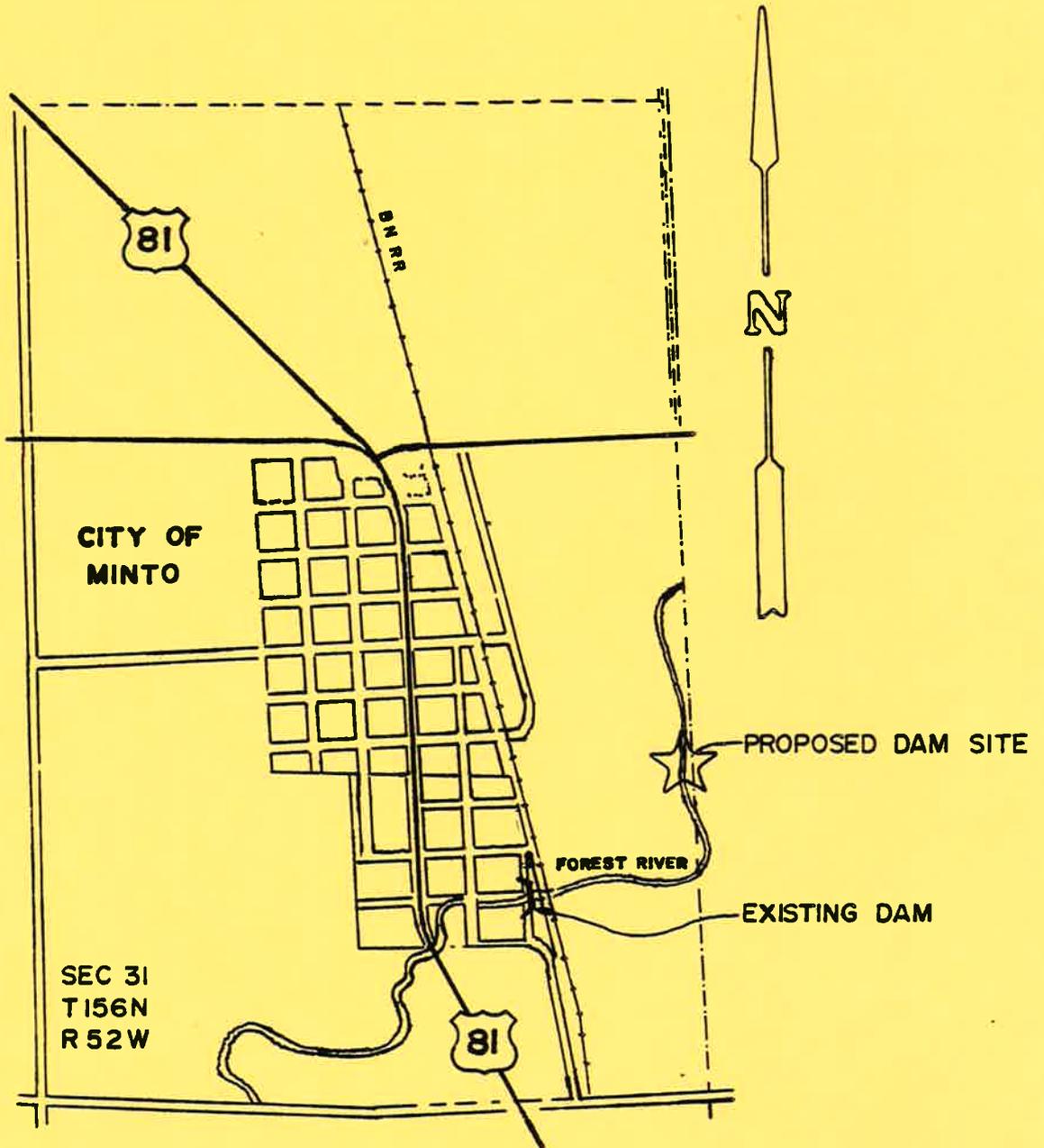


PRELIMINARY ENGINEERING REPORT

**FEASIBILITY STUDY
FOR THE PROPOSED
MINTO WATER SUPPLY DAM**



**NORTH DAKOTA
STATE WATER COMMISSON**

MARCH 1980

SWC PROJECT 448

PRELIMINARY ENGINEERING REPORT

MINTO WATER SUPPLY DAM
SWC PROJECT #448

March 4, 1980

PREPARED BY:

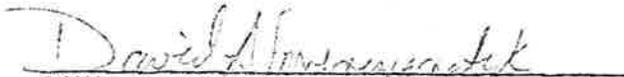


RONALD A. SWANSON, P.E.
DESIGN ENGINEER

PREPARED BY:

NORTH DAKOTA STATE WATER COMMISSION
STATE OFFICE BUILDING
900 EAST BOULEVARD
BISMARCK, NORTH DAKOTA 58505

SUBMITTED BY:



DAVID A. SPRYNCZYNATYK, P.E.
DIRECTOR OF ENGINEERING

PREPARED FOR:

CITY OF MINTO, NORTH DAKOTA

APPROVED BY:


VERNON FAHY, P.E.
STATE ENGINEER

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I. INTRODUCTION

Purpose and Scope

The purpose of this report is to study the feasibility of constructing a low head channel dam on the Forest River near Minto in order to provide a water supply reservoir for the city.

