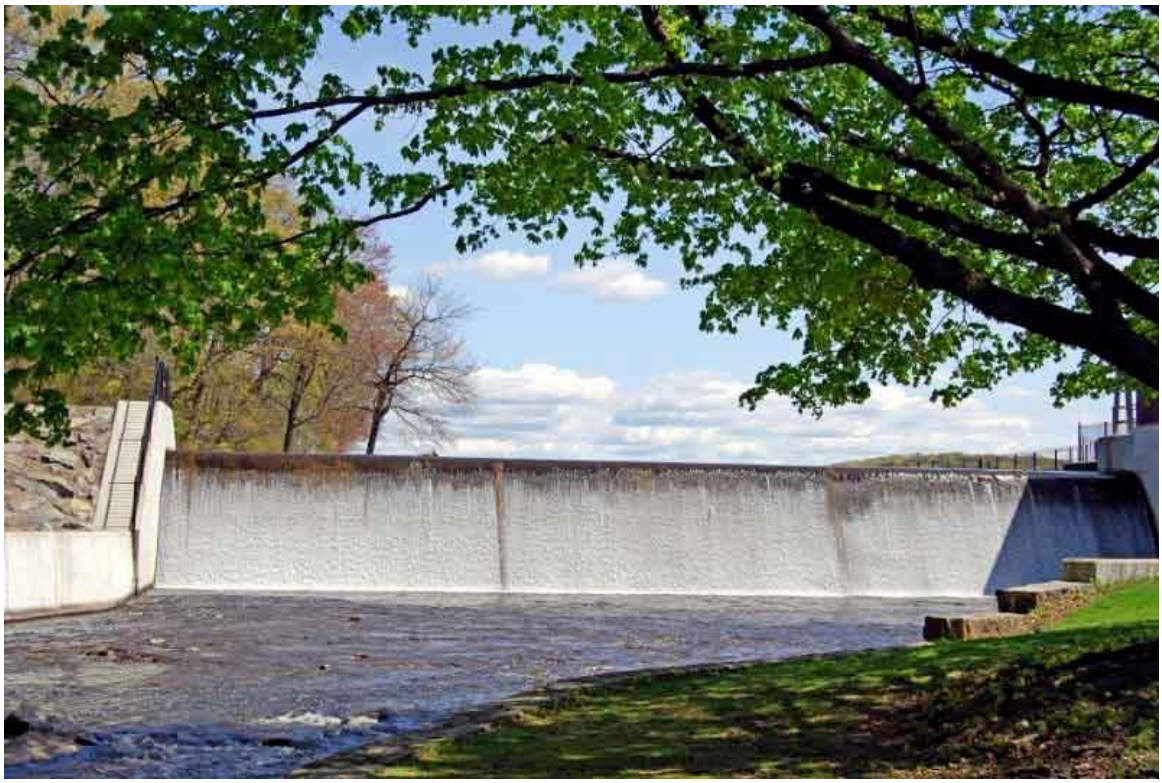
LAKE HOPATCONG WATER LEVEL MANAGEMENT PLAN

2011



March 2011

New Jersey Department of Environmental Protection
Bob Martin Commissioner

Disclaimer: At no time is this plan is intended to restrict the ability of the Superintendent in charge of Hopatcong State Park to exercise best professional judgment in response to unusual or unforeseen circumstances as necessary to minimize property damage or the threat to human safety in the Lake Hopatcong and Musconetcong Watershed.

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Photographs provided by Chuck Gullage, Dan McCarthy and Larry Baier

Lake Hopatcong Water Level Management Plan
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Conversion Factors

1 square mile = 640 acres
1 acre = 43,560 square feet
1 inch = .083 feet
1 day = 86,400 seconds
1 cubic foot = 7.48 gallons
1 cubic foot per second (CFS) = .65 million gallons per day (MGD)
1 MGD = 1.56 CFS

SUMMARY
WATER LEVEL MANAGEMENT PROCEDURES

Schedule of Water Lowering Events

In order to allow for waterfront maintenance and to protect property from ice damage, the water level in Lake Hopatcong will be lowered by 26 inches to a surface elevation of 6.83 feet, as measured from normal pool elevation, each fall. Every fifth year, the lake level will be lowered by 60 inches to allow for major repairs to lakeshore structures and any necessary repairs to the dam.

Year	Maximum Scheduled Drawdown*	Elevation (gauge elevation)
2010	26”	6.83 ft
2011	26”	6.83 ft
2012	26”	6.83 ft
2013	60”	4 ft
2014	26”	6.83 ft
2015	26”	6.83 ft
2016	26”	6.83 ft
2017	26”	6.83 ft
2018	60”	4 ft

*Normal pool elevation is 9 feet

Normal Condition
Lake Hopatcong Drawdown / Refill Dates and Procedures
Summary
(See Detail Sections for Special Conditions)

Summer Lake Elevation

- During the non-drawdown months, the water level in the lake shall be managed to maintain a water surface elevation of 9 feet, but not to exceed 9.5 feet, but shall at all times meet the minimum passing flow of 12 cubic feet per second.
- When water spilling over the dam is sufficient to meet the 12 CFS passing flow all gates shall be closed, unless the water surface elevation is above 9.25 feet (9 feet, 3 inches) and rising.

26 Inch Annual Drawdown[1]

[1] In the fall of 2010 the Department operated the drawdown starting on November 19 with a rate of 1 inch per day. A two-inch rainfall event on December 1 caused the Department to miss the December 15 target

- If the water level in the lake is at 9 feet: beginning on November 12th the gates shall be opened to reduce the water level in the lake by .79 inch per day (88 CFS = 2.44 feet on the gage).
- The start date for the drawdown shall be adjusted according to the water level in the lake, such that if the lake is above 9 feet the drawdown will begin one day earlier for each inch above 9 feet and if the lake is below 9 feet the start of the drawdown will be delayed by one day for each inch below 9 feet. The rate of drawdown shall be adjusted to account for rainfall throughout the drawdown period.
- The rate of release shall be adjusted to reach a water elevation in the lake of 6.83 feet by December 15th.

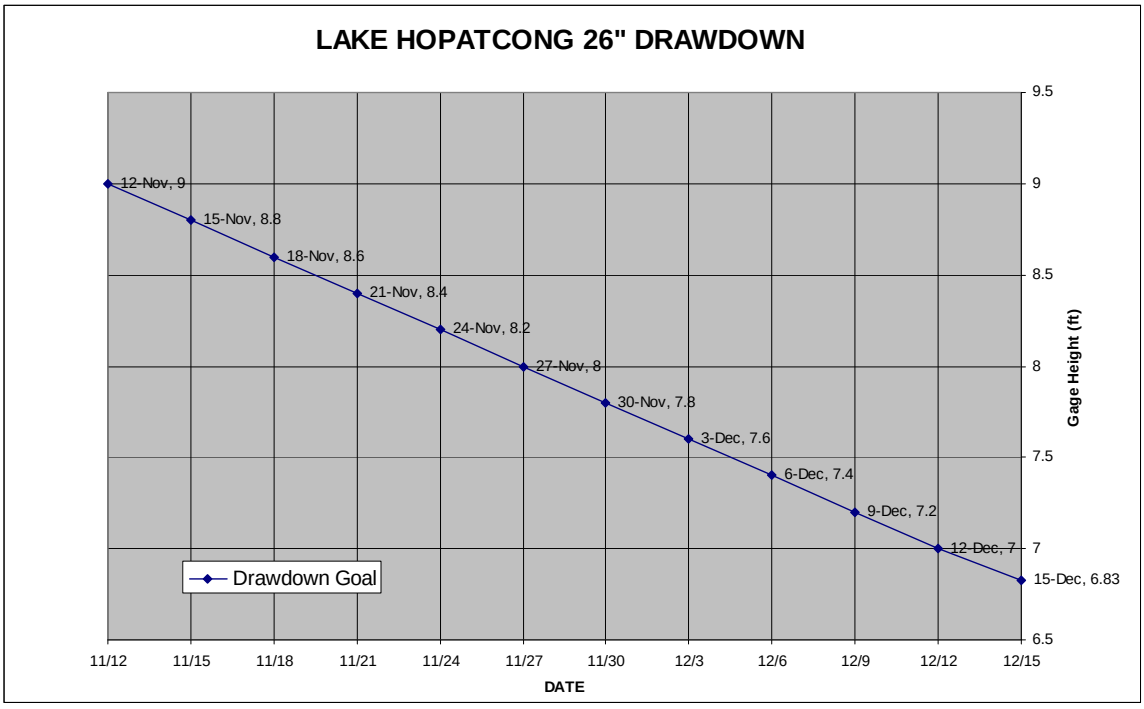

Figure 1: Lake Elevation Goal on each date during the 26 inch drawdown

Winter Water Level Management

- Unless ice would cause damage, the release of water shall be adjusted as needed throughout the winter in response to rainfall or melting snow, to maintain the water elevation in the lake at 6.83 feet, and the required minimum passing flow of 12 CFS shall be met throughout the winter.

Refill Procedures

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date by seven days. The rainfall event was followed by very cold weather. Though the Department received no reports of ice damage to property from the falling water level, the Department is concerned that such damage may occur in the future. Based on this experience the Department has adjusted the schedule to begin the drawdown seven days earlier than in the draft plan.

- When, in the opinion of the Hopatcong State Park Superintendent, spring thaw has softened the ice on the lake sufficient to avoid ice damage to private property, the gates on the Lake Hopatcong Dam shall be closed to allow the 12 CFS passing flow and the lake shall be allowed to fill to the spillway crest elevation of 9 feet.

60 Inch 5-Year Drawdown[2]

- If the water level in the lake is at 9 feet: beginning on September 22nd the gates shall be opened to reduce the water level in the lake by 1.5 inches per day.
- The start date for the drawdown shall be adjusted according to the water level in the lake, such that if the lake is above 9 feet the drawdown will begin one day earlier for each inch and a half above 9 feet and if the lake is below 9 feet the start of the drawdown will be delayed by one day for each inch and a half below 9 feet. The rate of drawdown shall be adjusted to account for rainfall throughout the drawdown period.
- The rate of release shall be adjusted to reach a water elevation in the lake of 4 feet by November 1st.

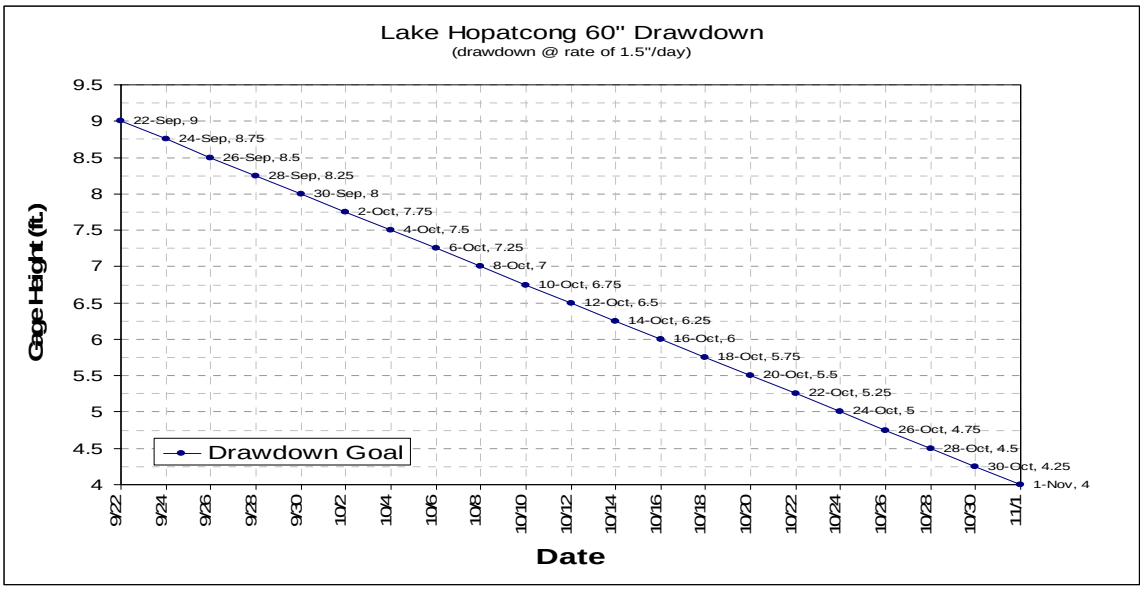


Figure 2: Lake Elevation Goal on each date during the 60 inch drawdown

Refill Procedures

- On December 15th the gates of the Lake Hopatcong Dam shall be closed except as required to meet the 12 CFS minimum passing flow. The lake shall be allowed to refill as much as possible, but not above 6.83 feet, until hard ice forms on the lake

[2] Based on the difficulty experienced in 2010 while trying to achieve a one-inch per day drop in lake elevation (see footnote one above), the Department will need to reevaluate whether the target 1.5 inch reduction in lake elevation can be accomplished. A final determination will be made during the winter 2012 annual review.

such that, in the opinion of the Superintendent, a continuing rise in water elevation may cause property damage.

- If the water elevation reaches 6.83 feet before a hard freeze occurs, the gates shall be operated in response to rainfall to maintain that water level.
- If the elevation does not reach 6.83 feet before the hard ice forms, the gates shall be operated to maintain the water level existing on the date of the hard freeze.
- If the water elevation of 6.83 feet is not achieved, and conditions change during the winter that soften the ice to the point that, in the opinion of the Superintendent a water level rise will not cause property damage, or unduly interfere with winter recreation on the lake, the water level will be allowed to rise during that period, but not over 6.83 feet.

INTRODUCTION

Lake Hopatcong lies on the southern border of Sussex and Morris Counties, and is located within the boundaries of four municipalities, the Boroughs of Hopatcong and Mount Arlington and the Townships of Jefferson and Roxbury. Lake Hopatcong is approximately nine miles long, with 38 miles of shoreline encompassing 2,658 acres (normal pool). For such a large lake, Lake Hopatcong has a relatively small drainage area of only 25.3 square miles. Lake Hopatcong is the largest freshwater lake in the State of New Jersey and through aggressive stocking programs supports perhaps the greatest diversity of freshwater fish anywhere in the State. The lake is a significant recreational resource for the residents of New Jersey providing year round opportunities for boating, fishing, swimming, ice skating, ice boating etc. The lake is a focal point for the local and regional economy.

Lake Hopatcong originally existed as two separate bodies of water formed by the retreat of the Wisconsin glacier over 12,000 years ago. In the 1750s a six-foot high dam was constructed across the Musconetcong River primarily as a water source for the Brooklyn Forge. The dam increased the water level and engulfed the two ponds and surrounding areas to form Lake Hopatcong. Later the dam was raised to supply water to the Morris Canal which connected the Delaware River to the Passaic River and ultimately to the Hudson River. The Morris Canal and Banking Company was chartered in the State of New Jersey in 1824 to construct the Morris Canal. Lake Hopatcong and downstream Lake Musconetcong were part of the Morris Canal and Banking Company (as were Cranberry and Greenwood Lakes). Fourteen (14) Canal Acts passed during the period of February 28, 1923 to March 13, 1925 continued these lakes as part of the Morris Canal and Banking Company, whose charter and rights were deeded in trust to the State of New Jersey. The Canal Acts placed the administration and management of the Company and its property under the Board of Conservation and Development. By succession these responsibilities now reside with the Department of Environmental Protection, Division of Parks and Forestry.

