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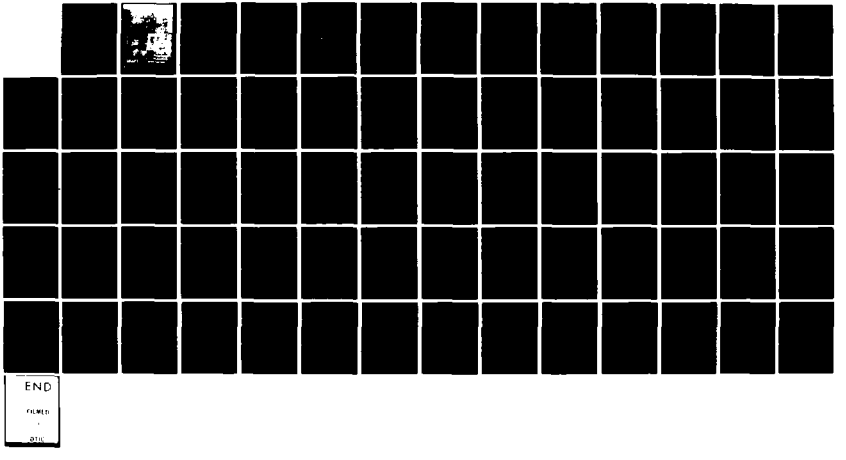

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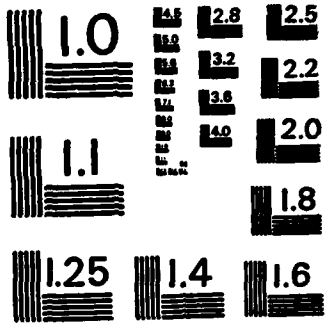

DRAFT

SNAKE RIVER
SNAGGING
CLEARING
SHELTER BELT

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16. DISTRIBUTION STATEMENT (of this Report)

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18. SUPPLEMENTARY NOTES

See also Final environmental impact statement, January 1982.

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

Environmental impact statements
Flood control
Snake River

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

The project would involve snagging and clearing of a 50-mile reach of the Snake River between its confluence with the Red River and the city of Warren, Minnesota. All non-rooted trees and snags in the primary channel would be removed. Standing timber within the primary channel would be cut within 6 inches of the ground. Pilings and rooted stumps in the wetted part of the channel would be cut as close to ground level as practicable. Shelterbelts would be planted along reaches of the river unprotected from drifting snow. This plan would

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reduce flood damages, prevent the reduction in channel capacity and the clogging effect of drifting snow, and increase the amount of riparian habitat. The loss of a large amount of aquatic and terrestrial habitat would occur along a 50-mile reach of the Snake River. The riparian wildlife community would suffer a loss in habitat valued for feeding, cover, perching or loafing, and movement corridors. Aquatic habitat lost would include areas important to the maintenance and production of fish populations.

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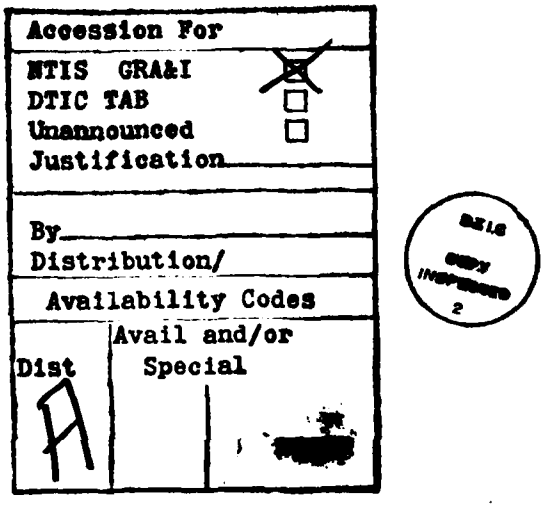
ENVIRONMENTAL IMPACT STATEMENT
SNAGGING AND CLEARING FOR FLOOD CONTROL
SNAKE RIVER, MINNESOTA



ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U.S. POST OFFICE AND CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101

JULY 1979

FOREWORD

In response to a resolution adopted 11 May 1971 by the Middle River-Snake River Watershed District, Marshall County, Minnesota, the Corps of Engineers conducted an investigation to determine the feasibility of snagging and clearing obstructions from the Snake River for the purpose of flood control. This study is authorized under Section 205 of the 1948 Flood Control Act.

A reconnaissance report on the feasibility of providing flood control improvements for the Snake River was issued in August 1972.

The National Environmental Policy Act of 1969 (NEPA) states, in part, that it is the continuing responsibility of the Federal Government to use all practicable means consistent with other essential considerations of national policy to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may:

Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

Assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.

Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.

Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice.

Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities.

Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Further, with respect to major Federal actions significantly affecting the quality of the human environment, Section 102(2)(c) of the NEPA calls for preparation of a detailed statement on:

The environmental impact of the proposed action.

Any adverse environmental effects which cannot be avoided should the proposal be implemented.

Alternatives to the proposed action.

The relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity.

Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

This draft environmental impact statement attempts to identify the associated environmental, economic, and social impacts in accordance with the requirements of the NEPA and is presented to the public in an effort to gain its comments. The public should be aware that the present plan is not absolute but is still subject to change; refinements will still be made.

This draft environmental statement is being furnished simultaneously to all known interests and to the United States Environmental Protection Agency. A notice of availability of this statement will be presented in the Federal Register and a 45-day review period will commence. The intent is to allow the public the opportunity to review and comment on this statement.

Following this review period, all written comments received and Corps responses will be presented in the final environmental impact statement. Following review by higher Corps offices, this final statement will be furnished to the United States Environmental Protection Agency and noted in the Federal Register. A 30-day review period will then ensue. No official action of the proposed project will be undertaken until these steps have been completed.

Coordination in planning with all known interests is a continuing process and attempts to maintain this coordination are being made. (See Section 9 of this report for more detailed information.) Single copies of this report are available at the Corps of Engineers, St. Paul District Office, 1135 U.S. Post Office and Custom House, St. Paul, Minnesota 55101.

SUMMARY

SNAGGING AND CLEARING FOR FLOOD CONTROL,

SNAKE RIVER, MINNESOTA

(X) Draft Environmental Statement ( ) Final Environmental Statement

Responsible Office: U.S. Army Engineer District, St. Paul, Minnesota

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: The project would involve snagging and clearing of a 50-mile reach of the Snake River between its confluence with the Red River and the city of Warren, Minnesota. All non-rooted trees and snags in the primary channel would be removed. Standing timber within the primary channel would be cut within 6 inches of the ground. Pilings and rooted stumps in the wetted part of the channel would be cut as close to ground level as practicable. All materials would be disposed of in the most environmentally acceptable way that meets State and Federal regulations. Also, suitable material would be made available for public use as cordwood.

Shelterbelts would be planted along reaches of the river unprotected from drifting snow. They will consist of a 3-row planting 30 feet wide. A variety of tree and shrub species that provides maximum height and density to the planting will be used.

3. Environmental Impacts

a. Favorable Environmental Impacts: The proposed Snake River plan would have some beneficial impacts in respect to flooding and development of wildlife habitat. Damages caused by the 3- to 5-year (33- to 20-percent chance) floods would be reduced as a result of the clearing and snagging. Shelterbelt construction would prevent the reduction in channel capacity and the clogging effect of drifting snow. There would also be an increase in the amount of riparian habitat as a result of the windbreak.

b. Adverse Environmental Effects: The loss of a large amount of aquatic and terrestrial habitat would occur along a 50-mile reach of the Snake River. The riparian wildlife community would suffer a loss in habitat valued for feeding, cover, perching or loafing, and movement corridors. Aquatic habitat lost would include areas important to the maintenance and production of fish populations. These areas are valued as a food source for some bird and mammal species as well as game fish of the Red River. The fishery also represents limited game fish populations. These would also be adversely affected.

4. Alternatives to the Proposed Project: No action, flood warning and emergency protection, flood insurance, flood proofing, floodplain regulation, evacuation, levee and floodway, channel modifications, diversion channel, upstream reservoirs, and snagging and clearing (proposed plan).

5. Comments Requested: Comments have been requested from the following (for a complete list of agencies, groups, and individuals who have been sent copies of the draft statement and from whom comments were requested see Section 9.00):

U.S. Environmental Protection Agency
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Energy
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Transportation
State of Minnesota
Local Governments
Libraries
News Media
Interest Groups
Individuals

6. Draft EIS to EPA:

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
SNAGGING AND CLEARING FOR FLOOD CONTROL
SNAKE RIVER, MINNESOTA

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1.00 PROJECT DESCRIPTION

Project Location

1.01 The Snake River watershed is located in northwestern Minnesota in Marshall, Polk, and Pennington counties, with the majority of the 922 square mile drainage area located in Marshall County. The project area of the Snake River traverses the intensively farmed, relatively flat Red River Valley. The study area itself covers a 50-mile reach of the Snake River, extending from its confluence with the Red River of the North to Warren, Minnesota, county seat of Marshall County. Alvarado, Minnesota, 11 miles west and 16 river miles downstream from Warren, is the only other community within the study area (Figure 1). The economies of both Warren (1970 population, 1,999) and Alvarado (1970 population, 302) are geared primarily to serving the needs of the surrounding agricultural areas.

Project Authorization

1.02 The proposed project provides for the snagging and clearing of approximately 50 miles of the Snake River. Also, shelterbelts will be constructed along selected areas of the river. The project runs from the city of Warren in Marshall County to the Snake River's confluence with the Red River of the North. The authority for this project is provided by Section 205 of the 1948 Flood Control Act. A map of the project area showing the proposed plan is shown in Figure 1. The proposed project could be completed in the winter of 1979-1980.

Project Purpose

1.03 The proposed project primarily would lessen crop destruction, reduced yields, and other agricultural losses resulting from flooding within the Snake River drainage basin. Reduction of inundated cropland also would alleviate damages as a result of delayed planting.

1.04 The project is expected to reduce flood damages by 17 percent and would be most effective for flood flows at or near channel capacity. It would lessen damages caused by 3-year floods (33 percent chance) and have progressively less effect on more infrequent floods.

The Proposed Plan

1.05 The Snake River plan is composed of 2 major activities, clearing and snagging and planting shelterbelts. The lower 50 miles of the river would be cleared of fallen timber and other debris which is obstructing the natural, free-flowing capacity of the river. These activities would be conducted in the winter to facilitate access and reduce the ecological impacts. Shelterbelts would be planted along preselected, unprotected sections of the

river and function as barriers to the accumulation of large quantities of snow within the primary channel. This accumulation blocks the river channel, preventing the drainage of spring snow melt. This results in increased overland flows, increased leaching of nitrogen from the soil due to a longer duration of standing water, and delay in spring planting.

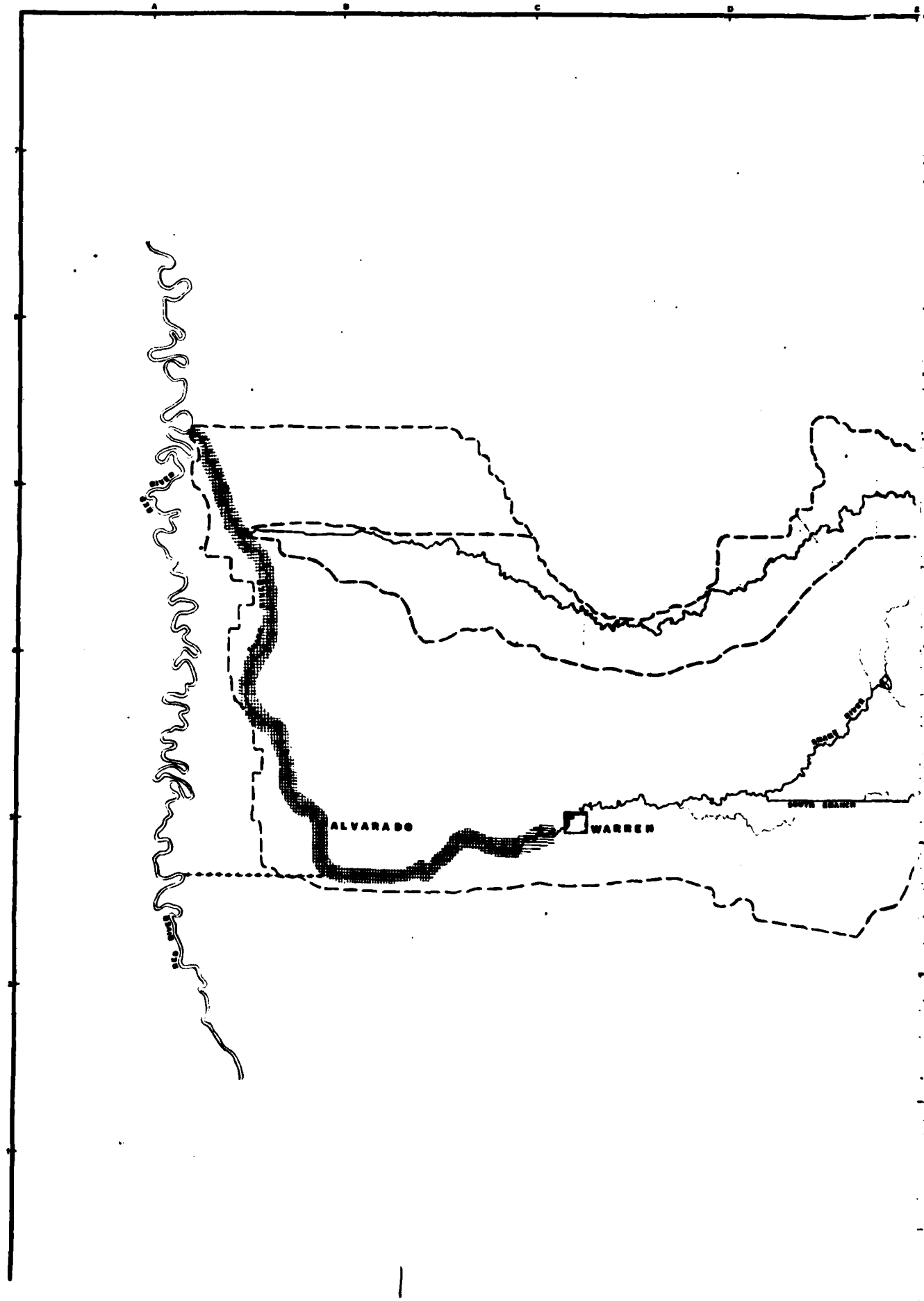
1.06 The clearing and snagging would involve the removal and disposal of all non-rooted fallen trees and snags within the primary channel of the river. Fallen trees that are still rooted would be cut no more than 6 inches above the ground. Dead or leaning trees, which are in immediate danger of falling into the channel, would be cleared. It is recognized that most trees on steep slopes or near areas such as lakes or rivers do lean, even though they are healthy; most of these specimens would be preserved by a selective tree marking program. Dense stands of brush would be cut if the removal is hydraulically desirable and would not increase or otherwise aggravate erosion. Brush removal would be selective and confined to the lower two-thirds of the channel banks. It would be cut as low as practicable but no higher than 6 inches above the ground.

