St. Anthony Falls Hydraulic Laboratory
University of Minnesota

Project Report No. 220

ENVIRONMENTAL IMPACTS OF HYDROPOWER DEVELOPMENT AT EXISTING MINNESOTA DAMS

by

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and

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Prepared for

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I. INTRODUCTION

The construction of hydropower facilities at existing dams usually causes a limited environmental impact because there is no land inundated due to new dam construction, and the character of the stream is not greatly altered. The environmental impact of these hydropower facilities should not be entirely discounted, however. There are likely to be a few cases where a fishery may be harmed, public health may be threatened due to dredge spoils, or a historic structure may be destroyed. Some regulatory agencies are taking the approach that small-scale hydropower facilities should be evaluated on an impact per kilowatt-hour scale if the environmental impacts are to be equitably compared with those of nuclear or coal fired power plants.

The analysis of environmental impacts should be an integral part of any small-scale hydropower development. The required depth and documentation of the analysis, however, will hopefully decrease with the size of the facility. This report is a general literature review which will identify the potential environmental impacts of small-scale hydropower facilities at existing dam sites. It is written to provide background information to legislators, regulators, and developers involved in hydropower development in Minnesota. The primary purpose of the report, however, is to give individuals involved in hydropower development a basis from which to assess the environmental impact of their proposed development, and to serve as a guide in the license and permit application process.

In order to evaluate the environmental impacts of a hydropower facility, the mode of operation must be specified. Operational modes may be divided into three general categories:

1) Seasonal Peaking. Reservoirs with sufficient storage may be used for seasonal peaking, storing water during low energy demand months, and generating additional energy during high energy demand months. Very large reservoirs are often used for a combination of flood control, seasonal peaking, and low flow maintenance. Seasonal peaking is normally associated with large reservoir water level fluctuations, as well as an altered streamflow regime.

2) Daily Peaking. Many dams have sufficient reservoir storage for peaking on a daily basis. When the river discharge is below hydroplant design discharge, the hydroplant operates at maximum output during peak energy demand hours of the day by drawing down the reservoir level. During off-peak demand hours the reservoir is allowed to refill while a specified minimum stream flow is released. This operational scheme may often be accomplished with less than one foot of reservoir drawdown. The downstream flow regime, however, is still altered from that which would normally occur.

3) Strict Run-of-River. Strict run-of-river means that the natural streamflow which exists at the dam site is entirely unaltered by hydroplant operation. Although this operational mode is often preferred over daily peaking from an environmental standpoint, the economic return of daily peaking operation is normally much greater than strict run-of-river because of its ability to generate the highly valued additional energy during demand hours.

The environmental impacts of a hydropower facility depend upon the mode of operation, construction techniques, and upon many factors specific to the site. These impacts have been divided into a number of subcategories for this report, as noted in the Table of Contents. At first glance, the sheer number of environmental impacts which need to be considered can appear awesome. For most sites, however, the large number of potential impacts may be quickly reduced to a short list of potentially significant impacts, which are studied in more detail.

An effective means of screening the site-specific environmental impacts is by utilizing an environmental impact matrix as shown in Fig. 1 [3]*. The example given in Fig. 1 is for a potential hydropower development at the Fish Hook River Dam in Minnesota. The facility would be operated to provide base load, using a large amount of reservoir storage to smooth out fluctuations in flow. It was debatable as to whether flow control would be a positive or negative impact on the fishery in this case. For this development there are as many positive as negative impacts.

*Numbers in brackets indicate references on page 38.

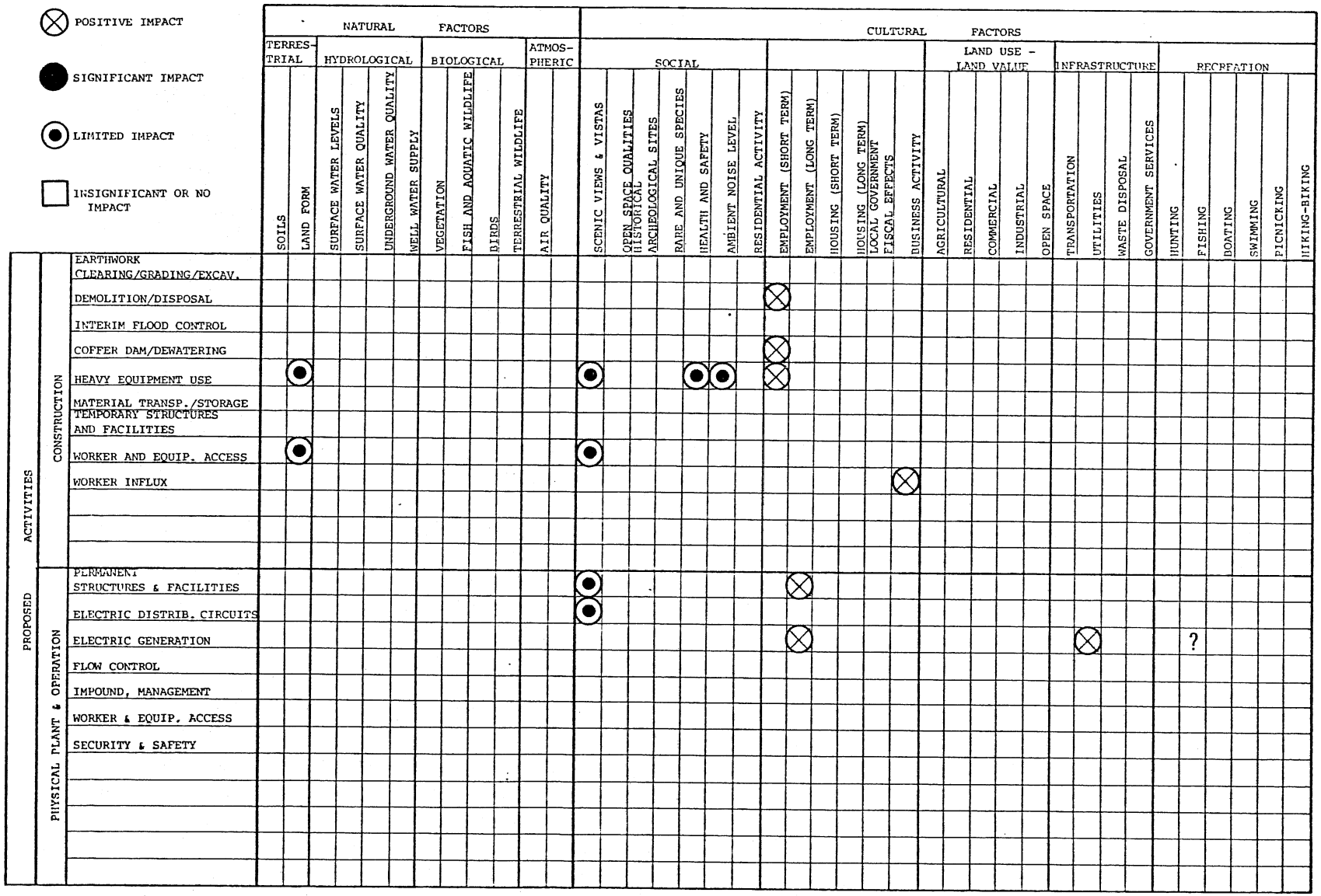


Fig. 1. Potential impacts of Fish Hook Dam Hydropower Development shown in an environmental matrix.

II. SUMMARY

The following effects are considered important in the operation of a small hydropower facility:

1) Minimum flow
2) Water level fluctuation
3) Fish passage through hydraulic turbines and upstream fish passages
4) Dredging and disposal of dredged material
5) Water quality impacts, and
6) Threatened or endangered species.

There will also be additional temporary impacts during construction. Timing of construction activities may be such that they minimize impact upon the spawning activities of fish and other facets of aquatic life.

Other construction activities which could have an adverse effect upon the environment include dredging and dust control. This is most easily controlled by installing a cofferdam to reduce excessively turbid releases to the stream. Land use impacts that should be addressed concern the fact that powerhouses and dams alter the general scenery along a river, displace streamside vegetation, and present obstacles to terrestrial wildlife species [21]. Indirect impacts of small-scale hydropower may lead to new opportunities and responsibilities for supporting recreational, commercial, agricultural and residential activity [21].

There are also several other considerations for which the degree of severity or applicability must be determined on a site-specific basis. These considerations include powerline construction, noise reduction, earthwork, historical and archaeological significance, endangered species (plants and animals), recreation (parks, canoe routes, etc.), and aesthetic quality. Also of prime importance in determining impacts would be the designation of a river or stream as a Wild and Scenic River on either a state or federal basis. There are usually no impacts incurred by the dam itself because if these impoundments have been in place a long time, it is likely that environmental modifications have already taken place. Fish and wildlife have probably been modified by the existing dam [21].

III. FERC REQUIREMENTS

The Federal Energy Regulatory Commission (FERC), in its application procedure, requires an environmental report to be filed. "The environmental report should be consistent with the scope of the project and the environmental impacts of the proposed action; e.g., authorization to operate and maintain a project... using an existing dam or other facility, would require less detailed information than authorization to construct a new project" [8].

The contents of an environmental report should include [8]:

(1) Brief description of project and mode of operation (run-of-river or peaking).

(2) Description of environmental setting in or near project area. (Special attention should be given to endangered plant and animal species, critical habitats, sites on Wild and Scenic Rivers, and sites eligible for or included on the National Register of Historic Places.)

(3) Impact of continued operation of project or from construction of a dam or hydropower facility.

(4) Description of equivalent alternative power means if the FERC license application is not authorized.

(5) Description of steps taken by the applicant in consulting with federal, state, and local agencies during preparation of the environmental report. Indicate which agencies received the final report and provide copies of letters containing the comments of these agencies.

The FERC relies heavily upon the response of state agencies to the environmental report. It is very rare for the FERC to issue a license contrary to the testimony of state agencies. This means that the battle for licensing and permits is won and lost at the state and local level, and requirements are specific to a given region.

The rules and regulations of the FERC may be obtained by writing the following address:

Division of Hydropower Licensing
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D. C. 20426
Phone: (202) 376-9171

IV. INSTREAM FLOWS AND WATER LEVEL FLUCTUATIONS

Minnesota law requires that the Department of Natural Resources establish lake elevations and minimum flows on ditches, streams, and rivers, as part of the Water Appropriations Permit for any water project. There are no standard guidelines for these regulations, however, because the potential impact of any water project is highly site-specific. This topic therefore requires a substantial effort by site developers and agency personnel to compile site-specific information and reach a resolution to the problem.

The primary impacts of hydropower development at most existing dam sites are the variation of instream flows and water level from that which would naturally occur. These variations are caused by seasonal and daily peaking operation. The importance of these two impacts is a function of operational mode and specifics of the site such as type of stream, aquatic environment, and recreational usage [14]. For example, the potential impacts of flow and water level fluctuations are not of concern at strict run-of-river projects because the operational plan does not involve the storage and release of water for peaking. Most hydropower projects in Minnesota, however, will request permission to alter streamflow and water levels because daily peaking will significantly enhance the project's economic return. Conversely, regulations on flow and water level fluctuations can severely reduce a project's economic return and, in some cases, can negate the project's feasibility. These regulations are therefore a continuing source of negotiation between developers and state agency personnel.

A. Reservoir Water Level Fluctuations

The impacts of reservoir water level fluctuations can be divided into three categories: aesthetic impacts, biological impacts in the littoral zone, and shoreline erosion [11].

The aesthetic impacts are measured by the response of people who use the reservoir to water level fluctuations. Navigation and access may be hindered, and large water level fluctuations may prevent the use of docks. Waterfront property owners may also voice concerns, especially if there is potential for a sandy beach shoreline to turn into a mud shoreline with weeds at the lowest water levels, or if a significant amount of shoreline property will be lost at higher water levels [14]. If hydroplant operation will alter reservoir water level, the permission of riparian landowners must be obtained and included in the Water Appropriations Permit Application to the DNR.

Water level fluctuation may also dewater the littoral zone (shallows), which can destroy or adversely alter spawning and shelter areas for fish

[14]. The littoral zone community may also be adversely affected if the amplitude and frequency of water level fluctuations are different than those to which the community is adapted [12].

Reservoir water level fluctuations are not a predominant issue in most Minnesota hydropower developments because a daily peaking plant can usually operate effectively with less than 2 ft of reservoir drawdown, and often with only 1/2 ft of drawdown.

To assist in determining the impact of reservoir water level fluctuations, the affected habitat area should be estimated from morphologic data. A DNR permit to work in public waters is required if water level will be altered significantly during project construction.

B. Instream Flows

1. Background

Instream flows are an important and controversial topic in the development of hydropower facilities. They are important for the following reasons:

1) Hydroplant operation generally affects a much greater stream reach downstream than upstream. In some cases, stream discharge can be altered for a reach of 200 or more miles downstream. Only the reservoir is affected upstream from the plant, corresponding to between 5 and 20 miles for a typical hydropower development in Minnesota.

2) The downstream habitat is more sensitive to a reduction in flow and the corresponding decrease in water level. This is especially important during spawning season when inadequate streamflow will reduce the success of spawning and egg incubation. In addition, migrating fish species, such as salmonoids and stream trout, have streamflow requirements during migration. Finally, a reduction of the low flow wetted perimeter will reduce the amount of benthic fauna available for harvest by fish, invertebrates, etc. This is because sections of the stream bed which are frequently dewatered generally will not provide a source of food for aquatic organisms. Maintenance of low flows, such as those exceeded 90 or 80 percent of the time, is therefore important in maintaining fish population. An extreme reduction of water level will, of course, result in more extreme adverse impacts such as the overharvest, stranding, and desiccation of fish and generally degraded stream aesthetics [17].

3) The downstream fishery is usually more important than the reservoir fishery because there is a higher concentration of fish in the fast flowing waters.

Instream flow requirements are controversial because in most states, including Minnesota, there are no specified guidelines which are generally

applied, or which may serve as a basis for negotiation. Each site is evaluated on an individual basis, and the decision is based upon the professional judgement of state agency personnel. These decisions can greatly affect the economic viability of a hydropower project. The ability to generate additional power during peak energy demand hours can add a large amount of income because the hydroplant's power is more dependable during this crucial time of the day. A high minimum streamflow requirement can restrict and even eliminate a hydroplant's daily peaking capability, thereby reducing the economic return of the project by as much as thirty percent in Minnesota. Unfortunately, the low flow periods of the year in Minnesota, such as July and August, correspond to the period when energy demand is greatest, and the peaking capability is most important.

2. Guidelines for Instream Flow Requirements

Because of time and financial constraints, the state agencies cannot spend a great deal of effort in the field evaluation of instream flow requirements for a given hydropower site. It is logical, therefore, that agency personnel will usually take a conservative approach and specify large minimum streamflows unless the developer applying for the permit can convince them that these high streamflows are not required. Applicants for a Water Allocation Permit must therefore do their homework.

Although there are no specified guidelines for instream flow requirements in Minnesota, there are a large number of methods for specifying instream flow requirements which have been suggested by various agencies throughout the United States. This report will review four methods which may be helpful in minimum streamflow negotiations.

a. Aquatic Base Flow (ABF)

The U. S. Fish and Wildlife Service formulated the ABF recommendation for the New England Region. Their recommendation is that the ABF is sufficient to maintain aquatic life under all conditions, and that for specific sites the flows required to maintain adequate protection may be significantly lower [17]. For flow records of acceptable length and accuracy, the ABF is the median August flow which is at the 50 percent exceedance level on the August flow duration curve. Additional releases may be specified during spawning and incubation periods. During these periods the monthly median flow is often specified. The spawning periods for fish species commonly found in Minnesota are listed by Eddy and Underhill [7].

The spawning months for most fish species in Minnesota are April, May, and June which are also high flow months. For most hydropower projects, minimum streamflow recommendations for these months will not greatly affect economic return because daily peaking is infrequent, e.g. there is usually sufficient flow to operate the plant for 24 hours a day. Specifying the median August flow as a minimum release during nonspawning periods, however, will often significantly alter economic return. The ability to operate in a daily peaking mode in July and August is crucial for a

hydroplant to increase its dependable capacity. Using the median August flow as a minimum flow is close to specifying that the hydroplant should operate as strict-run-of-river.

Cunningham [5] studied the impact of the ABF recommendation on 17 hydropower sites in New England and found that specifying the ABF as the minimum streamflow adversely affected the economic return of all 17 projects and changed the economic feasibility of four projects from positive to negative. The New England District of the U. S. Fish and Wildlife Service later studied the specific conditions of four of the sites, however, and determined that the required minimum streamflow would be below the ABF for all four sites. This indicates that although the ABF may be a treateningly high minimum flow, it is often not required for a given hydropower development.

b. Monthly Flow Duration Curve

The Northern Great Plains Resource Program [17] recommendations use the monthly flow duration curve, such as that given in Fig. 2 for the St. Cloud Dam. A Summary of all the monthly flow duration curves is given in Fig. 3. The method is applied as follows:

- Daily flow records are collected for a long time period, such as 25 to 50 years, and then are compiled and distributed by month into 12 separate records.
- Abnormal events such as droughts and floods are eliminated from the record using statistical criteria such as student's T-test.
- The remaining data are used to develop a flow duration curve for each month, e.g. all January data for the period of record.
- Minimum streamflow during spawning months is set at 50 percent exceedance of the flow duration curve for those months.
- Minimum streamflow during all other months is set at the 90 percent exceedance level of the flow duration curve for each month.

This method contains the implied assumption that the portions of the streambed which are submerged less than 90 percent of the time will not provide a good food base for fish and associated aquatic organisms.

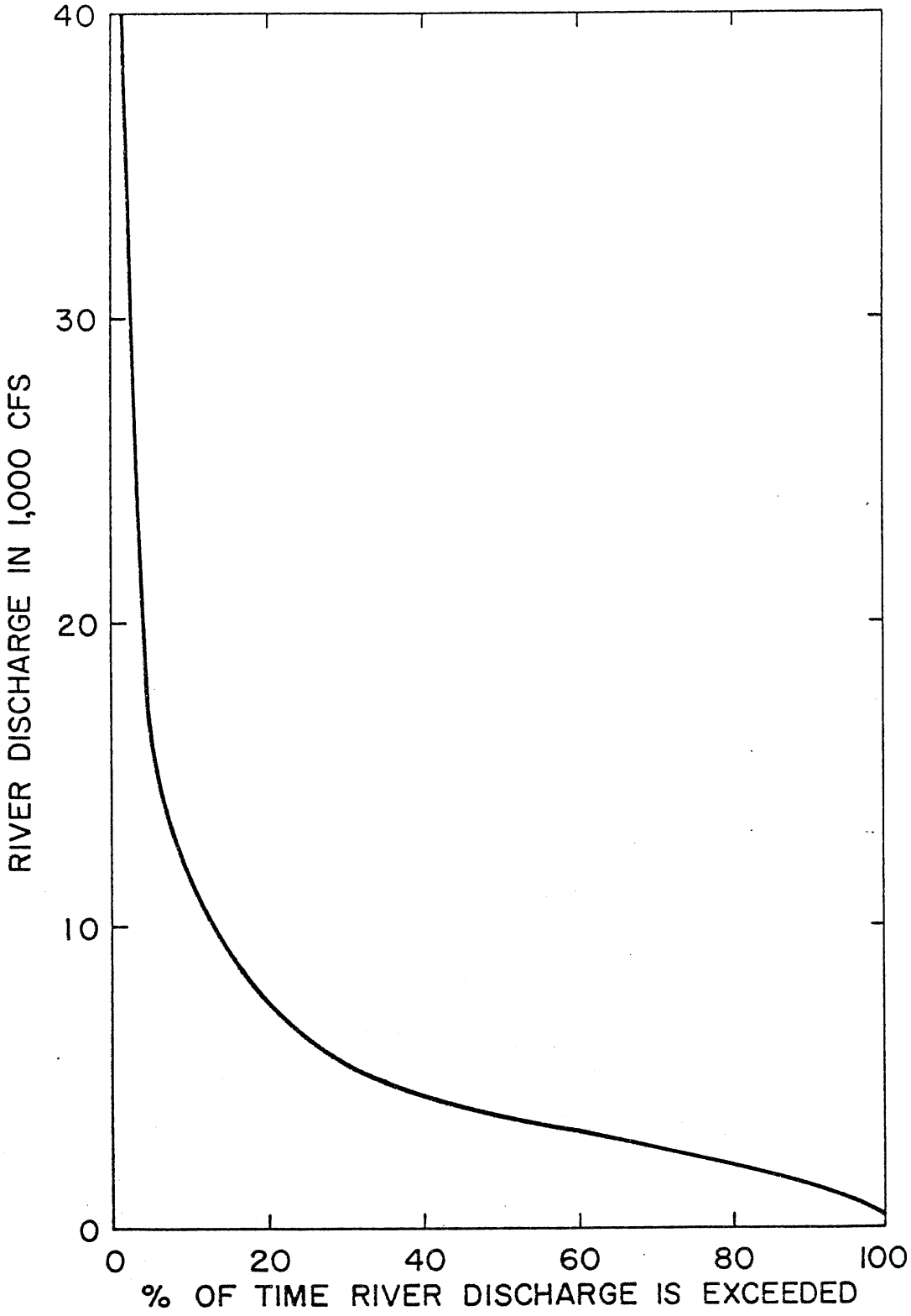


Fig. 2. July flow duration curve at St. Cloud Dam.

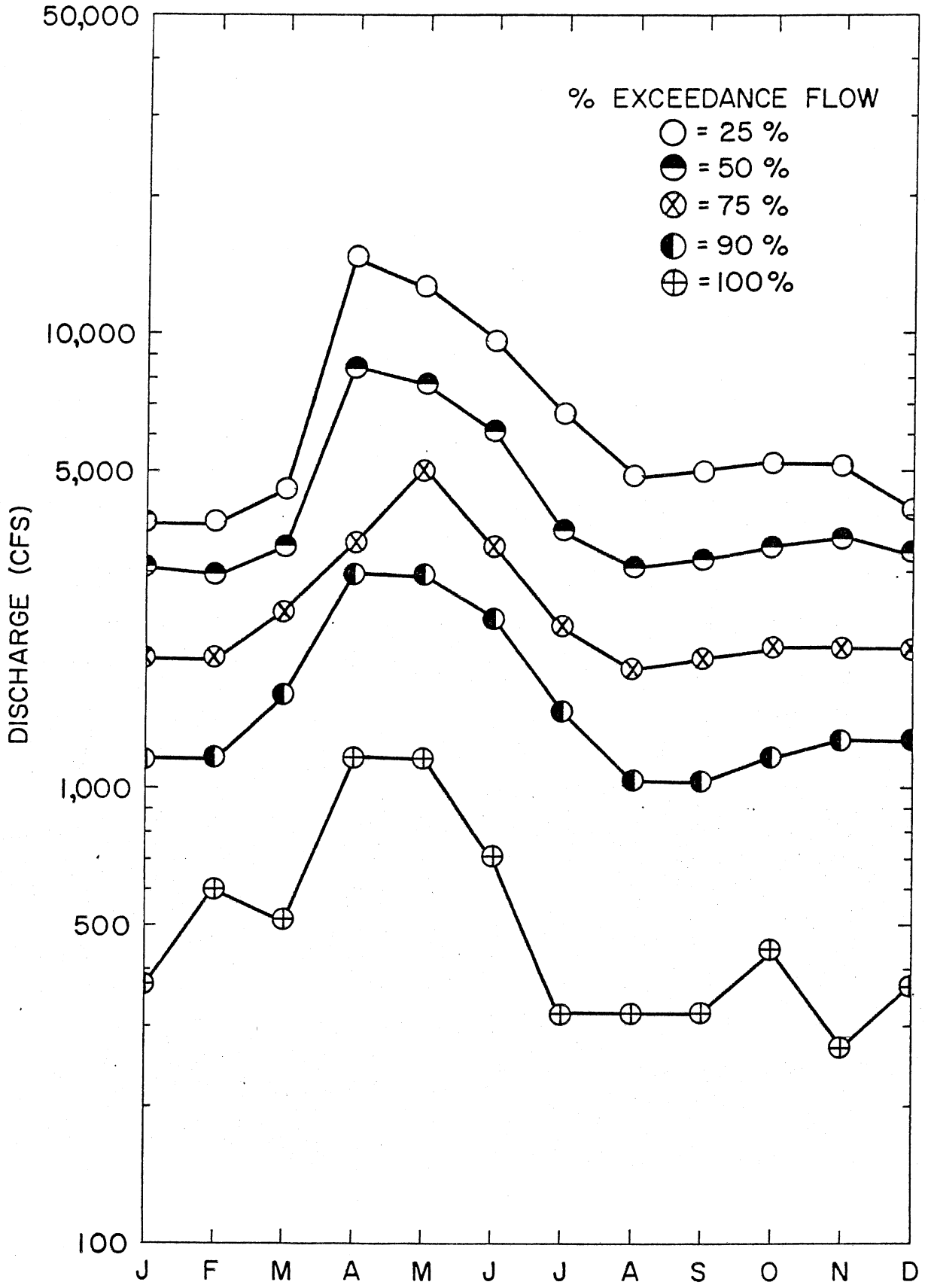


Fig. 3. Summary of monthly flow duration curves at St. Cloud Dam.

c. Habitat-Discharge Method

The habitat-discharge method was developed by the U. S. Forest Service for mountainous regions [1], but it addresses a major concern in other types of streams as well, that is, the reduction of food producing habitat. The method requires a stage-discharge curve and a depth profile curve at one or more (preferably more) downstream cross sections. The important habitat parameter, such as wetted perimeter, for the particular stream is plotted versus stream discharge as illustrated in Figs. 4 and 5. Both stream discharge and habitat parameter are represented as a percent reduction from a given index value. One problem is that there is no specified criteria for what the index value should be. The authors suggest using ABF as an index value, and then using the habitat-discharge method to determine what reduction in habitat will occur at lower values of minimum streamflow. Bartschi has suggested that a 20 percent reduction in habitat is acceptable [1].

d. Annual Flow Duration Curve

The annual flow duration curve may also be used to determine minimum streamflow. However, it does not differentiate between high and low flow months. The State of Iowa has used the 84 percent exceedance level on the annual flow duration curve to set minimum streamflow. This policy is currently under review, however [28].

