C.2. Lake Warren Dam (State Dam #D005004)

Figure C-6 - Lake Warren Dam spillway from downstream (7/17/2017) and the pond drain structure with the spillway in the background (9/13/2019)

C.2.1. Introduction

Lake Warren Dam on Pine Cliff Road in Alstead, NH is an Affected Dam. This dam management plan is part of the Cold River Instream Flow Water Management Plan and is required for every Affected Dam in the Cold River WMPA.

New Hampshire Department of Environmental Services (NHDES) prepared this Dam Management Plan in consultation with the Alstead Select Board, the Alstead Road Agent, the Alstead Conservation Commission, Mill Hollow Heritage Association, and the Lake Warren Association.

The Town of Alstead owns and operates the Lake Warren Dam. This dam management plan describes actions to be taken by the Town of Alstead when certain specified low flow conditions occur. Dam management is applied in the form of relief pulses from one or more dams when Catastrophic Events occur on the Cold River. Catastrophic Events are described in the Protected Instream Flow Study Report – Cold River and in the Cold River Instream Flow Water Management Plan.

The Lake Warren Dam impounds the great pond named Lake Warren located in Alstead, NH. Lake Warren is a natural lake expanded by a dam to impound 200.3 acres at the normal full pool. NHDES Dam Bureau (Dam Bureau) identifies the Warren Lake Dam as D#005004 (formerly 005.04). The National Dam Registry identifies the dam as NH00008. The Dam Bureau lists the dam's hazard classification as a Significant Hazard Dam. A dam has a significant hazard potential because it is in a location and of a size that failure or misoperation of the dam would probably result in no loss of lives; but possibly major economic loss to structures or property; structural damage to roads; major environmental or public health losses, including public water systems, release of wastes, or non-reversible environmental damage.

Lake Warren Dam is a municipal dam owned by the Town of Alstead, who accepted the dam from the owner in 2006. The dam is active and is used primarily for recreation. The Lake Warren Association was formed, in part, to preserve Lake Warren and its environments. There is a boat ramp at the northwest end of the lake. Skicraft were banned from the lake in 1998. The New Hampshire Fish and Game

Department describe the fishery as warmwater. Fish and Game Department stocks 1090 trout in the lake each spring. The dam raised the natural pond level approximately 6 feet. The average depth of the lake is 7.2 feet with a maximum depth of 13.8 feet. The dam impounds 1,182 acre-feet when it is full, and the water level is at the spillway crest.

Lake Warren has a watershed area of 4.88 square miles. The outlet to Lake Warren is Warren Brook, which flows 4.2 miles from the Lake Warren Dam to the Cold River. Warren Brook enters the Cold River 6.5 miles upstream of the confluence with the Connecticut River and 0.6 miles upstream of the USGS gage at Alstead.

Chases Mill Dam (NH Dam #0001003, aka Mills Hollow Dam) is on Warren Brook between Warren Lake Dam and the Cold River. Chases Mill Dam is 0.15 miles downstream of Lake Warren but only has a small amount of permanent storage, about 1.48 acre-feet (64,469 cubic feet). It was usually kept nearly full during 2022 but was occasionally refilled by brief releases from Lake Warren to top off their impoundment.

Figure C-7 - Lake Warren and the location of the Lake Warren Dam at the northwest end of the lake

C.2.2. Dam Design

The dam was constructed in 1771 to impound water for public use and to provide power to downstream mills. Features of the dam can be seen in ***Figure C-6***, ***Figure C-8*** and ***Figure C-9***. ***Figure C-7*** shows an aerial view of Lake Warren and the location of its dam. ***Table C-10*** contains values for the dam's characteristics. The dam consists of a 170-foot-long earth and stone embankment with a wide, concrete apron weir spillway that is 29 feet long. The spillway is set into the embankment between concrete abutments that extend down 2.5 feet from the top of the embankment to the spillway. The height of the dam is 10 feet from the top of the embankment to the dam's toe.

Survey plans (Fellows, 1992) in the Dam Bureau's files show the spillway height is 1,197 feet in elevation, although there is a discrepancy with a painted board on the dam saying the spillway elevation is 1,198.8 feet. The elevations from the survey plans will be used for elevations in this report.

A pond drain (marked as "gate" in Figure C-8) is to the left of the spillway. The drain is controlled by 2-inch-wide boards of various heights in a 24-inch wide, stoplog bay. Behind the boards, a 7.5-foot deep (bottom at 1,191.5 feet elevation) 4-foot by 4-foot sump drains to a 2-foot diameter pipe set that feeds out to Warren Brook immediately downstream of the spillway. The bottom of the sump is at an elevation of 1,191.5 feet. The stoplogs are set above the spillway height at an elevation about 1,197.5 feet.

