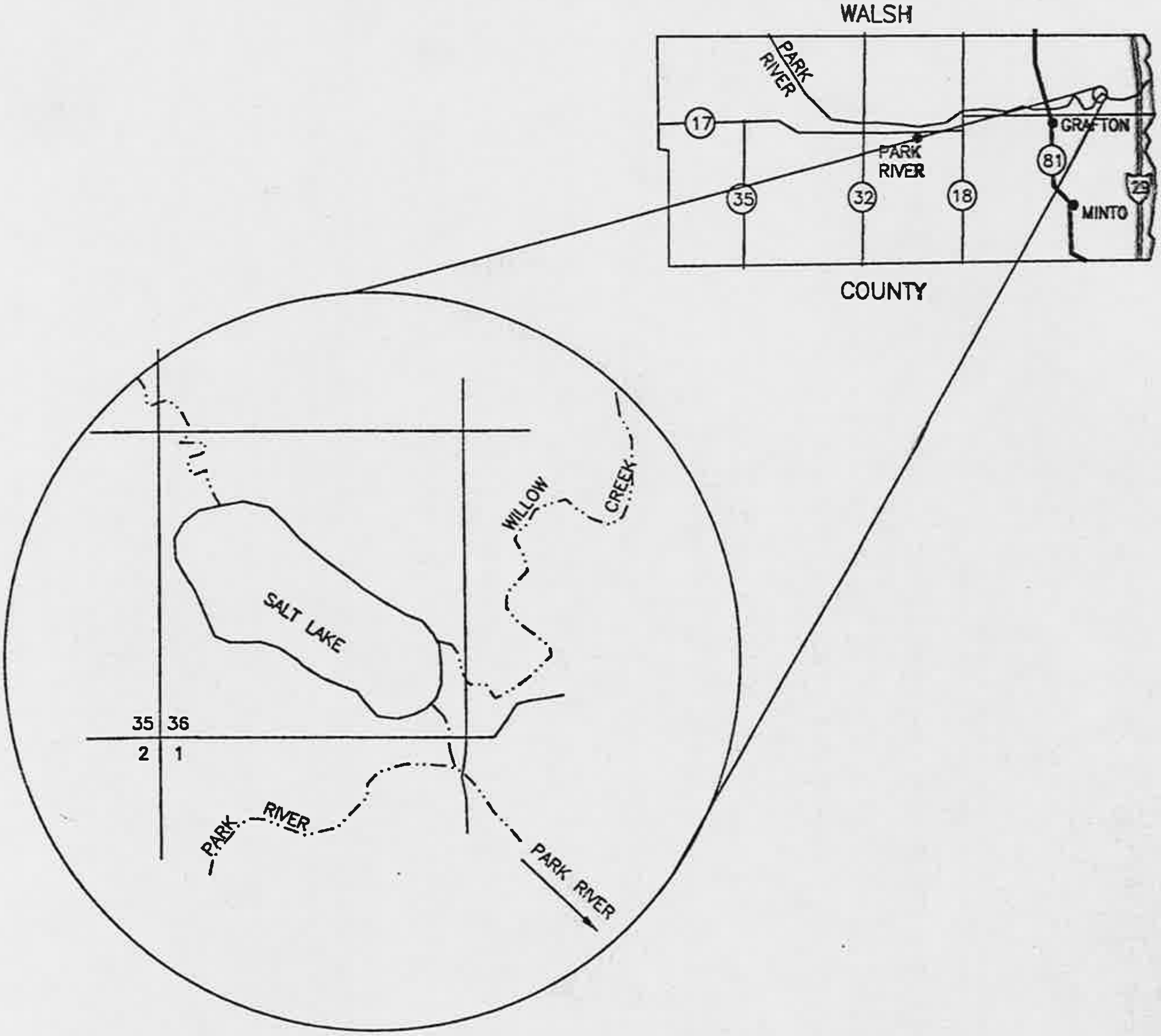
PRELIMINARY ENGINEERING REPORT

SALT LAKE

SWC NO. 1312
WALSH COUNTY



NORTH DAKOTA
STATE WATER COMMISSION

May 1995

PRELIMINARY ENGINEERING REPORT

Salt Lake Flood Control

SWC Project #1312

May 1995

North Dakota State Water Commission
900 East Boulevard
Bismarck, ND 58505-0850

Prepared by:

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Director of Water Development

Approved by:

David A. Sprynczynatyk, P.E.
State Engineer

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I. INTRODUCTION

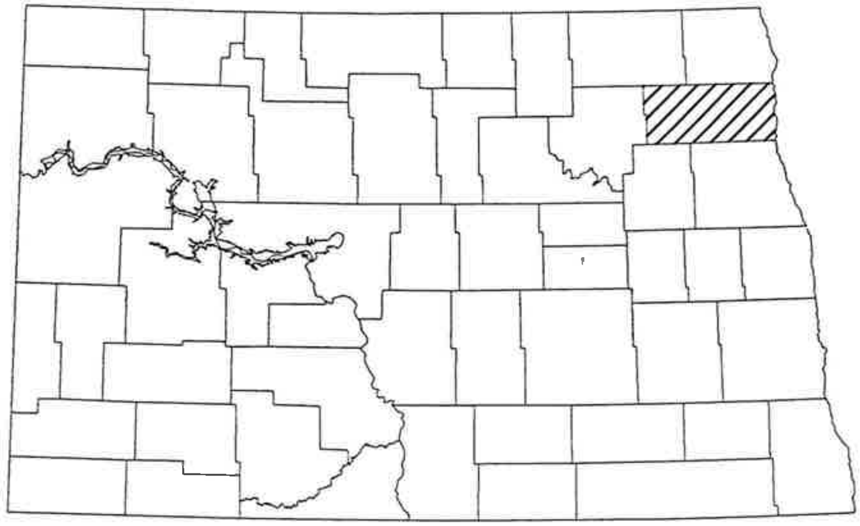
Study Objectives:

In May of 1993, the North Dakota State Water Commission and the Walsh County Water Resource District entered into an agreement to investigate the feasibility of storing additional floodwaters from the Park River in Salt Lake. The agreement called for the State Water Commission to study the feasibility of installing a gated block at the outlet of Salt Lake, or a diversion structure on the Park River, to provide maximum flood storage; determine the effect the proposed project will have on flood flows in the Park River and Red River; develop a plan to operate the structure to obtain the greatest reduction in flows on the Park River during the period when the Red River is at its peak elevation; prepare a preliminary cost estimate for the project; and prepare a preliminary engineering report presenting the results of the investigation. A copy of the agreement is contained in Appendix A.

