3.10 – Drought Hazard Profile

The drought hazard in New York State is often underestimated because other natural hazards occur more frequently (e.g., hurricanes, tornadoes, flooding) and are much more visible. The Mitigation Plan Development Team researched the drought hazard as it affects the State. Contents of this section result from research and outreach including the following sources:

- The New York State Department of Environmental Conservation, Bureau of Water Resources Management, Division of Water, staff and web site, http://www.dec.state.ny.us
- New York State Climate Office, Department of Earth and Atmospheric Sciences at Cornell University web site, http://www.nrcc.cornell.edu/drought/
- The National Drought Mitigation Center http://drought.unl.edu/dm/monitor.html
- National Weather Service, Climate Prediction Center, http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.shtml
- The National Climatic Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
- United States Department of Agriculture, Natural Resource Conservation Service, http://www.nrcs.usda.gov/
- The United States Geological Survey, http://ny.water.usgs.gov/projects/duration/

The following chart provides the definition of a drought:

Term	Definition
Drought	A normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. Defining drought is therefore difficult; it depends on differences in regions, needs, and disciplinary perspectives. In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Whatever the definition, because of its potential impact, it is clear that drought cannot be viewed solely as a physical phenomenon.

The Concept of Drought

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.

Drought is an insidious hazard of nature. Although it has scores of definitions, it originates from a deficiency of precipitation over an extended period of time, usually a season or more. Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a particular area, a condition often perceived as “normal”. It is also related to the timing (i.e., principal

season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought in many regions of the world and can significantly affect its severity.

Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed countries, resulting economic and environmental impacts and personal hardships have highlighted the vulnerability of all societies to this natural hazard.

Agricultural Drought

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced ground water or reservoir levels. Crop water demand depends on prevailing weather conditions, biological characteristics of the specific crops, its stage of growth, and the physical and biological properties of the soil. A good definition of agricultural drought should be able to account for the variable susceptibility of crops during different stages of crop development, from emergence to maturity. Deficiency in topsoil moisture at planting may hinder germination, leading to low plant populations per hectare and a reduction of final yield. However, if topsoil moisture is sufficient for early growth requirements, deficiencies in subsoil moisture at this early stage may not affect final yield, providing subsoil moisture is replenished as the growing season progresses or if rainfall meets crop water needs.

Hydrological Drought

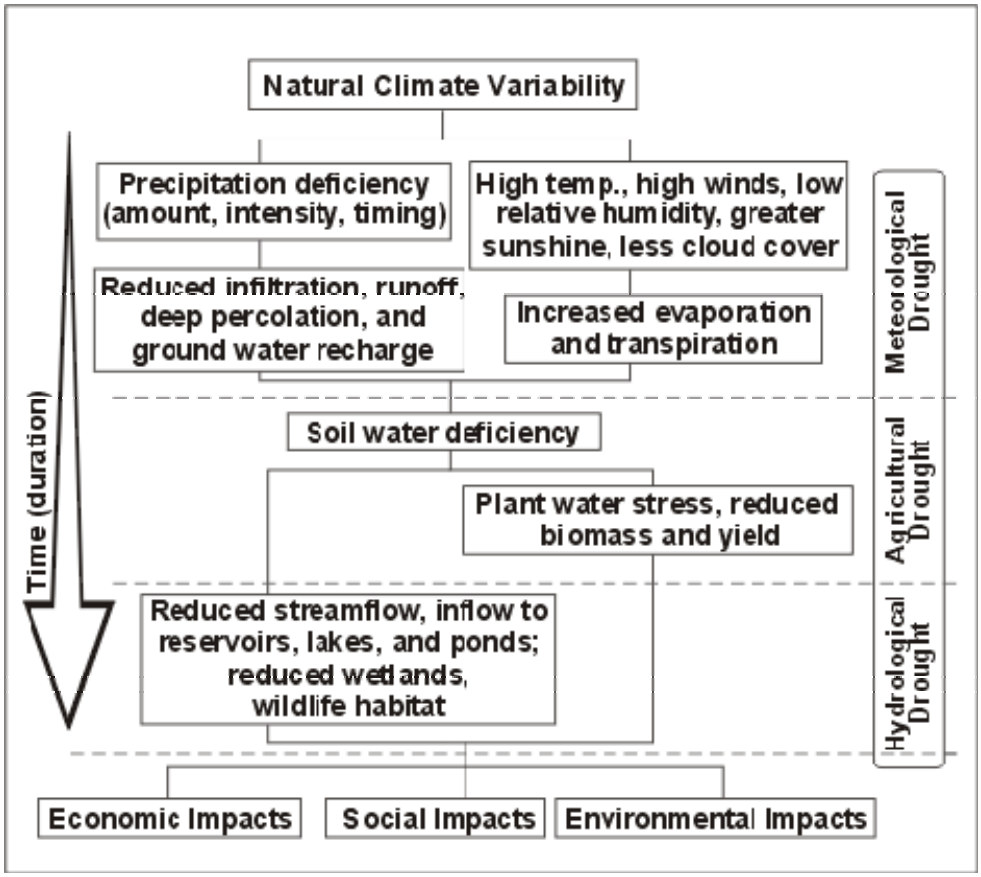
Hydrological drought is associated with the effects of substandard periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with, or lag the occurrence of, meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors. For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately noticeable to agriculturalists, but the impact of this deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months. Also, water in hydrologic storage systems (e.g., reservoirs, rivers) are often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, wildlife habitat), further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought and conflicts between water consumers increase significantly.

