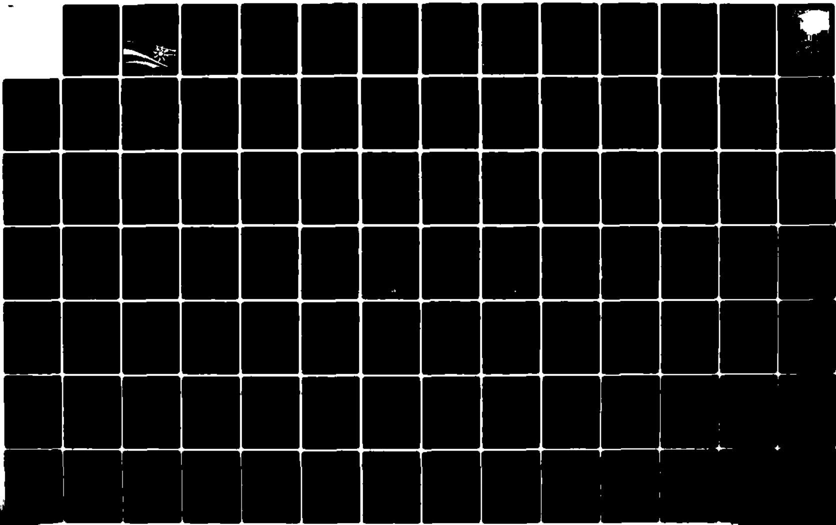
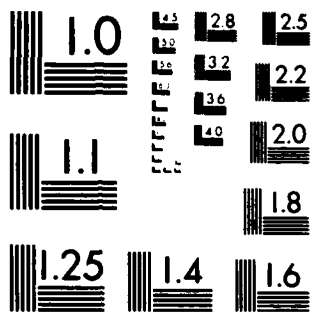
AD-A129 707 LOCK & DAM 5 MISSISSIPPI RIVER NEAR MINNEISKA MINNESOTA 1/2
RECONNAISSANCE REPORT FOR HYDROPOWER(U) CORPS OF
ENGINEERS ST PAUL MN ST PAUL DISTRICT SEP 81

UNCLASSIFIED F/G 10/2 NL

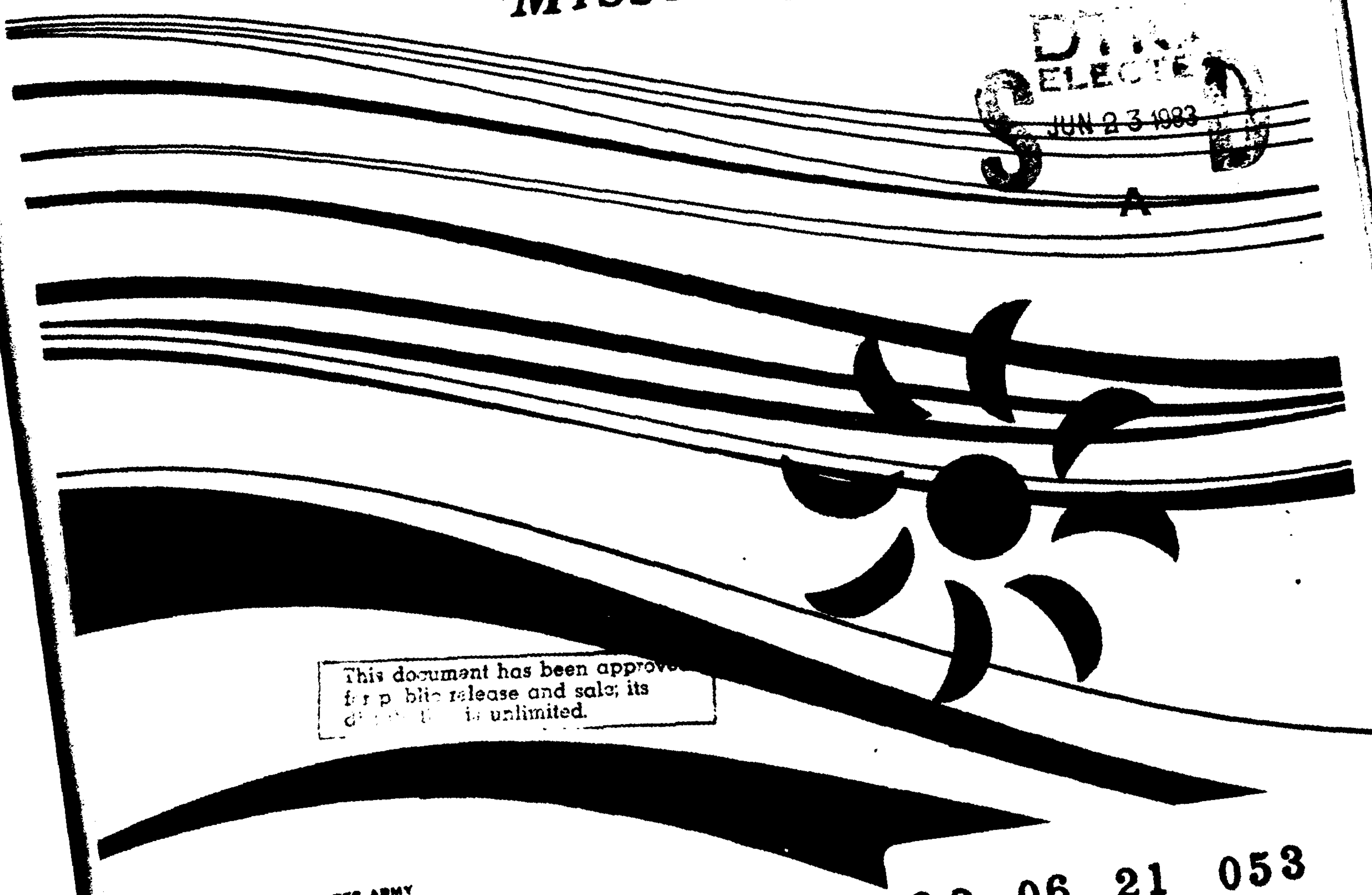



1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

Reconnaissance Report

HYDROPOWER

Lock & Dam 5
Mississippi River



UNITED STATES ARMY
CORPS OF ENGINEERS
ST. PAUL DISTRICT
1135 U. S. P. O. & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101

SEPTEMBER 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) RECONNAISSANCE REPORT FOR HYDROPOWER, LOCK & DAM #5, Mississippi River.		5. TYPE OF REPORT & PERIOD COVERED Preliminary
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Paul Plan Formulation 1135 USPO & Custom House, St. Paul, MN 55101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE Sept 1981
		13. NUMBER OF PAGES 92 p.
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Hydroelectric power
Locks (Waterways)
Minneiska, Minnesota

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report present preliminary evaluation of the addition of hydropower at the existing navigation lock and dam #5. The study shows that installation of a hydroplant with a 6,000-kW, 8,000k-W or 10,800k-W nameplate rating is economical. A 8,400-kW system would produce an average energy equivalent of 82,000 barrels of oil or 23,000 tons of coal per year.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

RECONNAISSANCE REPORT

FOR HYDROPOWER

LOCK AND DAM 5

MISSISSIPPI RIVER

NEAR

MINNEISKA, MINNESOTA

PERTINENT DATA

LOCK AND DAM 5 - MINNEISKA, MINNESOTA

Normal upper pool (feet)	Elevation 660.0
Normal minimum tail water (feet)	Elevation 651.0
Nominal lift (feet)	9.0
USGS gage number	05-3785
Location	Winona, Minnesota
Gage drainage area (square miles)	59,200
Project drainage area (square miles)	58,845
Project pool area (acres)	12,580
Maximum flood flow (Apr 1965)(cfs)	270,000
Average flow (cfs)	26,200
Median flow (cfs)	18,200
Minimum flow (Dec 1933) (cfs)	2,200
Roller gates (60 by 20 feet)	6
Top of roller gate sill (feet)	Elevation 640.0
Tainter gates (35 by 15 feet)	28
Top of tainter gate sill (feet)	Elevation 645.0
Top of earth dike (feet)	Elevation 670.0
Top of lock wall	Elevation 665.0
Flood crest, pool (Apr 1965) (feet)	Elevation 668.73
Flood crest, tail water (Apr 1965)(feet)	Elevation 668.10

PROPOSED HYDROPOWER PLANT

Option:	10 units	14 units	18 units
Total nameplate capacity (kW)	6,000	8,400	10,800
Dependable capacity (kW) (Jul-Aug)	6,000	7,500	8,800
Dependable capacity (kW) (Dec-Jan)	6,500	7,800	8,400
Plant factor	.83	.75	.67
Average annual energy (MWh)	43,400	55,100	63,400
Construction first cost ($1,000)	23,240	32,000	40,700
Benefit-cost ratio	1.30	1.19	1.09

UNIT DESIGN PARAMETERS

Turbine type	Horizontal propeller turbine with adjustable blades
Runner diameter	118.1 inches (3.0 meters)
Design head	7.5 feet (2.3 meters)
Minimum head	3.3 feet (1.0 meter)
Design flow	1,121 cfs/unit
Generator nameplate capacity	600 kW
Turbine efficiency	.89
Speed increaser efficiency	.99
Generator efficiency	.98

MAIN REPORT

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

TABLES

FIGURES

APPENDIXES

RECONNAISSANCE REPORT
FOR HYDROPOWER

LOCK AND DAM 5
MISSISSIPPI RIVER
NEAR MINNEISKA, MINNESOTA

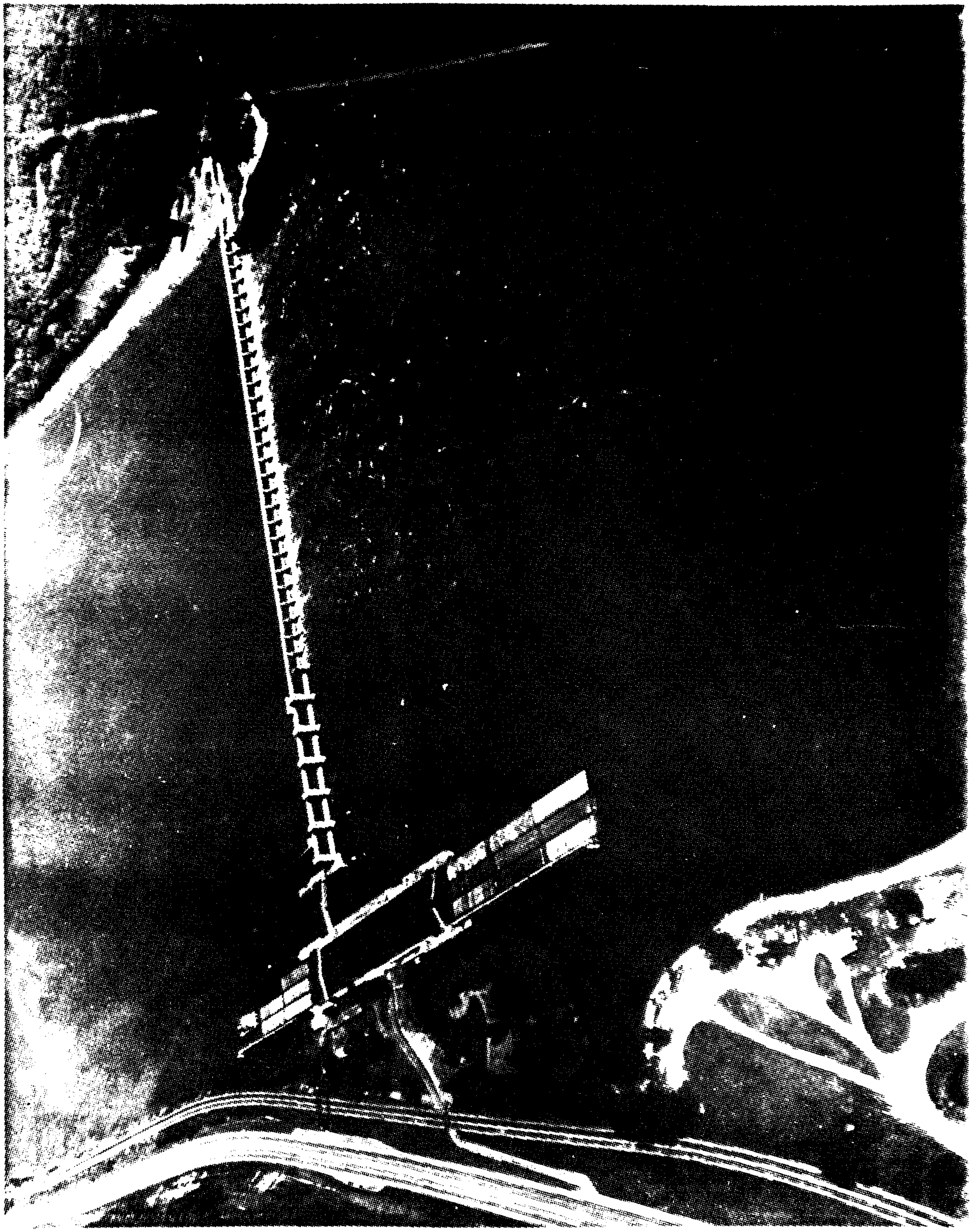
SYLLABUS

This report presents a preliminary evaluation of the addition of hydropower at the existing navigation lock and dam 5. The study shows that installation of a hydroplant with a 6,000-kW (kilowatt), 8,400-kW, or 10,800-kW nameplate rating is economical. Pertinent data concerning the site and potential hydropower installations are shown on the facing page.

Severe environmental impacts are not necessarily associated with construction of a plant of the sizes investigated despite the proximity of the lock and dam to an environmentally sensitive area. Hydropower is one of the most ecologically sound means of producing electricity because it uses a nonpolluting, renewable energy source - water flow - allowing nonrenewable energy sources to be conserved.

The energy available at lock and dam 5 can be an important contribution to our Nation's energy independence. A 8,400-kW system would produce an average energy equivalent of 82,000 barrels of oil or 23,000 tons of coal per year.

The District Engineer recommends that the Corps of Engineers prepare a feasibility report which can serve as a basis for congressional authorization for hydropower plant construction at lock and dam 5.



Lock and Dam 5

RECONNAISSANCE REPORT
FOR HYDROPOWER

LOCK AND DAM 5
MISSISSIPPI RIVER
NEAR MINNEISKA, MINNESOTA

STUDY AND REPORT

SCOPE OF THE STUDY

The studies presented in this report represent preliminary or reconnaissance level detail. The purpose of the report is to determine whether a feasibility study should be conducted. Significant time and resources can be invested in a feasibility study; thus, a decision to proceed with a study should be based on a finding that a potentially viable project can be developed. Therefore, the reconnaissance study is a relatively complete small-scale feasibility investigation in which the issues expected to be important in the feasibility stage are raised, and a first cut economic analysis is performed. A favorable reconnaissance level finding is a strong indication that further detailed study (a feasibility study) is warranted subject to assessment of potentially critical issues.

STUDY AND AUTHORITY

Recognizing the importance of continued and successful operation of completed projects, Congress provided the Corps with the authority to study possible modifications to existing projects. This authority is contained in the House Committee on Public Works Resolution, dated 11 December 1969, which requests the Corps of Engineers:

> ". . . to review the reports of the Chief of Engineers on the Mississippi River between Coon Rapids Dam and the mouth of the Ohio River . . . with a view toward determining whether any modifications of the existing project should be made at this time in the interest of providing increased flood control, and for allied purposes on the Mississippi River."

COORDINATION AND STUDY PARTICIPANTS

Agencies and interests were informed of the initiation of the study and were invited to participate. A copy of the notice and pertinent responses are included in Appendix B, Coordination.

Primary participants in the study include the Federal Energy Regulatory Commission (FERC), Fish and Wildlife Service (FWS), and the St. Paul District, Corps of Engineers. Under the Federal Power Act and other legislation, FERC has broad responsibilities related to planning, construction, and operation of water resource projects, particularly in regard to power development. One of those responsibilities is establishment of values for power that might be produced at lock and dam 5. Correspondence related to power value determination is included in appendix B.

The FWS, under the authority of the Fish and Wildlife Coordination Act, is the primary agency from which the Corps of Engineers will obtain Federal fish and wildlife resource data and planning input. The FWS has provided preliminary comments regarding a potential hydropower project at lock and dam 5. Its planning aid letter is included in appendix B.

The Department of Energy (DOE), Office of Power Marketing Coordination, is responsible for all marketing of Corps-produced power. This office will be contacted during the feasibility study regarding distribution of power that may be produced at lock and dam 5.

The St. Paul District, Corps of Engineers, is chiefly responsible for this study and the report. The reconnaissance report will be distributed to all interested Federal and State agencies and the public. Comments received will help guide future efforts during the feasibility study.

STUDIES OF OTHERS

The Corps of Engineers is completing the National Hydropower Study; lock and dam 5 is one of the sites investigated.

The National Hydropower Study was authorized by Section 167 of the Water Resources Development Act of 1976 (Public Law 94-587). The study will provide a general but comprehensive appraisal of the potential for incremental or new hydropower generation at existing dams and other water resource projects, as well as undeveloped sites in the United States. Preliminary results of that study, which is being managed by the Institute for Water Resources of the Corps of Engineers, show economic feasibility for a hydropower addition of 5.8 MW at lock and dam 5.

In a closely related study (both geographically and hydrologically), Dairyland Power Cooperative has appraised the hydroelectric potential at lock and dam 8 at Genoa, Wisconsin. The study was prepared by Commonwealth Associates. Dairyland Power did the economic analysis. The results indicate that hydroelectric development at lock and dam 8 may be feasible from a technical, environmental, and economic standpoint. Because of required coordination of the hydroelectric facility with Mississippi River navigation and Corps of Engineers ownership of the existing dam, Dairyland has indicated that it may be appropriate for the Corps of Engineers to develop and operate hydroelectric facilities at the existing navigation dams with Dairyland purchasing the energy output from the Corps-owned facilities.

THE REPORT AND STUDY PROCESS

Results of the reconnaissance study are contained in this report including recommendations that a feasibility study be conducted.

The reconnaissance study was started in July 1981 and culminates with this report. Much of the information presented here was derived from the study of lock and dam 7 which was initiated in February 1980. If approved by Corps of Engineers higher echelons, the feasibility study for hydropower addition at lock and dam 5 will begin in fiscal year 1983 and will be completed in spring 1985. The final feasibility report would be submitted to Congress which could authorize a hydropower project at lock and dam 5. However, the authorization, advance planning, and funding by Congress are necessary before any recommended actions could be taken.

PROBLEM IDENTIFICATION

EXISTING CONDITIONS

Location

Lock and dam 5 is located on the Mississippi River at river mile 738.1 above the mouth of the Ohio River. It is near Minneiska in southeast Minnesota and is one of the 13 navigation locks and dams built in the 1930's along the upper Mississippi River in the St. Paul District. The dam and dike which connect the Minnesota and Wisconsin shorelines create almost 13,000 acres of lake which is a very valuable aesthetic, recreation, and biological resource.

Structural Integrity

The stability and structural integrity of lock and dam 5 are, at the least, satisfactory. The latest periodic inspection in 1978 did not reveal any major deterioration of the dam or dike. The foundation soil (see the boring logs on plate 3) consists largely of grey sand of varying size mixed with silt and some gravel to at least a depth of 60 feet. This soil should provide a stable and competent foundation for the proposed structures and should not present any problems during dewatering and construction.

Long-term ongoing erosion both upstream and downstream of the gated concrete dam section has been occurring since the structure was built in the 1930's. This scour has resulted in lowering the river bottom elevation up to 25 feet upstream and downstream of the dam.

The existing scour poses no threat to the stability of the concrete dam; however, because the erosion is continual, remedial measures may have to be taken some time in the future. These measures might include the placement of fill in the scour holes and extending the existing riprap above and below the dam.

Hydrologic Conditions

The flow available for hydropower production at lock and dam 5 is estimated from 50 years of gage data at Winona, Minnesota (USGS 05-3785). This gage is at river mile 725.7 from the mouth of the Ohio River, and is 12.4 miles downstream of lock and dam 5. The total drainage area upstream of the project is 58,845 square miles, which is 0.6 percent less than the area upstream of the gage. There are no major tributaries between the gage and the project site.

The average monthly flows at Winona are shown in the table below.

Average monthly flows, Mississippi River at Winona

Month	Flow (cfs	Month	Flow (cfs)
January	13,600	July	28,200
February	13,800	August	19,000
March	27,300	September	19,800
April	58,100	October	19,000
May	45,400	November	19,900
June	37,500	December	15,500
Average annual flow	28,900	Median flow	20,200

Environmental Setting

Physical Setting - The main geographic feature of the region is the Mississippi River valley. Near lock and dam 5 the river valley is about 3 miles wide and is bordered by bluffs which rise 400 to 500 feet above the river level. The river channel occupies the western one-fourth of the valley. The climate is humid continental, with severe winters and about 29 inches of precipitation annually.

Terrestrial Resources - The woodlands in the area can be divided into two general groups: the upland xeric southern forests of Wisconsin and Minnesota and the southern lowland vegetation of the floodplain.

Much of the floodplain area in pools 5 and 5A is managed as part of the Upper Mississippi River Wild Life and Fish Refuge. The study area provides habitat for a very diverse assemblage of plants and animals and is a noted feeding and resting area for a variety of migratory waterfowl. The John A. Latsch State Park in Minnesota and the Merrick State Park in Wisconsin are located in the study area.

Aquatic Resources - The Mississippi River in the study area is impounded by lock and dam 5a at Winona and by lock and dam 5 above Fountain City, Wisconsin. The Whitewater and Zumbro Rivers both originate in eastern Minnesota and flow into pool 5. Waumandee Creek originates in western Wisconsin and carries a significant sediment load into Fountain City Bay.

Water quality of the Mississippi River in pools 5 and 5A is good. Because of its turbulent nature the river is well aerated. Plant nutrients are ample to support luxuriant growth of rooted aquatics and algae.

Pools 5 and 5A are reported to have 79 and 74 species of fish, respectively. The pools are valuable sport fishing areas with high harvest rates. Of special significance are the tail-water areas below the locks and dams which provide some of the river's best sport fishing. The commercial fishery in the study area is of economic significance but is small when compared to other Mississippi River pools.

The wetland system in the Mississippi River floodplain provides outstanding habitat and is largely responsible for the abundance and diversity of fish and wildlife resources in the study area. These wetlands are widely recognized as significant resources and are protected by Federal, State, and local laws.