This report is limited to only this specific water supply structure and is intended to serve as a supplement to the report submitted by the U.S. Army Corps of Engineers entitled "FOREST RIVER BASIN, NORTH DAKOTA, FEASIBILITY REPORT FOR FLOOD CONTROL AND RELATED PURPOSES" dated June, 1975. This aforementioned report, hereinafter referred to as the "FOREST RIVER REPORT", is quite comprehensive and covers both the flood control problems on the Forest River and the Minto municipal water supply. Since most of the background data, such as historical narrative, hydrologic studies, geological investigations and environmental consideration are equally applicable to this report, no attempt is made to re-state them. Instead, the reader is advised to consult the Forest River Report for such information.

Since the Forest River Report was prepared, there has been one additional study made that should be briefly mentioned. This is the Corps of Engineers report, "THE MINTO DAM, PHASE I INSPECTION REPORT, NATIONAL DAM SAFETY PROGRAM", dated July 18, 1978. This report, hereinafter referred to as the "MINTO DAM SAFETY REPORT" specifically addresses the existing water supply dam, but it is not of sufficient significance that it should be included in the background documentation of our study. A copy of the "MINTO DAM SAFETY REPORT" has been provided to the Mayor of Minto by letter dated October 27, 1978.

II. HISTORICAL BACKGROUND

The existing Minto Dam was constructed in 1938 under the Works Progress Administration (WPA) Program. In 1956, repairs of an undisclosed nature were made to the structure by the City of Minto and the North Dakota State Water Commission.

On February 1, 1973, the structure washed out. Repairs began on February 21, 1973. These consisted of driving steel sheet piling upstream of the remaining concrete section, adding rock and concrete between sheet piling and the remaining section and at a later date, adding a concrete cap along the crest.

III. PROPOSED WATER SUPPLY DAM

The proposed dam is to be located in Section 31, Township 156 North, Range 52 West, approximately 2200 feet downstream from the existing water supply dam, as shown in Figure No. 1.

The site was chosen over the other two alternative locations mentioned in the Forest River Report because of several reasons, (1) the additional storage available downstream, (2) the existing sediment deposits in the upstream pool, (3) the downstream site offers greater ease of construction away from city congestion. The various alternatives are discussed in Appendix "A" which is an excerpted portion of "The Forest River Report".

These advantages of the downstream site are not offset by any specific advantages of the upstream sites. The other factors, such as soils and geological conditions are equal at all locations. The structural type and size of a dam at any site would be the same.

