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SAND HILL RIVER WATERSHED DISTRICT PROJECT NO.4 THE WINGER DAM

**Polk County, Minnesota
June, 1987**



**Minnesota
Department of Natural Resources**

DRAFT ENVIRONMENTAL IMPACT STATEMENT

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SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4
DRAFT ENVIRONMENTAL IMPACT STATEMENT
ERRATA SHEET FOR SUMMARY

SUMMARY Page i - change second paragraph to:

All alternatives except the no-build alternative are designed to provide approximately 6,800 acre-feet of gated flood storage and to maintain similar flood control benefits.

SUMMARY Page iii - change second sentence of first paragraph to:

Stress to aquatic organisms was indicated by dissolved oxygen results.

DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4
THE WINGER DAM, POLK COUNTY, MINNESOTA

PREPARED BY:

MINNESOTA DEPARTMENT OF
NATURAL RESOURCES

ASSISTANCE OF:

SAND HILL RIVER WATERSHED
DISTRICT AND
HOUSTON ENGINEERING, INC.

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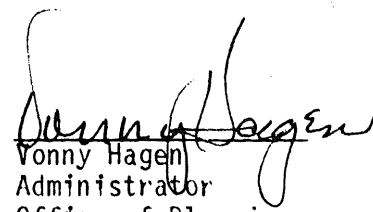
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ABSTRACT

This Draft EIS discusses the impacts, alternatives and mitigation requirements associated with the construction of a 1,600-acre Class I High Hazard Dam for flood control, for recreation purposes, and to facilitate a crossing of the Sand Hill River for State Trunk Highway 59.

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SUMMARY

DESCRIPTION OF THE PROPOSED PROJECT

Sand Hill River Watershed District Project No. 4, the Winger Dam is a proposal by the Sand Hill River Watershed District to construct a Class I or high hazard dam on the Sand Hill River in southeastern Polk County 1 mile south of Winger, Minnesota. The purpose of the proposed project is to provide for flood damage reduction for downstream areas, provide a recreational lake, and facilitate an upgraded crossing of the Sand Hill River for T.H. 59. The project involves the construction of an earth-fill flood reduction dam with recreational pool. The reservoir is 6.8 miles long with a permanent or recreational pool of 1,217 acres surface area and a depth of approximately 20.0 feet at the dam. The temporary flood pool for flood water storage with 1,613 acres surface area will be above the permanent pool with a depth of approximately 26.0 feet at the dam. The dam will provide a total of 6,881 acre-feet of gate controlled flood storage and 1,548 acre-feet of ungated or temporary flood storage.

The principal spillway is designed to handle the 100-year event and includes a 48" diameter low-flow pipe, a concrete riser structure with gate mechanisms to detain up to approximately 6,800 acre-feet of flood flows, reinforced concrete main pipe through the dam, and a stilling basin, and provides the roadbed for T.H. 59 over the top of the earth-fill dam structure.

There will be a depressed section of T.H. 59 (1,420 feet long) to serve as the emergency spillway and to pass the full Probable Maximum Flood Discharge of 20,840 cfs. The purpose of the emergency spillway is to pass abnormally high discharges within a limited and controlled area to preserve the safety of the dam.

The depressed section emergency spillway is designed to be adequately protected on the upstream and downstream side slopes to protect the integrity of the dam.

Approximately 1,613 acres of land are to be acquired under easement for all lands lying below the temporary flood pool. A number of modifications to area transportation facilities are proposed affecting T.H. 59, Polk County Road No. 204, Polk County State Aid Highway Nos. 1 and 8, and Sletten and Winger township roads.

ALTERNATIVES

Five alternatives proposed by the Sand Hill River Watershed District include the project proposal of the project sponsors (Alternative No. 1), design modifications to the proposed project (Alternatives No. 2, No. 3 and No. 4), and the no-build alternative (Alternative No. 5).

All alternatives except the no-build alternative are designed to provide approximately 6,800 acre-feet of gated flood storage. and to maintain similar flood control benefits.

ENVIRONMENTAL IMPACTS

Construction associated impacts - unavoidable construction process impacts on the surrounding environment which can be mitigated within the plans and specifications of project construction.

Dam Safety - all alternatives except Alternative No. 5 are proposed as Class I high hazard, large dams, with significant storage volumes, and some component is adjacent to or in close proximity to T.H. 59 and the Soo Line Railroad. The magnitude of downstream damages resulting from a dam failure does not significantly vary among Alternatives No. 1 to No. 4.

Fisheries resources - a fishery investigation was conducted to develop information on fish community structure with overall results indicating low populations of large fish species and poor diversity. Habitat reduction and oxygen deficiencies during low flow are primary limiting factors to the establishing of a healthy fish community structure.

High water fertility, shallow depth and low flows on the Sand Hill River increase the probability that the proposed impoundment will experience frequent winterkill conditions.

Implementation of fish management techniques such as stocking would require an adequate public access. To maintain a sport fishery, installation and operation of an aeration system would be required.

Wildlife resources - a Habitat Evaluation Procedure (HEP) study was undertaken to determine the impact of alternatives on wildlife resources. Alternative No. 1 eliminates a number of wetland acres within the permanent pool, but some additional wetland cover type is projected to be created or enhanced. Alternative No. 2 would result in a net loss of habitat units to upland and wetland species. Alternative No. 3 and Alternative No. 4 would result in a net habitat loss to upland species and a net gain to wetland species. Alternative No. 5 would not have a net impact on wetland or upland species.

Upland species mitigation is required for all alternatives except Alternative No. 5 and wetland species mitigation is required for Alternative No. 1 and No. 2. Alternative No. 3 and No. 4 would produce gains in wetland species habitat units.

Sand Hill River downstream flow analysis - the greatest downstream effects on the natural existing environment will occur to the wetland system downstream of T.H. 59. Except for Alternative No. 5 all of the alternatives have similar downstream effects. Alterations include both change in channel structure and change in wetlands.

An instream flow operation plan designed to replicate natural occurrences is discussed in the DEIS. There is an existing established protected flow on the Sand Hill River and the DEIS estimates that approximately 1.7 cfs should be released from the reservoir to meet the established protected flow requirements.

Project and downstream water quality - Nine water quality parameters were evaluated as indicators of the suitability of the aquatic environment. Dissolved Stress to aquatic organisms has indicated by dissolved oxygen results. No unusual phenomena were exhibited in data for total dissolved solids, total alkalinity or sulfate values. Total phosphorus values in sampled locations were high enough to support extensive algae blooms under impounded conditions such that watershed management practices would have to be improved to support any appreciable fisheries or other recreational amenities.

Land management practices/land use changes - sediment will accumulate within the proposed reservoir at a rate of 12.6 acre-feet/yr. or 21,900 tons/yr. Vegetative and land use changes will occur in the immediate vicinity of the proposed reservoir and in downstream areas. There is a potential for recreational development. Changes to the current shoreland management classification are recommended.

Agricultural impacts - it is estimated that there could be a loss of 1,019 acres of agricultural land, including 248 acres of cropland, 152 acres of pasture and 619 acres of Type 2 wetland, with Alternative No. 1. The agricultural net acre loss is estimated at 44 acres for Alternative No. 2, 155 acres for Alternative No. 3 and 223 acres for Alternative No. 4.

Economic analysis - an evaluation of the project engineer's economic analysis at two different discount rates is provided in Section 3.9. At a rate of 5 7/8%, Alternatives No. 1 to No. 4 have a positive benefit/cost (B/C) ratio greater than 1 while at the 8 7/8% rate, none of these Alternatives yield a B/C ratio greater than 1.

Archaeological investigation - no debris of significance detected.

MITIGATION MEASURES

Some mitigation measures are necessary and take the form of erosion control measures, an emergency action plan in the case of dam failure, upland and wetland species mitigation for habitat units loss, and downstream resources mitigation for instream flow effects. These are discussed in Section 4.0.

GOVERNMENTAL APPROVALS

Federal, state and local permits and approvals will be required under any of the alternatives selected and are shown in tabular form in Section 5.0.

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LIST OF PREPARERS

The following people were primarily responsible for preparing the Draft Environmental Impact Statement:

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Carmen Converse B.S. Horticulture	6 years, natural area survey and environmental review	Vegetation description and significant ecological features
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Daniel C. Thul B.S. Soil and Water	12 years, hydrologic modeling, watershed management and planning	Overall water resources coordination
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Name Education Professional Discipline	Experience	Project Responsibilities
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Jim Leach B.S., M.S. Wildlife, Biology, Zoology	9 years wildlife biology and environmental review	HEP Team Member U.S. Fish and Wildlife Service
Paul Richert B.S. Wildlife Management	7 years, environmental assessment and impact analysis	HEP Team Member U.S. Army Corps of Engineers

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Rick R. St. Germain E.I.T., B.S.C.E., M.S.C.E. pending Civil Engineering	2.5 years, civil engineering in water resources projects, inspection, hydraulic and hydrologic analysis, and design	Hydrologic and hydraulic analysis and design
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1.0 DESCRIPTION OF PROPOSED ACTION

1.1 PURPOSE OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

The purpose of an EIS is to provide information to evaluate a proposed project with the potential for significant environmental effects, to consider alternatives, and to explore methods for reducing adverse environmental effects. The EIS is not intended to justify either a positive or negative decision on a project but is to be used as a guide in issuing or denying permits or approvals for a project and in identifying measures necessary to avoid or mitigate adverse environmental effects. An EIS is required by the rules of the Minnesota Environmental Quality Board (EQB) for the construction of a Class I or high hazard dam. This DEIS discusses and evaluates the impacts, alternatives and mitigation measures on the surrounding environment associated with the construction of the proposed Sand Hill River Watershed District Project No. 4, the Winger Dam.

In addition to the information contained in the DEIS, readers and reviewers of this document may want to refer to the following additional reports (a general statement of the content of these documents is contained in the Selected References section) which have been prepared by the Department of Natural Resources (DNR), the project sponsors, and other governmental agencies:

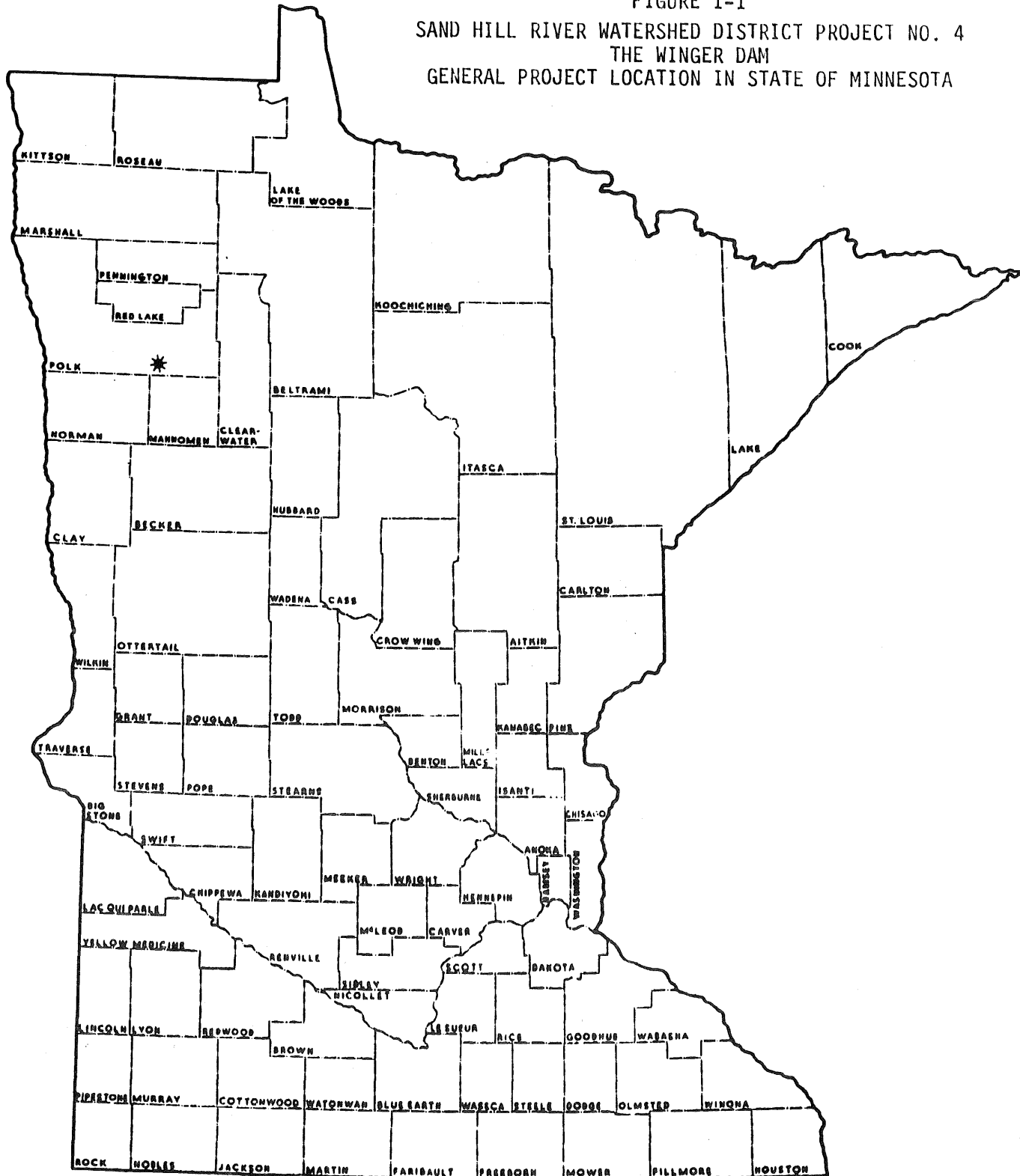
- Scoping Environmental Assessment Worksheet for Sand Hill River Watershed District Project No. 4.
- Scoping Decision Document for Sand Hill River Watershed District Project No. 4.
- Sand Hill River Watershed District Project No. 4 Preliminary Engineer's Report.
- Sand Hill River Watershed District Project No. 4 Preliminary Engineer's Report Economic Analysis.
- Sand Hill River Watershed District Project No. 4 Preliminary Engineer's Report Dam Safety and Risk Analysis.
- U.S. Army Corps of Engineers Section 205 Flood Control Reference Document for Initial Appraisal Report.
- Minnesota Department of Transportation Section 4(f) Evaluation for State Project 6008-06 (T.H. 59), Minnesota Project F 002-4(39) in Polk County.

1.2 PROJECT PURPOSE AND GENERAL LOCATION

Sand Hill River Watershed District Project No. 4, the Winger Dam is a proposal by the Sand Hill River Watershed District to construct a Class I or high hazard dam on the Sand Hill River in southeastern Polk County. The general project location within the State of Minnesota is shown in Figure 1-1. The purpose of the proposed project is to provide for flood damage reduction for downstream areas, provide a recreational lake, and facilitate an upgraded crossing of the Sand Hill River for T.H. 59. For the purposes of this DEIS, the proposal of the Sand Hill River Watershed District is, as discussed in Chapter 2.0, is identified, addressed, and evaluated as an alternative.

The proposed dam is to be located at the existing State Trunk Highway (T.H.) 59 crossing of the Sand Hill River, one mile south of Winger, Minnesota. The project location within Polk County is shown in Figure 1-2. The dam site is located on the section line between Sections 26

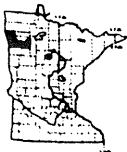
FIGURE 1-1
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4
THE WINGER DAM
GENERAL PROJECT LOCATION IN STATE OF MINNESOTA



GENERAL HIGHWAY MAP

POLK COUNTY MINNESOTA

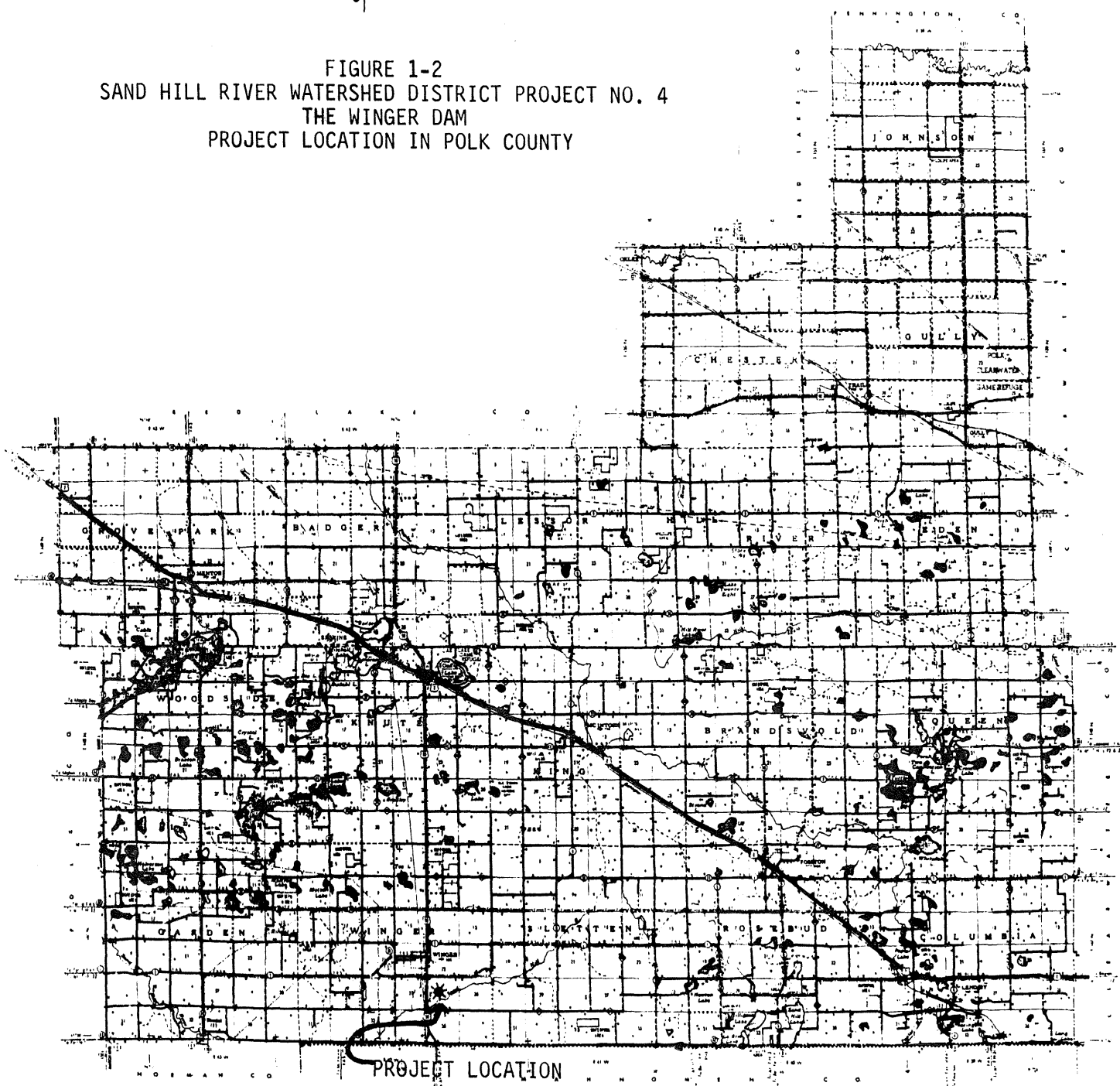
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SCALE OF STATUTE MILES



FIGURE 1-2
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4
THE WINGER DAM
PROJECT LOCATION IN POLK COUNTY



and 27 and between Sections 34 and 35 of Winger Township (T147N, R42W) in Polk County. The project is within the Sand Hill River watershed and the Red River of the North drainage basin. The project location within the Sand Hill River Watershed is shown in Figure 1-3.

The drainage area of the project is approximately 90 square miles. The Sand Hill River outlets into the Red River of the North at Climax, Minnesota, 50 miles downstream of the dam site.

1.3 EARTH-FILL DAM

The project involves the construction of an earth-fill flood reduction dam with recreational pool on the Sand Hill River at the T.H. 59 crossing of the Sand Hill River. A summary of the major project elements is shown in Table 1-1 and schematically in Figures 1-4, 1-5, and 1-6.

1.4 RESERVOIR

The reservoir is 6.8 miles long. The permanent or recreational pool with 1,217 acres surface area will be at elevation 1190.0 M.S.L. (Mean Sea Level Datum). The depth of the permanent pool is approximately 20.0 feet at the dam.

The temporary flood pool for flood water storage with 1,613 acres surface area will be above the permanent pool up to elevation 1196.0 M.S.L. The depth of the pool is approximately 26.0 feet at the dam. The flood water storage components of the project consist of both gated and ungated storage. The dam will provided a total of 6,881 acre-feet of gate controlled flood storage between elevations 1190.0 and 1195.0 M.S.L., and 1,548 acre-feet of ungated or temporary flood storage between 1195.0 and 1196.0 M.S.L.

Reservoir design inflow and outflow values were computed using the U.S. Army Corps of Engineers (USCE) HEC-1 computer program and by storage routing these flows through the dam assuming a no gate operation. These inflow and outflow values are shown in Table 1-2. A no gate operation assumes that the main gates remain fully open and that the initial reservoir elevation is at elevation 1190.0 M.S.L. prior to the occurrence of the runoff event.

TABLE 1-2
RESERVOIR DESIGN INFLOW AND OUTFLOW VALUES

<u>Flood Event</u>	<u>Design Inflow</u>	<u>Design Outflow</u>
2 year, 24 hour	269 CFS	114 CFS
5 year, 24 hour	487 CFS	274 CFS
10 year, 24 hour	735 CFS	394 CFS
25 year, 24 hour	1004 CFS	554 CFS
50 year, 24 hour	1241 CFS	700 CFS
100 year, 24 hour	1656 CFS	954 CFS
2 year, 10 day	239 CFS	136 CFS
5 year, 10 day	465 CFS	320 CFS
10 year, 10 day	783 CFS	519 CFS
25 year, 10 day	1194 CFS	798 CFS
50 year, 10 day	1510 CFS	1014 CFS
100 year, 10 day	1873 CFS	1261 CFS

PRELIMINARY CONSTRUCTION PLANS
PROJECT NO. 4 - WINGER DAM
SAND HILL RIVER WATERSHED DISTRICT
FERTILE, MINNESOTA

1986

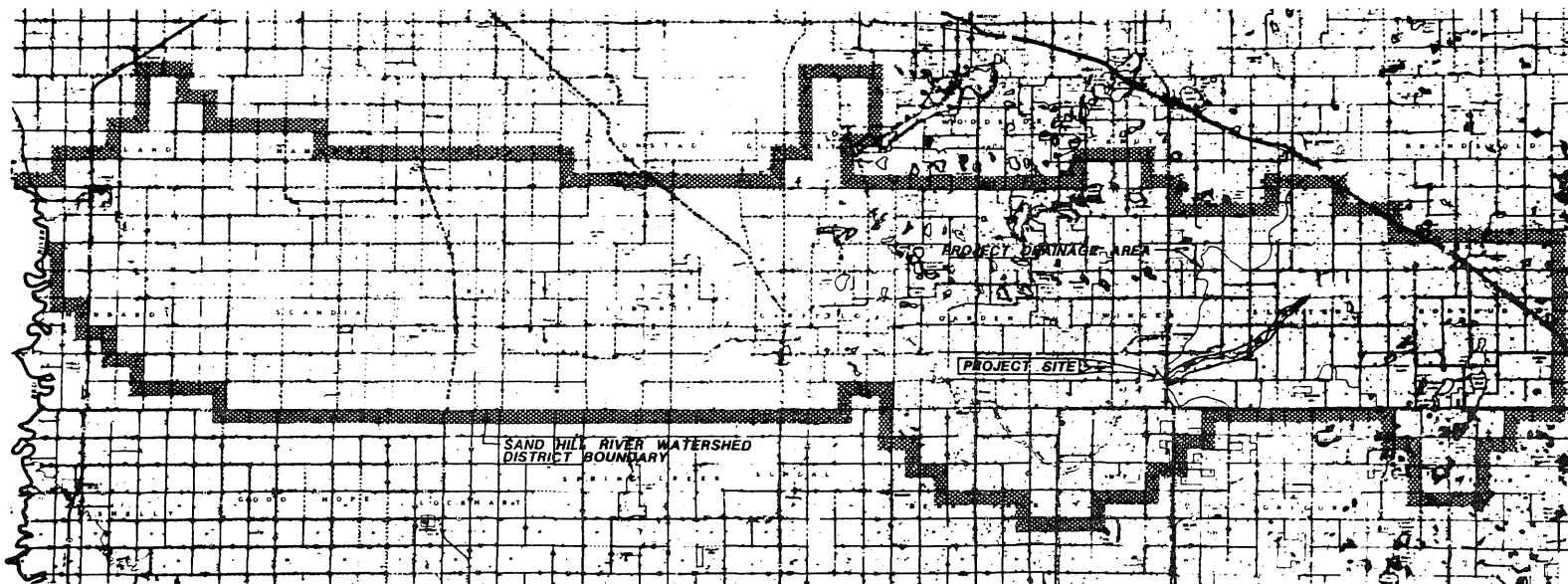


FIGURE 1-3

PROJECT LOCATION AND DRAINAGE AREA MAP				
PROJECT NO. 4 - WINGER DAM, SAND HILL RIVER				
SAND HILL RIVER WATERSHED DISTRICT				
FERTILE, MINNESOTA				
0.5 MILES	1.0	1.5	2.0	2.5
HOUSTON ENGINEERING INC.				

APPENDIX A

TABLE 1-1
SUMMARY OF PROJECT ELEMENTS

Road Dam

Type	Earth-fill
Crest Elevation	1200.0 M.S.L.(top of dam)
Crest Length	3,300 feet
Crest Width	40.0 feet
Freeboard	4 feet (above 100-year design flood)
Upstream Slope	4:1
Downstream Slope	4:1

Principal Spillway (100-Year Design)

Low Flow Pipe	48" Dia. RCP @ Elevation 1165.2 M.S.L.
Main Pipe	8.5' x 8.5' Reinforced Concrete Box (72.25 sq. ft.)
Concrete riser	8.5' x 22.0' Main Chamber
Fixed Crest	2-22' Weirs @ Elevation 1190.0 M.S.L.
Moveable Crest	2-22' Weirs from Elevation 1190.0 to 1195.0 M.S.L.

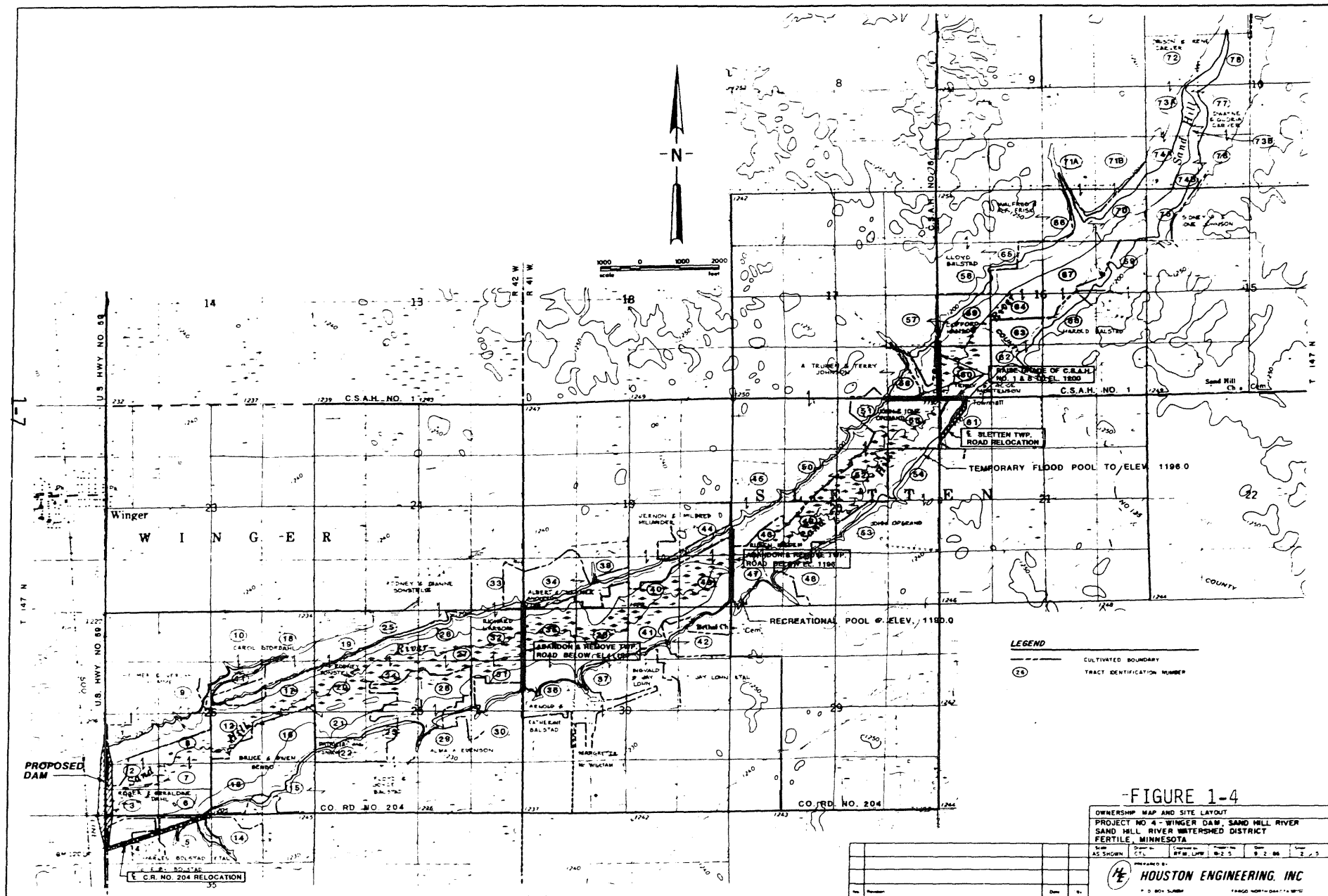
Emergency Spillway (Full PMF Design)

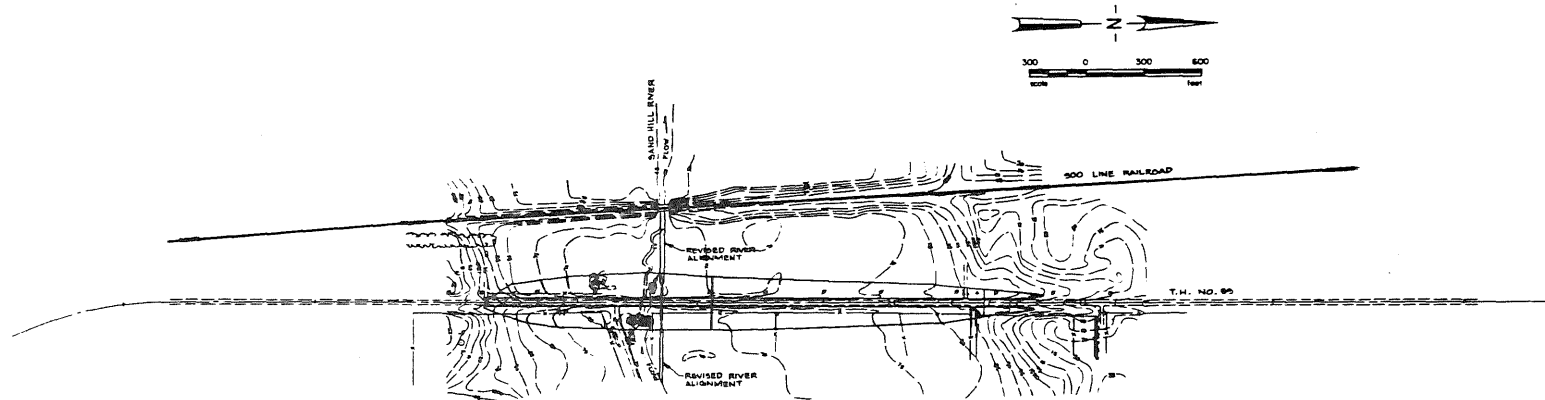
Road overflow section	At Elevation 1197.15 M.S.L.
Length	1,420 feet
Geotextile, sod, and sheet piling to protect embankment	

Reservoir

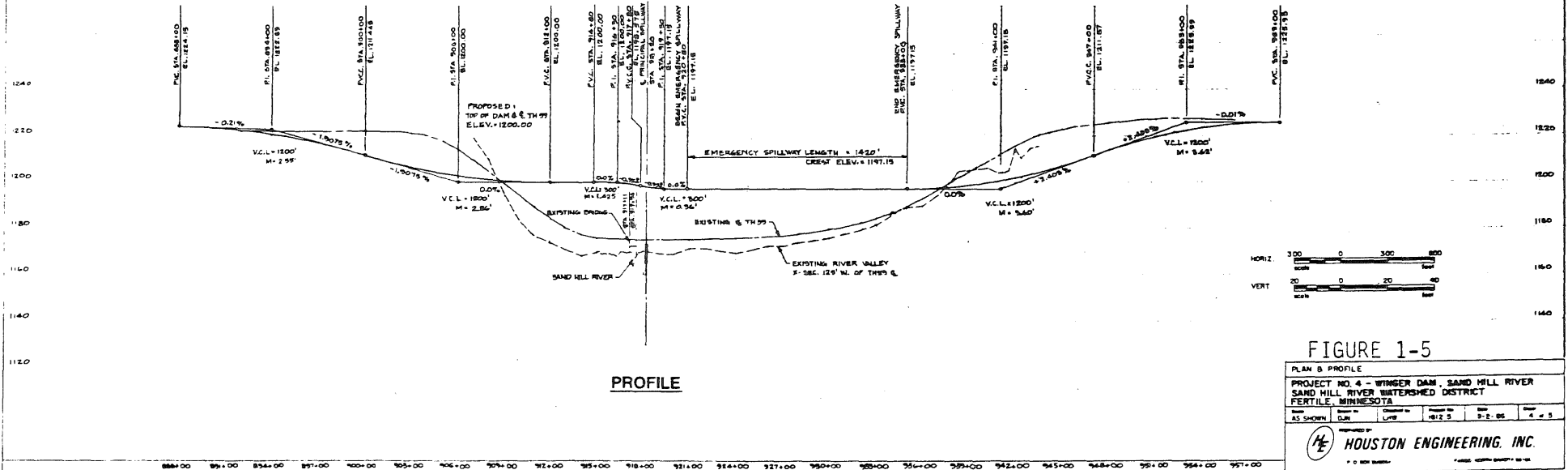
Flowline Elevation	1165.2 M.S.L. (stream bottom)
Recreation Pool Elevation	1190.0 M.S.L.
Temporary Flood Pool Elevation	1196.0 M.S.L.
Surface Areas with Storage Capacities	

<u>Elevation</u>	<u>Surface Area</u>	<u>Storage Volume</u>
1188 M.S.L.	1,098 acres	8,816 acre-feet
1190 M.S.L.	1,217 acres	11,131 acre-feet
1192 M.S.L.	1,317 acres	13,666 acre-feet
1194 M.S.L.	1,482 acres	16,465 acre-feet
1196 M.S.L.	1,613 acres	19,560 acre-feet





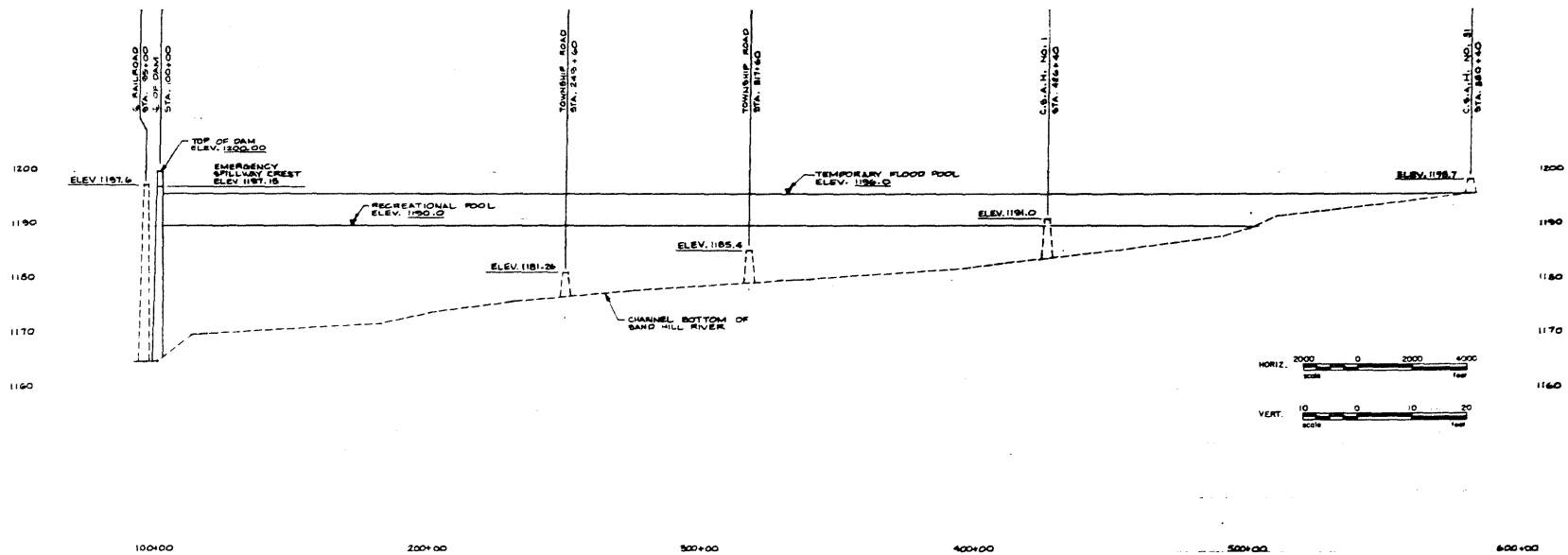
PLAN VIEW



PROFILE

FIGURE 1-5

PLAN B PROFILE			
PROJECT NO. 4 - WINGER DAM, SAND MILL RIVER			
SAND MILL RIVER WATERSHED DISTRICT			
FERTILE, MINNESOTA			
Drawn by	Checked by	Scale	Date
AS SHOWN	DUN	1/2" = 1'	3-2-55
HOUSTON ENGINEERING, INC.			



