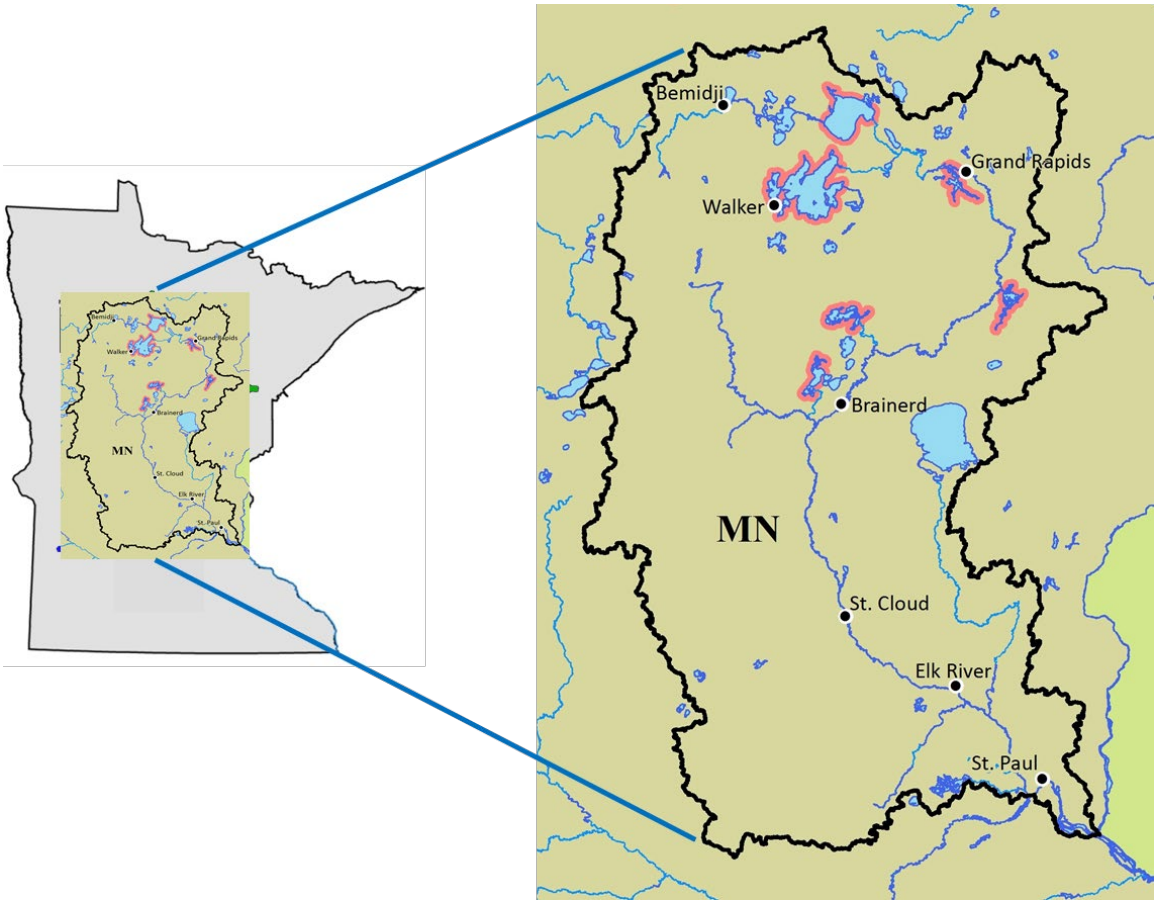
FINAL Letter Report

Sustainable Rivers Program: Mississippi Headwaters Public Outreach

U.S. Army Corps of Engineers, St. Paul District



US Army Corps of Engineers
St. Paul District

February 2022

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Introduction

Sustainable Rivers Program

The Sustainable Rivers Program (SRP) started in 1998 when The Nature Conservancy (TNC) approached the U.S. Army Corps of Engineers, Louisville District, to collaboratively develop an operations plan for the Green River Dam. The program aims to improve the health and life of rivers by modifying reservoir operations to achieve ecologically sustainable flows while maintaining or enhancing other project benefits. In 2000, TNC and the Corps signed a Memorandum of Understanding to seek opportunities relating to the conservation, understanding, management and sustainable use of the Nation's water and related land resources. The Institute for Water Resources (IWR) plays a role in the implementation of this agreement and in managing the SRP.

Annually, the SRP receives funding that is used to support various efforts across the Nation. Corps districts submit funding proposals for SRP efforts and IWR reviews those proposals and distributes funding to support them. This report, which summarizes the results to date of a public outreach effort in the St. Paul District, was funded in this manner through the SRP.

Mississippi River Headwaters Reservoirs

The St. Paul District is responsible for the operation and maintenance of six reservoirs within the Headwaters region of the Mississippi River: Lake Winnibigoshish, Leech Lake, Pokegama Lake, Big Sandy Lake, Cross Lake, and Gull Lake. These reservoirs are a set of impounded natural lakes in north-central Minnesota. The operating plans for the Headwaters reservoirs of the Mississippi River were developed in most part from the 1930s to the 1960s. Since then, only minor modifications have been made to the plans. However, there have been dramatic changes to environment of the Headwaters, most noticeably through increased development.

In 2001, a Reservoir Operating Plan Evaluation, or ROPE study, was initiated to evaluate alternative operating plans to improve operation of the system to balance benefits in consideration of tribal trust, flood risk reduction, environmental benefits, water quality, water supply, recreation, navigation, hydropower and other public interests. Several operating plans were developed that would address these interests in varying degrees. The draft recommended plan included environmental features that would result in a somewhat more natural hydrologic regime; most notably a gradual decline in water levels starting in mid-summer, that would total about six inches by early fall. The public was strongly opposed to this proposed plan and the final plan selected was nearly a copy of the existing, or no-action plan. The Record of Decision implementing the final alternative was signed on 19 January 2010.

Headwaters Public Outreach Overview

Since the conclusion of the Headwaters ROPE study, there has been little interest in another comprehensive review of those operating plans. While there is still an opportunity to realize environmental benefits by revising the operating plans, public support for doing so would need to be evident prior to initiating such a study. Without this support, it is likely that efforts to change the operating plans would again be unsuccessful. With that understanding, this public outreach effort was started under the SRP with the intent of engaging the public to provide information regarding the current operation of the Headwaters reservoirs, determine the current level of interest in modifying the operating plans, and to begin building public support for doing so, specifically by identifying individuals interested in becoming involved.

Outreach Partnership

The outreach initiative has been conducted in partnership with The Nature Conservancy (TNC rep: Kristen Blann), the Leech Lake Band of Ojibwe (LLBO rep: Eric Krumm), the Minnesota Department of Natural Resources (MNDNR rep: Luther Aadland), and the Corps of Engineers (Corps rep: Steve Clark). Presenting such a partnership is important to the public because it provides credibility to the goals of the effort. Furthermore, each organization is best able to provide focus to a particular viewpoint. The Corps focuses of the overall management of the reservoirs and is best able to explain current operations and the potential tradeoffs of changes. The MNDNR is best able to provide a perspective of the natural resources affected by the operation, and the potential benefits of changes. The LLBO is able to provide a perspective as a sovereign Tribal Nation within the region, explaining Tribal interests in natural resources. Finally, TNC is experienced in developing public support and provides a more neutral perspective as a non-governmental organization (NGO). The partnership representatives met routinely to plan and execute the outreach program, each member contributing content and guidance.

Execution

Website

A Corps website was developed as the primary platform to engage the public: https://www.mvp.usace.army.mil/SustainableRiversProgram/. The website contains a variety of information pertaining to the Headwaters SRP as described below. It also has an email link the public can use to provide input and ask questions.

Informational Videos

A series of informational videos were recorded and are available on the website. St. Paul District Commander Col. Karl Jansen provided an introductory welcome video to the Headwaters SRP.

Steve Clark (Corps) presented on the current reservoir operating plans. Kristen Blann (TNC) presented on the SRP and past successes. Luther Aadland (MNDNR) presented on the ecological issues of dams. Eric Krumm (LLBO) presented on Tribal issues related to the reservoirs. The public meeting presentation by Steve Clark is also available. Finally, a link to a Headwaters documentary is provided courtesy of Lakeland PBS.

Partner Weblinks

https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/sustainable-rivers-project/

https://www.llojibwe.org/

http://www.hec.usace.army.mil/sustainablerivers/

https://www.hec.usace.army.mil/

Frequently Asked Questions and Answers

Why does the Corps want to manage water levels for fish and wildlife when the dams were built for flood risk management?
Although flood risk management is an important authorized purpose of the reservoirs, fish and wildlife management, water supply and recreation are other purposes authorized by Congress. The Corps also conducts its activities under our Environmental Operating Principles which were developed to ensure that Corps' missions include totally integrated sustainable environmental practices.

How will this proposed project affect the reservoirs' ability to reduce flood risk?
At this time there are no plans to change reservoir operations. If changes are considered in the future, impacts to flood risk reduction would be prevented or minimized.

How will this project affect recreation at the Mississippi River Headwaters reservoirs?
At this time there are no plans to change reservoir operation. If changes are considered in the future, impacts to recreation would be evaluated. Recreation in the Headwaters is also dependent on the natural resources in the region. Water levels that improve environmental conditions may improve recreation, even if there are minor impacts to recreational boat access.

What are the current operating plans for the six reservoirs?
The operating plans have been summarized and can be within the documents section of this webpage.

Operations for flooding seem to focus on the need to protect the city of Aitkin. Has the Corps considered ways to protect Aitkin that don't involve reservoir operations?
The Corps has studied other ways to reduce flood damages at Aitkin, but finding acceptable cost-effective solutions is difficult. However, even if a solution for Aitkin was implemented, there are

other locations within the system that would require operating the reservoirs for flood risk management.

How are Tribal interests considered now and in future operating plans?
Tribal interests are very important to the Corps of Engineers and are an important consideration in our daily operations of the reservoirs. Tribal interests are very important for future operational changes as well, which is why we are partnering with the Leech Lake Band of Ojibwe in this new Sustainable Rivers Program initiative.

If the operating plans were changed, what process would take place to implement those changes, and would the public be involved?
First, the Corps would determine if there is public interest in considering an operation change. Then, a study to develop a new operating plan and evaluate its effects would be conducted. The public would be involved in that process and have multiple opportunities to participate. Only after the conclusion of that process, with full public participation, would any change to operations be made.

SRP Handout and Reservoir Operation Summaries

A handout was developed to summarize the Headwaters SRP initiative and foster public interest. Also, summaries of the operating plans for each reservoir were developed. All of these are available on the website and included in the appendices here.

Public Meetings

Two open house public meetings were held to gather ideas and seek public comments on plans to enhance the environment at Headwaters reservoirs. One meeting was held in Crosslake, Minnesota, July 20, at the Corps' Cross Lake Recreation Area, and another in Walker, Minnesota, July 21, at the Walker Area Community Center. Both meetings began at 5:30 p.m. with a brief presentation about the Corps of Engineers' current reservoir operations and the Sustainable Rivers Program. It was emphasized that no current changes are planned for the reservoirs, and that there was a desire to hear the public's thoughts on areas that could potentially be enhanced through modifications to the current reservoir operation plans. Following the presentation, Corps officials and partners with The Nature Conservancy, Minnesota Department of Natural Resources and the Leech Lake Band of Ojibwe were available to discuss the program.

Public meeting attendance was rather limited. The Cross Lake meeting was attended by five members of the public and the Walker meeting was attended by two. Those attendees held a strong interest in the future of the Headwaters. However, their interest in modifying operations at this time was generally unclear, though they didn't seem opposed.

Public Response

One of the primary intentions of this outreach effort was to gather input from the public. The public meetings were held in part to accomplish this, but additionally the website includes an

invitation to provide comments and questions. Only one person has provided a comment via email as of the date of this report. They are a resident that lives along the Gull River downstream of the dam. They commented that the high spring and summer flows have resulted in bank erosion and the seasonal loss of nesting birds. They contend that the operation of the dam is suited to the residents on the lake and neglects downstream impacts.

Future Efforts

At this time, future efforts for the Headwaters SRP are likely to be limited to maintaining the SRP website and gathering additional public comments. The apparent limited interest in changes to the reservoir operating plans seems to confirm that public interests have not substantially changed since the completion of the ROPE Study. Because of this, pursuing studies to review and implement fundamental changes in operations is likely to be unwarranted. However, over time public values may change and that could lead to a future opportunity to revisit the possibility of large-scale operational changes.

