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ENVIRONMENTAL IMPACT STATEMENT. FLOOD CONTROL, BURLINGTON DAM, --ETC(U)
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SUPPLEMENTARY NOTES

See also Final EIS, January 1978; Draft EIS, October 1977.

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

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Environmental impact statements
Environmental assessment
Burlington Dam
Souris River

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

Because of extensive modifications to the proposed project, the EIS for Burlington Dam of January 1975 was updated by one dated January 1978. This EIS proposed a dam near Burlington, a raise of Lake Darling Dam, a diversion tunnel, and downstream levee improvements. This supplement includes a biological assessment which addresses the impacts of all currently listed threatened or endangered species and an evaluation of the fill activities associated with the proposal and its alternatives.

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Souris Riv
Burlington Dam

(1)

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

REPLY TO
ATTENTION OF:

NCSED-ER

31 December 1979

The draft supplement to the environmental impact statement (EIS) for Flood Control, Burlington Dam, Souris River, North Dakota is inclosed.

In compliance with the requirements of the National Environmental Policy Act of 1969, a draft revised EIS was furnished to the public in February 1974. A final updated EIS was distributed in January 1975. However, because of extensive modifications to the proposed project, it was deemed necessary to reconsider the environmental, economic, and social impacts of the project. A new draft EIS addressing these impacts was circulated to Federal, State, and local interests in October 1977. After consideration of comments on the draft EIS, a final EIS was prepared. This document is currently undergoing an agency review at the Washington level; when this review has been completed and the document is approved for release, the final EIS will be distributed for public review.

A Notice of Intent for the accompanying supplement was published in the 13 June 1979 Federal Register. A Revised Notice of Intent appeared in the 14 September 1979 Federal Register to reflect a change in the scheduled publication date.

This supplement has been prepared to fulfill requirements which were established subsequent to preparation of the final EIS: (1) the Endangered Species Act of 1973, as amended, and (2) Section 404(b) of the Clean Water Act of 1977 and applicable Corps of Engineers regulations and guidance. The supplement itself consists of two parts: (1) a biological assessment which addresses the impacts on all currently listed threatened or endangered species and (2) a Section 404(b)(1) evaluation of the fill activities associated with the proposal and its alternatives.

NCSED-ER 31 December 1979

This draft supplement is being forwarded to the Environmental Protection Agency. A public notice of availability should be published in the Federal Register within 1 to 2 weeks. An official 45-day review period will commence when this public notice appears. If you wish to have your comments incorporated in the final supplement, please forward them prior to the end of this 45-day review period. All letters should be addressed to the District Engineer, St. Paul District, Corps of Engineers, 1135 U.S. Post Office and Custom House, St. Paul, Minnesota 55101.

Sincerely,

WILLIAM W. BADGER
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

DRAFT SUPPLEMENT
ENVIRONMENTAL IMPACT STATEMENT
FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER, NORTH DAKOTA

BIOLOGICAL ASSESSMENT

AND

SECTION 404(b) EVALUATION

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

December 1979

BIOLOGICAL ASSESSMENT

BURLINGTON DAM FLOOD CONTROL PROJECT

1.00 PROJECT LOCATION AND DESCRIPTION

1.01 The proposed plan for flood damage reduction on the Souris River includes a dam near Burlington, North Dakota, on the Souris River; a raise of Lake Darling Dam; a diversion tunnel to carry flood flows on the Des Lacs River to the Souris River above Burlington Dam; and downstream channel works consisting of levee improvements in developed subdivision areas between Burlington and Minot, North Dakota, and levee improvements at the communities of Sawyer, North Dakota, and Velva, North Dakota (see Plates 1 and 2). The plan also includes raising the McKinney Cemetery headstones and fence in place; acquiring and removing damageable property in Renville County Park; modifications to water control structures in the Upper Souris and the J. Clark Salyer National Wildlife Refuges; and acquisition in fee title and management of suitable lands to compensate for adverse effects to wildlife habitat caused by the reservoir. The purpose of the proposed plan is to provide protection for floodplain residents, in particular at Minot and adjacent suburban areas, from floods originating from the Souris River, the Des Lacs River, and local coulees upstream from Minot. There are no provisions for a permanent conservation pool behind the dam. The reservoir would be used only for the temporary impoundment of floodwater when flows in excess of 5,000 cfs threaten Minot. The diversion tunnel would protect Minot against infrequently occurring Des Lacs River floods, and the downstream channel works would increase flood protection from the local uncontrolled drainage area and would also serve to facilitate operation and drawdown of the reservoir.

2.00 IMPACTS ON THREATENED OR ENDANGERED SPECIES

2.01 Coordination with the U.S. Fish and Wildlife Service, Region 6 (see Exhibit 1), has indicated that there are three listed species and one proposed species which might be present in the project area. The three species which are classified as endangered are the whooping crane (*Grus americana*), bald eagle (*Haliaeetus leucocephalus*), and the peregrine falcon (*Falco peregrinus*). The proposed listed species is the Dakota skipper (*Hesperia dacotae*). No known species of plants which are listed as threatened or endangered are found within the project area. See also Federal Register, Volume 44, No. 12 - Wednesday, January 17, 1979.

2.02 The peregrine falcon has not been recorded as breeding in North Dakota since 1960 (Stewart, 1975). The only specimens that would be encountered would be seasonal migrants, during the fall and spring. No part of the project area is currently classified or proposed as critical habitat for this species. It is therefore unlikely that the construction or operation of the proposed project would have a negative impact on this species.

2.03 There is one known active bald eagle nest in the State of North Dakota. This site was observed by E. Bry in 1975 and documented in Stewart (1975). It is located along the Missouri River in McLean County. A large number of bald eagles migrate through the project area during the fall and spring, particularly through the J. Clark Salyer National Wildlife Refuge. No part of the project area is currently classified or proposed as critical habitat for this species. It is unlikely that the construction or operation of the proposed project would have a negative impact on this species.

2.04 Breeding populations of the whooping crane were extirpated from North Dakota during the period from 1880 to 1920 (Stewart 1975). Currently, a wild population migrates annually, from September to early December, to their wintering grounds on or near Aransas National Wildlife Refuge, Texas (Federal Register, Vol. 43, No. 160 - August 17, 1978). During April and May the flock migrates northward along the same route toward the only known nesting area in the wild, which is Wood Buffalo National Park, Northwest Territories, Canada.

2.05 Based on a review of confirmed sightings of whooping cranes (listed on file at the St. Paul District Office) and the 17 August 1978 Federal Register, it appears that the Burlington Dam project area is on the eastern third of what could be termed the primary migrational route.

2.06 Preliminary studies conducted by Johnson (personal communication, 1979)[1/] indicate that whooping cranes require three basic types of habitat during migration: feeding, loafing, and roosting habitat.

2.07 Whooping cranes appear to utilize a wide variety of habitats in obtaining their nutritional requirements. They have been observed feeding in cereal grains during various stages of plant growth. They have also been observed feeding in summer fallow fields, tame pastures, alfalfa fields, wet meadows, shallow braided rivers, mudflats in lakes and reservoirs, alkali lakes, and shallow freshwater marshes (Types 1, 2, 3, and 4).

2.08 Availability of suitable roosting habitat during migration is critical to the survival of the remaining whooping cranes. They fly during daylight hours and require a place to stop and rest each evening. A roosting site must be relatively isolated and safe from predators. Almost without exception, whooping cranes utilize surface water in some form as their roost site. Sandbars in shallow, slow-moving rivers, shallow freshwater lakes, mudflats in artificial reservoirs, stockponds, and freshwater wetlands are all used as roosting sites. Most roosting sites can be characterized as having shallow surface water (less than 18 inches deep and greater than 2 inches deep), good lateral visibility (unobstructed view at ground level of at least 75 yards), good vertical visibility (no overhanging vegetation, tall trees, or high banks), a gradual shoreline slope, and little or no emergent vegetation.

1/ The following requirements should be considered preliminary and subject to revision after further studies are completed (Johnson, 1979).

2.09 Loafing activity is generally associated with those areas which meet the criteria as roosting or feeding areas.

2.10 Comments on previous project documents have expressed concern about the effects that the Tolley Flats drainage project would have on the operation of Lake Darling (with or without Burlington). In addition, concerns were expressed about the construction of Burlington Dam and its effect on the feasibility of the Tolley Flats drainage project. These comments are of significance because of sightings of migrating whooping cranes in the Tolley Flats area. The Tolley Flats area of Ward and Renville Counties is part of a 200-square-mile upland region between the Des Lacs and Souris Rivers. This area has no natural outlet. A proposed North Dakota State Water Commission project involves the construction of 11.8 miles of channel and a small dam on Mackobee Coulee to trap sediment and regulate flows into Lake Darling.

2.11 Any drainage plan in the Upper Souris River basin would most likely be designed for a flow well below 5,000 cfs. Since the Burlington Reservoir would not begin storing water until the flow at Minot reaches 5,000 cfs, the reservoir's presence should have no bearing on whether a drainage proposal should or should not be implemented. The primary obstacle to the Tolley Flats project is the lack of financial capability. Construction of Burlington Dam would not alter this obstacle.

2.12 The following projected impacts are based upon the available information concerning the whooping crane's migrating requirements. Ongoing studies by the U.S. Department of the Interior should help define critical habitat and potential impacts on the species.

2.13 Construction activity and related noise during the spring and fall could affect the behavior of cranes moving through the area. This could cause them to alter their flight patterns, and not use the area for roosting.

2.14 Any agricultural lands which are inundated during the migration season would be unavailable as potential feeding areas. This impact should be of little consequence because of the vast potential feeding areas which would still be in close proximity to roosting sites.

2.15 The impact of a sustained 500 cfs discharge on downstream wetlands (as whooping crane roosting habitat) is indeterminate. Until whooping crane use within the Souris River basin can be described, the exact extent of all project-related impacts will remain unknown. However, considering the fact that the project area is on the eastern third of their migratory corridor, the impacts may be significant.

2.16 During the years that water is impounded between Burlington Dam and Lake Darling, this area would be unavailable as suitable roosting habitat. Although cranes have been sighted in this area (primarily feeding in farm fields), it appears to have less significance as a migratory stop-over than the area in and around the Des Lacs National Wildlife Refuge.

2.17 The Dakota skipper is proposed for listing as a threatened species in the State of North Dakota (see Federal Register, Volume 43, No. 128 - Monday, July 3, 1978 and Exhibit 1). The habitat of the Dakota skipper is both high, dry, virgin prairie and low, moist, virgin prairie (McCabe, 1977). Three populations of the species in the Souris River basin were identified by McCabe in the summer of 1979 (list on file at the U.S. Army Corps of Engineers, St. Paul District Office). All three sites are far enough removed from from the Souris River so that vegetative changes (due to impounding water or sustained discharges) should not occur as a result of construction and operation of the project.

3.00 ESTIMATED DATES OF INITIATION AND COMPLETION OF CONSTRUCTION

3.01 Construction is scheduled for the 1981 through 1985 construction seasons.

4.00 COORDINATION WITH THE U.S. FISH AND WILDLIFE SERVICE

4.01 On 17 October 1979, a preliminary version of this biological assessment was sent to the U.S. Fish and Wildlife Service in Denver, Colorado (Region 6). Based on their review of that assessment, it was determined that the proposed project may affect the whooping crane (Grus americana) as a listed species present in the project area. Therefore, on 5 November 1979, the St. Paul District, Corps of Engineers, requested that consultation be initiated with the U.S. Fish and Wildlife Service (as outlined in Section 7 of the Endangered Species Act of 1973, as amended) on the Burlington Dam Flood Control Project. On 15 November 1979, the Regional Office of the U.S. Fish and Wildlife Service acknowledged this request and stated that their biological opinion on the Burlington Dam Flood Control Project would be sent no later than 15 February 1979 (see Exhibit 2).

REFERENCES CITED

Johnson, Kurt, 1979. Unpublished Data, Personal Communication, Department of Wildlife Ecology, University of Wisconsin, Madison, Wisconsin.

McCabe, T.L. and R.L. Post, 1977. Skippers of North Dakota. Department of Entomology, Agricultural Experiment Station, North Dakota State University.

McCabe, T.L., 1979. Unpublished Data, Personal Communication, Curator of the Insects, New York State Museum, Albany, New York.

Stewart, Robert E., 1975. Breeding Birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, North Dakota.

United States Department of the Interior
FISH AND WILDLIFE SERVICE

MAILING ADDRESS
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO
FA/SE/COE--Souris & Sheyenne
Rivers & Enderlin

MAR 26 1979

Mr. Roger G. Fast
Chief, Engineering Division
Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Mr. Fast:

The following listed and proposed species may be in the project areas mentioned in your letter of March 12, 1979:

1. Souris River and Tributaries, North Dakota
   Listed: whooping crane, peregrine falcon, and bald eagle
   Proposed: Dakota skipper

2. Sheyenne River, North Dakota
   Listed: bald eagle and peregrine falcon
   Proposed: Dakota skipper

3. Enderlin, North Dakota
   Listed: bald eagle and peregrine falcon
   Proposed: Dakota skipper

Please refer to our memorandum of February 21, 1979, describing the next step in the consultation process.

Sincerely yours,

James C. Gritman

JAMES C. GRITMAN
Acting Regional Director

Exhibit 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

IN REPLY REFER TO
FA/SE/COE--Burlington Dam Flood
Control Project (6-2-80-F-47)

NOV 15 1979

Mr. Roger G. Fast
Chief, Engineering Division
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Mr. Fast:

This is to acknowledge your November 5, 1979, request for initiation of the consultation process under Section 7 of the Endangered Species Act. We will send you our biological opinion on the Burlington Dam Flood Control Project as soon as possible, but no later than February 15, 1979.