PROJECT PROFILE

FIGURE 1-6

PROJECT NO. 4 - WINGER DAM, SAND HILL RIVER
 SAND HILL RIVER WATERSHED DISTRICT
 FERTILE, MINNESOTA

The fluctuation in pool levels is dependent on operation of the two 22-foot movable weirs. The operation of the movable weirs (or gates) will vary depending on time of year and on flood predictions on the Red River of the North at Grand Forks, North Dakota. Spring operation of gates is designed to reduce flood peaks on the Red River of the North mainstem during the spring snowmelt season extending to about the middle of May. The two gates are designed to be in a lowered position (elevation 1190.0 M.S.L.) throughout the winter and preceeding the spring runoff. The gates will remain closed until such time peak flow predictions by the National Weather Service (NWS) equal or exceed 40 feet at Grand Forks; the equivalent of about 33,250 cubic feet per second (cfs).

Based on USCE frequency curves, this flow rate at Grand Forks has a 14% chance of occurring in any given year. (A flow rate that can be expected to occur once in every seven years.) The reservoir fluctuations that can be expected to occur for various 10-day design frequency events without flood gate operation are shown in Table 1-3.

TABLE 1-3
10-DAY DESIGN FREQUENCY RESERVOIR FLUCTUATION

<u>Frequency</u>	<u>Peak Reservoir Elevations</u>
2 year	1191.0 M.S.L.
5 year	1191.7 M.S.L.
10 year	1192.4 M.S.L.
25 year	1193.0 M.S.L.
50 year	1193.8 M.S.L.
100 year	1194.4 M.S.L.

Summer operation of the gates is designed to reduce flood peaks on the mainstem Red River of the North during the summer storm season. This season usually extends from about the middle of May to freeze-up. This operation is for the two gates to be in a lowered position throughout this season until such time as peak flow predictions by the NWS equal or exceed 40 feet at Grand Forks (the equivalent of about 33,250 cfs). However, storm events do not produce the runoff volume usually associated with spring snowmelt, thus the chances for a flow rate of 33,250 cfs at Grand Forks occurring during the summer season as a result of a summer storm event is about 1% in any given year. (A flow level that can be expected to occur once in every 100 years.) The reservoir fluctuations that can be expected to occur for various 24-hour design frequency events without summer flood gate operation are shown in Table 1-4.

TABLE 1-4
24-HOUR DESIGN FREQUENCY RESERVOIR FLUCTUATION

<u>Frequency</u>	<u>Peak Reservoir Elevations</u>
2 year	1190.9 M.S.L.
5 year	1191.6 M.S.L.
10 year	1192.0 M.S.L.
25 year	1192.5 M.S.L.
50 year	1193.0 M.S.L.
100 year	1193.7 M.S.L.

1.5 PRINCIPAL SPILLWAY

The principal spillway is designed to handle the 100-year event. The principal spillway will include a 48" diameter low-flow pipe moving waters from the bottom of the reservoir, a concrete riser structure with gate mechanisms to detain up to approximately 6,800 acre-feet of flood flows, an 8.5' x 8.5' reinforced concrete main pipe through the dam, and a stilling basin to dissipate the velocities produced. The principal spillway also provides the roadbed for T.H. 59 over the top of the earth-fill dam structure. The principal spillway plan, section, and facilities are shown in Figure 1-7.

Design hydrology was developed using the USCE HEC-1 Flood Hydrograph Package. Since no gaging records are available at or near the project site, synthetic inflow hydrographs were developed for various frequencies and durations of rainfall over the project drainage area. The HEC-1 model was then used to develop corresponding runoff hydrographs from the rainfall input.

Due to the nature and importance of the roadway passing over the top of the proposed dam, the principal spillway is designed to pass the critical 100-year runoff event. The critical 100-year event is defined as that precipitation duration which, when converted to a runoff hydrograph and routed through the dam, produces the maximum reservoir elevation. In this case the project engineers determined the 100-year, 10-day rainfall event to be the critical event. The Sand Hill River Watershed District, the project sponsors, also decided to limit the maximum reservoir elevation of the 100-year critical event to elevation 1196.0 M.S.L.

The design of the principal spillway assumes the reservoir to be at full gated capacity prior to the occurrence of the design critical event. Thus, the principal spillway was sized to pass the 100-year, ten-day runoff hydrograph with the reservoir initially at maximum design capacity (elevation 1195.0 M.S.L.). This design also assumes that, should the hypothetical design conditions occur, then both main gates would be lowered from their closed position (elevation 1195.0 M.S.L.) to the fully open position (elevation 1190.0 M.S.L.). Under these conditions, the maximum inflow would equal the maximum outflow.

The principal spillway facilities for the proposed project are sized for the 100-year event. For more frequent runoff events, the proposed dam would have varying effects of flood reduction, depending on the operation of the main gates.

The low flow discharge system removes waters from the bottom of the reservoir through the 48" diameter low flow pipe. This water moves up the 8.5' x 22.0' concrete riser chamber, is then passed over the 8.5' wide base flow weir, and then through the 8.5' x 8.5' main pipe. A 4' x 4' opening with a sluice gate has been provided in case it becomes desirable to totally draw down the reservoir. Under normal conditions of a permanent pool, the 4' x 4' sluice gate would remain closed.

The low flow passage system as proposed is designed to maintain the currently existing base flow characteristics of the Sand Hill River. The low flow discharge system is not designed to augment downstream river flows but to maintain existing downstream conditions as nearly as practicable.

1.6 EMERGENCY SPILLWAY

There will be a depressed section of T.H. 59 at 1197.15 M.S.L. to serve as the emergency spillway. This depressed section will be adequately protected and designed such that the Probable Maximum Flood (PMF) discharge will be passed without failure over the emergency spillway. The top of the dam will be set at elevation 1200.0 M.S.L. The purpose of the emergency spillway is to pass abnormally high discharges within a limited and controlled area to preserve the safety of the dam. The emergency spillway section is shown schematically in Figure 1-7.

The emergency spillway selected for the proposed project consists of a depressed section of the dam, 1,420 feet long. Since the top of the dam also serves as the roadbed for T.H. 59, the approaches to the emergency spillway are designed with vertical curve transitions to maintain sufficient sight distances and satisfy Minnesota Department of Transportation driver comfort criteria.

The crest elevation of the emergency spillway was set at elevation 1197.15 M.S.L. (centerline of T.H. 59) and established so that wave action in conjunction with a maximum gated pool elevation would not be higher than the road shoulder. The length of the emergency spillway was determined by routing the Probable Maximum Flood (PMF) through the structure, so that the top of dam elevation of 1200.0 M.S.L. was not exceeded.

The depressed section emergency spillway is designed to be adequately protected on the upstream and downstream side slopes to protect the integrity of the dam.

The PMF was developed from Probable Maximum Precipitation values for the area using the USCE HEC-1 computer program. The PMF discharge is 20,840 cfs. The design assumes that the emergency spillway section would have to pass the 20,840 cfs without consideration of the principal spillway capacity.

1.7 PROPOSED OPERATION AND MAINTENANCE PLAN

Operation and maintenance of the Winger Dam will be the responsibility of the Sand Hill Watershed District and will be operated in compliance with applicable federal, state, and local laws. The Operation and Maintenance Plan proposed by the project sponsors describes in detail the Winger Dam operation and maintenance plan and is reproduced as Appendix A.

1.8 EASEMENTS

Options for purchase of easements are presently planned for all lands lying below elevation 1196.0 M.S.L. Those tracts for which options cannot be negotiated will have to undergo condemnation proceedings. Currently, approximately 1,613 acres of land are to be acquired under easement. Additional lands may be required to provide for green belts, public access to the lake, and other facilities that may be necessary.

1.9 ROAD RELOCATIONS

Approximately 1/2 mile of Polk County Road No. 204 will be relocated to the south of its present location and rebuilt at an elevation equal to or above the temporary flood pool elevation (1196.0 M.S.L.). This work is located in Winger Township in the NW 1/4 of Section 35. Polk County State Aid Highways (CSAH) Nos. 1 and 8 will each be raised to an elevation above the temporary flood pool of 1200.0 M.S.L. The work involves about 2,150 feet of CSAH No. 1 and 1,700 feet of CSAH No. 8. This work is located at the corner in Sletten Township (T147N, R41W) common to Sections 16, 17, 20, and 21.

Approximately 1.4 miles of Sletten Township Road in the NW 1/4 of Section 21 will be relocated to the east and built at an elevation equal to or above the temporary flood pool elevation of 1196.0 M.S.L. Approximately 2,200 feet of Sletten Township Road below elevation 1196.0 M.S.L. between Section 25 of Winger Township and Section 30 of Sletten Township will be abandoned and removed. Approximately 1,900 feet of Sletten Township Road below elevation 1196.0 M.S.L. between Sections 19 and 20 of Sletten Township will also be abandoned and removed. Part of the submerged roadbed in both locations may be retained, if needed, for fisheries enhancement.

1.10 DESCRIPTION OF CONSTRUCTION METHODS CONTROL MEASURES

The proposed project will consist of an earth-fill dam with associated spillway works. The embankment is proposed to be a zone fill. The core of the embankment will be constructed of clay till select fill with compaction at maximum dry density and optimum moisture content. The outside zones of the embankment will be designated as random fill. The random fill zones will be constructed of a more free draining material than the core. Preliminary soil borings indicate that the upland areas adjacent to the dam site contain sufficient clay till of suitable quality for the core zone. Random fill may be obtained from existing roadway embankment and other required excavations adjacent to the dam site.

The project proposers have identified, based on commonly used construction practices, the following general sequence of construction:

- (1) Remove old bridge and existing roadway embankment within the project area. Equipment utilized would include scrapers, dozers, backhoes, and draglines.
- (2) Prepare embankment foundation and cut core trench using scrapers, dozers, backhoes, and dragline.

- (3) Install impervious cutoff to clay till stratum. A slurry trench cutoff is presently being proposed for this purpose. The clay slurry would be installed using backhoes and dragline.
- (4) Construct select and random fill sections of dam in lifts of approximately one foot. Scrapers, sheeps-foot compactors, and dozers would be utilized for this purpose.
- (5) Construct principal spillway components in coordination with embankment components. This work consists of forming and placing reinforced concrete as required.
- (6) At the same time as embankment and spillway construction, the river flow must continue to be passed through the work area. Although river control is normally left up to the contractor, the location of the principal spillway is such that the existing T.H. 59 bridge could be used until the principal spillway is completed. At that time, the river could be rerouted through the principal spillway and the bridge removed.
- (7) After completion of the embankment and spillway facilities, the embankment side slopes will be seeded and the T.H. 59 roadway surface constructed.
- (8) Prior to gate closure, all required upstream road relocations, abandonments, or raisings must be completed.
- (9) Upon completion of all project features, the dam would be closed by closing the 4' x 4' low flow sluice gate and the permanent pool would be formed.

1.11 NATURE OF THE ENVIRONMENTAL SETTING

1.11.1 Pre-settlement vegetation

The proposed Winger Dam site is located along a narrow strip of the Fosston Till Plain found between two portions of the Mahanomen Lacustrine Plain. The presettlement vegetation of these geomorphic regions graded from wet prairie and marshes of the lowland alluvial soils, to blacksoil prairie interspersed by aspen thickets and oak groves on the moderate to well-drained upland soils. Hardwood forests lined portions of the prairie riverbottoms.

1.11.2 Present vegetation

Presently, most of the side slopes and uplands of the Sand Hill River site are either cultivated for agricultural crops or are pastured. Forested areas typically are dominated by aspen species (Populus tremuloides, P. deltoides, P. balsamifera) with lesser amounts of bur oak (Quercus macrocarpa) and boxelder (Acer negundo). Understory shrub species included hazelnut (Corylus sp.) and gray dogwood (Cornus racemosa).

Several prairie remnants occur on the steeper slopes. The best example of prairie in the area is a 4-acre parcel located in well drained calcareous soils on a SE facing slope in the SE 1/4 of the NE 1/4 of Section 26, T147N, R42W. This glacial till hill prairie is dominated by little bluestem (Schizachyrium scoparium), side-oats grama grass (Bouteloua curtipendula) and porcupine grass (Stipa spartea). Big bluestem (Andropogon gerardi) and indiangrass (Sorghastrum nutans)

increase in dominance on lower portions of the slope. Some typical forbs include Petalostemum purpureum, Aster laevis, Liatris aspera, L. punctata and Solidago nemoralis. Some exotic species including sweet clover (Melilotus spp.) and Agrostis spp. are present. Buckbrush (Symphoricarpos occidentalis) and buffalo berry (Shepherdia argentea) are most prevalent in steep ravines or at forested edges. In general, this prairie is in good condition despite its small size, and represents the only known occurrence of a natural feature of interest in the project area.

Wetland vegetation bordering the Sand Hill River includes marshes dominated by Scirpus spp. and Typha sp. in the wettest portions, and extensive grass/sedge (Carex spp.) meadows dominated by reed canary grass (Phalaris arundinacea). Salix interior and other willow species are scattered throughout this wetland area. Slightly more mesic grasslands have been degraded by grazing and often contain exotic species such as Agrostis spp. and Phleum pratense.

1.11.3 Rare plants and animals

There are no known occurrences of rare plant or animal species within the boundaries of the project site. Given the current land use and vegetative cover of the area, it is unlikely that any would be found.

1.11.4 Glacial Till Prairie

The prairie described in the discussion on present vegetation is an example of a glacial till prairie considered state threatened by the Natural Heritage Program. Glacial till prairies typically are found on somewhat deep droughty soils formed in calcareous glacial till on steep side slopes along rivers and drainageways. The prairie found at the proposed site is an example of this type, but because of its small size, it is not regarded as a highly significant occurrence. Larger and more diverse occurrences of this type are found on protected areas in this region.

1.11.5 Land use and topography

The Sand Hill Watershed has an average width of only 8 miles and is approximately 55 miles long. The proposed project is located towards the upper end of the Sand Hill River Watershed. This area is glacial in origin and supports agricultural uses. It is mostly gently rolling terrain.

In the immediate vicinity of the proposed dam, the Sand Hill River has a very well defined floodplain with steep side slopes. The elevation difference between the river bottom and the top of the valley is approximately 60 feet. The Sand Hill River channel has an approximate slope of 2.5 feet per mile through the proposed project site.

The land use study area for this project is the same as the study area discussed in Section 3.4 (Wildlife Resources) and is defined as an area approximately 1/8 of a mile beyond the outer edge of the flood pool boundary for the proposed project. In general, the project area can be summarized as agricultural with the majority of the land being used for

agricultural purposes. About 34% of the study area is in cropland or crop hayland, 16% in pasture, 29% Type 2 wetland (summer pasture), 4% Type 3 wetland, 6% grassland and 8% wooded. Table 1-5 shows the acres of existing land use and cover type in the project area.

TABLE 1-5
EXISTING LAND USE AND COVER TYPE IN PROJECT STUDY AREA

	Recreation Pool	Flood Pool	Adjacent Area	Total
Crop	135	89	746	970
*Type 2 wetland	658	108	51	817
*Type 3 wetland	107	0	0	107
*Type 6 wetland	17	2	5	24
*Bottomland				
hardwoods (1L)	2	4	0	6
Grasslands	48	19	115	182
Woods	100	29	83	212
Pasture	128	93	226	447
Farmsteads	--	2	47	49
Roads	9	--	2	11
Totals	1204	346	1275	2825

*Wetland Types 1 to 6, as defined by the U.S. Fish and Wildlife Service in Wetlands of the U.S., Circular 39 are reproduced in an abbreviated form as Appendix F.

The DNR Protected Waters and Wetlands inventory has identified the Sand Hill River and four Type 3 wetland basins in the study vicinity subject to the regulatory authority of the Department, of which three are within the pool area and one is downstream of the dam site. The basins in the pool area include 580W (160 acres), 579W (282 acres), and 502W (114 acres). The basin downstream of the dam is 503W (160 acres).

1.11.6 Geology and ground water levels and flow patterns

The Sand Hill River is located in a broad valley about 1/2 mile in width. The valley has relatively steep side slopes, a broad flood plain and a shallow meandering channel. The thickness of the glacial drift is about 300 feet and overlies crystalline bedrock of Precambrian age. The unconsolidated material in the river valley consists chiefly of alluvial silts and clays with some gravel, sand and small boulders. Ground water in the upland area can be obtained from random sand and gravel lenses within the glacial till at depths generally less than 150 feet.

The Sand Hill River east of T.H. 59 is in a discharge area for the glacial till in the upland areas. Percolating water moves downward through the till as it flows in a predominately westerly direction toward the river valley. Upon reaching the river valley, discharge is to the Sand Hill River.

The water table level near T.H. 59 on March 11, 1981 was found to be at approximately elevation 1168.0 M.S.L. in the river flats and at approximately elevation 1185.0 M.S.L. in soil borings at a ground elevation of 1200.0 M.S.L. (the crest elevation of the dam). The water table is at the 1200 foot elevation about 1/2 mile from either side of the Sand Hill River at T.H. 59. This 1200 foot water table contour converges to the Sand Hill River within 7 miles upstream of T.H. 59.

When the proposed impoundment is filled, the surface configuration of the water table will change in the immediate vicinity. The existing water table elevation surrounding the impoundment will rise to the impoundment level (generally 1190.0 M.S.L.) and seep into the river bank until it coincides with the natural water table. This is shown schematically in Figure 1-8. The subsurface area ultimately affected due to the impoundment is dependent largely on the unknown upland water table elevation. Although insufficient water table data are available to determine the boundary of the affected area, it is unreasonable to expect that the subsurface area affected will move far landward from the impoundment for non-flooding conditions.

The effect of seasonal and less frequent floods on the water table should not extend significantly beyond the surface water inundated area, since flood levels are short term and assumably would not seep significantly in this alluvial clay material. Structures located near or within the 1200 contour may adversely affect the region's water quality through surface water interaction.

Five sites have been identified which may adversely affect the area's water quality. These sites are shown in Figure 1-9 and were identified since they may have wells and septic systems located near or within the 1200 foot contour. Minimum setbacks for wells and septic systems from an impoundment are governed by either the Minnesota Water Well Construction Code or local Shoreland Management ordinances. These codes and ordinances should be referred to for proper remedial action for wells and septic systems affected by the proposed impoundment.

1.11.7 Shoreland Management considerations

The state Shoreland Management program and Department of Natural Resources Rules outline statewide minimum standards and criteria for the management of shoreland areas and for the development of county shoreland ordinances. Polk County has a state approved shoreland ordinance.

The Sand Hill River at the location of the proposed Winger Dam is classified as a General Development stream under the Polk County Shoreland Management ordinance. The Rules authorize the Commissioner of Natural Resources to, as the need arises, reclassify any protected waters. In the event a county feels that the classification should be changed, a written request may be submitted for consideration to the Commissioner of Natural Resources. The policy of the DNR to only consider a request submitted in the form of an official resolution of the County Board of Commissioners. The DNR may also initiate a reclassification on its own.

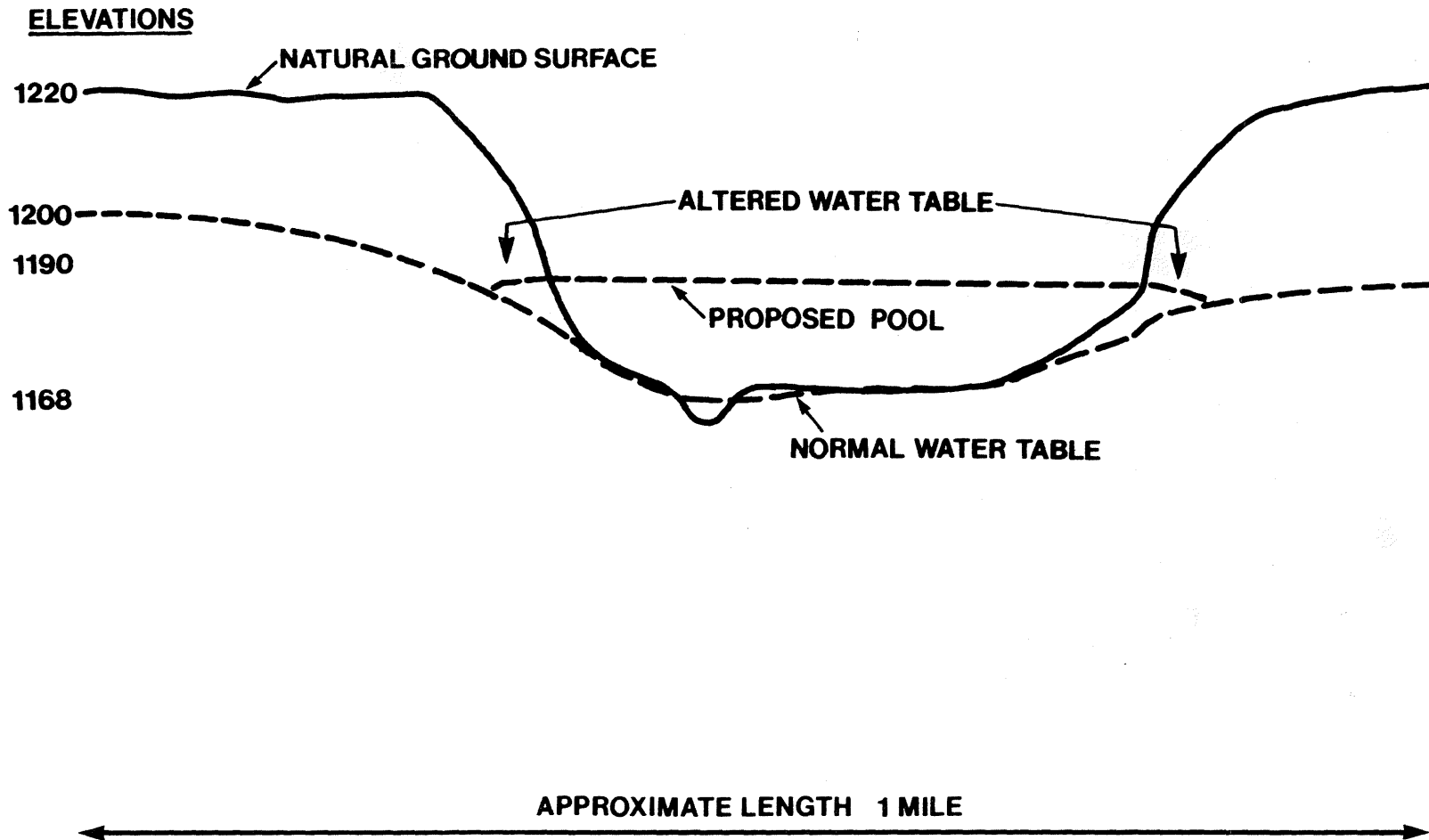


FIGURE 1-8
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO.4
THE WINGER DAM
VALLEY CROSS-SECTION NORMAL AND ALTERED WATER TABLES

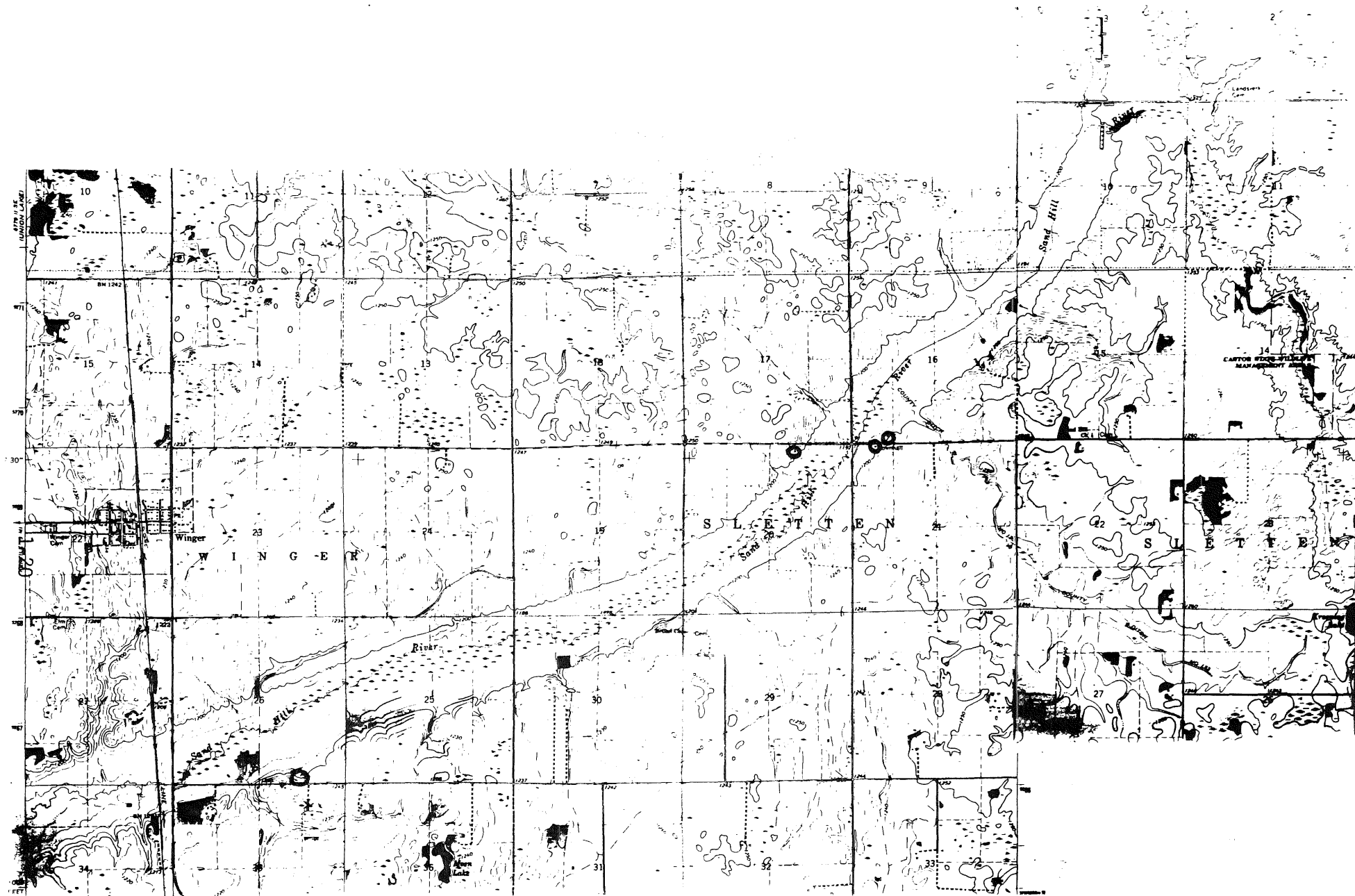


FIGURE 1-8
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4 - THE WINGER DAM
GROUNDWATER SITE LOCATION MAP FOR STRUCTURES AFFECTED BY PROPOSED IMPOUNDMENT

The criteria for determining classification or reclassification include size of the water body, crowding potential, amount and type of existing development, existing natural characteristics of the water body and surrounding shorelands, and county and regional public water needs.

Three classification options which presently exist are Natural Environment, Recreation Development, and General Development. The management goals and objectives of the General Development classification are to provide minimum regulations of areas presently developed as high density, multiple use areas, and to provide guidance for future growth of commercial and industrial establishments which require locations on protected waters. For the Recreational Development classification, the goals and objectives are to provide management policies reasonably consistent with existing development and use, to provide for the beneficial use of protected waters by the general public and riparian owners, to provide a balance between the lake resource and lake use, to provide for a multiplicity of lake uses, and to protect areas unsuitable for residential and commercial uses from development.

The proper management of the proposed lake created by the dam will need to be incorporated into the County Shoreland management program based on the goals and objectives presented in the rules. The Commissioner of Natural Resources recommends the classification be amended to a Recreational Development lake, be managed according to Recreational Developmental classification goals and objectives, and that Polk County submit the required request for a classification change.

1.11.8 Nature and extent of flooding problems

The proposed Winger dam is planned and designed to be operated to address both local and Red River mainstem flood damage reduction.

Floods in the Sand Hill River basin usually occur in the months of March through July. This period usually produces major flooding problems, which result from spring snowmelt accelerated by rains. During some years, ice jams have increased river stages by several feet. These floods may force delays in planting operations up to three weeks, resulting in depressed yields through the effect of hot weather on immature crops. With a limited growing season, water ponded on the land too long may further preclude planting.

Flood damage also occurs following high-intensity summer rains. Although they occur less frequently than spring snowmelt floods, these summer floods are characterized by high peak flows that cause damage to maturing crops or make crop harvest difficult or impossible.

The topography of the subbasin also influences flooding problems. In the nearly flat terrain of the lower part of the subbasin, flood flows in excess of channel capacities move overland and inundate thousands of acres in the western third of the subbasin, disrupting transportation facilities and damaging cropland, roads, bridges, and farmsteads. The central part of the subbasin, from approximately six miles west and three miles east of the City of Fertile, consists of beach ridges, moraines and sand dunes associated with glacial Lake Agassiz. A major

drop in elevation of nearly 300 feet results in a well-entrenched floodplain through this area. The upper reaches flow through an area of gently rolling terrain. Flows in this area are generally contained in well definable floodplains.

At Beltrami, Minnesota, floods of record occurred in 1978 and 1979. They were not directly attributable to high water on the Sand Hill River adjacent to the town, but resulted from overland flow from the Sand Hill River east of Beltrami. The Burlington Northern Railroad and T.H. 9 are located along parallel alignments in a north-south direction through Beltrami, and act to impound flow on the east side of the city. Restrictive culverts under the railroad, approximately 1,500 feet north of the Sand Hill River, cause water to remain in town for several days. Flow is generally shallow, but has caused some property damage. In the past, flood elevations at Beltrami have been raised by ice jams obstructing flow at hydraulic structures.

Prior to the 1958 improvement of the Sand Hill River channel, large snowmelt generated spring floods in 1882, 1897, 1936, 1947, and 1950 damaged the village of Beltrami and delayed seeding operations. More serious floods were triggered by severe rainstorms in July 1909, July 1919, June 1941, and May 1942. These floods destroyed maturing crops resulting in severe economic losses for the farmers of the area. Since 1958, flood flows exceeding the design capacities of the channel have occurred in 1965, 1966, and 1969. The 1965 spring flood, which was caused by rainfall on frozen soil, produced a peak flow of 4,560 cfs at Climax compared with the upstream channel capacity of 1,560 cfs. The high flows with moving ice flooded the village of Beltrami and many acres of cropland, damaged several bridges, and severely eroded the improved channel reach, particularly at the concrete drop structures and side ditch inlets. The April 1969 flood which had a peak flow of 4,300 cfs at Climax inundated considerable farmland but did not affect the village of Beltrami due to emergency protective measures. Average annual flood damages to the Sand Hill River basin approximate \$332,400 (in 1981 dollars).

The size of the Sand Hill River 100-year floodplain is approximately 30,000 acres. Major components include: 1) an upper segment of 10,000 acres in the gently rolling headwaters area, 2) a middle segment of 4,000 acres centered east of Fertile in the beach ridge area, and 3) 16,000 acres comprising the lower one-third of the subbasin adjoining the Red River.

The upper segment extends from Fosston to a point approximately three miles east of the City of Fertile. Marsh areas in proximity to the river floodplain account for approximately 4,000 of the 10,000 acres in this segment. Extensive overland flooding occurs at the point where the Sand Hill River flows out of the White Earth Indian Reservation.

As the river traverses the beach ridge area, the width of the floodplain narrows markedly to a distance of no more than a quarter mile. This confined floodplain is characteristic of the area around Fertile and continues to a point about six miles further downstream. The river then enters the flat valley plain of the Red River in the lower segment and once again widens considerably. At the juncture with Kittleson Creek,

the floodplain becomes over a mile wide. The width increases temporarily to two miles just east of Beltrami. At a point about four miles west of Beltrami, the floodplain broadens again to two miles before becoming much more confined approximately four miles south of Climax.

Originally, the Sand Hill River in its natural state passed south of the city of Beltrami in a poorly defined channel and dispersed in the so-called Beltrami Marshes, which extended from the city of Beltrami westerly a distance of ten miles or more. At the westerly rim of the marshes, the stream reappeared as three small creeks which eventually united and carried their waters into the Red River of the North.

Past efforts to confine the Sand Hill River floodwaters included State Ditches No. 6 and No. 7 which were constructed between 1894-1898. Reconstruction was completed in 1917 after establishment of a new State ditch along the route of the old ones.

After a quarter of a century, drainage and flood problems continued along the watercourse of the Sand Hill River. In 1958, the U.S. Corps of Engineers completed about 20 miles of channel straightening, clearing, and enlarging of the Sand Hill River and Sand Hill Ditch for flood control. The project included a southward diversion of Kittleson Creek to the Sand Hill River at a point six miles east of Beltrami, and enlargement and straightening of the Sand Hill River and Sand Hill Ditch to a point about 13 river miles above the confluence with the Red River.

The USCE project constructed in the subbasin is generally in good to excellent condition. There are two problems with that project that aggravate flood conditions: 1) bank sloughing, and 2) during construction, all spoil material was deposited on the left (south) side of the channel immediately upstream of Beltrami. Although the improved channel has sufficient capacity for summer rainstorms, spring snowmelt often exceeds channel capacity. The material deposited on the left side of the channel forces overbank flow to the right and potentially could cause additional flood damage to the town.

In 1981, the Sand Hill Watershed District constructed a flood detention dam (known as Project No. 1 or Bear Park Dam) on the Sand Hill River in northeastern Norman County. The township road between Sections 11 and 12, Bear Park Township (T146N, R43W) is located on top of the embankment for the dam. The dam provides about 3,800 acre-feet of temporary storage for flood control with no permanent pool. The dam consists of an earthen embankment, a principal spillway, and an emergency spillway.

