



**NEW JERSEY GEOLOGICAL &
WATER SURVEY**
Technical Memorandum 18-1



Reservoir Operations in New Jersey Preceding Hurricane Sandy, October, 2012



New Jersey Department of Environmental Protection
Water Resources Management
Division of Water Supply & Geosciences
New Jersey Geological & Water Survey
2018

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At the same time, it is crucial to understand how actions of this agency can impact the State's economic growth, to recognize the interconnection of the health of New Jersey's environment and its economy, and to appreciate that environmental stewardship and positive economic growth are not mutually exclusive goals: we will continue to protect the environment while playing a key role in positively impacting the economic growth of the state.

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The mission of the New Jersey Geological & Water Survey is to map, research, interpret and provide scientific information regarding the state's geology and groundwater resources. This information supports the regulatory and planning functions of DEP and other governmental agencies and provides the business community and public with information necessary to address environmental concerns and make economic decisions.

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On the Cover: Oblique aerial photographs of Seaside Heights, NJ, before and after Hurricane Sandy. View looking west along the New Jersey shore. Storm waves and surge destroyed the dunes and boardwalk, and deposited the sand on the island, covering roads. The red arrow points to a building that was washed off of its foundation and moved about a block away from its original location. The yellow arrow in each image points to the same feature. Pictures and descriptive text from the U.S. Geological Survey: <http://coastal.er.usgs.gov/hurricanes/sandy/photo-comparisons/newjersey.php>

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by
Jeffrey L. Hoffman
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Epigram

Floods are “acts of God,” but flood losses are largely acts of man.
- Gilbert Fowler White 1945.

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I. Introduction

In late October 2012 a major hurricane (Sandy) approached the eastern seaboard of the United States. The National Weather Service issued warnings several days in advance about the potentially catastrophic nature of this storm. New Jersey emergency response personnel made numerous preparations in order to mitigate the expected impact of Hurricane Sandy. On October 27, 2012 Governor Christie issued a state of emergency for New Jersey to assist in storm preparations.

On October 29, 2012 New Jersey Department of Environmental Protection (NJDEP) Commissioner Martin ordered the lowering of Woodcliff Lake, Lake Tappan and Oradell Reservoir (all operated by United Water New Jersey), Charlotteburg Reservoir (City of Newark), Wanaque Reservoir (North Jersey District Water Supply Commission), Boonton Reservoir (Jersey City), and Pompton Lake and Lake Hopatcong (NJDEP). This order did not specify volumes to be released or specific drops in water levels.

Hurricane Sandy struck New Jersey on October 29-30, 2012 and caused considerable damage along the Atlantic Coast. Heaviest precipitation in the State was in the south where 8 to 12 inches of rain fell. Precipitation totals throughout northern New Jersey were 1 to 2 inches, much less than had been forecast. No flooding in northern New Jersey resulted from precipitation. Hurricane Sandy's destruction was primarily due to a massive storm surge along the coast and to strong winds across the State.

This report estimates released volumes, reservoir declines and increased streamflows resulting from the State-ordered releases preceding Hurricane Sandy's landfall.

Acknowledgments

Numerous water-supply professionals contributed to this report. They include John Hroncich (Jersey City Department of Public Works), Bob Lincoln (Newark Watershed Conservation Development Corporation), John Moyle (NJDEP Dam Safety & Flood Control), Emily Rich (NJDEP Parks & Forestry), Joe Stroin (North Jersey District Water Supply Commission) and Patrick Tuohy (United Water New Jersey).

All streamflow data and most of the reservoir water levels and precipitation data come from surface-water observation network of the U. S. Geological Survey. Their New Jersey Water Science

Center provides a web site that significantly eases data retrieval. The analysis in this report would not have been possible without use of this site:

<http://nj.usgs.gov/infodata/surfacewater.html>¹

The New Jersey State Climatologist's New Jersey Weather & Climate Network website provided the precipitation data for the Haworth gage, located next to the Oradell Reservoir, and the Charlotteburg gage:

<http://www.njweather.org/>

II. Background

II.A. Reservoirs in northeast New Jersey

Northeastern New Jersey contains many reservoirs and lakes used either primarily for, or to supplement, water supply (fig. 1, table 1). Most were constructed for water-supply purposes and paid for by the customers of the water companies. Lake Hopatcong and Greenwood Lake were originally constructed to augment the water supply of the Morris Canal. These two lakes now serve recreational uses but have mandated releases for aquatic ecology protection (Hoffman and Domber, 2013). The two lakes can also serve as water-supply sources during droughts (Greenwood Lake Commission, 2011; NJDEP, 2011).

Table 1 lists basic physical characteristics of the reservoirs and lakes. It includes the watershed area upstream of the reservoir dam. It also includes an estimate of the amount of water that would enter the reservoir if one inch of precipitation fell on the watershed and all of it ran off into the reservoir, what percentage of reservoir storage would be filled by this runoff, and the length of time the reservoir's release mechanism would need to spill this runoff volume.

¹ All web links active September 2013.

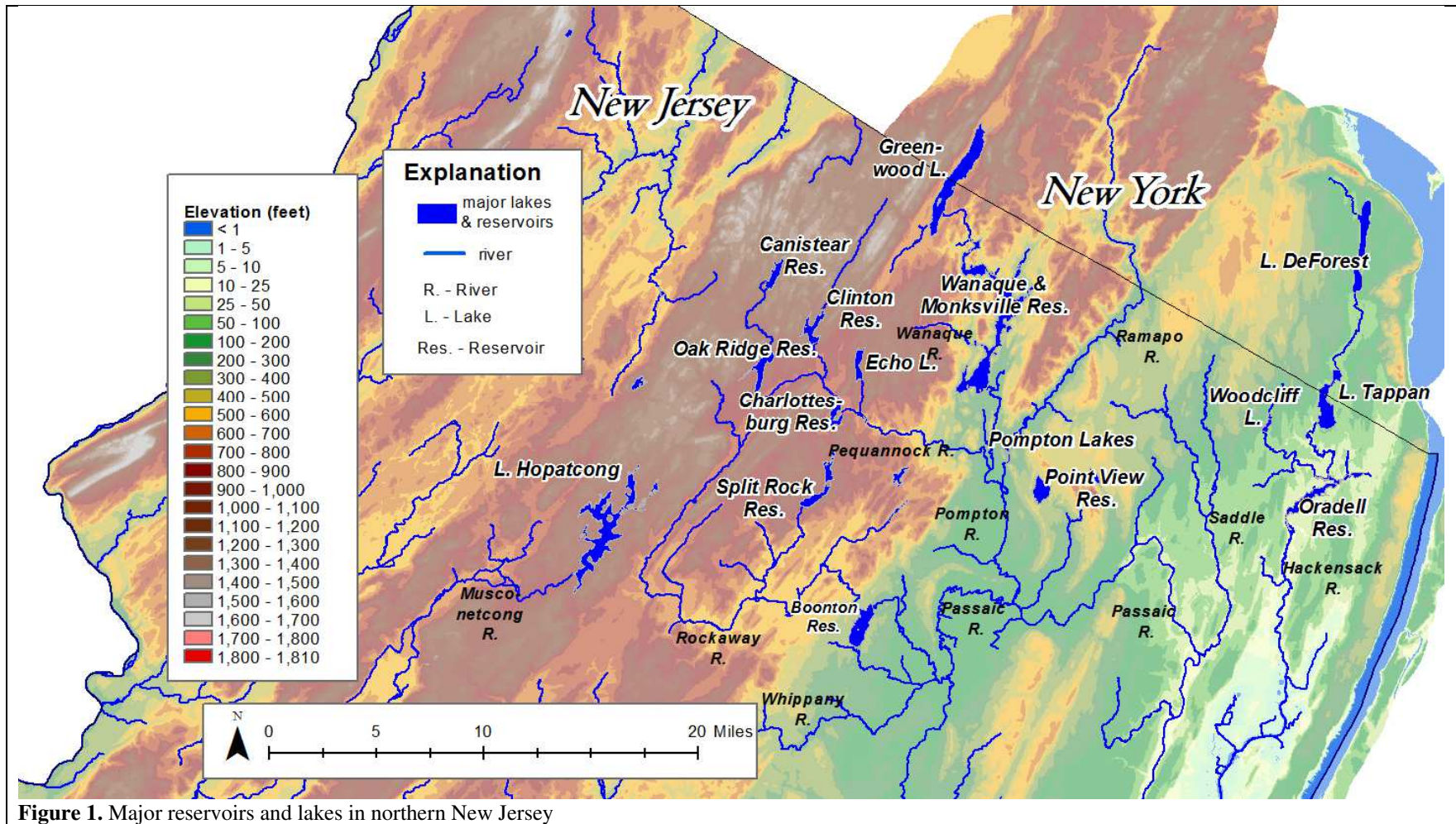


Figure 1. Major reservoirs and lakes in northern New Jersey

Table 1. Characteristics of selected reservoirs and lakes in northern and central New Jersey