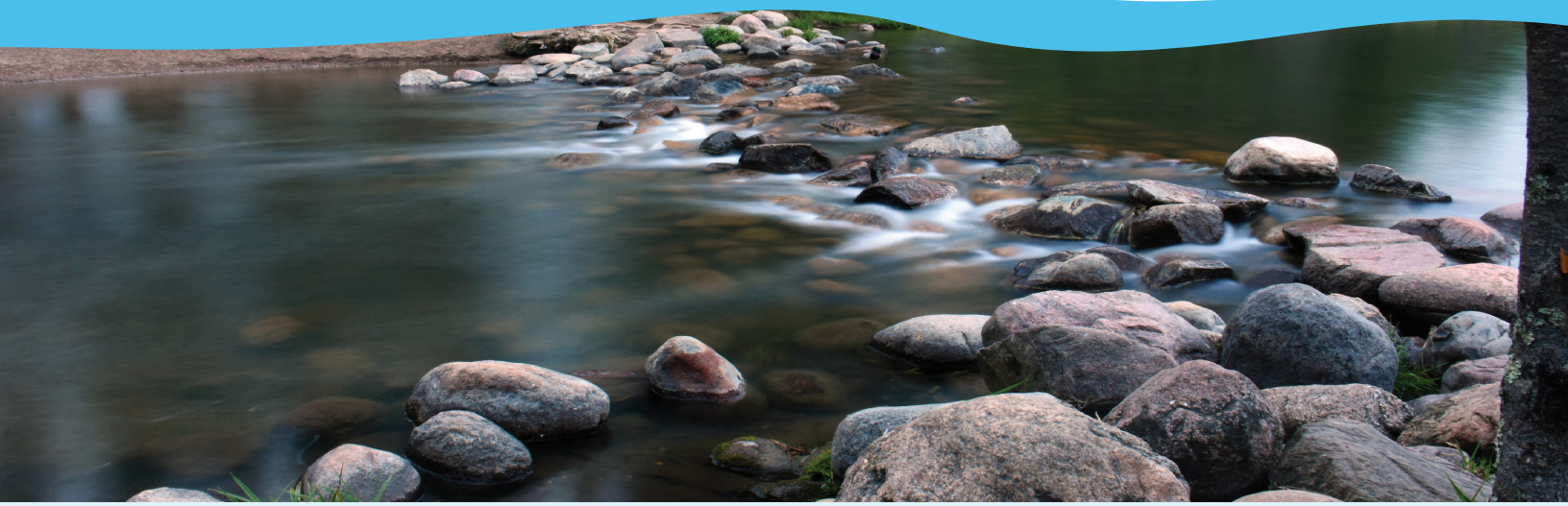
The SRP workshop did identify a variety of potential minor adjustments in dam operations at these reservoirs that may result in some environmental benefits while having negligible impacts to other uses. Those potential changes have been documented in a separate report and will continue to be pursued as SRP funding allows.

Appendix A.

SRP Handout

SUSTAINABLE RIVERS PROGRAM

The Sustainable Rivers Program is a partnership between the U.S. Army Corps of Engineers and The Nature Conservancy that was established in 2002.



Our Vision

The mighty Mississippi River is one of the world's most important rivers, flowing through America's heartland to the Gulf of Mexico. Critical and nationally important, the river is connected with:

- Water supply & water quality
- Habitat for fish & wildlife
- Tribal trust
- Recreation & ecotourism
- Flood risk management

We hope to develop a deeper, shared understanding of our missions to include flood risk management and reservoir operations to help chart a course toward a brighter future for generations to come.

The Sustainable Rivers Program attempts to improve the ecosystem by adjusting USACE-managed reservoir operations. No changes are currently proposed or planned, but we do want to hear your ideas and input.

SUSTAINABLE RIVERS PROGRAM

The Sustainable Rivers Program is a partnership between the U.S. Army Corps of Engineers and The Nature Conservancy to evaluate existing Corps of Engineers dams and reservoirs for opportunities to adjust operational flows that benefit the environment while maintaining the original project purposes.

WHY THE MISSISSIPPI RIVER HEADWATERS?

The Mississippi Headwaters reservoirs, managed by the St. Paul District, are an ideal location to explore ways to improve reservoir management and identify opportunities to provide greater benefits to people and nature, while ensuring the ecological health of the system and the Mississippi River Headwaters remain naturally resilient to future changes.

Measured improvements

- Improve the ecological and biological health of the rivers
- Enhance economies and quality of life
- Benefit Indigenous, local and other water connected communities

US Army Corps of Engineers®
St. Paul District

Leech Lake Band of Ojibwe

Department of Natural Resources

The Nature Conservancy
Protecting nature. Preserving life.

NGOs

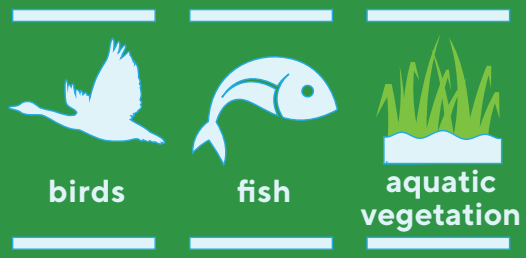
PUBLIC

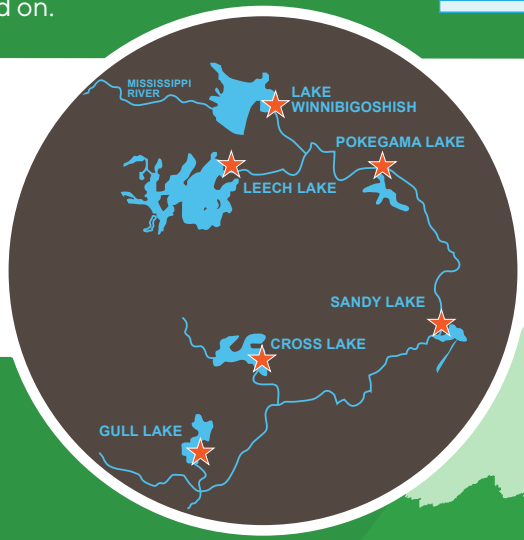
www.mvp.usace.army.mil/SustainableRiversProgram

THE SUSTAINABLE RIVERS PROGRAM

Sustainable Rivers Program
Prescription for a brighter future

The program is all about fine-tuning reservoir operations to benefit both the communities that live and recreate in these waters and the ecosystem that wildlife and flora depend on.





BIRDS

More than 40 percent of North American migrating birds use the Mississippi River corridor as their migration route. Improving their habitat provides opportunities for hunting and birdwatching.

FISH

Rivers, wetlands and lakes provide habitat for many fish and aquatic species. Millions of people enjoy recreating within the Mississippi Rivers Headwaters every year.

AQUATIC VEGETATION

In the Ojibwe language, wild rice is translated as manoomin, meaning good berry, harvesting berry or wondrous grain. Wild rice is just one type of important aquatic vegetation found within the Mississippi River Headwaters.

The St. Paul District manages six reservoirs within the Mississippi River Headwaters. They include Leech Lake, near Federal Dam, Minnesota; Lake Winnibigoshish, near Deer River, Minnesota; Big Sandy Lake, near McGregor, Minnesota; Cross Lake, near Crosslake, Minnesota; Gull Lake, near Brainerd, Minnesota; and Pokegama Lake, near Grand Rapids, Minnesota.

Appendix B.

Reservoir Operation Summaries

Reservoir Summary: Big Sandy Lake and Big Sandy Lake Dam

Project General Objectives: The reservoir is regulated primarily for recreation, flood control, fish and wildlife and Tribal Trust. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife and Tribal Trust concerns. The low-flow plan manages water resources both upstream and downstream of the dam during critical periods.

Project Location Map (Figure 1):

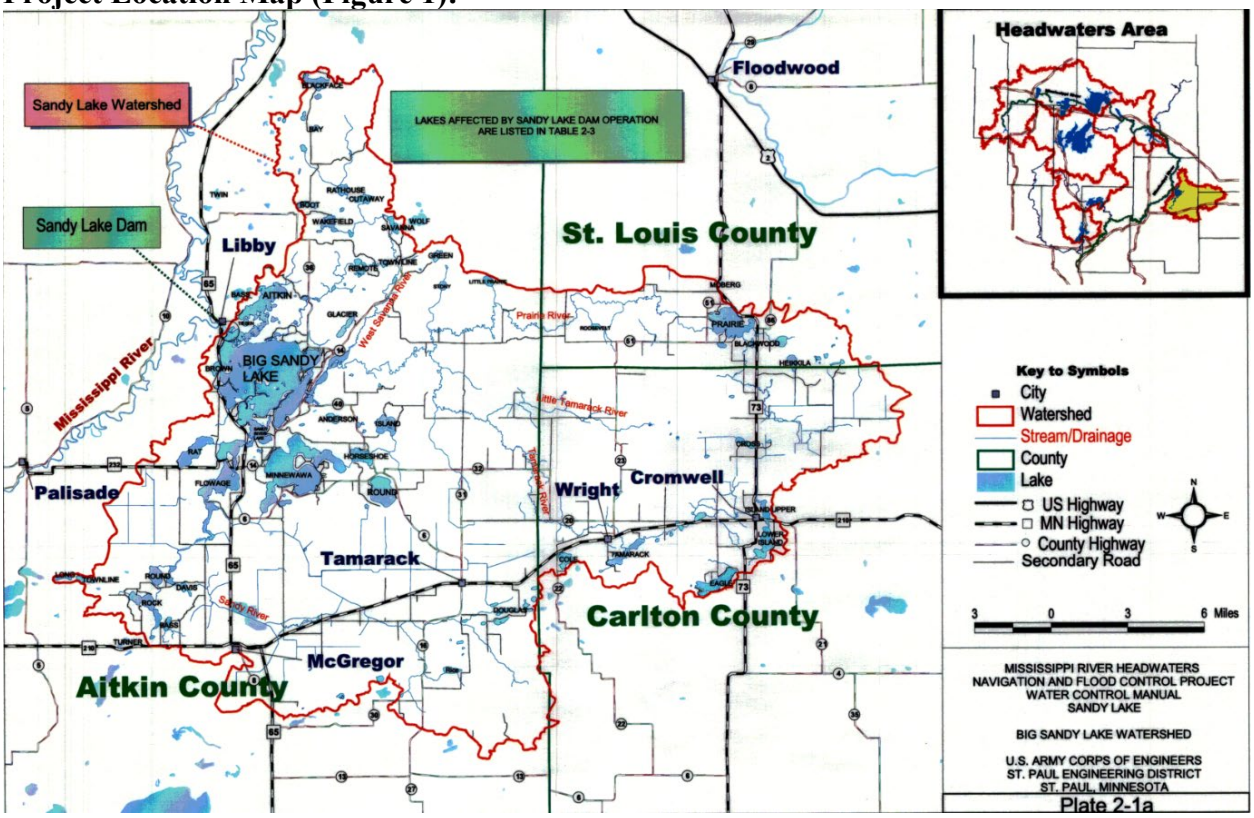


Figure 1. Project location map, Big Sandy Lake.

Pertinent Data:
Datum = NGVD 29

Sandy Lake	Elevation in Feet	Area in Acres	Cumulative Storage in Acre-Feet
Top of Control Structure	1221.31	12,900	118,000
Maximum Operating Limit	1218.31	10,700	82,000
Normal Summer Pool Level	1216.31	9,400	62,000
Minimum Operating Limit	1214.31	8,100	44,000
Sill	1207.31	---	0

HYDROLOGY

Drainage Area	421 square miles
One Inch of Runoff Equals	22,453 acre-feet
Storm Types	Thunderstorm, frontal rain, snow
Flood Season	15 March - June
Low Flow Season	July - October
Minimum Daily Inflow	Flow is very low during dry periods.
Minimum Mean Monthly Inflow	Flow is very low during dry periods.
Minimum Mean Annual Inflow	76 cfs, 1934
Maximum 24-hr. Average Inflow	6,910 cfs, 8 May, 1950
Maximum Mean Monthly Inflow	2,870 cfs, May 1950
Maximum Mean Annual Inflow	549 cfs, 1953
Average Annual Inflow	249 cfs, (Period, 1899-1985)
Maximum Flood Volume from Mississippi River included)	254,600 ac-ft, April 16 - June 8, 1950 (overflow
Name and Location of Key Stream-Flow Stations	Mississippi at Aitkin, Minnesota and Aitkin diversion channel

Watershed Characteristics

Sandy Lake Dam was built on the outlet of Sandy Lake, a lake on the Mississippi River headwaters. The runoff from Sandy Lake watershed is slow and significantly attenuated as a result of the relatively flat topography and the presence of many lakes and wetlands. Sandy Lake Dam controls the runoff from a 420 square mile area, of which 31 percent is dry land, 12 percent is water, and 57 percent is wetlands. In general, the land not covered by wetlands is forested. The average overland slope is 14.78 feet per mile

Figure 2 shows a duration hydrograph of the discharges from the dam.