Hydrological Drought and Land Use

Although climate is a primary contributor to hydrological drought, other factors such as changes in land use (e.g., deforestation), land degradation, and the construction of dams all affect the hydrological characteristics of the basin. Because regions are interconnected by hydrologic

systems, the impact of meteorological drought may extend well beyond the borders of the precipitation-deficient area. For example, meteorological drought may severely affect portions of the northern Adirondack region of the State; however, since the Hudson River and its tributaries drain this region to the south, there may be significant hydrologic impacts downstream. Similarly, changes in land use upstream may alter hydrologic characteristics such as infiltration and runoff rates, resulting in more variable streamflow and a higher incidence of hydrologic drought downstream. Land use change is one of the ways human actions alter the frequency of water shortage even when no change in the frequency of meteorological drought has been observed. **Figure 3-119** shows the interrelationship of the hydrological cycle.

Figure 3-119



Sequence of Drought Impacts

The sequence of impacts associated with meteorological, agricultural, and hydrological drought further emphasizes their differences. When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. Soil water can be rapidly depleted during extended dry periods. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface water (i.e., reservoirs and lakes) and subsurface water (i.e., ground water), for example, are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use intensity.

When precipitation returns to normal and meteorological drought conditions have abated, the sequence is repeated for the recovery of surface and subsurface water supplies. Soil water reserves are replenished first, followed by streamflow, reservoirs and lakes, and ground water. Drought impacts may diminish rapidly in the agricultural sector because of its reliance on soil

water, but linger for months or even years in other sectors dependent on stored surface or subsurface supplies. Ground water users, often the last to be affected by drought during its onset, may be last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the drought event terminates.

Socioeconomic Drought

Socioeconomic definitions of drought associate the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Because of the natural variability of climate, water supply is ample in some years but unable to meet human and environmental needs in other years. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

In most instances, the demand for economic goods is increasing as a result of increasing population and per capita consumption. Supply may also increase because of improved production efficiency, technology, or the construction of reservoirs that increase surface water storage capacity. If both supply and demand are increasing, the critical factor is the relative rate of change. Is demand increasing more rapidly than supply? If so, vulnerability and the incidence of drought may increase in the future as supply and demand trends converge.

Understanding the Risk

Each drought produces a unique set of impacts, depending not only on its severity, duration, and spatial extent but also on ever-changing social conditions. Society's vulnerability to drought is determined by a wide range of factors, both physical and social, such as demographic trends and geographic characteristics. One of the challenges of planning for a drought is understanding its impacts, both direct and indirect. An overview of drought impacts and several reviews of the unique impacts of past droughts are presented in this section.