1.07 Standing trees to be removed include those in the lower two-thirds of the channel that are in danger of falling into the channel because their root systems have been undermined. These trees would also be cut 6 inches or less from the ground, measured on the upslope side.

1.08 All loose and uprooted stumps would be removed from the ice, as would those portions of partially submerged debris above the ice. Some completely submerged stumps and debris would be left in place. Root systems which aid in stabilizing the channel would also be left in place. All trees which do not deflect the current against an unprotected bank would be left in place because they would tend to either have no effect on or improve bank stability. Decisions of this type would be made during the selective tree-marking operations conducted by the Corps of Engineers. At this time, access points to the river would also be selected. Stumps from broken or previously cut trees along the channel would be cut to the same height above ground as standing trees. Any pilings encountered within the clearing limits would be cut as nearly flush to the ground or bottom of the channel as possible. The snagging and clearing work would be continuous through all bridge sites within the limits of the contract work. All bridges would remain intact and be protected from any damage. Precautions would be exercised to prevent damage to existing side ditch inlets and road and field ditches along the rivers.

1.09 Normally, the first 10 feet on either side of the primary channel would be cleared of floatable debris and fallen timber to prevent material from being washed into the river channel. However, this would only be a problem if the wooded debris were of substantial length and girth and in an area where it would not lodge in surrounding vegetation before washing into the channel. Live vegetation would not be removed from this area. Because there is little floatable debris on the top of the bank, this aspect of the project would not be undertaken, unless, during the selective tree-marking program, certain areas are recognized as requiring the removal of excess debris.

1.10 Except for the reach of river through Warren (river miles 48 to 51), the river upstream from mile 20 has not been previously cleared. The reach


A
B
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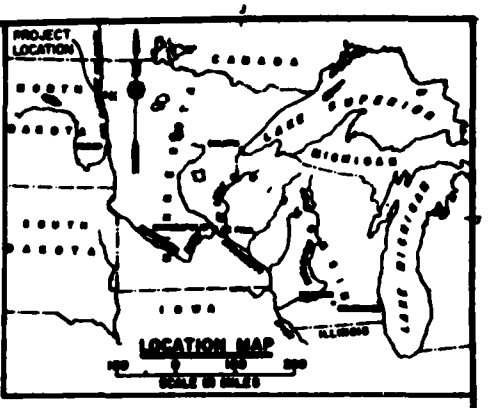
ALVARADO
WARREN



LEGEND

- LEVEE & FLOODWAY SYSTEM
- CHANNEL MODIFICATION
- DIVERSION CHANNEL
- RESERVOIR
- CLEARING & SNAGGING
- MIDDLE RIVER WATERSHED

SECTION 205, DETAILED PROJECT REPORT
FLOOD CONTROL – SNAKE RIVER
BELOW
WARREN, MINNESOTA

GENERAL PLAN
ALTERNATIVES CONSIDERED

IN 4 SHEETS SHEET NO. 1

SCALE AS SHOWN

ST. PAUL DISTRICT CORPS OF ENGINEERS

SUBMITTED RECOMMENDED APPROVED

DRAWN BY: FILE NO. TRANSMITTED WITH REPORT

U.S.GPO:1979-665-055/23-6

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between Alvarado and State Ditch 5 contains large amounts of debris and fallen timber which would require removal. The area between State Ditch 5 and the upstream clearing limits contains much less material that needs to be removed than the reach immediately downstream. Construction in the lower reach of the river (from the mouth to river mile 20) would consist of debris removal only, since this reach was cleared and snagged by the Middle River-Snake River Watershed District in 1969 and 1971 and does not require much work. This project was funded by the State of Minnesota and the U.S. Office of Emergency Preparedness following the 1969 flood.

1.11 As part of the proposed plan, windbreaks would be planted at points along the river where the wooded corridor is not continuous and the unprotected channel becomes filled with snow, which hampers spring runoff and contributes to the overland flooding problem. These windbreaks would reduce windblown siltation and snow accumulations.

1.12 Shelterbelts would be planted parallel to the river, with the inner edge of the planting no less than 150 feet from the top of the channel (the minimum distance necessary to prevent channel drifting). The shelterbelts can be as far as 500 feet from the primary channel to accommodate agricultural use and to reduce the amount of land removed from production. Optimally, the windbreak should be four or more rows wide, planted on both sides of the channel, to obtain maximum benefits; but, due to local opposition to the amount of agricultural land lost under this plan, a compromise plan has been developed, with a three-row planting limited to the north side of the channel on the project reach between Warren and Alvarado. It should provide channel protection from northerly-blown (the prevalent wind direction) snow. There will be no protection from southerly storms or wind-blown snows.

1.13 Within the windbreak, rows would be 15 feet apart. Within the shrub rows, plantings would be 3 to 4 feet apart; within the tree rows, 10 feet apart. This spacing will provide an effective barrier against windblown snow, yet eliminate most of the natural pruning which occurs on plantings that are too close together (U.S. Department of Agriculture, 1964). The planting would be arranged so that the outer row (farthest from the channel) would include a combination of short trees, using box elder (Acer negundo), Russian Olive (Elaeagnus angustifolia), and American plum (Prunus americana). The center row of the belt would be composed of a combination of shrub species, including Allegheny blackberry (Rubus allegheniensis), buffaloberry (Shepherdia argentea), chokecherry (Prunus virginiana), honeysuckle (Lonicera tartarica),and multiflora rose (Rosa multiflora). The inner row (closest to the river) would be a tall tree row composed of cottonwood (Populus deltoides) and green ash (Fraxinus pennsylvanica). Such a planting scheme maximizes the protective benefits of the belt, in addition to reducing the possibility of the belt being destroyed by a disease affecting a single species. Species composition would provide wildlife food and cover in an area where agricultural clearing has destroyed most of the natural habitat.

Operation and Maintenance

1.14 The clearing and snagging operation would be conducted during the winter so that the river channel could be used as a base of operations. Contract specifications would require that the work be conducted from the ice except where conditions prove hazardous. If the project cannot be completed during the winter, it would be finished at times when there is no flow, which is sometimes the case with the Snake River. Summer removal may be necessary in heavily snagged areas, where an entire tree has fallen into the channel or a large portion of the debris is under the water surface. The dry channel would still be used as a base of operations.

1.15 The shelterbelt planting would be done in April or May, after the frost is out of the ground and before any new growth occurs on the trees to be planted.

1.16 The Minnesota DNR has proposed the purchase of a 100-acre tract of land, located between Alvarado and State Ditch 5 in Sections 8 and 17 of T. 154 N. and R. 49 W., to be maintained as a wildlife management area. The Snake River meanders through this area for about three-quarters of a mile. Project activities in this area would be limited to removal of debris and snags that are causing a serious impediment to the flow. This aspect of the project has been coordinated with the MDNR in the event that the land is acquired and their management plans implemented.

1.17 Materials and debris from the snagging and clearing operation would be removed from the site and disposed of in the most environmentally acceptable way. Salvagable material would be stockpiled where it would not interfere with existing land-use practices; and, in the interest of conservation, all suitable timber could be used to produce marketable saw-logs, posts, or cordwood. All unsalvagable material would be disposed of by burning (when and where allowable), burial, or hauling to an approved disposal site. Debris disposal would be accomplished in a manner most agreeable to the local landowners and in compliance with Federal, State, and local regulations. Members of the Snake River-Middle River Watershed District Board have commented that the demand for cordwood has markedly increased in recent years and they recommended that as much of the salvagable material as possible be made available for this use. The District Board also recommended that any salvagable materials from the downstream reaches of the river be stockpiled at a selected upland site to substantially remove it from the floodplain of the Red River of the North.

1.18 Maintenance of the flood-carrying capacity of the improved channels would be essential to assure effective operation of the overall drainage system and realization of the anticipated project benefits. To properly evaluate the condition of the river channel within the project limits, annual inspections are recommended as a minimum requirement. It is anticipated that debris removal may be required annually or after each flood event in some isolated reaches, and minor clearing of new growth required every 3 to 4 years in critical sections of the channel. Project maintenance would be the responsibility of local interests and is part of the local cooperation requirements discussed in the Detailed Project Report (on file at the St. Paul District Office).

Economics

1.19 The proposed project would result in estimated average benefits of $107,500 with the shelterbelts and $87,600 without the shelterbelts, yielding benefit-cost ratios of 1.9 and 1.7, respectively. Shelterbelt benefits reflect economic values but do not take into account the unquantifiable wildlife values of the windbreak planting. Benefit calculations are based on October 1978 prices, a 6-7/8 percent interest rate, and a 50-year period of amortization.

2.00 ENVIRONMENTAL SETTING WITHOUT THE PROJECT

Geographical Setting

2.01 The Snake River is a slow moving, meandering tributary of the Red River of the North, which drains an area of about 922 square miles in northwestern Minnesota and has a total length of over 80 miles. The Middle River drains into the Snake River about 5 miles above its mouth through State Ditch Number 3.

2.02 The Middle River and Snake River watersheds are located in southwest and westcentral Marshall County (768 square miles), in northwestern Pennington County (22 square miles), and in northwestern Polk County (132 square miles). An extensive system of ditches in the area, some of which drain into the Snake River, provides drainage for large expanses of land. Sometimes, during the summer months, the Snake River has intermittent flow.

2.03 The area is used almost entirely for agricultural purposes, but areas of woodland exist along the river.

Geology

2.04 This portion of Minnesota was affected by glacial action, and the watersheds of the Middle and Snake Rivers are within a featureless plain considered to have been submerged in ancient glacial Lake Agassiz about 10,000 years ago. The eastcentral part of the watershed is crossed by low ridges which are the remnants of the beaches of Lake Agassiz as it receded.

Topography

2.05 The lowest elevation in the watershed is at the mouth of the Snake River where the ground is about 765 feet above mean sea level. The higher elevations are found in the extreme northeastern portion of the Middle River watershed where some elevations slightly exceed 1,190 feet. The difference in elevation is 425 feet.

2.06 The slopes in the Middle and Snake River watersheds range from ½ foot per mile near the Red River to 2 feet per mile in the headwaters area. Near the Red River, slopes are slight, and the streams originally had no discernible channels, so artificial channels have been constructed across these flat areas. State Ditches 3 and 5 are early channels, constructed in this area about 1896.

Soils

2.07 Soils in the Snake River drainage basin are alluvial in the river bottoms, while the upland soils are predominantly the Fargo and Bearden soils series.[1]

---

[1] Soil Conservation Service, 1939 Reconnaissance Soil Survey of the Red River Valley Area, Minnesota.

2.08 Alluvial soils are undifferentiated and occur in long, narrow strips along the channels of streams. These soils range from clay to outwash sand and include loamy sands and silt loams, vary in color from black to light brown, and range in stoniness from an absence of stones to very stony. These areas are poorly drained, and, therefore, only portions are cultivated. Most of these areas are forested.

2.09 The Fargo soils have high clay and organic matter contents which cause a conspicuously heavy texture and a black-colored surface soil. The natural richness of these soils makes them well suited to agricultural purposes, and they are cultivated extensively.

2.10 The Bearden series consists of two principle types: loam and silt loam. These soils are not as naturally fertile as the Fargo soils but are still used extensively for agricultural purposes.

Climate

2.11 The climate of the Snake River basin is characterized by wide variations in temperature with moderate rainfall and snowfall. The mean annual precipitation averages 19.73 inches with snow accounting for about 2.6 inches of the total. The mean temperature is 38°F. Extreme temperatures recorded range from a high of 108°F to a low of -49°F. Frost-free days, as observed at the University of Minnesota Experiment Station at Crookston, Minnesota, average 124 days annually. The average date of the last frost in spring is 19 May, and the first frost in fall is 20 September, on the average.

Water Quality

2.12 Analysis of water samples from the Snake River indicates moderate to high alkalinity and sulfate concentrations. A small percentage of the samples exhibited less than desirable dissolved oxygen concentrations. However, ionic constituents indicate generally good water quality with values typical of other surface waters in the same geographic areas (Table 1).

Water Supply

2.13 Small to moderate supplies of groundwater are available in the uplands in the eastern part of the basin. In the remainder of the basin, especially more westerly areas adjacent to the Red River of the North, suitable groundwater supplies are limited and inadequate. Surface waters seem to be the largest potential source of water for the Snake River basin, the best source of which appears to be the Red River of the North due to the intermittent characteristics of the Snake River and the nearby Middle River.