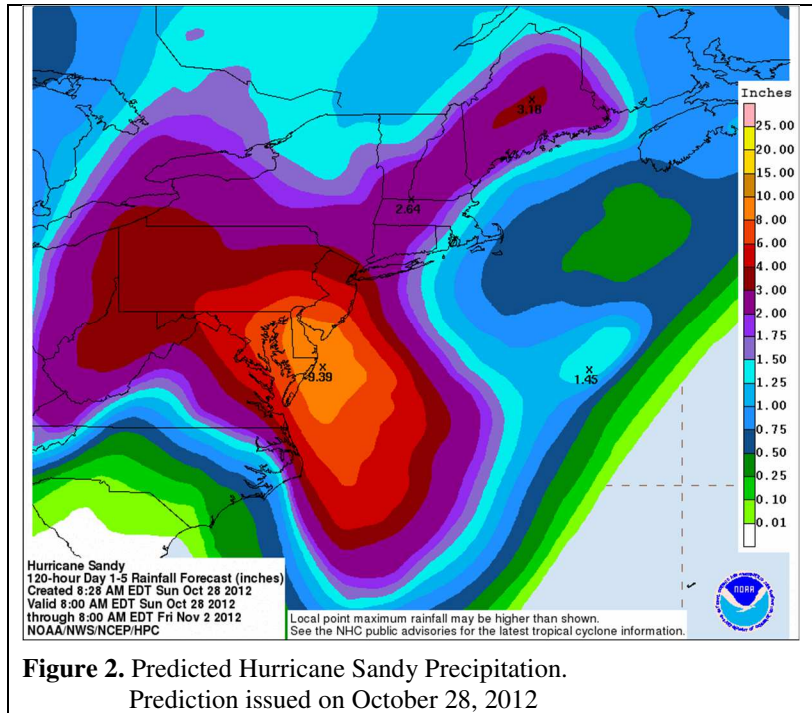
Reservoir/Lake	Owner/ Controller	Year com- pleted	Located on	Water- shed (miles ²)	Capacity (bgal)	Release rate (mgd)	1 inch of rain on watershed*		
							bgal	Percent of res- ervoir filled	Hours to release
Split Rock Res.	Jersey City	1948	Beaver Brook	5.5	3.31	120.0	0.10	2.9%	19.1
Boonton Res.	"	1904	Rockaway River	119	7.37	1,300	2.07	28.1%	38.2
Canistear Res.	Newark	1896	Pacock Brook	6.08	2.41	60	0.11	4.4%	42.3
Clinton Res.	"	1892	Clinton Brook	10.5	3.52	75	0.18	5.2%	58.4
Oak Ridge Res.	"	1982	Pequannock River	27.3	3.89	320	0.47	12.2%	35.6
Echo Lake	"	1925	Macopin River	4.35	1.58	170	0.08	4.8%	10.7
Charlotteburg Res.	"	1961	Macopin River	56.2	2.96	130	0.98	32.9%	180.3
Wanaque & Monks- ville Res. System	NJDWSC	1927/ 1988	Wanaque River	90.4	36.60	60	1.57	4.3%	628.4
Pompton Lake	"	1908	Ramapo River	160	0.30	10,300	2.78	926.8%	6.5
Lake De Forest Res.	UWNY	1956	Hackensack River	27.5	5.67	1,150	0.48	8.4%	10.0
Lake Tappan	UWNJ	1966	Hackensack River	49	3.85	2,000	0.85	22.1%	10.2
Woodcliff Lake	"	1905	Pascack Brook	19.4	0.87	320	0.34	38.7%	25.3
Oradell Res.	"	1922	Hackensack River	113	3.51	3,200	1.96	56.0%	14.7
Spruce Run Res.	NJWSA	1963	Spruce Run	41.3	11.00	180	0.72	6.5%	95.7
Round Valley Res.	"	1966	off stream	5.7	55.00	460	0.10	0.3%	5.2
Greenwood Lake	NJDEP	1837	Wanaque River	27.1	6.86	410	0.47	6.9%	27.6
Lake Hopatcong	"	1828	Musconetcong River	25.3	15.50	590	0.44	2.8%	17.9

* Assumes 100 percent of rainfall runs off into reservoir

Abbreviations: Res.–reservoir; NJDWSC –North Jersey District Water Supply Commission; UWNY-United Water New York; UWNJ-United Water New Jersey; NJWSA-New Jersey Water Supply Authority; NJDEP – New Jersey Department of Environmental Protection; bgal-billions of gallons; mgd-million gallons per day.

II.B. Predicted Precipitation

Hurricane Sandy's advance was closely monitored². The National Weather Service (NWS) issued many bulletins on its expected course and impact, starting on October 22, 2012.³ On October 28, 2012 the NWS issued a prediction of the anticipated precipitation for New Jersey (fig 2). Forecast precipitation ranged from 8 to 10 inches in Cape May and 4 to 6 inches in northern New Jersey. This amount of precipitation would have caused state-wide flooding. It was this forecast that elicited calls from local officials for the lowering of reservoirs.⁴



II.C. Sandy Emergency Operations

Governor Christie declared a statewide emergency on Thursday, October 27, 2012 (Executive Order 104, Appendix A) in anticipation of the impact of Hurricane Sandy. This activated the State Emergency Operation Plan in order to coordinate the emergency response of state, county and municipal responders.

On Friday, October 26, 2012, Governor Christie ordered actions to reduce the expected impact of flooding in northern New Jersey. NJDEP Commissioner Martin ordered eight reservoirs and lakes in northern New Jersey to lower pool levels in advance of Hurricane Sandy (table 2). Locations of the lakes and reservoirs are shown on figure 1. A press release detailing the ordered actions is in appendix B.

The lowerings were to take place 20 to 30 hours in advance of Sandy's forecast rain. This lead time would allow the released water to move downstream past flood-prone area and thus not exacerbate the flooding expected to occur related due to Sandy. The goal was to create storage in the reservoirs that would fill during the hurricane and thus help mitigate downstream flooding.

² NOAA web site: http://www.nasa.gov/mission_pages/hurricanes/archives/2012/h2012_Sandy.html

³ FEMA web site "Hurricane Sandy: Timeline" <http://www.fema.gov/hurricane-sandy-timeline>

⁴ http://www.northjersey.com/news/Ahead_of_Sandy_NJ_gives_order_to_lower_reservoirs_open_flood_gates.html

Table 2. Reservoirs and lakes with ordered releases

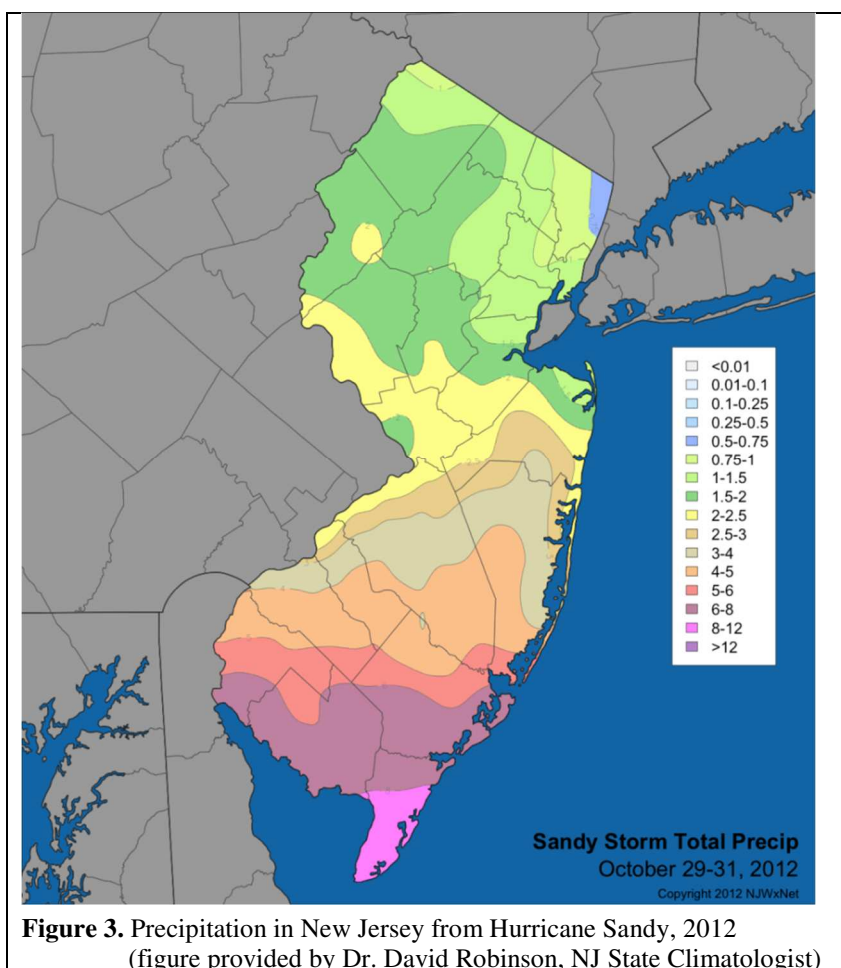
Boonton Reservoir	Oradell Reservoir
Charlotteburg Reservoir	Pompton Lake
Lake Hopatcong	Wanaque Reservoir
Lake Tappan	Woodcliff Lake

II.D. Observed Precipitation

The center of Hurricane Sandy tracked across southern New Jersey October 29-30, 2012. Figure 3 shows observed precipitation in the state. Precipitation was greatest south of the center and much less so to the north. Northern New Jersey generally received 1 and 2 inches of rain. Throughout New Jersey most damage resulted from high winds or a flood surge along the coast. Damage from precipitation-caused flooding was minimal.

II.E. Observed Impacts

Hurricane Sandy killed 22 people in New Jersey and had numerous impacts across the state.⁵ A storm surge on the Atlantic Coast, Raritan Bay and Newark Bay flooded significant areas and damaged or destroyed tens of thousands of homes (Halsey, 2013; Uptegrove and others, 2013). Wind damage inland included the downing of numerous power lines, cutting power to an estimated 2.7 million people. The power outages lasted weeks in especially hard-hit areas.



⁵ <http://bigstory.ap.org/article/state-state-look-superstorms-effects-1>

restrictions (Administrative Order 2012-12) in order to limit water demands and thus energy needs. This water emergency continued until lifted on December 20, 2012 (Executive Order 120). NJDEP also lifted water restrictions that day (Administrative Order 2012-19).

III. Observed Precipitation, Reservoir Releases, and Streamflow

Reservoir and lake operators made pre-Sandy releases from the Boonton, Wanaque, Oradell and Charlotteburg reservoirs, and from Tappan, Woodcliff, Pompton and Hopatcong lakes. Some operators began releases prior to the Governor’s emergency declaration in order to allow the released water sufficient time to flow downstream past flood-prone areas before Sandy struck. Release times and volumes are summarized in table 3. Table 4 summarizes information on the stream gages used to report on releases from the reservoirs; table 5 the precipitation gages. The following sections describe available precipitation, pool elevation, and release data for each reservoir.