Impacts of Drought

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services.

Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs. Direct or primary impacts are usually biophysical. Conceptually speaking, the more removed the impact from the cause, the more complex the link to the cause. In fact, the web of impacts becomes so diffuse that it is very difficult to come up with financial estimates of damages. The impacts of drought can be categorized as economic, environmental, or social.

Many economic impacts occur in agriculture and related sectors, including forestry, fisheries, and waterborne activities, because of the reliance of these sectors on surface and subsurface

water supplies. In addition to obvious losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and grass fires increases substantially during extended droughts, which in turn places human and wildlife populations, as well as property, at higher levels of risk.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a rippling effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for Local, State, and Federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the affected region. Reduced water supply impairs the navigability of rivers and results in increased transportation costs because products must be transported by rail, or truck. Hydropower production may also be curtailed significantly, due to the effects of a drought.

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and grass fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social implications as well.

Economic Impacts

Costs and losses to agricultural producers

- Annual and perennial crop losses
- Damage to crop quality
- Income loss for farmers due to reduced crop yields
- Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.)
- Insect infestation
- Plant disease
- Wildlife damage to crops
- Increased irrigation costs
- Cost of new or supplemental water resource development (wells, dams, pipelines)

Costs and losses to livestock producers

- Reduced productivity of rangeland
- Reduced milk production

- Forced reduction of foundation stock
- High cost/unavailability of water for livestock
- Cost of new or supplemental water resource development (wells, dams, pipelines)
- High cost/unavailability of feed for livestock
- Increased feed transportation costs
- High livestock mortality rates
- Disruption of reproduction cycles (delayed breeding, more miscarriages)
- Decreased stock weights
- Increased predation
- Grass fires

Loss from timber production

- Wildland fires
- Tree disease
- Insect infestation
- Impaired productivity of forest land
- Direct loss of trees, especially young ones

Loss from fishery production

- Damage to fish habitat
- Loss of fish and other aquatic organisms due to decreased flows

General economic effects

- Decreased land prices
- Loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, dairies, etc.)
- Unemployment from drought-related declines in production
- Strain on financial institutions (foreclosures, more credit risk, capital shortfalls)
- Revenue losses to Federal, State, and Local governments (from reduced tax base)
- Reduction of economic development
- Fewer agricultural producers (due to bankruptcies, new occupations)
- Rural population loss

Loss to recreation and tourism industry

- Loss to manufacturers and sellers of recreational equipment
- Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc.

Energy-related effects

- Increased energy demand and reduced supply because of drought-related power curtailments
- Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power

Water Suppliers

- Revenue shortfalls and/or windfall profits

- Cost of water transport or transfer
- Cost of new or supplemental water resource development

Transportation Industry

- Loss from impaired navigability of streams, rivers, and canals

Decline in food production/disrupted food supply

- Increase in food prices
- Increased importation of food (higher costs)

Environmental Impacts

Damage to animal species

- Reduction and degradation of fish and wildlife habitat
- Lack of feed and drinking water
- Greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion
- Disease
- Increased vulnerability to predation (from species concentrated near water)
- Migration and concentration (loss of wildlife in some areas and too much wildlife in other areas)
- Increased stress to endangered species
- Loss of biodiversity

Hydrological effects

- Lower water levels in reservoirs, lakes, and ponds
- Reduced flow from springs
- Reduced streamflow
- Loss of wetlands
- Estuarine impacts (e.g., changes in salinity levels)
- Increased groundwater depletion, land subsidence, reduced recharge
- Water quality effects (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity)

Damage to plant communities

- Loss of biodiversity
- Loss of trees from urban landscapes, shelterbelts, wooded conservation areas

Other Effects

- Increased number and severity of fires
- Wind and water erosion of soils, reduced soil quality
- Air quality effects (e.g., dust, pollutants)
- Visual and landscape quality (e.g., dust, vegetative cover, etc.)