These four methods were reviewed because they use information which is readily available in hydropower development projects, and they require no special biological expertise to apply. Two other criteria which are often cited are 20 percent of average annual flow (Montana Method) [25], which overemphasizes high flow occurrences and the seven-day, ten-year flow (7Q10) which was developed for waste treatment facilities and is greatly affected by drought occurrences. Neither of these two criteria offer any advantage over the four methods mentioned above.

Trout streams will generally have more restrictive minimum streamflows during the migrating season. The DNR Commissioner's Order No. 2089, given in Appendix A, lists designated trout streams in the State of Minnesota. The State of Minnesota also has a Wild, Scenic, and Recreational Rivers Program which includes 18 rivers, six of which are considered to be wild and scenic. These rivers may also be subject to more strict minimum streamflows as well as recreational flow requirements. A description of the program was supplied by the DNR and is given in Appendix B. The only federally designated wild and scenic river in Minnesota is the lower St. Croix River.

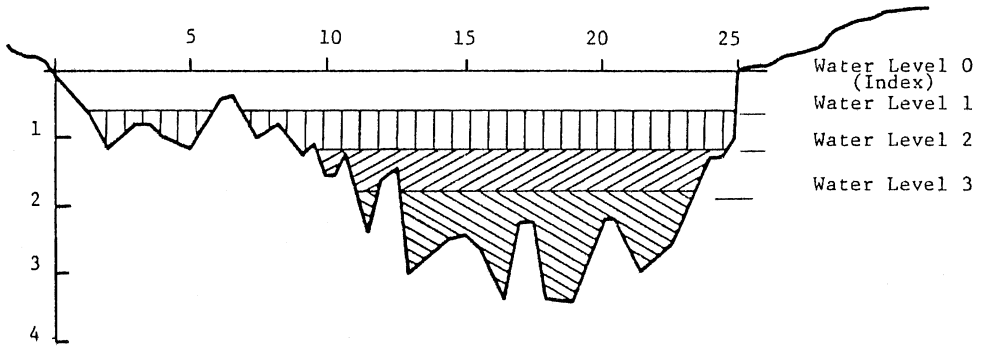


Fig. 4. A channel profile showing the measuring index discharge level and other selected discharge levels.

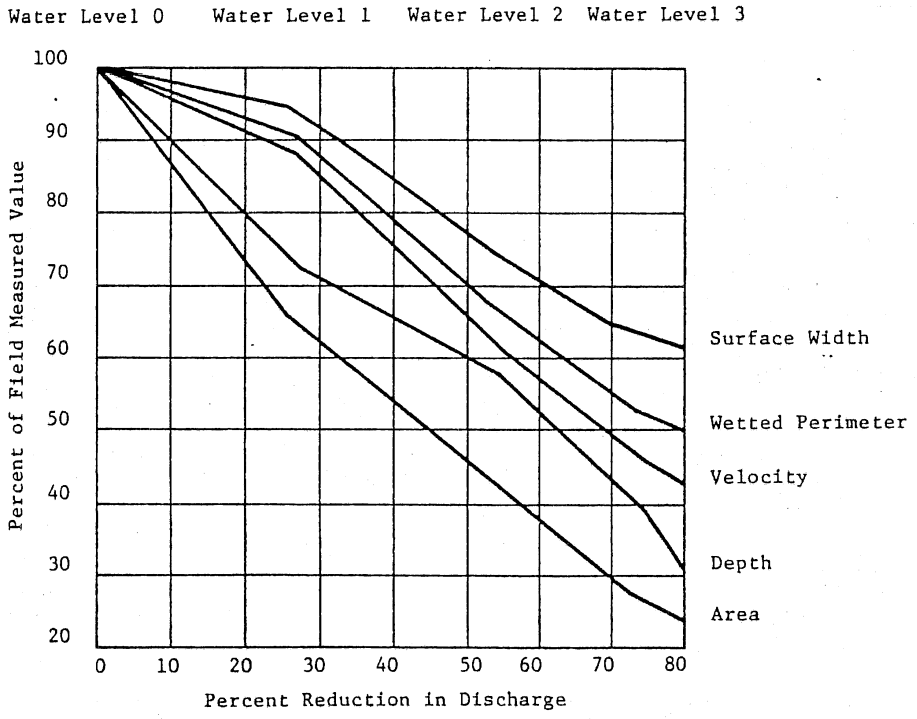


Fig. 5. Hydraulic variables at index and other selected discharge levels.

V. WATER QUALITY

A. Background

Hydropower development at existing dam sites normally will not affect the water quality of the reservoir but can have a significant negative impact downstream from the dam. For hydropower development of existing dams in Minnesota, there are three site specific conditions which require further investigation of potential water quality problems:

1. Stratified Reservoir

If the reservoir is thermally stratified and water is withdrawn from the bottom portion of the reservoir, altered temperature regimes, changes in turbidity and dissolved oxygen concentration, and increases in toxic metals and nutrients are possible downstream.

The water quality problems associated with hydropower development at a stratified impoundment are illustrated in Fig. 6. If the reservoir is greater than 5 meters deep, it will likely be segmented into three regions during the summer months:

- An epilimnion, or a surface layer, which is kept well-mixed by wind. The temperature is close to air temperature and dissolved oxygen concentration is usually high because of exposure to the air. The epilimnion is usually 3 to 5 meters deep.

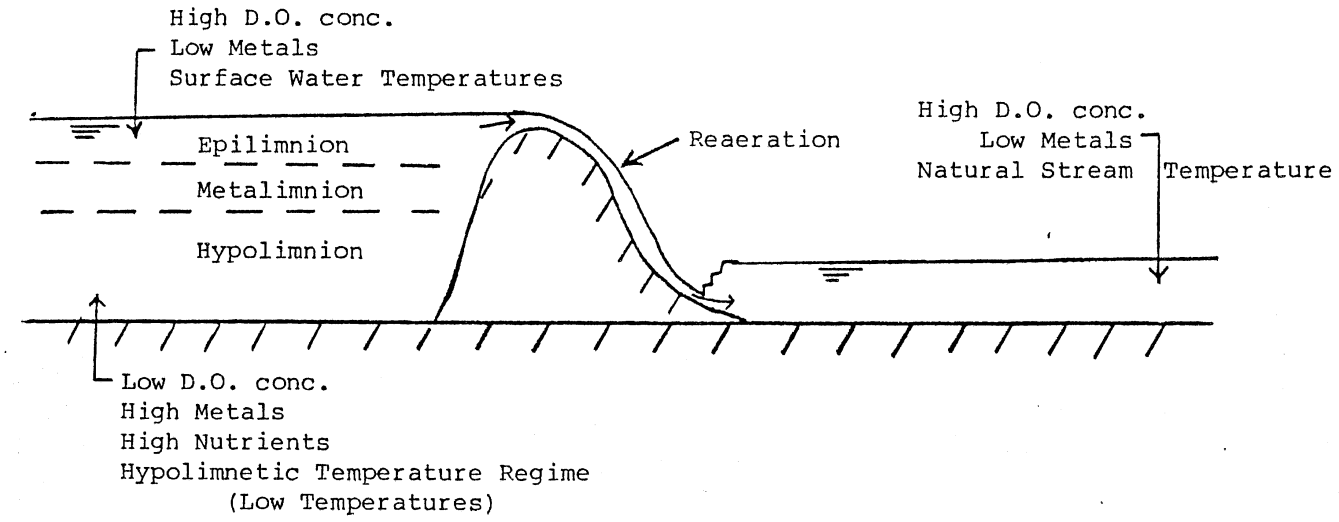
- A metalimnion, which is a relatively stratified region in which temperature drops quickly with depth.

- A hypolimnion, which is a cold, semi-mixed region at the bottom of the lake (usually 13 m depth and below). The cold water temperature is a holdover from the previous winter.

If the reservoir is moderately eutrophic (green and murky rather than clear and blue), the sediments will have a high oxygen demand and will pull almost all of the oxygen out of the hypolimnetic water before midsummer. Oxygen from the surface waters does not reach the hypolimnion because the lake is stratified, and metalimnetic mixing is very low. When D.O. concentration in the hypolimnion is near zero, nutrients, metals, toxics, etc. are released from the sediments into the water, where they remain until fall turnover.

Water quality problems may result from hydropower development at an existing dam if the hydroplant withdraws water from the hypolimnion with

WITHOUT HYDROPOWER



WITH HYDROPOWER

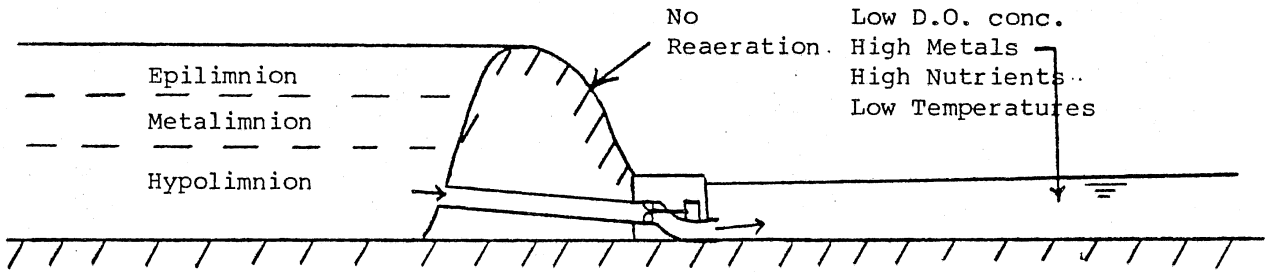


Fig. 6. Illustration of potential water quality problems associated with hydropower development.

its lower temperature and D.O. concentration, and higher nutrient and metals concentrations. Water flowing over the spillway is drawn from the epilimnion, and is very similar to what would naturally be found in a stream (Fig. 6). Water drawn from the hypolimnion by a hydroplant will have abnormally low temperatures and may have low D.O. and high nutrient and metals concentrations (Fig. 6). This will usually have a negative impact on the downstream fishery.

One means of assessing the water quality impacts of hydropower development at a dam with a stratified reservoir is to measure D.O. concentration and temperature over the full reservoir depth in late July and August, when the greatest impact will occur. The change in water temperature and D.O. concentration due to the hydroplant may then be determined quantitatively. The downstream fish population is unlikely to be affected by low D.O. unless the hypolimnetic D.O. concentration goes below 5 g/m^3. The release of nutrients, metals, and other toxics from the reservoir sediments does not normally occur until the hypolimnetic D.O. is below 3 g/m^3.

2. Low Dissolved Oxygen Concentrations

If the reservoir or downstream reach periodically experience low D.O. concentrations (below 5 g/m^3) in the surface waters, the hydropower plant may adversely affect the downstream fishery. The reason for this is that the dam spillway acts as a source of reaeration, which increases D.O. concentration. At an existing dam without hydropower, this reaeration may be one of the significant sources of D.O. during low flow. A hydroplant will eliminate this source of D.O. for approximately 75 percent of the time because the water which previously went over the spillway flows through the hydroturbines (see Fig. 6). This problem may be rectified with hydroturbine aspiration, which reaerates the water flowing through the hydroturbine. The cost of this aspiration, however, is a decrease in turbine efficiency. The Tennessee Valley Authority has considerable experience in hydroturbine aspiration [6, 24, 26] and should be contacted if aspiration is contemplated for a given site.

The spillway reaeration during a typical low flow at a dam may be determined by measuring D.O. concentration upstream and downstream of the reservoir during one or more typical low flows. Information on known D.O. measurements at existing Minnesota Dams with hydropower potential is given in Appendix B.

3. Dredging

Hydropower developments which require dredging during construction or plant operation can adversely impact the stream and reservoir through increased turbidity and an accelerated release of nutrients, organics, and toxics from the sediments.

Dredging is required at most existing dam sites to clear intake/outlet structures and to repair powerhouses. Accumulation of material may occur at a dam site over a number of years, and it may be necessary to reclaim

partial reservoir storage capacity. Dredging may also be needed during the operation of the plant if a significant amount of deposition occurs in the inlet/outlet works. The significance of impacts associated with dredging and dredged material disposal will be primarily influenced by the physical and chemical characteristics of the sediments and the amount of dredging required [12, 16].

a. Potential Dredging Impacts

The primary impacts of dredging are due to sediment resuspension which inevitably occurs, increasing turbidity and bringing contaminants in the sediments back into the water body. Some other, less severe (and usually ignored) impacts are changes in water circulation patterns, sediment particle size, and sediment porosity. In a fragile stream ecosystem, these secondary impacts may be important.

The highly turbid water released during dredging can reduce fish mobility, impair respiration of fish and other organisms, and reduce primary production by limiting light penetration. In addition, the eventual deposition of the sediments can destroy fish spawning areas and benthic habitats, and smother mussels and submerged macrophytes. If the disposal site is located adjacent to the reservoir, runoff from that site can have the same impact as the dredging operation. In most cases, dredging during spawning season is not recommended because the potential impacts are great. The spawning seasons of fish species commonly found in Minnesota are given by Eddy and Underhill [7].

The chemical and nutrient release from resuspended sediments are important because stream and reservoir sediments tend to cleanse the water body by adsorbing dissolved metals, nutrients, and other chemicals. The sediments therefore have a very high concentration of these chemicals, which are likely to be released into the water when the sediments are resuspended during dredging. The water quality can be significantly impacted if contaminants such as heavy metals and chlorinated hydrocarbons are present in the sediments. The nutrients released from the sediments can increase productivity (and make the water body more eutrophic) if the water body is not already supersaturated with nutrients. Finally, when deep anoxic sediments are exposed to open water they exert an oxygen demand upon the overlying water. The amount of oxygen used by the sediment depends upon the amount of sediment suspended, hydraulic flushing time of the water body, and the sediment's redox potential [16].

b. Dredging Guidelines

The U. S. Army Corps of Engineers, the Minnesota Department of Natural Resources, and the Minnesota Pollution Control Agency must all be contacted if dredging is contemplated at a hydropower site. The actual permits of these agencies are discussed in Section XII. This section gives some brief guidelines on determining the type of dredging method, documenting its impact (or lack thereof), and choosing mitigative procedures, when necessary. These guidelines are:

1) Determine quantity of dredging required.

2) Select dredging method. A small amount of dredging around the hydroplant intake and outlet may be performed with a mechanical dredge, which is typically a bucket type (with jaws). The advantages to mechanical dredging are a low water/sediment ratio and the fact that the dredged material may be trucked to an upland disposal area. The primary limitation to using a mechanical dredge is the distance from the streambank that dredging is required. A dragline from a mechanical dredge can operate 50 to 60 feet from the bank, as long as the bank can support the crane.

3) A larger amount of dredging is usually performed with a hydraulic cutterhead. The advantages to hydraulic dredging are less turbidity and a lower cost for large dredging volumes. The main disadvantage is a high water/sediment ratio, typically 5/1, which adds expense to disposal. Confined, upland disposal is usually recommended [16].

4) Mitigative measures can be taken to minimize the high turbidity levels which may occur with mechanical dredges. Some of these measures are:

   - the use of vertically-hanging silt curtains, or "diapers,"
   - the correct operation and maintenance of equipment,
   - the use of chemical flocculants, and
   - the use of one of the recently developed unconventional dredging systems which are designed to pump sediment at a high solids content and/or to lessen turbidity. Of these, the Mud Cat is the most popular; it is a small, portable modified hydraulic cutterhead dredge.

5) Review records and take sediment samples to determine concentrations of heavy metals, toxics, H_2S, NH_4, etc. in sediments.

6) Time dredging operation so that it does not correspond to spawning and other high productivity periods. Generally spring through midsummer should be avoided, and fall is usually best for dredging.

7) The selection of a dredging method must consider both the economics and the environmental effects of the operation [16].

c. Dredging Disposal

There are three ways to dispose of dredgings: 1) open water, 2) shallow water/wetland, or 3) upland disposal. Open water is not the desirable location for dredging disposal, especially if the reservoir is used as the disposal area, thus decreasing storage and partially defeating the purpose of the dredging. This type of disposal could have a negative environmental impact; therefore, a state water quality certificate must be applied for under Sec. 401 of the Federal Water Pollution Control Act [16].

Disposal of any dredged material on wetlands is controlled under Sec. 10 of the Rivers and Harbors Act and Sec. 404 of the FWPCA (administered by the U.S. Army Corps of Engineers), and a state water quality certificate is also required [16]. Due to the environmental impacts of placing dredgings in a wetland and the current policy of wetland protection, this type of disposal is also undesirable.

In order to increase the storage capacity of an impoundment, the dredged material would have to be removed from the reservoir and placed in confined or unconfined upland (not in water or a wetland) disposal. Plantico [21] has stated that only uncontaminated wastes should be considered for unconfined disposal since "dumping the spoil on the river's bank" (or nearby) "might result in sediment runoff and possible toxic pollution where chemicals are found in the dredged spoil." The most environmentally sound alternative, especially for contaminated (but not toxic) wastes, is confined upland disposal [16]. The use of specialized dredging equipment along with confined upland disposal may be necessary, however, if the sediments are highly contaminated, and this normally results in high transportation costs [3]. Confined upland disposal has not been practiced to a great extent, so its environmental effects are not well known. Although contamination of surface water and groundwater could occur, it would be to a much lesser degree than in unconfined disposal [16].

Other problems that could occur as a result of improper management of the dredging disposal are odors, mosquito breeding, and an increase in the number of undesirable wildlife [16]. However, a well-managed operation could produce such benefits as fertile land production, the filling of strip-mines and landfills, and others, posing no threat to either the terrestrial or aquatic environment [21, 26].

Highly contaminated dredgings that are defined as "toxic" are controlled by the U. S. Environmental Protection Agency under Sec. 6(e)(1) of the Toxic Substances Control Act and under the Solid-Waste Disposal Act (as amended by the Resource Conservation and Recovery Act of 1976). These dredgings must be disposed of at approved hazardous waste sites. Since Minnesota does not yet have such a facility, the toxic dredging wastes must be transported to an appropriate site out-of-state, therefore causing the transportation costs to be quite high.

For nontoxic dredgings, the type of permit required depends on the type of water the dredging takes place in. "Navigable waters," as defined

by the Corps of Engineers, are called Sec. 10 waters, and any dredging in such waters requires a permit. Section 404 waters require a permit for the placement of the dredged material but no permit is required for the dredging itself. A map published by the Corps of Engineers shows Sec. 10 and Sec. 404 waters. For dredging amounts of less than 10 yd^3, a nationwide permit can be applied for instead of the permits listed above. The processing time for the nationwide permit is two to three weeks, much less than the two months it takes for the regular permits [15].

Due to the greater amounts of dilution water used, hydraulic dredging creates larger volumes of dredged material than mechanical dredging, and therefore requires a larger disposal area. The environmental impacts on the disposal area could then also be greater, as could the costs. The greater amount of dilution water would also cause the surface runoff from the disposal site to be greater than the runoff from mechanically-dredged material [16].

4. Reservoir Flushing

In the case of an impoundment which fills rapidly with silt during operation and therefore needs to be flushed periodically, the water quality of the stream is adversely affected [10]. The effects are similar to that of dredging. The sudden release of water high in turbidity and in dissolved and suspended solids can lower the dissolved oxygen concentration downstream and can result in fish kills and the disappearance of some insects [10]. The turbidity, solids concentration and dissolved oxygen concentration could also be in violation of water quality regulations.

If flushing is necessary, measures should be taken to lessen the effects on the downstream environment. These measures could include: avoiding flushings during peak spawning times so that uninhibited spawning can occur, adhering to an annual schedule of flushing so that insects can recolonize, and maintaining a minimum flow downstream in order to increase fish egg and larvae survival and decrease insect losses [10].

For an impoundment which would not be conducting periodic flushings, water quality may improve since suspended material could have enough time to settle out, and some dissolved material and bacteria could break down into less harmful species [23]. However, impoundments may have a negative impact upon water quality in some ways. One negative effect could be the leaching of plant nutrients and other soluble inorganics from soil that is not usually water-covered but is now flooded (due to water-level fluctuations). The decay of flooded vegetation can also release these chemicals into the water [23].

B. General Water Quality Criteria

The water quality of a stream or reservoir is dependent upon a large number of parameters; the primary ones being water temperature, dissolved oxygen concentration, pH, biochemical oxygen demand (BOD), suspended and dissolved solids, and toxic metals. Other substances, such as selenium and

cyanide, may also be present and will adversely affect the quality of water.

The purpose of this section is to give background on when the water quality of a stream or reservoir is poor, good, or somewhere in between. A hydropower development is less likely to adversely impact water quality when that water quality is generally good. If the water quality of a site is poor, however, there is a greater chance that hydropower development will further degrade the condition, and greater care should be taken.

The California State Water Quality Control Board has published an extensive review of water quality criteria which will be summarized on the relevant topics herein.

1. Water Quality Without Toxic Substances

In the absence of toxic substances or pollutants, water which meets the following limits will support a good mixed fish fauna:

1) Dissolved oxygen, greater than 5 mg/ℓ,

2) pH, between 6.7 and 8.6, with extreme occurrences within the range 6.3 to 9.0,

3) Specific conductance, 150 to 500 mhox10^{-6} at 25°C,

4) Free carbon dioxide, less than 3 cc per liter,

5) Ammonia, less than 1.5 mg/ℓ, and

6) Suspended solids, such that the light intensity at 5 meters depth is greater than one millionth of that at the surface.

If a water body meets the above criteria, and toxic substances are not present in amounts greater than those given below, its water quality is generally considered to be good.

2. Water Quality Impact of Toxic Metals

The sediment of a stream or reservoir act as a "trap" of metallic substances through adsorption onto sediment surfaces. These metallic substances are then released slowly over time, often many years after they were adsorbed by the sediments. If there is some past source of toxic metal pollution at or upstream from a site, the toxic metal concentration may be high enough to harm the fishery. This section considers the permissible limit of a number of toxic metals which may occur at a hydropower site. If the toxic metal concentration is above a permissible level at a given site, care must be taken to insure that the development does not further degrade the fishery.

The California State Water Quality Review Board has indicated the following limits for toxic metal concentration, above which the fishery may be harmed:

Substance	Maximum Concentration Before Adverse Impact on Fishery
Arsenic	1.0 mg/ℓ
Cadmium	0.01 mg/ℓ
Iron	0.2 mg/ℓ
Lead	0.1 mg/ℓ
Manganese	1.0 mg/ℓ
Mercury	0.01 mg/ℓ
Nickel	1.0 mg/ℓ
Selenium	2.0 mg/ℓ
Zinc	0.01 mg/ℓ
If no trout are present	0.1 mg/ℓ
Total Metals (sum of Above)	1.0 mg/ℓ

These limits are purely informational and are not standards to be strictly followed. If any of the above limits at a potential site are approached, a more detailed analysis of the impact of the development upon toxic metal concentrations may be necessary.

