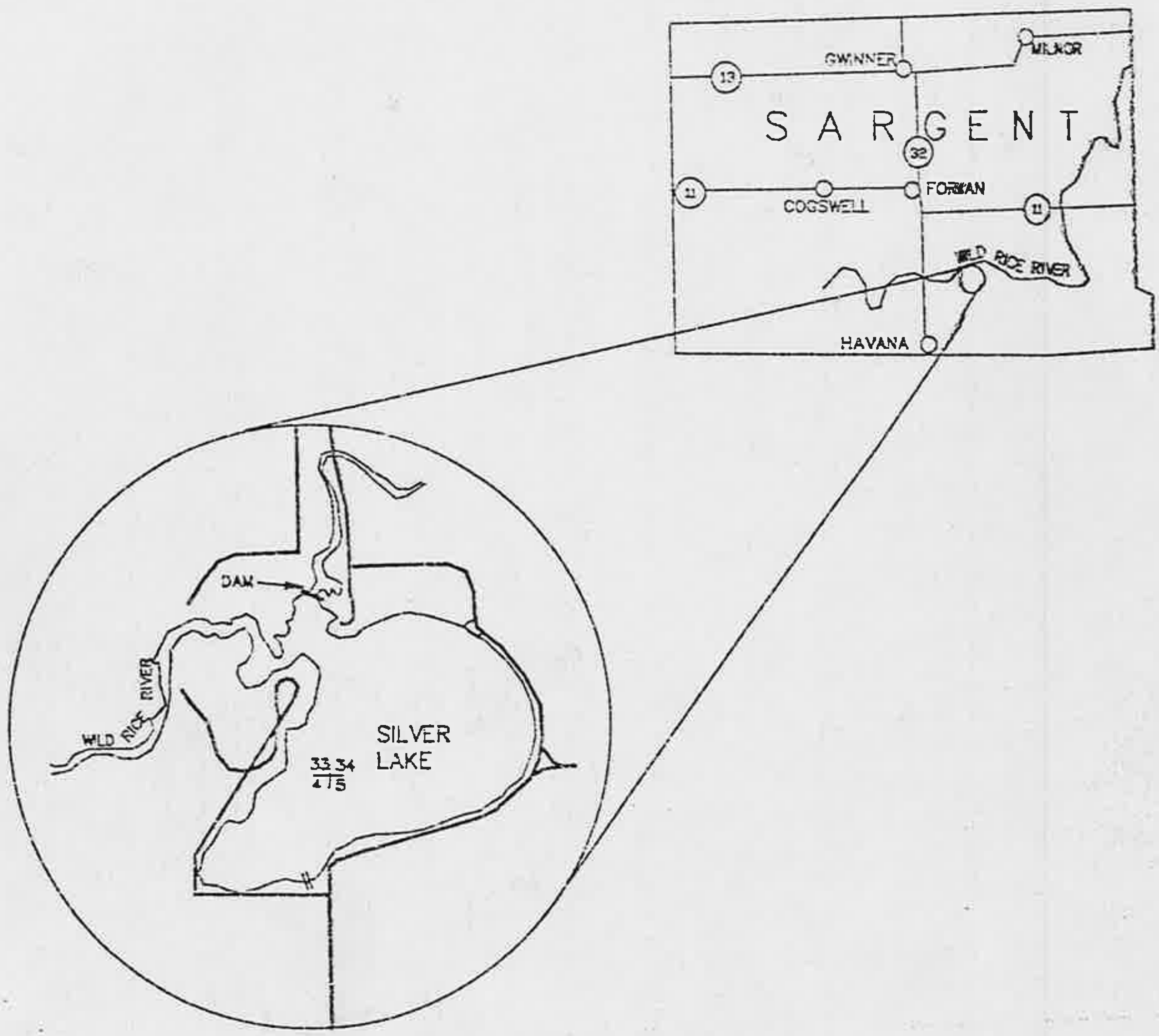
PRELIMINARY ENGINEERING REPORT

SILVER LAKE

SWC NO. 391
SARGENT COUNTY



NORTH DAKOTA
STATE WATER COMMISSION

January 1994

PRELIMINARY ENGINEERING REPORT

Silver Lake
SWC Project #391

January 1994

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

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I. INTRODUCTION

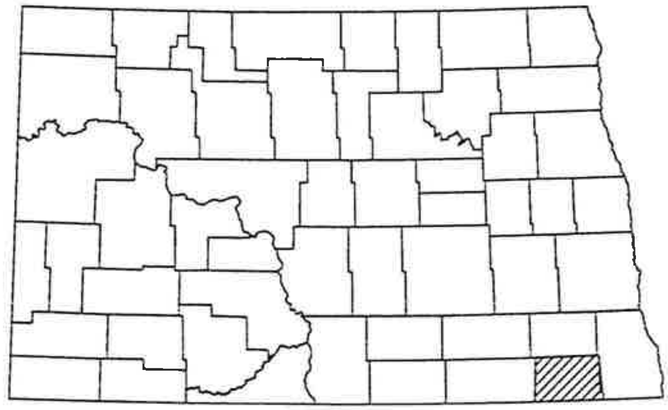
Study Objectives:

In March of 1992, the North Dakota State Water Commission and the Sargent County Water Resource District entered into an agreement to investigate the feasibility of raising the water level in Silver Lake approximately 2 feet. The agreement called for the State Water Commission to conduct a field survey of the embankment and land adjacent to the reservoir including topographic data, area-capacity data, and bridge and channel geometry; conduct a study of the hydrology of the watershed upstream of the dam; design the outlet works necessary to pass the design flood through the dam; prepare a preliminary cost estimate for the modifications; 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:

Silver Lake is located in Sections 33 and 34, Township 130 North, Range 55 West, and Sections 3 and 4, Township 129 North, Range 55 West in Sargent County, approximately 5 miles southwest of the city of Rutland, North Dakota. Figure 1 shows the location of Silver Lake within the state of North Dakota.

Silver Lake was constructed in 1937 by the Works Progress Administration (WPA). The dam was constructed across the Wild Rice River to raise the water level in the lake, which lies adjacent to