Cultural Resources - The Mississippi River valley has been occupied from about 12000 B.C. to the present. Historically, the valley has been the site of the earliest European and American settlements. There is one known archeological site near lock and dam 5. No sites currently listed or eligible for the National Register of Historic Places are located in the immediate area of lock and dam 5.

Recreational Resources - The major recreational uses of pools 5 and 5A are hunting, boating, and fishing. The study area is within 50 miles of three metropolitan areas: Winona and Rochester, Minnesota, and La Crosse, Wisconsin. The two pools supported about 912,000 activity occasions in 1980.

Population Centers - The nearest population centers to lock and dam 5 are the cities of Winona (25,100), Rochester (57,885), and La Crosse (48,300). These areas are located about 12, 35, and 40 miles, respectively, from lock and dam 5.

A more thorough discussion of the environmental setting of the project is presented in appendix E.

CONDITIONS IF NO ADDITIONAL FEDERAL ACTION IS TAKEN

If no Federal hydropower is recommended and subsequently developed, one of two futures is probable. One future is no action or no change from existing conditions. This case would have no environmental or social impacts other than those expected under present conditions. However, with no action, several opportunities will be forgone including utilization of a renewable and environmentally clean energy source and capitalization on a relatively economical source of energy.

A more probable alternative future is the development of lock and dam 5 for hydropower by someone other than the Federal Government. Low cost federally financed loans for feasibility studies and licensing are available for investigation of hydropower development at existing dams. Even though lock and dam 5 is federally owned, non-Federal entities may apply for hydropower licensing at a Federal site. In addition, Federal low-interest loans for construction are available to small rural communities and certain non-profit organizations for such developments. Thus, if the Federal Government does not add hydropower to lock and dam 5, some other interest will probably add it because ample incentives appear present.

A list of competing applicants for an FERC (Federal Energy Regulatory Commission) permit to develop hydropower facilities at lock and dam 5 follows.

Application number	Applicant	Capacity MW	Average annual Energy (MWh)
3652	Mitchel Energy, Inc.	14	85,800
4280	Enagenics	6	45,200
4305	City of Hibbing	6	30,000
4322	Northeastern Minnesota Municipal Power Agency	6	30,000
4430	Wisconsin Public Power, Inc.	-	-
4755	City of Winona	7.2	45,300

Impacts of non-Federal development would probably not differ appreciably from those that would occur with Federal development.

PLANNING CONSTRAINTS

Any possible hydropower development plan proposed for lock and dam 5 must be technically and economically sound, environmentally acceptable, and capable of being implemented. Technical factors include constraints that:

1. The plan fit in with the geometric configuration of the existing structure and not adversely affect navigation, which is the principal and primary purpose for lock and dam 5.

2. The plant must operate as a run-of-river facility chiefly to eliminate adverse environmental effects.

To be recommended for further study, the selected plan must be economically justified. In other words, the benefits of the installation must outweigh the costs for construction and maintenance.

Possible adverse impacts on wild and scenic rivers, historic sites, endangered species, migratory fish, wildlife, and other environmental amenities must be assessed. Significant impacts should be eliminated if possible and mitigated when they cannot be eliminated.

PLANNING OBJECTIVES

The "Principles and Standards for Planning Water and Related Land Resources" require that all federally assisted water resource projects be planned to achieve these national objectives:

- National Economic Development (NED) - Enhance the Nation's economy by increasing the output of goods and services and improving national economic efficiency.

- Environmental Quality (EQ) - Minimize adverse impacts and enhance the quality of the environment by conserving, preserving, or restoring natural and cultural resources.

The social well-being and regional development accounts are also important and will be considered in the planning process.

To address these national objectives, the specific objectives of this study are to:

1. Increase the national economic efficiency through the development of a less costly energy source, thus helping to reduce dependence on foreign fuels in the Nation and study area.

2. Enhancement of the environment by reducing the use of nonrenewable fossil fuels in the Nation and the study area, resulting on conservation of those resources.

3. Minimize site-specific environmental effects of hydropower development.

ANALYSIS OF PRELIMINARY ALTERNATIVES

PLAN FORMULATION RATIONALE

The purpose of plan formulation is to evaluate alternative measures for fulfilling the national and specific planning objectives. For this reconnaissance report, formulation is not based on detailed technical evaluation but is based to a large degree on professional judgment. The level of detail for this report is only designed to answer whether a feasible solution can probably be developed and whether the study should be continued. If warranted, feasibility studies will commence, and alternatives will be more thoroughly evaluated.

An interdisciplinary team was assembled to develop a strategy for selecting a site along the dam and adjoining dike at which installation of hydropower might be most practical from all viewpoints of the team. After the site was selected, an evaluation was made of different scales of development and use of different machinery to find the most cost effective and least environmentally damaging measures. The following sections provide more detail on how the preliminary plan for hydropower additon at lock and dam 5 was developed.

LOCATIONS CONSIDERED

Lock and dam 5 is supported on timber piling, driven in sand and gravel, with steel sheet-piling cutoff walls. The main lock is 110 feet wide and 600 feet long; the upper gate bay of an auxiliary lock is provided in the event it becomes necessary to add another lock in the future. The movable dam section consists of 6 roller gates, 60 feet wide by 20 feet feet high, and 28 tainter gates, 35 feet wide by 15 feet high. A service bridge spans the entire length of the movable dam and storageyard, providing for the operation of the derrick and hoist cars. An earth dike, 18,219 feet in length with a 20-foot roadway at its crest, completes the dam along the Wisconsin side of the river. The site plan is shown on plate 1. Consideration was given to locating the hydroelectric plant at several sites along the area described above.

To be cost effective, hydropower development must use the maximum flow the Mississippi River has to offer. Placing the power plant at the earth dike or storageyard area would require construction of a very large channel through the Upper Mississippi River Wild Life and Fish Refuge, resulting in severe environmental impacts. In addition, required channel excavation would likely make this location uneconomical.

Because maintaining flows essentially as they presently exist appears to have the least negative impacts, the area in and around the existing lock and dam structure, where most Mississippi River flow is passed, seemed most appropriate. Several locations in that area were considered.

In some respects, the auxiliary lock which was never completed for navigation would be a good site for hydropower units. The auxiliary lock could be dewatered relatively easily for the construction of the hydropower plant and its proximity to the main lock control station would aid in the monitoring of the facility and maintenance after construction. In addition, a design for the auxiliary lock could be applied at other locks and dams along the Mississippi River with unused auxiliary locks. However, the large amount of flow which would pass through the auxiliary lock might adversely affect navigation. A model study of the hydropower plant located in the auxiliary lock would be necessary; funding and time allotted for the reconnaissance did not allow such an in-depth evaluation. For this reason and because using the auxiliary lock for hydropower would eliminate the future option of its use as a naviagation lock, the site at the auxiliary lock was eliminated from consideration, at least for this preliminary stage of study.

The six roller gates are not an acceptable site for a hydropower plant because they are used for the sole source of discharge in the winter when the tainter gates are frozen in place.

The tainter gate bays, because they are farthest from the navigation channel, seemed to be the best site for installing hydropower. Flow opening through the gate bays to provide for flood flows must generally be preserved; however, this should not be a problem because of the large number of tainter gates (28) available. For this reconnaissance study the site selected for hydropower development is in the tainter gate bays on the east (Wisconsin) side of the dam. This location will minimize impacts on navigation; the site would not be immediately adjacent to the earth dike, however, to prevent erosion of that area. Plate 1 shows the locations for the site selected for each scale of proposed hydropower development. A more thorough evaluation of power plant sites will be made during the feasibility study.

HYDROLOGIC POWER AND ENERGY ANALYSIS

Background

Following is a shortened discussion of the hydrologic power and energy analysis found in appendix C of this report. For further information and location of plates mentioned below, consult appendix C.

The production of power from the force of falling water follows from basic principles of physics. Work (energy) can be expressed as a force moving through a distance. In the case of hydropower production, the force is the weight of the water, and the distance is the vertical fall, or "head," which is the difference between pool and tail-water elevations.

Power is the rate at which the energy is produced. Expressed as kilowatts:

$$P = Q \cdot H \cdot e / 11.82$$

where Q represents the flow in cfs and H represents the head in feet. The factor "e" represents the combined efficiency of the turbine, speed increaser, and generator. For preliminary calculations involving modern machinery, an average efficiency of 0.86 is often used.

Power is the rate of production of energy, so the total energy produced in a given period is found by multiplying the average power during the period, in kilowatts, by the length of the period in hours.

E = Power (kW) x time (hours) = Kilowatt-hours (kWh)

Sometimes energy is expressed as megawatt-hours (MWh) or gigawatt-hours (GWh):

1 MWh = 1,000 KWh - 1 GWh = 1,000,000 KWh

Since the flows at a given site are usually quite variable, it would be useful to store excess volumes for use during lower flow periods. The St. Paul District's navigation dams have only minimal storage available (pondage). For several reasons, including navigation, environment, recreation, and business interests, pool fluctuations are kept to a minimum; and without pool fluctuations, the useful storage is negligible. An allowable fluctuation range of 0.4 foot would give about 5,000 acre-feet of storage, which would give about 6 hours of operation for the proposed 6-MW plant. This would give some daily "peaking" capability, but it will not allow storage of high flows for later use. This type of plant, with low available storage capacity (pondage), is called a "run-of-river" plant.

Average Annual Energy

The power capacity and energy production for run-of-river plants can be adequately predicted from the flow-duration curve. Daily flow values for the period of record are grouped into flow classes. Each flow class is then plotted according to its cumulative percentage of occurrence. The result is the flow-duration curve shown in figure A (appendix C).

The gross head was reduced by the estimated trash rack and tailrace losses to produce the curve of net head shown on figure A. Each flow class is assigned an average head for the class. Higher flows cause a reduction in the available head at lock and dam 5. Production of power would cease when the head drops below approximately 3 feet, which corresponds to a flow of approximately 70,000 cfs. A flow of 70,000 cfs has a 65-percent chance of being exceeded at least once in a year, and on the average will be exceeded 18 days per year.

For each flow class along the flow-duration curve, the power is calculated for the available flow or capacity, whichever is less. If the available average head is different from the design head, the turbine flow is calculated by the "orifice equation" to be proportional to the square root of the ratio of the available head to the design head.

The product of the head and flow gives the power; the power is then multiplied by the duration of the flow class (in hours) to find the estimated energy. Summation of the energy of all the flow classes, i.e., the area under the power curve, gives the average annual energy (AAE) for each option.

Within the head and flow constraints, three optional plant capacities were selected to allow analysis of significantly different levels of development. In plate C-1, the power curves have been plotted for the three options considered. The ratio of the average load on the plant to the plant capacity, called the plant factor, has also been calculated. A table of average annual energy and plant factor for each option is presented below.

Average annual energy for lock and dam 5

Plant capacity option (MW)	A.A.E. (MWh)	Plant factor
6.0	43,400	.83
8.4	55,100	.75
10.8	63,400	.67

Dependable Capacity Evaluation

Dependable capacity (firm power) is that capacity which can be relied upon (on the average) during a certain period. It is of interest to know the dependable capacity for the year and for critical load periods. The critical periods for this region are July-August and December-January. The dependable capacity can be thought of as the size of conventional plant which would replace the hydro plant to provide the same dependable capacity, on the average. The dependable capacities for each option are shown in the table below. For a more detailed discussion of method, see appendix C.

Dependable capacity (MW) for lock and dam 5

Period	Plant capacity option 6.0 MW	8.4 MW	10.8 MW
July-August	6.0	7.5	8.8
December-January	6.5	7.8	8.4
All year	5.9	7.4	8.5

Weekly Power Generation

Estimates for weekly power generation were done to provide input for determination of project benefits. The procedures used are outlined in appendix C.

HYDROPOWER PLANT SIZES CONSIDERED

As previously discussed, three optional scales of development were considered to better optimize the project: plant capacities of 6, 8.4, and 10.8 MW. Because Allis-Chalmers tube turbine units are standardized and appeared to be most economical for low-head applications, the three levels of development were based on using those units. A 3.0-meter (9.84-foot) runner diamter unit was selected, primarily because of head and flow characteristics. Each unit could produce 600 kW at a rated head of

7.5 feet. Therefore, the three optional scales of development would use 10, 14, and 18 of the standard 3-meter units to produce 6.0, 8.4, and 10.8 MW. As previously stated, these units would be located in the tainter gate bays, two units per bay for a total of five, seven, or nine bays.

ECONOMIC ANALYSIS

Economic feasibility analysis compares economic costs with project benefits. The comparison is made using a common value base. Costs and benefits are stated in dollar values as of January 1981, and this fixed price level is used for valuing future costs and benefits. The time frame used for the benefit-cost analysis begins in 1990 when the project is assumed to be installed and extends through the 100-year economic life of the project to 2090. A 7 3/8-percent interest rate is used.

Basis for Measuring Power Value

The Chicago Regional Office of the Federal Energy Regulatory Commission did the benefit analysis. In its 10 September 1981 letter to the St. Paul District (appendix B), benefits were calculated as follows: power values are the benefits produced by a hydroelectric plant and are based on the surrogate costs of constructing and operating the most likely alternative if the hydroelectric project is not constructed.

Using a coal-fueled steam-electric plant as the most likely alternative to the proposed hydroelectric project, power values are summarized in the following table. These are "at market" values; no transmission line costs for the hydroelectric development have been included. All values are based on January 1981 levels.

Power values include "capacity value" plus "energy value." Capacity value is based on the investment cost (annualized) necessary to construct the most likely alternative. Energy value is the net savings in operating costs of a hydroelectric plant over the most likely alternative. The current energy values were escalated to recognize real cost increases projected for fuel.

Power value summary, lock and dam 5, Mississippi River (January 1981 cost base and 7 3/8-percent interest rate)

Item	Hydroelectric units 10	14	18
Capacity, kW	6,000	8,400	10,800
Average annual energy, MWh	43,400	55,100	63,400
Unit capacity value, $/kW-year	$135.80	$122.20	$110.60
Unit energy value, $/MWh			
Current	18.70	19.20	19.40
Escalated	39.40	39.50	39.50
Annual hydroelectric benefits			
Capacity benefit, $/yr	814,800	1,026,500	$1,194,500
Energy benefit, $/yr	1,710,000	2,176,400	2,504,300
Total benefits, $/yr	2,524,800	3,202,900	3,698,800

System operating costs for both the hydroelectric plant and the alternative steam electric plant were simulated using a probabilistic production costing computer model. The POWRSYM version 48 production costing model was used for this analysis. Northern States Power Company was used as a "typical" system to measure operation costs.

Adjustment Factors Applied to Power Values

The capacity value includes a credit of 5.0 percent to reflect the greater operating flexibility (quicker start-up time) of the hydroelectric plant. In addition, the capacity value has been adjusted to incorporate the relative availability of the hydroelectric plant capacity in comparison with the availability of the coal-fueled steam-electric plant alternative. The availability of the hydroplant is based on dependable flow capacities; availability for a steam-electric plant is based on the probability of a breakdown. The relative availability of the 10-, 14-, and 18-hydrounit options results in 29-, 16-, and 5-percent credits, respectively, for these hydroelectric plant capacities.

Energy values are given based on both current fuel cost levels and on projected real fuel price increases. Escalated real fuel costs assume a 1990 project-on-line date and a 7 3/8-percent cost of money to levelize them over the 100-year life of the hydroelectric plant. Real fuel cost escalation factors were taken from Department of Energy data published 23 January 1980 in the Federal Register, Part IX.

Benefit-Cost Comparison

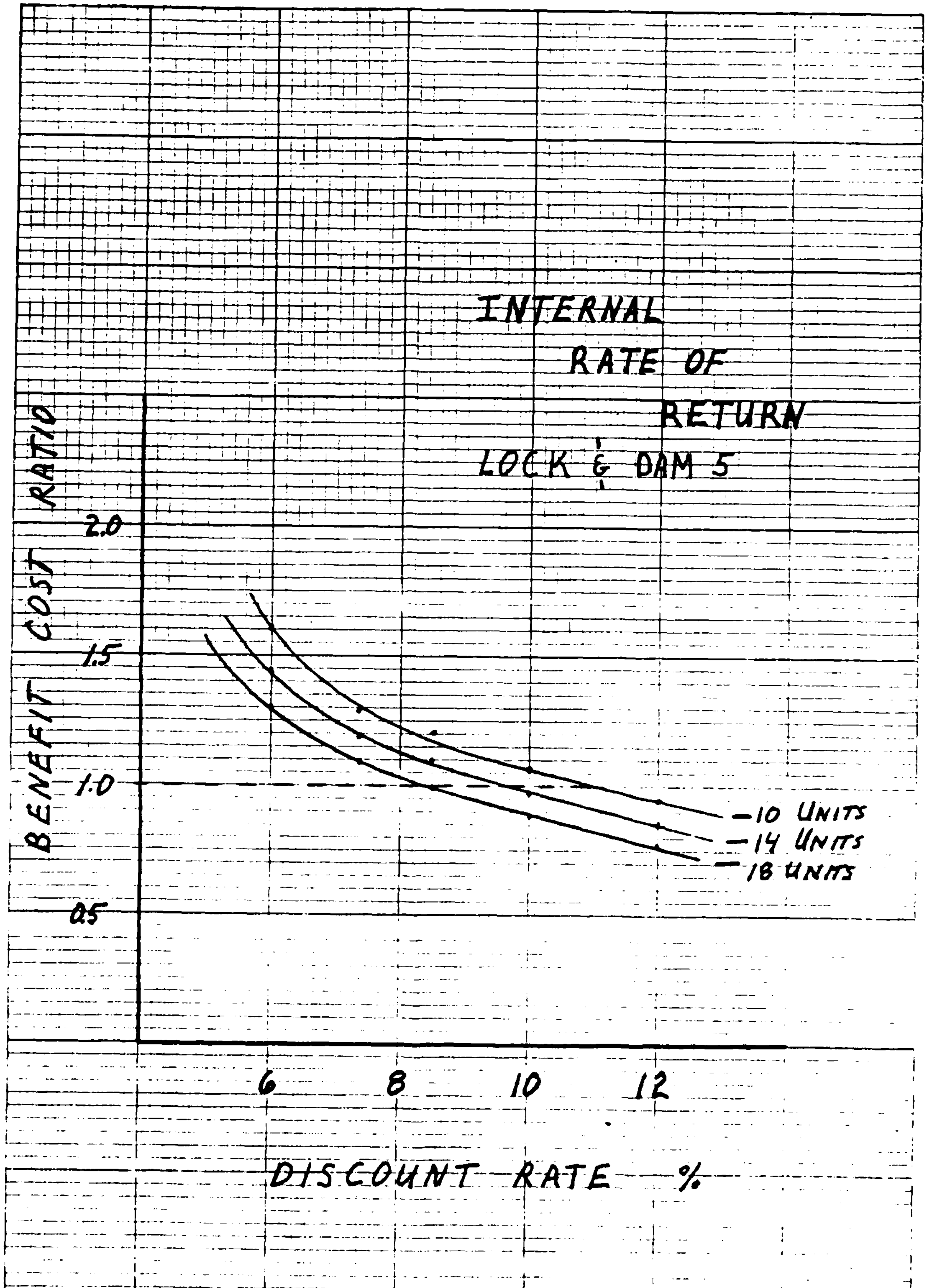
The following table shows annualized costs and benefits of the three alternatives considered.

Average annual costs and benefits ($1,000)

Item	10 units	Alternatives 14 units	18 units
First costs	23,240	32,000	40,700
Total Federal investment(1)	24,923	34,315	43,643
Interest and amortization of Federal investment(2)	1,840	2,533	3,221
Operation and maintenance	106	149	179
Average annual costs	1,946	2,682	3,400
Average annual benefits	2,525	3,203	3,699
Net benefits	579	521	299
Benefit-cost ratio	1.30	1.19	1.09

(1) Includes first costs plus present worth of project rehabilitation at year 50; salvage value at year 50 and year 100; and interest during construction. See appendix A for itemization of costs.
(2) 100-year economic life at 7 3/8 percent interest rate.

Net benefits are $579,000, $521,000, and $299,000 for the 10-, 14- and 18-unit plants. The 10-unit plant has a slightly greater benefit-cost ratio (1.30) compared with the others. Each size was evaluated to determine its internal rate of return, i.e., the interest rate at which benefits equal costs (see the following figure). The internal rate of return is 11, 9 1/2, and 8 1/2 percent for the 10-, 14-, and 18-unit plants.


INTERNAL
RATE OF
RETURN
LOCK & DAM 5
BENEFIT COST RATIO
2.0
1.5
1.0
0.5
6
8
10
12
DISCOUNT RATE %
10 UNITS
14 UNITS
18 UNITS

ENVIRONMENTAL IMPACTS

A brief discussion of potential project impacts and a list of issues that need detailed study are summarized here and presented in appendix E. A more detailed assessment will be made during the feasibility study.

No Action Alternative

The no-action alternative would not alter existing conditions.

10-, 14-, and 18-Unit Alternatives

These alternatives would utilize five, seven, and nine of the existing tainter gate bays, respectively, on the east side of the dam (see plate 1).

Impacts on Natural Resources

Construction Impacts - Terrestrial construction impacts would result from construction of a powerline corridor and construction storage yard, upgrading the existing access road, acquisition and disposal of material used in building the cofferdam, and disposal of excavated and dredged materials. Construction of the powerline corridor has the greatest potential for damaging terrestrial resources. The alignment of the corridor should avoid the heron and egret rookery east of the dam and other valuable wildlife habitat in the Fountain City bay area. The other construction activities could also result in the disturbance or loss of terrestrial habitat.

Aquatic construction impacts would result from riprapping the river bottom upstream and downstream of the power plant and the installation and removal of temporary cofferdams. Placement of riprap on the river bottom would destroy the existing benthic community along with some tail-water fish spawning and foraging habitat. The riprapped area would be recolonized by a benthic community better adapted to coarser substrates and higher current velocities. Construction activities could temporarily increase levels of turbidity and change flow and sedimentation patterns.

Operation Impacts - The impacts of hydropower operation on the terrestrial ecosystem of pools 5 and 5A are expected to be minor. Because the facility would be a run-of-the-river operation, no change to the existing pool levels would result. No impacts to the shoreline of pools 5 and 5A resulting from fluctuating water levels are therefore expected. Concentration of flows through the hydropower facility could, however, increase the potential for erosion of existing banks.

