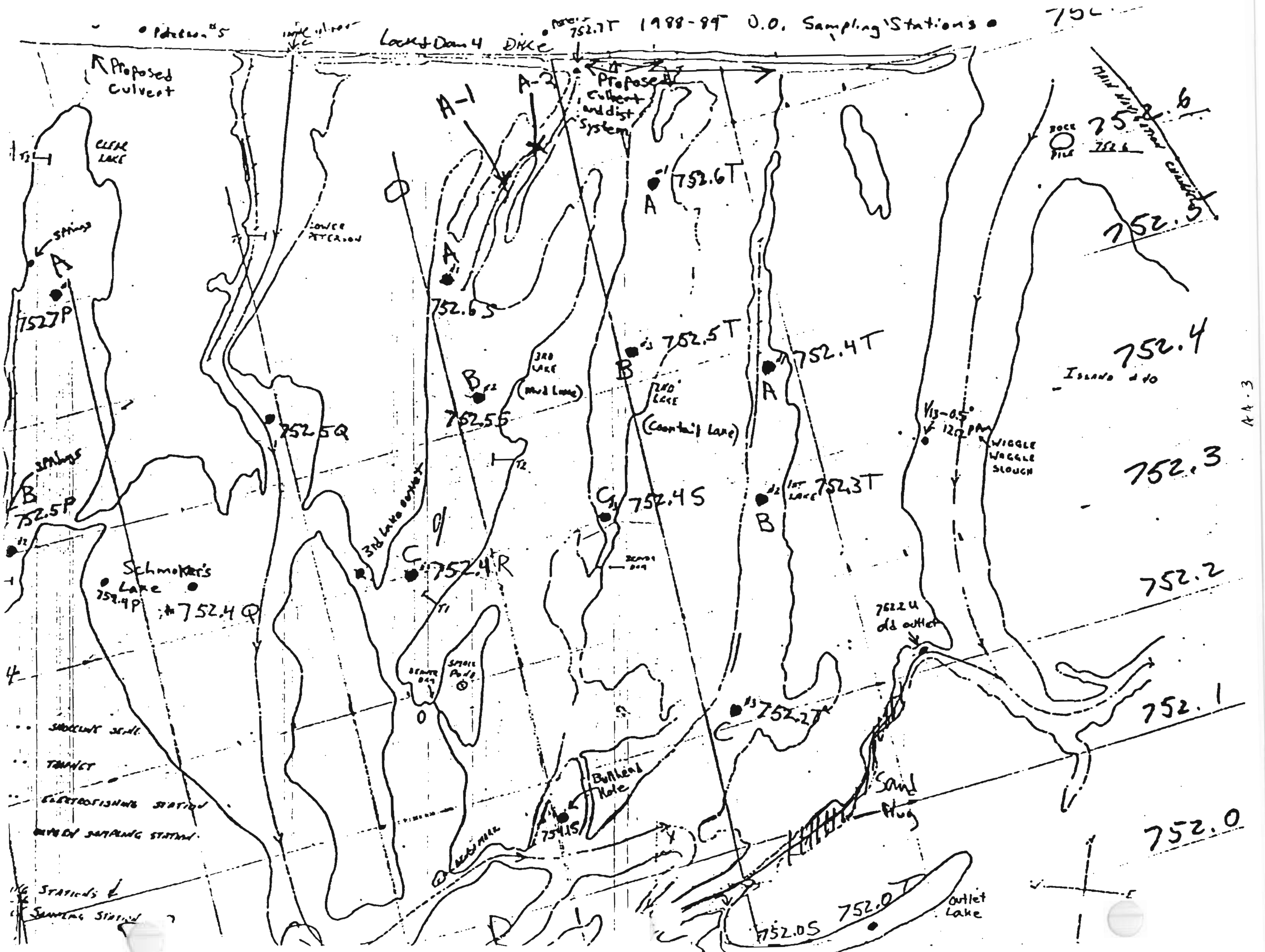
Date	Lake	Station	Sample Depth (ft)	ppm
2-28-63	Clear		3.0	6.2
2-28-63	Clear		4.0	4.7
2-28-63	Clear		5.0	4.0
2-28-63	Clear		4.0	3.2
2-10-64	Clear			7.5
1-17-75	Clear	1	3.5	11.4
1-17-75	Clear	2	3.5	6.0
12-16-75	Clear	1	2.5	18.2
12-16-75	Clear	2	2.5	11.0
12-17-76	Clear	1	3.0	4.6
12-17-76	Clear	2	1.0	3.7
2-7-77	Clear	1	2.5	1.3
2-7-77	Clear	2	2.5	1.0
2-28-63	Lower Peterson		4.0	0.0+
2-28-63	Lower Peterson		3.0	0.2+
2-28-63	Lower Peterson		3.0	0.3+
2-28-63	Lower Peterson		4.0	0.9+
2-10-64	Lower Peterson			5.0+
2-10-64	3rd			3.0
1-17-75	3rd	1	4.0	0.8
1-17-75	3rd	2	4.0	4.4
1-17-75	3rd	3	4.0	3.4
12-16-75	3rd	1	3.0	7.6
12-16-75	3rd	2	4.5	3.6
12-16-75	3rd	3	4.0	3.6
12-17-76	3rd	1	3.0	0.6
12-17-76	3rd	2	5.0	0.6
12-17-76	3rd	3	3.0	2.3

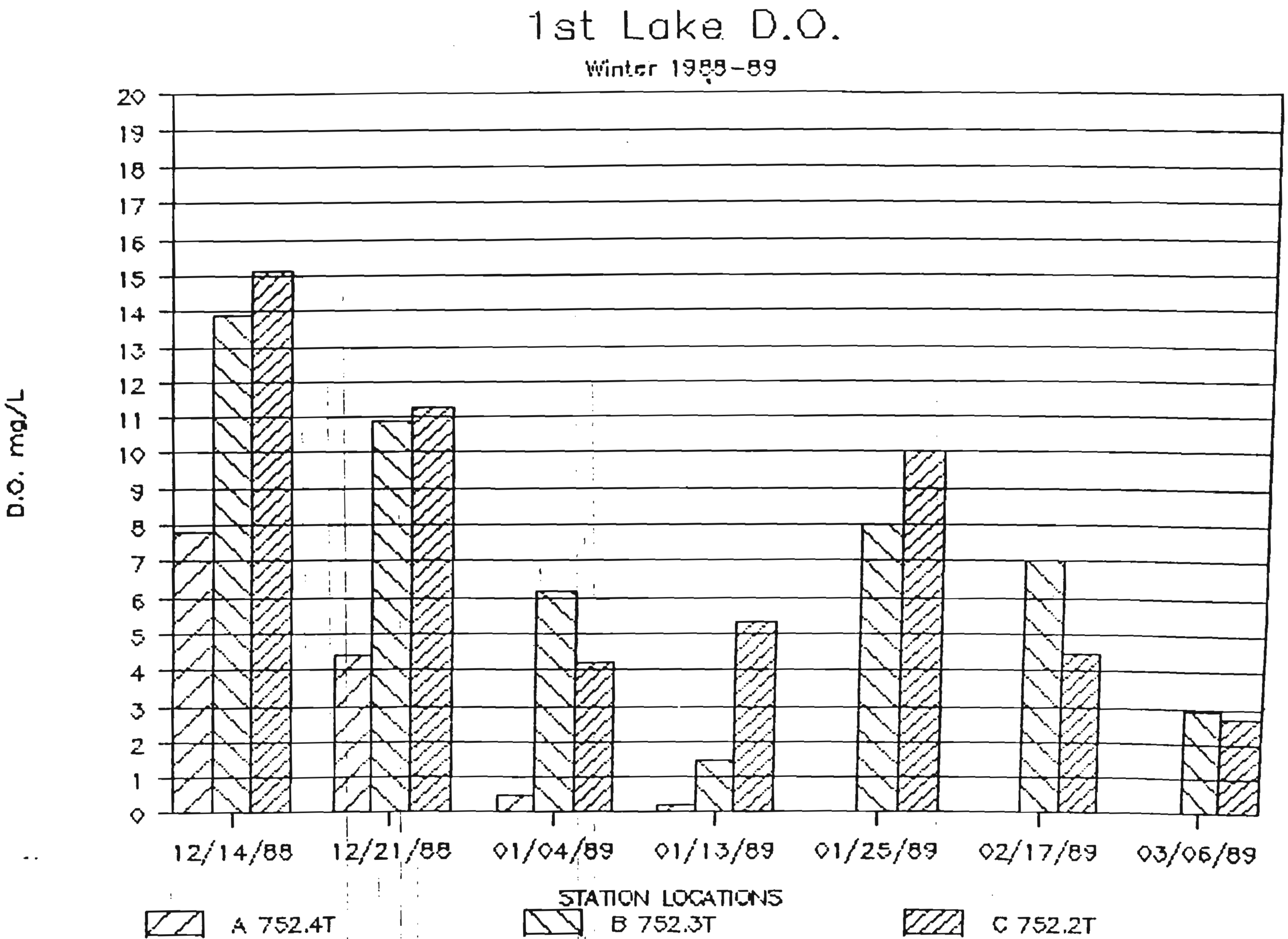
Date	Lake	Station	Sample Depth (ft)	ppm
2-7-77	3rd	1	3.0	0.8
2-7-77	3rd	2	2.0	0.9
2-7-77	3rd	3	3.0	0.9
12-17-76	Small Pond•• Below 3rd Lake		2.0	0.6•
1-17-75	2nd	1	2.0	0.6•
1-17-75	2nd	2	6.0	0.2•
1-17-75	2nd	3	2.5	0.8•
12-16-75	2nd	1	2.5	3.6•
12-16-75	2nd	2	4.5	4.2•
12-16-75	2nd	3	2.0	13.0•
12-17-76	2nd	1	1.5	0.7•
12-17-76	2nd	2	5.0	4.2•
12-17-76	2nd	3	1.5	3.9•
2-7-77	2nd	2	2.5	0.8•
2-7-77	2nd	3	2.0	0.8•
1-17-75	1st	1	2.5	0.6
1-17-75	1st	2	2.5	0.4
1-17-75	1st	3	3.0	9.4
12-16-75	1st	1	2.5	3.4
12-16-75	1st	2	2.5	3.4
12-16-75	1st	3	3.0	8.0
12-17-76	1st	1	2.5	2.6
12-17-76	1st	2	2.5	3.5
12-17-76	1st	3	3.0	3.5
2-7-77	1st	2	2.0	1.2

