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RECONNAISSANCE REPORT FOR HYDROPOWER(U) CORPS OF
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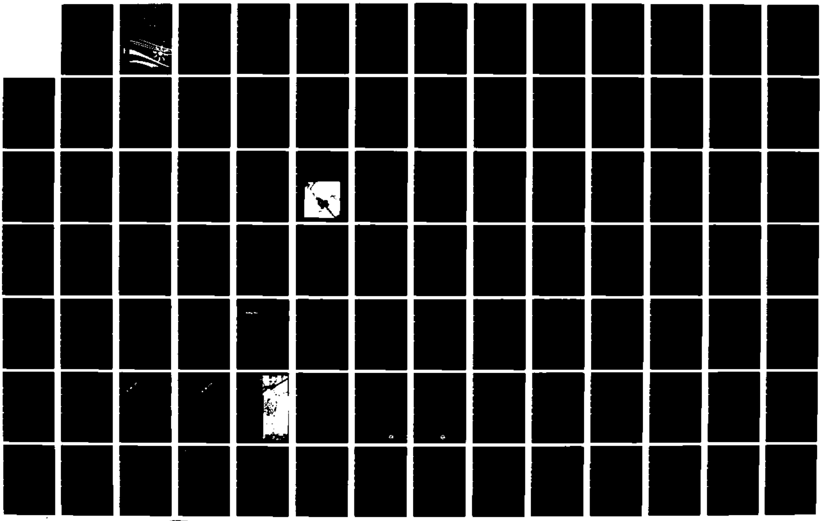

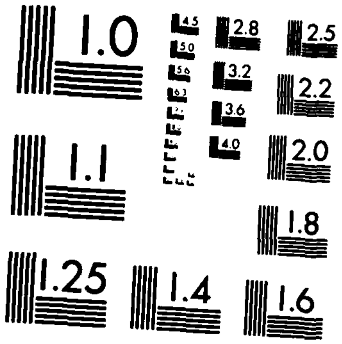

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Reconnaissance Report

HYDROPOWER

Lock & Dam 7

Mississippi River

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

DECEMBER 1980

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This report presents a prelinimary evaluation of the addition of hydropower at the existing navigation lock and dam 7 on the Mississippi River. The study show that installation of a hydroplant with a 4,800k-W or 7,200k-W nameplate rating is economical. A 7,200k-W system would produce an average energy equivalent of 70,000 barrels of oil or 20,000 tons of coal per year.

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RECONNAISSANCE REPORT

FOR HYDROPOWER

LOCK AND DAM 7

MISSISSIPPI RIVER

NEAR LA CROSSE, WISCONSIN

PERTINENT DATA

LOCK AND DAM 7 - LA CRESCENT, MINNESOTA (NEAR LA CROSSE, WISCONSIN)

Normal upper pool	Elev. 639.0
Normal minimum tailwater	Elev. 631.0
Nominal lift	8.0 feet
Drainage area	62,340 square miles
Project pool area	13,440 acres
Maximum flood flow (Apr 1965)	274,000 cfs
Minimum flow (Dec 1933)	2,300 cfs
Average flow	27,800 cfs
Roller gates	5 @ 80 by 20 feet
Tainter gates	11 @ 35 by 15 feet
Top of roller gate sill	Elev. 619.0
Top of tainter gate sill	Elev. 624.0
Top of earth dike	Elev. 649.0

PROPOSED HYDROPOWER PLANT

	8-unit option	12-unit option
Total nameplate capacity (kW)	4,800	7,200
85% firm power (kW) (Jul-Aug)	2,900	3,900
85% firm power (kW) (Dec-Jan)	4,100	4,900
Plant factor	0.78	0.72
Average annual energy (MWh)	33,000	45,300
Construction first cost	$16,300,000	$24,600,000
Benefit-cost ratio	1.03	1.01

UNIT DESIGN PARAMETERS

Turbine type	Horizontal propeller turbine with adjustable blades
Runner diameter	118.1 inches (3.0 meters)
Design head	7.0 feet
Minimum head	3.0 feet
Design flow	1,180 cfs
Capacity	600 kW

RECONNAISSANCE REPORT

FOR

HYDROPOWER

LOCK AND DAM 7

MISSISSIPPI RIVER

NEAR LA CROSSE, WISCONSIN

SYLLABUS

This report presents a preliminary evaluation of the addition of hydropower at the existing navigation lock and dam 7. The study shows that installation of a hydroplant with a 4,800-kW (kilowatt) or 7,200-kW nameplate rating is economical. Pertinent data concerning the site and two optional installations are shown on the preceding page.

Severe environmental impacts do not appear to be 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 7 can be an important contribution to our Nation's energy independence. A 7,200-kW system would produce an average energy equivalent of 70,000 barrels of oil or 20,000 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 7.

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LOCK AND DAM 7

MISSISSIPPI RIVER

NEAR LA CROSSE, WISCONSIN

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. The reconnaissance study is designed to reduce the chance of a subsequent unfavorable finding and maximize the potential for identifying and moving forward with attractive projects. 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 economic feasibility finding is a strong indication that further detailed study (a feasibility study) is warranted subject to assessment of potentially critical negative 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 Section 216 of the Flood Control Act of 1970 (Public Law 91-611) which states:

> "The Secretary of the Army, acting through the Chief of E[illegible]rs, is authorized to review the operation of projects, the construction of which has been completed, and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to the significantly changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or the operation, and for improving the quality of the environment in the overall public interest."

The reconnaissance study for hydropower addition at lock and dam 7 was conducted under this authority. If warranted and approved, an interim feasibility study will be done under the authority 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

Because this reconnaissance study is preliminary, an intensive public involvement program was not conducted. Agencies and interests were informed of the initiation of the study and were invited to participate in the study. 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 7. Correspondence related to power value determination is included in Appendix B.

The FWS, under the authority of and in accordance with 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 7. 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 has not been officially contacted regarding distribution of any power that may be produced at lock and dam 7. If a feasibility study is done, coordination will be maintained regarding power marketing.

The St. Paul District, Corps of Engineers, is chiefly responsible for this study and the report. The reconnaissance report will serve as a coordination vehicle because it 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

No other agency or interest has studied lock and dam 7 in detail for hydropower addition. The Corps of Engineers is completing the National Hydropower Study; lock and dam 7 is one of the sites investigated.

The National Hydropower Study was authorized by Section 167 of the Water Resources Development Act of 19,, (Public Law 94-587). The study is to 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 apparent economic feasibility for hydropower addition at lock and dam 7.

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. Lock and dam 8 is one site included for future study in the Corps of Engineers hydropower investigation.

Mitchell Energy, Inc., of Boston, Massachusetts, has applied for a preliminary permit from FERC to study lock and dam 7 for hydropower. DOE funding for such studies is available. The preliminary permit is still pending, and, if granted, Mitchell Energy (or other entity granted the permit) will be entitled to study the site. If results are favorable, a permit for development could be sought. No duplication of study effort or Federal funding between the Corps and Mitchell Energy (or other) is anticipated. Corps study documents and backup are open to all upon request. The Corps will, however, continue its hydropower study in satisfying agency obligations to Congress, even where non-Federal interests have sought or received a FERC permit to study hydropower development at that Corps project.

THE REPORT AND STUDY PROCESS

Results of the reconnaissance studies are contained in this report and include recommendations for further feasibility investigations. The report consists of a main report (including plates showing drawings of selected alternatives) and technical appendixes.

The reconnaissance study was started in February 1980 and culminates with this report. If warranted and approved by Corps of Engineers higher echelons, the feasibility study for hydropower addition at lock and dam 7 will begin in fiscal year 1982 and will be completed in April 1985. The final feasibility report would be submitted to Congress which could authorize a hydropower project at lock and dam 7. However, authorization, advance planning, and funding by Congress are necessary before any recommended actions could be taken.

PROBLEM IDENTIFICATION

NATIONAL OBJECTIVES

In accordance with the Principles and Standards for Planning Water and Related Land Resources, national economic development and environmental quality are the two principal planning objectives. These guidelines mandate that all federally assisted water resources projects be planned to achieve these national objectives.

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

• Environmental Quality (EQ) - Enhance the quality of the environment by managing, conserving, preserving, restoring, or improving natural and cultural resources and ecological systems.

The social well-being and regional development accounts are also considered important. Viable alternatives to solve current and prospective water and related land resource problems will be evaluated and examined in light of the goals of increasing national and regional economic gains, enhancing the quality of the environment, and improving social well-being.

EXISTING CONDITIONS

Lock and dam 7 is located on the Mississippi River at river mile 702.6 above the mouth of the Ohio River. It is near La Crosse in west-central Wisconsin. It is one of the 13 navigation locks and dams built in the 1930's along the Upper Mississippi in the St. Paul District. The dam and dikes which connect the Minnesota and Wisconsin shorelines create the large expanse of Lake Onalaska which is a very valuable aesthetic, recreation, and biological resource. Pool 7 is heavily used by recreation boaters from the La Crosse area. Lock and dam 7 has the greatest number of pleasure boats passing through it of all locks in the St. Paul District.

The Dairyland Power Cooperative serves the potential market area for energy generated at lock and dam 7. Because a cooperative is designated as a preferred customer for sale of any federally generated power, Dairyland would probably receive priority consideration if hydropower were developed at lock and dam 7. Assuming an installed capacity of 12.7 MW (megawatts) as derived during the National Hydropower Study and that this capacity was considered firm, a hydropower project at lock and dam 7 would provide only about 1.8 percent of Dairyland's current winter system demands. About 1 percent might be more realistic considering a somewhat lower value for the development's firm capacity during the critical winter period.

Structural Integrity

The stability and structural integrity of lock and dam 7 is considered excellent. The latest periodic inspection in 1978 did not reveal any sizable settlement or deflection for the gated concrete dam and storage yard piers. The foundation soils (see the boring logs on plate 1) are fine to medium coarse sand to at least a depth of 30 feet. Other borings not shown indicate sand to a depth of 62 feet. The clean sands would provide a stable and competent foundation for the proposed structures and would 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 10-15 feet upstream of the dam and 40-50 feet downstream of the dam, with slopes averaging 1V on 3H, beginning just off the structure and extending to the toe of the scour.

In 1979, a local slope failure occurred on the downstream slope of the storage yard, immediately east of the wing wall that borders on the easternmost tainter gate monolith. The failure exposed about 35 feet of the concrete wing wall and created a scarp approximately 150 feet long, 60 feet wide, and 30 feet deep. The massive sand slide was attributed to the undercutting of the toe of the embankment by the scour action generated from adjacent tainter gates. The failure was repaired and the slope stabilized with the placement of 8,100 tons of rock fill.

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 gated concrete dam.

Hydrologic Power Evaluation

The flow from the Mississippi River at lock and dam 7 is estimated from the 51 years of data from the U.S. Geological Survey gage at Winona, Minnesota. The drainage area of the basin above the project is 62,340 square miles, which is 5.3 percent larger than the drainage area above Winona. The only major tributary between these two points is the Black River, which drains 2,250 square miles of Wisconsin into Lake Onalaska.

At lock and dam 7, all the gates are raised out of the water when the flow reaches approximately 82,000 cfs (cubic feet per second). The head (loss) at the dam is approximately 0.7 foot for all flows above 82,000 cfs. In an average year, flows in the spring will keep the gates out of the water for 1 to 2 weeks. Additional periods of heavy rain during the summer and fall can also cause high flows and sometimes flooding.

The average monthly flows at lock and dam 7 are shown in the following table:

Average monthly flows

Month	Flow (cfs)	Month	Flow (cfs)
January	14,300	July	29,700
February	14,500	August	20,000
March	28,700	September	20,900
April	61,200	October	20,000
May	47,900	November	21,000
June	39,500	December	16,300

The production of hydropower is always directly related to two factors-head and flow. A third factor, the amount of storage available, strongly influences the flexibility of the power production. If the flows in a stream are variable, because of weather and other factors, storage can be used to moderate the flows and will allow flood volumes to be used for power rather than spilled.

The volume of the reservoir at lock and dam 7 is variable and depends on the flow in the river and the stages at the dam and upstream control point. For stages of 639.0 and 640.0, the total storage volume in the pool is approximately 50,000 acre-feet. However, the pool is required by regulation procedures to remain at elevation 639.0 ± 0.2 foot for normal operations. The net storage is reduced to about 5,000 acre-feet. This amount could allow some flexibility for daily operations during special periods; however, daily cycling for hydropower probably would not be allowed. Plants with only minimum storage (pondage) are usually termed "run-of-river plants," because the power available at any moment is limited by the existing flow conditions. Lock and dam 7 is a classic example of a "run-of-river" project.

Flow reliability is a strong design factor in run-of-river plants. The flow at lock and dam 7 is greater than 10,000 cfs on 8 days out of 9. This flow of water is reasonably steady for power generation. However, for flows above 20,000 cfs, the usable head begins to fall off quite rapidly because more of the available head is being used for transport of the river's flow. At 57,000 cfs, the net head is 3 feet, approximately the lower limit for practical turbine operations.

For run-of-river plants, an analysis using the flow-duration technique is satisfactory for determining available power and energy. Usually, the flow is represented by the flow-duration curve, and an average head is used. However, for this and similar cases where head is variable, it is appropriate to consider this variation. This method is shown in Appendix C, Hydrologic Power and Energy Analysis. Included in this analysis are sections for average annual energy, firm power analysis and average weekly generation.

Environmental Setting

Terrestrial Resources - The main geographic feature of the study area is the Mississippi River gorge or valley. Within the 5-mile-wide valley in the vicinity of lock and dam 7 are a series of stream terraces on the east side, the floodplain, and the river on the west or Minnesota side of the valley.

The climate is humid-continental, with severe winters and about 29 inches of precipitation annually.

The vegetation in the immediate project area is primarily floodplain forest. Pools 7 and 8 contain a variety of vegetation types, with extensive areas of marsh and aquatic vegetation and floodplain forest.

Most of the floodplain of pools 7 and 8 is managed as part of the Upper Mississippi River Wild Life and Fish Refuge. Besides terrestrial game species, the complex riverine wetlands in the refuge support furbearers and an abundance of migratory waterfowl, including canvasback ducks. Lake Onalaska, immediately upstream of lock and dam 7, is noted as a feeding and resting area for migratory waterfowl.

Aquatic Resources - Pools 7 and 8 of the Mississippi River contain a variety of aquatic habitats in addition to the main river channel. The Black River, Shingle Creek, and Tank Creek (Wisconsin tributaries to pool 7) form an extensive delta in the river floodplain. Lake Onalaska, just downstream of this delta and separated from the main channel of the Mississippi River by a chain of islands, is immediately above lock and dam 7. The lake is rapidly filling with sediment and progressing toward a hypereutrophic condition. The physical character of Lake Onalaska is expected to change drastically in the next 30 to 40 years.

Water quality of the Mississippi River at lock and dam 7 is relatively good, at least when compared with other reaches of the river. The water is moderately hard, is well supplied with dissolved oxygen, and has sufficient plant nutrients to support summer algal blooms. Turbidity varies seasonally from about 2 to 3 JTU's (Jackson Turbidity Units). Water temperature fluctuates from 0° C to about 30° C.

Seventy-four species of fish have been reported from pool 7, and 86 species have been reported from pool 8. The extensive open water area, variety of fish habitat, and productive waters support an abundant and diverse fishery. Sport fishing is popular near lock and dam 7, especially on Lake Onalaska and in the tailwaters of the dam. Commercial fishing is economically significant.

Social Setting - Lock and dam 7 is within the La Crosse Standard Metropolitan Statistical Area (SMSA). The population of the La Crosse SMSA was 85,855 in 1975. Major industries are retail trade, services, and manufacturing.

Recreation Resources - Pool 7 is used extensively for recreation because it is close to the La Crosse metropolitan area. Duck hunting, fishing, and water-oriented recreation are the most popular activities on the pool. Access to pool 7 is good. O. L. Kipp State Park in Minnesota and Louis Nelson Park in Wisconsin are located on pool 7. The area supports an estimated 670,000 activity occasions annually.

Pool 8 supports an estimated 955,000 activity occasions per year with recreational opportunities similar to those described for pool 7.

Cultural Resources - No known prehistoric and/or historic sites are recorded within the immediate project area. As of 12 November 1980, no sites currently listed on or eligible for the National Register of Historic Places are in the immediate project area.

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 7 for hydropower by someone other than the Federal Government. Low cost federally financed loans for feasibility studies and licensing are available for investigation of proposed projects associated with existing dams not being used to generate hydropower. Even though lock and dam 7 is federally owned, non-Federal entities are not prohibited from applying for hydropower licensing at such a Federal site. In addition, Federal low-interest loans for construction are available to small rural communities and certain nonprofit organizations for such developments. Thus, if the Federal Government does not add hydropower to lock and dam 7, some other interest might.

Impacts of non-Federal development would probably not differ appreciably from those that would occur with Federal development. Opportunities forgone in the no action alternative would be regained with this alternative.

PLANNING CONSTRAINTS

Any possible hydropower development plan proposed for lock and dam 7 must be technically and economically sound, socially and 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 7.

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.

Finally, the authority for this Section 216 reevaluation study limits the area of consideration solely to that of the original and existing project. Any other options not directly associated with lock and dam 7 would have to be addressed under other authorities.

PLANNING OBJECTIVES

The objectives of the study are derived from problems identified for the area and from Federal, State, and local laws and regulations. In addition, the "Principals and Standards for Planning Water and Related Land Resources" require that all federally-assisted water resource projects be planned to achieve the national objectives stated earlier.

Specific planning objectives are definite needs, opportunities, and problems that can be addressed to enhance national economic development or environmental quality. Specific planning objectives for this study include:

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

2. Contribute to a maximum reduction in the use of nonrenewable fossil fuels in the study area and the Nation during the period of analysis, resulting in conservation of those resources and in the enhancement of the environment by reducing air pollution associated with plant emissions and terrestrial degradation associated with fossil fuel discovery and mining.

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

FORMULATION OF PRELIMINARY ALTERNATIVES

PLAN FORMULATION RATIONALE

The purpose of the formulation of preliminary plans is to identify and evaluate alternative measures for fulfilling the national and specific planning objectives. Plan formulation is iterative and designed to identify and evaluate all possible solutions so that the best and most feasible solution can be selected. For this reconnaissance report, formulation is not based on detailed technical evaluation of all preliminary alternatives, 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 early in the reconnaissance study 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, the team met periodically to evaluate the 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 details on how the preliminary plan for hydropower addition at lock and dam 7 was developed.

LOCATIONS CONSIDERED

As discussed under Existing Conditions and shown on plates 1 and 2, lock and dam 7 consists of the navigation and auxiliary locks, the dam with adjustable roller and tainter gates, an earth dike and spillway connecting the dam to French Island, and the Onalaska earth dike and spillway which extends from French Island to La Crosse County on the Wisconsin side of the river. Consideration was given to locating the hydroelectric plant at several sites along the area described above.

The Onalaska spillway adjacent to the Wisconsin mainland discharges water from the Black River which flows along the east side of French Island and joins the Mississippi River at the island's downstream end. The spillway and dike were built to prevent Mississippi River flows from diverting through the Black River channel, thus holding up the navigation pool after the navigation lock and dam and earth dike to French Island were completed. The spillway is designed to pass flows which would have occurred in the Black River channel under natural (before lock and dam 7) conditions.

To be cost effective, hydropower development must use the maximum flow that the Mississippi River has to offer at lock and dam 7. Placing the development at the Onalaska spillway would divert most of the Mississippi River flow through Lake Onalaska and downstream along the Black River channel. The flow regime through Lake Onalaska and downstream along the Black River channel would be modified significantly. Because Lake Onalaska is a sensitive and relatively fragile environmental system, this change in flow would have adverse impacts. Also, extensive and costly channel modifications along the Black River downstream of the spillway would be necessary to accommodate the high flows associated with the hydropower development. For the above reasons, the Onalaska spillway was not considered further as a site for the project.

The earth dike section which joins the navigation dam to French Island was also considered as a potential hydropower site. The fixed concrete spillway offered some positive aspects for construction. The easy road access to the east end of the spillway from French Island along the dikes would facilitate construction and would allow for access for future maintenance and operation of the hydropower plant. However, as with the Onalaska spillway site, increased flow through that area after plant construction would change flow patterns in Lake Onalaska. In addition, the increased flows would adversely affect the wetland areas downstream of the spillway. For these latter reasons, the dike section was dismissed as a possible site for the development.

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 an ideal site for hydropower units. The auxiliary lock could be dewatered relatively easily for the construction of the hydropower plant. 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 at lock and dam 7 could be almost universally applied at other locks and dams along the Mississippi River with unused auxiliary locks. For this study, locating the plant in the auxiliary lock was not considered. Because the flow which would pass through the auxiliary lock with the hydropower plant in place is large, it was felt that navigation might be adversely affected. A model study of the plant located in the auxiliary lock would be necessary to develop a plan which would ensure that no such effects would occur. 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 navigation lock, the site at the auxiliary lock was eliminated from consideration, at least for this preliminary stage of study.

The tainter gate bays, because they are farthest from the navigation channel, seemed to be the best "in river" site for installing hydropower. Flow opening through the gate bays to provide for flood flows must generally be preserved and is a constraint on applications in the gate bays. Maintaining adequate opening, however, was not seen as insurmountable, and the gate bays were retained for consideration as plant sites.

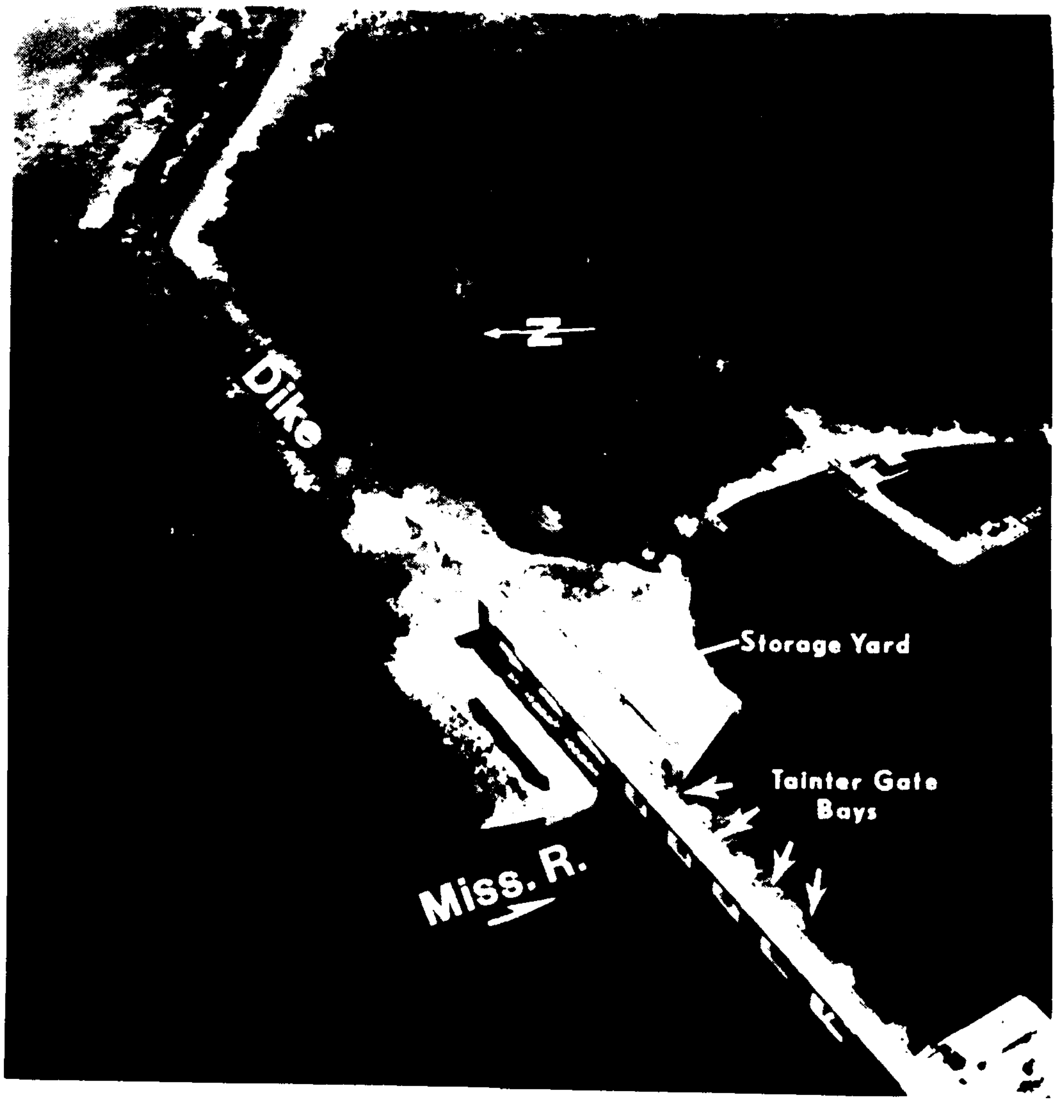
The area in the storage yard adjacent to the tainter gates and the portion of the dike adjoining the storage yard was considered. This area would accommodate more traditional construction methods and plant designs compared with those probable in the tainter gate bays. Hydropower development in this area would probably not affect navigation. Moving eastward to any great length along the dike, however, might affect the outflow channel from Lake Onalaska which exits north of the small island just upstream of the area as shown on plate 2. This storage yard area was also considered further as a plant site.

The sites being considered further have engineering considerations which may not preclude development of a hydropower project, but do affect the feasibility of the project. One of these considerations involves the construction of cofferdams above and below the gated concrete dam and portions of the storage yard. Because of the depth of scour in these areas, cofferdam construction of sand materials from excavation would result in a cofferdam with a wide bottom and long side slopes. When the cofferdam is tied into the dam, five or six tainter gates would have to be closed. Closing of such a large number of gates would interfere with normal discharges, so a steel cell cofferdam plan using a narrow tie-back intact at the piers was considered. The steel cells are more costly, but provide a suitable alternative for cofferdams during construction.

Finally, placement of the hydropower project in the storage yard dike area would involve a large amount of excavation, primarily for the discharge channel. Though the gated concrete dam, storage yard, and storage yard dike project sites all have some restrictions, none are considered severe enough to preclude further study.

ALTERNATIVES CONSIDERED

As described in the preceding section and shown on the following photograph, locating potential development at lock and dam 7 was primarily considered along the dike adjacent to the storage yard, in the tainter gate bays, and in the storage yard area.



Three optional scales of development were considered to better optimize the project. 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 3,000-millimeter (9.84 foot) runner diameter unit was selected, primarily because of head and flow characteristics. The three optional scales of development considered using 8, 12, and 16 of the standard 3,000-millimeter units which at a rated head of 7.0 feet would produce 4.8, 7.2, and 9.6 MW, respectively. These figures are lower than the 127 MW reported in the National Hydropower Study because project costs rose significantly during the reconnaissance study.