SILVER LAKE

SWC # 391

LOCATION MAP

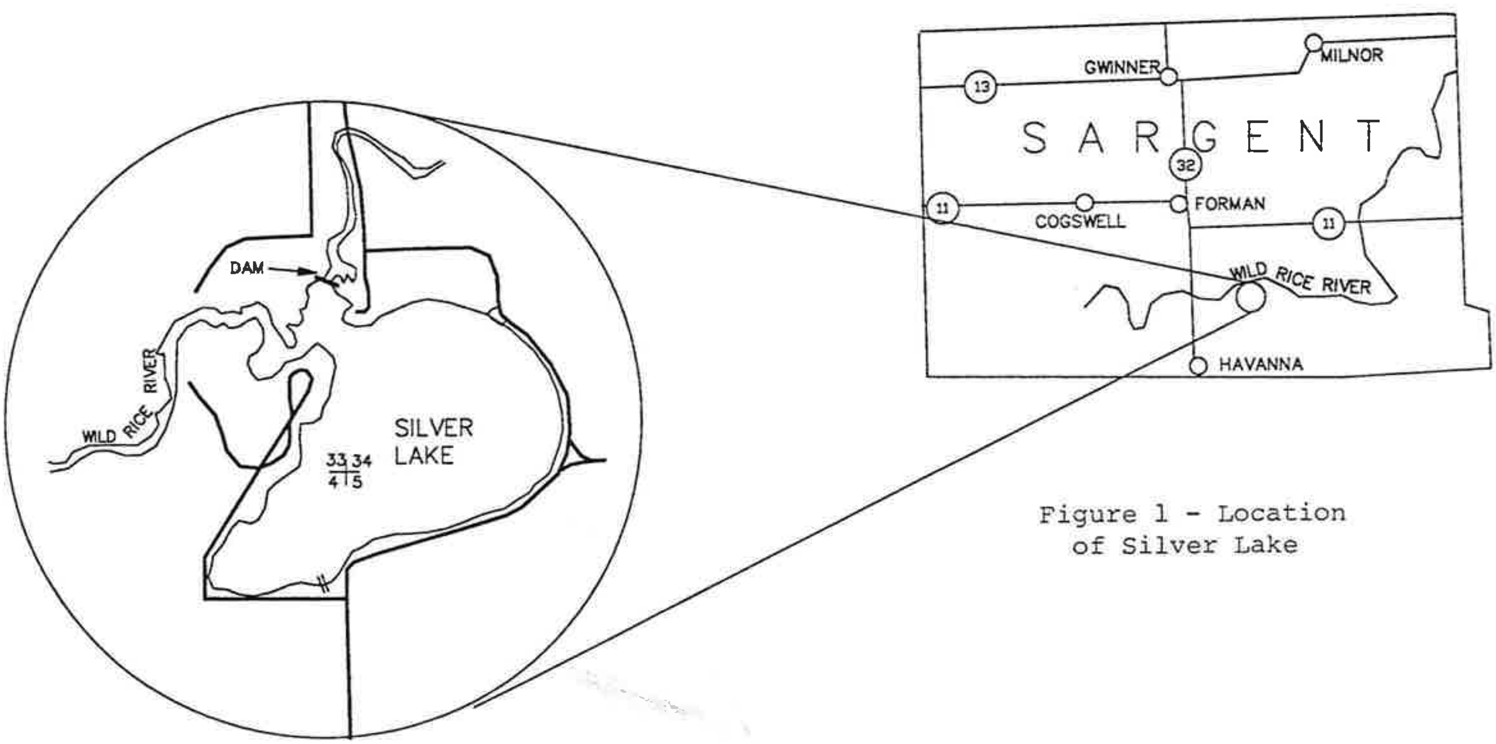


Figure 1 - Location of Silver Lake

the river. The spillway for the dam consists of a 70-foot wide weir. The crest of the weir lies approximately 4 feet above the channel bottom. The spillway was reconstructed in 1967 through a joint effort of the U.S. Bureau of Outdoor Recreation, the Sargent County Park Board, and the State Water Commission.

Silver Lake provides recreational opportunities for a large number of residents in southeast North Dakota. The lake and associated recreation complex provide opportunities for fishing, swimming, boating, camping, picnicking, and other water-based recreational activities.

The water level in Silver Lake fluctuates significantly, depending on the amount of flow in the Wild Rice River, which flows intermittently. Low water levels in recent years have limited the recreational opportunities associated with Silver Lake. This investigation will evaluate the feasibility of raising the water level in Silver Lake 2 feet. A higher water level will enhance the use of Silver Lake and its associated recreational facilities.

II. GEOLOGY AND CLIMATE

Silver Lake is located adjacent to the Wild Rice River. The Wild Rice River drainage basin rises in the glaciated uplands in western Sargent County, and extends easterly through Lake Tewaukon before turning northward to join the Red River in Cass County, 8 miles south of Fargo. The topography of the basin varies greatly from its source to its mouth. From the headwaters north of the Sisseton Hills to Lake Tewaukon, the river flows through an area of drift prairie characterized by morainic hills, large swamps, low swales and potholes with no well-established drainage system. As the river continues on towards its confluence with the Red River, the valley depth diminishes then completely disappears.

The climate for the Wild Rice River Basin is characterized by warm summers and cold winters. Frequent spells of hot weather and occasional cool days characterize the summer. Temperatures are very cold in the winter, when arctic air frequently surges over the area. The average temperature for the basin is 42 degrees Fahrenheit. The annual precipitation for the basin is 19.0 inches, most of which falls during the growing season. During summer, most precipitation comes from thunderstorms, which produce heavy rainfalls in short periods over small areas. The prevailing wind direction is from the northwest.

III. COMPUTER MODELS

HEC-1:

A hydrologic analysis of the Wild Rice River Watershed upstream of Silver Lake 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 rainfall, the rainfall 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 Wild Rice River watershed. The results obtained through the use of the model include: (1) inflow hydrographs, (2) reservoir stage hydrographs, and (3) outflow hydrographs.

HEC-2:

A hydraulic analysis of the channel downstream of Silver Lake was performed using the HEC-2 computer model, developed by the U.S. Army Corps of Engineers. HEC-2 computes water surface profiles for steady, gradually varied flow in natural or man-made channels for flows due to various precipitation events. The data needed to perform these computations includes: flow regime, starting water surface elevation, discharge, loss coefficients, cross-section geometry, and reach lengths. The computational procedure used by the model is based on the solution of the one-dimensional energy equation with energy loss due to friction evaluated with Manning's equation. This computation is generally known as the Standard Step Method.

IV. PRELIMINARY DESIGN

Dam Classification:

The first step in the investigation of Silver Lake was to determine the dam classification. Design criteria are based on hazard classification and the height of the dam. Hazards are potential loss of life or damage to property downstream of the dam due to releases through the spillway or complete or partial failure of the structure. Hazard classifications listed in the "North Dakota Dam Design Handbook" are as follows:

Low - dams located in rural or agricultural areas where there is little possibility of future development. Failure of low-hazard dams may result in damage to agricultural land, township and county roads, and farm buildings other than residences. No loss of life is expected if the dam fails.

Medium - dams located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, railroads, or cause interruption of minor public utilities. The potential for the loss of a few lives may be expected if the dam fails.

High - dams located upstream of developed and urban areas where failure may cause serious damage to homes, industrial and commercial buildings, and major public utilities. There is a potential for the loss of more than a few lives if the dam fails.

Considering that it is located in a rural area, and that no loss of life is expected if the dam fails, Silver Lake is classified as a low-hazard dam.

After a dam has been given a hazard category, it can be classified according to its height. The following table was listed in the "North Dakota Dam Design Handbook":

Table 1 - Dam Design Classification

	Hazard Categories		
Dam Height (feet)	Low	Medium	High
Less than 10	I	II	IV
10 to 24	II	III	IV
25 to 39	III	III	IV
40 to 55	III	IV	V
Over 55	III	IV	V

Silver Lake has a low hazard classification and an embankment height of less than 10 feet. Based on this, it is given a Class I classification for design purposes.

For a Class I dam, the spillway must pass the flow due to a 25-year precipitation event without overtopping the dam, and pass the flow due to a 10-year precipitation event within an acceptable velocity.

Hydrology:

The watershed above Silver Lake was defined using USGS 7.5-minute quadrangle maps of the area. The contributing drainage area for the dam was calculated to be 344 square miles. Figure 2 shows the drainage basin above Silver Lake.