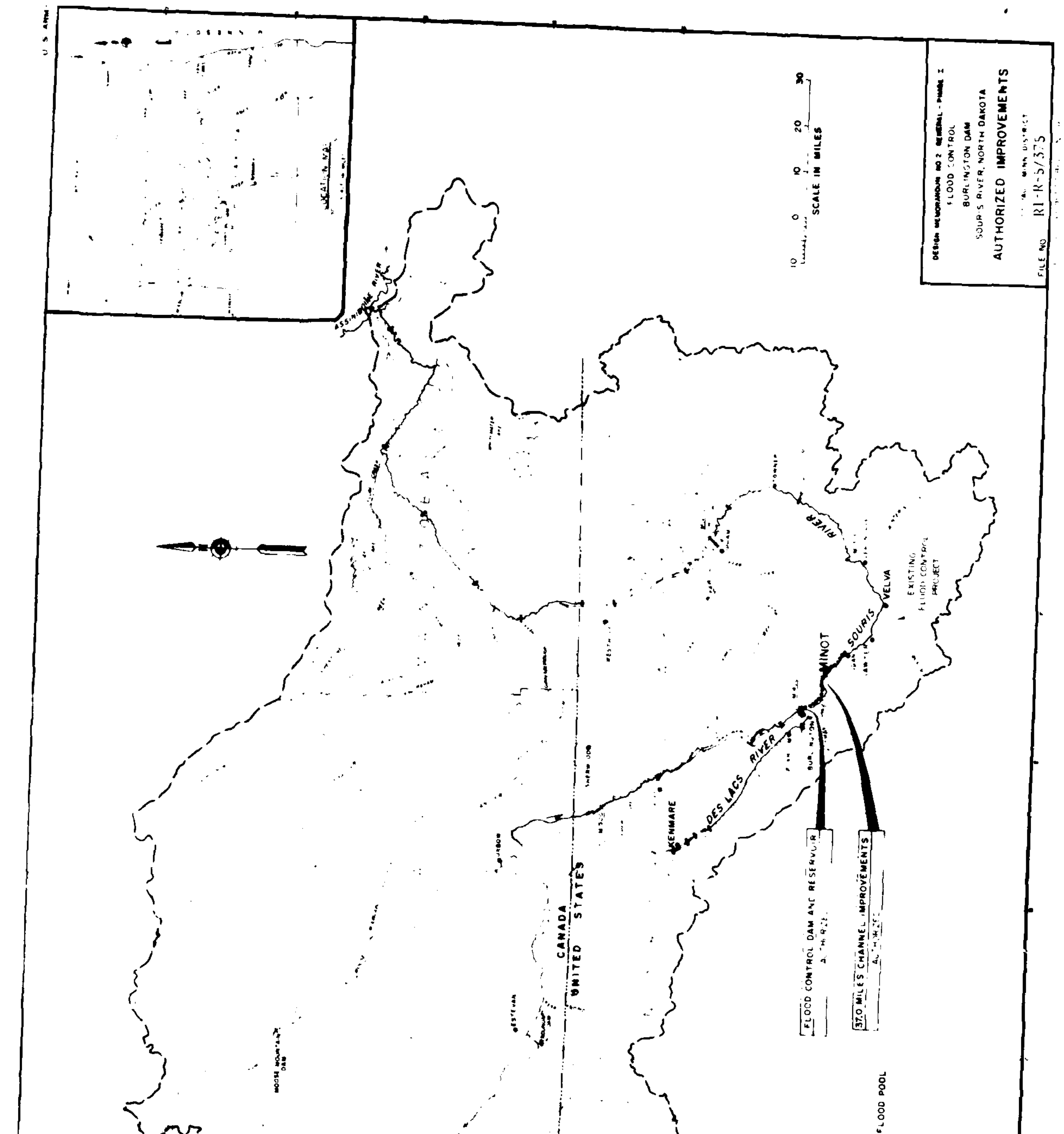
Sincerely yours,

Marvin P. Duncan
Acting Regional Director

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

Exhibit 2



DESIGN MEMORANDUM NO 2 GENERAL - PHASE I
FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER, NORTH DAKOTA
AUTHORIZED IMPROVEMENTS
FILE NO RI-R-5/375
SCALE IN MILES
10 0 10 20 30
ASSINIBOINE RIVER
SOURIS RIVER
MINOT
VELVA
EXISTING FLOOD CONTROL PROJECT
DES LACS RIVER
KENMARE
CANADA
UNITED STATES
FLOOD CONTROL DAM AND RESERVOIR
37.0 MILES CHANNEL IMPROVEMENTS
LEGEND
RIVER BASIN BOUNDARY
INTERNATIONAL BOUNDARY
STATE OR PROVINCE BOUNDARY
AUTHORIZED CHANNEL IMPROVEMENTS
OUTLINE FOR AUTHORIZED RESERVOIR FLOOD POOL
MILES ABOVE MOUTH
EXISTING DAM
AUTHORIZED DAM SITE

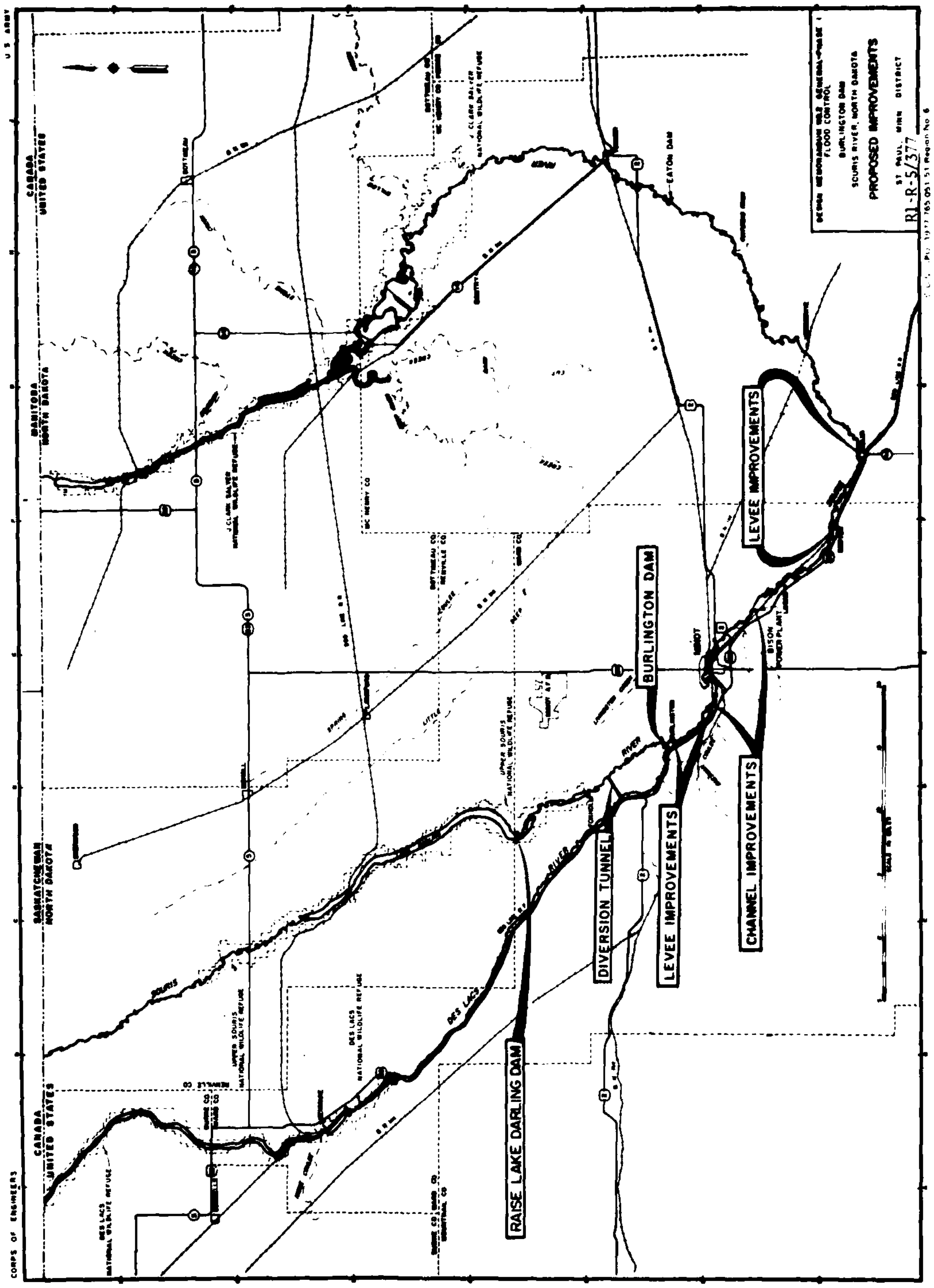

RAISE LAKE DARLING DAM
DIVERSION TUNNEL
LEVEE IMPROVEMENTS
CHANNEL IMPROVEMENTS
BURLINGTON DAM
LEVEE IMPROVEMENTS
PROPOSED IMPROVEMENTS
CANADA
UNITED STATES
SASKATCHEWAN
NORTH DAKOTA
MANITOBA
NORTH DAKOTA
DES LACS
SOURIS
RIVER
CORPS OF ENGINEERS
U.S. ARMY

Plate 2

SECTION 404(b) EVALUATION
FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER, NORTH DAKOTA

The following is an evaluation of the proposed construction and fill activity in accordance with the requirements of Section 404 of the Clean Water Act of 1977.

1. <u>PROJECT DESCRIPTION</u>

The project for flood damage reduction on the Souris River, North Dakota, recommended by the Chief of Engineers in House Document No. 321, 91st Congress, 2nd session, provides for two major structural measures: channel modification through Minot, North Dakota, and upstream reservoir development. The channel modification in Minot was approved by Senate and House Public Works Committees' resolutions adopted 25 June and 14 July 1970, respectively. The reservoir and related works were authorized later in the Flood Control Act approved 31 December 1970, Public Law 91-611. Construction of the Minot channel modification, which has been completed, was authorized separately to provide limited flood protection for the city at the earliest possible date.

The project features considered in this report are those recommended in the Phase II General Design Memorandum, dated August 1978, as modified by subsequent comments by reviewing authorities. The principal features of the project, as shown in Figures 1 and 2, include an earth fill dam near Burlington on the Souris River, a raise of the Lake Darling Dam, a diversion tunnel to carry flood flows on the Des Lacs River to the Souris River above Burlington Dam, levee improvements between Burlington and Minot and at Sawyer and Velva, and modifications to refuge dams in the Upper Souris and J. Clark Salyer National Wildlife Refuge.

The features of the proposed Burlington Dam are shown in Figure 3. Located 1½ miles northwest of Burlington on the Souris River, the earth fill dam would have a maximum height of 75 feet above the streambed, a crest length of 3,685 feet, and a top width of 38 feet. The embankment of the dam would consist of a central section primarily of compacted earth fill with 1 vertical on 4.5 horizontal upstream side slopes and 1 vertical on 3 horizontal downstream side slopes. Uncompacted earth berms would be provided both upstream and downstream of the central section to insure stability of relatively weak clay soils in the foundation of the dam. The upstream face of the compacted embankment would be protected against wave action and erosion with a layer of riprap on a filter blanket. Topsoil with grass cover would be provided to protect remaining embankment surfaces from erosion. The spillway would consist of three tainter gates 43 feet wide by 21 feet high with a crest elevation 30 feet below the top of the embankment and a reinforced-concrete stilling basin for control of large floods exceeding the reservoir design flood.

The low-flow outlet works for the reservoir would consist of three rectangular, concrete, gate-controlled conduits 11.25 feet wide and 15.0 feet high; an intake structure with slide-gate controlled portals; and a flared stilling basin at the conduit outlet.

The raise of Lake Darling Dam shown on Figure 4 is an integral part of the Burlington Reservoir flood control storage plan. The Lake Darling Dam would be raised 4 feet, and the slopes flattened and riprapped to insure stability. The low-flow conduit and gate would be removed and a new structure capable of passing 2,500 cfs placed at the left abutment. The outlet works would consist of a two-barrel rectangular conduit 8.5 feet wide by 11.0 feet high, controlled by slide gates. The spillway would be located riverward of the outlet works in approximately the same location as the existing spillway. The ogee section of the spillway would be controlled by three tainter gates 24 feet wide by 22 feet high, and its crest would be 26 feet below the top of the embankment.

To provide the Minot area with a greater degree of protection from the Des Lacs River than afforded by the channel improvement project, the plan includes diversion of the Des Lacs River via a tunnel outletting behind the proposed Burlington Dam. The diversion dam and tunnel portal would be located on the Des Lacs River, about 8 valley miles northwest of Burlington and the tunnel outlet structure and channel would be located on the Souris River Valley about 7 valley miles northwest of Burlington. The general location and features of the diversion tunnel and related works are shown on Figure 5. The diversion facilities would include a small earth dam about 1,800 feet long and an average of 6 feet high, designed as an overflow structure with a concrete crest. The ungated conduit through the dam is designed to pass 4,000 cfs (cubic feet per second). An inlet channel and an uncontrolled concrete weir structure are located at the portal of the tunnel. The tunnel would be concrete-lined with an inside diameter of about 22 feet and a total length of 5,360 feet. A concrete chute energy dissipator and channel would be provided at the outlet end of the tunnel.

In the Burlington to Minot reach, 5.4 miles of levees in six intermittent levee systems would be upgraded to meet current engineering standards for foundation stability and interior drainage. The emergency levees will be realigned and regraded as necessary to pass a flow of 5,000 cfs plus up to 3 feet of freeboard. In places where the levees are constructed between the channel and adjacent development, the channel would be realigned to permit proper design of levee slopes. Riprapping would be included where necessary to prevent erosion of the channel and the riverward slope of the levees. The permanent plan of protection also includes the provision of six pumping stations, ponding areas, and interceptor ditches and conduits, as necessary. Levee construction at Sawyer and Velva would be similar to that in the Burlington to Minot reach except that the levees in these two communities will be upgraded to pass a flow of 8,000 cfs including 5,000 cfs from the dam and a local inflow allowance of 3,000 cfs. The levee protection at Velva includes the construction of a channel cutoff and realignment of the existing levee. The urban protection reaches are shown on Figure 6.

Refuge dams 96, 87, and 41 in the Upper Souris Refuge, and 320, 326, 332, 341, and 357 in the J. Clark Salyer Refuge, as shown on Figures 7 and 8, respectively, would be modified to insure their continued functioning and manageability with Burlington Dam in place. Work on the three refuge dams would include modification of embankments, spillways, and outlet works. The embankments would be constructed to present elevations and be stabilized as necessary to withstand prolonged periods of inundation. Deteriorated concrete in the gated outlet structures and the overflow spillways would be removed and replaced. Gates would be replaced, and electric hoists and heaters would be installed on the gates. Dams 332, 341, and 357 in the J. Clark Salyer Refuge would be raised 2.0, 3.6, and 4.1 feet, respectively, to prevent overtopping from the 100-year flood. Several service roads and dikes for ponds below the Lake Darling Dam would be modified to assure continued functioning. A carp control structure is recommended to be constructed at Dam 357 of the J. Clark Salyer Refuge to assure that the United States portion of the Souris River remains carp-free.