High flows on the Sand Hill River also aggravate flooding downstream on the Red River of the North. Since early settlement, flooding has been the principal water resource problem in the Red River of the North Basin. The basin is particularly susceptible to severe flooding due to its flat topography and the northward flow of the Red River. When the river overtops its channel banks, vast areas of flat adjacent land become inundated. During spring snowmelt, the thaw generally begins in the southern reaches. The northern reaches of the river, normally frozen for a longer period, inhibit the northward flow and can aggravate the flooding problem.

The Water Resources Engineering/Planning Program report prepared in 1984 for the Lower Red River Watershed Management Board identified damages associated with Red River flood events. Large historic floods were recorded in the basin in 1826, 1852, 1861, 1882, and 1897. Recent large floods of 1975, 1978, and 1979 have caused enormous economic hardship with flood damages on the Red River of the North mainstem alone in excess of \$108 million. Emergency works carried out during those floods prevented approximately \$37.9 million of damages. The Red River basin-wide flood damages during the same years were estimated to exceed \$423 million. Unreported flood damages could raise the above figures.

The average annual flood damages associated with the Red River mainstem flooding in the United States are shown in Table 1-6.

TABLE 1-6
AVERAGE ANNUAL FLOOD DAMAGES
RED RIVER OF THE NORTH MAINSTEM SUBBASIN

<u>Category</u>	<u>Damages (October 1981 Dollars)</u>	<u>Percentage</u>
Urban	\$2,760,000	49.1
Agricultural	2,710,000	48.2
Transportation	<u>150,000</u>	<u>2.7</u>
Total	\$5,620,000	100.0

Past efforts to address the flooding problem concentrated solely on the effects of single projects on local areas or sub-basins, and neglected an overall basinwide objective. The result has been a major effort in the Red River Valley to develop management tools to understand and promote a basin-wide perspective.

Floodwater retention projects located in the tributary watersheds can impact mainstem flood flows. The effect of the proposed Winger Dam project on reducing mainstem flows is a function of design and operation. The design and operation in turn must take into account the location of the dam.

A dam in the Red River basin must be designed to be able to store the runoff when necessary and for as long as necessary, based on downstream flood flows.

1.11.9 Floodplain Management aspects

The State Floodplain Management Program and the Rules of the Department of Natural Resources outline statewide minimum standards and criteria for the management of floodplain areas and for the development of county floodplain ordinances.

The Sand Hill River through the vicinity of the proposed Winger Dam project is included as part of the state-approved Polk County Floodplain Management Ordinance. The reach is within the unincorporated portion of the county and no detailed study has been completed through this reach. The flood hazard area is mapped on the December 20, 1977 Flood Hazard

Boundary Map for the unincorporated areas of Polk County, Minnesota. The flood hazard area is within Zone A which represents a special flood hazard area. This area is outlined by the base flood which is a flood that has a 1% chance of occurring each year (100-year flood).

Any amendments to floodplain management ordinances prior to adoption must be submitted to the Commissioner of Natural Resources for approval. The information developed in the design of the project will better define the 100-year flood level and should be incorporated into the county zoning ordinance or made available for use in the administration of the existing ordinance.

The proposed Winger Dam project would alter the present flood hazards downstream of the dam and it may offer a greater degree of protection than presently afforded. However, the Department of Natural Resources has classified the proposed Winger Dam as a Class I or high hazard dam. This poses the possibility of an extreme hazard if a dam failure would occur. Existing zoning under the present Polk County and Norman County floodplain management ordinances does not reflect the hazards associated with a failure downstream of the proposed dam. Floodplain zoning which adequately reflects the associated hazards is required under the provisions of the DNR's Minnesota Statutes Chapter 105 permitting authority. Further dam safety interests are addressed in Chapters 3.0 and 4.0 of the DEIS.

1.12 MAINTENANCE OF THE DAM

Maintenance of the Winger Dam will be the responsibility of the Sand Hill River Watershed District. The dam will be maintained in compliance with applicable federal, state, and local laws (see also Section 1.7). The Watershed District will conduct inspections annually in May or June, after unusually severe floods, and after the occurrence of any other unusual conditions which might adversely affect the structural integrity of the dam. Written reports will be completed by the engineer after all inspections. The reports will describe the conditions found and identify any corrective action needed along with a time schedule necessary to complete each action. The Sand Hill River Watershed District will maintain a record of all inspections and significant actions taken.

The Minnesota Department of Transportation will assume responsibility for all maintenance and repair relative to the T.H. No. 59 road surface.

1.13 LIABILITY AND INSURANCE

Dam ownership carries with it significant legal responsibilities. Liability can be imposed upon a dam owner if they fail to maintain, repair, or operate the dam in a safe and proper manner. A clear, complete, and approved plan of operation and maintenance is essential.

The Sand Hill River Watershed District will be the owner of the proposed Winger Dam and will be responsible for the safety of the dam. The Sand Hill Watershed District will maintain the dam in a reasonable and safe condition and will conduct regular inspections of the dam and repair deficient items. The Watershed District will do what is necessary to avoid anticipated conditions which could injure persons or property, even those persons (such as trespassers) not authorized to use the site. Warning signs will be posted at potentially hazardous locations and security fencing will be utilized where necessary.

Sand Hill River Watershed District managers are currently examining insurance options with various carriers. Final insurance arrangements will depend on final design and project establishment.

Further information concerning the liability and responsibility of dam owners is contained in Appendix F of the Sand Hill River Watershed District Preliminary Engineer's Report (referenced in Section 1.1). This appendix is an excerpt from the Minnesota Edition of the Dam Safety Guidebook and also represents the position of the project sponsors.

2.0 ALTERNATIVES

2.1 GENERAL DISCUSSION

The alternatives proposed by the Sand Hill River Watershed District include the proposed project, design modifications to the proposed project, a reduced scale to the proposed project and the no-build alternative.

All alternatives except the no-build alternative are designed to provide approximately 6,800 acre-feet of gated flood storage. This gated flood storage designed requirement was established by the Lower Red River Watershed Management Board in order for them to justify participation in funding of any proposed project near Winger, Minnesota. All alternatives except the no-build alternative are also designed to maintain similar flood control benefits to those described in Chapter 1.0 for the proposed project.

2.2 ALTERNATIVE NO. 1 - PROPOSED WINGER DAM PROJECT

Alternative No. 1 is the project proposed by the Sand Hill River Watershed District. As described in Chapter 1.0, it is an earth-fill multipurpose dam for flood damage reduction, to provide a recreational lake, and to facilitate an upgraded crossing of the Sand Hill River for T.H. 59.

2.3 ALTERNATIVE NO. 2 - FLOOD REDUCTION DAM WITHOUT PERMANENT POOL

Alternative No. 2 is an earth-fill dual purpose dam for flood reduction and to facilitate an upgraded crossing of the Sand Hill River for T.H. 59. The location of the proposed dam for Alternative No. 2 is along the alignment of T.H. 59 in the same location and at the same height as proposed for Alternative No. 1. This alternative differs from Alternative No. 1 since there is no provision for a permanent recreational pool. The maximum flood pool elevation of Alternative No. 1 is reduced from 1196.0 M.S.L. to 1186.0 M.S.L. This alternative functions as a dry dam and develops a reservoir only during flood events. The alternative location and facilities are shown in Figure 2-1.

The project elements consist of a combination principal/emergency spillway system, an earth-fill embankment dam with a highway surface across the top, and a reservoir area for the temporary storage of floodwaters. The flood control storage area consists of both gated and ungated storage. The dam embankment would be essentially the same as described in Alternative No. 1 except the depressed length in the road section has been eliminated. The principal/emergency spillway system would consist of a low flow conduit, a concrete riser, a concrete main conduit, and a stilling basin. These facilities are similar to those described for Alternative No. 1 except the main roller gates at the top of the riser have been eliminated. In addition, the main conduit would be designed to pass both design and emergency flows. During normal low flows, the upstream reservoir would be empty and would be similar to existing run of the river conditions. At the 100-year capacity, the

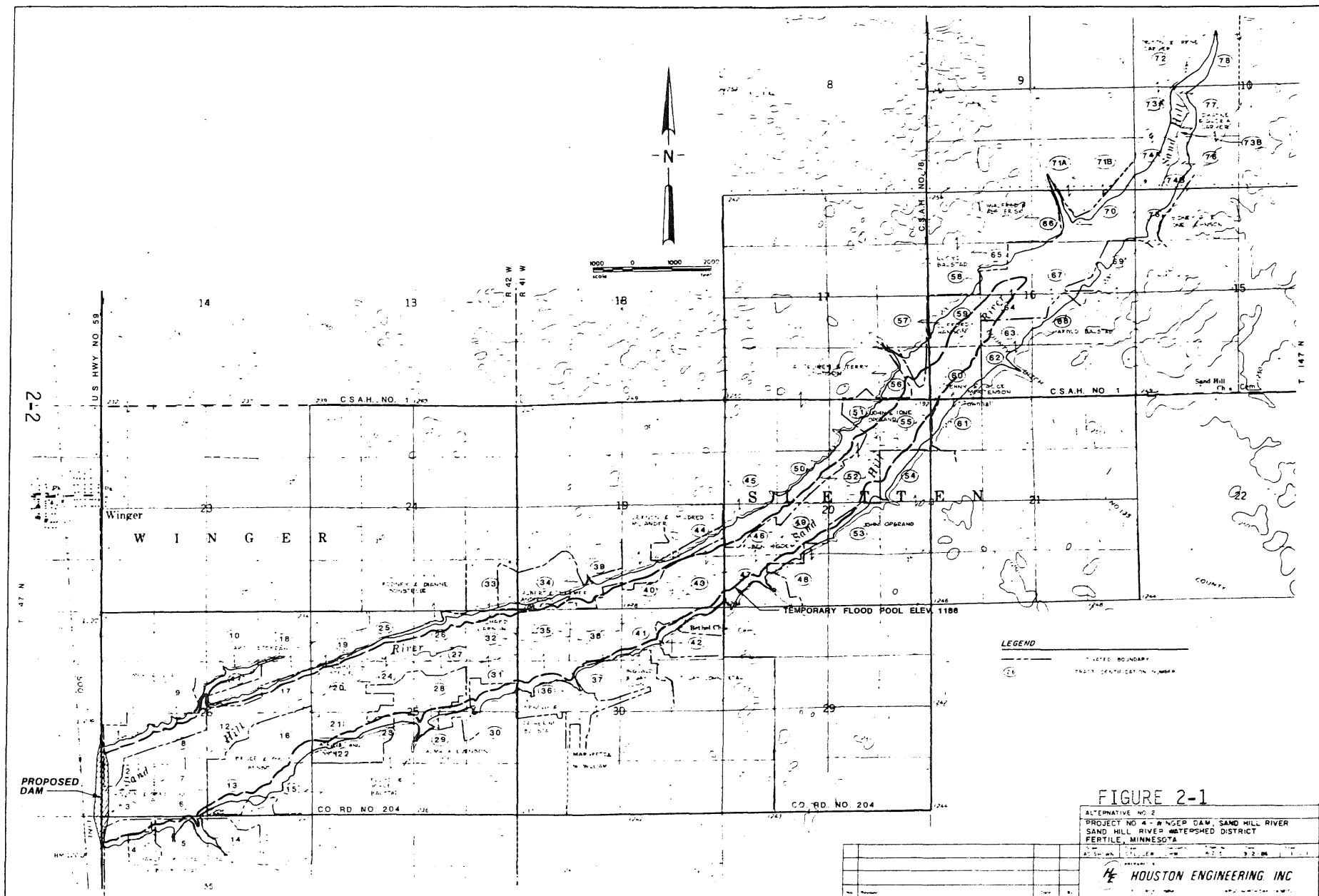


FIGURE 2-1

ALTERNATIVE NO. 2
PROJECT NO. 4 - WINGER DAM, SAND HILL RIVER
SAND HILL RIVER WATERSHED DISTRICT
FERTILITE, MINNESOTA

HOUSTON ENGINEERING INC.

reservoir elevation would be 1186.0 M.S.L. with a surface area of 963 acres. This corresponds to a storage of about 6,800 acre-feet. This storage would be either gated storage or ungated storage, depending upon conditions outlined in the operational plan. Gate operation would essentially be in accordance with the operational plan described for Alternative No. 1. Flows in excess of design capacity would pass over the top of the riser and through the main conduit. The principal spillway system is also capable of passing emergency spillway flood magnitudes.

The operational plan for gating flood flows would be almost identical to that for Alternative No. 1. The only difference would be that a sluice gate will be used in lieu of roller gates. Normally, the gate will remain open to pass normal river flows with no upstream ponding. If downstream conditions indicate that no gate operation is required, the dam would operate automatically by temporarily ponding excess flows to an elevation of 1186.0 M.S.L. (100-year event). The reservoir elevations achieved in this fashion depend upon the magnitude and frequency of the inflow flood hydrograph.

Reservoir surface areas developed under this alternative vary from 0 acres to 963 acres at elevation 1186.0 M.S.L. Thus, easement requirements would be significantly reduced from that required for Alternative No. 1. Since the proposed maximum water surface elevation is about 10 feet lower than Alternative No. 1, only 963 acres of easement or right-of-way would have to be acquired. There would be reduced recreation benefits because of the omission of a permanent pool. The present General Development shoreland classification would most likely remain the same.

Road relocations, raisings, or abandonments are slightly altered from Alternative No. 1. Polk County Road No. 204 would be required to be relocated, but to a lesser extent than Alternative No. 1. No modifications would have to be made to either Polk CSAH No. 1 or CSAH No. 8 under this alternative. A Sletten Township road in the northwest corner of Section 21 would have to be relocated as proposed under Alternative No. 1. The township road between Winger and Sletten Townships would have to be abandoned as described under Alternative No. 1. The township road between Sections 19 and 20 of Sletten Township can be retained by adding approximately two feet to its elevation.

Construction methods, water quality certification requirements, maintenance of the dam, and liability and insurance requirements are similar in nature to those described under Alternative 1. Groundwater impacts would be similar to those under Alternative No. 1 except to a lesser extent. In addition, since no permanent pool is provided, the groundwater impacts would be less permanent in nature.

2.4 ALTERNATIVE NO. 3 - REDUCED SIZE FLOOD REDUCTION DAM WITH PERMANENT POOL

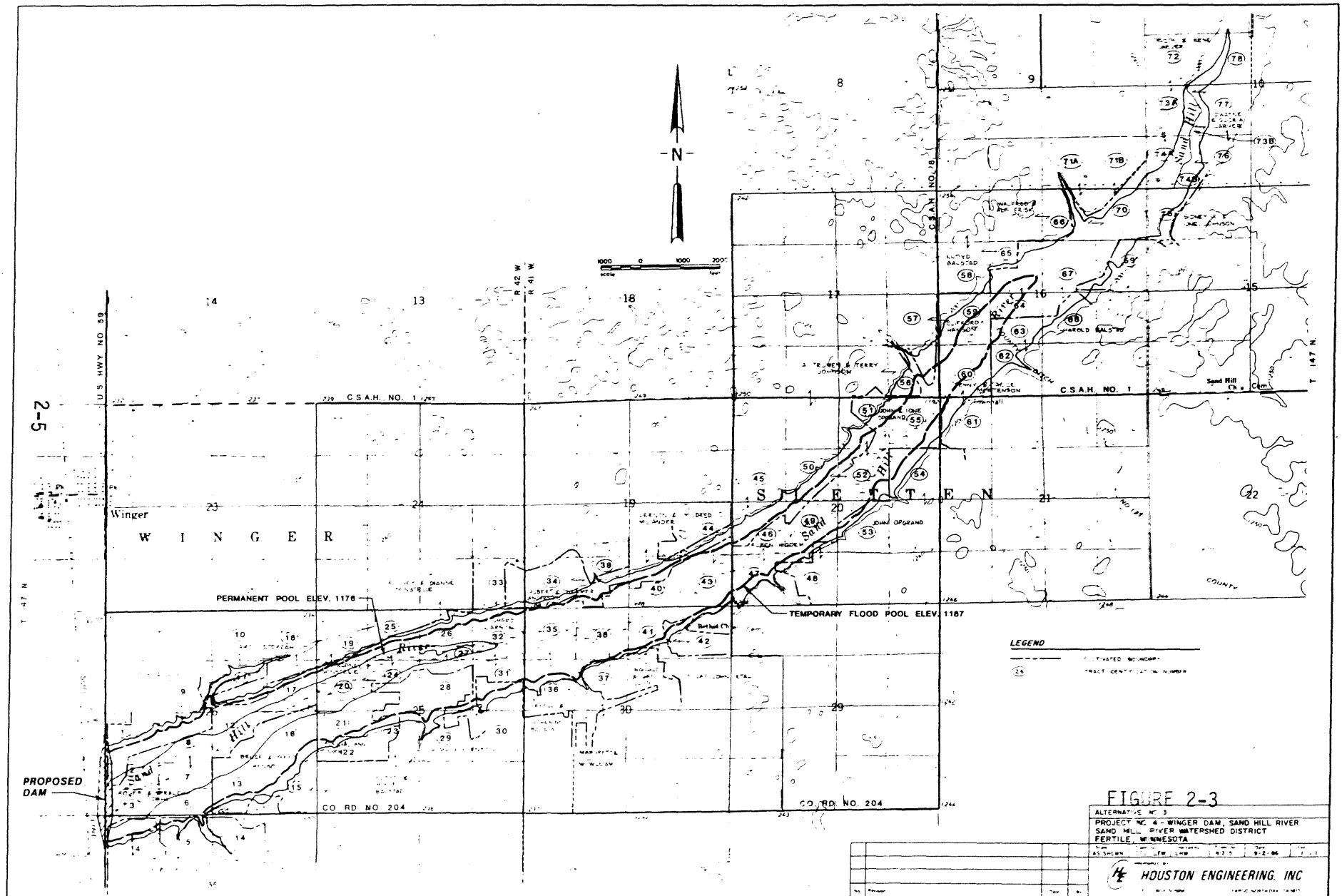
Alternative No. 3 consists of an earth-fill multipurpose dam for flood reduction, for development of a recreational or conservation pool, and to facilitate an upgraded crossing of the Sand Hill River for T.H. 59.

The location of the proposed dam for Alternative No. 3 is along the alignment of T.H. 59 in the same location and at the same height as proposed for Alternative No. 1. The alternative location and facilities are shown in Figure 2-2. This alternative differs from Alternative No. 1 since the permanent pool has been significantly reduced in elevation and in surface area. The permanent pool for Alternative No. 3 has been set at elevation 1176.0 M.S.L. and provides a surface area of 237 acres. This allows for a permanent pool depth at the dam of about 6 feet. The flood pool elevation also differs from Alternative No. 1 and has been set at 1196.5 M.S.L., which provides for a flood storage acreage of 1,000 acres. Alternative No. 3 functions in an almost identical manner to Alternative No. 1. The major difference between the two alternatives is the reduced acreage of both the permanent pool and the temporary flood control pool.

The elements of this alternative consist of the combination principal/emergency spillway system, an earth-fill embankment dam with a highway surface across the top, a 237-acre permanent pool at elevation 1176.0 M.S.L., and additional reservoir capacity for the temporary storage of floodwaters. The flood control storage area consists of both gated and ungated storage. The dam embankment would be essentially the same as for Alternative No. 1 except that the depressed length in the road section has been eliminated. The principal/emergency spillway system would consist of a low flow conduit, a concrete riser, a main conduit, and a stilling basin. The principal spillway would have all of the gate mechanisms described under Alternative No. 1. In addition, the main conduit would be designed to pass both design and emergency flows. During normal low flows, the operation would be identical to that described for Alternative No. 1. At 100-year capacity, the reservoir elevation would be 1186.5 M.S.L., with a surface area of 1,000 acres. This corresponds to about 6,800 acre-feet of flood storage between the permanent pool at elevation 1176.0 M.S.L., and the 100-year reservoir elevation at 1186.5 M.S.L. This storage would be either gated storage or ungated storage, depending upon conditions identified in the operational plan. Gate operation would essentially be as described in the operational plan for Alternative No. 1. Flows in excess of the design capacity would pass over the top of the riser and through the main conduit. The principal spillway system is also capable of passing emergency spillway flood magnitudes so that a depressed overflow section in the roadway would not be required.

The reservoir surface acreage developed under this alternative varies from 237 acres at elevation 1176.0 M.S.L. to 1,000 acres at elevation 1186.5 M.S.L. Easement requirements would be significantly reduced from those required for Alternative No. 1. However, there would be reduced recreation benefits because of the reduction in the size of the permanent pool.

Road locations, raisings, or abandonments vary from Alternative No. 1. Polk County Road No. 204 would be required to be relocated, but to a lesser extent than under Alternative No. 1. No modifications would be required to either Polk CSAH No. 1 or CSAH No. 8 under this alternative. A Sletten Township road in the northwest corner of Section 21 would have to be relocated as proposed under Alternative No. 1. The township road between Winger and Sletten Townships would have to be abandoned as



described under Alternative No. 1. The township road between Sections 19 and 20 of Sletten Township can be retained by adding approximately 2.5 feet to its elevation.

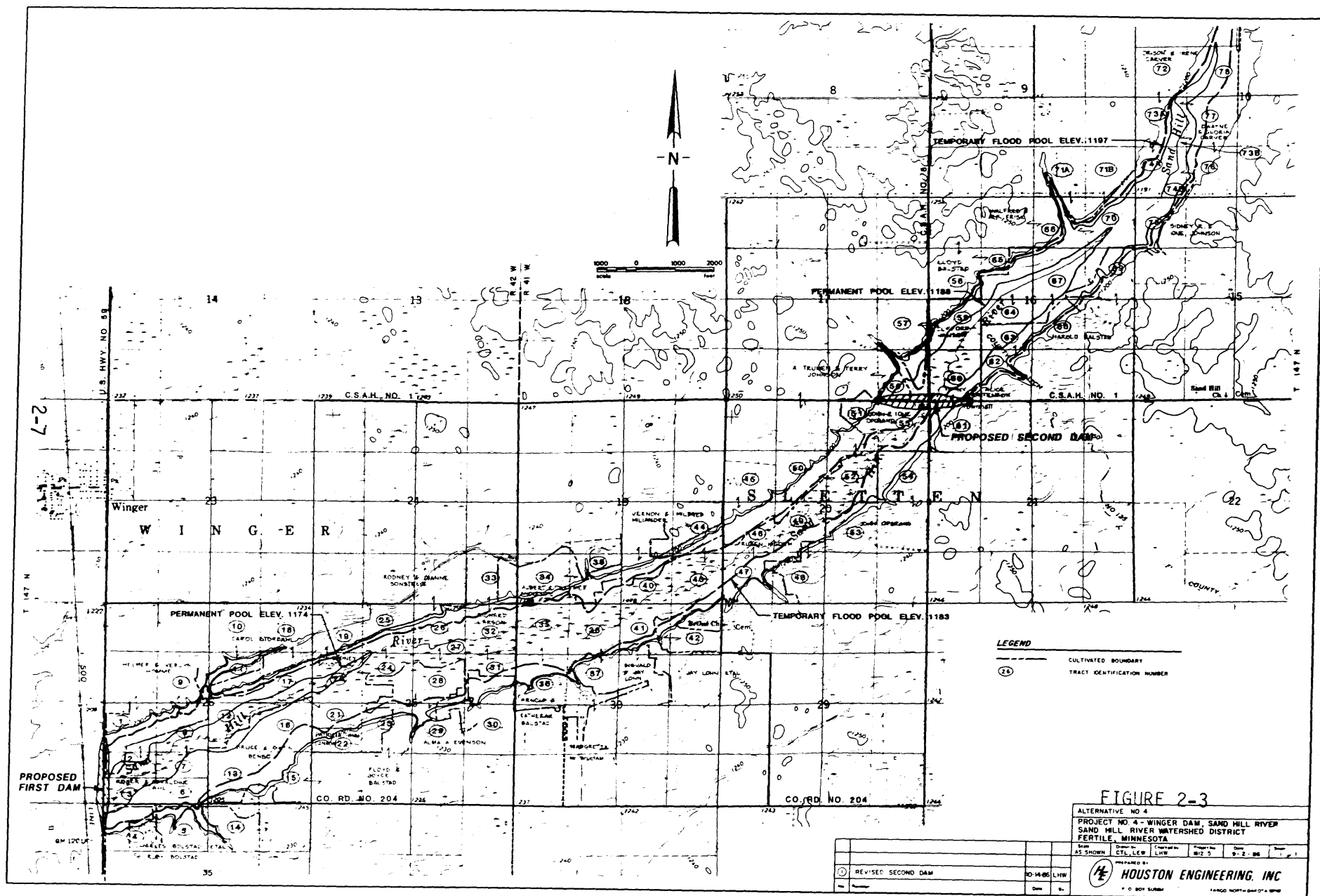
Construction methods, water quality certification requirements, operation and maintenance of the dam, and liability and insurance requirements are similar in nature to those described under Alternative No. 1. Since the proposed 100-year water surface elevation is about 9.5 feet lower than Alternative No. 1, only 1,000 acres of easement or right-of-way would have to be acquired. Groundwater impacts would be similar to those under Alternative No. 1, except to a lesser extent because of the permanent pool elevation.

2.5 ALTERNATIVE NO. 4 - REDUCED SIZE FLOOD REDUCTION DAMS WITH PERMANENT POOLS

Alternative No. 4 consists of two multipurpose earth-fill dams for flood control, for permanent conservation pools, and the alternative facilitates crossings of the Sand Hill River for T.H. No. 59 and Polk CSAH No. 1. A lower dam would be located along the alignment of T.H. 59 in the same location and at the same height as proposed for Alternative No. 1. An upper dam would be located along the alignment of Polk CSAH Road No. 1 at its crossing of the Sand Hill River in Sections 16 and 17. Alternative No. 4 differs from Alternative No. 1 since provisions for flood control and conservation storage are divided between two locations on the Sand Hill River. The location and facilities are shown in Figure 2-3.

The project elements of the alternative consist of two earth-fill dams with their associated spillway systems, highway crossings across the top of each structure, a permanent conservation pool area for each structure, and a reservoir area for the temporary storage of floodwaters. Flood control storage for each structure involves both gated and ungated storage. Dam embankments for the upper and lower structures would be essentially the same as for Alternative No. 1, except that the depressed length in the road section has been eliminated. The principal/emergency spillway system would consist of a low flow conduit, a concrete riser, a main conduit, and a stilling basin. The principal spillway would also have all of the gate mechanisms described under Alternative No. 1. In addition, the main conduit would be designed to pass both design and emergency flows. During normal low flows, the operation would be identical to that of Alternative No. 1.

At 100-year capacity, the reservoir elevations would be 1183.0 M.S.L. and 1197.0 M.S.L. with corresponding water surface areas for each dam of 750 acres and 501 acres, respectively. The combined flood control storage for both dams between the proposed permanent pool elevation and flood storage elevations is approximately 6,800 acre-feet. This storage would be either gated or ungated storage, depending upon conditions identified in the operational plan. Gate operation would essentially be as described in the operational plan for Alternative No. 1. Flows in excess of the design capacity would pass over the top of the risers of each structure and through the main conduits. The principal spillway system is also capable of passing emergency spillway flood magnitudes and a depressed overflow section in the roadway for each structure would not be required.



The permanent pool for the lower structure would be set at elevation 1174.0 M.S.L. with a surface area of 113 acres, a maximum depth of 4.0 feet at the dam, and a volume of 263 acre-feet. The permanent pool for the upper structure would be set at a maximum elevation of 1188.0 M.S.L. with a surface area of 124 acres, a maximum depth of 5.0 feet, and a volume of 264 acre-feet.

The reservoir surface areas developed under this alternative vary from a combined total of 237 acres at the permanent pool elevations, to a combined total of 1,251 acres at the 100-year flood storage elevations. Easement requirements would be significantly reduced from those required for Alternative No. 1. However, there would be reduced recreation benefits because of the reduction in the size of the permanent pool.

Road relocations, raisings, or abandonments are modified from Alternative No. 1. Polk County Road No. 204 would be required to be relocated, but to a lesser extent than for Alternative No. 1. Major modifications would have to be made to both Polk CSAH No. 1 and Polk CSAH No. 8 under this alternative. Polk CSAH No. 1 would have to be reconstructed as a road dam in a fashion similar to that for T.H. 59 but to a significantly reduced extent. Polk CSAH No. 8 would have to be relocated to the west around the periphery of the reservoir. The Sletten Township road in the northwest corner of Section 21 would have to be relocated as proposed under Alternative No. 1. The township road between Sletten and Winger Townships could be retained if it was raised approximately 2 feet. The township road between Sections 19 and 20 of Sletten Township can be retained.

Construction methods, water quality certification requirements, operation and maintenance of the dams, and liability and insurance requirements are similar in nature to those described under Alternative No. 1. Since the proposed maximum water surface elevation for each structure is lower than that proposed for Alternative No. 1, only 1,251 acres of easement or right-of-way would have to be acquired. Groundwater impacts would be similar to those under Alternative No. 1.

2.6 ALTERNATIVE NO. 5 - NO-BUILD

Alternative No. 1 proposes no class I high hazard dam development on the site. Existing land use character and specific uses would be maintained essentially as described in Nature of the Environmental Setting (Section 1.11). Minnesota Department of Transportation planned T.H. 59 roadway and bridge improvements would occur with this alternative.

3.0 ENVIRONMENTAL IMPACTS

3.1 CONSTRUCTION ASSOCIATED IMPACTS

The impacts of the construction process on the surrounding environment are unavoidable. However, they can be mitigated within the plans and specifications. Detailed specifications for the control of temporary air and water pollution, soil erosion, and siltation will be included as part of the construction contract. Under the proposed specifications, the contractor must supply to the engineer a schedule to accomplish both temporary and permanent erosion control work and the methods of operation. No work shall be started until approved by the engineer. The engineer also has authority to limit the area of erodible material exposed during construction and to direct the contractor to provide immediate measures to minimize erosion. The contractor will be required to incorporate all permanent erosion control features at the earliest practicable time.

Construction of the proposed project is planned to occur over two construction seasons. The Department of Transportation is concerned with the amount of time the proposed project could result in the closing of T.H. 59 and the necessity for a detour of that major arterial. The project proposers have indicated that certain elements of the project could be completed in each construction season to minimize the impacts of road closings. The exact closing date and duration for both T.H. 59 and the other road relocations discussed in Section 1.9 have as yet not been conclusively determined.

3.2 DAM SAFETY

3.2.1 Project justification

Minnesota Dam Safety Rules require that there be adequate justification before a high hazard dam can be constructed. The justification shown by the project sponsor is contained in the October 1986 Preliminary Engineer's Report, Economic Analysis referenced in Section 1.1. The engineer's report addresses the justification issue by evaluating four project alternatives and by presenting quantifiable project benefits. Alternative No. 5 is not addressed since as a no-build alternative it does not include a Class I dam.

3.2.2 Alternatives considered

The remaining alternatives considered are all Class I dams and are presented by the project engineer as follows:

- 1) Alternative No. 1 - proposed project, 35-feet high earthen dam at T.H. 59 on the Sand Hill River. The reservoir is to provide for a permanent recreation pool and for flood control storage, with a depth of the permanent pool of 20 feet at the dam.

- 2) Alternative No. 2 - a 35-feet high earthen dam at T.H. 59. No permanent pool for recreation is proposed.
- 3) Alternative No. 3 - a 35-feet high earthen dam at T.H. 59. This alternative differs from Alternative No. 1 in that the permanent recreation pool has been significantly reduced in depth and area. The recreation pool would be about 6 feet deep at the dam.
- 4) Alternative No. 4 - two multi-purpose earthfill dams including a 35-feet high dam at T.H. 59 and a 15-feet high dam at Polk CSAH No. 1. Permanent pool depths would be 4 feet at T.H. 59 and 5 feet at Polk CSAH No. 1.

All of these four alternatives provide the same flood control storage of approximately 6,800 acre feet.

The engineer's report includes a dam failure analysis and assessment of probable damages that would result from the breach. This analysis was conducted only for the proposed project. The analysis determined that probable damages would be quite significant. The DNR has designated the proposed project to warrant a Class I (high hazard) classification. Breach analyses were not included for the other alternatives.

3.2.3 Comparisons of hazard classifications

It is possible that the other alternatives would also be high hazard dams. This is based on the fact that the alternatives are also fairly large dams with significant storage volumes at the top of dam elevation. Also, the alternatives are all adjacent to or in close proximity to T.H. 59 and the Soo Line Railroad. The magnitude of downstream damages resulting from a dam failure would probably not vary significantly for any of the alternatives. Therefore, it is probable the same magnitude of design flood would be needed for any of the alternatives considered.

3.2.4 Quantifiable benefits

Dam safety regulations require the project to have adequate need in terms of quantifiable benefits.

The engineer's report presents the benefits as "annual economic benefits." Annual economic benefits and costs are compared for each of the four alternatives. Benefits are listed in six categories: 1) flood control, 2) transportation improvements, 3) land value increases, 4) land intensification, 5) recreation, and 6) employment. Annual economic costs are listed in three categories: 1) construction, right-of-way, engineering, legal, administrative, 2) operation and maintenance, and 3) construction interest. All of the alternatives considered provide the same flood control benefits. Annual benefits and costs are presented in the engineer's report as follows:

	<u>Annual Benefits</u>	<u>Annual Costs</u>
Alternative No. 1	\$422,155	\$399,035
Alternative No. 2	258,925	312,435
Alternative No. 3	268,290	327,530
Alternative No. 4	315,850	506,690

Analysis of these benefits and costs is presented in Section 3.9. Annual costs are primarily dependent upon cost of construction and the cost of money (discount rate). Cost of construction will essentially be known when construction bids are received. The discount rate varies annually and could be different (than assumed) when details of project financing become firm. Determining annual benefits is more hypothetical and involves economic assumptions for a variety of items.

Only with Alternative No. 1 does the project engineers report show benefits to exceed costs, and the net benefit is minimal. Final designs also have not been completed and could have an upward or downward impact on currently estimated construction costs. It would be advisable to recompute costs and benefits when construction and financing costs are exactly known. This would be at the time when bids are received and would provide a more current documentation of costs and benefits.

3.2.5 Consequences of a dam failure

The engineer's report includes an assessment of possible damages that would result from a dam failure. The entire reach of river from the dam to the Red River was included in the assessment. The dam failure could occur during a large flood event or during a non-flood situation. Damages would become less severe as the breach impact attenuates in the downstream direction from the dam. A summary of probable damaged areas includes 4 trunk highways, 11 county highway locations, 24 township roads, 3 railroad crossings, 41 farmsteads, 4 municipalities and the Bear Park Dam. Loss of life is possible, but this risk could be reduced with proper emergency planning, evacuation procedures, and signing of washed out transportation crossings. Floodplain zoning and emergency planning are items of mitigation that are necessary with the construction of high hazard dams. In the event of dam construction, the project sponsor and local authorities would have to implement these safety mitigation procedures.

3.2.6 Risk assessment and analysis

Because the Winger Dam will be a high hazard dam, normal engineering practice would be to use the probable maximum flood (PMF) design flood. The project sponsor's original plan as identified in the Scoping Decision Document was to design the dam for the 1/2 PMF flood and to justify this on the basis of risk assessment. Risk analysis is a recognized technical process that has been used to reduce the magnitude of design flood for dam projects. Upon further investigation during the risk assessment process, the engineer decided to use the full PMF design because the 1/2 PMF would not provide enough savings in construction cost. Since the full PMF design will be used, a detailed discussion herein of risk assessment is not needed and the Scoping Decision varies in that respect.

3.2.7 Design flood

The design flood selected by the engineer for the dam is the probable maximum flood (PMF). The magnitude of the PMF flood is 20,840 cfs. During the PMF, the principal spillway and the emergency spillway will pass 20,840. The depth of flow over the depressed roadway section (emergency spillway) during the PMF would be about 2.8 feet. The dam and these spillways will have to be designed, constructed, and operated to be safe and stable for the PMF or smaller runoff events. T.H. 59 traffic would be interrupted during the infrequent times when water would overflow the roadway emergency spillway. T.H. 59 would also have to be inspected and repaired after each overflow event. The downstream slope of the dam embankment and the emergency spillway overflow area will have to have significant erosion/scour protection to operate safely during the PMF event.