Positioning of the units for each option was considered at various sites along the area near the east end of the dam as stated above. For each option, the following three alternatives were considered:

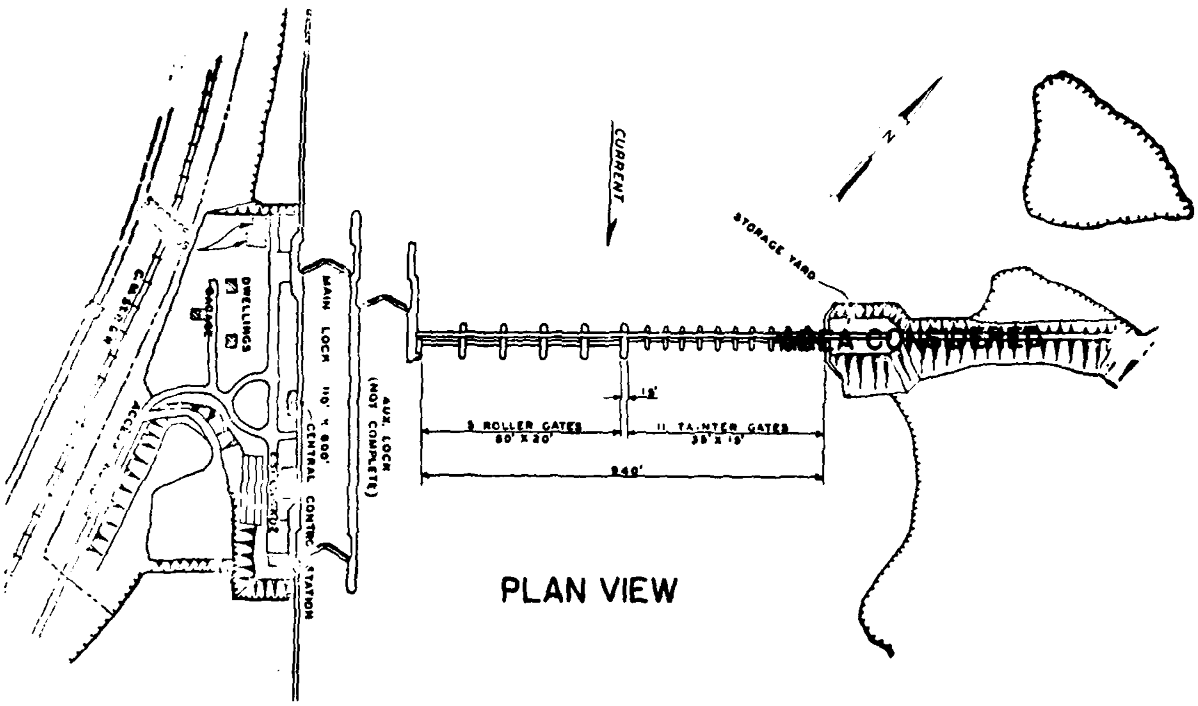
1. Installing all units in the dike adjacent to the storage yard. These alternatives were designated "D" in the following figure.

2. Installing six units in the storage yard bays and two units permanently in the far eastern tainter gate bay with additional units in the dike east of the storage yard. These alternatives were designated "SD" in the following figure.

3. Installing six units in the storage yard bays and two units permanently in the far eastern tainter gate bay as above with additional liftable units in the adjoining tainter gate bays. These alternatives were designated "GS" alternatives in the following figure.

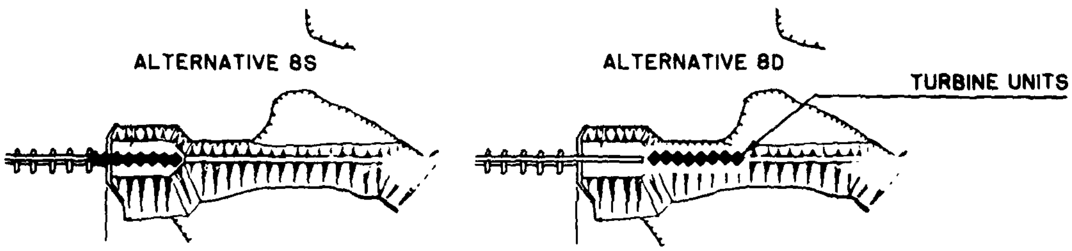
In all, eight alternatives were considered. The following figure shows the location of each alternative.

LOCK & DAM NO. 7 HYDROPOWER ALTERNATIVES

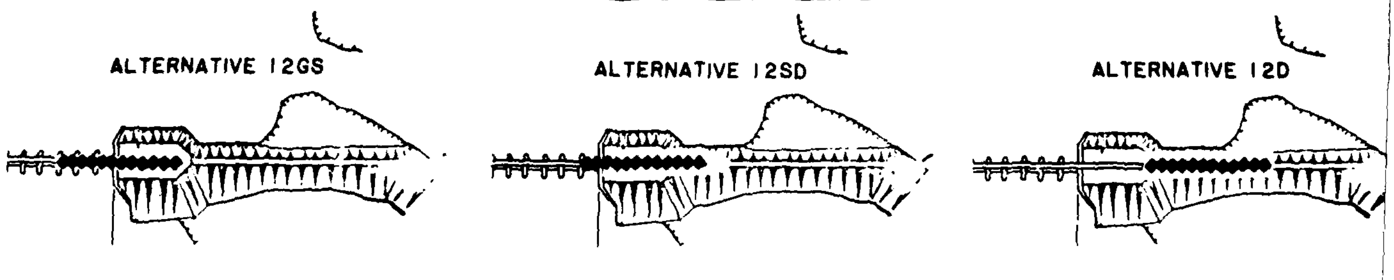


PLAN VIEW

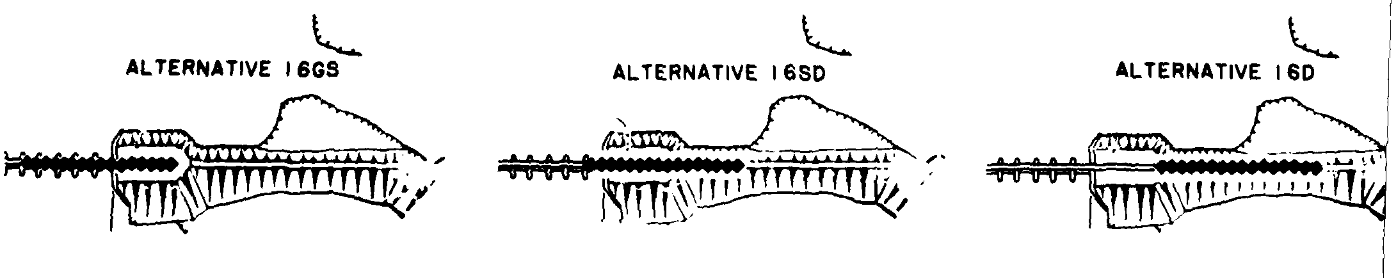
8 TURBINE UNIT OPTION



12 TURBINE UNIT OPTION



16 TURBINE UNIT OPTION



PLANS OF OTHERS

No plans for development of hydropower at lock and dam 7 have been considered by local utility companies, public entities, or other Federal agencies.

ASSESSMENT AND EVALUATION OF PRELIMINARY ALTERNATIVES

NARROWING ARRAY OF ALTERNATIVES

Each preliminary alternative was evaluated by the interdisciplinary team. The following table shows the results of the assessment/evaluation.

Preliminary alternatives matrix

Formulation criteria	Alternatives considered 8D	8S	12D	12GS	12SD	16D	16GS	16SD
Economic effects								
Preliminary first cost ($1,000,000's)	16.2	14.8	23.1	21.6	22.0	30.1	28.5	29.0
Certainty of constructability at or under estimated cost	certain	mod. certain	certain	less certain	mod. certain	certain	less certain	mod. certain
Ranking (most to least certain) 1/	(1)	(4)	(2)	(7)	(5)	(3)	(8)	(6)
Benefits will likely support cost	yes	yes	yes	yes	yes	probably not	maybe	maybe
Ranking (most to least net benefits) 1/	(3)	(1)	(5)	(2)	(4)	(8)	(6)	(7)
NED ranking (likely to be most economic) 1/	(2)	(1)	(3)	(5)	(4)	(8)	(7)	(6)
Environmental effects								
EQ ranking (least to most damaging) 1/	(4)	(1)	(7)	(2)	(3)	(8)	(5)	(6)
Combined effects								
Overall ranking 1/	(2)	(1)	(5)	(4)	(3)	(8)	(7)	(6)

1/ Ranking of 1 is best, 8 is worst.

As shown on the table, the dike alternatives (8D, 12D, and 16D) rank lower in relation to comparative scales of development of the "SD" and "GS" alternatives. The construction first costs for the dike (D) alternatives are slightly higher, and adverse environmental effects are more severe. However, alternative 8D ranks second overall.

The environmental effects are more adverse for the dike (D) alternatives for two reasons. First, placing hydropower generation facilities in the dike would require significantly more excavation for headrace and tailrace channels. This material would probably have to be trucked to an upland disposal site. Other alternatives would require less excavation, and the effects of transportation and placement of the material would be less environmentally severe. Second, the headrace channel for the dike alternatives would encroach on the small island just north and east of the storage yard. The damage to the island and the proximity of the headrace channel to the outlet of Lake Onalaska north of the island would cause adverse effects. Probably most significant is the likelihood of changed lake outflows which might adversely affect the Lake Onalaska ecosystem.

Placing the units in the storage yard dike (alternatives 12SD and 16SD) compares closely in cost with the gate-storage yard alternatives (12GS and 16GS). Environmental effects are slightly but not significantly more adverse. Certainty of constructability, however, is greater for alternatives 12SD and 16SD. Thus, the overall ranking is comparatively higher for the SD alternatives than the overall ranking of the GS alternatives.

As stated earlier, formulation is intended to develop the optimal scale of development from among a range of options. Alternatives 8S and 8D are ranked first and second overall. However, because both consider installation of the same scale of development (eight units), only alternative 8S was retained for further consideration. Since alternative 12SD was ranked third overall it was also retained for further consideration. None of the 16-unit alternatives were retained because of their low ranking and doubtful economic feasibility.

SELECTED ALTERNATIVES

As discussed in the previous section, two alternatives were considered for further study -- alternative 8S which consists of six standard tube turbine units located in the storage yard area and two standard units in the east tainter gate bay of the dam and alternative 12SD which is similar to the above alternative with four additional units located in the dike adjacent to the storage yard. The following sections evaluate and assess these alternatives from their economic and environmental perspectives as well as their physical and engineering feasibility. Financial feasibility analysis to determine specific cash flow characteristics of the project was not undertaken for this stage of study.

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 October 1980, 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). Therefore, the benefit-cost comparison was prepared for the year 1990 using 1980 dollars and prices.

The Chicago Regional Office of the Federal Energy Regulatory Commi sion (FERC) did the benefit analysis of a hydropower addition to lock and dam 7. In its 3 December 1980 letter to the St. Paul District, FERC calculated the benefits as follows:

> Using a coal-fueled steam-electric plant as the most likely alternative to the proposed hydroelectric project, power values are summarized in the attached table. These are "at-market" values; no transmission line costs for the hydroelectric development have been included. All values are based on October 1, 1980 levels and reflect the following general assumptions.
>
> Basis for Measuring Power Value
>
> 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 likely alternative if the hydroelectric project is not constructed. This cost is given as the investment cost (capacity value) necessary to construct the most likely alternative and the production cost (energy value) which results from operation of the alternative.

Power values are based on an analysis of the difference in "system" costs resulting from the system being operated using the alternative and using the proposed hydropower addition. System operating costs for each of these cases are simulated using a probabilistic production costing computer model. The POWRSYM Version 48 production costing model was used for this analysis.

Electric "System" Simulated Using the Model

The combined MAPP Pool systems, as they are projected to exist in 1990, were selected as the "system" simulated using the production costing model. For 1990, the total energy requirement for this system is projected to be 160,658,000 megawatt-hours with a peak load of 32,349 megawatts expected to occur during the summer period.

Adjustment Factors Applied to Power Values

The capacity value includes a credit of 5.0 percent to reflect the greater operating flexibility of the hydroelectric plant. In addition, the capacity value has been reduced by 6 percent to incorporate the relative value of the hydroelectric plant capacity based on the probability distribution describing its availability in comparison with the availability of the coal-fueled steam-electric plant alternative. Accordingly, the capacity value given in the attached table is applicable to the installed capacity of the proposed hydroelectric plant and already incorporates the consideration of dependable capacity.

The energy values given in the attached table reflect the inclusion of the "energy value adjustment" which results from the difference in annual "system" energy production between the steam-electric alternative and the hydroelectric project. For the energy values shown, a credit of 0.9 mill/kWh was included. 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 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 January 23, 1980 in the Federal Register, Part IX.

POWER VALUE SUMMARY

Lock and Dam No. 7, Mississippi River

(October 1, 1980 Cost Base and 7-3/8% Cost of Money)

4800 kW - 8 Unit Installation

Capacity Value (based on installed capacity)		$97.00/kW-yr
Energy Value -		
Current Fuel Costs		$18.7/MWh
Escalated Real Fuel Costs		$28.2/MWh

Annual Hydroelectric Benefit

Energy Benefit 32563 MWh @ $28.2/MWh	$ 918,277
Capacity Benefit 4800 kW @ $97.00/kW-yr	$ 465,600
Total Annual Benefit	$1,383,877

7,200 kW - 12 Unit Installation

Capacity Value (based on installed capacity)		$97.00/kW-yr
Energy Value -		
Current Fuel Costs		$18.8/MWh
Escalated Real Fuel Costs		$28.4/MWh

Annual Hydroelectric Benefit

Energy Benefit 47665 MWh @ $28.4/MWh	$1,353,686
Capacity Benefit 7200 kW @ $97.00/kW-yr	$ 698,400
Total Annual Benefit	$2,052,086

(end of excerpt from FERC letter)

The following table shows annualized costs and benfits of the two alternatives considered. The table on page 35 further breaks down NED benefits and costs in the format suggested in the 14 December 1979 Federal Register, Subpart H - NED Benefit Evaluation Procedures: Power (Hydropower).

Average annual costs and benefits (1)

Item	Amount ($1,000's) 4,800 kW (8 units)	Amount ($1,000's) 7,200 kW (12 units)
First costs	16,300	24,600
Present worth of deferred costs (2)	73	103
Interest during construction (3)	993	1,499
Present worth of salvage value (4)	21	31
Net Federal investment	17,345	26,171
Average annual charges	1,280	1,932
Operation and maintenance	67	102
Average annual costs	1,347	2,034
Average annual benefits	1,384	2,052
Net benefits	37	18
Benefit-cost ratio	1.03	1.01

(1) 7 3/8-percent interest rate, October 1980 prices.
(2) Deferred costs are the present worth of the value of costs required for project rehabilitation at year 50.
(3) Considers 2-year construction period.
(4) Considers present worth of the value of salvageable machinery at year 50 and year 100.

Summary of annualized NED benefits and
costs for structural measures (1)
(Thousands of month, year dollars)
Applicable Discount Rate: 7 3/8%

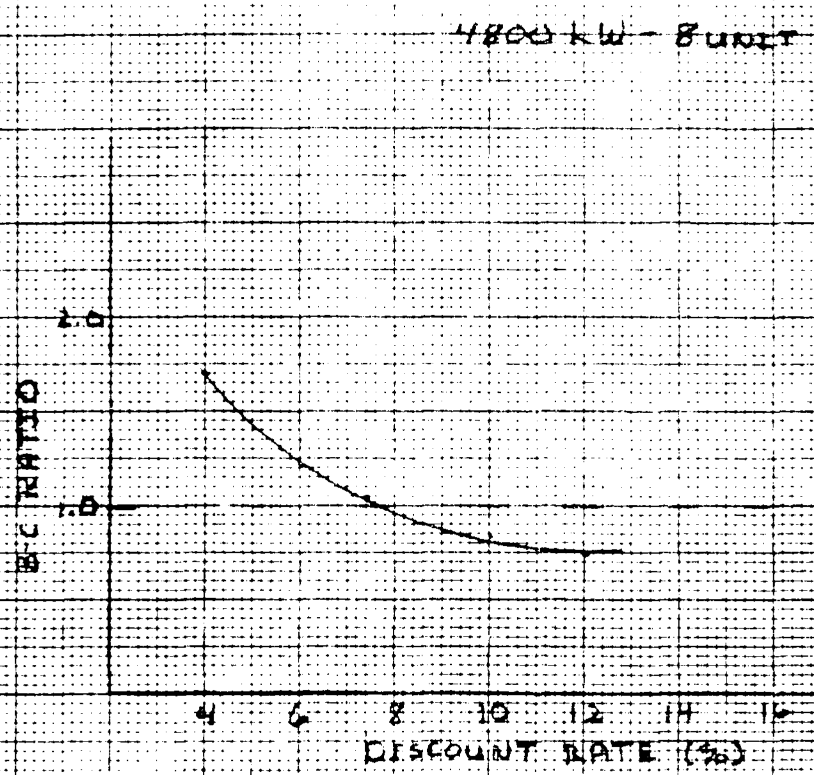
Item	Alternative 8S	Alternative 12SD
Plant data		
Installed capacity, MW	4.8	7.2
Dependable capacity, MW	4.8	7.2
Intermittent capacity, MW	0.0	0.0
Average annual energy, GWh	32.563	47.665
Average annual capacity factor (percent)	78	72
Benefits		
Unit capacity value ($/kW-yr)	(97.00)	(97.00)
Dependable capacity benefits ($1,000's)	465.6	698.4
Intermittent capacity benefits	0.0	0.0
Unit energy value (mills/kWh)	(17.8)	(17.9)
Energy benefits	579.6	853.2
Unit system energy cost adjustment (mills/kWh)	(.9)	(.9)
System energy cost adjustment	29.3	42.9
Real fuel cost escalation rate (percent)	(1.508)	(1.5106)
Period of real fuel cost adjustment (years)	(20)	(20)
Real fuel cost adjustment	309.3	457.5
	918.2	1,353.6
Total hydro benefits ($1,000's)(2)	1,384.	2,052.
Other purpose benefits (list)		
Annualized cost	1,347	2,034
Structural measures		
Nonstructural measures		
Net annual benefits	37	18
Benefit-cost ratio	1.03	1.01

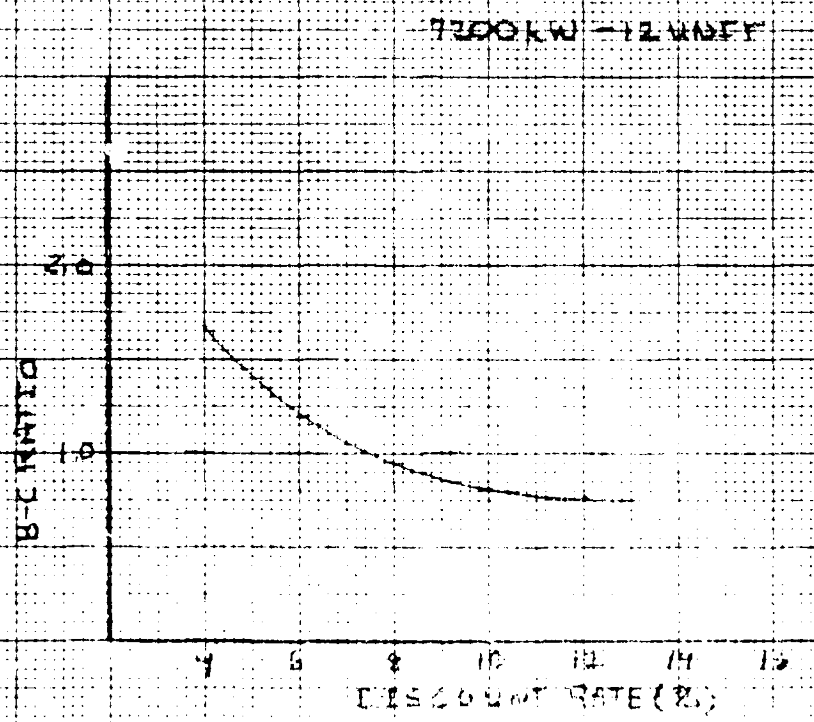
(1) Explanation of items discussed in Federal Register dated 14 December 1979, Volume 44, No. 242, pages 72938-72941.
(2) Rounded to the nearest 1,000.

Net benefits are $37,000 and $18,000 for the 4,800-kW and 7,200-kW plants, respectively. The 4,800-kW plant has a slightly greater benefit-cost ratio (1.03 compared with 1.01). Both sizes were evaluated to determine their internal rate of return (see the following figure). The internal rate of return for both units is between 7 3/8 and 7½ percent.

INTERNAL RATE OF RETURN

LOCK AND DAM 7 OCTOBER 1980 PRICES





ENVIRONMENTAL IMPACTS

No Action Alternative

The no-action alternative would not alter existing projected conditions. However, Lake Onalaska would continue to degrade as indicated in Appendix E.

8- and 12-Unit Alternatives

Construction Impacts - Terrestrial construction impacts would result from construction of an access road, construction storage yard, and approaches for a cofferdam; construction site preparation; excavation of a discharge channel; construction of a powerline corridor; and disposal of excavated and dredged materials. About 7 acres of floodplain forest would be disturbed by construction, in addition to an undetermined area needed for dredged and excavated material disposal. Transmission lines could interfere with the flight of migratory birds. Construction activity, noise, and dust would disturb wildlife in the immediate area.

Aquatic construction impacts would result from excavation of an intake and discharge channel, installation and removal of temporary cofferdams, construction of a permanent closing dike, and construction of a stream crossing for the access road at the spillway. The 12-unit alternative would require the excavation of more material from the riverbed than would the 8-unit alternative. Approximately 5 acres of substrate would be altered. Benthic life there would be destroyed, and some fish habitat would be lost. Placement of rock riprap would increase hard substrate available for benthic macro-invertebrates. Increases in turbidity and suspended solids in the water column would be temporary and fairly localized. River flow patterns would be altered during construction by the cofferdams. These changed flow patterns could affect Lake Onalaska flow patterns and the tailwater fishery.

Operation Impacts - The hydropower installation would be operated in a run-of-river mode, with no changes to the existing water level regime. No impacts to the shoreline of pools 7 and 8 resulting from fluctuating water levels are expected. Riverbanks subjected to increased current velocities near the powerhouse would be riprapped.

Increased human activity in the area and noise from the powerhouse could disturb wildlife in the area. Transmission lines could interfere with the flight of migratory birds.

Changes in flow patterns through the dam could alter flow patterns and the sedimentation rate in Lake Onalaska. Tailwater flow would be altered considerably, with much of the river flow diverted through the turbines. Changes in bottom contour, substrate, and current velocities would change the character of tailwater fish habitat at lock and dam 7. Diversion of water through the turbines could restrict fish movements through lock and dam 7.

No gas supersaturation problems are expected. Aeration of water passing through the dam could be reduced, but is not expected to significantly alter dissolved oxygen conditions in the river.

The size of the tube-type turbines, the low head, and the relatively slow speed of the runners should allow survival of most fish, fish eggs, fish larvae, drifting macroinvertebrates, and other plankton passing through the units. The magnitude of potential increased fish mortality caused by entrainment and impingement and the impact of any increased mortalities on fish populations are not known.

Social Impacts - Social impacts resulting from construction activity, noise, and dust would be most severe in residential areas on French Island. 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.

Recreation Impacts - Altered tail water flow patterns could cause safety problems for recreational boaters. Reduced tail water fishing and access to fishing locations could adversely affect recreation in the immediate project area. Most impacts associated with construction are expected to be minor and short term. Improvements to current recreation use at the site could be accounted for during project construction.

Impacts on Cultural Resources - Most of the proposed construction areas were disturbed during construction of lock and dam 7. The potential for finding intact prehistoric and/or archaeological sites in the immediate project area is low.

Project coordination has been initiated with the Wisconsin State Archaeologist, State Historic Preservation Officer, and Heritage Conservation and Recreation Service.

A more thorough discussion of impacts associated with the selected alternatives is presented in Appendix E.

Outstanding Environmental Issues Associated with Hydropower Development at Lock and Dam 7

The following is a list of environmental issues that deserve special attention in future planning efforts for hydropower development at lock and dam 7. 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 on wetlands.

2. Effects of hydropower operation on Lake Onalaska flow patterns and the associated impact on sedimentation rates and the aquatic biota in Lake Onalaska.

3. Effects of altered tailwater flow patterns and fish habitat on fish populations and fish utilization of the lock and dam 7 tailwater area.

4. The potential for entrainment and impingement of adult fish, eggs, larvae, and young in the turbines and the impact of increased mortality caused by entrainment and impingement in the hydro units on fish populations.

5. The impacts of transmission lines on migratory waterfowl.

6. The impacts of construction on endangered species, especially the Higgins' eye pearly mussel and bald eagle.

7. The effects of a hydropower installation on the lock and dam 7 tailwater sport fishery and associated recreation.

8. The effect of construction on social conditions on French Island.

9. The effects of construction on any currently unknown cultural resources in the project area.

HYDROLOGIC POWER AND ENERGY ANALYSIS

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.

Average Annual Energy

The flow-duration technique was used to estimate annual energy production. Daily flows for the period of record were grouped into flow classes. Each flow class was plotted according to its cumulative percentage of occurrence. The result is the flow-duration curve shown on plate C-1.

The head, or difference between the head and tailwater elevations, at lock and dam 7 varies significantly. The head reduces with increasing flows. The gross head was reduced by the estimated trashrack and tailrace losses to produce the curve of estimated net head shown on plate C-1.

Using the flow and net head values for each percentage of occurrence, power values for the 8- and 12-unit options were developed. Power values are also plotted on curve C-1.

Average annual energy is represented by the area under the power curve. The average annual energy calculated for the 8-unit option is 33,000 MWh(1); that for the 12-unit option is 45,300 MWh(1).

(1) These values are slightly different from the summation of average weekly generation values used for benefit calculations. The effect of using above energy values is a 0.9-percent increase in total benefits for the 8-unit option and a 3-percent decrease in total benefits for the 12-unit option.

Average Weekly Generation

FERC used a computer program to estimate benefits attributable to the project. The program requires average weekly generation values as input. Average weekly generation values were developed for each option. Appendix C discusses the method used to arrive at these weekly values. Plate C-6 shows the average weekly generation. Total average annual energy using the weekly generation techniques is 32,563 and 47,665 MWh for the 8- and 12-unit options, respectively.

Firm Power Evaluation

During July-August and December-January each year, power demand is high, and the reliability of capacity is critical. To evaluate the capacity of the 8- and 12-unit options during these critical periods, power-duration curves for July-August and December-January for the period of record were developed. Using these curves (plates C-3 and C-4) firm power values were determined for various degrees of reliability in percent and are shown below.