VI. FISH PASSAGE

A. Fish Mortality in Turbines

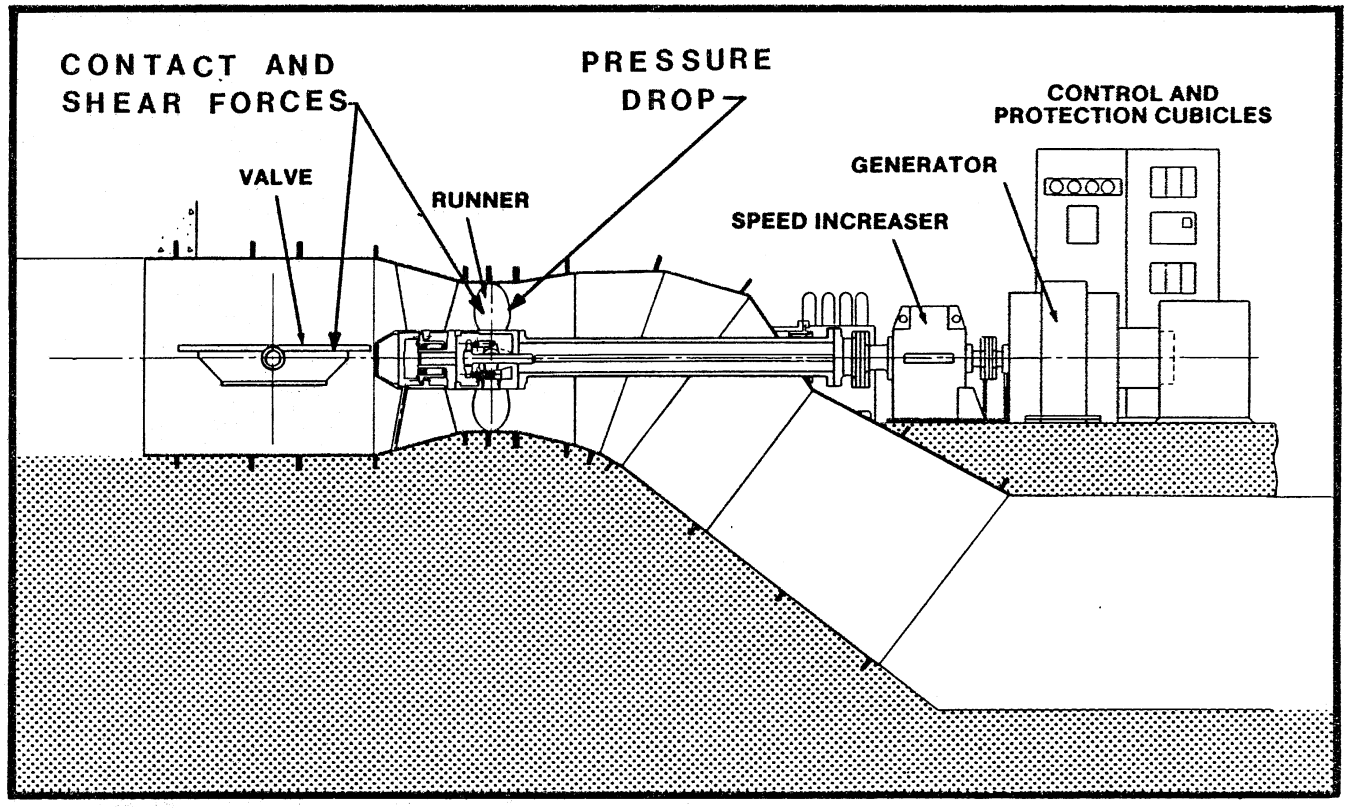
An impoundment acts as a barrier to the migration of fish. Since the scope of this report is limited to hydropower development at existing dam sites, it is evident that the environmental impact due to the impoundment has already taken place. At sites where turbines are presently operating, fish pass either over the spillway or through the hydraulic turbines, depending upon the natural river flows. At sites where power generation has been stopped, fish pass only over the spillway. Existing impoundments usually create two separate environments; namely, the two reaches upstream and downstream. The habitats and populations of fish in each reach can vary greatly.

For instance, fish populations (as determined through electrofishing) show that, in general, more fish exist downstream of the impoundment. This is primarily due to the fact that fish prefer the fast rushing water over the slow moving water behind the impoundment. Therefore, fish in the downstream reach may be affected not only by the fluctuating water levels, but also by passage through the turbines.

The mortality of fish passing through hydraulic turbines has been shown to correspond to various turbine characteristics [27]. The survival of fish, for example, is found to be at a maximum when the turbine is operated at maximum efficiency. Furthermore, fish survival is greater when cavitation is eliminated in turbine operation.

Most of the new standardized turbine designs, such as that given in Fig. 7, have not been tested for fish mortality. However, many of the standardized designs are of the propeller type. Studies have been conducted on similar turbines in the past. Turbak et al. [27] have reviewed these studies and concluded that of the many factors affecting fish passage through turbines..."cavitation is believed to be the most serious. Decapitation and the production of 'pulpy' tissues and internal hemorrhages are examples of severe injuries attributable to cavitation. Pressure changes of a magnitude less than those producing cavitation can also be harmful to fish. In addition, shear forces produced by rapid changes in the direction of water flowing through the unit and contact between fish and the turbine's mechanical features (runner hub, runner blades, wicket gates, etc.) may cause mortality" [27]. In general, total mortality increases as the tailwater load is dropped, even though the point of cavitation is not reached.

Fish mortality is also directly related to the pressure drop which occurs across the turbine, i.e. net head. Turbine mortality is greater in



FISH SURVIVAL IS GREATEST WHEN

1. TURBINE IS OPERATED AT MAXIMUM EFFICIENCY
2. CAVITATION IS NOT PRESENT

Fig. 7. Descriptive sketch of the sources of fish mortality in a turbular turbine.

turbines with a larger net head, and the corresponding larger pressure drop through guide vanes and runner blades. Fish mortality tests on the Columbia River indicated a fingerling survival rate of 90 to 95 percent, with a net head of 91 ft [20]. The Rock Island project, on the other hand, had 97 percent fingerling survival with a net head of 41 ft. The high survival rate was due to the relatively low net head and the smooth passageways of the bulb turbine installation at Rock Island.

It must be emphasized, however, that turbine mortality is just one means by which a fish could die in its travel downstream. For example, at existing dams, fish have historically been passed directly over spillways as well as through turbines. Trash racks located at the intake to turbines have metal bars which are spaced so that only the smallest fingerlings may pass into the turbines. This partially eliminates possible fish mortality at the source. It is also possible that impingement against the trash racks may injure fish, if trash rack velocities are high.

B. Migrating Fish Passage

The United States Fish and Wildlife Service (USFWS) encourages the construction of facilities that allow for the upstream passage of fish around dams, including dams already in place. This construction is encouraged because the USFWS found that fish will attempt to migrate upstream around a dam, even after the dam has been in place for many years [18]. However, the Minnesota Department of Natural Resources (DNR) takes a different position. Due to the undesired presence of rough fish such as carp and bullheads, the DNR does not want fish passageways to be constructed at existing dam sites in order to discourage the migration of these rough fish. Fish passageways would only be needed at new dams and at dams that are on trout streams [30]. This policy is beneficial to hydropower developers since these fish passageways are costly to build, and the entire cost must be borne by the developer. If fish passages are required, the design of the passages must be approved by the USFWS personnel, who have no incentive to reduce costs [2].

Whether fish passageways will be required or not has to be decided on a site-specific basis. Developers of dams located on trout streams should contact the DNR to determine if passageways will be required. The DNR Commissioner's Order No. 2089 lists all of the designated trout streams in Minnesota by county. A summary of design considerations for passageways is given by Hildebrand, et al. [13].

VII. OTHER CONSTRUCTION IMPACTS

In some circumstances, it is possible that the impacts due to construction activities may be greater than impacts associated with normal plant operation. The impacts related to dredging and disposal of dredged material have been discussed previously. It should be emphasized, however, that an analysis of the accumulated sediments should be taken to determine whether or not the sediments contain large amounts of nutrients or significant levels of toxic substances.

Other impacts may result from excavation and clearing activities. For example, removal of vegetation, disposal of spoil and changes of land form may collectively or individually lead to erosion if not adequately protected. An interruption in releases during construction could possibly affect aquatic wildlife and downstream users. This may be considered necessary in circumstances where building in the stream bed may result in temporary increases in stream turbidity. Related impacts involving noise and dust control must also be mitigated.

Mitigation of several of the above impacts may be achieved by damping for dust control, reseeding of vegetation and spacing of blasting to avoid disturbance (e.g. if recreation users are nearby). Depending on the design and existing outlet works, cost increases (in the mitigation effort) might also result where the releases from the reservoir must be maintained during the construction period [29].

The Minnesota DNR Permit to Work in Public Waters has special provisions which may be applied to a hydro project. One of these provisions calls for seeding, or some other form of covering/protection, to be applied after the construction is completed in order to prevent soil erosion, sedimentation and discoloration of the water.

VIII. HISTORIC PRESERVATION

In the course of FERC's licensing procedure, the Advisory Council on Historic Preservation and the State Historic Preservation Officer must be consulted to assure that no historic or cultural sites will be adversely affected. Novak [19] observes that,

> "Many older hydropower sites, while not of national significance, have played an important role in the local history of an area and thus are important enough to stimulate local concerns. Additions and other needed alterations of the exterior of a structure should be designed in keeping with the historic and aesthetic value of an area, especially if other historic structures are in close proximity."

Sites on the National Register of Historic Places are given special protection by federal law. It is therefore important to review each site for potential archeological, cultural, and historical significance.

Two examples of older hydropower plants with historic significance are the Granite Falls and Park Rapids hydroplants, shown in Figs. 8 and 9. Both of these hydroplants have contributed significantly to the early history of the respective cities. The Granite Falls hydroplant was built in 1882 and is one of the oldest hydropower facilities still in operation. The Park Rapids hydroplant was originally the center of industry in the City of Park Rapids, and was operated from 1910 through 1943.

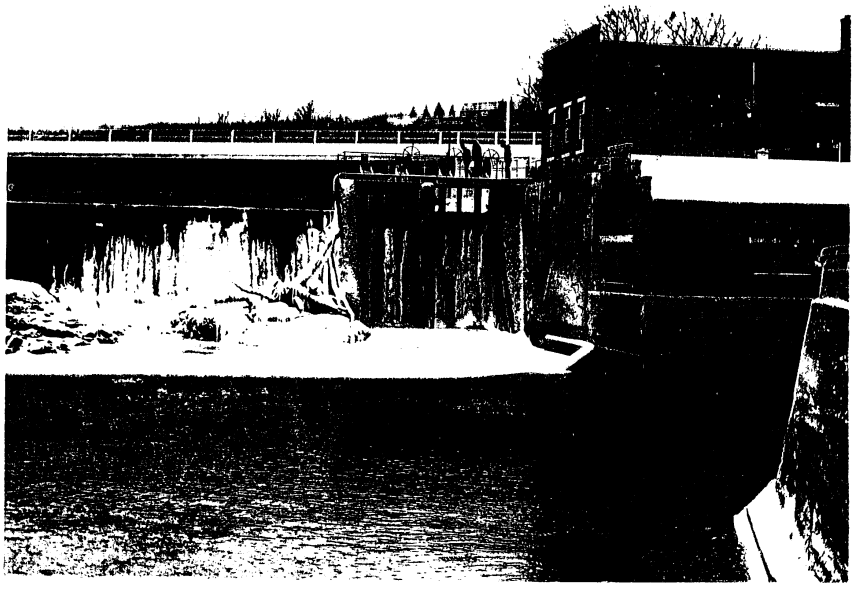


Fig. 8. Granite Falls hydropower plant. View from downstream.

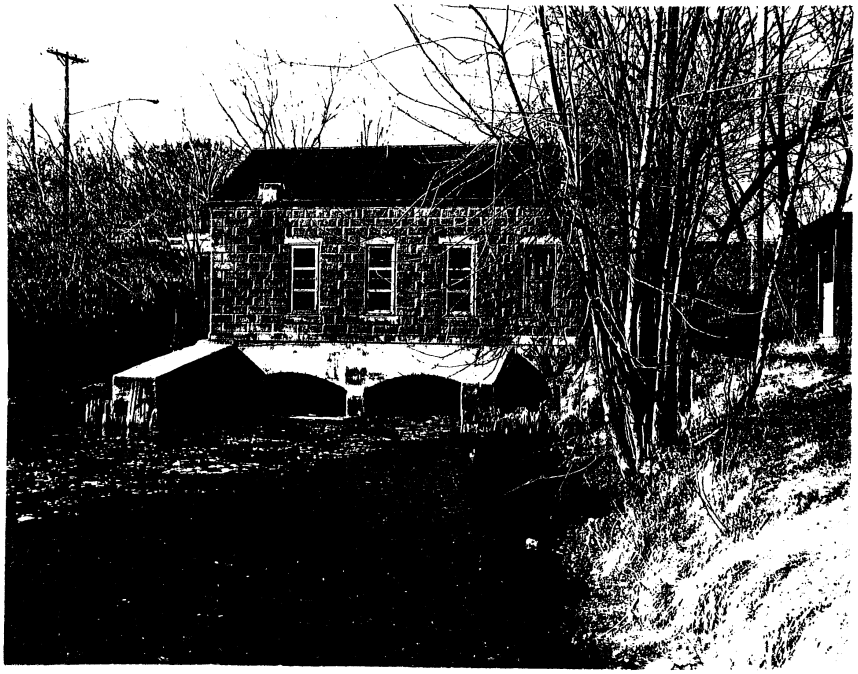


Fig. 9. Park Rapids hydropower plant. View from downstream.

IX. ENDANGERED SPECIES

The most difficult environmental issue to mitigate is the presence of a threatened or endangered species or its critical habitat in the vicinity of a proposed hydrolectric site. Mitigative measures will vary depending upon the distribution and abundance of the species at the site and the proposed design and operation of the project. At sites where the occurrence of an endangered species or its critical habitat is suspected, personnel in the appropriate state and federal agencies should be consulted. Such consultation should take place during the initial stages of project development.

Hydropower development at existing dams will not normally impact threatened or endangered species because the habitat alterations associated with construction of a new dam have already occurred. In some cases, water level fluctuation, reduced flow, or an impaired water quality will impact an endangered species.

The mussel populations which exist below the spillway are impacted by hydropower development at an existing dam because there will be no flow over the spillway a large portion of the time. If the stream has been degraded by siltation from erosion and construction activities in the watershed, the small region below the spillway is often the only portion of the stream where the mussel population is intact. That population may contain threatened or endangered mussel species [12].

X. RECREATION

Through the Wild and Scenic Rivers Act of 1968, The U. S. Government can designate rivers as wild, scenic, or recreational. The designation depends upon the degree of development of the river. A river with an existing dam can still be designated as recreational. The problem is that the current policy of FERC is not to license these dams to produce electricity. This policy holds, even if the qualities which give the river its designation can be preserved in the development and operation of the hydroplant [2].

The Minnesota Wild and Scenic River Law also designates rivers in such a manner. A dam located on a State Wild and Scenic River is usually regarded as an "existing use," so there should not be any problem encountered in the development of the site for hydropower. However, the Minnesota DNR will pay more attention to such an application than to an application for a site on a nondesignated river. On the designated rivers, run-of-river is the state recommended mode of operation [31].

XI. THE POSITIVE IMPACTS OF HYDROPOWER DEVELOPMENT

Although this study focuses on the assessment and mitigation of the negative impacts of hydropower development, there are many positive impacts which should not be discounted. The most obvious is the supply of power and energy. Hydropower development should be compared with other sources of power and energy, such as nuclear power, which has yet to solve the problem of radioactive waste disposal, and coal-fired power, which is the primary cause of acid rain. The eventual impacts of these two sources of power are difficult to determine, and the cost of mitigation is correspondingly elusive. The impacts of hydropower development, on the other hand, are local and immediate. Assessment of the impacts and mitigation measures are a problem of the present, rather than the future, and the results are more definitive and, in the authors' opinion, less of a risk.

Another positive impact is employment. Developing a hydroplant will provide short-term employment during construction and long-term employment in the operation and maintenance of the plant.

Although water level fluctuations are usually a negative impact of hydropower development, they can be positively influenced in some situations. A reservoir which is poorly managed or unmanaged may have an improved water level control with a hydroplant because water level is so important to plant operation.

Historic preservation is often a positive impact of rehabilitating a retired hydroplant. The retired hydroplant is usually a significant part of local history. Many towns and cities in Minnesota were founded on the basis of a good hydropower location, and the hydroplant is associated with early development in the region. These retired hydroplants are normally in a certain degree of decay. Plant rehabilitation, even if new equipment is installed, will restore the structural integrity of the powerhouse and eliminate the appearance of decay.

XII. CONTACTS AND CORRESPONDENCE WITH FEDERAL, STATE AND LOCAL AGENCIES

Close coordination with public agencies is essential early in the developmental phases of a hydropower project to assure that regulatory requirements and acceptable policies become known. Hildebrand, et al. [12, 14] have also addressed this topic.

> "Both beneficial and adverse effects of small hydropower development will be a function of project design and operation as well as the nature of the existing environment that will be altered. Successful mitigation of adverse effects associated with such development will depend upon (1) accurate prediction of the magnitude of adverse impacts and (2) early awareness of potentially significant environmental issues. Ecologists and environmental scientists must be consulted during the preliminary design phase of project development. By defining the relevant environmental issues at this stage, meaningful discussions can be held with all responsible and interested agencies and groups" [14].

It should be noted that mitigation of impacts at existing dam sites should be viewed in the context of an already perturbed environment. Feasibility studies completed to date and referenced by Carlisle [3] have validated this assumption: "The experience of our firm in conducting feasibility studies at three hydroelectric sites indicates that identifiable adverse environmental impacts associated with restoration of the three facilities are relatively minor."

This section discusses contacts and correspondence with Minnesota state and local agencies that is required or recommended for hydropower development. In addition, required permits from federal agencies, excluding the FERC, are included. These agencies are as follows:

1. Minnesota Department of Natural Resources

   a. Division of Waters

      The Division of Waters issues a Permit to Work in Public Waters, which also includes a Dam Safety Permit. The Permit to Work in Public Waters covers the concerns of:

      - work in public waters,
      - water appropriation,
      - dam safety or dam modification,

- water regulation and usage,
- fish and wildlife habitat, including rare species, and
- recreation.

It is therefore the most comprehensive permit issued for a hydropower project. The Division of Waters consults with DNR personnel from Fisheries and Recreation in reviewing the permit application. The permit will usually include restriction on construction practices, minimum streamflow regulations, and restrictions on water level fluctuation. Consultation with the DNR on minimum streamflow requirements should be undertaken well before submitting the permit application [22].

The Division of Waters also issues a Permit to Appropriate Groundwater, which includes surface water. This permit is usually required only if water is taken out of the stream and returned at another location, as in a diversion or a long penstock.

b. Division of Wildlife

The Division of Wildlife should be consulted to determine whether there are any endangered species present at the project site.

Inquiries can be made to:

Director
Division of Waters
Department of Natural Resources
444 Lafayette Road
St. Paul, MN
Attn: Development Section

2. Minnesota Pollution Control Agency (PCA)

The PCA is involved in 401 Certification, a federal permit to which the state can apply conditions. The 401 Certification covers general water quality and land disposal of dredgings. The general requirements of the MPCA for certification are given in Appendix D [9].

Inquiries can be made to:

Minnesota Pollution Control Agency
Division of Water Quality
Permit Section
1935 West County Road B2
Roseville, MN 55113
Phone: (612) 296-7221

3. U. S. Army Corps of Engineers

The U. S. Army Corps of Engineers issues permits for dredging and dredging disposal. Section 10 (navigable) waters require a dredging permit. Section 404 waters require a permit for placing the dredge material, but not for the dredging itself. Section 10 and 404 waters are defined by law, and listings of these waters can be obtained through the Corps of Engineers [15].

A Nationwide Permit may be applied for instead of a 404 Permit if the following conditions are met:

- the dredge material is less than 10 yd^3,
- the project's capacity is less than 1.5 MW,
- the project qualifies for short form FERC licensing, and
- the project has minimal environmental impact.

The Nationwide Permit generally has a much shorter processing time. The special conditions of the Nationwide Permits are given in Appendix E [15].

Inquiries can be made to:

Department of the Army
St. Paul District
Corps of Engineers
Regulatory Functions
1135 U.S. Post Office Bldg.
St. Paul, MN 55101
Phone: (612) 725-7777

4. Minnesota Department of Energy, Planning, and Development

This department issues certificates regarding power plant siting for the following conditions:

- If the plant capacity is greater than 50 MW, a Certificate of Site Compatability and Certificate of Need are required.

- A Certificate of Need is also required for the construction of 200 kV transmission lines greater than 50 miles in length, or of 300 kV transmission lines greater than 20 miles in length.

Inquiries can be made to:

Minnesota Department of Energy,
Planning & Development
Energy Division
980 American Center Building
150 East Kellogg Blvd.
St. Paul, MN 55101
Phone: (612) 296-5120

5. Environmental Quality Board

The Environmental Quality Board (EQB) is the primary government unit responsible for Environmental Assessment worksheets (EAW) and Environmental Impact Statements (EIS).

The purpose of the EAW is to provide information on a project in order to determine whether or not an EIS is needed. The Minnesota Department of Energy, Planning, and Development recommends that project developers complete an EAW, even if not mandatory, in order to bring the project before the public early in the development sequence and avoid delays later in the project [4]. If the EQB gives a "negative declaration" on the EAW, an EIS will not be required.

The various aspects of the EAW are reviewed by a Responsible Government Unit (RGU), which prepares a response. An EAW is required if a hydropower project meets any of the following criteria (6 MCAR S 3.038).

- Total plant capacity of 25 MW or greater. The EQB is the RGU.

- Construction of a transmission line with a nominal capacity of 70 kV or more, and length of 20 or more miles in Minnesota. The EQB is the RGU.

- A new or additional permanent impoundment of water creating a water surface of 160 or more acres. The DNR is the RGU.

- The diversion or channelization of a designated trout stream or a natural watercourse with a total watershed of ten or more square miles. Local unit of government is the RGU.

- Projects that will change or diminish the course, current or cross section of one acre or more of any protected water or protected wetland, except for those to be drained with a permit pursuant to Minnesota statues. Local government unit is the RGU.

- Projects that will change or diminish the course, current or cross section of 40 percent or more or five or more acres of a Type 3 through 8 wetland (as defined in U.S. Fish & Wildlife Service Circular No. 39-1971 edition) of 2.5 acres or more, excluding protected wetlands, if any part of the wetland is within a shoreland area, delineated flood plain, a state or federally designated Wild & Scenic River District, the Minnesota River Project River Bend Area, or the Mississippi Headwaters Area. Local government is the RGU.

- A new appropriation of either surface or groundwater averaging 30,000,000 gals/month or exceeding 2,000,000 gallons in any day during usage period. The DNR is the RGU.

- Projects resulting in the permanent physical encroachment on lands within a national park, state park, wilderness area, state lands and waters within the BWCA, scientific and natural area, or state trail corridor when the encroachment is inconsistent with laws applicable to or the management plan prepared for the recreational unit. The DNR or local government unit is the RGU.

- Destruction of a property that is listed on the National Register of Historic Places. The permitting state agency or local government unit is the RGU.

An Environmental Impact Statement is required if a project meets any of the following criteria (6 MCAR S3.039).

- Construction of a large electric power generating plant (50 MW or more). The EQB is the RGU.

- Construction of a high voltage transmission line (200 kilovolts or more). The EQB is the RGU.

- Projects that will eliminate a protected water or protected wetland except for those to be drained with a permit pursuant to Minnesota statutes. Local government unit is the RGU.

The following projects are specifically exempt from EAW and EIS requirements (6 MCAR S 3.041, 3.043).

- Construction of an electric generating plant or combination of plants at a single site with a combined capacity of less than 5 MW.

- Construction of a transmission line with a nominal capacity of 69 kilovolts or less.

- A new or additional permanent impoundment of water creating a water surface of less than 10 acres.

- All National Pollutant Discharge Elimination System Permits granted by the Minnesota Pollution Control Agency under the authority given by the U. S. Environmental Protection Agency are exempt unless otherwise decided by the EQB.

- Any federal permits for which review authority has been delegated to a nonfederal governmental unit by the federal government may be exempted by resolution of the EQB.

Finally, for those projects which fall within the range between an exempt and a required EAW, the RGU will determine if an EAW should be required. Any challenges to decisions made by the RGU are to be resolved by the RGU itself.

Inquiries can be made to:

Environmental Quality Board
Room 100, Capitol Square Bldg.
St. Paul, MN 55101
Phone: (612) 296-2723

6. Minnesota Heritage Program

The Minnesota Heritage Program is concerned with rare or endangered species which may be impacted by project development. This program is a part of the DNR Environmental Review Process; however, during early project phases they may be contacted directly at the following address:

Minnesota Heritage Program
Division of Fish and Wildlife
Department of Natural Resources
3rd Floor Centennial Office Bldg.
658 Cedar Street
St. Paul, MN.
Phone: (612) 296-4284

7. Minnesota Historial Society

The Minnesota Historical Society will provide information on the historical significance of a dam and powerhouse. Contract:

Minnesota Historical Society
690 Cedar Street
St. Paul, MN. 55101
Phone: (612) 296-6126

8. Watershed Districts

A permit may be required from the local watershed district. The local district should be contacted.

9. County and/or Township

The individual county and/or township may have zoning or shoreline management requirements and should be contacted.

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APPENDIX A

STATE OF MINNESOTA, DEPARTMENT OF NATURAL RESOURCES

COMMISSIONER'S ORDER NO. 2089

Regulations Designating Trout Streams

and Regulating the Taking of Fish Therein

STATE OF MINNESOTA, DEPARTMENT OF NATURAL RESOURCES

COMMISSIONER'S ORDER NO. 2089

STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
COMMISSIONER'S ORDER NO. 2089

REGULATIONS DESIGNATING TROUT STREAMS AND REGULATING THE TAKING OF FISH THEREIN, SUPERSEDING COMMISSIONER'S ORDER NO. 2062

Pursuant to authority vested in me by law, I, Joseph N. Alexander, Commissioner of Natural Resources, hereby prescribe the following regulations designating trout streams and regulating the taking of fish therein.

Section 1. The following described streams and portions of streams and their tributaries within the sections specified are hereby designated as trout streams. The abbreviations "T.", "R.", and "S." as used herein mean Township, Range and Section, respectively, within the specified counties.