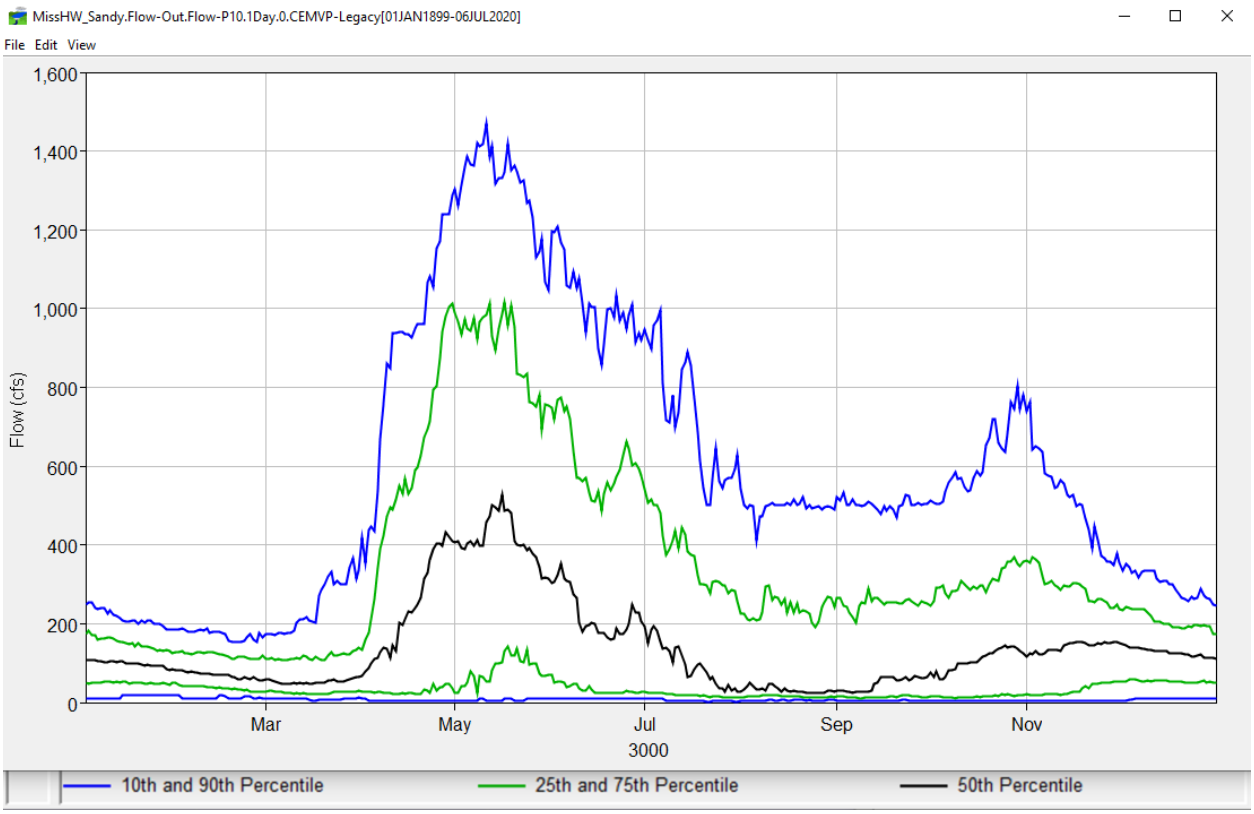


Figure 2. Duration hydrograph for Big Sandy Lake discharges.

Pool Allocation

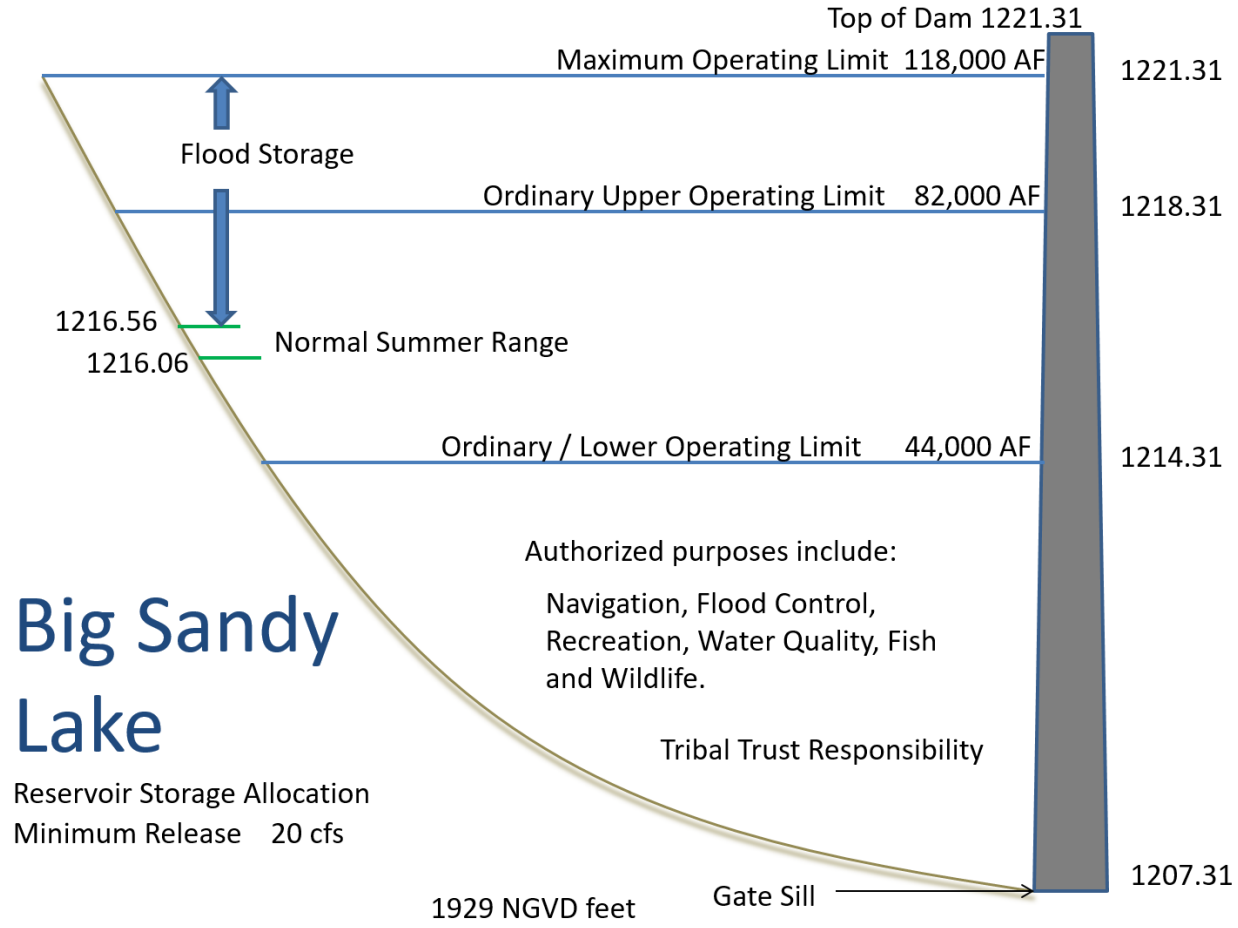


Figure 3. Pool allocations, Big Sandy Lake.

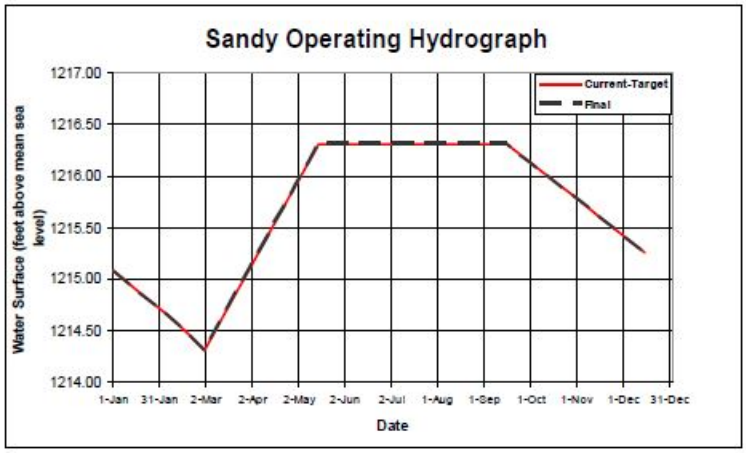
Overall Plan for Water Control

Sandy Lake reservoir is regulated between a minimum elevation of 1214.31 feet and a maximum elevation of 1221.31 feet (**Figure 3**). If possible, the reservoir level should be within its summer range/band of 1216.06 feet to 1216.56 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The ordinary (normal) spring drawdown elevation is 1214.31 feet, which is the lower operating limit of the reservoir. Significant shoreline erosion begins to occur at approximately elevation 1218.31 feet but storage to elevation 1221.31 feet can be used if needed to prevent flooding downstream.

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-7 SANDY LAKE OPERATING RULES		
	CURRENT	FINAL
Summer Band (elev. - feet)	1216.06-1216.56	1216.06-1216.56
Summer Target (elev. - feet)	1216.31	1216.31
Band Width (ft.)	0.5	0.5
Normal Drawdown (elev. - feet)	1214.31	1214.31
Maximum Drawdown (elev. - feet)	1214.31	1214.31
Rate of Release (change/day)	20-30%	20-30%
Spring Pulse	NA	490 cfs
Minimum Flow Requirements	>=(1214.31): 20 cfs	>=(1214.31): 20 cfs
	<(1214.31): 10 cfs	<(1214.31): 10 cfs

Figure S-5. Final Plan Operating Hydrograph, Sandy Lake



Reservoir Summary: Cross Lake Project

Project General Objectives: The reservoir is regulated primarily for recreation, flood control and fish and wildlife. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife concerns. The lowflow plan manages water resources both upstream and downstream of the dam during critical periods.

Basin Map (Figure 4)

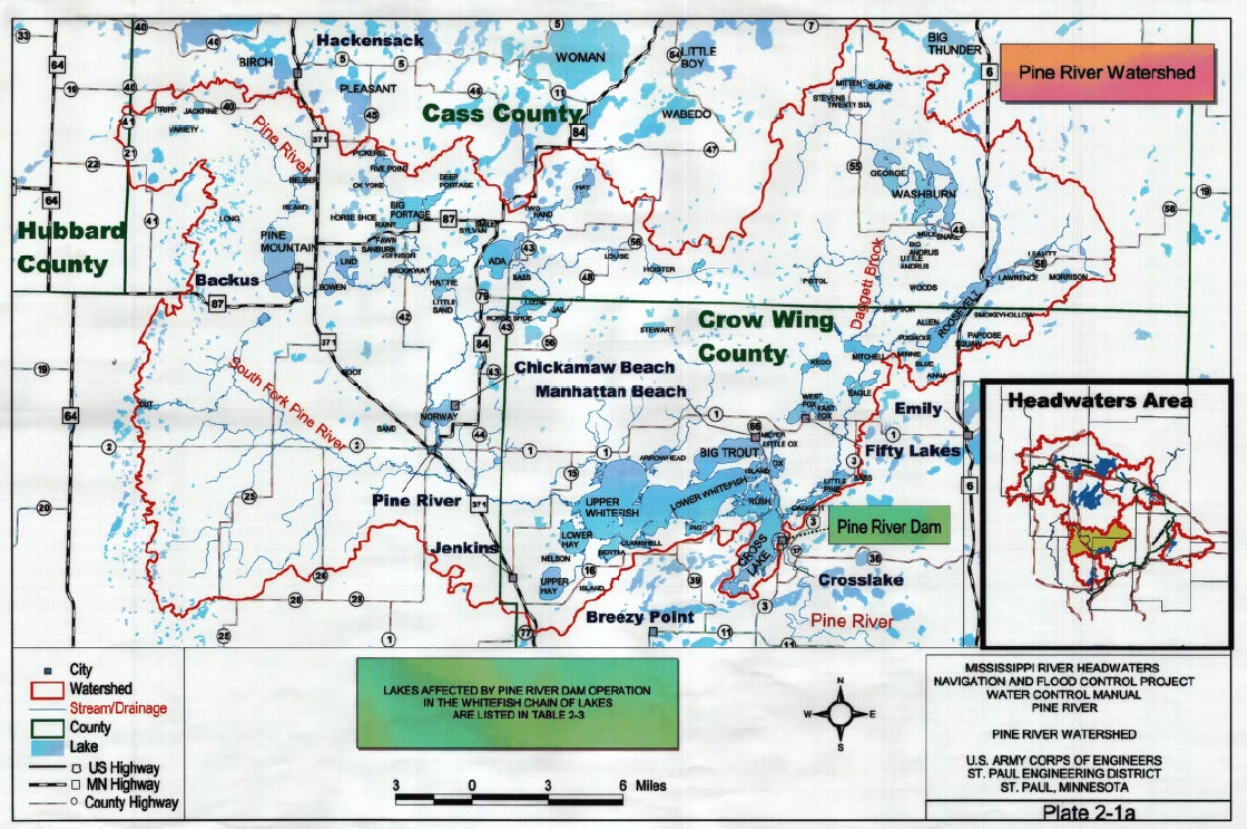


Figure 4. Project location map, Cross Lake.

Pertinent Data Sheet

Location	Pine River Dam is located at the outlet of Cross Lake on the Pine River at Crosslake, Minnesota, 14.5 miles upstream of the confluence with the Mississippi River. The confluence is at river mile 1023.8 above the Ohio River. The dam is in Crow Wing County, 22 miles north of Brainerd, Minnesota. It is at Lat. 45° 40 '09" N, Long. 96° 06' 44" W in Section 21, T137 N, R27 W.
Type of Project	Dam and Reservoir
Project Owner	U.S. Government, Department of the Army
Operating Agency	U.S. Army Corps of Engineers, St. Paul District.
Regulating Agency	U.S. Army Corps of Engineers, St. Paul District.
Closure Date	Dam discharge records begin 26 March 1886. Timber structure complete 1887. Timber replace by concrete structure 1905 to 1908.

RESERVOIR

Cross Lake Reservoir Pine River Dam	Elevation in Feet	Area in Acres	Cumulative Storage in Acre-Feet
Maximum Operating Limit	1235.3	15,500	188,000
Normal Summer Pool Level	1229.32	13,600	101,000
Minimum Operating Limit	1225.32	12,500	49,100
Slide Gate Sill	1216.65	---	0

Maximum Pool Elevation (Historic) 1234.73 ft., 7 July 1916 event

Real Estate Taking Line for Easement 4 ft. above a 18.5 ft stage = Elev. 1238.82 ft.