Included in those legislative enactments at N.J.S.A. 13:12-5 is direction to the Department of Environmental Protection concerning the management of Lake Hopatcong stating:

> "The waters of Lake Hopatcong may be used as an aquatic public park, for boating, bathing, fishing, and winter sports, and the lake level shall be maintained for such purposes at the normal high water mark as established on March eleven, one thousand nine hundred and twenty-two, natural elements permitting."

Following the adoption of the 1922 Act, a court action by the Association of Musconetcong Millers resulted in a court order requiring the construction of a fountain below the newly constructed Lake Hopatcong Dam designed to measure the minimum flow of 7.5 million gallons per day (12 CFS) from Lake Hopatcong down the Musconetcong River (from "A Summary Report on the Morris Canal and Banking

Company", by Frederick A. Eckhardt, Sr. June 27, 1975).[3] Initial rules for the manipulation of Lake Hopatcong water levels date from October 20, 1932. Historically water levels in Lake Hopatcong were lowered by 30 inches annually for waterfront maintenance and to protect property from ice damage. Effective January 1, 1990 the annual drawdown was reduced to 26 inches. Since 1982, the lake is lowered 60 inches once every five years to allow for major repairs to lakeshore structures and facilitate inspection and repairs to the lake Hopatcong Dam. Prior to 1982 the five-year lowering was 84 inches. The next 60 inch drawdown is scheduled to occur in September 2013. Prior to this update the plan was most recently updated in 2000.

From Lake Hopatcong flows the Musconetcong River. About 1.25 miles downstream from Lake Hopatcong, the Musconetcong River feeds Lake Musconetcong, another of the water reservoirs used to support the Morris Canal. Lake Musconetcong has a surface area of 315 acres and an additional drainage area of 4.4 square miles (29.7 sq. mi. total). Eight miles below Lake Musconetcong, the River has been designated as a recreational and scenic river and was included in the National Wild and Scenic River System in 2006. The Musconetcong River also provides an important recreational trout fishery. In general, as the distance along the Musconetcong River increases from the Lake Hopatcong Dam, the operation of the Lake Hopatcong Dam has less of an effect on flows in the river. For example, while Lake Hopatcong flows make up a significant portion of the flow of the Musconetcong River between Lake Hopatcong and Lake Musconetcong, at Bloomsbury the 12 CFS passing flow from Lake Hopatcong makes up only about 10 percent of the median flow.

The United States Geological Survey (USGS) maintains a stream gauge 300 feet downstream of the Lake Hopatcong Dam (# 01455500) on the left bank just upstream of the highway bridge on Lakeside Boulevard. Water releases from the lake are measured at this gauge. A USGS lake level gauge (#01455400) is also maintained and is located in the Lake Hopatcong gatehouse. The base elevation for this gauge is 914.57 (1929 NGVD). Lastly, USGS maintains a rain gauge at Lake Hopatcong (#405502074295601). Data gathered from these gauges can be viewed on the USGS web site at http://waterdata.usgs.gov/nj/nwis/current/?type=flow. All gauges are funded by the New Jersey Department of Environmental Protection.

[3] Although the fountain was designed to measure the minimum passing flow of 12 CFS required by the court, Helen Maurella, Superintendent of Hopatcong State Park reports that it actually releases more than 12 CFS.

GOAL OF THE LAKE HOPATCONG WATER LEVEL MANAGEMENT PLAN

The goal of this plan is to protect the environmental health and the natural, and scenic resources of Lake Hopatcong / Musconetcong River System, maximize recreational opportunities, minimize the potential for damage to property and waterfront structures, while maintaining the minimum flow requirements necessary to protect downstream uses, including but not necessarily limited to: aquatic biota, historic resources and water quality.

OBJECTIVE OF THE LAKE HOPATCONG WATER LEVEL MANAGEMENT PLAN

To establish a set of easily understood management and operational guidelines for the manipulation of the Lake Hopatcong water control structure to maintain a lake elevation as near as possible to 9 feet in Lake Hopatcong between May 1st and November 19th conditions permitting, except during the five-foot drawdown years when the drawdown shall start on or about September 22, while meeting the requirements of downstream uses.

Disclaimer: At no time is this plan is intended to restrict the ability of the Superintendent in charge of Hopatcong State Park to exercise best professional judgment in response to unusual or unforeseen circumstances as necessary to minimize property damage or the threat to human safety in the Lake Hopatcong and Musconetcong Watershed.

RESOURCE MANAGEMENT CONSIDERATIONS

The annual drawdown of Lake Hopatcong is primarily intended to protect waterfront structures from ice damage that would be caused by fluctuating water levels once solid ice has formed on the Lake. An ancillary benefit from the annual drawdown is that it provides waterfront property owners and the municipalities the ability to perform minor maintenance, sediment and debris removal. The five-year, five-foot drawdown provides an opportunity for property owners to schedule and perform more significant maintenance. It is noted that due to the bedrock geology beneath the lake, typical marine construction practices (e.g. driving of sheet pile and pilings) employed in the coastal waters of New Jersey cannot be applied everywhere in Lake Hopatcong. Consequently, many structures are supported by concrete or rock revetments and rock-filled crib structures. Maintenance of these structures typically cannot occur under water and would require coffer damming if the Lake was not lowered. Underwater construction techniques may be available but are generally cost prohibitive.

Fish and Wildlife

The Division of Fish and Wildlife (DFW) notes that both the fishery in Lake Hopatcong and the fishery downstream in the Musconetcong River are important resources and management requires balancing the needs of both. The DFW stocks Lake Hopatcong, Lake Musconetcong, and the Musconetcong River, both in-between the two lakes and downstream of the Lake Musconetcong dam, with a variety of fish. All three water bodies provide strong recreational fisheries.

Lake Hopatcong supports an abnormally large number and diversity of top level predators including trout, walleye, musky, hybrid striped bass, and channel catfish. The ability of the lake to support these predators owes to its high productivity resulting in a strong forage base of fish such as alewife. These forage fish have little difficulty adjusting to the water level in the lake as it is raised or lowered. Lake Hopatcong is designated as FW2 Trout-Maintenance in the New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B). This designation means that water quality in the lake is good enough year-round to support trout, though reproduction of trout in the lake does not occur probably due to the lack of suitable substrate.

The Division's regulations governing water lowering in impoundments (N.J.A.C. 7:25-6.25) require that north of I-195 lake lowering must be completed by November 1 in order to protect hibernating turtles and amphibians. The DFW has made an exception to this requirement for Lake Hopatcong due to the lake's large size. Requiring drawdown to be completed by November 1 would result in the initiation of lowering in the late summer and early fall when recreational use of the lake is still at its peak. These regulations also require that downstream flows must be maintained at all times.

The Musconetcong River below the Lake Hopatcong Dam is classified as Trout-Maintenance, it supports trout on a year round basis. The Division of Fish and Wildlife surveyed the Musconetcong River, downstream of the lake, during the summer of 2009, and found 15 species of fish reside in the river. Some of those species such as trout and margined madtom are indicators of high water quality and habitat. Trout in particular are very sensitive to elevated water temperatures. Stream temperatures are dependent on flow conditions. Reductions in stream flows result in accelerated temperature increases resulting in the significant mortality to the trout that reside in the river year round. Lake Musconetcong by comparison is designated as FW2 Non-Trout because it cannot support trout year-round.

Maintaining stream flows below the lake is extremely important to maintaining aquatic life in the river. These flows are especially critical during the summer months, when hot, dry weather results in natural increases in water temperatures. Reduced or low flows exacerbate these already stressful conditions.

Musconetcong River between Lake Hopatcong and Lake Musconetcong

The Division of Fish and Wildlife believes that the 12 CFS passing flow in the current plan is generally protective of the downstream resources. In fact, the ecology of the section of the Musconetcong River between Lake Hopatcong and Lake Musconetcong has stabilized in reliance on the passing flow that has been in place since prior to 1932.[4] Under extreme circumstances the Division of Fish and Wildlife may entertain a further reduction to 8.2 CFS; however, the Division stresses that numerous considerations must be taken into account including spawning seasons, spawning habitat requirements, water temperature, day and night air temperature, weather pattern forecasting and duration, wettable habitat and others. During the spring of 2009 when the DEP reduced flows below 8.2 CFS to facilitate refilling of the lake very close monitoring of in-stream conditions was required. Weather conditions during that period were generally cool and rainy which allowed additional flexibility in minimum flows without jeopardizing the aquatic resources downstream of the lake. Absent those mitigating conditions (had it been hot and dry) the reduction in stream flow may have resulted in fish kills in the Musconetcong River, and the reduction in flow could not have occurred.

Water Quality

The New Jersey Pollutant Discharge Elimination System (NJPDES) program is federally delegated under the federal Clean Water Act (N.J.A.C. 7:14A). The program sets effluent limits for point source discharges (such as industrial discharges and wastewater treatment plant discharges). Specific water quality criteria for various pollutants are established in the Surface Water Quality Standards as necessary to protect the designated uses of the surface waters of the State. The designated uses of Lake Hopatcong and the Musconetcong River are: primary and secondary contact recreation; maintenance, migration and propagation of the natural and established biota; potable water supply after conventional filtration and treatment; and industrial and agricultural water supply. Effluent limits are set to be protective of human health and ecological resources, by meeting the Surface Water Quality Standards (N.J.A.C. 7:9B) in the receiving waters.

[4] Please see Unresolved Issues Raised by the CAC toward the end of this document.

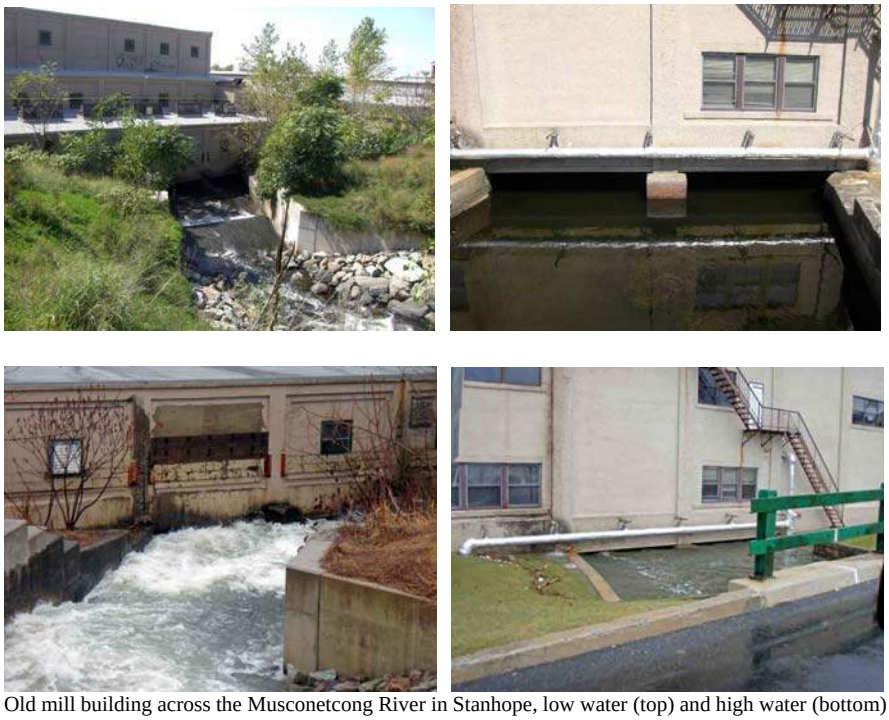
Most Surface Water Quality Criteria are established as concentrations of a particular pollutant in the receiving water for aquatic life (acute and chronic) and human health criteria. Therefore, effluent limits are driven by the amount of dilution (flow) available in the stream under low flow conditions. Typically different flows are used to establish effluent limits for "acute" criteria (those where a short term exposure will cause unacceptable impacts) and "chronic" criteria (those conditions that can be tolerated for a longer duration before a negative effect is observed) and human health carcinogenic and non-carcinogenic effect-based criteria. For example, the DEP uses the MA1CD10 flow (the one day minimum flow with a return interval of 10 years) for acute criteria; and the MA7CD10 (the seven day minimum flow with a return interval of 10 years) for chronic and human health non-carcinogenic criteria; and the MA30CD10 (the 30 day low flow with a return interval of ten years) for ammonia nitrogen. The nearest regulated discharge with effluent limits on the Musconetcong River is the Musconetcong Sewerage Authority (MSA) (NJPDES Permit # NJ0027821). MSA's discharge point is located approximately 1.45 river miles downstream of the Lake Musconetcong Dam. The drainage area to the MSA discharge is 30.9 square miles of which 25.3 square miles is contributed by Lake Hopatcong. Consequently, the operation of the Lake Hopatcong Dam may have a significant effect on the dilution available at MSA's discharge, particularly during extended dry periods or droughts.

At present MSA discharges about 4.31 million gallons per day (MGD) of treated wastewater, but its permit allows that discharge to increase to 5.79 MGD. MSA's effluent limits are set based on low river flows of 3.6 CFS, 4.4 CFS and 5.4 CFS at the discharge point. If low flows in the Musconetcong River were reduced below these levels, MSA would receive more stringent effluent limits, which could lead to costly treatment plant upgrades. During periods of drought the minimum passing flow has been reduced to lower levels. Historically this had been reduced to 6.2 CFS, however, during the 2002 drought this flow level was evaluated and found to provide inadequate dilution to protect aquatic life from toxic concentrations of ammonia due to the loading from a downstream publicly owned wastewater treatment plant and a new low flow criterion of 6.8 CFS was recommended.

Flooding

As a result of the August 11 - 14, 2003 flood, the stage discharge relationship for the Lake Hopatcong stream gauge has changed. Flood stage as reported by USGS downstream of Lake Hopatcong is now 4 feet (increased from 3.3 feet). However, based on personal experience, Superintendent Maurella believes the maximum discharge that can safely be accommodated by the downstream structures is equal to a gauge height of 3.5 feet. This rate of out flow cannot be exceeded and will control how fast the water level in the lake can be lowered. There is an old mill building located on Furnace Road in Stanhope that straddles the Musconetcong River. There is a second building immediately downstream that also straddles the River. That building is presently occupied, and the dam cannot be operated so as to put that property at peril. Members of the citizens advisory committee suggest that a diversion channel has been created around

this building and that flooding of the structure may not be an issue. An inspection of this diversion channel reveals that floodwaters would hit the building and make a 90 degree left hand turn into the concrete channel that surrounds the building. While this channel may reduce flood elevations upstream of the building and the pressure on the upstream wall, it will not likely keep the building itself from being damaged. Numerous other buildings downstream of Lake Hopatcong also lie in the floodplain of the Musconetcong River. A number of structures around Lake Hopatcong are also located in the floodplain. The Superintendent will have to evaluate conditions both around the Lake and downstream to determine what adjustments to the sluice gates on the Lake Hopatcong and Lake Musconetcong Dams, if any should be made to reduce flood the potential for flood damage.



Old mill building across the Musconetcong River in Stanhope, low water (top) and high water (bottom)

Dam Safety

The Lake Hopatcong Dam spillway is about 100 feet long and has an elevation of 9 feet. The dam also has a water control structure consisting of a fountain and four sluice gates which allow the water level to be manipulated below the spillway elevation. The Lake Hopatcong Dam is a Large Dam as it impounds in excess of 1,000 acre/feet of water. The Lake Hopatcong Dam is also classified as a High Hazard Dam. The High Hazard classification owes to the inundation potential and threat to life and property if the dam were to fail. The classification has nothing to do with the condition of the dam itself.