AITKIN COUNTY	T.	R.	S.
Libby Brook	50	23	5,6
	50	24	1,2
Long Lake Creek	46	25	10,15
Morrison Brook (also Itasca Co.)	52	26	4,9,10,14,15
Two Rivers Springs	51	23	19
	51	24	24,25,26
BECKER COUNTY			
Dead Horse Creek	138	38	3,4,7,8,9,16
Elbow Lake Creek (also Clearwater County)	142	38	6
Straight Creek, Upper	141	36	30,31
	141	37	24,25
Straight Lake Creek	140	36	6
	140	37	1,2
Straight River (also Hubbard County)	139	36	1
	140	36	28,29,33,34,35,36
Sucker Creek	138	40	18
	138	41	13
Toad River	138	38	6,7,18,19,30
	139	38	30,31
	139	39	25,36
	138	39	25,26
BELTRAMI COUNTY			
Battle River, So. Br.	151	30	2,3,4,11
Clearwater River	148	35	5,6,8,17,20,29,31,32
	149	35	20,29,31,32
Hoover Creek (also Koochiching County)	152	30	13,24
Meadow Creek	151	30	6
	151	31	1,2
Mud River	150	33	21,28
O'Brien Creek	149	32	2
	150	32	23,24,26,35
Spring Creek	149	30	4,5,9,10
Spring Lake Creek	148	35	34,35
BENTON COUNTY			
Bunker Hill Brook	38	30	6
	38	31	1,2,10,11
Rock Creek, Little (also Morrison County)	38	31	3,4,10,15,21,22,28
BLUE EARTH COUNTY			
Unnamed Creek	108	28	1,2
Unnamed Creek	108	28	5
	109	28	32
Unnamed Creek	108	28	6
	109	29	25,36
BROWN COUNTY			
Hindeman Creek	111	32	19,20
	111	33	24
John's Creek	110	32	1
	111	31	31
	111	32	36
CARLTON COUNTY			
Anderson Creek	46	17	14,15,22,26,27
Blackhoof River	47	16	29,30
	47	17	6,7,9,10,14,15,16,17,18, 19,20,22,25,26,27,28
	48	17	30,31

CARLTON COUNTY (Con't.)	T.	R.	S.
Clear Creek	46	17	9,10,11,12,16,17,20,29
Clear Creek	47	15	7
	47	16	1,2,3,4,12
	48	16	33
Crystal Creek	48	16	6
	48	17	1
Deer Creek	47	16	19,20,28,29,30
	47	17	11,12,13,24
Elm Creek (also St. Louis Co.)	49	16	1,2
Gill Creek	48	16	2
Hasty Brook (also St. Louis Co.)	49	19	18
	49	20	4,5,9,10,13,14,15,23
Hay Creek (also St. Louis Co.)	49	16	3,4,9,10,15
Hunter Creek	46	18	2,11,12,13
	47	18	34,35
King Creek	47	18	18,19
	47	19	1,12,13
Midway River (also St. Louis Co.)	49	16	1,12,13,14,15,21,22
Mission Creek (also St. Louis Co.)	49	16	25,26,36
Moosehorn River	46	19	1,11,12,14,15,16,21
	47	18	4,5,8,9,17,18,19
	47	19	24,25,35,36
	48	18	3,9,10,14,15,16,23,26,34,35
Mud Creek	47	15	18
	47	16	5,6,8,9,10,11,13,14,15,16
Nemadji Creek	46	17	7,8,9,18
	46	18	13,14,15,16,22
Nemadji River, North Fork	46	17	1,2,3,8,9,10,17,18,19,31, 32,33
	46	18	24,25,36
	47	15	19,30
	47	16	23,24,25,26,27,28,29,31,32
	47	17	35,36
Nemadji River, South Fork	46	16	4,5,6,7
	46	17	1,11,12
	47	15	30
	47	16	25,33,34,35,36
Net River (also Pine Co.)	46	16	3,4,8,9,17,20,21,29,31, 32,33
	47	16	34
Net River, Little	46	16	3,10,15,22,26,27,34
Otter Creek, Big	48	16	7
	48	17	3,4,10,11,12
	49	17	19,20,26,27,28,29,30, 32,33,34,35
	49	18	25,26
Otter Creek, Little	48	17	7,10,15,16,17,18
	48	18	11,12,13,14
Red River	48	15	30
	48	16	25,26
Rock Creek	47	16	7,17,18,20,21,22,23,24
	47	17	12
Scanlon Creek	49	17	25
	49	16	30
Section 36 Creek	46	16	1,2,11,12,13
	47	16	36
Silver Creek, Big	46	17	14,23,24,25
Silver Creek	48	16	15,16,17,21,28,29
Squaw Creek	49	17	9,16,17,18,19,20,21
State Line Creek	46	15	6,7,18,19,30,31
	46	16	12,13,24,25,36
	47	15	30,31
Stony Brook	46	17	10,11,15,16,21
CARVER COUNTY			
Assumption Creek	115	23	2
	116	23	34,35
CASS COUNTY			
Bungo Creek	137	30	6
	137	31	1,11,12,14,21,22,23
	138	30	31
Cedar Lake Creek	138	31	14,23,26,27,28
Corey Brook	135	30	9,15,16,21,22,27
Dabill Brook	137	31	1,2,9,10,11,16
	138	31	36
Farnham Creek	135	32	5,6,7
	136	32	2,3,9,10,16,19,20,21,29, 31,32

CASS COUNTY (con't.)	T.	R.	S.
Hay Creek	135	31	8,9,17
Hoblin Creek	137	30	17,18,19
Michaud Brook	140	25	7,17,18
Olson Brook	136	30	12,13,14
Peterson Creek	134	30	29,33
Poplar Brook	135	32	5,6
	136	32	22,27,28,32,33
Rogers Brook	134	30	29,32
Shingobee River (also Hubbard County)	141	31	16,17,18,19
Spring Brook	139	26	3,10,11,14
Stoney Brook	135	29	5,8,9
	136	29	30,31,32
	136	30	20,21,22,25,26,27,29,30
	136	31	24,25,26
Unnamed Creek	137	31	4,5
CHIPPEWA COUNTY			
Cottonwood Creek (also Swift County.)	119	41	4
CHISAGO COUNTY			
Beaver Creek	35	20	7,8,17
	35	21	3,4,10,12,13,14,15
	36	21	33,34
Beaver Creek, So. Tributary	35	21	15
Hay Creek	35	20	7,8
Lawrence Creek	33	19	2,3,10
CLAY COUNTY			
Felton Creek	141	44	7,8,17
	141	45	7,8,12,13,14,15,16,17,18,22
	141	46	8,9,12,13,14,15,16
CLEARWATER COUNTY			
Auganash Creek	144	38	5
	145	38	27,28,31,32,33
Buckboard Creek	144	37	19,30,31
	144	38	11,12,13,24
Elbow Lake Creek (also Becker County)	143	38	31,32
Lost River	148	38	20,21,22,27,28
Mud Creek	144	37	13,14,22,23,24
Nassett Creek	148	38	28,29
Sucker Brook (Gould Creek)	144	36	27,28,32,33
COOK COUNTY			
Assinika Creek	63	1E	1
	63	2E	7,8,16,17
	64	1E	36
Bally Creek	61	1W	3,4,5,6,7,8,9,10,11
	61	2W	12
Barker Creek	60	3W	5,6,7,8
	60	4W	2,3,9,10,11,12
	61	4W	34,35
Beaver Dam Creek	63	3E	2,3,4,5
	64	3E	32,33,34,35
Blind Temperance Creek	60	4W	19,29,30,32
Bluff Creek	63	1W	13,23,24,25
Brule River	62	2E	1,2
	62	3E	4,5,6,9,10,15,16,22,27,34
	63	2E	21,22,23,25,26,27,28,33, 35,36
	63	3E	30,31,32
Brule River, Little	62	3E	19,20,29,32,33
Burnt Creek	62	4W	8,9,16,17,20
Caribou Creek	60	3W	2,3,10
Caribou River (also Lake Co.)	59	5W	19,20,29,30,31
Carlson Creek (Stony Brook)	62	4E	3,4,9,10
	63	4E	31,32,33,34
Cascade River	60	2W	1
	61	1W	19,20,21
	61	2W	1,12,13,14,24,25,26,35,36
	62	2W	3,10,11,14,15,16,22,23, 24,25,36
Cedar Creek	59	5W	2
	60	5W	14,22,23,25,26,35,36
Cliff Creek	61	2E	3,4,5,9,10
	62	2E	29,30,31,32
Colville Creek, East	61	3E	5
	62	2E	25
	62	3E	30,31,32
Cross River (Inlet to Gunflint Lake)	65	3W	19
	65	4W	24,25,26,27,28,34
Cross River (also Lake Co.)	58	5W	1
	59	5W	4,5,8,9,15,16,21,22,23,25, 26,35,36
	60	5W	30,31,32

COOK COUNTY (Cont.)	T.	R.	S.
Cutface Creek (Good Harbor Creek)	61	1W	27,28,29,34
Deer Yard Creek (Spruce Creek)	60	2W	4,5,6,7,8,9,10,15,16,17
	61	2W	32
Devil Track River	61	1E	1,2,3,10,11,12,13
	62	1E	26,31,32,33,34,35,36
Devil Track River, Little	61	1E	4,5,6,7,8,9,10
	61	1W	1,2,11,12
Durfee Creek	61	2E	5,6,8
	62	1E	25,36
	62	2E	31
Elbow Creek	62	1E	3,4,9,10,15,22,27,34
	63	1E	33,34
Farquhar Creek	62	4E	2,11
	63	4E	34,35
Fiddle Creek	63	1W	2,3,10,15
	64	1W	34,35
Flute Reed River	62	3E	1,2,3,10,11,12,13,14
	62	4E	17,18,19,20
	63	3E	26,34,35,36
Fourmile Creek (also Lake Co.)	60	5W	17,18,19
Fox Farm Creek	62	1E	19,30
Gauthier Creek	62	3E	16,20,21,22,27
Grand Portage Creek	63	5E	1
	63	6E	4,5,6
	64	6E	31,32,33
Greenwood River	63	2E	1,2,3,10,11,12,13,14,15, 22,23,24
	64	2E	34
	63	3E	6
	64	3E	31
Heartbreak Creek	59	4W	18,19
	59	5W	2,11,12,13
	60	5W	27,28,33,34,35
Hollow Rock Creek	63	5E	9,10,11,14,15,16,23,24,25
Honeymoon Creek (Spring Creek)	61	4W	28,31,32,33
Indian Camp Creek	60	2W	3,10,11
	61	2W	34
Irish Creek	63	3E	8,9,10,13,14,15,23,24,25,26
	63	4E	17,18,19
Jonvick Creek	60	2W	19
	60	3W	12,13,14
Junco Creek	62	1W	1,2,9,10,11,12,13,14,15, 16,21,28
	62	1E	6,7
	63	1E	20,29,30,31
	63	1W	24,25
Kadunce Creek	61	2E	2
	62	2E	9,10,12,13,14,15,16,22, 23,25,26,35
Kimball Creek	61	2E	3,4,10
	62	2E	7,16,17,18,19,20,21,28, 29,33,34
Koski Creek	61	4W	5,8
	62	4W	31,32
Last Creek	58	5W	16,17
Lullaby Creek	63	1E	4,5,8,9
Mark Creek	61	2W	1,2,3,4,5,6,9
Mississippi Creek	61	2W	1,2,3
	61	3W	1
	62	2W	31,32,33,34,35,36
	62	3W	24,25,35,36
Mississippi Creek, Little	62	2W	20,21,26,29,32,33,34,35
Mistletoe Creek	60	3W	3,4
	61	2W	7,18,19
	61	3W	11,13,14,15,23,24,25,26, 34,35
Monker Creek	61	1E	6,7
	62	1E	31
	62	1W	36
Mons Creek	62	3E	4
	63	3E	28,29,33
Mud Creek	62	1E	9,16,17,21,22
Murmur Creek	61	2W	15,20,21,22,29,30
Myhr Creek	62	3E	23,24,26
Nestor Creek	61	1W	4,5,6
	61	2W	1
	62	1W	31,32,33
Onion Creek	59	4W	1,2,3,4,12
	60	4W	24,25,26,35,36
Pancake Creek	60	4W	17,18
	60	5W	11,13,14
Pecore Creek	61	4W	19,20,21
Pike Lake Creek	61	2W	10,11,15
Pine Mountain Creek	63	1E	23,26,27,28,33

COOK COUNTY (Con't.)	T.	R.	S.
Plouff Creek	61	4W	17,18
	61	5W	2,3,11,13,14,15,22,23
	62	5W	23,26,34,35
Poplar River	60	3W	3,4,5,6,7,8,9,10,15,16, 19,20,21,28,33
	61	3W	30,31
	61	4W	10,13,14,15,22,23,25,26,36
Portage Brook	64	3E	24,25,26,27,28,29,32,33,34
	64	4E	19,20
Red Rock Creek	63	5E	21,22,26,27,28,35
Reservation River	62	5E	6
	63	4E	23,25,26,36
	63	5E	16,17,18,19,20,21,29,30,31
Rollins Creek	59	3W	6
	60	3W	29,30,31
	60	4W	36
Rosebush Creek (Fall River)	61	1W	13,23,24,25
	61	1E	18
Sawbill Creek	62	4W	7,18,19,20,28,29,30
	62	5W	25
Section 15 Creek	58	5W	9,10,15
Section 16 Creek	58	5W	16
Section 29 Creek	58	5W	17,19,20,29
Sixmile Creek	60	4W	13,14,15,22,23,27,28,33
Stickle Creek	63	1W	1,2,11,12,14
Stone Creek	61	2E	2,3
	62	2E	21,22,27,34,35
Stony Creek, Little	63	2E	4,5,7,8,9,16,17,21
	64	2E	31,32,33
Stumble Creek	59	5W	16,21,22,26,27,28
Sugarloaf Creek	58	5W	29,30
Sundling Creek	61	1W	10,11,15,16,17,18
	61	2W	13
Swamp River	63	3E	25,26,36
	63	4E	20,29,30
	64	4E	21,27,28
Swamper Creek	64	1E	20,29,32
Swanson Creek	61	4W	6,7,8
Tait River	60	3W	4
	61	3W	28,33
Temperance River	59	4W	4,5,6,7,8,18,19,30,31,32
	60	4W	6,7,8,17,20,28,29,32,33
	61	4W	4,8,9,16,17,19,20,30,31
Thompson Creek	62	1W	17,19,20
	62	2W	24
Timber Creek	62	1E	1
	63	1E	25,36
	63	2E	31
Torgenson Creek	61	4W	30
	61	5W	24,25
Two Island River (also Lake Co.)	58	5W	2,3,4,11
	59	5W	7,8,17,18,20,21,27,28,29, 31,32,33,34
COTTONWOOD COUNTY			
Scheldorf Creek	106	36	19,30,31
	106	37	13,24,25
CROW WING COUNTY			
Barbour Creek	44	28	28
Black Bear Brook	44	28	7,8
Black Hoof Creek	46	29	16
Borden Creek	44	28	8,9,17,20
Camp Creek	43	28	4,5
Cullen Brook	136	28	18,19,30
	136	29	13
Long Brook, Lower South	44	30	12,13
Long Brook, Upper South	44	29	6,7
Round Creek	43	31	14,15
Sand Creek	45	30	2,3,11,13,14
	46	30	34
Spring Brook	138	28	27,34
Van Sickle Brook	138	26	14,15,23,24
Whitley's Creek	45	30	16,17,20,21
DAKOTA COUNTY			
Kennaley's Creek	27	23	18
Trout Brook (also Goodhue Co.)	113	17	26,27,35,36
Unnamed #1	27	23	18
	27	24	13
Unnamed #3	27	24	24
Unnamed #4	27	24	24
Unnamed #7	27	24	26
DOUGLAS COUNTY			
Spruce Creek (also Otter Tail Co.)	130	36	3,4,9,10

FILLMORE COUNTY	T.	R.	S.
Bear Creek	104	13	36
Big Springs Creek	104	9	21,22,27
Camp Creek	102	10	5,8,17
Diamond Creek	103	9	11,13,14,24
Duschee Creek	102	10	1
	103	10	23,24,25,26,36
Etna Creek	102	13	25,36
Forestville Creek, No. Br.	102	12	13,14,15
Forestville Creek, So. Br.	102	12	24,25
Gribben Creek	103	9	9,16,21,27,28
Jordan Creek, Little	104	12	21,22,27,28
Kedron Creek	104	13	36
Lost Creek	104	11	18
	104	12	9
Lynch Creek	104	11	2,11,14
Nepstad Creek	102	8	4,5,7,8,9
Pine Creek (also Winona Co.)	104	9	2
Rice Creek	103	11	3,4
	104	11	14,23,33
Riceford Creek (also Houston Co.)	101	8	12
Root River, So. Br.	102	10	5,6
	102	11	1,2,3,4,5,7,8,9,10,11,18
	102	12	13,21,22,23,24,26,27
	103	11	36
Root River, So. Fork	102	8	17,18,19
	102	9	24,25,26
Rush Creek (also Winona Co.)	104	8	2,3
Spring Valley Creek	103	12	8,17,18,19,20,30
	103	13	23,24,25,26
Torkelson Creek	104	10	25,36
Trout Run Creek (also Winona Co.)	104	10	4,5,8,9,16,17,20,21
Watson Creek	103	11	30
Willow Creek	102	11	1,12,13
Wisel Creek	101	8	5,8
	102	8	19,20,29,30,32
GOODHUE COUNTY			
Bullard Creek	112	14	1,2,3,10
	113	14	36
Hay Creek	111	15	4
	112	14	19
	112	15	12,13,23,24,26,27,33,34
Mazeppa Creek (also Wabasha Co.)	110	15	24,25
Spring Creek	112	15	6,7,18
Trout Brook (also Dakota Co.)	112	17	1
Trout Brook (Trib. to Hay Cr.)	112	14	2
	113	14	35,36
HOUSTON COUNTY			
Badger Creek	103	6	16,21,22,27,28
Beaver Creek	102	6	5
	103	6	31,32
Beaver Creek, East	102	6	5,6,8,17
Beaver Creek, West	102	6	5,6,7,18,19,30
	102	7	12,13,24,25
Bee Creek	101	6	29,32,33
Butterfield Creek	103	4	7,8,18
Crooked Creek, Main Br.	102	4	18,19,20,28,29,30
	102	5	25,26,36
Crooked Creek, North Fork	102	5	16,17,20,21,22,23,26
Crooked Creek, South Fork	102	5	26,27,28
Daley Creek	103	7	4,5,8
	104	7	33
Dexter Creek	103	5	12,13,14,15,21,22
Silver Creek (also Winona Co.)	104	6	1,2,11,12,14
Storer Creek	104	5	17,18,19,30
Swede Bottom Creek	103	6	10
Thompson Creek	103	4	5,6,7
	103	5	12,13,14,23,24,25,26
	104	4	32
Wildcat Creek	103	4	26,27,28,29,34,35
Winnebago Creek	101	5	7,8,14,15,16,17,22,23
	101	6	12
HUBBARD COUNTY			
Bungoshine Creek	145	32	28,29,30
	145	33	25,26,34,35
Cold Creek	145	33	19
Grassy Creek	143	33	23,24,25,26
Hellcamp Creek	140	33	19
	140	34	24
Hennepin Creek	144	35	3,10,15,16,21
	145	35	34
Kabekona River	143	32	6,7,18,19
	143	33	2,3,4,9,11,12,24
	144	33	29,30,32,33
	144	34	24,25,36

HUBBARD COUNTY (Con't.)	T.	R.	S.
Kawishiwash Creek	142	32	12
LaSalle Creek	143	35	6
	144	35	19,30,31
Muckey Creek	139	33	1,2,10,11,12
Pickedee Creek	144	32	29,30
	144	33	24,25
Schoolcraft Creek	142	34	5,7,8,17
Schoolcraft River	143	34	20,29,32
Shingobee Creek	141	32	26,35
Shingobee River (also Cass Co.)	141	32	24
Stall Creek	143	33	12,13,14
Straight River (also Becker Co.)	139	35	4,5,6,9,10,11,12
Wallingford Brook	139	33	1,2,11
	140	33	25,36
ITASCA COUNTY			
Bruce Creek	53	22	6,7
	53	23	25,26
	54	22	18,19,30,31
	54	23	25,26
	54	25	1,2
Cole Creek	149	25	7,17,18,19,30
Fletcher Creek	62	23	10
Harrigan Creek	54	26	35,36
Matuska's Creek	148	29	3
Moose Creek	149	29	21,22,27,34
Morrison Brook (also Aitkin Co.)	53	26	7,8,18,19,29,30,32,33
Pancake Creek	54	22	20,28,29,32,33
Peters Creek	54	22	22,23,27,28
Pickerel Creek	56	22	7,18
	56	23	13
Pokegama Creek	54	26	26,27,28
Pokegama Creek, Little	54	26	26,27,34,35
Rosholt Creek	55	23	22,23,24
Sand Creek	55	23	15,22,27,28,29,32,33
Shine Brook	62	25	11,14,15,16
Sisseebakwet Creek	54	26	19,29,30
Smith Creek	53	26	1,9,10,11,12,13,14,15
	54	26	35,36
Smith Creek, Unnamed Trib.	54	26	35,36
Smith Creek, Unnamed Trib.	53	26	11,12
Spring Creek	55	23	25,26,27
Stoney Brook (also St. Louis Co.)	60	22	3,4
	61	22	13,24,25,35,36
Sucker Creek	57	25	6
	58	25	31
Tibbetts Creek	147	27	15,16
Trout Brook	54	22	1
Unnamed Stream	54	26	22,23,27
Valley River (also Koochiching County)	62	23	1,2,3,4,10,11,12,13,14,24
Venning Creek	60	23	1,2,11,12,13,14
	61	23	35
Warba Creek	54	23	13,14,15,21,22,23,24
KOOCHICHING COUNTY			
Dinner Creek	153	26	4,9,10,12,13,14,15,23,24
	154	26	7,18,19,29,30,32,33
	154	27	1,12
	155	26	30,31
	155	27	25,35,36
Hay Creek	153	26	4,8,9,17,20
Hoover Creek (also Beltrami Co.)	152	29	19,26,27,28,29,30,35
Trout Brook	66	26	19,30
	66	27	24,25
Valley River (also Itasca Co.)	63	22	6,7,8,9,16,17,18,19,20, 21,28,29,30
	63	23	24,25,26,35
LAKE COUNTY			
Arrowhead Creek	60	8	3,10,11,13,14,15,22, 23,26,27,28,34
	61	8	14,15,21,22,27,28,34
Baptism River	56	7	3,4,5,9,10,14,15
	57	7	20,27,28,29,33,34
Baptism River, E. Branch	57	6	6
	57	7	1,2,3,9,10,11,12,16,17,20
	58	6	30,31
	58	7	19,20,21,22,23,25,26,29, 30,36
	58	8	22,23,24,25,26,27
Baptism River, West Branch	57	7	7,17,18,20
	57	8	1,2,12
	58	8	2,3,4,9,10,11,15,16,20, 21,22,28,33,34,35,36
	59	8	27,34,35

LAKE COUNTY (Con't.)	T.	R.	S.
Beaver River	55	8	1,2,5,6,7,8,9,10,11,12, 16,17
	55	9	1,2
	56	8	31
	56	9	4,5,6,8,9,16,17,19,20, 21,22,23,26,27,28,32,33, 34,35,36
	57	9	28,29,31,32,33
Beaver River, East Branch	55	8	2
	56	8	4,5,6,8,9,15,16,17,20,21, 22,25,26,27,35,36
	57	8	6,7,18,19,30,31
	57	9	1,2,3,11,12,13,14,15,23, 24,25,26,36
Beaver River, West Branch	55	8	17,18
	55	9	3,4,10,11,13,14
Berry Creek (Breda) (also St. Louis County)	56	11	6
	57	11	10,15,16,21,28,29,31,32
Blesner Creek	58	6	20,29,30,31
Budd Creek	55	9	7,17,18,20,21
Camp Creek	60	8	3,4,5,7,8,9,10,16,17,20, 21,29
	61	8	33
Camp Creek, East	60	9	7,18
	60	10	11,12,14
Caribou River	58	6	1,2,11,13,14,15,22,23,24, 25,26,36
	59	6	23,24,25,26,35,36
Castle Danger Creek	54	9	30,31,32
Cedar Creek	56	8	13,14,23,24,26
Cloudy Spring Creek	57	9	5,6,7,18
	57	10	12,13,24
Cross River (also Cook Co).	60	6	13,24,25
Crow Creek	53	10	1,2
	54	10	15,22,23,26,35
Crown Creek	57	8	2,3,4,5,9,10,11
	58	8	5,6,7,8,18,19,20,29,30, 31,32,33
	58	9	1,12,13,14,24,36
	59	8	31,32
Crystal Creek	56	7	10,11
Dago Creek	54	9	18,19
	54	10	2,11,12,13
	55	10	27,34,35
Dragon Creek	57	6	8,9,16,17,21
Egge Creek	57	7	2,3,4,11
Encampment River	53	10	3,10,11
	54	10	8,16,17,21,27,28,34
Four Mile Creek (also Cook Co.)	60	6	24
Gooseberry River	54	9	18,19,20,21,22,27
	54	10	4,5,6,8,9,10,11,12,13
	55	10	4,9,16,17,20,29,30,31,32
	56	10	33
Gooseberry River, Little	54	10	6
	54	11	1
	55	10	31
	55	11	34,35,36
Harris Lake Creek	60	10	6
	61	10	19,30,31
Heffelfinger Creek	57	7	17,18,19
	57	8	13,16,20,21,22,23,24,25, 26,27,28,29,32,33,34
Hill Creek	60	8	30
	60	9	24,25
Houghtaling Creek	59	6	2,3,4,5,6
	60	6	25,32,33,35,36
Inga Creek	60	9	2
	61	9	11,12,14,22,23,27,34,35
Isabella River, Little	59	8	3,4,5,6,9,10
	60	8	31,32
	60	9	5,6,8,9,10,15,16,22,25,26, 27,36
	61	9	3,4,9,10,16,17,20,21,22, 29,32
	62	9	34
Jack Creek	61	8	14,23,24,25,26,36
Jack Pine Creek	60	8	5,6,7,8,18
	61	8	19,20,29,30,31,32
Kennedy Creek	57	7	35,36
Kinney Creek	57	10	15,21,22,28,33
Knife River (also St. Louis Co.)	52	11	4,5,8,9,17,18,19,31
	53	11	4,5,7,8,17,18,20,29,32,33
	54	11	20,29,30,32