The most significant impacts on aquatic resources by operational activities are expected to result from changes in the flow pattern through the dam. The concentration of most of the river flow through the power house, coupled with additional riprap in the discharge area could alter the tail-water fish habitat below lock and dam 5. In addition, the change in flow pattern could cause sedimentation in nearby side channels, thereby restricting the flow and aeration of the backwater area near the dam. The closure of dam gates to divert water through the power plant would restrict movements of fish through lock and dam 5 to some degree.

The size of the tube-type turbines and the relatively slow speed of the runners should allow aquatic life to safely pass through the machinery.

Impacts on Cultural Resources

Most of the proposed construction areas were disturbed during construction of lock and dam 5. There is still the possibility, however, that historical and/or archeological sites will be negatively affected by hydropower development. Coordination will be initiated with the Wisconsin State Archeologist and State Historic Preservation Officer.

Recreation Impacts

The most significant impacts would be the potential changes in fishery habitat previously described. No impacts on general boating are expected; however, altered tail-water flow patterns may cause safety problems for recreational boaters. There is a potential to incorporate improvements for bank fishing as part of the project.

Social Impacts

Social impacts resulting from construction activity, noise, and dust are not expected to be large as there are no nearby residential areas. Social controversy could arise through selection of a transmission line corridor, dredged material disposal sites, inequitable distribution of project costs and benefits, and conflicts with recreation or management of wildlife and fish refuge lands.

Outstanding Environmental Issues Associated with Hydropower Development at Lock and Dam 5

The following is a list of environmental issues that deserve special attention in future planning efforts for hydropower development at lock and dam 5. Some of these issues have been identified as important by the Fish and Wildlife Service in initial coordination (see letter in appendix B). Further detailed studies are necessary to quantify existing resources that might be affected, better predict the type and magnitude of potential impacts, and develop appropriate plans for mitigating or minimizing adverse impacts.

1. Impacts of construction and operation on aquatic habitat.
2. Effects of altered tail-water flow patterns on fish populations and fish utilization of the lock and dam 5 tail-water area.
3. The potential for entrainment and impingement of adult fish, eggs, larvae, and young in the turbines and the resultant impact of increased mortaility.
4. The impacts of transmission lines on migratory waterfowl.
5. The imapcts of construction and operation on endangered species.
6. The effect of construction on social conditions in the affected area.
7. The effects of construction on any currently unknown cultural resources in the project area.

MECHANICAL AND ELECTRICAL FEATURES

General

A standardized packaged predesigned turbine generator, tubular-type, would meet the hydraulic conditions at this site. Plate 2 illustrates the adaptation of information furnished for the Allis-Chalmers predesigned units. The units selected would be capable of delivering 0.6 MW each with a rated head of 7.5 feet. The major equipment furnished as part of each package would include generator, turbine, control panel, cubicle for metering equipment, intake gate speed increaser, coupling, blade positioner, and oil system.

Intake Structure

The existing lock and dam was built with 28 tainter gates; 5, 7, or 9 tainter gate bays would be used for this project. The tainter gate bays would be used for hydropower development as lock and dam 5 has a larger gate capacity than needed to pass flood flows. The water passage configuration in the existing tainter valve structure is not completely compatible with the proposed units. Therefore, a concrete transition section, as shown on plate 2, would be used.

Mechanical Equipment

The on-off control of intake water would be by a tainter gate. The gate would be equipped for emergency closure upon loss of power. The operator would be arranged to lower the gate against full turbine runaway speed discharge. The bulkhead slots would be used if the operating gate requires maintenance.

An overhead bridge crane would be considered for maintenance of the turbines and generators. This would allow inspection of the runners without the need for a mobile crane.

Standard ceiling-type exhaust fans would be provided for powerhouse cooling. Because the generators are air cooled, the fans would be sized to maintain temperature limits using outdoor air only.

Two small submersible pumps would be provided for drainage and dewatering. Portable pumps could also be used for dewatering.

Turbine

An adjustable 3-blade tubular turbine available from several manufacturers is considered because it is the largest standardized package unit which will fit the existing structure. The turbine has a throat diameter of 3,000 millimeters (118.1 inches). As shown in the following figure, at a rated head of 7.5 feet, generator output of the unit can be estimated at 670 kW. To account for possibly lower than advertised efficiencies and mechanical and transmission losses, an output of 600 kW per unit was adopted.

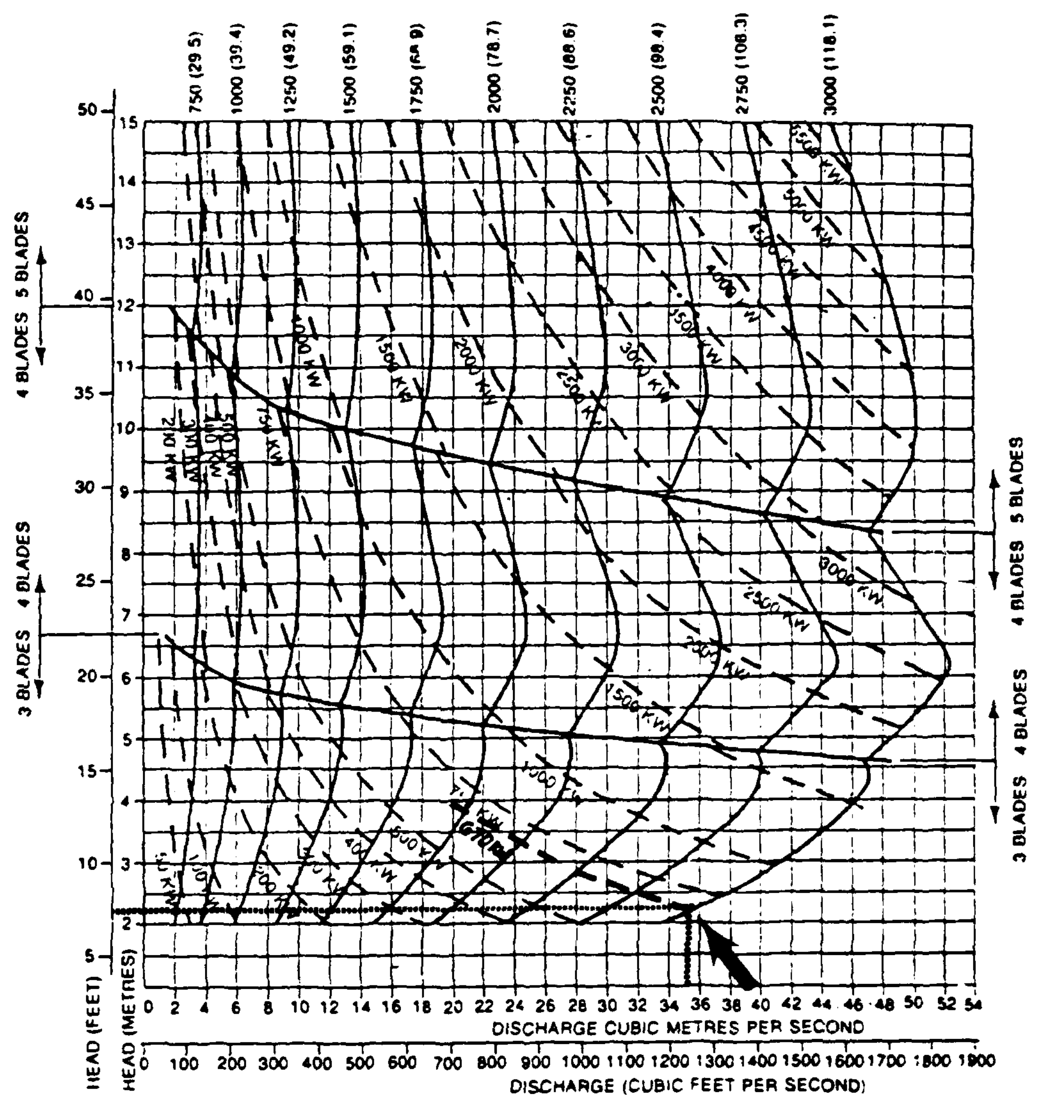
Other turbines, such as bulb turbines and "Ossberger" cross-flow type turbines, may be suitable for this installation. All suitable turbine types will be evaluated during the feasibility study.

Generators and Breakers

The generator would be a synchronous type, rated 667 kVA, 0.9 PF, 3-phase, 60 Hz, 4.16 kV, 900 rpm. A drip-proof guarded enclosure would be provided for the generator. The generator would have an 80^{o}-C rise Class B insulation system without provisions for overload. It would have full runaway speed capability eliminating the need for a disconnect clutch. The generator breaker will be a metal clad draw-out type rated 250 MVA (nominal), 5kV, 1,200 amp continuous. Breakers will be combined into metal clad switchgear lineups common to groups of four units, also containing generator surge protection and instrument transformers as well as station service switch gear in two of the lineups.

Sizing Chart

STANDARD *TUBE* TURBINE UNITS
OPERATING RANGES
750 mm to 3000 mm
GENERATOR OUTPUT IN KILOWATTS
TEN UNIT-SIZES — MILLIMETRES (INCHES)



NOTE. OUTPUT BASED ON UNIT CENTERLINE SETTING OF ONE-HALF (½) RUNNER DIAMETER (DIA/2) ABOVE TAILWATER. CENTERLINE OF UNIT AT ELEVATION 150 m (500 ft.) ABOVE SEA LEVEL

Source: Figure 9 from Standardized Hydroelectric Generating Units by Allis-Chalmers.

Excitation System

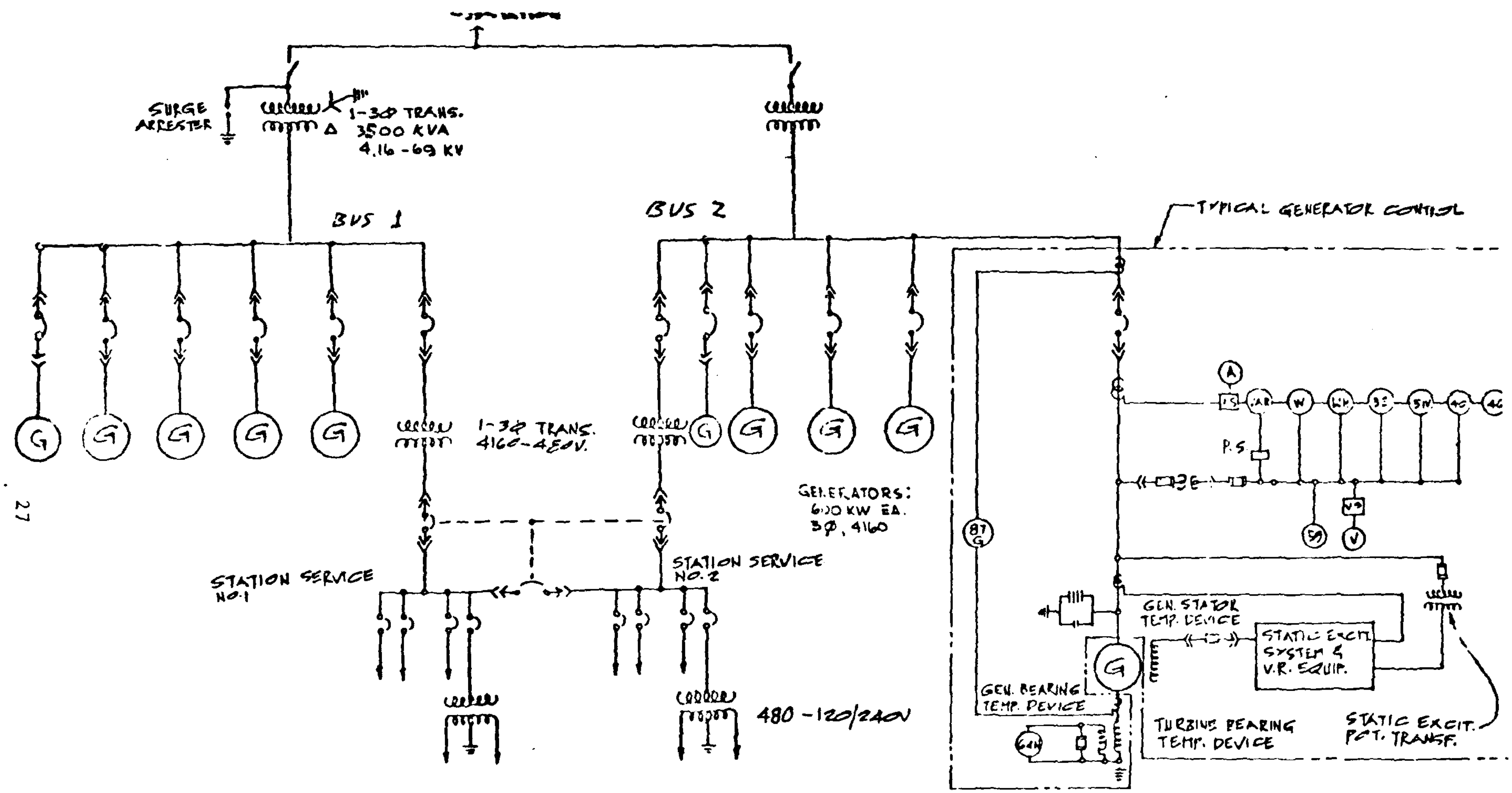
The excitation system for the unit would be of the bus-fed, power potential source, static type, excitation power being derived from the generator terminals. During starting, the generator filed will be automatically flashed (permitting generator voltage buildup) from a rectified A-C station service source.

Unit Control and Protective Equipment

A complete complement of generator protective relays (differential, overvoltage, overcurrent, etc.), start-up and shut-down controls, and other unit control relays would be provided in the metal-clad switch gear lineup containing the generator circuit breaker. Synchronizing would be accomplished by speed switches. The generator breaker would close at 95 percent speed with the static excitation system being energized at 98-percent speed. The generator would be provided with connected amortisseur to facilitate pull-in with the system. The packaged unit would have electrical and mechanical protective devices as indicated on the following one-line diagram.

Station Service

There would be two separate sources of station service power. One source would be bus tap between two generator circuit breakers and a main power transformer, and from a similar tap from the second bus as shown on plate 3. Station service switch gear would be arranged to provide full service from either source. Also, the former above source would supply station service from a single unit when generation into the utility system is shut down. Station service switch gear (4,160 volts) would be included in generator circuit breaker switch gear lineups. Station service power distribution would be at 480 volts 3-phase and 120/240 volts single phase.



MAIN ONE LINE DIAGRAM - L&D No. 5 HYDRO STATION

14 UNIT STATION: ADD 2 GENERATORS TO EACH BUS AND INCREASE TRANSFORMER TO 4000 KVA.

18 UNIT STATION: ADD 4 GENERATORS TO EACH BUS AND INCREASE TRANSFORMER TO 4500 KVA.

Connection to Load

A 3-phase 69 kV overhead transmission line would tie directly to the local utility substation. The substation is approximately 4 miles from the powerhouse site. The plant would have 5, 7, or 9 generator step-up transformers with two units connected to each transformer. Each transformer would be rated 3,500 kVA, 60 kV "WYE" connected high-voltage winding, 4.16 kV "DELTA" connected low voltage winding, 3-phase 60 Hz. The transformers would be bused together on the hgh-voltage side through disconnect switches at the powerhouse for connection to the transmission line.

14-Unit Station

For a 14-unit station, 7 generators would be connected to each bus. The two step-up transformers would be rated at 4,000 kVA for the 14-unit station.

18-Unit Station

For an 18-unit station, 9 generators would be connected to each bus. The two step-up transformers would be rated at 4,500 kVA for the 18-unit station.

CIVIL FEATURES

General

This section describes the civil features pertaining to the installation of tube turbine power generating units at lock and dam 5. Civil features include the powerhouse, intake and exit channels, permanent access, and site work. A brief description of some important construction considerations is also included. The site plan is shown on plate 1.

Powerhouse

The most economically feasible powerhouse location placed pairs of horizontal tube turbines in the existing tainter gate gays.

The powerhouse would be made of reinforced concrete and would house the power generating units and electrical equipment. Flow to the turbines would be regulated by tainter gates installed upstream of the turbines. The existing tainter gates could possibly be salvaged, modified, and used as the turbine regulating gates. Sheet-pile cutoff walls would be driven at the upstream and downstream edges of the powerhouse to prevent undermining of the structure. Trash racks with small openings to protect the turbines from damage during operation would be installed upstream of the turbines. Stop-log grooves would be provided on the upstream and downstream edges of the powerhouse so that individual pairs of turbines could be dewatered for maintenance. Batter piles would be driven under the downstream half of the powerhouse to insure that the current foundation stability criteria are attained.

The interior of the powerhouse would be totally open from one end of the powerhouse to the other to provide maximum space for maintenance. The turbines and the associated mechanical and electrical equipment would be grouped in pairs located between the existing tainter gate piers.

Channels

Intake and exit channels would have to be constructed to accommodate turbine operations. The upstream channel protection is placed directly on the existing slope of the upstream scour hole. No excavation of material is required for the intake channel. The exit channel requires excavation to an invert elevation of 628.5. The amount of excavation is small as the exit channel "daylights" in the existing downstream scour hole approximately 45 feet downstream of the powerhouse. Concrete wing walls would be constructed extending approximately 40 feet downstream of the powerhouse on each side of the exit channel. The wing walls are needed to retain the 12.5-foot elevation difference between the powerhouse exit channel and the exit invert elevation of the adjacent tainter gates. The invert elevation of the discharge channel is determined by the submergence requirements for the turbine selected.

Erosion protection requirements were developed for the intake and exit channels for each alternative considered. The analysts for riprap design considered average inlet and outlet velocities, the possibility of flow concentration, and the possibility of local increase in shear stress at channel transitions such as elevation changes in the approach channels to the turbines. Proposed riprap location, thickness, and gradation are shown on plate 1.

Access

Permanent access for operation and maintenance of the powerhouse would be needed. This access must be usable during flooding of the Mississippi River. To provide permanent access to the powerhouse, a road would be built on the top of the levee extending from the Wisconsin side of the river to the powerhouse site. A parking and turnaround area would be provided adjacent to the storageyard area. A lockable gate restricting public vehicles access to the dike would have to be installed at the Wisconsin end of the levee. Access of personnel to the powerhouse would be slightly inconvenient as they would have to walk across the existing lock and dam service bridge from the storage yard to the powerhouse location.

Because of the middle of the river location of the powerhouse, heavy or bulky maintenance or construction materials or equipment would need to be transported to the powerhouse site by raft or barge.

Impact on Existing Structures

Permanent impacts on existing structures include the sharing of the service bridge and the effect of regular traffic on the dike. It is recognized that a small potential exists for requiring the use of the service bridge between the storage yard and the powerhouse by Corps personnel and hydropower personnel at the same time. It is assumed that an agreement between the Corps of Engineers and the hydropower operating authority can be reached beforehand governing the use of the service bridge. Regular vehicular traffic on the levee will probably increase the need for maintenance of the levee. Responsibility for the maintenance of the levee would be assigned in the access agreement mentioned in the discussion of service bridge access.

There will be no detrimental effect on the stability of the dam. The stability of the dam in the area of the powerhouse will actually be minimal.

Temporary impacts include the interference of normal dam operation during construction and the closing of additional tainter gates during construction. The construction of the powerhouse will certainly affect normal dam operations because of simultaneous use of the storageyard and probable conflicts in the use of the service bridge. Two or more gates in addition to those being converted to hydropower would have to be shut down during construction to provide a location for the construction of cofferdams to tie into the existing dam.

Cofferdams

Earth cofferdams would be used in the construction of the powerhouse. The earth cofferdams can be used at this location because of shallow scour holes upstream and downstream of lock and dam 5. Well point dewatering would be used to dewater the area inside the cofferdams. The cofferdams would be tied into the dam, closing down additional tainter gates on each side of the powerhouse.

CONCLUSIONS

This reconnaissance investigation establishes that hydropower development at lock and dam 5 is technically and economically feasible and would not necessarily cause significant environmental damage.

PLAN FOR FUTURE STUDY

The favorable finding of the reconnaissance study indicates that further detailed study (a feasibility study) is justified.

If a feasibility study is undertaken, it would formulate a small hydropower project, prepare an implementation strategy, and provide the basis for an implementation commitment. The significant institutional, engineering, environmental, marketing, and economic aspects will be assessed in support of the investment decision.

The feasibility study, if approved, would begin in fiscal year 1983 and be completed in spring 1985. The District's report would be sent forward to higher Corps echelons for review and then submission to Congress for authorization of the recommended plan. The figure in appendix D illustrates the procedure of approval of the feasibility report.

The level of detail envisioned for the feasibility study would provide a basis for direct development of plans and specifications for project implementation. Assuming prompt funding following congressional authorization, the plant would be completed 3 to 4 years after allocation of construction funds. Appendix D outlines in detail a plan of study for the feasibility investigation.

