

**CITY OF NEW YORK  
DEPARTMENT OF ENVIRONMENTAL PROTECTION**

**DROUGHT MANAGEMENT PLAN  
AND RULES**

**DECEMBER 29, 1998**

**CITY OF NEW YORK  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
DROUGHT MANAGEMENT PLAN AND RULES**

**TABLE OF CONTENTS**

INTRODUCTION.....	1
DROUGHT PHASES.....	4
COORDINATION WITH OTHER AGENCIES.....	4
ACTIONS AND RULES.....	5
DROUGHT WATCH.....	6
DROUGHT WARNING.....	6
DROUGHT EMERGENCY.....	7
SANCTIONS.....	12
VARIANCES.....	13
GLOSSARY OF TERMS.....	14
MANAGEMENT OF CROTON SYSTEM IN DROUGHT.....	14
MANAGEMENT OF CATSKILL SYSTEM IN DROUGHT.....	14
MANAGEMENT OF DELAWARE RESERVOIRS IN DROUGHT.....	16
EMERGENCY SUPPLY AT THE CHELSEA PUMPING STATION.....	19

**ILLUSTRATIONS**

**FIGURES**

1. NEW YORK CITY WATER SUPPLY SYSTEM.....	2
2. DRBC OPERATION CURVES FOR DELAWARE SYSTEM RESERVOIRS.....	18

**TABLES**

1. CAPACITIES/COMPONENTS OF THE NEW YORK CITY WATER SUPPLY SYSTEM.....	3
2. CROTON SYSTEM CONSUMPTION WITHIN NEW YORK CITY .....	15
3. DRBC INTERSTATE OPERATION FORMULA FOR REDUCTIONS .....	16
4. DRBC FLOW OBJECTIVES FOR SALINITY CONTROL.....	17

## INTRODUCTION

The New York City Water Supply System, which serves the five boroughs of the City of New York (NYC) and many communities in Southeastern New York State, is supplied by three source-water reservoir systems. These three systems, the Croton, Catskill, and Delaware, include 18 reservoirs and three controlled lakes, and have a collective storage capacity of 558 billion gallons. Typically these systems provide 10, 35 and 55 percent of the total daily supply, respectively. The major components of the systems are shown in Figure 1, and their capacities are listed in Table 1.

In addition to the tunnels, aqueducts and the three reservoir systems, there are features in the NYC System which allow for contingency and emergency operations. Several interconnections exist between the reservoir systems. Through these interconnections, water can be transferred from one system to another in response to localized water quality or quantity concerns. In 1996 NYC acquired the former Jamaica Water Supply Company wells located in Queens, NY. A number of these wells regularly supplement the System's surface water supply, while others are available for emergency use (maximum available quantity: 62 MGD) . A pumping station at Chelsea, New York which is capable of drawing water from the Hudson River, is also available to augment the water supply by 100 MGD under emergency conditions.

New York City observes a "water-year" which runs from June 1 to May 31. Using historical data, a profile of typical system-wide storage levels has been established. Using this profile, criteria have been developed to assess the probability of achieving reservoir refill by the start of the succeeding water year. These criteria are used to identify potential or impending drought conditions. The City's Department of Environmental Protection (DEP) monitors and records daily reservoir storage levels, inflow and releases. These conditions are reviewed and regularly compared with the criteria to forecast the probability of achieving adequate reservoir levels to serve the system's consumers throughout the coming water year.

In the event that this comparison reveals emerging and worsening drought conditions, the operators of the system can implement the contingency and emergency operations to supplement the water supply. Conservation measures will also be taken to reduce the demand for water. These measures can slow the depletion rate of the stored water and potentially postpone or eliminate the threat of serious shortage. The City's water supply options and controls are described in the following pages.

Figure 1  
New York City's  
Water Supply System



- Catskill / Delaware Watershed Area
- Croton Watershed Area
- Rivers and Reservoirs
- Catskill Aqueduct and Tunnels
- Croton Aqueduct
- Delaware Aqueduct and Tunnels
- County Borders
- State Borders

[www.ci.nyc.ny.us/dep](http://www.ci.nyc.ny.us/dep)