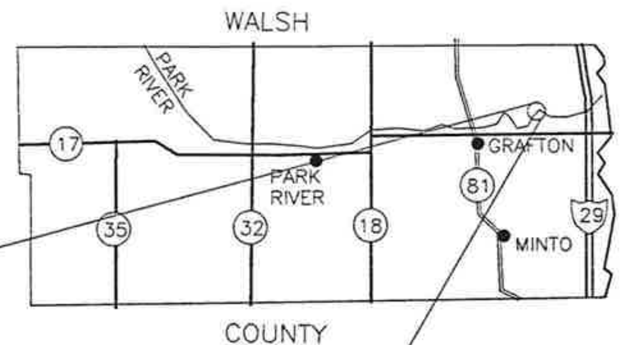
Project Location and Purpose:

Salt Lake is located in Section 36, Township 158 North, Range 52 West, in Walsh County, approximately 8 miles northeast of the city of Grafton, North Dakota. Figure 1 shows the location of Salt Lake within the state of North Dakota.

Salt Lake is a natural lake located adjacent to Willow Creek approximately 1200 feet upstream of its confluence with the Park River. Based on USGS 7.5-minute



SALT LAKE
SWC # 1312
LOCATION MAP



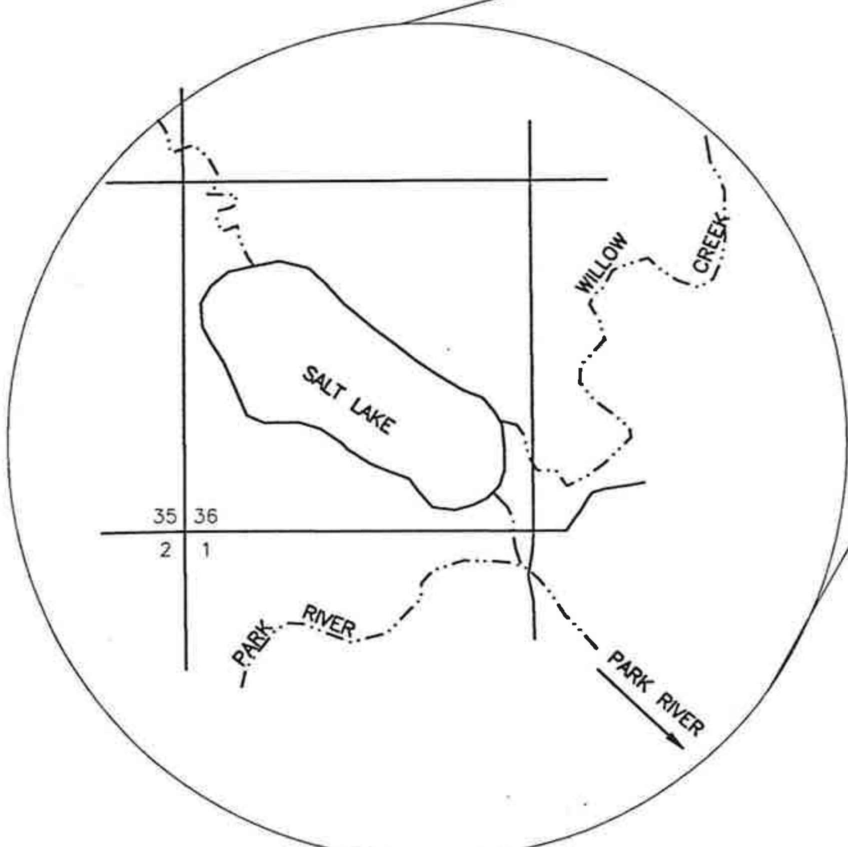


Figure 1 - Location of Salt Lake

quadrangle maps, the outlet channel for Salt Lake is at an elevation of approximately 780 msl. At this level, Salt Lake has a surface area of approximately 220 acres. During high flow events, Salt Lake fills due to inflow from Willow Creek and backwater from the Park River and Red River. As the Park River and Red River levels recede, the level of Salt Lake drops. The purpose of this study is to evaluate the feasibility of storing additional floodwaters from the Park River in Salt Lake to reduce flooding on the Park River and Red River.

Historical Background:

The concept of storing additional floodwaters in Salt Lake was presented in a report titled "Proposal for Mitigation" written by Leonard Fagerholt, representing Walsh County of North Dakota; and Winton Knutson, representing Marshall County of Minnesota. The report proposed constructing a gated block at the lower end of Salt Lake to store surplus water. No permanent pool was proposed. The report indicated that impounding water at Salt Lake will create a lake surface of approximately 1,750 acres, with 8,800 acre-feet of temporary storage.

II. GEOLOGY AND CLIMATE

Willow Creek is a subbasin of the Park River drainage basin, which is a subbasin of the Red River of the North drainage basin. The Park River drainage basin is located within the Central Lowlands Province of the Interior Plains physiographic division. Bedrock consists of deposits of limestone and dolomite with a shale and sandstone base overlain by shale, limestone, and sandstone. Glacial sediments include clay and silt lake deposits occupying the eastern half of the basin and till composed of clay, silt, sand, and gravel in the western portion. The Pembina Escarpment forms the approximate boundary between these two areas. Holocene alluvium silt and fine sand outwash deposits are found along the floodplains of the Park River branches and tributaries.

The climate for the Park River drainage basin is characterized by variations in temperature and moderate amounts of rainfall and snowfall. The average temperature for the basin is 39 degrees Fahrenheit. The average annual precipitation for the basin is 18 inches, of which approximately 75 percent falls in April through September, which is the growing season for most crops. The prevailing wind direction is from the northwest.

III. COMPUTER MODELS

HEC-1:

A hydrologic analysis of the Willow Creek watershed upstream of Salt Lake and the Park River watershed below the city of Grafton, was performed using the HEC-1 computer model, developed by the U.S. Army Corps of Engineers. The model was used to determine the peak discharges and flow volumes of various frequency storms. It formulates a mathematical hydrologic model of the watershed based on the following data: the amount of precipitation, the precipitation distribution, soil type, land use, and the hydraulic characteristics of the channels and drainage areas. The HEC-1 model is designed to compute the surface runoff of the watershed in relation to precipitation by representing the basin as an interconnected system of hydrologic and hydraulic components. Each component of the model represents an aspect of the precipitation-runoff process within a portion of the subbasin. These components were put into the model to determine the magnitude and duration of runoff from hydrologic events with a range of frequencies.

The model was developed to determine the hydrologic response of the Willow Creek and Park River watersheds. The results obtained through the use of the model include: (1) inflow hydrographs, (2) reservoir stage hydrographs, and (3) outflow hydrographs.

IV. HYDROLOGY

The watershed above Salt Lake was defined using USGS 7.5-minute quadrangle maps. Willow Creek, which drains into Salt Lake, has a drainage area of approximately 187 square miles. The Park River above the confluence with the Salt Lake outlet has a drainage area of approximately 760 square miles. Figure 2 shows the drainage basins for Willow Creek and the Park River above Salt Lake.

