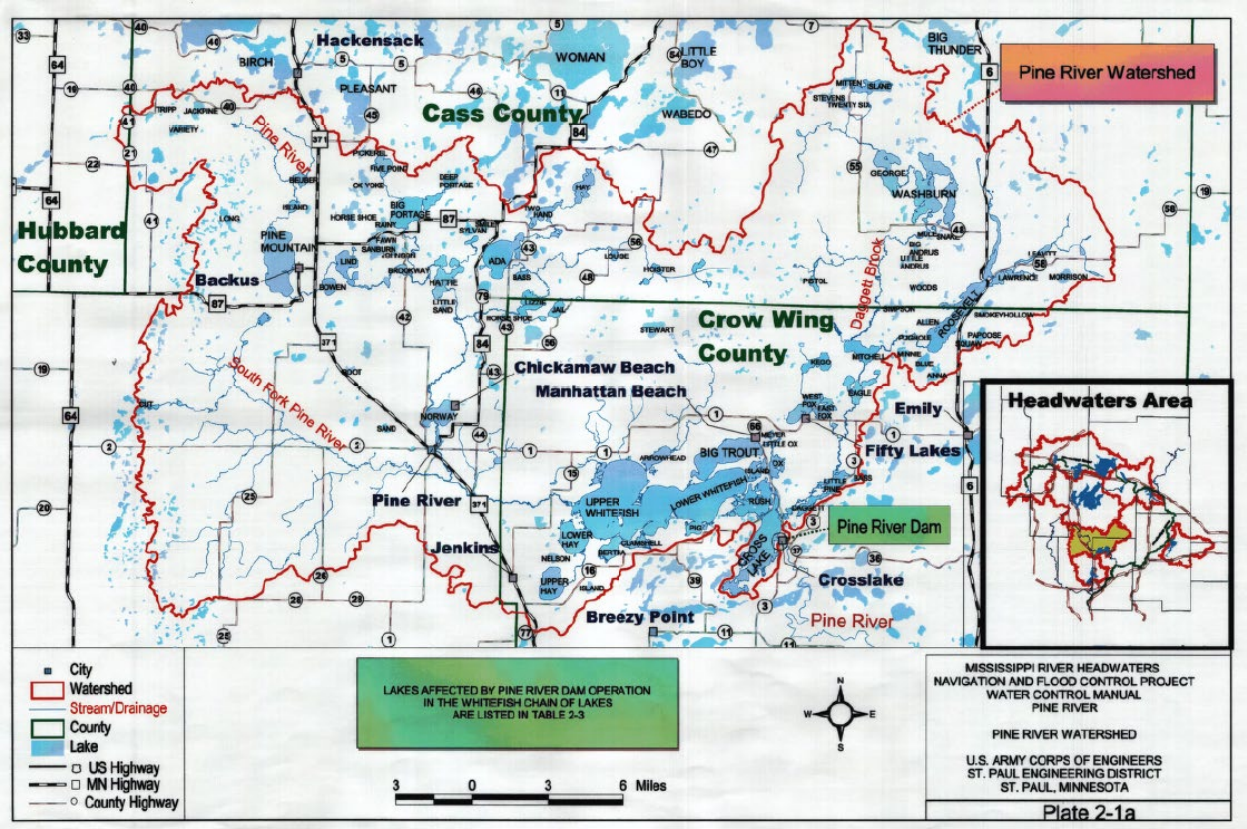
Reservoir Summary: Cross Lake Project

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



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

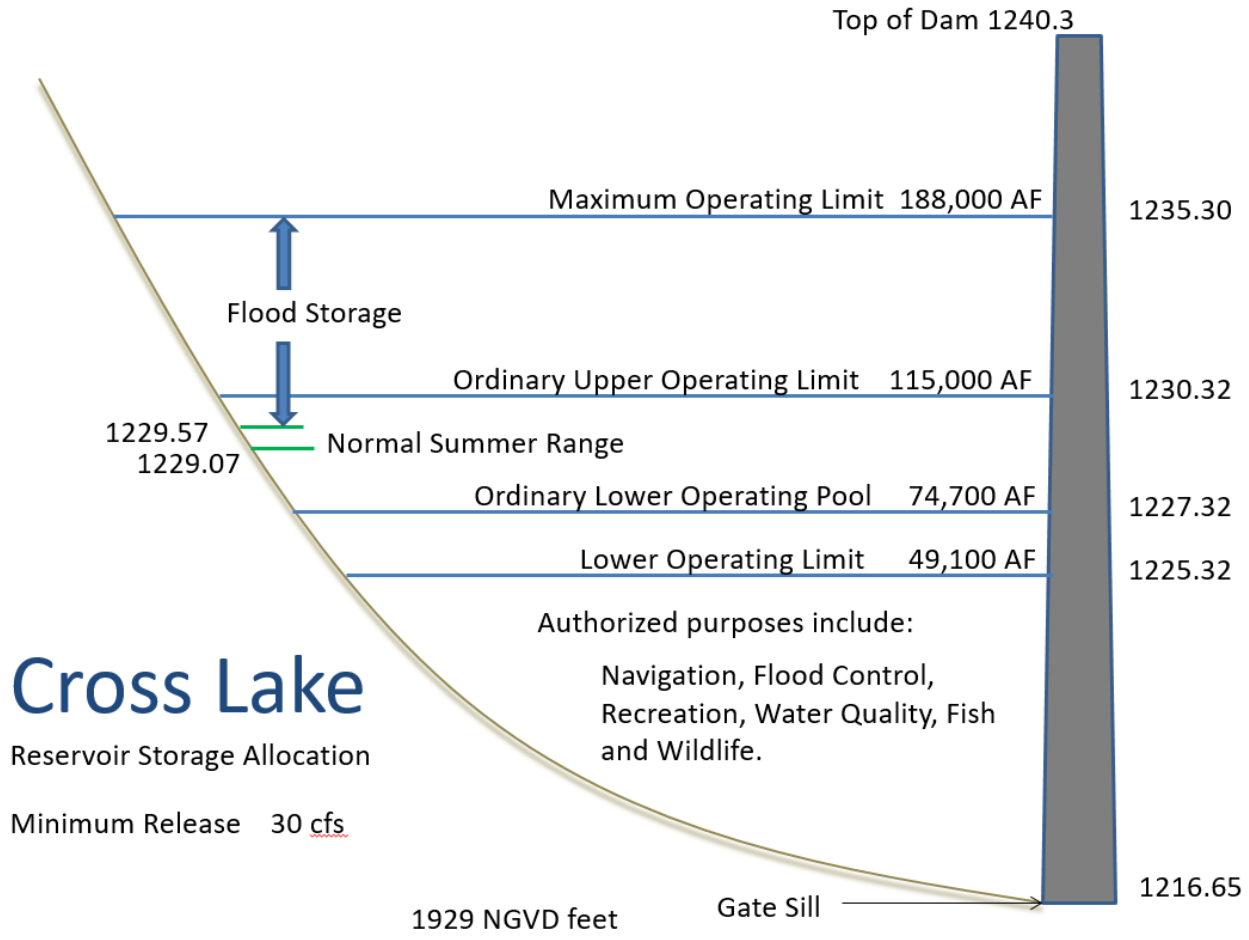
SPILLWAY APRON

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



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. 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