Construction of the proposed Burlington Dam and flood storage up to design pool elevation 1620.0 would periodically inundate several roads, utilities, a railroad, and a cemetery. State Highway 5, the major traffic carrier across the valley, would be raised to a level 5 feet above the reservoir design pool elevation. The proposed highway raise would require a new bridge with a river diversion channel at the west side of the valley. The plan also provides for raising State Highway 28, Grano Crossing, and Renville County Road 9 to a level 5 feet above pre-project grades. The Soo Line Railroad crossing would be raised to 6 feet above pre-project grade. McKinney Cemetery, located 1/4 mile south of State Highway 5 on the west edge of the river valley, contains about 250 graves within a 4.3-acre site. The cemetery would be inundated by flood storage up to the reservoir design pool elevation 1620. Due to objections by local interests to relocation of the cemetery, an alternative of approximately equal cost is proposed. The plan involves placing fill over the cemetery area to the design pool elevation. Grave markers would be relocated directly above their present location. The average depth of fill would be approximately 12 feet. An alternative of protecting the cemetery with a levee is also being considered.

a. Description of the Proposed Discharge of Dredged or Fill Materials

(1) General Characteristics, Source and Quantity of Material - Earth fill for construction of the Burlington Dam and the raise of Lake Darling would be obtained from excavation in the sides of the valley near the sites of the structures. The fill would consist of sand and silt from glacial sediments and clay, silt, and sand from the Tongue River formation. For the Soo Line Railroad and State Highway 28 raises the pervious (water permeable) material required for that portion of the fill beneath the surface of Lake Darling would be obtained from sand and gravel deposits on the adjacent bank near the crossings. Random fill (all usable earthen materials not

specifically designated for zones in the structure) for the balance of the embankments would be obtained from required channel excavation and from glacial till at the ends of the crossings. Glacial till in the Souris Basin is composed of clay, silt, sand, and gravel. The random fill required for other road raises and the cemetery raise would be obtained from required channel excavation and from glacial till in the valley walls near the sites of construction. All disturbed areas not covered with riprap or pavement would be seeded for the establishment of a grass cover. Riprap and granular bedding material for erosion protection would be obtained from scattered piles of stone in fields near the project and from local gravel pits. Much of the earth required for construction of levees in urban areas is available in the existing emergency levees. Where required, levee borrow would be obtained from glacial till deposits at either side of the valley.

Concrete aggregate of acceptable quality can be produced locally from gravel pits in glacial terrace deposits along the Souris and Des Lacs Rivers. The material must, however, be carefully processed to remove iron-oxide concentrations and shale, which can reduce structural soundness.

Riprap and bedding are available locally. Riprap must be obtained from fieldstone piles of glacial boulders located within a radius of 15 miles from the project and from oversized material screened from gravel production. If the supply of boulders in the area is consumed, riprap would have to be shipped in from outside the area. The closest reliable source of quarried stone is Ortonville, Minnesota, a distance of 400 miles. Bedding material can be produced from local gravel pits.

A total of 3,300,000 cubic yards of embankment fill and berm fill would be required to construct the Burlington Dam as presently designed. The required excavation for the spillway and outlet works approximately equals amount of fill in the dam. Therefore, little if any borrow excavation would be required. Approximately 40,000 cubic yards of riprap and 50,000 cubic yards of concrete would be required for the dam.

The Des Lacs Diversion Dam requires about 20,000 cubic yards of glacial till which would be obtained from the tunnel excavation and about 350 cubic yards of concrete for the crest and outlet works of the dam. Some 1,240 cubic yards of rock would be placed in gabions on the downstream slope of the dam and about 2,100 cubic yards of riprap would be needed. Required fill quantities for the Lake Darling Dam raise and modification include 48,000 cubic yards of backfill, 133,000 cubic yards of random fill, and 174,000 cubic yards of impervious fill, totaling 355,000 cubic yards of mainly glacial till and Tongue River materials. About 20,000 cubic yards of this same type of fill would be used to upgrade the levees of three refuge ponds below the Lake Darling Dam. Approximately 420,000 cubic yards of common excavation would be taken from the spillway and outlet area to provide sufficient quantities of fill material in the Lake Darling Dam area. In addition, an estimated 16,000 cubic yards of concrete would be needed to complete dam modifications, and about 20,000 cubic yards of riprap would be needed for both faces of the dam embankment.

The Soo Line Railroad raise would entail about 164,000 cubic yards of pervious sand and gravel fill, and 153,000 cubic yards of random fill consisting of glacial till to complete both the detour and the main embankment. Almost 290,000 cubic yards of excavation would be required to alter the location of the river channel. Some of this material may be used in the railroad embankment. About 24,000 cubic yards of riprap would be needed.

A total of 300,000 cubic yards of random fill is required to construct the embankment for the State Highway 5 road raise to elevation 1626. Riprap needed would be about 31,000 cubic yards.

Road raises of State Highway 28, Grano Crossing (FAS 3828), and Renville County Road 9 (FAS 3809) have been grouped together for discussion purposes since the raises would be relatively small and embankment designs would be similar. Renville County Road 9 (old FAS 729) and State Highway 28 are north-south roads that cross the Souris River Valley 3 miles north of State Highway 5 and 1 mile north of the Soo Line crossing, respectively. Grano Crossing (old FAS 471) is an east-west road that crosses the Souris River Valley 2½ miles south of the Soo Line crossing. All three roads would be raised to elevation 1610 to decrease the frequency of inundation. The maximum embankment raise would be about 5 feet for Renville County Road 9, 5 feet for State Highway 28, and about 9 feet for Grano Crossing. The centerlines of the raised embankments would coincide with the centerlines of the existing embankments to the maximum extent practical in order to minimize settlements and fill quantities.

The slopes of all road raises would be riprapped to provide protection from wave action. Fill for the embankments would be obtained from borrow areas since there would be no significant amount of required excavation at any of the three road raises. Random fill can be obtained from glacial till deposits at either end of all three road raises. Pervious fill would be required for that portion of the State Highway 28 and Grano Crossing embankments below elevation 1597 since these two roads cross Lake Darling. The pervious fill can be obtained from sand and gravel terrace deposits at the right abutment of both raises. A new bridge would be constructed to replace the existing bridge on State Highway 28. On Renville County Road 9 and Grano Crossing, the superstructures of the existing bridges would be raised to elevation 1610. An estimated 388,000 cubic yards of fill material and 81,000 cubic yards of riprap would be needed to complete these road raises.

The upgrading of Ward County Roads 17 and 10 to meet current standards for a Federal Aid Secondary Road would result in partial or total filling of the wetland areas adjacent to both sides of the road. This upgrading and widening of the right-of-way along 6 miles of County Road 17 from County 10 north to County Road 8 would require 156,000 cubic yards of excavation and subsequent regrading of the existing roadbed. Fourteen specific wetland sites were identified as being an integral component of the area's wetland complex. The loss of these wetlands would be minimized by excavating depressions in an amount equal to those filled (allowing future succession to wetland habitat), grading of the ditches in a manner to duplicate existing drainage patterns, and maintaining existing elevations on culvert inverts.

Upper Souris National Wildlife Refuge structures would be modified under the proposed plan. Dam 41 would require 15,000 cubic yards of fill and 4,000 cubic yards of riprap. Necessary riprap for Dam 87 would be 3,450 cubic yards and for Dam 96, 3,700 cubic yards. In addition to the 20,000 cubic yards of fill needed to upgrade Ponds A, B, and C, 6,500 cubic yards of riprap material would be needed for stabilization.

J. Clark Salyer National Wildlife Refuge structures would also be upgraded. Dam 320 would be riprapped with 20,000 cubic yards of material. Dam 326 would need 6,000 cubic yards of fill and 20,000 cubic yards of riprap. Dam 332 would require 18,000 cubic yards of fill and 12,000 cubic yards of riprap. Necessary materials for Dam 341 include 31,000 cubic yards of fill and 13,000 cubic yards of riprap. Dam 357 would need 34,000 cubic yards of fill and 10,000 cubic yards of riprap.

Levee work in the three main units - Burlington to Minot, Sawyer, and Velva - entails no raising, only shaping of existing levee structures. The Burlington to Minot levee unit would require about 9,000 cubic yards of riprap material. The Sawyer unit would need about 1,000 cubic yards of riprap About 1,500 cubic yards of riprap material would be necessary for the Velva unit.

b. Description of the Proposed Disposal Sites for Fill Material

(1) Location - The proposed project includes a dam near Burlington, North Dakota, on the Souris River, a raise of Lake Darling Dam, a diversion tunnel to carry flood flows on the Des Lacs River to the Souris River above Burlington Dam, levee upgrading between Burlington and Minot and at Sawyer and Velva, modifications to small dams in the Upper Souris and J. Clark Salyer National Wildlife Refuges (NWR), along with several project related road raises (see Figures 1-8).

(2) Type of disposal sites - Fill areas would be within the channel, adjacent wetland areas (see Table 1), and along the banks of the Souris River. The Des Lacs Diversion Dam would cross the Des Lacs River channel.

(3) Method of discharge - Fill would be placed with normal construction equipment such as bulldozers and cranes equipped with buckets.

(4) When will disposal occur? - Construction is scheduled for the 1981 through 1985 construction seasons.

(5) Projected life of the fill sites - The projected life of the project is 100 years.

(6) Bathymetry - Water depths in the Souris and Des Lacs Rivers would be unchanged by project structures during low flows. Depending on the flood control needs predicted for each season, the depth of Lake Darling could be decreased to elevation 1591 by drawdown and increased by maximum Burlington flood storage up to elevation 1620. At the Burlington Dam site the maximum depth changes could be about 65 feet between low flow discharge elevation and maximum flood pool elevation.

The maximum depth behind the Des Lacs Diversion Dam would be about 23 feet at an 8,500 cfs flow in the Des Lacs River, of which 4,500 cfs would be diverted into the tunnel and 4,000 cfs would pass down the river. When flows reach 1,400 cfs, diversion through the tunnel would begin with the effect of reducing depths below the diversion dam below those which would have occurred in this reach without project conditions.

2. PHYSICAL EFFECTS (40 CFR 230.4-1(a))

a. Potential Destruction of Wetlands - Effects on (40 CFR 230.4-1(a)(1)(i-vi))

(1) Foodchain production - During construction, increased turbidity, decreased water quality, covering by fill, and siltation could reduce foodchain production. A temporary decrease in light penetration could reduce aquatic plant photosynthesis. Invertebrates could be covered by fill and sediments, and the gills of fish and some invertebrates could be irritated by suspended particles, reducing their survival. These impacts would diminish after construction.

The long-term impacts to foodchain production in the affected wetlands would primarily be the result of flood storage and fluctuating water levels. Aquatic plants could be destroyed by inundation or exposure. Pre-flood drawdowns in Lake Darling could reduce dissolved oxygen and cause mortality in fish and invertebrate populations. Both mammal and avian populations (particularly waterfowl) could suffer decreased production through the loss of food and cover inundated by floodwaters.

(2) General habitat - Burlington Dam would inundate approximately 4,000 acres of natural and managed marsh for almost an entire growing season for a flood having a frequency of occurring once in 1500 years (i.e., a .07 percent chance flood)(see Table 3). Approximately 1,900 acres of the wetlands subjected to flood storage are between Lake Darling Dam and the Saskatchewan border.

Although wetlands are a semi-aquatic plant community and subject to less drastic changes than terrestrial communities, damage could be significant. In many areas floodwater storage would kill existing emergent and submergent, perennial and annual, rooted aquatic and wetland plants through reduced light transmission, removal of contact with air, etc. Recovery could take place over a few years, particularly in the managed marsh units on the Upper Souris NWR which could be drawn down to allow the germination of desirable perennial emergents. Whether such a program would be compatible with the existing program of marsh management through water level manipulation would depend upon the refuge program at the time. In general, there would likely be a conflict, since refuge pools are now in various states of flooding at any one time, whereas after project operation, all pools would be in the initial successional stage at the same time. In addition, the fringe of emergent vegetation around Lake Darling which is also an important marsh habitat would be subject to damage due to fluctuating water levels, increased depth and duration of flooding, and increased ice damage.

(3) Nesting, spawning, rearing, and resting sites for aquatic and land species - Project construction and operation would have two primary impacts on the functions of wetland ecosystems: water quality changes and water level fluctuations. Increases in water depth may convert areas of dense stands of emergent vegetation to sparse stands or areas of open water. Shallow marsh areas may be replaced by deep marsh zones with associated changes in vegetation. If nests were started prior to flood storage, they could be destroyed by inundation and wave action. Similar effects could also be experienced by downstream wetlands during years of sustained discharges from the Burlington Reservoir. Increased water levels would also reduce the flexibility of affected refuges to manipulate water levels in their impoundments to obtain desired management objectives. Depending on the refuge's desired management objectives and the degree to which increased flows hampered the obtainment of these objectives, productivity of desired species could be reduced through decreases in suitable habitat.

Water quality influences the suitability of nesting, spawning, and rearing habitats through the parameters of dissolved solids, turbidity and resultant siltation effects, dissolved oxygen, biochemical oxygen demand, temperature, pH, nutrients, and chemical contaminants. These parameters affect aquatic plants and invertebrates as well as fish. If project-induced changes in these parameters reduce populations of aquatic plants and invertebrates, or render former spawning areas unsuitable, wildlife and/or fish production could suffer (see Table 2).

A possible indirect effect of water level changes could be the introduction of carp into the Souris River above Wawanesa Dam. Carp introduction could have severe impacts on waterfowl production areas because of their destructive effects on aquatic plants and invertebrate populations. The recommended project includes measures to prevent the introduction of carp.

(4) Those areas set aside for aquatic environment study, sanctuaries, or refuges - Two National Wildlife Refuges (NWR) would be affected by the proposed project. The J. Clark Salyer NWR extends from east of Bantry downstream to the international border. It contains waterfowl habitat which is impounded by a series of five low-head dams. The Upper Souris NWR, located along the Souris River northwest of Minot in Ward and Renville Counties includes a large storage reservoir known as Lake Darling, created by a dam located at the Ward-Renville County line. Also, there are six smaller impoundment areas in the refuge.

The Upper Souris Refuge has been identified by the Heritage Conservation and Recreation Service in its ecological theme analysis of the Great Plains Natural Region as having outstanding natural features potentially suitable for receiving a National Landmark designation. These features include stable communities of deciduous lowland forests and native grasses, as well as seasonal concentrations of native animals, especially waterfowl.

Raising Lake Darling Dam and the construction of Burlington Dam could potentially expose these outstanding natural communities to partial or total destruction through inundation. The degree of impact would depend on frequency of inundation, elevation reached, and length of time that water is held at this elevation before drawdown. Tolerance to inundation varies widely among the plant species in these communities. For example, some species, especially certain deciduous trees, can be destroyed by a single, relatively short period of flooding, whereas other species can survive annual, long-term inundations. Destruction of plants would also adversely affect various animal species depending on the degree to which the plant species involved were necessary to the animal's habitat requirements. Table 3 gives acreages of habitat types which could be affected by varying degrees of inundation.

Lake Darling Reservoir has a capacity of about 121,000 acre-feet at the existing spillway elevation of 1598.0 and at that elevation forms a lake with a surface area of about 12,000 acres which extends up the valley about 27 miles. Lake Darling's primary purpose is to provide a regulated water supply to the downstream marsh impoundments. Because it is the only structure capable of any significant flood storage, it has been operated to provide a maximum amount of flood protection to the downstream urban areas. In recent years Lake Darling has been drawn down an average of 5.2 feet prior to the spring flood season. Drawdown reduces the amount of space available for fish and increases the ratio of sediment to water volume, creating conditions conducive to reduced dissolved oxygen concentrations. Such a situation contributed to a severe winterkill in 1967. (See 2.a. (2) and (3) and Tables 1 and 3 concerning the impacts to the refuge wetlands.)