Under the Dam Safety Rules the Lake Hopatcong Dam must be inspected by a Licensed Professional Engineer every year (N.J.A.C. 7:20). A drawdown of the lake is not required to perform this inspection, though it is beneficial to stop water from spilling over the dam to facilitate inspection of the downstream face of the dam. Based on the most

recent inspection the dam is in good condition. The Department typically schedules necessary repairs to the dam to coincide with the regularly scheduled five-year drawdown of the lake. Recent repairs to the dam include: 1983: armored the earthen embankments because the spillway dimensions are hydraulically inadequate to accommodate the 100-year design storm. 2007: concrete repairs on the spillway were conducted. Repairs to the trash racks may be required in the near future.


Lake Hopatcong Dam


Lake Musconetcong Dam

Historic Resources

The Morris Canal is a National Engineering Landmark and is listed on both the Federal and State Registers of Historic Places. Having some water in the Canal west of Lake Musconetcong is important to understanding the Canal workings. Water is diverted into the Canal at the Lake Musconetcong Dam. The Canal is also used by the Borough of Stanhope as a water source for fire fighting.

The historic mills at Waterloo Village depend on water supplied through the Canal to power their water wheels. This is an important part of the historic interpretation at the Waterloo Village. Although the mills are not currently operating it is planned to reactivate them at some point in the future. The actual quantity of water required to provide for these uses in the Morris Canal is unknown but believed to be well below the current passing flow of 12 CFS. Moreover, Waterloo Village is located about four miles downstream of Lake Hopatcong and therefore the relative importance of the 12 CFS passing flow to the operation of the mills is diminished.

The previous Lake Hopatcong Water Level Management Plan (LHWLMP) notes that minimum flows over the Musconetcong spillway are necessary to prevent ice damage to the wood cap on the top of the Lake Musconetcong Dam. The Lake Musconetcong Dam is a historic feature; however the wood cap (approximately 1 foot high) was added later to increase the water level in Lake Musconetcong and is not a historic feature of that structure. The DEP is presently looking at possible replacement or rehabilitation of the Lake Musconetcong Dam which would eliminate the wood cap. DEP does not believe that protection of the wood cap is central to the LHWLMP since icing concerns would only be significant in the winter, when the Lake Hopatcong water level is generally being held static to avoid damage to waterfront structures.

Water Supply

The Water Supply Management Act and Rules (N.J.A.C. 7:19) direct the Department to regulate large diversions of water (100,000 GPD or more, 50,000 GPD in the Highlands Preservation Area) such that downstream uses and users are protected, including the natural environment of the waterways of the State. The DEP is required to set minimum passing flows on all diversions that will ensure that these uses are protected. Passing flows can only be altered under a declared water emergency by the Governor (N.J.A.C. 7:19-10.2(a)6).

There had been two significant downstream permitted users of water in the Musconetcong identified in the prior version of the Lake Hopatcong Water Level Management Plan: U.S. Mineral Wool and MSA. Presently neither is diverting water from the river or has approval to do so. There are six other approved diversions downstream on the Musconetcong River, but these appear to be far enough downstream that it is unlikely that the Lake Hopatcong Water Level Management Plan would have a significant effect on them. Consequently, there appear to be no current downstream permit holders that would be affected by the LHWLMP. However, there are downstream uses that must be protected including: dilution required for the MSA discharge; the historic uses at the Morris Canal and Waterloo Village; the Wild and Scenic River designation of the Musconetcong River; recreational uses and fisheries and wildlife concerns.

There is one in-lake registered user of water, Lakeshore Village Condos, who is allowed to take water directly from Lake Hopatcong not to exceed 3.1 million gallons per month (MGM), using three 70 gallons per minute pumps. Note, diversions of 100,000 GPD or 3.1 MGM require a permit from NJDEP, (50,000 GPD in the Highlands Preservation Area). To date they have not reported any water use. Also the Delaware River Basin Compact allows the Delaware River Basin Commission to order releases from Lake Hopatcong of up to 75 CFS down to elevation 915.2 feet (18 CFR Part 410, 2.5.6D.3.b.viii, D.3.f., E.3.a.) during water emergencies (.62 feet on the gauge).

Historical notes:

1) The current LHWLMP provides reference to a court ordered passing flow of 12 CFS from Lake Hopatcong as the result of a court action brought against the State by the Musconetcong Millers Association. DEP does not believe that the Musconetcong Millers Association still exists. However, the court order is unpublished and DEP has been unable to locate a copy of to assess whether it remains in full force and effect. An August 22, 1924 letter from Cornelius Vermeule to the Board of Conservation and Development references the dispute between the millers and the lake community.
2) During the drought of record from 1961-67, passing flows from Lake Hopatcong were reduced significantly and records indicate at times no outflow from the Lake occurred.

3) Lake Hopatcong has been used as a source of water during droughts. During October, November and December of 1965 approximately 3.675 billion gallons of water was pumped from Lake Hopatcong to the Rockaway River. Between November 1980 and February 1981 approximately 2.5 billion gallons of water was pumped from Lake Hopatcong to the Rockaway River. Although no pumping equipment is in place presently, the pipeline is still intact and was inspected during the drought of 2001-02. Under previous declared water emergencies, the passing flow out of Lake Hopatcong has been reduced. During the 2001-02 drought the Department calculated the minimum required passing flow for dilution at MSA to be 6.8 CFS.
4) A July 9, 1985 letter from Deputy (DEP) Commissioner Richard Dewling to Morton A. Siegler established rules for the use of Lake Hopatcong as an emergency water supply based on Boonton Reservoir levels.

Hopatcong State Park

Releases from Lake Hopatcong and consequently water levels in the lake are controlled through a series of four sluice gates and one "fountain" located at the Hopatcong State Park. The fountain is designed to release 12 CFS as required by the Musconetcong Millers Association court order; however, it actually releases more than 12 CFS when fully open. The State Park has not been able to control access to the fountain to keep unauthorized bathing out of the basin surrounding the fountain. The "fountain" lacks water quality testing required for bathing, and lifeguards to prevent drowning or other accidents. Therefore, the State Park has shut the fountain off during the bathing season and opted to use the sluice gates to meet passing flow requirements.

The sluice gates and the fountain must be manually opened and closed by turning wheels in the gate house. The wheels are not automated and not graduated; however, seven turns of the wheel will open or close the gate by about one inch.[5] Once an adjustment is made staff must read the staff gauge downstream of the Dam and readjust based on water elevation in the stream (web reporting from the USGS gauge is delayed perhaps by up to several hours). Staffing issues are a major limitation with regard to manipulating the control structure. The Park does not have staff dedicated to just watching the Dam, and staff are not available 24 hours a day, 7 days a week. However, the State Park does believe it can monitor and adjust the flow out of the lake in the morning and in the evening on any day that the Park is open and adequately staffed.

Other than the winter drawdown and spring refill, park staff regulate the water level in the Lake during the summer to prevent the Lake from reaching 9.5 feet at the gauge at the dam which results in a "no-wake" declaration on the Lake, and to maintain a static water level to the extent possible during the winter to reduce ice damage potential.

The State Park does not have specific facilities that require routine lowering of the water level. However, the State Park does try to arrange any required maintenance around the

[5] Per Superintendent of Hopatcong State Park

established drawdown schedule. The schedule can be found in the Water Level Management Procedure section of this Plan.

Lake Hopatcong Gate House

Hand cranks control sluice gates and fountain

Lake Hopatcong sluice gates

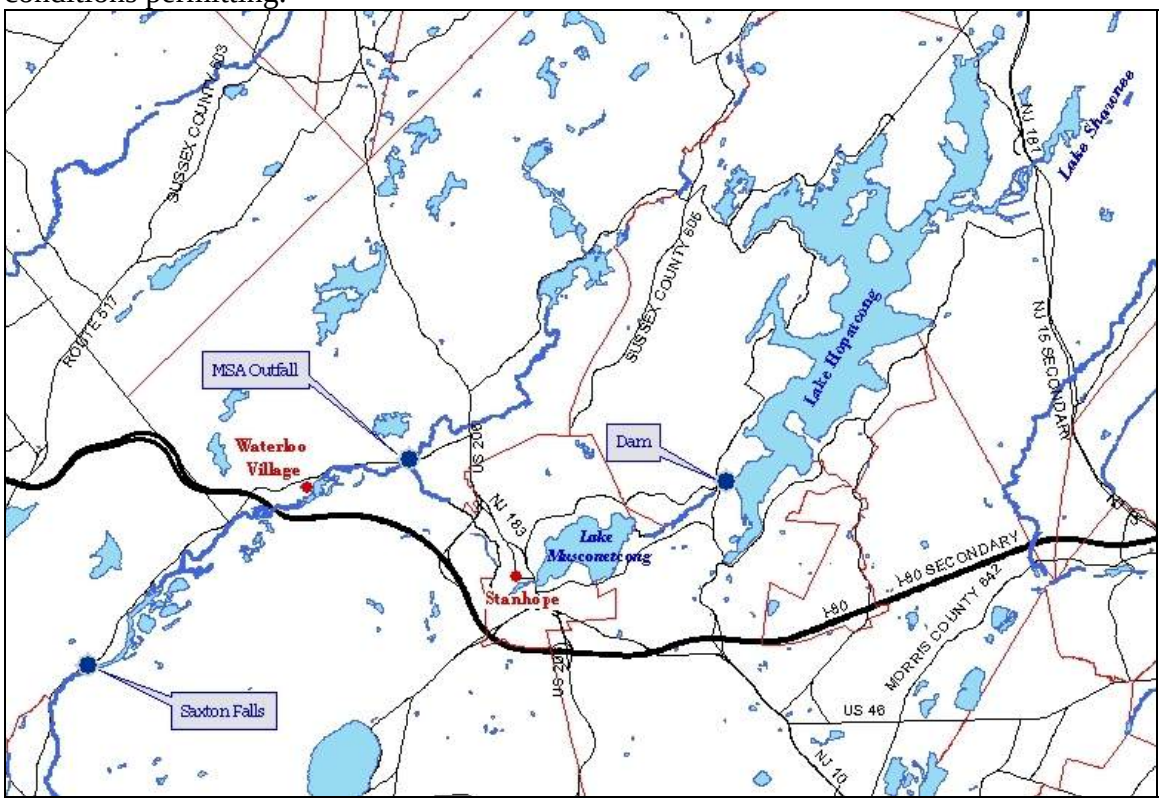
Fountain at Lake Hopatcong.
Stream gauges are located under bridge in the background

Wild and Scenic River

On December 26, 2006 President Bush signed P.L. 109-452 designating the Musconetcong River below Saxton Falls as a National Wild and Scenic River. The 3.5 mile segment from Saxton Falls to the Route 46 Bridge is designated a "scenic" river and the 20.7 mile segment below the King's Highway Bridge is designated a "recreational" river. One of the requirements for designation is that a river must be in a "free flowing condition." The operation of the Lake Hopatcong Dam in a manner that would significantly reduce or eliminate flows to the designated segments could be cause for action by the National Park Service and the downstream municipalities that make up the Musconetcong management partnership. Saxton Falls is located about 8 miles downstream of Lake Hopatcong and the drainage area to the river at that location is about 68 square miles. Lake Hopatcong's drainage area by comparison is just over 25 square miles. Therefore, Lake Hopatcong's flow would be expected to make up less than half of the flow at Saxton Falls under natural conditions. However, during extremely dry weather the 12 CFS passed from Lake Hopatcong may be more important to maintaining downstream flows.

Lake Hopatcong Recreational Boating

The spillway elevation of Lake Hopatcong is 9 feet. Marina owners who are members of the CAC report that ten percent (10%) of their slips are not usable when the water level in the lake drops to 8.25 feet. In addition to the loss of dockage, low water levels increase the risk to boaters from submerged rocks in the lake. The CAC reports that recreational boating will be severely impacted if the water surface elevation drops to 7.5 feet. High water also affects recreational boating. At an elevation of 9.5 feet a "no wake" declaration is issued by the State Police Marine Division in Lake Hopatcong to reduce the potential for shoreline erosion and damage to structures due to wake action. A "no wake" declaration negatively impacts recreational boating activities. In order to maximize recreational boating opportunities the goal of the plan is to maintaining a water surface elevation below 9.5 feet and above 7.5 feet during the spring and summer months, conditions permitting.



Conclusion

There are several downstream and in lake considerations that must be balanced by the Lake Hopatcong Water Level Management Plan. In general, the Department believes the 12 CFS passing flow from Lake Hopatcong to be protective of all of the downstream resources. Based on the information above, if a reduction in the passing flow is contemplated the most sensitive resource consideration is the protection of aquatic life in the segment between Lake Hopatcong and Lake Musconetcong. This river segment relies almost exclusively on the water released from Lake Hopatcong. The release from

Lake Hopatcong makes up less of the overall flow in the Musconetcong River as one moves progressively farther downstream. However, during extremely dry periods all resource considerations enumerated above should be examined before any departure from the Lake Hopatcong Water Level Management Plan is authorized.

WATER LEVEL MANAGEMENT PROCEDURES

General Information

The LHWLMP has been established to maximize recreational opportunities, minimize the potential for damage to property and waterfront structures, while maintaining the minimum flow requirements necessary to protect downstream uses. The plan also takes into consideration the important aquatic resources residing within the lake. To this end, the following Water Level Management Procedures have been established through the cooperative efforts of the Lake Hopatcong Citizens Advisory Committee, the Lake Hopatcong Commission, and several facets of the Department of Environmental Protection, including the Division of Parks and Forestry, Division of Watershed Management, Division of Water Supply and the Division of Fish and Wildlife.

In order to maximize recreational opportunities, a lake level of 9 feet (spillway elevation) is targeted for the spring and summer months. Depending on the location within the lake, certain recreational uses may be impeded at lower surface elevations, ranging from 8.25 to 7.5 feet. To the contrary, an elevation of 9.5 feet a "no wake" declaration is issued by the State Police Marine Division in Lake Hopatcong to reduce the potential for shoreline erosion and structural damage due to wake action. A "no wake" declaration negatively impacts recreational boating activities. So to the extent possible, elevations below 9.5 will be maintained. However, it is important to note that downstream flooding concerns will dictate how much water can be released from Lake Hopatcong and how quickly lake elevation may be reduced at any given time.

The flood elevation established by the United States Geological Survey for the gauge immediately downstream of Lake Hopatcong is 4 feet. However the Park Superintendent believes that downstream flooding concerns actually limit the discharge to 3.5 feet on the gauge. An elevation of 3.5 feet on this staff gauge is equivalent to a discharge of 213 CFS from Lake Hopatcong. At this rate of discharge, and assuming no additional water is entering the lake, the lake can be lowered by approximately 1.9 inches per day. The actual rate of allowable discharge will be determined by the superintendent based on flooding conditions downstream of Lake Hopatcong and shall be managed so as to avoid causing or increasing downstream flood damage and to ameliorate such damage when possible.

To minimize the potential for property damage, an annual lowering of 26 inches will be performed to prevent waterfront structures from ice damage. This also permits some minor maintenance to be completed along the shoreline. A static water level will be maintained until spring once ice has hardened. A more substantial drawdown of 60

inches will occur every five years to provide lakefront property owners time to perform more significant repairs or replacement of shoreline structures. To the extent feasible, any necessary dam maintenance/repair will be scheduled in accordance with this timetable.