LAKE COUNTY (Con't.)	T.	R.	S.
Knife River, West Branch (also St. Louis Co.)	52	11	5,6,8
Knife River, Little - East Branch	53	11	17,20,21,22,27,33,34
Knife River, Little - West Branch (also St. Louis Co.)	52	11	5,6
	53	11	31
Leppanen Creek	57	7	15,21,22,28
Lindstrom Creek	57	7	19,30,31,32
	57	8	25
Manitou River	57	6	3,4,10,11
	58	6	4,5,6,7,8,16,17,18,20, 21,28,29,32,33,34
Manitou River, North Branch	58	6	6
	58	7	1,2
	59	6	31
	59	7	15,16,18,19,20,21,22, 25,26,27,28,33,34,35,36
	59	8	1,2,12,13,23,24,25,26
Manitou River, South Branch	58	6	6
	58	7	1,4,5,6,7,8,9,10,11,12, 16,17,18
	59	7	29,30,31,32,33
	58	8	1,2
Manitou River, Little	57	6	2
	58	6	34,35
Marais River, Little	57	6	5,8,16,17,21
Mary Ann Creek	58	10	16,21
Martin Creek	58	6	2,3,11
McCarthy Creek (also St. Louis Co.)	53	11	18
Mike Kelly Creek	60	11	14,15,23
Mile Post Forty-Three Creek	56	8	2,3,9,10,11,14,15
Mink Creek	54	9	4,5,9
	55	9	30,31,32
	55	10	25,26,36
Mitawan Creek	60	9	1,12
	61	8	5,6,7,18,19,31
	61	9	1,2,12,13,24,25,36
	62	9	35
Moose Creek	59	6	31,32,33,34
Mud Creek, Little	57	11	11,12,14,22,23
Murphy Creek	56	11	4,5,8,17,18,19
	57	10	4,7,8,9,18
	57	11	13,21,22,23,24,26,27,28, 33,34
Nicadoo Creek	56	7	7
	56	8	1,12
	57	8	25,35,36
Nine Mile Creek	58	6	3,4,9,16,17
	59	6	27,28,33,34
Nip Creek	59	11	3,4
	60	11	21,22,27,28,34
Nira Creek	61	11	22,23,27
Oliver Creek (Silver)	57	7	5,6
	57	8	1
	58	7	31,32
Palisade Creek	56	7	16,17,18,19,20,21,22
	56	8	24
Robin Creek	60	10	2,3
	61	10	26,35
Rock Cut Creek	58	6	18,19,20
	58	7	13,24
Sawmill Creek	57	6	18
	57	7	1,12,13,22,23,24,26,27,34
Schoolhouse Creek	58	7	35,36
Scott Creek	59	7	4
	60	7	9,10,15,16,21,22,27,33, 34,35
Section 30 Creek (also St. Louis County)	63	11	30
Sliver Creek	53	10	6,7,16,17,18,21
	53	11	1
	54	10	18,19,30
	54	11	11,12,13,25,36
Silver Creek, East Branch	53	10	5,8,9,16,21
Skunk Creek	54	9	4,9,16,17,20
	55	9	19,29,30,32,33
	55	10	13,14,24
Snake Creek	60	9	6
	60	10	1
	61	9	19,30,31
	61	10	24,25,36
Snake River	60	10	3,4
	61	9	7,18,19
	61	10	12,23,24,26,27,33,34

LAKE COUNTY (Con't.)	T.	R.	S.
Sphagnum Creek	60	9	4
	61	9	28,29,33
Split Rock River	54	8	6,7
	54	9	1,2,12
	55	9	26,28,34,35,36
Split Rock River, East Branch	55	9	4,5,6,9,10,14,15,22,23,24, 25,26
	56	9	30,31,32
	56	10	1,11,12,13,14,23,24,25
Split Rock River, West Branch	55	9	6,7,8,16,17,21,22,26,27,28
	55	10	1
	56	10	22,26,27,33,34,35,36
Spur End Creek	58	9	8,9,15,16,17,18,22
Stanley Creek (also St. Louis County)	52	11	18,19
Stewart River	53	10	18,19,20,29
	53	11	2,3,10,11,13,14,15
	54	11	3,4,10,15,22,26,27,34,35
Stewart River, Little	53	10	19,20,29
	53	11	9,15,16,22,23,24
Stewart River Tributary (also St. Louis Co.)	55	11	7
Stoney Creek (Rock)	55	9	30
	55	10	20,23,24,25,27
Stream Number 30	54	8	5,6
	55	8	19,30,31
Sullivan Creek	56	11	1,2,10,11,15
	57	10	19,30
	57	11	24,25,36
Thirty-nine Creek, Big	56	8	19,30,31
	56	9	1,2,3,11,12,13,14,15,18, 22,23,24,25
	57	9	22,26,27,35,36
Thirty-nine Creek, Little	56	8	6,7,8,17,18,19,20,29,30
	56	9	1,12
Tikkanen Creek	57	7	5,6,8,16,17
Tomlinson Creek	60	7	18,19,31
	60	8	24,25,36
Tower Creek	57	7	4,9
Trappers Creek	56	11	2,3,9,10,16,17,19,20
	57	11	35
Twin Points Creek	54	9	10,11,13,14
Two Island River (also Cook Co.)	59	6	11,12
Unnamed Creek	55	8	20,21,29,32,33
Victor Creek	60	9	12,13
Wanless Creek	60	6	25,26,33,34,35,36
Weiss Creek	59	9	2,3,4,11
	60	9	27,34
Wenho Creek	58	10	17,20,21,27,28,34
Whyte Creek	57	10	1,2,11,14,23,26,27,34
Williams Creek	56	7	20,28,29
LAKE OF THE WOODS COUNTY			
Tomato Creek	161	34	3,9,10
	162	34	35
LESUEUR COUNTY			
Paul's Creek	110	26	14,15
Unnamed Creek	110	26	10,11
LYON COUNTY			
Redwood River	110	42	5,8,17
	111	42	32
MAHNOMEN COUNTY			
Bad Boy Creek	144	39	13,14,22,23,27,28,34
Schermerhorn Creek	144	39	6
	145	39	31
	145	40	25,26,36
MEEKER COUNTY			
Sucker Creek	118	30	4,5,6,7
Willow Creek (also Stearns Co.)	121	29	23
MORRISON COUNTY			
Broken Bow Creek	131	29	19
	131	30	13,24
Camp Ripley Brook	132	30	13,24
Nelson Hay Creek	130	31	1,2
Relmrick Brook	133	30	21,28
Rock Creek, Little (also Benton County)	39	30	17,18,20,21,22
	39	31	13,14,22,23,26,27,33,34
NICOLLET COUNTY			
Robinson Brook	110	30	3,4,5,8
OLMSTED COUNTY			
Dry Run Creek (also Wabasha Co.)	108	14	4
Kinney Creek	105	13	1,12,13
	106	12	31
	106	13	36
Logan Creek	107	11	3

OLMSTED COUNTY (Con't.)	T.	R.	S.
Mill Creek	105	11	31
	105	12	14,23,25,26,36
Whitewater River, Middle Br. (also Winona Co.)	106	11	2,3,10
	107	11	24,25,26,35
Whitewater River, North Br. (also Winona & Wabasha Counties)	107	11	1,2,3
OTTER TAIL COUNTY			
Brandberg Creek	133	38	20,21,28,29,30
Finn Creek	135	37	27,34
Holmstad Creek	136	37	7
	136	30	12,13,14
Long Branch Creek	134	42	7
Long Lake Creek	132	41	9
Rush Lake Creek	135	38	23,26,27,28
Spruce Creek (also Douglas Co.)	131	36	28,29,31,32,33,34
Willow Creek	133	38	2,11
	134	38	26,35
PINE COUNTY			
Bang's Brook	41	17	15,20,21,22,29
Barnes Spring	41	18	1,12
Bjork Creek	42	16	2,9,10,11
Cons Creek	41	17	15,16,22
Crooked Creek	41	17	18,19,20,29,30
	41	18	11,12,13
Crooked Creek, West Fork	41	18	11,12
	42	18	3,4,9,10,16
	43	18	27,34
Crystal Creek	41	16	9,10,15
Grindstone River	42	21	20,21,28,29
Hay Creek	40	18	6,7,8,18,19
	41	18	10,15,20,21,22,29,32,33
Hay Creek, Little	40	18	8,9
Larson Creek	44	17	4,5
	45	17	29,32
Lost Creek	40	19	9,10,15
McCullen Creek	42	16	28,33
Mission Creek	40	21	1,2
	41	20	31
	41	21	36
Net River (also Carlton Co.)	45	16	6
	45	17	1
Pelkey Creek	41	20	33,34,35
Sand River	43	18	4,5,7,8,18,19
	44	18	33
Spring Brook	41	20	16,17,18,21
Wilbur Brook	41	17	29,30
	41	18	23,25,26
Willow River	45	17	19,23,29,30
	45	18	13,14,15,24
Wolf Creek	42	18	4,9,16
	43	18	32,33
POLK COUNTY			
Lengby Creek	147	39	33,34
POPE COUNTY			
Mud Creek	123	36	28,29
REDWOOD COUNTY			
Ramsey Creek	112	36	1
	113	36	35,36
RICE COUNTY			
Spring Brook	111	20	2,3
ROSEAU COUNTY			
Bemis Hill Creek	161	37	17,19,20,29,30
ST. LOUIS COUNTY			
Ahlenius Creek	53	14	9,10
Amity Creek	50	14	1
	50	13	5,6
	51	13	31,32
	51	14	26,27,28,35,36
Amity Creek, East Br.	51	13	30,31
	51	14	13,14,15,22,24,25,36
Angora Creek	61	18	9,10,15,16,21,22
Artichoke Creek	52	17	7,17,18
Ash River	66	20	4,5,9
	67	20	4,5,6,8,9,16,17,18,19,20, 28,29,30,31,32
	67	21	36
	68	20	13,14,20,21,22,23,24,28
	68	19	17,18
	68	21	36
Bear Trap Creek	51	16	30
	51	17	16,21,22,23,25,26,27,28
Beauty Creek	67	21	23,24,25,26

ST. LOUIS COUNTY (Con't.)	T.	R.	S.
Berry Creek (Breda) (also Lake County)	55	12	6,7
	55	13	12,13
	56	12	1,11,12,14,15,16,21,28,29, 31,32
Blackduck River	66	19	5,6,7,8,17
	66	20	1
	67	19	29,31,32
	67	20	2,3,4,10,14,15,23,24,25, 26,36
	68	20	26,27,28,33,34
Captain Jacobson Creek	52	12	1,2,3
	53	12	33,34,35
Carey Creek	53	14	28,33
Carlson Creek	52	12	19
	52	13	14,15,23,24
Cemetery Creek	51	17	4,5,9
Chellberg Creek	51	16	7
	51	17	1,2,3,10,12
Chester Creek	50	14	7,8,9,14,15,16,23
Chester Creek, East Br.	50	14	4,5,9,15,16
Coolidge Creek	55	14	19,29,30
	55	15	25,26,35,36
Dark River	60	19	19,20,30
	60	20	10,11,12,13,24
Dutchess Slough Creek	50	17	4,9,10,13,14,15,24
Elm Creek (also Carlton Co.)	50	16	35
Fawn Creek	66	20	1,2,3,4,12
	67	20	15,22,23,26,34,35
French River	51	12	7,17,18
	51	13	1,2,3,12
	52	13	8,9,16,17,20,21,23,26, 27,28,29,34,35
Grassy Creek	61	13	6
	61	14	1
Hartley Creek	50	14	3,4
	51	14	29,33,34
Hasty Brook (also Carlton Co.)	50	20	28,29,32,33
Hay Creek (also Carlton Co.)	50	16	20,21,28,29,32,33
Hellwig Creek	53	17	13,14,23,24,25,26
Hornby Junction Creek	55	13	5,6,7
	56	13	28,32,33
Humphrey Creek	54	14	23,26,27,33,34
Indian Creek	55	12	3
	56	12	14,22,23,27,34
Joe Martin Creek	50	18	3,4,5,7,8
	50	19	12
Johnson Creek	50	17	3,10,11,14
	51	17	34
Johnson Creek	55	12	35,36
Johnson Creek	50	17	13
Johnson Creek	60	18	6,7,8,17,20
Keene Creek	49	14	18
	49	15	1,12,13
	50	15	24,25,36
Kehtel Creek	51	15	8,17,18,19,20
Kingsbury Creek	49	15	4,9,10,11,13,14
	50	15	33,34
Kinmount Creek	67	20	19
	67	21	13,14,15,20,21,22,23,24
Kinney Creek	58	19	11
Knife River (also Lake Co.)	52	12	24,25,26
Knife River, West Br. (also Lake County)	52	12	1
	53	12	2,3,10,15,16,22,23,27,28, 34,35,36
	54	12	35,36
Knife River, Little	52	12	16,17,21,22,23,26,27,28, 35,36
Knife River, Little, West Br. (also Lake County)	53	12	13,14,23,24,25,26,36
Laurentian Creek	59	17	7,18,19,30
	59	18	1,12,13,24
Lavi Creek	52	15	21,28
Lehtinen's Creek	61	17	13,14
Lester River	50	13	4,5,8
	51	13	5,6,7,8,16,17,18,19,20, 21,28,32,33
	51	14	1,2,10,11,12,13,15,16,24
	52	13	31,32
	52	14	21,22,23,27,28,34,35
Longstorff Creek	62	12	6,7
	63	12	31

ST. LOUIS COUNTY (Con't.)	T.	R.	S.
Lost River	65	19	6
	65	20	1,2,3,4,5,6,7,8,12
	65	21	1
	66	20	20,25,27,29,31,32,33,34, 35,36
Marshall Creek	52	15	10,15
McCarthy Creek (also Lake Co.)	53	12	12,13
McNiven Creek	59	19	10,16,21,28,32,33
Midway River (also Carlton Co.)	49	15	5,6
	50	15	7,8,14,15,16,17,20,21,22, 23,28,29,32,33
Miller Creek	49	14	4
	50	14	6,18,19,29,30,32,33
	50	15	12,13
	51	14	31,32
Mission Creek (also Carlton Co.)	48	15	5,6
	49	15	31
Mud Creek	54	12	20,21,22,29,30
Nine Mile Creek	66	19	4
	67	19	7,8,18,19,20,21,27,28, 29,33
	67	20	12,13,14,23
Pine River (White Pine)	50	16	4,8,9,15,16,17,18,19,20, 21,29,30,32
	50	17	23,24,26
Purvis Creek	62	13	28,29,33
Railroad Creek	50	17	1,11,12,14
Rocky Run Creek	49	15	6
	50	15	30,31
	50	16	11,12,13,24,25
Ross Creek	52	13	1,2,3,4,5
	53	13	13
Ryan Creek	55	14	14,15,22
Sand Creek	60	21	3,4,5,10,11,14
	61	20	19
	61	21	3,10,11,14,15,23,24,25, 26,27,33,34,35
	62	21	34
Sargent Creek	48	15	4,5,9,10
	49	15	28,29,32
Schmidt Creek	51	12	5,6,8,17
	52	12	31,32
	52	13	25,36
Section 30 Creek (also Lake Co.)	63	12	24,35
Spider Creek	52	18	19,20,21,22,27,28,29,30
	52	19	9,10,13,14,15,24
Spring Creek	54	12	1,2
Spring Creek	60	18	8,9
Stanley Creek (also Lake Co.)	52	12	4,5,8,9,10,11,12,13
Stewart Creek	49	15	21,22,26,27
Stewart River Trib. (also Lake Co.)	55	12	12,13
Stoney Brook (also Itasca Co.)	61	21	7,18
	51	12	3,4,10
	52	12	18,19,30,31,32,33
	52	13	1,12,13,24,25
	53	12	19,20,30,31
	53	13	24,25,36
Swan Creek, East	56	20	3,4,5,10,11
Swan Creek, Little	56	19	17,19,20,30
	56	20	25,26,35
Swan River, East	55	19	18,19,30,31
	55	20	1,2,12,13
	56	20	11,14,23,26,27,35
	57	20	28,33,34
Talmadge Creek	51	12	19
	51	13	9,10,13,14,15,24
Tischer Creek (Congdon Creek)	50	14	2,11,13,14
Tower Creek	55	14	8,9,17,18,19
	55	15	24,25,26
Two Rivers, East	61	14	7,8
	61	15	1,2,3,4,12
	62	14	29,30,31,32
	62	15	32,33,34,35,36
Two Rivers, West	61	15	6,7,8,9,14,15,16,17
Ugstad Creek	51	15	21,22,26,27,28
Unnamed Creek	65	19	4,5
	66	19	33
Wyman Creek	58	14	3,4,10
	59	14	11,13,14,23,24,26,27,34,35
SCOTT COUNTY			
Eagle Creek, Main Br.	115	21	7,18
	115	22	13
Eagle Creek, East Br.	115	21	18

SCOTT COUNTY (Cont.)	T.	R.	S.
Shakopee Mill Pond	115	22	5,6
	116	22	32
SHERBURNE COUNTY			
Briggs Creek	35	29	2,11,12,14,15,22
Snake River	33	28	1
	34	28	2,11,14,15,23,26,35,36
	35	28	20,28,29,33,34,35
STEARNS COUNTY			
Cold Spring Creek	123	30	14,25
Fairhaven Creek	121	28	5
	122	28	29,31,32
Hanson Brook (Three Mile)	122	28	21,22,25,26,27,36
Kinzer Creek	123	30	27,34
Luxemburg Creek	123	28	16,17,18,19,20,21,22,30
Meyers Creek	122	28	4
	123	28	22,27,33,34
Robinson Hill Creek	123	28	4,9,10,15
	124	28	31,32,33
Smart's Creek	126	28	17,18,20
Spring Brook	121	28	7
	121	29	12
Thiel Creek (Teal)	121	28	5,6,8
Willow Creek (also Meeker Co.)	121	29	10,11,14
SWIFT COUNTY			
Cottonwood Creek (also Chippewa Co.)	120	41	21,28,33
TODD COUNTY			
Duel Creek	129	32	20
Larson Creek	128	32	6
Round Prairie Creek	127	33	4
	128	33	20,29,32,33
Sauk Creek, Little	127	34	1,2
	128	34	35,36
Unnamed Brook	133	32	10,15,16
WABASHA COUNTY			
Beaver Creek (also Winona Co.)	108	11	24
Cold Spring Brook	110	13	30,31
Dry Run Creek (also Olmsted Co.)	109	14	33
Gilbert Creek	111	13	1,2,3,4,10,11,12
Gorman Creek	109	11	1
	110	10	29,30,31
	110	11	36
Indian Creek, East	109	10	21,22,26,27,28,29,31,32
	109	11	36
Indian Creek, West	109	11	6,7,8,16,17,21
Mazeppa Creek (also Goodhue Co.)	110	14	19,29,30,32
Miller Creek	111	12	7,8,9,18
	111	13	23,24
Snake Creek	109	10	10,11,14,15,16
Trout Brook	110	11	8
Trout Valley Creek (also Winona Co.)	109	9	31
Unnamed Creek	110	11	28,33
Whitewater River, No. Br. (also Winona & Olmsted Counties)	108	11	32,33,34
WADENA COUNTY			
Cat Creek	137	35	4,9,10,11,12,13
Fawn Creek	134	33	22,27,33,34
Hay Creek	134	33	7,8,9,10,11,17,18
Union Creek	134	35	18,19,30,31
WASHINGTON COUNTY			
Brown's Creek	30	20	20,21
Old Mill Stream	31	19	6
	31	20	1
	32	20	36
Unnamed Stream	31	19	19
Valley Creek	28	20	9,10,14,15,16,17
WILKIN COUNTY			
Lawndale Creek	135	45	5,6
	135	46	1,2
WINONA COUNTY			
Bear Creek	107	9	13,14,15,16,22
Beaver Creek (also Wabasha Co.)	108	10	15,16,19,20,21
Burns Valley Creek, East Br.	106	7	3,10,15
Burns Valley Creek, West Br.	106	7	3,4
	107	7	34
Burns Valley Creek, Main Br.	106	7	2
	107	7	35
Campbell Creek	105	6	21,28,29,32
Cedar Valley Creek	105	6	6
	106	6	14,15,21,22,28,29,31,32
Coolridge Creek	105	9	23,26
Corey Creek	105	6	18,19
	105	7	24,25,26,27,34

WINONA COUNTY (Con't.)	T.	R.	S.
Dakota Creek	105	4	7
	105	5	1,2,3,11,12
Ferguson Creek	105	8	18
	105	9	12,13
Garvin Brook	106	8	4,5,8,17
	107	8	14,23,26,27,33,34,35
Gilmore Creek	106	7	6
	107	8	29,30,31,32
Hemmingway Creek	105	9	26,34,35
Lane Valley Creek	105	5	24,25,36
Money Creek	105	7	3,4,6,7,8,9,16,17
Peterson Creek	106	8	7,8
Pickwick Creek	106	5	18
	106	6	13,23,24,26,34,35
Pickwick Creek, Little	106	5	18,19,29,30,32
	106	6	13
Pine Creek (also Fillmore Co.)	105	9	25,26,34,35
Pine Creek	105	5	18,19,20,29,30,31,32
	105	6	13,36
Pine Creek, South Fork	105	5	19
	105	6	24
Pleasant Valley Creek	106	6	7,18,19
	106	7	1,12,13,24,25
Rollingstone Creek, Middle Br.	107	8	9,16
Rose Valley Creek	105	5	22,27,34,35
Rupprecht Creek	107	9	12,13,24,25,26,35
Rush Creek (also Fillmore Co.)	105	8	6,7,18,19,20,29
	105	9	1,2,12
	106	9	35,36
Silver Creek (also Houston Co.)	105	6	34,35
Speltz Creek	108	8	31
	108	9	36
Stockton Valley Creek	106	8	2,3,10,11,14,23
	107	8	34
Trout Run Creek (also Filmore County)	105	10	18,19,30,31,32
Trout Run - Whitewater Park	107	10	29
Trout Valley Creek (also Wabasha County)	108	9	5,8,17,20
Unnamed Creek	105	7	19,29,30
	105	8	24
Unnamed Creek	106	5	21,22,27,28
Unnamed Creek	106	5	17,20,21
Unnamed Creek (Deering Valley Cr.)	108	8	20,28,29
Whitewater River, Main Br.	107	10	2,3,9,10
	108	10	14,15,22,23,26,27,35
Whitewater River, Middle Br. (also Olmsted Co.)	107	10	9,10,16,17,19,20,30
Whitewater River, North Br. (also Wabasha & Olmsted Counties)	107	10	5,6,7,8,9
Whitewater River, South Br.	106	9	6
	106	10	1
	107	9	31
	107	10	3,10,11,14,24,25,36
YELLOW MEDICINE COUNTY			
Canby Creek	114	45	17,18
	114	46	13,14,21,22,23

Sec. 2.

a. The taking of fish of any variety is prohibited in the waters designated as trout streams by this order, except during the open season for the taking of stream trout in streams.

b. The taking of minnows in the waters designated as trout streams by this order is prohibited at all times.

Commissioner's Order No. 2062 is hereby superseded.

Dated this 9th day of June, 1981.

JOSEPH N. ALEXANDER
Commissioner

APPROVED AS TO FORM AND EXECUTION
WARREN SPANNAUS
Attorney General

C. PAUL FARACI
Deputy Attorney General

APPENDIX B

DESCRIPTION OF MINNESOTA WILD, SCENIC, AND RECREATIONAL RIVERS PROGRAM

MINNESOTA WILD, SCENIC AND RECREATIONAL

RIVERS PROGRAM

A list of designated Minnesota rivers and communities that are under special management pursuant to Minnesota Statutes 104.31-104.40 (Minnesota Wild and Scenic Rivers Act) and M.S. 104.25 (Lower St. Croix National Scenic Riverway).

This list identifies the stretch of river that is designated, designation year, the type of classification and the communities affected. A table and figure are presented at the end of the list to illustrate the minimum requirements for new development according to the type of classification. For most municipalities, the less restrictive standards of the Minnesota Shoreland Management Program (M.S. 105.485) apply, as listed behind municipalities and shown in the table.