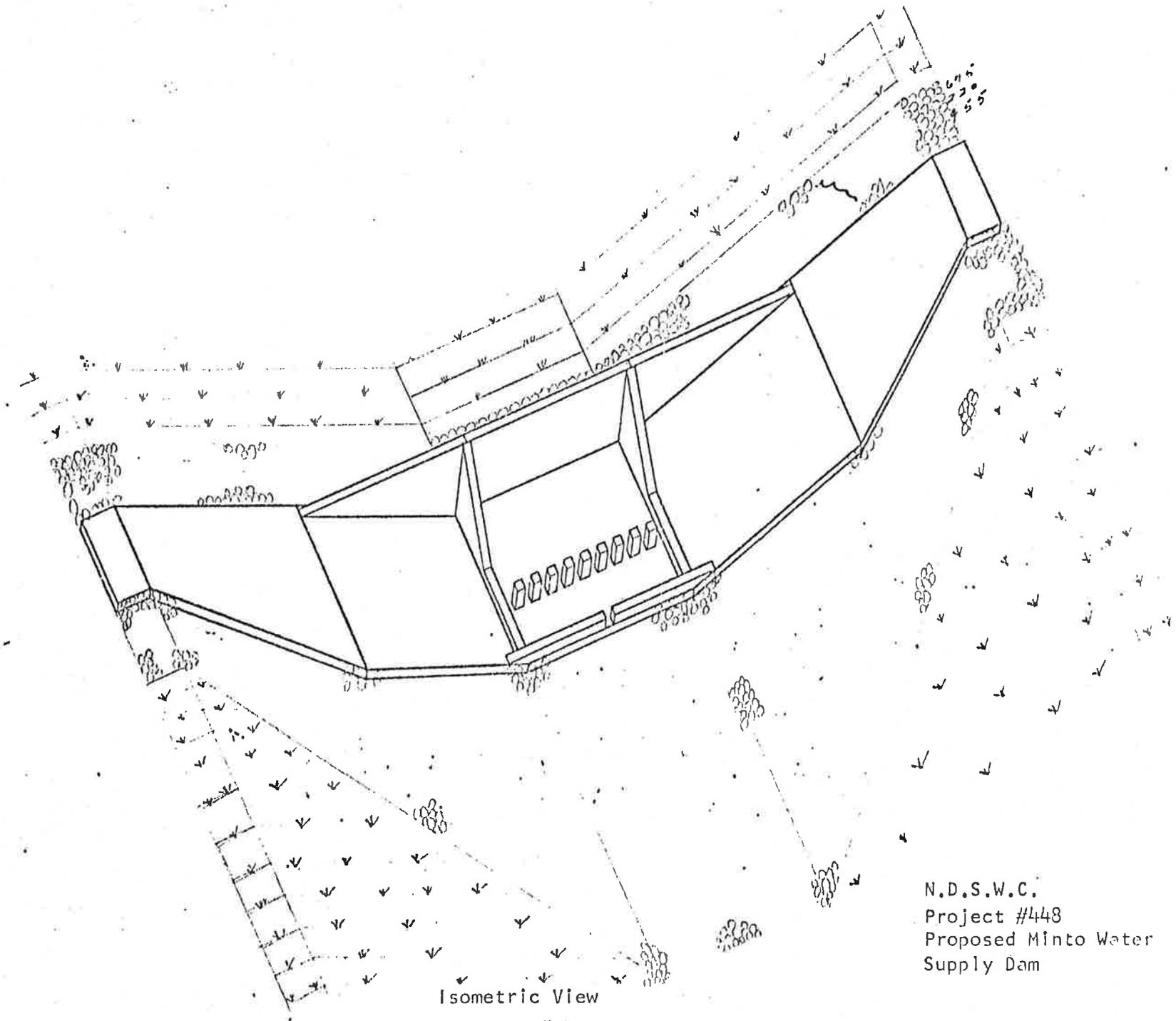
One additional factor considered was the retention of the existing dam to act as a siltation collection basin in order to maintain the storage effectiveness of the downstream reservoir and also to thereby improve the quality of the water stored within. This would, of course, require that some maintenance work be performed periodically upon the existing dam in order to keep it functioning as a settling basin.

The repairs, however, should be of a minor nature since the hydraulic head difference between the upstream and downstream face would become small due to the presence of the downstream reservoir.

IV. HYDRAULIC DESIGN

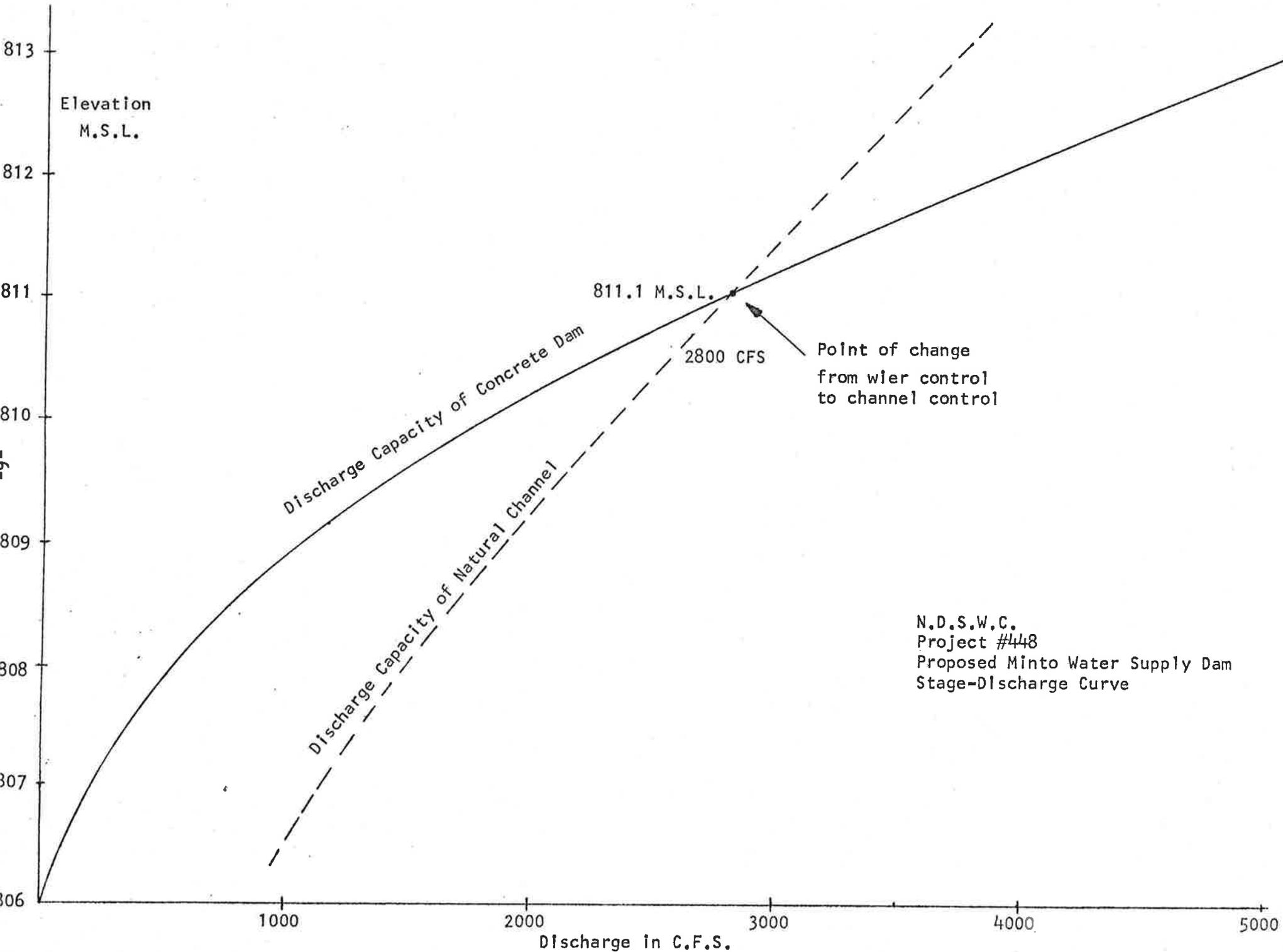
A low head channel dam such as shown in Figure No. 2 is designed so that it has greater weir capacity than the normal channel. Therefore, as the discharge increases, the control of river flows will change from weir control to downstream channel control. Thus there will not be an increase in upstream flooding occurring with the new dam in place greater than there is now with the existing dam (see Figure No. 3). The permanent storage pool will remain within the river channel and the water surface profiles of the various flood stage will not be increased.