Firm power values for lock and dam 7

Installed capacity (kW)	December-January 85%	90%	95%	July-August 80%	85%	90%
4,800	4,100	3,900	3,600	3,300	2,900	2,200
7,200	4,900	4,600	4,000	4,300	3,900	3,000

MECHANICAL AND ELECTRICAL FEATURES

General

A standardized packaged predesigned turbine-generator, tubular-type, would meet the hydraulic conditions at this site. Plate 3 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 7.0 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 provisions for 14 tainter gate bays; 3 existing storage bays would be used for this project. One tainter gate bay would be closed for hydraulic control to provide space for an additional generating unit. If 12 generating units are used, four additional erection bays would have to be provided on the dike. The water passage configuration in the existing tainter gate structure is not completely compatible with the proposed units. Therefore, a concrete transition section, as shown on plate 3, 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 adjustible 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 7.0 feet, generator output of the unit can be estimated at 650 kW. To account for possibly lower than advertized efficiencies and mechanical and transmission losses an output of 600kW 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°C rise Class B insulation system without provisions for overload. It would have full run-away speed capability eliminating the need for a disconnect clutch. The generator breaker will be a metal clad drawout 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 switchgear in two of the lineups.

Excitation System

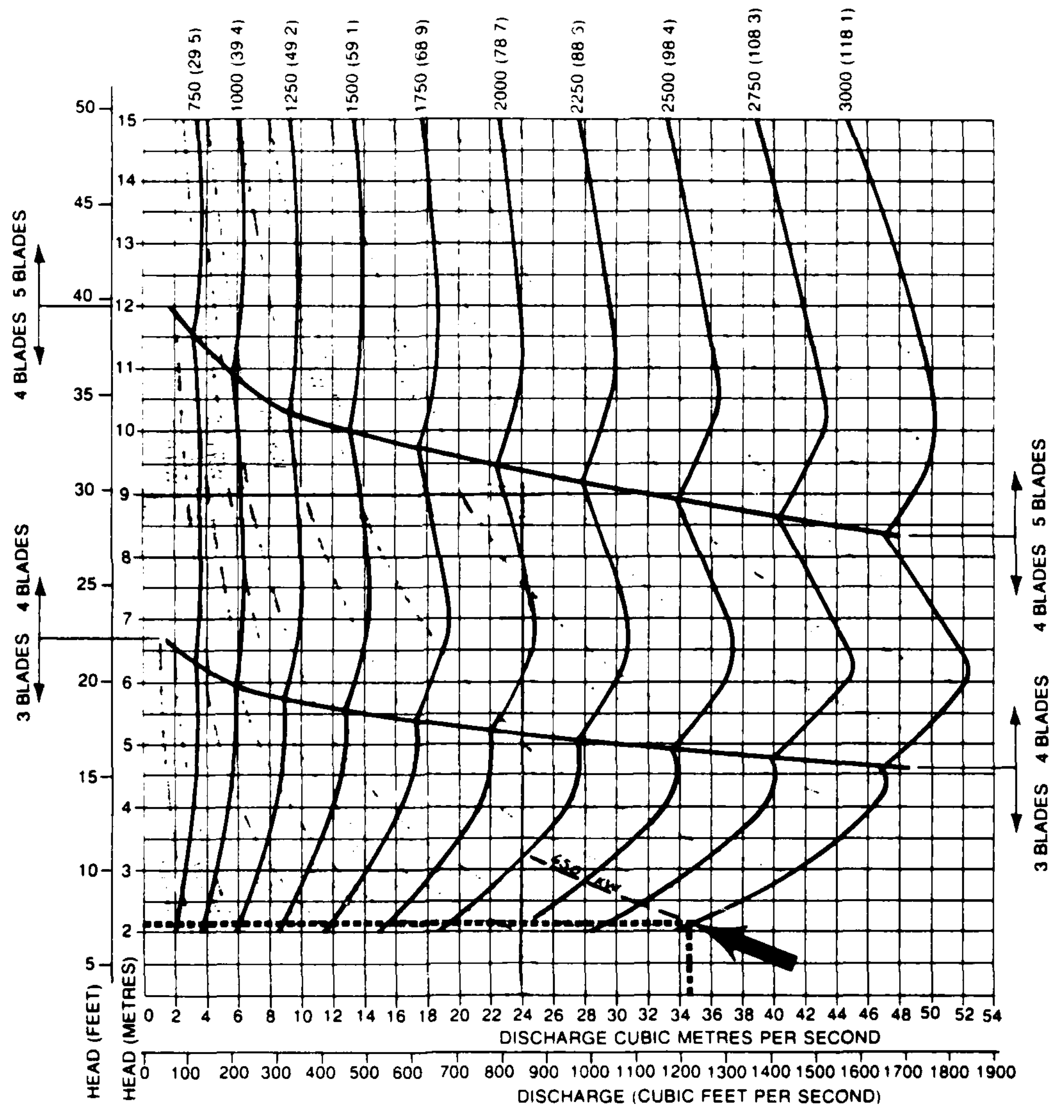
The excitation system for the unit would be of the bus-fed, power potential source, static type, excitation power being derived from the generator terminals. During starting, the generator field will be automatically flashed (permitting generator voltage build-up) from a rectified A-C station service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

Unit Control and Protective Equipment

A complete complement of generator protective relays (differential, overvoltage, over current, etc.), start-up and shut-down controls and other unit control relays would be provided in the metal-clad switchgear 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.

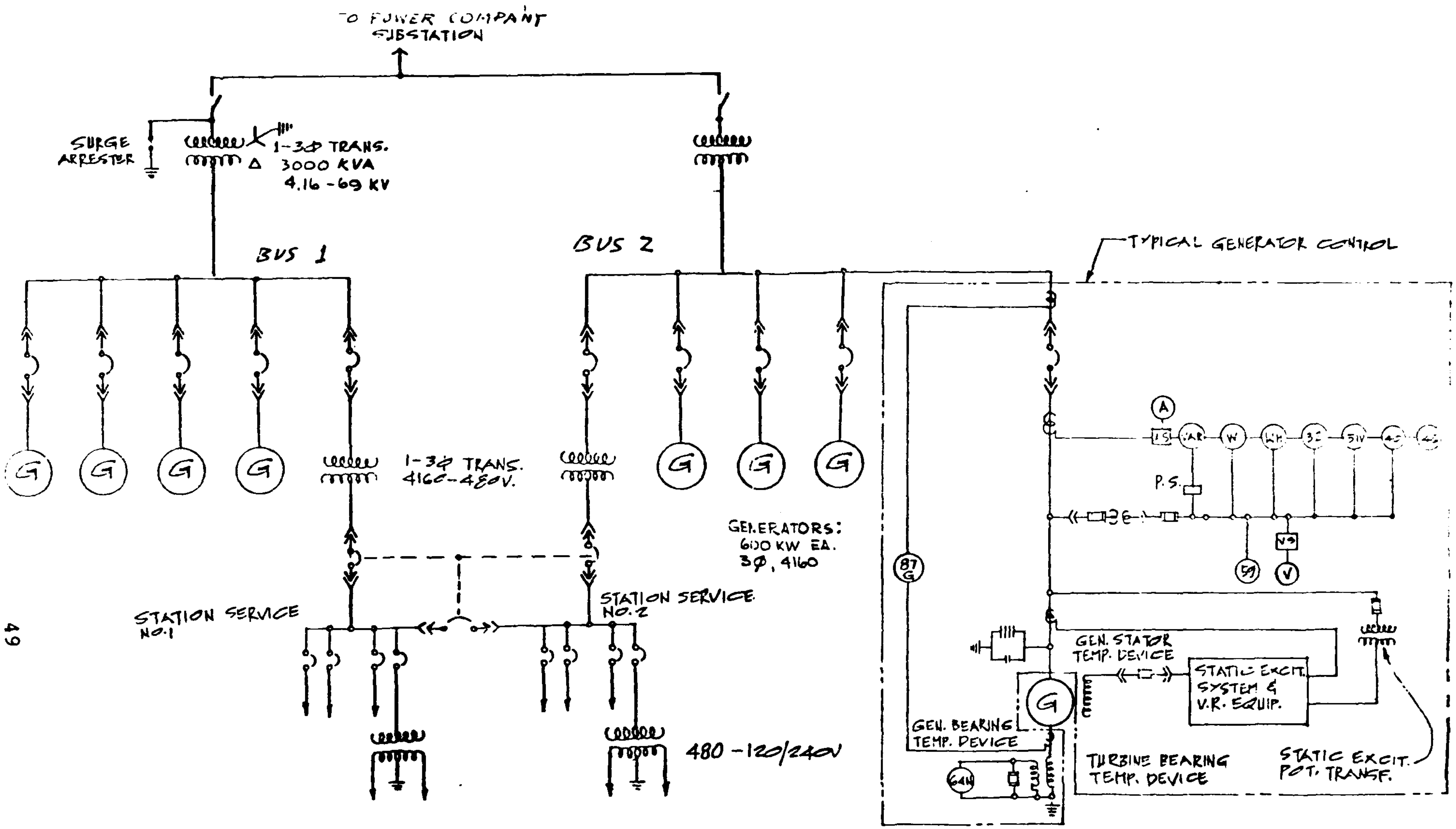
Sizing Chart

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.



MAIN ONE LINE DIAGRAM - L & D No. 7 HYDRO STATION

NOTE: FOR 12 UNIT STATION ADD 2 GENERATORS TO EACH BUS AND INCREASE TRANSFORMER TO 3750 KVA.

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 switchgear 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 switchgear (4,160 volts) would be included in generator circuit breaker switchgear lineups. Station service power distribution would be at 480 volts 3-phase and 120/240 volts single phase.

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 four generator step-up transformers with two units connected to each transformer. Each transformer would be rated 3,000 kVA, 69 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 high-voltage side through disconnect switches at the powerhouse for connection to the transmission line.

12-Unit Station

For a 12-unit station, 6 generators would be connected to each bus. The two step-up transformers would be rated at 3,750 kVA for the 12-unit station.

CIVIL FEATURES

This section describes the civil features pertaining to the installation of tube turbine power generating units at lock and dam 7. Civil features would include the powerhouse, intake and exit channels, permanent access, and site work. A brief description of some important construction considerations is also included.

Powerhouse

The most economically feasible powerhouse location studied placed two tube turbine units in the end tainter gate bay of the existing dam and six tube turbine units under the existing storage yard (Alternative 8S - eight turbines). Placing four additional tube turbine units in the existing dike adjacent to the storage yard was studied as a second alternative (Alternative 12SD - 12 turbines).

The powerhouse would be made of reinforced concrete and would house the power generating units and electrical equipment. Sheet-pile cutoff walls would be driven at the upstream and downstream edges of the powerhouse to prevent undermining of the structure. Trash racks would be installed upstream and downstream of the turbines. Upstream trash racks will have small openings to protect the turbines from damage during operation. Downstream trash racks would have large openings to prevent debris from entering the turbines during flood conditions. Flow to the turbines would be regulated by tainter gates installed upstream of the [illegible] existing tainter gate could be used for the turbine installed in the existing tainter gate bay. Stoplog grooves would be provided on the upstream and downstream edges of the powerhouse so that individual pairs of turbines could be dewatered for maintenance.

The interior of the powerhouse is totally open from one end to the other with the interior dimensions and layout of equipment virtually identical for each pair of turbines. The powerhouse would be underground in the storage yard and dike areas.

Channels

Intake and exit channels would have to be excavated to accommodate turbine operations. The upstream channel invert elevation is 621.0 and the exit channel invert is 607.0. The invert elevation of the downstream channel is determined by submergence requirements for the turbines selected. Both channels "daylight" in the scour holes upstream and downstream of the existing dam. Riprap is placed immediately upstream and downstream of the powerhouse on the channel bottom and is placed full length on the channel side. The riprap will be of minimum size and thickness because of the low entrance and exit velocities (3 and 2 fps (feet per second)).

A training dike constructed of material excavated for the powerhouse would be installed upstream of the powerhouse on the left bank. The purpose of the training dike is to prevent the turbines from drawing flow from Lake Onalaska which could suffer environmental damage.

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 top of the dike extending from the Wisconsin side of the river to the powerhouse site. A bridge designed for small vehicle traffic, constructed of precast concrete planks with steel supports, would be needed to cross the 1,000-foot long Onalaska spillway. Equipment used in the construction of the hydropower facility could be transported to the site by raft or barge or by constructing a temporary crossing below the spillway. An alternative to the bridge would be to construct a crossing downstream of the spillway. Ramps would be constructed to get off and on the dike and a culvert provided to cross the water below the spillway. The culvert crossing would be washed away by spillway overflow every 25 years and would have to be replaced. Access provided downstream of the spillway would not be usable during high water. A parking and turnaround area would be provided at the powerhouse.

Site Work

The powerhouse would be underground except for the portion installed in the existing tainter gate bay. The storage yard would be restored to its original size and elevation. Restoration of the storage yard is essential to operation of the lock and dam. The dike would also be restored to its original size and elevation if alternative 12SD is selected, because restoration is necessary for flood control. Most of the site work would be restoration of these areas.

Other site work would include fencing around the storage yard area and the establishment of grass along the access road and around the parking area. Access to the powerhouse would be provided outside of the storage yard.

Construction

The following items must be considered during construction of the hydropower facility:

1. Dewatering would be required to construct the powerhouse. Upstream and downstream cofferdams would need to be placed to facilitate the dewatering. Placement of the cofferdams would be made more difficult by the proximity of the upstream and downstream scour holes. Because the soil is pervious, the dewatered area would have to be pumped.

2. Disposal of the excavated material in an environmentally acceptable manner could be a problem because of the large volume of material excavated. The hydropower facility was located to produce minimum excavation but the volume is still large enough to warrant consideration.

3. A temporary storage yard would have to be provided, especially since the construction will take more than one summer.

4. Installation of the powerhouse between the storage yard piers would require special construction. Sheet pile would be driven around the piers as shown on plate 3. Steel ties would then be installed as excavation progresses to provide support for the sheet piling. The sheet piling would remain in place and be used as forms for the powerhouse. This method of construction would be cheaper than replacing the piers.

5. The base slab in the existing tainter gate bay would have to be chipped away to accommodate the tube turbine as shown on plate 3. The downstream part of the powerhouse would require a pile foundation in the tainter gate area as a safety measure against possible undermining.

CONCLUSIONS

This reconnaissance investigation establishes that hydropower development at lock and dam 7 is technically possible and economically feasible and would not cause significant environmental damage. Although economic justification for a hydropower project appears marginal, further study is warranted because economic feasibility will be positively affected by rapidly changing technology and probable future high costs of alternative energy sources.

PLAN FOR FUTURE STUDY

The favorable economic feasibility finding of the reconnaissance study indicates that further detailed study (a feasibility study) is justified as was suggested in the conclusions.

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

A feasibility report is a decision document that defines and recommends a course of action. The finding of a feasibility report is whether a commitment to implement is warranted. If the finding is positive, the report defines the steps necessary for implementation. A positive economic feasibility finding is normally necessary for implementation. However, other concerns can be equally important in serving the broad public interest, and the feasibility study would be performed in the modern spirit of wise natural resource management and the multiobjective planning process.

The feasibility study would begin in fiscal year 1982 which begins in October 1981. The final feasibility report is scheduled for completion in spring 1985. After completion of the District's report, the report would be sent forward to higher Corps echelons for review, comment, approval, and final submission to Congress for authorization of the recommended plan. The figure on page D-19 in Appendix D illustrates the procedure of approval of the feasibility report.

The level of detail envisioned for the feasibility study would be sufficient 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 lock and dam 7 feasibility investigation.

EXECUTIVE ORDER 11988

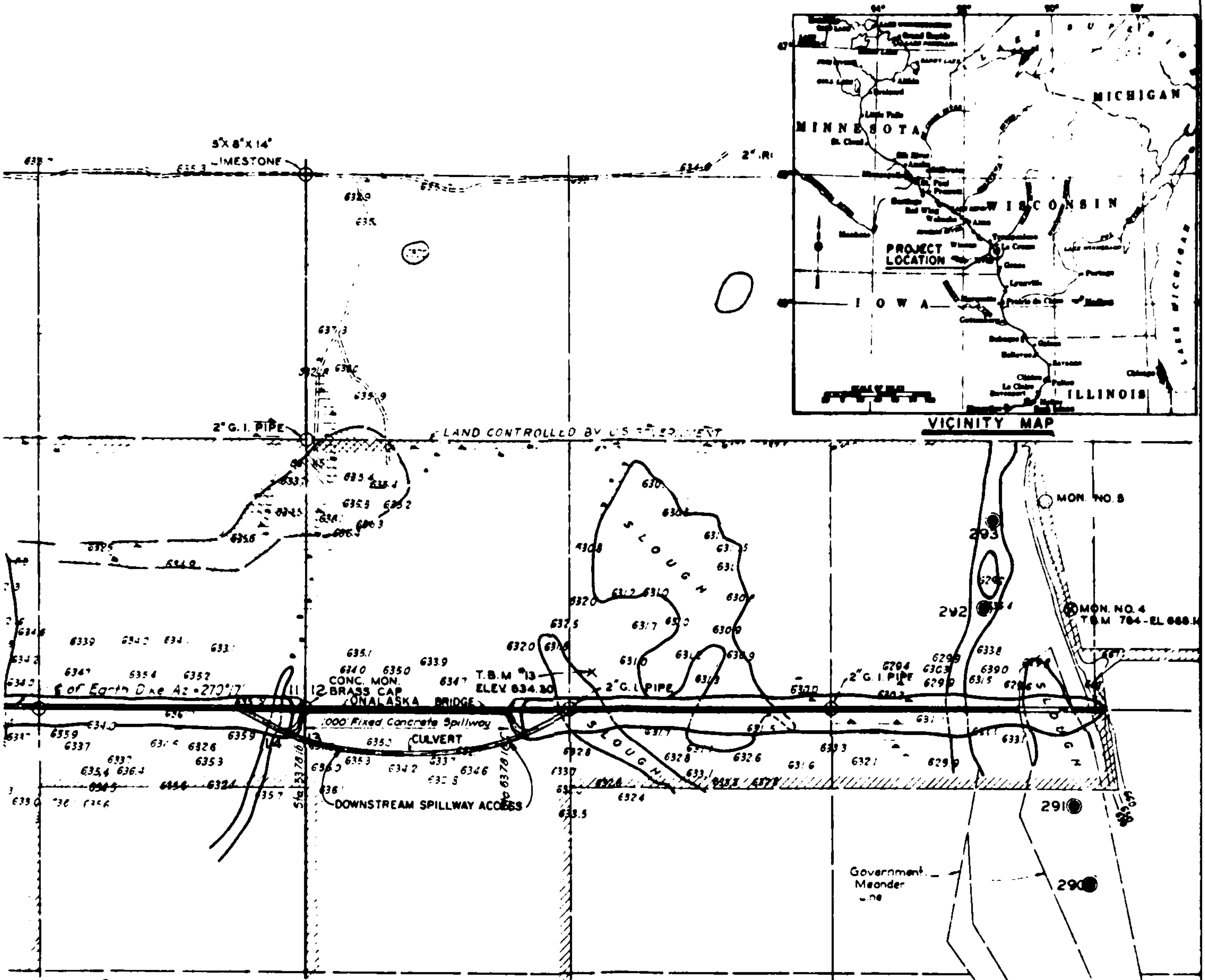
Executive Order 11988 requires Federal agencies to recognize the significant values of floodplains and consider the public benefits that would be realized from restoring and preserving them. It is the Corps' policy to formulate projects which, to the extent possible, avoid or minimize adverse impacts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

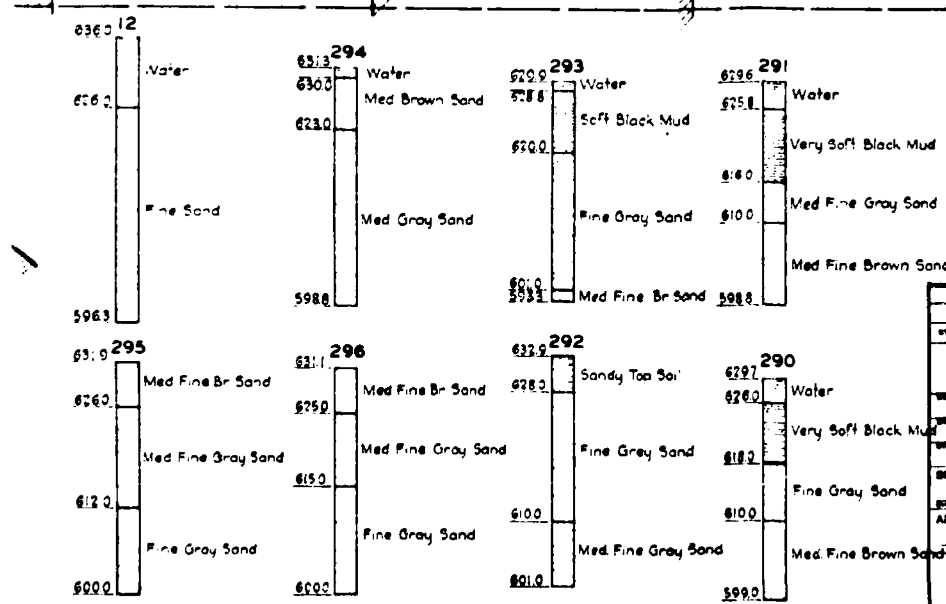
Development of hydropower at lock and dam 7 requires use of the floodplain for the hydropower facilities. There is no alternative in which floodplain land would not be affected. Hydropower development, however, will not induce floodplain development. Expected impacts on floodplain values are found in Appendix E.

RECOMMENDATION

I recommend that a feasibility report be prepared and that it be allowed to begin immediately. I further propose that the report be comprehensive enough so that it can be used as a basis for construction authorization by Congress and that the feasibility report be completed within 2 years from the date of this report.

WILLIAM W. BADGER
Colonel, Corps of Engineers
District Engineer





NOTES

HIGH WATER 1880	ELEV	645.35
ADJUSTED HIGH WATER	ELEV	646.35
LOW WATER 1934	ELEV	626.0
UPPER POOL	ELEV	639.0
LOWER POOL	ELEV	631.0
ROLLER GATE SILL	ELEV	619.0
TAINTER GATE SILL	ELEV	624.0

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

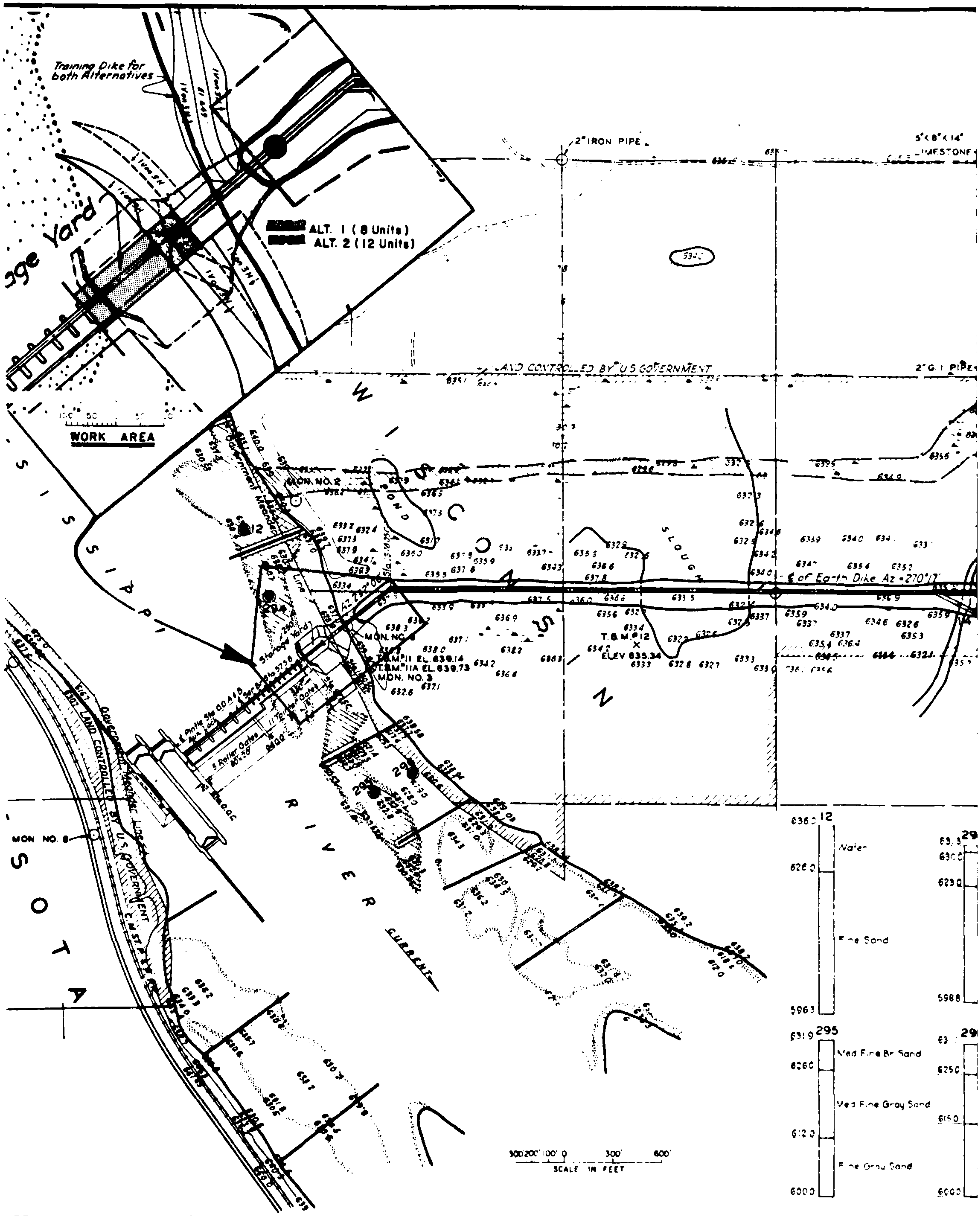
DESIGNED BY S.P.L.
DRAWN BY JU
CHECKED BY S.P.L.
SUBMITTED BY
APPROVED

MISSISSIPPI RIVER
LOCK & DAM NO. 7
SITE PLAN
HYDROPOWER RECONNAISSANCE STUDY

DATE DECEMBER 1980
SCALE AS SHOWN
DRAWING NUMBER
SHEET OF

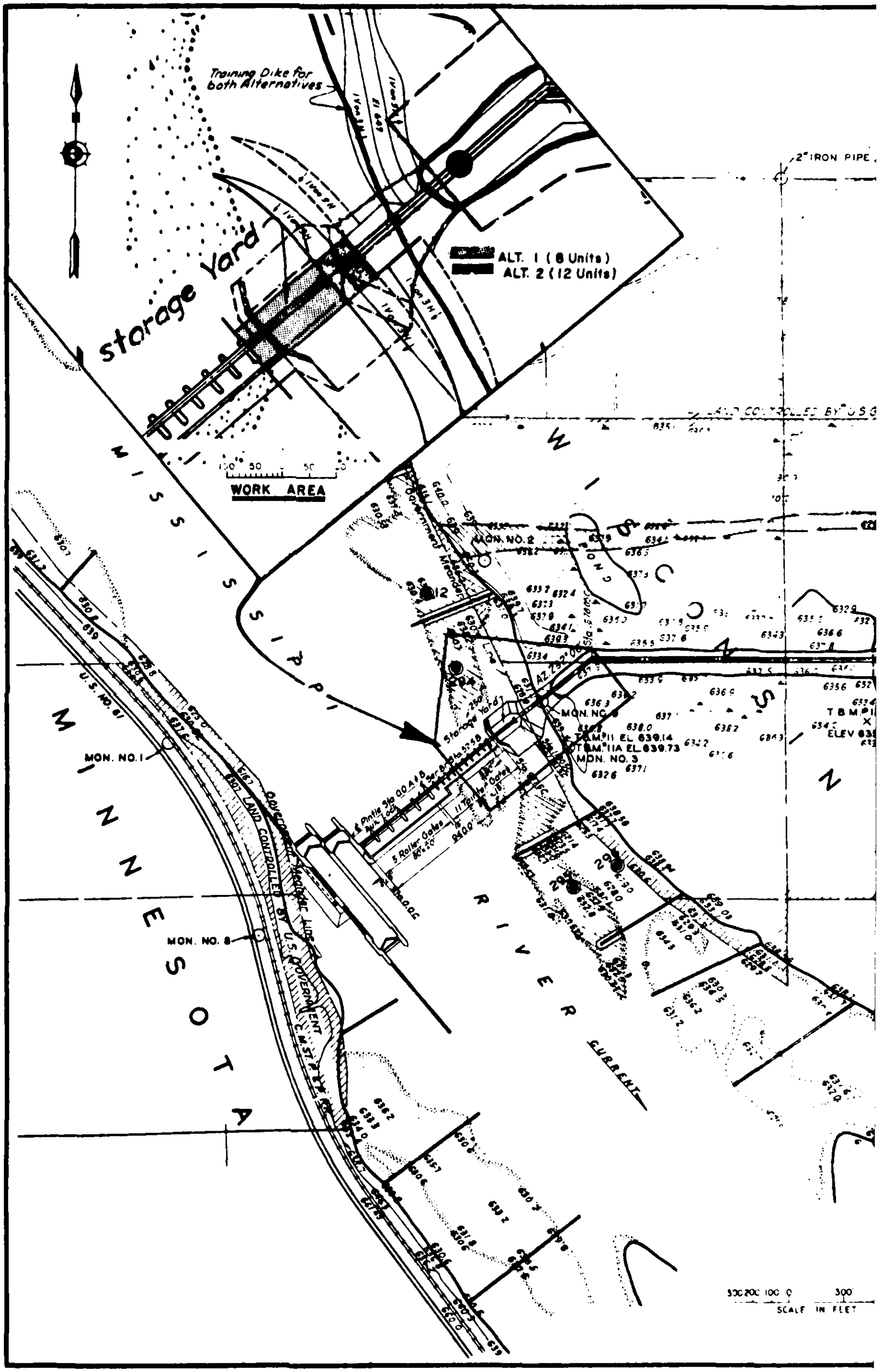
PLAT

(1)