3.2.8 Operation and Maintenance Plan

An operation and maintenance plan for the dam must be documented and submitted to the DNR for approval before the dam is placed in operation. The plan shall describe all operational features and procedures for the dam. Operation during periods of normal flow, as well as during floods and droughts, needs to be described. Provisions for maintaining adequate streamflow through the dam at all times shall be part of the plan. The operating and maintenance plan is needed for the proper and safe operation of the dam and to ensure that the multipurpose intended benefits are realized.

The preliminary engineering report describes the proposed operation of the dam to be that normal pool elevation would be 1190.0 M.S.L. (10 feet below the roadway crest). During the 100-year flood event, the pool would not exceed elevation 1196.0 M.S.L. and all discharge would be through the principal spillway. An 1,420 feet long depressed highway section would be used to provide additional discharge capacity for floods larger than the 100-year event. A 48-inch diameter conduit will serve as a low discharge to pass normal base flows without excessive pool fluctuations. This conduit will remove water from the bottom of the reservoir and will also serve as a draw down device, should it become necessary to totally drawdown the reservoir.

The Sand Hill River Watershed District will be responsible for the operation and maintenance of the dam. This may require an agreement between the Watershed District and the Department of Transportation.

3.2.9 Easements

Before proceeding with the construction and operation of this dam, the project sponsor is required to acquire the rights and interests in property necessary for both construction activity and flowage. Easements for flowage in the impoundment area will be acquired to elevation 1196.0 M.S.L. This elevation corresponds to the pool elevation resulting from the 100-year runoff event. Larger runoff events could cause inundation of impoundment areas not secured by easement. In this case, the dam owner could be subject to liability for damages. Flowage from the spillway may also require easements from the Soo Line Railroad and the Minnesota Department of Transportation. All necessary easements need to be secured before the sponsor applies for the Dam Safety Permit.

3.3 FISHERIES RESOURCES

3.3.1 Description of stream survey and fisheries study area

A fishery investigation was conducted on the Sand Hill River on April 23 and June 23, 24 and 25, 1986 to develop information on fish community structure. Water samples were taken throughout the summer of 1986 at five locations to determine the general water chemistry, Biochemical Oxygen Demand (BOD) and fecal coliform bacteria levels (see Section 3.6 for discussion of water quality sampling activities). The water quality sampling locations are shown in Figure 3-1.

The study area of the river is a wide valley with grazed marshland abutting the stream. The upland area is gently rolling terrain dominated by row crops. Tree cover along the banks is sparse and emergent or semi-aquatic plant species are the dominant vegetation. The common representatives were sedges, reedtop and reed canary grass and cattail. Willow, green ash and american elm were the most common tree species. Aquatic plants were abundant by mid-June and the river became weed-choked from mid-summer until fall, especially in the low gradient areas. The aquatic plants noted during the survey are shown in Table 3-1.

TABLE 3-1
AQUATIC PLANTS OF THE SAND HILL RIVER IN THE WINGER DAM STUDY AREA

	Scientific name	Common name
Emergent vegetation	<u>Acorus calamus</u>	sweet flag
	<u>Carex spp.</u>	sedge
	<u>Phalaris arundinacea</u>	reed canary grass
	<u>Scirpus validus</u>	softstem bulrush
	<u>Sparganium chlorocarpum</u>	greenfruited burreed
	<u>Typha spp.</u>	cattail
Submerged vegetation	<u>Callitriche palustris</u>	water starwort
	<u>Nuphar variegatum</u>	yellow waterlily
	<u>Potamogeton natans</u>	floatingleaf pondweed
	<u>Potamogeton strictifolius</u>	narrowleaf pondweed
	<u>Sagittaria cristata</u>	crested arrowhead
	<u>Vallisneria americana</u>	wild celery

PRELIMINARY CONSTRUCTION PLANS
PROJECT NO. 4 - WINGER DAM
SAND HILL RIVER WATERSHED DISTRICT
FERTILE, MINNESOTA

1986

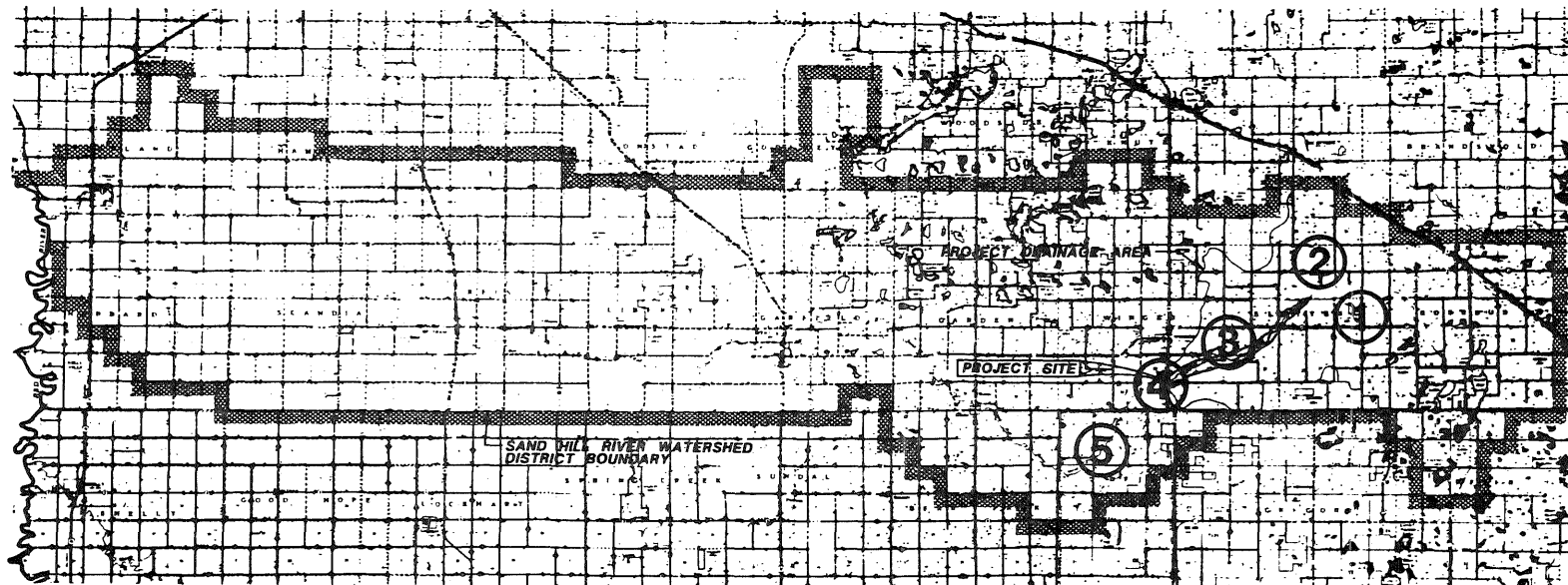


FIGURE 3-1
 WATER QUALITY SAMPLING LOCATIONS

PROJECT LOCATION AND DRAINAGE AREA MAP					
PROJECT NO. 4 - WINGER DAM, SAND HILL RIVER					
SAND HILL RIVER WATERSHED DISTRICT					
FERTILE, MINNESOTA					
1:2 MILES	1:4	1:8	1:16	1:32	1:64
HOUSTON ENGINEERING, INC.					

APPENDIX A

River substrates were predominantly sand-gravel with muck along the banks. Streamflows at the T.H. 59 bridge were estimated at 103 cfs and 15 cfs on June 23 and July 22, respectively. The flow on September 15 at the T.H. 59 bridge was approximately 10 cfs. Secchi disc readings at the time of the June survey were 4.8 feet at Water Quality Station 3, 6.0 feet at Water Quality Station 4, and 3.5 feet at Water Quality Station 5.

3.3.2 Fisheries investigation

An electrofishing survey was conducted on a segment of the Sand Hill River in June 1986. Electrofishing station locations are shown on Figure 3-2. A catch of 345 fish including 11 species was recorded during 1.35 hours of electrofishing and is shown in Table 3-2. Three large fish species, northern pike, white sucker and black bullhead were taken. The remainder of the catch was minnows and other small fish species. Nearly 90% of the large fish species catch was taken from Stations 1 and 2 as shown in Table 3-3.

White suckers comprised 96% of the large fish species catch and 95% by weight as shown in Table 3-4. Most of the white suckers were sub-adult age, as shown in Table 3-5. Northern pike were the only game fish taken. The catch included one young-of-year and two sub-adults.

Catch rates per unit of effort are shown in Table 3-6 and ranged from 876.0 fish per hour in Station 1 to 85.8 fish per hour in Station 4. The overall catch rate for the four stations combined was 255.6 fish per hour. The small fish species contributed 75% of the overall catch. Station 1 provided 71% of the small fish species catch. Brook stickleback, fathead minnow and finescale dace were most abundant.

A preliminary electrofishing assessment was conducted in April 1986 to determine the presence, in the vicinity of the proposed project, of any spawning concentrations of fish, particularly northern pike. No spawning concentrations were observed. The large fish species observed at this time consisted of 28 white suckers and three northern pike.

TABLE 3-3
COMPOSITION OF THE LARGE FISH SPECIES AT
FOUR STATIONS ON THE SAND HILL RIVER
JUNE 1986

Station	1		2		3		4		Overall	
	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)
Northern pike	1	(3.0)	1	(2.3)	-	(-)	1	(25.0)	3	(3.5)
White Sucker	31	(93.9)	43	(97.7)	4	(80.0)	2	(50.0)	80	(93.0)
Black bullhead	1	(3.0)	-	(-)	1	(20.0)	1	(25.0)	3	(3.5)
Total	33	(100)	44	(100)	5	(100)	4	(100)	86	(100)

PRELIMINARY CONSTRUCTION PLANS
PROJECT NO. 4 - WINGER DAM
SAND HILL RIVER WATERSHED DISTRICT
FERTILE, MINNESOTA

1986

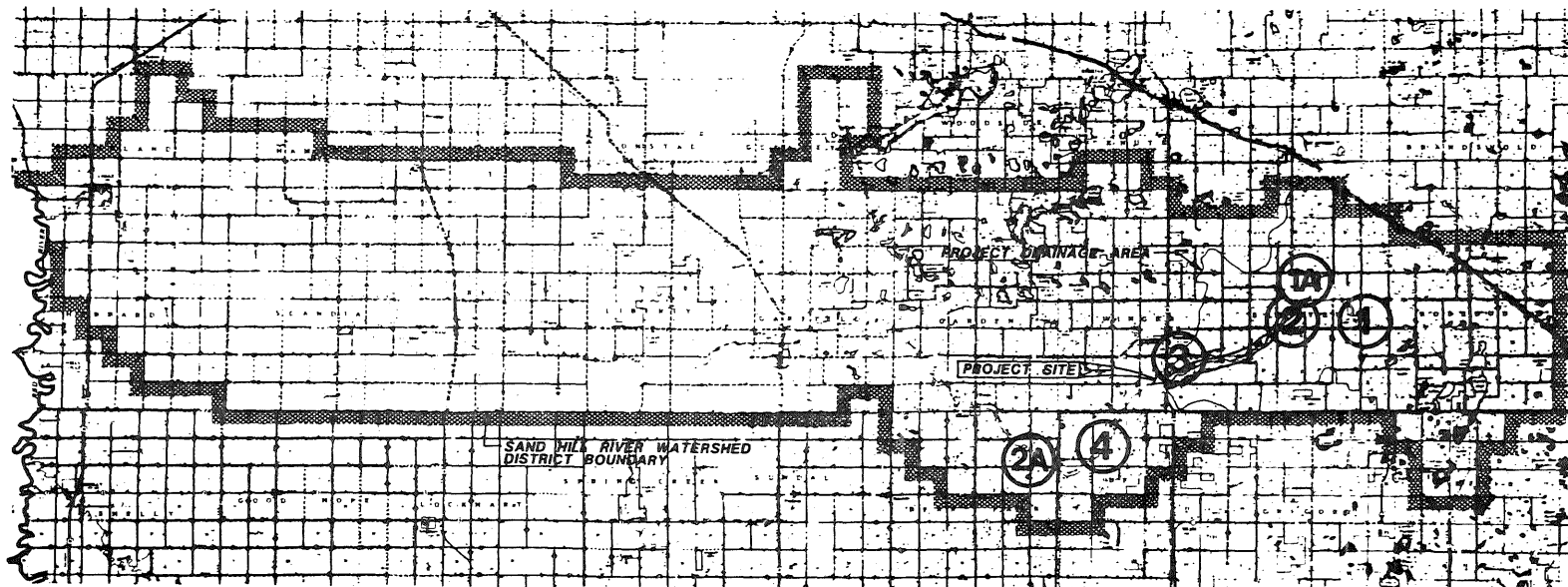


FIGURE 3-2
 ELECTROFISHING STATION LOCATIONS

PROJECT LOCATION AND DRAINAGE AREA MAP			
PROJECT NO. 4 - WINGER DAM, SAND HILL RIVER SAND HILL RIVER WATERSHED DISTRICT FERTILE, MINNESOTA			
DATE	BY	SCALE	REVISION
10-2-86	LEW	1" = 1/2 MILE	1
 HOUSTON ENGINEERING, INC. 1001 N. 10TH ST. SUITE 100 FERTILE, MN 55934			

APPENDIX A

TABLE 3-2
TOTAL NUMBER OF FISH AT FOUR STATIONS ON THE SAND HILL RIVER
JUNE 1986

Station	1	2	3	4	Total
Northern pike	1	1	-	1	3
White sucker	31	43	4	2	80
Black bullhead	1	-	1	1	3
Subtotal	33	44	5	4	86
Central mudminnow	-	3	6	-	9
Finescale dace	40	1	6	4	51
Fathead minnow	48	5	8	17	78
Blacknose dace	5	-	-	-	5
Creek chub	1	-	-	-	1
Brook stickleback	78	9	8	1	96
Iowa darter	14	-	1	-	15
Blackside darter	-	-	-	4	4
Subtotal	186	18	29	26	259
Total	219	62	34	30	345

TABLE 3-4
COMPOSITION BY WEIGHT OF THE LARGE FISH SPECIES AT
FOUR STATIONS ON THE SAND HILL RIVER
JUNE 1986

Station	1 Lbs. (%)	2 Lbs. (%)	3 Lbs. (%)	4 Lbs. (%)	Overall Lbs. (%)
Northern pike	1.3 (22.0)	0.8 (2.0)	- (-)	0.1 (16.7)	2.2 (4.6)
White sucker	4.4 (74.6)	39.0 (98.0)	1.2 (85.7)	0.3 (50.0)	44.9 (94.1)
Black bullhead	0.2 (3.4)	- (-)	0.2 (14.3)	0.2 (33.3)	0.6 (1.3)
Total	5.9 (100.0)	39.8 (100.0)	1.4 (100.0)	0.6 (100.0)	47.7 (100.0)

3.3.3 Existing fisheries resources impact

Overall results indicated low populations of the large fish species and poor diversity. Habitat reduction and oxygen deficiencies during low flows are primary limiting factors to the establishment of a healthy fish community structure. Low oxygen conditions result from the abundant submerged aquatic vegetation during periods of plant respiration, and the sediment oxygen demand in areas with low stream velocity. A U.S. Army Corps of Engineers channelization project downstream from the City of Fertile prevents movement of fish into the study area and the upper reaches of the river. There are drop structures that vary from 4.0 feet to 6.5 feet and that create vertical barriers to fish passage.

TABLE 3-5
LENGTH FREQUENCY DISTRIBUTIONS OF LARGE FISH SPECIES IN THE SAND HILL RIVER, JUNE 1986

Species:		NORTHERN PIKE																																	
		Length (mm & in)																																	
Station		25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	
1																				1															
2																1																			
4						1																													
Totals						1										1				1															

Species:	WHITE SUCKER																																	
	Length (mm & in)																																	
Station	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	
1			6	9	1	1	2	4	3	3	2																							
2								1	3	3	3	9	7	6	7	4																		
3						2		1					1																					
4							1					1																						
Totals			6	9	1	3	3	6	6	6	6	9	8	6	7	4																		

Species:		BLACK BULLHEAD																																				
		Length (mm & in)																																				
Station		25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825				
1												1																										
3												1																										
4													1																									
Totals												2	1																									

TABLE 3-6
CATCH PER UNIT OF EFFORT (FISH/HR.) AT FOUR STATIONS ON THE SAND
HILL RIVER, JUNE 1986

Station	1	2	3	4	Overall
Northern pike	4.0	2.5	-	2.9	2.2
White sucker	124.0	107.5	11.4	5.7	59.3
Black bullhead	4.0	-	2.9	2.9	2.2
Subtotal	132.0	110.0	14.3	11.5	63.7
Central mudminnow	-	7.5	17.1	-	6.7
Finescale dace	160.0	2.5	17.1	11.4	37.8
Fathead minnow	192.0	12.5	22.9	48.6	57.8
Blacknose dace	20.0	-	-	-	3.7
Creek chub	4.0	-	-	-	0.7
Brook stickleback	312.0	22.5	22.9	2.9	71.1
Iowa darter	56.0	-	2.9	-	11.1
Blackside darter	-	-	-	11.4	3.0
Subtotal	744.0	45.0	82.9	74.3	191.9
Total	876.0	155.0	97.2	85.8	255.6
Effort (hrs)	.25	.40	.35	.35	1.35

3.3.4 Projected fisheries for proposed reservoir project and proposed alternatives

Data collected from the fishery investigation, water sampling and flow measurements provide the baseline data on which the projected fisheries were developed. A number of publications giving case histories of reservoir fisheries and predictive yield models were also used.

As a reservoir is filling and during the subsequent several years, the fish species composition undergoes considerable change as it seeks a level of equilibrium. The fisheries survey of the Sand Hill River found a species composition comprised mostly of white sucker, black bullhead, northern pike, and a number of minnow species. During the early years of the reservoir, most of the fish biomass will likely be comprised of black bullhead followed by white sucker and northern pike. Due to the prolific nature of black bullhead and their ability to withstand harsh environmental conditions, it is likely that they could quickly dominate the fish community. The optimal range of total dissolved solids (TDS) for black bullhead is 100-600 ppm (Jenkins 1976; Finnell 1979). Black bullheads can withstand low levels of dissolved oxygen (D.O.). The lethal oxygen threshold of the species decreases during the winter, which allows for their survival after most fish species have died (Moore 1942). The black bullhead can also tolerate high levels of pollutants (Scott and Crossman 1973).

Northern pike populations generally expand during the early years of a reservoir followed by declining numbers as the reservoir ages. As a reservoir is filling, terrestrial vegetation is flooded providing good spawning habitat for northern pike. During this developmental stage of a reservoir, the habitat is expanding faster than the fish population can expand. With good spawning habitat and little competition for space, northern pike population usually expand and provide good fishing during the first decade in the life of a reservoir. June (1976) reported strong year-classes on Lake Oahe, South Dakota during years when the reservoir was filling and years of high spring water levels. As the reservoir ages the spawning habitat for northern pike deteriorates and their population levels decrease. Groen and Schroeder (1978) reported that in most Kansas reservoirs fish populations declined as the reservoir ages and becomes windswept and turbid. Reproductive success for northern pike is usually low in flood control reservoirs due to fluctuating water levels.

The productivity (pounds of fish flesh per acre) and the species composition of a body of water are dependent on the physical and chemical properties. Moyle (1956) used a number of key physical and chemical parameters to classify the productivity and species composition of fish lakes. As a body of water becomes more eutrophic, the type of lake shifts from walleye to centrarchid to roughfish/gamefish to bullhead. Physical and chemical characteristics of the proposed reservoir are most closely related to a bullhead type of lake. Table 3-7 illustrates physical and chemical characteristics of principal Minnesota fish lake types.

TABLE 3-7
PHYSICAL AND CHEMICAL CHARACTERISTICS OF PRINCIPAL MINNESOTA FISH LAKE TYPES*

Lake Type	Eutrophism						Winger Reservoir
	Softwater Walleye	Hardwater Walleye	Centrarchid Walleye	Centrarchid	Roughfish Gamefish	Bullheads	
Shoal Bottom Type (percentage)							
Bedrock-Boulder	30-100	-	-	-	-	-	-
Gravel-Sand	20	90	75	75	80	30	-
Organic	20	10	25	25	20	70-100	100
Percentage Littoral Area	15-20	25-35	25-50	25-50	35-70	75-100	86
Dissolved O ₂ below Thermocline	May be absent	May be absent	May be absent	Usually absent	May be unstratified	Usually unstratified	Usually unstratified
Temperature (Max. Epilimnion)	70°F	75°F	80°F	85°F	85°F	85°F	80-85°F
Total Alkalinity	40 ppm	100 ppm	100 ppm	100 ppm	100 ppm	100 ppm	276 ppm
Total Phosphorus	.025	.03	.05	.05	.05	.10	.13
Typical Size, acres	1000	1000	600	300	Variable	Variable	1600
Typical Maximum Depth, feet	50	35	25	25	Variable	20	24

* From Scidmore 1970

Moyle (1956) demonstrated a relationship between total alkalinity, total phosphorus, percent littoral area (less than 15 feet in depth) and maximum depth to the types of fish lakes found in Minnesota. A comparison of the water quality data collected on the Sand Hill River in 1986 with Moyle's work reveals that a reservoir on the Sand Hill River is likely to be a very eutrophic roughfish reservoir. (See also the results of the Water Quality sampling described in Section 3.6.)

There are a number of variables which could limit the fishery potential of a reservoir located on the Sand Hill River. Water quality parameters influence the species composition and productivity of a reservoir. Physical parameters include mean and maximum depth and surface area. Other variables include the length of the growing season, reservoir age, water level fluctuations, and winter oxygen levels.

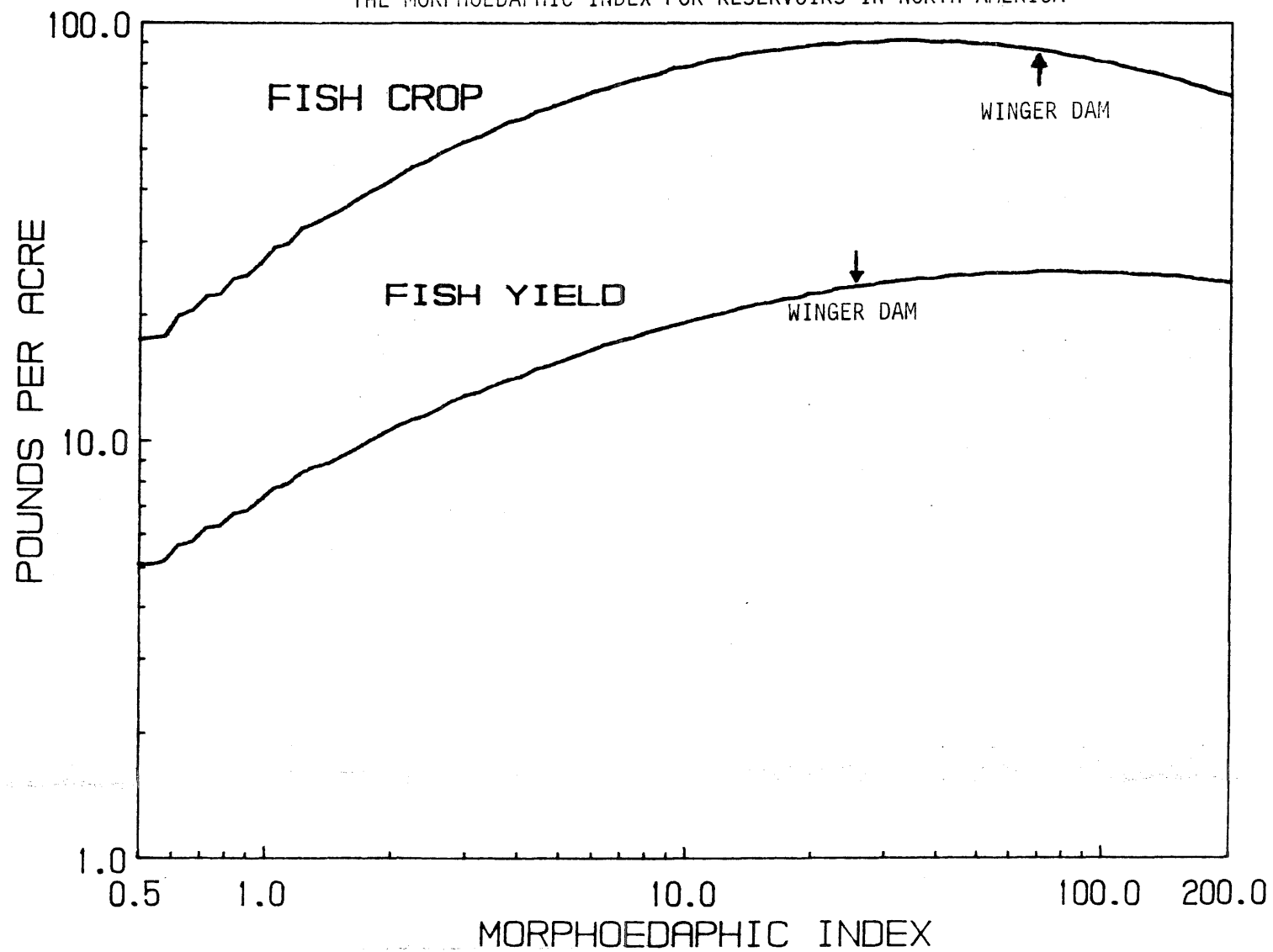
Ryder (1965) developed a morphoedaphic index (MEI) to estimate the potential fish yield in Canadian lakes. The MEI is determined by dividing total dissolved solid (TDS) in mg/liter by mean depth in meters. Jenkins (1982) found significant correlations between MEI and fish standing crops in 290 reservoirs in the United States.

By applying Jenkins (1982) regression formulas for fish crop and fish yield based on MEI to the data available on the proposed reservoir, an estimate can be made on the productivity of the reservoir. Total dissolved solids from the Sand Hill River water quality data ranged from 338 to 592 mg/liter with a mean of 423 mg/liter. Mean depth of the reservoir is estimated at 2.8 meters (9.1 feet). Estimated mean fish standing crop will be 73 pounds per acre with minimum value of 67 pounds per acre and a maximum value of 81 pounds per acre. Fish yield (harvest) is estimated at a mean of 25 pounds per acre with a range of 24 to 26 pounds per acre. These values are shown in Figure 3-3.

No predictions of the proposed fisheries were made for any of the alternatives. As discussed further in this section and in the sections on Sand Hill River downstream flow analysis (Section 3.5) and on project and downstream water quality (Section 3.6), factors including high water fertility, shallow depth of the reservoir (20.0 feet maximum at the dam site), and low flows on the Sand Hill River increase the probability that the proposed impoundment will experience frequent winterkill conditions. Summer and winterkill potential are even more probable for Alternatives No. 3 with maximum depths at the dam of 6.0 feet and Alternative No. 4 with maximum depths at the dam sites of 4.0 feet and 5 feet. None of the alternatives were suited for supporting a fishable population.

Stratification of the reservoir should not become a significant problem because of a combination of factors including only a small area of the reservoir near the dam has any potential for stratification, mixing of the water column through wave action, and the composition of the fisheries expected for reservoir. These factors reduce the potential for or significance of stratification problems in the reservoir and the Scoping Decision varies in that respect. Temporary stratification could occur under the right weather conditions for a limited period of time.

FIGURE 3-3
COMPARISON OF REGRESSIONS OF RESERVOIR FISH CROP AND FISH YIELD (HARVEST) ON
THE MORPHOEDAPHIC INDEX FOR RESERVOIRS IN NORTH AMERICA



3.3.5. Fish management techniques to provide a desired fishery and fisheries management plan development

Prior to the implementation of fish management techniques such as stocking by the Minnesota Department of Natural Resources, there must be an adequate public access on the proposed reservoir. The statutory provisions relating to public access sites (Minnesota Statutes, Sections 86A.05, Subd. 9, 97A.141, and 97C.201) are reproduced as Appendix B. The Department of Natural Resources State Water Access Site Policy which identifies the designation process and criteria, site acquisition and development, and the site management policies is also reproduced in Appendix B.

A public access at the proposed reservoir site is not identified as a part of the Department of Natural Resources' current priority system for DNR public access designation, site acquisition or development. The Department of Natural Resources cannot acquire land in fee or easement for a Department maintained and operated public access on a non-meandered water body. The DNR can establish public accesses on land owned by others through lease or cooperative agreements. If land for a public access was not provided to the DNR through cooperative agreements or lease, other governmental entities, such as a county or a watershed district, could operate and maintain the public access.

After this public access requirement is met, the DNR can then develop a management plan best suited for the particular body of water. Evaluation of the water quality data, physical characteristics of the proposed reservoir and the flow characteristics of the Sand Hill River severely limit the management potential.

The installation and operation of an aeration system would be required to maintain a sport fishery. The combination of shallow depth, inundation of vegetation and low input flows containing a high nutrient level will cause winterkill due to oxygen depletion. The proposed reservoir contains a large (86% of the permanent pool acreage) littoral zone (water depth of 0 to 15 feet) and a maximum depth of only 20 feet. Decomposition of the inundated wetland and upland vegetation and the contribution of commercial fertilizers, agri-chemicals and animal waste from the predominantly agricultural upstream watershed will contribute to a high biochemical oxygen demand. These conditions describe conditions similar to lakes in Minnesota which are subject to frequent winterkill. Therefore, it is likely that the impoundment will experience frequent winterkill conditions and aeration will be necessary to maintain some kind of sport fishery. Aeration equipment should be included as part of the project costs.

The two primary sources of oxygen for a lake are atmosphere (where oxygen is supplied through wind and wave action at the air/water interface), and photosynthesis (where oxygen is supplied by aquatic plants requiring sunlight). During the winter months when the lake is ice and snow covered, atmospheric supply of oxygen is essentially eliminated and photosynthetic oxygen is much reduced. However, demands for oxygen, decomposition, and respiration continue and the lake's supply of oxygen is depleted. When the demand for oxygen exceeds the supply, oxygen concentration falls below the minimum required to sustain fish, and winterkill occurs.

Aeration is proven to be an effective, but often costly means to prevent winterkill. There are several types of aeration systems presently used in Minnesota. Three aeration methods appear to be best suited for the proposed impoundment. Pump and baffle systems function through direct aeration of a significant portion of the lake volume. A large volume of water is pumped out of the lake to the top of a flume where it cascades back into the lake over a series of baffles, adding oxygen and releasing unwanted gases. Pump and baffle systems create a small area of open water and are considered to be one of the safer methods of aeration. Because this type of system pumps water rather than air, it is energy intensive and expensive to operate. Where frequent winterkill is anticipated, this type of system may not be cost effective.

Two other aeration systems commonly used in Minnesota to prevent winterkill function by removing the ice cover from a sizeable area of the lake thus allowing gas exchange between the open water and the atmosphere. A bubbler system introduces air to the bottom of the lake from an air compressor or blower through weighted airlines to diffusers of various designs. As the air bubbles rise to the surface they entrain (lift) the warmer, more dense bottom water and bring it to the surface removing the ice cover. A small percentage of the oxygen is absorbed directly from the air introduced by the diffusers (15%) but the greatest portion of the oxygen is supplied by the atmosphere. Oxygen absorption and circulation are enhanced by wind and wave action. The re-oxygenated water is also circulated by the pumping effect of the diffuser and density currents. Bubbler systems are more energy efficient because air rather than water is pumped. Bubbler systems are better suited for lakes which experience frequent winterkill because they are less expensive to operate. They are started when oxygen levels begin to decline and run continuously while the lake is ice covered.

Pusher pumps or air injection systems introduce air just below the surface of the water. These systems also remove large areas of ice from the surface of the lake allowing oxygen transfer to take place and set up currents which circulate the re-oxygenated water.

The net result of all three methods is an area of water with sufficient oxygen, a refuge, where fish can survive through the winter.

Aeration systems operated during the winter months are hazardous because they create open water at a time when Minnesota lakes are normally ice covered. A permit from the Minnesota Department of Natural Resources is required to install and operate an aeration system in Protected Waters. Specific operation of aeration systems is governed by DNR Commissioner's Orders 2194 and 2258 and included in the DEIS as Appendix C. There is no application fee or charge for the permit if one is granted. However, the permittee must provide proof of insurance or financial responsibility for personal liability and property damage of \$600,000 before the permit is valid for winter operation.

Factors to consider before aerating a marginal lake are the possible conflict of open water areas and thin ice with wintertime recreational activity, frequency of winterkill, proximity of permanent fish lakes in the area, type of fish population the lake could be expected to support with aeration, importance of the lake to the local community, cost of restocking fish without aeration, cost of installation and operation of

the aeration system, proximity of intensive use areas on shore such as parks, and cost of increased non-game fish control programs. In addition, unless accompanied by other efforts such as non-game fish removal, chemical rehabilitation and/or barrier construction, improvements made by aeration may not justify the expenditure.

Table 3-8 shows estimated equipment costs of the three types of systems described. These costs do not include installation or engineering expenses, electrical service to control panels, structures to house equipment (pumps, blowers, etc.) or other expenses that may occur. It is estimated that these expenses will equal equipment costs. The table also illustrates estimated operating expense based on 1986 electrical rates. These estimates do not include maintenance or depreciation allowances. Cost of liability insurance is not included. If the sponsor's existing insurance coverage is not adequate this coverage is likely to cost from \$500 to \$2,000/year.

Cooperative agreements for the operation of aeration systems on protected waters between the DNR and sportsmen groups, lake associations, or the project sponsors are an option. The aeration systems are usually purchased by the DNR and the installation, operation costs and securing an annual permit are the responsibility of the sportsmen group, lake association, or project sponsor.

TABLE 3-8
AERATION SYSTEM ESTIMATED EQUIPMENT COSTS

Aeration System	Size (Hp)	Equipment Cost	Estimated Power Consumption for a 4 month season	*Operating cost for a 4 month season
Bubbler	15	\$22,540.00	32,400 KWH	\$1,657.00
Pusher pump	20 (10-2 Hp)	\$26,700.00	43,200 KWH	\$2,208.00
Pump and Baffle	15	\$26,360.00	32,400 KWH	\$1,657.00

* Based on electrical rate of \$0.06/KWH for first 500 KWH, and \$0.051 KWH thereafter.

Without an aeration system it is likely that winterkills will occur often enough to limit the development of a game fish population. Fish

stocking is a method which can be used to improve a fish population. The success of a stocking program is based on choosing a species best suited for the water into which it will be stocked. Evaluation of the water quality data and physical data indicate that the best species for stocking should be limited to largemouth bass, bluegill and channel catfish. Periodic evaluations should be made by the DNR to determine the success of any stocking activities.

A water level management plan is important to maintain a good fish population. Groen and Schroeder (1978) suggest maintaining high water levels in the spring to improve fish spawning and nursery conditions. During the mid-summer period the reservoir should be drawn down to promote revegetation of the shallow areas and improve predation of forage fish.

It is difficult to justify the addition of this reservoir solely for creation of additional fishing opportunities. The costs of maintaining a fishery are significant. Within a 50-mile radius of the project in the Detroit Lakes, Park Rapids, Bemidji and Walker areas there are an abundance and variety of good fishing lakes. There are a number of marginal lakes close to the Winger area which experience periodic winter-kills due to oxygen depletion. For fisheries management purposes, it may be more economical to improve these local vicinity lakes for fishing than to develop a reservoir with low water quality and a marginal fishery.