(5) Natural drainage characteristics - The Souris River basin lies in the southeastern portion of Saskatchewan and the southwestern portion of Manitoba in Canada, and in the northwestern part of North Dakota.

The proposed project would alter drainage during specific design floods. The operating plan is based on coordinating the operation of Lake Darling and the Burlington Reservoir with the flow from the uncontrolled drainage area (the area between Minot and the Burlington Dam) to prevent discharge at the Minot gage from exceeding 5,000 cfs. The objective is to reduce the flow at Minot to 2,000 cfs by 10 May and 500 cfs by 20 May (midsummer rainstorm runoff would also be held at 500 cfs). After spring runoff, the Lake Darling pool would be lowered to elevation 1596.0; then the USFWS would take over the operation of Lake Darling for refuge management purposes. All floods up to one having about a 2-percent chance of occurring during any one year would be regulated by the storage provided behind raised Lake Darling Dam. Floods larger than the 2-percent flood would require storage behind Burlington Dam to avoid flows in excess of 5,000 cfs at Minot.

The Des Lacs River diversion would begin operation when the discharge from the Des Lacs River reaches 1,400 cfs (equivalent to a flood having about a 14-percent chance of occurring in any one year). However, the diverted flow would not be stored behind Burlington Dam until the flow at Minot reaches 5,000 cfs (equivalent to about a 0.4-percent probability on the Des Lacs River). At design capacity, the tunnel would divert a flow of 4,500 cfs. When Des Lacs River flows exceed 8,500 cfs (0.06-percent Des Lacs River probability), the excess flow would overtop the diversion dam. There would be about a 6-percent chance of water overflowing the channel banks immediately upstream of Burlington Dam in any one year which is similar to existing conditions.

(6) Sedimentation patterns - No detailed stream or reservoir sedimentation data are available for the Souris River Basin. From measured sedimentation rates at Baldhill and Homme Reservoirs in North Dakota, an average sedimentation rate of 0.3 acre-feet per square mile per year was assumed. It was also assumed that the volume of all upstream reservoirs will be available for sediment storage. Based on these assumptions, sediment generated during 100 years is estimated to be 68,600 acre-feet of which 62,200 acre-feet would accumulate in Lake Darling, 2,000 acre-feet in the Burlington Reservoir below Lake Darling, and 4,400 acre-feet pass on through the Burlington outlet. The 100-year sedimentation volume at Des Lacs Dam is estimated to be 8,800 acre-feet.

Channel erosion and bank instability could be problems for some reaches of the Souris River during sustained releases from the Burlington Reservoir. The potential for increased sedimentation in downstream wetlands could occur under those conditions.

(7) Salinity characteristics - No salinity parameters are applicable to the project.

(8) Flushing characteristics - The level of existing flushing of floodplain areas by floodwaters would be reduced during project operation. Flushing downstream of the Des Lacs diversion tunnel would be reduced when Des Lacs River flows exceed 1,400 cfs. Floodwater storage in Lake Darling and the Burlington Reservoir would significantly reduce the flushing characteristics of the Souris River during spring runoff.

Overall, the project would decrease the effect of peak flood flows upon the downstream wetland and terrestrial ecosystems. The area flooded and the frequency of peak flooding would be reduced, producing a somewhat drier condition (at least along the outer fringe of the floodplain) allowing encroachment of trees, brush, and herbs characteristically found in drier environments. In addition, the growth rate of the floodplain tree species on the fringe would be reduced.

(9) Current patterns - Flood flows would be maintained at no greater than 5,000 cfs through Minot. Sustained discharges from the Burlington Reservoir could reach 700 cfs per day in the fall, depending on the magnitude of floodwater retention. The velocities of discharges would be greater than velocities of pre-existing low flows.

(10) Wave action, erosion, storm damage protection - The project would reduce flood generated erosion problems. Holding water in Lake Darling at elevation 1598 for long periods, as well as inundation to higher elevations behind both Burlington and Lake Darling Dams could increase erosion around these reservoirs. Sustained discharges from the Burlington Reservoir could cause channel erosion and bank instability problems for some downstream reaches of the Souris River.

(11) Storage areas for storm- and floodwaters - The capacity of the primary existing flood storage area, Lake Darling, would be enlarged. The area between the Burlington Dam and Lake Darling would become available for flood storage during floods larger than the 2-percent flood.

(12) Prime natural recharge areas - The Souris River Valley in the Burlington and Lake Darling reservoir areas is carved in a thick, regional deposit of glacial till which is primarily a sandy, stony clay with occasional seams, channels, and lenses of sand and gravel. The permeability of the material is very low except in the sandy phases. Therefore, changes in groundwater levels near the valley induced by infrequent storage in the Burlington reservoir would be insignificant due to the length of time required for the water table to adjust to the temporary change in base level. For the same reasons, no perceptible change in groundwater levels would result from the revised operation of Lake Darling Dam or due to diversion of water from the Des Lacs to the Souris valley. No permanent change in the local water table should develop from the construction of the diversion tunnel. Any temporary dewatering required for construction of any of the structures is not expected to have an adverse effect on the availability of groundwater for other demands in the area.

The effects of the proposed project on the geology of the basin downstream from the Burlington Dam would be restricted to the floodplain area. Except for the times when water would be stored in the reservoirs, the natural discharge of the river would be maintained, and no change in the existing conditions would occur. The exception to this evaluation is in Minot where some of the channel meanders are cut off with bypass channels. The river in this area is considered to contribute some recharge to deep valley aquifers. The project, however, provides for continued flow through the existing meanders. The channel area available for recharge to underlying aquifers is, therefore, increased slightly, and any recharge from the river increased accordingly.

During those years when floodwater is stored and later released, above-normal flows in the river downstream from Burlington Dam would extend over a greater length of time. In the case of the 1-percent flood, this condition could extend up to 9 months. Effects on the geology to be considered in these extreme cases are changes in groundwater levels and erosion of the stream channel. For any sustained rise in river level, the groundwater level under the floodplain will also rise and, if given sufficient time, be nearly the same level as the river. Upstream from Verendrye no significant rise in the groundwater level is expected, except following floods near the 1-percent magnitude. Even following these extremely large floods, any adverse rise in the water table would not be expected to exceed one month in April and May because the channel capacity would be adequate to handle the discharges without an excessively high stage. Also, the floodplain sediments upstream from Verendrye are generally silts, clays, and fine sands with low permeability which would retard the effect of high river stages on the water table over a large area. Downstream from Verendrye, however, the channel capacity is lower and the floodplain sediments more pervious. Therefore, a high water table in that area during the spring, fall and winter should be expected to accompany discharges made after storage of a major flood.

b. Impact on Water Column (40 CFR 230.4-1(a)(2))

(1) Reduction in light transmission - Short-term impacts to the aquatic ecosystem in the Souris and Des Lacs River valleys would be associated with project construction activities, including dam and tunnel constructions, modification of refuge impoundments, the proposed Velva Channel Cutoff, and channel and levee construction. These impacts would result from direct physical disruption and increases in suspended sediments which would bury aquatic invertebrates, irritate exposed membranes of fish and invertebrates (possibly to the extent that secondary bacterial infections could occur), and reduce autotrophic and photosysthetic production through a reduction in light penetration. All of these effects would result in a decrease in aquatic production for several years.

An example of these types of effects was noted by the USFWS below Minot where channel modifications were in progress. Within a 14-mile (river miles 381.5-367.4) reach of the river below Minot, macroinvertebrate populations were severely reduced. Within the next 22-mile reach (to river mile 345.2) considerable recovery had occurred, and by river mile 330.7 (Velva, North Dakota) complete recovery from siltation effects was assumed with an associated increase in the number of aquatic taxa. This reach was also affected by organic pollution from Minot, and these effects were not completely separable from siltation effects.

(2) Aesthetic values - Water clarity and color are the primary aesthetic values associated with a water column. Although the contractor would be required to minimize introduction of sediments into the water, some turbidity

level increases would be unavoidable during construction. The "settling pond effect" of retaining floodwaters behind dams should reduce turbidity levels of water released downstream below the high levels normally associated with floods.

(3) Direct destructive effects on nektonic and planktonic populations - Disturbance of the aquatic habitat during construction may cause some destruction to populations of nekton (actively swimming organisms) and plankton (passively floating organisms) primarily through the effects of suspended sediments which could smother these organisms and reduce light penetration which could decrease some food sources by reducing photosynthetic productivity.

c. Covering of Benthic Communities (40 CFR 230.4-1)

(1) Actual covering of benthic communities - Covering of benthic communities by fill placed for dam and diversion constructions, modification of refuge impoundments, the proposed Velva Channel Cutoff, and channel and levee construction would occur during project construction activities.

Coverage of benthic communities by suspended sediment downstream of structures could be a relatively more significant effect. Until channel reaches are stabilized below structures, benthic community productivity could be reduced by the effects of suspended sediment which include losses of habitable substrate as well as covering of organisms.

(2) Changes in community structure or function - The effects of short-term siltation and community disruption resulting from project construction can be expected to temporarily reduce species diversity and numbers of organisms present in the benthic communities of the Souris and Des Lacs Rivers for an undetermined distance below project structures. In areas where rock fill is placed in the channel, additional habitat would be provided for those species normally associated with rocky substrates. Concrete structures would likely provide attachment sites for various algal species.

d. Other Effects (40 CFR 230.4-1(a))

(1) Changes in bottom geometry and substrate composition - Significant changes in bottom geometry would occur where channel modifications are made above and in Minot and Velva. Although channel bottom elevations would not be changed, channel profiles would be noticeably different from existing profiles. Most channel side slopes would be approximately 1 vertical on 2.5 horizontal.

Some channel realignment and modification work would be done at the Burlington and Lake Darling damsites. Low flows would be redirected to pass through the east sides of both dams. These realigned sections would have a more uniform geometry than existing channel sections at these sites.

Much of the Souris River channel bottom in the project area currently exists as mud, silt, and sand. Rocks have been placed at most road crossings and below dams to serve as riprap protection against erosion. Construction activities would increase the levels of suspended sediments in the water, but would not significantly alter the physical structure of mud and silt substrates. Existing rock and pure sand substrates could be silted over. A relatively small amount of rock fill and concrete substrates would be created at the damsites, Des Lacs River diversion structure, road relocations, and channel modifications.

(2) Water circulation - During project construction and operation, existing patterns of water circulation in the Souris River would be significantly changed. Water impoundment behind Burlington and Lake Darling Dams would restrict circulation. During years of impoundment and continuous discharge from Burlington Dam, Souris River circulation patterns would be altered considerably by continuous high flows. During periods of diversion from the Des Lacs River, lower than normal circulation patterns would prevail in the Des Lacs River channel. Rerouting low flows to the east sides of the Burlington and Lake Darling Dams, and the operation of separate low-flow outlets for refuge pond management at Lake Darling Dam and Dam 87 would also alter circulation in these reaches.

(3) Salinity gradient - Not applicable.

(4) Exchange of constituents between sediments and overlying water with alterations of biological communities - Fill material is expected to be clean, reducing the potential for exchange of constituents between sediments derived from fill sources and overlying water. Other project-related impacts on sediments would affect chemical exchanges with the water and could alter biological communities to some degree. For example, proposed channel modifications in already organically-polluted areas near Minot could stir up these contaminated sediments, causing further reduction in water quality in these reaches.

Holding Lake Darling at elevation 1598 for prolonged periods of time, coupled with inundation to higher elevations, could increase erosion around, and sedimentation in, the reservoir. Although the sedimentation increase is not anticipated to be large, the physical effects of increased sediment deposition in the reservoir and the increase in nutrient loading from ions adsorbed on the sediments could aggravate the already eutrophic conditions. The Environmental Protection Agency's National Eutrophication Survey Report on Lake Darling indicated the possibility of the lake being nitrogen limited. Since a high percentage (88 percent) of the nitrogen input to the lake is caused by agricultural practices, measures to minimize nitrogen input (time of fertilizer application, land treatment measures, and the like) should be advocated by the Soil Conservation Service and the Water Management Districts. Further degradation of the lake would decrease the value of the existing game fishery and hasten its succession to a panfish/bullhead fishery. Alternating drawdown and flooding is expected to adversely affect plant life, and production of animal food for fish and waterfowl within the littoral (shoreline) zone.

During years of sustained discharge from the Burlington Reservoir of up to 500 cfs, the rate of sediment transport through the lower Souris would be higher than that of normal flows. However, this could be much less devastating an impact on lower Souris biological communities than that caused by the severe erosive force of a flood under present conditions.

3. CHEMICAL-BIOLOGICAL INTERACTIVE EFFECTS (40 CFR 230.4-1(b))

a. Does the Material Meet the Exclusion Criteria? - The fill material meets the exclusion criteria under 40 CFR 230.4-1(b)(1), (2), and (3) which states that:

Dredged or fill material may be excluded from this evaluation, if:

(a) The material proposed for discharge is substantially the same as the substrate at the proposed disposal site; and

(b) The site from which the material proposed for discharge is to be taken is sufficiently removed from sources of pollution to provide reasonable assurance that such material has not been contaminated by such pollution; and

(c) Adequate terms and conditions are imposed on the discharge of dredged or fill material to provide reasonable assurance that the material proposed for discharge will not be moved by currents or otherwise in a manner that is damaging to the environment outside the disposal site.

4. DESCRIPTION OF SITE COMPARISON (40 CFR 230.4-1(c))

a. Total Sediment Analysis (40 CFR 230.4-1(c)(1))- No total sediment analysis has been performed. The use of clean fill presents no major environmental impact in regard to concentration differences of critical constituents between the fill sites and the fill material.

b. Biological Community Structure Analysis (40 CFR 230.4-1(c)(2)) - No biological community structure analysis was performed. The use of clean fill material should preclude the community structure analysis because there should be no substantial potential for adverse environmental impacts from toxic fill at the proposed fill sites.

5. REVIEW APPLICABLE WATER QUALITY STANDARDS

a. Compare Constituent Concentrations - The water quality of the Souris and Des Lacs Rivers is basically eutrophic with non-point source agricultural runoff serving as a major contributor to nutrient loading problems. Water treatment is generally required before human consumption can be allowed. During the duration of project construction, turbidity levels would increase, but should return to normal after project completion.

b. Consider Mixing Zone - Not applicable. No liquid would be discharged.

c. Based on a. and b. Above, Will Disposal Operation be in Conformance with Applicable Standards? - Fill activities would be in conformance with North Dakota State standards, except during construction when turbidity levels could exceed acceptable limits. This effect would be temporary and should not have any long-term, adverse effects on the environment.