Training Dike for both Alternatives
ALT. 1 (8 Units)
ALT. 2 (12 Units)
WORK AREA
Storage Yard
2" IRON PIPE
5"x8"x14" LIMESTONE
LAND CONTROLLED BY U.S. GOVERNMENT
2" G.I. PIPE
MON. NO. 2
MON. NO. 3
MON. NO. 8
POND
SLOUGH
℄ of Earth Dike Az. 270°17'
T.B.M. #12
ELEV 635.34
T.B.M. #11 EL. 639.14
T.B.M. #11A EL. 639.73
5 Roller Gates
Tainter Gates
GOVERNMENT LAND CONTROLLED BY U.S. GOVERNMENT
M I S S I S S I P P I
R I V E R
CURRENT
W I S C O N S I N
M I N N E S O T A
SCALE IN FEET
Water
Fine Sand
Med Fine Br Sand
Med Fine Gray Sand
Fine Gray Sand

2


Training Dike for both Alternatives
storage Yard
ALT. 1 (8 Units)
ALT. 2 (12 Units)
WORK AREA
2" IRON PIPE
MISSISSIPPI
WISCONSIN
POND
MINNESOTA
RIVER
CURRENT
U.S. NO. 61
MON. NO. 1
MON. NO. 2
MON. NO. 3
MON. NO. 8
Storage Yard
5 Roller Gates
LAND CONTROLLED BY U.S. GOVERNMENT
SCALE IN FEET

(2)

LOC AM

MAIN LOCK

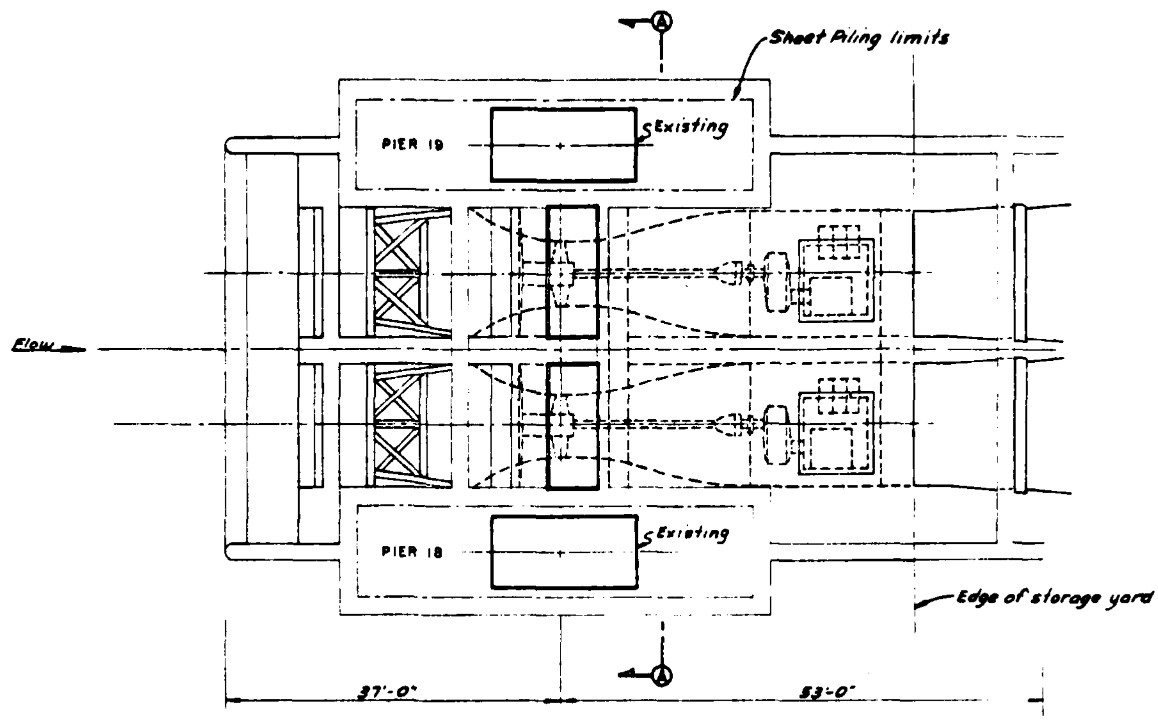
AUXILIARY LOCK (NEVER COMPLETED)

DAM WITH ROLLER & TAINTER GATES

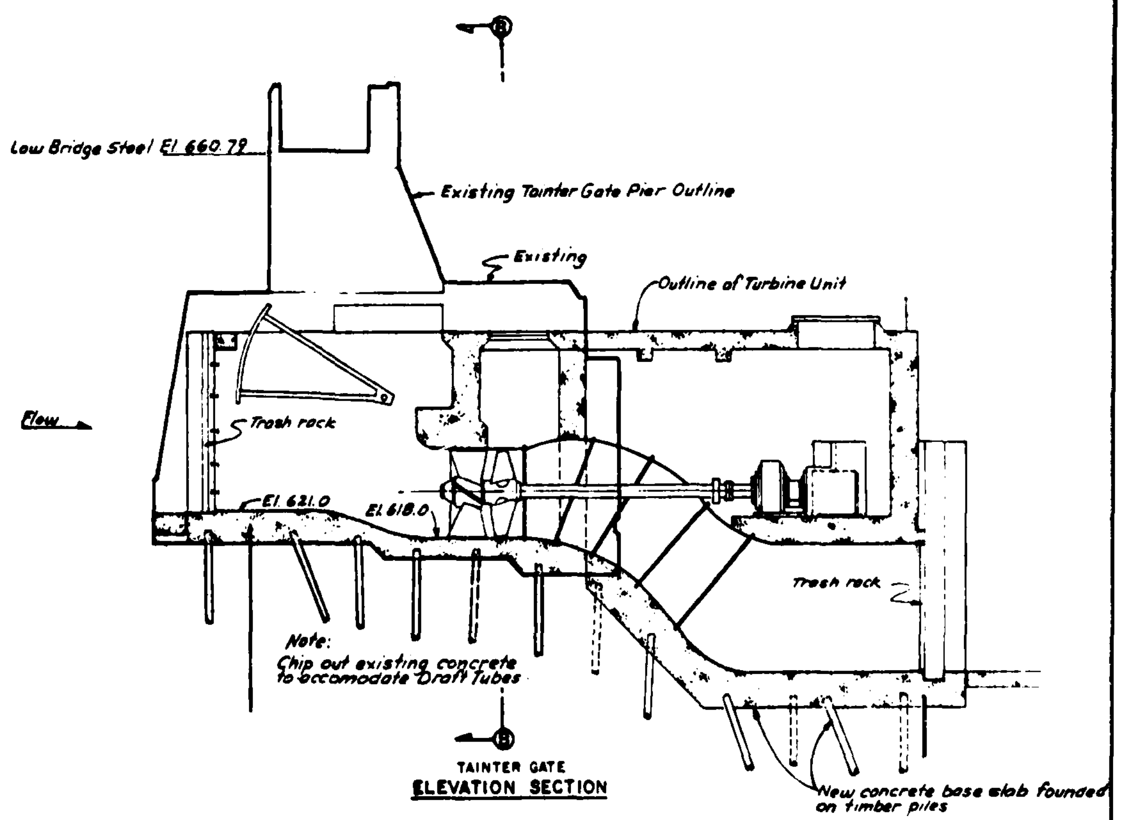
STORAGE YARD

FIXED CONCRETE SPILLWAY

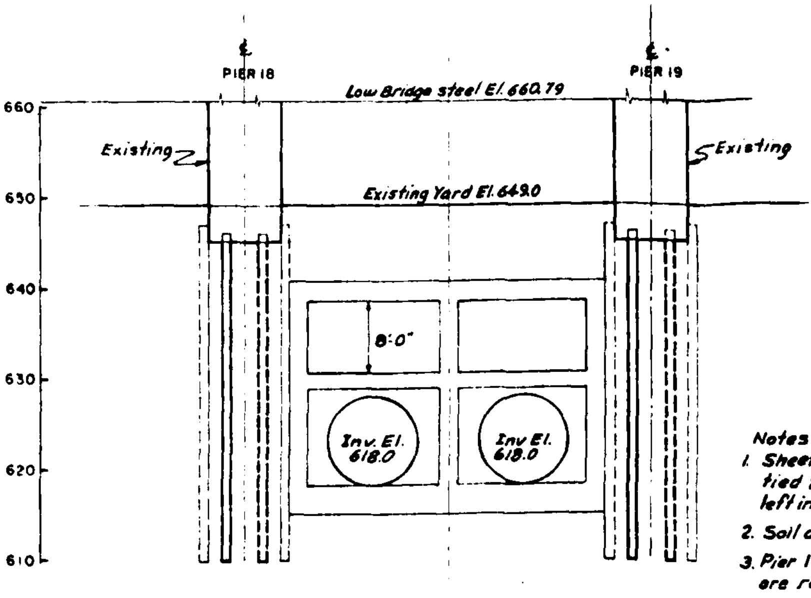
SCALE (APPROX.) 1" = 1,300'



STORAGE YARD
PLAN



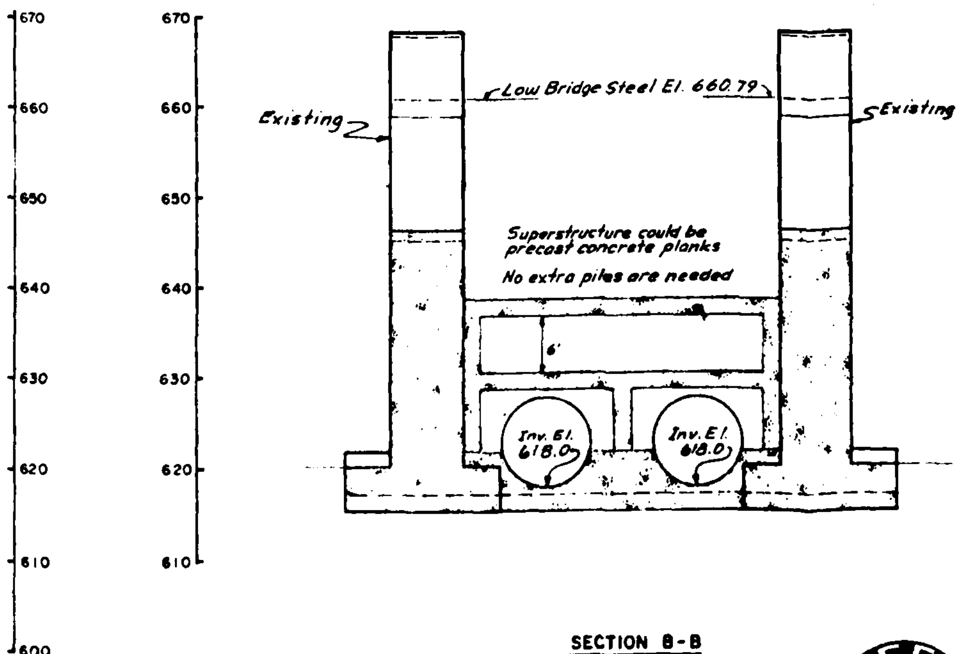
TAINTER GATE
ELEVATION SECTION



SECTION A-A

Notes
1. Sheet piling to be used along Bridge Piers tied to sheet piling on opposite side of Pier left in place
2. Soil anchor tiebacks are used at Pier 20
3. Pier 17 foundation at El. 618.- no tiebacks are required

SCALE: 1/8" = 1'0"



SECTION B-B

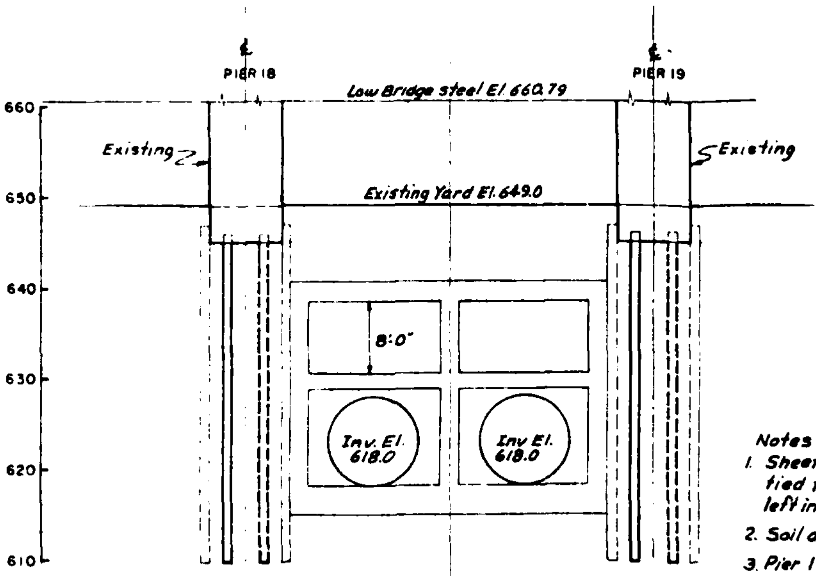
General note:
Existing structures denoted by Hea

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

SPL
JU
SPL
SUBMITTED BY:
APPROVED:

MISSISSIPPI RIVE
LOCK & DAM
TURBINE INSTALLATIO
HYDROPOWER RECONNAIS
AS SHOW
SHEET

☆ U.S.GPO:1980-765-057/70-6



SECTION A-A

Notes
1. Sheet piling to be used along Bridge Piers tied to sheet piling on opposite side of Pier left in place
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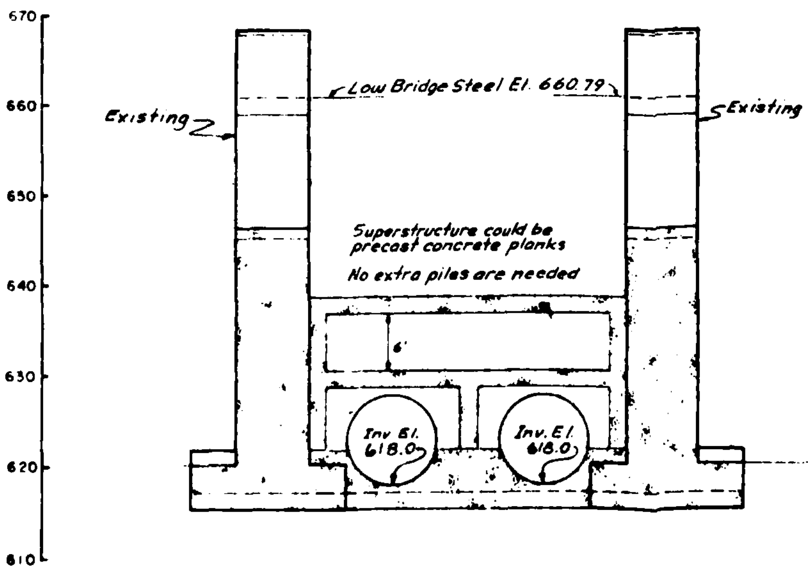
SCALE: 1/8"=1'0"



SECTION B-B

General note:
Existing structures denoted by Heavy Lines.

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

DESIGNED BY: SPL
DRAWN BY: JU
CHECKED BY: SPL
SUBMITTED BY:
APPROVED:

MISSISSIPPI RIVER
LOCK & DAM NO. 7
TURBINE INSTALLATION DETAILS
HYDROPOWER RECONNAISSANCE STUDY

DATE: DECEMBER 1980
SCALE: AS SHOWN
DRAWING NUMBER
SHEET OF

☆ U.S.GPO:1980-765-057/70-6

SAFETY PAYS

APPENDIX A

CONSTRUCTION COST ESTIMATE

APPENDIX A
CONSTRUCTION COST ESTIMATE

BASIS FOR COST ESTIMATES

Estimated costs in this appendix are generally based on unit prices adjusted to reflect average bid prices received by the St. Paul District on comparable work. Costs for electromechanical machinery are an exception. These costs are based on a 9 October 1980 quote from Allis-Chalmers. An allowance of 15 percent for contingencies is included in the estimated costs.

FIRST COSTS

The detailed estimate of first costs for the two alternatives fully evaluated in this report is given in tables A-1 and A-2. The costs shown are based on October 1980 price levels. No costs for lands are included because the site considered is federally owned.

Table A-1 - Detailed estimate of first costs - alternative 8S (six units in storage yard, two units in gate)

Description or item	Quantity	Unit	Unit cost	Total cost
Tube turbines	8	EA	$1,043,000	$8,344,000
Powerhouse civil costs	-	LS	2,400,000	2,400,000
Electrical equipment	-	LS	777,000	777,000
Miscellaneous plant equipment	-	LS	180,000	180,000
Switchyard civil costs	-	LS	20,000	20,000
Switchyard equipment costs	-	LS	107,000	107,000
Transmission line	-	LS	223,000	223,000
Clearing and grubbing	1	AC	1,200	1,200
Upstream cofferdam	12,000	CY	3.50	42,000
Downstream cofferdam	11,200	CY	3.50	39,200
Dewatering	-	LS	144,000	144,000
Excavation (1)	19,600	CY	2	39,200
Backfill	15,000	CY	4	60,000
Sand fill (dike)	20,000	CY	3	60,000
Riprap	6,700	CY	22	147,400
Type I bedding	3,100	CY	14	43,400
Type II bedding	2,000	CY	14	28,000
Sheet pile (cells)	8,900	SF	16	142,400
Cell fill	1,500	CY	3	4,500
Spillway bridge	-	LS	112,000	112,000
Dike road	-	LS	151,000	151,000
Wingwall removal	-	LS	28,000	28,000
Storage yard civil work	-	LS	218,000	218,000
Gate civil work	-	LS	55,000	55,000
Storage yard piles	-	LS	96,000	96,000
Subtotal				13,462,300
Contingencies				2,019,300
Subtotal				15,481,600
Engineering and design				428,300
Supervision and administration				392,600
Project cost (alternative 8S)				16,302,500
			Use	16,300,000

(1) Includes disposal costs as appropriate.

Table A-2 - Detailed estimate of first costs - alternative 12SD (six units in storage yard, two units in gate, four units in dike)

Description or item	Quantity	Unit	Unit cost	Total cost
Tube turbines	12	EA	$1,043,000	$12,516,000
Powerhouse civil costs	-	LS	3,595,000	3,595,000
Electrical equipment	-	LS	1,111,000	1,111,000
Miscellaneous plant equipment	-	LS	210,000	210,000
Switchyard civil costs	-	LS	24,000	24,000
Switchyard equipment costs	-	LS	139,000	139,000
Transmission line	-	LS	236,000	236,000
Clearing and grubbing	3	AC	1,200	3,600
Upstream cofferdam	26,600	CY	3.50	93,100
Downstream cofferdam	14,200	CY	3.50	49,700
Dewatering	-	LS	225,000	225,000
Excavation (1)	166,000	CY	2	332,000
Backfill	30,000	CY	4	120,000
Sand fill (dike)	26,000	CY	3	78,000
Riprap	15,900	CY	22	349,800
Type I bedding	8,000	CY	14	112,000
Type II bedding	5,600	CY	14	78,400
Sheet pile (cells)	8,900	SF	16	142,400
Cell fill	1,500	CY	3	4,500
Spillway bridge	-	LS	2,000	112,000
Dike road	-	LS	15[illegible],000	151,000
Wingwall removal	-	LS	28,000	28,000
Storage yard civil work	-	LS	218,000	218,000
Gate civil work	-	LS	55,000	55,000
Storage yard piles	-	LS	96,000	96,000
Dike piles and cut-off wall	-	LS	126,000	126,000
Dike area wingwalls	-	LS	73,000	73,000
Subtotal				20,278,500
Contingencies				3,041,800
Subtotal				23,320,300
Engineering and design				648,300
Supervision and administration				589,900
Project cost (alternative 12SD)				24,558,500
			Use	24,600,000

(1) Includes disposal costs as appropriate.

ESTIMATE OF ANNUAL CHARGES

Annual charges for the proposed alternatives are based on an interest rate of 7 3/8 percent and an amortization period of 100 years. Also included in annual charges is an allowance for interest during an assumed 2-year construction period.

Table A-3 - Estimate of annual charges - alternative 8S (six units in storage yard, two units in gate)

Item	First costs or present value	Annual charges
Construction first cost	$16,300,000	
Present value deferred cost (1)	73,000	
Interest during construction	993,000	
Present value of salvage (2)	-21,000	
Federal investment	17,345,000	
Interest and amortization of Federal investment ($17,345,000 x 0.07381) (3)		$1,280,000
Operation and maintenance (4)		67,000
Total annual charges		1,347,000

(1) Considers major rehabilitation of operating machinery 50 years after construction.

(2) Considers salvageable items after rehabilitation 50 years hence and at end of project economic life.

(3) Interest and amortization for 100-year life at 7 3/8-percent interest rate.

(4) Includes winter operation costs.

Table A-4 - Estimate of annual charges - alternative 12SD (six units in storage yard, two units in gate, four units in dike)

Item	First costs or present value	Annual charges
Construction first cost	$24,600,000	
Present value deferred cost (1)	103,000	
Interest during construction	1,499,000	
Present value of salvage (2)	-31,000	
Federal investment	26,171,000	
Interest and amortization of Federal investment ($26,171,000 x 0.07381) (3)		$1,932,000
Operation and maintenance (4)		102,000
Total annual charges		2,034,000

(1) Considers major rehabilitation of operating machinery 50 years hence.

(2) Considers salvageable items after rehabilitation 50 years hence and at end of project economic life.

(3) Interest and amortization for 100-year life at 7 3/8-percent interest rate.

(4) Includes winter operation costs.

APPENDIX B

COORDINATION

APPENDIX B

TABLE OF CONTENTS

LETTER	PAGE

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 7. The material inclosed includes letters in response to the 27 February 1980 notice of the lock and dam 7 hydropower reconnaissance study. Also included is other pertinent correspondence related to the study.

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

27 February 1980

NOTICE

LOCK AND DAM 7 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 7 on the Mississippi River near La Crosse, Wisconsin. The reconnaissance report culminating the study will be completed by September 1980.

The intent of the reconnaissance study is to establish, in a general way, whether hydropower production at lock and dam 7 is economically justified and to assess the issues that may be critical to implementation. Existing information will be used to the extent practicable. No detailed formulation of a plan or optimal scale of development will result from the reconnaissance; rather, the outcome of 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 1981 which begins 1 October 1980.

Because of the preliminary nature of the reconnaissance study, 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. In addition, news releases to the general public will be prepared, as appropriate. Upon completion of the reconnaissance study, a public meeting will be held to discuss the report and its findings and to help direct feasibility study efforts, should that be recommended in the reconnaissance report.

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

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

S. E. DRAPER
Major, Corps of Engineers
Acting District Engineer

Public Notice on Lock & Dam 7
Hydropower Study

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Federal Energy Reg. Comm.
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Commander
Second Coast Guard District
U.S. Dept. of Transportation
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St. Louis, Missouri 63103

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State Conservationist
Soil Conservation Service
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Mr. Harvey Nelson
Regional Director
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District Chief
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St. .aul, Minnesota 55101

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Minnesota Dept. of Agriculture
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St. Paul, Minnesota 55107

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Commissioner, Minnesota Dept. of Economic Development
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Environmental Quality Council
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MN-WI Boundary Area Commissio
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Statewide R. Basin Coordinato
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Madison, Wisconsin 53702

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Director, Budget & Planning
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Secretary
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Secretary
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Madison, Wisconsin 53702

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MN Energy Agency
150 East Kellogg Blvd.
St. Paul, Minnesota 55101

Public Notice on Lock & Dam 7
Hydropower Study

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Jackson, Michigan 49201

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Mr. James Adducci
Dairyland Power Cooperative
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La Crosse, Wisconsin 54601

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Region V
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Mr. Hugh Gardner
Department of Energy
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Chicago, Illinois 60604

Mr. J. A. Volkenant
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507 Marquette Avenue
Minneapolis, Minnesota 55402

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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

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Honorable Arlen Erdahl
House of Representatives
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Honorable Arlen Erdahl
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Governor of Wisconsin
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Honorable Gaylord A. Nelson
United States Senate
Washington, D. C. 20510

Honorable William S. Proxmire
United States Senate
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Honorable Alvin Baldus
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Division Engineer
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North Central
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District Engineer
U.S. Army Engineer District,
Rock Island
Clock Tower Building
Rock Island, Illinois 61201

DAIRYLAND POWER COOPERATIVE

La Crosse, Wisconsin

54601

March 5, 1980

District Engineer
St Paul District Corps of Engineers
Attn: Planning Branch
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

Dear Sir:

A notice issued by the St. Paul District Corps of Engineers dated February 27, 1980, indicates that a reconnaissance study to determine the hydro power potential at Lock & Dam 7 near La Crosse will be initiated.