This conservative design has the drawback of reducing the storage capacity of the reservoir. The design capacity of the proposed reservoir is 68 acre-feet or 22,000,000 gallons. At a possible water supply demand of 100,000 gallons per day, this would be a 220 day supply, assuming no losses or inflow. However, a better estimate would be that it would only contain a 110 to 150 day supply. This means that even with the new dam in place, the water supply is of a marginal quantity and vigilant monitoring of use would still be required during dry periods.



Isometric View
Figure # 2

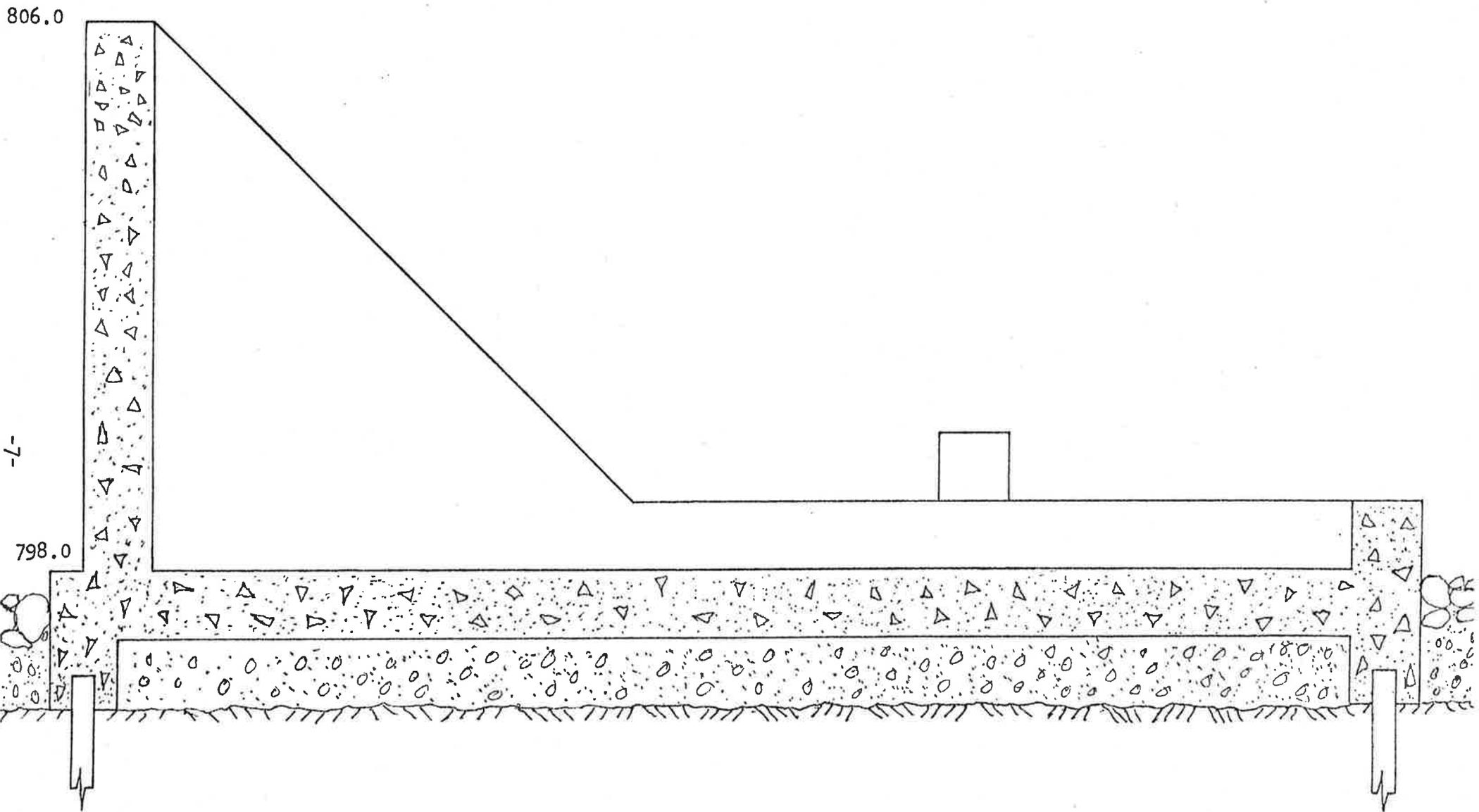
N.D.S.W.C.
Project #448
Proposed Minto Water
Supply Dam