Stream gage records from a gage located approximately 6 miles downstream of Silver Lake near the city of Rutland, North Dakota, were incorporated into the hydrology for the project. Records of yearly peak flow dating back to 1960 were input into a Log Pearson Type III distribution to determine the flow due to various recurrence interval precipitation events. Table 2 contains the results of the Log Pearson Type III distribution that was performed on the Rutland stream gage data.

Table 2 - Results of Log Pearson Type III Distribution

Recurrence Interval	Flow (cfs)
10-year	584
25-year	969
50-year	1,312
100-year	1,696

The peak flow resulting from the 1978 spring runoff at the Rutland stream gage was 600 cfs. This event was approximated as a 10-year precipitation event for design purposes. The flow volume at the Rutland stream gage for the 1978 spring runoff was calculated to be 9,200 acre-feet.

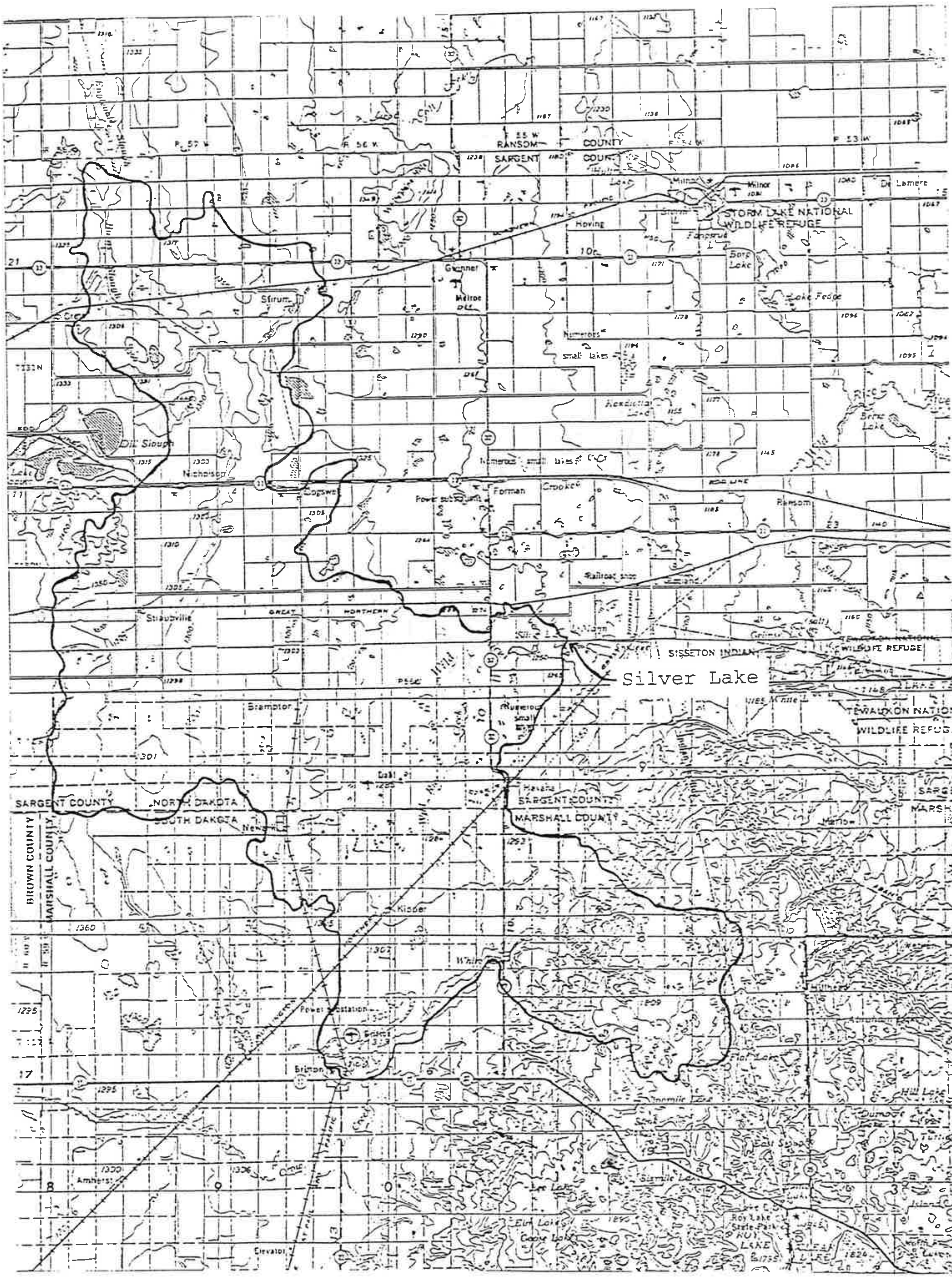


Figure 2 - Drainage Basin Above Silver Lake

The contributing drainage area upstream of the Rutland stream gage was determined to be 352 square miles. Approximately 8 square miles of the drainage area lies downstream of Silver Lake. An HEC-1 model was developed to simulate the 1978 spring runoff at the Rutland stream gage. The HEC-1 model yielded a peak flow of 583 cfs and a total inflow volume of 10,970 acre-feet. Figure 3 shows a comparison of the hydrographs resulting from the 1978 spring runoff and the HEC-1 model used to approximate the 1978 spring runoff.

The 10-year precipitation event at Silver Lake was modelled by removing the 8 square miles of drainage area lying downstream of Silver Lake from the HEC-1 model developed to simulate the 1978 spring runoff at the Rutland stream gage. The 25-year precipitation event at Silver Lake was modelled by changing the precipitation data for the 10-year model. Table 3 shows the resulting peak inflows and total inflow volumes for Silver Lake resulting from the HEC-1 computer model.

Table 3 - Peak Inflows and Volumes for Design Frequency

Event	Peak Inflow (cfs)	Total Inflow Volume (acre-feet)
10-year snowmelt	574	10,730
25-year snowmelt	1,035	19,161