Social Impacts

Health

- Mental and physical stress (e.g., anxiety, depression, loss of security, domestic violence)
- Health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced fire fighting capability, etc.)
- Reductions in nutrition (e.g., high-cost food limitations, stress-related dietary deficiencies)
- Loss of human life (e.g., from heat stress, suicides)
- Public safety from forest and grass fires
- Increased respiratory ailments
- Increased disease caused by wildlife concentrations

Increased conflicts

- Water user conflicts
- Political conflicts
- Management conflicts
- Other social conflicts (e.g., scientific, media-based)

Reduced quality of life, changes in lifestyle

- Increased poverty in general
- Population migrations (rural to urban areas)
- Loss of aesthetic values
- Reduction or modification of recreational activities

Disruption of cultural belief systems

- Religious and scientific views of natural hazards
- Loss of cultural sites

Re-evaluation of social values

- Priorities
- Needs
- Rights

Public dissatisfaction with government drought response

- Perceptions of inequity in relief, possibly related to socioeconomic status, ethnicity, age, gender, seniority

Table 3-46
Past Occurrences of Drought in New York State

Date	County/Area Effected	Types of Damages	Dollar Amount of Damages
August - December **1993**	Albany, Columbia, Delaware, Dutchess, Greene, Otsego, Rensselaer, Schoharie, Sullivan, Ulster	Mainly agricultural damage. Estimates of feed grain losses were well over 40% and in some cases nearly 100%. Especially hard hit were hay and corn crops as well as other fruits and vegetables.	$50,000,000
February – April **1994**	Delaware, Dutchess, Greene, Otsego, Schoharie, Sullivan, Ulster	Reduction in the usable storage of the New York City water supply.	Unknown
October **1994**	Statewide	October 1994 tied for the 7th driest month on record at Albany.	Unknown
June - September **1995**	Catskills, Hudson Valley, Mohawk Valley, Southern Tier	A lack of rainfall across much of eastern New York prompted officials to institute water restrictions in some areas and seek federal aid for some counties. • Especially hard hit were Rensselaer and Oneida counties where damage to various vegetable and grain crops were excessive. • Additionally, vines crops were hard hit with plants either killed or production limited. Other crops severely impacted include: corn, hay, peppers and onion. • Some private drinking wells ran dry. Municipal water supplies in Montgomery County were dangerously low. Water tankers were brought in to Herkimer and Montgomery counties to assist farmers and residents with dry wells. • The salt front had migrated north on the Hudson River, causing communities that draw their drinking water from the Hudson to experience high levels of sodium in their drinking water. • The Susquehanna River level was 1/3 of normal • The Capital District annual crop harvest was down 35% • The Mohawk Valley crop yields were down 30-60%.	Unknown
August 1, **1997** - August 31**,1997**	Sullivan County	A very dry summer finally culminated in major crop failures come harvest time towards the end of August. Sweet corn and tomatoes, two of the major money making crops for small farmers. • Sullivan county, appeared to suffer some of the worst damage • According to figures from some of the individual farmers themselves and also the New York State Agricultural Extension Service, losses nearing a quarter of a million dollars were tallied. Financial assistance was granted in many cases • Precipitation figures across the region averaged	$200,000