3.4 WILDLIFE RESOURCES

3.4.1 The Habitat Evaluation Procedures study process and methodology

To determine the impact of the proposed project and alternatives on wildlife, the Habitat Evaluation Procedure or HEP developed by the U.S. Fish and Wildlife Service (USFWS 1980) was conducted. The HEP process was developed for use in environmental impact assessment and project planning. HEP provides a means to measure quality and quantity of wildlife habitat and allows comparisons of impacts of various project alternatives on wildlife habitat. HEP utilizes documented wildlife species models to determine the habitat quality of a defined area to a particular species. This value or quality rating is called Habitat Suitability Index or HSI. HSI values range from 0 to 1 with a value of 1 representing optimum habitat, and a value of 0 representing no value. The HSI is then multiplied by the number of acres of habitat available to the species. This result represents the number of Habitat Units available for a particular species within a defined area.

$$\text{Habitat Units} = \text{HSI} \times \text{Acres (of habitat)}$$

A species' Habitat Unit(s) (HU) could increase or decrease during the life of a project alternative due to projected changes in the acres of habitat and/or the species' HSI value. To make comparisons of different species or alternatives the HU of each species are averaged into Average Annual Habitat Units (AAHU). A species AAHU is the average number of HU provided to that species each year for that project alternative. These species' AAHU are then used to compare anticipated impacts from each of the project alternatives.

A team of biologists (the HEP Team) representing the Minnesota Department of Natural Resources (DNR), Minnesota Department of Transportation (MNDOT), U.S. Fish and Wildlife Service (USFWS), and U.S. Army Corps of Engineers (USCE), was established to conduct a HEP analysis on the project area including baseline (existing condition), and for each of the proposed project alternatives.

The goal of the Team was to identify the impacts of the Sand Hill River Watershed District Winger Dam Project alternatives on wildlife and wildlife habitat within the project area and the mitigation measures needed to fully compensate for any loss of wildlife habitat using Habitat Evaluation Procedures.

The Team used the following procedures to accomplish their goal:

- 1) Definition of the study area limits;
- 2) Identification of cover types within the study area;
- 3) Selection of wildlife species models to represent the various cover types of the study area;
- 4) Evaluation of the existing habitat within the cover types to determine its value to the selected wildlife species; and
- 5) Identification and evaluation of the anticipated future cover types within the study area for each of the project alternatives to determine its value for the selected wildlife species.

3.4.2 Study area and cover type

The Team established a study area to facilitate evaluation of impacts for each project alternative. The boundary of the study area was the T.H. 59 centerline (proposed dam site) on the west and 1/8 of a mile beyond the outer edge of the flood pool boundary delineated for the proposed project (Alternative No. 1) for the remainder of the area. The HEP study area is shown in Figure 3-4. The study area included the permanent pool (PP) and flood pool (FP) boundaries for all of the alternatives. All primary and secondary impacts of the project alternatives would be evaluated within this study area.

The Team developed a baseline cover type map as shown in Figure 3-4 which outlined the following cover types:

- 1) Wetlands (river and associated floodplain wetlands)
- 2) Cropland (including cultivated hayland)
- 3) Grassland (undisturbed)
- 4) Woods
- 5) Pasture
- 6) Farm (farmsteads)
- 7) Road (gravel or pavement surface).

The cover types were delineated from aerial photographs and ground checked. Baseline (existing condition) acreage figures were determined by cover type and are shown in Table 3-9. The wetland habitat was delineated and cover typed according to the wetland classification (Type 1 bottomland hardwoods = 1L, Type 2 = T2, Type 3 = T3, etc.) described in U.S. Fish and Wildlife Service Circular 39, Wetlands of the U.S. (Shaw and Fredine 1956). Wetland types were identified and delineated to provide the Team the opportunity to better evaluate complex wetland cover types.

TABLE 3-9
WINGER DAM BASELINE COVER TYPE ACREAGES AND COVER TYPE ACREAGES
WITHIN EACH ALTERNATIVE* PERMANENT POOL (PP) AND FLOOD POOL (FP)

Baseline for Study Area by		Alt. 1		Alt. 2		Alt. 3		Alt. 4	
		PP	FP	PP	FP	PP	FP	PP (1+2)	FP (1+2)
Acres	Cover Type	Elevations							
		1190	1196		1186	1176	1186.5	1174-1188	1183-1197
817	Wetland-T2	658	108	--	582	118	465	186	531
107	Wetland-T3	107	--	--	107	54	52	19	87
24	Wetland-T6	17	2	--	20	5	13	9	9
6	Wetland-1L	2	4	--	--	--	2	--	5
970	Crop	135	89	--	86	1	92	--	90
182	Grassland	48	19	--	14	--	17	--	26
212	Woods	100	29	--	77	19	74	4	77
447	Pasture	128	93	--	74	5	73	20	123
49	Farm**	--	2	--	--	--	--	--	4
11	Road**	9	--	--	--	--	--	--	--
Totals		1204	346		960	202	788	238	952
2825		1550			960	990		1190	

* Alternative No. 5 is not given, the No Build Alternative does not have a PP or FP.

** Only 2 acres or larger are noted as being affected for these two cover types. Acreages less than 2 were not noted.

3.4.3 Species model selection

The Team then selected species models for evaluating project impacts. Selection of species models for use in the HEP evaluation was based on the following criteria.

- 1) An HSI species model is available for a candidate species.
- 2) The species is associated with or utilizes the cover type for which it was chosen.
- 3) The species is known or has the potential to exist in the area of the Winger Dam Project Site.
- 4) To the extent possible, the species represents a single cover type user.

The species models selected and the cover types that were evaluated for the HEP are as follows:

<u>Cover Type</u>	<u>Species</u>
Woods	Black-capped chickadee
Cropland Pasture Grassland	Grey Partridge
Wetland	Muskrat Mink Wood Duck

The number of species chosen for the HEP analysis was kept to a minimum due to time and budgetary constraints. The wetland cover type, because of its complexity (diversity), was assigned the most species. The selection of species for the respective cover types allowed for a representative evaluation of habitat related impacts resulting from the proposed project alternatives.

3.4.4 Baseline conditions

Field data collected in August 1986 and aerial photo interpretation were used to develop baseline HSI from each species' model. Baseline HSI and acreages, are shown in Table 3-10. The Team evaluated each wetland species for the appropriate wetland types utilized by that species within the overall wetland cover type complex. Therefore, acreage figures vary between wetland species.

3.4.5 Future projections

The Team projected the cover type acreages and species HSI that would exist for the proposed project alternatives. These projections as shown in Table 3-10 were based on review of the hydrological data, economic analysis, consultation with other biologists (DNR, USCE, and USFWS), and a review of other water control projects in Minnesota (Lac Qui Parle/Marsh Lake, Traverse Lake, Big Stone Lake, and Orwell Reservoir). To precisely determine for each project alternative cover type acreage and related HSI value for each species would be impossible, but reasonable determinations can be made.

TABLE 3-10
WINGER DAM STUDY AREA COVER TYPE, ACREAGE, AND HSI BY SPECIES AND ALTERNATIVE

Species	Cover Type	Baseline		Alt. 1*		Alt. 2*		Alt. 3*		Alt. 4*		Alt. 5**	
		Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI
Gray Partridge	Grassland Pasture Cropland	1599	.26	1258	.23	1584	.25	1574	.25	1557	.26	1599	.26
Black-capped Chickadee	Woods	212	1.00	103	1.00	194	1.00	155	1.00	188	1.00	212	1.00
Wood duck	Wetland - 1L, T3, T4, T5, Woods	325	.22	361	.10	307	.18	416	.12	520	.13	325	.22
Mink	Wetland - T2, T3, T4, T5,	924	.74	452	.86	909	.74	973	.80	979	.80	924	.74
Muskrat	Wetland - T3, T4, T5, T6	131	.80	261	1.00	149	.80	312	1.00	361	1.00	131	.80

* Acreage and HSI are based on the 1st year following completion of the dam(s) (TY2).

** Baseline and Alternative No. 5 (No-build alternative) are equal.

For the HEP analysis, the Team made the following general assumptions in projecting future HSI and cover type acreages for the alternatives:

- 1) Alternatives will have a project life of 50 years.
- 2) Target years (TY) will be used to project the future changes and development of species AAHU in Alternatives No. 1 to No. 4.
 - a) TY0 - Equals baseline or existing conditions, no dam or construction.
 - b) TY2 - Project (dam) is built and habitat changes (cover type and HSI) have occurred.
- 3) If no project is built (Alternative No. 5), the baseline species HU will not change for the life of the project (50 years).
- 4) Cover type vegetative characteristics will not change from baseline measurements except where specified.
- 5) Road surfaces (gravel or pavement) and farmsteads do not provide habitat for the selected HEP species.

The Team calculated the acreages that would be included in each alternative by PP and FP (Table 3-9). These acreage figures are based on aerial photographs and the 10 foot contour maps provided by the project engineers. Permanent and flood pool contours and elevation acreages are also based on these 10 foot contour maps. A two foot contour map of the area was developed but the 10 foot contour was more workable and was used for all the HEP calculations. The acreage figures given in the Preliminary Engineers report on the alternatives are based on the two foot contour maps. Therefore, while acreage figures (PP, FP) between the HEP calculations and the engineers report may differ, the variations are not considered significant for the HEP analysis.

The HEP Team made the following predictions and assumptions on the project area cover types and species HSI values for each alternative.

Alternative No. 1

Alternative No. 1 would include a large PP of 1,204 surface acres and an additional FP of 346 acres. The Team projects that of the 1,204-acre permanent pool, 254 acres will be considered wetlands. The remaining 950 acres is considered open water (lake). This is derived from the following assumptions. All water area with a depth of 0-4 feet will become wetlands (emergent and submergent vegetation) except that portion located on the south shore of the PP from the dam to 3 miles upstream and that portion located on the north shore of the PP from the dam to 1 1/2 miles upstream. The remaining portion of the PP that is deeper than 4 feet is not considered wetland except that portion located north of CSAH 1. These areas are not considered wetland because wetland vegetation would have a poor chance to develop due to wind, wave and ice action, steep slopes, and the expected eutrophic condition of the lake. The associated development and recreational use would also prevent significant use of these areas by wildlife species.

The wetland emergent vegetation is expected to be dominated by cattail (Typha spp.) and bulrush (Scirpus spp.). Approximately 60 percent of

the wetlands surface area will be covered by emergents. Submergent vegetation is expected to be dominated by water milfoil (Myriophyllum sp.), pondweeds (Potamogeton spp.), and bladderwort (Utricularia sp.).

Alternative No. 1 Flood Pool

To determine the impact to the cover types located in the FP, cover type acres were divided into three zones. Assuming all cover type acres within the FP are equally distributed, cover type acreages were divided into equal proportions within three zones. The zones according to elevation are:

- 1) Zone 1 - elevation 1190.0 to 1191.0 M.S.L.
- 2) Zone 2 - elevation 1191.0 to 1193.0 M.S.L.
- 3) Zone 3 - elevation 1193.0 to 1196.0 M.S.L.

The cover type acreages for the Alternative No. 1 are shown in Table 3-11.

Zone I would receive inundation of flood water by any rain storm (provided the PP was at normal level) and would be completely inundated by a 2-year frequency storm*. This zone would also be closest to a raised water table associated with the development of a PP. Therefore, the Zone I non-wetland cover types would change to wetland (i.e. T2 or T6). The wetlands now present in Zone I would not change.

Zone II (Elevation 1191.0 to 1193.0 M.S.L.) would be inundated during a less frequent storm (5 to 50 year storm*). This zone would also be affected by a higher water table. The land use changes include the loss of cropland and some woods due to frequent flooding and lakeshore development resulting from the project. The cropland and woods would revert to grassland or pasture in equal amounts. Wetlands in Zone II will not change, and no new wetlands will be created.

Zone III (Elevation 1193.0 to 1196.0 M.S.L.) would receive inundation only during major storm events (50-100 year storm*). Therefore, no major land use changes are likely to occur and cover type acreages will remain the same.

Alternative No. 1 Outside the PP and FP

Assumptions made by the Team for the area outside the PP and FP are as follows:

- 1) Wetlands will remain unchanged (ie. no drainage caused by the project).
- 2) Woods would be lost to lakeshore development but these losses would be offset by the growth of new trees in the development.

* Water level elevations are based upon ungated dam operation (the dam gates are open and remain open) for a given storm event. Closing the gates to retain additional flood storage would increase the elevation and acreage flooded by the various storm events in the flood pools. Gate closure would also increase the length of time the area in the FP is covered by water.

TABLE 3-11
WINGER DAM PP AND FP COVER TYPE ACREAGES WITH ALTERNATIVE NO. 1

Permanent Pool - Elevation 1190 and below WP*

254 acres Wetland T3, T4, T5

950 acres Non-wetland (Open Water)

Flood Pool, Elevation 1190-1196

FP Baseline Acres	Cover type	Zone I		Zone II		Zone III		Total WP
		1190-1191**	WP	1191-1193	WP	1193-1196	WP	
108	Wetland T2	18	57	36	36	54	54	147
--	Wetland T3	--	--	--	--	--	--	--
2	Wetland T6	--	--	1	1	1	1	2
4	Wetland 1L	1	1	1	1	2	2	4
89	Crop	15	--	30	--	44	44	44
19	Grassland	3	--	7	24	9	9	33
29	Woods	5	--	9	5	15	15	20
93	Pasture	16	--	31	48	46	46	94
2	Farm	--	--	--	--	2	2	2
0	Roads	--	--	--	--	--	--	--
Total								
346		58	58	115	115	173	173	346

* WP = With project built

** Elevations of the area included in the zone.

- 3) Pasture, cropland, grassland would be lost in equal portions to lakeshore development. This would affect the gray partridge by decreasing its overall habitat acres (129 acres). Development would have no effect on HSI. The loss to the gray partridge is projected to have occurred at TY10 with 129 acres of its habitat lost to lake cabins (i.e. 1258 to 1129 acres).

A summary of the changes in cover type acres for Alternative No. 1 is shown in Table 3-12 and the summary of changes in species HSI for the Alternative 1 is presented in Table 3-9.

TABLE 3-12
WINGER DAM STUDY AREA COVER TYPE ACREAGES WITH ALTERNATIVE NO. 1

Baseline Acreage	Cover Type	PP loss/gain	FP loss/gain	Acreage with Alternative 1
817	Wetland T2	-658	+39	198
107	Wetland T3	-107	--	--
0	Wetland T3-T4-T5	+254	--	254
24	Wetland T6	-17	--	7
6	Wetland 1L	-2	--	4
970	Crop	-135	-45	790
182	Grassland	-48	+14	148
212	Woods	-100	-9	103
447	Pasture	-128	+1	320
49	Farm	--	--	49
11	Road*	-9	--	2
0	Pool	+950	--	950
2825	Total	0	0	2825

* non-wetland

Alternative No. 2

Alternative No. 2 land use changes were derived using similar criteria and assumptions as outlined in Alternative No. 1. Due to larger FP bounces in these alternatives, cover types could not be divided equally into zones as was done in Alternative No. 1. The Team determined cover type impacts within the FP by assessing impacts of various storm events on cover type maps for each alternative.

Alternative No. 2 is a large dry dam. The land use changes that are projected to occur are due to the 960-acre FP, no PP exists. The area outside the FP is not expected to change from its present or baseline condition. Assumptions for projected land use changes within the FP include:

- 1) A mud flat of approx. 30 acres will develop at the dry dam due to sedimentation.
- 2) The majority of the land use changes will occur at or below the 1176.0 M.S.L. elevation because of frequent flooding.
- 3) Wetlands will remain unchanged except for the creation of the mud flat.

A summary of changes for Alternative No. 2 cover type acres is shown in Table 3-13 and the summary of changes in species HSI is shown in Table 3-10.

TABLE 3-13
WINGER DAM STUDY AREA COVER TYPE ACREAGES WITH ALTERNATIVE NO. 2

Baseline Acreage	Cover Type	PP loss/gain	FP loss/gain	Acreage with Alternative 2
817	Wetland T2	--	-15	802
107	Wetland T3	--	--	107
24	Wetland T6	--	+18	42
6	Wetland 1L	--	--	6
970	Crop	--	-49	921
182	Grassland	--	+14	196
212	Woods	--	-18	194
447	Pasture	--	+20	467
49	Farm	--	--	49
11	Road	--	--	11
0	Mud Flat	--	+30	30
2825	Total	--	0	2825

Alternative No. 3

Alternative No. 3 land use changes were derived using similar criteria and assumptions as outlined in Alternative No. 1. Alternative 3 consists of a 202-acre PP and a 788-acre FP. All of the PP will provide wetland habitat because the open water area is much smaller and shallower than Alternative No. 1. The emergent and submergent vegetation is expected to be the same as Alternative No. 1. The FP cover type changes were determined based on criteria and methods discussed for Alternatives No. 1 and 2, respectively.

The area outside the PP and FP is not expected to change from baseline or present condition. A summary for Alternative No. 3 of the cover type acreage changes is shown in Table 3-14 and the summary of changes in species HSI is shown in Table 3-10.

Alternative No. 4

Alternative No. 4 land use changes were derived using similar criteria and assumptions as outlined in Alternative No. 1. Alternative 4 has two

PPs and two FPs. The same assumptions made about the PP in Alternative 3 were made for Alternative 4, therefore, both of the PPs (238 acres) are considered wetlands. The FPs (952 acres) cover type changes were determined based on criteria and methods given in Alternatives No. 1 and No. 2, respectively.

The area outside the PPs and FPs are not expected to change from baseline or present condition. A summary for Alternative No. 4 of cover type acreage changes is shown in Table 3-15 and the summary of changes in and species HSI is shown in Tables 3-10.

Table 3-14
WINGER DAM STUDY AREA COVER TYPE ACREAGES WITH ALTERNATIVE NO. 3

Baseline Acreage	Cover Type	PP loss/gain	FP loss/gain	Acreage with Alternative 3
817	Wetland-T2	-118	+19	718
107	Wetland-T3	-54	--	53
24	Wetland-T6	-5	+38	57
0	Wetland-T3-T4-T5	+202	--	202
6	Wetland-1L	--	--	6
970	Crop	-1	-47	922
182	Grassland	--	+31	213
212	Woods	-19	-38	155
447	Pasture	-5	-3	439
49	Farm	--	--	49
11	Road	--	--	11
2825	Total	0	0	2825

TABLE 3-15
WINGER DAM STUDY AREA COVER TYPE ACREAGES WITH ALTERNATIVE NO. 4

Baseline	Cover Type	PP loss/gain	FP loss/gain	Acreage with Alternative 4
817	Wetland-T2	-186	+22	653
107	Wetland-T3	-19	--	88
0	Wetland-T3-T4	+238	--	238
24	Wetland-T6	-9	+20	35
6	Wetland-1L	--	--	6
970	Crop	--	-24	946
182	Grassland	--	+17	199
212	Woods	-4	-20	188
447	Pasture	-20	-15	412
49	Farm	--	--	49
11	Roads	--	--	11
2825	Total	0	0	2825

3.4.6 Habitat unit analysis by alternatives

To simplify the HEP analysis, the species AAHU are summarized into two groups, upland species and wetland species. The upland species group contains the black-capped chickadee and the gray partridge, the wetland species group contains the muskrat, mink and wood duck. The gain or loss of species AAHU by alternative are shown in Table 3-16.

The study area has a baseline total of 628 HU for upland species and 861 HU for wetland species. Alternative No. 1 eliminates a number of wetland acres within the permanent pool, but some additional wetland cover type is projected to be created or enhanced. The net loss to upland species is 257 AAHU, and the net loss to wetland species is 171 AAHU. Alternative No. 1 would have a negative impact on HEP wildlife species within the study area and mitigation measures would be needed to offset these impacts.

Alternative No. 2 is a large dry dam. This alternative would not have a permanent pool. The effect of this development would be a net loss of 37 AAHU to upland species and a net loss of 13 AAHU for wetland species. This alternative would not have as much adverse impact as Alternative No. 1, but still would require mitigation to offset the losses.

Alternative No. 3 consists of a small permanent pool with a large flood pool. The net loss to upland species is 78 AAHU but the wetland species have a net gain of 275 AAHU. This net gain is a result of less impact on the existing wetland cover types and the permanent pool being considered all wetland. This alternative would provide more wetland species HU because the permanent pool was considered wetland and the flood pool would not significantly affect the existing cover types.

Alternative No. 4 consisting of two small permanent pools and 2 large flood pools would result in a net loss of 35 AAHU for upland species and a net gain of 344 AAHU for wetland species. This net gain in HU is the result of both pools being considered wetland and the flood pool is not significantly affecting the existing cover types.

Alternative No. 5 is a no-build alternative, no dam would be constructed. The area would not be impacted by construction of a dam. The net impact to wetland species or upland species would be zero.

Mitigation will be required by the project sponsor to offset the impacts of the project. Upland species mitigation is required for all alternatives, except No. 5, and wetland species mitigation is required only in Alternatives No. 1 and 2. Alternatives No. 3 and 4 would need no wetland species mitigation, rather they would produce substantial gains in wetland species HU. Mitigation measures and requirements are discussed in Section 4.3.

TABLE 3-16
WINGER DAM STUDY AREA SPECIES AAHU BY BASELINE AND ALTERNATIVES

Species	Baseline	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Hungarian Partridge	416	266 (-150)*	396 (-19)	394 (-22)	405 (-11)	416 (0)
Black-capped Chickadee	212	105 (-107)	194 (-18)	156 (-56)	188 (-24)	212 (0)
** Total upland species AAHU	628	371 (-257)	590 (-37)	550 (-78)	593 (-35)	628 (0)
Muskrat	105	258 (+153)	119 (+14)	308 (+203)	356 (+251)	105 (0)
Mink	684	395 (-289)	673 (-11)	776 (+93)	781 (+97)	684 (0)
Wood Duck	72	37 (-35)	56 (-16)	50 (-21)	68 (-4)	72 (0)
** Total wetland species AAHU	861	690 (-171)	848 (-13)	1134 (+275)	1205 (+344)	861 (0)

* () net change from Baseline AAHU

** Alternative totals may vary 1 or 2 AAHU due to rounding in comparison to the baseline total.

3.5 SAND HILL RIVER DOWNSTREAM FLOW ANALYSIS

The Sand Hill River downstream of the proposed Winger dam at T.H. 59 is a continuation of the wetland system found upstream of the proposed dam. Beginning immediately downstream of the railroad crossing in Winger Township Section 34, the wetland system is classified as a 160.4 acre Protected Wetland, number 503W.

The greatest downstream effects from the Winger dam on the natural existing environment will occur in this protected wetland and in those downstream of it. If the dam is operated to maintain this wetland system, it is assumed the remaining wetlands downstream to the Bear Park Dam will also be maintained. The downstream flow analysis study area encompasses the protected wetland 503W; however, comments on the effects and mitigation (see Section 4.4) apply to wetlands downstream of 503W also.

3.5.1 Downstream Effects

The effects of the proposed project on the downstream channel and adjacent wetlands are described in two interrelated categories. All of the alternatives, except the no-build alternative, will have similar effects downstream, thus the study does not differentiate for each alternative.

Change in channel structure

- 1) Aggradation will occur upstream of the dam with the reservoir acting as a desilting basin for the water flowing in the system. As a consequence of sedimentation in the reservoir, the water flowing out of the dam will be largely devoid of much of its sediment load. The river, in an attempt to regain equilibrium, will have a tendency to degrade the channel below the dam. The channel slope will steepen and the river will begin eroding at a faster rate from banks and beds in an attempt to flatten its profile. This phenomenon has been widely documented (Lane, 1934; Stanley, 1972; Gregory and Park, 1974; Park, 1977). Studies have also shown this degradation may occur up to 69 channel widths downstream before hitting grade of equilibrium (Wolman, 1967).

This relationship is complex due to the interrelated hydraulic, sedimentologic and biotic factors. Along the Sand Hill River, the profuse vegetation will actually stabilize the bed and bank material, and the slope and profile of the river as long as the vegetation is not infused with sediment during construction or removed.

The degradation is also related to the ratio of the mean annual discharge before and after construction. If the ratio increases due to seepage or increasing base flow the river will have more erosive power. In order to reduce this effect on the channel, the original vegetation below the dam should be maintained and the rock rip rap proposed should be designed as a riffle to help dissipate the energy. The riffle length will depend on the slope of the riffle and roughness of the riffle area.

- 2) The purpose of the project is to reduce the magnitude and frequency of peak stream flow response in the downstream channel. The general channel response to this change in existing flow regimen will be a reduction in channel capacity (Leopold, 1973; Park, 1977; Bovee, 1982). Change in the magnitude or frequency of the dominant discharge¹ is also likely to force changes in the channel as the following equations illustrate (adopted from Leopold & Maddock, 1953; Bovee, 1982).

$$\begin{aligned} W_a/W_p &= (Q_a/Q_p)^b & b &= .50 \\ D_a/D_p &= (Q_a/Q_p)^f & f &= .40 \\ V_a/V_p &= (Q_a/Q_p)^m & m &= .10 \end{aligned}$$

(coefficients come from studies done on alluvial streams in the Northern Plains area.)

Where W = width,
D = depth,
V = velocity
Q = discharge
a = altered condition
p = existing condition

Assuming the one-year flood event (Q_1) is the dominant discharge, the equations would be:

a)	$Q_a = 60 \text{ cfs}$	$W_a = .60 W_p$	b)	$Q_a = 17 \text{ cfs}$	$W_a = .58 W_p$
	$Q_p = 164 \text{ cfs}$	$D_a = .67 D_p$		$Q_p = 50 \text{ cfs}$	$D_a = .65 D_p$
		$V_a = .90 V_p$			$V_a = .90 V_p$

However, according to the HEC-II analysis, 50 cfs will more likely be the dominant discharge. The outflow for 50 cfs will be reduced to approximately 17 cfs. Under either scenario, the width of the new channel will be reduced by 40-42% of the old channel width. The mean depth will be reduced by 33-35% and velocity reduced by 10%. This change will make the channel less efficient for carrying flows and may affect the channel/wetland interactions.

¹Dominant discharge is defined as the discharge that exerts the most influence on the channel morphology/geometry. It has generally been found to be the bankfull discharge usually the Q_1 to Q_2 (Wolman and Miller, 1960; Leopold, Wolman and Miller, 1964).

Alteration of channel pattern, periodicity and alignment are other changes that may occur. The periodicity to riffles and pools or meander bends can be related to the following equation for alluvial channels (Leopold et. al., 1964).

$$X = 6.6W^{0.99}$$

Where X = meander wave length
W = channel width

As altered flow regimen could potentially reduce width by 40-42%, the same reduction in meander length could be expected. This shortening of meander length can again reduce the channel efficiency.

These are potential changes based on other studies and theories and may not happen as specified; however, changes will occur to some degree as shown in Figure 3-5. The prediction of actual changes requires a combination of complex analytical tools, comparison with other systems, and a large amount of experience. Prediction of actual changes would require more time than available for this component of the Draft EIS.

The predicted channel changes can be reduced by allowing the dominant discharges to flow for specified periods of time. The instream flow operation plan discussed later in this analysis attempts to address this requirement.

Independent Variable		Dependent Variable					
Stream Discharge	Sediment Load	Channel Width	Average Channel Depth	Meander Wave Length	Channel Slope	Ratio of Valley Slope to Channel Slope	Width/Depth Ratio
+	No change	+	+	+	-	-	-
-	No change	-	-	-	+	+	+
No change	+	+	-	+	+	-	+
No change	-	-	+	-	-	+	-
+	+	+	±	+	±	+	-
-	-	-	±	-	±	+	-
+	-	±	+	±	-	+	-
-	+	±	-	±	+	-	+

+ = direction of change is an increase
- = direction of change is a decrease
± = direction of change is indeterminate

Figure 3-5 Changes in channel morphology resulting from streamflow alterations and sediment yield alterations. Modified from Schumm (1977).

Change in wetlands

Of more serious consequence will be the alteration of the existing wetlands downstream by changing flood flow regimen and sedimentation rates during floods. Wetlands are dynamic systems where short- and long-term water fluctuations are dominant forces that control plant and animal communities. The short-term water cycles important to wetland maintenance are dependent on local rainfall or headwaters flooding from

March to July. If these short-term flood events (e.g., the 1 and 2 year flood events) are held in reservoirs and the depth and duration of downstream flooding is altered, the most important flood patterns for wetland maintenance will be changed as these wetlands appear to be more a function of streamflow than groundwater flow. The modification to flow patterns reduces quantity and quality of wetland habitat by:

- 1) Loss or reduction of primary productivity;
- 2) Loss in complementary units of wetland complex;
- 3) Loss or reduction of thermal and protective cover;
- 4) Loss of nesting, feeding and perching sites; and
- 5) Change in diversity of riparian vegetation composition.

Riparian wetlands, similar to still water or upland wetlands, have many natural benefits as follows:

- 1) Water quality - nitrogen and sulfur recycling, sediment traps.
- 2) Additional flood control.
- 3) Wildlife habitat.
- 4) Storage - aids in prevention of downstream droughts.

However, evaluation of the riparian wetlands is different than evaluating upland wetlands due to their more complex nature of energy exchange, nutrient recycling and their interconnectedness with the flowing water system. Riparian ecosystem structure and organization are the result of the energy and pattern of water delivery.

Five factors appear critical in determining wetland floral species response to changes in water level. These are: 1) time of the year, 2) flood frequency, 3) flood duration, 4) water depth and 5) siltation. The hydrologic and geomorphic factors of the riparian zone and upland watershed are a major influence on the riparian system. With modification of hydrologic and geomorphic processes in a floodplain, there is some evidence that secondary succession will occur more rapidly (e.g., Type 3 wetland fills in and becomes Type 2 or Type 6 wetland) in flood plains than it does in upland areas (Frye and Quinn, 1979).

Studies suggest that the position of plants on riverine floodplains are related to the frequency, intensity, and duration of flooding (Hack and Goodlet, 1960; Bell, 1980; Hupp, 1982). When natural flooding characteristics are changed due to stream flow alterations, species are affected differently depending on their positions on stream floodplains. Without the small flood events, the abundance of many of the wetland associated plants will decline due to soil moisture stress, reduced reproductive potential, invasion of competitive species and encroachment of crop farming.

In riparian ecosystems, soil moisture is an important variable because small topographic variations in a seemingly level floodplain can mean the difference between a water-logged, anaerobic environment and a well-drained aerobic substrate (Brinson et.al., 1981a). As a result, abrupt changes in species composition may occur in a floodplain with small changes in topography, water surface elevation and discharge.

Alterations in the existing fluvial processes brought about by changes in flow regimen and sediment deposition is likely to create a new set of floodplain features that plant and animal communities must adapt or change to meet. Moreover, reduction in the sediment loads and sediment deposition on the floodplain will eliminate the rejuvenation of the soil profile. This, in turn, will affect the plant species composition (Simons et.al., 1975). Not only does the ecosystem lose its inflow of materials that sustain their nutrient-rich properties but it is likely they will become sources, rather than depositories of nutrients and sediments (Brinson et.al., 1981a). Studies have shown (Rhodes et.al., 1985) that up to 99% of the incoming nitrate nitrogen is removed in a headwaters watershed as denitrifying bacteria are active in anerobic saturated zones. If this changes due to loss of flooding, then the ecosystems downstream will also be affected by the changes and must adapt to receiving more organic matter and nutrient supply.

Groundwater supply is another major environmental factor controlling the growth of floodplain vegetation. Studies of riparian wetlands show that water table fluctuations in the floodplain can be controlled by the water level in the stream channel during high flows (Bell and Johnson, 1974); and, alluvial aquifers are recharged during sustained high flows. During periods of low-flow, the direction is reversed and groundwater helps sustain the base flow.

Water storage capacity of the alluvial deposits is particularly critical for maintaining riparian vegetation during the warmer, drier season. Streamflow in the Sand Hill River is sustained in the headwaters by lake storage and ground water effluent. When baseflow of such streams is dependent on groundwater storage, it is advantageous to maximize groundwater recharge through over bank flooding. Without over bank flooding, the downstream environment will be affected reducing water storage capacity and groundwater recharge within the floodplain.

The plant and animal communities along the Sand Hill River are adapted to and dependent on the existing fluctuating flows. The small flood events are the most important environmental factor to maintaining diversity and productivity. The larger flood events, such as the 10-year flood event or greater, are stressful to the system (Odum, 1978). Thus maintaining the downstream environment is not in conflict with the proposed impoundment as a flood control project. There will, however, be conflicts with the proposed permanent pool set at elevation 1190.0 M.S.L.

3.5.2 Instream flow operation plan

Flood reduction control projects stabilize rather than maintain the dynamic nature of the hydrologic and fluvial processes. In order to maintain the dynamic process, the operation plan needs to replicate the natural occurrences as closely as possible.

Description of flow needs

The Sand Hill River in the project area below the proposed dam location consists of two wetland systems:

- 1) A riverine system bounded by the channel bank or by wetlands dominated by trees, shrubs and persistent emergents. The subsystem is lower perennial defined by low gradient and slow water velocities with some water flows all year and a well-developed floodplain. Substrates consist mainly of sand and mud. Oxygen deficits may occur in the channel and adjacent wetlands. Fauna is mostly species that reach maximum abundance in still water.
- 2) A palustrine system composed of wetlands dominated by shrubs and persistent emergents (cattail, bullrush, sweet flag, sedge, reed canary grass) with water depths less than 3 feet at low water. These wetlands are situated on the surrounding floodplain and tied to the riverine system by flooding and subsurface water.

The wetlands in both systems are maintained by various flow levels. The persistent vegetation in both systems needs flow levels in the seasonally to temporarily flooded categories as shown in Figure 3-6. Seasonally flooded can be defined as surface water present for extended periods of time, especially early in the growing season (April) but is absent by the end of the growing season. The subsurface water is usually near the land surface. Temporarily flooded is defined by the presence of surface water for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season (Cowardin, et.al., 1979).

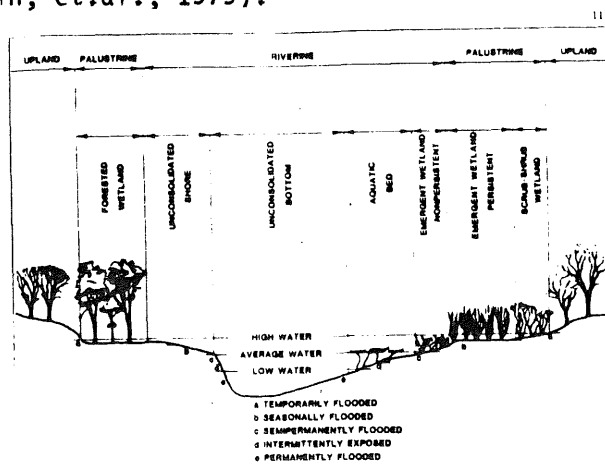


Fig. 4. Distinguishing features and examples of habitats in the Riverine System.

Figure 3-6. Elements of Riverine Wetland System (from Cowardin, et. al., 1979)

Sedge and reed canary grass (Type I-II wetlands) exist well in temporarily flooded areas. Cattail, bullrush, and sweet flag require more water for maintenance and thus are usually found in seasonally flooded zones.

In 1977 the Department of Natural Resources established a protected flow of 8 cfs on the Sand Hill River. The flow is determined at the Climax, Minnesota gage and correlates to the flow exceeded or equalled 90 percent of the time. All existing water appropriation permits on the Sand Hill River include the following special condition:

Appropriation authorized by this permit shall cease whenever the discharge on the Sand Hill River is 8.0 cubic feet per second or less at the U.S. Geological Survey Gaging Station No. 05069000 at Climax, Minnesota. Appropriation shall not resume until the discharge is large enough to compensate for the reduction of flow caused by the total draft of all appropriators of this water supply.

Any new water appropriation permits will require the same condition.

There are currently two water appropriation permits on the Sand Hill River downstream of the project. The total water appropriations permitted for these two permits is .20 cfs (47.6 million gallons per year).

The 8 cfs protected flow is to provide for minimum limited protection for fishery survival and waste assimilation for wastewater treatment discharges from the cities of Fertile, Winger and Climax.

Methodology

Some field work and subsequent hydraulic modeling was necessary in order to determine the approximate flows necessary to maintain the existing environment. Data was collected on the channel and floodplain along six cross-sections located in Sections 27, 33 and 34 of Winger Township. The data collected included channel and floodplain cross-section profiles, water surface elevations, water depths, discharge, plant associations and bridge elevations.