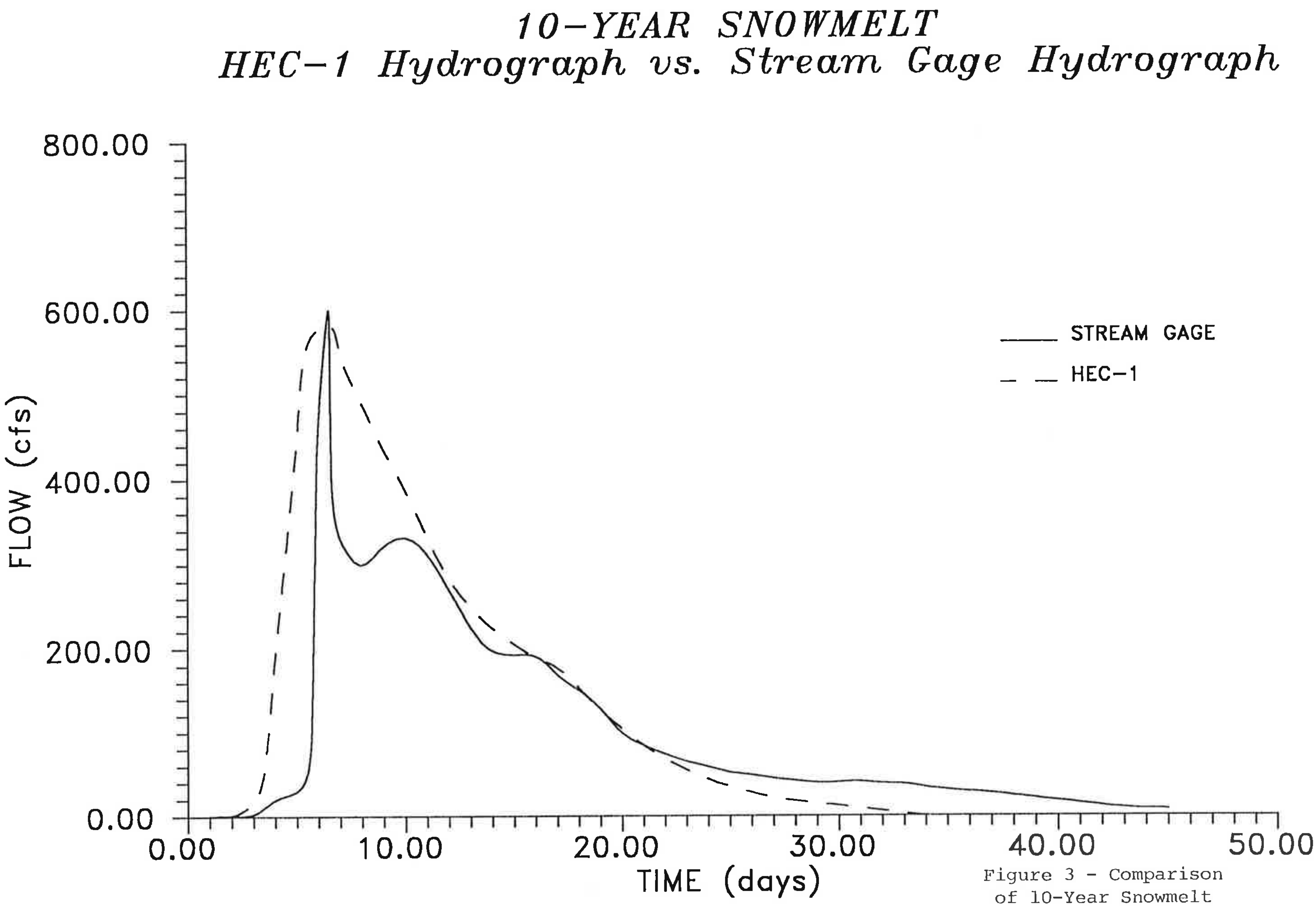


Figure 3 - Comparison of 10-Year Snowmelt Hydrographs

Reservoir Level:

The level of Silver Lake is currently controlled at an elevation of 1223.8 msl. At this level, the lake has a maximum depth of approximately 11 feet, an average depth of 7.3 feet, and a volume of 830 acre-feet.

The water level of Silver Lake fluctuates significantly from year to year due to the intermittent flows in the Wild Rice River. Therefore, it is proposed that the water level of Silver Lake be raised approximately 2 feet to enhance the use of the lake and its associated recreational facilities. The new water level will be 1225.8 msl. At this level, Silver Lake will have a maximum depth of approximately 13 feet, a volume of 1,067 acre-feet, and an average depth of 8.5 feet.

Hydraulic Design:

The HEC-1 computer model was used to simulate the precipitation versus runoff response for the Wild Rice River Basin upstream of Silver Lake and to route the flows through the dam. The area-capacity curve for the lake and the rating curve for the spillway were needed in order to use the HEC-1 model. The area-capacity curve for Silver Lake was developed using existing information and survey data obtained for the investigation. Figure 4 shows the area-capacity curve. The rating curve for the principal spillway was calculated using the equation for weir flow. The rating curve for the emergency spillway was calculated using

SILVER LAKE
AREA-CAPACITY CURVE

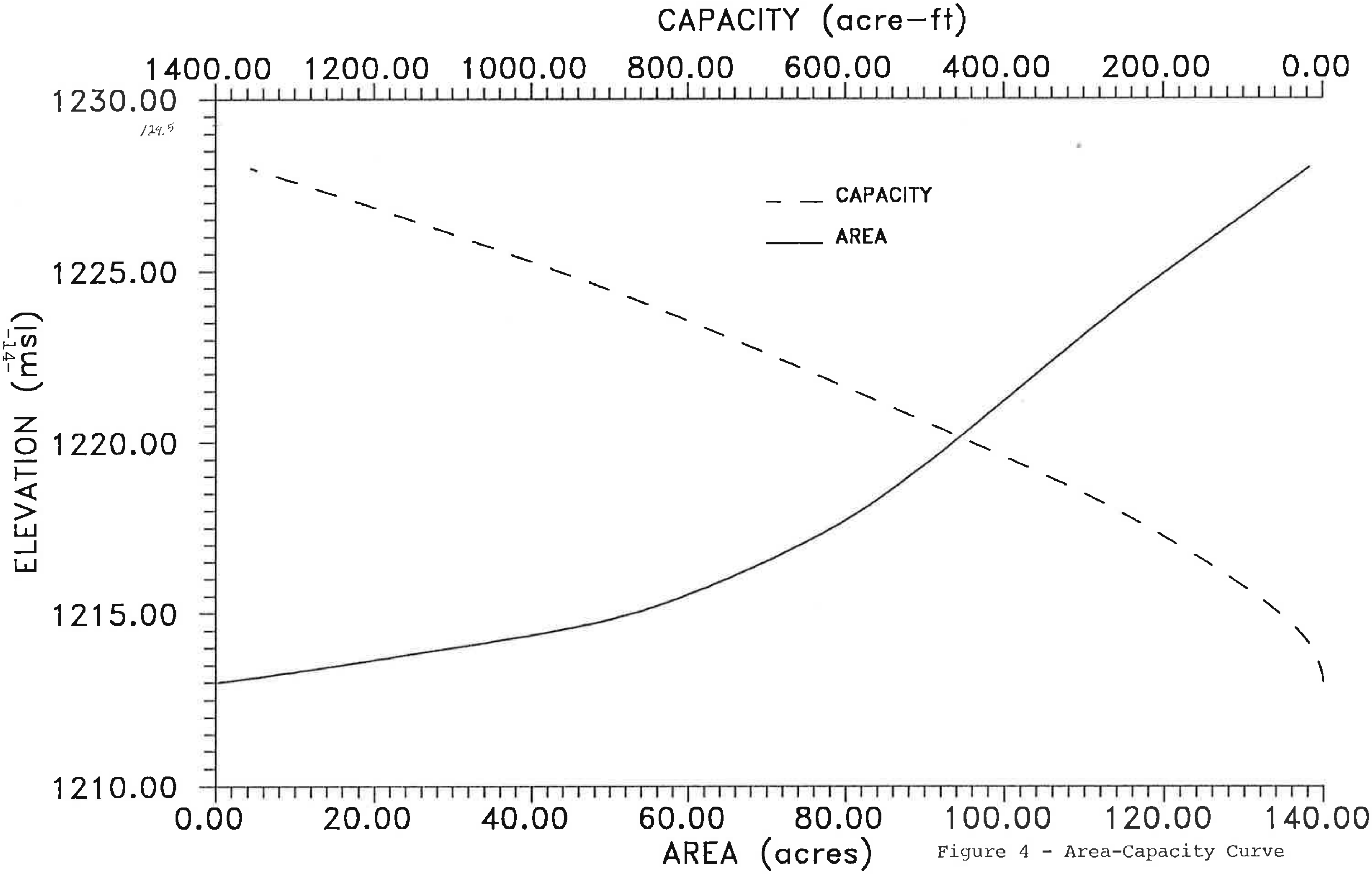


Figure 4 - Area-Capacity Curve

the HEC-2 computer model. The rating curve for the existing spillway on Silver Lake is contained in Table 4.