**Table 1**  
**Capacities and Components of The New York City Water Supply System**

DELAWARE SYSTEM			CATSKILL SYSTEM			CROTON SYSTEM		
<i>Reservoirs</i>			<i>Reservoirs</i>			<i>Reservoirs</i>		
<u>Source Reservoirs</u>	Storage <sup>1</sup> (billion gallons)	Mandated Releases (million gallons/day)	<u>Source Reservoirs</u>	Storage <sup>1</sup> (billion gallons)	Mandated Releases (million gallons/day)	<u>Source Reservoirs</u>	Storage <sup>1</sup> (billion gallons)	NYS DEC Mandated Releases (million gallons/day)
Delaware Basin			Schoharie	176	- 9	Boyd's Corner	17	10
Neversink	34.90	3-29 5	Ashokan	122.9	- 7	West Branch	10.0	5-20 6
Pepacton	140.20	4-45 5	<b>Total - Catskill Sources</b>	<b>140.5</b>		Bog Brook	4.4	5
Cannonsville	95.70	5-210 5	<u>Balancing Reservoir</u>			East Branch	5.2	25
Sub-Total	270.80		Kensico (Catskill/Delaware System)	30 <sup>2</sup>	- 7	Middle Branch	4.0	- 13
Rondout	49.60	0-15 5	<u>Distribution Reservoirs</u>			Croton Falls	0.9	30
<b>Total - Delaware Sources</b>	<b>320.40</b>		Hillview (Catskill/Delaware System)	0.21 <sup>3</sup>		Diverting		
			Silver Lake Tanks (two)	0.1 <sup>4</sup>		Croton Falls	14.2	20
<u>Balancing Reservoirs</u>			<i>Tunnels &amp; Aqueducts</i>			Cross River	10.3	5
West Branch (Croton System)	10.0	5-20 6	Connecting	Nominal Capacity <sup>8</sup> (million gallons/day)		Amawalk	6.7	5-10 6
Kensico (Catskill/Delaware System)	30 <sup>2</sup>	- 7	Shandaken Tunnel	Schoharie to Esopus Creek	615	Titicus <sup>11</sup>	7.2	5
<u>Distribution Reservoirs</u>			Catskill Aqueduct	Ashokan to Kensico	610	Muscoot	4.9	- 13
Hillview (Catskill/Delaware System)	0.21 <sup>3</sup>			Kensico Bypass	600	New Croton	23.8	0-75
Silver Lake Tanks (two)	0.05 <sup>4</sup>			Kensico to Hillview	800	3 Controlled Lakes Kirk Lake, Lakes Gilead & Glenelda	1.3	- 14
<i>Tunnels &amp; Aqueducts</i>			<b>TRANSFERS BETWEEN SYSTEMS</b>			<b>Total - Croton</b>	<b>94.6<sup>12</sup></b>	
Connecting		Nominal Capacity <sup>8</sup> (million gallons/day)	Hydraulic Pumping Transfer Capacity to Delaware Aqueduct (million gallons/day)		Approximate Turbine Discharge to Croton River (million gallons/day)	<b>Sources</b>		
West Delaware	Cannonsville to Rondout	500	Croton Falls	35-65 <sup>10</sup>	+/- 100	<b>Distribution</b>		
East Delaware	Pepacton to Rondout	750	Cross River	14-27 <sup>11</sup>	+/- 60	<b>Reservoirs</b>		Jerome Park <sup>15</sup> 0.19
Neversink	Neversink to Rondout	500		Transfer Capacity from Catskill Aqueduct (million gallons/day)		<b>Tunnels &amp; Aqueducts</b>		Central Park <sup>16</sup>
Delaware	Rondout to West Branch	890	New Croton Aqueduct	35-65		Connecting		Nominal Capacity <sup>8</sup> (million gallons/day)
	West Branch Bypass	1000				New Croton Aqueduct	New Croton to Gatehouse No. 1 in Van Cortlandt Park	300
	West Branch to Kensico	1000					Gatehouse No. 1 (VCP) to 135th Street Gatehouse	250
	Kensico Bypass	1000						
	Kensico to Hillview	1800						

1. Storage is the estimated volume between the crest of the spillway and the lowest elevation of outlet of the reservoir  
2. Under normal operations the available storage is 10.1 bg. By changing the drawdown from 15 feet to 57 feet to the invert of the outlet structure (El. 300 ft.) the volume of usable storage could be increased to 30.6 bg  
3. Total Storage is 0.93 bg  
4. Total Storage is 0.1 bg  
5. Release varies depending on stream flow and DRBC drought conditions  
6. Release varies depending on stream flow and storage conditions  
7. No release is required from this reservoir.  
8. Nominal Capacity is based on full reservoir. Capacity is reduced when source reservoir are drawn down.

9. There is no release required from the reservoir into Schoharie Creek. The flow of Shandaken Tunnel which discharges to Ashokan Reservoir via Esopus Creek must be sufficient to maintain a year-round minimum flow in the Creek of 160 mgd.  
10. Croton Falls Pumping Station is scheduled to be taken off-line in conjunction with Dam reconstruction work, and is expected to be temporarily out-of service in 2002 and 2003.  
11. Cross River Pumping Station is currently off-line. Restoration of service is not expected until 2003.  
12. Available storage is the maximum that can be withdrawn from the reservoir through the existing outlet structure and aqueduct  
13. There is no natural stream between this reservoir and the next downstream reservoir  
14. Release varies depending on stream flow and storage conditions and time of year.  
15. Total Storage is 0.77 bg.  
16. This reservoir has been taken off-line and is not intended to return to service

## **DROUGHT PHASES**

The New York City Drought Management Plan has three phases, which are invoked sequentially as conditions dictate. These are Drought Watch, Drought Warning and Drought Emergency. (Drought Emergency is further subdivided into four stages with increasingly severe mandated use restrictions.) Guidelines have been established to identify when a Drought Watch, Drought Warning or Drought Emergency should be declared and the appropriate responses should be implemented. These guidelines are based on factors such as prevailing hydrological and meteorological conditions, as well as certain operational considerations. In some cases, other circumstances such as low storage or operational constraints on the Croton system may influence the timing of drought declarations.

### **Drought Watch**

A Drought Watch is declared when there is less than a 50% probability that either of the two largest reservoir systems, the Delaware (Cannonsville, Neversink, Pepacton, and Rondout Reservoirs) or the Catskill (Ashokan, and Schoharie Reservoirs), will fill by the next June 1 – the start of the water-year.

### **Drought Warning**

A Drought Warning is declared when there is less than a 33% probability that either the Catskill or Delaware Systems will fill by the next June 1.