Once ice has thawed in the spring the refilling of the lake will begin. In general, the Department has more control over lowering the lake level than raising it. The key ingredient to increasing the water level in the lake is precipitation. Adequate and consistent rainfall events are especially important to the lake considering its large size but relatively small drainage area that contains no significant tributaries. Average rainfall during the summer is about 4.5 inches per month. Each inch or rain typically raises the lake by two inches for a total increase of about 9 inches. The 12 CFS passing flow requirement, absent rainfall, would reduce the lake elevation by an estimated 3.6 inches per month. The evaporation loss of water from the lake would reduce the lake elevation by 4.3 to 4.5 inches per month.[6] Therefore, with normal rainfall the water surface elevation in the lake should remain relatively constant. However, precipitation is not distributed evenly over time periods and if rainfall is below average during the summer the water level in the lake will drop due to outflow from the lake and evaporation. Retaining water in the lake when rainfall is abundant is an important consideration. Consequently, this water level management plan recommends a conservative approach that will maintain the water level above the 9 foot spillway elevation, but below the 9.5 "no wake" elevation, when possible while continually meeting the 12 CFS passing flow requirement.

Schedule of Water Lowering Events

The LHWLMP includes an annual 26-inch lowering, and a 60-inch lowering to be performed every five years. The annual 26-inch drawdown of Lake Hopatcong is primarily intended to protect waterfront structures from ice damage that would be caused by fluctuating water levels once solid ice has formed on the lake. An ancillary benefit from the annual draw down is that it provides waterfront property owners and the municipalities the ability to perform minor maintenance, sediment and debris removal. The five-year, 60-inch drawdown provides an opportunity for property owners to schedule and perform more significant maintenance. It is noted that due to the bedrock geology beneath the lake, typical marine construction practices (e.g. driving of sheet pile and pilings) employed in the coastal waters of New Jersey cannot be applied everywhere in Lake Hopatcong. Consequently, many structures are supported by concrete or rock revetments and rock-filled crib structures. Maintenance of these structures typically cannot occur under water and would require coffer damming if the lake was not lowered. The five foot drawdown also provides some aquatic weed control benefits. The extent of

[6] A CDM report for the Water Supply Authority calculated summer evaporation at Lake Hopatcong during the summer of 1965 to average 4.3 inches per month. The National Oceanic and Atmospheric Administration calculated pan evaporation loss at the Canoe Brook Reservoir located in western Essex County NJ for the period between 1994-1997 at 6.4 inches per month. Lake evaporation is typically in the neighborhood of 70 percent of the pan evaporation loss or 4.5 inches per month.

weed control is dependent on winter weather conditions. Long, cold winters provide greater aquatic weed control benefits as the roots of the exposed plants are subject to frost and freezing. Snow cover on the lake for long durations also assists in controlling weeds in the lake.

Based upon the guidelines outlined in this Plan the schedule of future lowering events is:

Year	Maximum Scheduled Drawdown*	Elevation (gauge elevation)
2010	26”	6.83 ft
2011	26”	6.83 ft
2012	26”	6.83 ft
2013	60”	4 ft
2014	26”	6.83 ft
2015	26”	6.83 ft
2016	26”	6.83 ft
2017	26”	6.83 ft
2018	60”	4 ft

Summer Water Level Management

In order to protect the aquatic biota residing in the Musconetcong River downstream of the lake a minimum passing flow of 12 CFS, from the Lake Hopatcong Dam, has been established in previous versions of the LHWLMP. Maintaining minimum passing flows during the summer months are particularly critical to protecting the downstream coldwater aquatic resources. Hot, dry weather patterns during the summer result in natural increases in water temperatures. Elevated water temperatures and resulting decreases in dissolved oxygen levels stress fish and other aquatics, particularly so with coldwater species. Reduced or low flows exacerbate these already stressful conditions. Without rainfall the water surface elevation in the lake will generally fall due to the requirement to pass 12 CFS downstream and evaporation. In general, absent rainfall the lake elevation response to passing 12 CFS out of the lake is to lower the water surface by about 3.6 inches per month. However, evaporation losses through the summer months can further reduce the water elevation in the lake by an additional 4.5 inches per month for a total loss of 8.1 inches per month. Average monthly precipitation during the summer months is about 4.5 inches and each inch of precipitation results in about 2 inches of increased elevation in the lake for a total make up of 9 inches per month. Dry periods or extended periods of below normal rainfall will result in the water level in the lake dropping due to the passing flow and evaporation. Therefore the goal of water level management in the summer months is to maintain a surface elevation at or slightly above 9-feet (the spillway elevation) whenever possible while still maintaining the passing flow of 12 CFS (river gauge at 1.26 feet).

At an elevation of 9.5 feet a “no wake” declaration is issued by the State Police Marine Division in Lake Hopatcong to reduce the potential for shoreline erosion and structural damage due to wake action. Therefore, the goal of the Water Level Management Plan

during the summer months shall be to maintain a water surface elevation below 9.5 feet. However, it must be understood that downstream flooding concerns will dictate how much water can be released from Lake Hopatcong and how quickly the Lake elevation can be reduced. The flood elevation established by the United States Geological Survey for the gauge immediately downstream of Lake Hopatcong is 4 feet, though the Superintendent observes that the maximum discharge without causing potential damage downstream is likely 3.5 feet. An elevation of 4 feet on this staff gauge is equivalent to a discharge of 292 CFS from Lake Hopatcong. At 3.5 feet on the gauge the discharge is approximately 213 CFS. Based on these figures, and assuming no additional water is entering the Lake, the Lake can be lowered by about 1.9 to 2.6 inches per day.[7] The actual rate of allowable discharge will be determined by the Superintendent based on flooding conditions downstream of Lake Hopatcong and shall be managed so as to avoid causing or increasing downstream flood damage and to ameliorate such damage when possible.[8]

1) The required minimum passing flow of 12 CFS shall be met at all times unless a lower passing flow is dictated by the NJDEP Assistant Commissioner for Natural and Historic Resources. The gates and or fountain shall be operated to ensure that this condition is met.

2) The operational goal shall be to maintain the water level in the Lake at or slightly above 9 feet while meeting the required passing flow. When water spilling over the dam is sufficient to meet the 12 CFS passing flow all gates shall be closed, unless the water surface elevation is above 9.25 feet (9 feet, 3 inches) and rising.

3) The operational goal shall be to prevent the water level from reaching 9.5 feet.

Lake Response to Summer Rainfall

Starting lake elevation in feet	24 hour precipitation in inches					
	.5”	1”	1.5”	2”	2.5”	3”
9.0	9.08	9.17	9.25	9.33	9.42	9.5
9.1	9.18	9.27	9.35	9.43	9.52	9.6
9.2	9.28	9.37	9.45	9.53	9.62	9.7
9.3	9.38	9.47	9.55	9.63	9.72	9.8
9.4	9.48	9.57	9.65	9.73	9.82	9.9
9.5	9.58	9.67	9.75	9.83	9.92	10.0

[7] The lake will typically be at 9.5 feet only after significant rain, consequently it is likely that there will be additional water entering the lake during these times. Based on June 2010 data from the USGS gauges it appears that it may take about 4 days for water entering the lake to return to “normal.”

[8] It may take 6-8 hours for adjustments at the Hopatcong Dam to be apparent downstream at the Compac building located on Furnace Road in Stanhope.

Note: this chart is provided for informational and illustrative purposes only. The lake elevations reported here are based on a limited set of observations and the actual lake elevation response may vary due to the intensity and duration of rainfall, ground saturation and other factors.

4) 222 CFS would have to be released to reduce the Lake surface elevation by 2 inches (.17 feet) in a 24 hour period.

Gauge Height / Discharge Relationship

Gauge Height in Feet	Discharge in CFS	24 Hour Lake Elevation Response in Feet
1.15	8.2	.006
1.26	12	.01
1.97	50	.04
2.56	100	.075
3.02	150	.11
3.41	200	.15
3.75	250	.19
4.0	292	.22

Note: full gauge / discharge relationship available at: http://waterdata.usgs.gov/nwisweb/data/exsa_rat/01455500.rdb

Water Level Management Procedure
Annual 26 Inch Drawdown

Once hard ice three inches thick forms on Lake Hopatcong, rising or falling water elevation in the lake can dislodge piles, crib structures, revetments, boat house foundations and bulkheads or lift decking.[9] To reduce the potential for ice damage, Lake Hopatcong shall be drawn down 26 inches to a water surface elevation of 6.83 each winter. Releases from Lake Hopatcong shall be made over the course of the winter in response to precipitation and snow melt as necessary to maintain the water level as near to 6.83 as possible. However, if significant rainfall is followed by a hard freeze, it may be necessary to maintain the water level at an elevation above 6.83 feet to prevent the potential for ice damage from a falling water level. Ancillary benefits from the annual drawdown are to allow minor maintenance on waterfront structures, minor debris and silt removal and the control of rooted aquatic weeds, also known as macrophytes. The target water surface elevation for the annual drawdown shall be achieved by December 15th.[10]

Refilling the lake will begin once the condition of the ice has softened sufficiently to reduce the concern over damage, generally when the ice is less than 4 inches thick, (typically around March 15th). Even if ice has freed itself from the shoreline, thick ice

[9] In the prior plan "hard ice" was defined as ice capable of supporting 100 pounds. There is no defined thickness of ice that will support 100 pounds as its strength will vary depending on climatic factors as the ice was formed. As a general rule of thumb for the public, if people are walking on the ice, it is too thick to alter the water level without the prospect of causing property damage.

[10] Historical Note: The prior version of the plan (2000) started the 26-inch annual drawdown on November 1st at a rate of .75 inches per day.

floating on the lake is subject to movement due to wind, which could cause damage if it is blown into structures on the shoreline. Beginning on March 1st the Superintendent in charge of Hopatcong State Park, shall monitor ice conditions at several locations around the lake. Recommended ice monitoring locations are: Byram Cove, Woodport, Main Lake, Davis Cove, Henderson Cove, Great Cove, Bertrand Island, River Styx and the Hopatcong State Park.

The Lake Hopatcong Commission may advise the Superintendent responsible for Hopatcong State Park as to the ice condition on the Lake. However, the Superintendent shall have the sole discretion to determine when to begin refilling the Lake based on ice conditions around the Lake. The Superintendent shall advise the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board of his or her findings and decision to begin refilling of the lake or not. The Lake Hopatcong Commission may publicize the decision on its web-site.

Fall Drawdown Procedure

1) The Superintendent shall apply for a Lake Lowering Permit from the Division of Fish and Wildlife as required by N.J.S.A. 25:5-29 on or before August 1st.

2) If the Lake elevation is at 9 feet on November 12th the gates at the Lake Hopatcong Dam shall be opened to reduce the lake elevation .79 inch per day (.066 feet). The date of the initiation of the drawdown shall be adjusted based on the actual water surface elevation. For each .79 inch (.066 feet) departure from the 9-foot water surface elevation the drawdown date shall be moved up or back by one day. [11]

3) The .79 inch rate of drawdown requires a release of approximately 88 CFS. The gauge depth downstream of Lake Hopatcong to achieve 88 CFS is about 2.44 feet.

4) Figure 1 provides the target water surface elevation for each date during the drawdown. The release rate of water through the Lake Hopatcong Dam shall be adjusted in response to rainfall during the drawdown to maintain a lake elevation as close as possible to the target which corresponds to the date on figure 1. The public must understand that the .79 inch per day drawdown is the Department's target and that significant rainfall may temporarily result in a higher than predicted water surface elevation. If such an event occurs, it will be the Department's goal to accelerate the drawdown rate to achieve the target elevation as soon as possible. If the actual lake elevation in comparison

[11] In the fall of 2010 the Department operated the drawdown starting on November 19 with a rate of 1 inch per day. A two-inch rainfall event on December 1 caused the Department to miss the December 15 target date by seven days. The rainfall event was followed by very cold weather. Though the Department received no reports of ice damage to property from the falling water level, the Department is concerned that such damage may occur in the future. Based on this experience the Department has adjusted the schedule to begin the drawdown seven days earlier than in the draft plan.

with the chart indicates that the drawdown is proceeding too quickly (i.e. the lake elevation is below the target for the date) the outflow shall be reduced to slow the rate of the drawdown until the lake elevation equals the target elevation.

5) The Superintendent has the latitude to determine the maximum rate of release from Lake Hopatcong based on downstream conditions so as to avoid or minimize the potential for flood damage downstream.

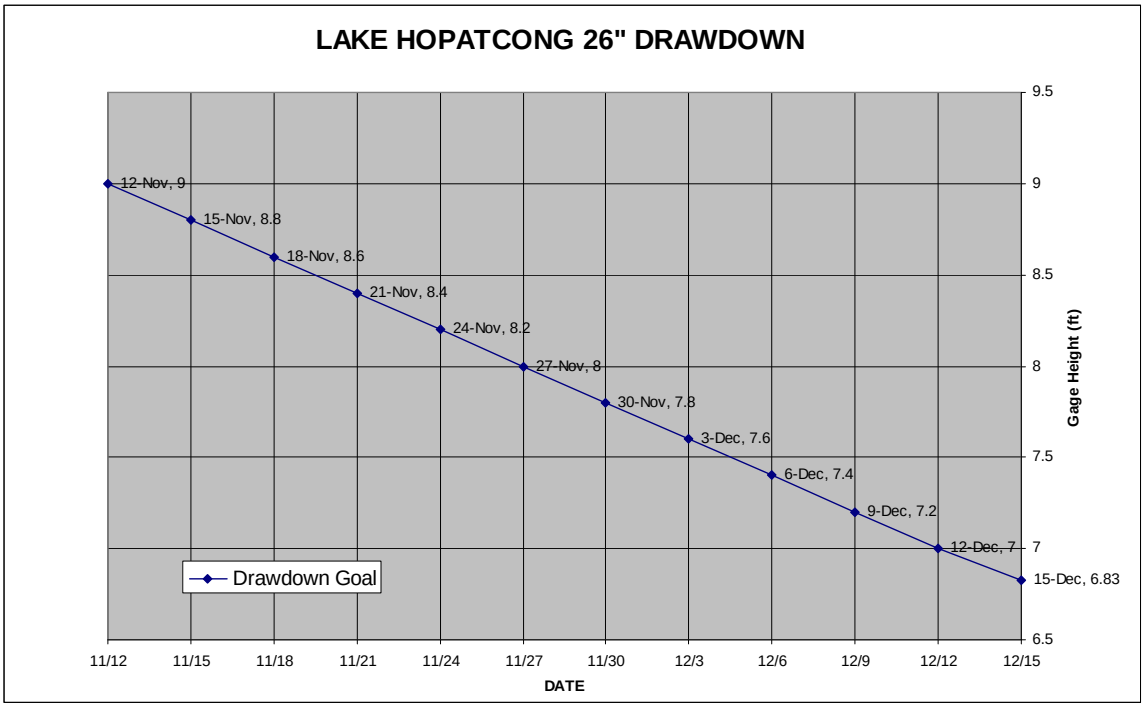


Figure 1: Lake Elevation Goal on each date during the 26 inch drawdown

Winter Maintenance Procedure

1) Water shall be released throughout the winter as required to meet the required 12 CFS passing flow. The release of water shall be adjusted as needed throughout the winter in response to rainfall or melting snow to maintain the water elevation in the lake as near as possible to 6.83 feet. Based on a limited set of recent observations in winter, an inch of rainfall will raise the lake surface elevation by about 4 inches. Based on personal experience the Superintendent believes the maximum discharge that can be safely released by Lake Hopatcong is 3.5 feet or 213 CFS.[12] This maximum rate of discharge would reduce the lake surface elevation by 1.92 inches (.16 feet) in 24-hours. Consequently, maintaining the Lake elevation following any 24 hour rainfall event over an inch may not be possible if a hard freeze follows within 24

[12] United States Geological Survey estimates four feet as measured on the stream gauge immediately downstream of Lake Hopatcong as flood stage at this location.

hours. The Superintendent shall aggressively release water as downstream conditions permit in an attempt to maintain a static water surface elevation.