The inflow hydrograph for Salt Lake was developed using the HEC-1 computer model. The 10-day snowmelt precipitation event was determined to be the critical event since it caused the highest peak flows and greatest inflow volumes. Precipitation events that were modeled include the 10-, 25-, 50-, and 100-year frequency events. Table 1 shows the peak inflows and total inflow volumes for Salt Lake for the various precipitation events that were modeled.

Table 1 - Peak Inflows and Volumes for Salt Lake

Event	Peak Inflow (cfs)	Total Inflow Volume (acre-feet)
10-year snowmelt	1,577	10,693
25-year snowmelt	2,636	17,703
50-year snowmelt	3,459	23,314
100-year snowmelt	4,333	29,446

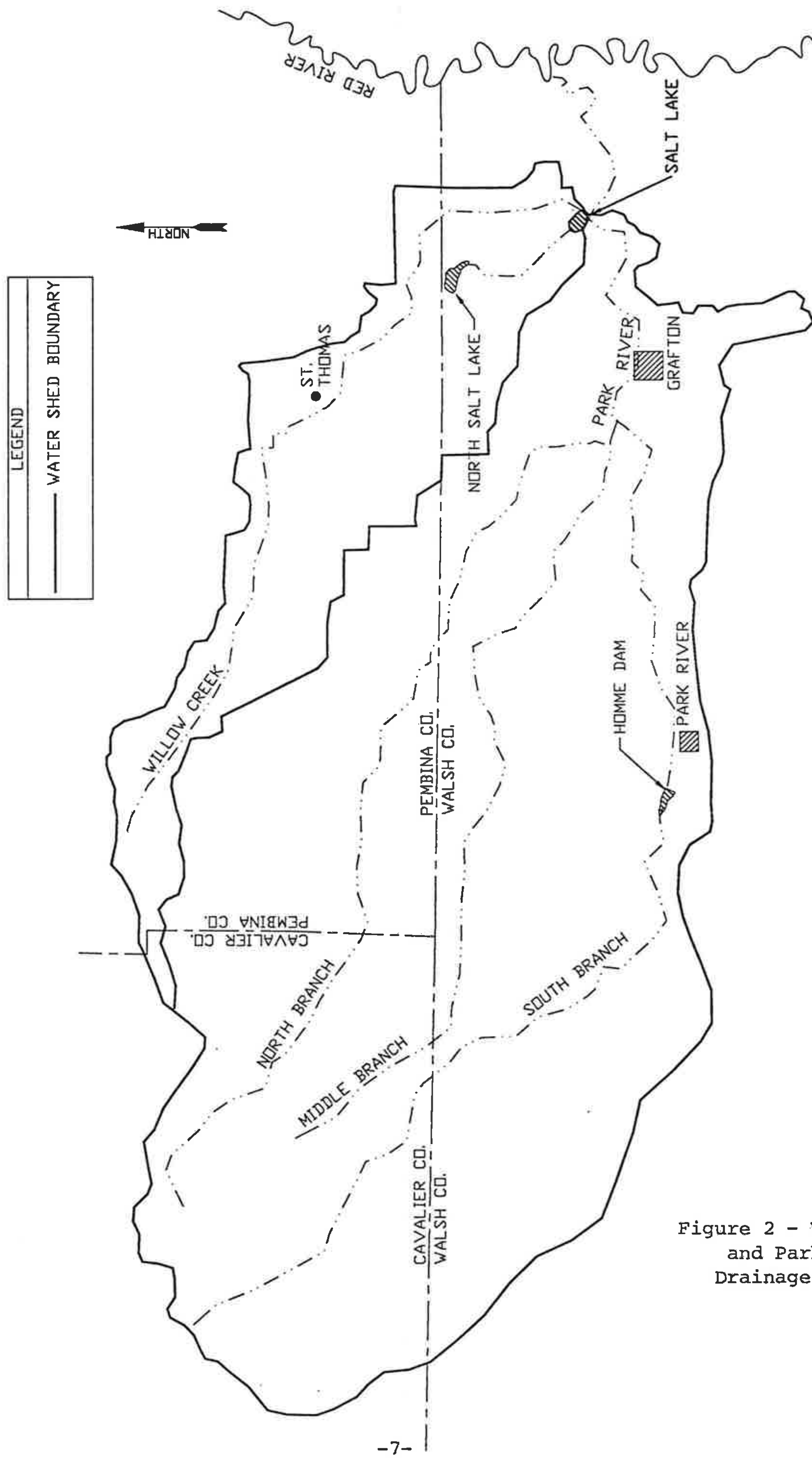


Figure 2 - Willow Creek and Park River Drainage Basins

Stream gage records from the Grafton gage were used in developing the Park River hydrology. Records of peak mean daily flow dating back to 1931 were input into a Log Pearson Type III distribution to determine the flow due to various recurrence interval precipitation events. The flows prior to 1950 were adjusted to account for Homme Dam. The flows prior to 1970 were adjusted to account for the impact of SCS reservoirs located on the Middle Branch of the Park River. Table 2 contains the results of the Log Pearson Type III distribution that was performed on the Grafton stream gage data.

Table 2 - Results of Log Pearson Type III Distribution

Recurrence Interval	Flow (cfs)
10-year	4,613
25-year	7,447
50-year	9,840
100-year	12,331

The flood hydrographs were approximated for the Park River at Grafton for the various recurrence interval precipitation events listed in Table 2 by using the 1979 spring flood as a base event. The 1979 flood had a peak mean daily flow of 8,300 cfs. The ordinates of the hydrographs for the various recurrence interval precipitation events were approximated by multiplying the ordinates of the 1979 hydrograph by the ratio of the Log Pearson Type III flow for that event divided by the 1979 peak mean daily flow. The ratios used for the 10-, 25-, 50-, and 100-year recurrence interval precipitation events are 0.556, 0.897, 1.186, and 1.486, respectively.

The hydrographs for the various recurrence interval precipitation events on the Park River, which were computed by the method listed above, were input into the HEC-1 computer model and routed to the confluence with the Salt Lake outlet using the Muskingum-Cunge channel routing method. The Park River hydrograph for the area between the city of Grafton and the confluence with the Salt Lake outlet was developed using the HEC-1 computer model.

To determine the existing Park River hydrograph below the confluence with the Salt Lake outlet, the hydrographs for Willow Creek and the Park River were combined. Since there is no existing control structure on Salt Lake, and the level of Salt Lake can be influenced by backwater from the Park River and Red River, the storage in Salt Lake was not considered in developing this hydrograph. Table 3 shows the peak flows and total inflow volumes for the Park River below the confluence with the Salt Lake outlet for the various precipitation events that were modeled.