### **Drought Emergency**

A Drought Emergency is declared when there is a reasonable probability that, without the implementation of stringent measures to reduce consumption, a protracted dry period would cause the City's reservoirs to be drained. This probability is estimated during dry periods in consultation with the New York State Drought Management Task Force and the New York State Disaster Preparedness Commission. The estimation is based on analyses of the historical record, the pattern of the dry period months, water quality, sub-system storage balances, delivery system status, system construction, maintenance operations, snow cover, precipitation patterns, use forecasts, and other factors. Because no two droughts have identical characteristics, no single probability profile can be identified in advance that would generally apply to the declaration of a drought emergency.

## **COORDINATION WITH OTHER AGENCIES**

Close coordination between City and State officials is required as drought conditions become evident and as they worsen. When conditions indicate difficulty in achieving appropriate storage levels in the reservoirs, NYC notifies the New York State Drought Management Task Force, the New York State Disaster

Preparedness Commission, and any other New York State authorities responsible for coordinating preparations for an imminent drought.

New York State has a Statewide Drought Response Plan. To best address the needs of the different regions of the State, New York has been subdivided into different drought management regions. Since NYC's watersheds are a significant portion of the State, the NYC supply system has its own subdivision designation, which is Drought Region IIA. Accordingly, the Statewide Drought Response Plan includes this document, which outlines the City's drought response plan. Pursuant to the requirements of the State Sanitary Code, the City's plan has been submitted to the New York State Department of Health.

Because the reservoirs of the City's Delaware system impound the headwaters of the Delaware River, NYC, along with the states of Delaware, New Jersey, New York and Pennsylvania, is party to a Supreme Court Decree which dictates the relationship of these parties pertaining to the use of the Delaware River. The decree is administered in part by the Delaware River Master. The States of Delaware, New Jersey, New York, Pennsylvania and the United States of America comprise the Delaware River Basin Commission (DRBC). The City of New York serves as an advisor to the State of New York for DRBC issues. The DRBC and the parties to the Decree have established a drought response plan which is based upon a different set of criteria than that of the NYC plan, but which binds NYC in certain regards (which are reflected in the NYC plan). The DRBC criteria are tied to certain storage levels in NYC's Delaware reservoirs. NYC and the DRBC maintain close coordination in the implementation of either of these drought management plans.

## **ACTIONS AND RULES**

When it becomes apparent that the probability of reservoir refill is approaching the drought criteria the DEP will initiate the following actions:

- Review the Drought Management Plan;
- More closely monitor NYC reservoir and watershed conditions; and
- Coordinate with NYS DOH, NYS DEC & DRBC.

As conditions dictate the declaration of the successive phases of the City's drought response plan, certain actions are to be implemented. For a Drought Watch, the DEP responses are primarily operational, while activities that involve the consumer community are primarily informative and voluntary. For a Drought Warning, voluntary use restrictions are heightened and other City agencies are required to modify their operations. When a Drought Emergency is declared, rules

and sanctions for failure to comply with them are imposed. The details of the specific responses to each of the drought phases follow.

### **Drought Watch**

When a Drought Watch is declared, the following actions are taken by DEP:

1. Apprise NYS DOH, NYS DEC, & DRBC on system status.
2. Institute a drought awareness media campaign within the City & regionally.
3. Maximize Croton Water usage by:
  - increasing gravity distribution;
  - fully utilizing hydraulic pumping stations\*; and
  - commencing operation of stand-by electric pumping stations.
4. Maximize the normal output of wells in Queens County from 23 million gallons per day (MGD) to 44 MGD and close selected interconnections to the surface water supply. Investigate boundary valve changes for future expansion of Croton distribution system and increase surveillance of pressure regulators throughout the distribution system.
5. Expand leak detection, leak repair and hydrant surveillance programs.
6. Budget for future resources to be used if drought conditions escalate.
7. Advise non-City consumer communities of the situation and request their cooperation in water conservation efforts.
8. Initiate dialogue with the Mayor's Office and other NYC agencies concerning actions to be taken if a "Drought Warning" is declared.

### **Drought Warning**

When a Drought Warning is declared, all of the actions that are implemented during a Drought Watch become enhanced, and these additional actions are implemented:

1. Request voluntary water use restrictions.
2. Develop plans and commence activities to prepare the Chelsea Pumping Station for operation.
3. Commence operation of standby wells in Queens County to increase the daily system output to approximately 50 MGD and close additional inter-connections to the surface water supply. Prepare additional standby wells in Queens County for operation.
4. Coordinate with non-NYC water system users to initiate appropriate water use restrictions.

---

\* NYS DOH approval required

5. Coordinate the following actions with other NYC agencies: \*
- *Sanitation Department* - suspend all street flushing activities;
  - *Police and Fire Departments* - assist closing illegally opened hydrants;
  - *Parks Department* - restrict water use for fountains and golf courses, stop providing make-up water for artificial pond & lakes;
  - *Housing Authority & Housing Preservation and Development* - Request plumbing leak surveys and appropriate repair work, seek installation of low flow devices;
  - *Metropolitan Transit Authority* - reduce fleet washing activities;
  - *Board of Education* -Initiate drought awareness programs for students; and
  - *Department of City-wide Administrative Services* - Conduct leak survey and leak repair activities where necessary at City facilities, cease building washing activities.