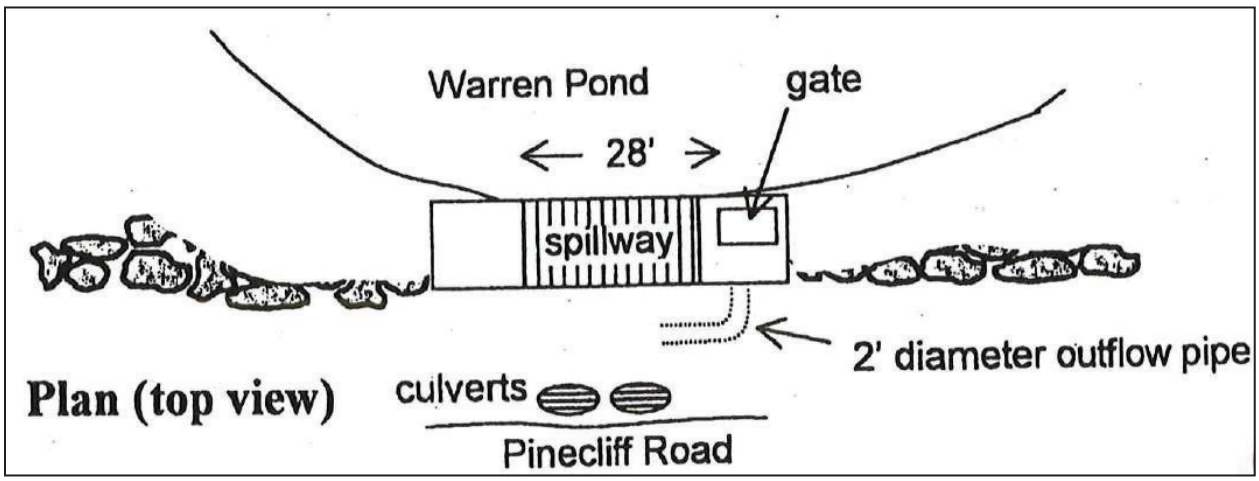

Figure C-8 - Plan view map of the Lake Warren dam showing the spillway and stoplog bay (identified as "gate").
Note there is only one culvert under Pine Cliff Road, the spillway is 29 feet wide, and the gate has been replaced with stoplogs.

C.2.2.1. Annual Operational Schedule

The lake level is controlled by a concrete spillway and by a pond drain controlled by boards acting as stoplogs that are rarely operated. When the lake is below the level of the spillway, there is no flow from the dam other than leakage. The stoplogs remain in place through the year except for occasional summer through fall operations related to an agreement with Mill Hollow Heritage Association to release water to fill the Chases Mill impoundment for mill demonstration purposes. An Operation, Maintenance and Response Form filed with the Dam Bureau on November 30, 2011 says that the town visually monitors the impoundment level each week. When heavy rains occur, monitoring is more frequent. If the water flow is high, boards are taken out of the pond drain. There is also an Emergency Action Plan dated August 2, 2004.

In 2022, NHDES installed a temporary water depth device (logger) in Lake Warren near the dam from May 18 through October 19. The purpose was to observe the daily and seasonal water level changes for that year. Half hour measurements were recorded.

Figure C-9 - Photo dated 11/7/2000 of the pond drain at the left end of the Lake Warren Dam showing the boards that control flow through the pond drain.

C.2.2.2. Contractual Obligations, Minimum Flow Requirements and Flowage Rights

The Town of Alstead has agreed to a request from Mill Hollow Heritage Association for occasional releases of water from Lake Warren. Chase's Mill (aka Mill Hollow Dam) is located at 801 Forest Road, East Alstead, New Hampshire, on Warren Brook, few hundred feet downstream of the Lake Warren Dam. Under the agreement, the Lake Warren Dam will release water under certain circumstances for the demonstration of waterpower technology at Chase's Mill as part of its educational mission. Releases need a selectperson present. According to the agreement dated 2022, no more water will be released once lake level drops three inches below the Lake Warren Dam spillway. Operations during 2022 showed that small releases from Lake Warren to Chases Mill lasted about a half hour and were used to top off the partially full Chase's Mill Impoundment. According to Alstead selectmen (McCarty, 2023), there are no minimum flow requirements, flowage rights or other agreements or obligations on the Lake Warren operations.

C.2.3. Potential Water Available for Release to Maintain Protected Instream Flows

Lake Warren's surface area at the full lake level is 200.3 acres. The lake is considered full when the water level is at the height of the spillway. The top inch of water when the is full holds 727,089 cubic feet of water. A relief pulse that would lower the lake level one inch is equivalent to 4.2 cfs if applied for 48 hours. The volume in the top two feet of the lake at full pool is estimated at 17 million cubic feet. ***Table C-6*** shows the estimated lake level decline over a range of hypothetical relief pulse rates applied for 48

hours. These estimates of water level change are based on the full lake's surface area, regardless of lake level decline or inflow rate. Outflow would dwindle as the lake level declines multiple inches because the area of the outlet is reduced. A relief pulse would be progressively less effective in providing the starting flow rate as the lake level falls during a 48-hour period. Also, the lake's surface area is reduced somewhat as the lake level declines such that the volume of outflow will be less per inch at successively lower lake levels.