Table 3 - Peak Flows and Volumes for the Park River Below Salt Lake

Event	Peak Inflow	Total Inflow Volume
	(cfs)	(acre-feet)
10-year snowmelt	6,692	71,978
25-year snowmelt	10,352	117,581
50-year snowmelt	13,894	155,938
100-year snowmelt	17,571	195,652

V. BACKWATER EFFECTS

During large runoff events, the water level in Salt Lake is affected by backwater from the Park River and Red River. Figure 3 shows an aerial photo of Salt Lake taken on April 16, 1969. This photo shows that Salt Lake is completely inundated. The flow on the Park River at the Grafton stream gage on this date is 2,450 cfs. Based on the frequency analysis that was performed on the Park River at Grafton, this is less than a 10-year recurrence interval runoff event on the Park River at Grafton at the time of the photo.

An analysis of data for the Red River on April 16, 1969, reveals that the Salt Lake level is affected by backwater from the Red River. Table 4 lists Red River stages at the confluence with the Park River for various frequency precipitation events. This data was taken from a 1991 update of the "Red River of the North Main Stem Hydraulics Study," published by the U.S. Army Corps of Engineers.

Table 4 - Red River Stages at the Confluence with the Park River

Recurrence Interval	Flow (cfs)
10-year	796.95
50-year	799.51
100-year	800.19

Figure 3 - Aerial Photo
of Salt Lake Taken
on April 16, 1969

An analysis of stream gage data for the Red River at Drayton reveals that on April 16, 1969, the discharge on the Red River was 37,800 cfs. This discharge would result in a Red River stage of approximately 795.3 msl, at the confluence with the Park River, located approximately 15.6 river miles upstream from the Drayton stream gage. Based on the stage, this was less than a 10-year recurrence interval event on the Red River at the confluence with the Park River at the time the aerial photo was taken. The actual discharge on the Red River at the confluence with the Park River will vary slightly from 37,800 cfs due to the travel time between the sites.

According to USGS 7.5-minute quadrangle maps, the outlet channel for Salt Lake is at an elevation of approximately 780 msl. This indicates the level of Salt Lake increased approximately 15 feet due to backwater from the Red River. Therefore, it is evident that backwater from the Park River and Red River can significantly affect the water level in Salt Lake.

VI. ALTERNATIVES

Two alternatives were evaluated to determine the feasibility of storing additional floodwaters in Salt Lake to reduce flooding on the Park River and Red River. Alternative One involves constructing an embankment across the outlet to Salt Lake and storing floodwater from Willow Creek in Salt Lake. Alternative Two involves constructing an embankment across the Park River below the confluence with the Salt Lake outlet channel to store floodwater from Willow Creek and the Park River in Salt Lake and the Park River floodplain. These alternatives do not consider backwater effects from the Park River and Red River. If the alternatives do not provide a significant reduction or delay in flow under these conditions, they should not be evaluated further since the reduction or delay in flow will be reduced when backwater effects are considered. The following sections describe these alternatives in detail.

Alternative One:

This alternative involves constructing an embankment across the outlet to Salt Lake and storing floodwater from Willow Creek in Salt Lake. Figure 4 shows the location of the proposed embankment. The elevation of the top of the embankment will be at approximately 800 msl and is limited by the topography of the area. At elevation 800 msl, Salt Lake will have a surface area of approximately 640 acres and approximately 8,400 acre-feet of temporary flood storage. Figure 5 shows an area-capacity curve for Alternative One.