### **Drought Emergency**

When a Drought Emergency is declared, drought rules are implemented which direct and restrict the use of water. Additional actions are also undertaken by DEP and other City agencies. Within this plan there are four successive stages of emergency in the Drought Emergency phase. Each stage represents an increase in regulatory activity commensurate with the severity of the drought conditions. As each successive Drought Emergency stage is declared, specific water use regulations and corresponding sanctions are imposed. The rules for Stages One through Three are outlined below. Since Stage Four conditions have not been experienced, rules have yet to be developed for such an occurrence. In the event that Stage Four conditions are imminent, appropriate rules would be developed and enacted.

Listed below are the general actions to be undertaken by DEP and other City agencies during a drought emergency and the specific regulations that would be imposed during each stage of a Drought Emergency.

#### DEP Actions during a Drought Emergency:

1. Implement and enforce Stages I-III Drought Emergency Rules, as appropriate,
2. Continue media campaign and seeking private sector efforts,
3. Continue maximizing Croton water use including use of the 178th Street Pumping Station diesel motor pumps,
4. Continue leak detection efforts and reevaluate leak backlog, determine what resources need to be allocated to rectify all identified leaks.

---

\* NOTE: the above listing of agency activities is not to be construed as a comprehensive itemization of all activities, but rather a summary of the major agency responsibilities.

5. Work with State Disaster Preparedness Commission and invoke provisions of upstate water agreements to compel non-NYC water system users to implement regulations/measures which are consistent with those in effect in NYC,
6. When water supply and quality are acceptable, enlarge the area supplied by the Croton System by making boundary changes in the local distribution system,
7. Obtain any necessary permits and commence operational activities at remaining standby wells in Queens County, and increase the daily system output to approximately 62 MGD,
8. Reduce pressures slightly ( $\pm 5$  pounds per square inch (psi)) at regulators and pumping stations, where feasible and in relation to the local distribution system needs,
9. Conduct leak and waste inspections in private buildings using Water Use Inspectors.
10. Include conservation notices with water and sewer billings, and
11. Obtain DOH/DEC permits and activate the Chelsea Pumping Station (Stage III only).

**Actions to be performed by other NY City Agencies during a Drought Emergency\***

1. *Department of City-wide Administrative Services* - Assign building inspectors to conduct leak surveys in private buildings
2. *Fire Departments* - Conduct leak and waste reports during routine fire inspections of buildings
3. *Housing (Public and Private)*- Encourage voluntary installation of low flow fixtures

**Drought Emergency Rules**

Summaries of the specific rules for each Drought Emergency Stage are provided below. It should be noted that the full text of these rules appear at Title 15 of the Rules of the City of New York, Chapter 21, "Drought Emergency Rules".

**Stage I**

**Part A:**

No person shall cause, permit or allow the use of public water:

1. to leak or otherwise be wasted from any water pipe, fixture, equipment or appurtenance connected to the public water supply system.
2. to wash vehicles via hose, hydrant or other active source.

---

\* See NOTE on previous page

3. to spray, wash, or wet streets, sidewalks, driveways, steps, or buildings via hose, hydrant or other active source.
4. for ornamental purposes.
5. to water lawns, plants, shrubs, trees and golf courses via hose, hydrant or other active source except as follows:
  - a. From 7 am - 9 am and from 7 pm - 9 pm, even numbered addresses may use public water for these purposes on even numbered days and odd- numbered addresses on odd-numbered days.
  - b. Plant nurseries and other commercial plant users may continue to use public water at 95% of previous normal usage.
  - c. Reasonable use of public water for these purposes is allowed if a hand held container is utilized.
6. to be taken from a fire hydrant for any purpose other than fire protection, except via permit obtained through DEP for a specific purpose.
7. to be served to patrons in eating establishments, unless specifically requested by the patron.
8. to operate 2 ton or larger rated air conditioning systems or 10 hp (horsepower) or larger refrigeration units unless the water is recirculated.
9. in swimming pools, except those using recirculating equipment which may be filled once during each calendar year and thereafter the minimum amount of public water necessary to maintain the water level.
10. through showerheads in premises unless they meet any one of the following water conservation criteria:
  - a. The maximum performance standard shall be 3 gallons per minute (gpm) at 60 pounds per square inch (psi);
  - b. The fixture is equipped with a flow restrictor designed to meet this standard; or
  - c. The item is included on the NYS DEC certified fixtures list;

When charged with violation of this section, it is the respondent's duty to demonstrate that the showerhead performs at or below a maximum rate of 3 gallons per minute and pressure of 60 pounds per square inch.

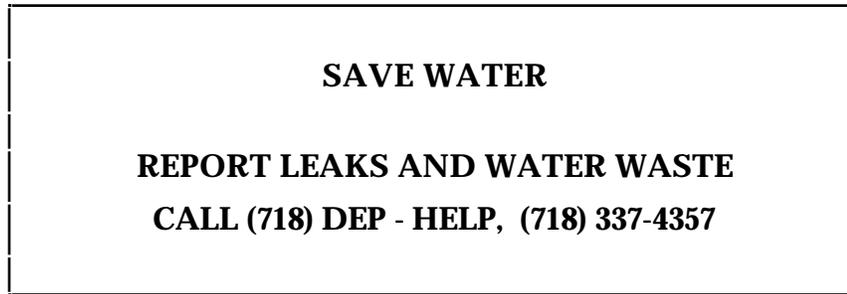
**Part B:**

Each non-residential public water user shall reduce normal water use by 15%.