Table 3. Pre-Sandy release times, flows and volumes.

Reservoir/ Lake	Release Times			Flows (cfs)		Releases (mg)		
	Start	Stop	Duration	Baseline ¹	Peak ²	Total ³	Baseline ⁴	Additional ⁵
Lake Tappan	10/26/12 10:30 PM	10/29/12 12:00 AM	3 days	50	93	104.58	74.34	31.09
Woodcliff Lake	10/26/12 8:45 PM	10/28/12 12:00 AM	1 day, 3.5 hours	23	58	31.67	17.03	14.64
Oradell Res.	10/27/12 8:30 AM	10/28/12 12:00 AM	15.5 hours	17	69	38.84	17.17	21.68
Wanaque Res.	10/26/12 6:00 PM	10/27/12 6:15 PM	1 day, 15 min	19	68	44.014	12.54	31.48
Pompton Lake	10/27/12 11:15 AM	10/27/12 10:45 PM	11.5 hours	281	2,410	410.34	80.15	330.20
Charlotteburg	10/27/12 ⁶	10/28/12 ⁶		n.a.	n.a.	~55	n.a.	n.a.
Boonton Res.	10/25/12 10:45 AM	10/28/12 1:00 PM	3 days, 2.2 hours	12	164	223.02	24.07	198.94
Lake Hopatcong	10/26/12 10:30 PM	10/29/12 12:00 AM	2 days, 1.5 hours	25	111	176.04	42.75	133.287

1. Flow just before ordered releases started.
2. Maximum observed flow during releases.
3. Total volume released from reservoir during the ordered release times.
4. Estimated release volume if additional releases hadn’t been ordered.
5. Estimated additional volume released due to Governor’s order.
6. Start-and-stop times not available.

Table 4. Selected stream gages in New Jersey*

Number	Name	Location
01377000	Hackensack River at Rivervale	4.1 miles downstream of Lake Tappan dam
01377451	Pascack Brook at Hillsdale	700 feet downstream of Woodcliff Lake spillway
01378500	Hackensack River at New Milford	0.6 miles downstream of Oradell Res. dam
01381000	Rockaway River below reservoir at Boonton	2,000 feet downstream of Boonton Res. dam
01387000	Wanaque River at Wanaque	750 feet downstream of Wanaque Res. dam
01388000	Ramapo River at Pompton Lakes	400 feet downstream of Pompton Lake dam
01388500	Pompton River at Pompton Plains	800 feet downstream of confluence of Pequannock and Ramapo rivers
01381900	Passaic River at Pine Brook	1.3 miles downstream of confluence of Rockaway and Passaic rivers
01389492	Passaic River above Beatties dam at Little Falls	100 feet upstream of Beatties dam
01455500	Musconetcong River at outlet of Lake Hopatcong	300 feet downstream of Lake Hopatcong dam

* All data from U.S. Geological Survey's New Jersey Science Center web page (<http://nj.usgs.gov/>)

Table 5. Precipitation gage information

Number	Name	Owner/Operator	Web Site
410043074025301	Woodcliff Lake USGS unheated rain gage NJ	U.S. Geological Survey	nj.usgs.gov
405934074164401	Pompton Lakes USGS heated rain gage NJ		
405502074395601	Lake Hopatcong USGS unheated rain gage NJ		
-	Haworth	New Jersey Weather & Climate Network	climate.rutgers.edu/njwxnet/
--	Charlotteburg		

III.A. Lake Tappan

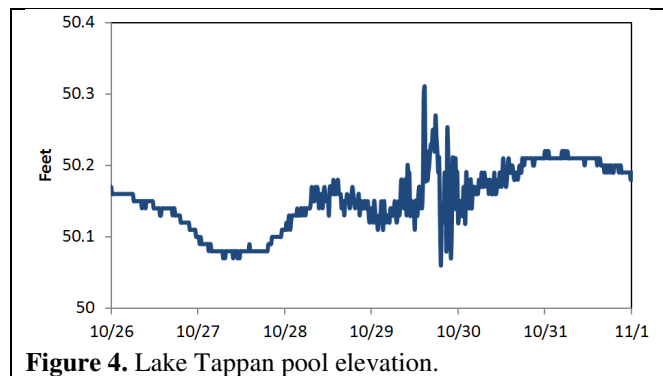
Lake Tappan is located on the Hackensack River downstream of the Lake DeForest Reservoir (in New York) and upstream of the Oradell Reservoir.

Precipitation

There is no precipitation gage at or immediately adjacent to the Lake Tappan. Precipitation on the reservoir's watershed is estimated to be less than an inch in the period October 29-31, 2012 (fig. 3).

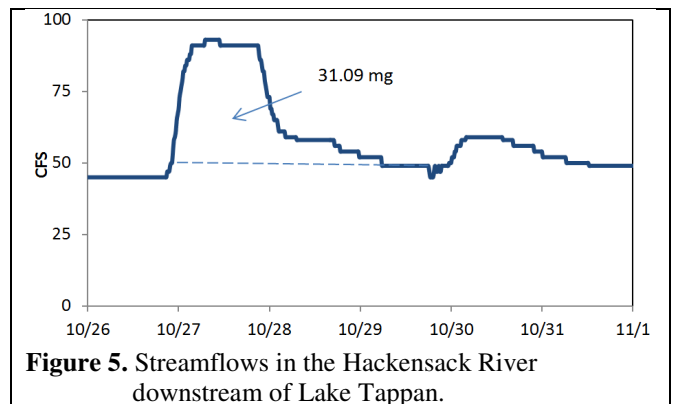
Reservoir Pool Elevation

Water elevation in Lake Tappan was about 50.1 to 50.2 feet throughout the period October 29 to November 1 (fig. 4). Pool elevations dropped about 0.1 foot from the 26th to the 27th due to the releases made before Sandy hit.



Releases

Background releases from Lake Tappan were 45 cfs before the Sandy-related releases started. These additional releases were first recorded at the gage (Hackensack River at Rivervale, NJ, which is 4.1 miles downstream of Lake Tappan) at 10:30 PM on October 26, 2012 (fig. 5). Flows rose to a peak of 93 cfs then decreased slowly to about 50 cfs on the morning of the 29th. They remained at that level until the morning of the 30th when the runoff from Sandy is seen in the streamflow. The total volume released during this period was 105.48 mg, of which 31.09 mg is attributed to the greater Sandy-related releases. The Sandy-related releases are about 0.8% of total storage in the lake. Lake Tappan is upstream of Oradell Reservoir. Water released from Lake Tappan flows into Oradell Reservoir where it caused a rise in water level.



III.B. Woodcliff Lake

Precipitation

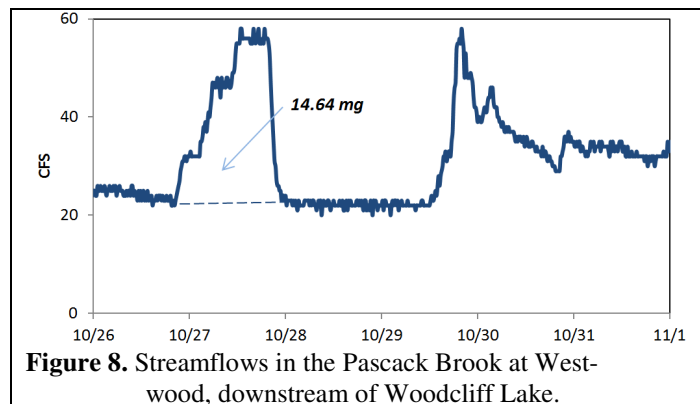
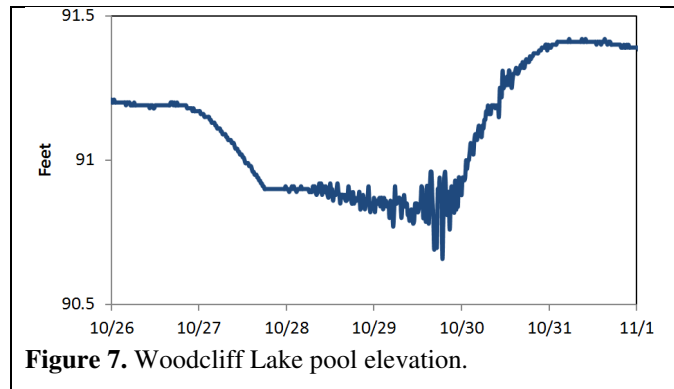
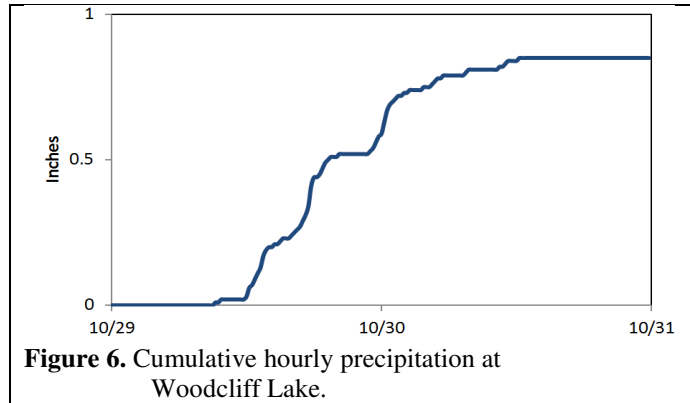
A USGS precipitation gage at Woodcliff Lake indicates precipitation from Hurricane Sandy started at 9 AM on October 29 (fig. 6). Total storm precipitation was 0.85 inch.

Reservoir Pool Elevation

Water level elevation in Woodcliff Lake declined from about 91.2 to 90.9 feet elevation from the 26th to the 27th due to the pre-Sandy releases made. Observed pool elevation was 90.87 feet at midnight on October 29 (fig. 7). Levels ranged from 90.66 to 90.96 feet on October 29. Runoff due to Hurricane Sandy raised the pool elevation to 91.41 feet by the end of October 30.