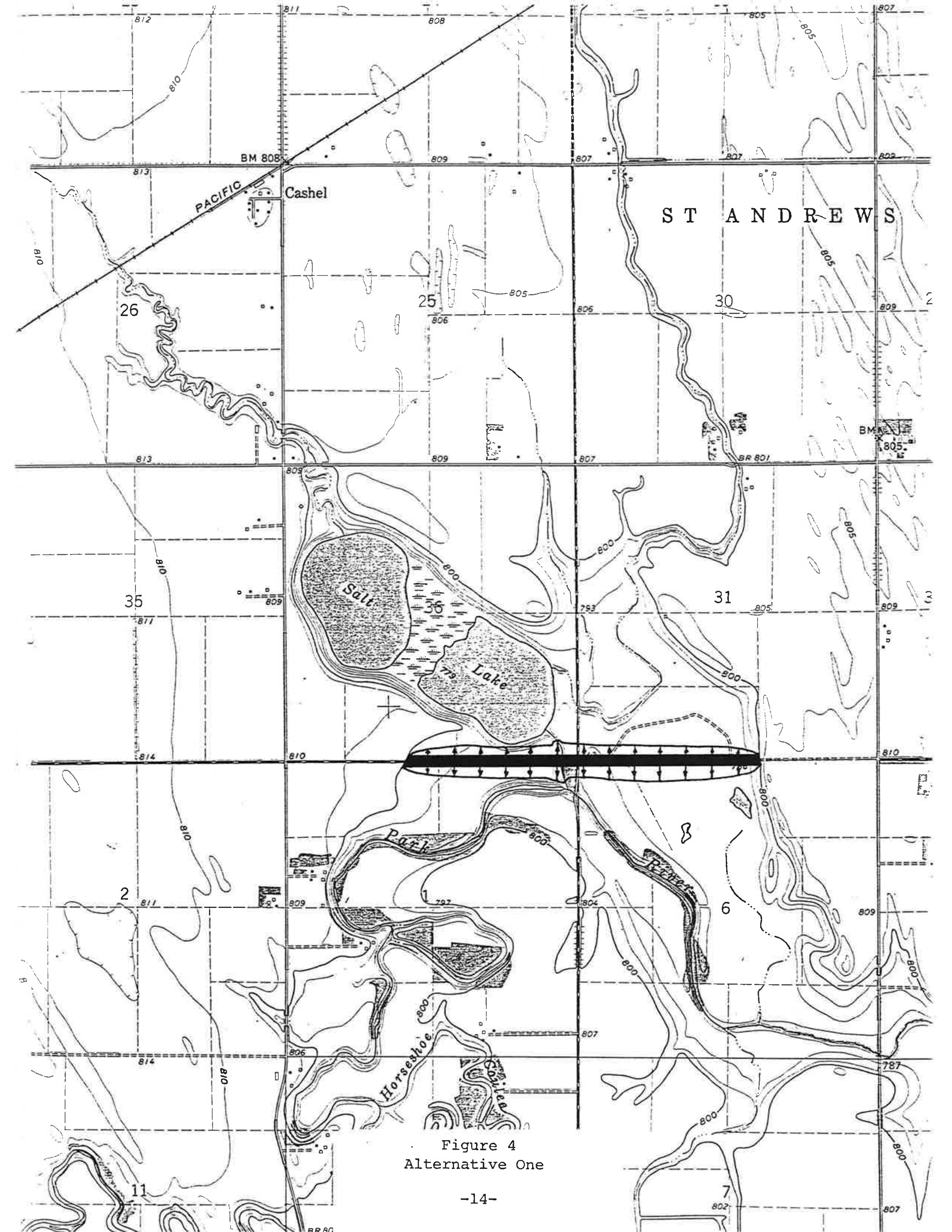


Figure 4
Alternative One

ALTERNATIVE ONE
AREA-CAPACITY CURVE

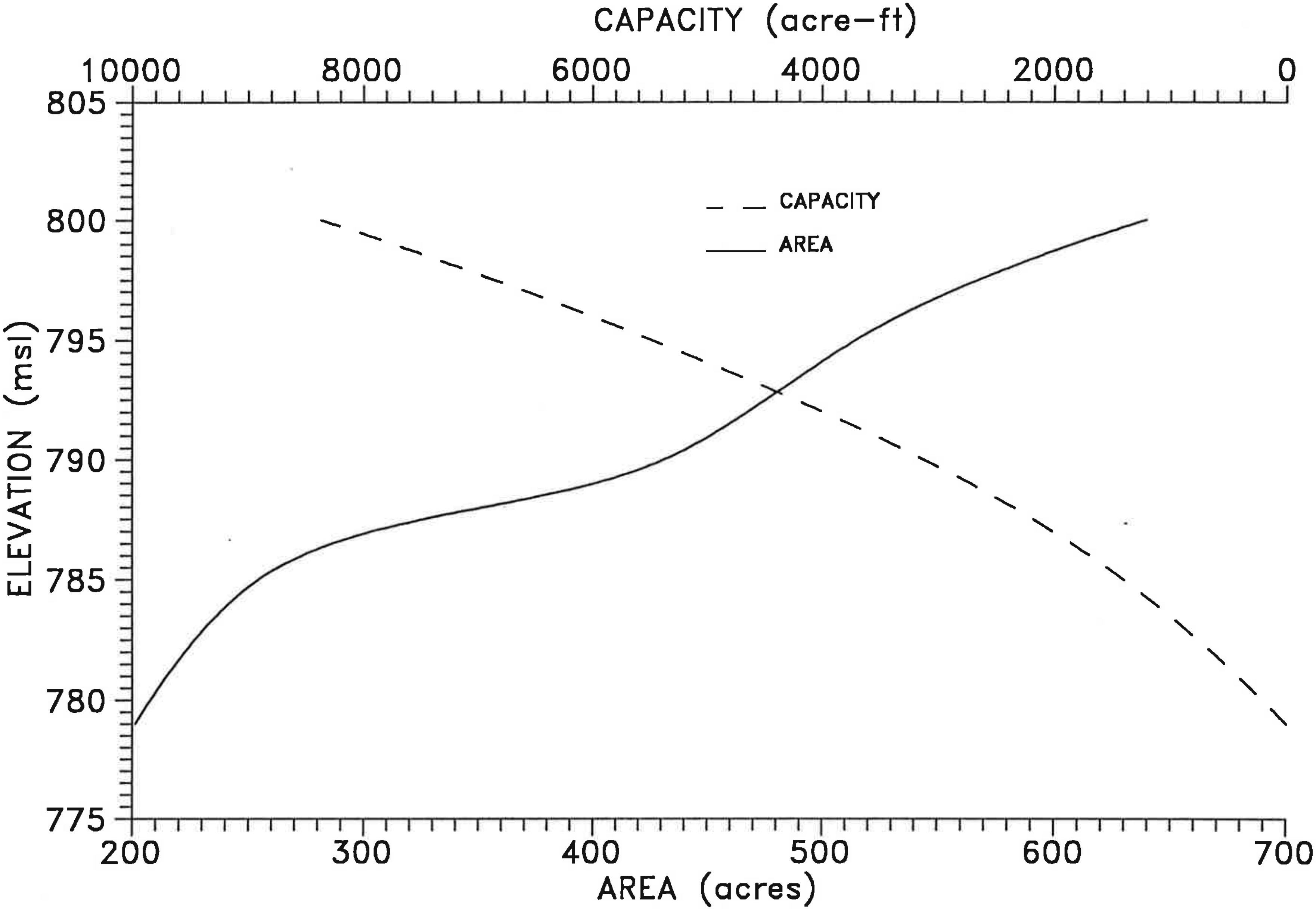


Figure 5
Area-Capacity
Curve for Alternative One

To evaluate the flood reduction ability of this alternative, a spillway rating curve was input into the HEC-1 computer model and the inflow hydrograph was routed through the reservoir. The spillway consisted of a 24-inch diameter corrugated metal pipe (CMP) drawdown structure placed at elevation 780 msl, which is the approximate natural outlet level for Salt Lake. A principal spillway consisting of a 100-foot wide weir was placed at elevation 790 msl. This alternative has only 10 feet of vertical storage and approximately 3,100 acre-feet of flood storage available before water passes over the principal spillway. Due to the preliminary nature of this analysis, no emergency spillway was sized for the embankment. It is estimated the cost to construct Alternative One is $2.0 million. Table 5 shows the cost estimate for Alternative One.

Table 5
Cost Estimate for Alternative One

Item	Quantity	Unit	Unit Price	Total
Mobilization	1	LS	$ 20,000.00	$ 20,000
Water Control	1	LS	10,000.00	10,000
Stripping & Spreading Topsoil	50,000	SY	0.25	12,500
Core Trench Excavation	52,000	CY	1.80	93,600
Fill	150,000	CY	1.20	180,000
Rock Riprap	15,000	CY	30.00	450,000
Rock Riprap Filter	3,750	CY	15.00	56,250
Spillway	1	LS	750,000.00	750,000
Drawdown Pipe	1	LS	20,000.00	20,000
Seeding	20	Ac	300.00	6,000
	Subtotal			$1,598,350
	+/-30% Contingency, Engineering, and Administration			401,650
	TOTAL			$2,000,000

The flows from Willow Creek were routed through Salt Lake and combined with the Park River flows for several recurrence interval precipitation events using the HEC-1 computer model. Table 6 shows a comparison of Park River flows below the Salt Lake outlet for existing conditions and for Alternative One.