For more information, please contact your local zoning official, DNR Area Hydrologist, or:

Bill Zachman
Minnesota Department of Natural Resources
Division of Waters
Box 32, Centennial Office Bldg.
St. Paul, MN 55155
Phone: (612) 296-9224

or:

Paul Swenson
Minnesota Department of Natural Resources
Office of Planning
Box 10, Centennial Office Bldg.
St. Paul, MN 55155
Phone: (612) 296-0568

RIVER (designation year)	CLASSIFICATION
1) Cannon (1979) --from Faribault city limits to Mississippi River in Red Wing	Scenic and Recreational a) Rice County, recreational --Dundas, NE/GD Shoreland --Northfield, NE/GD Shoreland b) Dakota Co., Scenic/Recreational c) Goodhue Co., Scenic/Recreational --Cannon Falls, RD Shoreland --Red Wind, Scenic
2) North Fork of the Crow (1976) --in Meeker County	Recreational a) Meeker Co., Recreational --Kingston, GD Shoreland
3) Kettle (1975) --in Pine County	Wild and Scenic a) Pine Co., Wild & Scenic --Willow River, GD Shoreland --Rutledge, GD Shoreland --Sandstone, GD Shoreland
4) Minnesota (1977) --from Lac Qui Parle Dam to Franklin (CSAH #11 Bridge)	Scenic and Recreational a) Lac Qui Parle Co., Scenic b) Chippewa Co., Scenic/Recreational --Montevideo, RD Shoreland c) Yellow Medicine Co., Scenic/Rec. --Granite Falls, RD Shoreland d) Renville Co., Scenic --Morton, RD Shroeland e) Redwood Co., Scenic --North Redwood, RD Shoreland
5) Mississippi (1976) --from St. Cloud (CSAH #7 Bridge) to Ransey-Anoka city limit boundary	Scenic and Recreational a) Stearns Co., Scenic --St. Cloud, GD Shoreland b) Sherburne Co., Scenic/Recreational --Becker, NE Shoreland --Elk River, GD Shoreland c) Wright Co., Recreational --Clearwater, GD Shoreland --Monticello, GD Shoreland d) Anoka Co., _____ --Ramsey, NE Shoreland e) Hennepin Co., _____ --Dayton, NE Shoreland

RIVER (designation year)	CLASSIFICATION
6) Rum (1979) --Lake Ogechie to Mississippi River in Anoka	Wild, Scenic and Recreational a) Mille Lacs Co., Wild/Scenic/Rec. --Onamia, RD Shoreland --Milaca, RD Shoreland --Princeton, RD Shoreland b) Sherburne Co., Scenic c) Isanti Col, Scenic --Cambridge, RD Shoreland --Isanti, RD Shoreland d) Anoka Co., Scenic/Recreational --St. Francis, RD Shoreland --Ramsey, RD Shoreland --Andover, Scenic --Anoka, RD Shoreland
7) St. Croix (1976) --from Taylors Falls Dam to Point Douglas	The classification scheme for this river is unique; please refer to page 56 for a listing of affected communities and their requirements.

TABLE 1: Dimensional Standards

MINNESOTA WILD, SCENIC AND RECREATIONAL RIVERS SYSTEM

These minimum standards shall apply to each designated river as follows:

	RIVER CLASSIFICATION		
	Wild	Scenic	Recreational
Lot Size*+	6 acres (261,360 sq ft)	4 acres (174,240 sq ft)	2 acres (87,120 sq. ft)
Water Frontage and Lot Width at Building Line*(ft)	300	250	200
Building Setbacks From:			
OMWM (ft)	200	150	100
Designated Tribut. (ft)	100	100	100
Bluffline (ft)	40	30	20
Sewage System Setback from:			
OHWM (ft)	150	100	75
Designated Tribut. (ft)	75	75	75

+Smaller lot sizes may be permitted for cluster developments.
*Applies only to newly platted lots.

State Shoreland Management Minimum Standards

	Natural Environment Lake & Streams	Recreation Dev. Lakes & Streams	General Development Lakes & Streams
Unsewered Areas			
Lot Size*+ (sq ft)	80,000	40,000	20,000
Water Frontage & Lot Width (ft)	200	150	100
Building Setback From OHWM (ft)	200	100	75
Sewage System Setback from OHWM (ft)	150	75	50
Sewered Areas			
Ripairan Lot Size (sq ft)	40,000	20,000	15,000
Other Lots	20,000	15,000	10,000
Water Frontage & Lot Width (ft)	125	75	75
Building Setback from OHWM (ft)	150	75	50

+Smaller lot sizes may be permitted for cluster developments.
*Applies only to newly platted lots.

LOWER ST. CROIX NATIONAL SCENIC RIVERWAY

MINIMUM DIMENSIONAL STANDARDS

	Rural	Urban	
		Unsewered	Sewered
Lot Size*	2-1/2 acres	1 acre	20,000 ft^2
Water Frontage and Lot Width at Building Line (ft)	200	150	100
Building Setback (ft)			
From: OHWM	200	100	100
Bluffline	100	40	40
Sewage System Setback (ft)			
From: OHWM	200	100	
Bluffline	40	40	

*for lots created after May 1, 1974.

Vegetative clearcutting of trees greater than 6" diameter at breast height is not allowed within the building setback distances.

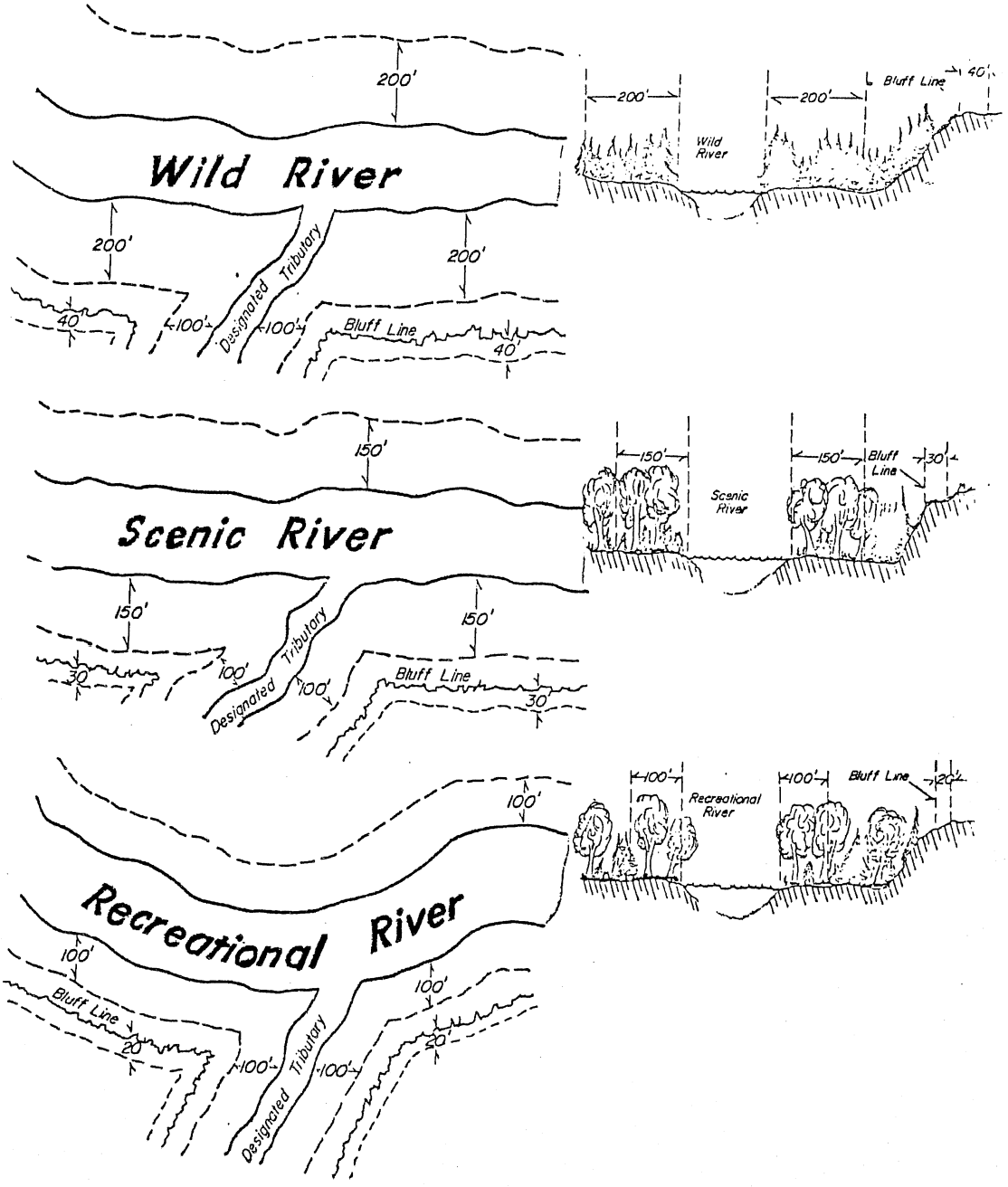
RURAL DISTRICTS: consist of those lands in the St. Croix Riverway in:

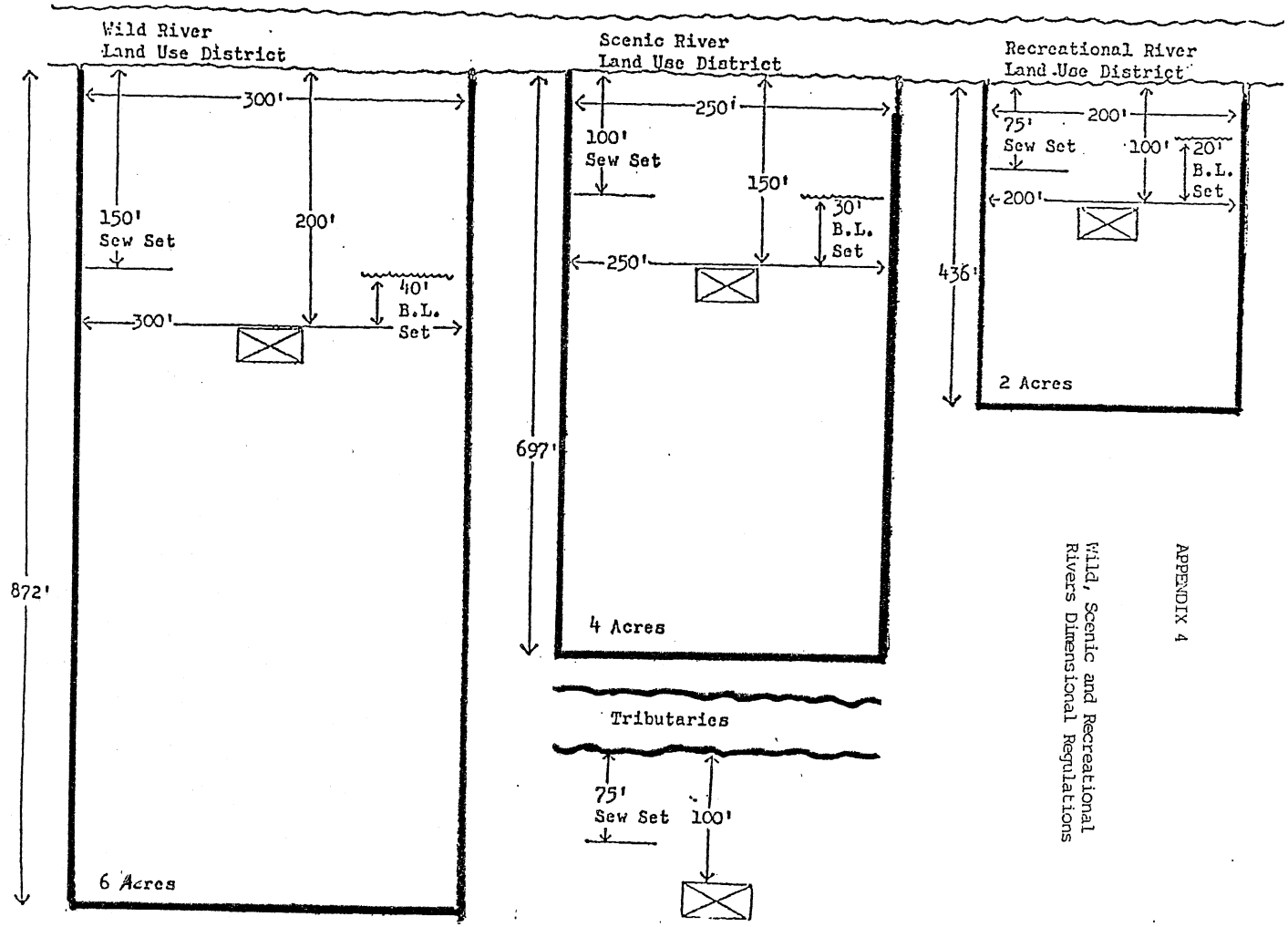
1) the unincorporated areas of Chisago County
2) The unincorporated areas of Washington County
3) Marine-on-St. Croix, north of the line separating Gov't lots 5 and 6 in Section 6
4) Afton, south of the line separating Gov't Lots 4 and 5, extending west to the riverway boundary in Sections 22 and 23

URBAN DISTRICTS: consist of those lands in the St. Croix Riverway in the Cities of:

1) Taylors Falls
2) Marine-on-St. Croix, south of the line described in the Rural Districts
3) Stillwater
4) Oak Park Heights
5) Bayport
6) Lakeland
7) Lakeland Shores
8) Lake St. Croix Beach
9) St. Mary's Point
10) Afton, north of the line described in the Rural Districts

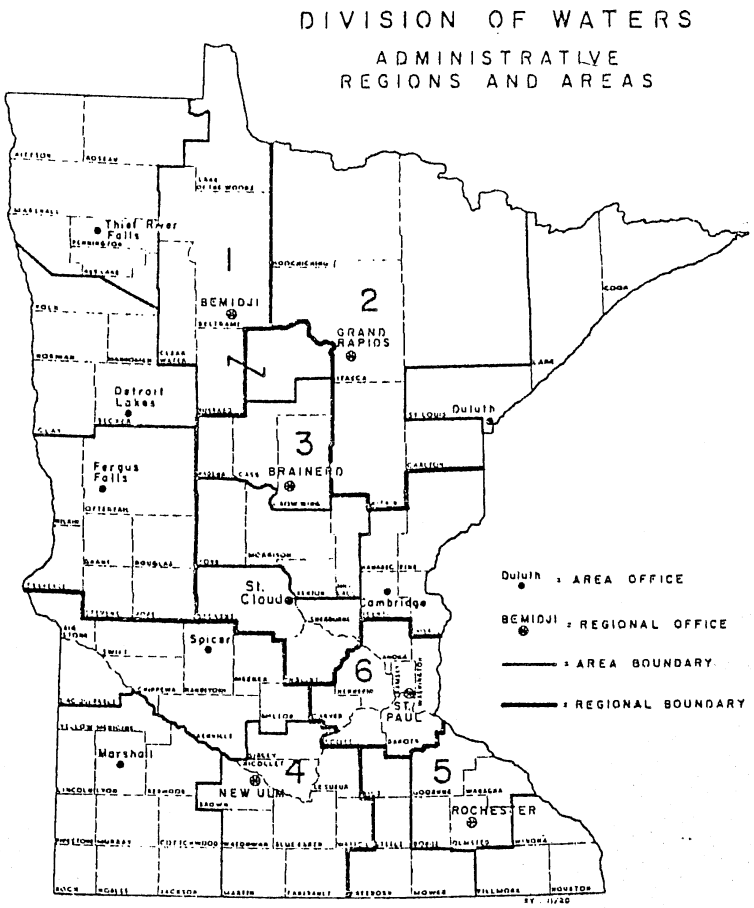
REGULATED VEGETATION CUTTING AREAS





Wild, Scenic and Recreational
Rivers Dimensional Regulations

APPENDIX 4



REGION 1

Regional Hydrologist
DNR - Division of Waters
Rural Route 5, Box 41A
Bemidji, MN 56601
(218) 755-3973

Thief River Falls Area

Area Hydrologist
DNR - Division of Waters
(Temporarily serviced out of Region 1 headquarters in Bemidji)

Detroit Lakes Area

Area Hydrologist
DNR - Division of Waters
P.O. Box 823
Detroit Lakes, MN 56501
(218) 847- 8275

Fergus Falls Area

Area Hydrologist
DNR - Division of Waters
1221 Fir Avenue East
Fergus Falls, MN 56537
(218)739-7578

REGION 2

Regional Hydrologist
DNR - Division of Waters
1201 East Highway 2
Grand Rapids, MN 55744
(218) 327-1716

Grand Rapids Area

Area Hydrologist
DNR - Division of Waters
(Served out of Region 2 headquarters)

Duluth Area

Area Hydrologist
DNR - Division of Waters
French River Hatchery
10029 North Shore Drive
Duluth, MN 58804
(218) 525-1872

REGION 3

Regional Hydrologist
DNR - Division of Waters
424 Front St., Box 648
Brainerd, MN 56401
(218) 829-2605

Cambridge Area

Area Hydrologist
DNR - Division of Waters
915 South Highway 65
Cambridge, MN 55008
(612) 689-2832

St. Cloud Area

Area Hydrologist
DNR - Division of Waters
3725 12th St. North
St. Cloud, MN 56301
(612) 255-4278

REGION 4

Regional Hydrologist
DNR - Division of Waters
Box 756, Highway 15 South
New Ulm, MN 56073
(507) 354-2196

Spicer Area

Area Hydrologist
DNR - Division of Waters
P.O. Box 457
232 Lake Ave. South
Spicer, MN 56288
(612) 796-2161

REGION 4 (Con't.)
Marshall Area

Area Hydrologist
DNR - Division of Waters
Bruce Street & East College Drive
Box 111
Marshall, MN 56258
(507) 537-7258

New Ulm Area

Area Hydrologist
DNR - Division of Waters
(Served out of Region 4 headquarters)

REGION 5

Regional Hydrologist & Areas
DNR - Division of Waters
2300 Silver Creek Road, N.E.
Rochester, MN 55901
(507) 285-7430

REGION 6

(No Areas)

Regional Hydrologist
DNR - Division of Waters
1200 Warner Road
St. Paul, MN 55106
(612) 296-7523

CENTRAL OFFICE

DNR - Division of Waters
Box 32, Centennial Office Building
St. Paul, MN 55155
(612) 296-4800