Releases

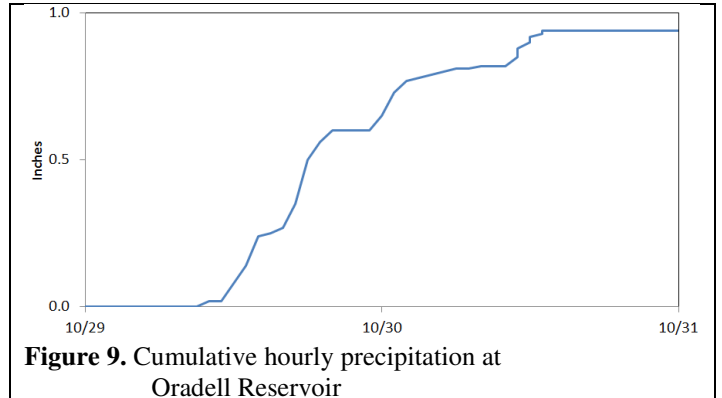
Flow in Pascack Book downstream of Woodcliff Lake was approximately 23 cfs before increased releases began. These increased releases were first recorded at the gage (Pascack Brook at Hillsdale, 700 feet downstream of Woodcliff Lake Spillway) at 8:45 PM on October 26, 2012 (fig. 8). Release rates increased to a maximum of 58 cfs about noon on the 27th and then declined to 20 cfs at midnight on the 29th. The total volume released during this period was 31.67 mg, of which 14.64 mg is attributed to the greater Sandy-related releases. The Sandy-related releases represent approximately 1.7% of storage in Woodcliff Lake. Flow remained at about 20 cfs until late on the 29th when storm runoff increased stream-flow.



III.C. Oradell Reservoir

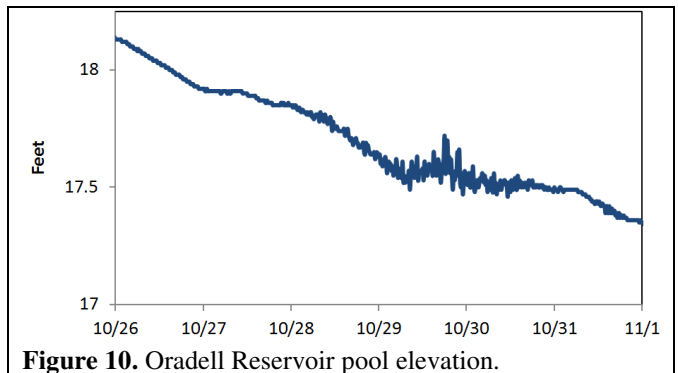
Precipitation

The NJ State Climatologist maintains the Hawthorn gage immediately adjacent to the Oradell Reservoir. Precipitation at this gage was 0.94 inches in the period October 29-31, 2012 (fig. 9).



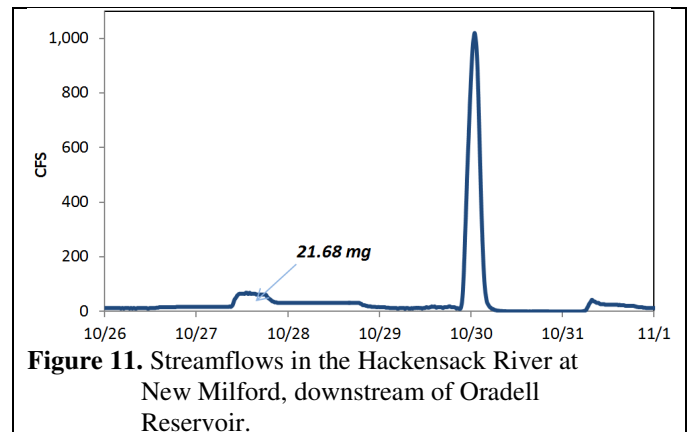
Reservoir Pool Elevation

The pool elevation in Oradell Reservoir was dropping before the pre-Sandy releases occurred. It is hard to determine what part of the observed decline over the period October 26th to the 28th is due to water removed from the reservoir for water supply and what part to the additional pre-Sandy releases. But it is clear that the water level in the reservoir did not increase during Hurricane Sandy (fig. 10). Enough storage space was available to store all storm runoff.



Releases

Pre-Sandy releases from the Oradell Reservoir are first observed in streamflow at 8:30 AM on October 29 (fig. 11). Flow increased from 17 cfs at that time to a peak of 69 cfs about 1:30 PM on the 29th. The pre-Sandy releases ceased at midnight on the 28th. These measurements are from the stream gage on the Hackensack River at New Milford, which is 0.6 mile downstream of the Oradell Reservoir. The total volume released during this period was 38.84 mg, of which 21.68 mg is attributed to the greater Sandy-related releases. The Sandy-related releases are approximately 0.6% of the capacity of Oradell Reservoir. The much larger streamflows on October 30 are due to storm runoff from Sandy.



III.D. Wanaque Reservoir

Precipitation

There is no precipitation gage at or directly adjacent to the Wanaque Reservoir. Precipitation on the reservoir's watershed was 1.0 to 1.5 inches in the period October 29-31, 2012 (fig. 3).

Reservoir Pool Elevation

The elevation of the pool in Wanaque Reservoir does not appear to change significantly due to the pre-Sandy releases made on the 28th and 28th. The pool elevation was between 290.5 and 290.7 feet during the period October 26 to October 29 (fig. 12). When Hurricane Sandy struck pool elevations rose to 291.5 feet. Spillway elevation of the Wanaque Reservoir is 302.40 feet.

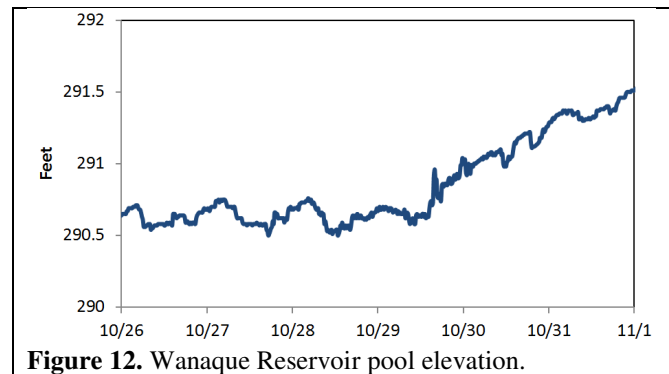


Figure 12. Wanaque Reservoir pool elevation.

Releases

Streamflows 750 feet downstream of the Wanaque Reservoir were 19 cfs before Sandy-related releases started. These releases were first noted at this gage (Wanaque River at Wanaque, NJ) at 6 PM on October 26 (fig. 13). Streamflows rose to 68 cfs and remained at that increased rate for 24 hours. By 9 PM on October 27, flows had returned to 19 cfs. Volume releases during this period totaled 44.01 mg, of which 31.48 mg is attributed to the greater Sandy-related releases. The Sandy-related releases are about 0.09% of the combined Wanaque-Monksville storage.

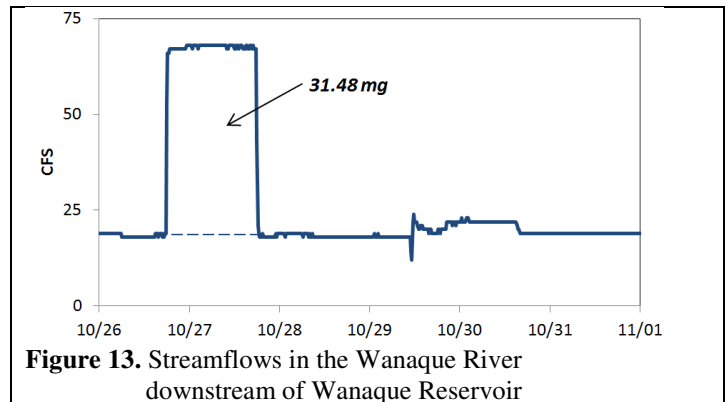


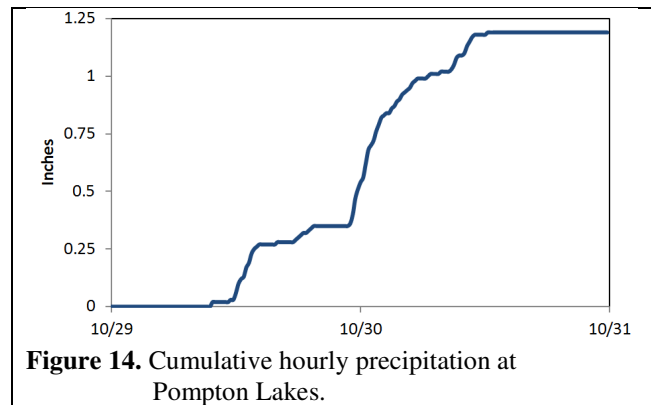
Figure 13. Streamflows in the Wanaque River downstream of Wanaque Reservoir

During Hurricane Sandy the Wanaque Reservoir system (which includes the Monksville Reservoir directly upstream) was able to absorb all floodwaters and spilled no water. All storm runoff was captured for future potable-supply use.

III.E. Pompton Lake

Precipitation

Hurricane Sandy precipitation started about 10 AM on October 29, as measured at the USGS precipitation gage at Pompton Lakes (fig. 14). By the time the rainfall stopped (about 11 AM on the 30th) a total of 1.18 inches of rain had fallen.