+ sample taken before the culvert was installed

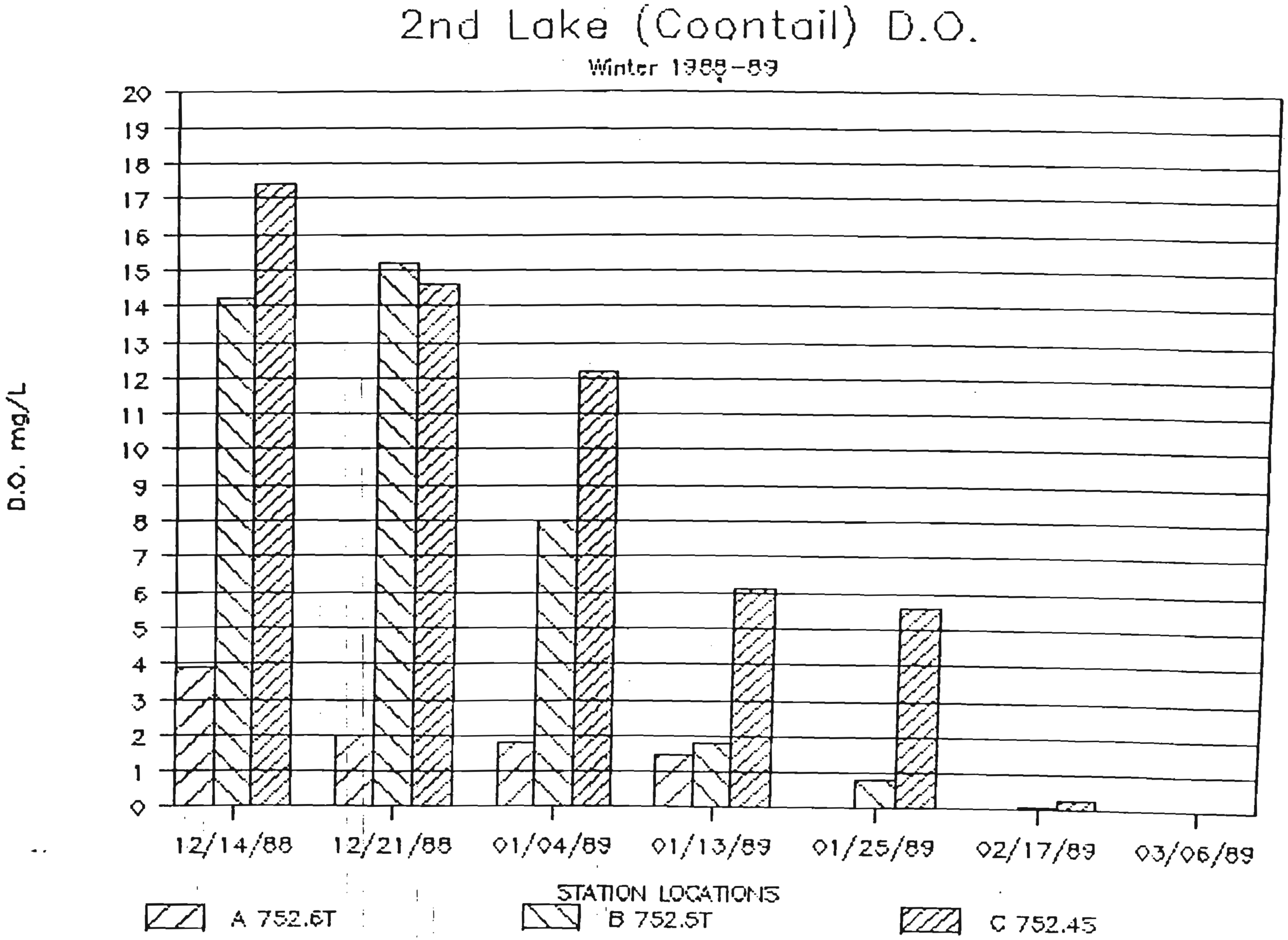
• known winter-kill area

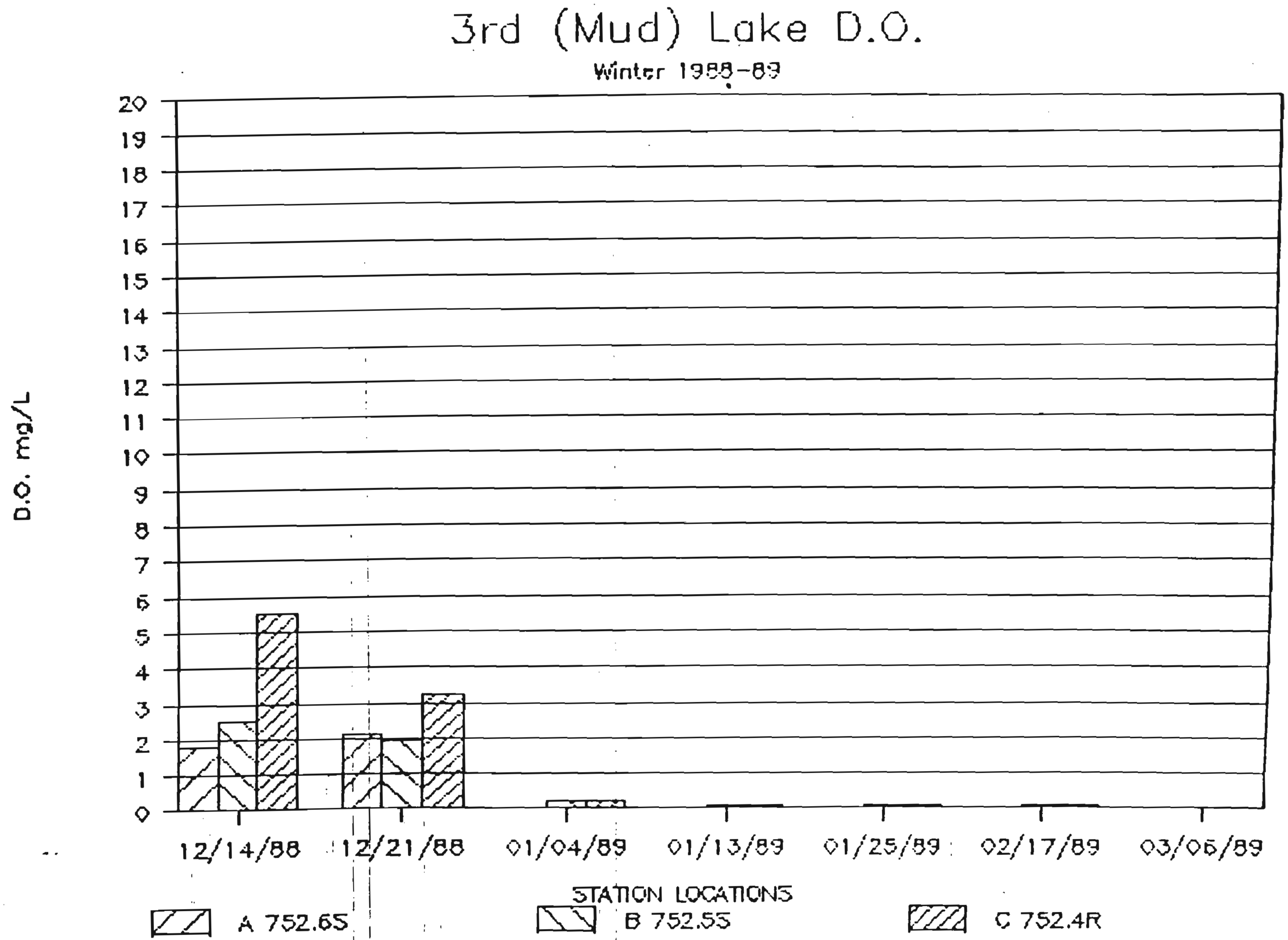
•• no previous data


1988-89 D.O. Sampling Stations
Lock & Dam 4 Dike
Proposed Culvert
Proposed Culvert and dist System
A-1
A-2
752.7T
752.6T
A
752.7P
752.6S
752.5T
B
752.4T
752.5Q
752.5S
3rd Lake (Mud Lake)
2nd Lake (Coontail Lake)
752.5P
752.4S
752.3T
1st Lake
C
752.4R
Schmoker's Lake
752.4P
752.4Q
752.2U old outlet
Wiggle Waggle Slough
752.2T
Bullhead Hole
Sand Plug
752.1S
752.0T
752.0S
Outlet Lake
752.5
752.4
752.3
752.2
752.1
752.0