N.D.S.W.C.
 Project #448
 Proposed Minto Water Supply Dam
 Stage-Discharge Curve

Discharge in C.F.S.

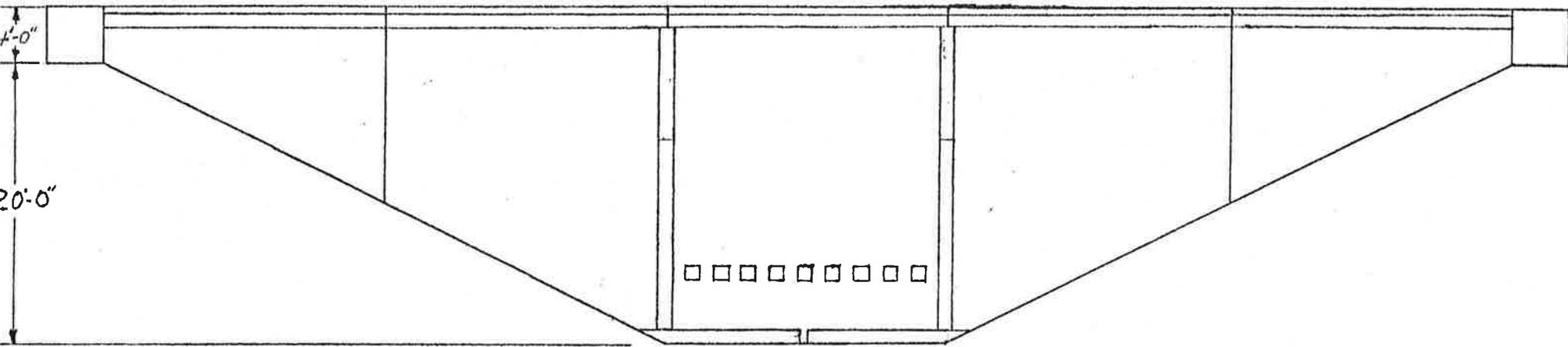
Figure #3



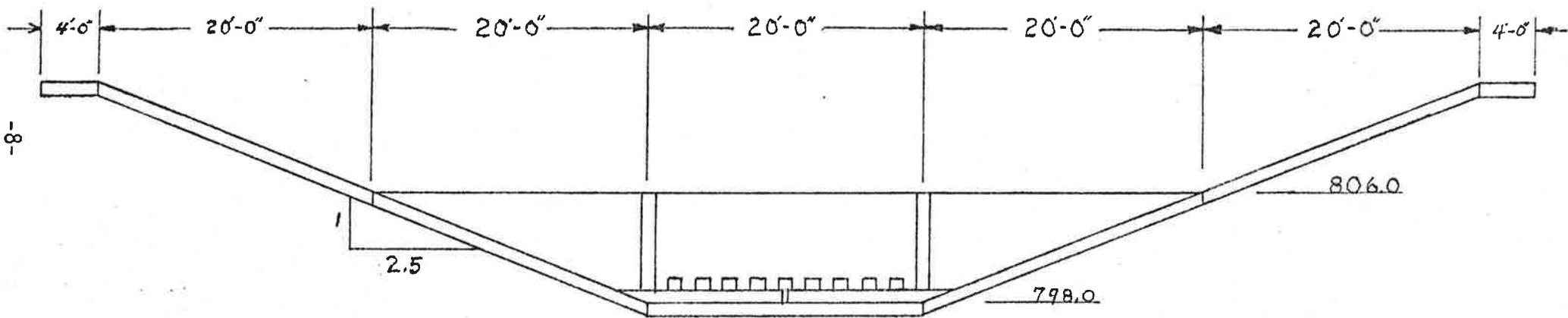
Section View
Scale 1/2" = 1'

N.D.S.W.C.
Project #448
Proposed Minto
Water Supply Dam

Figure # 4



Plan View



Elevation View

Scale $3/32" = 1'$

Figure # 5

N.D.S.W.C.
 Project #448
 Proposed Minto
 Water Supply Dam

V. STRUCTURAL DESIGN

Since the time of "The Forest River Report", findings have shown that the gated type structure previously proposed, besides being much more costly also becomes too much of a channel obstruction during flood flows. A clean cut, low head channel dam is now considered to be the proper structure for this purpose. Therefore, the cost estimate shown in Section VI is lower than that shown in Appendix "A".