EXECUTIVE ORDER 11988

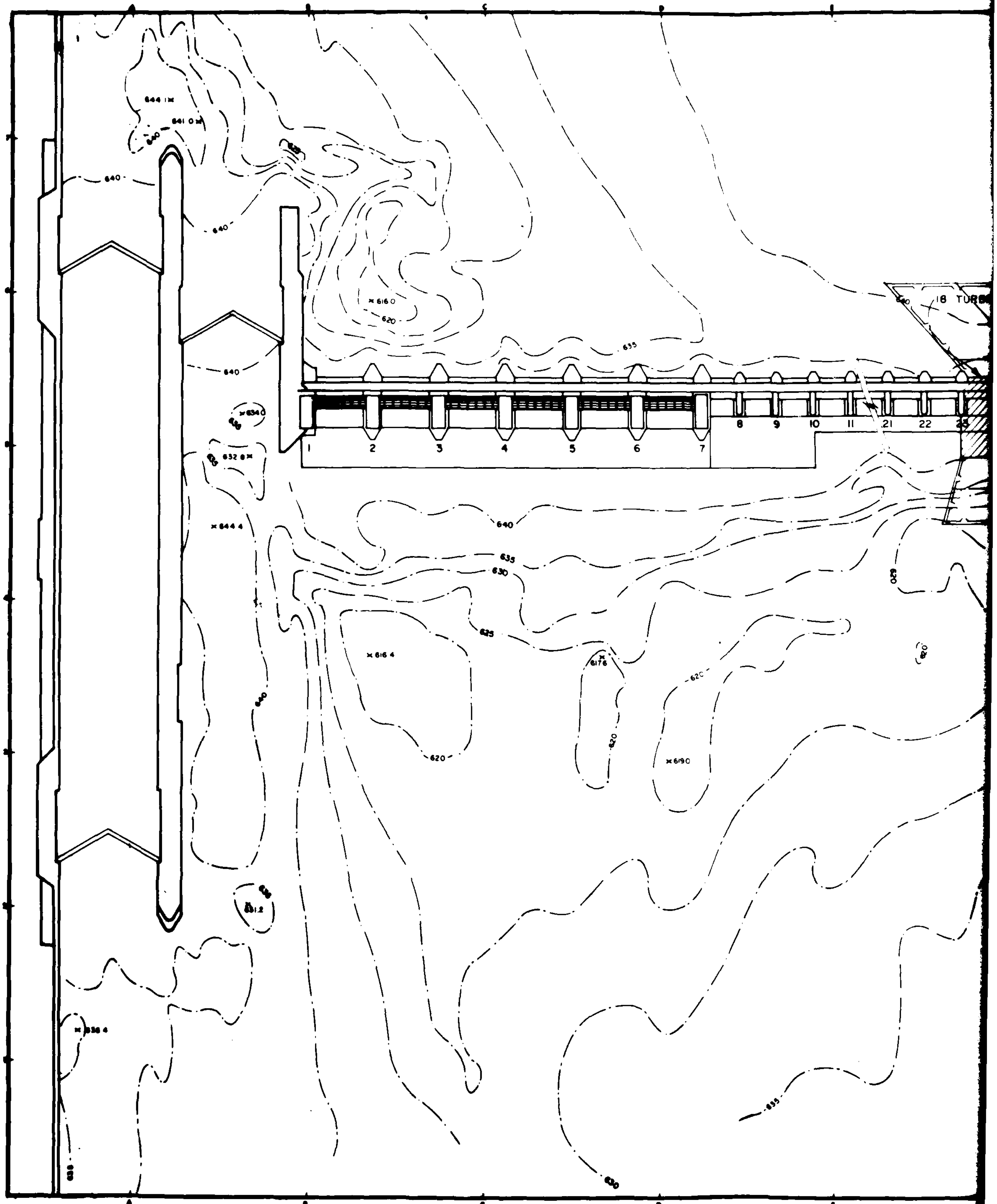
Executive Order 11988 requires Federal agencies to recognize the significant values of floodplains and consider the public benefits that would be realized from restoring and preserving them. It is the Corps' policy to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with the use of the floodplain and avoid inducing development unless there is no practicable alternative.

Development of hydropower at lock and dam 5 requires use of the floodplain for the hydropower facilities. There is no alternative in which floodplain land would not be affected. Hydropower development, however, will not induce floodplain development. Expected impacts on floodplain values are found in appendix E.

RECOMMENDATION

I recommend that a feasibility report be prepared and that it be allowed to begin in fiscal year 1983 and be completed in 2 years. I further propose that the report be comprehensive enough so it can be used as a basis for construction authorization by Congress.

WILLIAM W. BADGER
Colonel, Corps of Engineers
District Engineer



A
B
C
D
E
644.1
641.0
640
616.0
620
635
1
2
3
4
5
6
7
8
9
10
11
21
22
18 TURB
634.0
632.8
644.4
616.4
617.6
619.0
631.2
630
625
620

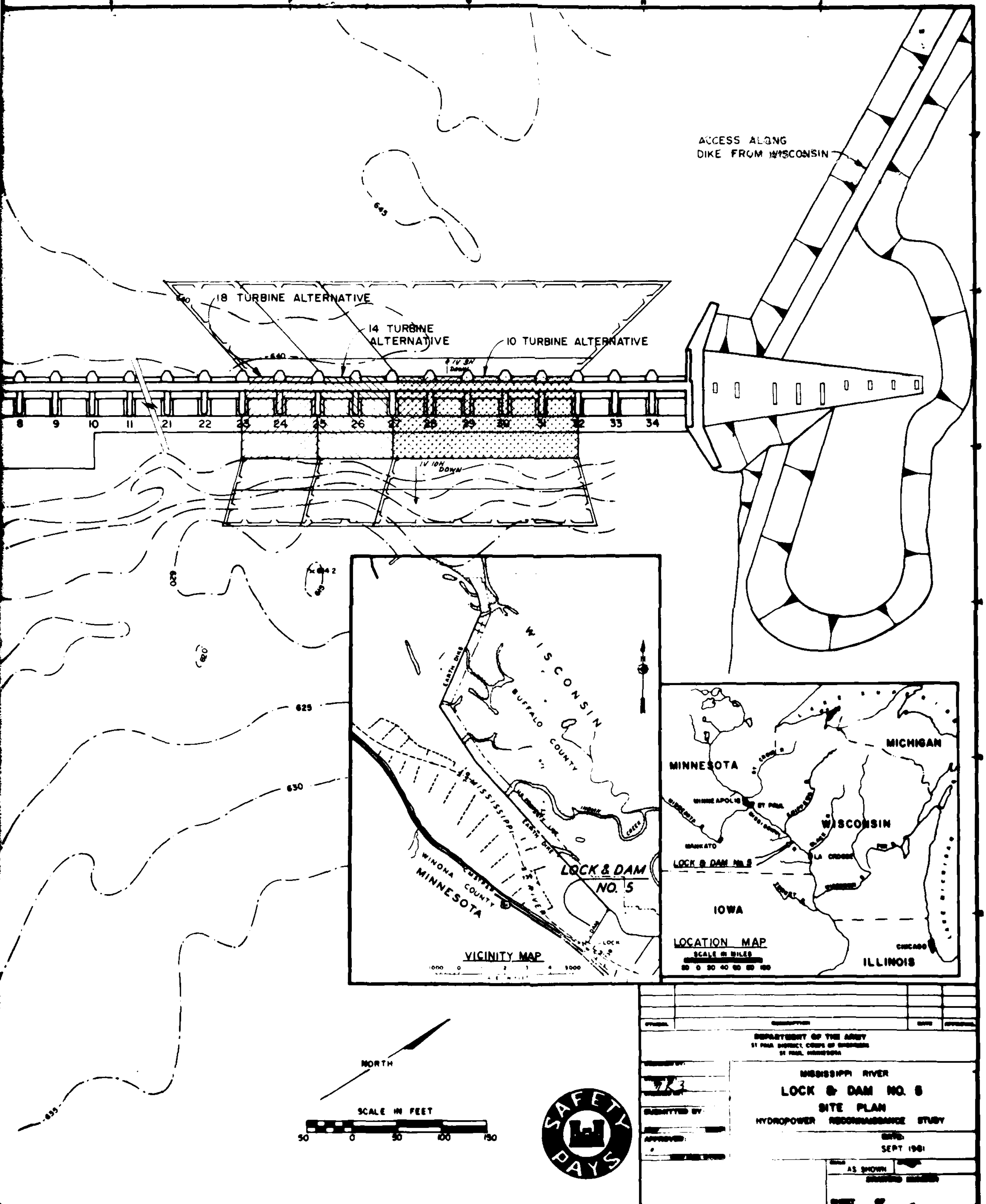
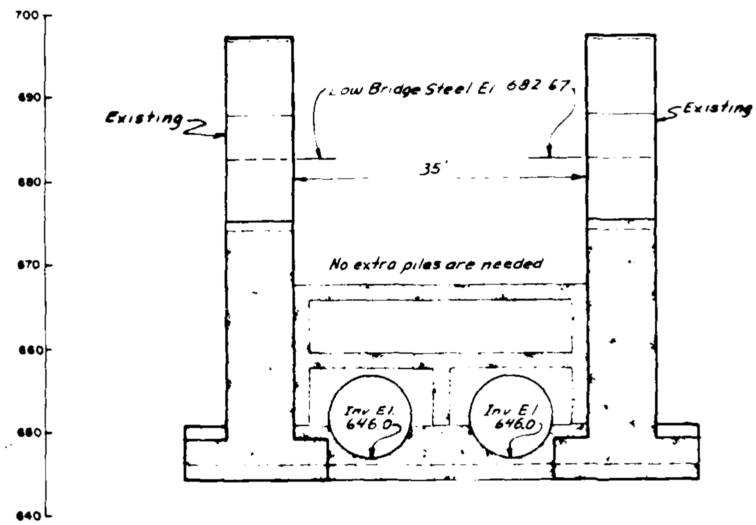
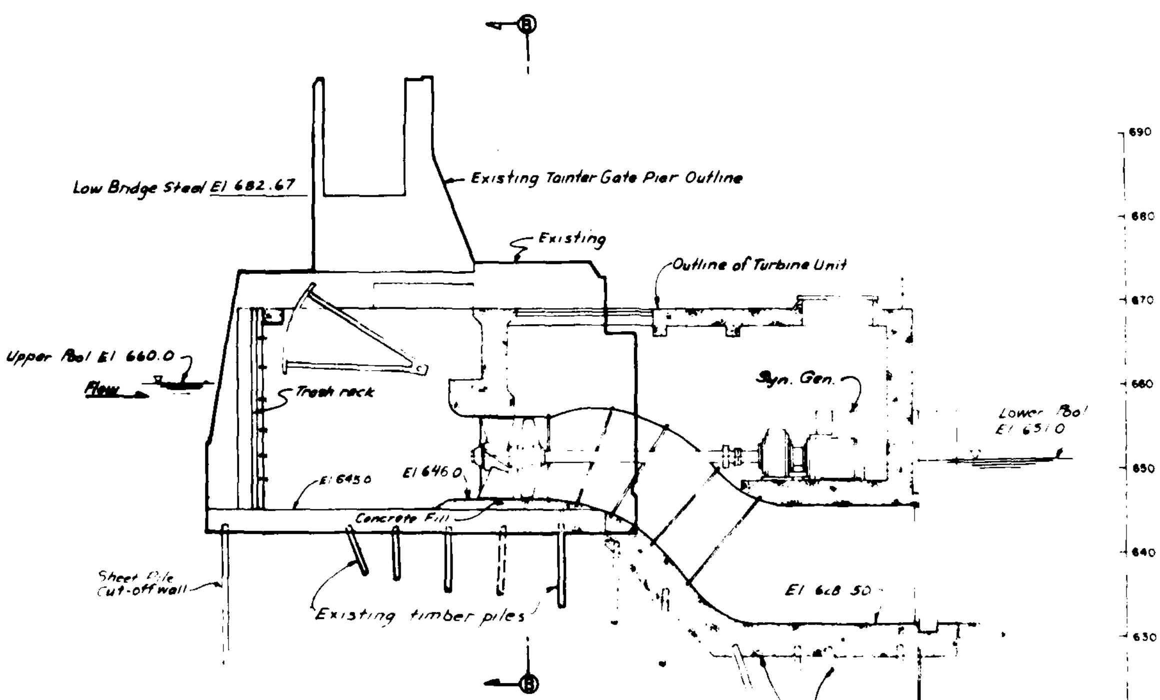

ACCESS ALONG
DIKE FROM WISCONSIN
18 TURBINE ALTERNATIVE
14 TURBINE
ALTERNATIVE
10 TURBINE ALTERNATIVE
645
640
625
630
635
WISCONSIN
BUFFALO COUNTY
MISSISSIPPI
EARTH DIKE
LOCK & DAM
NO. 5
WINONA COUNTY
MINNESOTA
VICINITY MAP
MINNESOTA
MICHIGAN
WISCONSIN
LOCK & DAM No. 5
IOWA
LA CROSSE
CHICAGO
ILLINOIS
LOCATION MAP
SCALE IN MILES
NORTH
SCALE IN FEET
SAFETY PAYS
DEPARTMENT OF THE ARMY
MISSISSIPPI RIVER
LOCK & DAM NO. 5
SITE PLAN
HYDROPOWER RECONNAISSANCE STUDY
SEPT 1981
AS SHOWN

PLATE I



SECTION B-B

SCALE IN FEET



TAINTER GATE

ELEVATION SECTION

SCALE IN FEET

General note
Existing structures denoted by Heavy Lines

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

SPL
JU
SPL
SUBMITTED BY:
APPROVED:

MISSISSIPPI RIVER

LOCK & DAM NO. 5

TURBINE INSTALLATION DETAILS

HYDROPOWER RECONNAISSANCE STUDY

DATE: SEPT 1981

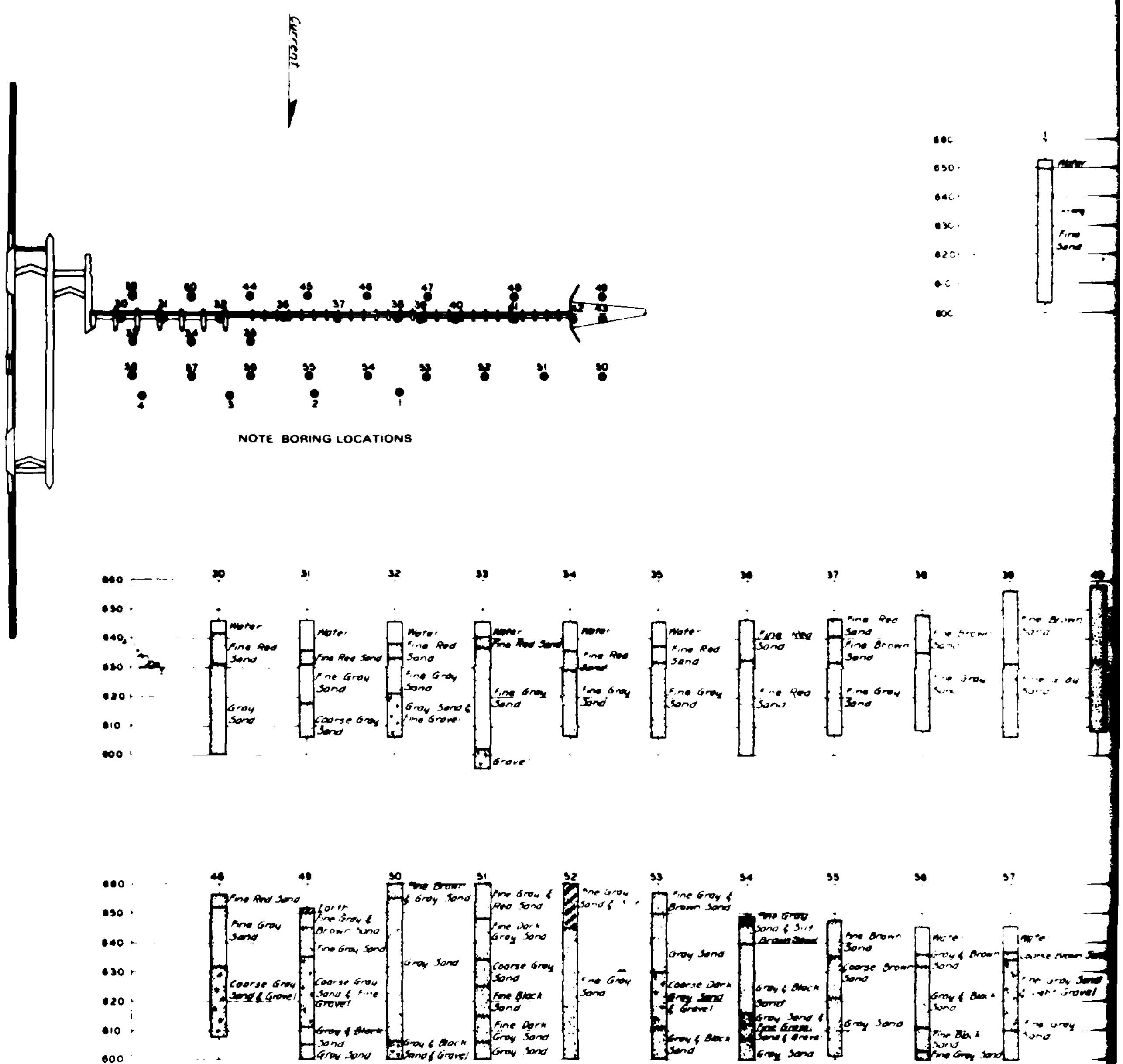
SCALE: AS SHOWN

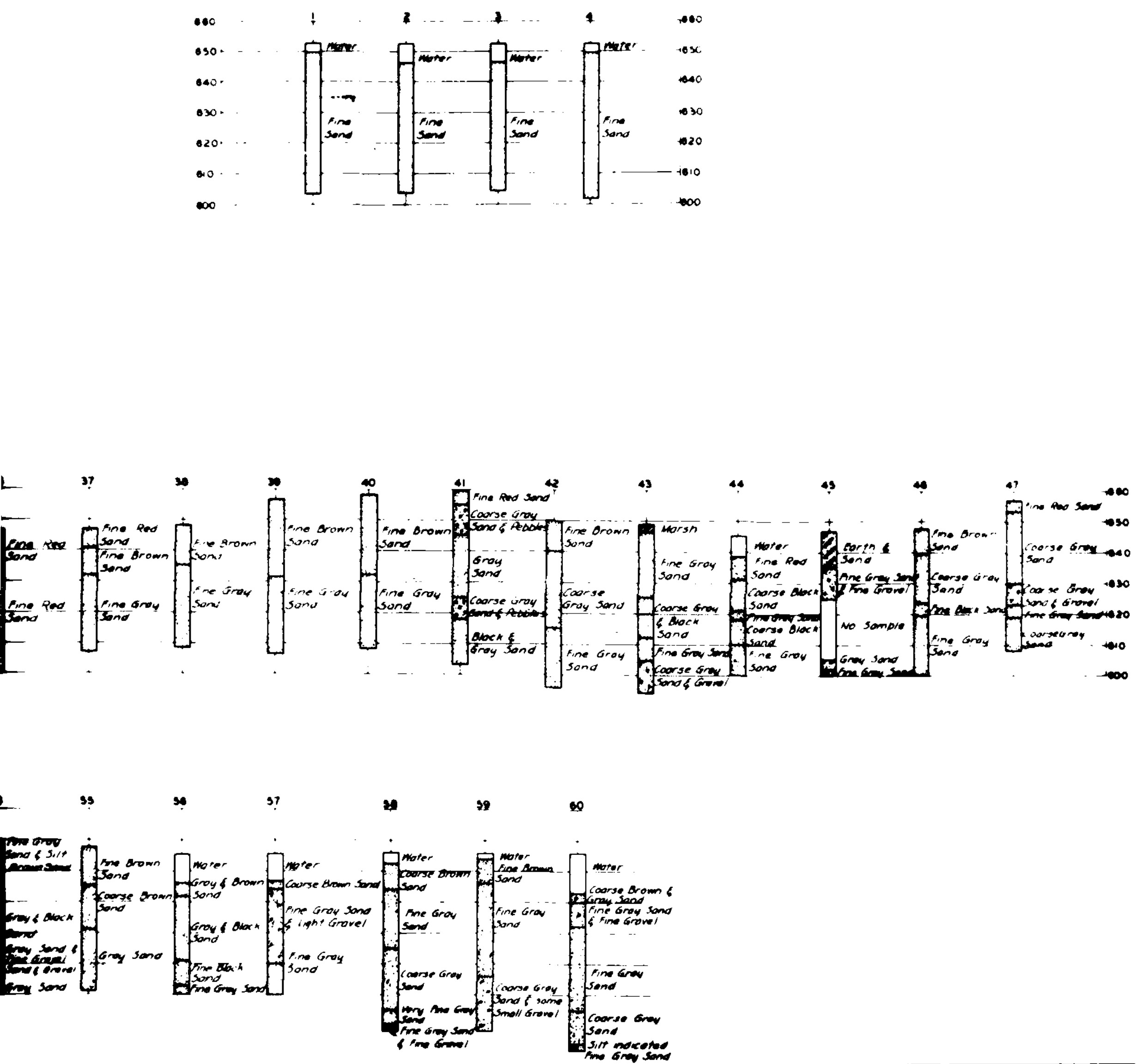
DRAWING NUMBER

SHEET OF

PLATE 2

WAR DEPARTMENT





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

MISSISSIPPI RIVER
LOCK AND DAM NO 5

BORING LOGS

HYDROPOWER RECONNAISSANCE STUDY

SUBMITTED BY

APPROVED

DATE SEPT 1981

AS SHOWN

DRAWING NUMBER

PLATE 3

SHEET

APPENDIX A
COST ESTIMATE

APPENDIX A

CONSTRUCTION COST ESTIMATE

TABLE OF CONTENTS

TABLES

APPENDIX A

CONSTRUCTION COST ESTIMATE

BASIS FOR COST ESTIMATES

The Guide Manual: Feasibility Studies for Small Scale Hydropower Additions, U.S. Army Corps of Engineers (HEC) (IWR), July 1979, was used to provide a basis for estimating the major share of construction costs that are governed by capacity and head. Costs for turbines and generators were based on a 25 September 1981 quote from Allis-Chalmers. Other site-specific costs were generated from calculated quantities and unit costs. A contingency factor of 15 percent has been used to allow for uncertainties and minor omissions. All costs reflect September 1981 price levels.