1st Lake D.O.
Winter 1988-89
D.O. mg/L
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89
STATION LOCATIONS
A 752.4T
B 752.3T
C 752.2T

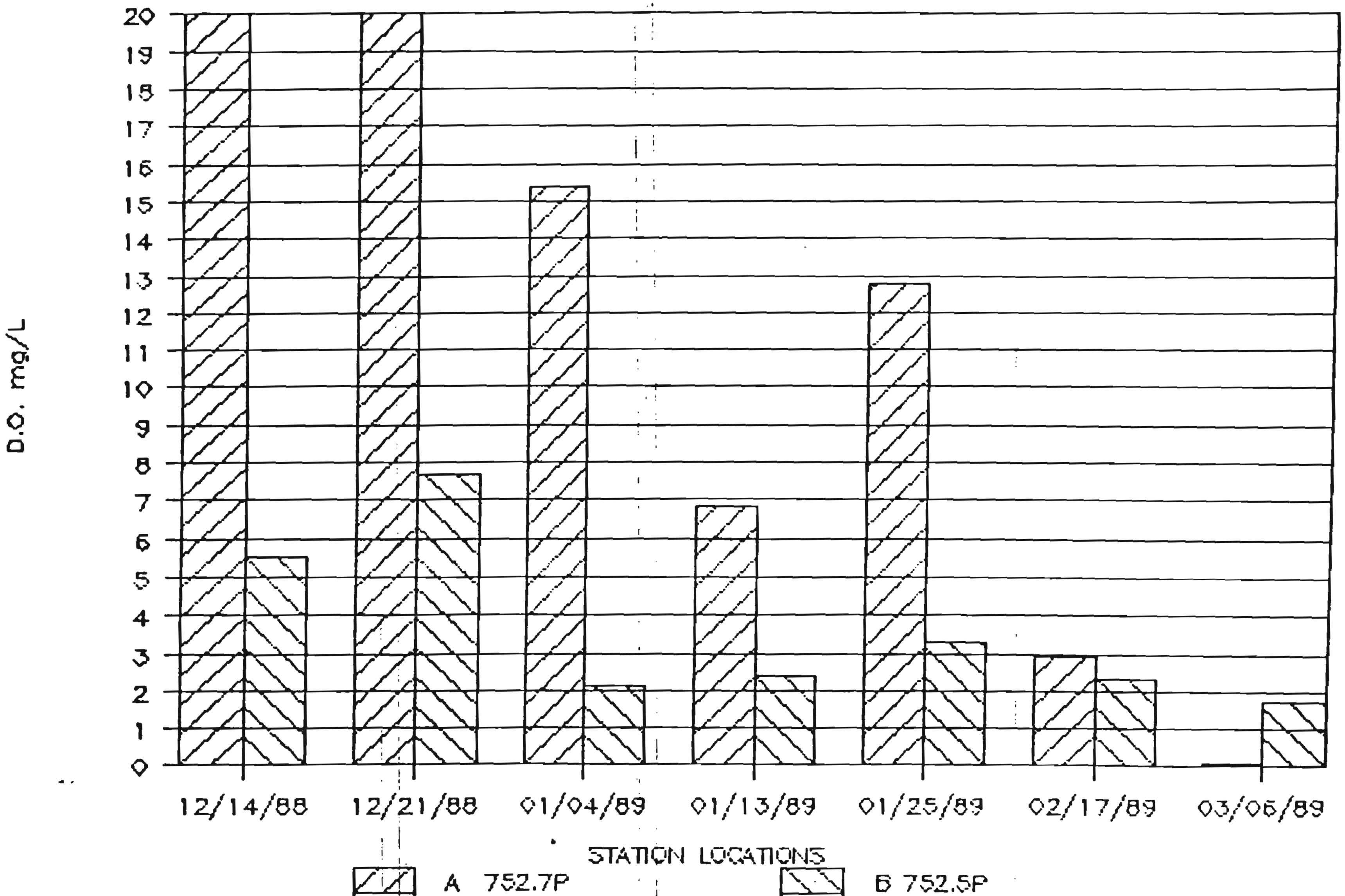

2nd Lake (Coontail) D.O.
Winter 1988-89
D.O. mg/L
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89
STATION LOCATIONS
A 752.6T
B 752.5T
C 752.45



3rd (Mud) Lake D.O.
Winter 1988-89
D.O. mg/L
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89
STATION LOCATIONS
A 752.65
B 752.55
C 752.4R

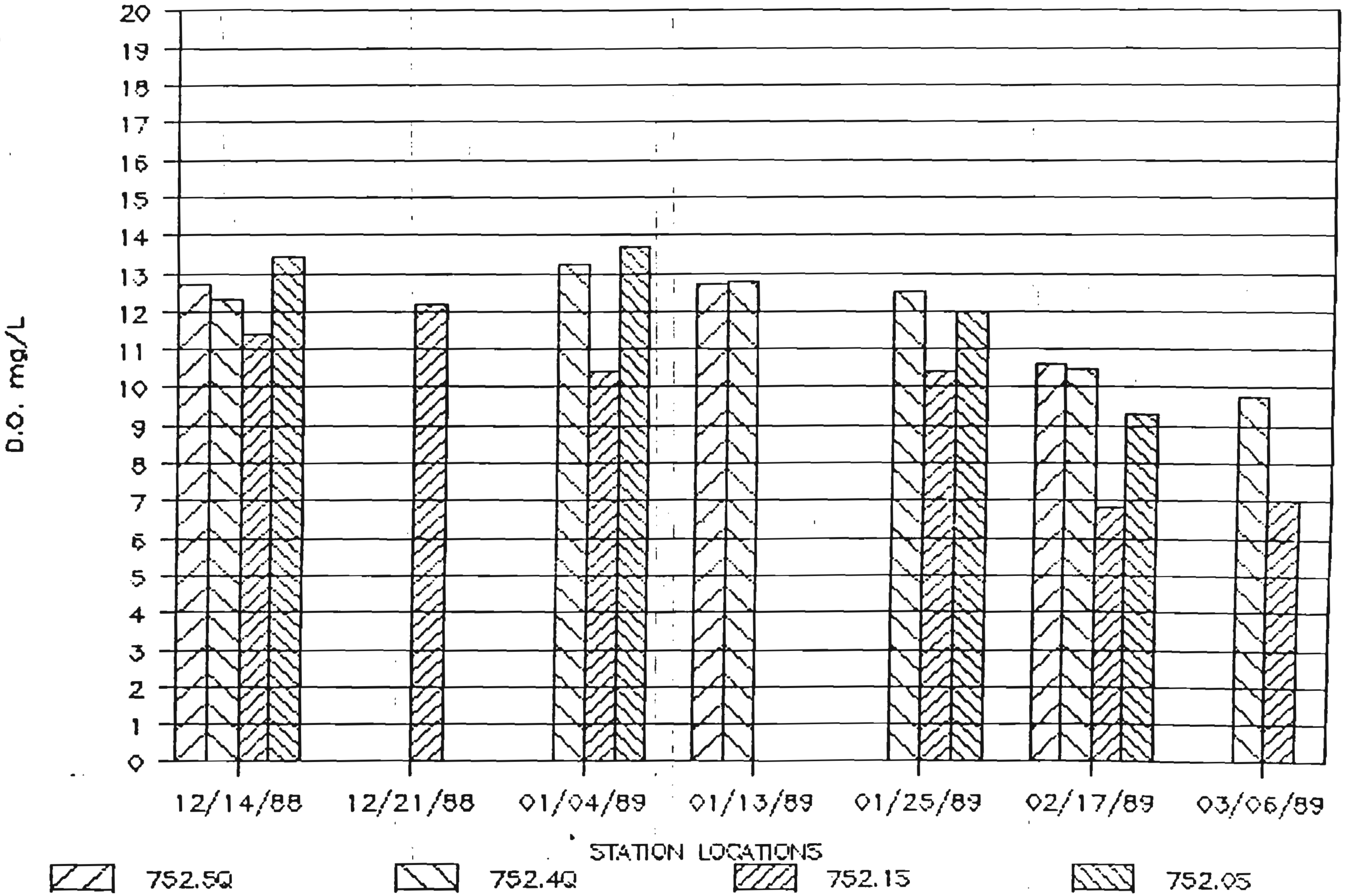
CLEAR LAKE D.O.