Lake Warren's outlet has flexible operability for generating a range of relief pulses. Boards acting as stoplogs in a stoplog bay control Lake Warren's outflow through the pond drain when the lake level is below the spillway. The stoplogs extend from above the lake level to about 5.5 feet below the lake level to the bottom of the sump. Removing the stoplog boards at the lower levels may be limited by leaves and lake bottom sediment in front of the stoplogs, but removing between two and three feet of stoplog boards is easily achieved.

The availability of water from Lake Warren may be affected by natural water level changes. NHDES measured the lake level during the summer of 2022 from May 18 to October 19, and much of this period was abnormally dry to moderate drought conditions in the Cold River Watershed. However, no Critical nor Rare Catastrophic Events occurred that would have prompted dam management. Therefore, lake levels were not as low as might be expected under management conditions. During this time, lake levels ranged 0.58 feet (6.9 inches), going from 0.34 feet (4.1 inches) above to 0.24 feet (2.9 inches) below the lake level recorded on August 9, 2022. The record also shows the lake rose and fell on a daily cycle due to inflows from the watershed and losses due to evaporation, commonly by about 0.6 inches.

During a brief release test on August 9, 2022, stoplogs were removed such that downstream flow was increased by 4.5 cfs for 45 minutes and increased by 16.3 cfs over the starting flow for 75 minutes, with an average of 11.8 cfs over two hours. The first rate was achieved by removing boards to leave a water column of 0.85 feet below the lake level. The 16.3 cfs increase was reached by removing 1.8 feet of stoplogs below the lake level. Increasing amounts of flow may be released by removing additional stoplogs. To release a specific flow volume, given a variable starting lake level, a variety of stoplog sizes may be necessary to create the appropriate water column height. During the release test, the pipe that drains the sump behind the stoplogs was a little more than half full and was not a limiting factor at this flow rate.

Lake level change during the release test was observed from records from the logger in the lake. During the August 9, 2022 release test, the lake level did not change from beginning to end. Inflow to the lake maintained the lake level instead of falling, therefore inflow to the lake was approximately equal to the 11.8 cfs being released.

To understand the potential impact of a full relief pulse, NHDES estimated the lake level change that would be caused by releasing water for 48 hours. Calculating the change in lake level resulting from continuing a relief pulse at 16.3 cfs requires ignoring the reduction of surface area from lake level decline, inflow from the lake's tributaries and evaporative losses on the lake surface. However, ignoring these factors, NHDES calculated a that a 16.3 cfs relief pulse continued for 48 hours would result in a lake level change of 0.32 feet (3.9 inches).

Table C-6 - Estimated water level change in Lake Warren at certain relief pulse rates for 48 hours (Estimates based on lake's surface area)

Release rate at Lake Warren (cfs)	Volume change (cubic feet)	Water level change (ft)	Water level change (inches)
2	345,600	0.040	0.48
3	518,400	0.059	0.71
4	691,200	0.079	0.95
5	864,000	0.099	1.19
6	1,036,800	0.119	1.43
7	1,209,600	0.139	1.66
8	1,382,400	0.158	1.90
9	1,555,200	0.178	2.14
10	1,728,000	0.198	2.38
11	1,900,800	0.218	2.61
12	2,073,600	0.238	2.85
13	2,246,400	0.257	3.09
14	2,419,200	0.277	3.33
15	2,592,000	0.297	3.56
16	2,764,800	0.317	3.80
17	2,937,600	0.337	4.04
18	3,110,400	0.356	4.28
19	3,283,200	0.376	4.52
20	3,456,000	0.396	4.75

C.2.3.1. Potential Impacts of Storage and Release for Relief Flows

NHDES has identified possible impacts from managing Lake Warren for instream flow protection. Water level changes may affect the ecology and the enjoyment of the lake if not carefully managed. Conditions related to the lake level, to harmful aquatic plants in Lake Warren, to flow on the Cold River and to downstream structures resulting from relief pulses are considered below.

Managing dams for relief pulses may involve raising the water level for storage or lowering the level during relief pulses. One common management action is to store additional water in the lake to allow for relief flows to meet instream flow requirements. Lake Warren has very little capacity for storing additional water. The stoplogs in the dam's outlet are already kept above the spillway level, so all inflow is being captured until the lake level is above the spillway. Above that level, water flows downstream by the spillway.