Lock and dam 5 hydropower - alternative 1 (10 units)

Item	Estimated quantity	Unit	Unit price	Estimated amount
Tube turbines	-	LS	-	$12,650,000
Powerhouse civil costs	-	LS	-	3,280,000
Station electrical equipment	-	LS	-	1,195,800
Miscellaneous power plant equipment	-	LS	-	257,400
Switchyard civil costs	-	LS	-	33,900
Switchyard equipment costs	-	LS	-	175,500
Transmission line costs	-	LS	-	228,200
Site specific				
Dewatering	-	LS	-	201,600
Cofferdams	110,000	CY	$7.00	770,000
Excavation	6,400	CY	5.00	32,000
Backfill	850	CY	4.00	3,400
Riprap	3,100	CY	25.00	77,500
Bedding material	2,700	CY	15.00	40,500
Downstream wing walls	200	CY	180.00	36,000
Levee road and parking lot	-	LS	-	84,000
Foundation piles	3,150	VLF	8.00	25,200
(Less steel salvage)	150	Ton	200.00	(-30,000)
Subtotal				19,061,000
Contingencies (15 percent)				2,859,200
Subtotal				21,920,200
Engineering and design (3 percent)				657,600
Supervision and administration (3 percent)				657,600
Project cost, alternative 1				23,235,400
			Use	23,240,000

Lock and dam 5 hydropower - alternative 2 (14 units)

Item	Estimated quantity	Unit	Unit price	Estimated amount
Tube turbines	-	LS	-	$17,710,000
Powerhouse civil costs	-	LS	-	4,592,000
Station electrical equipment	-	LS	-	1,607,600
Miscellaneous power plant equipment	-	LS	-	292,500
Switchyard civil costs	-	LS	-	46,200
Switchyard equipment costs	-	LS	-	210,600
Transmission line costs	-	LS	-	289,000
Site specific				
Dewatering	-	LS	-	288,000
Cofferdams	129,000	CY	$7.00	903,000
Excavation	8,800	CY	5.00	44,000
Backfill	850	CY	4.00	3,400
Riprap	4,100	CY	25.00	102,500
Bedding material	3,300	CY	15.00	49,500
Downstream wing walls	200	CY	180.00	36,000
Levee road and parking lot	-	LS	-	84,000
Foundation piles	4,500	VLF	8.00	36,000
(Less steel salvage)	210	Ton	200.00	(-42,000)
Subtotal				26,252,300
Contingencies (15 percent)				3,937,800
Subtotal				30,190,100
Engineering and design (3 percent)				905,700
Supervision and administration (3 percent)				905,700
Project cost - alternative 2				32,001,500
			Use	32,000,000

Lock and dam 5 Hydropower - alternative 3 (18 units)

Item	Estimated quantity	Unit	Unit price	Estimated amount
Tube turbines	-	LS	-	$22,770,000
Powerhouse civil costs	-	LS	-	5,904,000
Station electrical equipment	-	LS	-	1,996,000
Miscellaneous power plant equipment	-	LS	-	327,600
Switchyard civil costs	-	LS	-	63,200
Switchyard equipment costs	-	LS	-	239,900
Transmission line costs	-	LS	-	334,600
Site specific				
Dewatering	-	LS	-	364,800
Cofferdams	148,000	CY	$7.00	1,036,000
Excavation	11,100	CY	5.00	55,500
Backfill	850	CY	4.00	3,400
Riprap	5,000	CY	25.00	125,000
Bedding material	3,900	CY	15.00	58,500
Downstream wingwalls	200	CY	180.00	36,000
Levee road and parking lot	-	LS	-	84,000
Foundation piles	5,700	VLF	8.00	45,600
Less steel salvage	270	Ton	200.00	(-54,000)
Subtotal				33,390,100
Contingencies (15 percent)				5,008,500
Subtotal				38,398,600
Engineering and design (3 percent)				1,152,000
Supervision and administration (3 percent)				1,152,000
Project total - alternative 3				40,702,600
			Use	40,700,000

ESTIMATE OF ANNUAL CHARGES

Annual charges for the proposed alternatives are based on an interest rate of 7 3/8 percent and an economic life of 100 years.

Estimate of annual charges ($1,000)

Item	Alternative 10 units	Alternative 14 units	Alternative 18 units
Construction first cost	23,240	32,000	40,700
Present value of replacement costs(1)	95	127	159
Interest during construction(2)	1,617	2,226	2,832
Present value of salvage(3)	-29	-38	-48
Federal investment	24,923	34,315	43,643
Interest and amortization of Federal investment(4)	1,840	2,533	3,221
Annual operation and maintenance(5)	106	149	179
Total annual charges	1,946	2,682	3,400

(1) Considers major rehabilitation of operating machinery 50 years after construction.
(2) Assumes 2-year construction period.
(3) Considers salvageable items after rehabilitation 50 years hence and at end of project economic life 100 years hence.
(4) 100-year economic life at 7 3/8-percent interest rate.
(5) Includes winter operation costs.

APPENDIX B
COORDINATION

APPENDIX B

COORDINATION

TABLE OF CONTENTS

APPENDIX B

COORDINATION

This appendix presents the views and comments of other Federal agencies and non-Federal interests with reference to considered hydropower development at lock and dam 5.

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

NCSED-PB 6 July 1981

NOTICE

LOCK AND DAM 5
HYDROPOWER RECONNAISSANCE STUDY

The St. Paul District, Corps of Engineers, has initiated a reconnaissance study to determine the potential for hydropower generation at the existing Corps of Engineers navigation lock and dam 5 on the Mississippi River near Fountain City, Wisconsin. The reconnaissance report culminating the study will be completed by September 1981.

The intent of the reconnaissance study is to establish, in a general way, whether hydropower production at lock and dam 5 is economically justified and assess the issues that may be critical to implementation. Existing information will be used to the extent practicable. The reconnaissance study will not provide detailed formulation of a plan or optimal scale of development. Rather, the study will show whether at least one plan is workable and feasible. If a plan is found justified, a more detailed feasibility study will be recommended to start in fiscal year 1982 which begins 1 October 1981.

Because the reconnaissance study is preliminary, an intensive public involvement program is not planned. Agencies and interests are being informed of the study at its outset and invited to participate by this mailed notice. News releases to the general public will be prepared, as appropriate. When the reconnaissance study is completed, a public meeting will be held to discuss the report and its findings and help direct feasibility study efforts, if further studies are recommended in the reconnaissance report.

At this time, we request your input and suggestions regarding the study. Your comments can be sent to:

Commander
St. Paul District, Corps of Engineers
ATTN: Planning Branch
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

for WILLIAM W. BADGER
Colonel, Corps of Engineers
Commander

Honorable William S. Proxmire
United States Senate
Washington, D.C. 20510

Public Notice on Lock and Dam 5 Hydropower Study

Mr. James Calvert
Project Manager
Commonwealth Associates
209 East Washington Avenue
Jackson, Michigan 49201

Mr. James Adducci
Dairyland Power Cooperative
2615 East Avenue South
La Crosse, Wisconsin 54601

Mr. Robert Bauer
Department of Energy
Region V
175 West Jackson Blvd.
Chicago, Illinois 60604

Mr. Hugh Gardner
Department of Energy
Region V
175 West Jackson Blvd.
Chicago, Illinois 60604

Mr. J. A. Volkenant
MARCA (Mid-Continent Area Reliability Coord. Agreement)
1250 Soo Line Building
507 Marquette Avenue
Minneapolis, MN 55402

Honorable Albert H. Quie
Governor of Minnesota
130 State Capitol
St. Paul, Minnesota 55155

Honorable Rudy Boschwitz
United States Senate
Washington, D.C. 20510

Honorable David F. Durenberger
United States Senate
Washington, D.C. 20510

Honorable Steven Gunderson
House of Representatives
Washington, D.C. 20515

Honorable Robert Kasten
United States Senate
Washington, D.C. 20510

Honorable David F. Durenberger
Room 174 Federal Building
110 South 4th Street
Minneapolis, MN 55401

Honorable Arlen Erdahl
House of Representatives
Washington, D.C. 20515

Honorable Arlen Erdahl
33 East Wentworth Avenue
West St. Paul, MN 55118

Division Engineer
U.S. Army Engineer Division, North Central
536 South Clark Street
Chicago, Illinois 60605

E. H. Schentzel
Northern States Power Co. (NSP)
414 Nicollet Mall, 2nd Floor
Minneapolis, MN 55401

District Engineer
U.S. Army Engineer District, Rock Island
Clock Tower Building
Rock Island, Illinois 61201

Mr. Jack Leifer
Assistant General Manager
Dairyland Power Cooperative
2615 East Avenue South
La Crosse, Wisconsin 54601

Mr. John Wilkenson
Brown-Boveri
Turbo Machinery
711 Anderson Avenue North
St. Cloud, Minnesota 56301

Honorable Lee Sherman Dre[illegible]
Governor of Wisconsin
P.O. Box 7863
Madison, Wisconsin 53707

Editor
Cochrane-Fountain-City Recorder
Cochrane, Wisconsin 54622

Mr. Al Smith
Suite 509
512 Nicollet Mall
Minneapolis, MN 55402

Mr. William Gaudreau
1 Hospital Trust Plaza
Suite 2401
Providence, RI 02903

Roger Arndt
Director
St. Anthony Falls Hydraulic Laboratory
Mississippi R. at 3rd Ave. SE
Minneapolis, MN 55414

Mr. Carroll Besad[illegible]
Secretary
Dept. of Natural Resources
[illegible]

Technical Advisory Group

Robert Wylie
Chairman
WI Valley Improvement Corp.
2301 North 3rd
Wausau, Wisconsin 54401

Bill Sayles
Public Service Commission
Hill Farms Office Bldg.
Madison, Wisconsin 53705

Ed Brick
Dept. of Natural Resources
Madison, Wisconsin 53702

Warren Gebert
U.S.G.S.
1815 University Avenue
Madison, Wisconsin 53706

Mike Popko
Lake Superior Power
301 Front Street East
Ashland, Wisconsin 54806

Mark Dahlberg
North West Electric Co.
104 South Pine Street
Grantsburg, WI 54840

Anthony J. Carroll
Project Coordinator
Division of State Energy
101 S. Webster
Madison, Wisconsin 53702

Dave Penn
Wisconsin Public Power Inc.
P.O. Box 44
Sun Prairie, WI 53590

Dr. Davoud Harari
UW-Milwaukee-Engineering
Milwaukee, Wisconsin 53201

William Harris
North American Hydro
Box 676
Wautoma, WI 54982

Dick Rudolph
Owen-Ayres & Associates
1300 West Clairemont Ave.
Eau Claire, WI 54701

Bill Keepers or Designee
Power Production
Wisconsin Power and Light
222 West Washington
Madison, WI 53702

Peter Burno
Route 1
Edgerton, WI 53534

Mark Mueller
North West Reg. Planning Comm.
302 Walnut Street
Spooner, WI 54801

FEDERAL AGENCIES

Eastern Region Forest Service
USDA, Region 9
633 West Wisconsin Ave.
Milwaukee, WI 53203

Mr. Robert E. Kohnke
Chief, River Basin Pl. Branch
USDA, SCS
P.O. Box 2890
Washington, D.C. 20013

U.S. Dept. of Transportation

Mr. D. E. Trull
U.S. Dept. of Transportation
Federal Highway Administration
18209 Dixie Highway
Homewood, Illinois 60430 (2

Mr. E. Dean Carlson, Div. Engr
Federal Highway Administration
Region V, U.S. Dept. of Trans.
Suite 490, Metro Square Bldg.
St. Paul, Minnesota 55101

Power Related Projects

N. Allen Anderson
Federal Administration
175 West Jackson Blvd.
Chicago, Illinois 60604

National Power Plant Team
U.S. Fish & Wildlife Service
2929 Plymouth Road, Rm 206
Ann Arbor, Michigan 48105

Advisory Council on Historic Preservation

Advisory Council on Historic
Preservation
1522 K Street NW
Washington, D.C. 20005

STATE AGENCIES

Ms. Karen Cole, Environmental
Coordinator, MN Energy Agency
740 American Center Building
160 East Kellogg Blvd.
St. Paul, Minnesota 55101

Mr. Gary Johnson
Minnesota Senate
Natural Resources & Agriculture
Committee, State Capitol
St. Paul, Minnesota 55101 (2)

Ms. Jackie Burke Rosholt
State House of Representatives
Room 225, State Office Bldg.
St. Paul, Minnesota 55101 (2)

Russell W. Fridley
State Historic Preservation
Officer, MN State Historical
Society, 240 Summit Ave.
St. Paul, Minnesota 55102

Christy A. H. Caine
State Archaeologist
Dept. of Sociology/Anthropology
Hamline University
St. Paul, Minnesota 55104

Director of Environmental
Affairs, MN Dept. of Trans.
807 Transportation Bldg.
John Ireland Boulevard
St. Paul, Minnesota 55155

Mr. Erling M. Weiberg
Administrative Secretary
MN Water Resources Board
555 Wabasha St., Room 206
St. Paul, Minnesota 55102 (2)

Mr. Bill Newstrand
MN/DOT
Room 820
Transportation Building
St. Paul, Minnesota 55155

Division Superintendent
Midwestern Gas Transmission
P.O. Box 70
Wadena, Minnesota 56482

Dr. F. James Rybak
State Office of Economic
Opportunity, 690 American
Center Bldg, 150 E Kellogg Blvd.
St. Paul, Minnesota 55101

Rick Wiederhorn
St. Paul Planning & Econ. Dev.
1200 City Hall Annex
25 West 4th Street
St. Paul, Minnesota 55102

CLEARINGHOUSES

Intergovernmental Planning
MN State Planning Agency
802 Capitol Square Bldg.
St. Paul, Minnesota 55101

Regional Clearinghouses

Metropolitan Council
Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

LIBRARIES

Minneapolis Public Library
Documents Division
300 Nicollet Mall
Minneapolis, MN 55401

Mrs. Zona DeWitt
111 Legislative Library
State Capitol
St. Paul, Minnesota 55155

Environmental Conservation
Library of Minnesota
300 Nicollet Mall
Minneapolis, MN 55401

St. Paul Public Library
Document Collection
90 West 4th Street
St. Paul, Minnesota 55102

Hill Reference Library
ATTN: Documents Librarian
Fourth & Market Streets
St. Paul, Minnesota 55102

LIBRARIES (Cont)

Metropolitan Council Library
Mr. William Schnieder
300 Metro Square
St. Paul, Minnesota 55101

Libraries - Education

University of Minnesota
University Libraries
Government Publications Div.
409 Wilson Street
Minneapolis, MN 55455

University of Minnesota
Agricultural Library
St. Paul Campus
ATTN: Documents Librarian
St. Paul, Minnesota 55101

STATE INTEREST GROUPS

Sierra Club
Chairman, North Star Chapter
111 Franklin Ave. E
Minneapolis, MN 55404

The Waterways Journal
666 Security Building
319 North 4th Street
St. Louis, Missouri 63102

LOCAL INTEREST GROUPS

Limnological Research Center
University of Minnesota
Minneapolis, MN 55455

Asst. Professor Robert T. Moline, Water Resources Dev. Comm., River Bend Association
Gustavus Adolphus College
St. Peter, MN 56082

J. W. Hoffman
Executive Vice President
Upper Mississippi Waterway Association, 1851 W. Wellesley Ave., St. Paul, MN 55105

James E. Carter, Ph.D.
Director, Energy Research
State of MN Energy Agency
124D State Capitol
St. Paul, Minnesota 55155

Dick Wallen
Minnesota Energy Agency
740 American Center Bldg.
160 East Kellogg Blvd.
St. Paul, Minnesota 55101

MN Dept. of Economic Dev.
Research Division
480 Cedar Street
St. Paul, Minnesota 55101

SUPPLEMENT - EDUCATIONAL

Mr. Archie D. Chelseth
Assistant Commissioner
DNR
Centennial Office Bldg.
St. Paul, Minnesota 55155

National Weather Service, NOAA
U.S. Dept. of Commerce
6301 34th Avenue South
Minneapolis, MN 55450

MN River Valley Nature Center
Izaak Walton League
Minneapolis Chapter
6601 Auto Club Road
Bloomington, MN 55438

Agricultural Extension Serv.
University of Minnesota
102 Green Hall
St. Paul, Minnesota 55101

Stan Nestigen
Dept. of Natural Resources
Madison, Wisconsin 53702

Dr. Gabor Karadi
UW-Milwaukee-Engineering
Milwaukee, Wisconsin 53201

Glen Tampke
Owen Ayres & Associates
1300 W. Clairemont Ave.
Eau Claire, WI 54701

Editor
Minneapolis Star & Tribune
[illegible] Portland Avenue
Minneapolis, MN 55415

Editor
St. Paul Dispatch & Pioneer
Press
[illegible] East Fourth Street
St. Paul, Minnesota 55101

Mr. Lawrence E. [illegible]
[illegible] Regional Office
Federal Energy Reg. Comm.
Federal Building, 31st Floor
[illegible] Dearborn Street
Chicago, Illinois 60604

[illegible] Norman C. Venzke
[illegible]
[illegible] Coast Guard District
[illegible] Dept. of Transportation
[illegible] Street
St. Louis, Missouri 63103

Mr. Harry M. Major
State Conservationist
[illegible] Conservation Service
[illegible] Federal Building
[illegible] Street
St. Paul, Minnesota 55101

[illegible]
[illegible] Director
[illegible] Fish & Wildlife Service
Federal Building
Fort Snelling
Twin Cities, MN 55111

Mr. [illegible] Haugerud
[illegible]
[illegible] Basin Comm.
[illegible] Avenue [illegible]
Minneapolis, MN 554[illegible]

Mr. Richard E. Friedman
Regional Dir., Region V
Public Health Service
300 South Wacker Drive
Chicago, Illinois 60606

Mr. Donald R. Albin
District Chief
U.S. Geological Survey
702 U.S. Post Office
St. Paul, Minnesota 55101

Mr. Frank Jones
Reg. Director, Lake Central
Region, Heritage Conservation
& Rec. Service
Federal Building
Ann Arbor, Michigan 48107

Mr. John McGuire
Acting Reg. Administrator
Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Mr. John E. Arnold
Economic Dev. Administration
407 Federal Building
515 West First Street
Duluth, Minnesota 55802

Mr. Mark W. Seetin
Commissioner
MN Dept. of Agriculture
90 West Plato Blvd.
St. Paul, Minnesota 55107

Commissioner, MN Dept. of
Economic Development
480 Cedar Street
St. Paul, Minnesota 55101

Mr. Charles Kenow
Environmental Quality Council
100 Capitol Square Bldg.
550 Cedar Street
St. Paul, Minnesota 55101

Mr. Joseph N. Alexander
Commissioner
MN Dept. of Natural Resources
Centennial Bldg.-Third Floor
St. Paul, Minnesota 55155

Mr. Larry Seymour
Dir., Division of Waters
MN Dept. of Natural Resources
444 Lafayette Road
St. Paul, Minnesota 55101

Mr. Arthur Sidner
Director
MN State Planning Agency
550 Cedar Street
St. Paul, Minnesota 55101

Ms. Terry Hoffman
Executive Director
MN Pollution Control Agency
1935 West County Road B2
Roseville, MN 55113

Mr. James M. Harrison
Executive Director
MN-WI Boundary Area Comm.
619 Second Street
Hudson, Wisconsin 54016

Mr. Al Johnson
Commissioner
MN Energy Agency
150 East Kellogg Blvd.
St. Paul, Minnesota 55101

United States Department of the Interior

FISH AND WILDLIFE SERVICE
TWIN CITIES AREA OFFICE
530 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

IN REPLY REFER TO:

AUG 13 1981

Colonel William W. Badger
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Badger:

This responds to your July 6, 1981, notice requesting our comments on the preparation of reconnaissance studies for hydropower generation at lock and dam 1, 5, and 8 on the Mississippi River in Minnesota and Wisconsin. We offer the following comments to assist you in the preparation of these studies.

Existing Fish and Wildlife Resources

Lock and Dam 1 -- Fish and wildlife populations are somewhat limited in the Minneapolis pools primarily because of the lack of shallow water habitat, the relatively small size of the pools, and industrial development along the riverbanks. Occasional periods of poor water quality further reduce the value of fishery habitat. However, valuable habitat for upland species can be found on the wooded bluffs along Pool 1. Sport fishing is common in the pools despite the relative lack of quality fishery habitat. Firearm restrictions prohibit hunting in the urban areas.

Fishery habitat is limited but generally good in Pool 2 upstream of downtown St. Paul. However, the quality of fishing declines in the lower portions of the Minnesota River and downstream portions of Pool 2 because of poor water quality. Valuable wildlife habitat can be found in the areas of Crosby Lake, Pigs Eye Lake, and Grey Cloud Island and on the Minnesota River within the Minnesota Valley National Wildlife Refuge and Black Dog Lake. Pigs Eye Lake, located in Pool 2 downstream of downtown St. Paul, has a unique heron-egret rookery located at its border. This rookery is maintaining itself and contains black-crowned night herons, great blue herons, and common egrets.

Sport fishing is provided in the tailwater areas of lock and dam 1 and at the outfall of Black Dog Lake. Hunting is prohibited in the majority of Pool 2 and on the Minnesota River within the metropolitan area.

Lock and Dam 5 -- Significant areas in Pools 5 and 5A are managed as wildlife refuges (UMRWLFR, Trempealeau, Wisconsin DNR areas). Pool 5 provides excellent and diverse habitat for both fish and wildlife. The backwaters of the Weaver Bottoms and Belvidere Slough provide excellent spawning, nesting, and rearing areas. A large portion of the Weaver Bottoms is closed to waterfowl hunting and provides an important resting and feeding sanctuary for migrating waterfowl. Pool 5 is also used extensively for public recreation (hunting, fishing, trapping, camping, and boating). Sport and commercial fishing, waterfowl hunting, and trapping are considered excellent in Pool 5.

Pool 5A also provides valuable fish and wildlife habitat. The Fountain City Bay area and the extensive areas between Fountain City Bay, Wisconsin, and Minnesota City, Minnesota, provide exceptional fishing, hunting, and trapping opportunities. A large heron and egret rookery exists in the Fountain City Bay area. In addition, Pool 5A is used heavily for public recreation. One major park -- Merrick State Park in Wisconsin -- is located adjacent to the pool. Several private developments provide additional recreational facilities. In addition, two archeological sites on the Minnesota side of Pool 5A are on the National Register. The Wisconsin Department of Natural Resources (WDNR) has designated one natural area -- Kammeroski Rookery at River Mile 734.

Lock and Dam 8 -- Significant areas in Pools 8 and 9 are also managed as wildlife refuges (UMRWLFR and State refuge areas). Pool 8 provides valuable fish and wildlife habitat and hunting, fishing, and trapping are considered excellent throughout the extensive backwater areas. In addition, backwater areas provide valuable resting and feeding habitat for migrating waterfowl, including canvasback ducks. A heron and egret rookery exists in the delta of the Root River. Pool 8 is also used extensively for public recreation. Two archeological sites have been documented on the pool, one at Goose Island and another along the Wisconsin shore at River Mile 693.5. Wisconsin has designated a natural area, Turtle Nesting Site, at River Mile 685. Most of the pool lies within the La Crosse District of the Upper Mississippi River Wild Life and Fish Refuge.

Pool 9 also provides excellent fish and wildlife habitat. Backwater areas provide valuable resting and feeding habitat for migratory waterfowl including canvasback ducks. In particular, areas near Lansing, Big Lake, Reno Bottoms, and Winneshiek Slough provide outstanding fish and wildlife habitat. Most of the pool lies within the Lansing District of the Upper Mississippi River Wild Life and Fish Refuge.

Pool 9 is also used extensively for public recreation. Hunting, sport fishing, trapping, and commercial fishing are considered outstanding in the pool. In addition, Pool 9 contains several cultural, natural, and scientific areas. A number of Indian mound sites are in the area including Waukon Junction, Keller, Capoli Bluff, Hemingway Mound Groups, and the Effigy Mounds National Monument. In addition, the Iowa State Preserve Board owns the Fish Farm Mounds Preserve south of New Albin, Iowa.