Winter 1988-89



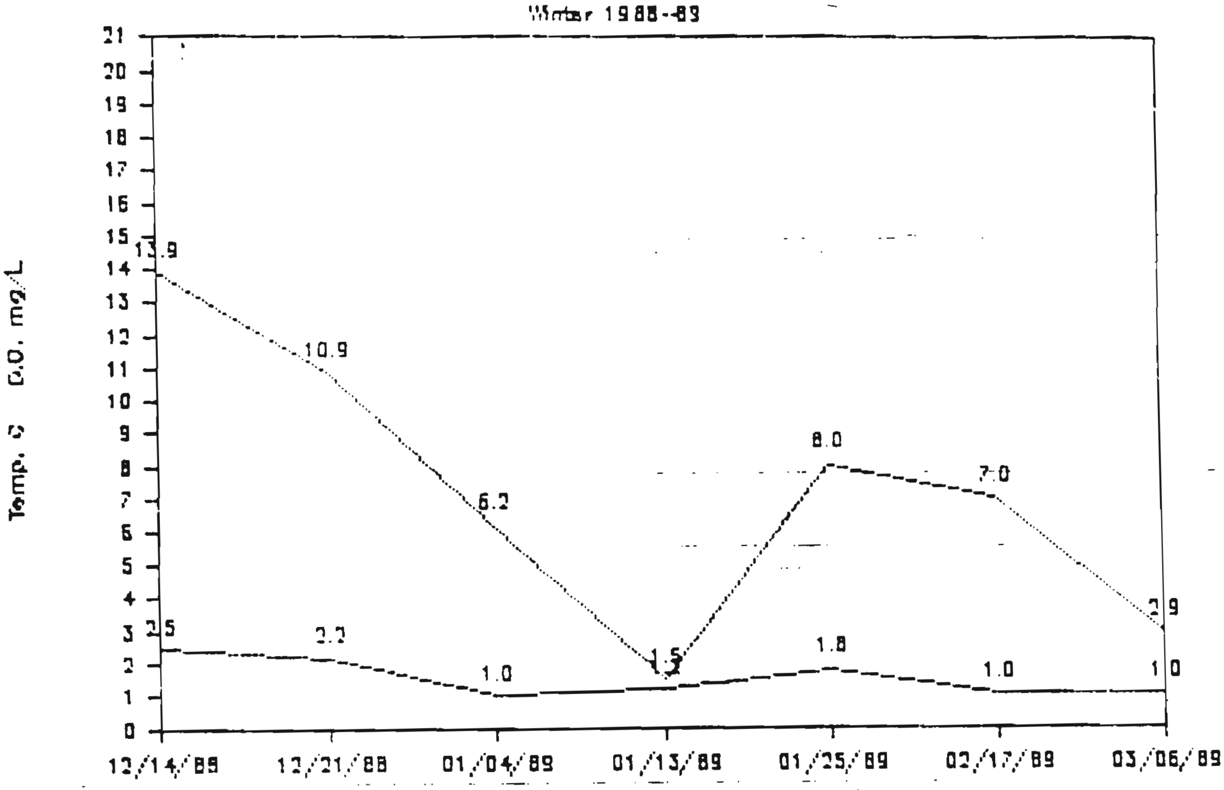
L.Peterson/Schmokers/B.head/Outlet D.O.