**Part C:**

"SAVE WATER" signs shall be prominently displayed in every building or premises connected to the public water system and it is the responsibility of every such property owner, or agent to assure these postings. This does not apply to under 5-family dwellings.

The sign should be not less than 6 inches by 9 inches and the heading "SAVE WATER" should be in letters not less than 3/4 of an inch in height. It must include the following language and may include other water conservation artwork or language:



Such signs shall be posted in the following locations:

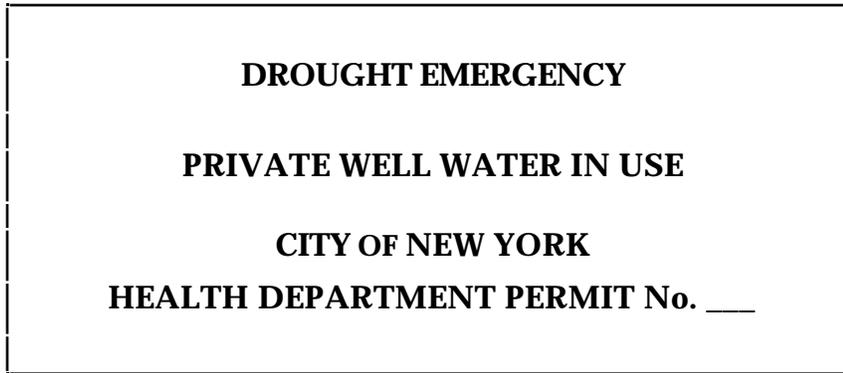
- In over 4-family dwellings, at each entrance and mailbox;
- In hotels, at each check-in desk and cashier, at each entrance, in each common bathroom, and at entrances to restaurants and eating places;
- In hospitals and other health care centers, at each entrance, in each bathroom and shower room, in each laboratory and in each restaurant or cafeteria;
- In office buildings, at each entrance, each bathroom, and in each dining room or cafeteria;
- In commercial and public laundries, at each entrance; and
- In schools, at each entrance, in each bathroom or shower room, laboratory and cafeteria or dining area.

**Part D:**

No person shall cause, permit or allow the use of a private well for any purpose for which the use of public water is prohibited unless:

- Such installation is covered by a valid permit from NYC Department of Health;
- No cross-connections exist and all swing-joint connections have been replaced by permanent rigid piping or the connection to the City system has been sealed; and

- Signs are prominently displayed, and are not less than 8.5 inches by 11 inches in size with lettering not less than 1 inch in height, bearing the following wording including the permit number:



### **Stage II Drought Emergency Rules**

Virtually all of the rules that are required for Stage II are the same as in Stage I with the following additions.

#### **Part A:**

No person shall cause, permit or allow the use of public water:

5. to water lawns, golf courses, plants, ornamental shrubs, and trees except as follows:
  - a. Public water may be used to irrigate, from a hand held container only vegetables or fruits grown for human consumption.
  - b. Plant nurseries and other commercial plant users may continue to use public water @ 80% of normal usage.
  
9. to fill or maintain the water level in swimming pools except municipal pools and other pools open to the public. These pools may be filled once during each calendar year and thereafter as necessary to maintain the water level, provided that such pools operate with water recirculating equipment

#### **Part B:**

Each non-residential public water user shall reduce normal water use by 20 %.

#### **Part C:**

The posting of "SAVE WATER" signs becomes more extensive during this phase of the drought. In addition to all of the aforementioned locations and rules regarding signs in Stage I, signs shall be posted in the following locations:

- In over 4-family dwellings, in each elevator
- In hotels, signs must be added to each elevator, all public hallways on each floor, and in the guest bathrooms. (Signs may be reduced to 3 inch by 5 inch for these bathrooms); and

- In hospitals, office buildings, and all other nonresidential buildings signs must be added to each elevator and every floor served by an elevator.

### **Stage III Drought Emergency Rules**

During this stage more stringent measures are enacted as follows:

Virtually all of the rules that are required for Stage III are the same as previous stages with the following additions.

#### **Part A**

No person shall cause, permit or allow the use of public water:

5. to water lawns, golf courses, plants, ornamental shrubs, and trees except as follows:
  - b. Plant nurseries and other commercial plant users may continue to use public water @ 75% of normal usage.
  - c. Ornamental shrubs, plants and trees may be watered only from a hand-held container with water that has already been used for some other non-prohibited use.
  
11. for water cooled air conditioning systems unless the room dry-bulb temperature is not permitted to fall below 79 degrees Fahrenheit, except:
  - a. This does not apply to health care facilities;
  - b. When essential, for the continuous operation of electronic data processing equipment the temperature in a room or floor occupied predominately by such equipment may be maintained lower than 79 degrees Fahrenheit but at the highest temperature compatible with such continuous operation. The burden of proof is upon the respondent to demonstrate this in any administrative hearing contesting such operation.

This section does not apply to air-conditioning using private well water, nor does it apply to air-cooled air conditioners.

#### **Part B**

Each non-residential public water user shall reduce normal water use by 25 %.