Storing additional water for relief pulses (by adding more stoplogs on the spillway and further raising the lake level) is not recommended. Lake Warren Dam is considered a Significant Hazard Dam. A dam that has a significant hazard potential because it is in a location and of a size that failure or misoperation of the dam would probably result in no loss of lives; but possibly major economic loss to structures or property; structural damage to roads; major environmental or public health losses, including public water systems, release of wastes, or non-reversible environmental damage.

The unoperated dam will pass 158 cfs with one foot of freeboard, but design requirements are to pass 308 cfs. Due to these reasons, additional water should not be stored in Warren Lake and is not recommended as part of the dam management plan.

Depending on the scale of the relief pulse, the lowering of the lake level for dam management could potentially impact the recreational use of the lake by boaters and swimmers. Fish and plants could be impacted if substantial lake bottom were exposed. NHDES conducted a bathymetry survey of the lake to identify the shallow areas that would be most sensitive to lower lake levels. The resulting bathymetry map is shown in ***Figure C-10***. Significant water level change may affect boating access mostly in parts of northern, eastern and southern shorelines.

Loons have not been observed nesting on Lake Warren. Dam management will not affect loon nesting.

Lake Warren's water level changed several inches during the 2022 summer vacationing season. The lake level between the Fourth of July and Labor Day 2022 fluctuated 0.46 feet (5.5 inches), from 0.22 feet to -0.24 feet (2.6 to -2.9 inches).

On August 9, 2022, an abnormally dry period, outflow from the lake was only 0.01 cfs. This is equivalent to 0.02 cfsm. Comparing this with expected summertime stream flows from small waterbodies of 0.25 to 0.3 cfsm indicates the Warren Brook and the Cold River are receiving less than expected from the 4.88 square mile Lake Warren watershed. Summertime flow in small watersheds the size of Lake Warren is commonly about 0.25 to 0.3 cfsm, equivalent to 1.2 to 1.5 cfs.

Lake Warren has been subject to cyanobacteria blooms in recent years. Cyanobacteria and aquatic invasive plants, as they relate to relief pulses, are discussed in Section 2.6.2 of the Cold River Instream Flow Water Management Plan. In summary, plant growth and algal blooms, including cyanobacteria, are more influenced by nutrient loading in the lake than by an increase in temperature. The small amount of lake level change would also mean that temperature change as a result of shallower water will be small. Increased plant growth is not a likely result from dam management on Lake Warren.

Features on the Cold River downstream of the dam would not be negatively impacted by the volume or flow rate of relief pulses. Warren Brook immediately downstream of the dam crosses under Pine Cliff Road and then passes under Prentice Hill Road. Warren Brook then winds back and forth under Rt. 123/Forest Road until Warren Brook meets the Cold River 4.4 miles downstream, near the junction of Rt. 123 and Rt. 123A. The largest proposed relief pulse from Lake Warren is 17 cfs, equivalent to 3.49 cfsm. Low spring flows consistently exceed 4 to 10 cfsm, meaning the Cold River commonly experiences flows higher than this on an annual basis. Chase's Mill Dam experiences flows much higher than the proposed relief pulses every year.