Winter 1988-89



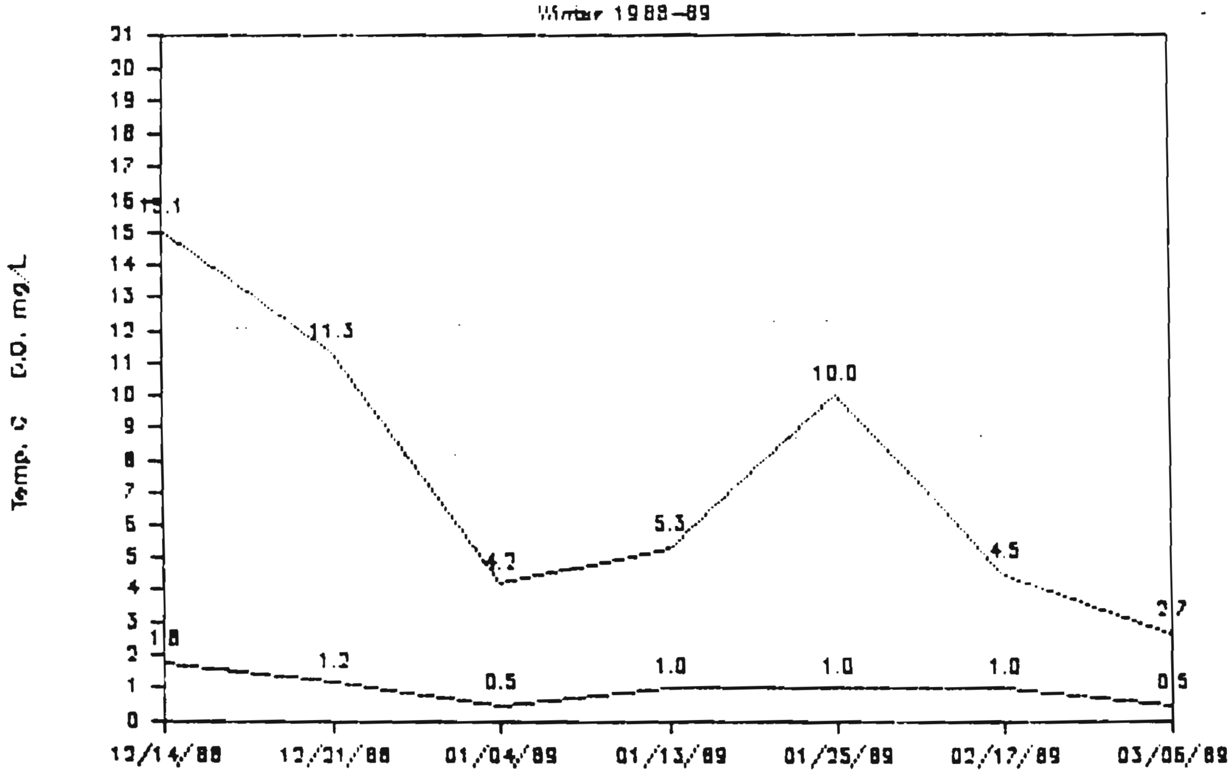
First Lake Station B D.O./Temp

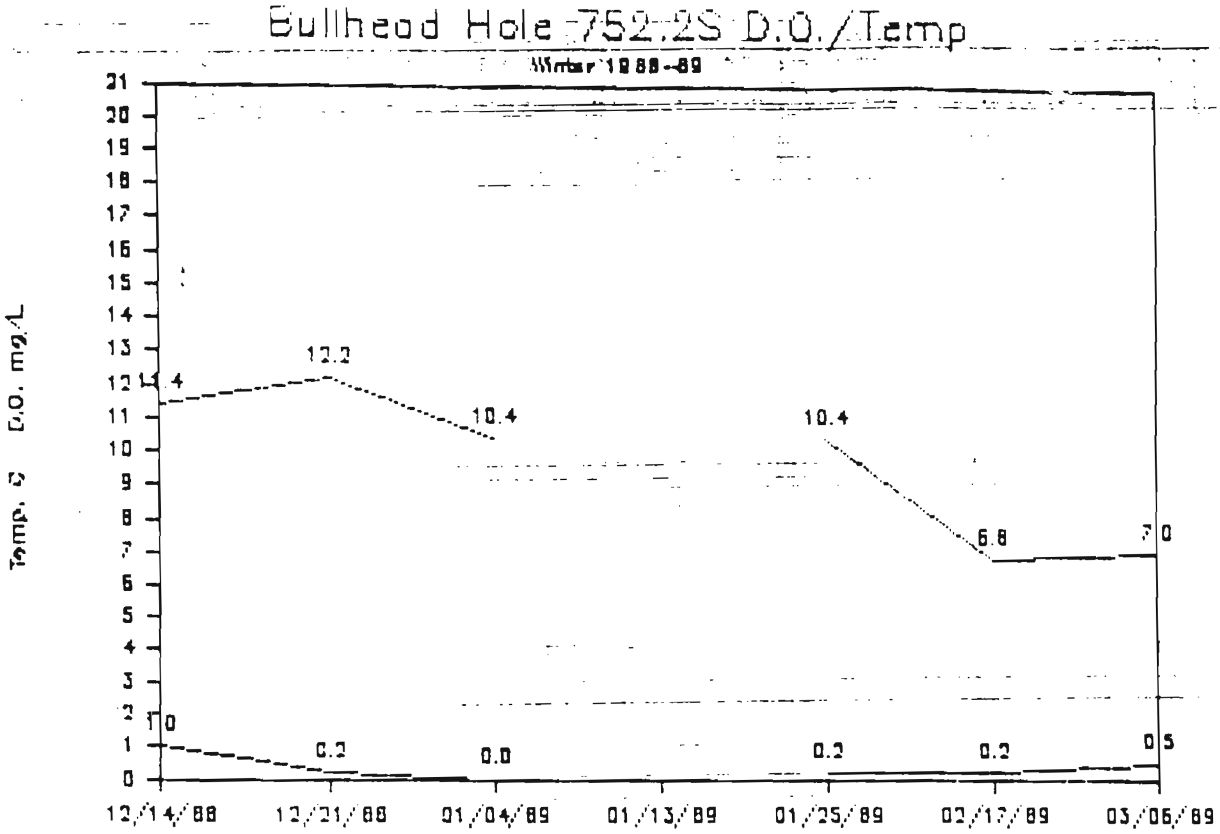
Winter 1988-89



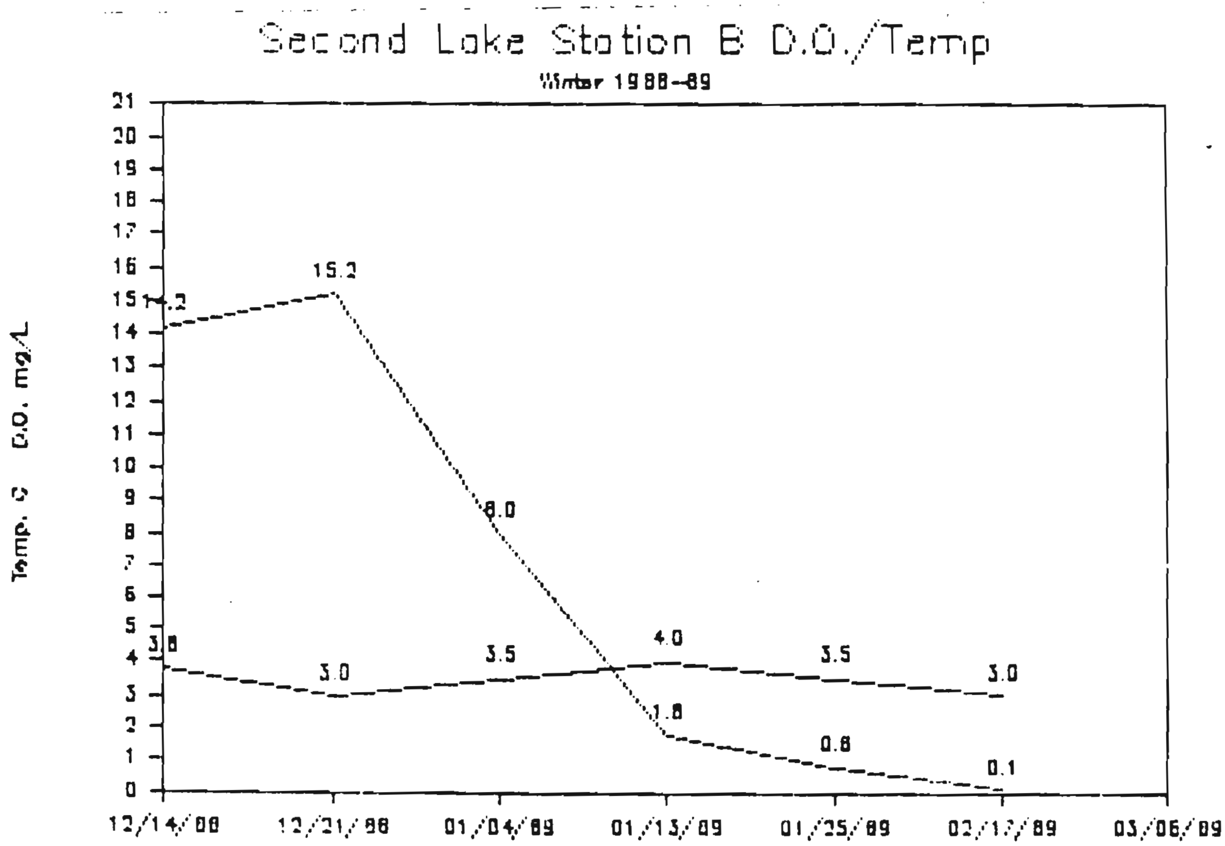
First Lake Station C D.O./Temp

Winter 1988-89





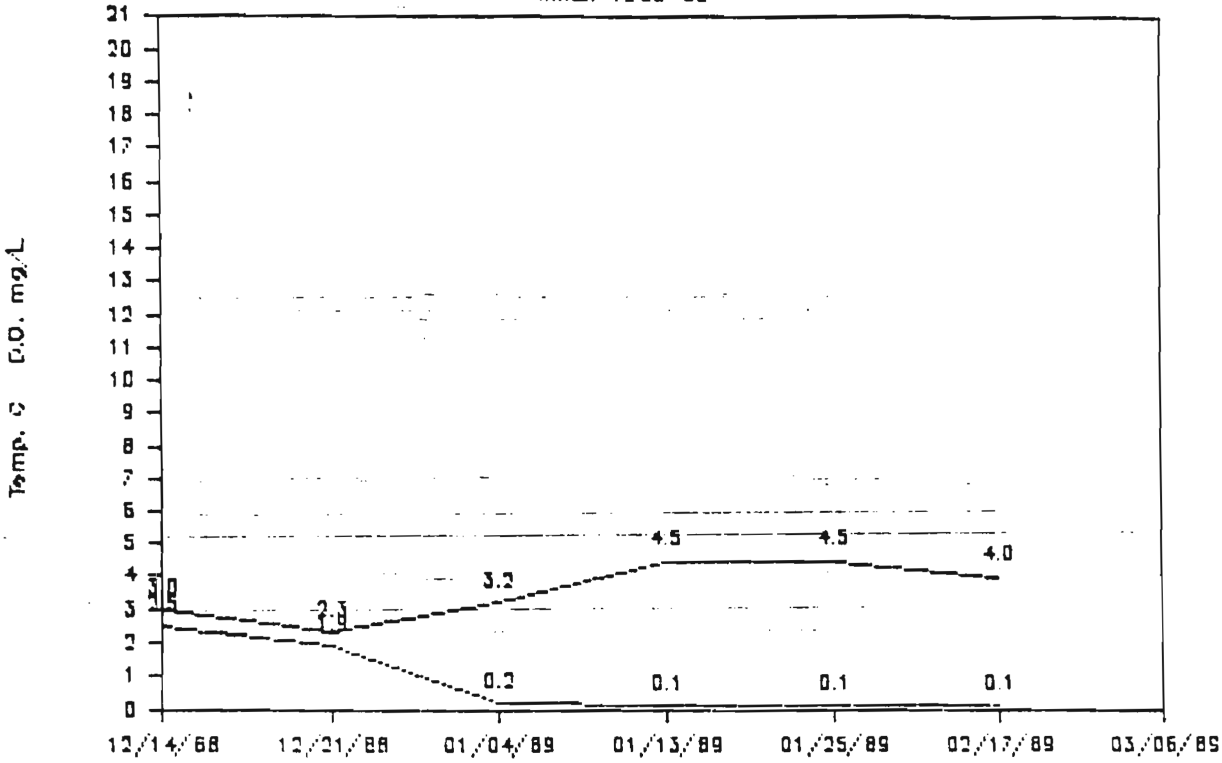
Bullhead Hole 752.2S D.O./Temp
Winter 1988-89
Temp. C D.O. mg/L
11.4
12.2
10.4
10.4
6.8
7.0
1.0
0.2
0.0
0.2
0.2
0.5
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89



Second Lake Station B D.O./Temp
Winter 1988-89
Temp. C D.O. mg/L
14.2
15.2
8.0
1.8
0.8
0.1
3.8
3.0
3.5
4.0
3.5
3.0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89