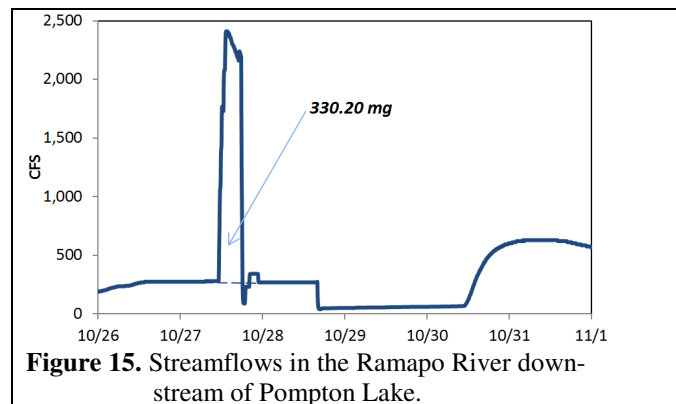


Reservoir Pool Elevation

Pompton Lake lacks a gage that automatically monitors water levels. However, NJDEP staff report that the releases lowered water elevation in Pompton Lake by five feet (John Moyle, NJDEP Bureau of Dam Safety & Flood Control, oral communication).

Releases

Increased releases from Pompton Lake started at 11:15 AM on October 27 (fig. 15). Flows increased from 281 cfs to a peak of 2,410 cfs as measured at the Ramapo River at Pompton Lakes gage which is 400 feet downstream of the Pompton Lake dam. The increased releases stopped at 11 PM on October 27. The total volume released during this period was 410.34 mg, of which 330.20 mg is attributed to the greater Sandy-related releases. The Sandy-related releases are approximately 110% of storage in Pompton Lake.



Flood stage is at the Ramapo River at Pompton Lakes gage is 11.5 feet above datum. The stage-discharge curve for this gage indicates this stage corresponds to a flow of 4,150 cf. Thus the maximum pre-Sandy releases from Pompton Lake did not cause stream levels to rise above flood stage.

III.F. Charlotteburg Reservoir

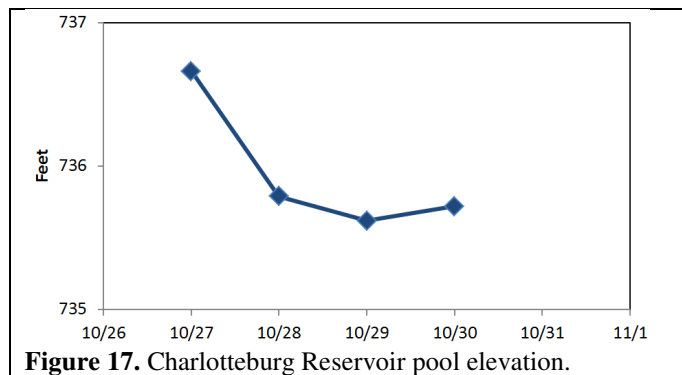
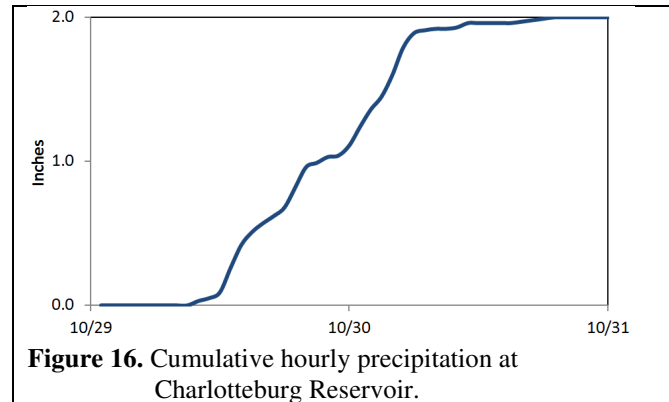
Analysis of releases from the Charlotteburg Reservoir is handicapped by the lack of gages. Pool elevation is not automatically measured, nor is there a downstream gage that measures releases.

Precipitation

Precipitation at Charlotteburg Reservoir started at 10 AM on October 29 as measured by the Charlotteburg precipitation gage maintained by the New Jersey Weather and Climate network. (fig. 16). It ended at 8 PM on October 29, by which time 2.0 inches of rain had fallen.

Reservoir Pool Elevation

The reservoir operators report that approximately 55 million gallons of water was released from Charlotteburg Reservoir on October 27-28, 2012. This is equivalent to approximately 1.9% of the reservoir storage. Pool elevations were lowered about a foot between October 27th and 30th (fig. 17). The Charlotteburg Reservoir monitoring system malfunctioned on the 30th and did not record any additional useful information until November 8, 2012 (Bob Lincoln, Newark Watershed Conservation and Development Corp., written communication, 2013).



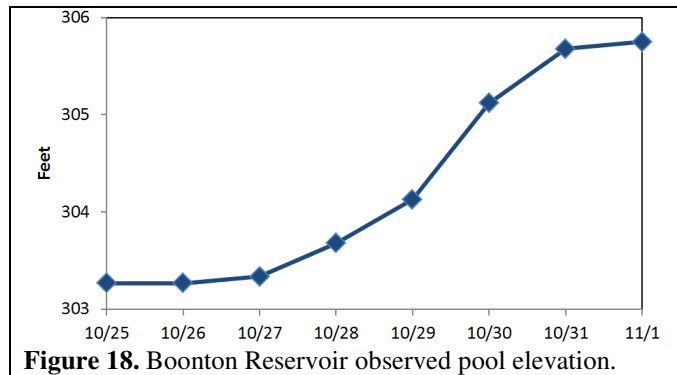
III.G. Boonton Reservoir

Precipitation

There is no precipitation gage at or immediately adjacent to the Boonton Reservoir. Precipitation on the reservoir's watershed was 1 to 1.5 inches in the period October 29-31, 2012 (fig. 3).

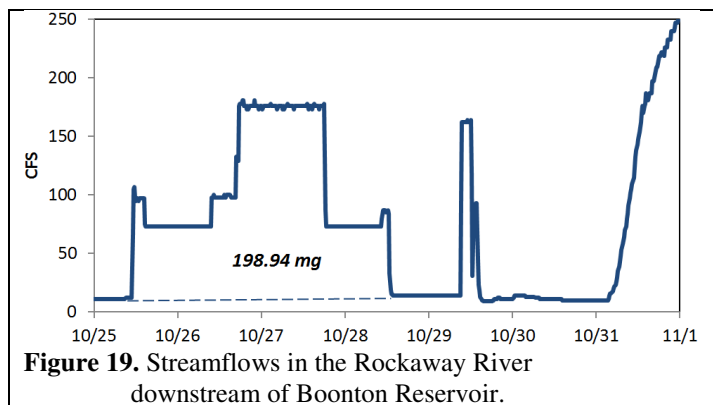
Reservoir Pool Elevation

The Boonton Reservoir did not have an active automatic gage during the period when Hurricane Sandy struck. Only daily pool elevations are available (fig. 18). The water elevation in the reservoir rose from 304.13 feet on October 29 to 305.75 feet on November 1, 2012. Spillway elevation of the Boonton Reservoir is 305.25 feet. There was no observable decline in water level in the reservoir due to the pre-Sandy releases.



Releases

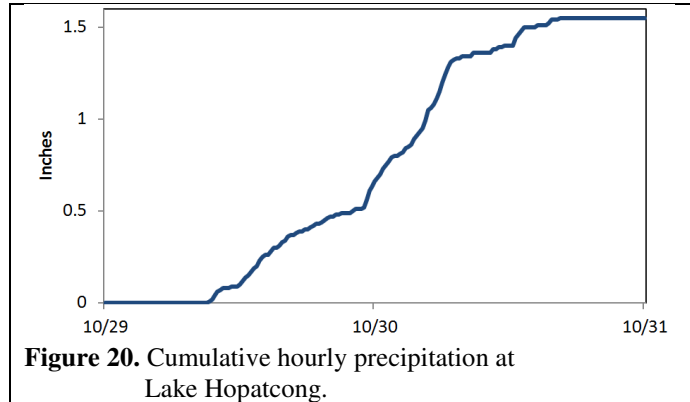
The Boonton Reservoir has a normal passing flow of 23 cfs (Hoffman and Domber, 2013). At 10:45 AM on the morning of October 25 flow was 12 cfs in the Rockaway River at the flow gage (Rockaway River below reservoir at Boonton, NJ) which is 2,000 feet downstream of the dam (fig. 19). At 11:15 AM streamflow increased to 105 cfs and then to 181 cfs at 10:00 PM on the 26th. Pre-Sandy releases ceased around 1 PM on the 28th. The total volume releases during this period of extra releases was 223.02 mg, of which 198.94 mg is attributed to the greater Sandy-related releases. The Sandy-related releases represent approximately 2.7% of total reservoir volume. Available data do not indicate that reservoir levels dropped appreciably due to these releases.



III.H. Lake Hopatcong

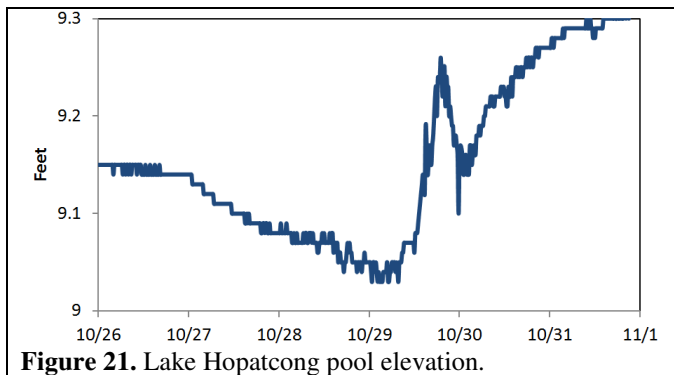
Precipitation

Hurricane Sandy precipitation started about 9 AM on October 29 as measured at the USGS Lake Hopatcong precipitation gage (fig. 20). By the time rainfall had stopped (about 4 PM on the 30th) a total of 1.55 inches of rain had fallen.