### **Sanctions**

- A. Violations of these rules shall be punishable by fines and penalties established by Administrative Code, Sections 24-337 and 24-346. Notices of Violation issued for such violations will be returnable to the Environmental Control Board of the City of New York. The minimum penalty is \$100 and the maximum penalty is \$1000. Guidelines for penalty levels may be established within these limits.
- B. In addition to any penalties which may be imposed by the Environmental Control Board, a penalty of no less than \$50 per day may be imposed by the Commissioner where a leak and waste notice has been served in accordance

with Section 24-337 of the Administrative Code and the condition to which such notice relates has not been corrected. Such penalties will be added to the water rents in accordance with the Administrative Code.

- C. Water service may be terminated for violation of any provision of these rules or for any waste of water.

### **Variances**

Upon the notarized application of any person or entity, the Commissioner may in his/her discretion, grant a variance relieving such person or entity from compliance with the requirements of these rules if such person or entity demonstrates to the satisfaction of the Commissioner:

1. that undue hardship would otherwise result;
2. that there are no possible alternatives;
3. that the applicant has taken and will take all possible measures to conserve water, with a complete description of such measures and the water savings to be effected; and
4. that such variance is not inconsistent with the purposes of these drought emergency rules.

In connection with any variance which may be granted, the Commissioner shall impose such terms and conditions as he/she deems appropriate.

Variance application forms may be obtained at the following locations:

Bronx	1932 Arthur Avenue, Room 601 Corner of East Tremont Avenue
Brooklyn	248 Duffield Street, 3rd Floor Between Fulton and Willoughby Streets
Manhattan	1250 Broadway, 8th Floor Entrance on 32nd Street
Queens	96-05 Horace Harding Expwy, 1st Floor Between Junction Boulevard and 99th Street
Staten Island	60 Bay Street, 6th Floor Between Slosson Terrace & Hyatt Street

The Commissioner may delegate any or all of his/her powers relating to drought emergency rule variances. The filing or pendency of a variance application shall not relieve any person or entity from complying with any drought emergency rules, and shall not immunize any person or entity from any civil or criminal prosecution or sanction respecting drought emergency rules.

## **Glossary Of Terms**

- "City water system" means the New York City water supply system including the portion of the former Jamaica Water Supply which lies within NYC.
- "City water" means water supplied by or taken from the City water system.
- "Public water system" means all systems supplying water to users within New York City, including without limitation the City water system.
- "Public water" means water supplied by or taken from such public water system.

## **MANAGEMENT OF THE CROTON SYSTEM IN DROUGHT**

Although the Croton watershed has an estimated safe yield of 250 million gallons per day (MGD), 208 MGD of the water is normally delivered, by gravity and pumping, to the low elevation areas of the Bronx and Manhattan.

When hydrological analysis indicates that the Croton System has a better chance of filling than either the Catskill or Delaware Systems, additional pumping will be commenced at the City's standby pumping stations. During a drought these plants can pump up to a rate of 40 MGD (Table 2), raising the potential Croton usage to 248 MGD.

## **MANAGEMENT OF THE CATSKILL SYSTEM IN DROUGHT**

The combined flows of the Catskill and Delaware Supply provide the system's consumers with the greatest portion of the supply. Normally, these flows are limited by the capacities of the transmission conduits that deliver water from these systems into the City. During drought operations, use of water from the Delaware system is restricted in accordance with interstate agreements. Under these circumstances it is critical for the Catskill System to be operated in a manner that maintains water quality and facilitates the greatest chance for refill of the West of Hudson reservoirs.

**TABLE 2**  
**Croton System Consumption within New York City**

	Capacity (MGD)	Normal Operation (MGD)	Drought Operation (MGD)
<b>GRAVITY</b>			
East Bronx	20	20	20
South Bronx	10	10	10
Shaft 33			
Lower East Side	30	30	30
Lower West Side	8	8	8
Harlem	55	55	55
Inwood	8	8	8
<b>Sub-Total</b>	<u>131</u>	<u>131</u>	<u>131</u>
<b>PUMPING STATIONS</b>			
Hydraulic (40th Street)	25	25	25
Diesel (179th Street)	30	0	10
Electric			
• Mosholu <sup>1</sup>	52	52 <sup>1</sup>	52 <sup>1</sup>
• Jerome <sup>2</sup>	30	0	30
• 86th Street <sup>3</sup>	<u>-50<sup>3</sup></u>	<u>0</u>	<u>-50<sup>3</sup></u>
<b>Sub-Total</b>	<u>137</u>	<u>77</u>	<u>117</u>
<b>Total</b>	<u>405</u>	<u>208</u>	<u>248</u>

1. Mosholu Pumping Station is under renovation , current capacity = 17 MGD, upon completion full capacity of 52 MGD is expected.
2. Jerome Pumping Station Capacity has been reduced from 50 MGD to 30 MGD due to the installation of a 36" slip-lining in the 48" line.
3. The 86th Street Pumping Station can only be operated if Central Park Reservoir service is restored. Since Central Park Reservoir has been taken off line, these values are not included in the totals

**Note: Hydraulic Pumping Stations on the Croton Watershed have not been included:**

	Capacity (MGD)	Normal Operation (MGD)
<b>Cross River<sup>4</sup></b>	35	12
<b>Croton Falls<sup>5</sup></b>	65	10

4. Cross River Pumping Station is currently off line. Restoration of service is not expected until 2003.
5. Croton Falls Pumping Station is scheduled to be taken off-line in conjunction with Dam reconstruction work, and is expected to be temporarily out-of-service in 2002 and 2003 .