6. SELECTION OF DISPOSAL SITES FOR FILL MATERIAL (40 CFR 230.5)

a. Need for the Proposed Activity - Flood damage reduction is needed for Minot and other Souris River Valley areas. Placement of fill for various construction features of the proposed plan is necessary to accomplish the flood protection objectives of the plan and to implement necessary structure modification measures.

b. Alternative Sites Considered - Alternatives for Souris River Flood Control are discussed in detail by the Phase I GDM (General Design Memorandum) and the Draft EIS (Environmental Impact Statement) (dated October 1977). The following alternative disposal sites for fill material were considered in selecting the proposed plan:

(1) An alternative dam site below the confluence of the Souris and Des Lacs Rivers was considered. Although this was an economically feasible alternative eliminating the need for a Des Lacs diversion, social, transportation, and environmental impacts would be undesirable.

(2) The alternative Lake Darling site was found to be the most economical plan and less environmentally damaging than the proposed Burlington site because of the smaller area affected. This site was rejected because it offered inadequate protection from Souris and Des Lacs Rivers floods.

(3) At one time a Des Lacs River diversion to Lake Darling was considered but was rejected because the considerable length would entail excessive costs. The present site is the most technically and economically feasible alternative for the diversion.

c. Objectives to be Considered in Discharge Determination (40 CFR 230.5(a))

(1) Impacts on chemical, physical, and biological integrity of the aquatic ecosystem (40 CFR 230.5(a)(1)) - The physical structure of benthic communities downstream of construction works would be affected temporarily by increased siltation. Effects on water quality and substrate characteristics by sedimentation could be stressful to some aquatic species until channel reaches below construction sites are stabilized.

When pre-flood drawdown is necessary in Lake Darling, decreases in dissolved oxygen and exposure of some floral and faunal elements of the biotic community could negatively impact the integrity of the aquatic ecosystem in Lake Darling.

(2) Impact on foodchain - The impacts of siltation and turbidity and the decreases in water quality could adversely affect the species elements of one or more trophic levels of the foodchain, particularly submerged aquatic plants, invertebrates, and fish (see also 2.a. (1)).

(3) Impact on the diversity of plant and animal species - Diversity of aquatic plant and animal species could be reduced temporarily by the effects of fill activities, but could recover after completion of construction. Some riparian vegetation at localized sites would be lost by fill placement for levee upgrades and dam construction or modification. The secondary impact of prolonged inundation during years of retention on both plant and animal species could cause a significant reduction in species diversity upstream of Burlington Dam. In one season of prolonged retention at the flood pool design elevation, most of the riparian woodlands could be destroyed. This would have long-term adverse effects on animal species dependent on riparian woodlands for all or part of their habitat requirements. The ultimate effect could be the emergence of a community composed of species having primarily upland habitat requirements. The species diversity in such a community would be significantly reduced over that of the original riparian community.

(4) Impact on movement into and out of feeding, spawning, breeding, and nursery areas - (See 2.a.(3), and 6.d.(3)). During normal low flows, movement of aquatic species between impoundments should not be significantly impeded by structures. Low flow outlets should permit movement to spawning, feeding, and nursery areas in the same manner that existing structures do. Under high flow periods, flood stages, and discharges from the Burlington Reservoir, the water velocity through outlet structures would probably be too great to allow upstream movement. This could be significant if high flows and spawning periods coincide. If a velocity barrier carp control structure were built, it would most likely prohibit upstream movement by other fish species but should not significantly affect production of resident populations in the refuges and other reaches of the Souris Loop.

The secondary impact of inundation of riparian habitat during years of retention behind Burlington Dam could significantly reduce available breeding, nesting, and feeding areas for terrestrial animal species. This impact would not only include the unavailability of these areas because of inundation, but destruction of many plant species intolerant of inundation could further reduce the availability of suitable habitat for these activities in subsequent years. Recovery could occur with time until the next inundation.

(5) Impact on wetland areas having significant functions of water quality maintenance - (See 2.a.(2) and Table 2). Construction activities could temporarily increase the sediment load to downstream wetlands. The presence of the fill itself should place no significant burden on the water quality maintenance capacity of wetlands during years of relatively low spring runoff. During

years of floodwater storage behind Burlington Dam and/or Lake Darling Dam, the "settling pond" effect could reduce sedimentation downstream. Floodwater storage in the wetlands of the Lake Darling and Burlington flood pools would affect the water quality of these areas (see also 2.a.(2)) and the rest of the Souris River as well. Some of the impoundment characteristics which would affect water quality are storage volumes, water depths in reservoir, orientation to prevailing wind direction, retention time, character of the underlying soils, upstream conditions, and the nature and extent of vegetation in the impoundment.

Dissolved oxygen concentrations in the waters impounded behind Burlington Dam and in downstream releases are probably the most important parameters to be considered. These concentrations would be primarily influenced by the oxygen demand of the decaying vegetation in the reservoir and the organic content of the soils.

Although it is impossible to predict decay rates and total effects of the decay of vegetation in the impoundment, it is thought that the vegetation would cause: (1) greater adverse effect than the underlying soils; (2) darkening of the water color; (3) release of nutrients; and (4) oxygen demand from decaying vegetation. Also, the organic soils would probably create anoxic conditions at the soil/water interface. Low dissolved oxygen concentrations are not expected throughout the entire water column because the reservoir is unlikely to stratify. The morphometry of the Burlington pool would be similar to that of Lake Darling, which does not stratify.

Algal growth in Lake Darling has been significant on occasion. Increased nutrient release from the soils and decaying vegetation in the Burlington Reservoir, plus the "seed" effect from Lake Darling, would result in algal growth in the Burlington Reservoir. Although it is recognized that algal blooms could occur, it is thought to be unlikely because of the relatively short residence time. Filling and emptying of the Burlington pool for the 100-year frequency (1-percent) flood is estimated to be about 270 days. Lake Darling has a mean hydraulic retention time of about 1.4 years.

During years of retention and subsequent discharge from the Burlington Reservoir, the J. Clark Salyer Refuge and other lower Souris wetlands may not be able to improve the water quality in terms of turbidity, suspended solids, nutrients, etc., in higher flows to the same degree as they do under present conditions.

(6) Impact on areas that serve to retain natural high waters or flood areas - Fill placement to upgrade Lake Darling Dam and modification of dams in the J. Clark Salyer Wildlife Refuge would increase the storage capacity of these impoundments which already serve some storage functions during high water periods.

(7) Methods to minimize turbidity - The contractor would be required to comply with water quality protection guidelines during construction. The contractor would institute erosion and sediment control measures appropriate to the various situations which could significantly contribute to turbidity levels.

(8) Methods to minimize degradation of aesthetic, recreational and economic values - The contractor would be required to properly dispose of wastes generated during construction. Control and correction procedures would be exercised to reduce the incidence and impact of spills.

Road relocations, raises, and bridge modifications would be included to minimize project impacts to Souris River Valley transportation which would in turn affect recreational activities or economic pursuits.

Project construction and operation would have unavoidable impacts to aesthetic, recreational, and economic values because of disturbance and periodic inundation of recreational and agricultural areas.

The major item of concern to aesthetic values would be those areas located upstream from the proposed Burlington Dam. The impacts of flooding on vegetation (see also 2.a.(2)) would bring about successional changes which by most people's standards are undesirable. These changes, along with flood-deposited debris and increased erosion, would make the Souris River Valley (upstream of the Burlington Dam) less attractive to the onlooker and would lower the value of the recreational experience.

In a State where forested land is not abundant, the projected losses of bottomland hardwoods are significant (see also 2.a.(4)). Although the loss of natural beauty of these areas is not measurable on an economic scale which calculates the benefits and costs of protecting development in the floodplain, these losses must nevertheless be acknowledged. These same aesthetic amenities contribute to what is so often referred to as our "quality of life." This is a loss that would not only affect present populations but also future generations.

Although project plans include tree planting on 1,000 acres of project lands, it would take several years for a mature biological community to develop. This community may not duplicate in species composition or diversity the bottomland hardwoods community impacted by project operation. The outstanding natural features of the Upper Souris Refuge identified by the Heritage Conservation and Recreation Service, which may be impacted by the project, may not be replaceable by planting trees and waiting for succession to develop a mature community.

The other features of the project, such as the Des Lacs diversion tunnel, and levee upgrading between Burlington and Minot and at Sawyer and Velva, would have lesser aesthetic impacts due to their urban locations or previously disturbed condition.

(9) Threatened and endangered species - The project area encompasses no known critical habitat for any endangered species. Three species listed as endangered by the U.S. Fish and Wildlife Service may be present in the project area: the peregrine falcon (*Falco peregrinus*), the whooping crane (*Grus americana*), and the bald eagle (*Haliaeetus leucocephalus*). The Dakota skipper butterfly (*Hesperia dacotae*) which is proposed for listing as an endangered species may also be present in the area.

Project construction during migration periods could disrupt the normal activities of any whooping cranes passing through the project area, forcing them to utilize other feeding and resting sites farther from construction areas. Potential feeding and resting sites below flood pool elevations in Lake Darling and the Burlington Reservoir could be inundated during years of floodwater retention. Significant impacts on the other named species are not expected from the project.

(10) Investigate other measures that avoid degradation of aesthetic, recreational, and economic values of navigable waters - There is little navigable water in the Souris River except for Lake Darling and possibly a few reaches suitable for canoeing and rafting. Degradation of aesthetic, recreational, and economic values of waters affected by project operation is unavoidable with all alternatives except the no action alternative.

d. Impacts on Water Uses at Proposed Fill Sites (40 CFR 230.5(b)(1-10))

(1) Municipal water supply intakes - Fill activities would not affect any municipal water supply intakes.

(2) Shellfish - Fill sites are not located in areas of significant shellfish production. Turbidity generated during construction activities would be temporary and less inhibiting to shellfish survival than that associated with heavily silt-laden floodwaters.

(3) Fisheries - (See 2.b.(1), 2.d.(4), 6.c.(1)-(2)). During project operation, when peak flow conditions are adequate to raise the water level in Lake Darling to elevation 1598, it is planned to hold the level there until northern pike spawning is complete.

The primary aquatic values of this area (between elevations 1596 and 1598) above Lake Darling appears to be for spawning of northern pike. By increasing the operational flexibility of Lake Darling (i.e., being able to hold water at 1598 without fear of reduced flood protection for downstream areas), it should be possible to encourage the successful reproduction of northern pike by avoiding too rapid a drawdown below elevation 1598 during spring spawning and hatching periods.

Depending upon timing of the flood, spawning success of northern pike could be reduced for larger, less frequent events due to rapid drawdown to 1598. Northern pike prefer to spawn over shallow (e.g., 7 inches) flooded vegetation when water temperatures are between 40° and 52°F. Eggs require about 21 days for hatching, and newly hatched young remain in the area for several more weeks. Drawdown following the flood peak would render much of the presently suitable area above 1598 unsuitable for northern pike spawning. However, flood events greater than a 50-year event are considered rare (i.e., their probability of occurrence in any year is very low - less than 2-percent). Similarly, it is doubtful that even the complete failure of a particular year class of game fish would seriously affect the Lake Darling and downstream fishery. Fish habitat impacts and fish kills would be more significant. The occurrence of large flood events in successive years could, however, cause a significant impact and would probably require stocking to supplement natural reproduction. It is unknown whether adequate stock would be available.

In most years (more than 75 percent of the time), however, northern pike spawning should be encouraged due to the capability to hold the water level at 1598 until the fry move off the spawning beds.

During years requiring storage behind Burlington Dam itself (less than twice in 100 years on the average), the impacts on the aquatic community between the dam and Lake Darling would be similar to those discussed for upstream reaches. These would include increased siltation, reduction or loss of spawning opportunities for northern pike and walleyes, and reduction of both diversity and numbers of invertebrates. This reach of river, as indicated by a Fish and Wildlife Service limnological survey, can be characterized as degraded, with discharges from Lake Darling contributing to the pollution-tolerant character of the species present. Because of the infrequent nature of the storage behind Burlington Dam, adverse aquatic impacts are not expected to be great in this reach. Because of the control of frequent flood events provided by the raise of Lake Darling Dam, the controlled release of water would encourage fish spawning and invertebrate populations which might otherwise be adversely affected due to high peak flows under existing conditions. During years with extended releases from Burlington and Lake Darling Dams (greater than a 50-year flood), the increased "base" flow would benefit the river environment by eliminating potential severe low flows for those years. (The probability of a large spring flood occurring the same year as a severe summer drought is very small, however.) This increased flow would not significantly enhance the existing river fishery, which is poor, because of its infrequent nature.

Drawdown and winterkill conditions are areas of concern with the recommended plan. Drawdown in anticipation of floods requiring control would involve drawdown to between elevations 1591 and 1594. In 1966-67 a severe winterkill occurred when the water level was at elevation 1593.6. Winterkill is of great concern because unlike loss of a year class due to poor spawning conditions, winterkill results in the loss of several year classes, including the brood stock.

The proposed project could enable carp, presently confined to the lower Souris River downstream of Wawanesa Dam, to migrate up through the upper Souris Loop. This is a prominent concern because of the impact of carp on waterfowl habitat. Carp directly impact waterfowl habitat by uprooting aquatic plants used for food, cover, and/or nesting. They also increase turbidity and act as nutrient pumps (thereby encouraging planktonic algae), both of which further act against flowering aquatic plants. These effects spread through the foodchain through adverse effects upon populations of certain invertebrates. Therefore, the recommended plan includes provision for carp control measures.

(4) Wildlife - (See 2.a., 6.c.(1)-(4)). Impacts of floodwater storage upon terrestrial wildlife would be severe. The response of deer and small mammals to the resulting damage to the woodland habitat would be a decline in population density in some proportion to the severity of flooding and inundation. The immediate response to inundation would be to move to high ground. Small mammals forced out of their protective shelter would be subject to greater predation and stress factors which would reduce the population size to conform with available habitat. Floodplain forests in this region of North Dakota are estimated to support breeding songbird populations ranging from 100 to 500 pairs per 100 acres of floodplain forest. This could translate into a loss ranging from 1,000 to 5,000 breeding pairs in the reservoir area for the year of the flood with effects into the future. Production in following years would be reduced or eliminated because of habitat damage. White-tailed deer, because of their importance to recreation as an intensively managed game species, are of special concern in this regard. Immediate effects of an approximate 50- to 75-year flood (2- to 1.33-percent chance) would include severe stress upon the deer herd due to loss of browse and cover. With most floods of this magnitude, the deer would be forced to leave the shelter of the valley somewhat prematurely, before the last of the severe weather had broken. Of more concern would be the long-term effects upon habitat. Damage to deer habitat is a major problem because the valley functions as a wintering area for deer from the surrounding uplands. Much of this value would be lost, and the project would have more than a local effect upon the deer herd. However, with large numbers of old dead trees existing after inundation (if they are not cut), the nesting areas for cavity-nesting species and other species which depend upon dead trees would be increased.