Reservoir Length at Top of Summer Pool Level 8.4 miles

Shoreline Length at Top of Summer Pool Level 112.0 miles

HYDROLOGY

Drainage Area	562 square miles
One Inch of Runoff Equals	29,973 acre-feet
Storm Types	Thunderstorm, frontal rain, snow
Flood Season	15 March - June
Low Flow Season	July - October

Note: All inflows are based on 24-hour averages from reverse routing.

Minimum Mean Daily Inflow	Flow is very low during dry periods.
Minimum Mean Monthly Inflow	Flow is very low during dry periods.
Minimum Mean Annual Inflow	90 cfs, 1934
Maximum 24-hr. Average Inflow	3,710 cfs, 2 June 1898
Maximum Mean Monthly Inflow	1,660 cfs, May 1950
Maximum Mean Annual Inflow	550 cfs,1905
Average Annual Inflow	270 cfs, (Period 1898-1985)

HYDROLOGY (continued)

Maximum Flood Volume	157,000 ac.-ft., 15 April - 10 June, 1950
Type of Meteorological Data Recorded at Site	Rainfall, snowfall, temperature, cloud cover, wind, snowpack
Number of Sediment Ranges	None

EMBANKMENT AND DIKES

Embankment	
Type	Earthfill with timber diaphragm with sheet pile, concrete capped wall
Slope Protection	Riprap and grass; bituminous top (roadway)
Length	1,552 ft. (total left and right)
Height	23.9 feet
Minimum Top Elevation	1240.3 feet
Perimeter Dikes	
Number	16
Purpose	Impoundment
Slope Protection	Varies; grass, some riprap and bituminous top
Length	9,805 feet total
Height	Varies; generally <20 feet
Type	Compacted earthfill
Minimum Top Elevation	1240.3 feet

OUTLET STRUCTURE

Type	Gated multi-bay reinforced concrete control structure with concrete apron.
Structure Length Between Abutments	150 feet
Number/Size/Type of Gates	13 - 6.0 ft wide x 17.0 ft. high slide gates

OUTLET STRUCTURE (cont)

Gate Sill Elevation	1216.65 ft.(slide gate bays)

SPILLWAY

No Service or Emergency Spillways — Gated concrete sluiceway outlet facility only

SPILLWAY APRON

Type:	Concrete and timber
Length:	55 feet
Width (between abutments):	150 feet
Floor Elevation:	1216.65 feet

Basin Characteristics

Cross Lake Dam is located on the Pine River 14.5 miles upstream of its confluence with the Mississippi River (at river mile 1023.8 above the Ohio River). The confluence of the Pine and Mississippi Rivers is at 5.9 river miles above Black Bear and Miller Lakes and 22.3 river miles above Brainerd, Minnesota. Cross Lake reservoir (Pine River Dam) watershed is slow and significantly attenuated as a result of the relatively flat topography and the presence of many lakes and wetlands. Pine River Dam controls the runoff from a 562 square mile area, of which 42 percent is dry land, 24 percent is water, and 34 percent is wetlands. In general, the land not covered by wetlands is forested. The average overland slope is 48.05 feet per mile.

Pool Allocation

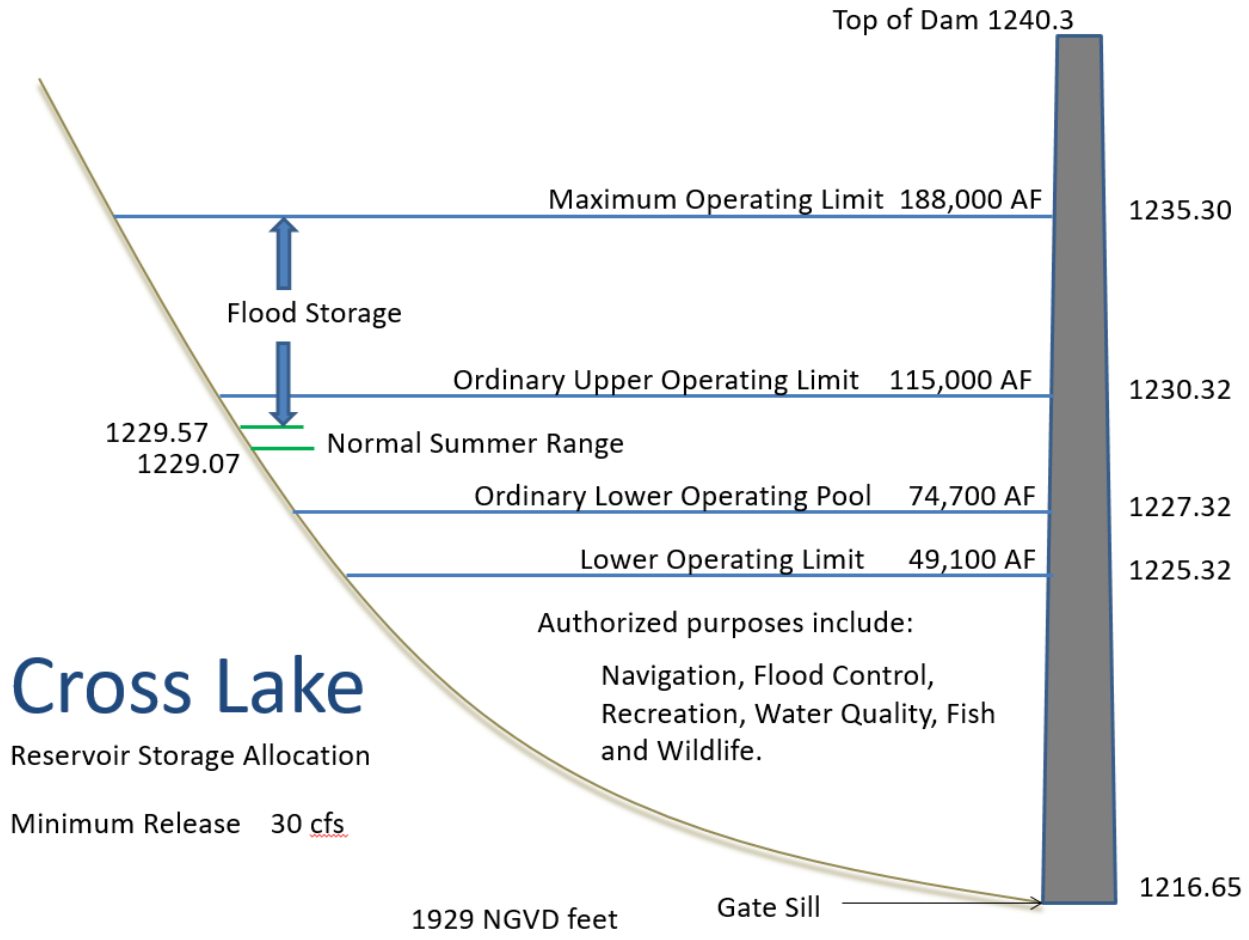


Figure 5. Pool allocations, Cross Lake.

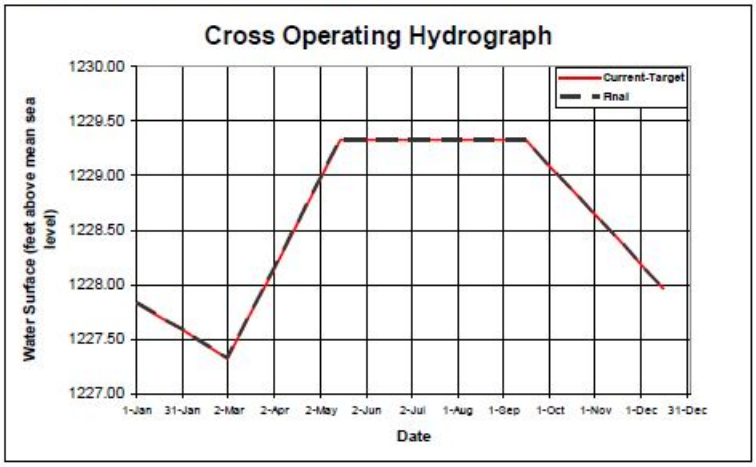
Overall Plan for Water Control

Cross Lake reservoir (Pine River Dam) is regulated between a minimum elevation of 1225.32 feet and a maximum elevation of 1235.30 feet (**Figure 5**). If possible, the reservoir level should be within its summer range/band of 1229.07 feet to 1229.57 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The ordinary (normal) spring drawdown elevation is 1227.32 feet, however the reservoir can be drawn down to 1225.32 feet if warranted by potential spring runoff conditions. Details of the water control plan are given in the following paragraphs. Significant shoreline erosion begins to occur at approximately elevation 1230.32 feet but storage to elevation 1235.30 feet can be used if needed to prevent flooding downstream. To promote whitefish spawning, the drawdown of the reservoir is coordinated with the Minnesota Department of Natural Resources

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-8 CROSS LAKE OPERATING RULES		
	CURRENT	FINAL
Summer Band (elev. - feet)	1229.07-1229.57	1229.07-1229.57
Summer Target (elev. - feet)	1229.32	1229.32
Band Width (feet)	0.5	0.5
Normal Drawdown (elev. - feet)	1227.32	1227.32
Maximum Drawdown (elev. - feet)	1225.32	1225.32
Rate of Release (change/day)	60 cfs or 0.25 ft. of TW change	20-30%
Spring Pulse	NA	500 cfs
Minimum Flow Requirements	>=(1225.32): 30 cfs	>=(1225.32): 30 cfs
	<(1225.32): 15 cfs	<(1225.32): 15 cfs

Figure S-6. Final Plan Operating Hydrograph, Cross Lake



Reservoir Summary: Gull Lake Project

Project General Objectives: The reservoir is regulated primarily for recreation, flood control and fish and wildlife. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife concerns. The lowflow plan manages water resources both upstream and downstream of the dam during critical periods.

Basin Map (Figure 6)

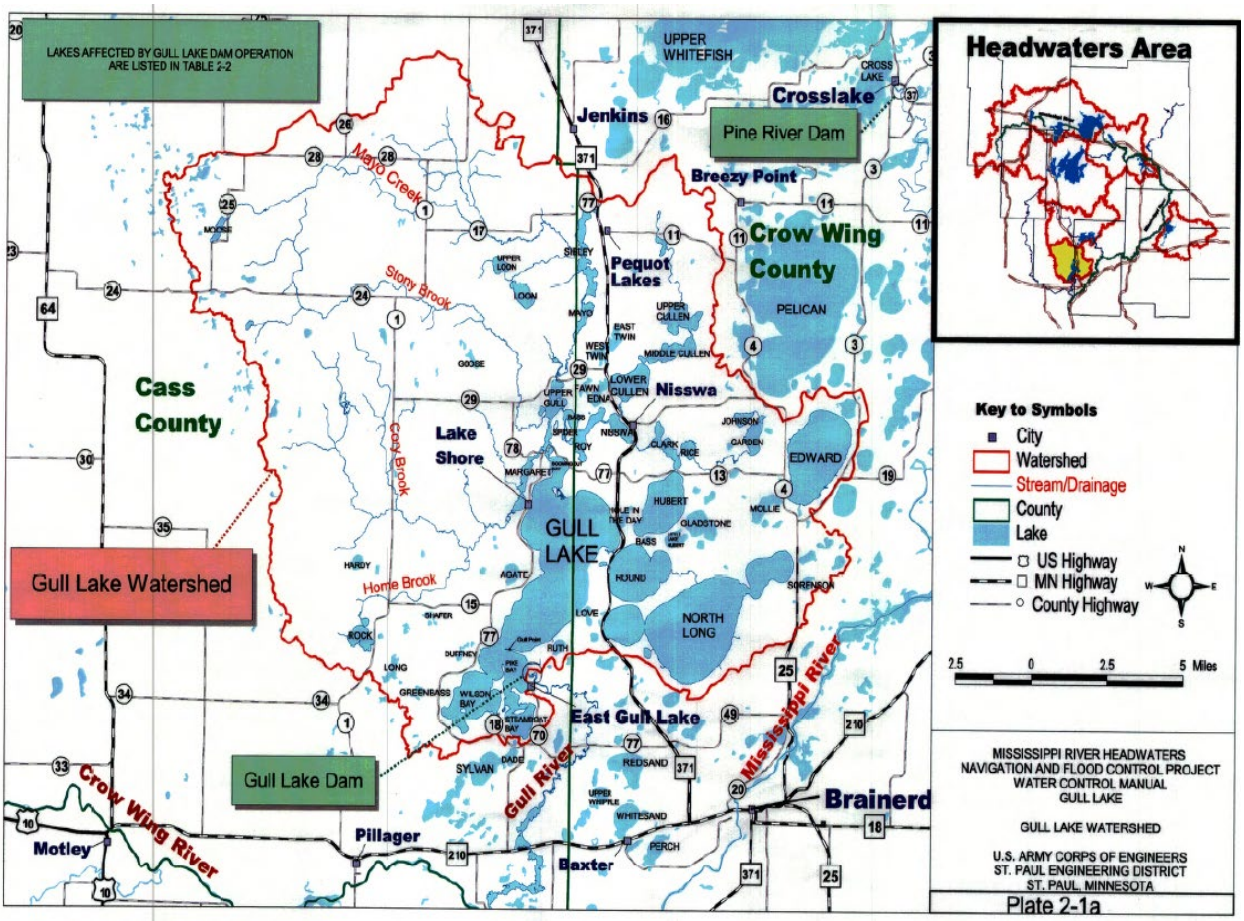


Figure 6. Project location map, Gull Lake.