2.14 Use of the groundwater supplies is limited due to the high dissolved solids content, which renders such waters unsuitable for domestic uses.

2.15 The Snake River has received a Fisheries and Recreations use classification (2B) by the Minnesota Pollution Control Agency. A 2B classification describes water quality standards that will "permit the propagation and maintenance of cool or warm water sport or commercial fishes and be suitable for aquatic recreation of all kinds, including bathing..." (Table 1).

TABLE 1 - WATER QUALITY STANDARDS FOR SNAKE RIVER

2B CLASSIFICATION

Parameter	Limit
Dissolved Oxygen	not < 6 mg/l April 1 - May 30 not < 5 mg/l any other time
Temperature	5°F above natural[1] - streams 3°F above natural[1] - lakes
Ammonia (N)	1 mg/l
Chromium (Cr)	0.05 mg/l
Copper (Cu)	0.01 mg/l
Cyanides (NC)	0.02 mg/l
Oil	0.5 mg/l
pH	6.5 to 9.0
Phenols	0.01 mg/l
Turbidity	25 Jackson Units
Fecal coliform	200/100 ml of sample
Radioactive material	Not to exceed the lowest concentration permitted by the authority having control over their use.

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[1]Minnesota Pollution Control Agency, Rules and Regulations, WPC 14, 4 October 1975. Based on monthly average of the maximum daily temperature except in no case shall the monthly average exceed the daily average temperature of 86 degrees Fahrenheit.

Wildlife Resources

2.16 The wildlife resources of the Snake River were determined from data collected on similar rivers in the area and from conversations with local naturalists and personnel from the Minnesota DNR.

2.17 The floodplain forests are prime habitat for many wildlife species. It is the preferred habitat for furbearers and other mammals. The bottomland woods also provide sanctuary for migrating birds as well as suitable habitat for permanent residents. The complexity and diversity of the wildlife resources are attributable to the area's water resources and vegetative composition, which have evolved with periodic flooding.

2.18 Fish - The fish resources of the Snake River are represented by a limited fishery composed of a small population of harvestable fish. These species are presumed to include silver and northern redhorse (Moxostoma anisurum and M. macrolepidotum), freshwater drum (Aplodinotus grunniens), quillback (Carpiodes cyprinus), mooneye (Hiodon tergisus), channel catfish (Ictalurus punctatus), and walleye pike (Stizostedion vitreum). The fish population may also include minnows, shiners, and other forage fish, which provide an input into the foodchain of the Red River of the North, thus providing a link between the Snake River's productivity and the fishery of the Red River.

2.19 Mammals - White-tail deer (Odocoileus virginianus) and an occasionally sighted moose use the channel area as a movement corridor through the relatively barren agricultural areas, to some of the woodlots of higher habitat value. White-tail deer wintering yards, with 20 to 30 head each, are found near Alvarado and Warren. The predominant furbearers found in the river corridor include beaver (Castor canadensis), mink (Mustela vison), raccoon (Procyon lotor), and muskrat (Ondatra zibethicus). Other mammals found in the area include foxes (Vulpes vulpes and Urocyon cinereoargenteus), weasel (Mustela sp.), rabbit (Lepus townsendii, L. americanus, and Sylvilagus floridanus), skunk (Mephitis mephitis), and squirrel (Sciurus carolinensis, S. niger and Tamiasciurus hudsonicus). The more obscure mammals inhabitating the area include the mole (Condylura cristata), shrew (Sorex sp. and Microsorex hoyi), bat (Myotis sp., Lasionyctetris noctivagans, Eptesicus fuscus and Tasiurus sp.), ground squirrel (Spermophicus sp.), chipmunk (Tamias striatus), and mice (Cricetidae and Zapodidae families).

2.20 Within the heavily farmed and cleared land of the Snake River area, the diverse river bottom habitat provides a variety of food and cover types making available a multitude of different niches. Many of the species present are adapted to a certain role or niche within this complex ecosystem, each of these organisms being somewhat dependent on the other organisms, whether in predator-prey or energy flow relationships. It is important, especially in an area like the Snake River, to maintain and, if possible, to propagate these ecosystems that represent the natural productivity of our land.

2.21 Birds - The Snake River area provides a diverse type of habitat for many different types of bird species. This diversity of habitats occurs in a horizontal plane starting at the river edge and moving through the various vegetative zones to the edge of the agricultural land. There is also a diversity found in a vertical plane. Different groups of bird species are associated within the different heights, types, and densities of shrub

and tree vegetation. This makes the Snake River bottoms rich in bird life, as evidenced by the large number of species that are known to use the area.

2.22 A list of 140 avian species has been compiled for the Snake River drainage basin. A composite report of the number of species occurring within each order is given in Table 2.

Amphibians and Reptiles

2.23 The limited amphibian and reptile resources of the Snake River area are primarily represented by frogs, snakes, and turtles. The amphibian species would include the tiger salamander (Ambystoma tigrinum), Dakota and plains toads (Bufo hemiophrys and B. cognatus), grey tree frog (Hyla versicolor), leopard and wood frog (Rana pipens and R. sylvatica), and the chorus frog (Triseriota pseudocris). The reptiles found in the Snake River area would include the plains and common garter snakes (Thamnophis sirtalis and T. radix), painted turtle (Chrysemys picta), and common snapping turtle (Chelydra serpentina).

2.24 Since the Snake River occasionally becomes dry in the summer, the amphibian and reptile life would be closely associated with beaver impoundments. Also, spring flooding would provide scattered pockets of temporary water that could be used by salamanders, toads, and frogs.

Endangered Species

2.25 Endangered or threatened species which may be found in the project area are the Arctic peregrine falcon (endangered) and the grey wolf (threatened in Minnesota). The peregrine breeds in the treeless tundra area of Arctic Alaska, Canada, and western Greenland. Its migration routes go through middle and eastern North America. No sitings of Arctic peregrine falcons have been recorded in the project area.

2.26 The range of the grey wolf extends through northeastern and north-central Minnesota. The project area lies on the periphery of this range. Wolves are normally found in the forested regions of Northern Minnesota. Presence of the grey wolf would be only occasional, if not unusual, in this extensively cleared, agricultural area.

Vegetation

2.27 The natural vegetation of the area is located primarily along the river with some native woodlands and planted shelterbelts on farmsteads. The riparian overstory of the Snake River, similar to that of the Forest River in North Dakota[1], would include willow (Salix sp.), cottonwood, green ash, box elder, and American elm (Ulmus americana).

2.28 Ordinarily a well-developed understory composed of small trees and shrubs is present in the floodplain forest. These would include prickly ash (Zanthoxylum americanum), dogwood (Cornus sp.), wolfberry (Symphoricarpos occidentalis), chokecherry, gooseberry (Ribes missouriensis), and wild grape (Vitis sp.), as well as several others.

[1]Wilkum, D. A. and M. K. Wali, 1974. "Analysis of a North Dakota Gallery Forest; Vegetation in Relation to Topographic and Soil Gradients." Ecological Monographs 44:441-464.

TABLE 2

NUMBER OF AVIAN SPECIES, BY ORDER, IN THE SNAKE RIVER BASIN

	Order	Common Member	No. of Spp.
1.	Podicipediformes	Grebes	1
2.	Ciconiiformes	Heron	1
3.	Anseriformes	Waterfowl	5
4.	Falconiformes	Hawks	7
5.	Galliformes	Grouse	4
6.	Gruiformes	Marsh birds	3
7.	Charadriiformes	Shorebirds	7
8.	Columbiformes	Doves	1
9.	Cuculiformes	Cuckoo	1
10.	Strigiformes	Owls	4
11.	Caprimulgiformes	Goatsuckers	1
12.	Apodiformes	Swifts/Hummingbirds	2
13.	Coraciiformes	Kingfisher	1
14.	Piciformes	Woodpeckers	7
15.	Passeriformes	Perchingbirds	95

TABLE 3- DISTRIBUTION OF LAND USE

(Percent of forties[2])[1]

Land Use	Counties		
	Marshall	Polk	Pennington
Cultivated	65.2	86.6	81.5
Pasture & Open	16.3	5.1	9.2
Forested	11.5	5.1	6.6
Water	1.4	1.3	0
Marsh	5.2	0.6	1.7
Residential	0.1	0.4	0.4
Non-residential or Mixed residential	0.2	0.7	0.4
Extractive	--[3]	0.1	0.1
Transportation	--[3]	0.1	0.1

[1] Minn. St. Planning Agency, Land Management Information in Northwest Minnesota, Report 1, 1972.

[2] A forty is 1/16th of a section, or 40 acres. It is the smallest unit of general land survey.

[3] Less than .1 percent

TABLE 4 - LANDSCAPE CHANGES[1]

County	Pre-Settlement Landscape (number of forties)			Present Landscape (number of forties)			Percent Change (number of forties)		
	Marsh	Forest	Grassland	Marsh	Forest	Grassland	Marsh	Forest	Grassland
Marshall	6,307	9,730	12,614	1,494	3,328	4,468	-76%	-66%	-62%
Polk	4,932	9,190	17,921	182	1,627	1,603	-96%	-82%	-91%
Pennington	1,960	4,064	3,829	157	639	941	-92%	-84%	-75%
Total	13,199	22,984	34,364	1,833	5,594	7,012			

[1]Minnesota State Planning Agency, Land Management Information in Northwest Minnesota, Report 1, 1972.

2.29 Aquatic vegetation found within the Snake River watershed would include pond weeds (Potamogeton sp.), arrowheads (Sagittaria sp.) bulrush (Scirpus sp.), sedges (Carex sp.), and cattail (Typha latifolia).

Land Use

2.30 The majority of the land within Marshall, Polk, and Pennington Counties is devoted to agriculture (Table 3). Approximately 75 percent of the land in the watershed is devoted to agriculture, 15 percent to woodland, and the remaining 10 percent to farmsteads, roads, ditches, marshes, and other miscellaneous uses.

2.31 Land-use activities in this region have significantly altered the original landscape through wetland drainage, forest clearing, agricultural development, and urban expansion (Table 4). Most of the forests remaining are near farmsteads or along stream valleys.

Potential Land Use

2.32 The Minnesota DNR has proposed the acquisition of a tract of woodland upstream of Alvarado as a wildlife management area. About a three-quarter mile reach of the Snake River flows through the proposed wildlife management area.

2.33 A wildlife manager with the DNR has stated that this is a unique 100-acre tract of land. It is one of the last substantial stands of timber along a watercourse in the intensively cultivated Red River Valley.

2.34 Existing in this area is a wide diversity of tree species including bur oak (Quercus macrocarpa), elm, cottonwood, aspen (Populus sp.), balm of Gilead (Populus candicans), ironwood (Ostrya virginiana), ash (Fraxinus sp.), box elder, American plum, and black willow (Salix nigra). Further away from the river a shrub layer is present consisting of chokecherry, raspberry (Rubus strigosus), and dogwood.

2.35 This area provides some of the best wildlife habitat within an 8-mile radius. Because of its size and good cover, it is a well-used deer wintering yard with approximately 30 deer annually congregating in the area. the area also provides preferred habitat for furbearers, squirrels, woodducks, and great horned owls plus several other mammalian and avian inhabitants.

Flooding

2.36 Floods causing significant damages in the city of Warren occurred in 1896, 1897, 1901, 1941, 1950, 1965, 1966, and 1969. The greatest flood of record occurred in 1969; however, a greater historical flood in 1897 probably exceeded the 1969 flood, but no official data are available.

2.37 During the record spring flood of 1969, about 75 percent of Warren was flooded to shallow depths. A record peak discharge of 4,300 cfs (cubic feet per second), compared with the existing channel capacity of only about 1,400 cfs, occurred on 10 April 1969. In Warren, the flooding was first caused by storm sewer backup, then by the river overtopping the channel banks in the northeast area of the city. For about 3 days, the business district lacked water and sewer service, and most basements were flooded.

2.38 Records have been kept for a relatively short period of time at Warren. U.S. Geological Survey discharge records for the Snake River at Warren cover only from March to September 1945 and from October 1953 to September 1956. Table 5 presents flood data.

TABLE 5

FLOOD CREST ELEVATIONS, SNAKE RIVER AT WARREN, MINNESOTA, MINNESOTA STREET BRIDGE

Date of crest	Estimated peak discharge (cfs)[1]	Stage[2]	Elevation[3]
4-6 May 1950	3,510	18.4	853.4
April 1965	3,250	17.9	852.9
3 April 1966	3,410	18.4	853.4
10 April 1969	4,300	19.4	854.4
Intermediate regional flood	5,500		854.6
Standard project flood	10,500		857.1

[1] From elevation-discharge rating curve for old U.S. Geological Survey gage.

[2] From high water marks.

[3] Feet, mean sea level, 1929 adj. Elevations are based on a gage height of 835.0 feet.

2.39 Because of the short period of miscellaneous discharge records for the Snake River at Warren and Alvarado, longer records from a nearby basin (the Middle River) were analyzed and compared. Studies of peak discharges and frequency curves in this area indicate that the long period of record for the adjacent Middle River at Argyle (drainage area = 248 square miles) correlates well with the Snake River at Warren (drainage area = 175 square miles). Studies of peak flows at Argyle and at Warren indicate that the peaks vary with the 0.65 power of the drainage area ratio. The Argyle frequency curve was transferred to the Snake River at Warren and Alvarado.

2.40 Discharge-frequency curves for the Middle River at Argyle were derived from a study of the 29 years of record (1945 and 1950-1977). Of the 29 years of record, five peak flows were much lower than the others and were considered as low outliers. The ten lowest peak flows are shown in Table 6.