The low head channel dam is to be constructed of reinforced concrete within the channel of the Forest River with a structural steel sheet piling cutoff wall along the upstream face running from abutment to abutment, with a shorter sheet piling wall along the downstream face to prevent undercutting. The upstream and downstream approaches to the dam will be shaped and covered with rock riprap erosion protection. The details and dimensions of the structure shall be as shown on the attached Figures No. 4 and 5.

VI. COST ESTIMATE

The cost estimate for the proposed new water supply dam is as follows:

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
Site Preparation and Restoration	L.S.		\$ 5,000.00
Water Control	L.S.		25,000.00
Excavation	L.S.		5,000.00
Backfill	L.S.		2,000.00
Concrete	120 C.Y.	\$375.00	45,000.00
Re-Steel	1200 Lbs.	.60	720.00
Rock Riprap	250 C.Y.	25.00	6,250.00

<u>Item</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Cost</u>
R.R.R. Filter Material	100 C.Y.	12.00	1,200.00
Gravel	400 C.Y.	10.00	4,000.00
Cobblestone	100 C.Y.	20.00	2,000.00
Sheet Piling	1,600 L.F.	20.00	32,000.00
Drain Pipe	L.S.		<u>500.00</u>
		SUB-TOTAL	\$128,670.00
		Contingencies	12,330.00
		Construction Inspection	12,000.00
		Contract Administration	<u>12,000.00</u>
		TOTAL	\$165,000.00

This price does not include the cost of land required for the project.

VII. ENVIRONMENTAL SURVEY

The following environmental survey will give an overview of the positive and negative environmental impacts that would result from the implementation of this project. This is not intended to be a comprehensive environmental assessment, however, it will identify subjects that would be analyzed in detail in an environmental impact survey. In the following paragraphs several environmental categories are identified and discussed specifically for the Forest River watershed.

Land Use

The project will not change the land use of the watershed area. The channel dam itself will be located within its present river bank. A small area will be used for a temporary construction zone. This area will be restored to its present condition upon completion of the construction effort.

Aesthetics

The project is limited to a small area, therefore aesthetics will change little. The dam, after seeding, will conform to the natural environment.

Effects on Downstream Flood Flows

The proposed channel dam will have no effect upon the downstream flows. The duration and quantities will remain the same as before the dam construction.

Effects on Downstream Water Quality

High velocity flows generally have a high sediment load which is deposited as velocity begins to slow. This project will have a negligible effect upon the downstream water quality. The existing dam will continue to act as a sediment trap, causing some of the transported material to settle out. There will be a small amount of additional material deposited within the pool of the proposed dam, but the effects thereof will be minor.

Effects on Fish and Wildlife

There is no existing water within the watershed that is suitable for maintaining a fish habitat, and the proposed project will not produce a body of water that would support significant fish life. There will perhaps be some minor improvement of fishing due to the new pool of clearer water. The project will not destroy any existing wildlife habitat. Wildlife will be temporarily driven from the area by the construction operations, but will return in due time. Degradation will not increase with the implementation of this project.

Irreversible and Irretrievable Commitment of Resources

Fossil fuel, construction materials, and labor used in the construction of the project will be irretrievably committed.

VIII. CONCLUSIONS

As specified in the Agreement between the North Dakota State Water Commission and the City of Minto, see Appendix B, the preliminary investigation as to the feasibility of constructing a new water supply dam has been made.

This study shows that a water supply dam can indeed be constructed and that the downstream site is the preferred location.

It is feasible from a structural, geological and hydraulic standpoint. It is somewhat questionable from a meteorological viewpoint. This is due to the fact that during a drought or even a semi-arid weather cycle, the available river channel storage capacity is too small to guarantee a satisfactory carry over for a winter season.

Also, the economic feasibility may be of a somewhat marginal value.

IX. RECOMMENDATIONS

It is recommended that the City again review all the alternatives discussed in Appendix A. Also, the city should determine what financial capability it possesses and which alternatives fall within its resources. The cost of the various alternatives is such that all options should be given serious consideration.