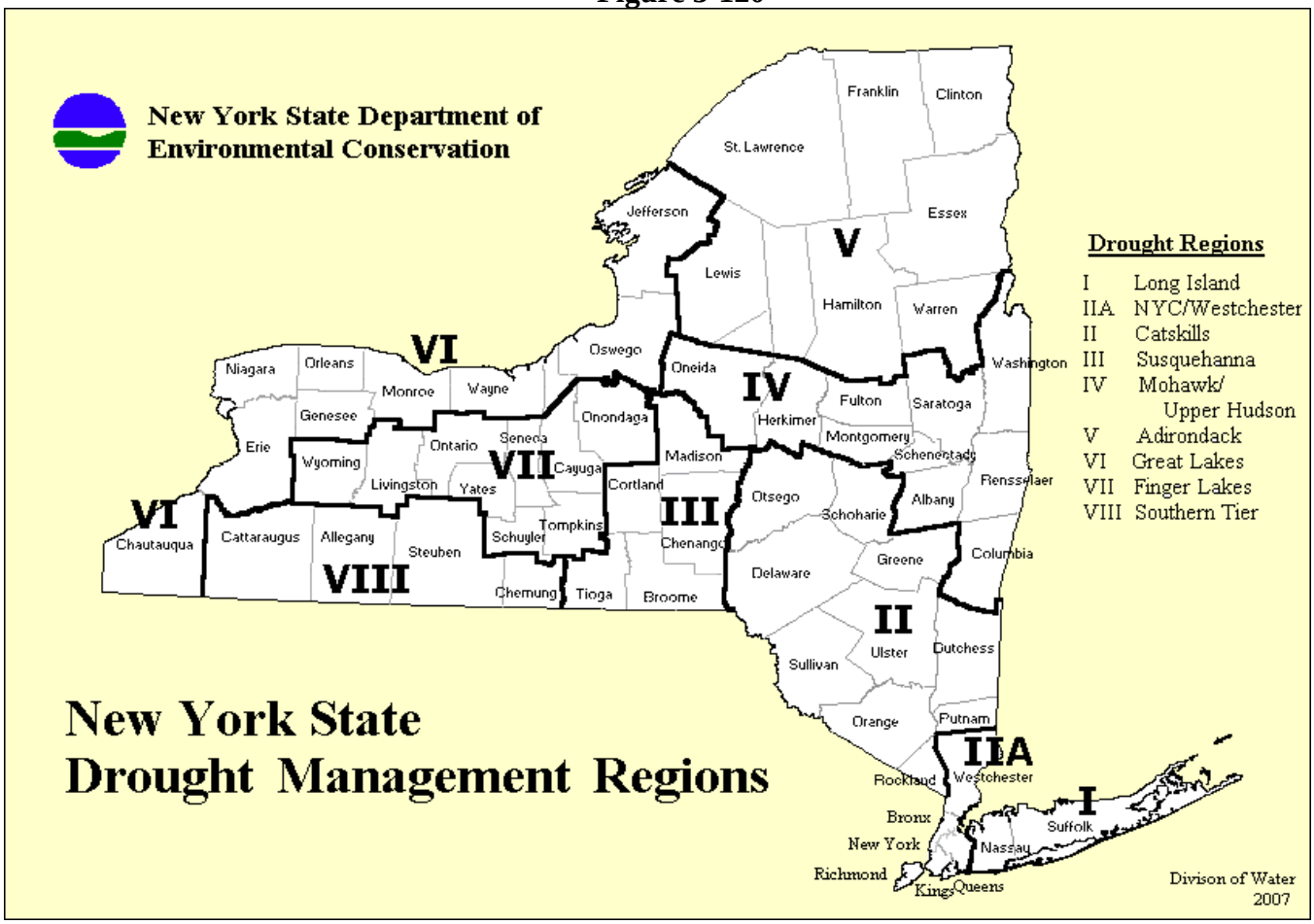
		less than 30% of normal for the period from June 1st to the end of August	
September 1, **1999** – September 30, **1999**	Broome, Cayuga, Chemung, Chenango, Cortland, Delaware, Madison, Oneida, Oneida, Onondaga, Otsego, Schuyler, Seneca, Steuben, Sullivan, Tioga, Tompkins, Yates	A very dry spring and summer caused major crop failures and some wells to run dry. Many streams and rivers were also brought to their lowest recorded levels • The crops most affected were corn and hay, which dealt a major blow to dairy farmers • According to preliminary figures from the New York State Department of Agriculture and Markets, the worst drought damage was reported in Cayuga ($17.7 million), Steuben ($15.3 million) and Madison ($5.9 million) counties	$ 50,000,000
November **2001** – January **2002**	Orange, Putnam, Rockland, Westchester, New York City, Long Island	The combined storage in the New York City water supply reservoir system was 41% of capacity (normal for this time is 71%).	Unknown
April – October **2002**	New York City, Long Island, Westchester, Orange, Putnam, Rockland,	Ground water and water storage facilities were below normal. The New York City reservoir system reached a low of 64.5%, which was 34% below normal.	Unknown