Table 6 - Comparison of Park River Flows for Existing Conditions and Alternative One

Event	Existing Peak Discharge (cfs)	Alternative Two Peak Discharge (cfs)	Salt Lake Stage (msl)
10-year snowmelt	6,692	5,730	792.57
25-year snowmelt	10,352	10,124	794.15
50-year snowmelt	13,894	13,634	795.04
100-year snowmelt	17,571	17,154	795.91

Alternative One will delay the peak flow on the Park River below Salt Lake approximately 6 hours. The maximum reduction in flow occurs during the 10-year snowmelt precipitation event, where the flow is reduced by approximately 14 percent. The flood reduction is reduced to approximately 2 percent during the larger precipitation events. A large spillway is required below Salt Lake due to the high inflow from the Willow Creek drainage basin. The total temporary flood storage that is available in Salt Lake, 8,400 acre-feet, is small compared to the total volume of flow on Willow Creek and the Park River (see Table 1 and Table 3).

During large runoff events on the Park River and Red River, the spillway on the embankment will be inundated by backwater from these rivers, and the flood reduction benefits on the Park River will be reduced from those listed in Table 6. Since this alternative does not produce significant flood reduction benefits on the Park River, it will not produce significant flood reduction benefits on the Red River. Due to the limited storage available in Salt Lake relative to the total volume of flow on Willow Creek and the Park River, the high cost associated with constructing the project, and considering the backwater effects from the Park River and Red River, this alternative was not evaluated further.

Alternative Two:

This alternative involves constructing an embankment across the Park River below the confluence with the Salt Lake outlet channel to store floodwater from Willow Creek and the Park River in Salt Lake and the Park River floodplain. Figure 6 shows the location of the proposed embankment. The elevation of the top of the embankment will be at approximately 800 msl and is limited by the topography of the area. At elevation 800 msl, Salt Lake will have a surface area of approximately 1,790 acres and approximately 15,500 acre-feet of temporary flood storage. Figure 7 shows an area-capacity curve for Alternative Two.

To evaluate the flood reduction ability of this alternative, a spillway rating curve was input into the HEC-1 computer model and the inflow hydrograph was routed through the reservoir. The spillway consisted of two 36-inch diameter CMP drawdown pipes placed at elevation 780 msl, which is the approximate channel invert elevation