TABLE 6 - MIDDLE RIVER AT ARGYLE, MINNESOTA
LOWEST PEAK FLOWS OF RECORD

Rank	Water Year	Flow (cfs)
20	1972	729
21	1976	631
22	1952	612
23	1959	570
24	1955	527
25	1961	135
26	1954	128
27	1953	112
28	1973	93
29	1977	80

2.41 Several different discharge-frequency curves were developed using guidelines and procedures outlined in Water Resources Council (WRC) Bulletin No. 17A. Low flows were omitted and resultant frequency curves were plotted.

2.42 The largest flood of record for the Middle River at Argyle on 3 July 1975 was not the largest observed flood peak at Warren for two reasons:

a. The 1 and 2 July 1975 storm centered on the headwaters of the Middle River basin and only covered a small portion of the Snake River headwaters.

b. An internal overflow on the Snake River headwaters caused a large portion of this flood to bypass Warren. Because the overflow area has now been diked, this overflow will not be repeated during future floods.

2.43 The discharge-frequency curves for the Snake River at Alvarado (drainage area = 220 square miles) are also based on the records for the Middle River at Argyle. The Argyle frequency curves were transferred to the Snake River at Alvarado using a factor of 0.92, the 0.65 power of the drainage area ratio. The Alvarado discharge-frequency curves were plotted using "expected probability P_N"and Weibull's plotting positions. These frequency curves were developed to be used in design studies and should not be used for flood insurance studies.

2.44 Table 7 shows a comparison of the 100-year (Corps of Engineers) design discharge data and the 100-year intermediate regional or regulatory flood peaks used for flood insurance studies:

TABLE 7 - 100-YEAR FLOOD DATA

Site	Drainage Area (Square Miles)	100-Year (1%) Frequency Flood Peaks For Design Studies	For Flood Ins. Studies
Middle River at Argyle	248	6,800 cfs	5,940 cfs
Snake River at Alvarado	220	6,310 cfs	5,460 cfs
Snake River at Warren	175	5,490 cfs	4,750 cfs

2.45 A coincidental frequency analysis for the Snake River at Alvarado and the Red River of the North has not been developed for this study. This data was not computed because no records are available to develop the coincidental frequency analysis. In addition, there is a serious question as to the independence of events on the Snake River and Red River. The profile data for the Red River of the North at Oslo, Minnesota (6 miles west of Alvarado), indicate that flows like the 100-year (1-percent frequency) peak and greater on the Red River of the North main stem would definitely cause flooding at Alvarado. Therefore, it can be assumed that the 500-year peak stage, as determined for this study, would occur more often and that the 500-year (0.2-percent frequency) profile would be somewhat higher than that computed for no backwater from the Red River. This same coincidental backwater condition could also affect the other profiles to some extent.

Existing Water Management Projects

2.46 In October 1966, after suffering a severe spring flood, local interests began to construct a ring levee around Alvarado to prevent the annual flooding. Although this levee was nearly overtopped by the record-breaking 1969 flood, local citizens succeeded in emergency efforts to raise and reinforce the levee, preventing substantial flood damage to the community.

2.47 Following the 1969 flood, funds from the State of Minnesota and the U.S. Office of Emergency Preparedness were used to finance a project to snag and partially clear about 23 miles of the Snake River from its confluence with the Red River of the North to about 10 miles downstream from Alvarado. The 16 miles of river channel between Alvarado and Warren include about 3 miles of ditch constructed in 1896 as State Ditch No. 5.

2.48 Existing flood damage reduction works at Warren are largely the result of flood emergency preparations undertaken in the spring of 1971 with assistance by the Corps of Engineers. The emergency work included snagging and partial clearing of the riverbanks for about a mile downstream from Warren and some minor channel enlargement at a meander within the city limits.

2.49 Farm levees have also been constructed in some areas to protect individual fields or developments. These are earthen embankments near the river or parallel to ditches that drain the area.

Recreation

2.50 The recreational resources in this area relate primarily to hunting and nature interpretation. Boating, swimming, and camping facilities are scarce due to competition from recreation areas in Minnesota Planning Regions 2 and 4 and to a lack of sizeable lakes.[1] Development of lake-associated facilities in Region 1 is not expected to attract visitors from outside the region.

2.51 No major recreation development is currently proposed for Planning Region 1. The 1974 SCORP lists boating, swimming, and camping facilities as scarce commodities in this area. Development is recommended at the State level.

Agriculture

2.52 Census data for Marshall and Polk Counties and the State of Minnesota from 1969 to 1974 indicate slight changes in the land area contained in farms while the proportion of farmland used for crops remained relatively constant. In these 5 years, although Minnesota as a whole showed a decrease in the amount of farmland, Marshall and Polk Counties showed a slight increase (Table 8). Land-use patterns (cropland/woodland/other) within this farmland remained similar with approximately 82 percent of all farmland being used for some sort of cropland.

2.53 Past trends indicate that increasing agricultural investment costs have resulted in a movement to fewer and larger capital-intensive farming operations, which displace smaller labor-intensive family farms and which require fewer agricultural employees. Also, good farmland resources are limited, and as the purchase of land requires ever-increasing amounts of capital, many farmers have turned to leasing or renting additional land as an optional means to enlarge farm operations.

2.54 Although these trends are beginning to level off, agricultural statistics (Census of Agriculture 1964-1974) for the State and counties still indicate a decrease in the number of farms and farm operators from 1959 to 1974 (Table 9). Census data shows the number of farms as equal to the number of

[1] 1974 Minnesota State Comprehensive Outdoor Recreation Plan (SCORP).

TABLE 8 - FARMLAND AND USAGE PATTERNS, 1969 AND 1974

	Minnesota		Marshall		Polk	
	1969	1974	1969	1974	1969	1974
Approximate total land area (acres)	50,744,768	50,744,768	1,145,152	1,145,152	1,288,128	1,288,128
Percent of total land in farms	56.7%	54.4%	71.7%	74.6%	80.5%	84.2%
Total number of all farms	110,747	98,537	1,732	1,652	2,361	2,049
Land in farms (acres)	28,785,240	27,605,228	821,030	853,809	1,115,662	1,111,993
Cropland (acres)	22,260,500	21,320,870	668,059	703,900	940,823	933,308
Percent of farm acreage in cropland	77.3%	77.2%	81.4%	84.2%	84.3%	83.9%
Woodland (acres)	2,844,213	2,454,218	79,396	71,138	60,901	52,240
Percent of farm acreage in woodland	9.9%	8.9%	9.7%	8.5%	5.5%	4.7%
Other (acres)	3,680,527	3,830,140	75,575	78,771	113,938	126,445
Percent of farm acreage in other uses	12.8%	13.9%	9.0%	9.4%	10.2%	11.4%
Average size of farm (acres)	260	280	474	517	473	543

Percents may not total 100 due to rounding.

Source: U.S. Bureau of the Census, 1974, Census of Agriculture, Minnesota, May 1977.

TABLE 9 - FARM OWNERSHIP

	MINNESOTA			MARSHALL			POLK		
	1969	1974	% Change	1969	1974	% Change	1969	1974	% Change
Number of farms	110,747	98,532	-11.0	1,732	1,632	-4.6	2,361	2,049	-13.2
Average farm size(acres)	260	280	7.7	474	517	9.1	473	543	14.8
Tenure of farm operator									
Full owner	67,602	59,423	-12.1	987	950	-3.7	1,218	985	-19.1
Part owner	30,225	29,358	-2.9	607	578	-4.8	922	853	-7.5
Tenants	12,920	9,756	-24.5	138	124	-10.1	221	211	-4.5

Source: U.S. Bureau of the Census, 1974, Census of Agriculture, Minnesota, May 1977.

farm operators. State figures show a decrease in the number of farms and farm operators of 32.3 percent over this period, while Polk and Marshall Counties show decreases of 34.4 percent and 20.1 percent, respectively. Classification of farms by tenure of farm operator indicates that, in general, a sizable portion of the decrease in number of farms from 1969 to 1974 (as in the past) may be explained by a loss of farms operated by full owners (those who operate only land they own) and tenants (those who operate only land they rent from others or who work on shares for others). Part owners (those who operate land they own as well as land that they rent from others), although also decreasing in number, on the average formed a larger proportion of farm operators in 1974 than in previous years (Table 9).

2.55 In conjunction with State trends, the values of land and buildings per farm in both counties have approximately doubled from 1969 to 1974, amounting to a combined total of slightly more than $507 million in 1974 (Table 10). In the same span, market values and production expenses per farm and the respective sales-cost ratios[1] for Marshall and Polk Counties were greater than State figures (Table 10). The market value of agricultural products sold per farm in Minnesota and in Marshall and Polk Counties increased from 1969 to 1974 primarily as a result of two basic factors: (1) the increase in average farm size and (2) the increase in crop prices. However, other factors include improved management, increases in cropland (Marshall County only), and improved technology. From 1969 to 1974, increasing market values of products sold and farm production expenses contributed to make the 1974 sales-cost ratio 1.5 for the State, 1.8 for Marshall County, and 1.7 for Polk County.

2.56 From 1969 to 1974, there was a notable increase in the percentage of total market value of crops sold (Table 10). In 1974, crops (including hay, and nursery, greenhouse, and forest products) contributed equally with livestock, poultry, and their products to the market value of agricultural products sold in Minnesota.

2.57 Unlike the State values, however, market values in Marshall and Polk Counties (1974) were heavily dependent on crops: over 90 percent of the market value came from crop products sold. Livestock, poultry, and their products yielded the remaining portion of market value for the two counties.

Income

2.58 Urban counties generally have a greater per capita income than predominantly rural counties. State per capita income, estimated from both rural and urban incomes, also exceeds rural per capita income. Differences

[1] Sales-cost ratios are calculated by dividing total market value of agricultural products sold by total farm production expenses. Therefore, the larger the ratio, the greater the income of the farmer for any given year.

TABLE 10 - LAND VALUES, MARKET VALUE OF PRODUCTS SOLD AND PRODUCTION EXPENSES FOR MINNESOTA AND FOR MARSHALL AND POLK COUNTIES, 1969 AND 1974

	State			Marshall			Polk		
	1969	1974	Percent change	1969	1974	Percent change	1969	1974	Percent change
Value of lands and buildings ($1,000)	6,502,359	11,855,130	82.3	90,105	183,917	104.1	171,845	323,521	88.3
Average per farm (dollars)	58,714	120,311	104.9	52,023	111,330	114.0	72,784	157,892	116.9
Market value of dairy products sold($1,000)	1,747,892	3,469,923	98.5	21,719	63,907	194.2	42,107	122,355	190.6
Average per farm (dollars)	15,782	35,214	123.1	12,540	38,685	208.5	17,834	59,714	234.8
Crops (including hay)[1]($1,000)	559,941	1,759,340	215.0	16,982	58,462	244.3	32,254	110,326	242.1
Percent of total market value	32.0	50.7		78.2	91.5		76.6	90.2	
Livestock, poultry, and their products ($1,000)	1,187,951	1,710,584	44.0	4,737	5,446	15.0	9,853	12,029	22.1
Percent of total market value	68.0	49.2		21.8	8.5		23.4	9.8	
Total farm production expenses ($1,000)	1,568,547	2,365,111	72.8	17,662	36,191	104.9	34,071	73,280	115.1
Average per farm (dollars)	12,357	24,048	94.6	10,198	21,907	114.8	14,430	35,764	147.8
Est.cost ratio	1.3	1.5		1.2	1.8		1.2	1.7	

[1] Nursery and greenhouse and forest products, which account for less than 1% of the market value for agriculture products sold,have also been included in this figure.

Source: U.S. Bureau of the Census, 1974, Census of Agriculture, Minnesota, May 1977.

in per capita income for the respective areas may be explained by differences in available employment: rural areas are high in agricultural employment while urban areas are high in services, wholesale-retail trade, and manufacturing employment. As expected, the predominantly rural counties of Marshall and Polk had per capita incomes ($1,971 and $2,366, respectively; see Table 11) well below the State per capita income of $3,052 in 1970. Rural non-farm and rural farm per capita incomes for Marshall and Polk Counties were also well below rural non-farm and rural farm per capita incomes for the State.

TABLE 11 - PER CAPITA INCOME AND INCOME LESS THAN POVERTY LEVEL, MINNESOTA, MARSHALL COUNTY, POLK COUNTY, 1970

	State	Polk	Marshall
Per Capita Income	$3,052	$2,366	$1,971
Rural non-farm	$2,491	$2,318	$2,278
Rural farm	$2,117	$1,956	$1,612
Income Less Than Poverty Level			
Families	75,923	590	900
Percent of all families	8.2	6.9	27.8

Source: U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Tables: 124, 135, 137.

2.59 A comparison of the two counties shows that Polk has a higher per capita income than Marshall and a smaller percentage of families earning incomes below poverty level (6.9 percent vs. 27.8 percent). Thus, income in Polk County is distributed more evenly over a larger portion of the population than in Marshall County. Opportunities for employment in areas other than agriculture are limited in Marshall County, contributing to higher rates of underemployment and unemployment; these conditions, in turn, result in lower per capita incomes and a larger percentage of families with earnings below the poverty level. In comparison, Polk County, with urban areas such as East Grand Forks-Grand Forks, provides more varied and numerous employment opportunities to offset decreases in agricultural employment.

Population

2.60 Over the 10-year period from 1960 to 1970, Marshall County, Polk County, and the State of Minnesota as a whole have experienced steady changes and shifts in population. During this period, the population in Minnesota increased by 11.5 percent while the populations of Marshall and Polk Counties declined by 8.4 and 4.8 percent, respectively (Table 12).

2.61 Accompanying the rise in State population has been a shift in population from rural to urban areas. Marshall and Polk Counties, although experiencing a general reduction in overall population from 1960 to 1970, have (like the State) experienced shifts in population from rural to urban areas (Table 12). As would be expected, population decreases in Marshall County (-8.4 percent) have been greater than population decreases in Polk County (-4.8 percent), since Marshall County lacks urban areas (such as East Grand Forks) to attract and retain the shifting rural population. Such decreases reflect a general mobility trend in Minnesota away from non-incorporated agricultural areas. In 1970, one-third of Minnesota's population was rural while the populations of Marshall and Polk remained primarily rural, accounting for 100 and 53.7 percent of the total populations for the respective counties.