Mitigating Drought

New York Drought Plan

Generally, New York State is in receipt of ample annual precipitation to recharge the State's reservoirs, lakes, rivers, and groundwater aquifers. But, from 1979-81, particularly the winter and spring of 1981, precipitation levels declined and drought-related impacts and problems started to become evident. Of particular concern were water shortages in the southern part of the State, including the New York City metropolitan area, where nearly two-thirds (2/3) of the State's population resides. As a result, the State's Drought Task Force was formed. **Figure 3-120** as excerpted from the NYS Drought Management Plan (DMP) identifies drought management regions as established by NYS DEC.

Figure 3-120



The New York State Drought Plan was written in 1982 and updated in 1988. Public water supplies are the main focus of the plan, which is primarily based on lessons learned from the 1980–81 and 1984–85 droughts. The Drought Management Task Force (DMTF) operates the plan, and the lead agency on the DMTF is the Department of Environmental Conservation.

The plan is divided into two parts: a state drought preparedness plan focusing on monitoring and evaluating conditions and options to minimize drought impacts, and a drought response plan that defines specific actions to be taken during various stages of drought. This arrangement is unique among state drought plans. The New York State Drought Plan also recommends programs and projects that should be completed to better prepare the state for drought, based on two time scales: short-term (up to 3 years), and long-term (3–10 years).

Table 3-47: New York State Drought Plan (developed 1982; revised 1988)
Monitoring Component

Lead agency:	Department of Environmental Conservation
Activation of component/monitoring frequency:	Monthly
Conditions monitored:	Climatological data, reservoir/lake storage, streamflow, groundwater levels
Indices:	Palmer Drought Index, State Drought Index
Triggers:	Both the Palmer and State Drought Index values unique to each of the nine drought regions established across the State *(see Figure 3-29)*. The five stages are: **Normal, Drought Alert, Drought Warning, Drought Emergency, and Drought Disaster**

Table 3-48: Summary of Response Actions in Drought Conditions: State, Local, and Water Suppliers

NORMAL CONDITIONS
Drought Management Task Force (DMTF) 1. Monitor and evaluate drought status. 2. Plan for "worst case" situations. 3. Periodically review the State Drought Management Coordination Annex and recommend and approve updates to such Annex as needed. 4. Coordinate drought-related activities in accordance with such Annex. 5. Maintain drought planning process. 6. Assist in review and development of local drought contingency plans in cooperation with Local, State, and Federal programs. 7. Meet as needed to ensure State response to drought conditions.
State Emergency Management Office (SEMO) 1. Prepare and keep updated the State Drought Management Coordination Annex. 2. Maintain and make available the emergency equipment stockpile for use during emergency situations.
Department of Environmental Conservation (DEC) 1. Prepare and keep updated the State Drought Forecasting Plan. 2. *Determine the current drought status for each region of the state.*
Department of Health (DOH) 1. Provide guidance for developing water supply emergency plans to address and respond to drought conditions. 2. Obtain and review water supply emergency plans from community water systems to ensure that community water systems have identified appropriate drought responses.
Individual DMTF Agencies 1. Encourage the development of local drought contingency plans. 2. Review and provide technical assistance in the development of local drought contingency plans. 3. Prepare and maintain information for use in public information campaigns. 4. Review and provide technical assistance in the development of additional water supply sources by water suppliers and local agencies
Local Agencies and Water Suppliers 1. Develop and keep current local drought contingency plans. 2. Maintain drought resource and response capability. 3. Make necessary improvements to water systems. 4. Initiate leak detection and repair programs. 5. Plan for worst case situations. 6. Local governments enact legislation to provide for local drought response and enforcement authority.
DPC 1. Support development of State and Local drought contingency plans.