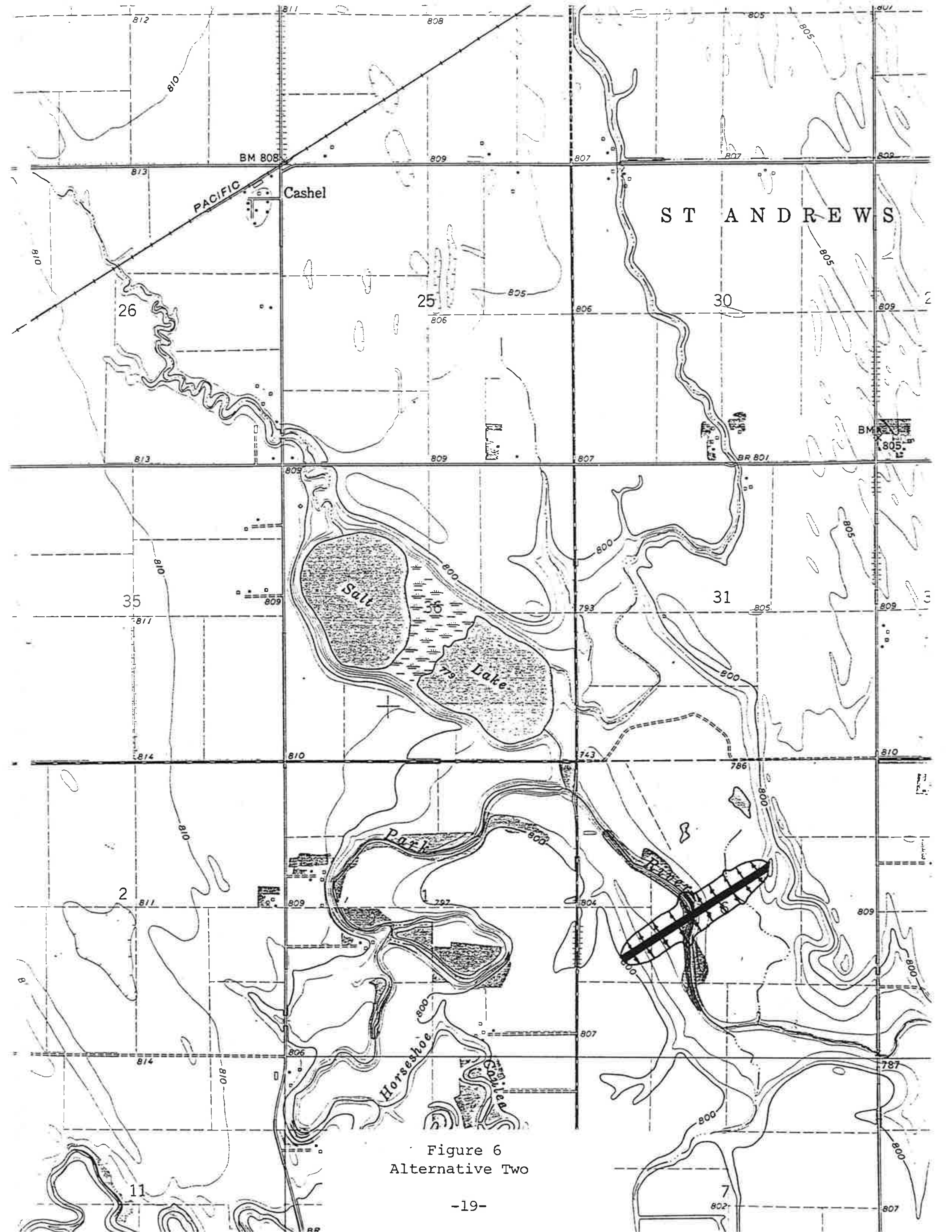


Figure 6
Alternative Two

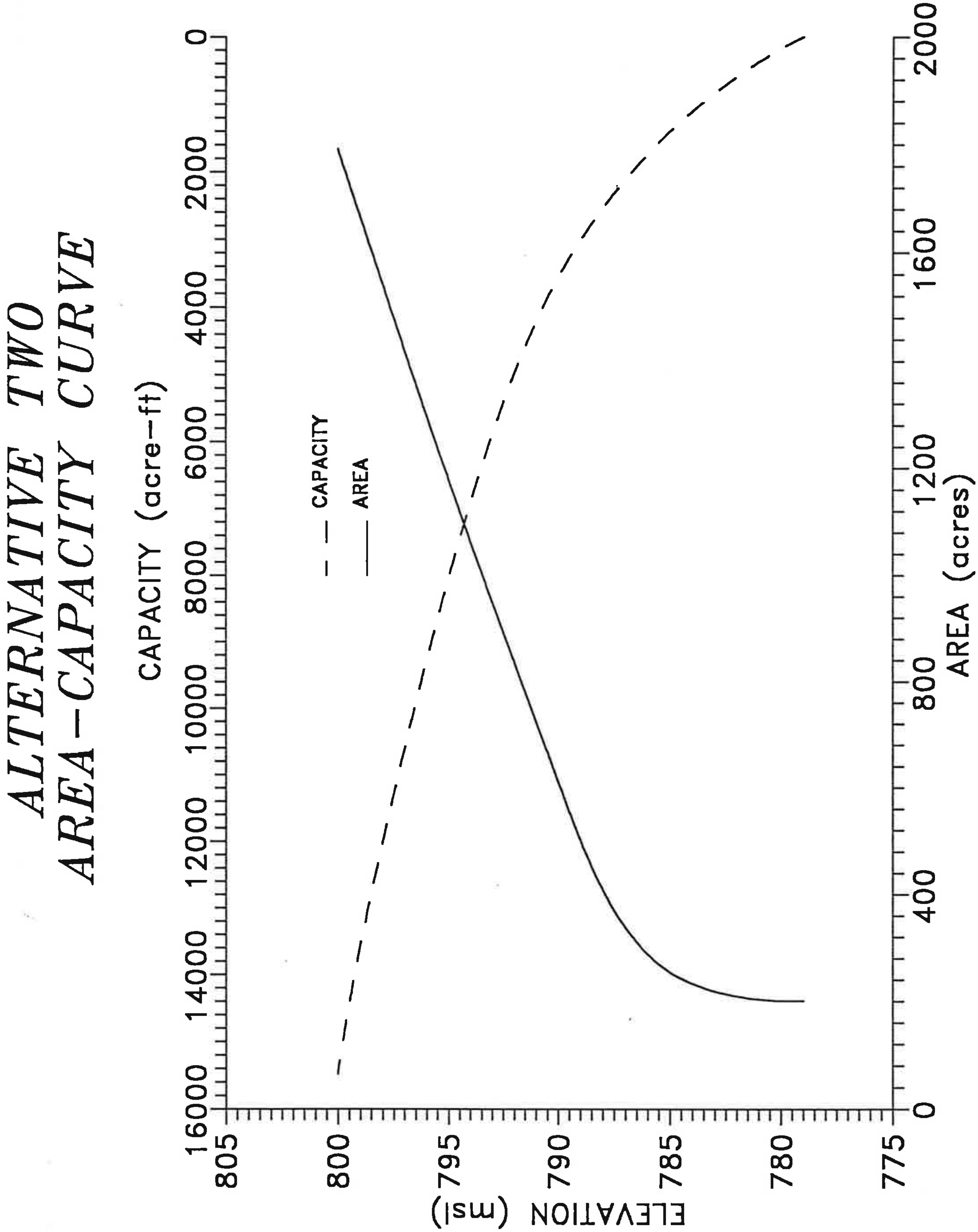


Figure 7
Area-Capacity
Curve for Alternative Two

on the Park River at the location of the proposed embankment. A principal spillway consisting of a 200-foot wide weir was placed at elevation 790 msl. This alternative has only 10 feet of vertical storage and approximately 3,600 acre-feet of flood storage available before water passes over the principal spillway. Due to the preliminary nature of this analysis, no emergency spillway was sized for the embankment. It is estimated the cost to construct Alternative Two is $2.6 million. Table 7 shows the cost estimate for Alternative Two.

Table 7
Cost Estimate for Alternative Two

Item	Quantity	Unit	Unit Price	Total
Mobilization	1	LS	$ 20,000.00	$ 20,000
Water Control	1	LS	50,000.00	50,000
Stripping & Spreading Topsoil	50,000	LS	0.25	12,500
Core Trench Excavation	35,000	CY	1.80	63,000
Fill	100,000	CY	1.20	120,000
Rock Riprap	112,000	CY	30.00	360,000
Rock Riprap Filter	3,000	CY	15.00	45,000
Spillway	1	LS	1,300,000.00	1,300,000
Drawdown Pipe	1	LS	20,000.00	20,000
Seeding	20	Ac	300.00	6,000
	Subtotal			$1,996,500
	+/-30% Contingency, Engineering, and Administration			603,500
	TOTAL			$2,600,000

The combined flows from the Park River and Willow Creek were routed through the proposed reservoir for several recurrence interval precipitation events using the HEC-1 computer model. Table 8 shows a comparison of Park River flows below the embankment for existing conditions and for Alternative Two.

Table 8 - Comparison of Park River Flows for Existing Conditions and Alternative Two

Event	Existing Peak Discharge (cfs)	Alternative Two Peak Discharge (cfs)	Salt Lake Stage (msl)
10-year snowmelt	6,692	6,582	794.99
25-year snowmelt	10,352	10,015	796.68
50-year snowmelt	13,894	13,458	798.20
100-year snowmelt	17,571	17,062	799.63

Alternative Two will delay the peak flow on the Park River below Salt Lake approximately 6 hours. The reduction in flow on the Park River is approximately 2 percent for the 10-year snowmelt precipitation event and approximately 3 percent during the larger precipitation events. A large spillway is required through the embankment due to the high flow experienced on the Park River. The total temporary flood storage that is available in Salt Lake and the Park River floodplain upstream of the embankment, 15,500 acre-feet, is small compared to the total volume of inflow from the Park River and Willow Creek (see Table 3).

During large runoff events on the Park River and Red River, the spillway on the embankment will be inundated by backwater from these rivers, and the flood reduction benefits on the Park River will be reduced from those listed in Table 8. Since this alternative does not produce significant flood reduction benefits on the Park River, it will not produce significant flood reduction benefits on the Red River. Due to the limited storage available in Salt Lake and the Park River floodplain relative to the total volume of flow on the Park River, the high cost associated with constructing the project, and considering the backwater effects from the Park River and Red River, this alternative was not evaluated further.

VII. SUMMARY

The feasibility of storing additional floodwaters from the Park River in Salt Lake has been examined. Salt Lake is located in Section 36, Township 158 North, Range 52 West in Walsh County, approximately 8 miles northeast of the city of Grafton, North Dakota. Salt Lake lies adjacent to Willow Creek, approximately 1200 feet upstream of its confluence with the Park River. The purpose of this study was to evaluate the feasibility of storing additional floodwaters from the Park River in Salt Lake to reduce flooding on the Park River and Red River.

Salt Lake is located approximately 1200 feet from the Park River. The confluence of the Salt Lake outlet channel and the Park River lies approximately 11.5 miles upstream of the Red River. The level of Salt Lake is affected by backwater from the Park River and Red River. Based on USGS 7.5-minute quadrangle maps, the outlet channel for Salt Lake is at an elevation of approximately 780 msl. The Red River stage at the confluence with the Park River for a 10-year recurrence interval runoff event is 796.95 msl. This indicates the level of Salt Lake will be raised approximately 17 feet due to backwater from the Red River during a 10-year recurrence interval runoff event on the Red River.