## MANAGEMENT OF THE DELAWARE RESERVOIRS IN DROUGHT

The City's three reservoirs in the Delaware River Basin, Cannonsville, Neversink, and Pepacton, are operated in drought according to the rule curves presented in the "Good Faith Agreement" of 1982 (see references at the end of this section). This agreement provides the guidelines for actions by the DRBC, and includes different criteria for initiating drought related activities. The following text and tables are taken, with minor editorial revisions, from the agreement.

For purposes of management during drought, a schedule of phased reductions in diversions, releases and flow objectives is described in this section and set forth in Tables 3 and 4. The formula is based upon a differentiation between "normal", "drought warning", and "drought" conditions as defined by the combined storage levels shown on the operation curves for Cannonsville, Neversink and Pepacton reservoirs (Figure 2). The division of the drought warning zone into upper and lower halves is defined as a physically equal division, or 20 billion gallons in each zone.

**TABLE 3**

### **Interstate Operation Formula for Reductions in Diversions, Releases, and Flow Objectives During Periods of Drought**

NYC Storage Condition	NYC Diversion (MGD)	NJ Diversion (MGD)	Montague Flow Objective (cfs)	Trenton Flow Objective (cfs)
Normal	800	100	1750	3000
Drought Warning Upper Half	680	85	1655	2700
Drought Warning Lower Half	560	70	1550	2700
Drought	520	65	1100-1650*	2500-2900*
Severe Drought	Diversions and Objectives to be negotiated based on Conditions			

\*Varies with the time of year and location of salt front. (See Table 4)

During drought conditions as defined by the operation curves shown in Figure 2., the Montague and Trenton flow objectives should vary according to the location of the salt front (250 mg/l chloride isochlor 7-day average), in accordance with the following table:

**TABLE 4**  
**Flow Objectives for Salinity Control During Periods of Drought**

Seven-Day Average Location of "Salt-Front" River Mile*	Flow Objective at Montague, N.J. (cfs)			Flow Objective at Trenton, N.J. (cfs)		
	Dec - Apr	May-Aug	Sept-Nov	Dec- Apr	May-Aug	Sept-Nov
Upstream of R.M. 92.5	1600	1650	1650	2700	2900	2900
Between R.M. 92.5 and 87.0	1350	1600	1500	2700	2700	2700
Between R.M. 87.0 and 82.9	1350	1600	1500	2500	2500	2500
Downstream of R.M. 82.9	1100	1100	1100	2500	2500	2500

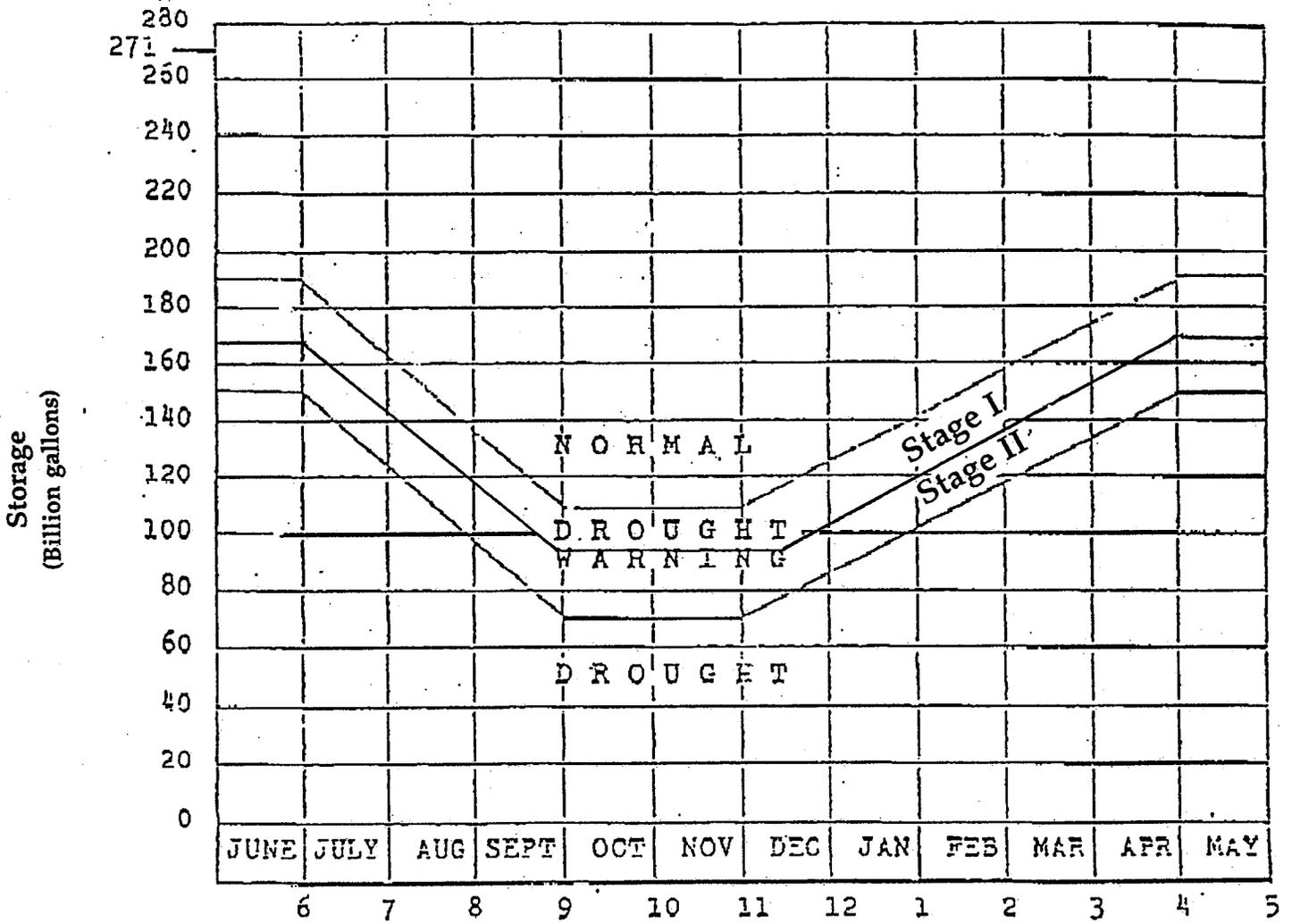
\* Measured in statute miles along the navigation channel from the mouth of the Delaware Bay