APPENDIX C

SUMMARY OF WATER QUALITY AND FISHERIES RESOURCES AT EXISTING DAMS IN MINNESOTA WITH HYDROPOWER POTENTIAL

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00549	Rum River	Anoka	Rum	City of Anoka	11.11	4.30	Iron	White Sucker (10.7/2.6), Northern Redhorse (10.7/3.50), Carp (5.3/11.90), Black Bullhead (0/12.82), Walleye (0/1.60), Silver Redhorse (7.30/0.6), Smallmouth Bass (4/2.2), White Crappie (0.0.3), Burbot (0/0.6), Spottail Shiner (0/0.3), Spotfin Shiner (10.7/11.5), Common Shiner (8/11.9), Brassy Minnow (0.0.3), Bluntnose Minnow (1.3/0.3), Fathead Minnow (0/2.6), Log Perch (0/0.6).
MN 00598	Cloquet	Carlton	St. Louis	Potlatch Corp. NW Paper Co.	8.33	4.90	Iron	Yellow Perch (2.7/2.7), Walleye (7.5/7.5), Largemouth Bass (0.9/0.9), Bluegill (0.2/0.2), Pumpkinseed (0.2/0.2), Rockbass (1.6/1.6), Smallmouth Bass(0.8/0.8), Burbot (0.2/0.2), Black Crappie (22.8/22.8). by Gillnets and Trapnets: Spottail Shiner (85.9/85.9), Common Shiner (1.7/1.7), Blacknose Shiner (0.7/0.7), Trout Perch (5.4/5.4), Log Perch (5.9/5.9), Channel Catfish (4.6/4.6), Brook Stickleback (0.2/0.2)
MN 00603	Fon Du Lac	Carlton	St. Louis	Minn. Power	8.33	4.90	Iron	White Sucker (98.6/28.1), Bullhead (0.97), Northern Pike (0.4/0), Walleye (1.0/0), Yellow Perch (0/53.4), Other Fishes (-/4.90).
MN 00605	Scanlon	Carlton	St. Louis	Minn. Power	8.33	4.90	Iron	White Sucker (12.80/100), Northern Redhorse (35.6/0), Northern Pike (3.90/0), Yellow Perch (2.70/0), Walleye (7.50/0), Largemouth Bass (0.9/0), Pumpkinseed (0.2/0), Bluegill (0.2/0), Rockbass (1.60/0), Smallmouth Bass (6.80/0), Black Crappie (22.8/0), Burbot (0.2/0). By Trapnetting and Gillnets: Spottail Shiner (85.9/-), Common Shiner (1.7/-), Blacknose Minnow (0.7/-), Trout Perch (5.4/-), Log Perch (5.9/-), Channel Catfish (4.6/-), Brook Stickleback (0.20/0).
MN 00606	Knife Falls	Carlton	St. Louis	Minn. Power	8.33	4.90	Iron	White Sucker (12.8/12.8), Northern Redhorse (35.6/35.6), Northern Pike (3.9/3.9), Yellow Perch (2.7/2.7), Walleye (7.5/7.5), Largemouth Bass (0.9/0.9), Bluegill (0.2/0.2), Pumpkinseed (0.2/0.2), Rockbass (1.6/1.6), Smallmouth Bass (6.8/6.8), Burbot (0.2/0.2), Black Crappie (22.8/22.8). By Gillnet and Trapnets: Spottail Shiner (85.9/85.9), Common Shiner (1.7/1.7), Blackhose Shiner (0.7/0.7), Trout Perch (5.4/5.4), Log Perch (5.9/5.9), Channel Catfish (4.6/4.6), Brook Stickleback (0.2/0.2).
MN 00585	Leech Lake Dam	Cass	Leech Lake River	DAEN-NCS	—	—	Zinc	Yellow Perch (-/8.2), White Sucker (-/22.7), Northern Redhorse (-/5.3), Rock Bass (-/3.1), Black Bullhead (-/25.8), Northern Pike (-/8.2), Walleye (-/6.9), Brown Bullhead (-/0.7), Blacknose Shiner (-/0.2), Spotfin Shiner (-/1.6), Red Shiner (-/1.6), Common Shiner (-/8.4), Mimic Shiner (-/0.2), Spottail Shiner (-/1.6), Johnny Darter (-/0.4), Golden Shiner (-/1.1), Tadpole Madtom (-/2.9), Log Perch (-/0.2), Slenderhead Darter (-/0.2), Fathead Minnow (-/0.7).
MN 00586	Winnibigo-shish Dam	Cass	Mississippi	DAEN-NCS	4.17	4.50	—	Yellow Perch (39.0), White Sucker (8.5/-) Rock Bass (5.5/-), Northern Redhorse (5.80/-), Black Bullhead (3.7/-), Walleye (2.50/-), Northern Pike (3.2/-) Black Crappie (2.5/-), Bluegill (1.0/-), Largemouth Bass (0.5/-), Pumpkinseed (0.4/-), Brown Bullhead (0.4/-), Burbot (0.3/-), Yellow Bullhead (0.1/-), Dogfish (0.1/-), Log Perch (0.4/-), Blacknose Shiner (5.5/-), Spotfin Shiner (4.7/-), Common Shiner (3.3/-), Mimic Shiner (3.0/-), Spottail Shiner (2.1/-) Johnny Darter (1.7/-), Blackchin Shiner (2.2/-), Golden Shiner (2.4/-), Tadpole Madtom (1.0/-), Banded Killifish (0.7/-), Bluntnose Minnow (0.3/-), Bigmouth Shiner (0.2/-), Fathead Minnow (0.1/-).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00601	Sylvan	Cass	Crow Wing	Minn. Power	16.67	1.90	Iron	White Sucker (42.1/49.1), Bowfin (0.7/0.6), Northern Redhorse (26.6/9.9), Yellow Bullhead (0/0.6), Northern Pike (0.7/7.45), Yellow Perch (0.7/1.2), Walleye (0/2.5), Largemouth Bass (2.3/1.2), Pumpkinseed (3.8/0.6), Bluegill (48.5/16.2), Rockbass (2.3/1.2), Silver Redhorse (0.7/0), Smallmouth Bass (0.1.20), Black Crappie (1.5/5.6), Burbot (0.2.5).
MN 00597	Brainerd	Crow Wing	Mississippi	Potlatch Corp. NW Paper Co.	4.17	4.90	—	White Sucker (1.8/44.8), Bowfin (0.9/0), Northern Redhorse (1.8/13.8), Black Bullhead (trace/0), Brown Bullhead (1.1/0), Yellow Bullhead (10.3/0), Northern Pike (1.8/2.2), Walleye (0.9/0.9), Yellow Perch (19.1/2.9), Largemouth Bass (0.5/0), Pumpkinseed (22.6/0), Bluegill (18.5/1.5), Rockbass (4.1/5.1), Silver Redhorse (2.3/6.6), Smallmouth Bass (0/1.8), Black Crappie (13.9/1.8), Burbot (0/1.1), Bigmouth Buffalo (trace/0), Greater Redhorse (0.2/0), Muskellunge (0/0.3), Golden Redhorse (0.7.3).
MN 00594	Lock and Dam #2	Dakota	Mississippi	DAEN-NCS	13.63	2.60	Iron	White Sucker (0/0.7), Carp (17.0/30.7), Walleye (0.4/0), Largemouth Bass (0.2/0), Bluegill (0/1.1), Silver Redhorse (0.2/1.8), Smallmouth Bass (0.6/4.2), White Crappie (0.2/0), Black Crappie (4.5/0), Spottail Shiner (8.2/0), Spotfin Shiner (3.3/0), Bluntnose Minnow (0.20/0), Johnny Darter (0.2/0), Quillback (0.4/1.6), Shorthead Redhorse (3.3/11.1), River Carp Sucker (0.0.7), Bigmouth Buffalo (.8/0.5), Channel Catfish (0.60/0.20), Sauger (0.6/6.0), Freshwater Drum (1.0/2.7), Emerald Shiner (22.7/0), Sandshiner (0.80/0), Gizzard Shad (16.5/30.3), Shiner S.P. (3.3/0), Hybrid Sunfish (0.0.5), Green Sunfish (0/2.7), White Bass (4.1/4.2), Moxostoma Sp. (1.96/0), Carpiodes Sp. (8.2/0), River Darter (0.2/0), Slenderhead Darter (0.20/0), High Carp Sucker (0.2/0), Smallmouth Buffalo (0.2/1.1).
MN 00514	Byllesby	Dakota and Goodhue	Cannon	Dakota and Goodhue	8.33	1.30	Iron	Carp (-/49.3), Common Sucker (-/14.5), White Bass (-/0.4), Northern Pike (-/0.9), Sheepshead (-/3.9), Shiner Sp. (-/5.2), Redhorse Sp. (-/14.8, Pimephales Sp. (-/3.5), Quillback (-/1.5), Walleye (-/2.2), Black Crappie (-/0.4), Black Bullhead (-/1.5), White Crappie (-/0.7), Largemouth Bass (-/0.1), Smallmouth Bass (-/0.1), Bigmouth Buffalo (-/0.1), Channel Catfish (-/0.4), Green Sunfish (-/0.7).
MN 00595	Lock and Dam #3	Goodhue	Mississippi	DAEN-NCS	13.63	2.60	Iron	White Bass (18.9/18.6), Carp (17.6/10.8), Gizzard Shad (10.3/3.2, Shorthead Redhorse (6.5/4.8), Bluegill (4.6/2.2), White Crappie (3.3/0.6), Black Crappie (14.4/17.2), Fresh Water Drum (11.2/4.8), Sauger (3.2/1.9), Smallmouth Bass (1.9/1.0), Walleye (1.7/1.0), Silver Chub (0/0.1), Carpsucker Species (0/0.7), Bullhead Minnow (0/4.4), Spotfin Shiner (0.3.4), Spottail Shiner (0.0.4), Emerald Shiner (0/18.0), Miscellaneous (6.6/6.7).
MN 00507	Coon Rapids	Hennepin	Mississippi	Hennepin Cty. Park Reserve	2.0	4.30	None	White Sucker (1.9/0.6), Bowfin (0.0.03), Carp (32.8/7.9), Yellow Bullhead (0/0.03), Northern Pike (0.32/0.40), Yellow Perch (0.0.03), Walleye (0.0.1), Bluegill (0/0.2), Largemouth Bass (0.0.03), Rockbass (0.3/0), Silver Redhorse (28.3/5.9), Smallmouth Bass (24/3.5), Black Crappie (0/0.3), Log Perch (0/1.10), Bigmouth Shiner (0.1.0), Spottail Shiner (0/0.2), Spotfin Shiner (0/5.1), Common Shiner (0/0.3), Bluntnose Minnow (0/1.7), Fathead Minnow (0/4.1), Trout Perch (0/0.4), Johnny Darter (0/10.8), Longnose Dace (0.0.3), Shorthead Redhorse (11.3/19.5), Quillback (0/0.8), River Carp Sucker (0/0.2), Bigmouth Buffalo (0/0.10), Channel Catfish (0/0.05), Greater Redhorse (0.6/0.08), Freshwater Drum (0.5/0.3), Sauger (0/0.03), Emerald Shiner (0/10.9), Brook Stickleback (0/0.3), Sucker S.P. (0/13.8), Northern Hog Sucker (0.6/0.2), Shiner S.P. (0/4.1).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00590	St. Anthony Falls Upper Lock and Dam	Hennepin	Mississippi	DAEN-NCS, NSP	2.0	4.30	None	White Sucker (0.8/0.8), Carp (30.5/30.5), Northern Pike (1.1/1.1), Bluegill (0.3/0.3), Rockbass (0.6/0.6), Silver Redhorse (14.6/14.6), Smallmouth Bass (25.3/25.3), Black Crappie (0.3/0.3), Shorthead Redhorse (24.7/24.7), Bigmouth Buffalo (0.6/0.6), Channel Catfish (0.6/0.6), Greater Redhorse (0.3/0.3), Fresh Water Drum (0.6/0.6).
MN 00591	St. Anthony Falls Lower Lock and Dam	Hennepin	Mississippi	DAEN-NCS, NSP	2.0	4.30	None	White Sucker (0.8/0.8), Carp (30.5/30.5), Northern Pike (1.1/1.1), Bluegill (0.3/0.3), Rockbass (0.6/0.6), Silver Redhorse (14.6/14.6), Smallmouth Bass (25.3/25.3), Black Crappie (0.3/0.3), Shorthead Redhorse (24.7/24.7), Bigmouth Buffalo (0.60/0.60), Channel Catfish (0.6/0.6), Greater Redhorse (0.3/0.3), Fresh Water Drum (0.6/0.6)
MN 00593	Lock and Dam #1	Hennepin	Mississippi	DAEN-NCS, Ford Motor Co.	2.0	4.30	None	White Sucker (0.6/0.6), Carp (39.3)/39.3), Green Sunfish (3.7/3.7), Silver Redhorse (3.1/3.1), Smallmouth Bass (38.0/38.0), Black Crappie (0.6/0.6), Shorthead Redhorse (8.6/8.6), Quillback (1.2/1.2), Bigmouth Buffalo (1.2/1.2), Fresh Water Drum (1.2/1.2), Gizzard Shad (2.5/2.5).
MN 00584	Lake Dam	Itasca	Mississippi	DAEN-NCS	4.7	4.5	--	Yellow Perch (-/39.0), White Sucker (-/8.5), Rockbass (-/5.5), Northern Redhorse (-/5.8), Black Bullhead (-/3.7), Walleye (-/3.5), Northern Pike (-/3.2), Black Crappie (-/1.5), Bluegill (-/1.0), Largemouth Bass (-/0.50), Pumpkinseed (-/04.), Brown Bullhead (-/04.), Burbot (-/0.3), Yellow Bullhead (-/0.1), Dogfish (-/0.1), Log Perch (-/0.4), Blacknose Shiner (-/5.5), Spotfin Shiner (-/4.7), Common Shiner (-/3.3), Mimic Shiner (-/3.0), Spottail Shiner (-/2.1), Johnny Darter (-/1.7), Blackchin Shiner (-/2.2), Golden Shiner (-/2.4), Tadpole Madtom (-/1.0), Banded Killifish (-/0.7), Bluntnose Minnow (-/0.30), Bigmouth Shiner (-/0.20), Fathead Minnow (-/0.1).
MN 00602	Blandin	Itasca	Mississippi	Blandin Paper Co.	4.17	5.50	—	White Sucker (-/28.1), Bowfin (-/1.75), Northern Redhorse (-/12.30), Black Bullhead (-/1.8), Brown Bullhead (-/3.50), Walleye (9.1/7.0), Yellow Bullhead (-/7.0), Northern Pike (2.2/3.5), Bluegill (-/1.80), Pumpkinseed (-/1.80), Rockbass (-/15.8), Black Crappie (-/8.8), Burbot (-/1.8), Bigmouth Buffalo (-/1.80), Pumpkinseed-Bluegill Hybrid (-/3.5).
MN 00117	Jackson Dam	Jackson	Des Moines	City of Jackson	6.9	3.8	Zinc Iron	Black Bullhead (3.60/-), White Sucker (10.7/-), Bigmouth Buffalo (3.60/-), Carp (28.6/-), Common Shiner (7.14/-), Fathead Minnow (17.9/-), Spotfin Shiner (7.1/-), Northern Pike (3.6/-), Black Crappie (10.7/-), Yellow Perch (7.1/-).
MN 00653	Rainy Lake Dam	Koochiching	Rainy	Boise Cascade	8.33	4.50	Zinc Iron	Burbot (-/0.5), Northern Pike (-/2.7), Quillback (-/), Longnose Sucker (-/0.2), White Sucker (-/5.5), Silver Redhorse (-/0.9), Northern Redhorse (-/3.1), Black and Brown Bullheads (-/83.8), Rock Bass (-/0.7), Smallmouth Bass (-/0.7), Black Crappie (-/0.3), Yellow Perch (-/0.5), Sauger (-/0.2), Walleye (-/2.2).
MN 00580	Lac Qui Parle Dam	Lac Qui Parle	Minnesota	DAEN-NCS	5.56	1.2	None	Smallmouth Bass (0.4/0.4), Walleye (10.4/10.4), Carp (27.3/27.3), Northern Pike (0.8/0.8), Channel Catfish (1.6/1.6), Green Sunfish (1.2/1.2), Black Crappie (0.4/0.4), Bowfin (0.8/0.8), Bigmouth Buffalo (9.6/9.6), Quillback (1.2/1.2), Golden Redhorse (14.1/14.1), Silver Redhorse (5.6/5.6), Shorthead Redhorse (22.1/22.1), White Sucker (2.8/2.8), Black Bullhead (0.4/0.4), Yellow Perch (0.8/0.8), Freshwater Drum (0.4/0.4).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00581	Hwy 75 Dam	Lac Qui Park	Minnesota	DAEN-NCS	5.56	1.2	None	Walleye (1.0/0.6), Sauger (0/2.4), Northern Pike (2.9/0.6), Channel Catfish (0/7.1), Flathead Catfish (0/0.6), Green Sunfish (4.9/1.2), White Crappie (0.3/0), Bigmouth Buffalo (2.0/1.2), Quillback (3.9/1.8), River Carpsucker (0/2.4), Shorthead Redhorse (14.7/31.4), Carp (17.6/25.4), Golden Redhorse (27.5/11.2), Silver Redhorse (14.7/8.9), Bowfin (0/0.6), Greater Redhorse (0/0.6), White Sucker (9.8/0), Shortnose Gar (0/1.8), Freshwater Drum (0/2.4).
MN 00607	Winton	Lake	Kawishiwi	Minn. Power	—	—	Zinc	Northern Pike (4.9/-), Walleye (7.3/-), White Sucker (13.6/-), Smallmouth Bass (0.5/-), Largemouth Bass (0.2/-), Northern Cisco Tullibee (19.6/-), Rockbass (11.3/-), Black Crappie (9.0/-), Bluegill (15.9/-), Yellow Perch (17.7/-).
MN 00599	Blanchard	Morrison	Mississippi	Minn. Power	4.17	4.90	None	White Sucker (13.1/12.2), Northern Redhorse (61.9/52.3), Carp (0/11.6), Walleye (4.8/1.7), Yellow Bullhead (1.19/0), Yellow Perch (4.8/1.2), Northern Pike (1.2/2.3), Pumpkinseed (0/0.6), Rockbass (2.4/2.3), Silver Redhorse (2.4/9.3), Smallmouth Bass (4.8/2.3), Black Crappie (3.6/2.9).
MN 00600	Little Falls	Morrison	Mississippi	Minn. Power	4.17	4.90	None	White Sucker (44.8/13.1), Northern Redhorse (13.8/61.9), Yellow Bullhead (0/1.2), Northern Pike (2.2/1.2), Yellow Perch (2.9/4.8), Walleye (9.1/4.8), Bluegill (1.5/0), Rockbass (5.1/2.4), Silver Redhorse (6.6/2.4), Smallmouth Bass (1.8/4.8), Black Crappie (1.8/3.6), Burbot (1.10/0).
MN 00608	Pillager Dam	Morrison	Crow Wing	Minn. Power	16.67	1.90	None	White Sucker (27.7/12.1), Bowfin (0.4/0.7), Northern Redhorse (42.7/26.6), Black Bullhead (0.04/0), Yellow Bullhead (0.18/0), Northern Pike (3.3/0.7), Yellow Perch (1.6/0.7), Walleye (6.32/0), Largemouth Bass (0.2.3), Pumpkinseed (0.4/3.82), Bluegill (0.2/48.5), Rockbass (7.6/2.3), Silver Redhorse (4.5/0.7), Black Crappie (0.1/1.5), Burbot (0.4/0).
MN 00364	Mayowood Lake	Olmsted	South Branch Zumbro River	Olmsted County	NIL	NIL	Iron Zinc	Brook Lamprey (0.4/-), Stoneroller (5.0/-), Ozark Minnow (0.1/-), Brassy Minnow (0.1/-), Hornyhead Chub (2.0/-), Common Shiner (7.8/-), Bigmouth Shiner (2.6/-), Rosyface Shiner (2.5/-), Redfin Shiner (0.2/-), So. Redbelly Dace (0.1/-), Bluntnose Minnow (4.6/-), Fathead Minnow (0.2/-), Blacknose Dace (0.1/-), Longnose Dace (1.6/-), Creek Chub (1.0/-), White Sucker (28.7/-), Northern Hog Sucker (7.8/-), Silver Redhorse (24.5/-), Stone Cat (1.2/-), Rockbass (1.5/-), Green Sunfish (0.4/-), Bluegill (0.1/-), Smallmouth Bass (1.7/-), Largemouth Bass (0.2/-), Rainbow Darter (1.4/-), Fantail Darter (1.4/-), Johnny Darter (1.6/-), Banded Darter (0.5/-), Blackside Darter (0.3/-).
MN 00365	Shady Lake	Olmsted	Middle Fork Zumbro	Olmsted County				Brown Trout (6.4/-), Northern Pike (13.3/6.3), Yellow Perch (-/19.0), Johnny Darter (22.5/1.6), Central Mudminnow (3.5/-), Northern Sculpin (7.5/-), Freshwater Burbot (8.7/7.9), Silver Lamprey (1.2/-), Greater Redhorse (-/20.6), Northern Redhorse (-/7.9), Silver Redhorse (-/12.7), White Sucker (22.5/9.5), Longnose Dace (11.0/7.9), Common Shiner (0.6/6.3), Blackshin Shiner (0.6/-), Black Crappie (0.6/-), Rockbass (0.6/-), Blacknose Dace (0.6/-).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00515	South Branch Zumbro River	Olmsted	South Branch Zumbro River	City of Rochester	NIL	NIL	Iron Zinc	Stoneroller (7.2/-), Carp (3.8/-), Hornyhead Chub (1.0/-), Common Shiner (10.3/-), Bigmouth Shiner (0.8/-), Rosyface Shiner (1.6/-), Spotfin Shiner (16.1/-), Sand Shiner (9.0/-), Suckermouth Minnow (10.5/-), Bluntnose Minnow (3.2/-), Fathead Minnow (0.2/-), Blacknose Dace (0.2/-), Longnose Dace (0.3/-), Creek Chub (1.7/-), Quillback Carp Sucker (0.9/-), White Sucker (8.2/-), Northern Hog Sucker (1.7/-), Silver Redhorse (5.2/-), Shorthead Redhorse (1.9/-), Yellow Bullhead (0.2/-), Channel Catfish (2.6/-), Stone Cat (0.6/-), White Bass (0.6/-), Rock Bass (0.2/-), Green Sunfish (2.4/-), Orangespotted Sunfish (0.1/-), Bluegill (1.2/-), Hybrid Sunfish (0.3/-), Smallmouth Bass (0.3/-), Largemouth Bass (0.2/-), White Crappie (0.2/-), Black Crappie (0.1/-), Rainbow Darter (0.2/-), Fantail Darter (0.3/-), Johnny Darter (0.6/-), Banded Darter (0.2/-), Log Perch (5.8/-), Blackside Darter (0.2/-), Slenderhead Darter (0.5/-).
MN 00190	Pelican Rapids	Ottertail	Pelican	City of Pelican Rapids	--	--	--	Numbers not available. Common Fish species found are: Dogfish, Tullibee, Brown Trout, Rainbow Trout, Brook Trout, Bigmouth Buffalo, Northern Carp Sucker, Common White Sucker, Northern Redhorse, Hornyhead Chub, Longnose Dace, Common Shiner, Northern Creek Chub, Golden Shiner, Spottail Shiner, Blackshin Shiner, Northern Sand Shiner, Blacknose Shiner, Fathead Minnow, Stoneroller, Bluntnose Minnow, Black Bullhead, Brown Bullhead, Yellow Bullhead, Central Mudminnow, Walleye, Northern Pike, Hybrid Northern Pike, Muskellunge, Western Banded Killifish, Yellow Perch, Northern Log Perch, Johnny Darter, Iowa Darter, Smallmouth Bass, Largemouth Bass, Green Sunfish, Pumpkinseed, Bluegill, Hybrid Sunfish, Rock Bass, Black Crappie, Brook Stickleback.
MN 00191	Pelican River Dam	Ottertail	Pelican	Warren B. Diedrich	--	--	--	Same as for MN 00190.
MN 00574	Orwell Reservoir and Dam	Ottertail	Ottertail	DAEN-NCS	--	--	--	Largemouth Bass (0.7/-), Walleye (5.5/4.2), Northern Pike (0.3/0.2), Channel Catfish (-/0.3), Rockbass (1.0/0.3), Black Crappie (0.7/0.6), Bigmouth Buffalo (-/1.6), Quillback (-/4.4), Carp (18.5/15.3), Golden Redhorse (6.8/6.1), Silver Redhorse (4.5/2.8), Greater Redhorse (9.6/7.2), Shorthead Redhorse (4.1/8.7), White Sucker (8.2/7.8), Brown Bullhead (0.3/-) Black Bullhead (-/2.3), Yellow Perch (1.0/1.2), Common Shiner (1.4/1.7), Spottail Shiner (0.3/18.4), Spotfin Shiner (0.3/6.4), Sand Shiner (-/2.7), Mimic Shiner (2.1/-) Hornyhead Chub (1.7/-), Longnose Dace (13.4/0.2), Stoneroller (7.5/0.2), Blackside Darter (2.4/-), Log Perch (9.6/7.3), Johnny Darter (-/0.2).
MN 00502	Red Lake River I	Pennington	Red Lake River	Thief River Falls	--	--	Zinc	Walleye (2.2/2.9), Northern Pike (0.9/0.2), Channel Catfish (-/0.4), Rockbass (5.3/1.1), Black Crappie (-/0.2), Quillback (-/2.4), Golden Redhorse (-/9.0), Silver Redhorse (-/2.6), Shorthead Redhorse (11.1/18.9), White Sucker (45.8/12.3), Carp (-/3.5), Brown Bullhead (0.4/0.4), Burbot (0.4/3.1), Yellow Perch (1.3/2.6), Freshwater Drum (5.8/13.2), Chestnut Lamprey (-/0.9), Cannon Shiner (4.0/2.4), Hornyhead Chub (7.6/0.9), Longnose Dace (-/5.5), Blackside Darter (15.1/16.7), Johnny Darter (-/0.7).
MN 00513	Kettle River	Pine	Kettle	State of Minnesota	--	--	Zinc Iron	Redhorse (64.1/32.6), Crappie (0.9/50.1), Lamprey (13.2/2.6), White Sucker (5.6/4.5), Walleye (3.7/1.1), Hog Sucker (-0.7), Bluegill (-2.6), Northern Pike (2.8/1.1), Rock Bass (0.9/1.9), Smallmouth Bass (-1.1), Yellow Perch (4.7/-), Burbot (-0.3), Sturgeon (-/0.7), Black Bullhead (2.8/-), Largemouth Bass (0.9/-).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00008	Red Lake River II	Polk	Red Lake River	Ottertail Power	--	--	Zinc	Walleye (4.7/3.3), Sauger (-/0.5), Northern Pike (-/0.5), Channel Catfish (-/2.3), Rockbass (0.3/4.7), Quillback (0.7/7.9), Golden Redhorse (46.1/26.6), Shorthead Redhorse (11.1/18.2), White Sucker (3.7/1.4), Carp (-/4.7), Mooneye (1.3/12.1), Freshwater Drum (3.7/10.3), Chestnut Lamprey (1.0/0.5), Emerald Shiner (1.0/0.5), Common Shiner (6.4/0.5), Bigmouth Shiner (-/0.5), Sand Shiner (-/0.5, Silver Chub (0.3/3.3), Longnose Dace (2.0/0.5), Blackside Darter (9.1/0.9), Johnny Darter (-/0.5), Silver Redhorse (2.4/-) Burbot (0.7/-), Hornyhead Chub (2.7/-) Trout Perch (1.0/-), River Darter (1.7/-).
MN 00010	Grand Forks East	Polk	Red Lake River	East Grand Forks	--	--	Zinc	Walleye (3.3/-), Sauger (0.5/-), Northern Pike (0.5/-), Channel Catfish (2.3/-), Rockbass (4.7/-), Quillback (7.9/-), Golden Redhorse (26.6/-), Shorthead Redhorse (18.2/-), White Sucker (1.4/-), Carp (4.7/-), Mooneye (12.1/-), Freshwater Drum 10.3/-), Chestnut Lamprey (0.5/-), Emerald Shiner (0.5/-), Common Shiner (0.5/-), Bigmouth Shiner (0.5/-), Sand Shiner (0.5/-), Silver Chub (3.3/-), Longnose Dace (0.5/-), Black Side Darter (0.9/-), Johnny Darter (0.5/-).
MN 00356	Cannon River II	Rice	Cannon	Archibald & Co.	8.33	1.30	Iron	Carp (-/36.1), Common Sucker (-/8.9), Sheepshead (-/5.2), Northern Pike (-/1.6), White Bass (-/0), Shiner Sp. (-/11.8), Redhorse Sp. (-/17.0), Pimephales Sp. (-/2.4), Quillback (-/3.4), Walleye (-/3.1, Black Crappie (-/1.0), Black Bullhead (-/4.2, White Crappie (-/2.4), Largemouth Bass (-/0.3), Bigmouth Buffalo (-/0.5), Green Sunfish (-/2.1).
MN 00093	Kettle River	St. Louis	Namakan	Boise-Cascade	4.4	8.33	Zinc Iron	Walleye (-/20.5), Northern Pike (-/9.1), Tullibee (-/4.2), Whitefish (-/35.8), Burbot (-/8.5), Sucker (-/21.8).
MN 00094	St. Louis River	St. Louis	St. Louis	Oglebay-Norton Co.	4.35	3.80	--	Northern Pike (0.4/1.4), Northern Redhorse (17.3/24.5), White Sucker (13.2/14.3), Channel Catfish (0.6/0), Burbot (0.4/0.8), Smallmouth Bass (5.8/0), Rock Bass (0.4/1.4), Bluegill (0.2/0), Pumpkinseed (0.2/0), Walleye (2.7/0.8), Longnose Dance (0.8/0.5), Common Shiner (0.2/1.4), Mimic Shiner (2.3/0), Log Perch (13.2/1.9), Trout Perch (0.8/3.8), Johnny Darter (0.4/2.2), Mottled Sculpin (0.2/0), Yellow Perch (0/1.4), Central Mudminnow (0/0.8), Spotfin Shiner (0/0.3).
MN 00610	Whiteface Lake	St. Louis	Skunk & Whiteface	Minn. Power	-	--	--	White Sucker (26.4/18.4), Northern Redhorse (2.0/-), Northern Pike (2.5/5.3), Smallmouth Bass (1.0/-), Bluegill (6.1/-), Rockbass (9.6/-), Burbot (0.5/18.4), Pumpkinseed (4.1/-), Black Crappie (1.0/-), Yellow Perch (2.0/-), Madtom (-/2.6), Johnny Darter (11.7/26.3), Blacknose Dace (12.7/-), Cannon Shiner (9.6/-), Longnose Dace (3.0/13.2), Mottled Sculpin (4.6/15.8), Bluntnose Minnow (2.0/-), Spottail Shiner (1.0/-).
MN 00612	Island Lake	St. Louis	Cloquet	Minn. Power	--	--	--	Northern Pike (3.8/1.2), Walleye (11.5/3.3), Rockbass (-/1.6), Channel Catfish (-/4.1), Smallmouth Bass (1.3/0.8), Northern Redhorse (25.6/37.4), White Sucker (11.5/28.0), Yellow Perch (18.2/4.1), Bluegill (-/8.1), Pumpkinseed (16.7/6.9), Yellow Bullhead (-/0.8), Brown Trout (-/0.4), Black Crappie (-/3.3), Burbot (1.3/-).
MN 00505	Sartell	Stearns	Mississippi	St. Regis Paper Co.	4.17	4.80	None	White Sucker (12.2/25.9), Northern Redhorse (52.3/21.2), Carp (22.6/10.6), Northern Pike (2.3/10.6), Yellow Perch (1.7/0), Walleye (1.7/10.6), Rockbass (2.3/0), Pumpkinseed (0.6/0), Silver Redhorse (9.3/0), Small Mouth Bass (2.3/20.9), Black Crappie (2.9/0).