STAGE 1: DROUGHT WATCH

Continue all actions initiated under "Normal", in addition the following actions will be taken:

DMTF

1. Monitor and evaluate drought status.
2. Meet as needed to ensure adequate state response to drought conditions.
3. Assess capability of governmental programs that apply to drought preparedness and response.

SEMO

1. Chair the Task Force, schedule meetings as necessary.
2. Prepare drought updates and generally disseminate drought related information.
3. As directed by the Task Force, coordinate drought related activities with appropriate local, state, and federal agencies.
4. Advise and respond to drought affected communities and coordinate implementation of recommended water-use restrictions.
5. Maintain and make available stockpiles of pipe, pumps, and other water treatment and transport equipment for use during emergency situations.

DEC

1. Monitor and evaluate technical data regarding meteorological and hydrological conditions from available sources.
2. Determine the current drought status for each region of the state.
3. Declare a change in status as warranted.
4. Coordinate state drought declarations with communities and interstate commissions.
5. Ensure the protection of aquatic habitats.
6. Prepare drought updates and generally disseminate drought related information.

DOH

1. Review and approve requests for use of equipment from the SEMO stockpile.
2. Monitor drinking water supplies and monitor surface water and groundwater supply storage levels once a month.
3. Report water supply levels to DEC for incorporation into the calculation of drought indices.
4. Obtain and review drought emergency plans from community water systems within drought affected areas and ensure that community water systems act in accordance with such plans.

NYS Agriculture & Markets

1. Ensure that agriculture receives appropriate access to non-potable water supplies.
2. Coordinate and consult with Soil and Water Conservation Districts in assessing local groundwater conditions.
3. Coordinate crop failure data with assistance from USDA FSA.
4. In coordination with SEMO, at the request of a county emergency manager, authorize use of stockpile equipment to the extent of its availability, to assist county efforts in delivering potable or non-potable water for critical livestock needs.
5. Provide DEC and the Task Force with agricultural drought information.

Individual DMTF Agencies

1. Provide technical assistance to localities.
2. Prepare drought updates for DMTF.
3. Intensify monitoring and appraisal of drought status.

4. Advise the Task Force and provide technical information.

Local Agencies and Water Suppliers

1. Review and update local drought plans.
2. Promote voluntary water conservation measures.
3. Monitor supply and demand conditions of local water systems, especially systems known to be "drought susceptible".
4. Check status of leak control programs. Expand efforts where appropriate.

STAGE 2: DROUGHT WARNING

Continue all actions initiated under "**Drought Watch**", in addition the following actions will be taken:

DMTF

1. Convene monthly to assess statewide drought conditions and implement State drought actions.
2. Accelerate drought management efforts as the situation worsens.
3. Continue to monitor and evaluate drought actions.
4. Alert the Disaster Preparedness Commission (DPC) as to status of situation.
5. Initiate coordination with Federal agencies and other states to alleviate potential drought impacts.
6. Recommend declarations of drought emergency to the DPC as appropriate (must be a unanimous vote of the DMTF).

SEMO

1. Chair the Drought Task Force and schedule at least one meeting a month during a Drought Warning.
2. Evaluate readiness of emergency equipment stockpile and request replenishment as needed.

DEC

1. Advise the Task Force and provide technical support.
2. Coordinate state drought declarations with communities and interstate commissions.

DOH

1. Request water suppliers in Stage 2 (Drought Warning) areas to implement water conservation measures.
2. Intensify monitoring of drinking water supplies.
3. Assist SEMO in evaluating readiness of water supply equipment in the emergency equipment stockpile.

NYS Thruway Authority (TWY)

1. Report to the Task Force regarding the availability of canals and reservoirs to provide water to drought affected regions of the state.
2. Coordinate with SEMO on the availability of TWY equipment for pumping and transporting water.