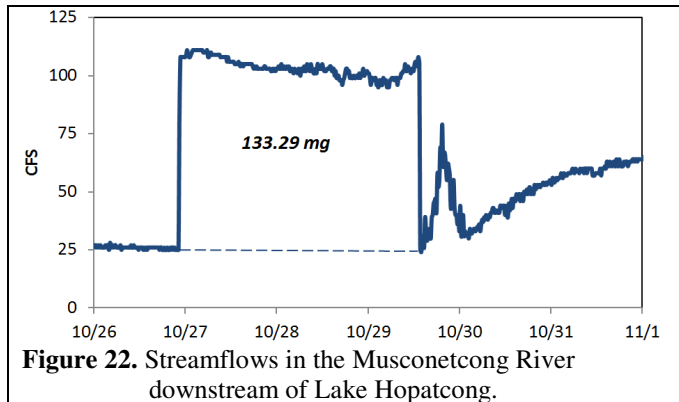
Reservoir Pool Elevation

The relative pool level in Lake Hopatcong was 9.15 feet at the start of the ordered releases (fig. 21). Levels in Lake Hopatcong declined to 9.03 feet at their lowest. Subsequently levels rose in response to runoff entering the lake to about 9.3 feet.



Releases

Increased releases from Lake Hopatcong started at 10:30 PM on October 26 (fig. 22). Flows increased from 25 cfs to a peak of 111 cfs as measured at the Musconetcong River gate at the outlet of Lake Hopatcong, which is 300 feet downstream of the lake's dam. The increased releases ceased at midnight on October 29. The total volume released during this period was 176.04 mg, of which 133.29 mg is attributed to the greater Sandy-related releases. The Sandy-related releases are about 0.9% of storage in the lake.



III. I. Cumulative impact on streamflow

A concern with pre-storm reservoir releases is that that the released water moves downstream below any area of flooding concern before the storm strikes. In the Passaic Basin, a series of stream gages make possible an analysis of this concern. A similar analysis in the Hackensack Basin is not possible due to a lack of sequential stream gages.

Figure 23 is a schematic of the rivers, reservoirs and stream gages in northeast New Jersey. Figure 24 shows streamflow at several gages that illustrate the impact of upstream releases for the period October 26 to 31, 2012. The dotted lines in figure 24 signify flow at gages directly downstream of a reservoir. Solid lines indicate flow at gages with two or more upstream reservoirs with ordered releases.

Additional releases from the Boonton Reservoir started at 11 AM on October 25th, peaked around 189 cfs the evening of the 26th and up until 5 PM on the 27th, and declined through the 28th and early 29th (fig. 24). This increase was monitored at the gage on the Rockaway River, 2,000 feet downstream of the Boonton Reservoir dam. The Passaic River at Pine Brook gage is downstream of the confluence of the Rockaway and Passaic Rivers. This gage is about 9.3 miles downstream of the Boonton Reservoir dam (table 6). It is also upstream of the confluence of the Pompton River and thus shows no effects of the releases from the Wanaque Reservoir and Pompton Lake (fig. 4). The lessening of releases from the Boonton Reservoir at 5 PM on the 27th appears to be reflected in a decline in streamflow at the Passaic River at Pine Book gage about 1 AM on the 28th. The second pulse of releases from the Boonton Reservoir is followed by a rise in flows at Pine Brook but this rise is too large to be caused entirely by the reservoir releases. The Boonton reservoir releases had a minor impact on flows in the Passaic River at Pine Brook and no readily apparent impact on Passaic River slows at Little Falls.

The increased releases in the Pompton watershed did significantly impact flows downstream. Pompton Lake is on the Ramapo River. The Ramapo River at Pompton Plains stream gage is 400 feet downstream of the Pompton Lake dam. Releases from Pompton Lake started at 11:15 AM on the 27th and lasted until 10:45 PM that day. Flows increased from 281 cfs to a peak of 2,410 cfs at 1:20 PM (fig. 24). The Ramapo River joins the Pequannock River downstream of Pompton Lake to form the Pompton River. The Pompton River at Pompton Plains stream gage is 2.1 miles downstream of the Ramapo River at Pompton Lakes gage (table 6). Streamflow at this Pompton River gage increased from about 602 cfs at 11:30 to 655 at 11:45 to a peak of 2,480 cfs at 3:00 PM.

Peak flows are also seen farther downstream. The Pompton River enters the Passaic at Two Bridges. The Passaic River at Little Falls is downstream of this confluence and is 10.0 miles downstream of the Pompton River at Pompton Plains gage (table 6). Flow increased at the Little Falls gage starting at 1:15 PM, about 2 hours after the increased releases started from Pompton Lake (fig. 24). Flow in the Passaic River was about 680 cfs at this time. The flows peaked at about 1,640 cfs at 7:45 PM that evening and then declined much more gradually than peak flows at the two upstream gages.

Releases from the Wanaque Reservoir were measured at a stream gage 750 feet downstream of the reservoir's dam (table 4). Releases from the Wanaque Reservoir started at 6:00 PM on the 26th and lasted until 6:15 PM on the 27th (fig. 24). Flows started at about 19 cfs and increased to a peak of 68 cfs. Flow downstream at the Pompton River at Pompton Plains gage (6.9 miles away) and at the Passaic River at Little Falls gage (16.9 miles away) show no obvious increase resulting from additional releases from Wanaque Reservoir.

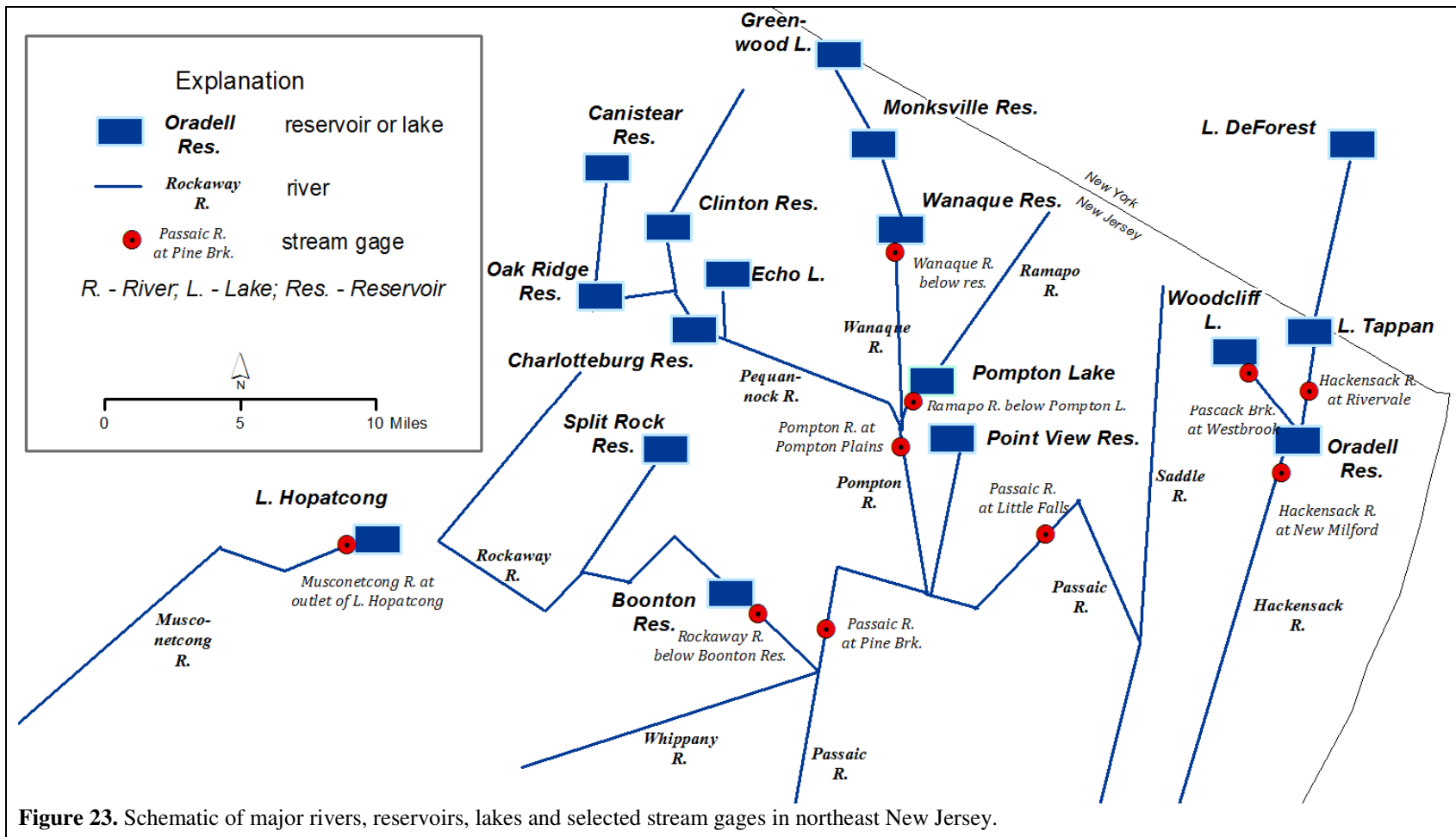


Figure 23. Schematic of major rivers, reservoirs, lakes and selected stream gages in northeast New Jersey.