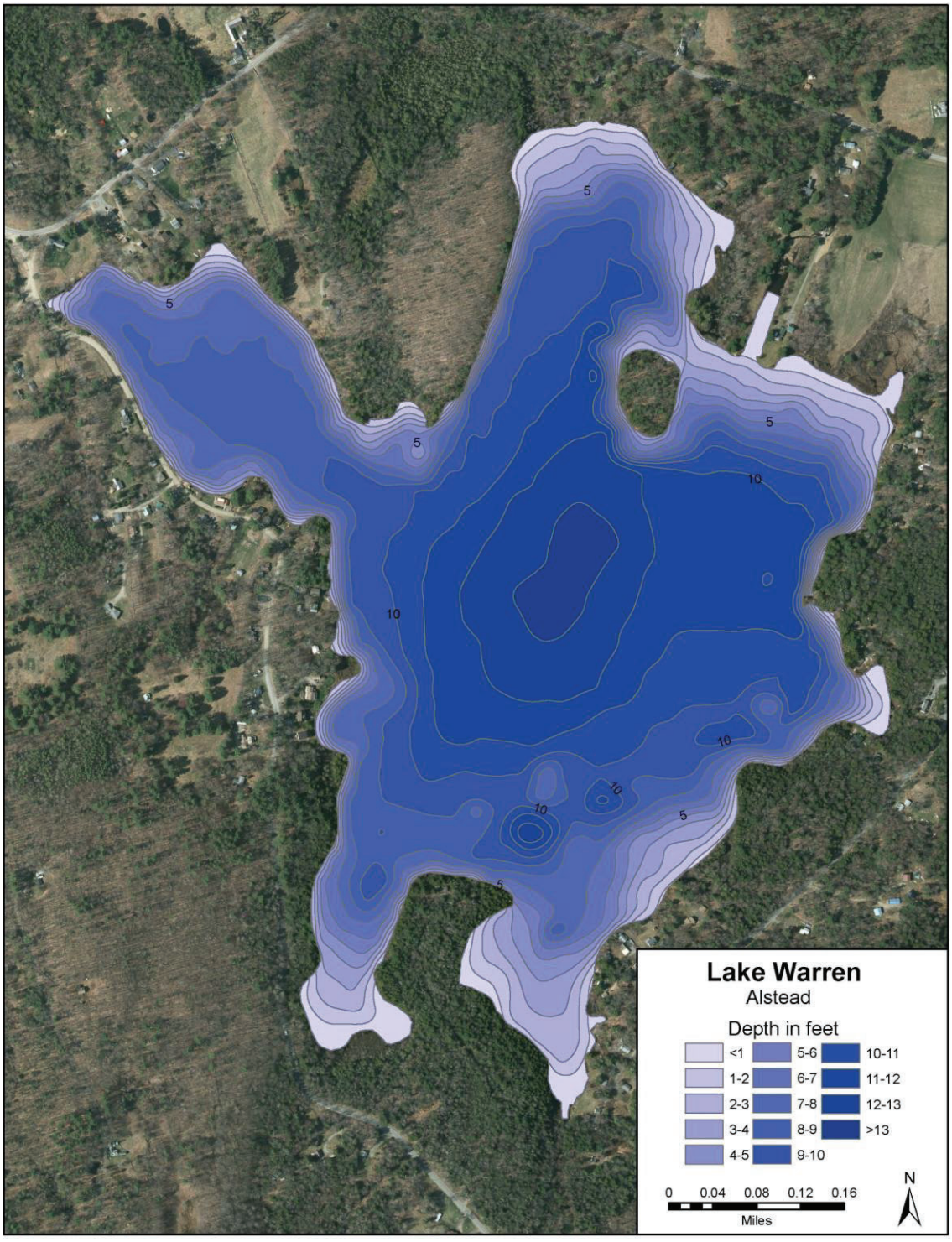

Figure C-10– Lake Warren bathymetric map showing one-foot contour intervals. Lighter colors are shallow.

C.2.3.2. Potential for Dam Management to Meet Instream Flow Requirements

There are several factors affecting the potential for using Lake Warren Dam to support instream flow management. These factors include the surface area of the lake, its location relative to flow to the Cold River, the effective impact of releases downstream, and the capacity of the outlet structure to pass water.

Lake Warren is located on a tributary, Warren Brook, of the Cold River. Warren Brook's confluence with the Cold River is 16.3 miles downstream of Crescent Lake, the headwaters of the Cold River, and 6.4 miles upstream from the confluence with the Connecticut River. Lake Warren affects flows on the lower 6.4 miles of the Cold River. A relief pulse must travel 4.2 miles down Warren Brook before reaching the Cold River and 0.6 more miles to reach the USGS gage. Warren Lake relief pulses could contribute to the relief pulses from Crescent Lake by adding flow below the Warren Brook confluence. The timing of relief pulses from these two lakes will need to be coordinated.

The surface area of the lake determines the amount of water available per inch of lake level decline. Lake Warren's surface area is 200.3 acres. One inch of water released over 48 hours of a relief pulse is equivalent to 4.2 cubic feet per second. ***Table C-7*** shows the deficit flows for each bioperiod to respond to the 90th percentile of historical Catastrophic Events for Cold River Watershed. Note that the Common Flow Magnitude is not managed, as discussed in the Cold River Instream Flow Water Management Plan. Based on this analysis, the largest relief flow to mitigate either a Critical or Rare Catastrophic Event would be 41.4 cfs over two days. Applied to only Lake Warren, this deficit would require lowering the lake level about 10 inches. However, some of the water to offset this deficit will be contributed from another source.

Table C-7 – Summary of 90th percentile Critical and Rare Catastrophic event deficits from 10/1/1950 through 6/30/2021 by bioperiod and prorated from the USGS gage to the end of the Cold River Watershed

Bioperiod	Bioperiod Name	Bioperiod Start	Bioperiod End	cfs required to exceed Rare Flow	cfs required to exceed Critical Flow
BP1	Winter Survival	1-Dec	28-Feb	15.2	30.7
BP2	Freshet	1-Mar	15-Apr	28.5	41.4
BP3	Sucker Spawning	16-Apr	15-May	29.6	41.4 *
BP4	Springtime Anadromous Fish	16-May	7-Jul	6.6	15.6
BP5	Rearing & Growth	8-Jul	21-Sep	1.9	5.8
BP6	Fall Salmonid Spawning	22-Sep	30-Nov	5.7	14.5

** No critical deficits occurred during BP3 within the period of record. NHDES assigned the previous bioperiod's relief pulse based on the trend of the rare relief pulse.*

The watershed area upstream of Lake Warren Dam is relatively large at 4.88 square miles. Small storms in the headwaters would be effective in replenishing the lake's water levels following a relief pulse. A half inch of rain with 15% effective recharge to Lake Warren would raise the lake level 1.2 inches.