The data was used in the U.S. Corps of Engineers HEC-II flood profile model. The output of the model used to determine flows necessary to maintain the wetlands included water surface elevations, extent of overbank flooding, top width, channel and overbank velocities and cross-sectional area at the discharges of interest. Figure 3-7 shows the results of the model for one cross-section.

The analysis showed that below the proposed Winger Dam, 165 cfs., the one-year 10-day spring flood peak, would be considered the upper limit for seasonally flooded zone. The lower limit would be 50 cfs. The upper limits should be maintained for 10 days whereas the lower limits should be maintained for a longer duration.

There is not adequate flow data at the proposed reservoir site to accurately correlate the 8 cfs protected flow from the Climax gage to the reservoir. An area-discharge ratio was used to get an estimate of the protected flow to be released from the reservoir to meet the 8 cfs

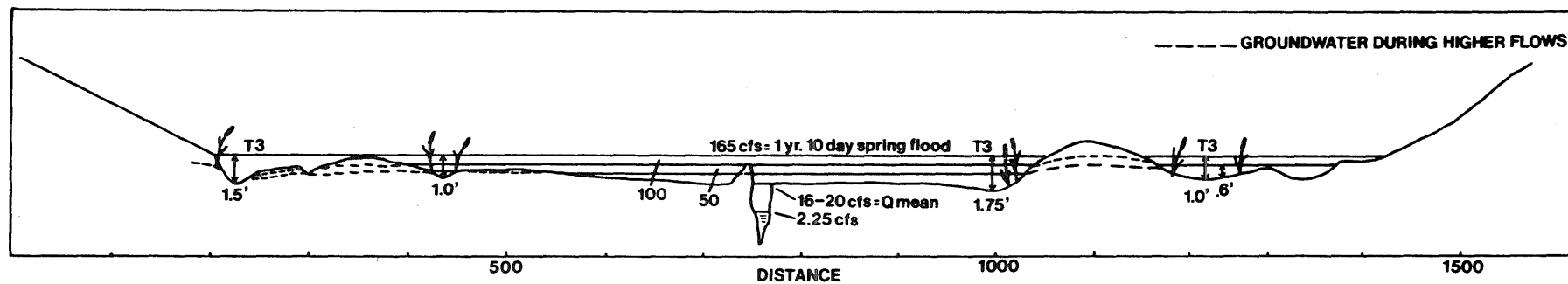


FIGURE 3-7
 SAND HILL RIVER WATERSHED DISTRICT PROJECT NO 4. - THE WINGER DAM
 CROSS-SECTION PROFILE SHOWING WATER LEVELS AT SPECIFIED DISCHARGES

requirement. Approximately 1.7 cfs should be released from the reservoir to meet the established protected flow requirements. Houston Engineering, Inc. (the project engineers) has been collecting flow data of the project site. As more data become available, the flows can be correlated to the Climax gage and the 1.7 cfs can be re-correlated to more accurate data.

Specific instream flow operation plan

An amendment to the operation and maintenance plan proposed by the project sponsors is necessary in order to maintain, as specified in the Preliminary Engineer's Report, existing downstream conditions as nearly as practicable to provide for downstream users and waste assimilation needs. The dam design may need modification to accommodate this change.

The following suggested operation plan amendment attempts to replicate the natural occurrence of flow required to maintain riparian wetland communities downstream of the dam. Implementation of this amendment will provide the best chance for the wetland communities to be maintained given the understanding of the many complex relationships involved.

Plan of operation

From March 25 to June 15 the following outflow pattern will be maintained:

- 1) When the inflow (as measured at a gage at the stream inflow point in the reservoir) is less than 50 cfs., the minimum outflow will be 70% of the inflow or 1.7 cfs, whichever is greater.
- 2) When the inflow is equal to or greater than 50 cfs. but less than 165 cfs., the outflow will be 100% of the inflow.
- 3) When the inflow is equal to or greater than 165 cfs., the minimum outflow will be maintained at 165 cfs.

For periods from January 1 to March 24 and from June 16 to December 31, the minimum outflow will equal 30% of the inflow or 1.7 cfs, whichever is greater. If the inflow, as measured at the stream inflow point to the reservoir, is less than 1.7 cfs then the reservoir outflow will equal the inflow.

3.5.3 Conclusion

Historically, damage to human activities has weighed strongly on flood control decisions. Concomitant with elimination of flooding is the possible decline of the plant and animal communities which are dependent on inundation of their environment. Since riparian ecosystems are subjected at different times to a variety of hydrologic regimes, geomorphic processes and catastrophic forces, generalizations from broad geographic areas are sometimes difficult to apply to site specific situations and it is speculative what changes will occur. It is certain, however, that changing the small flood regimes will change the

riparian character in a matter of time; this change will occur more quickly if the area becomes formed in response to lower water levels on the floodplain.

The operation plan proposed would not be in conflict with the purposes of flood control in that only the one-year 10-day spring flood event is recommended to be released. The plan may be in conflict with the project alternatives to maintain the reservoir pool at 1190.0 M.S.L.

The Upper Mississippi River Basin Commission (1977) reported a major problem in the Sand Hill River subbasin that stream flows in later summer, fall and winter are inadequate to assimilate wastes and meet minimum streamflow requirements for recreational and environmental uses. The size of the watershed above the project, the inadequate streamflows during high evaporation periods and evaporation from the reservoir (evaporation exceeds inflow in the months of July to September) combine to create a depletion problem.

A preliminary HEC-I analysis of incoming flow, based on a median year hydrograph with evaporation, shows there will be depletions in the reservoir. This scenario is modeled from the operation plan in the Preliminary Engineer's Report and does not include the change identified and proposed in this section of DEIS. Based on the scenario described by the project sponsors, depletions will occur if existing conditions downstream are maintained (not augmented). Depletions will occur even if existing conditions downstream are not maintained. The proposed recreational reservoir design appears to be too optimistic for the size and inputs of the watershed.

3.6 PROJECT AND DOWNSTREAM WATER QUALITY

Historical water quality monitoring data is lacking for the Sand Hill River. The United States Geological Survey (USGS) monitoring station at Climax provides stream flow information only, and there are no MPCA routine water quality monitoring stations located on the river. In order to provide some minimum baseline data for pre-project analysis, the Department of Natural Resources initiated water quality sampling in the spring of 1986. Five locations as shown in Figure 3-1 were sampled approximately once a month between April and September.

Water Quality Station 1 is located upstream of the proposed project reservoir and Water Quality Station 2 is upstream of the reservoir site on County Ditch #16. Water Quality Stations 3 and 4 are located within the proposed reservoir area and Water Quality Station 5 is downstream of T.H. 59.

A minimum number of water chemistry parameters were selected as indicators of the suitability of the aquatic environment. Biochemical oxygen demand (BOD), fecal coliform bacteria, total suspended solids (TSS), total dissolved solids (TDS), total alkalinity, pH, total phosphorus and sulfate were laboratory determinations. Some field determinations for water temperature and dissolved oxygen (DO) were conducted. Individual values and median values by station and parameter are shown in Table 3-17.

During the sampling period, DO was the only parameter indicative of substantial stress to aquatic organisms. Stations 2 and 3, within the project area, exhibited the highest incidence of values below 5 mg/l. These areas were characterized by abundant submerged aquatic plant growth and lower stream gradients. The data, although limited, show effects of diurnal oxygen concentration flux as a result of the photosynthesis/respiration processes. More extensive oxygen monitoring would likely show even more precipitous declines in DO concentrations during the pre-dawn hours.

On the June 25, 1986 sampling date, Water Quality Station 2 on the upstream tributary County Ditch #16 showed elevated levels of TSS and fecal coliform. Sulfate and total phosphorus also showed increases at this time. Cattle were observed in the vicinity of the stream and it is likely that their disturbance of bottom sediments caused the elevated values.

Total dissolved solids, total alkalinity and sulfate values exhibited no unusual phenomena. Concentrations were relatively stable between the stations and the most observable trend was for increasing values as spring flows receded and groundwater contributed a higher proportion of the flow.

Total phosphorus, of the water quality parameters sampled, is most indicative of future potential reservoir quality. Stream concentrations sampled were generally high enough to support extensive algae blooms under impounded conditions. Therefore watershed management practices would have to be improved substantially in order for the proposed impoundment to support any appreciable fisheries or other recreational amenities. Present phosphorus levels under impounded conditions will likely result in noxious alga blooms and/or proliferative growths of submerged aquatic macrophytes on the extensive littoral areas of the proposed reservoir.

TABLE 3-17
WATER QUALITY DATA FOR SELECTED PARAMETERS AT FIVE LOCATIONS ON THE
SAND HILL RIVER - (APRIL - SEPT.) 1986

	Station 1	Station 2	Station 3	Station 4	Station 5
WATER TEMPERATURE - °F					
7-22-86	67°	63°	70°	73°	74°
9-15-86	47°	47°	52°	53°	52°
DISSOLVED OXYGEN - mg/l ¹					
6-25-86	9.2 (11:45 AM)	13.8 (11:35 AM)	2.8 (11:10 AM)	4.0 (10:45 AM)	6.3 (10:00 AM)
7-22-86	4.8 (9:15 AM)	9.5 (10:00 AM)	1.6 (10:35 AM)	4.5 (11:20 AM)	6.5 (12:20 PM)
9-15-86	8.0 (11:20 AM)	15.0 (11:45 AM)	8.1 (12:00 PM)	9.0 (12:20 PM)	10.2 (10:20 AM)
BIOCHEMICAL OXYGEN DEMAND (5-DAY) - mg/l					
4-24-86	1.8	0.8	1.1	0.9	1.0
5-28-86	2.3	3.0	2.0	1.2	1.5
6-25-86	0.7	1.7	3.6	2.0	1.6
7-22-86	1.6	1.4	3.0	1.1	1.3
9-15-86	2.4	2.3	2.5	1.4	1.7
median	1.8	1.7	2.5	1.2	1.5
FECAL COLIFORM - MEM ² /100 ml					
5-28-86	13	21	20	12	26
6-25-86	60	TNTC ³	63	88	114
7-22-86	25	30	30	50	14
9-15-86	27	52	5	51	12
median	26	41	33	51	20

TABLE 3-17 (CONTINUED)

	Station 1	Station 2	Station 3	Station 4	Station 5
TOTAL SUSPENDED SOLIDS - mg/l					
4-24-86	4.1	12.4	2.8	1.2	3.6
5-28-86	3.0	12.5	2.6	2.3	1.5
6-25-86	7.6	142.0	2.0	1.2	26.5
7-22-86	10.8	14.4	4.3	2.7	22.0
9-15-86	8.9	4.2	17.6	4.3	17.1
median	7.6	12.5	2.8	2.3	17.1
TOTAL DISSOLVED SOLIDS mg/l					
4-24-86	338	507	402	408	426
5-28-86	340	460	380	400	410
6-25-86	371	592	395	364	368
7-22-86	357	480	407	372	366
9-15-86	471	481	516	487	489
median	357	481	402	400	410
TOTAL ALKALINITY mg/l					
4-24-86	220	256	246	248	248
5-28-86	234	281	274	279	279
6-25-86	215	326	222	208	212
7-22-86	252	350	295	261	256
9-15-86	351	367	355	340	337
median	234	326	274	261	248
pH					
6-25-86	7.8	7.9	7.4	7.5	7.7
9-15-86	7.4	8.0	7.7	7.7	8.0

TABLE 3-17 (CONTINUED)

	Station 1	Station 2	Station 3	Station 4	Station 5
TOTAL PHOSPHORUS mg/1					
4-24-86	0.03	0.03	0.02	0.03	0.02
5-28-86	0.13	0.08	0.12	0.14	0.14
6-25-86	0.16	0.27	0.17	0.07	0.06
7-22-86	0.13	0.16	0.26	0.31	0.26
9-15-86	0.11	0.08	0.11	0.11	0.16
median	0.13	0.08	0.12	0.11	0.14
SULFATE mg/1					
4-24-86	35	35	30	35	35
5-28-86	18	55	15	23	8
6-25-86	30	100	30	30	45
7-22-86	30	45	25	45	20
9-15-86	60	65	80	75	80
median	30	55	30	35	35

- 1 Field determinations
 2 Membrane Filter Method
 3 Too numerous to count

3.7 LAND MANAGEMENT PRACTICES/LAND USE CHANGES

Land use and land management practices can be evaluated in a number of different ways. However, baseline or existing conditions must be defined initially. The Universal Soil Loss Equation (USLE) is a good preliminary model to establish baseline conditions for soil erosion within the watershed and sedimentation within the reservoir.

Utilization of the USLE on the project drainage area results in sediment generation rate of about 1.90 tons/acre/year. Not all of this sediment reaches the proposed reservoir. Some is deposited within lakes, wetlands or other locations. Using an appropriate sediment delivery ratio, it is estimated that approximately 0.40 tons per acre per year reaches the reservoir. This is the sediment yield.

The amount of sediment actually trapped and retained within the reservoir depends on the trap efficiency of the reservoir. Based upon an analysis of conditions with respect to the proposed Winger Dam, a trap efficiency of 95% has been determined. Therefore, it is estimated that sediment will accumulate within the reservoir at a rate of 21,900 tons/year or 12.6 acre-feet/year. Assuming no removal of sediment, the reservoir would fill with sediment according to the schedule shown in Table 3-18.

TABLE 3-18
WINGER DAM RESERVOIR SEDIMENT

Year	Accumulated Sediment Inflow (Acre-feet)	Remaining Storage (Acre-feet)	Percent Storage Remaining
0	0	11,131	100
10	126	11,005	99
20	252	10,879	98
30	378	10,753	97
40	504	10,627	95
50	630	10,501	94
60	756	10,375	93
70	882	10,249	92
80	1008	10,123	91
90	1134	9,997	90
100	1260	9,871	89

Sediment inflow to the reservoir can never be totally eliminated. However, it can be significantly reduced and the reservoir life extended by the implementation of proper land treatment measures within the contributing watershed. Such measures could include contour farming, minimum tillage practices, planting of shelter belts, and other actions. The relative effects of these measures could be compared with existing conditions by making appropriate adjustments in the USLE. However, based on the present governmental jurisdictions with authority in the project area, the extent of land treatment measures that could be accomplished

would be education and voluntary programs. Development of a county soil loss ordinance would assure program implementation. Such an ordinance would require the combined efforts of all political entities involved. The future of such an ordinance is remote and seems to be limited during the early life of any proposed impoundment project. In the meantime, the Sand Hill River Watershed District will continue to work with the local Soil and Water Conservation Districts to educate landowners and encourage voluntary soil conservation efforts.

Potential land use changes expected are presently limited to the immediate vicinity of the dam and recreation pool as well as the downstream areas which will be provided a reduction in flooding potential. The recreation pool area will be converted to a lake environment. The HEP analysis (see Section 3.4) discusses the estimated land use changes expected due to the change to a lake environment. In addition, that area within the flood pool will also be subject to vegetative and land use changes due to the increased risk from flooding. This involves the area between elevation 1190.0 M.S.L. (recreation pool) and the maximum design flood pool 1196.0 M.S.L. Due to the frequency of flooding between elevation 1190.0 M.S.L. and 1191.0 M.S.L., it is estimated that non-wetland cover types will convert to Type 2 wetland. The area between elevations 1191.0 and 1193.0 M.S.L. will be less subject to flooding (than will areas at elevations between 1190.0 and 1191.0 M.S.L.) so that all cropland within this area will be converted from cropland to grassland or pasture. A small portion of the wooded area would also be converted to either grassland or pasture. The area between 1193.0 and 1196.0 M.S.L. will be subject to flooding on an infrequent basis, to the point of not severely affecting existing land use and/or cover types.

The potential for recreation development also will account for possible land use changes surrounding the proposed project. It is estimated that up to 60% of the shoreland between the proposed dam site at T.H. 59 and Polk CSAH No. 1 could be developed for lakeshore lots within 10 years. With assumed lot sizes of 100 feet by 200 feet, approximately 68 acres of cropland and 25 acres of pasture could be affected. Non-agricultural uses such as woods and grasslands (36 acres) would probably not be impacted much because they are compatible with shoreland development. A public access (operated and maintained by either state or local governmental entities) and park areas are also expected to be developed.

The shoreland management classification will determine the degree to which the lakeshore is developed. As discussed in Section 1.11, the Sand Hill River is presently classified as General Development under the Polk County Shoreland Management Program. A Recreational Development classification is more suited to the proposed project and reclassification to that classification is recommended. The Recreation Development classification would restrict the minimum lot size to 150 feet by 267 feet.

Downstream changes to present land use are also expected primarily due to the less frequent flooding expected from the operation of the gates for floodwater retention. The economic study completed by the project engineers estimates that the proposed project will reduce average number of acres subject to flooding on the Sand Hill River by 907 acres. These

acres, because of being less subject to periodic flooding will be more intensely utilized for agriculture. Most likely, a shift from uses such as pasture and/or hayland to cash crops is expected on 25% or 227 acres of these lands.

Land use changes on the Red River of the North are not expected to occur because of the proposed project. Only when many such projects are built which can conclusively be shown to reduce frequency of flooding, will such changes occur.

For Alternative No. 2, because of the flowthrough characteristics, sedimentation within the temporary reservoir would not be a significant problem. After the passage of a major flood event, sediment deposition could be mechanically removed from the reservoir area.

Sedimentation problems for Alternative No. 3 are similar to those for Alternative No. 1. However, it can be anticipated that the permanent pool would fill with sediment within 55 years of project construction. This estimate is based on an annual sediment accumulation within the reservoir of 12.6 acre-feet per year.

Sedimentation problems for Alternative No. 4 (two reservoirs) are similar to those for Alternative No. 1. However, it can be anticipated that the permanent pools would fill with sediment within 40 years of project construction. This estimate is based on an annual sediment accumulation within the reservoirs of 12.6 acre-feet per year.

3.8 AGRICULTURAL IMPACTS

Agricultural lands within the immediate project area will be lost as a result of the construction and operation of the proposed Winger Dam. Loss of agricultural lands will be the result of permanent flooding by the recreation pool, temporary flooding by the flood pool, and land use changes associated with recreation development and use.

Acres estimated to be affected are based on cover type maps illustrated in Figure 3-4 and shown in Table 3-9. The cover type mapping identifies cropland (including hay land), pasture, and Type 2 wetlands (summer pasture) as land involving agricultural uses. Type 2 wetlands are defined as inland fresh meadows which usually have standing water in the spring and may be used as pasture during the summer. For purposes of assessing the agricultural impacts, it is assumed that all Type 2 wetlands in the project area are utilized as summer pasture.

Obviously those agricultural lands permanently flooded by the recreation pool will be lost. Approximately 135 acres of cropland, 658 acres of Type 2 wetland, and 128 acres of permanent pasture will be permanently flooded. Those agricultural lands within the flood pool (1190.0 to 1196.0 M.S.L.) will be affected by high water during flood periods. Most agricultural lands in this area will be converted to other cover types or land uses because of their vulnerability to flooding. It is estimated that approximately 45 acres of crop land will be lost or converted to other uses. Also, approximately 39 acres of Type 2 wetland and one acre of permanent pasture will be gained within the flood pool area.

Agricultural lands lost due to recreational development and use is much harder to estimate. The potential level of recreation use and development will depend on a variety of factors. The primary factor will be the physical characteristics of the proposed lake in terms of water quality, wildlife habitat, fisheries resources, etc. Potential development includes lakeshore lots, public accesses, and parks. The Shoreland Management classification is presently General Development, however as discussed in Section 1.11, reclassification to Recreation Development is recommended.

Although the lake would be shallow and susceptible to nutrient and sediment accumulation, through design and management it could support swimming, marginal fishing (see discussion in Section 3.3), boating, and hunting opportunities. There appears to be the need and the desire at the local level to develop the lake for recreation. Nearby lakes are highly developed so the potential for development is also high.

It is assumed that the only shoreline suitable for lakeshore development is the 48,000 linear feet along both banks of the proposed reservoir between the proposed dam site at T.H. 59 and the existing Polk CSAH No. 1 crossing of the Sand Hill River. The economic analysis prepared by the project sponsors assumed 60% of this shoreline could be expected to be developed. With an average lot depth of 200 feet about 129 acres would be impacted by such lakeshore development. In contrast to the area flooded by the recreation pool or the area affected by the flood pool, this conversion would take place over an extended period of time (the project proposer's economic analysis suggests 10 years). Based on this assumption, approximately 68 acres of cropland and 25 acres of pasture will be converted or developed as shown in Table 3-19.

TABLE 3-19
SUMMARY OF AGRICULTURAL LAND AFFECTED

	<u>Crop Land</u>	<u>Pasture</u>	<u>Type 2 Wetlands</u>	<u>Total</u>
Recreation Pool	-135	-128	-658	- 921
Flood Pool	- 45	+ 1	+ 39	- 5
Recreation Development	- 68	- 25	0	- 93
	<u>-248</u>	<u>-152</u>	<u>-619</u>	<u>-1019</u>

It should be noted that over 50% of the total agricultural lands affected are a result of the recreation pool flooding Type 2 wetlands (summer pasture).

Additional agricultural lands downstream of the proposed Winger Dam will be subject to less flooding due to the storage of floodwaters behind the Winger Dam. The economic study completed by the project engineer identifies a 907-acre reduction in the average area flooded between the dam and the Red River of the North. Additional agricultural lands will be protected along the Red River due to the design and operation of the flood control gates. Even though a quantifiable amount of protected lands along the Red River is not available, benefits to agricultural lands have been quantified in the proposer's economic analysis.

Other agricultural lands adjacent to the proposed Winger Dam will also be affected primarily through restricted access. Restricted access would be a result of abandoning the two township roads which presently traverse the river. Those landowners who own or lease lands for farming on both sides of the river would have to find alternate routes for farm equipment to farm on both sides of the proposed impoundment. According to ownership maps provided by as a part of the Preliminary Engineer's Report, only one landowner appears to be seriously affected by the abandonment of the roads. The majority of landowners near these two township roads own land on only one side of the proposed pool. It is impractical to assess impacts associated with leased land.

In addition to access restrictions for farming operations due to the abandonment of these two township roads, other uses including school buses, milk trucks, fire trucks, and mail trucks will have to use alternate routes.

Other areas affecting impacts on the agricultural community include two farmsteads which lie close to the proposed pools. Both of these farmsteads would be above the recreation pool level but would require protection from flood pool levels. They are located in the S 1/2 of the SE 1/4 of Section 26, T147N, R42W (Winger Township) and in the SW 1/4 of the SW 1/4 of Section 16, T147N, R41W (Sletten Township). Feed lot operations on these two farmsteads are also a concern.

In Alternative No. 2 (the dry dam) land utilization below the maximum reservoir water surface elevation would be subject to periodic inundation to a greater extent than present. Some agricultural land will be lost due to temporary flooding of the area below elevation 1186.0 M.S.L. No agricultural lands will be lost due to a permanent recreational pool, and no loss of agricultural land due to recreational use or development is anticipated. Crop, Pasture, and Type 2 wetland (summer pasture) cover types identified in Table 1-5 involve agricultural uses. It is estimated that approximately 49 acres of cropland and 15 net acres of Type 2 wetland will be lost or converted to other uses. Approximately 20 acres of pasture are estimated to be gained by Alternative No. 2. Total net acres of agricultural lands lost would be 44 acres.

For Alternative No. 3 (reduced flood reduction pool and recreational pool), agricultural impacts would be significantly reduced under this alternative because of the reduced acreage requirements. Some agricultural lands will be lost due to the permanent recreation pool, and due to temporary flooding between 1176.0 and 1186.5 M.S.L. Little, if any, agricultural lands will be lost due to recreation use or development. Some lands may be utilized for public access sites. Crop, Pasture, and Type 2 wetland (summer pasture) cover types identified in Table 1-5 involve agricultural uses. It is estimated that approximately one acre of cropland, 5 acres of pasture, and 118 acres of Type 2 wetland (summer pasture) would be lost to the permanent recreation pool. Approximately 47 acres of cropland and three acres of pasture will be lost or converted to other uses due to being located in the flood pool area. Approximately 19 acres of Type 2 wetland (summer pasture) is expected to be gained in the flood pool area. Total net acres of agricultural lands lost would be 155 acres.

In Alternative No. 4, agricultural impacts would be significantly reduced under this alternative because of the reduced acreage requirements. Some agricultural lands will be lost due to the permanent recreation pools, and due to the temporary flood pools. Little, if any, agricultural lands will be lost due to recreation use or development. Some lands may be utilized for public access sites. Crop, Pasture, and Type 2 wetland (summer pasture) cover types identified in Table 1-5 involve agricultural uses. It is estimated that approximately 20 acres of pasture, 186 acres of Type 2 wetland (summer pasture), and no cropland will be lost due to the permanent pools of both structures. Approximately 24 acres of cropland, and 15 acres of pasture will be lost or converted to other uses due to being located in the two flood pool areas. Approximately 22 acres of Type 2 wetland (summer pasture) will be gained in the two flood pool areas. Total net acres of agricultural lands lost would be approximately 223 acres.

The utilization of agricultural lands adjacent to the potential reservoirs under Alternative No. 4 would be affected in ways other than flooding. However, in comparison to Alternative No. 1, none of the township roads would have to be abandoned. Therefore, these important farm to market roads would remain available for utilization.

3.9 ECONOMIC ANALYSIS

An economic analysis prepared by the project engineer for the Sand Hill River Watershed District is contained in the Preliminary Engineer's Report Economic Analysis, which is referenced in Section 1.1 and listed in the Selected References portion of the DEIS. This analysis as prepared by the project engineers is based in part on a 1984 report by the U.S. Army Corps of Engineers (USCE) which is also referenced in both Section 1.0 and the Selected References portion of this document. A component of the USCE report includes an evaluation of projected economic costs and benefits associated with the project proposed by the Sand Hill River Watershed District.

The purpose of this section is to present an evaluation of the Winger Dam economic analysis prepared by project engineer. The DEIS evaluation is focused predominantly on the methodology used in the analysis, rather than on the actual numbers presented. The numbers presented in the project engineer's analysis are questionable due to the methods used; however, they are used in this evaluation solely to show the effect on the benefit-cost ratio of using different and more realistic discount rates. The comparison of net benefits based on different discount rates as presented in the DEIS, is designed to provide an evaluation of the project engineer's analysis and is not presented to justify the benefits and costs presented by the project engineer.

The major general problem with the engineer's benefit-cost (B/C) analysis is that it is not sufficiently detailed to serve as a document for decision-making purposes. Much of the analysis is based on the USCE Section 205 Document, and since that 1984 report was a preliminary appraisal of a proposed project, it was not intended to be used as a decision document. In addition, the analysis was concluded in 1984, and many of the numbers need to be updated to reflect current conditions.

Methodology

As an economic analysis, the treatment of the benefits and costs of road construction in the Preliminary Engineer's Report Economic Analysis is inconclusive. In general, and as identified in the discussion of the project description (Chapter 1.0) and in the description of Alternative No. 5 (the no-build alternative), whatever highway construction is going to take place, regardless of the dam construction, should not be included in the analysis for the dam. The analysis of the dam should focus on benefits and costs that occur "with" the project versus "without." Thus, if the Minnesota Department of Transportation (MNDOT) is planning to commit \$1.02 million to construct the bridge for the T.H. 59 crossing of the Sand Hill River, then the simplest way to handle this in the economic analysis would be to omit the benefits and cost of this bridge from the analysis of the proposed dam and reservoir. If the benefits and/or costs of the bridge are for some reason different, when the bridge is constructed in conjunction with the dam, then these differences should appear in the B/C analysis.

In the project engineer's report, the benefits and costs of the bridge for T.H. 59 are included in the analysis of the dam. The benefits are greater than the costs, without an explanation for the difference. If there are cost savings or additional benefits associated with the construction of the bridge with the dam, this should be identified and the analysis should be limited to the changes in bridge benefits and/or costs resulting from joint construction with the dam. A similar problem is relevant and applicable to the discussions, for all of the alternatives, of the county and township road changes.

There are a number of other problems with the methodology. First, it is incorrect to calculate both urban damages as a function of agricultural damages, and downstream transportation damages as a function of agricultural damages because the damages and benefits are unrelated. Second, the mainstem (Red River of the North) benefits are presented in 1981 dollars, when 1984 dollars are presented for all other calculations. Third, the recreation benefits are calculated as a maximum benefit, and there are no costs included for the recreation facilities discussed. Lastly, the discount rate of $5 \frac{7}{8}$ percent (while used for water development projects in this geographic area) is without question inapplicable at today's prices.

To provide some simple comparison analysis for this B/C analysis, this DEIS re-evaluated the numbers provided in the project engineer's study using a more realistic discount rate of $8 \frac{7}{8}$ percent. This is the rate currently used by the USCE for its analyses of projects of a type as proposed by the project sponsors. As an example, Table 3-20 shows the changes in benefits for Alternative No. 1 due to the use of a higher discount rate. Table 3-21 shows a comparison of each alternative at the two discount rates of $5 \frac{7}{8}$ and $8 \frac{7}{8}$ percent. None of the alternatives yields a B/C ratio greater than 1 with the $8 \frac{7}{8}$ percent discount rate.

TABLE 3-20

SUMMARY OF TANGIBLE ANNUAL BENEFITS IN DOLLARS FOR
ALTERNATIVE NO. 1 AT 5 7/8% (8 7/8%) DISCOUNT RATES

<u>Item</u>	<u>Annual Benefit (\$/Year)</u>	
1. Flood Control Benefits		
a. Agricultural Crop Benefits	61,440	
b. Other Agricultural Benefits	20,480	
c. Urban Benefits	5,705	
d. Red River Mainstem Benefits	56,320 (80,050)	
e. Downstream Transportation Benefits	<u>6,490</u>	
Total Flood Control Benefits	\$150,435 (174,165)	\$150,435 (174,165)
2. Transportation Improvement Benefits		
a. Trunk Highway No. 59	60,125 (85,455)	
b. County and Township Roads	30,340 <u>(43,120)</u>	
Total Transportation Improvement Benefits	90,465 (128,575)	90,465 (128,575)
3. Increase in Land Value Benefits		67,400 (95,800)
4. Land Intensification Benefits		4,015 (5,705)
5. Recreation Benefits		37,270 (35,580)
6. Employment Benefits		72,570 <u>(87,470)</u>
TOTAL ANNUAL BENEFITS		\$422,155/yr. (527,295/yr.)

TABLE 3-21

SUMMARY OF ECONOMIC ANALYSES (IN DOLLARS) FOR ALTERNATIVES
USING 5 7/8% AND 8 7/8% DISCOUNT RATES

	<u>Alt. No.1</u>		<u>Alt. No.2</u>		<u>Alt. No.3</u>		<u>Alt. No.4</u>	
	<u>5 7/8%</u>	<u>8 7/8%</u>	<u>5 7/8%</u>	<u>8 7/8%</u>	<u>5 7/8%</u>	<u>8 7/8%</u>	<u>5 7/8%</u>	<u>8 7/8%</u>
Total Annual Economic Cost	390,035	551,000	312,435	441,965	327,530	462,360	506,690	714,560
Total Annual Economic Benefits	422,155	527,295	258,925	326,460	268,290	335,685	315,850	387,250
Benefit-Cost Ratio	1.08	0.96	0.83	0.74	0.82	0.73	0.62	0.54
Annual Net Benefits	32,120	-23,705	-53,510	-115,505	-59,240	-126,675	-190,840	-327,010

3.10 ARCHAEOLOGICAL INVESTIGATION

Phase I intensive archaeological surface survey and shovel test excavation of the proposed Winger Dam and reservoir on the Sand Hill River was conducted by Cougar Consulting of St. Paul, Minnesota. The results of these investigations have produced largely negative results.

Much of the area has been recently plowed and in most instances fresh exposures of the surface occur over 50-70% of the study area. Both high potential and low potential areas were examined. Low potential areas were walked and the exposed surfaces examined, and the high potential areas were also shovel tested where surfaces were covered with vegetation. All of these areas were either hand inspected (shovel tests matrix sifted or troweled) or walked by the investigators -- again with largely negative results. Surface survey included the inspection of ravines, gopher burrows, blow outs, plowed fields, and 540 shovel test excavations.

No prehistoric or historic archaeological debris was found in any quantity at any one location. Only a top of a medicine bottle, a few chert fragments of questionable context and aboriginal manufacture, and fractured bone have been collected from the study area. These find spots, locations from which isolated (possible) artifacts have been obtained, appear to be of little NRHP (National Register of Historic Places) significance as no additional material has been found in the immediate vicinity of these isolated finds. The presence of such items would suggest a prehistoric occupation and the paucity of material, the absence of such occupations.

The consultant's report suggests that no additional work need be done in the area to be impacted by the impoundment of the Sand Hill at Winger. The report does recommend, however, that an archaeologist be present when the initial excavation is made into the flood plain at the site of the proposed Winger Dam. The consultant feels it would wise to obtain a geo-archaeological sample from the sediments in this area since so little is known about the depositional regime of alluvial deposits in these extinct glacial drainage ways. If other cuts are to be made along the valley floor, it is further suggested that an archaeologist be present when these cuts are made. Even though it is exceedingly unlikely that early prehistoric remains might be unearthed during these excavations, it remains a possibility, that important and significant geo-archaeological and geological fossil evidence might be encountered.

Since no historic or prehistoric cultural debris of NRHP significance was found in any quantities in any of the survey areas and because a search of the historical records has produced no new information on the possible existence of cultural resources within the boundaries of the proposed construction zone, no additional extra-ordinary management procedures are recommended to be instituted at this time. Phase II testing and mitigation of the proposed impoundment as defined in this study are also, in the opinion of Cougar Consulting, not needed at this time.

The preliminary report of Cougar Consulting is reproduced as Appendix D of the DEIS. Appendix D also includes the review report by the Minnesota State Historic Preservation Officer. That report essentially concurs with the findings in the archaeological consultant's report.

4.0 MITIGATION MEASURES

4.1 EROSION CONTROL MEASURES

Specific temporary water pollution, soil erosion, and siltation control measures may include berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, and slope drains. Temporary construction control measures may also include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, temporary plant sites, and haul roads.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into the river, nor into natural or manmade channels.

In the event of an accidental loss of gasoline, paint, cleaning materials, debris, oil, or other potential pollutants, into waters of the state, the incident shall be promptly reported to the Minnesota Pollution Control Agency (MPCA) and the contractor will take immediate action to recover the lost material and to minimize any adverse impacts to waters of the state.

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

Construction, demolition and/or removal operations shall be controlled as far as possible so as to prevent materials from falling into waters of the state. When feasible and practical, excavation shall be conducted from landward to the water and breakthrough shall occur at the last practical moment. All dredging and/or work on the bed and banks of waters of the state shall be conducted in such a manner so as to minimize the extent of the bottom disturbance and minimize any increase in suspended solids in the waters. Oil and other liquid substances capable of polluting waters of the state will be stored in accordance with the requirements of Minnesota Rules Parts 7100.0010 to 7100.0090 (1985). Stream bank stabilization shall be utilized if it is needed to prevent erosion, and shall be constructed of materials which will not pollute waters of the state.

The disposal of solid waste and demolition material will be required to be in an acceptable landfill. In some instances, soil material unsuitable for the core zone may be placed in random fill zones. However, such disposal would be tightly controlled and only on the approval of the project engineer. Except for the required project elements, all waste material generated would be required to be disposed of in acceptable landfills outside of the flood plain.

Complete temporary air and water pollution, soil erosion, and siltation control plans, and stream diversion and foundation dewatering plans identified by the Sand Hill River Watershed District are contained in and included in Appendix E to the DEIS.

4.2 DAM SAFETY

4.2.1 Emergency Action Plan

Failure of the dam could have substantial negative impacts to downstream areas and also to the impoundment area. Since this is a high hazard dam, Minnesota dam safety regulations require the documentation and implementation of an Emergency Action Plan (EAP) before the dam is placed in operation. The owner of the dam is responsible for preparing and implementing the plan. Local civil defense or disaster emergency personnel also need to provide input for the plan. A vital part of the plan will be notification to MNDOT and the Soo Line Railroad in the event of a dam-related emergency. Zoning measure should be implemented to limit the building of facilities in the floodplain downstream from the dam. This limitation should be applied to areas subject to inundation from a dam breach situation. The area of inundation would be shown on appropriate aerial photos or maps. The EAP should describe the primary items of emergency recognition, notification, and evacuation. This EAP would be a requirement of the Department of Natural Resources dam safety construction permit. The owner of the dam is responsible for assuring the EAP is carried out during an emergency situation.