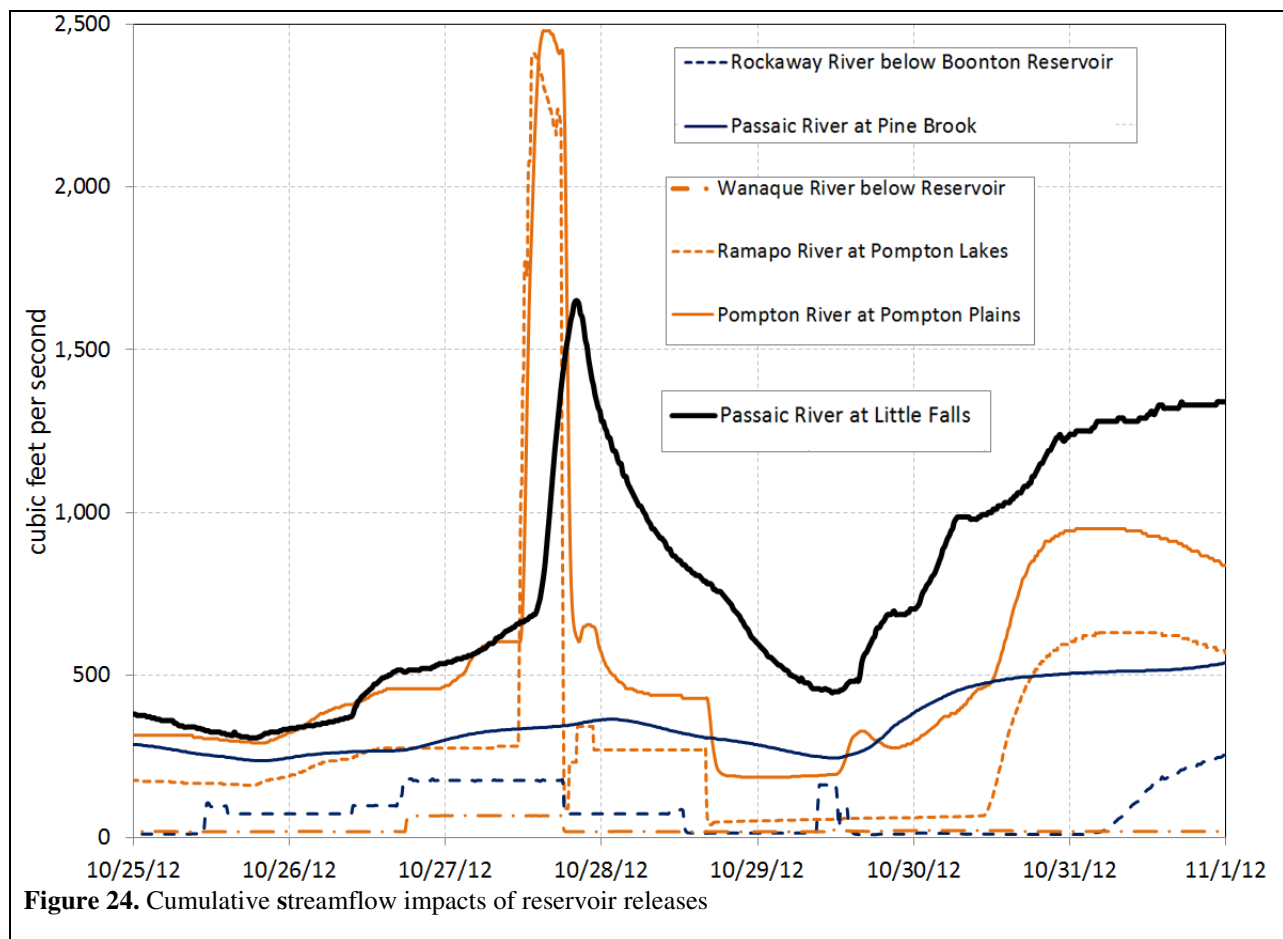


Table 6. Distances between selected stream gages*

Upstream gage	Downstream gage	Distance (miles)
Rockaway R. below reservoir	Passaic River at Pine Brook	9.3
Passaic River at Pine Brook	Passaic River at Little Falls	15.0
Wanaque River at Wanaque	Pompton River at Pompton Plains	6.9
Ramapo River at Pompton Lakes	Pompton River at Pompton Plains	2.1
Pompton River at Pompton Plains	Passaic River at Little Falls	10.0

*All distances from Helen Pang, NJDEP, written communication, 2013

IV. Additional Lake Releases

Before Hurricane Sandy struck, municipal and county officials ordered releases on small lakes across New Jersey. An internet search shows that they ordered partial draining of 14 lakes in advance of the hurricane (table 7). Data are unavailable on changes in lake levels, volume releases, or changes in downstream flows as a result of these lowerings. There are no reports of downstream flooding caused by these releases.

Table 7. Lake, pond and reservoir lowerings ordered by municipalities and counties in advance of Hurricane Sandy.

Lake/Pond	Municipality	County	Ordered by
Verona Park Lake	Verona	Essex	county
Diamond Mill Pond	Millburn	Essex	county
Peddie Lake	Hightstown	Mercer	municipality
Brainerd Lake	Cranbury	Middlesex	municipality
Lake Lefferts	Matawan	Monmouth	municipality
Spring Lake	Spring Lake	Monmouth	municipality
Lake Como	Belmar	Monmouth	municipality
Lake Weamaconk	Englishtown	Monmouth	municipality
Lake of the Lillies	Point Pleasant	Ocean	municipality
Nomahegan Lake	Cranford	Union	county
Clark Reservoir	Clark	Union	county
Bloodgoods Pond	Clark	Union	county
Jackson Pond	Clark	Union	county
Milton Lake	Rahway	Union	county

V. References

- Greenwood lake Commission, 2011, Greenwood Lake Water Level Management Plan: Greenwood Lake, NY, 14 p, available at http://www.gwlc.org/images/ZMWater_Level_Management_Plan_2009.pdf.
- Halsey, S.D., 2013, Like a thief in the night: Superstorm Sandy's stealth storm surge: presentation at the Geological Society of America Northeastern Section 48th Annual meeting, March 18-20, 2013, available at <https://gsa.confex.com/gsa/2013NE/webprogram/Paper215188.html>.
- Hoffman, J.L. and Domber, S.E., 2013, History of passing flows in New Jersey, with contemporary and future applications: N.J. Geological & Water Survey Open File Report 13-1, 56 p., available at <http://www.njgeology.org/pricelst/ofreport/ofr13-1.pdf>.
- N.J. Department of Environmental Protection, 2011, Lake Hopatcong water level management plan: Trenton, NJ, 53 p., available at <http://www.lakehopatcong.org/Pubs/WATER LEVEL MGT PLAN/Lake Hopatcong Water Level Management Plan final march 2011.pdf>.
- New Jersey Department of Environmental Protection, 2012, Estimating the safe yield of surface water supply reservoirs: guidance manual, 44 p., available at <http://www.nj.gov/dep/watersupply/pdf/safe-yield-manual.pdf>
- Uptegrove, J., Farrell, S., Smith, B., and Stanford, S., 2013, Impacts of Hurricane Sandy on the New Jersey coastline & how can we respond?: presentation at the Geological Society of America Northeastern Section 48th Annual meeting, March 18-20, 2013, available at <https://gsa.confex.com/gsa/2013NE/webprogram/Paper216120.html>.
- White, G.F., 1945, Human adjustment to floods: The University of Chicago, Department of Geography, Research Paper no. 29, 225 p.

Appendix A. Executive Orders

EXECUTIVE ORDER NO. 104⁶

WHEREAS, the National Weather Service is predicting that Hurricane Sandy will move along the New Jersey coast beginning on October 28, 2012, bringing the potential for severe weather conditions, including heavy rains, high winds, dangerous storm surges, and stream and river flooding that may threaten homes and other structures, and endanger lives in the State; and

WHEREAS, it is necessary to take action in advance of the storm to lessen the threat to lives and property in this State; and

WHEREAS, the impending weather conditions may cause outages of power, impede transportation and the flow of traffic in New Jersey, and thereby make it difficult or impossible for citizens to obtain the necessities of life, as well as essential services such as police, fire, and first aid; and

WHEREAS, the impending weather conditions constitute an imminent hazard, which threatens and presently endangers the health, safety, and resources of the residents of one or more municipalities and counties of this State; and

WHEREAS, this situation may become too large in scope to be handled by the normal county and municipal operating services in some parts of this State, and this situation may spread to other parts of the State; and WHEREAS, the Constitution and statutes of the State of New Jersey, particularly the provisions of N.J.S.A. App. A:9-33, et seq., N.J.S.A.38A:3-6.1, and N.J.S.A.38A:2-4, and all, confer upon the Governor of the State of New Jersey certain emergency powers;

NOW, THEREFORE, I, CHRIS CHRISTIE, Governor of the State of New Jersey, in order to protect the health, safety, and welfare of the people of the State of New Jersey, DO DECLARE and PROCLAIM that a State of Emergency exists in the State of New Jersey and I hereby ORDER and DIRECT the following:

1. I authorize and empower the State Director of Emergency Management, who is the Superintendent of State Police, to activate those elements of the State Emergency Operations Plan that he deems necessary to further safeguard the public security, health, and welfare, to direct the activation of county and municipal emergency operations plans as necessary, and to coordinate the preparation, response, and recovery efforts from this emergency with all governmental agencies, volunteer organizations, and the private sector.

2. I authorize and empower the State Director of Emergency Management, in accordance with N.J.S.A. App. A:9-33, et seq., as supplemented and amended, through the police agencies under his control, to determine the control and direction of the flow of vehicular traffic on any State or interstate highway, municipal or county road, and any access road, including the right to detour, reroute, or divert any or all traffic and to prevent ingress or egress from any area that, in the State Director's discretion, is deemed necessary for the protection of the health, safety, and welfare of the public, and to remove parked or abandoned vehicles from such roadways as conditions warrant.

3. I authorize and empower the Attorney General, pursuant to the provisions of N.J.S.A.39:4-213, acting through the Superintendent of State Police, to determine the control and direction of the flow of vehicular traffic on any State or interstate highway, municipal or county road, and any access road, including the right to detour, reroute, or divert any or all traffic, and to prevent ingress or egress and further authorize all law enforcement officers to enforce any such order of the Superintendent of State Police within their respective municipalities.

⁶ Retrieved from: <http://nj.gov/infobank/circular/eocc104.pdf>

4. I authorize and empower the State Director of Emergency Management to order the evacuation of all persons, except for those emergency and governmental personnel whose presence the State Director deems necessary, from any area where their continued presence could present a danger to their health, safety, or welfare because of the conditions created by this emergency.

5. I authorize and empower the State Director of Emergency Management to utilize all facilities owned, rented, operated, and maintained by the State of New Jersey to house and shelter persons who may need to be evacuated from a residence, dwelling, building, structure, or vehicle during the course of this emergency.