Dam I.D. #	Site Name	County	River/Stream	Owner	Low D.O. Occurrence Frequency % of Samples	Minimum D.O. Concentration Recorded (ppm)	Toxic Metals which occur in Conc. above Permissible Limits	Fish Species as Percent of Total Population (Above Dam/Below Dam)
MN 00506	St. Cloud	Stearns	Mississippi	St. Cloud	4.17	4.80	None	White Sucker (15.9/-), Northern Redhorse (21.2/-), Carp (10.6/-), Northern Pike (10.6/-), Walleye (10.6/-), Smallmouth Bass (20.9/-).
MN 00011	Zumbro River	Wabasha	North Fork Zumbro	Village of Mazeppa				White Sucker (-/42.8), Creek Chub (-/9.70), Common Shiner (-/21.6), Bigmouth Shiner (-/0.4), Sand Shiner (-/1.1), Horneyhead Chub (-/2.6), Blacknose Dace (-/3.5), Longnose Dace (-/3.0), Bullhead Minnow (-/0.4), Bluntnose Minnow (-/0.4), Fathead Minnow (-/0.4), Stoneroller (-/12.3), Johnny Darter (-/1.9), Fantail Darter (-/0.4).
MN 00358	Zumbro Lake	Wabasha	Zumbro	City of Rochester	--	--	--	Channel Catfish (-/9.0), Carp (-/2.6), White Sucker (-/9.0), Shorthead Redhorse (-/18.7), Hog Sucker (-/5.8), Smallmouth Bass (-/9.7), Walleye (-/2.0), Sauger (-/5.2), White Crappie (-/1.3), Rock Bass (-/1.3), Black Crappie (-/5.8), Green Sunfish (-/4.5), Bluegill (-/2.0), Stoneroller (-/0.7), Quillback (-/12.3), Drum (-/2.6), Black Bullhead (-/6.5), White Bass (-/1.3).
MN 00587	Lock and Dam #7	Winona	Mississippi	DAEN-NCS	13.63	2.60	Iron	Northern Pike (0.8/-), Channel Catfish (12.7/-), White Bass (1170/-), Rock Bass (13.6/-), Green Sunfish (0.8/-), Bluegill (7.60/-), Hybrid Sunfish (0.8/-), Smallmouth Bass (18.6/-), Black Crappie (2.5/-), Quillback (5.9/-), Silver Redhorse (9.30/-), River Redhorse (4.2/-), Shorthead Redhorse (12.7/-), Freshwater Drum (1.70/-).
MN 00588	Lock and Dam #5A	Winona	Mississippi	DAEN-NCS	13.63	2.60	Iron	Channel Catfish (-/1.80), Bluefill (-/5.5), Black Crappie (-/14.5), Sauger (-/16.4), Longnose Gar (-/7.3), Carp (-/9.1), Shorthead Redhorse (-/3.6), Freshwater Drum (-/3.6), False Map Turtle (-/5.4), Northern Pike (-/5.4), Orangespotted Sunfish (-/1.8), Largemouth Bass (-/3.6), White Crappie (-/5.4), Shortnose Gar (-/3.6), River Carpsucker (-/1.8), Spotted Sucker (-/1.8), Western Painted Turtle (-/7.3), Snapping Turtle (-/1.8).
MN 00589	Lock and Dam #5	Winona	Mississippi	DAEN-NCS	13.63	2.60	Iron	Channel Catfish (1.80/-), Bluegill (5.5/-), Black Crappie (14.5/-), Sauger (16.4/-), Longnose Gar (7.3/-), Carp (9.1/-), Shorthead Redhorse (3.6/-), Freshwater Drum (3.6/-), False Map Turtle (5.4/-), Northern Pike (5.4/-), Orangespotted Sunfish (1.8/-), Largemouth Bass (3.6/-), White Crappie (5.4/-), Shortnose Gar (3.6/-), River Carpsucker (1.8/-), Spotted Sucker (1.8/-), Western Painted Turtle (7.3/-), Snapping Turtle (1.8/-).
MN 00152	Minnesota River I	Yellow Medicine	Minnesota	NSP	5.56	1.2	None	Walleye (4/24.8), Northern Pike (0/0.8), White Bass (3.2/0.8), Orangespotted Sunfish (0.8/0.8), Hybrid Sunfish (0/0.8), Rockbass (1.6/0), Bigmouth Buffalo (0/1.7), Quillback (0.8/0), Carp (12.7/36.4), Golden Redhorse (6.3/0.8), Shorthead Redhorse (0.8/0),White Sucker (8.7/4.1), Brown Bullhead (0.8/0), Black Bullhead (1.6/0), Yellow Bullhead (1.6/0), Yellow Perch (54.0/29.0), Freshwater Drum (3.2/0).
MN 00510	Granite Falls	Yellow Medicine	Minnesota	City of Granite Falls	5.56	1.2	None	Walleye (0.7/1.0), Northern Pike (1.5/2.9), Channel Catfish (1.5/0), Green Sunfish (1.5/4.9), Orangespotted Sunfish (0.7/0), White Crappie (0.0.3), Bigmouth Buffalo (3.0/2.0), Quillback (0/3.9), Golden Redhorse (13.4/27.5), Silver Redhorse (4.5/14.7), Shorthead Redhorse (28.4/14.7), Greater Redhorse (2.2/0), White Sucker (10.5/9.8), Carp (30.6/17.6), Black Bullhead (1.5/0).

APPENDIX D

GENERAL MPCA REQUIREMENTS FOR 401 CERTIFICATION OF A HYDROPOWER PROJECT

Hydropower Installation

General Requirements

1. A sedimentation control plan that would become part of the construction contract, utilizing reasonably available control technology. The plan would be approved by the MPCA.

2. A water quality monitoring plan to include turbidity, dissolved oxygen and other parameters of concern. This plan would be submitted to the MPCA for approval so that perconstruction monitoring can be conducted.

3. A study of fish impingement and entrainment indicating the potential impacts on fish populations. The results of this study shall be submitted to the MPCA for approval. The applicant would implement any reasonable and effective mitigative measures.

4. A study of the operational procedures and the effects of the project under various flow conditions, with consideration of the effect on the one in 10 year seven day low flow, the study would be submitted to the MPCA for approval.

5. Disposal of dredged material and demolition material shall be conducted in accordance with the requirements of the MPCA.

6. The project shall otherwise be generally conducted in accordance with the application for certification and attachments submitted to the MPCA.

7. The project shall otherwise be conducted in accordance with the requirements of the Minnesota Department of Natural Resources.

Dam and Impoundment, Construction, Repair, or Replacement Special Conditions

The applicant will contact the Minnesota Pollution Control Agency prior to construction associated with this project to determine appropriate operational monitoring which may be required. Monitoring of discharges and the effect of mitigation measures will be considered at that time.

PART I: Operations

a) The applicant shall develop a management plan which includes consideration for mitigating the potential water quality impact of the project. The plan shall consider maintenance of the structure, and operation practices affecting algae growth, dissolved oxygen, temperature, flow, and other parameters which may be altered by the proposed project. The plan should discuss mitigation of the potential problems should they arise.

The plan should provide for the following conditions so that the project:

1. does not degrade water quality including temperature and other parameters,
2. does not reduce the one in 10 year seven (7) day low flows, ($7Q_{10}$),
3. does not change the water use classification,
4. provides green belts for non-point source pollutants,
5. provides mitigation for unpredicted impacts when they are discovered,
6. is coordinated with any area wide water quality plan when such plans are adopted (e.g. Section 208 of PL 95-217).

PART II: Construction

a) Prior to the commencement of any work, the applicant shall submit to the MPCA plans, for approval, to provide for the following:

1) Water from dewatering operations including effluents from the initial drawdown between the cofferdam and water affected by construction activities shall only be discharged when the effluent complies with the applicable water quality and effluent standards. Dewatering shall be performed using well points where feasible and practical. All other dewatering shall be performed so as not to result in increased turbidity in the receiving water. This may require the use of disilting ponds to reduce suspended solids. When the MPCA requires, permits must be obtained.

2) A Disposal System Permit shall be obtained by the applicant from the MPCA prior to any hydraulic dredging or tunneling, or other activies which includes an effluent which may contain potential pollutants.

b) Prior to the start of the project the applicant shall develop construction specifications, which include water pollution abatement plans, which adhere to the following applicable steps:

1) Material, labor and equipment for temporary control measures and the acceptable maintenance thereof shall be provided during the life of the project, to effectively prevent water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. Surface cover materials shall be anchored to reasonably prevent their entering waters of the State by erosion or rising water levels.

2) Temporary pollution control measures shall be included for all construction activity associated with the project where such work is necessary for example borrow pit operations, haul roads, equipment storage, and plant or waste disposal sites.

3) The temporary pollution control provisions contained herein shall be coordinated with any permanent erosion control features to the extent practical to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

4) The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations shall be minimized and immediate permanent or temporary control measures shall be taken to prevent contamination of adjacent streams and other water courses, lakes, ponds, and areas of water impoundment. Cut slopes shall be stabilized by methods such as seeding and mulching as the excavation proceeds to the extent considered practicable. Slopes shall be graded properly to minimize erosion.

5) The Applicant will be required to incorporate all permanent erosion control features into the project at the earliest practicable time. Provisions should be made for continual checking and maintenance of all control measures, particularly during periods of rainfall, to insure maximum effectiveness. Temporary pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent erosion control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with the permanent control features on the project.

6) The Applicant will control the area of excavation, borrow and embankment operations commensurate with his progress with finish grading, mulching, seeding, and other such permanent erosion control measures. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken to the extent feasible.

c) In the event of an accidental loss of gasoline, paint, cleaning materials, debris, oil, or other potential pollutants, into waters of the State, the incident shall be promptly reported to the MPCA and the Contractor shall take immediate action to recover the lost material and to minimize any adverse impacts to waters of the State. The Compliance and Enforcement Section of the Division of Water Quality shall be notified by telephone (612-296-7373) followed by submittal of a written report to the MPCA relating the circumstances.

d) Solid waste materials such as collected paint chips and sand, empty paint pails, rags and debris from construction and demolition operations shall be transported to a MPCA permitted site for disposal. Sand and paint chips from blasting operations may be recycled, but ultimate disposal shall be to an MPCA permitted sanitary landfill. Sludges, and wastes regulated pursuant to Section 307 of the Clean Water Act including spent aqueous cleaning solutions, spent solvents, and cans or pails containing waste paint shall be disposed of in a manner approved by the MPCA.

e) Construction, demolition and/or removal operations shall be controlled as far as possible so as to prevent materials from falling into waters of the State. Any materials which do fall into the water, or onto areas where there is a likelihood that they will be picked up by rising water levels, whether unavoidably or otherwise, shall be retrieved and stored in areas where such likelihood does not exist.

f) When feasible and practical excavation shall be conducted from landward to the water and breakthrough shall occur at the last practical moment. Silt curtains shall be considered and shall be utilized in a limited number of cases if deemed a reasonable and beneficial measure. All dredging and/or work on the bed and banks of waters of the State shall be conducted in such a manner so as to minimize the extent of the bottom disturbance and minimize any increase in suspended solids in the waters.

g) Oil and other liquid substances capable of polluting waters of the State will be stored in accordance with the requirements of Minnesota Regulation WPC 4.

h) Stream Bank Stabilization shall be utilized if it is needed to prevent erosion, and shall be constructed of materials which will not pollute waters of the State.

i) Painting, and all work associated therewith, shall be so conducted as far as possible so as to preclude waste materials from falling into waters of the State. The Contractor shall contain waste materials on the project site and provide for their disposal in accordance with Minnesota laws and regulations. Paint overspray and drippings, used paint pails and rags, spent solvents and cleaning solutions, paint chips (that are collected to the maximum practicable extent) and other related solid debris from construction or operations are considered waste materials.

It is the responsibility of the Applicant to provide the following safeguards at all times, wherever and whenever possible, during cleaning and painting operations:

1) Primary safeguards such as drop cloths, curtains, or similar devices, together with adequate structural support such as scaffolding or rope nets, shall be utilized to contain waste materials in the work area. Catchment systems shall be emptied as often as necessary to maintain their functional integrity.

2) Safeguards such as floating booms, mats of absorbent material, or similar systems shall be employed on streams wherever and whenever necessary to avoid nuisance conditions in the stream caused by cleaning or painting operations.

3) Cleaning and painting operations shall be suspended during periods when unfavorable weather conditions, such as high winds, reduce the effectiveness of the above noted safeguards.

4) Cleaning and painting materials shall be contained in locked storage to prevent access by vandals.

5) In situations where use of some of the safeguards listed are not feasible, other inovative safeguards shall be employed. Emphasis shall be placed on containment of waste materials rather than placing reliance on safeguards such as booms, straw dams, or absorbent mats. These shall be considered backup systems to guard against water pollution which may result from the failure of primary safeguards.

j) Placement of fill in wetlands and waterways should be minimized, as much as practicable, while maintaining adequate safety slope, and protection to prevent erosion. Slopes which are safe and stable while minimizing the extent of filling in wetlands should be utilized on a case by case basis.

k) Upon completion, the project area shall be rehabilitated by landscaping, planting, and maintaining vegetation or other work, so that the area will be restored to the satisfaction of the State.

l) Any applicant who conducts a project under this certification shall maintain a record of plans and specifications available for review by the MPCA, for a period of two years after completion of the project.

m) This Certification shall in the event of conflict between these requirements and any applicable pollution control laws, rules, or regulations of other Federal, State or local agencies, the more restrictive requirements shall apply.

n) In accordance with Minnesota Statutes Section 115.07 Subd. 3, application must be made, plans and specifications submitted, and a permit obtained for any addition to or extension of a sanitary sewer prior to the commencement of construction.

o) No certification may be assigned or transferred by the holder without the approval of the Agency. In the event of any changes in control or ownership of the facilities a request for transfer, signed by both parties shall be sent to the Agency, Attn: Compliance and Enforcement Section. Any succeeding owner or controller shall also comply with the terms and conditions of this certification.

p) This certification may be modified, suspended or revoked in whole or in part during its term for cause including, but not limited to a violation of any terms or conditions of this certification, obtaining this certification by misrepresentation or failure to disclose fully all relevant facts, or items contained in Agency Regulation WPC 36 (s) (l).

If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307 (a) of the Act or Minnesota Statutes, Chapters 115 and 116 as amended, for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this certification, this certification shall be revised or modified in accordance with the toxic effluent standard or prohibition and in accordance with applicable laws and regulation.

q) The Applicant shall, pursuant to Section 308 of the Act and Minnesota Statutes 115.04, allow the Director of the Agency, the Regional Administrator, and their authorized representatives, upon presentation of credentials:

1) to enter upon the applicant's premises where the proposed work or operation thereof is located for the purpose of obtaining information, examination of records, conducting surveys, or investigations;

2) to examine and copy any books, papers, records, or memoranda pertaining to the installation, maintenance, or operation of the project, including but not limited to, monitoring data ore records required to be kept under the terms and conditions of this certification.

3) to inspect any monitoring equipment or monitoring procedures required in this certification; and

4) to sample any discharge of pollutants.

r) Nothing in this certification shall be construed to relieve the applicant from civil or criminal penalties for non-compliance with the terms and conditions provided herein.

s) Nothing in this certification shall be construed to preclude the institution of any legal action or relieve the applicant from any responsibilities, liabilities, or penalties to which the applicant is or may be subject to under Section 311 of the Act and Minnesota Statutes, Chapters 115 and 116 as amended.

t) Nothing in this certification shall be construed to preclude the institution of any legal or administrative proceedings or relieve the applicant from any responsibilities, liabilities, or penalties for violation of effluent and water quality limitations not included in this certification.

u) The issuance of this certification does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

v) The provisions of this certification are severable, and if any provisions of this certification, or the application of any provision of this certification to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

w) The applicant is responsible for complying with the terms of this certification.

APPENDIX E

SPECIAL CONDITIONS OF

U. S. ARMY CORPS OF ENGINEERS

NATIONWIDE PERMITS

SPECIAL CONDITIONS OF NATIONWIDE PERMITS

(1) That the discharge will not be located in the proximity of a public water supply intake;

(2) That the discharge will not destroy or jeopardize a threatened or endangered species as identified under the Endangered Species Act, or destroy or adversely modify the critical habitat of such species. In the case of Federal agencies, it is the agency's responsibility to review its activities to determine if the action "may affect" any listed species or critical habitat. If so, the Federal agency must consult with the Fish and Wildlife Service and/or the National Marine Fisheries Service;

(3) That the discharge will consist of suitable material free from toxic pollutants in toxic amounts;

(4) That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution;

(5) That the discharge will not occur in a component of the National Wild and Scenic River System.

(6) The activity will not significantly disrupt the movement of those species of aquatic life indigenous to the waterbody (unless the primary purpose of the fill is to impound water).

(7) Any structure or fill authorized will be properly maintained.

(8) The activity, if it involves a structure, will not cause an unacceptable interference with navigation.

THESE MANAGEMENT PRACTICES SHOULD BE FOLLOWED TO MINIMIZE ADVERSE EFFECTS ON THE AQUATIC ENVIRONMENT

(1) Discharges of dredged or fill material into waters of the United States shall be avoided or minimized through the use of other practical alternatives;

(2) Discharges in spawning areas during spawning seasons shall be avoided;

(3) Discharges shall not restrict or impede the movement of aquatic species indigenous to the waters or the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters);

(4) If the discharge creates an impoundment of water, adverse impacts on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow, shall be minimized;

(5) Discharge in wetlands areas shall be avoided;

(6) Heavy equipment working in wetlands shall be placed on mats;

(7) Discharges into breeding areas for migratory waterfowl shall be avoided;

(8) All temporary fills shall be removed in their entirety.

Incl 1

Authorization for the following activities is given at 33 CFR

☐ 330.4(a)(1) - Discharges into non-tidal rivers, streams and their lakes and impoundments, including adjacent wetlands, that are located above the headwaters.

☐ 330.4(a)(2) - Discharges into other non-tidal waters of the United States (see CFR 323.2(a)(3)) that are not part of a surface tributary system to interstate waters or navigable waters of the United States.

☐ 330.5(a)(1) - The placement of aids to navigation and regulatory markers which are approved by and installed in accordance with the requirements of the U.S. Coast Guard (33 CFR Part 66, Subchapter C).

☐ 330.5(a)(2) - Structures constructed in artificial canals within principally residential developments where the connection of the canal to a navigable water of the United States has been previously authorized (see CFR 322.4(g)).

☐ 330.5(a)(3) - The repair, rehabilitation, or replacement of any previously authorized, currently serviceable, structure or fill or of any currently serviceable structure or fill constructed prior to the requirement for authorization; provided such repair, rehabilitation, or replacement does not result in a deviation from the plans of the original structure or fill, and further provided that the structure or fill to be maintained has not been put to uses differing from uses specified for it in any permit authorizing its original construction. Maintenance dredging is not authorized by this nationwide permit.

☐ 330.5(a)(4) - Fish and wildlife harvesting devices and activities such as pound nets, crab traps, eel pots, lobster traps, duck blinds, clam and oyster digging.

330.5(a)(5) - Staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar scientific structures.

☐ 330.5(a)(6) - Survey activities including core sampling, seismic exploratory operations, and plugging of seismic shot holes and other exploratory-type bore holes.

☐ 330.5(a)(7) - Outfall structures and associated intake structures where the effluent from that outfall has been permitted under the National Pollutant Discharge Eliminating System program (Section 402 of the Clean Water Act) (see 40 CFR Part 122) provided that the individual and cumulative adverse environmental effects of the structure itself are minimal.

☐ 330.5(a)(8) - Structures for the exploration, production, and transport of oil, gas, and minerals on the outer continental shelf within areas leased for such purposes by the Department of Interior, Bureau of Land Management, provided those structures are not placed within the limits of any designated shipping safety fairway or traffic separation scheme (where such limits have not been designated or where changes are anticipated, District Engineers will consider recommending the discretionary authority provided by Section 330.7) and further subject to the provisions of the fairway regulations in 33 CFR 209.135.

Incl 2

Authorization for the following activities is given at 33 CFR

☐ 330.5(a)(9) - Structures placed within anchorage or fleeting areas to facilitate moorage of vessels where such areas have been established by the U.S. Coast Guard.

☐ 330.5(a)(10) - Non-commercial, single-boat, mooring buoys.

☐ 330.5(a)(11) - Temporary buoys and markers placed for recreational use such as water skiing and boat racing provided that the buoy or marker is removed within 30 days after use has been discontinued.

☐ 330.5(a)(12) - Discharge of material for backfill or bedding for utility lines including outfall and intake structures provided there is no change in preconstruction bottom contours (excess material must be removed to an upland disposal area). A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquifiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. (The utility line and outfall and intake structures will require a Section 10 permit if in navigable waters of the United States. See 33 CFR Part 322. See also paragraph (a)(7) of this section.)

☐ 330.5(a)(13) - Bank stabilization activities provided:

(i) The bank stabilization activity is less than 500 feet in length.
(ii) The activity is necessary for erosion prevention.
(iii) The activity is limited to less than an average of one cubic yard per running foot placed along the bank within waters of the United States.
(iv) No material is placed in excess of the minimum needed for erosion protection.
(v) No material is placed in any wetland area.
(vi) No material is placed in any location or in any manner so as to impair surface water flow into or out of any wetland area;
(vii) Only clean material free of waste metal products, organic materials, unsightly debris, etc., is used; and
(viii) The activity is a single and complete project.

☐ 330.5(a)(14) - Minor road crossing fills including all attendant features both temporary and permanent that are part of a single and complete project for crossing of a non-tidal waterbody, provided that the crossing is culverted, bridged or otherwise designed to prevent the restriction of and to withstand expected high flows and provided further that discharges into any wetlands adjacent to the waterbody do not extend beyond 100 feet on either side of the ordinary high-water mark of that waterbody. A "minor road crossing fill" is defined as a crossing that involves the discharge of less than 200 cubic yards of fill material below the plane of ordinary high water. The crossing will require a permit from the U.S. Coast Guard if located in navigable waters of the United States (see 33 USC 301). Some road fills may be eligible for an exemption from the need for a Section 404 permit altogether (see 33 CFR 323.4).

Incl 2

Authorization for the following activities is given at 33 CFR

☐ 330.5(a)(15) - Fill placed incidental to the construction of bridges across navigable waters of the United States including cofferdams, abutments, foundation seals, piers, and temporary construction and access fills provided such fill has been authorized by the U.S. Coast Guard under Section 9 of the River and Harbor Act of 1899 as part of the bridge permit. Causeways and approach fills are not included in this nationwide permit and will require an individual or regional Section 404 permit.

☐ 330.5(a)(16) - Return water from a contained dredged material disposal area provided the State has issued a certification under Section 401 of the Clean Water Act (see 33 CFR 325.2(b)(1)). The dredging itself requires a Section 10 permit if located in navigable waters of the United States.

☐ 330.5(a)(17) - Fills associated with small hydropower projects at existing reservoirs where the project which includes the fill is licensed by the Department of Energy under the Federal Power Act of 1920, as amended; has a total generating capacity of not more than 1500 kw (2,000 horsepower); qualifies for the short-form licensing procedures of the Department of Energy (see 18 CFR 4.61); and the individual and cumulative adverse effects on the environmental are minimal.

☐ 330.5(a)(18) - Discharges of dredged or fill material into waters of the United States that do not exceed ten cubic yards as part of a single and complete project provided no material is placed in wetlands.

☐ 330.5(a)(19) - Dredging of no more than ten cubic yards from navigable waters of the United States as part of a single and complete project.

☐ 330.5(a)(20) - Structures, work and discharges for the containment and cleanup of oil and hazardous substances which are subject to the National Oil and Hazardous Substances Pollution Contingency Plan provided the Regional Response Team which is activated under the Plan concurs with the proposed containment and cleanup action.

☐ 330.5(a)(21) - Structures, work, and discharges associated with surface coal mining activities provided they are authorized by the Department of the Interior, Office of Surface Mining, or by states with approved programs under Title V of the Surface Mining Control and Reclamation Act of 1977; the appropriate District Engineer is given the opportunity to review the Title V permit application and all relevant Office of Surface Mines or State (as the case may be) documentation prior to any decision on that application; and the District Engineer makes a determination that the individual and cumulative adverse effects on the environment from such structures, work, or discharges are minimal.

☐ 330.5(a)(22) - Minor work or temporary structures required for the removal of wrecked, abandoned, or disabled vessels or the removal of obstructions to navigation.

Incl 2

Authorization for the following activities is given at 33 CFR

☐ 330.5(a)(23) - Activities, work, and discharges undertaken, assisted, authorized, regulated, funded, or financed, in whole or in part, by another Federal agency or department where that agency or department has determined, pursuant to the CEQ Regulation for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR 1500 et seq.), that the activity, work, or discharge is categorically excluded from environmental documentation because it is included within a category of actions which neither individually nor cumulatively have a significant effect on the human environment and the Office of the Chief of Engineers (ATTN: DAEN-CWO-N) has been furnished notice of the agency or department's application of the categorical exclusion and concurs with that determination.

☐ 330.5(a)(24) - Any activity permitted by a state administering its own permit program for the discharge of dredged or fill material authorized at 33 U.S.C. 1344(g)(1) shall be permitted pursuant to Section 10 of the River and Harbor Act of 1899 (33 USC Part 403). Those activities which do not involve a Section 404 state permit are not included in this nationwide permit but many will be exempted by Sec. 154 of Pub. L. 94-587. (See 33 CFR 322.2(a)(2)).

☐ 330.5(a)(25) - Discharge of concrete into tightly sealed forms or cells where the concrete is used as a structural member which would not otherwise be subject to Clean Water Act jurisdiction.