2.62 In 1970, the percentage of rural population living on farms (rural farm population) in Marshall and Polk Counties was 46.1 percent and 49.2 percent, respectively, while the remaining rural populations, 53.9 percent and 50.8 percent, respectively, lived in small towns and communities (rural non-farm).

2.63 In 1970, the populations of Marshall County and Polk County were 13,060 and 34,435, respectively. The distribution of these populations by age and race in the two counties differs slightly from the distribution of these factors for the State population (Table 13). The percentage of dependent persons (those under 18 years old or 65 and over not earning incomes) exceeds the State percentage (47.0 percent) in both Marshall County (50.6 percent) and Polk County (50.5 percent).

TABLE 12 - POPULATION BY URBAN AND RURAL AREAS (1960, 1970)

	State		Marshall		Polk	
	1960	1970	1960	1970	1960	1970
Total population	3,413,864	3,804,971	14,262	13,060	36,182	34,435
Urban	2,122,566	2,526,560	0	0	15,544	15,951
Percent of total pop.	62.2	66.4	0	0	43.0	46.3
Rural	1,291,298	1,278,411	14,262	13,060	20,638	18,484
Percent of total pop.	37.8	33.6	100	100	57.0	53.2
Rural Non-farm	NA	790,126	NA	7,053	NA	9,385
Percent of rural pop.	NA	20.8	NA	53.9	NA	50.8
Rural Farm	NA	488,285	NA	6,027	NA	9,099
Percent of rural pop.	NA	12.8	NA	46.1	NA	49.2

Source: U.S. Bureau of the Census, Selected Characteristics of Population, 1970.

TABLE 13 - POPULATION BY AGE, 1970

	State	Marshall	Polk
Population	3,804,971	13,060	34,435
Percent change 1960-1970	11.5	-8.4	-4.8
Percent under 18 or over 65 years	47.0	50.6	50.5
Percent under 18 yrs.	36.3	38.0	36.1
Percent over 65 yrs.	10.7	12.6	14.4
Percent 18 years to 64 years	52.9	46.3	49.5

Source: U.S. Bureau of the Census, Selected Characteristics of Population, 1970.

2.64 From 1965 to 1970, the number of out-migrants exceeded the number of in-migrants in both Marshall and Polk Counties (Table 14). Many younger persons, motivated by greater economic opportunities, move from farms and small towns to larger towns and communities, making out-migration for the two counties greatest in the age category of 15 to 24 years. In-migration for the two counties was most numerous in the age category of 30 to 44 years.[1]

TABLE 14 - GROSS MIGRATION BY SELECTED CHARACTERISTICS FOR MINNESOTA AND MARSHALL AND POLK COUNTIES 1965 TO 1970

	Age in 1970							
	Under 15 yrs.	15 to 19 yrs.	20 to 24 yrs.	25 to 29 yrs.	30 to 44 yrs.	45 to 64 yrs.	65 yrs. and over	Total
Marshall								
Net	45	-243	-486	72	79	-75	-125	-733
In-migrants	414	157	163	284	318	264	92	1,692
Out-migrants	369	400	649	212	239	339	217	2,425
Polk								
Net	-306	-403	-1,026	-283	52	31	51	-1,884
In-migrants	1,409	782	807	609	1,077	753	496	5,933
Out-migrants	1,715	1,185	1,833	892	1,025	722	445	7,817

Source: U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 701, Gross Migration by County: 1965 to 1970, U.S. Government Printing Office, Washington, D.C., 1977.

2.65 Minnesota Population Projections 1970-2000 (source: Office of the State Demographer) indicates that county population in Marshall and Polk Counties will continue to decline through the year 2000 (Table 15).

TABLE 15 - POPULATION PROJECTIONS

	1970	1980	1990	2000
Marshall	13,100	13,000	13,100	12,800
Polk	34,400	34,800	35,000	33,700

Source: Minnesota Population Projections 1970-2000, Office of the State Demographer, State Planning Agency, Division of Developmental Planning November, 1975.

[1] The highest percentage of in- and out-migrants was actually in the age category under 15 years old; however, persons in this age category are generally not independently mobile and thus will not be addressed at this time.

Employment

2.66 Employment trends for Marshall and Polk Counties are similar to those found throughout rural Minnesota. Over the past two decades (1950 to 1970), the labor forces in Marshall and Polk Counties have steadily declined in number while shifting concentration from agricultural employment to services, wholesale and retail trade, and manufacturing. Agricultural employment in the two counties declined by nearly 3,150 persons per decade (a percent change of -66.1 percent from 1950 to 1970). This decline is due primarily to shifts toward greater energy-intensive farming practices which require greater capital investments and fewer farm laborers. Substantial decreases in agricultural employment, however, have only partially been offset by increases in other areas of employment (see Tables 16 and 17).

2.67 It should be noted that, in 1970, agriculture remained the major employer in Marshall County, employing 30.51 percent of the net labor force. Services, followed by wholesale and retail trade, were the next largest employers, providing 22.92 and 19.19 percent of all jobs, respectively. Employment in agriculture for Polk County, however, ranked third behind services and wholesale and retail trade, accounting for a mere 16.9 percent of the net labor force. Wholesale and retail trade accounted for 29.5 and 22.7 percent of the net labor force, respectively.

2.68 Nevertheless, employment strongly reflects the importance of agriculture in Marshall and Polk Counties. Many employers (in both trade and services) are still closely tied to agricultural production. Obviously, the implement dealer provides for the rural population and is highly dependent on the farmer in these counties, despite the trend toward non-agricultural employment.

TABLE 16 - EMPLOYMENT BY INDUSTRY, MARSHALL COUNTY, MINNESOTA, 1950-70

Industry	1950 Number	1950 Percentage of total	1960 Number	1960 Percentage of total	1970 Number	1970 Percentage of total	1950-1970 percent change
Agriculture, forestry, and fisheries	3,705	63.74	2,853	55.48	1,197	30.51	-67.7
Mining	2	0.03	8	0.16	0	0	-100.0
Construction	235	4.04	267	5.19	251	6.40	6.8
Manufacturing	94	1.62	149	2.90	418	10.65	344.7
Transportation, communications and utilities	244	4.20	202	3.93	185	4.72	-24.2
Wholesale and retail trade	746	12.83	738	14.35	753	19.19	.9
Finance, insurance and real estate	54	0.93	62	1.21	62	1.53	14.8
Services	559	9.62	680	13.22	899	22.92	60.8
Government (Public Administration)	119	2.05	128	2.49	158	4.02	32.8
Industry not reported	54	0.93	52	1.01	0	0	-
Armed forces	1	0.01	3	0.06	0	0	-
Total	5,813	100.00	5,142	100.00	3,923	100.00	-32.5

Source: U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Table 123.

TABLE 17 - EMPLOYMENT BY INDUSTRY, POLK COUNTY, MINNESOTA, 1950-1970

	1950		1960		1970		1950-1970
	No.	% of total	No.	% of total	No.	% of total	% change
Agriculture	5,737	44.5	3,915	31.3	2,004	16.9	-65.1
Mining	11	.09	8	.06	14	.1	-27.3
Construction	638	4.9	719	5.8	612	5.1	-4.1
Manufacturing	608	4.7	695	5.6	1,301	10.9	114.0
Transportation, communications, & utilities	1,129	8.8	911	7.3	1,026	8.6	-9.1
Wholesale and retail trade	2,293	17.7	2,757	22.1	2,698	22.7	17.7
Finance, insurance and real estate	191	1.5	244	2.0	282	2.4	47.6
Services	1,870	14.5	2,606	20.8	3,504	29.5	87.4
Government (Public Administration)	323	2.5	358	2.9	443	3.7	37.2
Armed Forces	5	.04	72	.6	-	-	-
Industry not reported	95	.7	213	1.7	-	-	-
Total	12,900	99.9	12,498	100.1	11,884	99.9	-7.8

Source: U.S. Bureau of the Census, General Social and Economic Characteristics, 1960 and 1970.

Cultural Resources

2.69 Between 21 August and 15 September 1975, a cultural resources survey was undertaken along 81.67 kilometers of the Snake River in Marshall and Polk Counties, Minnesota. The purpose of the survey was to inventory and assess the impact of the snagging and clearing project upon archaeological and historical resources. During the survey, information on 30 previously unknown sites was recorded. In addition to these, two sites identified during the literature search and records review were field checked. One site (21 MA 8), dating to the Late Woodland Blackduck Phase was partially excavated in 1960 by Elden Johnson of the University of Minnesota.

2.70 Three classes of sites were recorded during the survey (Lane 1975):

a. Bone concentration: Areas in which a large amount of animal bone was found without associated artifacts or features.

b. Activity areas: Areas for which evidence of past human activity exists, but without sufficient artifactual remains or associated features to indicate long-term occupation.

c. Occupation sites: Areas of fairly well defined artifactual and contextual remains, indicating somewhat long-term human occupation.

2.71 The most numerous class of site found was the activity area, with 21 reported along the Snake River. Two bone concentrations were located, one probably the result of natural deposition. Nine occupation sites were also located during the survey.

2.72 A total of 19 sites (59.3 percent) were assigned to a cultural period. All but one of these, a historic site, contained some materials which were woodland in nature. Only one site (No. 72) was able to be placed in an earlier context than Woodland. This activity area was dated to the Late Archaic/Early Woodland Period, based on projectile point typology. Of the 18 sites identified within a Woodland context, 12 were unable to be placed within a Woodland subperiod, one was Early Woodland, two were Middle Woodland, and three were Late Woodland. Two of the three Late Woodland sites could be assigned to the Blackduck Phase.

2.73 The late nature of the sites located along the Snake River is not surprising since this area was once a portion of Glacial Lake Agassiz. During the terminal glacial period (6000-3000 B.C.), Lake Agassiz was still a glacial lake, although somewhat reduced in size from its former levels during the Port Huron (11000-10000 B.C.) and Valders (9000-8500 B.C.) glacial advance. Not until sometime after 3000 B.C. would this area have been available for continual occupation. Evidence recovered during the survey substantiates this fact. Occupation of the Snake River begins during the Late Archaic Period (ca. 3000 B.C.) and continues up until the present. Lane reports that settlement patterns during the past 5000 years have remained fairly constant. Larger, long-term settlements are found on the higher river terraces, while short-term seasonal sites and activity areas are located both on the higher and lower terraces.

3.00 RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS

3.01 Marshall, Polk, and Pennington Counties have not adopted any State-approved floodplain regulation program, but the counties do administer their own interim programs relative to issuance of building permits and shoreline regulations. These counties are also covered by National Flood Insurance programs. Marshall County is in the process of formulating floodplain regulations. Marshall and Polk Counties were requested by the State to formulate regulations for the area of the 100-year floodplain of the Red River of the North, which involves portions of the Snake River drainage system. Floodplain regulation ordinances would be consistent with the proposed snagging and clearing project. Agriculture generally is considered a compatible floodplain use.

3.02 Polk County has adopted a comprehensive development plan under which future use of this portion of the Snake River will be oriented toward agriculture.

3.03 The Middle River-Snake River Watershed District also has applied to the Soil Conservation Service (SCS) for assistance under Public Law 83-566. However, it would be a few years before SCS could investigate the application, which was approved by the State board in December 1971 and placed in the priority pool for planning in August 1976.

4.00 IMPACTS OF THE PROPOSED PROJECT

4.01 The proposed Snake River plan would have both adverse and beneficial impacts on fish and wildlife habitat and floodplain vegetation. The severity of the adverse impacts would vary with the amount of clearing and snagging done. The clearing and snagging would cause a significant loss of fish and wildlife habitat, and predator-prey relationships. Beneficial impacts of the shelterbelt construction would be channel protection and wildlife habitat development.

Flora

4.02 The proposed plan would remove some selected areas of shrubs and live trees and all non-rooted fallen trees and snags within the primary river channel. Specific types of vegetation exist in a floodplain because they can withstand periodic flooding. A future reduction in the amount of flooding could affect the productivity of the woodland and cause a change in species composition, a reduced growth rate, or a combination of the two.[1]

4.03 Long-term effects of less frequent flooding on species composition and productivity would depend on the degree of flood reduction. Decreased productivity and altered species composition would be insignificant because the snagging and clearing would have minimal effect upon the overall flooding conditions. Regrowth, if snagging and clearing is not maintained, would cause the minimal flood reduction benefits to vanish.

4.04 The removal of the streambank vegetation would adversely affect the cycling of nutrients and organic matter. Leaves and insects from trees and shrubs fall into the river, adding nutrients and organic matter to the stream. This in turn is used by aquatic organisms and contributes to the overall energy flow of the stream.

4.05 Construction activities associated with the proposed plan would also have adverse impacts upon the vegetation. The winding nature of the river channel, particularly between Warren and Alvarado, would present a problem in confining the movement of construction equipment within the channel. The nature of the channel and the possibility of limited ice cover may require some on-bank movement of machinery. Access routes to the river channel might also have to be cleared because of the limited number of natural access points for areas requiring work. These activities would have a destructive effect on the river vegetation.

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[1] Hibbard, E.A. 1972. Vertebrate Ecology and Zoogeography of the Missouri River Valley in North Dakota. Ph.D. Thesis. North Dakota State University, Fargo, North Dakota. 216 pp.

Johnson, W.D. 1971. The Forest Overstory Vegetation of the Missouri River Floodplain in North Dakota. Ph.D. Thesis, North Dakota State University, Fargo, North Dakota. 151 pp.