Other prominent wildlife species which would be affected by flooding of wetlands (and carp introduction, if control is not effective) include muskrat, beaver, and mink. The flooding of marshes would cause these animals to be displaced from their natural cover or dens and to be separated from their natural food sources. Mortality of both adults and young would increase during such circumstances. Long-term habitat effects would greatly affect recovery.

One of the primary functions of the National Wildlife Refuges in the project area is production and maintenance of waterfowl populations. The Souris and Des Lacs wetland, riparian, and open water habitats are particularly valuable components of the available waterfowl habitat in this region of North Dakota, in light of the declining numbers of wetland areas lost to agricultural development. The refuges serve as vitally important, dependable waterfowl habitat reserves during drought years when many potholes are dry.

Under normal flow conditions the project should have little significant impact on waterfowl habitat. Floodwater storage would severely reduce available habitat for waterfowl and other wildlife purposes in the area inundated. The amount of habitat lost would depend on the flood pool elevation reached and the duration of floodwater storage. However, an event entailing lengthy storage at high pool elevations could severely limit production of waterfowl and other wildlife during that season in the areas affected. Sustained discharges preventing drawdowns or other management measures in the Salyer Refuge could also limit its contribution to North Dakota's waterfowl production for the year.

(5) Recreation impacts

(a) Lake Darling - Impacts on recreation at Lake Darling include the flooding of recreation areas adjacent to Lake Darling and the Souris River and alterations in the fishery. Permanent facilities at Mouse River Park (restrooms and cottages) would receive the greatest damage. Acquiring and removing damageable property would be necessary, possibly with later mitigation through development of more compatible recreation features at the site in cooperation with a local sponsor. Other recreation areas would not be significantly impacted. Flooding would require the temporary removal of picnic facilities and would require clean-up operations after flooding at the five boat landings on Lake Darling, including picnicking and bank fishing facilities at Grano and Greene.

(b) Burlington Dam - Some recreation potentials would be made available by the Burlington Dam. Potentials exist for sightseeing, picnicking, hiking, fishing, and camping along the Souris River and within the lower section of the Upper Souris National Wildlife Refuge. Sightseeing, picnicking, and fishing are presently accommodated within the wildlife refuge. Along the Souris River, limited potential exists to develop camping, picnicking, and hiking facilities.

Impacts upon existing recreation due to periodic flooding include disruption of fish and wildlife habitat (affecting fishing and hunting) and inundation of fishing and picnicking areas at Baker Bridge and St. Mary's Bridge. Post-flood clean-up operations would be required at picnic areas.

Constraints upon future development due to flooding require that permanent facilities (restrooms and picnic shelters) be located above flood elevation. Picnic areas, hiking trails, camp pads and boat access areas could be put in inundation areas but would sustain some damage. Any fishing access and parking provided later by the Corps may mitigate for flooded fishing areas. It is unlikely fishing quality at these areas would equal fishing at areas such as Baker Bridge.

(6) Threatened and endangered species - See 6.c.(9).

(7) Benthic life - See 2.b.(1), 2.c.

(8) Wetlands - (See 2.a.(1)-(2), 6.c.(5)). It is estimated that approximately 74 acres of wetlands would be removed by fill activities. Table 1 outlines acreage losses of wetlands for various work features involving fill activities. Secondary impacts to wetlands due to inundation during flood storage periods and sustained discharges during Burlington Reservoir drawdown have been discussed above and are included in Table 3.

(9) Submersed vegetation - (See 2.a.(2), 2.b.(1), 6.c.(5)). Submersed vegetation could be covered by fill placed for dam construction, refuge structure modifications, road raises, diversion structures, and levees. Vegetation would also be destroyed in channelized reaches. Reestablishment would depend on the suitability of post-construction conditions of substrate, depth, side gradient, turbidity levels, water quality, and the rate, timing, and magnitude of water level fluctuations.

(10) Size of disposal sites - Disposal sites would be no larger than that necessary to accomplish the desired protective or corrective measures.

(11) Coastal zone management programs (40 CFR 230.3(e)) - The proposed project would have no effect on coastal zone management programs.

e. Considerations to Minimize Harmful Effects (40 CFR 230.5(c)(1-7))

(1) Water quality criteria - (See 5.a., c. and 6.c.(5), (7), (8)). Fill material would be obtained from clean sources. It is expected only turbidity criteria would be exceeded during construction and would return to pre-construction levels after project completion. The secondary impacts to water quality associated with project operation have been discussed above. Erosion control measures, such as terracing side slopes, revegetation, and a program to remove fallen timber on a periodic basis from the Burlington Reservoir could reduce some harmful water quality effects of the project.

(2) Investigate alternatives to open water disposal - Material must be placed in the water to accomplish the desired flood protection measures.

(3) Investigate physical characteristics of alternative disposal sites - For road raises, levee areas, and wildlife refuge structure modifications, no other fill locations would be suitable. Alternative sites were considered for a dam on the Upper Souris River and the Des Lacs diversion works, but the present sites were chosen as being the most technically and economically feasible locations for these structures (see 6.b.).

(4) Ocean dumping - Not applicable.

(5) Where possible, investigate covering contaminated dredged material with cleaner material - Not applicable. All fill material would be clean.

(6) Investigate methods to minimize effect of runoff from confined areas on the aquatic environment - Not applicable. No confined areas for the disposal of hydraulic dredged material would be needed.

(7) Coordinate potential monitoring activities at disposal site with EPA - No monitoring activities are planned because of the clean nature of the fill materials.

7. STATEMENT AS TO CONTAMINATION OF FILL MATERIAL IF FROM A LAND SOURCE (40 CFR 230.5(d))

Fill material consisting of sand, silt, clay, gravel, and rock would be obtained from local sources, generally on or near construction sites. Much of the material would come from required excavation activities. Local gravel pits, fieldstone, and valley glacial till deposits would also be used. No contaminants, other than sedimentary material released during construction, would be added to the water from fill materials.

8. DETERMINE MIXING ZONE

Not applicable. No liquids should be discharged into the water.

Table 1 - Acres of Wetlands Removed by Filling

Work Feature	Acres of Wetlands	Type of Wetlands Affected
Burlington Dam	10.0	1
Des Lacs Diversion Inlet	1.0	1
Des Lacs Diversion Outlet	0.5	1
Upper Souris Refuge Structures		
Dam 41	1.0	3
Lake Darling Dam	2.5	4 & 5
	10.0	3 & 4
Dam 87	1.0	3 & 4
Dam 96	1.3	3 & 4
Road Raises		
Renville Co. 9 (FAS729)	0.5	2
Hwy. 5	10.0	3
Hwy. 28	3.0	5
Grano Crossing (FAS471)	3.5	5
Soo Line Railroad Raise	3.0	5
Levee Areas		
Burlington to Minot	8.6	1 & 3
	3.0	3
Sawyer	2.4	1 & 2
	1.8	2
Velva	6.4	1 & 3
	5.0	3
J. Clark Salyer Refuge Structures		
Dam 320	4.0	3,4,5
Dam 326	2.0	3 & 4
Dam 332	1.0	3 & 4
Dam 341	1.0	3 & 4
Dam 357	1.0	3 & 4
Estimated Total of Impacted Wetlands	73.7	

Table 2 - Impacts of Burlington Dam on Water Quality in the Souris River

Item (1)	In Reservoir (2)	Downstream (3)
Nutrients	Slight increase	-
Dissolved solids	Little change	Probable decrease because release waters will normally be that from spring runoff period which has lower dissolved solids.
Color	Slight increase	-
Ammonia	Increase but not to toxic levels	-
Phytoplankton	Growth but not to nuisance levels	-
Temperature	-	Slight decrease primarily due to higher flow rates.
Dissolved oxygen	Anoxic at soil-water interface to near saturation at surface	Minimum 85 percent saturation because of reaeration by outlet works.

Table 3 Acreages of Habitat Types Between Burlington Dam and the Saskatchewan Border Based on 1975 Aerial Photos and Supplied by the USFWS

Evaluation Segment[1/]	Frequency of Inundation[7/]	Elevation Contour Interval	Acres			
			Bottomland[2/] Hardwood	Marsh[3/]	Agricultural[4/] Land	Grassland[5/]
	2	1590-1600[6/]	60	491	0	160
I	50	1600-1610	589	135	1133	766
	1000	1610-1620	241	250	779	391
		Total	890	876	1912	1317
	2	1590-1600[5/]	6	1009	19	129
II	50	1600-1610	4	49	106	1028
	1000	1610-1620	13	0	32	779
		Total	23	1058	157	1936
	55	1575-1580	85	1250	50	25
	65	1580-1585	100	385	100	50
	70	1585-1590	40	-	145	150
	73	1590-1595	-	-	75	120
III	83	1595-1600	-	-	25	112
	120	1600-1605	-	-	34	130
	180	1605-1610	-	-	25	145
	450	1610-1615	-	-	35	75
	1500	1615-1620	-	-	20	115
		Total	225	1635	509	992
	50	1565-1570	175	250	-	-
	50	1570-1575	52	216	782	240
	55	1575-1580	-	-	264	150
	65	1580-1585	-	-	-	106
	70	1585-1590	-	-	-	90
IV	73	1590-1595	-	-	-	133
	83	1595-1600	-	-	-	67
	120	1600-1605	-	-	-	80
	180	1605-1610	-	-	-	45
	450	1610-1615	-	-	-	120
	1500	1615-1620	-	-	-	115
		Total	227	466	1046	1146

1/ Segment 1: Saskatchewan to upper limit of Lake Darling
Segment II: Upper limit of Lake Darling to Lake Darling Dam
Segment III: Lake Darling Dam to Baker Bridge (downstream boundary of Upper Souris NWR)
Segment IV: Baker Bridge to Burlington Dam

2/ Wooded areas in coulees were included under grassland because of small individual acreages

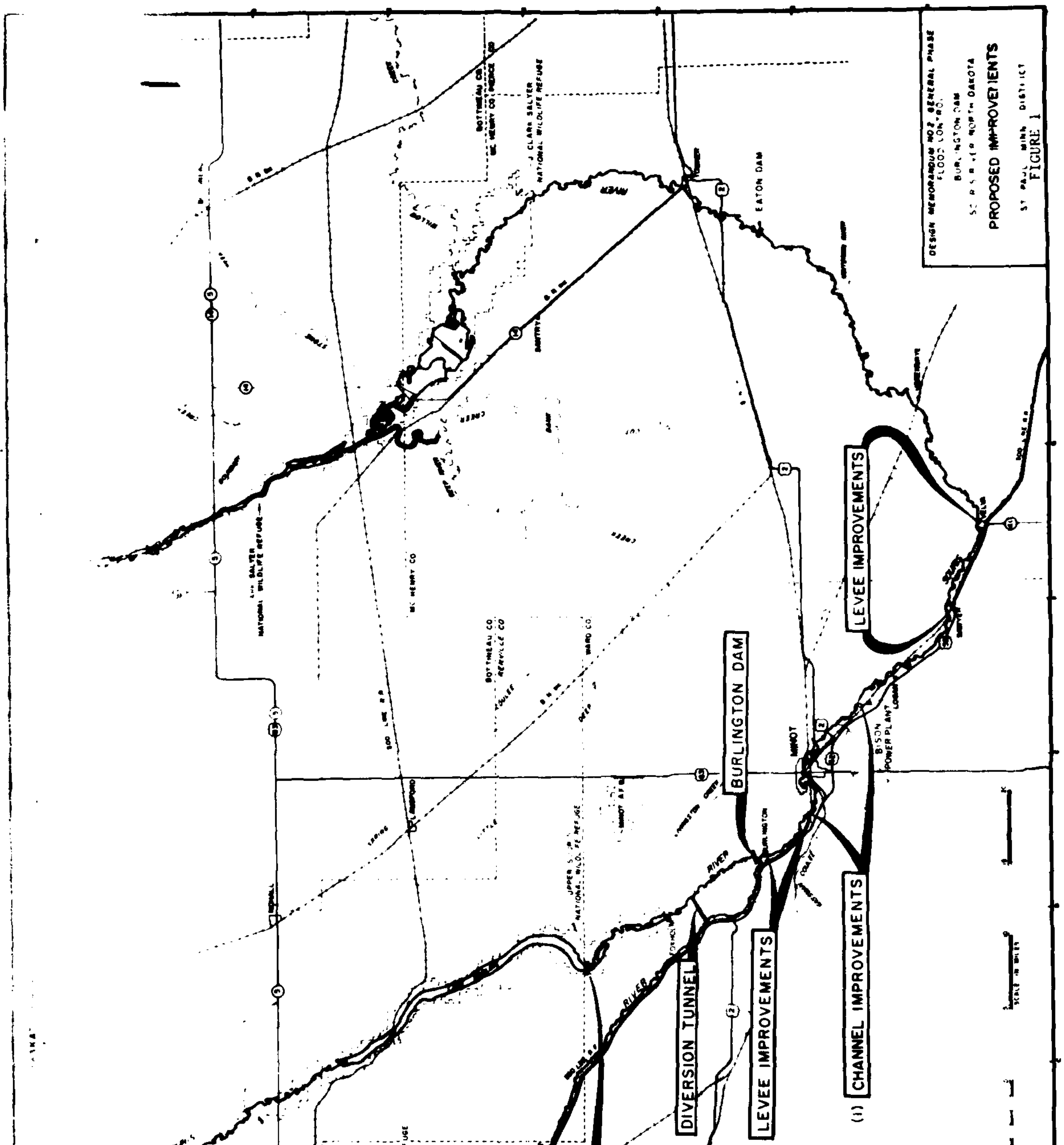
3/ Includes fringe of emergent vegetation around Lake Darling and along river channel

4/ Includes cultivated areas, alfalfa, bare ground, and cultural features

5/ Includes native and tame grassland, pasture shrubs, and prairie shrubs (wooded coulees)

6/ Spillway level of existing Lake Darling is 1598 while normal operating pool is 1596

7/ Frequency of inundation at mid-point of Elevation Contour Interval, i.e., elevation 1595 would be inundated every two years.