Dairyland has recently completed an appraisal study of the hydroelectric potential at Lock & Dam 8 near Genoa, Wisconsin. This appraisal study was prepared by Mr. James Calvert of Commonwealth Associates with the economic analysis prepared by Dairyland personnel. The results of this appraisal study indicates that hydroelectric development at Lock & Dam 8 may be feasible from a technical, environmental and economic standpoint.

This study was presented to the Dairyland Board of Directors last week. The Board indicated that it would be desirable to pursue hydroelectric development at Lock & Dam 8. It is our opinion that due to the scope of such a project, the required coordinated operation of a hydroelectric facility with Mississippi River Navigation and present Corps of Engineers ownership of the existing Dams, 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 these Corps owned facilities.

Enclosed for your information is a copy of the Appraisal Study, along with testimony I presented to the Wisconsin Public Service Commission that deals with the economics of hydroelectric development at Lock & Dam 8.

We wholeheartedly support your study of hydroelectric development at navigation dams on the Mississippi River. It is our opinion that Lock & Dam 8 may be a better site to study feasibility. However, we wish to offer our full cooperation and assistance in any manner possible, irregardless of which site you select for study. We would be most happy to meet with you at any time and provide any information that we have as you prepare your studies.

Very truly yours,
DAIRYLAND POWER COOPERATIVE

Jack Leifer, Assistant General Manager

JL:rb
cc: F. Linder
J. Adducci

DIRECT TESTIMONY OF JOHN P. LEIFER
ON HYDRO DEVELOPMENT AT
U.S. ARMY CORPS OF ENGINEERS
LOCK & DAM NO. 8, GENOA, WISCONSIN
AND ON ECONOMIC ANALYSIS , WIND ELECTRIC SYSTEMS

PLEASE STATE YOUR NAME AND ADDRESS AND SUMMARIZE YOUR EDUCATIONAL, PROFESSIONAL QUALIFICATIONS.

My name is John P. (Jack) Leifer and I am Assistant General Manager, System Engineering Group, Dairyland Power Cooperative, 2615 East Avenue South, La Crosse, Wisconsin. I have previously presented my qualifications in this proceeding.

PLEASE DESCRIBE THE PURPOSE OF YOUR TESTIMONY.

The purpose of my testimony is to discuss in general Dairyland's investigations into the development of low head hydro electric generating facilities to meet future energy requirements. More specifically I would like to discuss the purpose, method, economic evaluation and conclusions of a study performed by Dairyland which was intended to determine the technical feasibility and economic desirability of constructing and operating a hydroelectric generating facility at the Corps of Engineers Lock & Dam facility at Genoa, Wisconsin, referred to as Lock & Dam No. 8. I will be assisted in this effort by Mr. James Calvert, a hydroelectric consultant retained by Dairyland to assist in this study. Mr. Calvert performed a feasibility study of hydro development at Lock & Dam No. 8. His complete report is attached to this testimony as Exhibit (JPL-1), and Mr. Calvert's education and professional qualifications may be found in that report.

A further purpose of my testimony is to present an economic analysis of the installation of large scale wind energy conversion systems on the Dairyland system. This analysis is formulated in conjunction with the analysis performed by Eric Hannen described in his testimony.

MR LEIFER, WHAT WAS DAIRYLAND'S PURPOSE IN UNDERTAKING THIS HYDRO STUDY?

As is the case with all organizations involved in the production of electric energy, Dairyland has experienced significant increases in the cost of fossil fuel over the last few years. In addition, because of inflation and increasingly stringent pollution abatement regulations, we have experienced sharp increases in the capital costs associated with the installation of new capacity. In the face of these rising costs the economic feasibility of hydroelectric generation has come under renewed scrutiny. As part of our ongoing effort to meet the demand and energy requirements of our member distribution cooperatives at the lowest practical cost, we though it appropriate for Dairyland to evaluate the potential and feasibility of adding hydro capacity to the Dairyland system. One of our first efforts was to make an inventory of existing dams in the Wisconsin service area where there had previously been generators installed, but these generators had been removed. The results of this inventory is shown as Exhibit (JPL-2). As can be seen from inspection of Exhibit there are about 25 existing dams in the Wisconsin service area which previously had generation installed. Most of these dams are owned by either NSP, Lake Superior District Power Company, Northwest Wisconsin Electric Company or Wisconsin Power & Light. None of these dams are owned by Dairyland.

It is also interesting to note that the total generation that was installed at these sites was approximately 7,000 kilowatts, with an average generation per site of approximately 282 kilowatts. Given the small amount of hydro potential at these existing sites, as well as the great number of sites that would have to be studied, it did not appear to be economically feasible to pursue studies relating to the economic and technical feasibility of adding generators to these existing dams. Another consideration was the expensive and time consuming process of obtaining a license for these hydro facilities from the Federal Energy Regulatory Commission. Therefore we have not pursued at this point the necessary details to develop small hydro sites shown on Exhibit .

Given the fact that the Dairyland service area is in effect bisected by the Mississippi River, which includes a series of navigation and flood control dams that are presently owned by the Corps of Engineers, it seemed logical to pursue the feasibility of installing low head generating equipment at these existing navigation dams. Our Engineering staff has worked with the Corps of Engineers, and from data received from the Corps on river flow and pool elevation, our Engineering staff has calculated that the potential hydro capacity at each Mississippi Lock & Dam in the DPC service area. This initial calculation of capacity was based on a five year average for the years 1974 through 1978, and did not allow for water bypassing turbines during spillage and lock operations.

We have included in this testimony Exhibit (JPL-3), which is a summary of our calculation of the potential hydro capacity at the Mississippi Lock & Dams in the Dairyland service area. Also included is a summary of the Corps of Engineers calculated potential for the same sites. You will note that these calculations are in pretty general agreement. Based on this calculation it appears that there is approximately 90 megawatts potential hydro on the 9 navigation dams on the Mississippi River throughout the Dairyland service area.

WHY WAS LOCK & DAM NO. 8 SELECTED FOR A DETAILED STUDY?

After evaluating the hydro potential at each of the navigation dams located in the Dairyland service area, it was necessary to develop an analysis of environmental, technical and economic feasibility, to determine if more detailed studies were justified. Our approach to the study of the hydro additions to the navigation dams was to select a dam which appeared on the face to be the best candidate for economic development and integration into the Dairyland system. If what appears to be the best potential site is not, after detailed study, proved to be a good candidate for hydro development, we would be very hesitant to spend money for studying other sites. If, on the other hand, what appears to be the best potential site does prove to be a good candidate, then we can proceed with investigations into the development of other sites along the dam system. Lock and Dam No. 8 was selected because the head and river flow data indicated that this dam had the maximum potential for development. Further, the Lock & Dam No. 8 near Genoa is located adjacent to the existing Dairyland Power Plant at Genoa, and also is readily accessible to the Dairyland transmission system.

[illegible] IN THE STUDY?

To more fully analyze the hydro potential at Lock & Dam No. 8, Dairyland retained Mr. James Calvert of Commonwealth Associates, who is a reputable and well known hydroelectric engineer, to conduct a more detailed [illegible] study which would develop in greater detail the hydro power potential [illegible] also the estimated cost for development of low head hydro at Lock & Dam No. 8. As part of this appraisal Mr. Calvert also investigated the major environmental problems that may be associated with such development. The approach taken in this segment of the study and the results of Mr. Calvert's evaluation are fully detailed in the attached report, Exhibit (JPL-1). In general the report concludes that there does not appear to be any severe environmental problems associated with this project development; secondly, the project appears to be technically and environmentally feasible , and Mr.Calvert recommends a number of steps that should be taken which will determine the ultimate feasibility of the project. These steps are summarized as follows:

1) Establish the firm level of capacity as related to system or pool requirements.
2) Perform an economic evaluation of the power potential considering the long life of hydro, low operating cost, and future escalation of alternative fossil fuels.
3) Determine the preliminary attitude of the Corps of Engineers, U.S. Fish & Wildlife Service, and other concerned agencies to the proposed project, and tentative method of development.
4) Seek a preliminary permit from the Federal Energy Regulatory Agency to perform detailed studies and prepare a license application.
5) Undertake a feasibility investigation, possibly with financial help from the Department of Energy under their Small Hydro Assistance Program.
6) Design and construct the project.

The appraisal also indicates that a hydro plant of 10,000 kW nameplate rating can be installed on Lock & Dam No. 8, and that in an average year could deliver to the Dairyland system about 52 million kilowatt hours of renewable energy. Although the plant would experience reduced or inoperative capacity for extended flood periods due to insufficient head, it was determined that at least 7,000 kW would be available for 90% of the time during an average winter period of November through February. This period is Dairyland's winter peak load and therefore we are of the opinion that the 7,000 kilowatts would be considered firm capacity. To put the output of this hydro facility in perspective the 52 million kilowatt hours of energy it would produce annually is 1.8% of Dairyland's total requirements in 1978. The 7 megawatt output is about 1.2% of Dairyland's peak load in 1978. By 1987 the output of this plant would provide less than 1% of both Dairyland's energy and capacity needs. It also should be noted that the calculated hydro potential at Lock & Dam by both Dairyland and the Corps of Engineers was approximately 14 megawatts. Based upon the assessment prepared by Mr. Calvert, the maximum unit that could be accomodated is 10 MW with a firm capacity of approximately 7 MW. Therefore it is safe to say that the balance of the dams on the Mississippi that were analyzed in all likelihood would have lower firm capacity than are listed on Exhibit (JPL-3). In fact, a column has been added to Exhibit (JPL-3) which is Mr. Calvert's assessment of other Lock & Dams in the Mississippi which flows through the Dairyland service area. As can be seen, the maximum potential is somewhat less than the calculated potential of both Dairyland and the Corps of Engineers. This indicates that the feasibility of each individual Lock & Dam must be analyzed in order to determine its feasibility. However, based upon the appraisal study thus far it would appear that Lock & Dam 8 is the most likely candidate to prove economic and technical feasibility for hydroelectric development.

WHAT WAS THE NEXT STEP PERFORMED IN YOUR STUDY?

Upon completion of the appraisal study of Lock & Dam No. 8, Dairyland made a detailed economic analysis of the project. This included taking the estimated construction costs as determined in Mr. Calvert's appraisal, which included all construction costs except for the transmission substations, administrative and general expenses, and interest during construction. Dairyland has made estimates for these costs and have developed a total cost of the project in January 1, 1980 dollars. This summary of costs is shown as Exhibit (JPL-4). The total cost for the project in January 1st 1980 dollars is $22,410,000.

It has been estimated by Mr. Calvert that this project could be completed in approximately three and a half years. Therefore we estimated the costs of the project in terms of a completion date of June 30, 1983. We have assumed that capital costs will escalate at 7% per year, and that Dairyland's interest during construction is based upon a 7½% interest rate.

We also made an analysis of the possibility of this unit being delayed due to long lead times for permit approval, environmental impact statements and other regulatory problems. This analysis assumed that the project would go in service on November 1st, 1987, which is the same date that we are proposing Project 87 to go in service. This analysis, with the November 1987 completion date, will allow a direct comparison of the power costs from this hydro project with Project 87 costs.

A summary of the estimated costs for completion in 1983 and 1987 is included in Exhibit (JPL-4). Other costs that have been included in our economic analysis are annual operating and maintenance costs and annual insurance costs. We have used the estimated costs for annual operating and maintenance costs that were developed in Mr. Calvert's appraisal. Our annual insurance costs have been developed based upon similar costs that we experienced in our Flambeau Hydro Station.

In determining the fixed charge rate we include the cost of money and also the impact of the property tax upon a project. The assumptions as to interest rates, annual escalation, interest during construction, property taxes, that were included in the economic analysis, are included as Exhibit (JPL-5).

WHAT WERE THE RESULTS OF THE ECONOMIC ANALYSIS?

The results of the economic analysis are summarized in Exhibit (JPL-6). The results of this analysis indicate that with an interest rate of 9% and a facility life of 50 years, and property taxes based on the present rates in Minnesota, that this project would have a levelized cost of 6.999¢ per kilowatt hour if it was constructed and completed by 1983. If the project is completed by November 1987 the annual levelized cost of the project would be 9.15¢ per kilowatt hour. This compares to the annual levelized cost of Project 87 of 7.15 ¢ per kilowatt hour.

DID YOU PERFORM ANY ANALYSIS TO CHECK THE SENSITIVITY OF YOUR ECONOMIC EVALUATION TO VARIATIONS IN YOUR ASSUMPTIONS?

Yes. A second economic analysis has been made which was based on several assumptions as to financing costs and tax credits. From our analysis of the incentives being offered by federal and state government for the development of hydro projects indicates that these incentives are in the reduction in interest rates for capital expenditures as well as tax credits. We have talked to several financial institutions about how these tax credits might affect Dairyland. It appears from current pending legislation in the United States Senate that industrial development bonds could be used to finance hydroelectric development. These industrial revenue bonds are bonds floated by municipals and other governmental bodies which are exempt from federal income tax. It would appear from our discussions with financial institutions that these bonds could carry an interest rate of several percentage points lower than Dairyland's present financing methods. Therefore we have assumed in our sensitivity analysis that an interest rate of 7% for development of the Genoa hydro project would be a reasonable rate to look at.

We have also assumed in the sensitivity analysis that the State of Minnesota would not tax the project with a property tax, and therefore would reduce the property tax to zero. These assumptions are speculative at this particular point. However, they do offer some sensitivity as to the incentives that could be offered by federal and state governments.

Based on the annual cost analysis included as Exhibit (JPL-7) it is indicated that with these reduced interest rates and no property tax that the annual levelized cost with the unit constructed and in service by 1983 would be 4.61¢ per kilowatt hour, and with the unit in service in November 1987 the levelized annual cost per kilowatt hour would be 6.03¢ per kilowatt hour. This compares to a levelized cost of 7.15 ¢ per kilowatt hour from Project 87.

IN PERFORMING YOUR STUDY HAVE YOU CONSIDERED THE POSSIBILITY OF RECEIVING GOVERNMENT FINANCIAL SUPPORT FOR THE DEVELOPMENT OF HYDRO CAPACITY?

Yes. In our answer in the previous question we have investigated the reduction in the interest rate of approximately 2%, and also have looked at a reduction or a cancellation in property taxes. The legislation currently pending in United States Senate would provide that interest on industrial development bonds issued to finance facilities the primary function of which is the generation of hydro electric power, is exempt from federal income taxation. If the bill were passed in the present form, the availability of industrial development bond financing for hydroelectric facilities in Wisconsin, Minnesota, Iowa and Illinois, would depend upon whether industrial development bond statutes of these states permit the financing of such facilities. The Wisconsin and Minnesota Statutes appear to be sufficiently broad to permit such a financing . However, legislation may be required for Dairyland to use industrial development bond financing for hydroelectric facilities in Iowa and Illinois.

As indicated in our previous discussion, this industrial development financing would allow the cost of money approximately 2 percentage points below present Dairyland financing sources. The proposed Genoa hydro development is located in the State of Minnesota. There is no indication that the State of Minnesota would not charge a property tax on the proposed development. However, it is felt that perhaps this kind of incentive could be offered by the legislature should development of the hydro potential at the Lock & Dam system become a reality. If we would embark upon this project we would investigate all possible sources of financing that may be available to these types of projects.

WHAT OBSTACLES DO YOU FORESEE TO THE PURSUIT OF HYDROELECTRIC DEVELOPMENT?

At the present time we see the licensing procedure of the Federal Energy REgulatory Agency to be a major obstacle to this or any hydro project. We also must investigate more closely the environmental effects of this project, particularly on the attitudes of the Corps of Engineers, U.S. Fish & Wildlife Service and other concerned agencies on the specific project. As the project is proposed, the power house will be located very close to the Fish & Wildlife Refuge, and there is concern that during construction we would need considerable amount of Refuge property for such things as material laydown, a cement batch plant, and other types of construction activity. We also would be required to move in and out of the site by way of the dike that extends from the end of the existing d[illegible] to the Minnesota side, and we understand that there are several nesting habitats of bald eagles in that particular region. Therefore, the attitude of the Fish & Wildlife Service is not completely understood at this particular time.

We also must study the effects upon the sport fishing in the Mississippi River below the dams, and the operation of the Lock & Dam system is primarily for navigation, with some flood control, we must investigate further with the Corps of Engineers their operating philosophy to determine if this operating philosophy would blend with the successful operation of a hydro project.

Another concern that would appear to be an obstacle is the small size of the project, and the relatively high cost. We have not investigated all the costs of the regulatory procedure to obtain approval of this particular project, but it would appear that these costs could be substantial, and without further investigation into these particular costs we don't know if the frontend cost of obtaining regulatory approval are worth the effort for such a small amount of installed generating capability.

DIRECTING YOUR ATTENTION TO A DIFFERENT TECHNOLOGICAL AREA, MR. LEIFER, WHAT SORT OF ECONOMIC ANALYSIS HAVE YOU PERFORMED IN CONJUNCTION WITH MR. HENNEN'S WIND ENERGY CONVERSION SYSTEM STUDIES?

An economic analysis has been made of various wind energy conversion systems (WECS). Mr. Hennen has made an estimate of the capital cost for constructing various types of WECS in either 100 unit arrays, or the same units constructed on a diversified basis throughout the Dairyland system. We have studied in detail two types of units, the WTG Unit, which is a 200 kilowatt rated unit, and the Alcoa Vertical Axis Unit, which is a 300 kilowatt rated unit.

Mr. Hennen in his testimony has discussed the energy output of each of these types of machines. Additionally we have looked at the MOD-2 Unit on an individual basis. Our estimates for these costs are very preliminary based on manufacturers data only and no experience. Mr. Hennen has discussed the MOD-2 Unit in his testimony.

Our evaluation assumed that the units would be installed either on 7-1-1983, or 11-1-1937. This was done for comparison purposes with the installation dates of other units considered in our studies. We have calculated the interest during construction and inflation to determine the investment cost required on those in-service dates. Exhibit (JPL-8) is a summary of the estimated construction cost of the various units analyzed.

Additionally we made an analysis of the Alcoa Units with the electrical generator and equipment price reduced by 50%. This was done to test the sensitivity of the economics should costs decline due to increased production of these generator units. These costs include the wind generator and supporting structures for the wind generating equipment.

As indicated, we have evaluated the units in either a 100 unit array, which would mean that the units would be installed in an array on a common site, each separated by ten blade diameters or blade heights, depending upon the type of unit. This installation would have advantages for operation and maintenance of a WECS system.

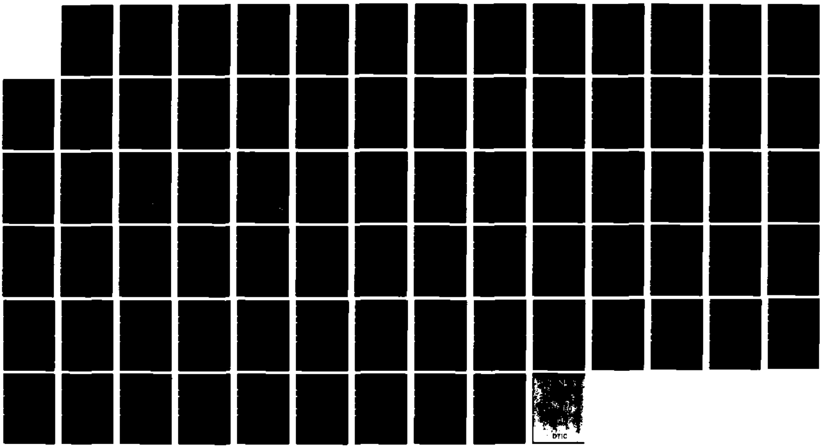
We have also evaluated the impact of taking the same 100 units of either the WTG or Alcoa type and installing them at dispersed locations throughout the Dairyland system. The detailed advantages of this type of installation will be presented by Mr. Hennen.

Based on the estimated construction costs shown in Exhibit (JPL-8) as well as the estimated operation and maintenance costs shown in Exhibit (JPL-9), we have determined the levelized annual cost of energy from each of the systems studied. The annual cost analysis to determine the levelized cost of energy from the WECS system was based on a facility life of 35 years, which hasn't been proven for wind machines.

Also included in the analysis for both the WTG 100 unit array, and the Alcoa 100 unit array, is a land revenue credit. There are wide areas of land available between each windmill in the array that could be grazed or planted. We have determined that this land could be rented for agricultural purposes and therefore the revenue from this rental is applied as a credit to the annual costs of these plans.

AD-A129 771 LOCK & DAM 7 MISSISSIPPI RIVER NEAR LA CROSSE WISCONSIN 2/2
RECONNAISSANCE REPORT FOR HYDROPOWER(U) CORPS OF
ENGINEERS ST PAUL MN ST PAUL DISTRICT DEC 80

UNCLASSIFIED F/G 10/2 NL



WHAT WERE THE RESULTS OF THESE ANALYSIS?

The economic analysis of the WECS systems studied indicate that the levelized annual cost in cents per kilowatt hour range from 9.6¢ per kilowatt hour to 17.4¢ per kilowatt hour for systems installed in 1983. The system installed in 1987 would have similar costs ranging from 12.8¢ per kilowatt hour to 23¢ per kilowatt hour. A summary of the levelized annual cost in cents per kilowatt hour is included as Exhibit (JPL-10).

DID YOU PERFORM ANY SENSITIVITY ANALYSIS IN CONJUNCTION WITH YOUR ECONOMIC ANALYSIS?

Yes, we have analyzed the sensitivity of our original analysis.

For study purposes we reduced the Alcoa generator costs, which includes the wind generator and all supporting structures, by 50%, to determine the effect upon the annual costs of the economies that could be gained by mass producing wind generating equipment. We selected the Alcoa Unit because it appeared to be the lowest cost unit compared to the WTG units. This sensitivity analysis is shown on Exhibit (JPL-10). With the present Dairyland financing and present property tax rates the levelized annual cost of energy from these units range from about 12¢ per kilowatt hour for units installed in 1983, to around 15¢to 17¢ per kilowatt hour if a unit is installed in 1987.

Additionally we made an analysis assuming that construction of these WECS systems could be financed using industrial development bond financing which has a interest rate approximately 2% lower than Dairyland's conventional source of financing, and also that the State of Wisconsin would not tax these systems and therefore subsidize them to some extent. Using these reduced interest rates and propertytaxes, we have calculated the levelized annual cost in cents per kilowatt hour for units installed in 1983 and in 1987. These costs range from 7.4¢ per kilowatt hour to 13.8¢ per kilowatt hour for1983 investments, or with units installed in 1987 the annual levelized cost would range from 10.1¢ to 18.4¢ per kilowatt hour. A summary of the levelized annual cost with the industrial development bond financing and property tax relief, is included in EXhibit (JPL-10).

WHAT HAVE YOU CONCLUDED AS A RESULT OF THIS WECS ANALYSIS?

Based upon the results of this analysis of the WECS system it would appear that the costs of WECS systems, particularly the smaller 100 and 300 kilowatt units, are not economically comparable to fuel prices from conventional fossil units. WE prepared a levelized cost of fuel analysis for Project 87, which indicates over the 35 year life of Project 87, that the levelized fuel cost would be about 4.7¢ per kilowatt hour, with fuel escalation at 7% per year.

With fuel escalation of 10% per year, a levelized fuel cost for the 35 year period of 7.6¢ per kilowatt hour would result.

Due to the vagaries of the wind WECS can be counted upon only as fuel savers and not as firm capacity for utilities. Therefore, it is proper to compare the annual costs of a wind system to the annual costs of a fuel which it will replace. As the Dairyland system produces most of its energy with coal-fired steam generating equipment, it would be proper to compare the fuel costs from these steam units to the levelized annual cost of the WECS systems.

Based upon our analysis it would appear that the larger MOD-2 WECS may be economically justifiable as a fuel saver in the future. The smaller 200 and 300 KW units do not appear at this time to be economically comparable to the fuel cost from fossil units. It would appear that Dairyland should continue to monitor the development of the MOD-2 WECS
It should be pointed out that the MOD-2 has not been built and the costs used in this analysis are costs based on estimates developed in 1977. The first installation of the MOD-2 program is a cluster of units to be installed by the Bonneville Power Authority in late 1980, or early 1981 The research and development of the WECS is rapidly getting under way, Dairyland is committed to monitoring these programs to determine their applicability to the Dairyland system.

DOES THAT CONCLUDE YOUR TESTIMONY?

Yes.

TABLE JPL-2

EXHIBIT

DAIRYLAND POWER COOPERATIVE
EXISTING DAMS WITH GENERATION REMOVED
IN WISCONSIN SERVICE AREA

County	Site	River	Owner	Generator Rating KW*
Crawford	Gays Mills	Kickapoo	WP&L	254
Richland	Muscoda	Mill Creek	Muni	145
Sauk	La Valle	Baraboo	Muni	125
Juneau	Mauston	Lemonweir	WP&L	300
Juneau	Necedah	Yellow	WP&L	200
Monroe	Angelo	La Crosse	NSP	150
La Crosse	West Salem	La Crosse	NSP	125
Dunn	Elk Creek	Elk Creek	DPC	125
Dunn	Eau Galle	Eau Galle	NSP	[illegible]
Dunn	Colfax	Red Cedar	NSP	1000
St. Croix	Hudson	Willow	NSP	[illegible]
St. Croix	Little Falls	Willow	NSP	300
St. Croix	Willow Falls	Willow	NSP	600
St. Croix	Mounds	Willow	NSP	180
St. Croix	McClure	Apple	NSP	100
St. Croix	Huntington	Apple	NSP	640
Polk	Little Falls	Apple	NSP	92
Polk	Country Day	Apple	NWME	50
Polk	Balsam Lake	Balsam Brook	NWME	68
Barron	Chetek	Chetek	NSP	250
Barron	Red Lake	Red Cedar	NSP	320
Chippewa	Tildem	Duncan Creek	Private	93
Pirce	Pixley Rapids	Flambeau	LSDP	347
Ashland	Mellon	Bad	LSDP	450
Bayfield	Iron River	Iron	LSDP	95
Total Generation				7,030 KW
Average Generation per site.				282.4 KW

*Rating when generators were in service.