Burgess, R.L., W.C. Johnson, and W.R. Keammerer. 1973. Vegetation of the Missouri River Floodplain in North Dakota. North Dakota State University, Fargo, North Dakota. WI-221-018-73.

4.06 Construction activities would be obstructed during winter because the channel area is frequently drifted in with snow, ranging in depth from 3 to 6 feet above the frozen surface. Snow removal in these areas would damage or destroy vegetation that the project would not normally have affected. These impacts could be reduced or eliminated by scheduling construction activities for early winter when the ground is frozen and there is little or no snow cover to interfere with construction.

Fauna

4.07 Fish - The clearing and snagging of the Snake River would affect the fish resources by the removal of essential habitat. In addition to the direct impact on the Snake River fishery, there would be a secondary impact on the Red River fishery. Tributaries of the Red River of the North produce a higher proportion of the forage fish species than does the main stem of the Red River of the North. Water quality of the tributaries is more conducive to forage species production than is the Red River itself. Therefore, removal of forage fish habitat in the Snake River would adversely affect the game fish species of the Red River.

4.08 The impact of the project upon aquatic life would result from the removal of scattered debris from the river and of shrubs and trees from the bank. The debris provides cover for fish and habitat for the aquatic organisms which are major fish food items. Removal of scattered debris usually reduces fish populations. The project would be conducted in the winter (at low water levels approaching the "dry" condition), but could conceivably remove significant amounts of seasonally submerged debris. If the river is partially dry or the water level is very low at the time of the project, large amounts of otherwise submerged debris would be removed. The more debris removed, the greater the effect on the fishery. Removal of trees that would have fallen into the river would also decrease the future fishery values by removing potential aquatic habitat for fish and forage species.

4.09 Removal of debris from the primary channel would eliminate habitat for attached or free-swimming invertebrates for part or all of their life cycle. Eliminating debris would also adversely affect fish population dynamics. Debris cover provides spawning areas for game and forage species such as walleye, pike, and flathead minnows. Submerged debris provides cover for and protects lower age and size classes from predation. The debris also provides invertebrate food sources for both game and forage species.

4.10 Reduction in the amount of vegetation along the edge of the river could have adverse effects on the benthic community as well as the fishery. The impacts result from a reduction in the amount of leaves and other organic debris that is generated from the edge vegetation. There is a reduction in the amount of invertebrates that live in association with the edge vegetation and end up as a food source for river organisms. Both

of these provide an input to the energy flow conditions of the river. Changes in bottom stability could cause a change or a loss in the benthic community. These effects are not expected to be significant overall.

4.11 Wildlife - Clearing and snagging would remove some existing and potential nesting and resting sites for wildlife. Some species of birds, such as nuthatch (Sitta sp.), chickadee (Parus sp.), bluebird (Sialia sialia), wood duck, woodpecker (Picidae sp.), and barred owl (Strix varia), nest in the cavities of trees. Removal of debris and trees would have an adverse effect on these birds. Resting, nesting, and feeding areas for species such as herons (Ardeidae sp.), bitterns (Ardeida sp.), kingfishers (Megaceryle alcyon alcyon), wood ducks, and hooded mergansers (Lophodytes cucullatus) would also be affected by clearing and snagging the river.

4.12 The project would remove some brush from the river channel. Dense stands would be cut if their removal is hydraulically desirable and would not aggravate erosion. The removal of shrubs would have adverse impacts on deer and other riverbank animals such as birds and beaver. The cutting of shrubs would remove cover, nesting habitat, and food for the wildlife. Shrubs, especially along river channels, are important habitat for non-game bird life. A large proportion of the cover and nesting sites for small birds is provided by shrubs and in trees less than 30 feet above the ground.

4.13 The bank area is important to many species of wildlife that are dependent on the water-vegetation edge for all or part of their life cycle. For example, beaver and mink forage in this area and use it for cover. Birds, both game and non-game, use this area for cover, nesting, and food. The removal of streambank vegetation would adversely affect these species. Clearing the streambank would also open the area to predation.

4.14 It is impossible to predict exactly what impact the clearing and snagging of the Snake River would have on fish and wildlife resources. Removal of significant amounts of debris can be expected to result in decreased wildlife populations. The more extensive the clearing (removing more debris or more extensive clearing activity), the more adverse the effects.

4.15 Shelterbelt construction would prove to be very beneficial for wildlife. It would provide a movement corridor through areas that have had their wooded cover eliminated or reduced to where it provides little benefit for wildlife. The planting scheme, involving a combination of tree and shrub heights and a variety of species which have food value

for wildlife, would create a zone of valuable habitat. This area would provide food and cover during winter and should help to alleviate some of the pre-reproductive season stresses. Increasing the diversity and amount of riparian habitat would involve development of many complex ecosystem relationships, including community diversity, protection from predation, winter shelter, forage and prey resources, winter food, nesting sites, and denning sites, as well as corridors of movement for transient as well as for local wildlife.

Endangered or Threatened Species

4.16 As noted in paragraphs 2.25-2.26, the grey wolf is the only endangered or threatened species known to occasionally frequent the project area. The removal of some edge vegetation would reduce the amount of cover and huntable habitat available to wolves that wander into the project area. This impact would be offset by the planting of shelterbelts in selected areas. There should be an overall insignificant impact on the grey wolf as a species and a population.

Flooding

4.17 Snake River channel capacities for existing conditions are computed to be 1400 cfs (3-year frequency) from the mouth to River Mile 21.2, 700 cfs (2-year frequency) from River Mile 21.2 to Warren, and 600 cfs upstream of Warren. The clearing of the lower two-thirds of the riverbank could result in a channel capacity of 900 cfs (3-year frequency) from River Mile 21.2 to Warren.

4.18 Benefits from shelterbelts would vary from year to year, due to changes in snowmelt rate and amount of snowfall. Shelterbelts would prevent snow accumulation from blocking the channel in spring, and thus help drain snowmelt waters from adjacent agricultural areas. This would reduce the spring overland flooding problems, damages to farm property and buildings, and the amount of nitrogen leached from the soil. These benefits would change with the severity of the winters, in terms of the amount of snow and the rate of melting.

4.19 Clearing and snagging would have little effect on a flood of more than a 3-year frequency (i.e., 33-percent chance flood), which would exceed the present channel capacity. It would reduce damages caused by the 3- to 5-year (33- to 20-percent chance) floods, have progressively less effect on floods over a 5-year frequency, and have no effect on fairly infrequent floods.

Land Use

4.20 The project is not expected to have adverse impacts on geological features. The recreational and aesthetic qualities would receive overall positive impacts, although clearing and snagging would have some negative impacts. This stretch of river at present supports little developed

recreational opportunity. The habitat created by the shelterbelts would create possibilities for development of recreational resources. An increase in trapping and hunting opportunities would be closely associated with an increase in the amount of habitat. Hunting and fishing activities would add to the economy of surrounding towns. Snowmobile activity in the area could increase with clearing of the channel. There would be an adverse impact on wildlife, however, associated with increased snowmobile activity. The value of the area for non-consumptive uses such as photography, hiking, and skiing would increase.

4.21 Agricultural impacts would generally be positive. Better melt water drainage would provide earlier access to the fields. There would be less leaching of nitrogen from the soil as a result of spring overland flows. There would be less agricultural damage because of heavy summer rains and associated flooding. The loss of some agricultural land to shelterbelt construction would have some adverse impacts. These lands could be of marginal value because their close proximity to the river makes crops very susceptible to high frequency floods.

4.22 The area on the leeward side of the shelterbelt could be adversely affected by possible snow build-ups where snow would melt more slowly than on the surrounding lands. Consequently, these areas would not be ready for planting at the same time as other farm lands in the area. The extent of this problem would vary with the amount of snowfall and the degree of drifting.

Air and Water Quality

4.23 Some degradation in air and water quality could result from construction equipment. Water pollution could result from oil, grease, or fuel spilled onto the ice or leaking from machinery. Airborne dust would not be much of a problem because the project work would be done during winter when the river is frozen. The project could have an impact on some water quality properties such as temperature, dissolved oxygen, and turbidity. The extent of these changes is not known. The effect of the vegetation removal on water quality parameters varies with the extent and methods of clearing and the characteristics of the stream. Selective clearing and snagging would probably result in some degree of increased turbidity, increased water temperature, and reduced oxygen levels.

4.24 Shelterbelts would reduce the amount of windblown soil (which contributes to turbidity and channel siltation) and pesticide drift and runoff into the channel.

Hydraulic Aspects

4.25 Extent of Clearing and Snagging - Because of the complexity of the processes occurring in natural flows involving the natural equilibrium of a stream, the analysis of the effects of clearing and snagging is generally limited to consideration of only the hydraulic relationships, assuming changes only in channel roughness. This approach shows that only limited clearing of the channel is needed to obtain most of the stage reduction benefits that can reasonably be expected from a clearing and snagging project.

4.26 In its most efficient form, a clearing and snagging project includes not only the complete clearing of debris and snags in the stream channel but also complete removal of all trees, fallen branches, and brush from the primary banks of the channel and the overbanks. The experience of the Corps of Engineers with projects of this type has led to the conclusion that, if complete clearing of the channel and at least 20 feet of the immediate overbanks is not accomplished in the initial phase, the effectiveness of the project for controlling the more frequent floods decreases rather rapidly with time. Subsequent maintenance of the project becomes more expensive and is required more frequently to keep the project effective. From a maintenance efficiency standpoint, the proposed Snake River project would use the least efficient clearing procedure.

4.27 General Effect of Clearing and Snagging - All actively meandering streams will show evidence of erosion and deposition. The Snake is typical, with deposition occurring on the inside and erosion on the outside of bends. Clearing and snagging will increase the speed by which the meander loops move downstream. Also, by increasing the amount of flow which remains in the channel, the meander length will change, probably by increasing. This change in stability can lead to increased erosion and possibly some channel shifts during unusually high flows. If trees and brush are not removed from the channel and immediate overbanks, more debris will fall into the river as it adjusts to its new equilibrium form. All flows that approach the new channel capacity in magnitude will cause some bank failure. With the limited clearing that is proposed on the Snake River, even minor bank sloughing could cause big trees and brush to fall into the river. After a few years, the river could be back to its pre-project condition unless continued maintenance is undertaken.

Recreation

4.28 Clearing, snagging, and shelterbelt development could have a beneficial impact on existing resource potential. Most of this impact will be derived from the additional wildlife habitat created by the shelterbelts and the selective clearing process proposed for this project.

Labor Force

4.29 Since the clearing, snagging, and shelterbelt planting require few workers, the project would only slightly benefit local employment. Labor to be used in project construction would be supplied by the locally employed labor force and will probably have no effect on persons presently unemployed. The clearing and snagging operation would be contracted with a local construction firm while a local agricultural extension office would assume responsibility for planting the shelterbelt. The local sponsor would be accountable for project maintenance and would most likely also use workers from the locally employed labor force. Once again, the number employed would be insignificant.

Aesthetics

4.30 Selective and minimal clearing and snagging of the Snake River (as prescribed in the detailed project report) would improve visual conditions by removing fallen trees and other debris from the river and its banks.

4.31 Shelterbelts planted at points along State Ditch 5 would enhance the aesthetic quality of the predominantly agricultural setting by adding a variety of vegetation and providing wildlife habitat.

Noise

4.32 During clearing and snagging operations and the planting of the shelterbelts, noise levels in the vicinity of Snake River would increase due to use of construction equipment. Persons living on farmsteads along the river would be affected. However, increased noise levels would be minimally significant since most of the clearing, snagging, and planting would occur along stretches of river immediately surrounded by agricultural fields.

Agricultural Land Use

4.33 Shelterbelts, 30 feet wide along the north side of the Snake River between Warren and Alvarado would reduce cropland acreage. To minimize land removed from production and to maximize agricultural use, shelterbelts would be planted 150 feet to 500 feet from the top of the channel. Although income would be lost as a result of land being taken out of production, agricultural damages prevented would help to offset losses. Clearing, snagging, and the protection provided by the shelterbelts would increase the carrying capacity of the Snake River. This increased capacity would reduce overbank flooding, thus giving farmers early access to fields, and reducing agricultural damages. A 17 percent reduction in damages is expected. Benefits provided by the shelterbelt, however, would differ yearly due to variations in the amount of snowfall and in the snowmelt rate.

4.34 Local landowners have requested that shelterbelts be incorporated as part of the project to prevent blockage of the river channel by snow and ice deposits that result in overland flooding. Landowners have testified that northwesterly winds are responsible for snow drifting into the channel. However, this has not been officially documented by the Corps due to insufficient study funds.

4.35 The Middle River-Snake River Watershed District would locate shelterbelts only where voluntary easements have been granted. At this time, the Watershed District has received verbal commitments from persons on the north side of the Snake River only between Alvarado and Warren.

4.36 Because shelterbelts would be placed only along the north side of the channel and only where permitted by landowners, it is possible that snow may drift into the channel from the south side, points where shelterbelt easements have not been granted, or downstream of the shelterbelted area, causing water to back up and overflow into shelterbelted properties. If this occurs, landowners who have granted easements may receive limited benefits despite the original costs they have incurred by allowing shelterbelts on their properties. Landowners with shelterbelts and landowners without shelterbelts, while equally accruing benefits from the project, may also equally experience losses due to insufficient shelterbelt easements. This possible inequitable distribution of costs and benefits may lead to controversy between landowners who have granted shelterbelt easements and those who have not.

Cultural Resources

4.37 In compliance with Section 106 of the National Historic Preservation Act of 1966 and Executive Order 11593, the National Register of Historic Places has been consulted. As of 23 July 1979, no sites currently listed on or determined to be eligible for nomination to the National Register are located within the Snake River clearing and snagging project.