Pertinent Data Sheet

Location — Gull Lake Dam is located at the outlet of Gull Lake on the Gull River, 11 miles upstream of its confluence with the Crow Wing River. This confluence is 16 miles upstream of its confluence of the Crow Wing and Mississippi River. The confluence with the Mississippi River is at river mile 990.4 above the Ohio River. The dam is in Cass County, 8 miles northwest of Brainerd, Minnesota. It is at Lat. 46° 24' 40", Long. 94° 21' 12", in Section 20, T134 N, R29 W.

Type of Project — Dam and Reservoir
Project Owner — U.S. Government, Department of the Army
Operating Agency — U.S. Army Corps of Engineers, St. Paul District
Regulating Agency — U.S. Army Corps of Engineers, St. Paul District.

Closure Dam — Dam discharge records begin 1 September 1911, concrete structure complete 1912. Some records for the logging dam at the outlet of Gull Lake are available back to September 1895.

Gull Lake	Elevation in Feet	Area in Acres	Cumulative Storage in Acre-Feet
Maximum Operating Limit	1194.75	13,100	71,000
Normal Summer Pool Level	1194.00	13,000	59,000
Minimum Operating Limit	1192.75	12,750	45,000
Sill	1188.75	---	0

Maximum Pool Elevation (Historic) — 1195.09 ft., 22 July 1952 event

Real Estate Taking Line for Easement — Elevation 1194.75 feet

Reservoir Length at Top of Summer Pool Level — 8.4 miles
Shoreline Length at Top Summer Pool Level — 35.6 miles

HYDROLOGY

Drainage Area — 287 square miles
One Inch of Runoff Equals — 15,307 acre-feet

OUTLET STRUCTURE

Type — Gated multi-bay concrete control structure

	with concrete apron
Structure Length Between Abutments	68.9 feet
Number/Size/Type of Gates	5 - 5.0 ft. wide x 4.0 ft. high slide gates 1 - 11.0 ft. wide stoplog bay (log sluice) (The 5.0 ft. wide fishway is blocked off.)
Entrance Invert Elevation	1188.75 feet
Top of Roadway Elevation (top of the curb)	1199.75 feet

Basin Characteristics

Gull Lake Dam is located on the Gull River 11 miles upstream of its confluence with the Crow Wing River. The confluence of the Crow Wing and the Mississippi Rivers (at river mile 990.4 above the Ohio River) is approximately 16 river miles downstream of the dam and 11.5 river miles downstream from Brainerd, Minnesota. Gull Lake Reservoir watershed is slow and significantly attenuated as a result of the relatively flat topography and the presence of many lakes and wetlands. Gull Lake Dam controls the runoff from a 287 square mile area, of which 54 percent is dry land, 23 percent is water, and 23 percent is wetlands. In general, the land not covered by wetlands is forested. The average overland slope is 58.08 feet per mile.

Pool Allocation

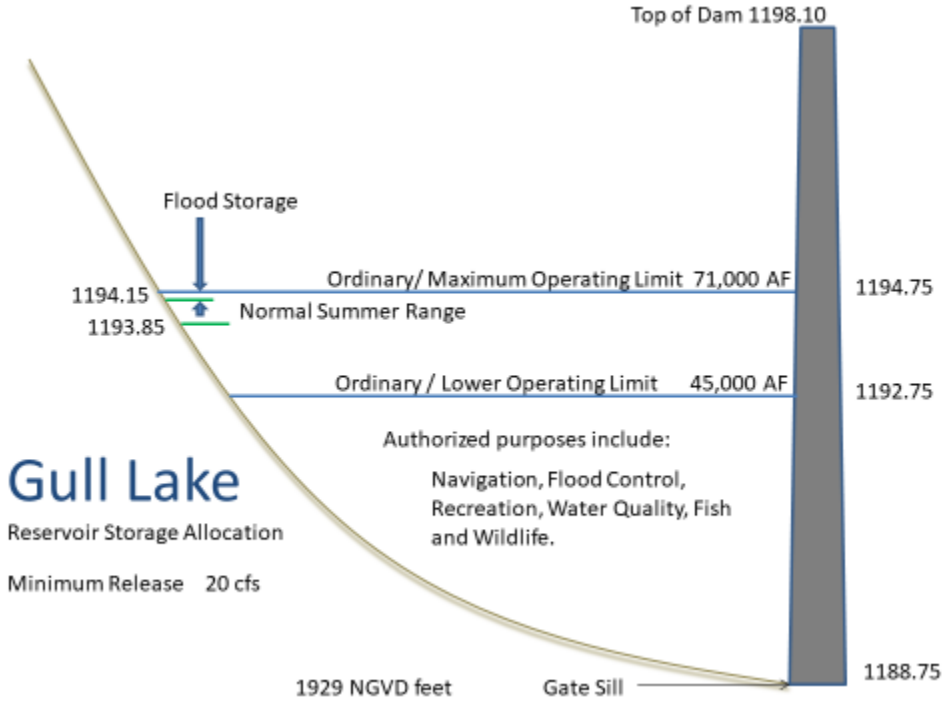


Figure 7. Pool allocations, Gull Lake.

Overall Plan for Water Control

Gull Lake reservoir is regulated between a minimum elevation of 1192.75 feet and a maximum elevation of 1194.75 feet (**Figure 7**). If possible, the reservoir level should be within its summer range/band of 1193.85 feet to 1194.15 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The ordinary (normal) spring drawdown elevation is 1192.75 feet, which is the lower operating limit of the reservoir.

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-9 GULL LAKE OPERATING RULES		
	CURRENT	FINAL
Summer Band (elev. - feet)	1193.75-1194.0	1193.85-1194.15
Summer Target (elev. - feet)	1193.87	1194.0 (May 1 – Sep 1)
Band Width (feet)	0.25	0.3
Normal Drawdown (elev. - feet)	1192.75	1193.0
Maximum Drawdown (elev. - feet)	1192.75	1192.75
Rate of Release (change/day)	20-30%	20-30%
Spring Pulse	NA	250 cfs
Minimum Flow Requirements	>=(1192.75): 20 cfs	>=(1192.75): 20 cfs
	<(1192.75): 10 cfs	<(1192.75): 10 cfs

TABLE S-10 Gull Late Summer Elevations			
	Current (feet)	Final (feet)	Difference (inches)
August 1	1193.87	1194.0	+1.56
September 1	1193.87	1194.0	+1.56
October 1	1193.87	1193.87	0

Note: The difference was calculated from the target in the current operating plan (1193.87), rather than the top of the band (1194).

Reservoir Summary: Leech Lake and Leech Lake Dam

Project General Objectives: The reservoir is regulated primarily for recreation, flood control, fish and wildlife and Tribal Trust. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife and Tribal Trust concerns. The low-flow plan manages water resources both upstream and downstream of the dam during critical periods.

Project Location Map (Figure 8):

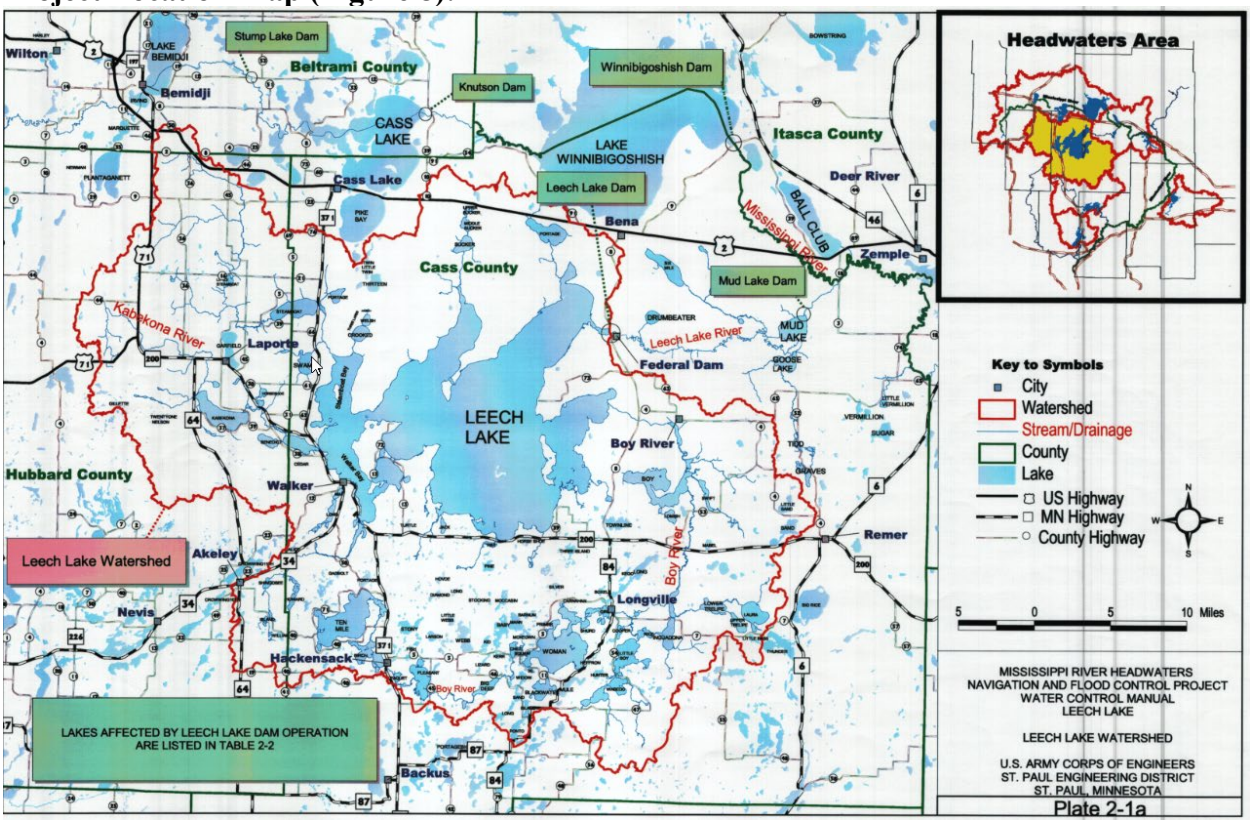


Figure 8. Project location map, Leech Lake.

Pertinent Data:
Datum = NGVD 29

Leech Lake	Elevation in Feet	Area in Acres	Cumulative Storage in Acre-Feet
Top of Control Structure	1299.54	174,500 (1)	1,233,300
Maximum Operating Limit	1297.90	161,000	1,037,000
Normal Summer Pool Level	1294.70	117,000	580,000
Minimum Operating Limit	1292.70	107,000	354,000
Gate Sill	1288.49	---	---
Stop Log Sill	1287.74	---	---
1. Extrapolated			

HYDROLOGY

Drainage Area	1,163 square miles
Storm Types	Thunderstorm, frontal rain, snow
Flood Season	March - June
Low Flow Season	July - October
Minimum Daily Inflow	Flow is very low during dry periods.
Minimum Mean Monthly Inflow	Flow is very low during dry periods.
Minimum Mean Annual Inflow	300 cfs, 1934
Maximum 24-hr. Average Inflow	20,600 cfs, 11 Oct 1973
Maximum Discharge	2,500 cfs, 7 June 1957 (result of dam failure)
Maximum Mean Monthly Inflow	3,940 cfs, May 1950
Maximum Mean Annual Inflow	1,100 cfs, 1985
Average Annual Inflow	720 cfs
Average Discharge	360 cfs (100 years of record)

Watershed Characteristics

Leech Lake Dam was built on the outlet of Leech, a very large lake draining into the Mississippi River headwaters. . The runoff from Leech Lake watershed is slow and significantly attenuated as a result of the relatively flat topography and the presence of many lakes and wetlands. Leech Lake Dam controls the runoff from a 1,163 square mile area, of which 65 percent is dry land, 10 percent is water, and 25 percent is wetlands. In general, the land not covered by wetlands is forested. The average overland slope is 6.9 feet per mile.

This geology along with a climate and pronounced spring snowmelt creates fairly consistent flows with the peak occurring from spring melt. **Figure 9** shows a duration hydrograph of the discharges from Leech Lake.