4.2.2. Operation and Maintenance Plan

An operation and maintenance plan for the dam must be documented and submitted to the DNR for approval before the dam is placed in operation. The plan shall describe all operational features and procedures for the dam. Operation during periods of normal flow, as well as during floods and droughts, needs to be described. Provisions for maintaining adequate streamflow through the dam at all times shall be part of the plan. The operating and maintenance plan is needed for the proper and safe operation of the dam and to ensure that the multipurpose intended benefits are realized.

The preliminary engineering report describes the proposed operation of the dam to be that normal pool elevation would be 1190.0 M.S.L. (10 feet below the roadway crest). During the 100-year flood event, the pool would not exceed elevation 1196.0 M.S.L. and all discharge would be through the principal spillway. An 1,420 feet long depressed highway section would be used to provide additional discharge capacity for floods larger than the 100-year event. A 48-inch diameter conduit will serve as a low discharge to pass normal base flows without excessive pool fluctuations. This conduit will remove water from the bottom of the reservoir and will also serve as a draw down device, should it become necessary to totally drawdown the reservoir.

The Sand Hill River Watershed District will be responsible for the operation and maintenance of the dam. This may require an agreement be between the Watershed District and the Department of Transportation.

4.3 WILDLIFE RESOURCES

4.3.1 Wildlife mitigation measures

The following criteria should be followed to provide adequate mitigation:

- 1) Mitigation for upland species HU (gray partridge and black-capped chickadee) would not be accepted for loss in wetland species (muskrat, mink, wood duck) habitat units or vice versa.
- 2) Upland species could mitigate for each other (i.e. gray partridge HU gained could compensate for black-capped chickadee) and wetland species could mitigate for each other.
- 3) The Team recommends the following mitigation measures are recommended to compensate for upland HU losses.
 - a) Increase undisturbed grassland acreage within the project area.
 - b) Maintain small scattered wildlife food plots.
 - c) Limit fall cropland tillage to no greater than 50% of the cropland within the entire study area.
 - d) Plant trees in selected areas.
- 4) The following mitigation measures are recommended to compensate for wetland HU losses.
 - a) Restoration of a drained basin(s) and/or enhancement of an existing wetland.
 - b) Restoration or enhancement should occur on private land, with acquisition and/or perpetual easements secured.
 - c) Wetland mitigation should occur within the project watershed (Sand Hill River watershed).
 - d) Excavation of basins is not preferred as a method to mitigate for wetland impacts. Project borrow areas will not be considered as wetland mitigation.
- 5) Mitigation for wildlife habitat losses must become a project feature and the cost of mitigation be included in the economic analysis.

4.3.2 Upland mitigation

The most feasible mitigation method for upland species would be to develop a management plan for land within the flood pool area. This land does require a flood easement and additional management could be incorporated in the easements. The management plan would incorporate wildlife food plots, grassland cover development and eliminate grazing on some of the pasture land. This management would also provide increased water quality and watershed benefits. The HEP Team would assist the project sponsors in developing a management plan to mitigate for upland species HU losses.

4.3.3 Wetland mitigation

The most feasible means to mitigate wetland species losses, is to restore a drained basin(s). This would require purchase and/or easement to protect the basin(s) from future drainage. Additional benefits from this mitigation would include increased flood control benefits, improved water quality and increased recreational opportunity in the area. The HEP Team will review potential sites identified by the project sponsors to determine suitability for mitigation.

All mitigation measures for upland and wetland species AAHU losses will be evaluated by the Team to determine their adequacy to compensate for impacts. The proposed mitigation sites will undergo the same HEP (i.e. same species) analysis to determine the amount of AAHU gained by the mitigation. To achieve adequate mitigation, close cooperation between the project sponsors and the HEP Team will be required.

4.4 DOWNSTREAM RESOURCES

4.4.1 Mitigation of downstream resources

While all uses of resources are not necessarily mutually exclusive, tradeoffs do result when resources are used for one or a combination of purposes. Sometimes the choice of using a resource for one purpose has a cost, the forgone opportunity for the other use. In the case of the proposed project, lost opportunity arises if the operation is not maintained in a natural manner and small floods events are not allowed to follow their course. Loss of the riparian ecosystem is essentially irreversible due to the complex natural factors needed to maintain these systems. In addition, the high cost of replacing the wetland is prohibitive. As such, it is particularly difficult to evaluate trade offs involving irreversible consequences (Krutilla and Fisher, 1975).

Mitigation for downstream resources only addresses the habitat values of the wetland areas downstream of the dam that may be lost or changed as a result of the project. Other wetland values which may be lost such as benefits to downstream water quality, groundwater recharge, and additional flood storage cannot be mitigated.

4.4.2 Mitigation process and estimate

Wetland areas adjacent to the Sand Hill River downstream from T.H. 59 to Mahanomen County CSAH 7 were cover typed from aerial photographs and ground checked. CSAH 7 was determined to be approximately about the upstream extent of backwater effects from the Bear Park Dam. The backwater effects should maintain the wetlands between the Bear Park Dam and CSAH 7 even if the proposed Winger Dam reduces flows in the Sand Hill River downstream of the proposed project. The wetland areas between T.H. 59 and Mahanomen County CSAH 7 will change unless the releases from the proposed Winger Dam are adequate to seasonally flood these areas. As in the HEP analysis, (described in Section 3.4), the wetland habitat between T.H. Hwy 59 and CSAH 7 was delineated and cover

typed according to the wetland classification system described in U.S. Fish and Wildlife Service Circular 39 (Shaw and Fredine, 1956). The existing or baseline acreages by wetland type are:

- 1) Type 2 - 237 acres;
- 2) Type 3 - 42 acres; and
- 3) Type 6 - 57 acres.

The wetland areas downstream of the proposed dam are a continuation of the wetland areas upstream of the proposed dam. It is assumed the wetlands downstream of the proposed dam have the same value to the three wetland species used in the HEP analysis (Mink, Muskrat, and Wood Duck) as do the wetlands upstream of the proposed dam. Therefore, the baseline HSI values for the downstream wetlands are equivalent to the baseline HSI values used in the HEP analysis for the upstream wetlands (see Section 3.4).

If the one-year 10-day spring flood peak (165 cfs) is not released when available, the wetland areas between T.H. 59 and CSAH 7 will change or be reduced in area. Type 2 wetlands will likely change to grassland, pasture or cropland. Type 3 wetlands will likely change to Type 2 or possibly Type 6 wetlands. Type 6 wetlands will probably change to woods, pasture or cropland. The estimated wetland acreage change or loss that will occur if the proposed project reduces the one-year 10-day spring flood peak from 165 cfs to 100 cfs or 50 cfs is shown in Table 4-1. This table also lists corresponding habitat units (HU) for the three wetland species used in the HEP analysis.

For the purposes of mitigation for downstream flow, the projected changes are shown in habitat units (HU) rather than in average annual habitat units (AAHU). When the final operation plan is developed, any required mitigation will be evaluated in AAHU similar to the that done by the HEP Team evaluation. The AAHU will be slightly smaller than the projected HU loss because of the assumption that effects of the dam will take two years to occur.

The estimate of downstream wetland losses and changes in wetland type is based primarily on Alternative No. 1 because flow data was only provided for that alternative. However, Alternatives No. 2, 3 and 4 will also cause losses of or changes in downstream wetlands if a result of the alternative is that the one-year 10-day spring flood peak of 165 cfs is not released when available. The effect of Alternatives No. 2, 3 or 4 on downstream areas cannot be determined in the absence of information on changes in downstream flow and seasonal flooding of the wetland areas that results from the particular alternative.

Mitigation for the downstream wetlands should be developed following the same criteria recommended to provide adequate mitigation for the upstream wetlands. The amount of mitigation that is required for the downstream wetlands will depend on the final design and operation plan that is developed for the proposed project. The volume, duration and timing of flows that are released to seasonally flood the downstream wetlands will determine the amount of wetland acreage that is changed or lost.

When a project alternative has been selected and changes in downstream flow and seasonal flooding of the wetland areas has been projected, the loss of or change in wetland acreages will be determined. AAHU will be determined with no project and with the alternative. The net change in AAHU will be determined and provided to the HEP Team. The HEP Team will combine the net change in AAHU for upstream and downstream wetlands to determine the amount of mitigation that is necessary. The HEP Team will use the criteria specified in the Section 4.3 (wildlife resources mitigation) to assure that adequate mitigation is provided.

TABLE 4-1

T.H. 59 TO MAHNOMEN COUNTY CSAH 7 - WETLAND SPECIES HABITAT UNITS (HU) FOR BASELINE ACREAGES AND ESTIMATED WETLAND ACREAGE CHANGES THAT WILL RESULT FROM REDUCING THE ONE-YEAR 10-DAY SPRING FLOOD PEAK FROM 165 CFS TO 100 OR 50 CFS

Species	Wetland Type	Baseline			Reduction of one-year 10 day spring flood peak to:					
		Acreage	HSI	HU	100 cfs			50 cfs		
					Acreage	HSI	HU	Acreage	HSI	HU
Mink	2&3	279	.74	206	183	.74	135(-71)*	143	.74	106(-100)
Wood Duck	3	42	.22	9	24	.22	5(-4)	14	.22	3(-6)
Muskrat	3&6	99	.80	79	65	.80	52(-27)	34	.80	27(-52)
Total wetland species HU				294	192(-102)			136(-158)		

* () net change from baseline HU

5.0 GOVERNMENT APPROVALS

Governmental permits, licenses and approvals required for the proposed Winger Dam project, the unit of government responsible for each action and the current status (if known) are identified as follows:

<u>LEVEL OF GOVERNMENT</u>	<u>TYPE OF APPLICATION</u>	<u>STATUS</u>
<u>Federal</u> U.S. Army Corps of Engineers	Sec. 404	Application pending
<u>State</u> Minnesota Department of Health	Licensed well driller as required for well abandonment	
Minnesota Department of Natural Resources	Protected Waters Permit (Dam construction) (work in Sand Hill River and wetlands) Establishment of public access Aeration permit Shoreland management reclassification Flood Plain Management ordinance amendment approval	
Minnesota Department of Transportation (MnDOT)	Work within MNDOT right-of-Way Plan approval on the project Cooperative agreement covering MnDOT partial funding contribution for roadway improvements	
Minnesota Pollution Control Agency (MPCA)	Sec. 401 Water Quality certification Compliance with Water Quality standards	
State of Minnesota bonding	Partial project funding	
<u>Local</u> Sand Hill River Watershed District	Partial project funding	
Polk County	Road relocation Shoreland Management reclassification Flood Plain Management ordinance amendment	

Winger and Sletten Townships

Partial project
construction

Wild Rice Electrical Co-op

Powerline relocation

Lower Red River Watershed
Mgmt. Board

Partial project funding

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Miscellaneous related documents

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- 2) "Feasibility Exploration Highway 59 Detention Structure, Winger, Minnesota Project Number 2334" by Midwest Testing Laboratory Fargo, North Dakota.
- 3) Soil Foundation Investigation for proposed bridge numbered 60020 by Minnesota Department of Transportation.
- 4) Mark Hurd two-foot contour map of dam impoundment.
- 5) Water Well Record, Refer to well logs #'s 101783, 107885 and 221038.
- 6) U.S. Geological survey Winger and Fosston West 7½ minute quadrangles.

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APPENDIX A

OPERATION AND MAINTENANCE PLAN

Project No. 4

Winger Dam

Sand Hill River

Sand Hill River Watershed District

Fertile, Minnesota

I. GENERAL PLAN OF OPERATION AND MAINTENANCE

- A. This plan of operation and maintenance will be for Sand Hill River Watershed District Project No. 4 - Winger Dam. The dam is located along the alignment of Trunk Highway No. 59, between Sections 26 and 27, Winger Township (T147N, R42W), Polk County, Minnesota.
- B. Operation and maintenance will be the responsibility of the Sand Hill River Watershed District.
- C. Project No. 4 will be operated and maintained in compliance with applicable Federal, State and local laws, including dam safety rules and regulations.
- D. Project No. 4 will be operated and maintained in a manner that will protect the environment and permit the project to serve the purpose for which it was installed.
- E. The Sand Hill River Watershed District will make inspections annually in May or June, and after unusually severe floods, and after the occurrence of any other unusual conditions which might adversely affect the structural elements of Project No. 4. The Board of Managers will instruct its Engineer to make a written report of all inspections of the project. The report will describe the conditions found and list any corrective action needed with a time frame to complete each action.
- F. The Sand Hill River Watershed District will maintain in a centralized location a record of all inspections and significant actions taken, cost of performance and completion date with respect to operation, maintenance and replacement.
- G. The Sand Hill River Watershed District will prohibit the installation of any structure or facilities that will interfere with the operation or maintenance of Project No. 4.
- H. The Sand Hill River Watershed District will assume responsibility for operation and maintenance of Project No. 4 upon construction completion and project acceptance. The operation and maintenance responsibility will remain with the District perpetually into the future. The Minnesota Department of Transportation will assume responsibility for all maintenance and repair relative to the T.H. No. 59 road surface.

II. PLAN OF OPERATION

- A. Winger Dam has one 4' x 4' sluice gate and two 22-foot roller gates. The sluice gate, in its closed position, allows the development of a permanent conservation and recreation pool to elevation 1190 MSL. The two 22-foot roller gates allow for gated storage of flood flows between elevations 1190 and 1195 MSL.
- B. The 4' x 4' sluice gate will normally be in a closed position in order to develop and maintain a permanent conservation and recreation pool at elevation 1190. This gate also provides the capability for complete reservoir drawdown to existing river conditions. Thus, any required maintenance or repair can be conducted under dry conditions below the permanent pool elevation. With the gate in its normal, closed position, excess base flows will be directed through the low flow weir in the gate chamber at about elevation 1190. These flows then pass into the main riser chamber and through the 8.5' x 8.5' principal spillway conduit. Low flows, therefore, are automatically controlled by the low flow weir.
- C. The two 22-foot roller gates will normally be in the open position at elevation 1190 MSL. One or both gates may be raised to elevation 1195 MSL should downstream conditions dictate. The operation of these gates will be discussed in greater detail under Section F, Spring Operation, and Section G, Summer Operation, of this Plan of Operation. During the winter and other times when an eminent flood danger does not exist downstream, the roller gates will be maintained in their open position, with the weir crests at elevation 1190.

Should local flooding conditions occur for which gate closing is not mandated, flood storage will be developed as follows. Excess flood flows will be directed over each of the 22-foot gate weirs, with a crest elevation of 1190. The excess discharge will then pass through the main riser chamber, and in turn the 8.5' x 8.5' principal spillway conduit. Flood storage will be effectuated by the development of required hydraulic head to pass the flood flows. Under this scenario, the entire operation is automatic with no manual control. The required reservoir elevation (hydraulic head) to pass local flood discharges will vary, depending on the volume and peak discharge of the flood hydrograph.

- D. Should local flood discharges and volumes exceed the capacity of the reservoir and principal spillway capacities, a 1,420-foot wide depressed section is provided in the top of dam (T.H. No. 59 roadway) to serve as an emergency or auxiliary spillway. The purpose of the emergency spillway is to pass abnormally high discharges within a limited and controlled area to preserve the integrity of the dam. The emergency spillway functions as a broad crested weir, with a weir elevation of 1197.15 MSL. Its operation is entirely automatic.

- E. General Operation. During nonflooding or purely local flooding conditions, the operation of the dam will be entirely automatic as discussed in the previous paragraphs. However, a major project objective is to aid in the mitigation of major flooding events along the main stem of the Red River of the North. It is for this reason that gated storage capacity is provided as part of the Winger Dam project. There are two basic types of floods which predominate throughout the Red River drainage basin. These are defined as spring floods and summer floods. Each type of flood has its own specific characteristics and behavior patterns. Consequently, the operational plan of Winger Dam must provide for each type of flood. The operation plan for Winger Dam can be broken down into two types of seasonal management - spring operation and summer operation. The main roller gates may or may not be operated depending on predetermined critical flood conditions on the Red River main stem. Spring and summer operational procedures are discussed at length in the following paragraphs.
- F. Spring Operation. Spring flooding in the Red River Valley is primarily due to spring snowmelt with or without the addition of spring rainfall. These floods are usually large in magnitude and cover large areas, from a Red River Basin perspective. Spring events account for the largest and most frequent type of flooding on the Red River main stem. Consequently, their control is a major objective of water management interests within the Red River Basin. A primary purpose of Winger Dam is to aid in the mitigation of Red River flooding.

Spring floods are characterized by their slow development. Because they result mainly from spring snowmelt, prediction of their magnitude is usually started with basin-wide snow pack estimates in late winter. The flood runoff normally begins in April or May and lasts for several weeks. Flooding usually starts in the lower (southern) part of the Red River Valley and proceeds with time to the north. The National Weather Service makes periodic predictions of flood stages at various strategic locations before and during flood development. These flood stage forecasts are updated should conditions change (i.e. spring rainfall, temperature changes, etc.).

Since the Sand Hill River outlets into the Red River at Climax, Minnesota, benefits from Winger Dam would be to the north of this point (i.e. Grand Forks - East Grand Forks, Drayton, Oslo, Emerson). The gated storage operation at Winger Dam is predicted on critical flood stage forecasts at Grand Forks, North Dakota, a major flood damage center. The operation procedure is as follows:

1. For initial NWS stage prediction of 40 or greater at Grand Forks, completely close one 22-foot roller gate. For stage predictions of less than 40, leave both roller gates in open position.

2. If one roller gate has been closed, continuously monitor reservoir elevation behavior for the duration of the flood event.
3. After the peak reservoir elevation has been reached and begins to drop, wait 36 hours and then close the second 22-foot roller gate. This will retain the receding part of the flood hydrograph volume, while at the same time allowing peak discharge reduction in the immediate vicinity of the dam. The volume of water gated within the reservoir has been determined to be of significant benefit to Red River flooding conditions. The maximum amount of gated storage is about 6800 acre-feet.
4. When downstream flooding conditions have receded (i.e. stage at Grand Forks drops below 40), open one or both roller gates to their open position. This will allow reservoir draw down to the permanent pool elevation of 1190 MSL.
5. For those situations when Red River flooding does not reach a critical condition, (i.e. stage at Grand Forks is less than 40), Winger Dam will operate with both gates in the open position as described previously. This operation will be completely automatic with no manual control.

The spring operation is designed such that a maximum reservoir elevation of 1196 MSL for a critical flood event is not exceeded. In the case of Winger Dam, the critical flood event was determined to be the 100-year, 10-day runoff. More frequent floods of lesser magnitude would be expected to produce lower peak reservoir elevations. The 36-hour delayed closure of the second gate is based on the critical runoff event.

- G. Summer Operation. Summer floods result from severe rainstorm events over the contributing and downstream watersheds. These floods are usually localized relative to the entire Red River drainage basin. In addition, their occurrence is less frequent than spring floods. However, summer floods can be expected to produce larger peak discharges and provide less warning time than spring floods. For example, the largest flood known to occur at Winger was the 1909 summer flood. Normally, summer floods will not develop critical stages on the Red River because of their localized nature. However, very infrequent basin-wide summer storms have occurred in recent times, when Red River stages have been significantly increased (i.e. 1975 summer storm). Consequently, gated control for these very infrequent basin-wide floods must be included as a project objective for Winger Dam.

The operation of Winger Dam during the summer will be, for the most part, automatic with the roller gates in a fully open position. There is a remote possibility that gate operation may be required if a severe basin-wide summer storm occurs over a major portion of the Red River Basin. The summer operational procedure is as follows:

1. If the NWS predicts a stage of 40 or greater at Grand Forks after a large basin-wide summer rainfall, keep the roller gates in an open position.
2. Continuously monitor reservoir elevation behavior for the duration of the flood event.
3. After the peak reservoir elevation has been reached, and begins to drop, wait 24 hours and then close both 22-foot roller gates completely. This will retain the receding part of the flood hydrograph volume, while at the same time allowing peak discharge reduction in the immediate vicinity of the dam. The volume of water gated within the reservoir has been determined to be of significant benefit to summertime Red River flooding conditions. The maximum amount of gated storage is about 6800 acre-feet.
4. When downstream flood conditions have receded (i.e. stage at Grand Forks drops below 40), open one or both gates to their open position. This will allow the reservoir to draw down to the permanent pool elevation of 1190 MSL.
5. For those conditions when summer rainstorms are localized and Red River stages do not reach a critical condition (i.e. stage at Grand Forks is less than 40), Winger Dam will operate with both gates in the open position as described previously. This operation will be completely automatic with no manual control.

The summer operation is designed such that a maximum reservoir elevation of 1196 MSL for a critical rainfall event is not exceeded. In the case of Winger Dam, the critical rainfall event was determined to be the 100-year, 10-day rainfall. More frequent rainfalls of lesser magnitude would be expected to produce lower peak reservoir elevations. The 24-hour delayed closure of both gates is based on the critical rainfall event.

- H. The Board of Managers of the Sand Hill River Watershed District will appoint and train a gate operator to carry out the actions required in the plan of operation for Project No. 4. The gate operator will record the rate of rise of reservoir elevation on forms provided by the District. The gate operator will report any emergency conditions to the District or its Engineer immediately.

III. MAINTENANCE AND REPAIR

- A. The Sand Hill River Watershed District will be responsible for and promptly perform all maintenance and repair of Project No. 4. The Minnesota Department of Transportation will be responsible for all maintenance and repair relative to the T.H. No. 59 road surface.
- B. When maintenance work is necessary, repair work will be accomplished within 60 days of inspection. The project element will be repaired and/or modified to restore it to the original or "state-of-the-art" specifications and plans.

- C. To prevent damage to vegetation, severe erosion, and adverse effect on wildlife resources, all motorized vehicles will be kept off the earth dam structure and emergency spillway, except where roadways are provided or as necessary for maintenance operations.
- D. Following is a list of maintenance items that may be needed:
 - 1. Vegetative cover will be maintained within the project area.
 - a. Should the vegetative cover be lost or destroyed, these areas should be reseeded as soon as possible. These areas will be reshaped, fertilized and reseeded according to the original construction specifications.
 - b. In critical areas where an immediate vegetative cover is desired, sodding will be considered as an alternative to reseeding.
 - c. Fertilize vegetation as required to maintain the desired vigor of the vegetative stand.
 - d. Mow grass at regular intervals or spray to maintain optimum cover and control weeds. Do not mow before July 15, to protect ground nesting birds.
 - e. To maintain a proper vegetative cover, grazing will not be permitted on the earth dam structure or emergency spillway. Other areas will have rotation grazing systems to prevent over-grazing of critical areas.
 - 2. The structural integrity and function of the earth dam structure will be maintained.
 - a. Replace soil removed by burrowing animals where damage could result to the structure. This is especially dangerous where the mass of the fill is small.
 - b. Remove trees and brush from dam and emergency spillway.
 - c. If slides develop on the embankment areas, remove and/or stabilize slide material as soon as practical.
 - d. Replace eroded material and revegetate eroded areas in emergency spillway.
 - e. Repair any unusual seepages, boils or settlements in fill.
 - f. Keep stilling basin free of debris.
 - g. Restore eroded earth materials or damaged riprap at stilling basin and inlet of principal spillway system and reseed the area if appropriate.

- h. Restore structural elements that have deteriorated or been damaged.
 - i. Maintain gate mechanism in proper working order. Immediately remove ice and debris that may hamper the principal spillway function. Restore protective coatings if necessary.
 - j. Remove logs, tree tops, or other debris that may have been carried into the floodwater storage area by flood waters.
 - k. Keep access roads for maintenance in usable condition.
 - l. Remove all beaver dams that may develop from 1000 feet downstream from the centerline of the dam.
- E. Consideration will be given in all operation and maintenance work so that requirements of necessary permits, air and water quality control, sediment control, and environmental concerns are met.
- F. The Sand Hill River Watershed Board will obtain the funds necessary for operation and maintenance. Such funds will be used for routine operation and/or to provide for contingency funds to meet unusual operation and maintenance needs.
- G. The annual operation and maintenance cost for Project No. 4 - Winger Dam is estimated to be \$3,000.00.

CHAPTER 86A

OUTDOOR RECREATION SYSTEM

86A.01 Citation.
86A.02 Policy.
86A.03 Definitions.
86A.04 Composition of system.
86A.05 Classification and purposes.
86A.06 Rules.
86A.07 Authorization and acquisition of units.

86A.08 Authorization of secondary units.
86A.09 Development and establishment of units.
86A.10 Outdoor recreation advisory task force.
86A.11 Registry of units.

86A.01 CITATION.

Laws 1975, chapter 353 may be cited as the outdoor recreation act of 1975.

History: 1975 c 353 s 1

86A.05 CLASSIFICATION AND PURPOSES.

Subd. 9. State water access site; purpose; resource and site qualifications; administration. (a) A state water access site shall be established to provide public access to rivers and lakes which are suitable for outdoor water recreation and where the access is necessary to permit public use.

(b) No unit shall be authorized as a state water access site unless its proposed location substantially satisfies the following criteria:

(1) The body of water to which access is being provided and surrounding lands can withstand additional recreational use without undue damage to the environment or undue risks to the health and safety of water users;

(2) Public access to the body of water is either nonexistent or inadequate.

(c) State water access sites shall be administered by the commissioner of natural resources or the commissioner of transportation in a manner which is consistent with the purposes of this subdivision to provide public access to water. Access roads, off-road parking areas, refuse containers, sanitary facilities, and facilities for limited picnicking and primitive camping may be provided when the commissioner determines that these activities are justifiable and are compatible with the resource and the natural environment.

GAME AND FISH LAWS

GENERAL PROVISIONS

- 97A.011 Citation.
- 97A.015 Definitions.
- 97A.021 Construction.
- 97A.025 Ownership of wild animals.
- 97A.031 Wanton waste.
- 97A.035 Removal of signs prohibited.
- 97A.041 Exhibition of wildlife.
- 97A.045 Commissioner, general powers and duties.
- 97A.051 Publication of orders and laws.
- 97A.055 Game and fish fund.
- 97A.061 Payment in lieu of taxes.
- 97A.065 Dedication of certain receipts.
- 97A.071 Wildlife acquisition account.
- 97A.075 Use of license revenues.
- 97A.081 Posting land.
- 97A.085 Game refuges.
- 97A.091 Hunting on game refuges.
- 97A.095 Waterfowl protected areas.
- 97A.101 Public water reserves and management designation.
- 97A.105 Game and fur farms.
- 97A.111 Muskrat farms.
- 97A.115 Establishment of private shooting preserves.
- 97A.121 Hunting in private shooting preserves.
- 97A.125 Wildlife habitat on private land.
- 97A.131 Game farms and hatcheries.
- 97A.135 Acquisition of wildlife lands.
- 97A.141 Public water access sites.
- 97A.145 Wetlands for wildlife.
- 97A.151 Leech Lake Indian Reservation agreement.
- 97A.155 Amendments to Leech Lake Indian Reservation agreement.
- 97A.161 Agreement with White Earth Indians.
- 97A.165 Source of payments for Indian agreement.

ENFORCEMENT

- 97A.201 Enforcement.
- 97A.205 Enforcement officer powers.
- 97A.211 Arrest procedures.
- 97A.215 Inspections.
- 97A.221 Confiscation of property.
- 97A.225 Seizure and confiscation of motor vehicles and boats.
- 97A.231 Search warrants.
- 97A.235 Jurisdiction over boundary waters.
- 97A.241 Reciprocity with other states in appointing officers.
- 97A.245 Rewards.
- 97A.251 Obstruction of officers.
- 97A.255 Prosecutions.

PENALTIES

- 97A.301 General penalty provisions.
- 97A.305 Impersonation of an enforcement officer.
- 97A.311 Licenses.
- 97A.315 Trespass.
- 97A.321 Dogs pursuing or killing big game.
- 97A.325 Penalties for unlawfully buying or selling wild animals.
- 97A.331 Penalties related to hunting.
- 97A.335 Penalties related to fishing.

LICENSES AND PERMITS

- 97A.401 Special permits.
- 97A.405 License requirements.
- 97A.411 Validity of licenses.
- 97A.415 License restrictions.
- 97A.421 Validity and issuance of licenses after conviction.
- 97A.425 Record and reporting requirements for dealers, tanners, and taxidermists.
- 97A.431 Moose licenses.
- 97A.435 Turkey licenses; application and eligibility.
- 97A.441 Licenses to be issued without a fee.
- 97A.445 Exemptions from license requirement.
- 97A.451 License requirements and exemptions relating to age.
- 97A.455 Nonresident students; fishing and small game.
- 97A.461 Nonresident licenses for boundary water hunting or fishing.
- 97A.465 Military personnel; fishing and hunting.
- 97A.471 Nonresident courtesy licenses.
- 97A.475 License fees.
- 97A.481 License applications under oath.
- 97A.485 Issuance of licenses.

POSSESSION AND TRANSPORTATION OF WILD ANIMALS

- 97A.501 Wild animals; general restrictions.
- 97A.505 Possession of wild animals.
- 97A.511 Fur-bearing animals.
- 97A.515 Pelts, skins, and hides taken on Indian reservations.
- 97A.521 Transportation of wild animals; generally.
- 97A.525 Transportation of wild animals by common carrier.
- 97A.531 Shipment of wild animals taken in Canada.
- 97A.535 Possession and transportation of deer, bear, and moose.
- 97A.541 Nonresident; small game tags.
- 97A.545 Transportation of game birds.
- 97A.551 Transportation of fish.

GENERAL PROVISIONS

97A.011 CITATION.

Chapters 97A, 97B, and 97C may be cited as the "game and fish laws."

History: 1986 c 386 art 1 s 1

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97A.141 PUBLIC WATER ACCESS SITES.

Subdivision 1. **Acquisition; generally.** The commissioner shall acquire access sites adjacent to public waters and easements and rights-of-way necessary to connect the access sites with public highways. The land may be acquired by gift, lease, or purchase, or by condemnation with approval of the executive council. An access site may not exceed seven acres and may only be acquired where access is inadequate.

Subd. 2. **Acquisition; limitations.** Access sites may not be acquired under this section adjacent to public waters that are unmeandered or completely surrounded by land owned and maintained for the purpose of an educational or religious institution. Access sites adjacent to public waters that contain less than 200 acres within the meander lines may not be acquired by condemnation and may only be acquired if:

- (1) the public water contains at least 150 acres within the meander lines; or
- (2) the public waters are to be managed intensively for fishing.

Subd. 3. **Maintenance.** The commissioner shall maintain the sites, easements, and rights-of-way acquired under this section. The commissioner may make an agreement for the maintenance of the site easements and rights-of-way with a county board if the connecting public highway is a county state-aid highway or county highway, or the town board if the connecting highway is a town road. The county board and town board may spend money from its road and bridge funds for maintenance under the agreement.

History: 1986 c 386 art 1 s 27 B-2

CHAPTER 97C

FISHING

FISHING HABITAT

- 97C.001 Experimental waters.
- 97C.005 Special management lakes.
- 97C.011 Muskellunge lakes.
- 97C.015 Mississippi river fish refuge.
- 97C.021 Angling restricted in trout streams.
- 97C.025 Fishing and motorboats prohibited in spawning beds and fish preserves.
- 97C.031 Lakes with unbalanced fish populations.
- 97C.035 Endangered fish populations.
- 97C.041 Commissioner may remove rough fish.
- 97C.045 Removal of rough fish from boundary waters.
- 97C.051 Special permits to use piscicides.
- 97C.055 Dead fish removal.
- 97C.061 Dragging a weight or an anchor through vegetation.
- 97C.065 Pollutants in waters.
- 97C.071 Permit required for structure in public waters.
- 97C.075 Fish screens in flowing waters.
- 97C.081 Fishing contests.

PROPAGATION

- 97C.201 State fish stocking prohibited without public access.
- 97C.205 Rules for sporting organizations to rear and stock fish.
- 97C.211 Private fish hatcheries.
- 97C.215 Special permits for United States agents.

FISHING METHODS

- 97C.301 License required to take fish.
- 97C.305 Trout and salmon stamp.
- 97C.311 Lake Superior fishing guide license.
- 97C.315 Angling lines and hooks.
- 97C.321 Restrictions on unattended lines.
- 97C.325 Prohibited methods of taking fish.
- 97C.331 Snagging fish prohibited.
- 97C.335 Use of artificial lights to take fish prohibited.
- 97C.341 Certain fish prohibited for bait.
- 97C.345 Restrictions on use and possession of nets and spears.
- 97C.351 Fish nets must have tag attached.
- 97C.355 Dark houses and fish houses.
- 97C.361 Restrictions on fish houses and dark houses in the boundary waters canoe area.
- 97C.365 Spears prohibited while angling in fish house or dark house.
- 97C.371 Spearing fish.
- 97C.375 Taking rough fish by spearing or archery.

- 97C.381 Harpooning rough fish.
- 97C.385 Commissioner's authority to regulate winter fishing.
- 97C.391 Buying and selling fish.
- 97C.395 Open seasons for angling.
- 97C.401 Commissioner authorized to prescribe limits.
- 97C.405 Muskellunge size limits.
- 97C.411 Sturgeon and paddlefish.
- 97C.415 Trout and salmon.

MINNOWS

- 97C.501 Minnow licenses required.
- 97C.505 Minnows.
- 97C.511 Minnow seines.
- 97C.515 Imported minnows.
- 97C.521 Transportation of carp fingerlings prohibited.
- 97C.525 Restrictions on transportation of minnows.

AMPHIBIANS

- 97C.601 Frogs.
- 97C.605 Turtles.
- 97C.611 Snapping turtles: limits.
- 97C.615 Commissioner may remove turtles.
- 97C.621 Areas may be closed to taking turtles.

MUSSELS AND CLAMS

- 97C.701 Taking mussels.
- 97C.705 Mussel seasons.
- 97C.711 Mussel size limits.

NETTING AND

COMMERCIAL FISHING

- 97C.801 Taking rough fish on Mississippi and Minnesota rivers.
- 97C.805 Netting of lake whitefish and ciscoes.
- 97C.811 Commercial fishing in inland waters.
- 97C.815 Commercial fishing areas.
- 97C.821 Possession, sale, and transportation of commercial fish.
- 97C.825 Lake of the Woods and Rainy Lake fishing.
- 97C.831 Namakan and Sand Point lakes; commercial fishing.
- 97C.835 Lake Superior commercial fishing.
- 97C.841 Helper's license.
- 97C.845 Interference with commercial fishing.
- 97C.851 Commercial fishing in international waters; resort owners.
- 97C.855 Upper and Lower Red Lake and Nett Lake; transportation, sale, and disposal.
- 97C.861 Fish vendor requirements.
- 97C.865 Fish packers.

* * *

97C.201 FISHING

2166

PROPAGATION

97C.201 STATE FISH STOCKING PROHIBITED WITHOUT PUBLIC ACCESS.

The commissioner and state agencies may only stock fish in waters where there is public access. The commissioner may stock fish in any stream within privately owned lands where the public is granted free access to and use of the stream for fishing purposes.

History: 1986 c 386 art 3 s 18; 1986 c 424 s 2



**DEPARTMENT OF
NATURAL RESOURCES**

Policy

Effective Date 5/30/80
Number 5

Rev. 8/18/80
Approved:

Approved: 

Supersedes
Number _____
Date _____

Other Guidelines	
Commissioner Orders #1828	
Rules & Regulations	
Operational Order	
Dept. Manual	
Other	M.S. 86A
	97.48
	138.40

SUBJECT:

STATE WATER ACCESS SITES

0354A

Preamble

The Outdoor Recreation Act of 1975, Minnesota Statutes 86A.01 to 86A.11, establishes an outdoor recreation system which will (1) preserve an accurate representation of Minnesota's natural and historical heritage for public understanding and enjoyment and (2) provide an adequate supply of scenic, accessible, and usable lands and waters to accomodate the outdoor recreational needs of Minnesota's citizens. State water access sites are established as one component of this outdoor recreation system.