4.38 Thirty-two prehistoric and historic sites were located during the 1975 cultural resources survey. Of these, 14 would not be adversely impacted by the project due to their extremely eroded nature or to the very limited extent of their cultural material. Nine sites have been recommended for further testing and nine others for mitigation. Comments on these recommendations were received from the Minnesota State Historic Preservation Officer and from Interagency Archaeological Services, Denver and are included as Exhibits 1 and 2.

4.39 Prior to the initiation of snagging and clearing operations, further testing will be undertaken at the nine sites recommended for further testing and also at the nine sites recommended for mitigation in order to assess the National Register significance of these resources. It is anticipated that avoidance of all, or a large part, of these resources will be possible during the snagging and clearing operations.

5.00 UNAVOIDABLE ADVERSE IMPACTS OF THE PROPOSED ACTION

5.01 Unavoidable adverse impacts involve the loss of a large amount of live and dead vegetation and aquatic habitat over a 50-mile reach of the Snake River. Clearing and snagging would have significant adverse impact on the fish resources of the Snake River and a secondary adverse impact on the fish at high levels in the food web (some game fish) in the Red River. Removal of riparian habitat would also adversely affect furbearers, snapping turtles, and avian fauna along the Snake River. Streamside vegetation and debris are invaluable ingredients in the life cycle of a number of wildlife species.

5.02 The increase in channel flow velocities which would result from the project would increase erosion and sedimentation in the project area. An increase in erosion would affect some water quality parameters such as turbidity. Sedimentation, shifting substrate, and siltation would also have an adverse effect on benthic organisms.

6.00 ALTERNATIVE PLANS CONSIDERED

No Action - Maintain Status Quo

6.01 Maintaining the status quo (recommending that no action be taken to alleviate flooding and related problems) would not burden local interests and the Federal Government with the costs associated with other alternatives. Nevertheless, average annual damages estimated at $325,000 would remain as a severe social and economic burden. Floodplain farmers would continue to sustain substantial loss of income due to periodic inundation of about 20,000 acres of cropland; soil erosion; and damage to houses, barns, stored crops, machinery, and other farm property. No changes in land use would be anticipated since the floodplain area under study is highly productive, almost totally cultivated agricultural land. Accordingly, the social well-being and environmental quality of the area would not be affected.

Nonstructural Alternatives

6.02 Because flooding is the major water-related problem under study and because nonstructural measures can often be employed effectively to reduce flood damages, such measures were considered for flood-prone areas along the Snake River below Warren. Nonstructural measures applicable to the flood-prone area include: flood warning and emergency protection, flood insurance, flood proofing, floodplain regulation, and permanent floodplain evacuation.

6.03 Plan 1 - Flood Warning and Emergency Protection - An emergency protection plan depends on an effective flood warning system. Flood warning consists of predicting the timing and magnitude of floods to allow for timely evacuation of flood-prone areas or erection of emergency flood protection.

6.04 The National Weather Service currently provides area officials and local news media with flood forecasts and warnings for the Snake River at Warren and Alvarado. The spring snowmelt flood and major floods that result from excessive summer rainfall can be reasonably predicted by methods currently available. However, the time intervals between rainfall, issuance of a flood warning, and beginning of flooding are much shorter than for snowmelt floods. Emergency evacuation of people and their belongings or construction of emergency flood protection might be effective for spring snowmelt floods, but such measures would be much less effective in preventing damages from floods caused by excessive rainfall runoff.

6.05 Emergency protection measures in the Snake River basin have been limited to localized dike construction at Alvarado and at several

TABLE 19- COMPARISON OF ALTERNATIVE
FLOOD DAMAGE REDUCTION PROGRAMS

Alternative	Degree of protection (frequency of flood in years)	Remaining average annual flood damages (in $100)	Total flood damage reduction (percent)
No action	-	325.0	0
Flood warning and emergency protection	-	320.0	1.0
Flood insurance	-	325.0	0
Floodproofing	100	299.8	17.0
Floodplain regulation	100	313.0	23.0
Evacuation	25	261.3	20.0
Levee and floodway	10	175.3	46.0
Channel modifications	10	175.3	46.0
Diversion channel	10	187.9	53.0
Upstream Reservoirs	<10	225.8	30.0
Snagging and clearing (proposed plan)	4-5	269.1	17.3

farms adjacent to the river to protect fields. Most of the emergency dikes in place were constructed and financed by local interests, do not meet standards for permanent levees, and therefore, require constant maintenance and repair during floods. Temporary evacuation of the protected area as a safety precaution also places a burden on the manpower and finances of those affected. The resources of local and other agencies are further strained to provide necessary and often specialized transportation, equipment, temporary lodging, and personal services.

6.06 Implementation of this plan would have no significant beneficial impacts on the economic development, environmental quality, and social well-being of the study area. Flood warnings with subsequent emergency actions could alleviate about 2 percent of the total flood damages in the Snake River watershed. Over $320,000 average annual flood damages would remain. Because the costs for providing flood warnings and emergency protective actions are uncertain, the net benefits of this plan cannot be estimated, and it is not known whether such a plan would be beneficial. Accuracy of the flood warnings and adequacy of the emergency actions taken would play a large role in determining actual costs and benefits of such a plan. On a short-term basis and in the absence of any other means of flood damage reduction, flood warning and subsequent emergency actions may help to reduce flood damages in the urban areas. However, as a means of permanent flood damage reduction and as a long-term solution to flood problems for the Snake River area below Warren, this plan would not be effective.

6.07 Plan 2 - Flood Insurance - Federally-subsidized flood insurance is available to area residents in the Snake River basin below Warren. The National Flood Insurance Program of the U.S. Department of Housing and Urban Development offers insurance coverage for farm homes, other farm buildings, and their contents, up to prescribed limitations. Unsubsidized crop insurance available under the U.S. Department of Agriculture Federal Crop Insurance Program now covers all natural disasters including floods. Only a small percentage of qualified property owners presently take full advantage of these programs, probably because of the high remaining costs involved. Based on current accrual rates and the Federal subsidized limitations, the total cost for complete flood insurance coverage would approximate $1,476,400 annually, with annual Federal and non-Federal costs of $1,052,000 and $424,400, respectively. Flood insurance does not solve flood problems and does not reduce the damages but merely spreads the monetary loss over a wider population sector. Thus, average annual damages of $286,700 would remain. Accordingly, flood insurance cannot be considered an acceptable long-term solution to the flood problem under study or a very suitable short-term solution because of limited participation due to high costs.

6.08 Plan 3 - Flood Proofing - Flood proofing involves a combination of structural changes and adjustments to flood-prone properties for reduction of flood damages. Several days of flooding and appreciable flood depths would cause seepage through the walls of most structures, even with effective sealing of doorway and window openings. Even if farmstead and residential structures could be protected successfully by flood proofing measures, flood proofing would alleviate only 9 percent of the estimated total average annual flood damages. Average annual remaining damages would approximate $261,300. The sociological effects of flooding (such as disruption of transportation, isolation of residents from their homes and farming operations, well contamination, vector production, and interrupted access to flood-proofed structures during severe floods) would remain. Implementation of this plan would not beneficially affect agricultural land, reduce crop damage, or change land use. Accordingly, the social well-being and environmental quality of the study area would remain essentially unchanged.

6.09 Plan 4 - Floodplain Regulation - Measures for modifying floodplain land use and development do not control or eliminate flooding but are designed to shape floodplain development to lessen the future effects of floods. Such measures require local governmental units to adopt and use legal tools to control the extent and type of future development permitted in the floodplain. This requires public understanding of the general flood problem, degree of risk, and various means of controlling land use. Floodplain regulation measures include zoning regulations, subdivision regulations, building codes, and bridge construction regulations. However, damages to crop production and existing developments rather than potential increased damages to future structures and facilities constitute the major flood problem under study. Thus, floodplain regulations would not significantly reduce flood damage because they could alleviate only about 5.6 percent of the total estimated annual damages. With floodplain regulations in effect, remaining average annual damages to crop production and existing development would approximate $271,000. No significant land-use changes would be anticipated because of the highly fertile and productive agricultural lands involved. Thus, floodplain regulation would have little impact on the social well-being of the people in the area and on environmental quality. Natural vegetation and wildlife would benefit only to the extent that developments were regulated.

6.10 Plan 5 - Permanent Floodplain Evacuation - Permanent evacuation of the floodplain and conversion of land use involves removal and relocation of all improvements including farmsteads, other buildings, equipment, and stored crops from the floodplain; evacuation and resettlement of the rural population; and permanent conversion of such lands to land uses less susceptible to flood damage. Floodplain evacuation, although completely unacceptable to local interests, has been analyzed for the buildings

located within the 1969 flooded area (approximately 25-year or 4-percent frequency flood) which involves about 262 farmsteads and residences. Evacuation of the rural community to a flood-free area would require moving both the improvements mentioned above and the population an average of 12 miles east into the escarpment area. This plan was found to be clearly economically infeasible, with average annual benefits and costs estimated at $85,900 and $3,663,000, respectively, yielding a benefit-cost ratio of only 0.02. The plan would alleviate only about 23 percent of the total flood damages while remaining average annual damage would approximate $221,100. In addition, massive social, institutional, and physical problems make this plan seem highly impractical. Rural community cohesion would be severely disrupted and long-standing sociological ties would be lost. Further, it is questionable whether the affected farming businesses could continue to function as a viable economic operation since the farm equipment and manpower would require mobilization and demobilization an average distance of 12 miles. In addition, this alternative would require about 400 acres of land, including 150 acres of cropland, 100 acres of grassland pasture, and 150 acres of upland woods in the Agassiz beach ridge area. Accordingly, this alternative has unacceptable impacts on wildlife habitat, lacks necessary economic feasibility, and is socially unacceptable.

Structural Alternatives

6.11 Structural measures applicable to the flood problems along the Snake River below Warren include: levee and floodway system, channel modifications, diversion channel, upstream reservoir storage, and clearing and snagging.

6.12 Plan 6 - Levee and Floodway System - This plan consists of a floodway system formed primarily by levees along both sides of the Snake River from just below Warren to the mouth. The floodway width between levees would range from 500 feet through the flatter downstream reach (mile 0 to mile $23^{\pm}$) to 400 feet in the steeper upper reach (mile $23^{\pm}$ to mile $48^{\pm}$). Levee heights would range from 5 feet to 7 feet, and the side slopes would be 3 on 1. The base widths of the levees would vary from 40 feet to 52 feet. The levees would contain the 10-year flood and more frequent floods with about 2 feet of freeboard.

6.13 The flanking levees required with this plan would inclose about 1,700 acres of river corridor, including approximately 1,000 acres of bottomland woods, 300 acres of pastureland, and 400 acres of cropland. The levees would be constructed on about 580 acres of adjacent cropland. Approximately 5 acres of wooded area at the upstream and downstream ends of the levee system would have to be cleared for the levee right-of-way.

In addition to the cropland affected, approximately 30 farmsteads would have to be relocated at least partially to provide the necessary levee alignment and right-of-way. The plan would benefit about 20,000 acres of agricultural land by reducing total estimated average annual damages by about 54 percent. Remaining average annual damages would be approximately $132,000. This plan is the most expensive structural alternative considered with an estimated first cost of $15.4 million.

6.14 The plan has a benefit-cost ratio of 0.21 and therefore lacks economic feasibility by a wide margin. In addition, removal of 580 acres of highly productive cropland from production and relocation of 30 farmsteads and residences would be unacceptable to local interests.

6.15 This plan would provide some overall net environmental benefits to biological systems because the required agricultural lands would be maintained as grassed floodway and levee slopes and because significant clearing of existing natural wooded and brushy habitat in the floodway would not be required. The net biological benefit would be enhanced by planting native prairie grassland species in lieu of the standard mixture of brome and bluegrass used in the past. This plan would also allow some continued natural recovery of aquatic biological systems along the "ditch." However, development of woody vegetation immediately adjacent to streambanks (where it performs a variety of significant biological functions) would be precluded because of floodway channel maintenance requirements.

6.16 Plan 7 - Channel Modifications - With this plan, the channel of the Snake River would be enlarged to contain the 10-year (10-percent chance) and more frequent (i.e., less severe) floods. The extent of channel enlargement depends upon the slope of the river channel. In the flatter downstream reaches of the river (mile 0 to mile 23), a channel with a 90-foot bottom width would be required; and, in the upper reach (mile 23 to mile 46), a channel with a 20-foot bottom width would be needed. Along with numerous side ditch inlets, a drop inlet structure would be required at the confluence of the Snake and Middle Rivers. Extensive slope protection would be provided at the drop inlet structure, side ditch inlets, and all bridges crossing the modified channel. Review of the available bridge data disclosed that one bridge would have to be replaced to provide adequate flow capacity. This plan would require about 750 acres of cropland and 450 acres of natural habitat consisting of woods and brush along the river corridor. Losses of lowland woods habitat would decrease wildlife values of the area, which are already limited. Adverse impacts would also occur due to the destruction of woodland.

6.17 This plan lacks economic feasibility with average annual benefits and costs estimated at $234,700 and $845,200, respectively, resulting in a benefit-cost ratio of 0.28. The plan would alleviate about 54 percent of the total flood damages along the Snake River below Warren, including about 45 percent of the agricultural crop damages. Average annual flood damages of $132,000 would still occur in the study area.

6.18 Plan 8 - Diversion Channel to the Red River of the North - This plan consists of a 6.8-mile diversion channel from the Snake River (upstream from Alvarado at mile 35) to the Red River of the North (mile 273.5). The diversion would consist of a channel about 12 feet deep, with a bottom width of 14 feet, five new bridges, flow control structures at the inlet and outlet ends of the diversion, and side ditch inlets at each road crossing and at intersections with existing watercourses. This plan would require about 325 acres of land (310 acres of cropland and 15 acres of bottomland woods).