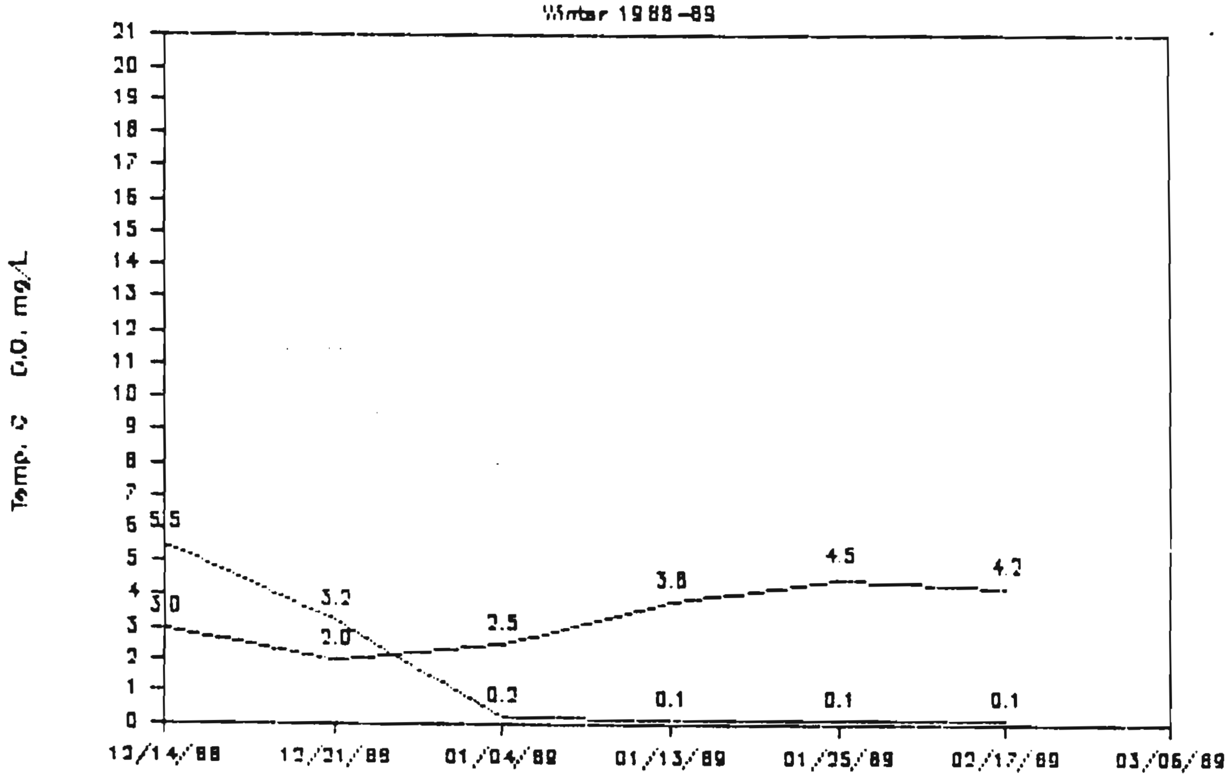
Third Lake Station B D.O./Temp

Winter 1988–89



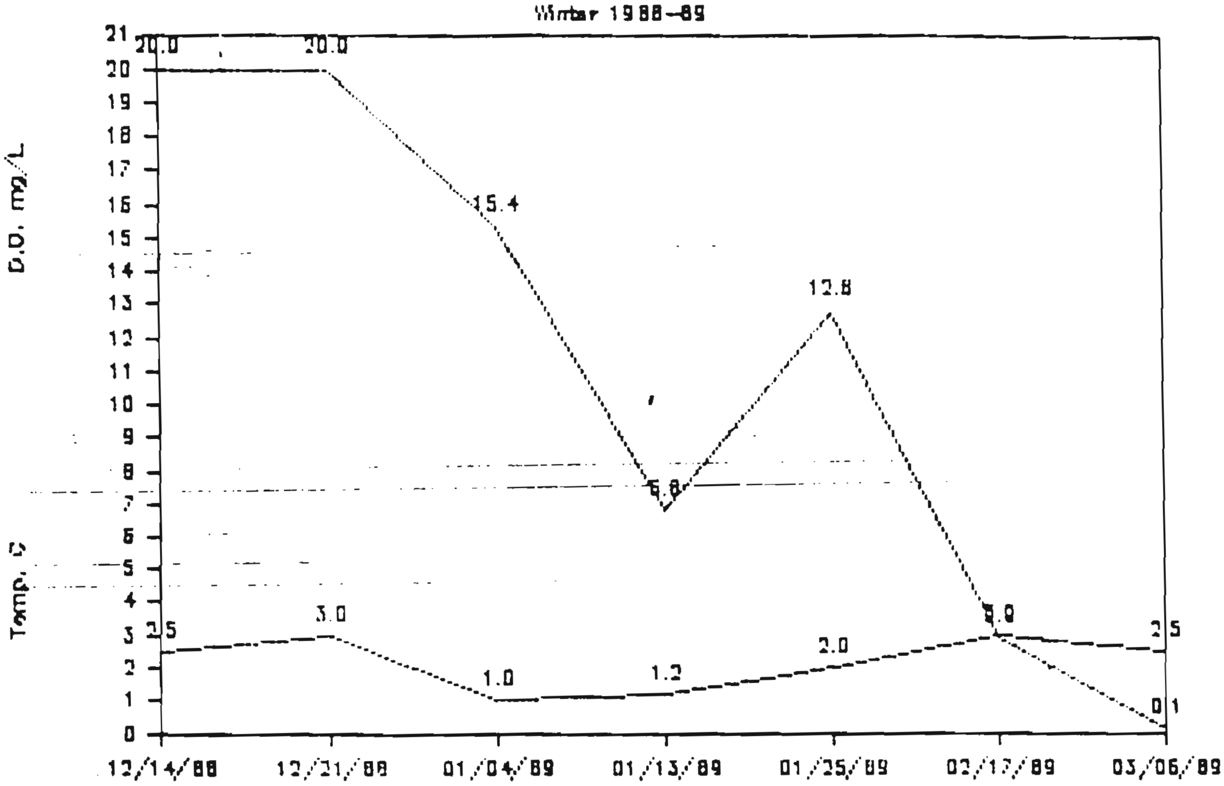
Third Lake Station C D.O./Temp

Winter 1988–89



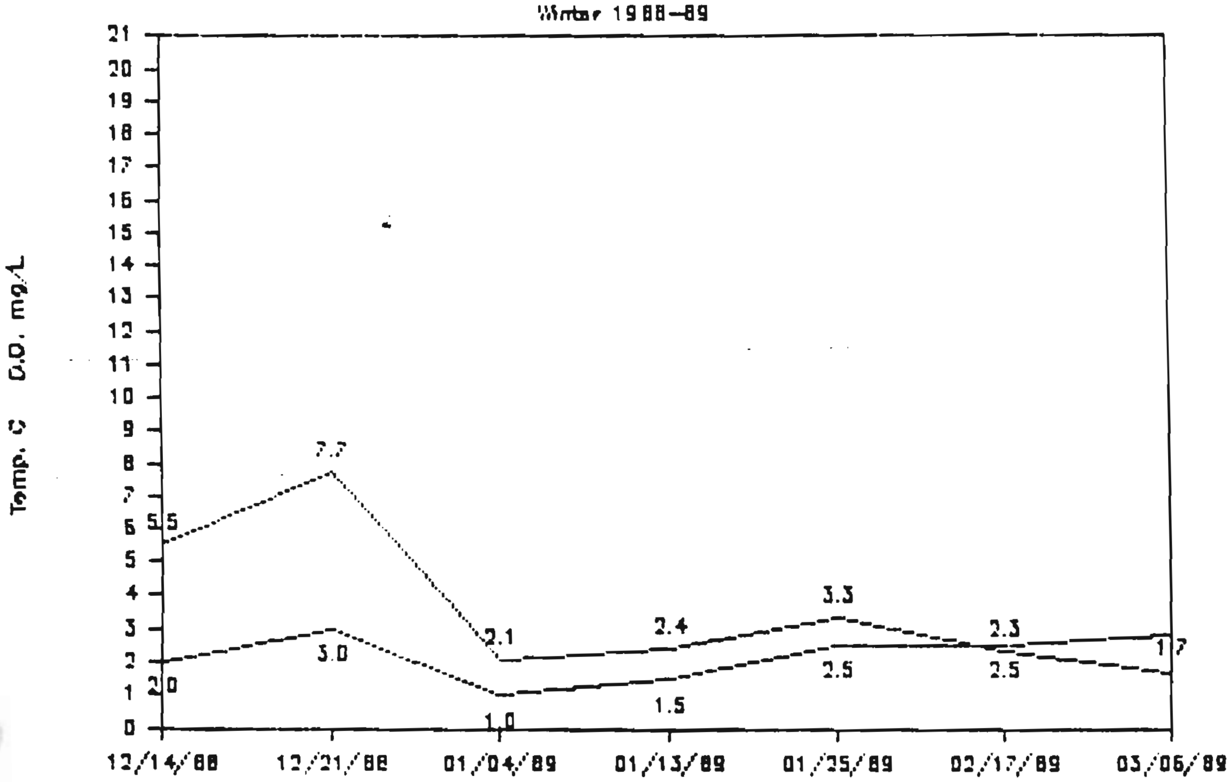
Clear Lake Station A D.O./Temp

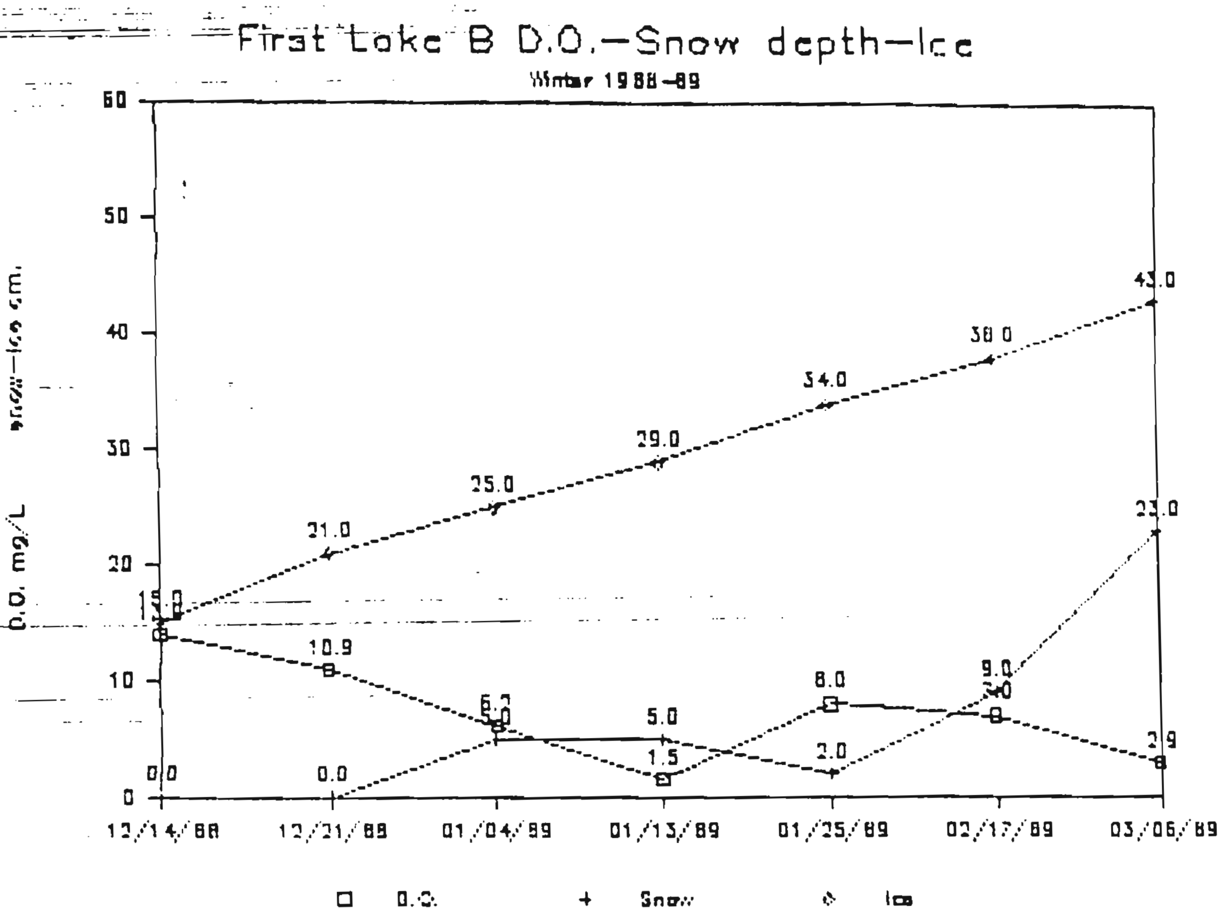
Winter 1988-89

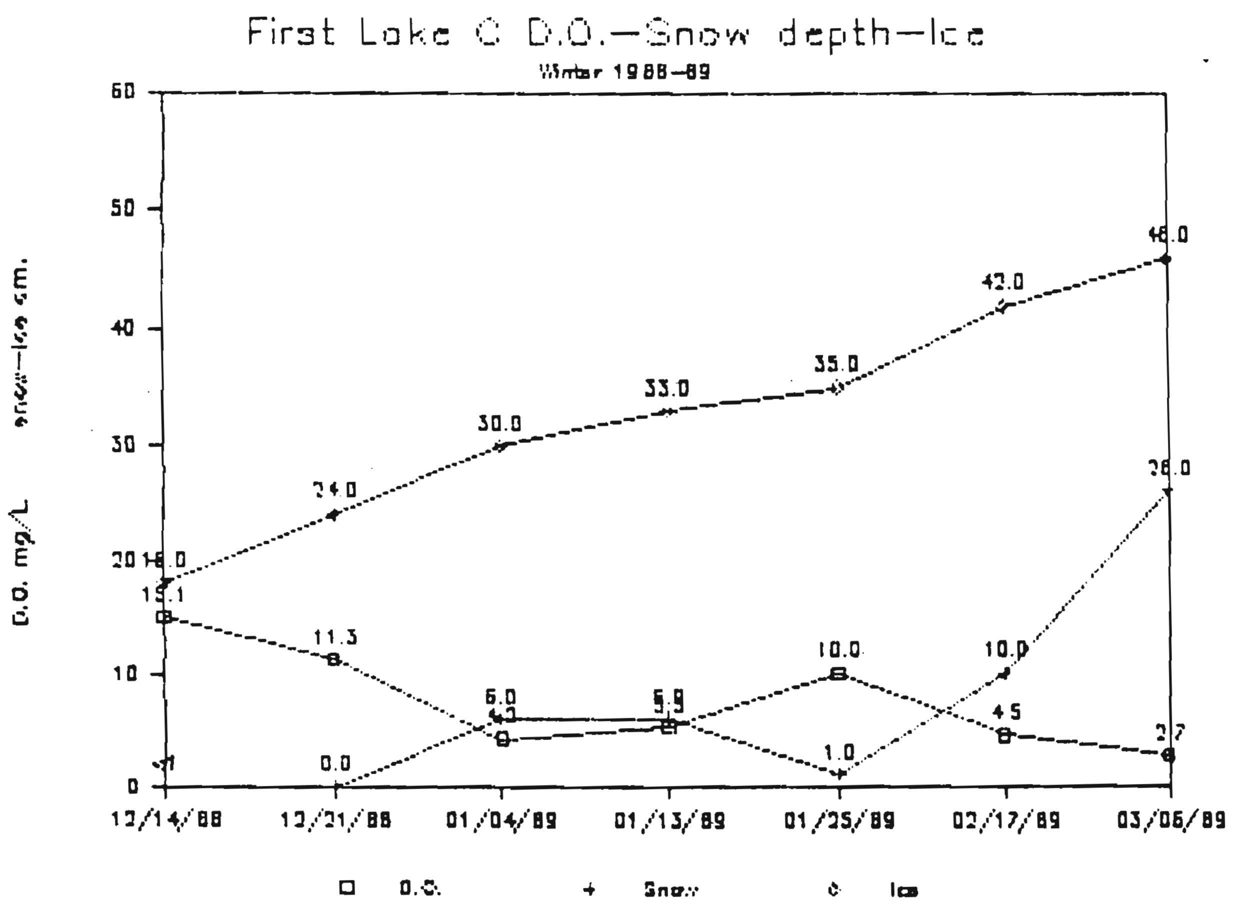