Two alternatives were evaluated to determine the feasibility of storing additional floodwater in Salt Lake. These alternatives were evaluated without considering backwater effects from the Park River and Red River. This was done with the intention that if the alternatives did not provide a significant reduction or delay in flow under these conditions, they would not be evaluated further since the reduction or delay in flow would be reduced if backwater effects were considered.

Alternative One involved constructing an embankment across the outlet to Salt Lake and storing floodwater from Willow Creek in Salt Lake. For a Salt Lake level of 800 msl, a temporary flood storage of approximately 8,400 acre-feet was available for this alternative. To evaluate the flood reduction ability of this alternative, a spillway consisting of a 24-inch diameter CMP drawdown pipe and a 100-foot wide weir was modeled using the HEC-1 computer model.

This alternative delayed the peak flow on the Park River below Salt Lake approximately 6 hours. It reduced the peak flow on the Park River below Salt Lake by approximately 14 percent during a 10-year snowmelt precipitation event and approximately 2 percent during the 25-, 50-, and 100-year snowmelt precipitation events. The flood reduction benefits provided by Alternative One are small because the temporary flood storage that is available in Salt Lake, 8,400 acre-feet, is small compared to the total volume of flow on Willow Creek and the Park River (see Table 1 and Table 3). The amount of flood storage that is available in Salt Lake is limited by the topography of the area. Due to the limited storage that is available for Alternative One, the high cost associated with constructing Alternative One, and considering that the backwater effects from the Park River and Red River further reduce its effectiveness, this alternative was not evaluated further.

Alternative Two involved constructing an embankment across the Park River below the confluence with the Salt Lake outlet channel to store floodwater from Willow Creek and the Park River in Salt Lake and the Park River Floodplain. For a Salt Lake level of 800 msl, a temporary flood storage of approximately 15,500 acre-feet was available for this alternative. To evaluate the flood reduction ability of this alternative, a spillway consisting of two 36-inch diameter CMP drawdown pipes and a 200-foot wide weir was modeled using the HEC-1 computer model.

This alternative also delayed the peak flow on the Park River below Salt Lake approximately 6 hours. It reduced the peak flow on the Park River below Salt Lake by 2-3 percent for the 10-, 25-, 50-, and 100-year snowmelt precipitation events. The flood reduction benefits provided by Alternative Two are small because the total flood storage that is available in Salt Lake and the Park River floodplain, 15,500 acre-feet, is small compared to the total volume of flow on the Park River (see Table 3). The amount of temporary flood storage that is available in Salt Lake and the Park River floodplain is limited by the topography of the area. Due to the limited temporary flood storage that is available for Alternative Two, the high cost associated with constructing Alternative Two, and considering that the backwater effects from the Park River and Red River further reduce its effectiveness, this alternative was not evaluated further.

VIII. RECOMMENDATIONS

Storing additional floodwaters from the Park River in Salt Lake does not appear feasible. Salt Lake is located near the lower ends of the Willow Creek and Park River drainage basins. The volume of water that can be stored in Salt Lake is small compared to the volume of flow on the Park River and is limited by the topography around the lake. The ability to store water in Salt Lake is further limited by backwater from the Park River and Red River.

Since storing additional floodwaters in Salt Lake does not significantly reduce or delay flooding on the Park River, it is unlikely that it will affect flooding on the Red River. Considering this, and the high cost associated with constructing the project, it is recommended that the Salt Lake project not be pursued further. Flood storage should be considered in other areas of the watershed to reduce flooding on the Park River and Red River, especially in higher topographic areas where backwater effects are not as significant.

APPENDIX A

COPY OF AGREEMENT

SWC Project #1312
May 4, 1993

A G R E E M E N T

Salt Lake Flood Control

I. PARTIES

THIS AGREEMENT is between the North Dakota State Water Commission, hereinafter Commission, through its Secretary, David A. Sprynczynatyk; and the Walsh County Water Resource District, hereinafter District, through its Chair, Merlin Linstad.

II. PROJECT, PURPOSE, AND LOCATION

The District has requested the Commission to investigate the feasibility of storing additional floodwaters from the Park River in Salt Lake. The Project is located in Section 36, Township 158 North, Range 52 West.

III. PRELIMINARY INVESTIGATION

The parties agree that further information is necessary concerning the proposed project. Therefore, the Commission shall conduct the following:

1. Study the feasibility of installing a gated block at the outlet of Salt Lake, or a diversion structure on the Park River, to provide maximum flood storage;

2. Determine the effect the proposed project will have on flood flows in the Park River and Red River;

3. Develop a plan to operate the structure to obtain the greatest reduction in flows on the Park River during the period when the Red River is at its peak elevation;

4. Prepare a preliminary cost estimate for the project; and

5. Prepare a preliminary engineering report presenting the results of the investigation.

IV. COSTS

The District shall pay 50 percent of the field costs for any field work that will be necessary for the investigation.

V. RIGHTS-OF-ENTRY

The District agrees to obtain written permission from any affected landowners for field investigations by the Commission, which may be required for the preliminary investigation.

VI. INDEMNIFICATION

The District agrees to indemnify and hold harmless the State of North Dakota, the Commission, the Department, and any employees or agents of those entities, from all claims for damages to property, rights or persons, as a result of any act or omission by the District, its agents, contractors, or employees. In the event a suit is initiated or judgment entered against the State of North Dakota, the Commission, or any of their employees or agents, the District shall indemnify them for all costs and expenses, including legal fees, and any judgment arrived at or satisfied or settlement entered, to the extent that such cost and expenses are caused by or resulting from any act or omission by the District, its agents, contractors or employees.

VII. MERGER CLAUSE

This agreement constitutes the entire agreement between the parties. No waiver, consent, modification nor change of terms of this agreement shall bind either party unless in writing, signed by the parties, and attached hereto. Such waiver, consent, modification or change, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein regarding this agreement.

NORTH DAKOTA STATE WATER COMMISSION	WALSH COUNTY WATER RESOURCE DISTRICT
By: David A. Sprynczynatyk	By: Hilary Feltman
DAVID A. SPRYNCZYNATYK Secretary	Hilary Feltman Chair
WITNESS: Dale L Frink	WITNESS: Sue Rose
DATE: 5-11-93	DATE: 5-6-93

APPENDIX B

SYMBOLS AND ABBREVIATIONS

SYMBOLS AND ABBREVIATIONS

cfs	-	cubic feet per second
CMP	-	Corrugated Metal Pipe
HEC	-	The Hydrologic Engineering Center
msl	-	mean sea level
SCS	-	Soil Conservation Service
SWC	-	State Water Commission
USGS	-	United States Geological Survey

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