Several federally designated endangered or threatened species have been known to occur in these areas of the Upper Mississippi River. The bald eagle (Haliaeetus leucocephalus), classified as a threatened species in Minnesota and Wisconsin and endangered in Iowa, winter in numbers on the Upper Mississippi River, concentrating below dams or near the mouths of tributaries where fish provide a ready food supply. Also, the endangered Higgin's eye pearly mussel (Lampsilis higginsi) inhabits portions of the river. Historically, the endangered peregrine falcon (Falco peregrinus) has also been known to occur in areas along the Upper Mississippi River.

Concerns

Construction and operation of hydropower facilities at the above locations will impact fish and wildlfe resources, the extent of which must eventually be documented should the projects appear feasible. A major concern involves potential effects to existing daily and seasonal water levels. A change in such levels could result in adverse impacts to wetlands, backwater areas, shoreline habitat, and associated fish and wildlife resources and may also conflict with the management of refuge lands. Regardless of a change in water levels, the location of the generating facility and its operation could alter existing flow patterns. Existing flows are fairly uniform across the river at the above locks and dams. Concentrating a portion of this flow through the generating facility could affect existing upstream and downstream flow patterns, terrestrial and aquatic habitats, possibly increase scouring and erosion, and affect the existing tailwater sport fisheries. We would be particularly concerned about this funneling effect during low flow periods.

We are also concerned with potential injury and mortality of aquatic organisms due to entrainment through the generating facilities. Impingement of organisms may also be an important factor if screening devices are used at the intakes. In addition to design, construction, and operation of the generating facility, construction of required transmission lines, corridors, and other facilities could also result in adverse impacts to fish and wildlife resources.

As stated earlier, most lands in the vicinity of lock and dam 5 and 8 are included in the Upper Mississippi River Wild Life and Fish Refuge. From the refuge standpoint, we are concerned that project construction and operation may adversely impact these holdings. Proposals for construction of hydropower facilities at these locations must, therefore, be closely coordinated with the Service.

The above concerns should be adequately addressed in the future studies if the addition of generating facilities appears economically feasible. We also suggest the projects be closely coordinated with the Wisconsin and Minnesota Departments of Natural Resources and Iowa Conservation Commission where appropriate. We appreciate the opportunity to offer our comments on these projects and look forward to our continued coordination on this matter.

Sincerely yours,

James L. Smith
Acting Area Manager

cc: UMRWLFR, Winona, MN
UMRWLFR, LaCrosse, WI
UMRWLFR, Lansing, IA
MN Valley NWR, Bloomington, MN

Wisconsin Power & Light Company
Investor-owned Energy
222 West Washington Avenue P. O. Box 192 Madison, Wisconsin 53701 Phone 608/252-3311

August 27, 1981

Department of the Army
St. Paul District Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, MN 55101

Attention: William W. Badger, Colonel
Corps of Engineers Commander

Re: Hydro Power Reconnaissance Studies

Gentlemen:

We are in receipt of your notices dated 6 July 1981 regarding reconnaissance studies to determine hydro power potential at existing Corps of Engineers lock and dam Nos. 8 at Genoa, Wisconsin, 5 near Fountain City, Minnesota, and 1 at Minneapolis, Minnesota.

Since Wisconsin Power & Light serves an area bordered in part by the Mississippi River and contiguous to other Corps of Engineers locks and dams, we are very much interested in the development and conclusions of the subject studies. We would appreciate receiving copies of these studies and any similar work in progress or proposed, particularly with regard to lock and dam Nos. 9, 10, and 11 at Lynxville, Wisconsin, Guttenberg, Iowa, and Dubuque, Iowa, respectively, which are adjacent to areas we serve.

At this time we have no specific input or suggestions to offer to apply to the work at hand, but are prepared to assist in any way we can. Please do not hesitate to call on us if we can be of service on this or similar work.

Very truly yours,

W.C. Register

W. C. Register
Director of System
Operations and Planning

WCR/jml
cc - Mr. James H. Dudley
Mr. W. L. Keepers

FEDERAL ENERGY REGULATORY COMMISSION
CHICAGO REGIONAL OFFICE
230 SOUTH DEARBORN STREET, ROOM 3130
CHICAGO, ILLINOIS 60604

September 10, 1981

Mr. Louis Kowalski
Chief, Planning Division
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Jenkins:

Your August 4, 1981 letter requests power values for use in the reconnaissance study for addition of hydropower at Lock & Dam No. 5 at Minnesota City, Minnesota. Proposed development would consist of adding 6,000; 8,400 or 10,800 kilowatts of new capacity.

Power values, based on a coal-fueled steam-electric plant as the most likely alternative to each of the proposed hydroelectric developments, are summarized in the attached table. These are "at-market" values; no transmission line costs for the hydroelectric development have been included.

The energy value for the hydroelectric development is determined by the difference in total system operating cost between a system utilizing the proposed hydroelectric installation and one using an equivalent size alternative steam-electric generating plant. Operating costs for the hydroelectric project and its equivalent alternative were simulated using a probabilistic production costing computer model. The POWRSYM Version 48 model was used for this analysis.

Northern States Power Company was used as a "typical" system to measure the annual production cost differences between future operation with the added hydroelectric capacity and its equivalent alternative. Operation of the system was simulated over the period 1980-2010 based on projected load and energy requirements for the Northern States Power Company system.

The capacity values given in the attached table are based on the annual fixed costs to install the alternative electric generating plant. A 5.0 percent credit has been given to the hydroelectric capacity to reflect its greater operating flexibility. In addition, the capacity value for the hydroelectric plant has been adjusted to reflect relative value based on its availability in comparison with the availability of the alternative steam plant. Accordingly, the capacity value given is applicable to the installed capacity of the proposed hydrolectric plant and already incorporates the consideration of dependable capacity.

Energy values are also given in the attached table which recognize the real fuel cost increases associated with multi-year operation of the system. Real fuel cost escalation factors were taken from Department of Energy data published in the October 17, 1980 Federal Register. Discount rates as specified in your letter were used to levelize these costs over the 100 year period requested.

If you have any questions regarding these power values, please contact Mr. David Simon of my staff at (FTS) 353-6701 and he will assist you.

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill, P.E.
Regional Engineer

Enclosure:
As stated

LOCK & DAM NO. 5 AT MINNESOTA CITY, MN ON THE MISSISSIPPI RIVER

Power Values at January 1981 Cost Levels:

Cost of Money %	New Capacity Added (MW)	Additional Generation (MWH)	Capacity Value $/KW-Yr.	Energy Value Current $/MWH	Energy Value Escalated $/MWH
7.375	6.0	46,800	135.80	18.7	39.4
	8.4	58,300	122.20	19.2	39.5
	10.8	66 200	110.60	19.4	39.5
8.5	6.0	46,800	153.60	18.7	38.6
	8.4	58,300	138.20	19.2	38.7
	10.8	66 200	125.10	19.4	38.7
10.0	6.0	46,800	180.00	18.7	37.6
	8.4	58,300	161.80	19.2	37.7
	10.8	66 200	146.50	19.4	37.6
12.0	6.0	46,800	219.30	18.7	36.4
	8.4	58,300	197.20	19.2	36.4
	10.8	66 200	178.50	19.4	36 4

APPENDIX C
POWER AND ENERGY

APPENDIX C

HYDROLOGIC POWER AND ENERGY ANALYSIS

APPENDIX C

TABLE OF CONTENTS

LIST OF PLATES

APPENDIX C

PROCEDURES USED IN HYDROLOGIC POWER AND ENERGY ANALYSIS

For a reconnaissance study, there are three main items to be determined for each plant size under consideration, to determine its economic value and relative productivity. These items are the average annual energy, the dependable capacity and the weekly generation. The several options for plant capacity are selected to provide significantly differing levels of development.

In each case, the available flow is considered along with the site conditions, current development, design considerations and ecological constraints. This process gives the best chance of finding an economically feasible and otherwise justifiable project.

Average Annual Energy

The flow duration technique was used to estimate average annual energy production. The daily flows for the period of record are grouped into flow classes. Each flow class is then plotted according to its cumulative percentage of occurrence. The curve (see Plate C-1) is assumed to represent an average year.

Since the head varies significantly with changes in flow, 5 years of data (representing wet, damp, average, dry and very dry years) were compiled to determine a head-versus-flow curve. This gross head was reduced by the estimated trashrack and tailrace losses to produce the curve of estimated net head (also shown on Plate C-1).

The power available depends upon the factors of head (H) and flow (Q). The amount of the power produced by the turbine depends upon these factors and the efficiency of the turbine. The equation for power is used to calculate the power for each flow class:

$$P = \frac{Q \times H}{13.7} \qquad \text{(kW)}$$

As previously noted, this equation assumes an overall efficiency of 0.86. For flows greater than the plant capacity, a mechanical availability of 90% is assumed. When capacity is in excess of flow, 100% availability is assumed. Thus the plant factors shown have included reliability as a consideration.

The estimated power for each flow class and option are plotted on the flow-duration curve. Since the horizontal axis represents an average year, the area under the power curves gives the average annual energy for those options. The calculated values for each flow class and option are shown on table C-2. The average annual energy is used to determine the average annual energy benefit.

Firm Power Evaluation

At certain times of the year, the demand for energy reaches a peak. In the upper Midwest region, there are two periods of peak demand, one during July and August, and one during December and January. The firm capacity is estimated for both of the critical periods and for the total year. (See Table C-3.) The firm power estimate given here is intended to indicate the size of conventional plant which would provide the same dependable capacity on the average. This approach considers 1) the sizes of the conventional and hydro plants and 2) their relative availabilities. The formula used is:

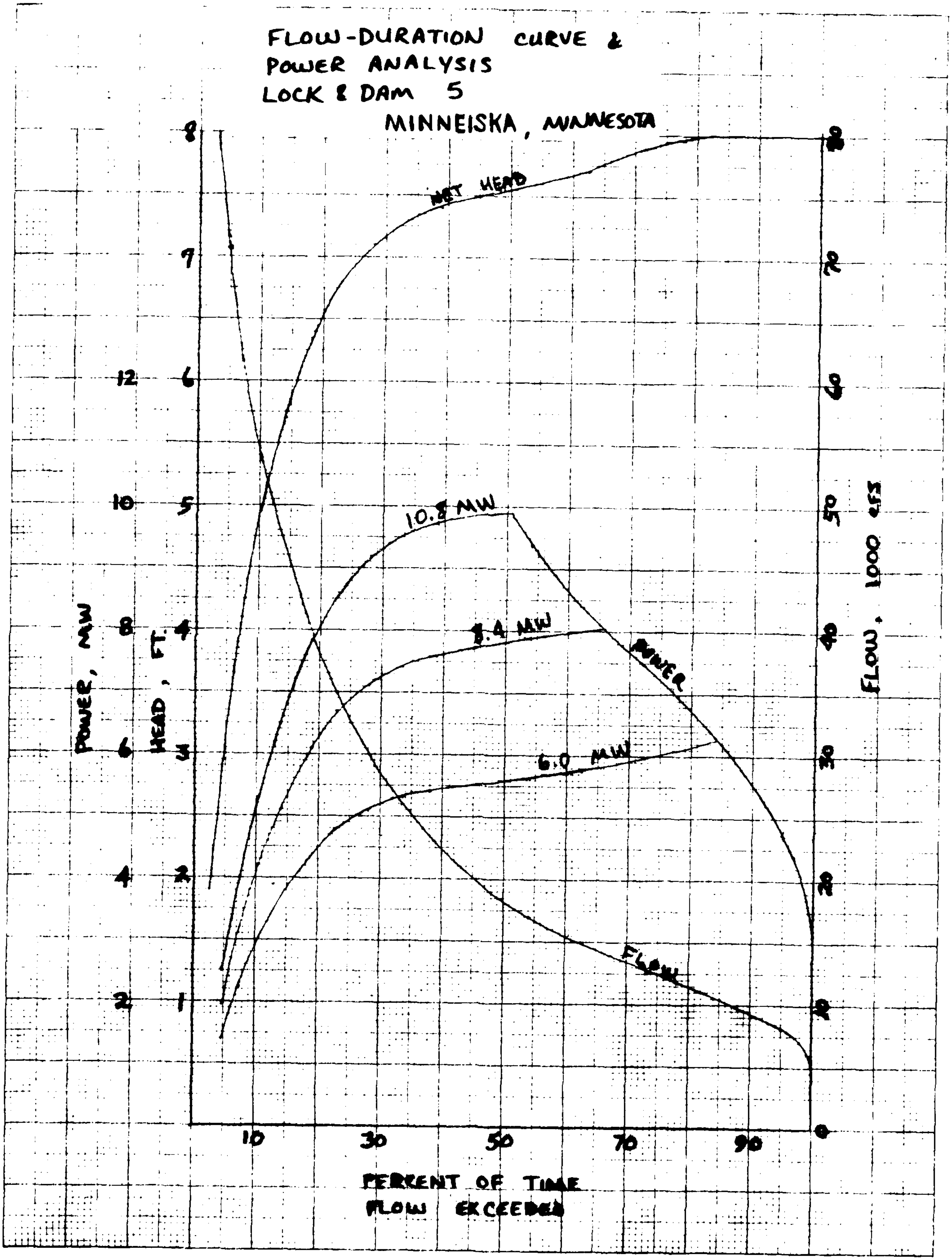
$$\text{Capacity Firm, (MW)} = \frac{\text{(Installed Capacity)(Hydro Plant Factor)}}{\text{(Conventional Plant Reliability)}}$$

Conventional and nuclear plants in this area have reliabilities from 63 to 95 percent, with an average of 85 percent. For this study, the conventional reliability was assumed to equal 85 percent.

This procedure is essentially that recommended by the staff of the Hydroelectric Design Branch of the North Pacific Division, Corps of Engineers.

Average Weekly Generation

To calculate the power values to be assigned to a proposed site, the Federal Energy Regulatory Commission (FERC) examines the performance of each option within the proposed power network by using a computer program for power network simulation. In order to do this, the proposed generation schedule is required on a weekly basis. Weekly average flows for the period of record were used to calculate weekly power values. These values were adjusted so that the annual totals equal those for the annual flow duration calculations. The average flows and weekly energy for each option are shown on Table C-4.



FLOW-DURATION CURVE &
POWER ANALYSIS
LOCK & DAM 5
MINNEISKA, MINNESOTA
NET HEAD
10.8 MW
8.4 MW
6.0 MW
POWER
FLOW
POWER, MW
HEAD, FT.
FLOW, 1000 cfs
PERCENT OF TIME
FLOW EXCEEDED

Plate C-1

COMPUTATION SHEET

Subject: ANNUAL FLOW-DURATION HYDROPOWER ANALYSIS
Project: BASED ON FLOW AT WINONA
Computation: LOCK AND DAM 5
Computed by: DESIGN HEAD = 7.5 ft
Checked by: DA. = 58845 mi^2
Date ____ Page ____ of ____ Pages
DESIGN FLOW PER TURBINE = 1121 cfs e = 0.86 6.0 mw 8.4 mw 10.8 mw

%-ile	FLOW CLASS	NET HEAD	# EVENTS OF 18627	Δ%	10 UNITS @ 600 KW FLOW CAPACITY	FLOW USED	POWER KW	ENERGY MWh	14 UNITS @ 600 KW FLOW CAPACITY	FLOW USED	POWER KW	ENERGY MWh	18 UNITS @ 600 KW FLOW CAPACITY	FLOW USED	POWER KW	ENERGY MWh
2.7	82500	1.9	521	2.8												
4.7	71600	3.0	360	1.9	7090	6381	1397	237	9926	8933	1956	331	12762	11486	2515	426
7.3	61600	4.1	496	2.7	8288	7459	2232	521	11604	10443	3125	727	14919	13427	4018	927
10.4	53700	5.0	566	3.0	9153	8238	3066	800	12814	11533	4209	1120	16475	14828	5412	1440
14.2	46700	5.7	695	3.7	9773	8795	3659	1196	13682	12314	5123	1674	17591	15832	6687	2153
18.7	39800	6.4	850	4.6	10355	9320	4354	1740	14497	13048	6095	2437	18640	16776	7837	3173
22.8	34800	6.8	763	4.1	10674	9607	4762	1711	14944	13449	6676	2395	19213	17292	8583	3080
28.1	29800	7.1	986	5.3	10907	9816	5085	2367	15270	13743	7122	3303	19633	17669	9157	4246
33.3	25800	7.3	963	5.2	11060	9954	5304	2402	15483	13935	7425	3363	19907	17916	9547	4324
38.9	22900	7.4	1043	5.6	11135	10022	5418	2655	15589	14030	7578	3717	20043	18039	9744	4779
45.4	19900	7.5	1222	6.6	11210	10089	5523	3174	15694	14125	7732	4444	20178	19900	10594	6261
53.9	16900	7.6	1568	8.4	11284	10156	5634	4155	15798	14218	7885	5816	20312	16900	9375	6913
62.4	14900	7.7	1591	8.5	11358	10222	5746	4799	15902	14900	8374	6266	20445	14900	8374	6266
72.5	12900	7.9	1875	10.1	11505	10355	5977	5365	16107	12900	7439	6559	20709	12900	7439	6559
82.3	10900	8.0	1839	9.9	11578	10900	6365	5505	16209	10900	6365	5505	20840	10900	6365	5505
89.6	9400	8.0	1357	7.3	11578	9400	5489	3503	16209	9400	5489	3503	20840	9400	5489	3503
94.9	8200	8.0	990	5.3	11578	8200	4788	2229	16209	8200	4788	2229	20840	8200	4788	2229
97.7	7100	8.0	512	2.7	11578	7100	4146	998	16209	7100	4146	998	20840	7100	4146	998
99.1	6200	8.0	261	1.4	11578	6200	3620	444	16209	6200	3620	444	20840	6200	3620	444
99.8	5300	8.0	138	0.7	11578	5300	3095	186	16209	5300	3095	186	20840	5300	3095	186
100.0	4600	8.0	41	0.2	11578	4600	2686	52	16209	4600	2686	52	20840	4600	2686	52
								43432				55073				63435
AVG. ANNUAL ENERGY, MWh								43400				55100				63400
OVERALL PLANT FACTOR								.83				.75				.67
INCREMENTAL PLANT FACTOR								N/A				.33				.29
INCREMENTAL PRODUCTION FACTOR = % INCREASE IN PRODUCTION / % INCREASE IN CAPACITY												26.8/40 = .67				15/29

NCS Form 53
17 Aug 77

Plate C-2

COMPUTATION SHEET

Subject (5) DEPENDABLE CAPACITY

Project BASED ON FLOWS AT WINONA

Computation LOCK AND DAM 5, 2 CRITICAL PERIODS - JUL-AUG, DEC-JAN

Computed by DESIGN HEAD 7.5 Checked by D.A = 58845 mi²

DESIGN FLOW 1121 e = .86 ÷ 13.7

Date ____ Page ____ of ____ Pages

FLOW CLASS	NET HEAD	%-ile	# EVENTS OF 3224	Δ %	ENERGY JUL-AUG 10 @ 600 KW (6.0 MW)	14 @ 600 KW (8.4 MW)	18 @ 600 KW (10.8 MW)	%-ile	# EVENTS OF 3162	Δ %	ENERGY DEC-JAN 10 @ 600 KW (6.0 MW)	14 @ 600 KW (8.4 MW)	18 @ 600 KW (10.8 MW)
92500	1.9	0.8	28					0.0	0				
71600	3.0	2.2	45	1.4	171	239	308	0.0	0	0.0	0	0	0
61600	4.1	4.6	77	2.4	467	654	841	0.0	0	0.0	0	0	0
53700	5.0	6.9	73	2.3	596	835	1073	0.0	0	0.0	0	0	0
46700	5.7	10.3	108	3.3	1074	1503	1933	0.0	1	0.0	10	14	18
39800	6.4	14.0	120	3.7	1420	1987	2555	0.6	19	0.6	217	304	391
34800	6.8	17.9	126	3.9	1632	2285	2938	1.4	24	0.8	317	444	571
29800	7.1	24.4	211	6.5	2917	4083	5250	2.6	39	1.2	550	770	989
25800	7.3	30.9	207	6.4	2983	4176	5369	4.9	74	2.3	1087	1522	1957
22900	7.4	37.2	203	6.3	2986	4180	5374	7.8	92	2.9	1380	1932	2482
19900	7.5	45.4	265	8.2	3977	5568	7844	13.9	191	6.0	2923	4092	5765
16900	7.6	55.0	310	9.6	4746	6644	7897	24.2	327	10.3	5104	7146	8493
14900	7.7	61.2	200	6.2	3122	4551	4551	36.5	388	12.2	6176	9002	9002
12900	7.9	69.8	277	8.6	4494	5599	5599	55.0	524	18.5	9660	12035	12035
10900	8.0	80.0	328	10.2	5673	5673	5673	70.2	482	15.2	8499	8499	8499
9400	8.0	87.5	242	7.5	3609	3609	3609	82.0	372	11.8	5657	5657	5657
8200	8.0	93.4	192	6.0	2498	2498	2498	91.0	284	9.0	3767	3767	3767
7100	8.0	96.2	91	2.8	1025	1025	1025	95.6	146	4.6	1677	1677	1677
6200	8.0	97.4	38	1.2	374	374	374	98.5	91	2.9	913	913	913
5300	8.0	99.3	62	1.9	521	521	521	99.5	32	1.0	274	274	274
4600	8.0	100.0	21	0.7	153	153	153	100.0	17	0.5	127	127	127
	AVG. ANNUAL ENERGY, MWh				44438	56158	65386				48338	58174	62619
	ASSUMED COAL/NUC RELIABILITY				.85	[illegible]	[illegible]				.85	.85	.85
					OPTION 1	OPTION 2	OPTION 3				OPTION 1	OPTION 2	OPTION 3
	CRITICAL PERIOD DEP. CAP.				6.0	7.5	8.8				6.5	7.8	8.4