Clear Lake Station B D.O./Temp

Winter 1988-89

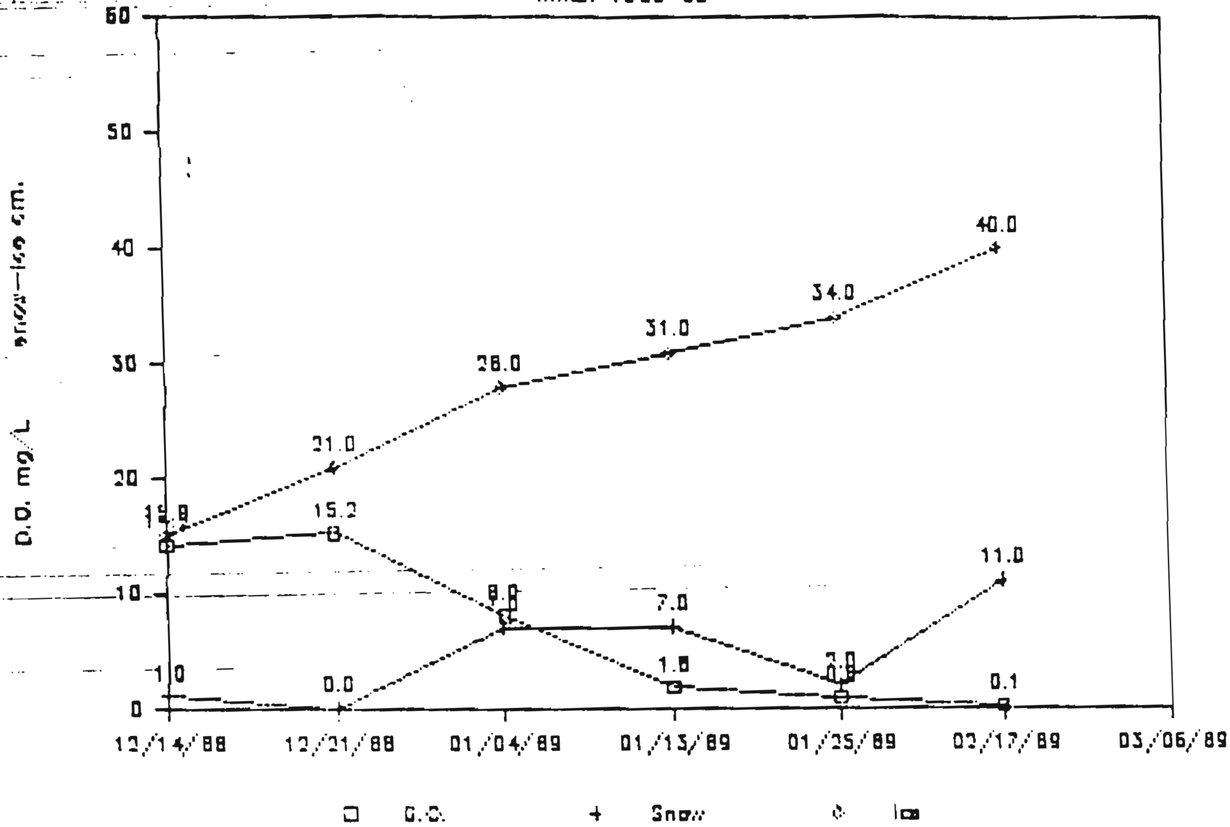



First Lake B D.O.—Snow depth—Ice
Winter 1988–89
D.O. mg/L snow—ice cm.
43.0
38.0
34.0
29.0
25.0
21.0
23.0
10.9
8.0
9.0
5.0
1.5
2.0
0.0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89
D.O.
Snow
Ice


First Lake C D.O.—Snow depth—Ice
Winter 1988–89
D.O. mg/L snow—ice cm.
46.0
42.0
35.0