NHDES evaluated the configuration of the dam's structure for conducting a relief pulse. The rate of water released is controlled by the size and configuration of the outlet and by the water level above the outlet controls as well as the size of the lake. Lake Warren Dam has a pond drain controlled by stoplogs that can be removed to release water. The rate of release can be increased by removing additional stoplogs. During a release test on August 9, 2022, conducted jointly by Town of Alstead and NHDES staff, multiple stoplogs were removed at test outflow at two different rates. The dam's outlet can release 4.4 cfs when the water level is 0.85 feet above the stoplogs and 16.2 cfs when the lake level is 1.8 feet above the stoplogs. More stoplogs were left in place below those that were removed. The average rate of the release was 11.8 cfs over 120 minutes. The average release rate was 11.8 cfs and the corresponding increase at the USGS gage was 4.3 cfs with a travel time of 6.75 hours, indicating a significant attenuation in flow.

C.2.4. Dam Management Plan

NHDES finds that an interim dam management plan is needed to test the effects of relief pulses at the USGS gage and to evaluate the effects on Lake Warren. Initially, dam management will follow the pilot test phase described below. Using the results from this phase, a management plan will be developed and finalized between NHDES and the Town of Alstead. The final management plan will describe the relief pulse flow rates and durations by bioperiod.

C.2.4.1. Pilot Test Phase

NHDES and the Town of Alstead have developed an interim dam management plan for the Lake Warren Dam. The interim plan will conduct relief pulse tests under actual low flow conditions.

Following adoption of the Cold River Instream Flow Water Management Plan, NHDES and the Town of Alstead will conduct relief pulse tests prior to determining appropriate relief pulse rates for the bioperiods being managed and limits on lake level change. These results will be added to the final Dam Management Plan and this Pilot Test Phase section will be eliminated.

If the protected instream flow criteria are not being met for the Critical or Rare Flow Magnitudes and the result is a Catastrophic Event, NHDES and the Town of Alstead will conduct a relief pulse test. NHDES and the Town of Alstead will coordinate on conducting a relief pulse test when a Catastrophic Event is imminent. NHDES will contact the Town of Alstead to schedule the pilot test at least three days before the test is to be conducted. Prior to a relief pulse test under this interim plan, NHDES and the Town of Alstead will measure the starting lake level and the flow rate out of the lake at the dam. At an agreed upon time, the Town of Alstead will direct its operator to begin a relief pulse by pulling a specified number of stoplogs.

The release rate for the pilot tests is specified at 17 cfs. At 17 cfs, the lake level decline will be about 0.34 feet (4.0 inches) over two days. Boards will be removed to a depth of 1.9 feet below the starting lake level. NHDES will remeasure flow rates from the dam and track lake level changes and other lake concerns, and the effective flow increase at the USGS gage.

The stoplogs will remain out for up to 48 hours and NHDES and the Town of Alstead will measure the change in the lake level and the outflow rate over that time. The duration of the relief pulse will be based on the change in lake level. A smaller or shorter relief pulse may be applied during the subsequent test(s)

and to the final management plan. No relief pulse will be started if the lake level is at less than or equal to seven inches below the spillway. If the lake level falls more than four inches from the starting level, the Town of Alstead may end the relief pulse by replacing the stoplogs. NHDES will be allowed to measure the rate of outflow before the Town of Alstead replaces the boards. A gradual reduction in outflow over the course of several hours is preferable to a sudden shut off. The Town of Alstead will replace the boards in the outlet structure to a height of their preference when this lake level is reached. Ideally, some amount of water will continue to be allowed to flow downstream as the remainder is retained to refill the lake. ***Table C-8*** provides an overview of the actions required at different flow magnitudes and durations.

Table C-8 - Management actions for the Town of Alstead to achieve protected instream flows on the Cold River, based on flow magnitudes and their durations (does not apply between April 16 and May 15)

In each bioperiod, when flows are:	Within Allowable Duration	Within Persistent Duration	Within Catastrophic Duration
At or below Common Flow Magnitude	No management action	No management action	No management action
At or below Critical Flow Magnitude	No management action	Prepare for relief pulse test, coordinate with NHDES	Conduct relief pulse test with NHDES
At or below Rare Flow Magnitude	No management action	Prepare for relief pulse test, coordinate with NHDES	Conduct relief pulse test with NHDES

The pilot test phase will continue until at least two test relief pulse events have been tested. Adjustments to subsequent tests may be made based on the results of previous tests. Adjustments may made in the initial outflow rate if the first pilot tests show lake level declines are greater than four inches as a result of the relief pulses during the pilot testing. The pilot test phase will be completed and results assessed before the final Lake Warren Dam Management Plan is agreed upon between NHDES and the Town of Alstead.