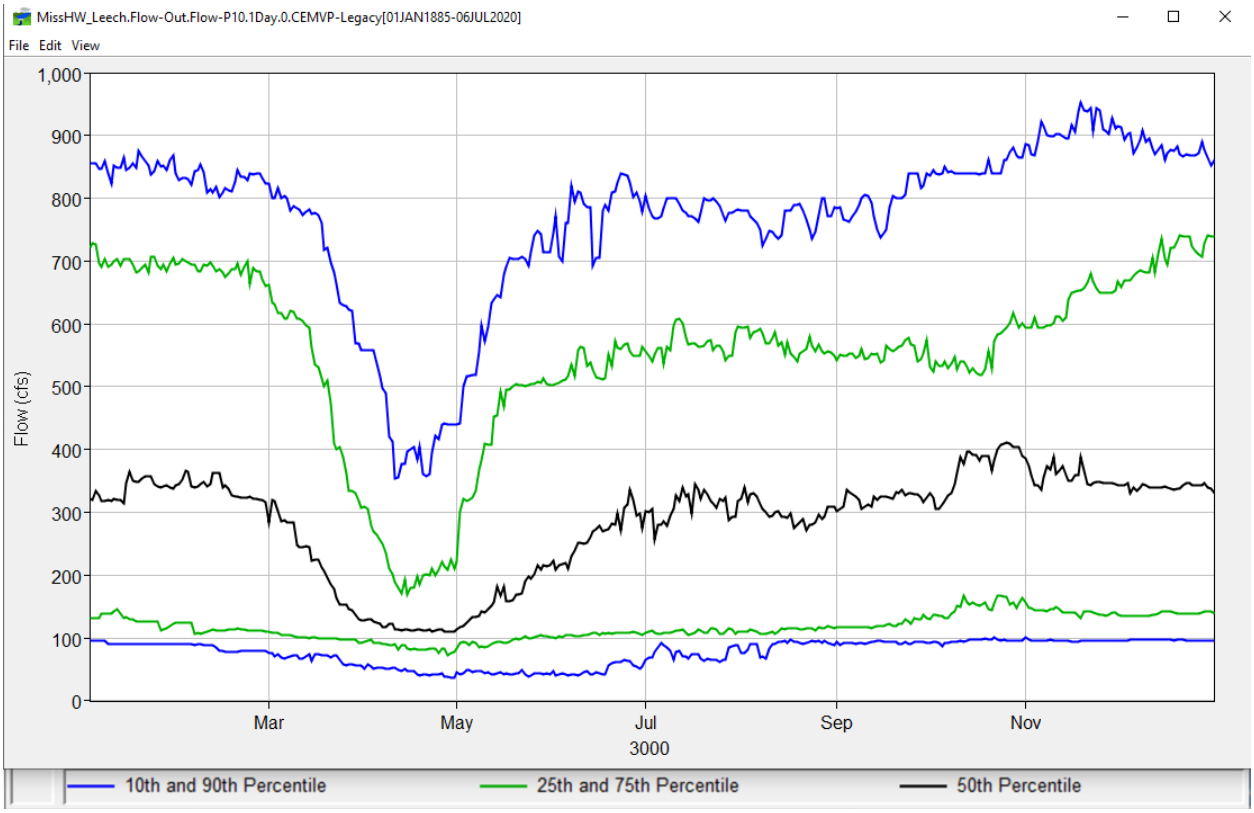


Figure 9. Duration hydrograph for Leech Lake discharges.

Pool Allocation

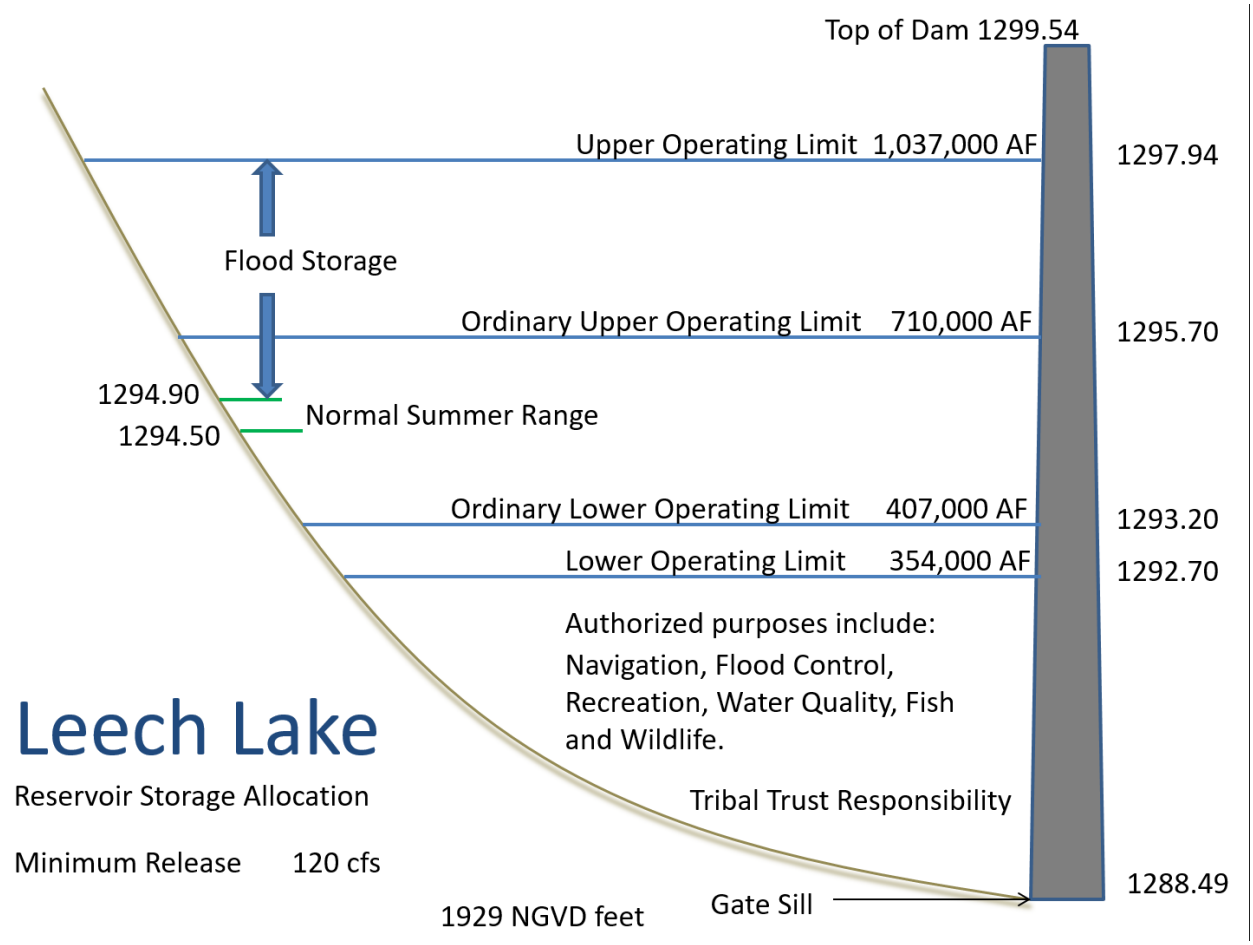


Figure 10. Pool allocations, Leech Lake.

Overall Plan for Water Control

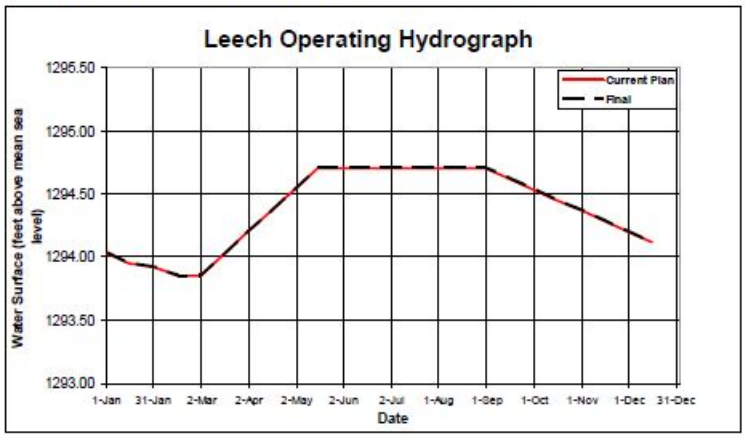
Leech Lake reservoir is regulated between a minimum elevation of 1292.70 feet and a maximum elevation of 1297.94 feet **(Figure 10**). If possible, the reservoir level should be within its summer range/band of 1294.50 feet to 1294.90 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The reservoir is usually drawn down to approximately elevation is 1293.80 feet, however the reservoir can be drawn down to 1292.70 feet if warranted by potential spring runoff conditions. Significant shoreline erosion begins to occur at approximately elevation 1295.70 feet but storage to elevation 1297.94 feet can be used if needed to prevent flooding downstream. Regardless of the season, the flood control operation is coordinated with Winnibigoshish and Pokegama reservoirs for flood control at Aitkin, MN and, if necessary, other downstream areas.

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-5
LEECH LAKE OPERATING RULES

	CURRENT	FINAL
Summer Band (elev. - feet)	1294.50-1294.90	1294.50-1294.90
Summer Target (elev. - feet)	1294.70	1294.70
Band Width (feet)	0.4	0.4
Normal Drawdown (elev. - feet)	1293.80	1293.80
Maximum Drawdown (elev. - feet)	1292.70	1292.70
Rate of Release (change/day)	100 cfs or 0.25 ft. of TW change	20-30%
Spring Pulse	NA	790 cfs
Minimum Flow Requirements	>=(1292.70): 100 cfs	>=(1292.70): 120 cfs
	<(1292.70): 50 cfs	<(1292.70): 60 cfs

Figure S-3. Final Plan Operating Hydrograph, Leech Lake



Reservoir Summary: Pokegama Lake and Pokegama Lake Dam

Project General Objectives: The reservoir is regulated primarily for recreation, flood control, fish and wildlife and Tribal Trust. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife and Tribal Trust concerns. The low-flow plan manages water resources both upstream and downstream of the dam during critical periods.

Project Location Map (Figure 11):

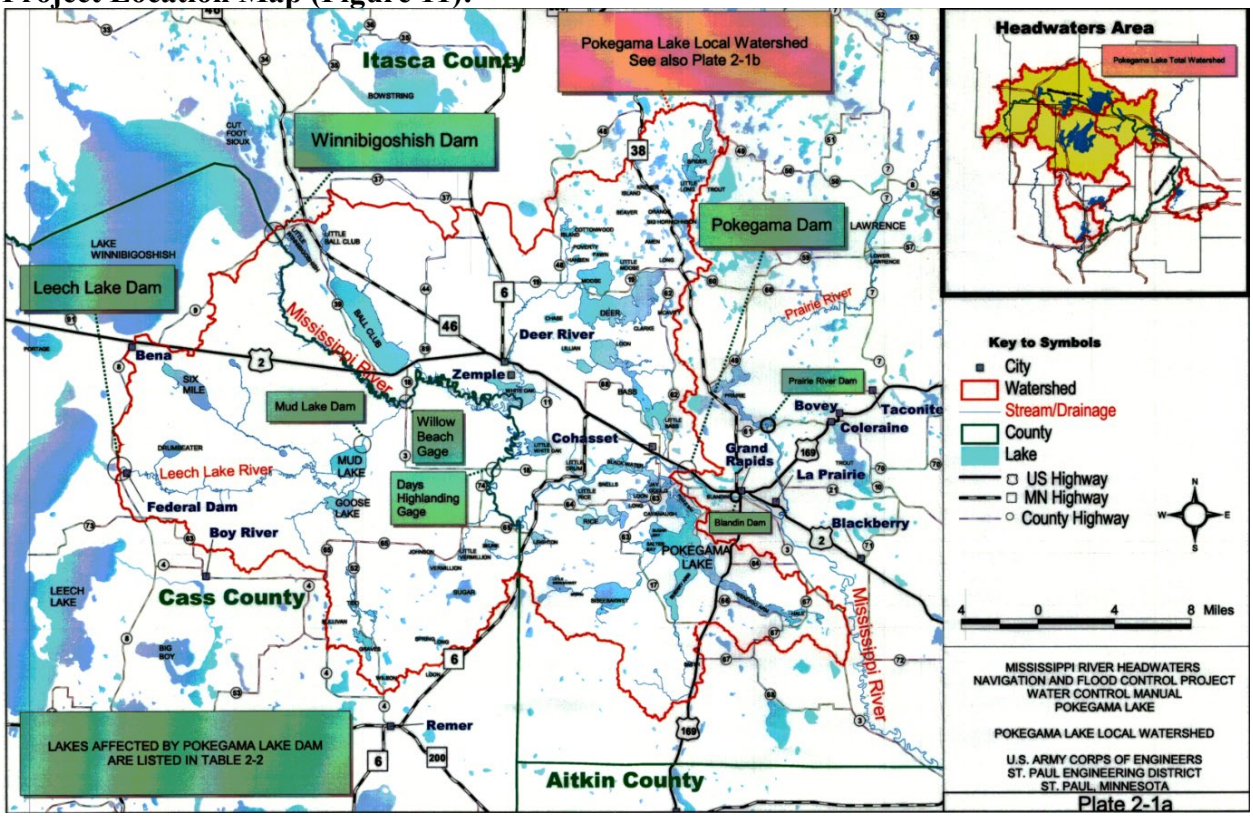


Figure 11. Project location map, Pokegama Lake.