PROPOSED IMPROVEMENTS
FIGURE 1
EATON DAM
LEVEE IMPROVEMENTS
BURLINGTON DAM
MINOT
BISON POWER PLANT
(1) CHANNEL IMPROVEMENTS
LEVEE IMPROVEMENTS
DIVERSION TUNNEL
RAISE LAKE DARLING DAM
DES LACS
RIVER
(1) MINOT CHANNEL PROJECT UNDER CONSTRUCTION

Figure 1

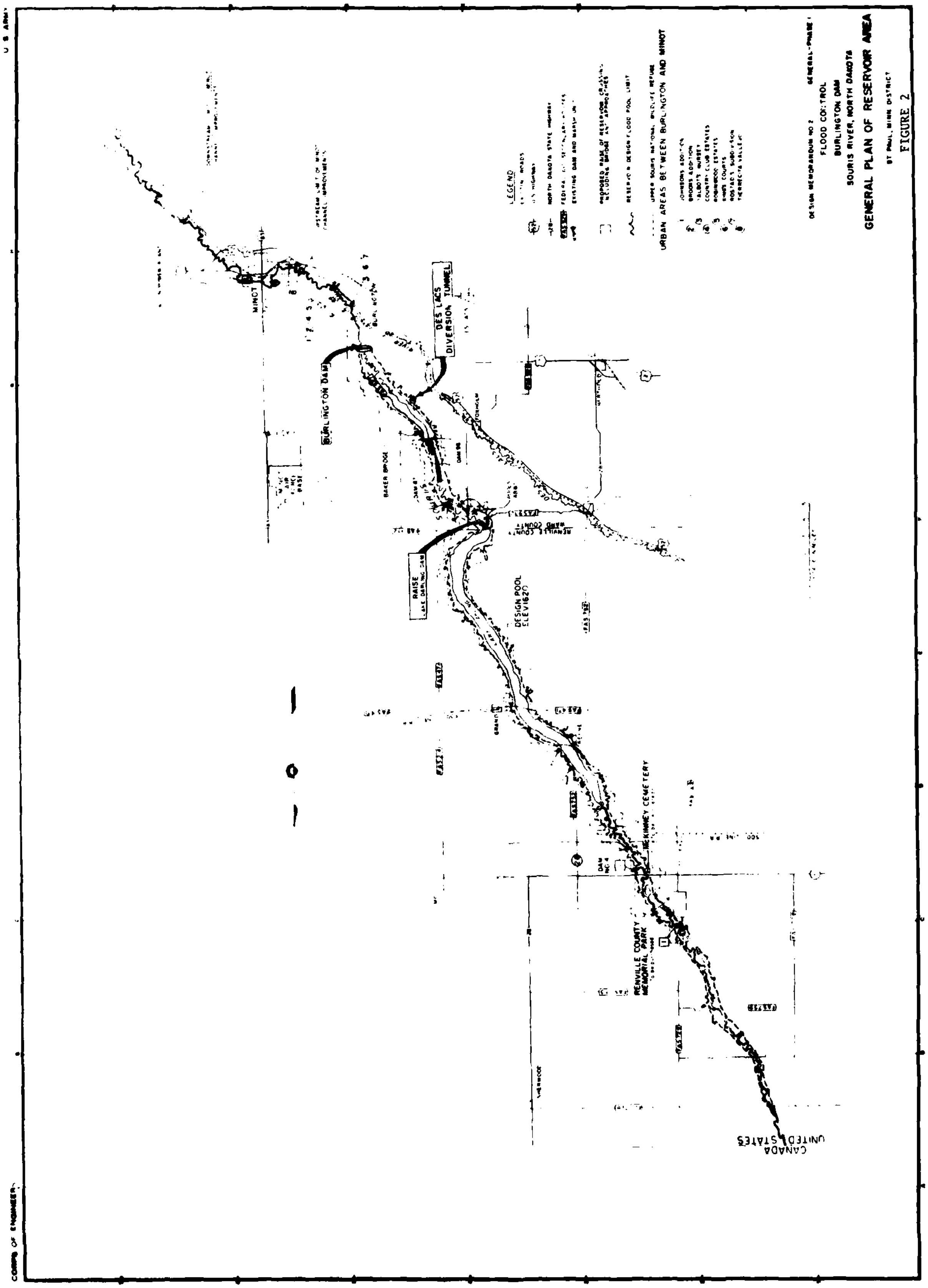

U S ARMY
CORPS OF ENGINEERS
MINOT
BURLINGTON DAM
DES LACS DIVERSION TUNNEL
RAISE LAKE DARLING DAM
DESIGN POOL ELEV1627
MCKINNEY CEMETERY
RENVILLE COUNTY MEMORIAL PARK
CANADA
UNITED STATES
LEGEND
URBAN AREAS BETWEEN BURLINGTON AND MINOT
FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER, NORTH DAKOTA
GENERAL PLAN OF RESERVOIR AREA
FIGURE 2

Figure 2

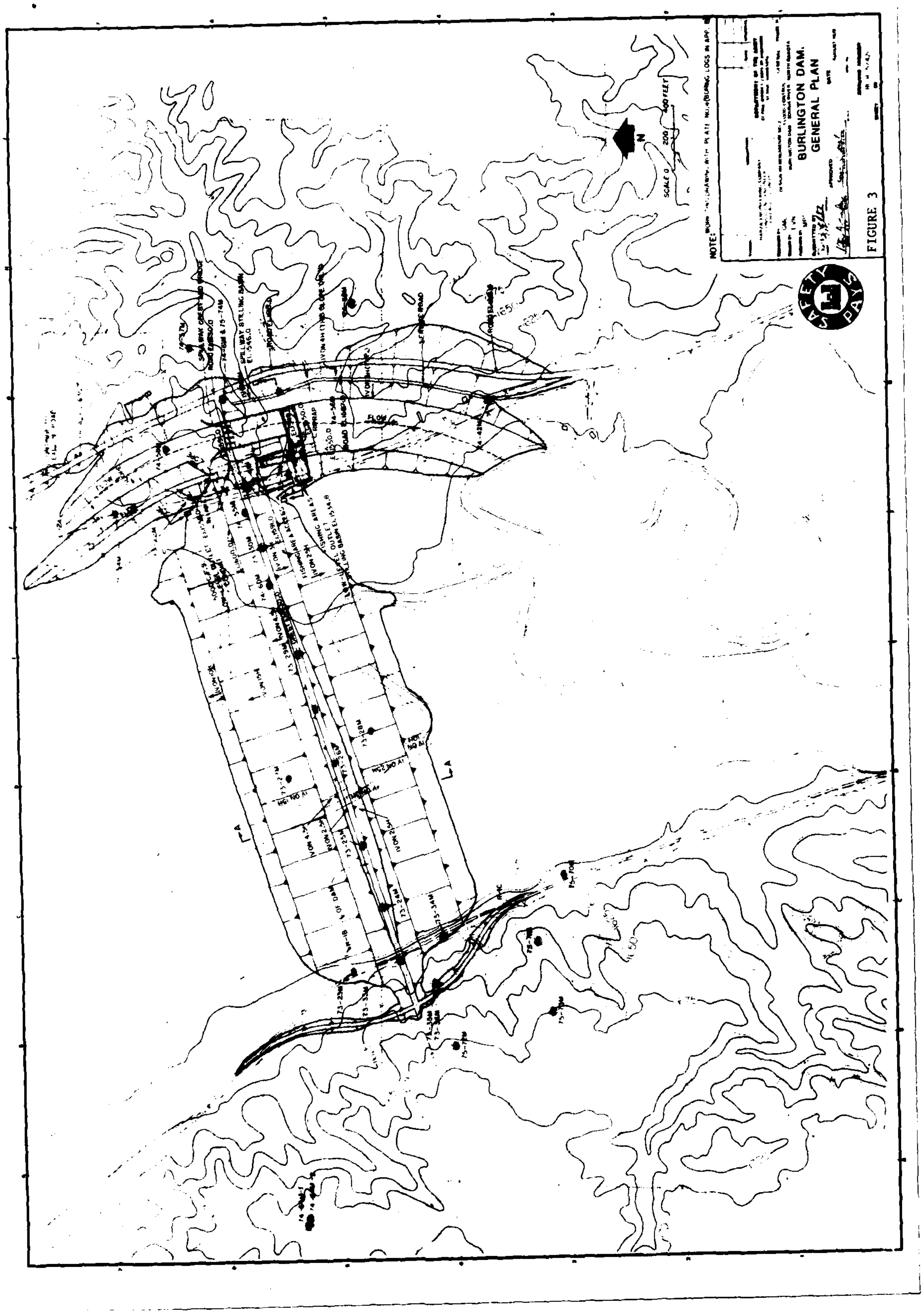
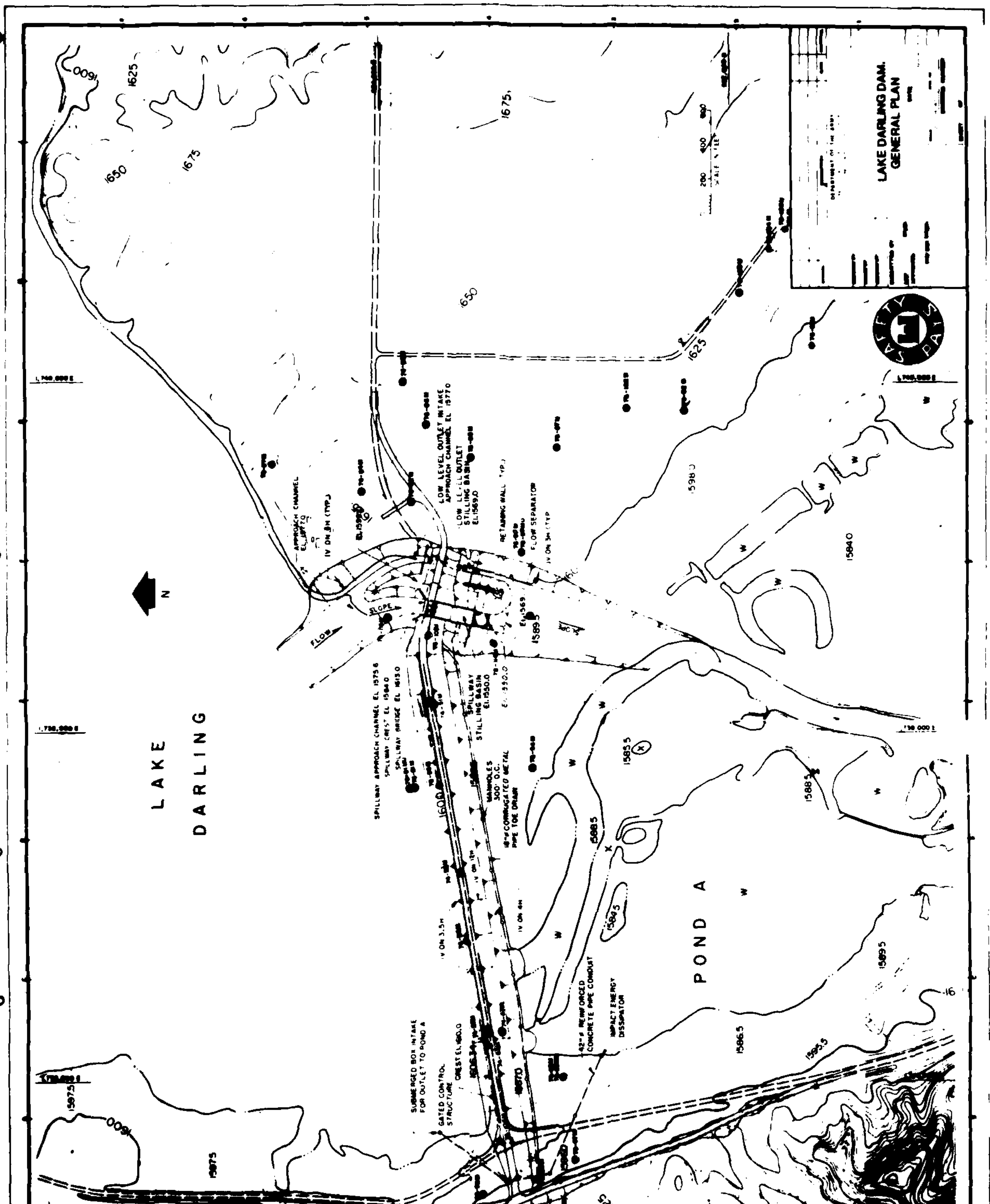


Figure 3


LAKE DARLING
POND A
LAKE DARLING DAM
GENERAL PLAN
N
FLOW
SPILLWAY STILLING BASIN
MANHOLES
SUBMERGED BOX INTAKE FOR OUTLET TO POND A
GATED CONTROL STRUCTURE
IMPACT ENERGY DISSIPATOR
RETAINING WALL
FLOW SEPARATOR