Table 4 - Spillway Rating Curve

Elevation	Q-Principal (cfs)	Q-Emergency (cfs)	Q-Total (cfs)
1223.8	-	-	-
1224.0	19	-	19
1224.5	127	-	127
1225.0	285	-	285
1226.0	481	-	481
1226.3	858	0	858
1226.5	963	13	976
1227.0	1,242	47	1,289
1227.2	1,360	83	1,443

Table 5 shows the inflow, outflow, and stage for the 10-year and 25-year frequency snowmelt precipitation events as generated using the HEC-1 computer model for existing conditions.

Table 5 - Results of Hydrologic Study on Existing Conditions

Event	Inflow (cfs)	Outflow (cfs)	Stage (msl)
10-year 10-day snowmelt	574	573	1225.7
25-year 10-day snowmelt	1,035	1,034	1226.6

Spillway Modifications:

The spillway for Silver Lake consists of a 70-foot wide weir. The crest of the weir is currently set at an elevation of 1223.8 msl. The dam also has a 100-foot wide emergency spillway located at the west edge of the embankment. The crest of the emergency spillway is at an elevation of 1226.3 msl. The top of the embankment is at an elevation of 1227.2 msl.

Raising the water level in Silver Lake by 2 feet will require that the crest of the weir be raised to an elevation of 1225.8. By raising the weir, the difference in elevation between the crest of the weir and the control elevation of the emergency spillway is reduced to only 0.5 feet. Considering this, the limited capacity of the emergency spillway, and the difficulty involved in raising the control elevation of the emergency spillway, the emergency spillway on Silver Lake could be eliminated. A Class I dam is required to pass the flows due to a 25-year precipitation event (freeboard precipitation event) without overtopping. Therefore, the principal spillway will be required to pass the freeboard design event. Table 6 shows the rating curve for the spillway on Silver Lake with the increased water level.

Table 6 - Spillway Rating Curve for Modified Spillway

Elevation	Spillway Discharge (cfs)
1225.8	0
1226.0	19
1226.3	77
1226.5	127
1227.0	285
1227.2	359
1227.5	481
1228.0	708
1228.5	963
1229.0	1,242
1229.5	1,544

Table 7 shows the inflow, outflow, and stage for the 10-year and 25-year frequency snowmelt precipitation events as generated using the HEC-1 computer model for the modified spillway. Figure 5 shows the inflow-outflow hydrograph for Silver Lake during a 25-year precipitation event.

Table 7 - Results of Hydrologic Study for Modified Spillway

Event	Inflow (cfs)	Outflow (cfs)	Stage (msl)
10-year 10-day snowmelt	574	572	1227.7
25-year 10-day snowmelt	1,035	1,034	1228.6

The results of the preliminary investigation show that a 2-foot raise in the water level of Silver Lake will require that the top of the dam be raised to a minimum elevation of 1228.6 msl to allow the passage of the freeboard precipitation event without overtopping the dam. Raising the dam to an elevation of 1229.5 msl will allow the modified spillway to have a capacity equal to the capacity of the existing spillway. Therefore, it is recommended that the dam be raised approximately 2.3 feet to an elevation of 1229.5 msl. The raised embankment will have a top width of 10 feet and 3:1 (3 Horizontal to 1 Vertical) side slopes.

Roadway Modifications:

Raising the water level and embankment for Silver Lake will cause several stretches of roadway around the lake to be inundated more frequently. These areas should be raised to a minimum