Table JPL-3

EXHIBIT

DAIRYLAND POWER COOPERATIVE

MISSISSIPPI RIVER HYDRO POTENTIAL

Location	Dam No.	DPC[a] MW	C. of E.[b] MW	CAI[c] MW
Red Wing	3	5.1	4.8	
Alma	4	9.6	8.8	5.3
Fountain City	5	13.7	14.0	7.0
Winona	5A	6.6	6.6	
Trempealeau	6	6.1	7.4	6.6
Dresbach	7	10.4	12.6	
Genoa	8	14.7	14.0	10.0
Lynxville	9	9.6	9.6	8.7
Guttenberg	10	12.2	13.6	8.0
Total		88.0	91.4	

(a) Hydro Potential calculated by DPC based upon average head and flow data for the 5 year period 1974-1978.

(b) Corps of Engineers Hydro Potential.

(c) Commonwealth Associates Hydro Potential based upon the results of the Genoa Hydro Appraisal Study.

EXHIBIT

DAIRYLAND POWER COOPERATIVE
ESTIMATED CONSTRUCTION COSTS
GENOA HYDRO PROJECT
1/1/80 - $1000

DIRECT COSTS	Est. Cost $1000
Land & Land Rights	150
Power Plant Structures	3,705
Reservoir, Dams & Waterways	1,849
Turbines & Generators	10,945
Accessory Elect. Equip.	946
Misc. Power Plant Equip	307
Roads	8
Transmission Station Equip	700
Total Direct Costs	18,610
INDIRECT COSTS	
Temp. Const. Facilities	300
Environmental Control	250
Misc. Indirect Const.	1,100
Total Indirect Costs	1,650
OVERHEAD COSTS	
Engineering	1,800
Legal Expenses	100
Administrative & General	250
Total Overhead Costs	2,150
TOTAL PROJECT COST 1/1/80	$22,410

ESTIMATED COST	Completion 7/1/83		Completion 11/1/87	
	$1000	$/KW	$1000	$/KW
Project Cost	$22,410	$3,201	$22,410	$3,201
Int. during construction	3,314	473	5,782	826
Escalation	4,659	666	11,624	1,660
Total Cost	$30,383	$4,340	$39,816	$5,688

EXHIBIT

ECONOMIC ANALYSIS STUDY ASSUMPTIONS

Interest	
REA guaranteed loan funds	9%
Industrial development	7%
Interest during construction	7.5%
Annual Escalation per year	
Investment	7%
Operating Costs	7%
Insurance Costs	4%
Property Taxes	
Wisconsin	1.8%
Minnesota	2.2%
Facility Life	
Hydro	50 years
Wind	35 years
Fossil	35 years

TABLE DPL-6

ANNUAL COST ANALYSIS

GENOA HYDRO PROJECT

UNIT DATA

Generating Capacity	7,000 kW
Annual Energy	52,000 MWH

ESTIMATED COSTS

	L/D 8 $1000	L/D 7 $1000	L/D 8 $/kW	L/D 7 $/kW
Investment				
1/1/80	22,410	24,600	3,201	3,400
7/1/83	30,383		4,340	
11/1/87	39,816		5,688	
ANNUAL OPERATING (7%)				
1/1/80	48	102		
7/1/83	63			
11/1/87	82			
INSURANCE (4%)				
1/1/80	12			
7/1/83	14			
11/1/87	16			

ANNUAL REVENUE REQUIREMENTS

Assumptions

Interest Rate	9%
Facility Life	50 years
Salvage Value	0
Taxes	2.2% Minnesota

Fixed Charge Rate (FCR) = CRF + Taxes

CRF = 9% 50 yrs = 9.12%

FCR = 9.12% + 2.2% = 11.32%

LEVELIZED COSTS - $1000

	In Service 7/1/83	In Service 11/1/87
Fixed Cost	$3,440	$4,507
Operating Cost	173	226
Insurance	23	26
Total Annual Cost	3,636	4,759
Annual Cost - ¢/KWH	6.99	9.15

TABLE [illegible]

ANNUAL COST ANALYSIS
[illegible] HYDRO PROJECT

[illegible]

Generating Capacity	7,000 KW
Annual Energy	52,000 MWH

ESTIMATED COSTS

	$1000	$/KW
Investment		
1/1/80	22,410	3,201
7/1/83	30,383	4,340
11/1/87	39,816	5,683

ANNUAL OPERATING (7%)

1/1/80	48
7/1/83	63
11/1/87	82

INSURANCE (4%)

1/1/80	12
7/1/83	14
11/1/87	16

ANNUAL REVENUE REQUIREMENTS

Assumptions

Interest Rate	7%
Facility Life	50 years
Salvage Value	0
Taxes	0

Fixed Charge Rate (FCR) = CRF + Taxes

CRF 7% - 50 yrs = 7.25%

FCR 7.25% - 0 = 7.25%

LEVELIZED COSTS - $1000

	In Service 7/1/83	In Service 11/1/87
Fixed Cost	$ 2,203	$ 2,887
Operating Cost	173	226
Insurance	23	26
Total Annual Cost	2,399	3,139
Annual Cost - [illegible]	4.61	6.03

EXHIBIT

WIND ENERGY CONVERSION SYSTEMS
ESTIMATED CONSTRUCTION COST
COSTS IN $1000

System	Construction Cost 1/1/80	Interest During Construction	Inflation	Tot... on In...
UNITS IN SERVICE 7/1/83				
WTG-100 Unit Array	26,724	3,725	5,764	36,213
WTG-100 Unit Diversified	28,934	4,033	6,240	39,207
Alcoa-100 Unit Array	26,965	3,759	5,816	36,540
Alcoa-100 Unit Diversified	24,881	3,468	5,366	33,715
Alcoa-100 Unit Array*	19,465	2,713	4,198	26,376
Alcoa-100 United Diversified*	17,381	2,423	3,748	23,552
MOD-2	3,031	423	645	4,099
UNITS IN SERVICE 11/1/87				
WTG-100 Unit Array	26,724	4,896	16,114	47,734
WTG-100 Unit Diversified	28,934	5,301	17,447	51,682
Alcoa-100 Unit Array	26,965	4,940	16,260	48,165
Alcoa-100 Unit Diversified	24,881	4,558	15,003	44,442
Alcoa-100 Unit Array*	19,465	3,566	11,737	34,768
Alcoa-100 Unit Diversified*	17,381	3,184	10,481	31,046
MOD-2	3,031	555	1,828	5,414

*Cost of wind generating equipment reduced by 50%.

TABLE JPL-[illegible]

EXHIBIT

WIND ENERGY CONVERSION SYSTEMS
ESTIMATED OPERATING COSTS
AND ANNUAL ENERGY OUTPUT

System	Operation Costs 1/1/80	Insurance Costs 1/1/80	Energy Output MWH	Installed Capacity MW
UNITS IN SERVICE 7/1/83				
WTG - 100 Unit Array	540	9	31,000	20
WTG - 100 Unit Diversified	600	9	33,700	20
Alcoa - 100 Unit Array	450	8	31,000	30
Alcoa - 100 Unit Diversified	600	8	38,800	30
MOD-2	91	2	7,689	2.5

EXHIBIT

WIND ENERGY CONVERSION SYSTEMS
SUMMARY OF LEVELIZED ANNUAL COSTS

I. Levelized Cost Assuming Present Financing and Property Tax Rates.

System	Levelized Annual Cost - ¢/KWH Installation 7/1/83	Installation 11/1/87
WTG - 100 Unit Array	17.4	23.1
WTG - 100 Unit Diversified	15.4	20.5
Alcoa - 100 Unit Array	16.2	[illegible]
Alcoa - 100 Unit Diversified	13.9	[illegible]
Alcoa - 100 Unit Array*	12.6	[illegible]
Alcoa - 100 Unit Diversified*	11.0	[illegible]
*Cost of wind generating equipment reduced 50%		
MOD-2	9.6	12.8
Project 87 Fuel Cost - 7% Escalation		4.7
10% Escalation		7.6

II. Levelized Cost Assuming Industrial Development Bond Financing and Property Tax Relief.

System	Levelized Annual Cost - ¢/KWH Installation 7/1/83	Installation 11/1/87
WTG - 100 Unit Array	13.8	18.4
WTG - 100 Unit Diversified	12.3	16.4
Alcoa - 100 Unit Array	12.3	16.4
Alcoa - 100 Unit Diversified	11.3	15.0
Alcoa - 100 Unit Array *	9.9	13.3
Alcoa - 100 Unit Diversified*	9.4	12.5
*Cost of wind generating equipment reduced 50%		
MOD-2	7.4	10.1
Project 87 Fuel Cost - 7% Escalation	-	4.7
10% Escalation	-	7.6

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

In reply refer to:
OEPR-CH-RB

March 7, 1980

COL William W. Badger, District Engineer
St. Paul District Corps of Engineers
ATTN: Planning Branch/NCSED-PB
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Badger:

I am responding to the February 27 Notice regarding the initiation of a reconnaissance study for hydropower addition at Mississippi River Lock & Dam No. 7. The Notice also requested information on our interests in the study.

Under provisions of the Federal Power Act, the various Flood Control and River and Harbor Acts, the Water Resources Planning Act, and related legislation, we have been assigned broad responsibilities relating to the planning, construction, and operation of water resources projects, particularly with regard to the development of power. These statuatory responsibilities require us to cooperate in Federal river basin investigations by making studies and furnishing information on such matters as the potentialities for power development, the market for potential power, and the value of the power. Therefore, we will provide information on these topics as requested.

If you have any further questions or if you would like to coordinate the receipt of the information for the study, you can contact Ron Lesniak on 312/353-7215 (FTS).

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill
Regional Engineer

The State of Wisconsin

BOARD OF COMMISSIONERS OF PUBLIC LANDS

505 NORTH SEGOE ROAD

MADISON, WISCONSIN 53705

(608) 266-1370

March 7, 1980

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

RE: NCSED-PB Lock and Dam 7 Hydropower Reconnaissance Study

Gentlemen;

I am now employed by the Board of Commissioners of Public Lands. The address and postion on the inclosed announcement are no longer valid and should be discontinued. I would suggest that future notice be sent to the State Planning Office which is located at 1 West Wilson St. Madison, WI, 53701. The letter could be addressed to the attention of the Director.

This office is responsible for leasing of public lands under the provisions of s. 24.39 Wis. Stats. If there is any matter that you are concerned with under the provisions of that section this office should then be notified.

Thank you for your attention to this matter.

Yours truly,

BOARD OF COMMISSIONERS OF PUBLIC LANDS

Stephen E. Gauger

Stephen E. Gauger, Secretary

United States Department of the Interior

FISH AND WILDLIFE SERVICE

St. Paul Field Office, Ecological Services
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

IN REPLY REFER TO:

March 12, 1980

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 February 11, 1980 letter concerning the preparation of a reconnaissance study to evaluate the potential for the addition of hydropower generating facilities at Lock and Dam 7 near LaCrosse, Wisconsin. We will be pleased to assist you in this matter. Our representative will be Mr. Gary Wege (725-7131) of this office.

We look forward to working with the St. Paul District on this project.

Sincerely,

Stanley L. Smith

for Richard F. Berry
Field Office Supervisor

cc: UMRWLFR, Winona
UMRWLFR, LaCrosse

COMMITTEES:
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1ST DISTRICT, MINNESOTA
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704 MARQUETTE BANK BUILDING
ROCHESTER, MINNESOTA 55901
507-288-2384

33 E. WENTWORTH AVENUE
WEST ST. PAUL, MINNESOTA 55118
612-725-7716

March 13, 1980

Major S. E. Draper
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Major Draper:

Thanks very much for your letter enclosing the news release about the Corps of Engineers reconnaissance study to determine the potential for hydropower generation at Lock and Dam 7 near LaCrosse.

As a strong believe in using hydropower wherever it is feasible, I am glad to see the Corps is looking into this possibility. Please advise me as to the outcome of the reconnaissance study.

With best regards, I am

Sincerely,

Arlen Erdahl

ARLEN ERDAHL
Member of Congress

AE:krm

United States Department of the Interior

GEOLOGICAL SURVEY
702 Post Office Building
St. Paul, Minnesota 55101
March 13, 1980

District Engineer
St. Paul District, Corps of Engineers
1135 Post Office Building
St. Paul, Minnesota 55101

ATTN: Planning Branch
NCSED-PB

Dear Sir:

This letter is in response to your request for comments on the Corps' hydropower reconnaissance study at lock and dam 7 near La Crosse, Wis. A cursory examination of flow records for the Mississippi River at La Crosse indicates that the 99-percent-duration flow is about 6,900 ft^3/s, and the 60-percent-duration flow is about 16,000 ft^3/s. With a differential head of 8 feet at the dam, about 4,700 kw could be generated 99 percent of the time, and about 11,000 kw could be generated 60 percent of the time. This amount of power is so small that we wonder if consideration is being given to raising the height of the dam to provide more head and to increase the flow available from storage. If so, questions may be raised by landowners, environmental groups, and the Fish and Wildlife Service concerning the inundation of additional land above the dam, including the wildlife refuge at Lake Onalaska. Your study might address this issue by providing information on the tradeoffs between power generation and potential damage to wetlands.

Please let me know if we can assist in the study by providing hydrologic data on streamflow characteristics in the vicinity of lock and dam 7.

Sincerely yours,

Donald R. Albin
District Chief

cc: Regional Hydrologist, USGS
Regional Director, FWS

ONE HUNDRED YEARS OF EARTH SCIENCE IN THE PUBLIC SERVICE

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

Colonel William W. Badger
Dist. Engineer, St. Paul Dist.
U.S. Army Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

Dear Colonel Badger:

This responds to your February 11, 1980 letter requesting our comments on the possible addition of hydropower generating facilities at lock and dam 7 near La Crosse, Wisconsin. Due to the preliminary nature of this subject and consequent lack of detailed project information at this time, our comments will be in general terms.

Existing Resources

Most of the area in Pools 7 and 8, including land adjacent to lock and dam 7, are managed as part of our Upper Mississippi River Wild Life and Fish Refuge (UMRWLFR). Pool 7 of the Upper Mississippi River provides excellent and extensive fish and wildlife habitat. Lake Onalaska and the deltas of Tank Creek, Shingle Creek, and the Black River provide valuable fish and wildlife habitat and excellent hunting, fishing, and trapping opportunities. Lake Onalaska in particular provides valuable resting and feeding areas for migrating waterfowl, including canvasback ducks, as well as habitat for a variety of important sport and commercial fishes. Pool 7 is used extensively for public recreation (hunting, fishing, trapping, camping, and boating). In addition, four archeological sites included in the National Register are located in this area. The Wisconsin Department of Natural Resources has also classified Tank Creek at River Mile 711 as a natural area.

Pool 8 also 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 also exists in the delta of the Root River. Like the upstream pool, 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.

Several federally designated endangered or threatened species have been known to occur in this area of the Upper Mississippi River. The bald eagle (Haliaeetus leucocephalus), a threatened species, winters 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 this area.

Concerns

Construction and operation of a hydropower facility at lock and dam 7 will impact fish and wildlife resources, the extent of which must eventually be documented should the project appear feasible. A major concern of ours is the possible 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 our management of the UMRWLFR. 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 lock and dam 7. Concentrating a proportion 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 fishery. 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 would also result in adverse impacts to fish and wildlife resources.

As stated earlier, most lands in this area of the Upper Mississippi River, and in particular those located immediately east of lock and dam 7, are included in our Upper Mississippi River Wild Life and Fish Refuge. From the refuge standpoint, we are concerned that project construction and operation may conflict with the intended purposes for which these lands were acquired as a wildlife refuge.

The above concerns should be adequately addressed in future studies if the addition of generating facilities in lock and dam 7 appears economically feasible. I have designated Mr. John Lindell, District Manager-UMRWLFR, P.O. Box 415, La Crosse, WI 54601 (608-782-3210) as our representative in this matter. We also suggest you closely coordinate this project with the Wisconsin and Minnesota Departments of Natural Resources.

The endangered species comments contained in this letter constitute informal consultation only. Should you encounter listed or proposed endangered or threatened species or their habitats in the area, the Department of the Army should initiate the formal consultation process. This can be accomplished by writing to the Regional Director, U.S. Fish and Wildlife Service, Federal Building, Twin Cities, MN 55111.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

We appreciate the opportunity to offer our preliminary comments and look forward to working with St. Paul District personnel on this project.

Sincerely yours,

James L. Smith
Acting Area Manager

cc: Minn. DNR, St. Paul
Wisc. DNR, Madison
Bruce Hawkinson, Minn. DNR, Lake City
Dan Wilcox, ERB, Corps of Engineers, St. Paul

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

July 9, 1980

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

Dear Colonel Badger:

Your June 15, 1980 letter requests current power values for a potential hydroelectric generating plant located at Lock & Dam No. 7 on the Mississippi River near LaCrosse, Wisconsin.

As discussed with Mr. Al Bjorkquist of your staff, we will require somewhat more detailed information before we can compute power values applicable to the particular site and project that you are evaluating. In particular, we will need the following data applicable to each proposal for which you want power values computed:

a) Installed capacity.

b) Dependable capacity based on availability during seasonal maximum electric demand periods--January/December and July/August. (These date may be given as capacity duration curves for the two periods)

c) Weekly generation schedule comprising average annual generation profile.

d) Weekly maximum and minimum capacity restrictions on hydro operation.

Since these data are probably somewhat premature at this stage of your investigation, "typical" power values may meet your need at this time. Detailed and site specific values can be furnished once project parameters are more narrowly defined.

Power values for a typical base load hydro addition, the type your letter states is currently envisioned, would be computed based on the construction and operating costs of a coal-fired steam-electric plant. Using a Federal interest rate of 7-1/8 percent and January 1, 1980 price levels, we would estimate the power values for a base load plant of this type to be approximately $125 per kilowatt of dependable capacity and $16.50 per thousand kilowatt-hours of average annual energy produced.

In the event, however, that the particular project does not have a significant dependable capacity, it may be appropriate to consider the most likely alternative to be something other than a base load steam plant. If, for example, there is no dependable capacity, or if the dependable capacity portion is quite small, the value of the project is more correctly based on the avoided production cost of the thermal energy displaced by the hydro operation or on the system costs associated with a combustion turbine plant as the most likely alternative.

As your study progresses, and as project parameters become better defined, we will be glad to furnish you with more project specific power values. Also, as you continue your investigation, if you have particular questions regarding the effect of a proposed operating plan on the benefits, please contact Mr. David Simon of my staff at (FTS) 353-6701 and he will be available to discuss the situation with you.

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill
Regional Engineer

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

December 3, 1980

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. Kowalski:

Your October 16, 1980 letter requests our analyses of the value of power at Lock and Dam No. 7 located on the Mississippi River near LaCrosse, Wisconsin. The Lock and Dam No. 7 project would consist of either a 4.8 or a 7.2 megawatt hydroelectric installation and could produce either 32563 or 47665 megawatt-hours of energy annually.

Using a coal-fueled steam-electric plant as the most likely alternative to the proposed hydroelectric project, power values are summarized in the attached table. These are "at-market" values; no transmission line costs for the hydroelectric development have been included. All values are based on October 1, 1980 levels and reflect the following general assumptions:

Basis for Measuring Power Value

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 likely alternative if the hydroelectric project is not constructed. This cost is given as the investment cost (capacity value) necessary to construct the most likely alternative and the production cost (energy value) which results from operation of the alternative.

Power values are based on an analysis of the difference in "system" costs resulting from the system being operated using the alternative and using the proposed hydropower addition. System operating costs for each of these cases are simulated using a probabilistic production costing computer model. The POWRSYM Version 48 production costing model was used for this analysis.

Electric "System" Simulated Using the Model

The combined MAPP Pool systems, as they are projected to exist in 1990, were selected as the "system" simulated using the production costing model. For 1990, the total energy requirement for this system is projected to be 160,658,000 megawatt-hours with a peak load of 32,349 megawatts expected to occur during the summer period.

Adjustment Factors Applied to Power Values

The capacity value includes a credit of 5.0 percent to reflect the greater operating flexibility of the hydroelectric plant. In addition, the capacity value has been reduced by 6 percent to incorporate the relative value of the hydroelectric plant capacity based on the probability distribution describing its availability in comparison with the availability of the coal-fueled steam-electric plant alternative. Accordingly, the capacity value given in the attached table is applicable to the installed capacity of the proposed hydroelectric plant and already incorporates the consideration of dependable capacity.

The energy values given in the attached table reflect the inclusion of the "energy value adjustment" which results from the difference in annual "system" energy production between the steam-electric alternative and the hydroelectric project. For the energy values shown, a credit of 0.9 mills/kWh was included. 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 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 January 23, 1980 in the Federal Register, Part IX.

If you have any questions regarding these power values, please let us know.

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill
Regional Engineer

Enclosure:
As stated

POWER VALUE SUMMARY

Lock and Dam No. 7, Mississippi River
(October 1, 1980 Cost Base and 7-3/8% Cost of Money)

4800 kW - 8 Unit Installation

Capacity Value (based on installed capacity)		$97.00/kW-yr
Energy Value -		
Current Fuel Costs		$18.7/MWh
Escalated Real Fuel Costs		$28.2/MWh

Annual Hydroelectric Benefit

Energy Benefit 32563 MWh @ $28.2/MWh	$ 918,277	
Capacity Benefit 4800 kW @ $97.00/kW-yr	$ 465,600	
Total Annual Benefit	$1,383,877	

7,200 kW - 12 Unit Installation

Capacity Value (based on installed capacity)		$97.00/kW-yr
Energy Value -		
Current Fuel Costs		$18.8/MWh
Escalated Real Fuel Costs		$28.4/MWh

Annual Hydroelectric Benefit

Energy Benefit 47665 MWh @ $28.4/MWh	$1,353,686	
Capacity Benefit 7200 kW @ $97.00/kW-yr	$ 698,400	
Total Annual Benefit	$2,052,086	

APPENDIX C

HYDROLOGIC POWER AND ENERGY ANALYSIS

APPENDIX C

HYDROLOGIC POWER AND ENERGY ANALYSIS

For this reconnaissance study, three options were proposed initially. These options were for 8, 12, and 16 units producing 4.8, 7.2, and 9.6 MW, respectively. It later became clear that several powerhouse locations would have to be studied for each option, and that the 16-unit, 9.6-MW option would be costlier than the other two options. At this point, the 16-unit option was set aside, pending the outcome of the other two options.

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) can be assumed to represent an average year.

Since the head varies significantly, 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 on the factors of head (H) and flow (Q). The amount of the power produced by the turbine depends on its efficiency (e).

$$\text{Power (kW)} = \frac{Q\ (\text{cfs}) \times H\ (\text{ft}) \times e}{11.8}$$

For every point along the flow duration curve, the power is calculated for the available flow. If the flow available is greater than the design flow, 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 efficiency is taken to be constant at $e = 0.86$.

The average annual energy is represented by the area under the power curve. In plate C-1, these areas have been calculated for both the 8- and 12-unit options. The average annual energy calculated for the 8-unit option is 33,000 MWh, and that for the 12-unit option is 45,300 MWh. The data for the flow duration curves is shown on plate C-2.

FIRM POWER EVALUATION

The Federal Energy Regulatory Commission requested the firm power for the two critical periods of July-August and December-January. The only problem with this request is the lack of definition of "firm". No hydropower is 100% certain, because it relies on rainfall. Plants with considerable storage can achieve quite high reliabilities, such as the 99.4% reported at Sault Ste. Marie. A run-of-river plant has relatively lower reliability for firm power.

Plates C-3 and C-4 show the flow-duration curves for July-August and December-January, respectively. Firm power for a given percent of time, say 85%, is that power available at least 85% of the time. For December-January, values were calculated for 85, 90, and 95% reliability. For July-August, values were calculated for 80, 85, and 90%. These values of firm power are shown on plate C-5.

AVERAGE WEEKLY GENERATION

To calculate the power values to be assigned to a proposed site, its performance within the proposed power network is simulated by a computer program. In order to do this, the proposed generation schedule is required on a weekly basis. One could average all the flows for each week in the year for the period of record, giving expected weekly flows, and thereby the amount of energy generated for each week. The method chosen was to simulate weeks out of the monthly averages. Starting with January, each monthly flow was proportioned out into weeks and the extra days which begin the first (partial) week in the next month. The flows were chosen to vary from week to week, but also so that the daily flows for the month averaged to the monthly average. The flows and energy for both options are shown on plate C-6.

As a check on validity, the annual totals were calculated. The values check within 2% for the 8-unit option, and about 5% for the 12-unit option. The reason for these differences is that variations which would normally occur within a week are lost in the averaging process. Values were adjusted somewhat within months to try to account for this.