Diversions and releases under this drought operation formula should go into effect automatically whenever combined storage in the City reservoirs declines below the drought warning line and remains below that level for five consecutive days. When the combined storage (including the projected water runoff equivalent of actual snow and ice) reaches a level 15 billion gallons above the drought warning line, and remains above that level for five consecutive days, the drought operation formula should automatically terminate and normal operations provided for in the Decree should be resumed.

Under the terms of the Good Faith Agreement, the drought operation formula described above will go into effect automatically and be binding on all parties for not less than 180 days following the triggering of drought warning operation, unless terminated automatically by improved storage conditions as described above. During the 180-day period, the parties will convene no less than once each month to review current conditions, and they may extend, modify or extend as modified the formula recommended here. If no unanimous agreement as to a continuing drought operation formula is reached within the 180-day period, all parties shall be released from the above formula and may pursue their rights and obligations under the Delaware River Basin Compact and the U.S. Supreme Court Decree.

*[REFERENCE: Parties of the U.S. Supreme Court Decree of 1954 to the Delaware River Basin Commission, Interstate Water Management: Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 to the Delaware River Basin Commission Pursuant to Commission Resolution 78-20 (with appendices), (the "Good Faith Agreement"), November, 1982.]*

**Figure 2**  
**Delaware River Basin Commission**  
**Operations Curves for New York City's**  
**Cannonsville, Pepacton and Neversink Reservoirs**



## **EMERGENCY SUPPLY AT THE CHELSEA PUMPING STATION**

The segment of the Delaware Aqueduct carrying water from Rondout Reservoir to West Branch Reservoir passes under the Hudson River at Chelsea, NY. Shaft 6 of the Delaware Aqueduct, located on the east bank of the river, was designed as a tunnel blow-off and dewatering shaft. The City owns and maintains a 100 mgd pumping station at Chelsea, NY which connects to the Delaware Aqueduct through Shaft 6.

The pumping station may be activated during a drought emergency only when approval to do so is granted by the State. Operation of the pumping station requires concurrent activities at the following sites:

1. The Chelsea Pumping Station All water pumped from the Hudson River at Chelsea passes through an intake crib and an intake conduit into the plant. The principal activities at the pumping station are running the pumps and operating the chemical addition facilities. Water pumped from the Hudson River is treated at the Chelsea site and is then pumped approximately 1/4 mile to Shaft 6, where it enters the Delaware Aqueduct.
2. Rondout Reservoir A chlorination facility at Rondout Reservoir, which is normally on stand-by status, is used to supplement disinfection activities at the Chelsea Pumping Station and to treat any water quality problems that may arise at Rondout Reservoir.
3. Delaware Aqueduct - Shaft 9 Water from Rondout Reservoir and the Chelsea Pumping Station flows through Shaft 9, to the West Branch Reservoir or the West Branch Reservoir By-Pass. Chlorine residuals are monitored. Dechlorination facilities are being proposed at Shaft 9.
4. Delaware Aqueduct - Shaft 10 At Shaft 10, water enters the Delaware Aqueduct from the West Branch Reservoir or the West Branch Reservoir By-Pass. A chlorination facility is in place to maintain required chlorine residuals at Shaft 17, where water enters Kensico Reservoir.
5. Delaware Aqueduct - Shaft 17 Dechlorination facilities are also being proposed for this site.

Prior to operation of the pumping station, the Department conducts extensive test operations at all five of these sites. The activities required at Chelsea, Rondout and Shaft 10 are staffed during appropriate stages of a Drought Emergency on a 24 hour basis, 7 days per week. The Department hires new workers to provide staff for these activities, including Stationary Engineers and Oilers. These new personnel assist in staffing the sites associated with the pumping operation and replace

experienced operators drawn from other Department locations to supervise the Drought Emergency operations.

A variety of water quality control operations are implemented during use of this emergency supply. These include, operating a 24-hour water quality laboratory at the Chelsea Pumping Station, sampling at West Branch, Kensico, and Hillview Reservoirs as well as City Tunnels #1, #2 and #3, chloride monitoring in the Hudson River and enhanced limnological monitoring in West Branch and Kensico Reservoirs and at the discharge of West Branch and Croton Falls Reservoirs. These activities are designed to meet applicable Federal, State and City Requirements.