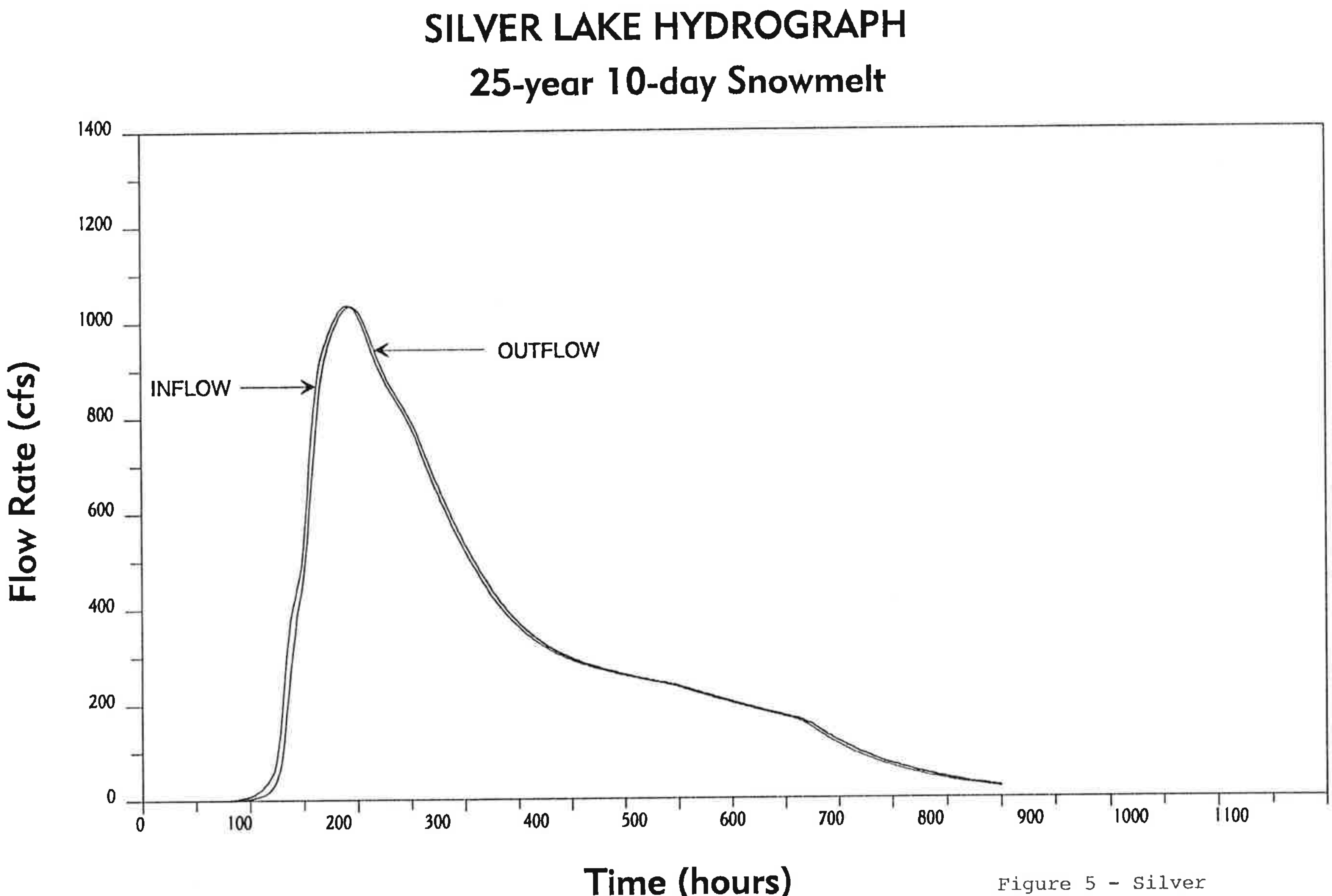


Figure 5 - Silver Lake Hydrograph

elevation of 1229.0 msl. This will ensure that the roads are passable when a 25-year frequency precipitation event is passed through the dam. Figure 6 shows the reaches of road that should be raised and the current center line elevation of the road. The higher water level and steep banks will increase the potential for erosion in these stretches of roadway. Therefore, the banks should be riprapped in these areas to protect the road.

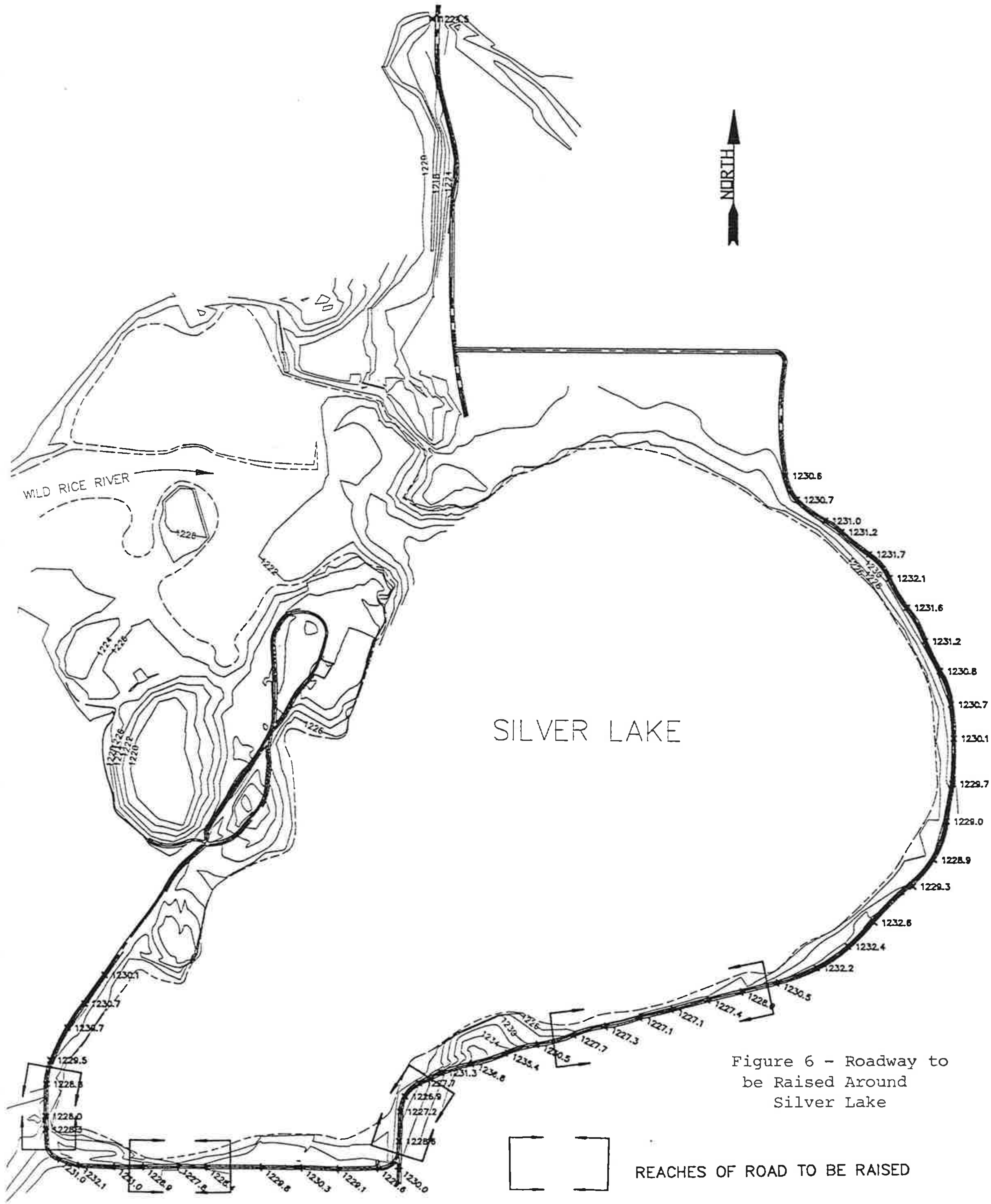


Figure 6 - Roadway to be Raised Around Silver Lake

V. FISH BARRIER

The Game and Fish Department requested that a fish barrier be designed as part of the investigation to reduce the movement of fish into and out of Silver Lake. The barrier will be located across the channel connecting Silver Lake to the Wild Rice River. Figure 7 shows the location of the fish barrier.

Two alternative fish barriers were considered. The first alternative consists of a rock riprap barrier. The barrier will have a 10-foot top width and 2:1 side slopes. The top of the barrier will be set at an elevation of 1228 msl. The barrier will be approximately 270 feet long and 12 feet high at the maximum section. The top of the barrier will be covered with a gravel overlay to improve access for anglers. Figure 8 shows a typical section of a rock riprap fish barrier. The cost to construct a rock riprap fish barrier is estimated to be $90,000. Table 8 shows the cost estimate for this alternative.

Table 8 - Cost Estimate for Rock Riprap Fish Barrier

Item	Quantity	Unit	Unit Price	Total
Mobilization	1	LS	$3,000.00	$ 3,000
Rock Riprap	2,630	CY	25.00	65,750
Gravel	1	LS	15.00	750
Subtotal				$69,500
Contingencies			(+/- 10%)	6,833
Contract Administration			(+/- 10%)	6,834
Engineering			(+/- 10%)	6,834
Total				$90,000