33.0
30.0
24.0
26.0
11.3
10.0
10.0
6.0
4.5
1.0
0.0
12/14/88
12/21/88
01/04/89
01/13/89
01/25/89
02/17/89
03/06/89
D.O.
Snow
Ice

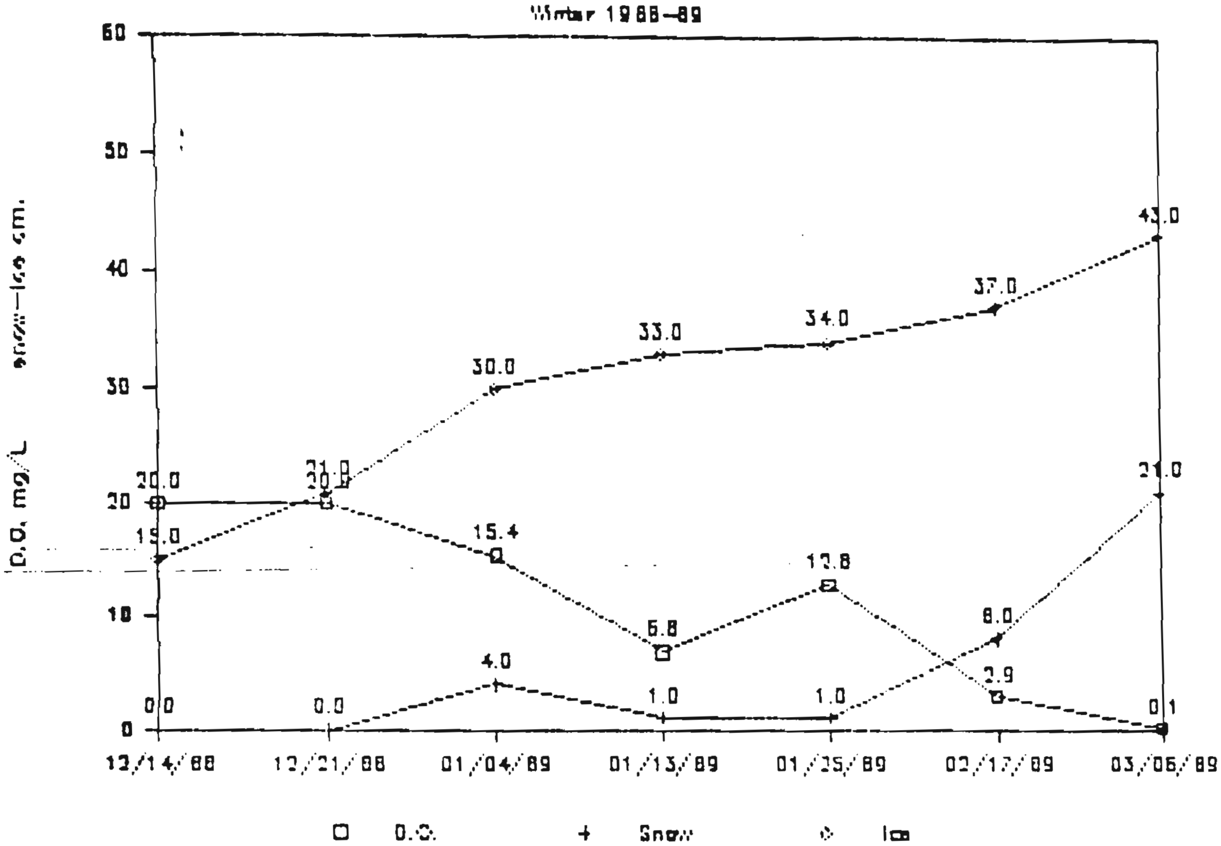
Second Lake B D.O.—Snow depth—Ice

Winter 1988–89



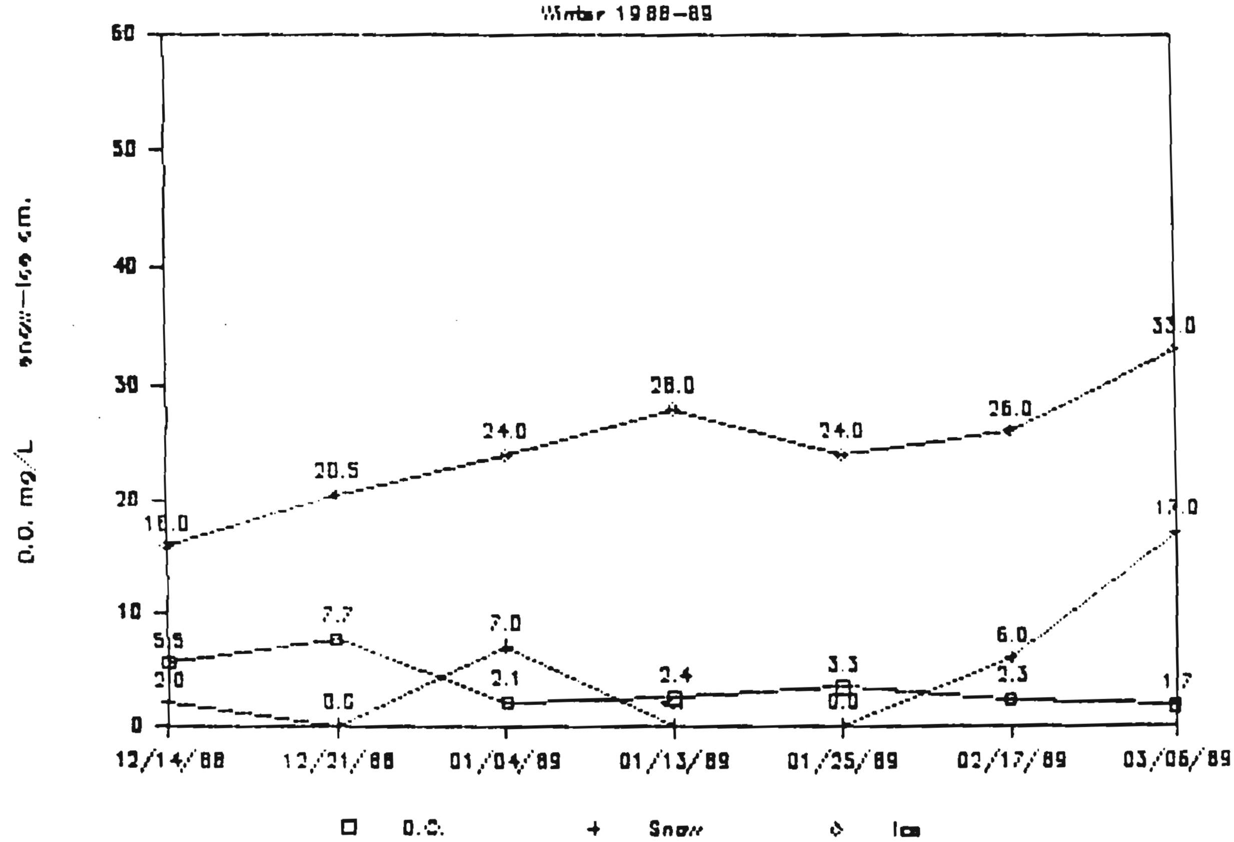
Clear Lake A D.O.—Snow depth—Ice

Winter 1988–89



Clear Lake B D.O.—Snow depth—Ice

Winter 1988–89



AA.5