Pertinent Data:
Datum = NGVD 29

Pokegama Lake	**Elevation in Feet**	**Area in Acres**	**Cumulative Storage in Acre-Feet**
Top of Control Structure	1278.42	24,800	203,000
Maximum Operating Limit	1278.42	23,200	158,000
Normal Summer Pool Level	1273.42	16,800	98,000
Minimum Operating Limit	1270.42	12,000	55,000
Sill	1264.42	---	0

HYDROLOGY

Drainage Area	3,265 square miles
One Inch of Runoff Equals	35,200 acre-feet
Storm Types	Thunderstorm, frontal rain, snow
Flood Season	March - June
Low Flow Season	July - October
Minimum Daily Inflow	Flow is very low during dry periods.
Minimum Mean Monthly Inflow	Flow is very low during dry periods.
Minimum Mean Annual Inflow	No flow at times
Maximum 24-hr. Average Inflow	8,480 cfs, 9 April 1952
Maximum Mean Monthly Inflow	4,570 cfs, April 1906
Maximum Mean Annual Inflow	2520 cfs, 1901
Average Annual Inflow	1,200 cfs
Average Discharge	1176 cfs (101 years of record)
1950 Flood Volume	281,000 acre-feet
Name and Location of Stream-Flow Station	Grand Rapids, Minnesota 3 miles downstream of dam
Typical Maximum Snowpack	15 - 31 March
Number of Sediment Ranges	None

Watershed Characteristics

Pokegama Dam was built on the outlet of Pokegama Lake, on the Mississippi River headwaters. The runoff from Pokegama Lake watershed is slow and significantly attenuated as a result of the relatively flat topography and the presence of many lakes and wetlands. There are 3,265 square miles of drainage area above Pokegama Dam. There are 660 square miles of local drainage area between Pokegama and the upstream reservoirs (Winnibigoshish and Leech) of which 64.5 percent is dry land, 8.5 percent is water, and 27 percent is wetlands. In general, the land not covered by wetlands is forested. The average overland slope is 5.6 feet per mile. A very large portion of the inflow to Pokegama reservoir following a precipitation or snowmelt event comes from discharges from Winnibigoshish and Leech Lake Dams. Discharges from those two dams generally take 30 to 36 hours to reach Pokegama reservoir. A significant portion of the local area is non-contributing.

This geology along with a climate and pronounced spring snowmelt creates fairly consistent flows with the peak occurring from spring melt. **Figure 12** shows a duration hydrograph of the discharges from the Mississippi River at Grand Rapids located 3 miles downstream of Pokegama Dam.

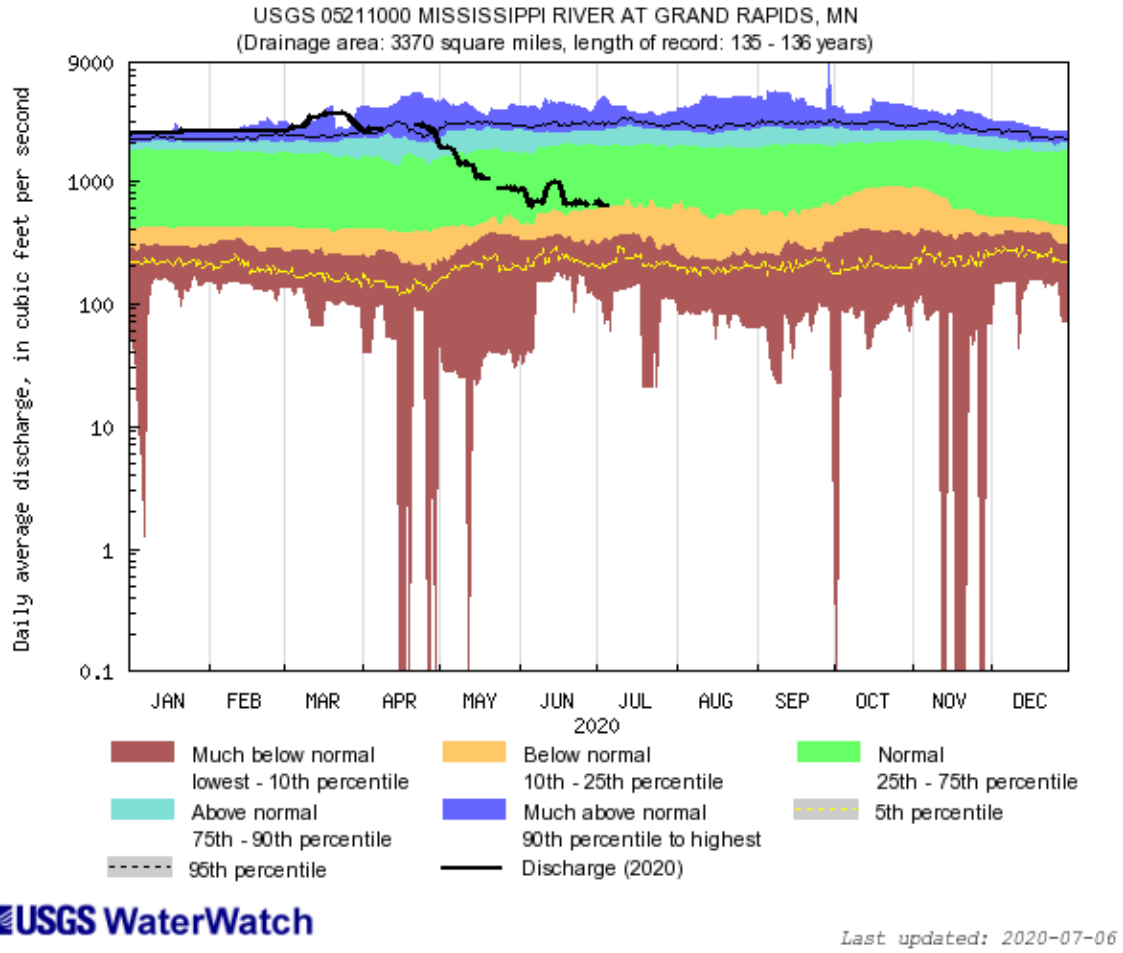


Figure 12. Duration hydrograph for Pokegama Lake discharges.

Pool Allocation

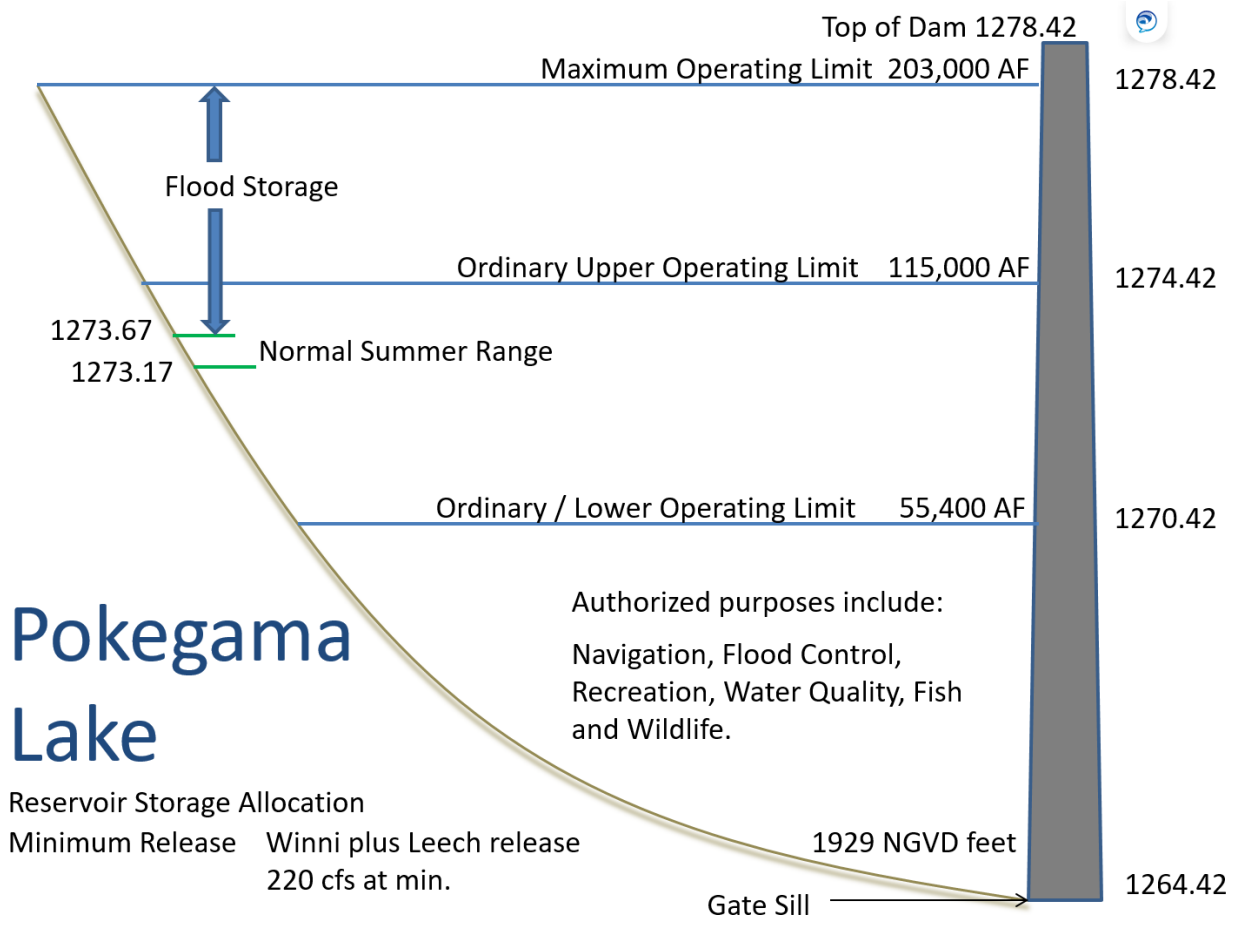


Figure 13. Pool allocations, Pokegama Lake.

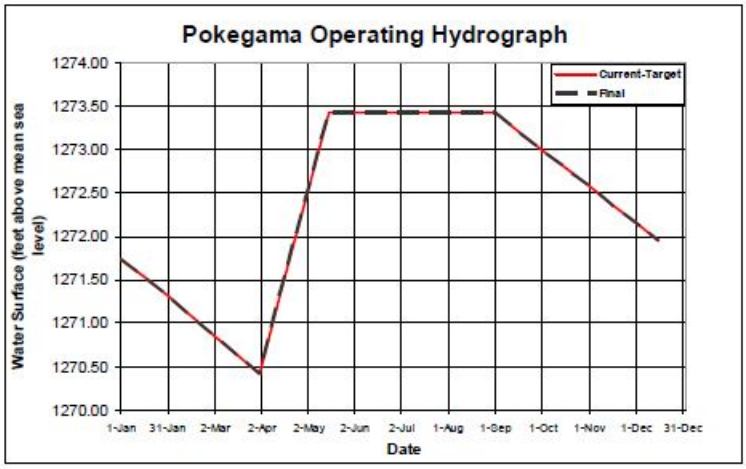
Overall Plan for Water Control

Pokegama Lake reservoir is regulated between a minimum elevation of 1270.42 feet and a maximum elevation of 1278.42 feet (**Figure 13**). If possible, the reservoir level should be within its summer range/band of 1273.17 feet to 1273.67 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The ordinary (normal) spring drawdown elevation is 1270.42 feet, which is the lower operating limit of the reservoir. Significant shoreline erosion begins to occur at approximately elevation 1274.42 feet but storage to elevation 1278.42 feet can be used if needed to prevent flooding downstream. Regardless of the season, the flood control operation is coordinated with Winnibigoshish and Leech reservoirs for flood control at Aitkin, MN and, if necessary, other downstream areas.

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-6 POKEGAMA LAKE OPERATING RULES		
	CURRENT	FINAL
Summer Band (elev. - feet)	1273.17-1273.67	1273.17-1273.67
Summer Target (elev. - feet)	1273.42	1273.42
Band Width (feet)	0.5	0.5
Normal Drawdown (elev. - feet)	1270.42	1270.42
Maximum Drawdown (elev. - feet)	1270.42	1270.42
Rate of Release (change/day)	20-30%	20-30%
Spring Pulse	NA	2410 cfs
Minimum Flow Requirements	>=(1273.17): 200 cfs	>=(1273.17): 200 cfs
	<(1273.17): Winni + Leech	<(1273.17): Winni + Leech

Figure S-4. Final Plan Operating Hydrograph, Pokegama Lake



Reservoir Summary: Lake Winnibigoshish and Lake Winnibigoshish Dam

Project General Objectives: The reservoir is regulated primarily for recreation, flood control, fish and wildlife and Tribal Trust. The Water Control Plan supports recreation by maintaining, when possible, stable reservoir levels within a specified elevation band during the summer. Flood control objectives are met by a fall/winter drawdown schedule and a designated flood control storage pool, which provides storage capacity for spring and summer flood events. Water levels are managed, when conditions permit, for various fish and wildlife and Tribal Trust concerns. The low-flow plan manages water resources both upstream and downstream of the dam during critical periods

Project Location Map (Figure 14):