APPENDICES

APPENDIX "A"
(Excerpted from "The Forest River Report")

ALTERNATIVE WATER SUPPLY FOR THE CITY OF MINTO

Municipal Water Supply

Six alternatives were investigated for supplying water to the city of Minto; two using water directly from the Forest River, two using ground water supply and two using water from the Red River. All water system alternatives were based on population estimated at 750 by 2020, and an average daily consumption of 100,000 gal/day. The present average daily consumption is 55,000 gal/day and a peak demand of 80,000 gal/day. The present water plant and distribution system has a rated capacity of 150 gpm (216,000 gpd) with a storage capacity of 70,000 gallons. The treatment plant is in good condition and is presently treating for hardness and biological agent.

Presently the city of Minto has a two inch feeder line to the existing Walsh County Rural Water District line, one mile north of the city. The pipeline north of Minto is a four inch line and does not have the capacity to meet existing or projected needs of Minto.

Alternative 1: Main Stream Forest River At Minto

The city of Minto currently receives its municipal water supply from the main stream of the Forest River. The water is stored within the channel of the Forest River by a lowhead channel dam. The existing dam is in a state of temporary repair and construction of a new dam has been proposed.

A new dam could be constructed at one of three sites: (1) the existing dam site; (2) 100 feet upstream from the existing site; and (3) 2,200 feet downstream from the existing site, Figure C-5. The capacity of these impoundments at control elevation 808.0 msl are:

The existing site	48 acre-feet
The upstream site	47 acre-feet
The downstream site	68 acre-feet

The dam would be a low-head reinforced concrete channel dam designed with a capacity sufficient to handle the bank full flood stage without creating any backwater effect.

Upgrading of a dam on the Forest River would require construction of new intake facilities for municipal water supply. Estimated costs for a dam and related facilities are \$406,000 with annual operation and maintenance costs totaling \$1200.

Alternative 2: Fordville Aquifer

As previously mentioned, the Fordville aquifer is 21 miles west of Minto and is the largest and most productive glacial-drift aquifer in Walsh County, Figure C-6. Ground water withdrawals from the Fordville aquifer are by wells. A well field consisting of 10 wells, each capable of producing 144,000 gpd, has been installed in the northern part of the aquifer by the U.S. Army for the purpose of supplying water to military installations. The city of Fordville, near the south end of the aquifer, pumps about 30,000 gpd. The total well pumpage for all purposes including farm use probably is small compared to the quantities that are being discharged annually.

The aquifer-test data and test drilling indicate that yields of more than 500 gpm are obtainable from the northeastern part of the Fordville aquifer.

Based on an areal extent of 33 square miles, an average saturated thickness of 20 feet and a storage coefficient of 0.15, about 63,000 acre-feet of water is in storage.

Water from the Fordville aquifer is a calcium sodium bicarbonate type of relatively good quality. Dissolved solids range from 315 mg/l to 595 mg/l.

Based on studies by the North Dakota State Water Commission, additional development of the Fordville aquifer for the Minto city water supply is feasible. The system serving Minto would have two production wells located in the northeastern portion of the aquifer with a rated capacity of 75 gpm for each well. Pumping and control facilities would be constructed at the Fordville site. Twenty one miles of four inch plastic pipe would be required to connect the well field to the city of Minto. Roadway right-of-way would undoubtedly have to be purchased for pipeline construction. The estimated cost for this plan is \$211,000 with operating and maintenance averaging \$2,700 per year. Project location is shown on Figure C-6.

Alternative 3: Red River Direct To Minto

This alternative involves the diversion of water from the Red River of the north twelve miles east to Minto. A lowhead dam would be constructed on the Red River to provide a pumping pool. A pumping station with a rated capacity of 150 gpm (two 75 gpm pumps) would be constructed

adjacent to the river and within the pumping pool. In addition, two pumps would be installed to increase the reliability of the system and a telemetering system installed to provide for constant monitoring at the city water works. A four inch plastic line running east from the pumping station, parallel to existing roadways, would connect the pump site to Minto's existing treatment plant, Figure C-7. The water quality in the Red and Forest Rivers is basically the same; therefore, the present treatment system should be adequate to treat water from the Red River. The estimated costs for this alternative are \$566,000 with annual operating and maintenance costs averaging \$3700.

Alternative 4: City of Grafton

At the present time, the city of Grafton is considering installing a water supply system from the Red River. The proposed plan would involve construction of a check dam on the Red River to serve as a pumping forebay, pumping facilities and a 20 inch, 14 mile pipeline to deliver water to the water treatment plant at Grafton. The system would provide Grafton with an assured supply of 1.6 million gallons per day. The estimated cost of this system is \$3,100,000 plus an additional \$500,000 to upgrade the water treatment plant.

Construction of this diversion system may allow the city of Minto to purchase treated water from Grafton. Minto would have to construct a pipeline from Grafton to the existing distribution system. A four inch line could parallel existing roadways between Grafton and Minto, as shown in Figure C-8. The estimated costs for the pipeline are \$73,000 with average annual operation and maintenance costs of \$500. The

estimated average monthly cost for treated water delivered to the city of Minto is \$1200 at a rate of 100,000 gpd. This does not include any charges for the water which Grafton may choose to apply.