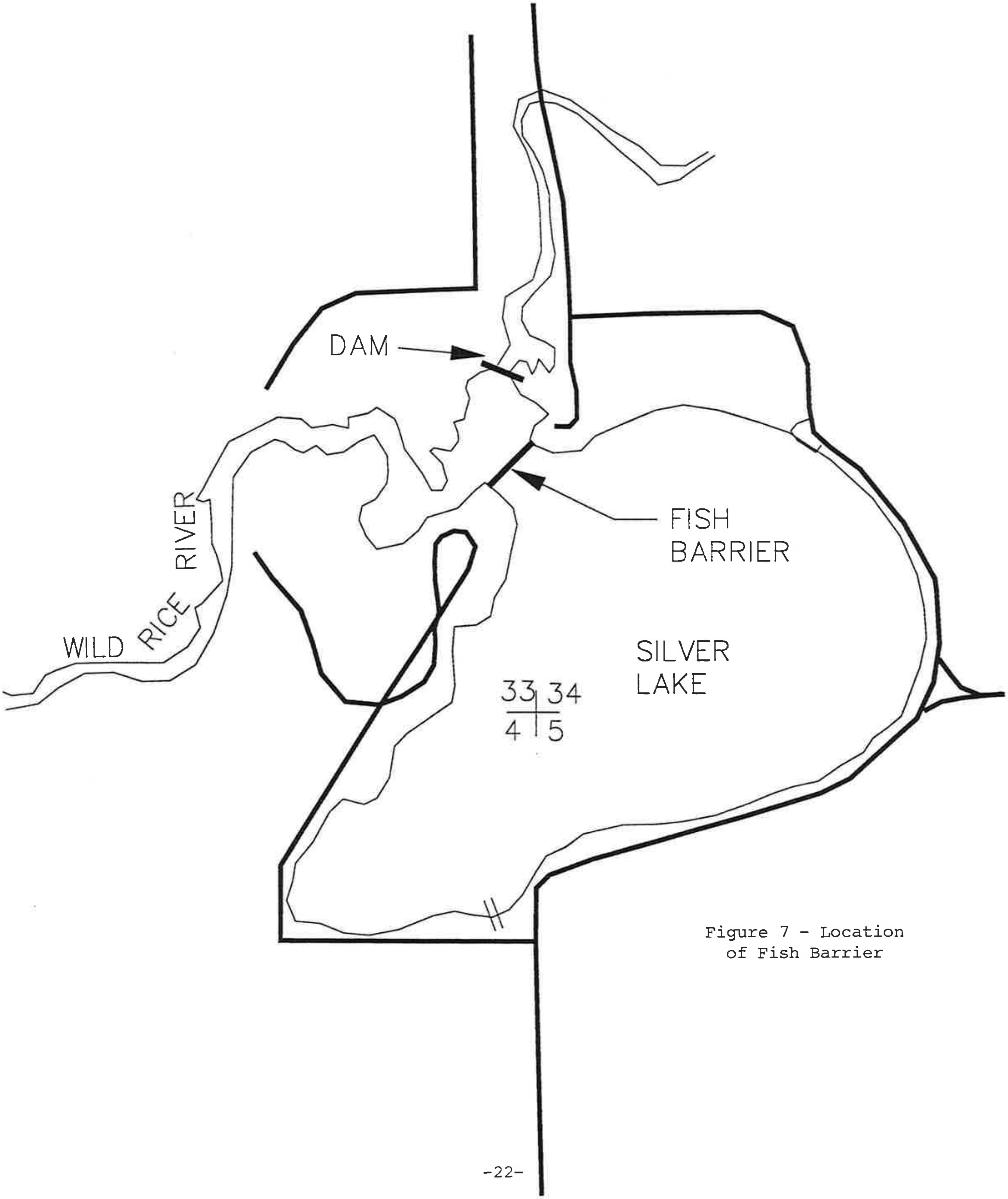
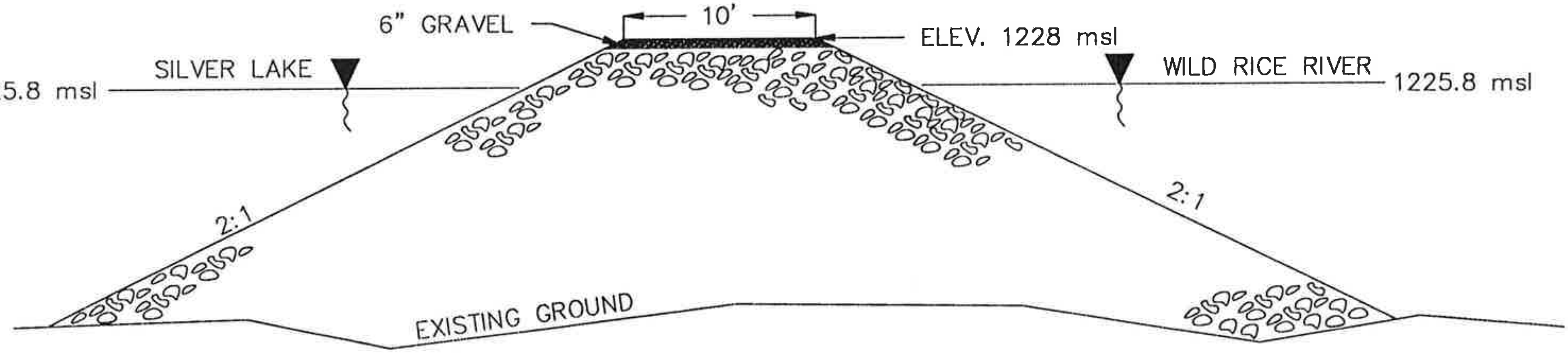


Figure 7 - Location
of Fish Barrier



ROCK RIPRAP FISH BARRIER

TYPICAL SECTION

Figure 8 - Typical Section of Rock Riprap Fish Barrier

The second type of fish barrier that was considered consists of a rock-filled gabion structure. The barrier will be constructed by placing sack gabions across the opening between Silver Lake and the Wild Rice River. The gabion structure will be 6 feet wide at the top. The top of the gabion structure will be covered with a gravel overlay to improve access for anglers. The top of the gabion structure will be set at an elevation of 1228 msl. The barrier will be approximately 270 feet long and 12 feet high at the maximum section. Figure 9 shows a typical section of a gabion fish barrier. The cost to construct a gabion fish barrier is estimated to be $70,000. Table 9 shows the cost estimate for this alternative.

Table 9 - Cost Estimate for Gabion Fish Barrier

Item	Quantity	Unit	Unit Price	Total
Mobilization	1	LS	$4,000.00	$ 4,000
Gabions				
(a) 6' long x 3' diameter	285	Ea.	35.00	9,975
(b) 9' long x 3' diameter	160	Ea.	50.00	8,000
(c) 6' long x 2' diameter	35	Ea.	30.00	1,050
Rock Riprap	850	CY	35.00	29,750
Gravel	60	CY	15.00	900
Subtotal				$53,675
Contingencies			(+/- 10%)	5,442
Contract Administration			(+/- 10%)	5,441
Engineering			(+/- 10%)	5,441
Total				$70,000

A problem associated with constructing a fish barrier across the channel connecting Silver Lake to the Wild Rice River is the potential for sediment to deposit in the fish barrier. Over time, the sediment could become sufficient to reduce the flow of water into Silver Lake. On years when there is low flow in the Wild Rice River, Silver Lake could end up with less water because the flows in the Wild Rice River would pass without much water flowing into the lake. Removing the sediment from the fish barrier, once it becomes a problem, would be very costly.

VI. LAND AND WATER RIGHTS

Raising the water level in Silver Lake 2 feet will cause additional land around the lake to be flooded. Any private land that will be affected by the increase in water level will require flood easements or purchase. Land acquisition is the responsibility of the local project sponsor. In addition, some of the recreational facilities surrounding Silver Lake, such as the boat ramps and swimming beach, may require some modification to accommodate the higher water level.