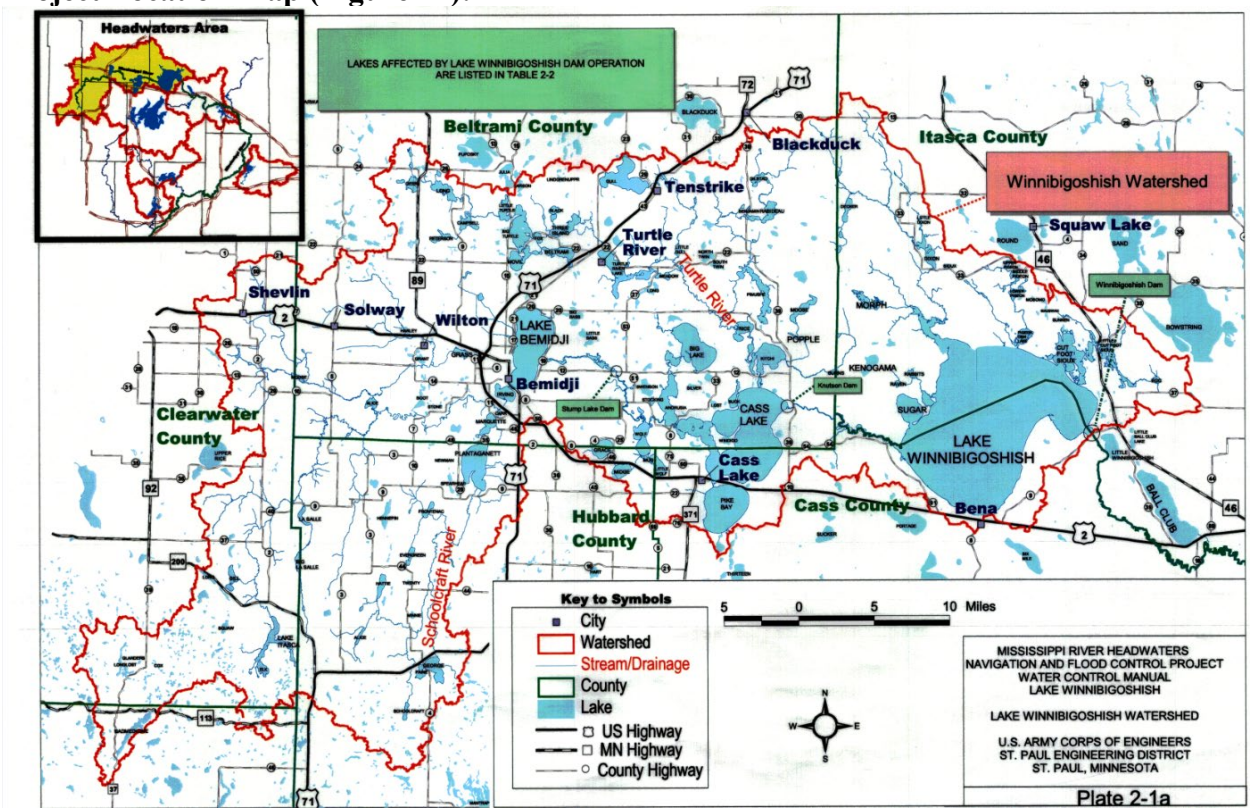


Figure 14. Project location map, Lake Winnibigoshish.

Pertinent Data:
Datum = NGVD 29

Lake Winnibigoshish	Elevation in Feet	Area in Acres	Cumulative Storage in Acre-Feet
Top of Control Structure	1304.36	121,000	1,240,000
Maximum Operating Limit	1303.14	115,000	1,114,000
Normal Summer Pool Level	1298.19	66,000	700,000
Minimum Operating Limit	1294.94	57,000	500,000
Gate Sill	1285.22	---	0

HYDROLOGY

Drainage Area	1,442 square miles
One Inch of Runoff Equals	76,907 acre-feet
Storm Types	Thunderstorm, frontal rain, snow
Flood Season	15 March - June
Low Flow Season	July - October
Minimum Daily Inflow	Flow is very low during dry periods.
Minimum Mean Monthly Inflow	Flow is very low during dry periods.
Minimum Mean Annual Inflow	210 cfs, 1934
Maximum 24-hr. Average Inflow	9,200 cfs, 29 July 1905
Maximum Mean Monthly Inflow	5,540 cfs, Oct 1900
Maximum Mean Annual Inflow	1,660 cfs, 1905
Average Discharge	520 cfs (100 years of record)
Average Annual Inflow	720 cfs
1950 Flood Volume	355,600 acre-feet

Watershed Characteristics

Lake Winnibigoshish Dam was built on the outlet of Cass Lake, a very large freshwater lake on the Mississippi River headwaters. Much of the drainage area is wooded with marsh land.

This geology along with a climate and pronounced spring snowmelt creates fairly consistent flows with the peak occurring from spring melt. **Figure 15** shows a duration hydrograph of the discharges from Lake Winnibigoshish Dam.

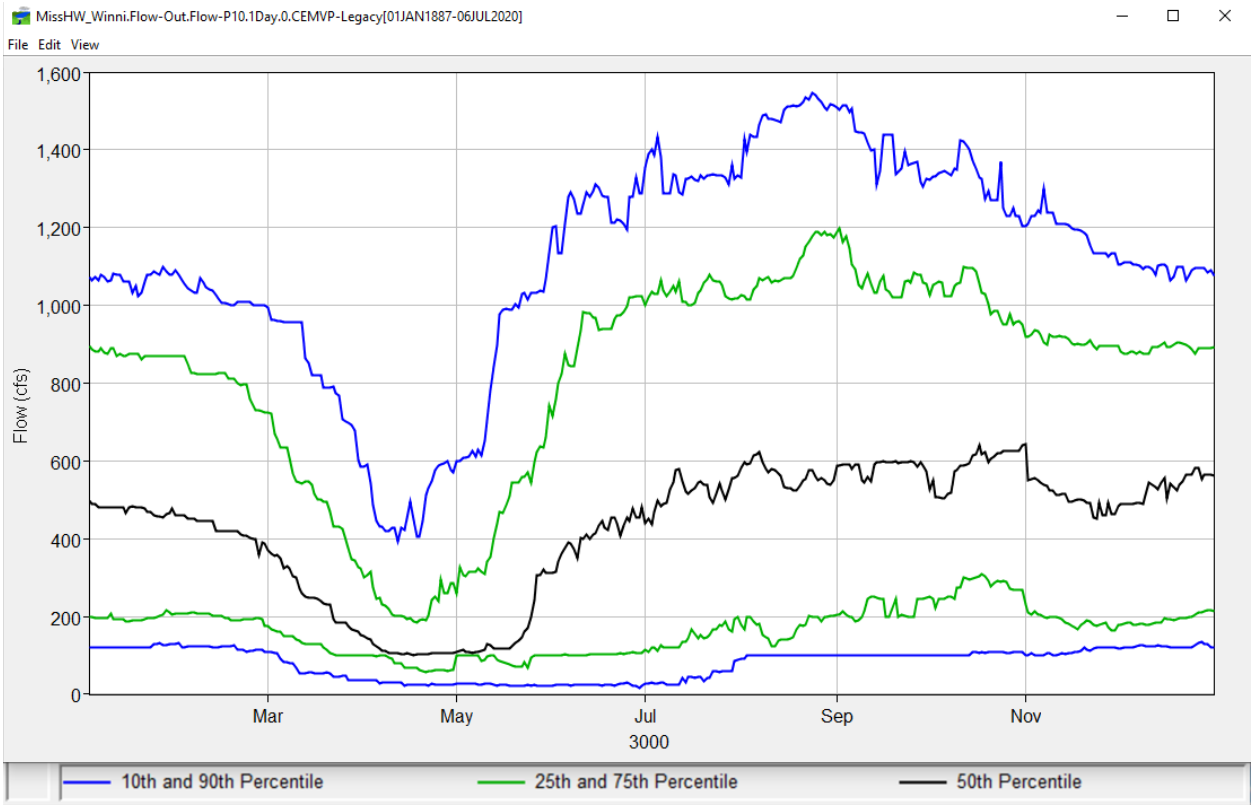


Figure 15. Duration hydrograph for Lake Winnibigoshish Dam discharges.

Pool Allocation

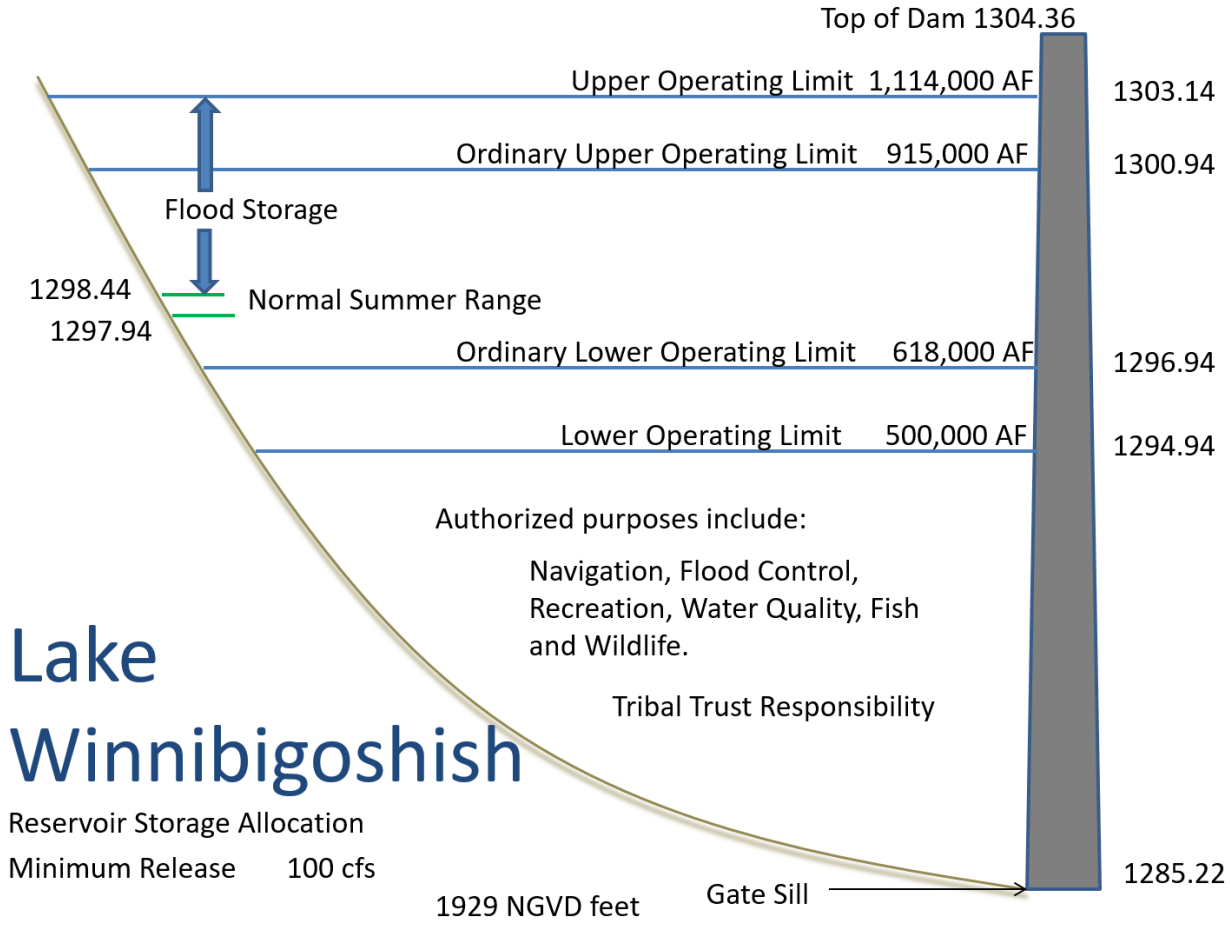


Figure 16. Pool allocations, Lake Winnibigoshish.

Overall Plan for Water Control

Lake Winnibigoshish reservoir is regulated between a minimum elevation of 1294.94 feet and a maximum elevation of 1303.14 feet (**Figure 16**). If possible, the reservoir level should be within its summer range/band of 1297.94 feet to 1298.44 feet by the first day of the fishing season (approx. mid-May). The winter drawdown of the reservoir for spring flood control begins in the fall. The ordinary (normal) spring drawdown elevation is 1296.94 feet, however the reservoir can be drawn down to 1294.94 feet if warranted by potential spring runoff conditions. The overflow spillways at Knutson Dam are inundated approximately elevation 1301.5 feet; however, storage in Winnibigoshish to elevation 1303.14 feet can be used if needed to prevent flooding downstream. Regardless of the season, the flood control operation is coordinated with Leech and Pokegama reservoirs for flood control at Aitkin, MN and, if necessary, other downstream areas. To promote walleye spawning, the reservoir has a target elevation range of 1297.44 to 1297.75 feet during 18 to 25 April (1297.75 ft. is optimal).

The Water Control Manuals (WCM) are in the process of being updated with the findings of the 2009 Reservoir Operating Plan Evaluation (ROPE) Study. The table below summarizes reservoir operation for both the WCM and ROPE parameters.

TABLE S-4
LAKE WINNIBIGOSHISH OPERATING RULES

	CURRENT	FINAL
Summer Band (elev. - feet)	1297.94 -1298.44	1297.94 -1298.44
Summer Target (elev. - feet)	1298.19	1298.19
Band Width (feet)	0.5	0.5
Normal Drawdown (elev. - feet)	1296.94	1296.94
Maximum Drawdown (elev. - feet)	1294.94	1294.94
Rate of Release (change/day)	200 cfs or 0.5 ft. of TW change	20-30%
Spring Pulse	NA	1060 cfs
Minimum Flow Requirements	>=(1294.94): 100 cfs	>=(1294.94): 100 cfs
	<(1294.94): 50 cfs	<(1294.94): 50 cfs

Figure S-2. Final Plan Operating Hydrograph, Lake Winnibigoshish