6. I authorize and empower the executive head of any agency or instrumentality of the State government with authority to promulgate rules to waive, suspend, or modify any existing rule the enforcement of which would be detrimental to the public welfare during this emergency, notwithstanding the provisions of the Administrative Procedure Act or any law to the contrary for the duration of this Executive Order, subject to my prior approval and in consultation with the State Director of Emergency Management. Any such waiver, modification, or suspension shall be promulgated in accordance with N.J.S.A. App. A:9-45.

7. I authorize and empower the Adjutant General, in accordance with N.J.S.A.38A:2-4 and N.J.S.A.38A:3-6.1, to order to active duty such members of the New Jersey National Guard who, in the Adjutant General's judgment, are necessary to provide aid to those localities where there is a threat or danger to the public health, safety, and welfare and to authorize the employment of any supporting vehicles, equipment, communications, or supplies as may be necessary to support the members so ordered.

8. In accordance with the N.J.S.A. App. A:9-34 and -51, I reserve the right to utilize and employ all available resources of the State government and of each and every political subdivision of the State, whether of persons, properties, or instrumentalities, and to commandeer and utilize any personal services and any privately owned property necessary to protect against this emergency.

9. In accordance with N.J.S.A. App. A:9-40, no municipality, county, or any other agency or political subdivision of this State shall enact or enforce any order, rule, regulation, ordinance, or resolution, which will or might in any way conflict with any of the provisions of this Order, or which will in any way interfere with or impede the achievement of the purposes of this Order.

10. It shall be the duty of every person or entity in this State or doing business in this State and of the members of the governing body and every official, employee, or agent of every political subdivision in this State and of each member of all other governmental bodies, agencies, and authorities in this State of any nature whatsoever, to cooperate fully with the State Director of Emergency Management in all matters concerning this state of emergency.

11. In accordance with N.J.S.A. App. A:9-34, N.J.S.A. App. A:9-40.6, and N.J.S.A.40A:14-156.4, no municipality or public or semipublic agency shall send public works, fire, police, emergency medical, or other personnel or equipment into any non-contiguous disaster-stricken municipality within this State, nor to any disaster-stricken municipality outside this State, unless and until such aid has been directed by the county emergency management coordinator or his deputies in consultation with the State Director of Emergency Management. 12. This Order shall take effect immediately and shall remain in effect until such time as it is determined by me that an emergency no longer exists.

Signed October 27, 2012

EXECUTIVE ORDER NO. 106⁷

WHEREAS, New Jersey has suffered substantial damage from Hurricane Sandy including significant disruption of the power generation necessary to maintain our State's water supply; and

WHEREAS, in the aftermath of Hurricane Sandy, the use of water throughout the State must be managed and reduced in order to preserve a dependable supply of water; and

WHEREAS, the Commissioner of the Department of Environmental Protection has found that emergency measures are necessary to prevent a water shortage; and

WHEREAS, cooperative efforts to ensure sound water use, both inside and outside the home, will reduce consumption and thereby minimize the need for treatment and production that places additional strains on our State's energy supply; and

WHEREAS, the damage caused from Hurricane Sandy, including fallen trees, downed power lines, damage to roadways, and disruptions in electrical service has produced dangerous conditions throughout the State that continue to jeopardize the public safety; and

WHEREAS, the Commissioner of the Department of Environmental Protection has the authority pursuant to N.J.S.A.58:1A-1, et seq. and N.J.A.C.7:19-1, et seq., to adopt such rules, regulations, orders, and directives as deemed necessary to help alleviate a water emergency; and

WHEREAS, it is necessary to take action to minimize additional risks to lives and the public safety as the State begins rebuilding and recovering from Hurricane Sandy; and

WHEREAS, on October 27, 2012, in light of the dangers posed by Hurricane Sandy, and pursuant to the authority provided under the Constitution and statutes of the State of New Jersey, particularly the provisions of N.J.S.A. App. A:9-33, et seq., N.J.S.A.38A:3-6.1, and N.J.S.A.38A:2-4, and all amendments and supplements thereto, I declared a State of Emergency; and

WHEREAS, in accordance with the N.J.S.A.App. A:9-34 and -51, I reserved the right to utilize and employ all available resources of the State government to protect against the emergency created by Hurricane Sandy;

NOW, THEREFORE, I, CHRIS CHRISTIE, Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER and DIRECT:

1. A state of water emergency exists throughout the State of New Jersey by reasons of the facts and circumstances set forth above.

2. The Commissioner of the Department of Environmental Protection is directed pursuant to N.J.S.A.58:1A-1, et seq. and N.J.A.C.7:19-1 et seq., and all other applicable authority, to take whatever steps are necessary and proper to alleviate the water emergency and effectuate this Order, including: a. Identifying and imposing such water use restrictions and conservation measures deemed necessary for the entire State, or for a specific region, taking into consideration region-specific hydrogeologic conditions and infrastructure; b. Identifying and implementing statewide strategies for the use of alternate water supplies; c. Identifying and implementing measures to establish priorities for the distribution of the State's water supply to mitigate the present water emergency; and d. Working with all Departments and Agencies of State government to reduce water consumption.

⁷ Retrieved from: <http://nj.gov/infobank/circular/eocc106.pdf>

3. It shall be the duty of every person and entity in the State to fully cooperate in all matters concerning this water emergency and to comply with the mandatory restrictions on uses of water as defined in Administrative Orders issued by the Commissioner of the Department of Environmental Protection pursuant to this Order.

4. Any person who shall violate any provision of this Order, or impede or interfere with any action ordered or taken pursuant to this Order, shall be subject to the penalties provided under N.J.S.A.58:1A-1 et seq., N.J.S.A. App.A:9-49 et seq., and N.J.A.C.7:19-1 et seq.

5. No municipality, county, or any other agency or political subdivision of the State shall enact or enforce any order, rule, regulation, ordinance, or resolution which conflicts with any provision of this Order, or any Administrative Orders issued by the Commissioner of the Department of Environmental Protection pursuant to this Order.

6. This Order shall take effect immediately.

Signed October 31, 2012

EXECUTIVE ORDER NO. 120⁸

WHEREAS, beginning on October 28, 2012, and continuing through October 30, 2012, Hurricane Sandy struck the State of New Jersey; and

WHEREAS, Sandy unleashed widespread destruction across the State, damaging homes, displacing communities, and devastating New Jersey's world-renowned beaches and shores; and

WHEREAS, the effects of Sandy, especially the significant power outages across New Jersey, disrupted the lives of residents and placed much of the State in immediate and serious harm; and

WHEREAS, on October 27, 2012, in light of the dangers posed by Sandy, and pursuant to the authority provided under the Constitution and statutes of the State of New Jersey, particularly the provisions of N.J.S.A. App. A:9-33, et seq., N.J.S.A.38A:3-6.1, and N.J.S.A.38A:2-4, and all amendments and supplements thereto, I declared a State of Emergency; and

WHEREAS, on October 31, 2012, in light of a finding by the Commissioner of the Department of Environmental Protection that emergency measures were necessary to prevent a water shortage, I declared a state of water emergency to exist throughout the State; and

WHEREAS, through the efforts of all New Jersey residents, our State continues to recover and rebuild; and

WHEREAS, coordinated water management efforts, including water conservation efforts and compliance with water use restrictions, exercised by water suppliers, State and local governments, private businesses, and all citizens of New Jersey, reduced water demands, allowed for the preservation of available supplies, and substantially improved the condition of the State's water supply;

NOW, THEREFORE, I, CHRIS CHRISTIE, Governor of the State of New Jersey, by virtue of the authority vested in me by the Constitution and by the Statutes of this State, do hereby ORDER and DIRECT:

1. Executive Order No. 106, signed on October 31, 2012, is rescinded.
2. This Order shall take effect immediately.

Signed December 19, 2012

⁸ Retrieved from: <http://nj.gov/infobank/circular/eocc120.pdf>

Appendix B. New Jersey Governor's Press Release, October 26, 2012⁹

GOVERNOR CHRISTIE TAKES ACTION TO MITIGATE POTENTIAL IMPACTS FROM HURRICANE APPROVES LOWERING OF NORTH JERSEY RESERVOIRS

TRENTON - Governor Chris Christie today is announcing actions to help mitigate potential flooding from Hurricane Sandy, including directing four reservoir systems in northern New Jersey to be drawn down beginning this evening and for releases to be made from Pompton Lake and Lake Hopatcong on Saturday.

"These actions are necessary due to the potentially unprecedented nature of the storm that is heading our way," Governor Christie said. "A great deal of rainfall is expected which could cause major flooding, so we are taking every step we can to try to mitigate the potential flooding that could occur."

Department of Environmental Protection Commissioner Bob Martin detailed the steps during a teleconference this evening with local officials.

"New Jersey's reservoirs are designed to provide water, not for flood control," Commissioner Martin said. "But given the situation, we decided we needed to get as much water out of the reservoir systems as possible, creating void space for runoff from the storm."

The reservoirs that will be drawn down are the Woodcliffe Lake-Lake Tappan-Oradell Reservoir system operated by United Water in Bergen County; the Charlotteburg Reservoir, operated by the City of Newark; the Wanaque Reservoir operated by the North Jersey Water Supply District; and the Boonton Reservoir operated by Jersey City.

The reservoirs will be drawn down over a period of about 20 to 30 hours. Releases will be stopped well in advance of heavy rains, which will give the released water ample time to pass through the downstream river systems.

The drawdown of much smaller Pompton Lake will take place around mid-day Saturday, and is expected to take five to six hours to complete. The Department of Environmental Protection will manually operate the flood gates and draw down the lake by five feet. This drawdown will end in sufficient time to allow the released water ample time to safely pass downstream communities. The gates will go back to automatic operations after the drawdown operation is completed.

Lake Hopatcong, which is a state-owned lake in Morris and Sussex counties, also will be drawn down on Saturday. The New Jersey Office of Emergency Management (OEM) is coordinating with local Offices of Emergency Management to prepare for any evacuations that may become necessary.

⁹ Retrieved from: <http://nj.gov/governor/news/news/552012/approved/20121026b.html>