C.2.4.2. Pilot Test Assessment

NHDES will assess the pilot phase results following two or more relief pulse events. The assessment will evaluate the release rates observed, lake level change, and the pulse's response at the USGS gage. The assessments will compare these results to the lake level change to determine the best compromise between rate, duration and lake level change.

The combined results of the releases from Crescent Lake and Lake Warren will be assessed at the USGS gage for flow and timing during actual low flow conditions. These results will be tailored to define relief pulses that best support the protected instream flows for the Cold River.

Regardless of the results of the pilot test, no management will be applied from Lake Warren during Bioperiod 2.

C.2.4.3. Dam Owner Responsibilities

The Town of Alstead will be responsible for observing the Current Cold River Instream Flow Conditions using the Cold River PISF Tracking Tool on the NHDES website to identify when management is required. NHDES will support these observations during the first two years following the Cold River Instream Flow Water Management Plan's adoption, or the duration of the pilot phase, by notifying the Town of Alstead of an imminent management event. The Town of Alstead will apply the outflow rates as appropriate to the bioperiod as presented in ***Table C-9***. (Table C-9 will be revised with the results of the pilot relief testing.)

Prior to dam management actions, the operators will observe conditions in the area of Lake Warren dam for algal blooms. Operators can check whether a waterbody currently has an active cyanobacteria advisory by looking at the NHDES Beach Map. If a new bloom is observed, it should be reported by filling out the Cyanobacteria Bloom Report form. If a suspected cyanobacteria bloom is present on the lake, dam operators should use caution when handling boards or other materials as part of opening and closing the dam, including taking precautions like wearing gloves and a mask.

C.2.4.4. Implementation Schedule

Dam management plans are required to have an implementation schedule establishing the time frame within which an Affected Dam Owner will complete any approvals, plans, property or equipment acquisitions, construction or other activities necessary to perform the operational requirements of the plan. An Affected Dam Owner with an implementation schedule longer than three years shall make periodic progress reports to the department following the rules in Env-Wq 1905.07. A final progress report is required within three months of completion by Env-Wq 1906.03 (e).

Dam management may begin at Lake Warren without implementation actions. No actions are necessary to prepare Lake Warren dam for operating under this dam management plan. The Town of Alstead will follow the interim dam management plan of applying the pilot testing beginning on adoption of the Cold River Instream Flow Water Management Plan by the NHDES commissioner. NHDES and the Town of Alstead will complete the final dam management plan after the completion of the pilot testing phase. The final plan will identify the relief pulse rates for each bioperiod, as applicable, and their durations. The Town of Alstead will not be required under the rules to make progress reports.

Table C-9- Interim Test Plan - Release Contribution from Lake Warren in the Event of Instream Flow Water Management

Bioperiod Name	Bio-period #	Period	Deficits at USGS gage to meet 90% of historical deficits (cfs)	Deficits prorated to end of river to meet 90% of historical deficits (cfs)	Relief pulse rate from Lake Warren (cfs)	Relief pulse duration from Lake Warren (hours)	Change in water level at Lake Warren (feet)	Notes
Winter Survival	1	Dec 1– Feb 28	22.6	31.0	17	Up to 48 hours	<0.34	--
Freshet	2	Mar 1- Apr 15	30.5	41.7	--	--	--	No management
Sucker Spawning	3	Apr 16 – May 15	30.5*	41.7*	17	Up to 48 hours	<0.34	--
Springtime Anadromous Fish	4	May 16 – July 7	11.5	15.7	17	Up to 48 hours	<0.34	--
Rearing & Growth	5	July 8 – Sept 22	4.3	5.9	17	Up to 48 hours	<0.34	--
Fall Salmonid Spawning	6	Sept 23 – Nov 30	10.7	14.6	17	Up to 48 hours	<0.34	--

** Applying Bioperiod 2 rate to Bioperiod 3 Catastrophic Events.*

C.2.4.5. Recordkeeping

The Town of Alstead will keep written records of their operations taken to comply with this dam management plan. The Town will make these records available to NHDES upon request.

As part of the management records, the Town of Alstead will record the start date and time of every relief pulse conducted under the interim plan or the final plan. The Town of Alstead will record the starting and ending water level at a fixed location that is not influenced by water moving out of the outlet. The Town of Alstead will identify in the records, details of actions taken for each relief pulse, including, but not limited to the names of the people conducting the relief pulse and the actions taken. Descriptions of actions will include times and dates when boards are managed, actions taken and the lake level before and after the relief pulse.

Affected Dam Owners and Affected Waters Users will notify NHDES in case of a sale of the property. Affected Dam Owners and Affected Waters Users will notify the purchaser prior to the sale of the property.