2) The Park Superintendent shall have the discretion to determine the rate of release from Lake Hopatcong Dam considering downstream flooding potential. The Park Superintendent shall have the discretion to maintain a higher lake elevation following a significant rainfall, if in the opinion of the Superintendent the risk of ice damage caused by lowering the water surface in the lake is unacceptable.

Lake Response to Winter Rainfall

Starting lake elevation in feet	24 hour precipitation in inches					
	.5”	1”	1.5”	2”	2.5”	3”
6.83	6.83	7.00	7.17	7.33	7.50	7.67

Note: This chart is provided for general information only and to illustrate that it may not be possible to maintain a static water elevation if significant rainfall occurs. The lake elevations reported here are based on a limited set of observations and the actual lake elevation response may vary due to the intensity and duration of rainfall, ground saturation and other factors. The predicted elevations assume maximum rate of discharge for all rainfall events over .5 inches.

Spring Refill Procedure

1) The timing of refilling shall be determined by the Superintendent in charge of Hopatcong State Park. Beginning on March 1st the Superintendent shall monitor ice conditions on the Lake. Recommended ice monitoring locations are: Byram Cove, Woodport, Main Lake, Davis Cove, Henderson Cove, Great Cove, Bertrand Island, River Styx and the Hopatcong State Park.

2) Refilling the lake will begin once the condition of the ice has softened sufficiently to reduce the concern over damage (generally less than 4 inches thick or when the ice will no longer support 100 lbs.) Once ice conditions are deemed safe, the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board shall be notified and all gates on the Lake Hopatcong Dam shall be closed except as necessary to maintain a passing flow of 12 CFS (1.26 feet on the gauge below the dam).

3) Once the gates are closed, the summer water level management procedure shall be followed (above).

Water Level Management Procedure
Five-Year 60-Inch (5 foot) Drawdown
Last 60-inch Drawdown 2008-09
Next Scheduled 60-inch Drawdown 2013-14

Depth to bedrock in places around the Lake prevents typical marine construction techniques (such as driving of pilings for docks and sheetpile for bulkheads) from being

employed. The purpose of the five-foot drawdown is to allow access to waterfront structures for inspection and maintenance. If the Lake were not drawn down, a cofferdam would have to be installed around work sites significantly increasing the cost of repairs. A drawdown also allows an inspection/repair of boat house foundations without hiring divers which can be expensive. Ancillary benefits to the five foot drawdown is that it allows clean up of the Lake bed, removing trash and debris and also seems to have the beneficial impact of reducing aquatic weeds in the following season. In the event that dam repairs or maintenance is required, the Department will schedule those repairs to coincide with the scheduled 5-foot drawdown whenever possible (see emergency conditions section).

Because the purpose of the five foot drawdown is to allow maintenance work on waterfront structures the drawdown must take place before winter weather makes it impossible to conduct repairs. The target date for completing the 60-inch drawdown is November 1st. At a proposed drawdown rate of 1.5 inches per day and assuming the water surface elevation in the lake is 9 feet, the drawdown would begin on September 22nd. The date of initiation of the drawdown will be adjusted based on the actual water surface elevation in the lake: 1 day earlier or later for each 1.5 inch departure from the 9-foot starting elevation. The Department will attempt to manage the drawdown to meet the corresponding target elevations on the dates reflected in Figure 2. Because the drawdown rate has been increased in this plan to three-quarters of the 1.9 inch maximum, the Department's ability to achieve the targets after rainfall will be more difficult. In the event that the lake elevation is higher than the target on any given date, the Department will accelerate, or maintain an accelerated drawdown rate until the water surface elevation is back on target. [13]

The drawdown schedule was designed to provide a water surface elevation of about 4 feet long enough to allow a reasonable opportunity to complete repairs: from November 1 until December 15. It should be noted that depending on the depth to bottom at any particular location repairs may begin before the drawdown is complete and continue after refilling begins. Refilling will begin on December 15th so that the water elevation in the lake can be maximized before hard ice forms on the lake (usually around the first week of January). This will assist in the recovery of the water level in the lake prior to the beginning of the boating season. In the event that an elevation of 6.83 feet (the level of the 26 inch annual drawdown) is achieved before hard ice forms, the Department will maintain that elevation in accordance with the procedures established for the 26 inch drawdown (above).

Historical Note: The prior edition of the plan started the drawdown on the day after Labor Day with a target end date of November 1st. This edition of the Water Level Management Plan proposes to increase the rate of drawdown from 1 inch per day to 1.5 inches per day so that the boating season can be extended by two weeks.

[13] Based on the difficulty experienced in 2010 while trying to achieve a one-inch per day drop in lake elevation (see footnote one above), the Department will need to reevaluate whether the target 1.5 inch reduction in lake elevation can be accomplished. A final determination will be made during the winter 2012 annual review.

Fall Drawdown Procedure:

1) Superintendent of the Hopatcong State Park shall apply for a Lake Lowering Permit on or before August 1st.

2) On September 1st Superintendent shall contact the Director of the Division of Water Supply to determine whether the 60-inch drawdown will proceed as scheduled. If drought or near drought conditions exist on September 1st the 60 inch drawdown may be postponed to the following year. Results of that contact shall be made known to the Lake Hopatcong Commission.

3) Assuming a water surface elevation of 9 feet: on September 22nd, the gates of the Lake Hopatcong Dam shall be opened to release sufficient water to reduce the surface elevation by 1.5 inches per day. Under dry conditions, 167 CFS would have to be released to reduce the water surface elevation by 1.5 inches per day. 167 CFS is roughly 3 feet on the stream gauge located downstream of the Lake Hopatcong Dam. If the lake elevation is more or less than 9 feet the start date shall be adjusted up or back by one day for each 1.5 inch departure from 9 feet.

4) Figure 2 provides the target water surface elevation for each date during the drawdown. The release rate of water through the Lake Hopatcong Dam shall be adjusted in response to rainfall during the drawdown to maintain a lake elevation as close as possible to the target which corresponds to the date on figure 2. The public must understand that the 1.5 inch per day drawdown is the Department's target and that significant rainfall may temporarily result in a higher than predicted water surface elevation. If such an event occurs, it will be the Department's goal to accelerate the drawdown rate to achieve the target elevation as soon as safely possible. In the event that the drawdown results in a lower water surface elevation than the target elevation the rate of release shall be slowed until the target elevation has been achieved.

5) The Superintendent has the latitude to determine the maximum rate of release from Lake Hopatcong based on downstream conditions so as to avoid or minimize the potential for flood damage downstream.

6) The target is to complete the 60 inch drawdown by November 1st and to maintain a water surface elevation in the lake of 4-feet until December 15th by adjusting the gates in response to precipitation. However the minimum downstream passing flow of 12 CFS must be met at all times.

Ice creep along shoreline of Lake Hopatcong

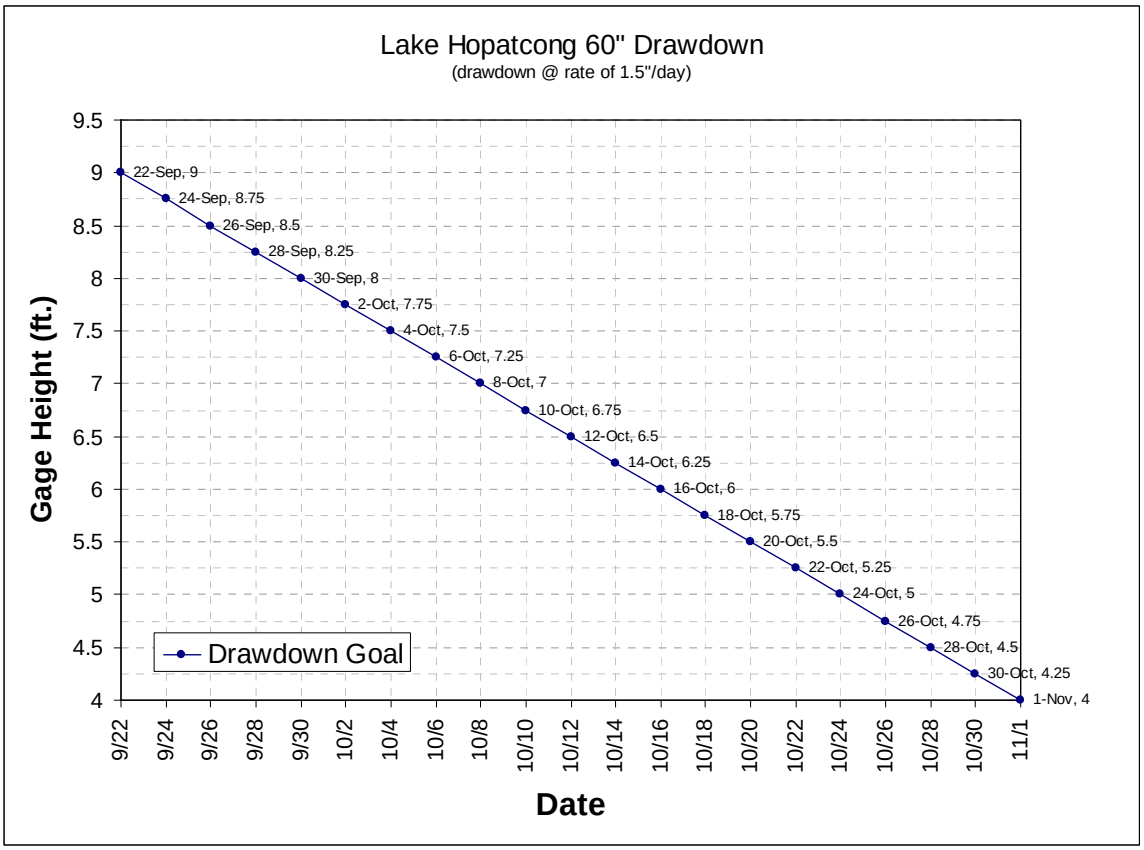


Figure 2: Lake Elevation Goal on each date during the 60 inch drawdown

Winter Refill Procedure:

1) On December 15th the gates shall be adjusted so that only the 12 CFS passing flow is released, (1.26 feet on the stream gauge downstream of the dam) thereby allowing the water level to rise until hard ice forms on the lake. The Lake Hopatcong Commission shall be notified when the gates are closed, and when the Superintendent determines to maintain the water elevation due to ice conditions.

2) If the water surface elevation in the lake reaches 6.83 feet before hard ice forms on the lake, that water surface elevation shall be maintained throughout the winter in accordance with the winter maintenance procedures listed for the 26-inch drawdown above.

3) When hard ice forms on the lake the gates shall be operated to regulate the release rate as necessary to maintain that water level or the 12 CFS passing flow whichever is greater. If, in the opinion of the Park Superintendent, ice conditions on the lake during the winter do not present a significant risk of property damage if the water level is allowed to rise then the Superintendent shall reduce the outflow from the lake and allow the water surface elevation to rise to a maximum of 6.83 feet. If hard ice reforms on the lake, the new water surface elevation shall be maintained.

4) In winter an inch of rainfall will raise the lake surface elevation by about 4 inches. Based on personal experience the Superintendent believes the maximum discharge from Lake Hopatcong without causing downstream flooding to be 3.5 feet or 213 CFS. This maximum rate of discharge would reduce the lake surface elevation by 1.92 inches (.16 feet) in 24-hours. Consequently, maintaining the Lake elevation following any 24 hour rainfall event over an inch may not be possible if a hard freeze follows within 24 hours. At any time that the water level increases over the winter, the Superintendent has the discretion to set a new water level to be maintained provided that the water level is not higher than 6.83 feet or if the level is above 6.83 feet if in the opinion of the Superintendent lowering the water level poses a greater threat of property damage than maintaining the newly established water level.

5) The Park Superintendent shall have the discretion to determine the rate of release from Lake Hopatcong Dam considering downstream flooding potential. The Park Superintendent shall have the discretion to maintain a higher lake elevation following a significant rainfall, if in the opinion of the Superintendent the risk of ice damage caused by lowering the water surface in the lake is unacceptable.

Spring Refill Procedure:

1) The timing of refilling shall be determined by the Superintendent in charge of Hopatcong State Park. Beginning on March 1st the Superintendent shall monitor ice conditions on the Lake. Recommended ice monitoring locations are: Byram Cove, Woodport, Main Lake, Davis Cove, Henderson Cove, Great Cove, Bertrand Island, River Styx and the Hopatcong State Park.

2) Refilling the lake will begin once the condition of the ice has softened sufficiently to reduce the concern over damage, (generally when the ice is

less than 4 inches thick and unable to support 100 pounds). Once ice conditions are deemed safe, the Lake Hopatcong Commission shall be notified and all gates on the Lake Hopatcong Dam shall be closed except as necessary to maintain a passing flow of 12 CFS (1.26 feet on the gauge below the dam).

3) Once the gates are closed, the summer water level management procedure (above) shall be followed.

CHANGES FROM NORMAL OPERATION

Imminent Danger

The Superintendent in charge of Hopatcong State Park shall have the discretion and authority to adjust the settings at the Lake Hopatcong Dam at all times as necessary to respond to specific local conditions for the protection of life and property at Lake Hopatcong and downstream of Lake Hopatcong. The Superintendent shall report any emergency actions to the Director of the Division of Parks and Forestry and the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board as soon as possible after those actions are taken.

Drought

If a drought warning is declared by the Commissioner of the Department of Environmental Protection, or a water supply emergency is declared by the Governor, the Assistant Commissioner for Natural and Historic Resources[14] shall consult with the Assistant Commissioner for Water Resources[15] to determine whether a departure from the Lake Hopatcong Water Level Management Plan is warranted. This could affect the drawdown schedule particularly the five-year 60-inch drawdown, as well a reduction in the passing flow out of Lake Hopatcong. Any deviation from the Lake Hopatcong Water Level Management Plan shall be immediately communicated to the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board so that it may be broadcast on the Commission's web-site. During the 2002 drought the Department calculated an absolute minimum passing flow of 6.8 CFS at the Musconetcong Sewerage Authority based on ammonia toxicity.

Also the Delaware River Basin Compact allows the Delaware River Basin Commission to order releases from Lake Hopatcong of up to 75 CFS down to elevation 915.2 feet (18 CFR Part 410, 2.5.6D.3.b.viii, D.3.f., E.3.a.) during water emergencies.

Spring Lake Water Level Recovery

[14] The Assistant Commissioner for Natural Resources oversees the Division of Parks and Forestry and the Division of Fish and Wildlife. It is the expectation of this plan that the Directors of those divisions will be consulted as part of any decision making involving the Assistant Commissioner for Natural Resources.
[15] The Assistant Commissioner for Water Resources oversees the Division of Water Supply and the Division of Water Quality. It is the expectation of this plan that the Directors of those divisions will be consulted as part of any decision making involving the Assistant Commissioner for Water Resources.

In the event that spring precipitation for any preceding three months is less than seven (7) inches in aggregate, (eight inches following a 60 inch drawdown) the Assistant Commissioner for Natural and Historic Resources, after consultation with, and upon the advice and consent from, the Commissioner for Water Resources may reduce the passing flow out of Lake Hopatcong below the normal 12 CFS passing flow. The outflow from Lake Hopatcong will not be altered in response to low water levels in the lake unless the potential impacts to downstream resources are minimal.