6.19 This alternative would contain the 10-year (10-percent) and more frequent (less severe) floods and would benefit about 10,000 acres of agricultural land. The total annual damages would be reduced by about 49 percent, with about $145,000 in remaining average annual damages. Estimated first costs for the alternative are $3,200,000, with average annual benefits and costs of $185,000 and $266,000, respectively. Because the benefit-cost ratio is only 0.70, this plan lacks economic feasibility.

6.20 Of the structural alternatives investigated, this alternative would have the least detrimental biological effects. The natural habitat disturbed by this plan would consist of 15 acres of bottomland hardwoods at each end of the diversion. A wildlife corridor could be created along the diversion channel by planting the channel and the dredged material banks with a native prairie grassland species and by maintaining the channel as a grassed floodway. Rows of trees, planted parallel to the channel (to serve as windbreaks to prevent the channel from becoming filled with snow) would provide additional wildlife habitat.

6.21 In summary, the plan could have some favorable effects on wildlife habitat; however, its lack of economic feasibility and the social impacts associated with the removal of 310 acres of cropland from production render it unacceptable.

6.22 Plan 9 - Three Upstream Reservoirs - This alternative would involve construction of three small reservoirs on the Snake River and South Branch of the Snake River upstream from Warren. One reservoir would be on the Snake River at about mile 77, and the other reservoirs would be on the South Branch at approximately mile 15 and mile 22. The total surface area of the conservation pools would be 460 acres, and the design flood pools would be about 3,450 acres. Although flood control storage of these reservoirs would be approximately 15,000 acre-feet, 11,500 acre-feet of this total would be provided by the upstream site on the South Branch of the Snake River.

6.23 This alternative would require about 3,500 acres of land, including 300 acres of cropland, 80 acres of pastureland, 160 acres of bottomland woods, and 2,960 acres of wetlands. The conservation pools of the reservoirs would inundate 460 acres of land, including 160 acres of bottomland woods and 300 acres of wetlands. The remaining 3,040 acres would be subject to short-term inundation during periods requiring floodwater storage.

6.24 This alternative lacks economic feasibility with average annual benefits and costs estimated at $103,600 and $1,019,700, respectively, representing a benefit-cost ratio of 0.11. Average annual flood damages of $184,000 would still be present in the Snake River basin.

6.25 Biological effects of this alternative would include a decrease in wildlife habitat due to permanent inundation of 460 acres of habitat. Hunting opportunities for deer and upland game would suffer due to loss of habitat; however, waterfowl habitat would increase substantially due to maintenance of a conservation pool in the larger reservoir.

6.26 Plan 10 - Clearing and Snagging (Both With and Without Shelterbelts) - With this alternative, the lower 50 miles of the Snake River would be cleared and snagged of fallen timber and other debris obstructing the natural free-flowing capacity of the existing channel. Except for the reach of river through Warren (river mile 48 to river mile 51), the river upstream from mile 20 has not been previously cleared. Work in the lower reach of the river, from the mouth to river mile 20, would consist of debris removal only, because this reach was cleared and snagged by the Middle River-Snake River Watershed District in 1969 and 1970. This work was funded by the State of Minnesota and the U.S. Office of Emergency Preparedness following the 1969 flood. From river mile 20 to river mile 50, all accumulations of debris and snags within 20 feet of the primary channel area would be removed.

6.27 The removal of standing timber and brush would be limited to the lower two-thirds of the channel bank to avoid significant effects on the canopy provided by the existing wooded corridor. The only standing trees to be removed beyond the lower two-thirds of the channel bank would be leaning trees that are in danger of falling into the river channel and causing a future flow obstruction. All vegetation which either helps maintain bank stability or provides fish and wildlife habitat but does not interfere with the natural unobstructed flow-carrying capacity of the channel would remain. The improved channel would be able to contain a 3-year (33-percent chance) flood.

6.28 Materials and debris from the clearing and snagging operation would be removed from the site and disposed of in the most environmentally acceptable way. All material would be stockpiled or disposed of by burial

or burning in a manner both agreeable to the local landowner and in compliance with Federal, State, and local regulations. Stockpiled material would be placed in a suitable location where it would not interfere with existing land-use practices but could be left as habitat for small animals.

6.29 At various points along the river where the wooded corridor is not continuous, the unprotected channel fills with snow and prevents full use of the channel capacity during initial spring runoff. To remedy this problem, rows of trees would be planted parallel to the river channel approximately 150 feet from the top of bank.

6.30 Of the plans investigated, this alternative is the only economically feasible damage reduction alternative. The average annual benefits would be $107,500 with the shelterbelt and $87,600 without the shelterbelt; average annual cost would be $55,500 and $51,500, respectively. The resulting benefit-cost ratios are 1.9 with a shelterbelt and 1.7 without one. These alternatives would provide substantial flood protection at the least cost and with the least requirement for additional agricultural land and natural habitat of the structural alternatives considered.

The National Economic Development and Environmental Quality Plans

6.31 The National Economic Development (NED) Plan, as described in the Principles and Standards for Planning Water and Related Land Resources Projects, is the proposed plan of snagging, clearing, and shelterbelts. The Environmental Quality (EQ) plan is also the proposed plan. As a result of shelterbelt construction, the plan makes net positive contributions to the environmental quality of the area, in terms of aesthetics, recreation, and habitat development.

7.00 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 The snagging and clearing aspect of the project would be a short-term flood damage reduction method if it is not properly maintained. The initial flood reduction benefits of this project are a reduction in area flooded and the possibility of making agricultural practices more timely.

7.02 The long-term effects of this project depend largely on maintenance activities. Maintenance of the clearing and snagging aspect of the project would result in the extended significant loss of habitat for fish, fur-bearers, birds, and turtles. This effect is brought about by the removal of vegetational regrowth and debris but it would also assure the growth of a healthy, efficient shelterbelt system. A maintained shelterbelt would develop at all horizontal and vertical strata. The long-term impact of this phase of the project would be an ever increasing effectiveness as a windbreak and the development of a habitat enhancing the value of the area for wildlife, as well as consumptive and non-comsumptive recreational use. The reduced flooding region would have no effect on vegetational productivity.

7.03 The long-term effects on the recreational status of the river are difficult to assess. Recreational possibilities of the river should increase with the growth and maturity of the shelterbelts. The cleared and snagged area would be visible for many years and the loss of vegetation would be noticeable and undesirable to many people.

8.00 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION

8.01 The natural resources (gasoline, etc.) used to construct and maintain the project would be irretrievable.

9.00 COORDINATION

9.01 Coordination with Federal, State, and local interests was an important part of this study. The U.S. Fish and Wildlife Service, Minnesota Department of Natural Resources, Soil Conservation Service, Minnesota State Planning Agency, and Middle River-Snake River Watershed Advisory Board, Minnesota Historical Society, National Park Service, Minnesota Department of Transportation, City of Warren, and City of Alvarado have contributed information, advice, and alternative plans.

9.02 The following agencies, interest groups, and individuals were furnished copies of this statement for review:

Hon. Albert Quie, Governor of Minnesota
Hon. Dave Durenberger, U.S. Senate
Hon. Rudy Boschwitz, U.S. Senate
Hon. Arlan Stangeland, U.S. House of Representatives
U.S. Environmental Protection Agency
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Energy
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
U.S. Department of the Interior
U.S. Department of Transportation
Advisory Council on Historic Preservation
Minnesota Department of Agriculture
Minnesota Department of Economic Development
Minnesota Energy Agency
University of Minnesota Department of Sociology/Anthropology
Minnesota Environmental Quality Board
Minnesota Senate, Natural Resources and Agriculture Committee
Minnesota House of Representatives
Minnesota State Archaeologist
Minnesota State Historical Society
Minnesota Pollution Control Agency
Minnesota State Planning Agency
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota-Wisconsin Boundary Area Commission
Minnesota Water Resources Board
Minnesota Department of Transportation
Minnesota State Soil and Water Commission
State Office of Economic Opportunity
Midwestern Gas Transmission
Minnesota Department of Education
Mayor of Alvarado
Mayor of Warren
Mayor of Crookston
Mayor of Thief River Falls
Mayor of Argyle
Fork Township, Supervisor
Clerk, Oak Park Township
Middle River-Snake River Watershed District
Marshall County Highway Department
Wildlife of America
Water Resources Research Center
Minnesota Futurists
Friends of the Earth
Izaak Walton League of America
Ducks Unlimited
National Audubon Society
Minnesota Environmental Control Citizens Association
Minnesota Public Interest Research Group

Sierra Club
The Waterways Journal
Environmental Defense Fund, Inc.
Coalition on American Rivers
Minnesota League of Women Voters
Soil Conservation Society of America
Northwest Regional Development Commission
Soil Conservation Service Work Unit
Agricultural Stabilization and Conservation Committee
Snake River Advisory Committee
Center for Urban Affairs
Souris-Red-Rainy UMRBC
Aquar, Iyring, Whiteman, Moser, Inc.
Aerial Surveys, Inc.
Myhre and Jorgenson
Northwest Regional Development Commission
Crookston Daily Times
Thief River Falls Times
Warren Sheaf
William E. Olson
Harveydale Maruska
Melvin Peterson
Professor H. Paul Friesema, Northwestern University
Metropolitan Open Space Information Project
S. East Minnesota Area-Wide Planning Organization
The Nature Conservancy
Minnesota Waterfowl Association
Minnesota Pheasants Unlimited
Environmental Quality Council
Freshwater Biological Foundation
Minnesota Environmental Education Council
Minnesota Association of Conservation Education
Minnesota Environmental Education and Conservation Association
Minnesota Education Association
Environmental Science Center
Bell Museum of Natural History
Limnological Research Center
Water Resources Development Commission
Metropolitan Nature Foundation
Minnesota Conservation Federation
Ecological Society of America
Environmental Concern Organization
Environmental Concerns, Inc.
Wetlands Task Force
Minnesota Association of Watershed Districts
Marshall County Commission
Polk County Commission

9.03 Copies of this statement were also sent to the following libraries where they should be made available to general public.

Minneapolis Public Library
Minnesota State Legislative Library
Environmental Conservation Library of Minnesota

Library of Congress
St. Paul Public Library
Metropolitan Council Library
University of Minnesota Library
Public Library, Thief River Falls
Public Library, Warren
Polk County Library

9.04 Single copies of this statement are available upon request from the St. Paul District Office, Corps of Engineers, 1135 U.S. Post Office and Custom House, St. Paul, Minnesota 55101.

BIBLIOGRAPHY

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3. Johnson, W.D. 1971. The Forest Overstory Vegetation of the Missouri River Floodplain in North Dakota. Ph.D. Thesis. North Dakota State University, Fargo, North Dakota. 151 p.

4. Lane, Richard B. 1975. An Archaeological Survey of the Snake River from 2 Miles East of Warren, Minnesota to the Red River of the North August-November 1975. A Report Submitted to the U.S. Army Corps of Engineers, St. Paul District (Contract No. DACW37-76-C-0037).

5. Minnesota Pollution Control Agency, Rules and Regulations, WPC 14, 4 Oct. 1975.

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7. Soil Conservation Service, 1939, Reconnaissance Soil Survey of the Red River Valley Area, Minnesota.

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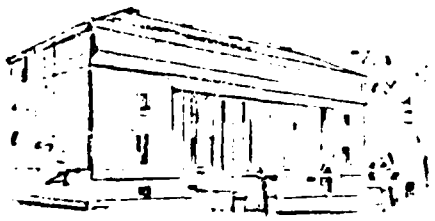

MINNESOTA HISTORICAL SOCIETY

690 Cedar Street, St. Paul, Minnesota 55101 • 612-296-2747

15 March 1976

Colonel Forrest T. Gay, III
District Engineer
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Attention: Permit and Statistics Branch

Dear Colonel Gay:

RE: NCSED-ER
Cultural Resources Report
Snake River, Minnesota,
Flood Control Project

On page 36 of the report described above the author, Mr. Richard Lane, lists nine sites which meet National Register criteria. These sites should undoubtedly receive the close attention of the Corps of Engineers as planning for the area continues, including, if necessary, proper mitigative measures. Mr. Lane also discovered, in the short time given him to prepare the survey, nine sites which should be analyzed in greater detail to determine their eligibility for the National Register. These nine sites are listed on pages 35 and 36 of his report. I hope that Mr. Lane's suggestions will be accepted and that these nine sites will receive the attention he requests.

Thank you for your attention to historic and archaeological resources in this project.

Sincerely,

Russell W. Fridley

Russell W. Fridley
State Historic Preservation Officer

RWF/fr

Exhibit 1

United States Department of the Interior

NATIONAL PARK SERVICE
INTERAGENCY ARCHEOLOGICAL SERVICES - DENVER
OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION
1978 SOUTH GARRISON - ROOM 107
DENVER, COLORADO 80227

IN REPLY REFER TO:

H22-(RMR)PI

APR 2 2 1976

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

DACW37-76-C-0037

Dear Mr. Fast:

The following comments are offered in regard to the adequacy of the report entitled: "An Archaeological Survey of the Snake River From 2 Miles East of Warren, Minnesota to the Red River of the North, August - November 1975" submitted by Richard B. Lane.

The fieldwork appears to have been carefully conducted and the sites well described from their surface features. However, the subsurface testing data, including stratigraphic profiles, should also have been included in the report. Further, the site mitigation recommendations appearing in Appendix C lack justification and thus lessen their creditability. Also, the sites should be evaluated for eligibility to the National Register of Historic Places and appropriate mitigative measures formulated for those sites determined to be of National Register quality.

Thank you for the opportunity to comment on this report, and we would appreciate being kept informed of subsequent phases of work involving cultural resource mitigation in the Marshall-Red River Flood Control Project.

Sincerely yours,

Jack R Rudy
Chief, Interagency
Archeological Services - Denver

Exhibit 2

END

FILMED

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