C.2.5. Deemed In Compliance

By complying with the actions in this dam management plan, the Town of Alstead will be deemed by NHDES to be in compliance with the water quality standards established in RSA 485-A and Env-Wq 1700 relative to stream flow affected by Lake Warren.

C.2.6. Dam Owner and Contact Information

Owner: Town of Alstead, NH c/o Selectmen
Mary Schoppmeyer, Office Administrator (alsteadadmin@alsteadnh.org)
Address: PO Box 60, Alstead, NH 03602
15 Mechanic Street, Alstead, NH 03602
Phone: 603-835-2986
Email: TOWNOFALSTEAD@COMCAST.NET

Operational Contact: Prescott Trafton, Road Agent
Phone: 603-835-2428
Email: prescotttrafton@comcast.net

Emergency Contact: Kim Kercewich – 603-209-1430(c); 603-8352928
Alternate Emergency Contact: David Crosby – 603-209-5353

Lake Association: Lake Warren Association
Address: Lake Warren Association,
P.O. Box 331
Alstead, NH 03602
Email: lakewarren.nh@gmail.com

Table C-10– Lake Warren Dam Characteristics

Elevation (ft) of recreation pool or height relative to lowest spillway	1199.8
Elevation (ft) of additional spillway crest(s) or height relative to the lowest spillway	30'W X 2'H
Elevation (ft) of streambed at the dam centerline or the height relative to the lowest spillway	1991.5
Height of the dam (ft) from toe to the highest point on the dam	10
Freeboard (ft)	2.5
Type of spillway controls or outlet works	Stoplog pond drain
Dimensions of spillway controls or outlet works	2 FT WIDE
Surface area (ac) of impoundment at maximum impoundment	200.3
Drainage area (sq. miles)	4.88
Maximum storage (ac-ft)	1,040
Normal or permanent storage (ac-ft)	501
Total discharge capacity (cfs)	395
Maximum unoperated discharge (cfs)	366
Design storm discharge (cfs)	128
Estimated 50-year flood flow (cfs)	NA
Estimated 100-year flood flow (cfs)	1,959

Source of information: NHDES Dam Bureau, NH Dams Data Sheet for Dam #005.04 and Thayer Fellows, P.E. 1992 survey. Note: NA – not available from NH Dams Data Sheet.

C.2.7. Glossary

Affected Dam Owner (ADO) - Env-Wq 1902.02 “Affected dam owner” means an owner of a dam with an impoundment with a surface area greater than 10 acres in the WMPA of a designated river.

Water Management Planning Area (WMPA) - Env-Wq 1902.13 “Water management planning area (WMPA)” means the tributary drainage area to a designated river for which a water management plan is required.

C.2.8. Sources of Information

NH Department of Environmental Services, Administrative Rules - Env-Wq 1700: Surface Water Quality Standards, effective 12-1-16.

NH Department of Environmental Services, Administrative Rules - Env-Wq 1900: Rules for the Protection of Instream Flow on Designated Rivers

Lake Warren Association website - https://www.lakewarrenalstead.org/what-we-do

Lake Warren Association, Lake Warren Communication, Spring 2022, March 25, 2022,

Lake Warren Watershed Management Plan prepared by: FB Environmental Associates in cooperation with the Southwest Region Planning Commission, the Lake Warren Association, the Lake Warren Watershed Steering Committee, and the New Hampshire Department of Environmental Services, December 2016

McCarty, Selectman Joel, Personal communication with Wayne Ives, NHDES Instream Flow Specialist, April 13, 2023.

New Hampshire Department of Environmental Services (NHDES) 2021. *Protected Instream Flow Study Report – Cold River,* NHDES-R-WD-R-WD-21-09. Prepared by Gomez & Sullivan.

NHDES Dam Bureau documents on file: NH Dams Data Sheet for Dam #005.04; 20211104 D005004 InspReport DRAFT.doc; 20010831 D005004 LOW FLOW LTR.doc; Misc directory; D005004 OMR 20111130.pdf, Survey plans of Lake Warren dam by Thayer R. Fellows, P.E. dated July 5, 1992

NH State Statutes re Lake Warren – Alstead - RSA 270:74-a - Skicraft banned 10/29/98. https://www.nhsp.dos.nh.gov/our-services/field-operations-bureau/marine-patrol/restricted-bodies-water

Conversion Factors for Volume and Flow Units			
1	cubic foot =	7.481	gallons
1	gallon =	0.1337	cubic feet
1	cfs =	448.86	gpm
1	acre-foot =	43,560	cubic feet
1	acre-foot =	325,872	gallons
1	cfs =	646,358.4	gpd
1	cfs =	0.65	MGD
1	gpm =	0.002227866	cfs
1	gpd =	0.00000154713	cfs
1	MGD =	1.5471	cfs