Alternative 5: Desalination of Ground Water

The Dakota Formation which underlies the Minto area is a possible water supply source; however, the water from this aquifer is highly saline, a T.D.S. of 4,000 mg/l, and would require desalination. The reverse osmosis process was used to estimate the cost of this alternative.

The salt brine from the desalting process could be disposed of by expanding the current sewage lagoon system. The estimated costs for this project are \$550,000 with annual operating and maintenance costs averaging \$46,000.

Alternative 6: Upstream Reservoir

The Soil Conservation Service has constructed six reservoirs and plans to construct one additional reservoir in the upper reaches of the Forest River. Of these seven reservoirs, only three have sufficient storage to meet Minto's requirements of 111 acre-feet per year. Whitman Dam, 41 miles southwest and Matejcek Dam, 31 miles southwest of Minto, have sufficient storage to meet Minto's present and future needs.

Dam No. 4 located on the Middle-South Branch of the Forest River in the SE $\frac{1}{4}$ of Section 6 and the NE $\frac{1}{4}$ of Section 7, Township 154 North, Range 55 West, in Grand Forks County, is scheduled for construction in 1976. The structure is primarily flood control and recreation. However, the dam could provide municipal water supply to the city of Minto. A pumping station would be located along the reservoir above the maximum pool

elevation. A plastic pipeline would connect the pumping plant at the dam site to Minto's existing treatment plant. The line would make use of existing road rights-of-way wherever possible. The estimated cost for this alternative is \$320,000 with average annual operation and maintenance costs of \$5000.

Preliminary Investigation
by the
North Dakota State Water Commission

APPENDIX B

I. PARTIES

THIS AGREEMENT is between the North Dakota State Water Commission, hereinafter referred to as the Commission, acting through the State Engineer, Vern Fahy, and the city of Minto, hereinafter referred to as the City, acting through its Mayor, Gerald Misialek.

II. PROJECT, LOCATION AND PURPOSE

The City has requested an investigation to determine the feasibility and design for a new water supply dam on the Forest River. Subsurface investigations have been conducted by the Commission at two proposed sites on the Forest River, near the city of Minto. The proposed locations are as follows:

(a) Immediately upstream from the existing dam structure approximately 125 feet in Section 31, Township 156 North, Range 52 West.

(b) Downstream from the existing dam structure along the assumed East-West quarter line between Sections 31 and 32, Township 156 North, Range 52 West.

For the purpose of this investigation and any hereafter, the proposed dam site upstream is referred to as Dam No. 1 and the proposed dam site downstream as Dam No. 2.

The City currently receives its municipal water supply from the Forest River. The water is stored within the channel of the river by a lowhead channel dam. The existing dam is in a state of temporary repair and is structurally unsound. The repairs made are not considered adequate to meet future water supply demands.

III. PRELIMINARY INVESTIGATION

The parties agree that further information is necessary concerning the proposed project. Therefore, the Commission shall conduct preliminary investigations consisting of the following: -19-

(a) Hydrologic studies and determination of reliability of water supply.

(b) Preliminary design studies

(c) Preliminary cost estimate report

(d) Recommendations and conclusions

Detailed field investigations, surveys and additional subsurface investigations for the "Feasibility and Specification Design Stages" of the investigation, shall not be made under this agreement.

IV. DEPOSIT - REFUND

The City shall deposit \$500.00 with the Commission. Upon completion of the preliminary investigation, upon receipt of a request from the City to terminate proceeding further with the preliminary investigation, or upon a breach of this agreement by the City, the Commission shall provide the City with a statement of all expenses incurred in the preliminary investigation and shall return any unexpended deposit funds.

V. RIGHTS OF ENTRY

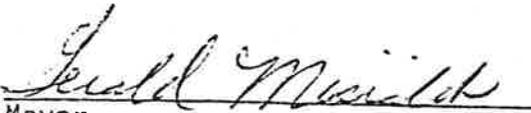
The City agrees to obtain written permission from any affected landowner for surveys by the Commission (or any contractor) which are required for the preliminary investigations.

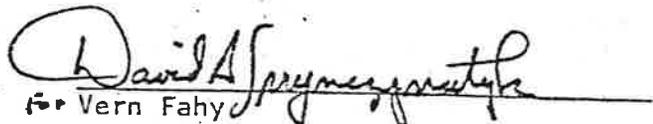
VI. INDEMNIFICATION

The City hereby accepts responsibility for, and holds the Commission free from, all claims and damages to public or private properties, rights, or persons arising out of this investigation. In the event a suit is initiated or judgment entered against the Commission, the Board shall indemnify it for any judgment arrived at or judgment satisfied.

CITY OF MINTO

NORTH DAKOTA STATE WATER COMMISSION


Mayor


for Vern Fahy
State Engineer

2 Feb 78

January 13, 1978