C-7

NCS Form 53
17 Aug 77

Plate C-3

COMPUTATION SHEET

NAME OF OFFICE	COMPUTATION	DATE 7/23/81	PAGE 1 OF PAGES 2

SUBJECT: LOCK AND DAM 5 WEEKLY GENERATION – ADJUSTED

ABSOLUTE VALUE – ÷ 0.952137 (EXISTING), 1.062830 ①, 1.159215 ②

PRICE LEVEL

COMPUTED BY | CHECKED BY | APPROVED BY

WEEK	FLOW @ WINONA	NET HEAD	ADJUSTED FLOW ⑤	OPTION ① 6.0 MW	OPTION ② 8.4 MW	OPTION ③ 10.8 MW
1	14196	7.8	14111	1033	1270	1170
2	13611	7.8	13529	1033	1218	1121
3	13654	7.8	13572	1033	1221	1125
4	13486	7.9	13405	1053	1222	1125
5	13240	7.9	13161	1053	1200	1105
6	13455	7.9	13374	1053	1219	1123
7	13935	7.8	13851	1033	1247	1148
8	14254	7.8	14168	1033	1675	1174
9	16492	7.6	16393	995	1247	1324
10	19336	7.5	17220	975	1222	1532
11	23236	7.4	23097	955	1198	1418
12	31645	7.0	31455	879	1102	1305
13	41694	6.2	41444	732	918	1087
14	50554	7.4	50251	955	1201	1418
15	58286	4.5	57936	453	568	672
16	64261	3.8	63875	352	441	522
17	58947	4.4	58593	438	549	651
18	52694	5.1	52378	546	685	812
19	48346	5.6	48056	629	788	934
20	44271	6.0	44005	697	875	1035
21	40651	6.3	40407	750	941	1114
22	39020	6.5	38786	787	986	1168
23	39140	6.5	38905	787	986	1168
24	36976	6.6	36754	805	1009	1195
25	37377	6.6	37153	805	1009	1195
26	36962	6.6	36740	805	1009	1195

Plate C-4

NCS Form 15 22 Dec 75

COMPUTATION SHEET

NAME OF OFFICE | COMPUTATION | DATE 7/23/81 | PAGE 2 OF 2 PAGES

SUBJECT: LOCK AND DAM 5 WEEKLY GENERATION - ADJUSTED

ABSOLUTE VALUE − ÷ 0.952137 (EXISTING), 1.062836 (1), 1.154215 (2) | PRICE LEVEL

COMPUTED BY | CHECKED BY | APPROVED BY

WEEK	FLOW @WINONA	NET HEAD	ADJUSTED FLOW (5)		WEEKLY GENERATION MWH 6.0 MW	(1) 8.4 MW	(2) 10.8 MW		
27	34964	6.8	34754		841	1055	1249		
28	31202	7.6	31015		879	1102	1305		
29	25540	7.3	25387		936	1173	1390		
30	22171	7.4	22038		955	1198	1418		
31	21130	7.4	21003		955	1198	1418		
32	20047	7.5	19927		975	1222	1588		
33	18987	7.5	18873		975	1222	1504		
34	17755	7.5	17648		975	1222	1406		
35	18225	7.5	18116		975	1222	1443		
36	20092	7.5	19971		975	1222	1592		
37	20273	7.5	20151		975	1222	1605		
38	20024	7.5	19904		975	1222	1586		
39	20148	7.5	20027		975	1222	1596		
40	18714	7.5	18602		975	1222	1482		
41	18371	7.5	18261		975	1222	1455		
42	18909	7.5	18796		975	1222	1498		
43	18891	7.5	18778		975	1222	1496		
44	19853	7.5	19734		975	1222	1572		
45	20795	7.4	20670		955	1198	1418		
46	20435	7.5	20312		975	1222	1447		
47	19615	7.5	19497		975	1222	1553		
48	17467	7.4	17362		955	1198	1365		
49	16239	7.6	16142		995	1247	1303		
50	14551	7.7	14464		1014	1285	1183		
51	15456	7.7	15357		1014	1364	1256		
52	15223	7.7	15132		1014	1345	1238		
			TOTALS		46800	58300	66200		

NCS Form 15 22 Dec 75

APPENDIX D
PLAN OF STUDY

APPENDIX D

PLAN OF STUDY

TABLE OF CONTENTS

FIGURES

APPENDIX D

PLAN OF STUDY

REPORTS DEVELOPED

STAGE I - RECONNAISSANCE STUDY

The study for hydropower addition will be conducted in two stages. During the first stage, principal emphasis is on identification of resource management problems, concerns, and opportunities. Because of the introductory nature of the planning process in this stage, the effort involves analyzing a wide range of data, which may be more qualitative than quantitative. The general purpose of this stage is to initially analyze the water and related management problems and opportunities and evaluate in a preliminary fashion alternative solutions. The product of Stage I is a reconnaissance report which shows the results of the analysis; recommends or terminates further study; and, if further studies are recommended, outlines a plan for future studies.

STAGE II - FEASIBILITY STUDY

The feasibility report analyzes differences among alternatives and the corresponding effects of trade-offs between the national economic development and environmental quality objectives. Major study efforts will involve collection and evaluation of required data and formulation of an optimum scale of development. Recommendations will be made in the report for authorization of the plan selected. However, the authorization by Congress, advance planning, and funding by Congress will be necessary before any of the measures recommended in the feasibility report could be developed.

PUBLIC INVOLVEMENT

PUBLIC PARTICIPATION

The objective of public involvement is to actively involve the public in hydropower studies to ensure that these studies respond to public needs and preferences to the maximum extent possible, within the bounds of local, State, and Federal programs, responsibilities, and authorities.

The public is any affected or interested non-Corps of Engineers entity including other Federal, regional, State, and local government entities and officials; public and private organizations; and individuals.

To be responsive to public needs and preferences, Corps planning must include a continuous dialogue between the Corps and the public. The need for cooperation and coordination among Federal agencies concerned with water resources development has become more apparent as the Federal interest in this activity has grown. The interests of affected States and involved local interests are significant concerns and must be recognized and considered. In recent years, this has been amplified by general concern for the environment, regional economic development, and social well-being. It is the policy of the Corps to coordinate the hydropower program and to resolve differences wherever possible. To accommodate this dialogue, cooperation, and coordination, the Corps will hold workshop meetings periodically to discuss study progress and elicit reaction to potential proposals.

PUBLIC MEETINGS

In addition to developing an effective public involvement program through citizen and agency coordination and informal workshops, the Corps will hold two official public meetings to afford all interests full opportunity to express their views and furnish specific data on matters pertinent to the study. These meetings will be held after initial public contacts and preliminary studies are undertaken through consultation with the agencies and the public. The purpose of each meeting is described as follows:

a. At the completion of the reconnaissance study, when alternative solutions are known but before a plan has been tentatively selected, a midstudy public meeting will be held. A major purpose of this meeting is to present the results of preliminary studies including the advantages and disadvantages of the various alternatives to the extent that such information has been developed and to further develop public views and desires, particularly as they relate to the various alternatives.

b. A late-stage public meeting will be held after detailed studies and before feasibility report completion. Findings of the detailed studies, including the rationale for any proposed solution, and the tentative recommendations will be presented. This meeting will ensure that any plan presented would be acceptable.

STUDIES REQUIRED

PLANNING

Planning studies will assess the power potential and issues related to its development. Alternative solutions will be investigated. Current formulation criteria and policies will be used to evaluate the development of alternative plans incorporating both nonstructural[1] and structural measures as appropriate. Analysis of alternatives and impacts of trade-offs among national economic development, environmental quality, and social well-being will be assessed in selection of the best solution. The major study effort will be to select a final plan that best meets overall needs and formulate the optimum scale of project development. As an integral part of the planning effort, coordination will be maintained with the public throughout all stages of the study. Report preparation and development will be a specific responsibility of this study element. Also, by using sound planning practices the study schedule will be maintained.

---

(1) Nonstructural alternatives are not required for small-scale hydropower projects of 25 MW or less.

ECONOMIC AND FINANCIAL ANALYSIS

The economic analysis deals primarily with development and application of benefit-cost analysis which is the most frequently used and accepted procedure for project economic evaluation. The objective of this analysis is to relate all project economic benefits to all project costs accruing to the project.

Studies to evaluate the economic worthiness of the project will include formulation of alternative project cost and benefit streams, screening and ranking of alternatives, benefit-cost analysis, and determination of risk and uncertainty related to project outcomes.

Average annual costs, using current interest rates, will be determined within the St. Paul District office. Annualized power value benefits will be supplied by the Federal Energy Regulatory Commission (see the section entitled "Power Value Analysis" in this appendix).

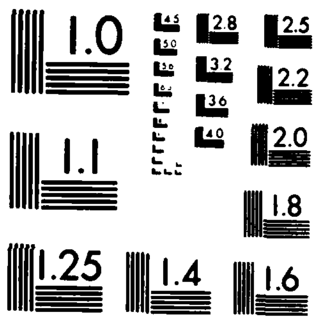
Financial feasibility deals with a project's ability to obtain funds for implementation and repay these funds on a self-liquidating basis. If the project is financed and operated by the Federal Government, financial feasibility loses meaning because the project does not have to be self-liquidating in the short run and federally established interest rates would be used for financial comparison. In this case, the economic and financial analysis would essentially be the same.

A financial analysis for the project, however, will be done based on non-Federal funding and operation. This analysis will consider the overall credit market at the time of study completion as it relates to possible funding of a hydroproject; inflation factors and how they affect the cost of capital, cash receipts, and cash disbursements; and determination of the project's minimum reverse requirement including a sensitivity analysis of risk.

AD-A129 707 LOCK & DAM 5 MISSISSIPPI RIVER NEAR MINNEISKA MINNESOTA RECONNAISSANCE REPORT FOR HYDROPOWER(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT SEP 81 2/2

UNCLASSIFIED F/G 10/2 NL

END
DATE
FILMED
7-83
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ENGINEERING

The types of engineering studies that will be performed include hydrologic power evaluation, foundation, mechanical and electrical, civil features, and design and cost studies. All of the studies undertaken will be accomplished using appropriate engineering standards, regulations, and guidelines and will be summarized in a report appendix for each study.

Hydrologic Power Evaluation

Hydrologic power evaluation establishes how much water can be diverted through the turbines and the hydraulic head associated with this flow. Studies for evaluation of power will essentially be an update and refinement of the technique used in the reconnaissance study.

Related studies concerning the flow pattern changes resulting from hydropower plant construction may be required. However, provision for a physical model study which would completely evaluate flow changes is not included in the work schedule and cost estimate section of this appendix. Such a study is considered unwarranted at this time.

Foundation Studies

Foundation studies will consist of the necessary instrument surveys to supplement existing boring and topography information in areas of any considered improvements. Sufficient foundation investigations will be made to determine the type and engineering characteristics of soils in any development area from field examinations of exposed cuts and channel banks and from research of existing available boring data. Additional soil borings and subsequent tests will be completed as appropriate.

Power plant channel design will include riprap if necessary. Final design of riprap will determine gradation, thickness, size and extent, and other erosion or scour preventive features. These designs will conform to current design methods and criteria.

Embankments will be designed which are safe against overtopping during occurrence of the design flood and stable and safe under extremes of operation. The embankments will be designed so as not to impose excessive stresses on the foundation materials, have slopes that are stable under all conditions of impoundment operations, and provide for control of seepage through the embankment foundation and abutments as necessary. Final designs will conform to current design criteria.

Mechanical and Electrical Features

Mechanical and electrical features convert the water's energy to electricity. These features also control the energy and transmit it to a power grid.

Studies will include evaluation of major equipment items such as the hydraulic turbines; electrical generators; and a switchyard consisting of a transformer, circuit breaker, and switchgear. Included also are supporting systems which control and protect these major equipment items. Evaluation of maintenance facilities such as a crane for lifting is also included under mechanical and electrical features investigations.

Because of plant size and likely marginal economic feasibility, standardized turbines and complete generating sets will be evaluated for application. In addition, relaxing the need for some of the traditional control and protection equipment will be assessed.

Civil Features

The civil features of small hydropower additions include site preparation works, hydraulic conveyance facilities, and powerhouse and appurtenant facilities.

Site preparation includes grading, foundation excavation, drainage and erosion control, access roads and parking facilities, and construction noise abatement and dust control. Hydraulic conveyance facilities include penstocks, tunnels, canals, valves and gates, inlet and outlet works, and tailrac

Powerhouse and appurtenant facilities include all structures for powerhouse and equipment handling facilities, foundations for both the powerhouse and switchyard, and fencing around the project area.

The civil features of small hydropower additions differ from those of major hydropower installations. Feasibility of the project may hinge upon adequate yet innovative designs for civil features. Therefore, studies in addition to evaluating the above features will include the analysis of appropriate outdoor type plants, portable lifting equipment for maintenance, and reduction in normal protection equipment.

Designs and Cost Estimates

Detailed project scope structural designs for all alternative features will be undertaken. Such designs will be in accordance with accepted criteria and guidelines. Design work will also include drafting of all report charts, illustrations, and plates in accordance with drafting standards. A detailed estimate of first costs will be accomplished including appropriate allowances for advance engineering, design, and contingencies. The estimates of first costs will reflect prevailing price levels for similar work in the area and be based on recent price information. An estimate of annual costs including appropriate allowances for operation, maintenance, and scheduled replacement of major project features will be prepared. These annual costs will be based on the interest rate prevailing at the time of report completion.

MARKETING ANALYSIS

The Department of Energy (DOE) is responsible for performing market analysis for Federal hydropower projects. The DOE will be provided a copy of this reconnaissance report and other data it believes it needs to complete its analysis. Its output would be a statement that power which the project would produce could be marketed at a price that would ensure repayment of project costs plus interest and operation, maintenance, and major replacement costs within the required 50-year period. Results of the marketing analysis will be included in the feasibility study.

POWER VALUE ANALYSIS

Hydroelectric developments must be planned and evaluated as components of comprehensive river basin plans as well as units of the electric power supply systems in which they are incorporated. In regard to the above, the Federal Energy Regulatory Commission (FERC) provides input to determine financial and economic feasibility of Federal hydropower projects.

Benefits attributable to the hydropower projects are determined and furnished by FERC in close coordination with the DOE and will be used in the above-mentioned economic and financial feasibility analysis. Power values are the benefits produced by a hydroelectric plant and reflect a measure of society's willingness to pay for the power produced. Because willingness to pay cannot be directly measured, power values are based on the surrogate costs of constructing and operating the most probable alternative if the hydropower project is not constructed. This cost is given as an investment cost (capacity values) necessary to construct the most probable alternative and the production cost (energy value) which results from operation of the alternative.

ENVIRONMENTAL RESOURCES

The potential for hydropower development is being investigated at several of the locks and dams within the district. Environmental studies will be undertaken to identify the impacts of alternatives on the natural and human environment. Specific studies will be undertaken in the categories of natural resources, cultural resources, and social effects.

Natural Resources

The objectives of natural resources studies would be to:

a. Identify the principal natural resources of the study area.

b. Determine those significant resources which would be affected by hydropower development.

c. Predict the potential environmental impacts of each alternative.

d. Identify opportunities for restoration and enhancement of the environment.

e. Recommend strategies for minimizing or eliminating impacts.

Natural resources studies conducted at one or more of the dams would be applicable to all because of the basic similarities among all the structures.

The tail water, the area immediately downstream of a dam, provides a valuable and heavily utilized fishery resource at many of the dams on the Upper Mississippi River. Studies would be conducted to determine what factors (e.g., current velocity, water depth) are of critical importance to the fishery and what effect the installation of hydropower would have on those factors.

The diversion of the majority of the river flow through turbines would have the potential to reduce dissolved oxygen levels. Studies would be made to predict possible reductions by determining existing oxygen values. Methods of improving aeration during power generation would be investigated.

An area of concern in power generation is the potential for entrainment (organisms drawn toward or into the turbine tube) or impingement (organisms trapped on trash collection screens). The possible extent of entrainment and impingement would be investigated. Screening and intake designs which would minimize the effects would be reviewed as well.

It is known that various species of fish, including white bass and sauger, move upstream from pool to pool. The extent and importance of this movement is not well understood. The effect of hydropower development on this phenomenon and the consequences would be investigated.

The placement of cofferdams and other excavated material as well as excavation itself (e.g., headrace, tailrace channels) would be detrimental to aquatic communities through habitat destruction or burial of organisms. The possible extent of such activities and methods of minimizing them would be investigated.

Studies would also be conducted to evaluate impacts on the unique significant resources of each individual hydropower site. Opportunities to restore or enhance previously disrupted resources would be sought at each individual site.

Recreation

The recreation studies will investigate and document any recreation resource related needs, as identified by prior studies, that could be satisfied by feasible recreation features incorporated in the national economic development, environmental quality, and recommended plans of improvement. Appropriate drawings, sketches, or illustrations showing any proposed recreation facilities will be included in the feasibility report along with associated cost estimates. The location and extent of any lands required for recreation resource development measures will be identified. Annual average recreation benefits attributable to the provision of new recreation resources will be determined in accordance with accepted guidelines. The need for and provision of project-related recreation measures will be analyzed in light of Corps Resource Management Plans and local and State recreation needs as identified in appropriate State Comprehensive Outdoor Recreation Plans. Project-related recreation features that might be considered include, but are not limited to, picnicking facilities, boat docks, fishing areas, hiking and biking paths, scenic overlook and pedestrian bridges, and other river related accesses. Provisions for use of facilities by the elderly and handicapped will be considered in the design of any recreation features.

Recreation studies will be closely coordinated with environmental and cultural investigations to assure compatibility among proposed design features.

Social

Investigations conducted during the feasibility study will analyze the social effects construction activities have on employment, community services, safety and health, noise and air pollution, and local transportation. Social effects resulting from energy requirements and conservation will also be assessed. In addition, should significant amounts of transmission facilities be required, impacts on property acquisition and relocation, community cohesion, aesthetic quality, and land use will also be assessed.

Institutional studies will investigate the consistency and impact of Corps facilities with existing power generation and distribution systems.

Cultural Resources

Because of the extensive prehistorical and historical use of the Mississippi River valley, actions related to hydropower development, such as powerline construction, stream diversion, channel flow changes, access road construction, powerhouse construction and riprapping, would be preceded by a cultural resource study. Coordination with the National Park Service, the State Historic Preservation Officer, and the State Archeologist will be initiated.

INTRAOFFICE COORDINATION

The requirements of the planning process necessitate an interdisciplinary planning approach to identify and define the planning objectives, develop creative alternative plans, and analyze a broad range of complex issues, including the probable economic, social, and environmental consequences of plan implementation. This is best accomplished by a planning team which employs a diversity of professional skills.

WORK SCHEDULE AND STUDY COST ESTIMATE

The feasibility study is scheduled to be completed in the spring of 1985. Dates for the applicable study milestones are presented in the following table.

Milestone schedule

Milestone number	Designation	Completion
6	Submission of draft feasibility report (including DEIS)	Fall 1984
7	Stage 3 (Stage 2 for hydropower studies) checkpoint conference	Fall 1984
8	Completion of action on conference MFR	Fall 1984
9	Coordination of draft feasibility report and DEIS	Winter 1984-1985
10	Submission of final feasibility report and revised draft environmental impact statement to Division	Spring 1985

To accomplish the schedule, the Corps needs funds as follows:

Fiscal year	Amount
1981	$25,000
1982	10,000
1983	195,000
1984	170,000
1985	20,000
Total	420,000

The study cost estimate (PB-6) shows the breakdown of that funding. The steps following submission of the feasibility report to authorization by Congress are shown in the following figure.

RCS: DAEN-CWB-12

STUDY COST ESTIMATE (PB-6)
($000)
For use of this form, see ER 11-2-220

APPROPRIATION TITLE: General Investigations

CATEGORY: Survey

CLASS: Flood Control

NAME OF STUDY: MISSISSIPPI RIVER, COON RAPIDS DAM To The Mouth of the Ohio River INTERIM REPORT #12 (L&D 5)

SUBCLASS:

LINE NO.	SUBACCOUNT NUMBER	SUBACCOUNT TITLE	CURRENT FEDERAL COST ESTIMATE – ACCOUNT – STAGE 1	STAGE 2	STAGE 3	TOTAL	PREVIOUS FEDERAL COST ESTIMATE AND DATE APPROVED (10 Oct 80)	REMARKS
	a	b	c	d	e	f	g	h
1	.00	Costs thru 30 Sep 78						
2	.01	Public Involvement	1		15	16	16	
3	.02	Institutional Studies	0		4	4	1	
4	.03	Social Studies	0		11	11	2	
5	.04	Cultural Resource Studies	0		5	5	5	
6	.05	Environmental Studies	1		65	66	29	Increase due to refinement of environmental requirements.
7	.06	Fish & Wildlife Studies	1		6	7	7	
8	.07	Economic Studies	4		11	15	29	
9	.08	Surveys & Mapping	0		7	7	7	
10	.09	Hydraulics & Hydrology	2		18	20	29	Increases due to revised
11	.10	Foundation & Materials	3		30	33	19	estimate of work quired.
12	.11	Design & Cost Estimates	5		80	85	28	Increases for detailed design required in DPR.
13	.12	Real Estate Studies	0		2	2	2	
14	.13	Study Management	6		18	24	24	

DATE PREPARED: 19 Jun 81

DIVISION: North Central

DISTRICT: Rock Island

REGION: UPPER MISSISSIPPI

BASIN:

Page 24 of 43

ENG FORM 1 APR 77 2204 EDITION OF 4 JAN 71 IS OBSOLETE.