PLATE C-1

FLOW-DURATION CURVE

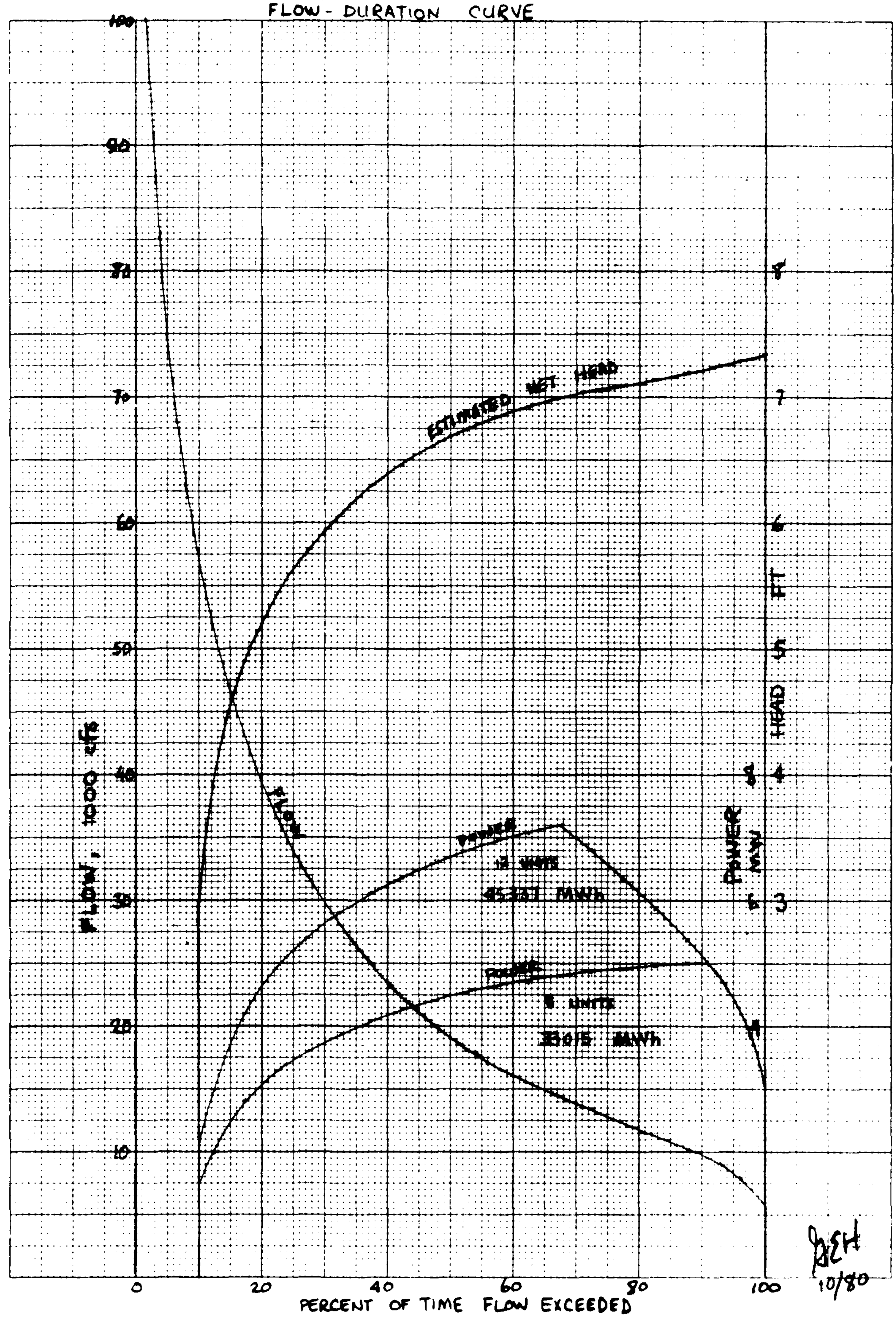

PLATE C-2

COMPUTATION SHEET

NAME OF OFFICE	COMPUTATION	DATE	PAGE OF

SUBJECT: Flow duration / Power curves for Lock & Dam 7 power house, for 8-600 kw and 12-600 kw units 7.0' design head

PRICE LEVEL

COMPUTED BY: HEITZMAN | CHECKED BY: | APPROVED BY:

PCT ANN.	GROSS POWER AVAIL	Flow	Gross Head	Net Head	Flow/Turbine	8 x Flow	8 x POWER (NET)	PERCENT JUL AUG	PERCENT DEC JAN	12 units Flow	12 u[nits] Pow[er] (NE[T])
1.5%		101 000	—					0.1			
2.7	3809	87 400	0.6	-				0.8		-	
4.7	7158	75 800	1.3	–				2.2			
7.3	10435	65 300	2.2	2.05	639	5104	761	4.6		7632	114
10.4	14053	56 900	3.4	3.15	792	6333	1449	6.9		9499	217
14.2	16001	49 500	4.45	4.15	909	7269	2191	10.3		10903	328
18.7	16208	42 100	5.30	4.95	992	7938	2854	14.0	0.6	11907	428
22.8	15546	36 900	5.80	5.40	1036	8291	3252	17.9	1.4	12 437	487
28.1	14346	31,600	6.25	5.80	1074	8593	3620	24.4	2.6	12859	543
33.3	13136	27400	6.60	6.10	1102	8812	3905	30.9	4.9	13216	585
38.9	11954	24 200	6.80	6.30	1119	8956	4098	37.2	7.8	13433	614
45.4	10729	21 100	7.00	6.50	1137	9097	4295	45.4	13.9	13645	644
53.9	9427	17 900	7.25	6.75	1159	9270	4545	55.0	24.2	13905	681
62.4	8493	15800	7.40	6.90	1172	9372	4698	61.2	36.5	14058	704
72.5	7464	13700	7.50	7.00	1180	9440	4800	69.8	55.0	13700*	696
82.3	6390	11500	7.65	7.15	1193	9541	4955	80.0	70.2	11500*	597
89.6	5608	10000	7.72	7.22	1198	9587	5028	87.5	82.0	10000*	524
94.9	4873	8600	7.8	7.30	1205	8600*	4560	93.4	91.0	8600*	456
97.7	4277	7500	7.85	7.35	1209	7500*	4004	96.2	95.6	7500*	400
99.1	3730	6500	7.90	7.40	1213	6500*	3494	97.9	98.5	6500*	34
99.8	3226	5600	7.93	7.43	1216	5600*	3022	99.3	99.5	5600*	30
99.9	2775	4800	7.96	7.46	1218	4800*	2601	100.	99.6	4800*	26
100.	2441	4200	8.00	7.50	1221	4200*	2288		99.8	4200*	22
100.	1395	2400	8.00	7.50	1221	2400*	1308		100.	2400*	13

* CASES WHICH ARE LIMITED TO FLOW AVAILA[BLE]

NCS Form 15 22 Dec 75

PLATE C-3
JULY - AUGUST

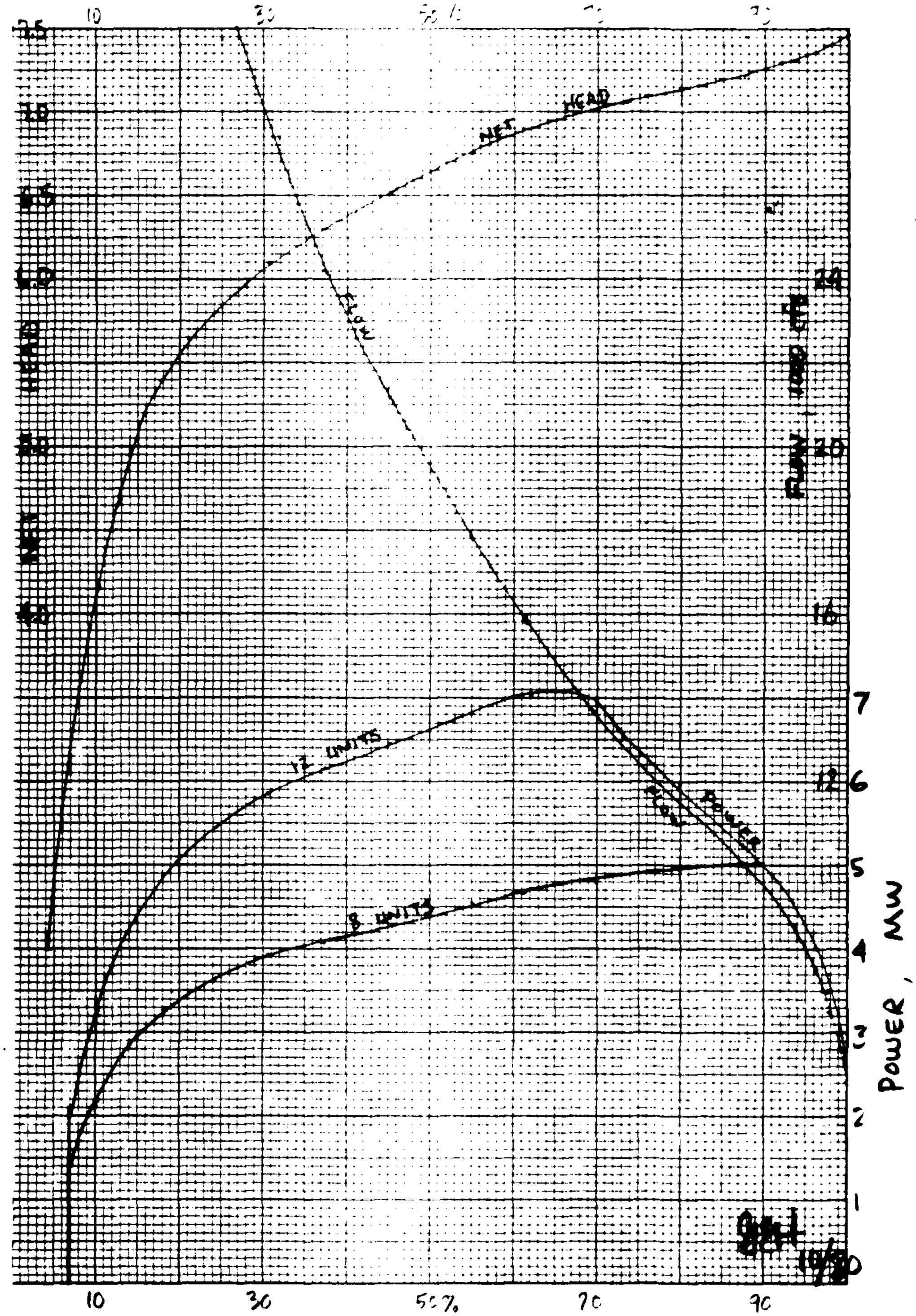

PLATE C-4
DECEMBER - JANUARY

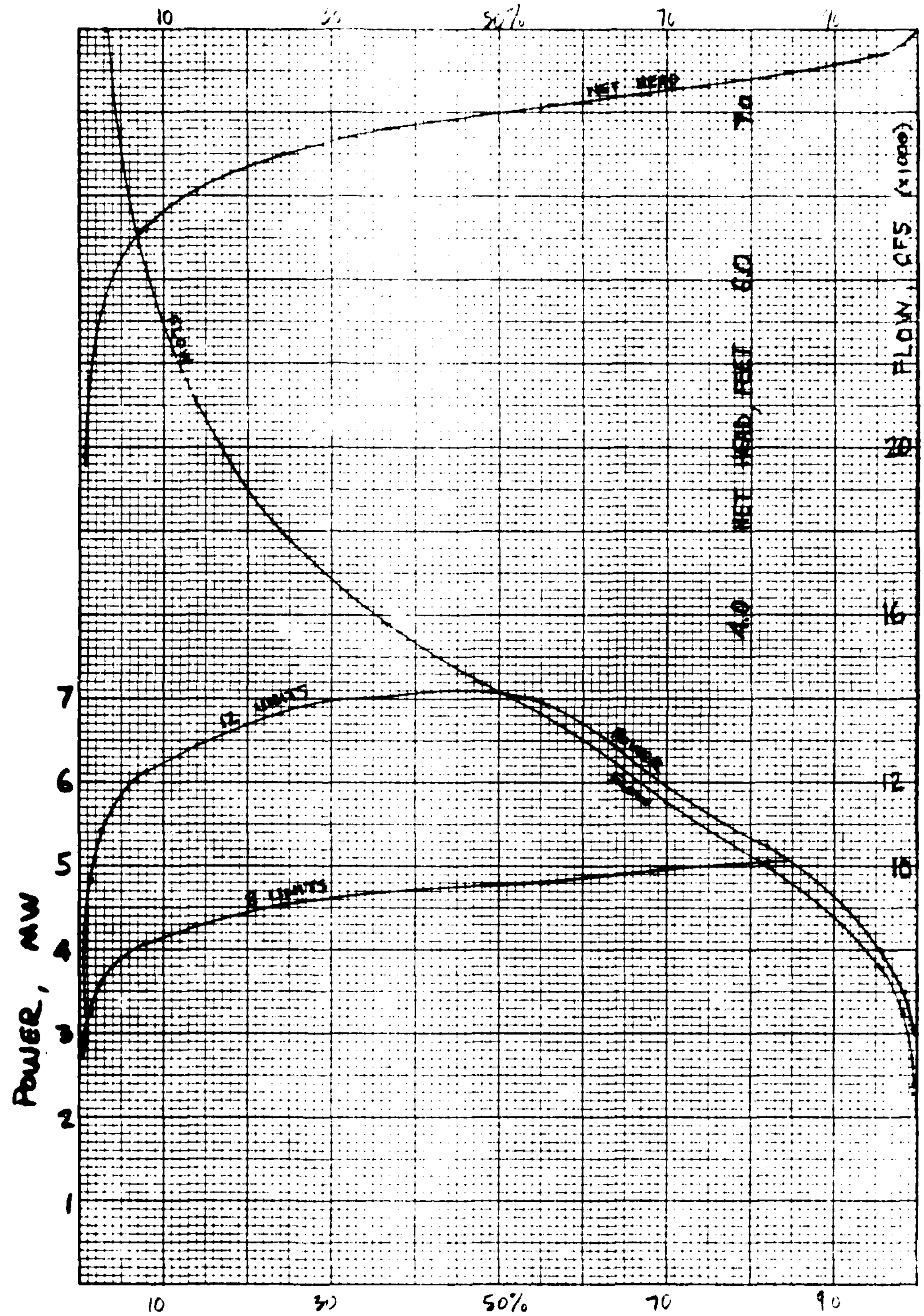

PLATE C-5

COMPUTATION SHEET

NAME OF OFFICE: NCSED-HF | COMPUTATION: | DATE: Oct 80 | PAGE OF PAGES

SUBJECT: FIRM POWER VALUES for LOCK 7 HYDROPOWER EXPRESSED IN KW by reliability in percent

PRICE LEVEL:

COMPUTED BY: HEITZMAN | CHECKED BY: | APPROVED BY:

INSTALLED CAPACITY KW		DECEMBER-JANUARY				JULY - AUGUST			
		85%	90%	95%		80%	85%	90%	
4800		4100	3900	3600		3300	2900	2200	
7200		4900	4600	4000		4300	3900	3000	

NCS Form 15 22 Dec 75

PLATE C-6

COMPUTATION SHEET

NAME OF OFFICE	COMPUTATION	DATE	PAGE
NCSED-GH		11-17-80	OF

SUBJECT: LOCK 7 HYDROPOWER

WEEKLY GENERATION VALUES - ENERGY (MWh) — PRICE LEVEL

COMPUTED BY: DEH — CHECKED BY: — APPROVED BY:

WEEK #	FLOW cfs	NET HEAD FT	8 UNITS ENERGY MWh	12 UNITS ENERGY MWh	WEEK #	FLOW cfs	NET HEAD FT	8 UNITS ENERGY MWh	12 UN ENER MW
1	16000	6.9	789	1184	27	33500	5.65	584	877
2	14200	7.0	806	1209	28	32000	5.75	600	90
3	11000	7.2	841	966	29	28500	6.0	640	96
4	16500	6.85	780	1170	30	24300	6.3	689	103
5	13000	7.05	815	1118	31	19600	6.6	738	110
6	9000	7.3	801	801	32	19300	6.7	755	113
7	15000	6.9	789	1184	33	19800	6.6	738	110
8	19500	6.65	747	1120	34	20500	6.6	738	110
9	16500	6.85	780	1170	35	21,800	6.5	722	108
10	19800	6.6	738	1107	36	21,500	6.5	722	108
11	27000	6.15	664	996	37	20900	6.55	730	109
12	37200	5.4	546	820	38	20600	6.6	738	110
13	47500	4.35	395	593	39	20100	6.6	738	110
14	57700	3.1	100	150	40	19000	6.7	755	113
15	65000	2.05	-0-	-0-	41	19300	6.7	755	113
16	66000	2.0	-0-	-0-	42	20200	6.6	738	110
17	60000	2.75	100	150	43	21000	6.55	730	109
18	52600	3.8	322	484	44	21700	6.5	722	108
19	50000	4.1	361	542	45	21500	6.5	722	108
20	46500	4.5	416	624	46	21200	6.5	722	108
21	45000	4.6	430	644	47	20500	6.6	738	110
22	42000	4.95	480	719	48	19,800	6.6	738	110
23	41000	5.05	494	741	49	21000	6.5	721	108
24	39300	5.2	516	774	50	16200	6.9	789	118
25	38,500	5.25	524	786	51	18000	6.75	763	114
26	37000	5.4	546	820	52	8500	7.3	757	75
		ANNUAL TOTALS for comparison			→			32563	476
								MWh 8 UNITS	MW 12 UN

NCS Form 18 22 Dec. 75

APPENDIX D

PLAN OF STUDY

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

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 tradeoffs 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 gener[illegible] ment, regional economic development, and soci[illegible] well-being. [illegible] policy of the Corps to coordinate the hydropower program [illegible] differences wherever possible. To accommodate this dialogue, and coordination, the Corps will hold workshop meetings periodi[illegible] discuss study progress and elicit reaction to potential proposals.

PUBLIC MEETINGS

In addition to developing an effective public involvement progr[illegible] 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 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).

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 [illegible] to supplement existing boring and topography information in are[illegible] considered improvements. Sufficient foundation investigations will [illegible] 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 tailraces. 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

Environmental studies will be undertaken to identify the impacts of alternatives and any selected plan on the natural and human environment. The objectives of these studies are to:

a. Assemble information on environmental elements which may be affected by hydropower alternatives and examine the interface between the social, economic, and environmental attributes in any project area.

b. Provide an environmental "early warning system" identifying the resources and amenities, both natural and man-made, which are part of the region's physical, biological, and cultural environments; are of local, statewide, national, or international significance; and should be preserved or protected.

c. Identify opportunities or possibilities for restoration and enhancement of the environment.

d. Provide an environmental inventory including scientific names for public information and participation discussions and coordination with other government entities.

Specific environmental work items would be as follows:

1. An investigation into Lake Onalaska flow patterns and an effort to predict changes in flow patterns in the lake that would result from operation of the alternative hydropower installations.

2. An effort to predict changes in sedimentation rate and distribution in Lake Onalaska because of the operation of the alternative hydropower installations.

3. An identification of measures that could improve the condition of Lake Onalaska or other mitigation to benefit fish and wildlife in conjunction with hydropower development at lock and dam 7.

4. A calculation of benefits resulting from measures that would be taken to improve the condition of Lake Onalaska in conjunction with hydropower development at lock and dam 7.

5. An effort to predict changes in tail water flow patterns resulting from operation of the alternative hydropower installations.

6. An investigation into changes in available tail water fish habitat resulting from construction and operation of the alternative hydropower installations.

7. An effort to predict entrainment and impingement mortality of fish passing through the alternative hydropower installations.

8. A study to predict the impact of entrainment and impingement-caused mortality on fish populations.

9. A study to predict the effect of the alternative hydropower installations on fish movements and the impact of restrictions of fish movements on the fish populations.

RECREATION

The recreation studies will investigate and document any recreation demand that could be satisfied by feasible recreation features incorporated in all nonstructural and structural alternatives and the national economic development, environmental quality, and recommended plans of improvement. Recreation studies will include survey-scope designs and cost estimates of proposed features. The location and extent of any lands required for recreation measures will be established. Monetary benefits attributable to satisfying unmet recreation needs will be determined in accordance with accepted guidelines. The need for and provision of project-related recreation measures will be established in accordance with local and State recreation guidelines. Project-related recreation features that might be considered include, but are not limited to, camping and picnicking facilities, boat docks, swimming areas, hiking and biking paths, scenic overlooks, and pedestrian bridges and other accesses. Provisions for use of facilities by the elderly and handicapped will be considered in the design of any recreation features. Appropriate drawings, sketches, or illustrations showing any proposed recreation facilities will be included in the feasibility report.

SOCIAL

Studies will be made to evaluate the social effects of all possible changes in any project on the residents of the area, esspecially effects of construction on French Island. Special emphasis will be made to determine these effects on those underprivileged, handicapped, aged, or minority groups affected. An assessment of the social effect of possible nonstructural changes in any project will be made. Effects of power line siting will be considered in social investigations.

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.

The interdisciplinary team approach works best when all participants have equal opportunity to be involved. This requirement does not mean that all participants will be involved in each activity, task, or stage, only that they will be involved when their skills could have a material effect on study progress and output.

The role of the study manager is pivotal to the successful accomplishment of interdisciplinary planning since the manager is responsible for coordinating and synthesizing the efforts of all involved. A study team concept described above with a study manager coordinating that team will be instituted early in the feasibility study.

WORK SCHEDULE AND STUDY COST ESTIMATE

Milestone schedule

Milestone No.	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 $10,000 in fiscal year 1981, $195,000 in fiscal year 1982, $170,000 in fiscal year 1984, and $40,000 in fiscal year 1985. The study cost estimate (PB-6) shows the breakdown of that funding.

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
OHIO RIVER
INTERIM REPORT #5 (L&D 7)
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			17	17	27	
3	.02	Institutional Studies			4	4	2	
4	.03	Social Studies			11	11	3	Increase for transmission line routing public opinion surveys.
5	.04	Cultural Resource Studies			5	5	9	
6	.05	Environmental Studies			77	77	50	Increase for added work identified in recon report.
7	.06	Fish & Wildlife Studies			6	6	11	
8	.07	Economic Studies			11	11	44	
9	.08	Surveys & Mapping			7	7	13	
10	.09	Hydraulics & Hydrology Invest.			18	18	48	
11	.10	Foundation & Materials Invest.			30	30	28	
12	.11	Design & Cost Estimates			80	80	41	Increase for detailed design required in DPR.
13	.12	Real Estate Studies			3	3	3	
14	.13	Study Management			20	20	32	

DATE PREPARED: 19 Jun 81
DIVISION: North Central
DISTRICT: Rock Island
REGION: UPPER MISSISSIPPI
BASIN:
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ENG FORM 1 APR 77 2204 EDITION OF 4 JAN 71 IS OBSOLETE.

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
OHIO RIVER
INTERIM REPORT #5 (L&D 7)

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	.14	Plan Formulation			10	10	16	Decrease due to findings
2	.15	Report Preparation			20	20	32	on Stage 1 reconnais-
3	.20	Other Studies			40	40	105	sance report and studies
4		Mechanical and Electrical			(40)	(40)	(105)	done by other districts.
5	.31	Supervision and Administration			56	56	71	
6								
7								
8								
9								
10								
11								
12								
13								
14		TOTAL			415	415	535	

DATE PREPARED: 19 Jun 81

DIVISION: North Central

DISTRICT: Rock Island

REGION: Upper Mississippi

BASIN:

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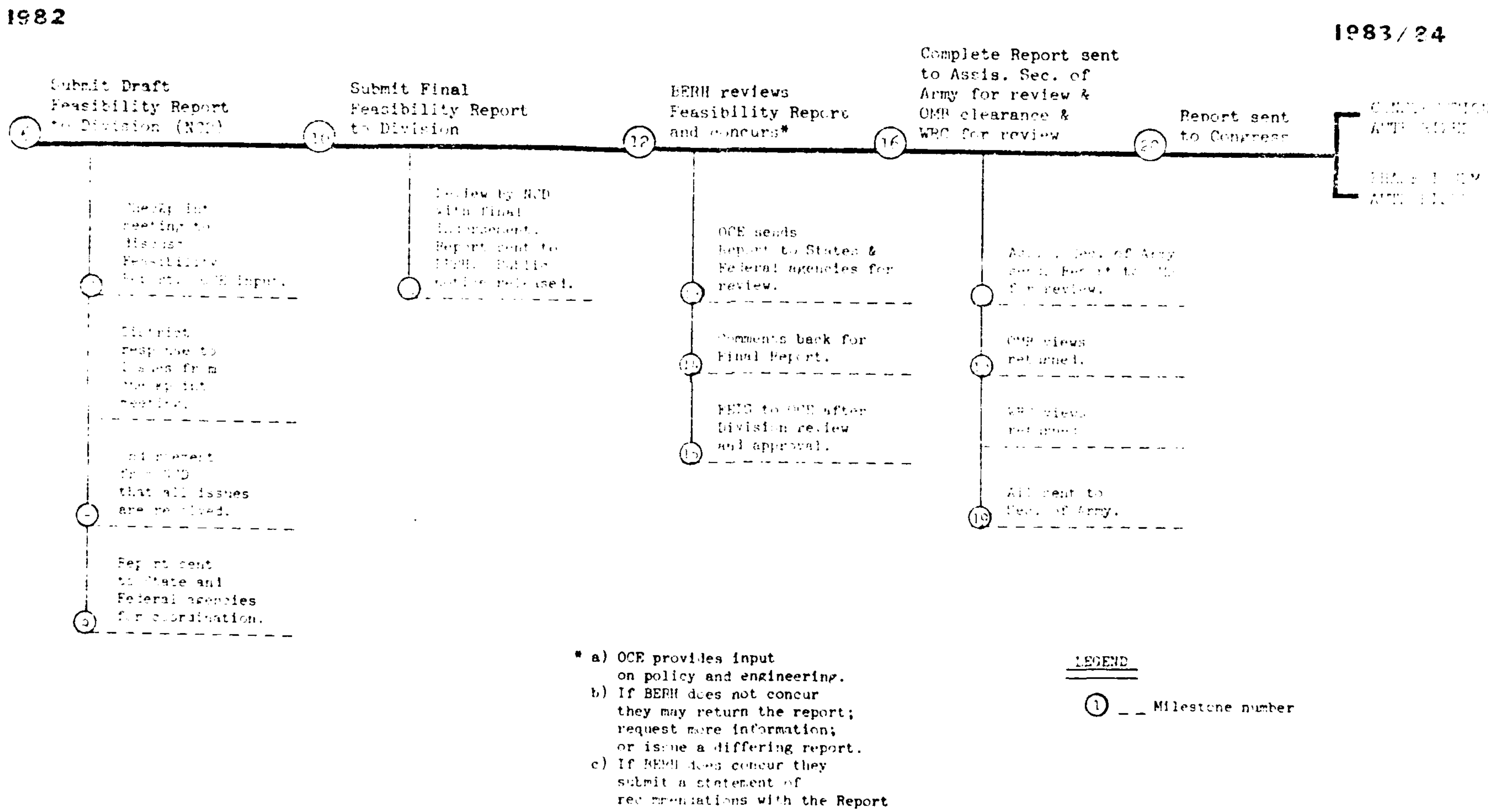
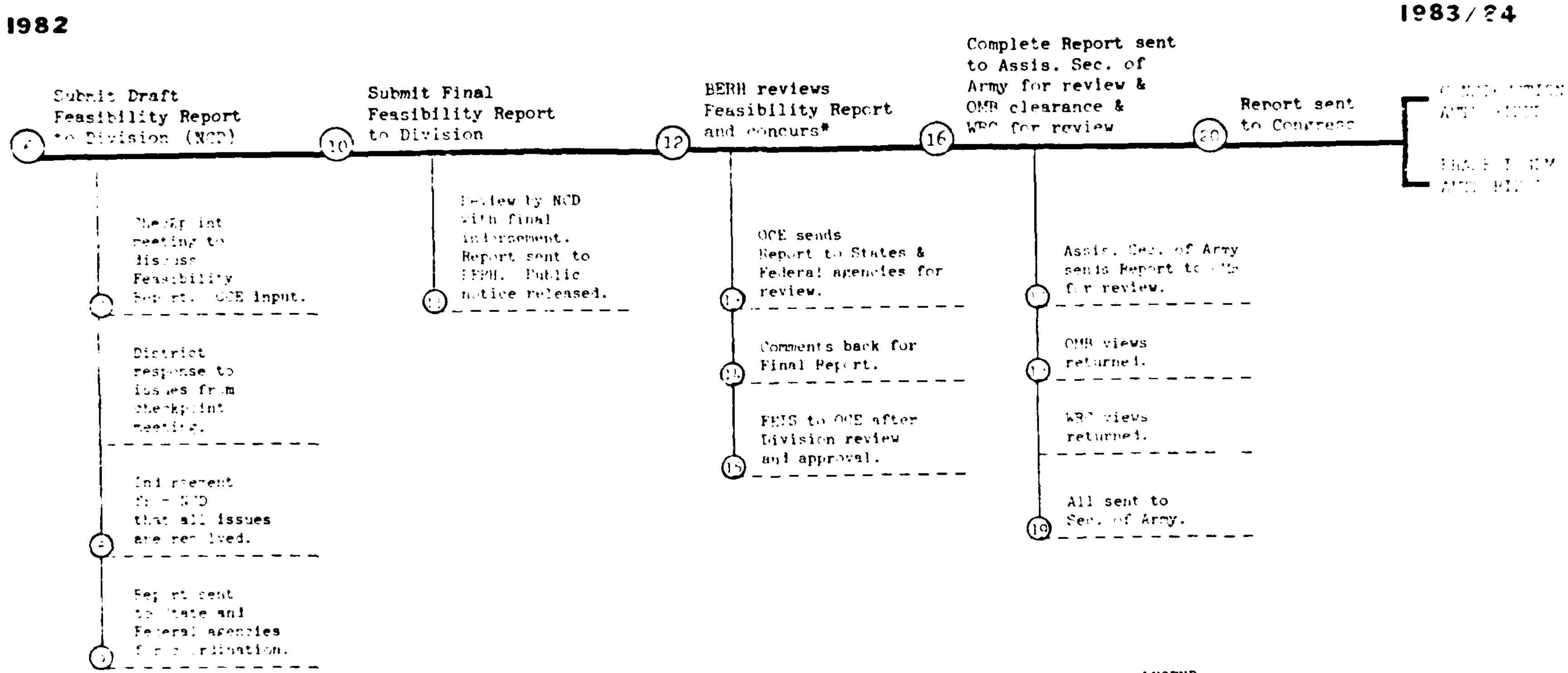
PROCEDURE FOR APPROVAL OF FEASIBILITY REPORT



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

○ _ _ Milestone number

APPENDIX E

ENVIRONMENTAL ANALYSIS

ENVIRONMENTAL SETTING

1.0 STUDY AREA

The study area is the geographic area that would be most directly affected by construction of a hydropower installation at Lock and Dam 7. The far-field effects of a hydropower installation can be very distant from the source. For example, the electricity produced is transmitted great distances, and effects on a riverine fish population could be noticed in other parts of the river system. For the purposes of this Reconaissance Report, however, the study area includes Pools 7 and 8 of the Upper Mississippi River, the shoreline areas of this reach of the river, and the portion of western Wisconsin in La Crosse County, Wisconsin.