In determining whether potential downstream impacts are minimal, the Department shall consider the flow conditions in the Musconetcong River downstream to ensure that adequate dilution exists at the Musconetcong Sewerage Authority discharge to avoid acute or chronic toxicity in the receiving waters. The Department shall monitor temperature, and/or other facets of stream habitat in the Musconetcong River at various locations downstream of Lake Hopatcong as it deems necessary to monitor conditions in the River and the importance of the Lake Hopatcong discharge in maintaining water quality (see Appendix E for locations and procedures).

Presently the Musconetcong River downstream of Lake Hopatcong is classified as FW2-Trout Maintenance (N.J.A.C. 7:9B-1.15(c)). The temperature criterion for trout maintenance waters is not to exceed an absolute maximum of 25 degrees Celsius (77^0 F) and not to exceed a rolling seven day average of maximum temperatures of 23 degrees Celsius (73.4^0 F) (N.J.A.C. 7:9B-1.14(d)11.). The dissolved oxygen criterion for Trout Maintenance waters is not less than 6 parts per million (ppm) as a 24-hour average concentration and no instantaneous concentration of less than 5 ppm. It must be noted that the Department does not have continuous monitoring equipment at its disposal and therefore samples will typically consist of “grab” samples taken during the afternoon. The Department will use best professional judgment taking into consideration factors which may include, but are not limited to, current river conditions, prevailing weather conditions, forecasted weather conditions, time of year relative to weather patterns, spawning seasons, recreational activities, stocking programs and lake levels in making a final determination as to whether outflow from Lake Hopatcong can be reduced. The Department will monitor stream conditions, as it deems necessary, during any period of reduced flow. Flow will be returned to the 12 CFS minimum passing flow level if changing conditions or the Department’s monitoring indicate an impact or potential impact to the river system and its ecology.

Table 1. Northern New Jersey 3-month precipitation totals, with months < 7" highlighted

7	Precipitation 3-month totals, northern New Jersey											
	01	02	03	04	05	06	07	08	09	10	11	12
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979	17.8	19.6	18.49	12.07	14.17	13.84	13.12	11.48	15.77	16.55	15.34	10.07
1980	7.91	5.33	10.39	15.67	17.19	13.2	9.27	8.45	6.8	7.87	9.48	8.45
1981	4.66	6.91	7.53	10.53	10.13	12.51	14.34	10.63	10.67	9.27	9.25	10.22
1982	11.21	12.54	10.19	11.05	11.21	14.95	12.47	12.92	9.98	8.16	8.48	7.08
1983	9.67	8.97	15.69	21.87	24.23	19.61	11.96	9.88	8.62	11.63	14.16	20.38
1984	16.74	15.03	12.3	16.09	21.92	19.24	22.78	14.72	13.48	7.65	8.39	9.66
1985	7.16	6.88	5.09	5.13	8.47	12.11	15.49	13.66	14.44	11.64	15.46	11.02
1986	13.85	10.08	10.75	12.22	9.99	11.12	11.15	14.66	14.05	10.09	11.96	14.41
1987	17.12	10.97	8.62	10.14	11.33	12.08	11.92	14.99	17.05	15.65	13.93	10.15
1988	8.22	8.85	9.29	8.65	10.19	8.83	15.2	12.98	14.76	8.79	12.86	11.32
1989	10.6	5.92	8.6	10	17.16	19.9	20.7	15.42	17.17	19.18	17.35	9.56
1990	8.51	7.74	9.95	8.31	15.01	15.57	16.59	16.6	15.55	17.02	11.41	15.12
1991	12.65	11.14	9.9	10.58	11.95	10.29	10.62	12.12	13.96	11.77	9.76	8.49
1992	8.46	7.61	7.75	7.67	9.09	11.58	14.2	15.11	12.57	9.39	11.28	12.27
1993	13.54	10.56	12.39	15.05	13.09	9.52	5.96	8.21	11.27	13.55	14.13	12.4
1994	13.8	13.29	14.74	12.48	12.84	12.28	13.63	15.87	13.34	9.91	8.26	8.2
1995	10.42	8.61	8.1	6.52	7.5	7.69	10.92	8.74	10.62	13.8	18	16
1996	14.3	11.19	13.15	12.08	13.19	14.28	16.62	15.48	16.49	16.44	17.36	19.04
1997	14.82	13.38	9.73	9.94	11.57	9.81	12.12	12.98	13.39	9.41	9.25	10.32
1998	11.92	12.51	12.58	14.54	16.74	18.89	14.96	11.08	7.11	8.35	6.73	5.47
1999	9.96	11.33	15.46	10.35	10.89	6.78	5.41	7.07	18.05	20.19	17.97	8.7
2000	8.75	8.16	8.94	9.38	12.04	13.3	15.53	16.24	15.35	10.45	7.98	8.63
2001	10.28	9.88	10.82	10.03	11.12	11.77	12.61	11.93	10.08	8.13	6.17	4.29
2002	5.38	5.08	6.56	9.01	13.25	14.78	11.96	10.77	9.68	15.29	16.3	16.42
2003	12.33	11.72	11.72	11.61	11.28	16.74	17.4	19.96	17.34	19.66	17.46	16.61
2004	13.17	11.35	7.88	10.53	12.72	12.59	16.31	16	22.04	14.86	15.14	10.2
2005	13.47	11.55	12.38	11.89	10.78	10.03	9.61	9.63	7.42	17.95	20.56	22.31
2006	13.19	11.25	8.55	7.17	8.44	16.25	17.52	18.04	14.43	16.31	18.37	15.71
2007	12.05	7.78	10.23	18.11	18.22	17.85	12.83	17.55	14.22	13.59	9.67	13.95
2008	10.16	13.6	13.13	14.13	12.21	10.7	12.02	10.26	13.92	13.55	13.92	13.61
2009	12.45	10.26	5.3	6.12	10.35	16.03	18.3	20.25	15.04	14.8	9.28	13.98
2010	10.8	14.4	17.6	18.2	16.54	8.83	8.92	9.16	10.15	12.81	11.61	11.74

Table 2. Northern New Jersey 3-month precipitation totals, with months < 8" highlighted

8	Precipitation 3-month totals, northern New Jersey											
	01	02	03	04	05	06	07	08	09	10	11	12
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1979	17.8	19.6	18.49	12.07	14.17	13.84	13.12	11.48	15.77	16.55	15.34	10.07
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1984	16.74	15.03	12.3	16.09	21.92	19.24	22.78	14.72	13.48	7.65	8.39	9.66
1985	7.16	6.88	5.09	5.13	8.47	12.11	15.49	13.66	14.44	11.64	15.46	11.02
1986	13.85	10.08	10.75	12.22	9.99	11.12	11.15	14.66	14.05	10.09	11.96	14.41
1987	17.12	10.97	8.62	10.14	11.33	12.08	11.92	14.99	17.05	15.65	13.93	10.15
1988	8.22	8.85	9.29	8.65	10.19	8.83	15.2	12.98	14.76	8.79	12.86	11.32
1989	10.6	5.92	8.6	10	17.16	19.9	20.7	15.42	17.17	19.18	17.35	9.56
1990	8.51	7.74	9.95	8.31	15.01	15.57	16.59	16.6	15.55	17.02	11.41	15.12
1991	12.65	11.14	9.9	10.58	11.95	10.29	10.62	12.12	13.96	11.77	9.76	8.49
1992	8.46	7.61	7.75	7.67	9.09	11.58	14.2	15.11	12.57	9.39	11.28	12.27
1993	13.54	10.56	12.39	15.05	13.09	9.52	5.96	8.21	11.27	13.55	14.13	12.4
1994	13.8	13.29	14.74	12.48	12.84	12.28	13.63	15.87	13.34	9.91	8.26	8.2
1995	10.42	8.61	8.1	6.52	7.5	7.69	10.92	8.74	10.62	13.8	18	16
1996	14.3	11.19	13.15	12.08	13.19	14.28	16.62	15.48	16.49	16.44	17.36	19.04
1997	14.82	13.38	9.73	9.94	11.57	9.81	12.12	12.98	13.39	9.41	9.25	10.32
1998	11.92	12.51	12.58	14.54	16.74	18.89	14.96	11.08	7.11	8.35	6.73	5.47
1999	9.96	11.33	15.46	10.35	10.89	6.78	5.41	7.07	18.05	20.19	17.97	8.7
2000	8.75	8.16	8.94	9.38	12.04	13.3	15.53	16.24	15.35	10.45	7.98	8.63
2001	10.28	9.88	10.82	10.03	11.12	11.77	12.61	11.93	10.08	8.13	6.17	4.29
2002	5.38	5.08	6.56	9.01	13.25	14.78	11.96	10.77	9.68	15.29	16.3	16.42
2003	12.33	11.72	11.72	11.61	11.28	16.74	17.4	19.96	17.34	19.66	17.46	16.61
2004	13.17	11.35	7.88	10.53	12.72	12.59	16.31	16	22.04	14.86	15.14	10.2
2005	13.47	11.55	12.38	11.89	10.78	10.03	9.61	9.63	7.42	17.95	20.56	22.31
2006	13.19	11.25	8.55	7.17	8.44	16.25	17.52	18.04	14.43	16.31	18.37	15.71
2007	12.05	7.78	10.23	18.11	18.22	17.85	12.83	17.55	14.22	13.59	9.67	13.95
2008	10.16	13.6	13.13	14.13	12.21	10.7	12.02	10.26	13.92	13.55	13.92	13.61
2009	12.45	10.26	5.3	6.12	10.35	16.03	18.3	20.25	15.04	14.8	9.28	13.98
2010	10.8	14.4	17.6	18.2	16.54	8.83	8.92	9.16	10.15	12.81	11.61	11.74

Low Water

In the event that the summer water surface elevation drops more than a foot below the normal levels identified in this plan (i.e. 8 feet or below), the Superintendent of Hopatcong State Park shall notify the Director of the Division of Parks and Forestry and the Assistant Commissioner for Natural and Historic Resources. The Superintendent shall also advise the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board that a low water condition exists. The Assistant Commissioner for Natural and Historic Resources after consultation with the Assistant Commissioner for Water Resources shall determine whether any reduction of the 12 CFS passing flow should be implemented.

In determining whether potential downstream impacts are minimal, the Department shall consider the flow conditions in the Musconetcong River downstream to ensure that adequate dilution exists at the Musconetcong Sewerage Authority discharge to avoid acute or chronic toxicity in the receiving waters. The Department shall monitor temperature, and/or other facets of stream habitat in the Musconetcong River at various locations downstream of Lake Hopatcong as it deems necessary to monitor conditions in the River and the importance of the Lake Hopatcong discharge in maintaining water quality (see Appendix E for locations and procedures).

Presently the Musconetcong River downstream of Lake Hopatcong is classified as FW2-Trout Maintenance (N.J.A.C. 7:9B-1.15(c)). The temperature criterion for trout maintenance waters is not to exceed an absolute maximum of 25 degrees Celsius (77^0 F) and not to exceed a rolling seven day average of maximum temperatures of 23 degrees Celsius (73.4^0 F) (N.J.A.C. 7:9B-1.14(d)11.). The dissolved oxygen criterion for Trout Maintenance waters is not less than 6 parts per million (ppm) as a 24-hour average concentration and no instantaneous concentration of less than 5 ppm. It must be noted that the Department does not have continuous monitoring equipment at its disposal and therefore samples will typically consist of "grab" samples taken during the afternoon. The Department will use best professional judgment taking into consideration factors which may include, but are not limited to, current river conditions, prevailing weather conditions, forecasted weather conditions, time of year relative to weather patterns, spawning seasons, recreational activities, stocking programs and lake levels in making a final determination as to whether outflow from Lake Hopatcong can be reduced. The Department will monitor stream conditions, as it deems necessary, during any period of reduced flow. Flow will be returned to the 12 CFS minimum passing flow level if changing conditions or the Department's monitoring indicate an impact or potential impact to the river system and its ecology.

Based on these discussions, the Assistant Commissioner for Natural and Historic Resources shall advise the Superintendent of any adjustments. The Superintendent shall notify the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board of any change in the passing flow. The outflow from Lake Hopatcong will not be altered in response to low water levels in the lake unless the potential impacts to downstream resources are minimal. Once a decision has been made to reduce the outflow the reduced outflow shall be maintained until the pool elevation in the lake

reaches 9 feet, unless changes in downstream conditions indicate an impact or potential impact to the River system or its ecology. The Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board shall be notified whenever adjustments to the passing flow are made pursuant to this paragraph and the reasons therefore.

Emergency Lake Lowering

The Division of Parks and Forestry will attempt to schedule repairs to the Lake Hopatcong Dam during the regularly scheduled 5-year 60 inch drawdown. However, in the event that emergency repairs are necessary, the Division of Parks and Forestry may implement an unscheduled drawdown of 60 or 84 inches. The Superintendent shall give as much notice as possible to the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board of any unscheduled drawdown, the reason for the drawdown, the depth of the drawdown and an approximate schedule for initiation and rate of the drawdown, and an estimate of the date refilling is expected to begin.

ROLES AND RESPONSIBILITIES

I. ASSISTANT COMMISSIONER FOR NATURAL RESOURCES

Assistant Commissioner Amy Cradic – (609) 292-3541

The Assistant Commissioner for Natural and Historic Resources oversees the Division of Parks and Forestry and the Division of Fish and Wildlife (among others). The Assistant Commissioner for Natural Resources shall have the authority to respond to abnormal circumstances, such as those outlined above, and order a deviation from normal operation under this plan. Any such order shall occur only after consultation with the Assistant Commissioner for Water Resources, who oversees the Division of Water Supply and the Division of Water Quality. The Assistant Commissioners shall draw upon the expertise under their aegis in making any such decision.

A. DIVISION OF PARKS AND FORESTRY

1. Director – John Trontis - (609) 292-2733

- The Director of the Division of Parks and Forestry shall consult with the Division Director of the Division of Fish and Wildlife, the Director of the Division of Water Supply and the Director of the Division of Water Quality to advise the Assistant Commissioner for Natural and Historic Resources whether adjustments to the passing flow can be accommodated in the event of inadequate rainfall during spring refilling or if the water surface elevation falls below eight (8) feet during the summer season.

- In the event of a drought emergency or drought warning, the Director of Parks and Forestry shall consult with the Division Director of the Division of Fish and Wildlife, the Director of the Division of Water Supply and the Director of the

Division of Water Quality to advise the Assistant Commissioner for Natural and Historic Resources whether any departure from this plan is required. If a departure from this plan is required, the Director of Parks and Forestry shall direct the Superintendent of the actions to be taken with regard to water level management.

2. Superintendent – Helen Maurella – (973) 398-7010

- The Superintendent shall direct operation of the water control structure at the Lake Hopatcong Dam in accordance with this plan or as otherwise directed by the Assistant Commissioner for Natural and Historic Resources.

- The Superintendent shall advise the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board of any departures from the procedures established in the Lake Hopatcong Water Level Management Plan, and the reasons therefore. The Superintendent shall also advise the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board when operations according to the Lake Hopatcong Water Level Management Plan are resumed.

- The Superintendent in charge of Hopatcong State Park shall have the discretion and authority to adjust the settings at the Lake Hopatcong Dam at all times as necessary to respond to specific local conditions for the protection of life and property at Lake Hopatcong and downstream of Lake Hopatcong. The Superintendent shall report any emergency actions to the Director of the Division of Parks and Forestry, and the Lake Hopatcong Commission the Lake Musconetcong Regional Planning Board as soon as possible after those actions are taken.