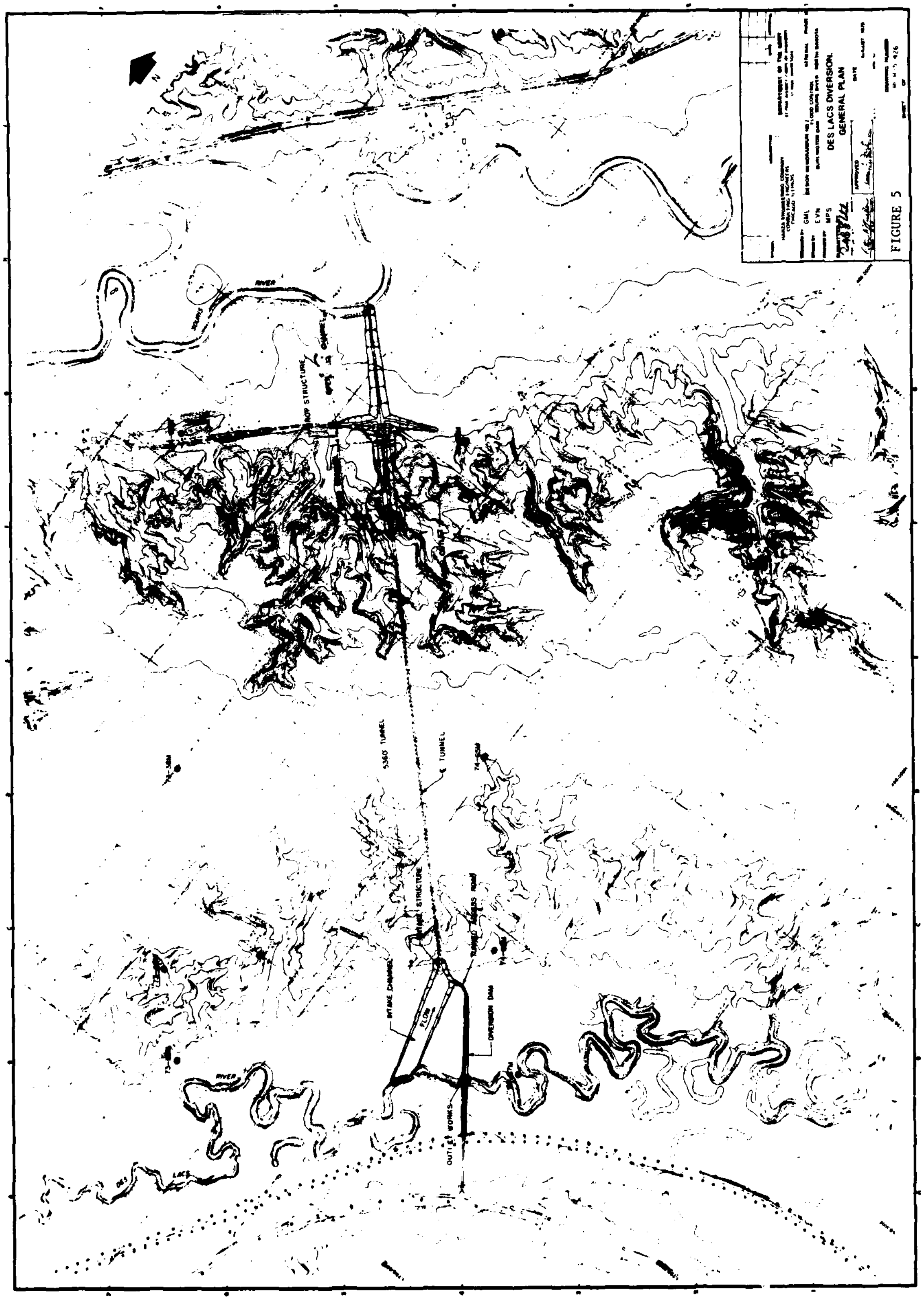
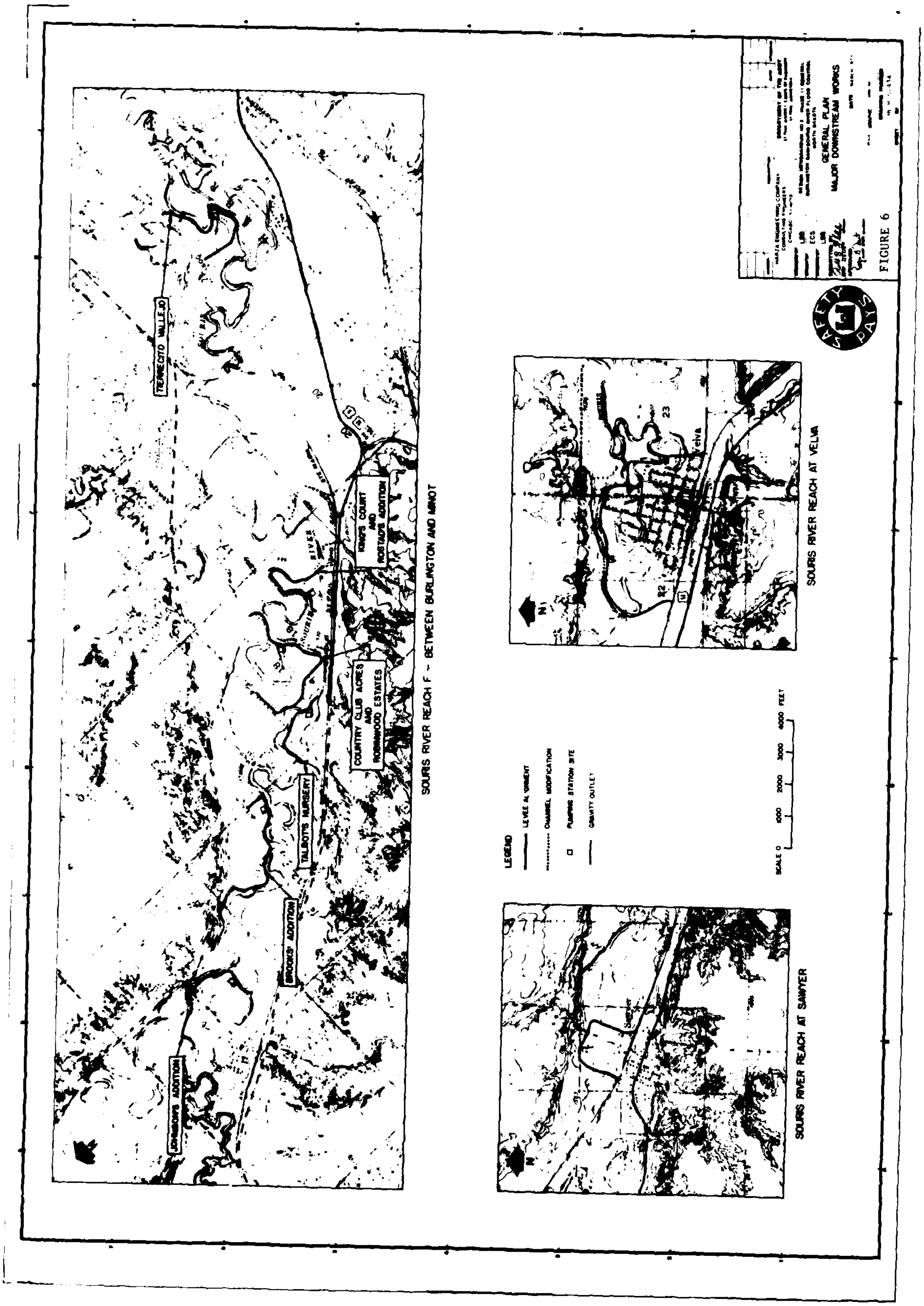
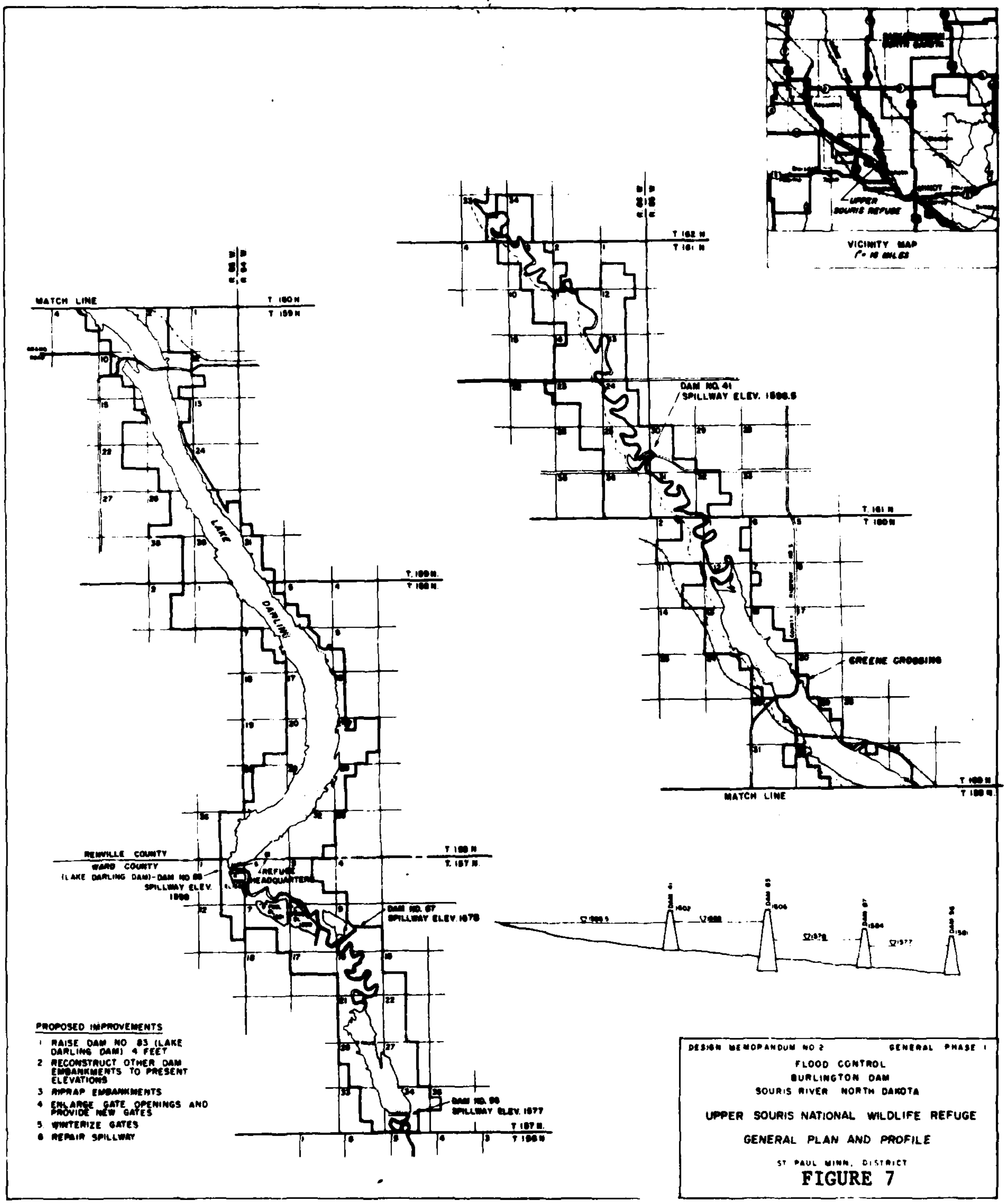

DES LACS DIVERSION
GENERAL PLAN
FIGURE 5
DROP STRUCTURE
5360' TUNNEL
℄ TUNNEL
INTAKE CHANNEL
STRUCTURE
DIVERSION DAM
OUTLET WORKS
FLOW
RIVER

Figure 5



SOURIS RIVER REACH F - BETWEEN BURLINGTON AND MINOT
TERRECITO VALLEJO
KING'S COURT AND ROSTAD'S ADDITION
COUNTRY CLUB ACRES AND ROBINWOOD ESTATES
TALBOT'S NURSERY
BROOKS' ADDITION
JOHNSON'S ADDITION
SOURIS RIVER REACH AT VELVA
SOURIS RIVER REACH AT SAWYER
LEGEND
LEVEE ALIGNMENT
CHANNEL MODIFICATION
PUMPING STATION SITE
GRAVITY OUTLET
SCALE 0 1000 2000 3000 4000 FEET
GENERAL PLAN
MAJOR DOWNSTREAM WORKS
FIGURE 6

Figure 6



DESIGN MEMORANDUM NO 2 GENERAL PHASE I

FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER NORTH DAKOTA

UPPER SOURIS NATIONAL WILDLIFE REFUGE
GENERAL PLAN AND PROFILE

ST. PAUL MINN. DISTRICT

FIGURE 7

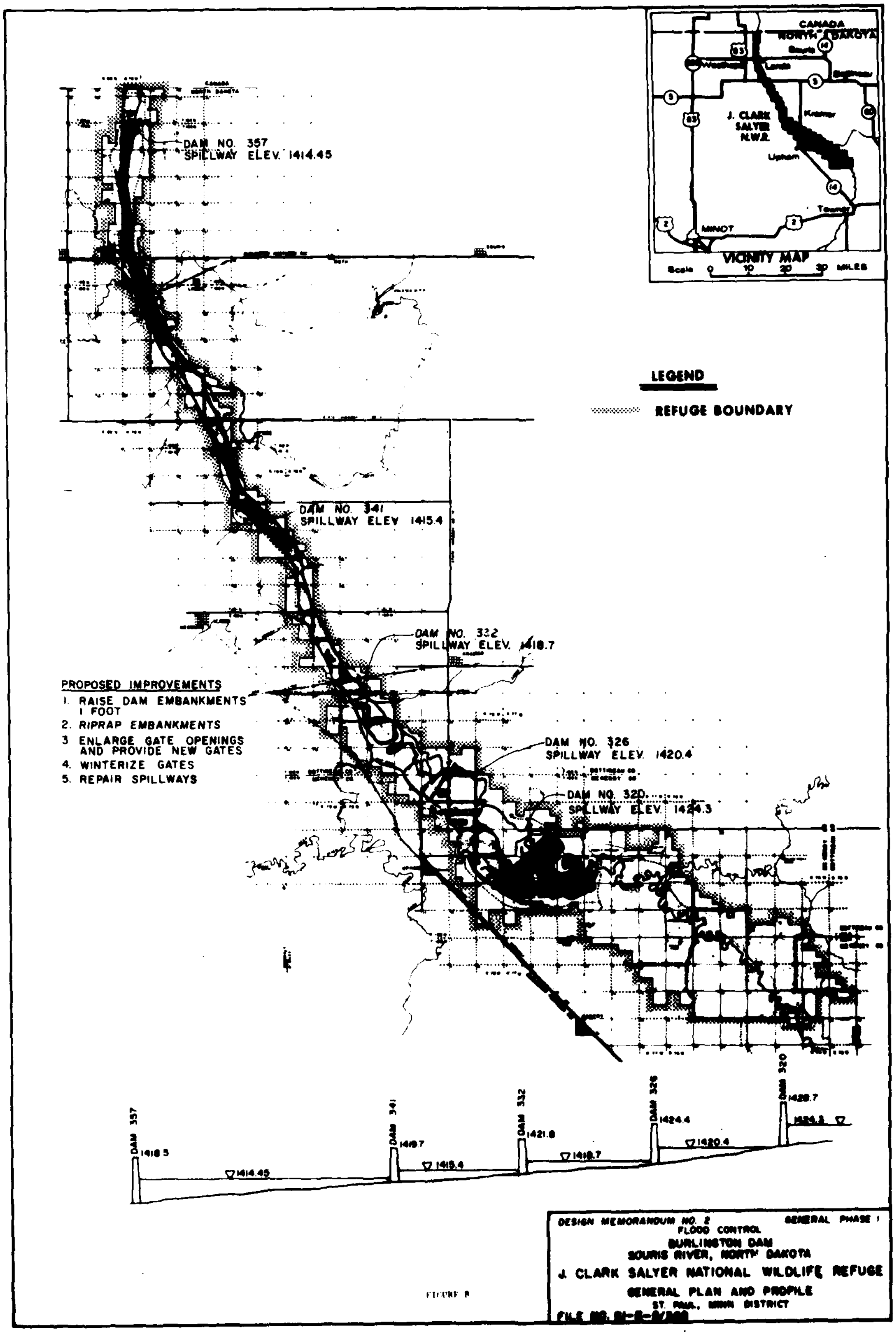

CANADA
NORTH DAKOTA
J. CLARK SALYER N.W.R.
MINOT
VICINITY MAP
Scale 0 10 20 30 MILES
DAM NO. 357
SPILLWAY ELEV. 1414.45
LEGEND
REFUGE BOUNDARY
DAM NO. 341
SPILLWAY ELEV 1415.4
DAM NO. 332
SPILLWAY ELEV. 1418.7
PROPOSED IMPROVEMENTS
1. RAISE DAM EMBANKMENTS 1 FOOT
2. RIPRAP EMBANKMENTS
3. ENLARGE GATE OPENINGS AND PROVIDE NEW GATES
4. WINTERIZE GATES
5. REPAIR SPILLWAYS
DAM NO. 326
SPILLWAY ELEV. 1420.4
DAM NO. 320
SPILLWAY ELEV. 1424.3
DAM 357
1418.5
1414.45
DAM 341
1419.7
1415.4
DAM 332
1421.8
1418.7
DAM 326
1424.4
1420.4
DAM 320
1428.7
1424.3
DESIGN MEMORANDUM NO. 2 GENERAL PHASE I
FLOOD CONTROL
BURLINGTON DAM
SOURIS RIVER, NORTH DAKOTA
J. CLARK SALYER NATIONAL WILDLIFE REFUGE
GENERAL PLAN AND PROFILE
ST. PAUL, MINN. DISTRICT

FIGURE 8

END

DATE
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