In keeping with the legislative mandate of the Outdoor Recreation Act of 1975 and to assure consistency in the selection and management of water access sites* the department has established a goal, objectives, and policies. This policy document compliments and is consistent with the water access document covering the seven county metropolitan area which was developed jointly by the Metropolitan Council, Department of Natural Resources, and the State Planning Agency and is consistent with existing state laws and regulations. These are complimented by a Department of Natural Resources water surface use policy document. It is the goal of the water access site program:

TO PROVIDE AND MAINTAIN FREE AND ADEQUATE PUBLIC ACCESS TO ALL OF MINNESOTA'S LAKE AND RIVER RESOURCES CONSISTENT WITH RECREATIONAL DEMAND AND RESOURCE CAPABILITIES TO PROVIDE RECREATIONAL OPPORTUNITIES.

In order to facilitate meeting this goal, objectives have been identified for the following areas:

Designation

I. Water Access Site Criteria

Management

II. Resource and Recreation Management

* Water access sites where The Department of Natural Resources has a proprietary interest, but not necessarily in fee ownership of land.

DESIGNATION

I. WATER ACCESS SITE CRITERIA

General Policy

To attain the goal of providing adequate access to public waters of the state, the department will adhere to the following objectives:

- A. To prioritize public waters, for the establishment of access sites, on the basis of their ability to accommodate appropriate recreational use without undue damage to the resource.
- B. To locate access sites on public waters where access is non-existent or inadequate.
- C. To consider the use of public property in establishing access sites.
- D. To minimize potential problems, development costs, and long term maintenance.

Specific Policy

The following department policies will be adhered to in the selection and location of water access sites:

1. Statewide priorities for the establishment of water access sites will be developed based on recreational use and demand survey data.
2. Lakes will be prioritized, for the provision of water access, using all of the following criteria which assess the recreational potential for watercraft-based recreational activities:
 - a) On the basis of their proximity to population centers proximity to areas of concentrated use, or location in areas of high demand
 - b) On the basis of their characteristics (ranked in order of importance)
 1. size and shape
 - a. 1000 + acres
 - b. 500-1000 acres
 - c. 150-500 acres
 - d. less than 150 acres and managed intensively* for fisheries
 2. fish or wildlife type (to be considered as separate categories with priorities established within each category)
 - a. fish
 1. game fish - most desirable
 2. game fish/rough fish
 3. winterkill-least desirable
 - b. wildlife
 1. waterfowl

* Intensive fish management - the stocking or removal of fish or habitat improvement measures.

3. water clarity
a. fish lakes

	<u>Depth of Secchi Disc Reading</u>	<u>Depth to which rooted aquatic plants grow</u>
1. very clear	10 feet & greater	20 feet & greater
2. clear	6-10 feet	12-20 feet
3. intermediate	2-6 feet	4-12 feet
4. turbid	2 feet and less	4 feet and less

b. wildlife lakes

1. suitability for hunting/trapping/wildlife observation

3. Rivers and streams will be prioritized for the establishment of water accesses based upon their proximity to population centers, proximity to areas of concentrated summer use, or location in areas of high demand.

4. Access is considered adequate if the land is held for the public interest, it is free,* and at total development (which may include one or more sites) the following guidelines are met:

a) Lake Access

1. Trailered boat access - one parking space is provided for each:
 - a. 20 acres of lake surface on lakes 0-1000 acres in size
 - b. 20 to 30 acres of lake surface on lakes 1000-1500 acres in size
 - c. 40 acres of lake surface on lakes 1500-5000 areas in size
 - d. guidelines for lakes 5000 acres or larger will be established on an individual basis
2. Car top boat access - one parking space is provided for each 10 acres of water surface
3. Walk-in access - one parking space is provided for each 10 acres of water surface

b) River and Stream Access: Access will be considered adequate for rivers and streams if there is one access site per 10-15 river miles, or when otherwise provided in specific river management plans or as indicated by user demand

5. The department will review surrounding land ownership, existing and expected recreational use, and recreation survey data, among other things, in determining the type of access (trailered, car-top, or walk-in) to develop at any one site.

* Free public access - No fees are charged for launching any craft and no special regulations that do not apply equally to all users are in effect. In addition, where an access is provided within a park, uniform fees to get in a park are charged of all users.

6. An inventory of the body of water under consideration for public access will be conducted to determine if other units of government own lakeshore on the body of water under consideration.
7. Location of proposed access sites will be coordinated with other units of government if they administer land suitable for public access establishment or the appropriate division director(s) for DNR administered lands.
8. The department in establishing water access sites will:
 - a) attempt to acquire a lot size of at least 1/2 acre but not in excess of 7 acres
 - b) provide adequate area at sites to meet established standards for turn around, buffer, ramp, roadway, and parking
 - c) attempt to acquire access sites adjoining existing public roadways
 - d) acquire sites that allow for safe access to public roadways
 - e) acquire, to the extent possible, sites that do not require extensive dredging or filling, have minimum slope, have upland soils, and require a minimum of shoreline alteration
 - f) attempt to acquire sites having the least potential for disturbance to existing land uses in the vicinity and the natural resources

General Procedural Policy

Water Access Program Acquisition and Development

The Special Assistant to the Commissioner, Trails and Waterways Unit, is responsible for and has the authority to implement the water access program statewide. The Water Access Supervisor is responsible to the head of the Trails and Waterways Unit for the planning and coordination of the statewide water access program as delegated and identified in departmental directives, operational orders, and policy.

The regional administrator is responsible for the acquisition, development, and maintenance of the water access program in the region as approved by the head of the Trails and Waterways Unit.

The regional trails and waterways coordinator is responsible for the implementation of the regional water access program as delegated by the regional administrator.

The acquisition development, and maintenance of water access sites shall be funded from the budget of the Water Access Program.

The following procedures will be adhered to in administering the water access program:

- A. Each region, under the direction of the regional administrator, will inventory all existing free water access sites to evaluate the adequacy of water access on the priority public waters identified in the region.

- B. Each region, under the direction of the regional administrator, will develop regional priorities for the establishment of water access using the designation criteria on pages 2, 3, and 4. The priority list will be forwarded to the appropriate regional development commission to ensure coordination of this program with programs administered by other agencies or units of government in the region.
- C. Regional administrators will submit regional priorities for acquisition and development on an annual basis to the Water Access Supervisor for review and approval by the head of the Trails and Waterways Unit.

When DNR administered lands are involved, the regional administrator and appropriate division director will jointly review and approve the priorities prior to submission to the Water Access Supervisor.

The approved annual priorities list will be transmitted to the regional administrator for implementation. The list will also be forwarded to division directors for their information.

- D. The Water Access Supervisor will identify statewide priority areas for the establishment of water access sites based on recreation user survey and demand data and recommendations from the regions. The program, to the extent possible, will allocate its resources based on these priorities.
- E. Appropriate regional supervisors and department personnel making the initial landowner contact on a project will be kept advised of a project's status for the purposes of coordination.
- F. Regional administrators shall, to the greatest extent possible, cooperate with local zoning and planning officials in establishing water access sites and shall file for necessary Corps of Engineers and Department of Natural Resources permits.

Specific Procedural Policy

In furtherance of these objectives, the following specific policies will be followed:

Acquisition

- 1. The regional administrator will, on a case-by-case basis, assign the responsibility for initial landowner contact to the most appropriate field personnel. The regional administrator, through the Water Access Supervisor, may request the assistance of the Land Bureau in initial landowner contact in areas of high priority.
- 2. Any department personnel initiating public access proposals shall work with the regional trails and waterways coordinator on the project proposal, project map, and fact sheet. The regional trails and waterways coordinator is responsible for necessary follow-up action on potential access sites.

3. Upon receipt of the project proposal, the regional trails and waterways coordinator shall review the proposal and complete a feasibility check based on the designation criteria (pages 2, 3, and 4) with input from:
 - a) the regional lands specialist - in regards to fact sheet review and verification of:
 1. legal description, and
 2. review to determine if existing public lands, located on the water body under consideration, are feasible for access development
 - b) the regional engineer - in regards to development feasibility (including possible permit requirements)
 - c) the regional hydrologist - in regards to necessary Corps of Engineers and DNR permits
4. Proposals (project proposal, fact sheet, and map) determined to be feasible will be given preliminary approval by the regional administrator and forwarded to the Water Access Supervisor.
5. The Water Access Supervisor will review proposals and:
 - a) forward proposals to the head of the Trails and Waterways Unit for approval, and
 - b) submit project proposals and fact sheets for approved projects to the Land Bureau for appraisal and negotiation. A copy of the transmittal will be returned to the regional administrator
6. The Bureau of Land, upon receipt of the project proposal and fact sheet, will notify the assigned regional realty specialist for monitoring purposes. The project will then be assigned to an appraiser for completion of an appraisal report. After review and certification of the appraisal by the Department of Administration, the project will be assigned to a negotiator to purchase the property.
7. Regional administrators will assign management responsibility to the appropriate discipline upon completion of acquisition.

Development

1. Regional administrators will assign development responsibility. Development shall be coordinated with the discipline responsible for management.
2. An annual development plan will be developed by the regional administrator in consultation with his/her staff. The annual development plan shall include a listing of proposed development projects and estimated cost, and shall be conducted in accordance with Operational Order 43.
3. The annual development plan shall be transmitted through the Water Access Supervisor for review and approval by the head of the Trails and Waterways Unit.

4. Upon approval of the annual development plan the Water Access Supervisor shall send an engineering requisition to the Bureau of Engineering for implementation of the annual development plan.
5. The Bureau of Engineering shall review the annual development plan and determine the appropriate level of responsibility for development on individual accesses (e.g., central office, regional office, or both).
6. No departure from the annual development plan will be allowed without prior approval of the Water Access Supervisor.

Acquisition and Development with
Other Units of Government

1. When non-DNR public lands may be potentially established as water access sites to waters that are listed as priorities, it will be the responsibility of the regional administrator to initiate contact with the appropriate public agency (county, city, regional development commission, MN/DOT, etc.) on establishment of a public access. This action may be delegated by the regional administrator to the regional trails and waterways coordinator or appropriate DNR field personnel where deemed desirable.
2. The regional administrator or his/her staff will cooperate with the appropriate agency in the establishment of a water access site. Criteria, procedures, and responsibility for establishment of water access sites on other public lands shall be the same as those listed for DNR administered lands, if appropriate. In addition, the following guidelines will be adhered to:
 - a) Written agreements, as prescribed by the commissioner, between other units of government and the department for the establishment, enforcement, and maintenance of water access sites shall be approved by the regional administrator
 - b) The regional administrator will submit the written agreement to the Water Access Supervisor for review and approval by the Legal Bureau

MANAGEMENT

II. RESOURCE AND RECREATION MANAGEMENT

General Policy

The department will rely on the following administrative objectives in managing water access sites:

- A. To establish water access sites primarily to provide for watercraft use.

- B. To provide and maintain quality water access sites for users.
- C. To maintain quality roads to water access sites for users.
- D. To establish a cooperative water access program with other units of government.

Specific Policy

To fulfill this general policy the department's policy is that:

1. Adequate road access, parking facilities, and a boat launching ramp will be the primary facilities provided at a water access site. Facilities will be designed so as to be barrier-free.
2. Funding for development shall be limited to access facilities only and shall not be used for other recreational facilities except that the commissioner may provide facilities for limited picnicking and primitive camping when it has been determined that these activities are justifiable and compatible with the resources and the natural environment. Facilities provided, if any, will be determined on a case-by-case basis and will be physically separated from the boat launching area, if possible, and in no way interfere with the boat launching area. Camping, where permitted, will be so designated.
3. Federal and state legal mandates governing floodplains, public waters, wetlands, archeological, historical, and other resource values must be complied with on sites involving federal funds.
4. Swimming or waterskiing from a water access site is not permitted unless the area is designated for such use. When permitted, swimming and waterskiing areas shall be developed and physically separated so as not to conflict with the launching of watercraft.
5. Standards for road width, amount of buffer, launch ramps, turn-around, and parking facilities shall be established. Such standards shall be used to develop specific classes of access sites to facilitate the Corps of Engineers permit process and provide consistency among facilities on a statewide basis.
6. Toilet facilities and trash receptacles, as a general rule, will be provided (at the site or in the vicinity) only at areas with a high level of use or when the only alternative for alleviating recurring problems is to provide such facilities. Sites without trash receptacles should be signed to promote a pack-out litter philosophy.
7. Wells and pumps should not be provided at water access sites.
8. All cases of encroachment or unauthorized use on water access sites shall be investigated promptly.

9. Fencing at access sites will be provided, when necessary, to prevent users from trespassing on adjacent private lands and to prevent unauthorized use of the public access site by adjacent landowners.
10. Adequate vegetative screening will be provided to serve as a visual barrier, when necessary.
11. Hours and times of operation:
 - a) Water access sites operated and maintained by the department shall be open 24 hours daily except for those within state parks or in areas with recurring enforcement problems. The commissioner, as a temporary solution to enforcement problems, may establish hours of operation for an access site. A water access site may be closed temporarily if the need arises.
 - b) Water access sites that are operated by another state agency or local unit of government shall be open at least 18 hours a day between the hours of 4:00 a.m. and midnight to qualify for fish stocking. Upon joint agreement an access site may be temporarily closed.
12. Water access areas, whether separate or in another governmental or DNR administered unit, shall be clearly posted and shall display the appropriate regulations. Signing of an access site in another governmental unit will indicate the project is a cooperative venture.
13. Water access sites which have been funded with federal monies must be appropriately signed, consistent with federal requirements, or, in lieu of signing, maps of a designated project must be readily available for the public.
14. Information signs should be placed on major highways (state and federal) within 5 miles (or further when necessary) of a public access site. The department will place signs at appropriate intersections from the main signs, so as to direct the public to the water access site.
15. Maps and other information suitable to inform the public of water access sites should be provided.
16. Access roads to water access sites will utilize public roads whenever possible.
17. Water access roads will be acquired to provide access from the closest public road to the site only. They are not to be considered as public roads. No private roads will be permitted to be constructed off from water access roads or sites unless easements have been acquired from the department by local units of government. All unauthorized roads shall be considered trespass and investigated promptly and appropriate action shall be taken.

18. The department may share in the maintenance (including snowplowing) of private and DNR roads to water access sites only where private homes and cabins were established before the access site or where the private or DNR road primarily serves the public access purpose. Though the state water access program serves Minnesotan's year-around, the program is primarily orientated to providing access to public waters for summer recreational activities. Therefore, snowplowing to provide parking for winter uses, shall be provided on a discretionary basis and then only at lakes with a high demand for winter fishing.
19. The department will actively pursue the establishment of water access sites in cooperation with other units of government and will seek to establish maintenance and enforcement contracts with local units of government so as to improve water access sites.
20. Written agreements for development, enforcement, maintenance, and acquisition of water access sites may be entered into with local units of government or other state agencies. Written agreements shall be (finalized) approved by the appropriate body in local government or other state agency and the commissioner before any funds are expended.

APPENDIX C

STATE OF MINNESOTA

DEPARTMENT OF NATURAL RESOURCES

COMMISSIONER'S ORDER NO. 2258

AMENDING COMMISSIONER'S ORDER NO. 2194
ESTABLISHING PERMIT REQUIREMENTS
FOR WATER AERATION SYSTEMS

Pursuant to authority vested in me by law, I, Joseph N. Alexander, Commissioner of Natural Resources, hereby prescribe the following amendments to Commissioner's Order No. 2194, establishing permit requirements for water aeration systems.

Section 1. Section 2(c) of Commissioner's Order No. 2194 is amended to read as follows:

(c) An aeration permit shall not be issued unless the Commissioner shall first determine that the installation and operation of such an aeration system shall result in substantial benefits to the lake resource.

Sec. 2. Section 2(d) of Commissioner's Order No. 2194 is amended to read as follows:

(d) An aeration permit shall not be issued for winter operation of an aeration system where such system is likely to create more than one open water area during ordinary winter weather, except that such a system may be specifically allowed when the Commissioner has first determined that its operation shall result in substantial benefits to the lake resource.

Sec. 3. Section 3(d) of Commissioner's Order No. 2194 is amended to read as follows:

(d) The applicant must provide, in addition to the application, proof that the applicant is financially able to maintain and operate the system and to meet any liability that might arise from the presence or operation of the system. This shall be done by complying with one of the following alternatives:

- (1) Obtaining insurance for personal injury or death in the amount of at least \$200,000 per individual and \$600,000 per occurrence, and for injury to or loss of property in the amount of at least \$50,000 per occurrence. The applicant must provide proof of insurance in the form of a binder or certificate of insurance before the permit shall be valid, and shall periodically provide proof of continuing insurance as the Director of Fish and Wildlife may request. Such insurance shall be in effect whenever the aeration system is in operation during all times any portion of the lake is ice-covered. The policy shall provide that the Director must be notified by the insurance company before the policy may be cancelled or terminated. Any lapse in such insurance coverage shall automatically render the permit null and void; or
- (2) In the case of a governmental entity, being self insured up to a minimum of \$600,000. The applicant

COMMISSIONER'S ORDER NO. 2258

must furnish a letter or resolution of the governing body to that effect signed by appropriate authorized persons.

Sec. 4. Section 3 of Commissioner's Order No. 2194 is amended by adding paragraph (f) to read as follows:

(f) Permittee agrees to assume the entire responsibility and liability for all damages or injury to all persons and to all property arising out of, resulting from or in any manner connected with the design, construction, installation, operation, maintenance, supervision or inspection of the permitted aeration system. Permittee agrees to indemnify, defend and hold harmless the State of Minnesota, its agents and employees, from all such claims, damages or injury. This indemnity agreement includes but is not limited to claims that the permittee was negligent or otherwise liable for allowing, designing, constructing, installing, operating, inspecting, maintaining, supervising or approving the permitted aeration system, or failing to so do.

Sec. 5. Commissioner's Order No. 2194 is amended by adding Section 8, to read as follows:

Sec. 8. VARIANCE

Any provisions of this order may be waived under special circumstances when deemed necessary by the Commissioner for the protection and preservation of the natural resources of the state.

COMMISSIONER'S ORDER NO. 2258

Sec. 9. Except as provided herein, all provisions of Commissioner's Order No. 2194 shall remain in full force and effect.

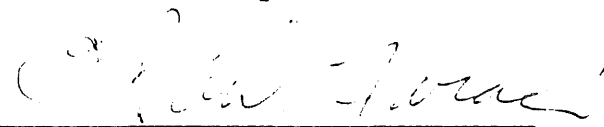
Dated at Saint Paul, Minnesota this 31 day of January, 1987.



JOSEPH N. ALEXANDER, COMMISSIONER
Department of Natural Resources

APPROVED AS TO FORM AND EXECUTION

HUBERT H. HUMPHREY, III
Attorney General



C. PAUL FARACI
Deputy Attorney General

STATE OF MINNESOTA

DEPARTMENT OF NATURAL RESOURCES

COMMISSIONER'S ORDER NO. 2194

ESTABLISHING PERMIT REQUIREMENTS FOR
WATER AERATION SYSTEMS;
SUPERSEDING COMMISSIONER'S ORDER NO. 2114

Pursuant to authority vested in me by law, I, Joseph N. Alexander, Commissioner of Natural Resources, hereby prescribe the following regulations for the establishment and operation of water aeration systems.

Section 1. DEFINITIONS

(a) "Aeration System" means a man-made system for introducing air into or inducing currents in a body of water. The purposes of such systems include, but are not limited to: preventing fish winterkill; keeping areas free of ice to aid navigation, to keep mooring facilities open, or to protect structures in the water from ice damage; maintaining open water for captive waterfowl; and rehabilitating lake water quality by methods such as destratification and hypolimnetic aeration.

(b) "Public Waters" has the meaning given it by Minnesota Statutes Section 105.37.

Sec. 2. PERMIT REQUIRED

(a) No aeration system shall be installed and operated in public waters except under permit issued by the Commissioner of Natural Resources, unless the system is used exclusively for and is no larger than the minimum size adequate to keep dock piers or mooring areas free of ice. All such systems may be subject to

regulations of other governmental entities such as county governments and watershed districts.

(b) An aeration permit shall not be issued for the purpose of attracting or delaying the migration of wild waterfowl.

(c) An aeration permit shall not be issued to aerate during periods of ice cover for the purpose of improving water quality, unless the Commissioner shall first determine that there is a history of winterkill in that lake.

(d) An aeration permit shall not be issued for winter operation of a system where the diffusers are placed in a configuration such that more than one open water area is created during ordinary winter weather, except that such a system may be specifically allowed when the Commissioner has first determined that it is necessary and effective for preventing winterkill in any given lake.

Sec. 3. APPLYING FOR A PERMIT

(a) No permit shall be issued for a period of more than one year. All permits must be renewed annually.

(b) Applications for permits shall be submitted on forms provided by the Commissioner and shall include:

(1) The reason the system is needed.

(2) A description of the system (location, size, number, devices to be used, etc.).

COMMISSIONER'S ORDER NO. 2194

(3) A sketch of the proposed system indicating the compass direction "North", location on the lake, roads in the vicinity, pertinent fire numbers, noteworthy landmarks, and enough detail on the sketch so the system can be located for inspection.

(4) The operating schedule.

(5) The anticipated result of the system operation.

(6) Such further information as the Commissioner may require, such as detailed water quality data, or fishing characteristics of the lake.

(c) The applicant shall be:

(1) A governmental entity such as a county, city, town, watershed district, or lake improvement district; or

(2) A private person, group or entity.

(d) The applicant must provide, in addition to the application, proof that the applicant is financially able to maintain and operate the system and to meet any liability that should arise from the presence or operation of the system. This shall be done by:

(1) Providing a Certificate of Insurance for the current period of operation. An insurance policy of \$500,000.00 combined single limit (minimum) coverage must be in effect while the system is in operation during all times any portion of the lake is ice-covered. An insurance binder is adequate until a

COMMISSIONER'S ORDER NO. 2194

Certificate is issued, at which time the Certificate must be delivered to the appropriate Regional Fisheries Supervisor; or

(2) Posting a bond for \$500,000.00; or

(3) In the case of a governmental entity, being self-insured, in which case the applicant must furnish a letter or resolution of the governing body to that effect signed by appropriate authorized persons.

(e) The Commissioner may also require that the applicant obtain a written resolution from the governing body of the county, city, town, or watershed district that it has no objection to the project. Alternatively, the applicant may supply proof that the governing body was petitioned for such a resolution and the body took no action within 40 days of the petition.

Sec. 4. CRITERIA FOR GRANTING A PERMIT

The Commissioner shall grant a permit for an aeration system when he concludes that:

(a) The system will accomplish the purpose for which it is intended; and

(b) The system will not significantly harm the fishery or other wild animals or natural resources of the lake and adjacent areas; and

(c) The goal of the system is compatible with Department of Natural Resources management objectives for the body of water; and

(d) The system satisfies the standards of Minnesota Statutes Section 116D.04, Subd. 6.

Sec. 5. PERMIT CONDITIONS

The Commissioner may include such conditions as he thinks are reasonable and necessary for the design, installation, and operation of the system, and provisions for monitoring the system and its effects by the permittee or the Commissioner.

(a) All permittees shall attend workshops to be held at designated locations throughout the state during the winter of 1984-85 and from time to time thereafter. New permittees shall attend a workshop prior to initial start-up of systems.

(b) Each aeration system shall be inspected by the permittee often enough to insure that the requirements of this order are met at all times. All discrepancies shall be promptly corrected. Under no conditions shall any system be inspected less than once every 7 days.

(c) The start-up and stopping dates for aerating during periods of ice cover shall be determined by the Regional Fisheries Supervisor and shall be specified in the permit.

(d) The Commissioner may revoke a permit without prior notice whenever, in his opinion, revocation is necessary to protect the interests of the public, to protect human life or natural resources or for violation of this Commissioner's Order or any permit issued hereunder.

Sec. 6. MARKING REQUIREMENTS

The following are minimum requirements for the marking of lakes where aeration systems are used during periods of ice cover:

(a) Where an aeration system is used in public waters during periods of ice cover, signs of the design specified in Minn. Rules Part 6110.1500 shall be posted by the permittee at a height of from four to six feet in a rectangular pattern at each corner of the open water, with at least two additional signs between the corner signs on any side exceeding 100 feet in length.

(b) Additional signs stating that an aeration system is in use and that open water or weak ice exists shall be posted by the permittee on the shoreline of the lake being aerated at each public access point and other areas commonly used by the public for access to the lake.

(c) It is strongly recommended that fencing be placed around the open water perimeter.

Sec. 7. PUBLICATION OF NOTICE

Advance public notice of the commencement of operation of any aeration system during periods of ice cover on public waters shall be given by the permittee. Minimum notice shall consist of publication of the location and date of commencement of operation of the system in a newspaper of general circulation in the area

COMMISSIONER'S ORDER NO. 2194

where the system is proposed to be operated at least two times between 5 and 20 days prior to commencement.

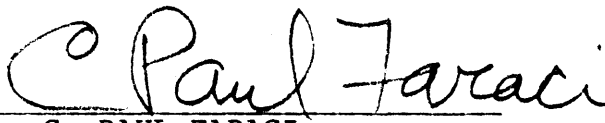
Commissioner's Order No. 2114 is hereby superseded.

Dated at Saint Paul, Minnesota, this 4 day of
out, 1984.


JOSEPH N. ALEXANDER, COMMISSIONER
Department of Natural Resources

APPROVED AS TO FORM AND EXECUTION

HUBERT H. HUMPHREY, III
Attorney General


C. PAUL FARACI
Deputy Attorney General

APPENDIX D

TO: Lawrence H. Woodbury P.E.
HOUSTON ENGINEERING, INC.
2505 N. University Drive
P.O. Box 5054
Fargo, North Dakota
58105

10/12/86

FROM: Gordon A. Lothson
COUGAR CONSULTING
606 E. Cook Ave.
St. Paul, Minnesota
55101

SUBJECT: Preliminary Report; Archaeological Survey and Testing
of the Winger Dam and Reservoir Area, Winger, Minne-
sota.

This letter is to inform you that we have completed both the surface survey and the shovel testing portions of the Phase I archaeological survey and testing of the Winger Reservoir. The results of these investigations have been completely negative and we feel that no addition survey or testing should be done at either the Phase II or Phase III levels of investigation. It is our opinion that no "formal test excavation or site mitigation is required at this time. Intensive surface examination and shovel testing of high potential areas were totally negative.

In addition to the surface survey and the shovel testing of the high potential or high probability areas--areas where sites have tended to occur in other archaeological areas, the investigators also interview a large number of the land owners also with negative results. None of the land owners or any of the local residents had prehistoric or historic collections from the area. The only materials collected from the study area were a medicine bottle fragment and few single fragments of white to gray chert and slate--materials that normally occur in the till deposits and materials that can not be considered to be significant.

Based upon these results we see no reason that the project should not proceed as planned and we see no need for any additional archaeological survey or testing. However, we must stress that we do not make these decisions. This preliminary letter report should not be considered to be permission to proceed with the work within or outside of the boundaries of the proposed construction zone. It contains professional opinions on cultural resources only and should be submitted to the appropriate review agencies (SHP0, MHS, SA0,) for their comments prior to the commencement of any ground disturbing activities.

The final report containing all of the relevant data will be submitted to the SHP0, SA0, Houston Engineering, Inc. and the Sand

Hills Watershed District within 60 working days of this date.

Sincerely
Gordon A. Lothson
Archaeologist / Director

COUGAR CONSULTING

cc: Mr. Ted Loftstrom, SHPO
Ms. Christy Caine, SAO



MINNESOTA HISTORICAL SOCIETY

FOUNDED IN 1849

Fort Snelling History Center, St. Paul, MN 55111 • (612) 726-1171

December 2, 1986

Mr. Lawrence H. Woodbury
Houston Engineering
2505 North University Drive
P. O. Box 5054
Fargo, North Dakota 58105

Dear Mr. Woodbury:

Re: Winger Dam and Reservoir, Sand Hill River Watershed District
Winger, Polk County
MHS Referral File Number: Z-183

Thank you for the copy of the above referenced report. No archaeological sites were located that were found to be eligible for inclusion on the National Register. Consequently, there are no sites of historic, architectural, cultural, engineering, nor archaeological significance in the area which are on the National Register, nor eligible for inclusion on the National Register, and, therefore, none which may be affected by your proposal.

Thank you for your participation in this important effort to identify and preserve Minnesota's cultural resources.

Sincerely,

Russell W. Fridley
State Historic Preservation Officer

RWF:dmb

cc: Gordon Lothson, Cougar Consulting
606 East Cook Avenue, St. Paul 55101

APPENDIX E

TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION AND SILTATION CONTROL PLANS Sand Hill River Watershed District Suggested Specifications

4.11.01 SCOPE

This section of the specifications covers the work related to furnishing all plant, labor, equipment, appliances, and materials, and in performing all operations in connection with temporary air and water pollution, soil erosion, and siltation control which will be required in the construction of the project.

This item shall consist of temporary control measures as shown on the plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, temporary plant site, and haul roads.

4.11.02 MATERIALS

- a. Grass. Grass which will not complete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.
- b. Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.
- c. Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.
- d. Slope Drains. Slope drains may be constructed of pipe, fiber mats, rubble, portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.
- e. Other. All materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

4.11.03 CONSTRUCTION REQUIREMENTS

- a. General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The engineer shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

- b. Schedule. Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.
- c. Authority of Engineer. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.
- d. Construction Details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

The Engineer will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitation make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Engineer, such work shall be performed by the Contractor at his/her own expense.

The Engineer may increase or decrease the area of erodible material to be exposed at one time as determined by analysis of project conditions.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

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

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

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

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

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

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

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

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

1. Primary safeguards such as drop cloths, curtains, or similar devices, together with adequate structural support such as scaffolding or rope nets, shall be utilized to contain waste materials in the work area. Catchment systems shall be emptied as often as necessary to maintain their functional integrity.
2. Safeguards such as floating booms, mats of absorbent material, or similar systems shall be employed on streams wherever and whenever necessary to avoid nuisance conditions in the stream caused by cleaning or painting operations.
3. Cleaning and painting operations shall be suspended during periods when unfavorable weather conditions, such as high winds, reduce the effectiveness of the above noted safeguards.

4. Cleaning and painting materials shall be contained in locked storage to prevent access by vandals.
5. In situations where use of some of the safeguards listed are not feasible, other innovative safeguards shall be employed. Emphasis shall be placed on containment of waste materials rather than placing reliance on safeguards such as booms, straw dams, or absorbent mats. These shall be considered backup systems to guard against water pollution which may result from the failure of primary safeguards.

4.11.04 MEASUREMENT AND PAYMENT

- a. All measurements and payment will be based on completed and accepted work. The payments listed below shall be full compensation for all plant, labor, materials, equipment, tools, and incidental items necessary to complete the work.
 1. Temporary seeding, mulching, slope drains, benches, dikes, dams, sediment basins, and fertilizing will not be measured for separate payment but shall be considered a subsidiary item to "Embankment (Clay Fill)".

WATER CONTROL

Sand Hill River Watershed District Suggested Specifications

4.2.01 SCOPE

The work covered by this section of the specifications consists of furnishing all plant, equipment, labor, and materials, and performing all operations in connection with stream diversion and foundation dewatering necessary to proceed with the flood detention structure construction.

4.2.02 GENERAL

The Contractor shall construct and maintain all necessary cofferdams, channels, flumes, drains, sumps, casings, wellpoints, and/or other temporary diversion, dewatering and protective works; shall furnish all materials required therefore, and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work. Unless otherwise specified, a diversion must discharge into the same natural drainageway in which its headworks are located. Foundations, cutoff trenches and other parts of the construction site shall be continuously dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. After having served their purpose, all cofferdams, casings, wellpoints, or other protective works shall be removed or leveled to the satisfaction of the Engineer.

Dam sites overlay an artesian water source sealed off by a clay till layer as shown on the soils logs in Part 5 of these specifications. Should the clay layer be ruptured in any manner during the construction operation, the Contractor will be required to repair the rupture at his own expense and the repair procedure will be subject to the approval of the Engineer.

The Contractor shall be responsible for and shall repair at his expense any damage to the foundations, structure, or any other part of the work caused by floods, water, or failure of any part of the diversion or protective works.

4.2.03 PLAN FOR DIVERSION AND CARE OF STREAM DURING CONSTRUCTION

The Contractor's plan for the diversion and care of the stream during construction shall be subject to approval. The plan may be placed in operation upon approval, but nothing in this section shall relieve the Contractor from full responsibility for adequacy of the diversion and protective works. The plan shall be submitted to the Engineer at least three weeks prior to planned date of diversion.

4.2.04 MEASUREMENT AND PAYMENT

- a. General: All measurements and payments will be based on completed and accepted work. The payments listed below shall be full compensation for all plant, labor, materials, equipment, tools, and incidental items necessary to complete the work.
 - 1. Water control (including installation and removal of all cofferdams, dikes, channels, flumes, casings, well points or other diversion and dewatering works as may be required for the job) will not be measured for separate payment but shall be considered a subsidiary item to "Embankment (Clay Fill)".

Circular 39 Definitions

Type 1 Wetland - The soil is covered with water, or is waterlogged, during variable seasonal periods but usually is well drained during much of the growing season. Plant species potentially present are smart weeds, wild millet, fall panicum, tealgrass, ragweed, and cocklebur.

1L - These are floodplain hardwoods which are seasonally inundated during periods of high water. Wetlands of this type offer considerably greater wildlife habitat than do other Type 1 wetlands.

Type 2 Wetlands - Inland fresh meadows. The soil is usually without standing water during most of the growing season but is waterlogged within at least a few inches of its surface. Vegetation includes grasses, sedges, rushes, and various broad-leafed plants. Representative plants include carex, rushes, red top, reed grasses, mannagrasses, prairie cord grass, and mints. These meadows may border shallow marshes on the landward side. These are utilized by waterfowl primarily for supplemental feeding areas.

Type 3 Wetlands - Inland shallow fresh marshes. The soil is usually waterlogged during the growing season; often it is covered with as much as six inches or more of water. Vegetation includes grasses, bulrushes, spike rushes, and various other marsh plants such as cattails, arrowheads, pickerel weed, and smartweeds. Common representatives include reed, white top, rice cutgrass, carex, and giant bur reed. These marshes may border deeper marshes on the landward side. Marshes of this type are used extensively as nesting and feeding habitat. In combination with deep fresh marshes (Type 4), they constitute the principal production areas for waterfowl.

Type 4 Wetlands - Inland deep fresh marshes. The soil is covered with six inches to three feet or more of water during the growing season. Vegetation includes cattails, reeds, bulrushes, spikerushes, and wild rice. In open areas, pondweeds, naiads, coontail, water milfoils, waterweeds, duck weeds, water lilies, or spatter docks may occur. Deep fresh marshes constitute the best breeding habitat in the country, and they are also important feeding places.

Type 5 Wetlands - Inland fresh open water. Water is usually less than ten feet deep and is fringed by a border of emergent vegetation. Vegetation (mainly at water depths of less than six feet) includes pond weeds, naiads, wild celery, coontail, water milfoils, muskgrasses, water lilies, and spatterdocks. These are used extensively as brood habitat areas when, in midsummer and late summer, the less permanent marshes begin to dry out.

Type 6 Wetlands - Shrub-Swamps. The soil is usually water logged during the growing season and is often covered with as much as six inches of water. Vegetation includes alders, willows, dogwoods, and swamp-privet. Shrub swamps occur mostly along sluggish streams and occasionally on floodplains. They are used to a limited extent for nesting and feeding.

FIGURE 3 - 4
SAND HILL RIVER WATERSHED DISTRICT PROJECT NO. 4 - THE WINGER DAM
HABITAT EVALUATION PROCEDURES (HEP) STUDY AREA AND BASELINE COVER TYPES