There are two water permits relating to the use of water in Silver Lake. Water Permit #648, held by Louis Silseth, authorizes the use of 125 acre-feet of water to irrigate 127 acres. Water permit #3544, held by the Sargent County Park Board, authorizes the appropriation of 590 acre-feet of water (354 acre-feet for storage and 236 acre-feet for annual use to cover evaporative losses) for recreation and fish and wildlife uses. Water permit #648 has a priority date of July 27, 1955, and water permit #3544 has a priority date of March 4, 1982. Since water permit #648 has an earlier priority date, water permit #648 is senior to permit #3544.

Raising the water level in Silver Lake will require an additional water permit for 354 acre-feet of water (286 acre-feet for additional storage and 68 acre-feet for additional annual use for evaporative losses). The new water permit will have a lower priority than the existing water permits on the Wild Rice River.

VII. PRELIMINARY COST ESTIMATE

As proposed, the cost to raise Silver Lake is estimated to be $73,000. This cost estimate does not include the cost of the fish barrier or the cost of any land acquisition. Table 8 shows the cost breakdown for raising Silver Lake.

Table 10 - Silver Lake Cost Estimate

Item	Quantity	Unit	Unit Price	Total
Mobilization	1	LS	$5,000.00	$ 5,000
Clearing and Grubbing	1	LS	3,000.00	3,000
Stripping & Spreading Topsoil	3,500	SY	0.25	875
Fill	2,300	CY	1.20	2,760
Concrete	20	CY	300.00	6,000
Reinforcing Steel	2,800	Lbs	0.50	1,400
Rock Riprap	500	CY	25.00	12,500
Filter Material	250	CY	15.00	3,750
Seeding	1	Ac.	300.00	300
Roadway Modifications				
(a) Fill	3,130	CY	1.20	3,756
(b) Gravel	250	CY	15.00	3,750
(c) Rock Riprap	400	CY	25.00	10,000
(d) Filter Material	200	CY	15.00	3,000
Subtotal				$56,091
Contingencies			(+/- 10%)	5,636
Contract Administration			(+/- 10%)	5,636
Engineering			(+/- 10%)	5,637
Total				$73,000

VIII. SUMMARY

The feasibility of raising the water level on Silver Lake approximately 2 feet has been examined. Silver Lake is located in Sections 33 and 34, Township 130 North, Range 55 West, and Sections 3 and 4, Township 129 North, Range 55 West in Sargent County, approximately 5 miles southwest of the city of Rutland, North Dakota. The dam is located on the Wild Rice River and raises the water level in the Silver Lake, which lies adjacent to the river. A higher water level in Silver Lake will enhance the use of the lake and its associated recreational facilities.

Silver Lake is located in a rural area. Failure may result in damage to a county road, but no loss of life is anticipated. Considering this, the dam is classified in the low hazard category. Based on a 9-foot embankment height and a low hazard classification, Silver Lake is classified as a Class I dam for design purposes.

Design events for the hydraulic structures are as follows: 1) the emergency spillway must pass the flows due to a 25-year precipitation event without overtopping the dam; and 2) the emergency spillway must pass the flows due to a 10-year precipitation event within an acceptable velocity. Since the emergency spillway for Silver Lake has a small capacity, and will be difficult to raise, it will be eliminated and the principal spillway will be designed to pass the flows due to a 25-year precipitation event without overtopping the dam.

The principal spillway for Silver Lake consists of a 70-foot wide weir. The crest of the weir controls the water level in Silver Lake at an elevation of 1223.8 msl. Raising the water level in the lake 2 feet will require that the crest of the weir be raised to an elevation of 1225.8 msl.

The HEC-1 computer model was used to simulate the precipitation versus runoff response for the Wild Rice River Basin upstream of Silver Lake and to route the flows through the dam. Analysis with the HEC-1 model indicates that a 2-foot raise in the water level of Silver Lake will require that the top of the dam be raised to an elevation of 1229.5 msl.

Raising Silver Lake 2 feet will cause additional land around the lake to be inundated. Any private land that will be affected by the raise will require easements or purchase. A water permit will also be required for the additional water needed to raise the lake.

The cost to raise the water level in Silver Lake 2 feet is estimated to be $73,000. This does not include the cost of any land acquisition that may be required for the project. The cost to construct a fish barrier between Silver Lake and the Wild Rice

River is estimated to be $90,000 for a rock riprap barrier and $70,000 for a rock-filled gabion barrier.

IX. RECOMMENDATIONS

The water level in Silver Lake fluctuates significantly due to intermittent flows in the Wild Rice River, varying weather conditions, and withdrawals from the lake for irrigation. Low water levels in recent years have limited the recreational opportunities associated with Silver Lake. Raising Silver Lake 2 feet will not solve the problem of fluctuating lake levels, but it will enable the storage of additional water when it is available. This will enhance the use of Silver Lake and its associated recreational facilities. Therefore, it is recommended that Silver Lake be raised 2 feet. The decision to proceed with this project is the responsibility of the Sargent County Water Resource District.

APPENDIX A - COPY OF AGREEMENT

SWC Project #391
December 2, 1991

A G R E E M E N T

Investigation of Raising the Water Level in Silver Lake

I. PARTIES

THIS AGREEMENT is between the North Dakota State Water Commission, hereinafter Commission, through its Secretary, David A. Sprynczynatyk; and the Sargent County Water Resource District, hereinafter District, through its Chairman, Danny Jacobson.

II. PROJECT, LOCATION, AND PURPOSE

The District has requested the Commission to investigate the feasibility of raising the water level in Silver Lake approximately 2 feet. The Project is located in Section 33, Township 130 North, Range 55 West. The District feels the additional water will help maintain a higher water level during dry periods, ensuring the use of their multi-use outdoor recreation complex.

III. PRELIMINARY INVESTIGATION

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

1. A field survey of the embankment and land adjacent to the reservoir including topographic data, area-capacity data, and bridge and channel geometry;

2. A study of the hydrology of the watershed upstream of the dam;

3. A preliminary design of the outlet works necessary to pass the design flood through the dam;

4. A preliminary cost estimate for the modifications; and

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

IV. COSTS

The District shall deposit a total of $2500.00 with the Commission to help defray the field costs associated with this investigation.

V. RIGHTS-OF-ENTRY

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

VI. INDEMNIFICATION

The District agrees to indemnify and hold harmless the State of North Dakota, the Commission, its Secretary, their employees and agents, from all claims, suits or actions of whatsoever nature resulting out of the design, construction, operation, or maintenance of the project. In the event a suit is initiated or judgment is entered against the State of North Dakota, the Commission, its Secretary, their employees or their agents, the District shall indemnify any or all of them for all costs and expenses, including legal fees, and any judgment arrived at or satisfied or settlement entered.

VII. MERGER CLAUSE

This agreement constitutes the entire agreement between the parties. No waiver, consent, modification or 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
By:

for DAVID A. SPRYNCZYNATYK
Secretary

WITNESS:

DATE: 3 Dec 91

SARGENT COUNTY WATER RESOURCE DISTRICT
By:

DANNY JACOBSON
Chairman

WITNESS: Sherry Hosford

DATE: 4 Mar 92

APPENDIX B - SYMBOLS AND ABBREVIATIONS

SYMBOLS AND ABBREVIATIONS

cfs - cubic feet per second

HEC - The Hydrologic Engineering Center

msl - mean sea level

SWC - State Water Commission

WPA - Works Progress Administration

USGS - United States Geological Survey