- Upon inspection of ice conditions at several locations around the lake, determine when spring refilling can commence. Notify the Director of the Division of Parks and Forestry, and the Lake Hopatcong Commission and the Lake Musconetcong Regional Planning Board when such a decision is made.

- The Superintendent may request from the Assistant Commissioner for Natural and Historic Resources, through the Division Director as appropriate, approval to reduce the outflow from Lake Hopatcong due to difficulty recovering the 9-foot normal water level in the spring, or if the lake water surface elevation falls below eight (8) feet during the summer season.

- Maintain accurate and complete records in regards to the operation of the gate, fountain, and overflow from the Lake Hopatcong dam, and reasons for adjustments for there operation as they occur.

B. DIVISION OF FISH AND WILDLIFE

1. Director – David Chanda – (609) 292-9410

- Assure that Water Lowering Permits are consistent with the procedures established in the Lake Hopatcong Water Level Management Plan.

- In the event that a potential reduction in passing flow is requested by the Park Superintendent, direct resources to assess stream conditions and current weather patterns to determine if minimum passing flows can be temporarily reduced to 8.2 CFS, or other outflow as may be required under drought conditions, without jeopardizing the downstream aquatic resources. If such a reduction is made, then the Division will monitor stream and weather conditions to determine when a minimum passing flow of 12 CFS must be reinstated to protect downstream resources.

II. ASSISTANT COMMISSIONER FOR WATER RESOURCES

Assistant Commissioner John Plonski – (609) 292-4543

The Assistant Commissioner for Water Resources shall advise the Assistant Commissioner for Natural and Historic Resources of any drought warning or drought emergency declaration, which may warrant an alteration, either an increase or decrease, of the outflow from Lake Hopatcong. The Assistant Commissioner for Water Resources shall make such recommendation in consultation with the Director of the Division of Water Supply and the Director of the Division of Water Quality. The Assistant Commissioner for Water Resources shall also provide consultation with respect to water quantity or quality at the request of the Assistant Commissioner for Natural and Historic Resources prior to any departure from normal operation of the Lake Hopatcong Dam.

A. DIVISION OF WATER SUPPLY

Director – Fred Sickels – (609) 292-7219

- In the event of a drought warning or water supply emergency, the Director of the Division of Water Supply shall advise the Assistant Commissioner for Water Resources, the Director of the Division of Parks and Forestry and the Director of the Division of Fish and Wildlife of any recommended departure from the Lake Hopatcong Water Level Management Plan required to ensure adequate water supply for the residents of the State. Drought warnings are declared by the Commissioner of the Department of Environmental Protection. Water supply emergencies are declared by the Governor.

B. DIVISION OF WATER QUALITY

Director – Michele Putnam – (609) 292-4543

- In the event that a decrease in the outflow from Lake Hopatcong is requested the Director of the Division of Water Quality shall provide consultation to ensure that adequate dilution of regulated point source discharges, such as the Musconetcong Sewerage Authority, is maintained. The Director of the Division of Water Supply shall be responsible to recalculate required dilution as necessary and provide information to the Assistant Commissioner for Water Resources.

III. LAKE HOPATCONG COMMISSION – (973)-601-1070

A. Chairman – Mayor Russ Felter, Jefferson Township
Administrator – Donna Macalle-Holly

- As a courtesy to the public, the Lake Hopatcong Commission shall prominently post information of significant operational activities, such as commencement of lowering or refilling, as well as any departures from this water level management plan on its web-site.

- Concerns and recommendations from the general public over the management of the Lake Hopatcong water level may be directed to the Lake Hopatcong Commission.

- The Lake Hopatcong Commission shall relay any concerns over the management of the Lake Hopatcong water level to the Superintendent or the Assistant Commissioner for Natural and Historic Resources as appropriate.

- The Lake Hopatcong Commission may make recommendations to the Superintendent concerning the water level in the Lake and may make requests for special management measures to the Director of the Division of Parks and Forestry or the Assistant Commissioner for Natural and Historic Resources.

B. Commissioner's Representative on the Lake Hopatcong Commission
Representative – Kerry Kirk-Pflugh – (609) 622-7242

- Facilitate annual reviews of the Lake Hopatcong Water Level Management Plan with members of the Citizens Advisory Committee, Lake Hopatcong Commission and the Division of Parks and Forestry and Division of Fish and Wildlife.

- Incorporate any necessary changes to the procedures outlined within this plan based upon annual review.

- Assist with the communication between the Department and the Lake Hopatcong Commission concerning any required departure from this plan and the reasons therefore.

- Facilitate succession planning by arranging meetings and briefings between the Lake Hopatcong Commission and any newly appointed Assistant Commissioner for Natural and Historic Resources, Director of the Division of Parks and Forestry or Superintendent of the Hopatcong State Park.

ANNUAL REVIEW

This water level management plan shall be reviewed annually prior to April 1 to determine whether adjustments to the plan are required. The annual review shall include the Lake Hopatcong Commission and a citizens advisory committee made up of representatives from each of the following: the Lake Hopatcong Commission, Mount Arlington, Hopatcong, Jefferson, Roxbury, the Lake Hopatcong Alliance, the Lake Musconetcong Regional Planning Board and the Musconetcong Watershed Association. The first such reexamination of the draft plan occurred in February 2011 and reviewed the 2010 fall drawdown. The next reexamination shall occur before April 1, 2012 and shall review the spring 2011 refill and the fall 2011 drawdown.

Appendix A - Lake Hopatcong and Watershed Statistics

Lake Hopatcong Surface Area - source
2658 acres – Lake Hopatcong Commission
2,658 * 43,560 sq.ft. / acre = 115,782,480 sq. ft.

Lake Hopatcong Watershed Area (to dam) – source
25.3 square miles – United States Geological Survey
16,192 acres = 25.3 sq. mi. * 640 acres / sq. mi. (includes surface area of the lake)

Lake Musconetcong Surface Area - source
315 acres - NJDEP Lakes coverage based on 2002 land use coverage – (GIS Calculated Area)

Lake Musconetcong Watershed Area (to dam) – source
29.7 square miles – United States Geological Survey
19,008 acres = 29.7 sq. mi. * 640 acres / sq. mi. (includes the surface area of both lakes)
2,816 acres = 19,008 – 16,192 (Musconetcong drainage area below Lake Hopatcong)

Average Monthly Precipitation – Source: Average of data from Oak Ridge Reservoir, Long Valley, and Hopatcong
Note period of record is 1971-2000, only Oak Ridge and Long Valley are certified stations
January = 4.18 / February = 3.14 / March = 4.21 / April = 4.29 / May = 4.64 / June = 4.61
July = 4.57 / August = 4.33 / September = 4.86 / October = 4.02 / November = 4.07 / December = 3.70

March – May = 4.38 inches / month
June – August = 4.50 inches / month
September – November = 4.32 inches / month

Average Pan Evaporation Losses – Source: NOAA 1994-1997 at Canoe Brook Reservoir as reported SESI Consulting Engineers, 1999
May = 5.51 inches
June = 6.17 inches
July = 6.4 inches
August = 5.63 inches
September = 4.15 inches

Winter / Spring Rainfall vs. Lake Elevation – observations March 7 – May 2, 2009 from USGS gauges at Lake Hopatcong
4 inches of rainfall through the period caused an 18 inch rise in surface elevation (outflows were reduced below 12 CFS)
1 inch of rainfall = 4 inches of Lake elevation (not including evaporation losses)

Summer Rainfall vs. Lake Elevation – observations June 13-14, 2010 from USGS gauges at Lake Hopatcong
1 inch of rainfall = 2 inches of Lake elevation (dam overtopped discharge about 22 CFS)

Appendix B - Calculated Water Level Responses

Lake Elevation Response to 12 CFS discharge (disregarding evaporation and precipitation)
12 CFS * 86,400 seconds/day = 1,036,800 cu.ft./day
1,036,800 cu ft. / 115,782,480 sq.ft. = **.01 ft./day = .12 inches per day = 3.6 inches per month**
.083 feet (1 inch) * 115,782,480 sq.ft. = 9,609,946 cu.ft.
9,013,391 cu.ft. / 1,036,800 cu.ft = **9.27 days to lower one inch**

Maximum Discharge Rate and Lake Elevation Response
Flood elevation = 4 feet on stream gauge – USGS web site
= 3.5 feet on steam gauge – Superintendent Maurella pers. obs.
8.2 CFS = 1.15 feet on stream gauge
12 CFS = 1.26 feet on stream gauge – current Lake Hopatcong Water Level Management Plan
75 CFS = 2.27 feet on stream gauge
120 CFS = 2.76 feet on stream gauge – observation 12/30/2009 USGS web site
213 CFS = 3.5 feet on stream gauge (max. per Superintendent personal observation)
292 CFS @ 4 feet gauge height

292 CFS * 86,400 = 25,228,800 cu. ft. per day
25,228,800 cu.ft. / 115,782,480 sq. ft. = .22 feet per day
.22 feet * 12 inches = 2.64 inches per day
26 inches / 2.64 inches = 9.84 days
4.32 inches (precip) * 4 inches (lake rise) = 17.28 inches
17.28 inches / 2.64 inches = 6.52 days
Total Days to lower 26 inches at 4 feet on gauge = 16.36 days
Total Days to lower 26 inches at 3.5 feet on gauge = 22.5 days

60 inches / 2.64 inches per day = 22.72 days
4.32 inches of precip * 4 inches lake elevation = 17.28 inches
17.28 inches / 2.64 inches per day = 6.52 days
Total Days to lower 60 inches at 4 feet on gauge = 29.24 days
Total Days to lower 30 inches at 3.5 feet on gauge = 40.25 days

Normal operation for 60 inch drawdown takes two months
213 CFS * 86,400 = 18,403,200 cu. ft. per day
18,403,200 cu. ft. / 115,782,480 sq. ft. = .16 ft. per day
.16 ft. * 12 in. per ft. = 1.92 in. per day
4.32 in. precip. per month * 2 months * 4 in. lake elevation = 34.56 in. during drawdown
60 in. + 34.56 in. = 94.56 in. / 1.92 in per day = 49.25 days

Appendix C – Unresolved Issues Raised by the CAC Members

Minimum Passing Flow

Some members of the Citizens Advisory Committee continue to question the need for a 12 CFS passing flow. As part of this reexamination of the Lake Hopatcong Water Level Management Plan the New Jersey Geological Survey reconstructed the streamflow in the Musconetcong River at Lake Hopatcong to estimate the flow in the river if the Lake did not exist (Technical Memorandum 10-1). The intent of this reconstruction was to determine whether the 12 CFS minimum passing flow established by court order was reasonable when compared to the expected flow if the Lake did not exist. That analysis indicates that the median monthly low flows for the Musconetcong River are predicted to be about 18 CFS. This means half of the low flows in August and September over the analysis period (1928-1962 and 2002-2009) would have been above 18 CFS and half would have been below 18 CFS. The 75th percentile flow for the period was 12 CFS and 13 CFS for August and September respectively (i.e. 75% of the time stream flows would have exceeded 12 CFS and 25% of the flows would have been less than 12 CFS). Based on the analysis a 12 CFS passing flow is not unreasonably high or low relative to the expected norm.

However, members of the CAC point out that historically from 1956 through 2005 the passing flow has often dropped below 12 CFS, without reports of widespread fish kills. Some of the events occurred during the winter and spring when water temperatures downstream of Lake Hopatcong would likely have been less critical. However, other excursions below 12 CFS were in direct response to water supply emergencies such as during the drought of 1961-67. More research is needed to determine duration of reduced passing flows, the prevailing weather conditions at the time and whether any information exists concerning the effects of these excursions on the downstream ecology. Representatives of the Lake community question whether there is a scientific basis for the 12 CFS passing flow and whether some lower flow might be equally protective of downstream resources. Representatives of the downstream interests objected to the allowance for reductions of the 12 CFS passing flow to address low water levels on Lake Hopatcong questioning the ecological effects of those reductions are understood. Therefore, CAC members ask that studies be performed downstream of Lake Hopatcong to document the ecological effects of reducing the passing flow with the goal of establishing a new science based passing flow.

Basis for the 12 CFS Passing Flow

The CAC recommends that the Department find a copy of the court order in the suit filed by the Association of Musconetcong Millers, which reportedly established the 12 CFS as a minimum passing flow. Without reviewing the document it is not possible to determine whether that court order has any continuing force and effect on the Department. The Department of Law and Public Safety, Division of Law was asked if it could find the court order, but it is an unpublished decision and their efforts were unsuccessful. The Department has found two period records that reference the Musconetcong Miller Association settlement: 1) March 1, 1923 letter from Oliver Hartwell (U.S.G.S. District Engineer to E.T. Critchlow (Department of Conservation and Development hydraulic engineer) concerning claims of damages made by the Millers Association due to the operation of the dam at Lake Hopatcong; and 2) August 22, 1924 letter from Cornelius Vermeule (consulting engineer) to Dr. Henrey B Mummel (Director Board of Conservation and Development) concerning the deisgn of the Lake Hopatcong Dam.

Depth of Annual Drawdown
The CAC members did not agree on the 26 inch depth of the annual winter drawdown as established in this plan. Some members did not believe that any winter drawdown was necessary to protect against ice damage. Other members felt as though a 30 inch drawdown would provide better protection, particularly when considering that there may be incremental increases in the lake elevation over the winter in response to significant rainfall. The majority of the membership agreed to retain the 26 inch depth from the 2000 Plan.

Summer Water Elevation
This water level management plan sets as a goal maintaining the water surface elevation at or slightly above 9 feet for as long as possible while still meeting the 12 CFS passing flow. One member of the CAC suggested that the target water surface elevation of the Water Level Management Plan should not exceed 9-feet because of the increased potential for property damage and shoreline erosion.

Water Quality
Some CAC members questioned whether the effects of a lowered water level in the Lake has water quality or ecological impacts in the Lake. These members requested that studies to be performed to quantify these effects. Readers should understand that the Lake Hopatcong Water Level Management Plan is intended to address quantity issues only.

Lake Hopatcong is currently listed as impaired for pH and Mercury. Mercury is the result of atmospheric deposition and altering the water level will not adversely affect concentrations of Mercury in fish tissue. Similarly, altering the water level will not affect its pH. Lake Hopatcong had previously been listed as impaired for Phosphorus. The Department has prepared a total maximum daily load for Phosphorus and the Lake Hopatcong Commission has prepared and is implementing a water quality restoration plan for the Lake. Reducing the water level in the Lake will not impact Phosphorus loads and concentrations in the Lake.

The exact impact of any water level fluctuation cannot be determined without detailed hydrography and substrate analysis. The biological effects of a lower lake level will depend on the severity, timing and duration of low water events. Shallow water areas are generally important for fish spawning, nursery and refuge. However, in large shallow lakes fluctuations in water level are common and the established community of fish and plants are well adapted. Fish in a lake environment will adjust to short duration changes water level by simply moving with the littoral, or near shore, zone as water levels fluctuate. The same is true of submerged aquatic plants which will grow in areas where light now penetrates to the bottom due to the lower water level.

Effect of the Fountain
The CAC questioned whether the fountain would have a significant net positive effect on dissolved oxygen in the Musconetcong River downstream of Lake Hopatcong. Presently the fountain is shut off in the summer months due to health and safety concerns associated with bathing in untested and unguarded waters. The summer is also the time of year when dissolved oxygen is most critical in the River. If the fountain does exert a significant positive effect on dissolved oxygen the State may wish to invest in a means of restricting access so that the fountain could be left on over the summer months.