2.0 NATURAL RESOURCES

2.1 Terrestrial Resources of the Study Area

2.1.1 Physical Geography- The main geographical feature of the region is the Mississippi River gorge or valley. Cut through the Prairie du Chien group limestone and St. Peter sandstone of the unglaciated uplands of western Wisconsin and southeastern Minnesota during glacial or preglacial times, the valley is about 5 miles wide at Lock and Dam 7. Bluffs rise about 360 feet above the level of the river on the Wisconsin side and about 520 feet on the Minnesota side. The Mississippi Valley in the study area near Lock and Dam 7 contains not only the river and its floodplain, but a prominent series of stream terraces, deposited and cut during glacial times. In the vicinity of Lock and Dam 7, the river and its floodplain occupy the western side of the bottomland. There is no stream terrace on the Minnesota side, except in the valley mouth at La Crescent. The complex of terraces in the Onalaska area to the east of Lock and Dam 7 rises in a series of scarps to approximately 100 feet above the floodplain and is breeched by the abandoned channel (now inundated) of the Black River.

2.1.2 Soils-The floodplain soils are alluvial materials deposited since the glacial period. The soils are clay, silt, and loam, sometimes sandy and often dark with organic matter. The subsoil is sand, which grades to coarser gravel and sand. 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.

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

2.1.4 Vegetation-Terrestrial vegetation of the study area consists of two main types: the xeric and dry-mesic forests of the uplands and the floodplain forests along the Mississippi River and Black River valleys. The upland forests are predominantly oak, ranging from savannah on the dry side of hills to more mesic forests on the protected side, with gradual transition stages in between. Some remnants of former prairie vegetation exist on the river terraces, such as French Island and Brice Prairie.

Pool 7 has 21,049 acres of floodplain: 3,947 acres in woody vegetation, primarily bottomland hardwoods with silver maple, cottonwood, and black willow, and 860 acres in terrestrial herbaceous vegetation such as sedge meadows. The Pool 8 reach of the Mississippi River floodplain is 39,274 acres, with 6,832 acres of woody vegetation and 3,100 acres of terrestrial herbaceous vegetation. More detailed inventory and description of vegetation of the Mississippi River bottomlands is presented in Minor, Caron, and Meyer, 1977, and Curtis, 1956.

2.1.5 Wildlife-Much of the floodplain area in Pools 7 and 8 is managed as part of the Upper Mississippi River Wild Life and Fish Refuge. The extensive bottomlands provide much valuable wildlife habitat. Whitetail 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 bottomlands in the vicinity of Lock and Dam 7, especially Lake Onalaska, are noted as a feeding and resting area for a variety of migratory waterfowl, including canvasback ducks.

2.2 Aquatic Resources of the Study Area

2.2.1 Waterbodies-The Mississippi River within the study area is impounded at Lock and Dam 7 at Dresbach, Minnesota, and at Lock and Dam 8 at Genoa, Wisconsin, to form Pools 7 and 8 of the waterway system. The Black River, originating in westcentral Wisconsin, flows into the Mississippi in Pool 7 at the head of Lake Onalaska. Tank Creek and Shingle Creek are also Wisconsin tributaries to Pool 7 that, along with the Black River, form an extensive delta above Lake Onalaska.

Pool 7 is 11.8 miles long and has 9,129 acres of aquatic habitat. The main channel of the river covers 2,195 acres; 922 acres are side channels; 1,150 acres are sloughs; 39 acres are ponds; and about 4,821 acres are open water lake. About 6,414 acres have submergent or emergent aquatic and marsh vegetation. Lake Onalaska covers about 5,400 acres in the lower third of Pool 7. Water enters Lake Onalaska from the Black River and from the Mississippi through a chain of islands separating the lake from the main channel to the west. Water exits the lake over the Onalaska Dam and Spillway, into the formerly abandoned Black River channel that is now inundated by Lock and Dam 8, and to the main channel of the Mississippi through channels between several islands immediately above Lock and Dam 7 in proximity to the proposed hydropower site. The lake contains several islands and extensive areas of submerged and emergent aquatic vegetation. The average depth is about 5 feet.

Pool 8 is 23.3 miles long and has 14,963 acres of aquatic habitat. The main channel covers 4,297 acres; 4,978 acres are side channels; 3,640 acres are sloughs; 1,311 acres are lakes; 278 acres are ponds; and 430 acres are tributary river. The Black River, the La Crosse River, and the Root River are tributaries to the Mississippi River in Pool 8.

Hydrological characteristics of the Mississippi River at Lock and Dam 7 are discussed in the Hydrology and Power Potential section, above.

2.2.2 Water Quality-The Mississippi River in the vicinity of Lock and Dam 7 is moderately hard, with total hardness rarely exceeding 175 mg/l $CaCO_3$. The dissolved oxygen concentration is generally in excess of 60 percent saturation. The river is well supplied with the plant nutrients nitrogen and phosphorous, sufficient to sustain dense algal blooms during the summer months. Water temperatures fluctuate annually from $0^{o}C$ to about $30^{o}C$. Turbidity varies seasonally with discharge and algal concentration ranging from about 2 to 30 JTU. The water quality of the Black River is similar to that of the Mississippi River, but has higher concentrations of dissolved organic matter and a darker color.

Lake Onalaska, immediately upstream of the potential hydropower location at Lock and Dam 7, has a high capacity to inflow ratio and a high sediment trapping efficiency. Between 55 to 60 percent of the inflowing suspended sediments and 100 percent of the bed load of inflowing water are deposited in the lake. There has been an alarming loss of lake volume in the last 40 years since closure of Lock and Dam 7, with up to 50 percent loss of depth. The lake is progressing toward hyper-eutrophy and drastic changes to the character of the lake are expected in the next 30 to 40 years (River Studies Center, University of Wisconsin-La Crosse, 1977).

2.2.3 Fisheries-The extensive water area and diversity of fish habitat in Pools 7 and 8 of the Mississippi River support an abundant and diverse fishery. Seventy-four species of fish have been reported from Pool 7 and 86 species of fish have been reported from Pool 8. This reach of the Mississippi River has provided sport and commercial fishing throughout man's development of the region.

The sport fishery harvest has been relatively constant in magnitude, and the diversity of sport fish species ensures some stability to sport fishing in the area. Angler harvest for the period 1972-1973 was estimated to be 166,949 pounds of fish from Pool 7 or 10.74 pounds per acre. Bluegill, crappie, white bass, sauger, walleye, channel catfish, and freshwater drum are the most commonly caught fish (rasmussen, 1979). Because of their proximity to the La Crosse metropolitan area, Pools 7 and 8 receive some of the highest sport fishing pressure on the Upper Mississippi River. Ice fishing is popular, especially on Lake Onalaska. Tailwater fishing below Lock and Dam 7 is also popular, especially during the spring.

The commercial fishery in Pools 7 and 8 is of economic significance. The average annual total catch between 1953 and 1957 was about 400,000 pounds for Pool 7 and 790,000 pounds for Pool 8. Carp, buffalo, catfish, and freshwater drum are the commonly harvested fish.

2.2.4 Wetlands-The abundance and diversity of fish and wildlife in the study area are supported by a complex riverine wetland system. A variety of wetland habitat occurs in the Mississippi River floodplain. Vegetation ranging from submerged aquatic plants to bottomland hardwood forests provide scenic diversity and valuable habitat.

2.3 Significant Natural Resources of the Study Area

The following resources of the study area are resources that are considered outstanding, critical, unique, and deserving of protection.

2.3.1 Refuge and Natural Areas-The Upper Mississippi River Wild Life and Fish Refuge, administered by the U.S. Fish and Wildlife Service, covers much of the Mississippi River floodplain in the study area. The State of Wisconsin administers the Midway Prairie Scientific Area bordering Lake Onalaska north of La Crosse, natural areas at Tank Creek, and a turtle nesting area at river mile 711. The State is considering several other areas for designation as natural or scientific areas within Pools 7 and 8, especially at the head of Lake Onalaska and the Black River delta.

The State of Minnesota has no designated natural or scientific areas within the study area, but does maintain a computerized inventory of significant natural resource locations within the State in conjunction with the Natural Heritage Program.

2.3.2 Fishery-The fishery, especially of Lake Onalaska, as described in Section 2.2.3 above, is a significant resource of the study area.

2.3.3 Lake Onalaska-Lake Onalaska, as described in Sections 2.2.1 and 2.2.2, besides providing outstanding fishing plus feeding and resting habitat for migratory waterfowl, is considered a critical resource because of its changing physical condition.

2.3.4 Migratory Waterfowl-The Mississippi River valley in the study area is noted for its migratory waterfowl, including the troubled canvasback duck. A heron and egret rookery exists at the delta of the Root River on Pool 8. The abundance and diversity of these waterfowl in the study area, the precarious status of some of the waterfowl species, and the popularity of waterfowl hunting and observation make this resource significant in the study area.

2.3.5 Threatened and Endangered Species-Several federally-listed endangered or threatened species have been observed in the study area. The bald eagle, a threatened species, winters in and migrates through the Mississippi valley, concentrating below dams or near the mouths of tributaries. The Higgins' eye pearly mussel, an endangered species, has been reported in both Pool 7 and Pool 8. The endangered peregrine falcon used to frequent the area.

2.3.6 Wetlands-Wetland areas are now recognized as valuable and are protected by Federal law, Executive Order, and various State and local regulations. The extensive riverine wetlands of the study area are a significant resource.

3.0 SOCIAL SETTING

Lock and Dam No. 7 is located within the La Crosse, Wisconsin, Standard Metropolitan Statistical Area (SMSA). The population of the La Crosse SMSA was 85,855 in 1975 (a 5.7 percent increase from 1970). Although the city of La Crosse has experienced a decline in population over that period, surrounding communities such as Campbell and Onalaska have increased in population. La Crosse SMSA per capita income in 1974 was $4165, compared with $4,466 for the State of Wisconsin. Major industrial employers are retail trade, services, and manufacturing.

4.0 RECREATION RESOURCES OF THE STUDY AREA

Pool 7 is the sixth largest of the 13 pools in the St. Paul District in terms of water acreage. The city of La Crosse, located immediately downstream of the dam structure, is the largest city in the District located on the river south of the Twin Cities. The pool area receives a great deal of public use pressure from the residents of La Crosse and is rated as the third most used pool segment in the District.

Most points along the outer limits on each side of Pool 7 are accessible by highway, with the city of La Crosse being the focal point for highways serving both Wisconsin and Minnesota. The new Interstate Highway 90, which crosses the river just downstream of Lock and Dam 7, provides a rapid and unrestricted means of reaching the lower end of the pool from the Minnesota zone of population influence.

Two major parks are adjacent to Pool 7, both State parks: O.L. Kipp Park in Minnesota and Louis Nelson Park in Wisconsin. The Lake Onalaska area provides an excellent wildlife and fishing area and attracts large numbers of duck hunters and year-round fishermen. Opening day duck harvest in this area is approximately 3000 to 4000, all species combined, with an average seasonal harvest of approximately 10,000 to 15,000. Creel surveys taken in 1972-1973 indicated that during that time period approximately 60,000 fishermen fished an estimated 218,500 hours and had an average catch of 1.5 fish per hour. Overall activity occasions for the pool are expected to increase from an estimated 670,000 in 1980 to 970,000 in 2025. Pool 7 ranks second highest in terms of needs for recreation resource facility development for all river pools within the District.

Pool 8 is the third largest pool in the District. Goose Island, located midway between the dams, is one of the most heavily used recreation sites in the northern portion of the river. The highway transportation system is similar to that of Pool 7, providing access to areas around the pool with LaCrosse serving as a focal point. But railroad lines along both sides of the pool, as in Pool 7, in many areas limit car access to the pool.

Major resource areas include Reno Bottoms, a major wildlife refuge, Crosby Slough, and the Target Lake Area. The main channel north of Genoa adjacent to Brownsville and north of La Crosse is heavily used for powerboating and water-skiing.

Again, similar to Pool 7, the majority of recreationists appear to reside in the La Crosse area and, according to recent surveys, have indicated a higher perception of resource crowding than indicated by users in adjacent pools. Activity occasions throughout the pool are projected to increase from 955,000 in 1980 to 1,300,000 in 2025. Estimated resource deficiencies in the pool have been indicated for boat-launching lanes, linear trails, and small-game hunting areas.

5.0 CULTURAL RESOURCES OF THE PROJECT AREA

The Mississippi River valley has been intensively occupied during prehistoric and historic times. Indian villages were located all along the valley floor, and burial mounds were built along the bluff tops. The valley has also been occupied historically by European peoples. In La Crosse county, a number of sites are recorded representing predominately Woodland, Oneota, and Mississippian components.

One Woodland and/or Upper Mississippian camp or village is located in the northeast corner of Section 13, T16N, R6W. This site would not be adversely affected by the proposed project.

Within the proposed project area, no known prehistoric and/or historic sites are recorded. As of 12 November 1980, no sites currently listed on or eligible for the National Register of Historic Places are located within the project area.

ENVIRONMENTAL IMPACTS OF THE SELECTED ALTERNATIVES

The following discussion on the impacts of construction and operation of a hydropower facility at Lock and Dam 7 is only general. It describes the potential impacts that are reasonably foreseeable at the present. A detailed analysis of the potential impacts has not been made.

1.0 IMPACTS OF SELECTED ALTERNATIVES ON NATURAL RESOURCES

1.1 Impacts of the No Action Alternative

The no action alternative would have no impact on the existing natural resources of the study area and would maintain existing conditions.

1.2 Impacts of the 8-Energy Unit and 12-Energy Unit Alternatives

1.2.1 Differences in Potential Impacts between the Two Alternatives- There would be few differences in the kind of impacts resulting from the construction and operation of the 8- and the 12-energy unit alternatives. The differences between potential impacts of the two alternatives would relate mainly to magnitude. Such differences are discussed below in the context of their expected occurrence.

1.2.2 Construction Impacts of the Selected Alternatives

1.2.2.1 Construction Impacts on Terrestrial Resources-Terrestrial impacts of hydropower development at Lock and Dam 7 would result primarily from construction of an access road, a construction storage yard, approaches for a cofferdam, construction site preparation, excavation of a discharge channel, a powerline corridor, and disposal of excavated and dredged materials.

The existing dike between French Island and Lock and Dam 7 would be used for an access road to the construction site at the east end of the dam. A short loop to the south of the dike and a low-water bridge would be necessary for the access road at the spillway. Construction of approaches and the low water bridge would disturb about 2 acres of floodplain forest.

Detailed site plans have not been developed; excavated material lay-down areas and dredged material disposal sites have not been identified. Construction activity near the east end of the dam (exclusive of on-land disposal area for dredged material) would result in the clearing of an estimated 5 acres of floodplain forest. The 12-energy unit alternative, because of its larger size, would require the excavation and dredging of more material and would disturb a somewhat larger area of floodplain than would construction of the 8-energy unit alternative.

Transmission of electrical power from a hydropower plant at Lock and Dam 7 would require a powerline right-of-way and transmission lines. Alternative routes for a powerline corridor have not been identified. The most direct route would extend east across the floodplain to tie into existing lines on French Island. Some clearing of trees and disturbance of soil would occur. The wires could interfere with the flight of birds, especially migratory waterfowl. Location of a transmission line corridor would require careful study to minimize impacts upon the floodplain wetlands and upon migratory waterfowl.

Construction activity, noise, and dust would disturb wildlife in the immediate vicinity of the access (dike) road and the construction site.

1.2.2.2 <u>Impacts of Construction on Aquatic Resources</u>-Material would be removed from the riverbed, riverbank, and the existing storage yard area at the east end of the dam to provide a curving approach and discharge channel for the hydropower units. Two temporary cofferdams would be constructed, one on the upstream side of the dam and one on the downstream side, to allow dry excavation and working conditions inside the cofferdams. A permanent closing dike would be constructed, extending from the existing dike to the first island separating Lake Onalaska from the Mississippi River. This dike would prevent scouring of the existing dike and would prevent, to some degree, increased currents in the southwest west portion of Lake Onalaska. Material would be placed in a wetland area for the spillway stream crossing for the access road. Rock riprap would be placed on all newly exposed riverbanks or the banks would be otherwise protected from erosion.

The amounts of materials that would be excavated, dredged, or filled have not yet been determined, and material disposal areas have not been designated. The 12-energy unit alternative would require the excavation and dredging of a larger amount of material for the intake channel, discharge channel, and powerhouse than would the 8-energy unit alternative.

Impacts to aquatic resources that would be associated with earthwork and dredging include burial or excavation of bottom substrate and increases in suspended solids concentration and turbidity in the water column. An estimated maximum of 5 acres of bottom substrate would be permanently altered. Benthic life in this area would be destroyed, and would not recolonize with the same abundance or community composition because of the substrate character and increased current velocity. Some tailwater fish spawning and foraging habitat would be lost during construction. Placement of additional rock riprap would increase hard substrate available for colonization by macroinvertebrates. Increases in turbidity and suspended solids concentration in the water column would be temporary and fairly localized. A more thorough analysis of the impacts associated with dredging and deposition of material into open water or wetlands for the hydropower project would be made in a 404(b) evaluation.

River flow and Lake Onalaska flow patterns would be altered by the upstream cofferdam during construction. Tailwater flow patterns below the dam would be altered by the downstream cofferdam. The overall effect of construction on river flow patterns would be a slight shift of river flow to the west. The easternmost two or three tainter gate bays would not be functional during construction. Outflow from Lake Onalaska would be restricted near the existing dike. Outflow would increase in the several more northerly channels between the chain of islands that separates the lake from the river.

1.2.3 Impacts Associated with Operation of the Selected Hydropower Alternatives at Lock and Dam 7

1.2.3.1 Operations Impacts on Terrestrial Resources-Either selected hydropower alternative would be operated as a run-of-the-river installation. No alteration of water levels on Pools 7 and 8 would be expected. No shoreline erosion or destruction of shoreline vegetation would be expected from hydropower operation at Lock and Dam 7. Riverbanks that would be subjected to increased current velocities in the vicinity of the hydropower installation would be riprapped.

Increased human activity along the access road dike that forms much of the southern boundary of Lake Onalaska could disturb migratory waterfowl on the lake and other wildlife in the adjacent floodplain. The spillway stream crossing would allow increased access to the river and adjacent floodplain from the French Island side.

Some noise would be generated at the powerhouse.

Transmission wires could interfere with the flight of migratory birds.

Much of the land area disturbed in construction would be replanted and allowed to return to floodplain forest.

1.2.3.2 Operations Impacts on Aquatic Resources-Because no water level fluctuations would be induced by hydropower operations, distant effects on littoral areas of Pools 7 and 8 are not expected.

Changes in water flow patterns both above and below Lock and Dam 7 are expected. Both the 8-energy unit and the 12-energy unit alternatives would divert a substantial portion of the Mississippi River flow through the turbines. This fraction would vary seasonally with river discharge and the head differential at the dam. Essentially all the river flow would pass through the turbines at certain times of the year (winter). The 12-unit alternative would divert a larger portion of the river flow than the 8-unit alternative.

These changes in flow patterns could alter flow patterns in Lake Onalaska. Given the lake's critical sedimentation problem linked with its hydraulic retention time, the effects of water flow patterns induced by hydropower installation deserve further study. Tailwater flow below Lock and Dam 7 would be altered considerably, with much of the flow through the dam passing through the turbines. Changes in flow patterns, current velocities, and bottom contour, along with an increased amount of rock riprap in the vicinity of the discharge channel, would alter the character of the tailwater fish habitat below Lock and Dam 7. Operation of the hydropower installation would increases current velocities on the east side of the tailwater area and generally decrease velocitities below the dam to the west. The extent to which these changes would affect fish populations using the tailwater area at Lock and Dam 7 is not known. Operation of the 12-unit alternative would have a greater impact on flow patterns than would the 8-unit alternative.

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 7 reach in 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 7 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 powerplant would restrict movements of fish through Lock and Dam 7. 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 7 and the impact of these restricted movements are not known at this time.

The intake and discharge channels could require occasional dredging to maintain adequate depth and configuration. The impacts of this maintenance dredging on the aquatic system are not expected to be great. Dredged material disposal areas for this potentially necessary maintenance work have not been identified.

2.0 SOCIAL IMPACTS OF HYDROPOWER DEVELOPMENT AT LOCK AND DAM 7

The most significant social impacts associated with the installation of hydropower units at Lock and Dam 7 would resùlt from construction activities and the addition of transmissión lines and corridors required to distribute generated power. In addition, social impacts would result from disposal of dredged and excavated material, employment opportunities, distribution of project costs and benefits, and conflicting resource use.

The social impacts of construction would be most severe in residential areas of the town of Campbell. Residents of Campbell would be temporarily inconvenienced by the hauling of construction materials, equipment, and byproducts and by workers commuting to and from the work site through residential areas. Impacts associated with these activities include increased noise and air pollution levels, road damage and repair costs, disruption of daily neighborhood activities, and a threat to the health and safety of neighborhood children caused by additional constuction-related traffic.

Transmission lines and corridors would be necessary for transporting power generated by the facility at Lock and Dam 7. The social consequences associated with placement of transmission lines and corridors would be significant and must be closely studied so that adverse social ipacts can be minimized and appropriately mitigated. Such an action may have social impacts because of relocation of private residences and/or commercial businesses, disruption to community cohesion, loss of property, decrease in property values, inequitable distributuion of project cost and benefits, and/or controversy.

Social impacts would also be likely to occur from disposal of excavated and dredged material. The degree and direction of these impacts depend on the means of disposal and the disposal site(s) selected. Similarly, the extenet and significance of the project's employment and economic benefits depend on other factors such as project size, size and location of the construction firm awarded the contract, and project operation and maintenance needs. Thus, further studies are required to determine the impacts described above.

An inequitable distribution of project costs and benefits may occur if areas inconvenienced or disturbed by construction activities, transmission lines and corridors, or other project-related activities do not receive benefits (additional power, lower electricity costs). If persons paying the costs perceive this inequitable distribution as unfair and avoidable, controversy is likely.

Controversy may also arise if hydropower operations prove incompatible with present resource uses such as managemnt of fish and wildlife refuge lands or recreation.

3.0 IMPACTS OF HYDROPOWER DEVELOPMENT AT LOCK AND DAM 7 ON RECREATION

The most significant impacts on recreation users and resources to be generated by the project are assumed to be directly related to the discharge of the turbines. The potential impacts on fisheries have been discussed above. The altered tailwater flow patterns could create boat safety problems which must be addressed in future studies. It is uncertain at this time what the impacts will be on fisherman user patterns at the dam.

The road access across the dike is used by fishermen to gain access to the spillway area. This access would not be available to them during construction, and a short-term decrease in fishery use is expected.

Most adverse impacts of the project, assuming a run-of-the-river operation, should be minor and short term. Improvements to current recreation use at the site might result if planned for during project construction. These actions might include fish habitat improvements in the discharge area and improvements to bank fishing access for the spillway site.

There has been some initial discussion regarding a possible visitor interpretation center to be located adjacent to Lock and Dam 7. If such a facility is identified and included in the Corps update to its recreation master plan, supporting facilities which could be implemented as a result of this study should be included.

4.0 IMPACTS OF HYDROPOWER DEVELOPMENT AT LOCK AND DAM 7 ON CULTURAL RESOURCES

Essentially the entire proposed construction area for the installation was previously disturbed by the construction of Lock and Dam 7. The potential for intact prehistoric and/or historic archeological sites to still exist is low. Bridge construction at the spillway would be in a previously undisturbed area; however, it is a low floodplain forest area. The potential for cultural materials to be located in this area is low. The only standing structure in the immediate project area is Lock and Dam 7.

Project coordination has been initiated with the Wisconsin State Archeologist, the State Historic Preservation Officer, and the Heritage Conservation and Recreation Service.

5.0 OUTSTANDING ENVIRONMENTAL ISSUES ASSOCIATED WITH HYDROPOWER DEVELOPMENT AT LOCK AND DAM 7

The following is a list of environmental issues that ahve been identified as deserving special attention in future planning efforts for hydropower development at Lock and Dam 7. Some of these issues were 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, to better predict the type and magnitude of potential impacts, and to develop appropriate plans for mitigating or minimizing adverse impacts.

1. Impacts of construction on wetlands.

2. Effects of hydropower operation on Lake Onalaska flow patterns and the associated impact on sedimentation rates and the aquatic biota.

3. Effects of altered tailwater flow patterns and fish habitat on fish population and fish utilization of Lock and Dam 7 tailwater area.

4. The potential for entrainment and impingement of adult fish, eggs, larvae, and young in the turbines and the impact of the increased mortality on fish populations.

5. The impacts of transmission lines on migratory waterfowl.

6. The impacts of construction on endangered species, especially the Higgins' eye pearly mussel and bald eagle.

7. The effects of a hydropower installation on the Lock and Dam 7 tailwater sport fishery and associated recreation.

8. The effect of construction on social conditions on French Island.

9. The effects of construction on any currently unknown cultural resource in the project area.

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