RCS: DAEN-CWB-17

STUDY COST ESTIMATE (PB-6)
($000)
For use of this form, see ER 11-2-220

APPROPRIATION TITLE: General Investigations

CATEGORY: Survey

CLASS: Flood Control

NAME OF STUDY: MISSISSIPPI RIVER, COON RAPIDS DAM To The Mouth of the Ohio River INTERIM REPORT #12 L&D 5)

SUBCLASS:

LINE NO.	SUBACCOUNT NUMBER (a)	SUBACCOUNT TITLE (b)	CURRENT FEDERAL COST ESTIMATE – ACCOUNT STAGE 1 (c)	STAGE 2 (d)	STAGE 3 (e)	TOTAL (f)	PREVIOUS FEDERAL COST ESTIMATE AND DATE APPROVED 10 Oct 80 (g)	REMARKS (h)
1	.14	Plan Formulation	0		9	9	9	
2	.15	Report Preparation	0		18	18	18	
3	20	Other Studies	0		40	40	59	
4		Mechanical and Electrical			(40)	(40)	(59)	
5		Supervision and Administration	2		56	58	41	
6								
7								
8								
9								
10								
11								
12								
13								
14								
		TOTAL	25		395	420	325	

DATE PREPARED: 19 Jun 81

DIVISION: North Central

DISTRICT: Rock Island

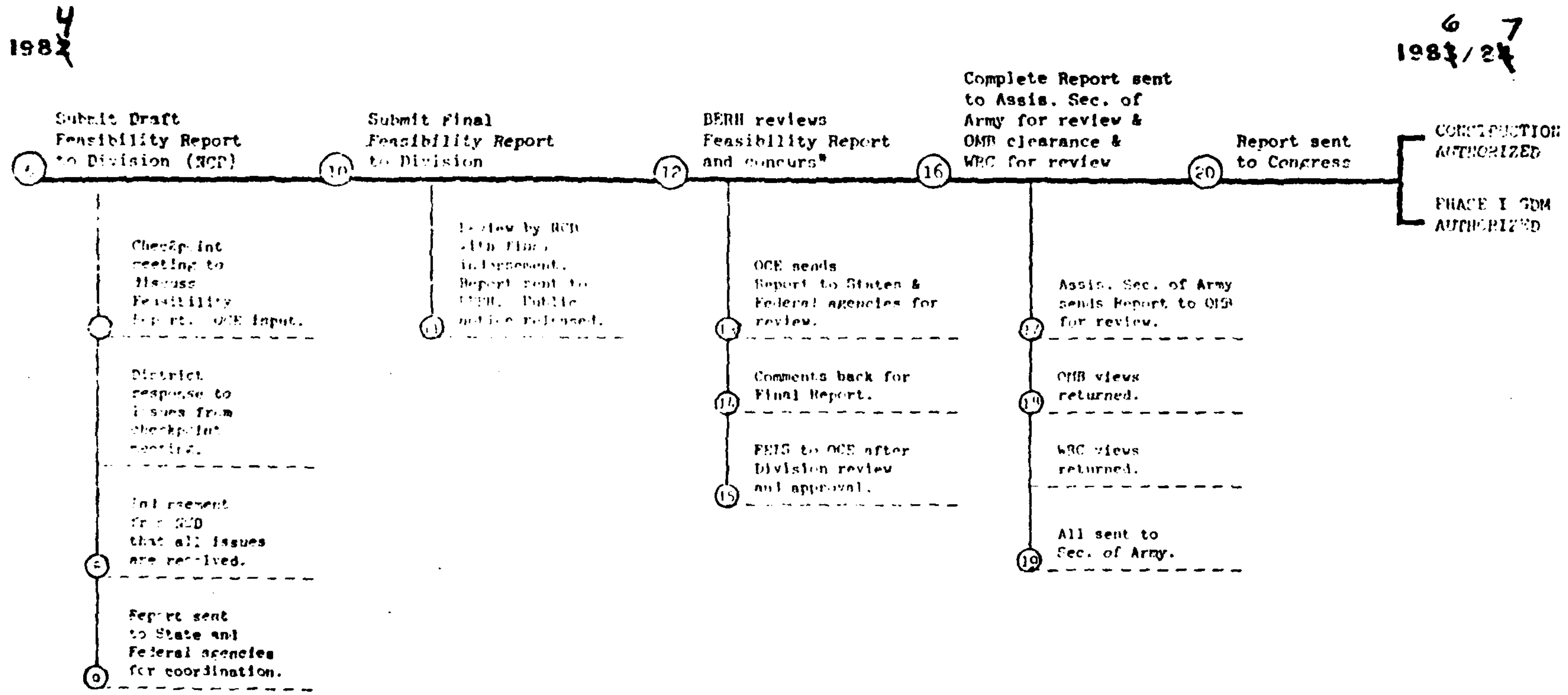
REGION: Upper Mississippi

BASIN:

Page 25 of 43

ENG FORM 1 APR 71 7204 EDITION OF 4 JAN 71 IS OBSOLETE.

PROCEDURE FOR APPROVAL OF FEASIBILITY REPORT



* a) OCE provides input on policy and engineering.
b) If BERH does not concur they may return the report; request more information; or issue a differing report.
c) If BERH does concur they submit a statement of recommendations with the Report

LEGEND

(1) __ Milestone number

APPENDIX E
ENVIRONMENTAL

APPENDIX E

ENVIRONMENTAL ANALYSIS

TABLE OF CONTENTS

TABLES

APPENDIX E
ENVIRONMENTAL ANALYSIS

ENVIRONMENTAL SETTING

STUDY AREA

The study focuses on the area which would be affected by hydropower generation at lock and dam 5. This area extends along the Mississippi River from Alma, Wisconsin, to Winona, Minnesota, and includes navigation pools 5 and 5A. Of primary concern are the areas immediately upstream and downstream of lock and dam 5 and any adjacent lands which may be proposed as corridors for transmission lines.

NATURAL RESOURCES

Physical Setting

The main geographical feature of the region is the Mississippi River valley. The valley in the study area ranges from about 2 to 4 miles in width and is bordered by bluffs which rise from 400 to 500 feet above the level of the river. In the vicinity of lock and dam 5, the river valley is about 3 miles wide with the river channel occupying the western one-fourth mile of the valley.

The floodplain soils are alluvial materials deposited since the last glacial period (10,000 to 20,000 years ago). The soils are clay, silt, and loam, sometimes sandy and often dark with organic matter. The subsoil is sand, which grades to coarser sand and gravel. Soils of the wetland areas are peaty and dark, derived from decaying organic matter. The soils of the floodplain are underlain by glacial outwash. Soils of the uplands in the study area are complex, with sandy loams on the stream terraces and heavier loess-derived soils farther inland.

The climate of the study area is humid-continental, with wide temperature extremes. The yearly average temperature is 46° F and the average annual precipitation is about 29 inches.

Terrestrial Resources

Vegetation - The woodlands in the watershed adjacent to most areas of the Upper Mississippi River can be divided into two general groups; the upland xeric southern forests of Wisconsin and Minnesota, and the southern lowland vegetation of the floodplain. The upland xeric forests are predominately oak forests (white oak, red oak, and black oak). They are located on well-drained sites on either sandy and porous flat lands, south and west slopes of hills, or thin soils on hilltops and ridges.

In the floodplain areas on recently disturbed sites such as sandbars and mud flats, the usual forest is dominated by black willow and cottonwood. On open sites near the upland edge of the wet ground, river birch or swamp oak are the usual dominants. As both of these types mature, they are invaded by silver maple and American elm.

A summary of the vegetation composition of pools 5 and 5A is given in table E-1.

Table E-1 - Composition of the floodplain in pools 5 and 5A[(1)]

Habitat type (acres)	Pool 5	Pool 5A
Length of pool	15 river miles	9.5 river miles
Open water	8,714	6,570
Main channel	2,760	2,527
Side channels	1,494	746
Sloughs	1,035	709
Ponds	53	2,417
Lakes	3,354	171
River (other than Mississippi)	18	-
Aquatic and marsh vegetation	2,991	3,528
Terrestrial and herbaceous vegetation	356	293
Woody vegetation	2,888	5,667

(1) From Minor, et. al., 1977.

Wildlife - Much of the floodplain area in pools 5 and 5A is managed as part of the Upper Mississippi River Wild Life and Fish Refuge. The extensive bottomlands provide much valuable wildlife habitat. White-tailed deer, fox, squirrel, gray squirrel, cottontail rabbit, and ruffed grouse are important terrestrial game species. Furbearers such as muskrat and beaver are common. Trapping is an economically significant activity in the study area. The Mississippi River bottomlands in the vicinity of lock and dam 5, especially the Weaver Bottoms, Belvidere Slough, and Fountain City Bay, are noted as feeding and resting areas for a variety of migratory waterfowl, and also provide excellent habitat for many nongame species.

Aquatic Resources

Water Bodies - The Mississippi River within the study area is impounded by lock and dam 5A at Winona and by lock and dam 5 above Fountain City to form navigation pools 5 and 5A of the waterway system. The Whitewater and Zumbro Rivers both originate in eastern Minnesota and flow into pool 5. Waumandee Creek originates in western Wisconsin and carries a significant sediment load into Fountain City Bay. The specific hydrological characteristics at lock and dam 5 are discussed in the Hydrology and Power Potential Section. A summary of the land and habitat composition of pools 5 and 5A is given in table 1.

Water Quality - In general, the water quality of the Mississippi River in pools 5 and 5A is good. Except in isolated sloughs and backwater areas, the dissolved oxygen content remains high during the entire year. Because of its turbulent nature, the river is well aerated and can tolerate considerable biological oxygen demand. Nutrient levels (nitrogen, phosphorus, potassium, calcium, etc.) are ample to support luxuriant growth of rooted aquatics and algae (COE, 1974, and Nielsen, et. al., 1978).

Fisheries - The extensive water area and diversity of fish habitat in pools 5 and 5A of the Mississippi River support an abundant and diverse fishery. Seventy-nine species of fish have been reported from pool 5 and 74 species of fish have been reported from pool 5A (Rasmussen, 1979). This reach of the Mississippi River has provided important sport and commercial fishing throughout man's development of the region during the past century.

Sport fisherman use of seven pools of the upper Mississippi River is summarized in tables E-2 and E-3. These tables show that pool 5 has a high harvest rate and an average catch rate when compared to the other pools. Valuable sport fishing areas in pools 5 and 5A include Weaver Bottoms, Fountain City Bay, Belvidere Slough, the tail-waters areas below the lock and main channel border areas.

Table E-2 - Catch rate (i.e., catch of all species combined) per angler hour of fishing during three surveys conducted in pools 4, 5, 7, 11, 13, 18, and 26 of the Upper Mississippi River

	Period			
Pool	1962-1963	1967-1968	1972-1973	Average
4	0.754	0.712	0.653	0.706
5	1.132	0.722	0.678	0.844
7	1.275	1.068	1.482	1.275
11	1.115	1.092	1.477	1.228
13	0.600	1.054	0.896	0.850
18	0.840	0.949	0.724	0.838
26	0.370	0.590	0.397	0.452
Average	0.869	0.884	0.901	0.885

Table E-3 - Pounds per acre of fish harvested from seven pools of the Upper Mississippi River during 1962-63, 1967-68, and 1972-73

	Pool							
Period	4	5	7	11	13	18	26	Average
1962-1963	12.82	10.50	13.41	6.00	1.64	7.74	1.92	7.20
1967-1968	16.62	11.21	10.74	7.19	4.23	7.12	2.22	8.37
1972-1973	13.00	14.63	10.74	12.46	3.34	0.75	3.48	8.24
Acreage*	23,305.3	11,705.2	15,543.5	19,875.0	28,117.0	11,746.0	17,457.0	

* Tables 2 and 3 from Rasmussen, 1979.

Although the commercial fishery of pools 5 and 5A is of economic significance, the harvest from these pools is small in comparison to the harvest from most of the other pools. The average annual total catch between 1973 and 1977 was 188,297 pounds for pool 5 and 187,153 pounds for pool 5A (Rasmussen, 1979). Carp, Buffalo, catfish, and freshwater drum are the commonly harvested fish. There is no significant commercial mussel fishing in pools 5 or 5A.

Wetlands - A variety of wetland habitats occur in the Mississippi River floodplain. This complex riverine wetland system, ranging from submerged plants to bottomland hardwood forests, is largely responsible for the abundance and diversity of fish and wildlife resources in the study area. Important wetlands within pools 5 and 5A include Fountain City Bay, Weaver Bottoms, Belvidere Slough, and Kieselhorse Bay.

Wetland Areas - Important wetland areas in pools 5 and 5A include Weaver Bottoms and Belvidere Slough in the middle of pool 5, along with the Fountain City and Kieselhorse Bays just below lock and dam 5. These wetland areas provide outstanding wildlife habitat for numerous game and nongame species (including a wide variety of waterfowl). The wetland areas below the locks and dams and around the wing dams provide excellent sport fishing opportunities. In general, the Mississippi River bottom wetlands are noted for their excellent hunting and fishing. These wetlands are widely recognized as significant resources and are protected by Federal, State, and local laws.

Fishery - The sport and commercial fishery of pools 5 and 5A, as described above, is a significant resource. Of special significance are the tail-water areas below the locks and dams. These areas of riverine habitat provide the flow and substrate requirements necessary to maintain good game fish populations, and consequently these areas provide some of the river's best sport fishing.

Waterbirds - The project area provides important feeding and resting habitat for a wide variety of bird species during spring and fall migration on the Mississippi flyway. The Weaver Bottoms are noted as a feeding and resting stop for several species including a large number of whistling swans.

The wetlands surrounding lock and dam 5 also provide good breeding habitat as evidenced by the heron and egret nesting area just to the east of the dam.

Threatened and Endangered Species - Three federally listed endangered or threatened species have been observed in the study area. The bald eagle, a threatened species, winters and migrates through the Mississippi Valley, concentrating below dams and near the mouths of tributaries. The Higgins' eye pearly mussel, an endangered species, is known to occur in the Upper Mississippi River, although there are no recent records of this species being found in pools 5 or 5A. Historically, the endangered peregrine falcon has also been known to occur in areas along the Upper Mississippi River. A list of species native to the project area and classified as threatened or endangered by the State of Wisconsin is currently being compiled.

Refuge and Park Areas - The following refuge and park areas are found in pools 5 and 5A. These are significant resources because they have been identified by State and Federal agencies as areas which should be managed to preserve the existing biological resources.

a. The Upper Mississippi River Wild Life and Fish Refuge (U.S. Fish and Wildlife Service). A large portion of the floodplain of pools 5 and 5A is managed as part of this refuge.

b. John A. Latsch State Park (Minnesota Department of Natural Resources). Located on the west side of the river at lock and dam 5.

c. Merrick State Park (Wisconsin Department of Natural Resources Located on the east side of the river 2 miles below lock and dam 5.

CULTURAL RESOURCES

The Mississippi River valley has been occupied from early prehistoric human periods (approximately 12500 B.C.) to the present. Indian villages were generally situated along the valley floor and burial mounds were usually built on the bluff tops. Historically, the valley has been the site of the earliest European and American exploration, trading centers and settlements.

There is one known archeological site near lock and dam 5 (site 21-WR-23). As of 28 August 1981, no sites currently on or eligible for the National Register of Historic Places are located in the immediate area of the lock and dam.

RECREATIONAL RESOURCES

The major recreational uses of the pool 5/5A area are hunting, boating, and fishing. The project area is within 50 miles of three major metropolitan areas: Rochester and Winona, Minnesota, and La Crosse, Wisconsin. It is estimated the two pools supported approximately 912,000 recreation activity occasions in 1980.

ENVIRONMENTAL EFFECTS

The intent of this section is to present a brief discussion of the potential impacts of the proposed action, and also to summarize any additional information which would be required to complete a detailed impact analysis. The detailed assessment of the environmental impacts associated with the 1- to 2-year construction period and operation of a hydropower facility at lock and dam 5 will be completed in later reports.

EFFECTS ON NATURAL RESOURCES

Construction Impacts on Terrestrial Resources

The terrestrial impacts of hydropower construction at lock and dam 5 would result primarily from construction of a powerline corridor, upgrading of the existing access road, creation of a construction storageyard, the acquisition and disposal of material used in the construction of the cofferdam, and the disposal of any dredged or excavated material.

The construction of the powerline corridor has the greatest potential for producing damage to the terrestrial resources of the project area. This construction would require removal of the larger trees and some soil disturbances in the area. The severity of the associated impacts would depend on the final location of the corridor and the number and quality of trees to be removed. The final alignment of the corridor from lock and dam 5 should avoid the heron and egret rookery east of the dam and the valuable wildlife habitat in the Fountain City bay area.

The creation of a construction storageyard, the upgrading of the access road, the acquisition and disposal of material used to construct the cofferdam, and the disposal of the dredged and excavated material would probably result in the disturbance or loss of some terrestrial habitat. Since the nature and size of these activities has not yet been determined, it is not possible to define the impacts on the terrestrial ecosystem. These impacts will be studied as the construction alternatives become finalized. In addition, some unavoidable disturbance of wildlife would result from the construction noise and dust in the vicinity of the access road and the construction site.

Construction Impacts on Aquatic Resources

Construction of hydropower facilities at lock and dam 5 would likely require the riprapping of a portion of the river bottom above and below the dam to prevent erosion and possible undermining of the dam. It would also require construction of temporary cofferdams upstream and downstream of the construction site to provide dry working conditions for installation of the turbines. Any or all of these activities could have an impact on the aquatic environment.

Placement of riprap on the river bottom would be the most likely activity to produce significant construction-related impacts on the aquatic ecosystem. The existing benthic community in this area along with some tail-water fish spawning and foraging habitat would be destroyed. After completion of the project, the riprapped areas would be colonized by a benthic community better adapted to coarser substrates and higher current velocities. Since the effects of these changes on the area's fish populations are not known, studies to determine the nature of these impacts will be conducted during the next study phase.

Construction activities could also increase level of turbidity and change flow and sedimentation patterns. Although these changes would be temporary and fairly localized, further study is required to determine their effects. In particular, these studies should focus on the potential for damage or enhancement of the area's fish spawning and forage habitat.

Operation Impacts on Terrestrial Resources

The impacts of hydropower operation on the terrestrial ecosystem of pools 5 and 5A are expected to be minor. Since the facility would be a run-of-the river operation, no changes in the existing water levels of pools 5 or 5A would result from power generation. By avoiding changes in the water levels, impacts such as shoreline erosion and associated habitat losses should not occur. Concentration of flows through the hydropower facility could, however, increase the potential for erosion of existing banks. Other potential operational impacts would probably be restricted to minor disturbances of wildlife from increased human activity at the dam, and some bird mortality from power transmission lines. Neither of these impacts is expected to be significant.

Operation Impacts on Aquatic Resources

The impacts of the operation of hydropower facility at lock and dam 5 could result from changes in the flow pattern through the dam, changes in water quality, entrainment and impingement of aquatic life in the turbines, and development of barriers to migration.

The most significant impact would be expected to result from changes in the pattern of water flow through the dam. Currently, the flow of the river is distributed fairly evenly across the dam. Operation of a hydropower facility would necessitate the concentration of river flows through the turbines, meaning an increase in flows through the eastern portion of lock and dam 5 and a decrease in flows through the western portion. The amount of flow which would pass through the turbines would range from approximately 90 percent during the winter months to 40 percent or 50 percent in the summer months to a minimal amount during high water periods. These changes, coupled with an increased amount of rock riprap in the discharge area, could alter the character of the tail-water fish habitat below lock and dam 5 and cause sedimentation in nearby side channels, thereby restricting the flow and aeration of the backwater areas near the dam. The extent to which these changes would affect fish populations using the tailwater and backwater areas is not known and would be investigated during the next study phase.

Operation of the hydropower installation is not expected to significantly affect water quality. No gas supersaturation problems are expected. The reduction in turbulence caused by diverting water from the dam gates through the turbines could reduce the potential for aeration of water at the dam. With the good dissolved oxygen conditions in the pool 5A reach of the river, this reduction is not expected to be a significant impact.

Entrainment and impingement of adult fish, eggs, and larvae induced by the hydropower units are not expected to significantly affect fish populations.

The size of the tube-type turbines and the relatively slow speed of the runners should allow survival of most fish, eggs, and larvae passing through the units. The magnitude of increased fish mortality at lock and dam 5 that would be caused by fish passage through the hydropower units over existing fish mortality sustained by passage through the dam gates is not known. There would be no intake bays or physical barriers to lateral escape by fish at the intakes of the hydropower units, except for some widely spaced trash racks. Approach velocities of water to the turbine intakes, which would have a large influence on the amount of entrainment of adult fish, have not been determined.

The closure of dam gates to divert water through the power plant would restrict movements of fish through lock and dam 5. It is known that fish movements up and down the river do occur with some species, such as saugers and white bass, but the degree to which fish movements would be restricted by hydropower development at lock and dam 5 and the impact of these restricted movements are not known at this time.

EFFECTS OF PROJECT CONSTRUCTION AND OPERATION ON CULTURAL RESOURCES

Much of the proposed construction area for the installation was previously disturbed by the construction of lock and dam 5. There is still the possibility that historical and/or archeological sites will be negatively affected by operations related to hydropower development. The construction of a cofferdam and disruption of the existing levee may have adverse impacts on cultural resources. The need for further cultural resource work will be determined during later planning stages in consultation with the appropriate State Historic Preservation Officers and State Archeologists.

IMPACT OF PROJECT CONSTRUCTION AND OPERATION ON RECREATIONAL RESOURCES

The most significant impacts would be the potential changes in fishery habitat described previously. No impacts on general boating would be expected. The concentration of flow through the hydropower turbines could possibly reduce the safety factor for people fishing in the tail-water area.

There is the potential to incorporate improvements for bank fishing as part of the overall project. As the plans for the project become more definite, other recreational opportunities may become apparent.

OUTSTANDING ENVIRONMENTAL ISSUES ASSOCIATED WITH HYDROPOWER DEVELOPMENT AT LOCK AND DAM 5

The following is a list of environmental issues that have been identified as deserving special attention in future planning efforts for hydropower development at lock and dam 5. Further detailed studies are necessary to quantify existing resources that might be affected, to better predict the type and magnitude of potential impacts, and to develop appropriate plans for mitigation or minimizing adverse impacts.

1. Impacts of construction and operation on aquatic habitat.
2. Effects of altered tail-water flow patterns on fish population. and fish utilization of lock and dam 5 tail-water area.
3. The potential for entrainment and impingement of adult fish, eggs, larvae, and young in the turbines and the impact of any resultant increase in mortality on fish populations.
4. The impact of transmission lines on migratory waterfowl.
5. The impact of construction and operation of the hydropower facility on endangered species.
6. The effect of construction on social conditions in the affected area.
7. The effects of construction on any currently unknown cultural resource in the project area.

LITERATURE CITED

Minor, J.M., L. M. Caron and M. P. Meyer, 1977. Upper Mississippi River Habitat Inventory. IAFHE RSL Res. Rept. 77-7, Phase III. USFWS Serv. Contr. No. 14-16-003-30, 686.

Nielsen, D. H. et. al., 1978. Phase 1 Study of the Weaver Belvidere Area, Upper Mississippi River prepared for U.S. Fish and Wildlife Service, St. Paul, Minnesota. Contract No. 14-16-0003-77-060.

Rasmussen, J. L. ed., 1979. A Compendium of Fishing Information on the Upper Mississippi River. Upper Mississippi River Conservation Committee.

U.S. Army Corps of Engineers, 1974. Final Environmental Impact Statement - Operation and Maintenance, 9-Foot Navigation Channel, Upper Mississippi River Headwaters of Navigation to Guttenberg, Iowa. St. Paul District.

DATE

FILMED

8