Accelerated 60 inch Drawdown Schedule

In the fall of 2010 the Department attempted to follow the proposed drawdown schedule from the first draft of this plan. That schedule increased the rate of drawdown from three-quarters of an inch per day starting on November 1 to one inch per day starting on November 19. Both schedules sought to have the 26 inch drawdown completed by December 15. The Department successfully followed the schedule from November 19 until December 1. On December 1, two inches of rainfall fell in a 24-hour period. This caused a significant rise in the lake water level. Park Superintendent maximized the outflow from Lake Hopatcong to the extent possible without causing flooding of the Compaq building in Stanhope. The Superintendent found that the maximum elevation on the gauge that could be sustained without impacting the building was 3.5 feet, not 4 feet as reported to be the flood stage for this gauge. Despite the Superintendent's best efforts the lake level did not achieve the 26 inch drawdown until December 22. The December 1 storm was followed by seasonally cold temperatures and ice quickly formed on the lake. The Department did not receive any reports of damage to waterfront structures due to the delay in reaching the 26 inch target. However, the Department as part of this final plan has adjusted the start date of the 26 inch drawdown to November 12 to account for the one-week delay in reaching our target.

More importantly, this plan seeks to delay the initiation of the 60 inch drawdown from the day after Labor Day to September 22 in an attempt to extend the boating season to the end of the summer. To accommodate this delay and still reach the desired 60 inch level by November 1, the rate of drawdown has been increased from one inch per day to an inch and a half per day. Given the experience of 2010, this accelerated schedule may not provide enough flexibility to account for a significant rainfall event such as a tropical storm or hurricane. Consequently, we recommend that the schedule be reevaluated based prior to the scheduled 2013 60-inch drawdown in light of experience gained in the fall of 2011 and 2012.

Appendix D – Permit Information

Lake Lowering Permit
Responsibility to obtain: Division of Parks and Forestry

Pursuant to N.J.S.A. 23:5-29 and N.J.A.C. 7:25-6:25, a water lowering permit must be obtained to partially or completely lower a body of water, regardless of ownership. Water withdrawal activities (water supply, irrigation etc.) which are already permitted or specifically exempted by the Department **do not** require a water lowering permit. For example: the lowering of water on a water supply reservoir for potable water use does not require a water lowering permit. However, a water lowering permit is needed for lowering the same body of water for dam repair, or aquatic vegetation control. If uncertain whether or not a permit is required please contact the Bureau of Freshwater Fisheries at (908) 236 – 2118 for clarification. The Division of Fish and Wildlife issues water lowering permits for the sole purpose of protecting the state's aquatic biota.

The timing, duration and extent of lowerings are tailored to each situation and are designed to avoid or minimize the loss of fish, and impacts to other biota. Permits are conditioned to further minimize these impacts to the extent possible and permittees assume responsibilities to protect aquatic biota while the waterway is lowered. Every lowering has an impact to both aquatic biota present within the waterway and downstream and no waterway should be lowered on a routine annual basis. Typically, the Division of Fish and Wildlife requires the lowering of lakes north of I-195 to be completed before November 1 to minimize impacts on reptiles and amphibians that hibernate by burrowing into the mud. The Division has routinely made an exception for Lake Hopatcong in consideration of the long standing water level management practices in the lake and as an accommodation to recreational boating uses on the lake.

APPLICATION INFORMATION
Applications are available on the Division of Fish and Wildlife's website www.NJFISHANDWILDLIFE.com or by contacting the Bureau of Freshwater Fisheries at (908) 236 - 2118. Applications should be submitted at least **two months prior** to the date requested to begin lowering to allow time for review and processing. **There is a $ 2 application fee. A separate application is required for each water body requested to be lowered.**

Applications should be submitted to:
Division of Fish and Wildlife
Bureau of Freshwater Fisheries
PO Box 394
Lebanon, NJ 08833

Land Use Regulation Permits
Responsibility to obtain: Individual property owners conducting regulated activities

Contact:
NJDEP, Division of Land Use Regulation
P.O. Box 439
Trenton, New Jersey 08625-0439

Phone: (609) 292-0060

MINOR DREDGING AND SHORELINE CLEANUP

No permits are required for the hand removal of accumulated sediment and debris. All material must be removed from the flood hazard area and properly disposed.

Flood Hazard Area Control Act (Stream Encroachment)
Mechanical removal of debris is covered by a permit-by-rule at N.J.A.C. 7:13-7.2(a)5 and requires written notification 14-days prior to initiation:

Attn: Permit-By-Rule Notification
NJDEP, Coastal and Land Use Compliance and Enforcement
P.O. Box 422
Trenton, New Jersey 08625-0422
Fax: (609)633-6798

Mechanical removal of accumulated sediment requires an individual Flood Hazard Area Control Act Permit.

Freshwater Wetlands Protection Act
N.J.A.C. 7:7A-5.13(b) – No Permit Required if: 1) Activity is in open waters only (no wetlands involved); 2) No fill is being place in open waters for any reason (no cofferdams); 3) Activity doesn't occur until water level has been lowered and finishes prior to water level being raised; 4) No dredging below the original lake bed.

N.J.A.C. 7:7A-5.13(a) – General Permit required if wetlands disturbance is proposed. In addition to limitations 2-4 above: 5) Only one acre and only emergent wetlands may be dredged; 2) temporary wetlands disturbance to gain access to dredging site is limited to .125 of an acre of other wetlands (.25 of an acre with justification); no permanent fill of dredged material may be placed in wetlands.

DOCKS AND PIERS

Flood Hazard Area Control Act (Stream Encroachment)
N.J.A.C. 7:13-7.2(b)14 – Permit-By-Rule (No notice required): 1) New dock up to 1,000 square feet built on pilings, 2) No more than 1,000 square feet of riparian zone vegetation disturbance.

Freshwater Wetlands Protection Act
N.J.A.C. 7:7A-5.19(a) – No Permit Required: Construction of docks and piers on pilings (or floating) only affecting state open waters (no wetlands disturbance).

N.J.A.C. 7:7A-5.19(b) – General Permit: Docks and piers must be elevated on pilings over wetlands, not exceed 6-feet in width and not disturb more than .1 of an acre (4,356 sq. ft.) of wetlands or transition area. Limit one dock per private property.

BOAT RAMPS

Flood Hazard Area Control Act (Stream Encroachment)
N.J.A.C. 7:13-7.2(a)6 – Permit-By-Rule (Requires prior written notice to the Department 14 days prior to commencing construction): 1) footprint not greater than 2,000 square feet; 2) must be constructed at or below grade; 3) not more than 2,000 square feet of vegetation removed from riparian zone.

Freshwater Wetlands Protection Act
N.J.A.C. 7:7A-5.19(b) – General Permit: 1) disturbance in wetlands, transition areas and open waters limited to .1 acre

REPAIR OF EXISTING STRUCTURES
(bulkheads, boat houses, crib structures, revetments)

Flood Hazard Area Control Act (Stream Encroachment)
N.J.A.C. 7:13-7.2(b)4: Permit-By-Rule (Requires prior written notice to the Department 14 days prior to commencing construction): 1) Structure is not a habitable building; is not enlarged; and does not result in any riparian zone vegetation clearing.

Freshwater Wetlands Protection Act
N.J.A.C. 7:7A-5.1 – General Permit (30 day review from receipt of a complete application): Repair, reconstruction, rehabilitation, replacement or maintenance of lawfully existing and currently serviceable structures provided that it is not put to a different use and shall not expand or enlarge the structure except for minor deviations due to changes in materials or construction techniques may be allowed.

Appendix E – Musconetcong River Monitoring Plan

Introduction / Purpose

Purpose: Under certain circumstances the Lake Hopatcong Water Level Management Plan requires the Department to consider reducing the outflow from Lake Hopatcong to assist in the attainment or maintenance of navigable conditions in the Lake. The Lake Hopatcong Water Level Management Plan and the New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B) require the Department to ensure that designated uses are maintained in the Musconetcong River. The Musconetcong River downstream of Lake Hopatcong is designated as FW2 Trout Maintenance. The designated uses of all FW2 waters include: the maintenance, migration and propagation of the natural and established biota;primary and secondary contact recreation; industrial and agricultural water supply; public potable water supply after conventional treatment; and any other reasonable uses. In revising the Lake Hopatcong Water Level Management Plan, the Department of Environmental Protection assessed all downstream uses and users to determine which is likely to be the most sensitive to any reduction in outflow from Lake Hopatcong. As a result of the analysis included in the plan, the Department concludes that the most sensitive use to any change in outflow is the protection of the natural and established biota. This Quality Assurance Protection Plan is provided to detail the sampling locations, equipment and methods the Department will employ to determine whether a reduction in outflow from Lake Hopatcong will be protective of the aquatic life criterion.

Quality Control Plan

QA/QC for Dissolved Oxygen/Temperature Monitoring Musconetcong River

Water chemistry measurements are determined in the field, using one or more YSI (Yellow Springs Instrument) meters. Field measurements for dissolved oxygen and temperature are recorded by means of a YSI (Yellow Springs Instrument) 85, or Professional Plus meters. A certified thermometer may also used to determine temperature.

For QA/QC purposes, oxygen meters are re-verified on a monthly basis against a Winkler Titration of de-ionized water samples, and certified thermometer readings. Temperature readings are verified against a BOD bottle filled with a de-ionized water sample stored for a 24 hour period in an incubator set at 21.0°C. YSI temperature probes have a resolution and accuracy of $\pm$ 0.1 °C. These re-verification procedures are also repeated after any atypical field readings to verify the meter was functioning properly. Records of re-verification are kept for each probe. Probes/meters failing to calibrate or that fail re-verification procedures against known solutions will be replaced and/or returned to the manufacturer for repair.

All meters are field calibrated prior to each use according to the manufacturer specifications.

Probes are stored in a moist environment in calibration/transport sleeve provided by the manufacturer during active field season. During winter months storage is consistent with manufacturer's recommendation.

DESIGNATED SAMPLING LOCATIONS – TEMPERATURE

1 Musconetcong River, immediately below Lk Hopatcong dam
40° 55' 3.3"N 74° 39' 52.3" W
2 Musconetcong River, approx. 50m downstream of Lakeside Blvd (Rt 602) bridge
40° 55' 1.2" N 74° 39' 58.2" W
3 Musconetcong River, at end of Trudy Court – wetland area
40° 54' 42.3" N 74° 40' 26.0" W
4 Musconetcong River, end of Willow Street (off Center St) by pump station
40° 54' 32.9° N 74° 40° 53.3" W
5 Musconetcong River, below Lk Musconetcong, approx. 50m downstream off Rt 183 bridge
40° 54' 7.1"N 74° 42' 19.2" W
6 Tributary stream to wetlands below Lk Hopatcong @ Brooklyn – Stanhope Rd bridge
40° 54' 53.5" N 74° 40' 31.0' W

Additional locations may be added as necessary to evaluate any particular area of concern. If additional locations are added the reasons for their addition shall be specified and the location shall be documented through landmark description and latitude and longitude consistent with the below sampling locations. Monitoring shall be performed near the center of the stream at each location.

All monitoring shall be performed by a fisheries biologist or other person trained in the field calibration, deployment, reading, transit and storage of the monitoring equipment specified by this plan. Temperature readings will be taken at designated locations after 12:00 pm. All monitoring shall be performed near center of stream at the designated locations. Temperature and Dissolved Oxygen monitoring data shall be recorded in the field at the time of sampling together with the location, date and time of sampling for each monitoring point. Field data collected may be supplemented with any additional observations that in the opinion of the person conducting the sampling may influence the determination with regard to best professional judgment. Field information shall be transferred to tabular format and shared with the Lake Hopatcong Commission.

QA/QC Field Measurements for Water Quality Parameters:

CALIBRATION TIMEFRAMES DURING ACTIVE FIELD SAMPLING:

Thermometer- Does not require calibration. Re-verified each month.

Dissolved Oxygen (DO) – Field calibrated before each use. Re-verified each month.

STORAGE PROCEDURES:

Less than 30 days:

Probes in moist environment in calibration/transport sleeve.

Long Term Storage:

Thermometer/Conductivity- No special storage required

Dissolved Oxygen probe (Professional Plus) - Stored dry. Membrane cap is removed, rinsed with clean water, let completely to air dry, and covered with a new and dry membrane cap. Probe assembly placed in field casing for protection.

Dissolved Oxygen probe (YSI 85) - Stored in moist environment with wet sponge in membrane cap.

MAINTENANCE PROCEDURES:

All O-Rings- O-rings are inspected whenever a probe is removed and are checked and replaced if cracks are seen or felt.

Dissolved Oxygen probe (Professional Plus) - has a polarographic sensor. The potassium chloride (KCl) solution in the membrane cap needs to be changed every 30 days or if air bubbles or cracks/scratches are seen on or under membrane. While changing the membrane an inspection of the gold cathode and silver anode is completed. If gold looks dull or silver looks black to resurface these probe parts.

Dissolved Oxygen probe (YSI 85) - Replace DO membrane cap if cracked, scratched, damaged or every 3 weeks. While changing the membrane an inspection of the gold cathode and silver anode is completed. If gold cathode looks dull restore with YSI reconditioning kit 5238. If silver cathode looks black soak overnight on 3% ammonium hydroxide solution. Fill new cap with Na_2SO^4, KCl oxygen probe electrolyte solution

Thermometer- Keep free of build up with the conductivity brush.

REFERENCES

Delaware River Basin Water Code with Amendments Through July 16, 2008, DRBC, September 12, 2008

Emergency Action Plan for Lake Hopatcong Dam, NJ File Number 25-42, Civil Dynamics, February 2005

Lake Hopatcong Water Level Management Plan, New Jersey Department of Environmental Protection, Division of Parks and Forestry, State Park Service, 2001

New Jersey Water Supply Authority Lake Hopatcong Emergency Water Supply System Hydraulic and Hydrologic Report, CDM, November 1985

New Jersey Water Supply Authority, Lake Hopatcong Emergency Water Supply System, Operations and Maintenance Manual, CDM, 1985

Proposed Scope of Work for the US EPA Targeted Watersheds Grant, Lake Hopatcong Commission, Princeton Hydro, LLC, May 6, 2005

Memorandum of Recommendations for Revised Passing Flows for Several Drought Regions, New Jersey Department of Environmental Protection, Drought Passing Flow Work Group, May 20, 2002

DATA SOURCES

Delaware River Basin Commission
http://www.state.nj.us/drbc/

Lake Hopatcong Commission
http://www.lakehopatcong.org/

Office of the New Jersey State Climatologist
http://climate.rutgers.edu/stateclim/

New Jersey Department of environmental Protection
http://www.state.nj.us/dep/index.html

NOAA
http://www.erh.noaa.gov/er/hq/

United States Geological Survey
http://nj.usgs.gov/

Real-time Stream Flow for USGS stream gauge (# 01455500)
http://waterdata.usgs.gov/nj/nwis/uv/?site_no=01455500&PARAmeter_cd=00065,00060

All available data for USGS stream gauge (# 01455500)
http://waterdata.usgs.gov/nj/nwis/nwisman/?site_no=01455500&agency_cd=USGS

Real-time Lake Level for USGS lake level gauge (#01455400)
http://waterdata.usgs.gov/nj/nwis/uv/?site_no=01455400&PARAmeter_cd=00065,00060

All available data for USGS lake level gauge (#01455400)
http://waterdata.usgs.gov/nj/nwis/nwisman/?site_no=01455400&agency_cd=USGS

Stage – Discharge Relationship for Lake Hopatcong, USGS stream gauge (# 01455500)
http://waterdata.usgs.gov/nwisweb/data/exsa_rat/01455500.rdb