Individual DMTF Agencies

1. Promote public information and technical assistance programs.
2. Review and update local and state drought plans.

Local Agencies and Water Suppliers

1. Make supply projections for predicting future drought effects.

2. Expand and enforce leakage detection and repair programs.
3. Intensify voluntary water conservation efforts. Local agencies may also initiate mandatory restrictions as provided for under local codes or drought plans.
4. Make provisions for utilization of emergency sources of supply.

Disaster Preparedness Commission (DPC)

1. Urge completion of drought contingency plans.

STAGE 3: DROUGHT EMERGENCY

Continue all actions initiated under "Drought Watch & Warning", in addition the following actions will be taken:

DMTF

1. Meet twice per month.
2. Review drought preparedness plans for deficiencies.
3. Review options for water from NYS Canal System reservoirs and/or Hudson River-Black River Regulating District.
4. Recommend needs for legislation, funds or other actions to improve State drought response capabilities.
5. Review Regional/State drought implications.
6. Review and prepare to initiate actions to meet "worse case" situation.
7. Initiate appropriate governmental programs to mitigate drought impacts, and provide public information regarding these programs.
8. Establish priorities for use of equipment and technical assistance.
9. Advise DPC of local and state emergency actions.
10. Make recommendations to the DPC.

SEMO

1. Coordinate stockpile use. Provide limited resources on a priority basis.

DEC

1. Issue emergency permits to water suppliers to withdraw water from streams and rivers under certain restrictions.
2. Intensify monitoring and evaluation of drought status.

DOH

1. Request suppliers, by letter, to adopt further measures to conserve water and to take advance actions that are necessary to utilize alternative water sources.
2. Assist SEMO in their prioritization for use of emergency water supply equipment.

NYS Office of Fire Prevention & Control (OFP&C)

1. Distribute Fire Service Guide "Suggested Fire Department Operations for Drought Emergencies.

All State Agencies

1. Provide equipment and technical assistance to localities.
2. Implement water conservation in State Office Buildings.
3. Utilize regulatory and emergency powers as appropriate.

Local Agencies and Water Suppliers

1. Re-evaluate and use as needed, alternate water resources.
2. Restrict water use in stages, banning non-essential use first, then reducing water for essential use.
3. Implement local public awareness and water conservation campaign.
4. Use emergency equipment and tap emergency sources of water.
5. Request technical assistance and equipment from the state, if necessary.
6. Initiate penalties for violations of water use restrictions.
7. Intensify leak detection and repair programs.
8. Take preparatory actions that are necessary to utilize alternative water sources.

DPC

1. Consider DMTF recommendations.
2. Consider need for a State declaration.
3. Appoint liaison officer to DMTF if a declaration is made.
4. Request emergency assistance from the Federal Emergency Management Agency.
5. Direct State agency response.
6. Establish task force to develop phased emergency disaster plans where needed.

STAGE 4: DROUGHT DISASTER

Continue all actions initiated previously, in addition the following actions will be taken:

DMTF

1. Respond to directives to implement DPC actions.

All State Agencies

1. Take actions as directed by the Governor and DPC.

Local Agencies and Water Suppliers

1. Initiate further restrictions on water use, including reducing flows to non-essential users.
2. Undertake all possible local disaster relief efforts.
3. Request State and Federal disaster declarations.
4. Enact emergency legislation and issue emergency orders as required.

DPC

1. Request Federal disaster assistance.
2. Implement appropriate "worst case" option.

As a result of the 1985–86 drought, major mitigation activities, for water conservation, were enacted. The state developed a “worst case” drought scenario, looking ahead to potential drought conditions in late 1985 and 1986. They created a simplistic predictive model for New York City composite reservoir storage for the scenario, and then predicted worst-case assumptions for the principal factors influencing reservoir storage (runoff, consumption, releases, conservation measures, other sources of supply).

Other actions of the State during the 1985–86 drought:

Department of Environmental Conservation (DEC)

- Distributed water conservation materials and stressed the need for conservation at drought information meetings and to media contacts
- Developed a drought index for the 9 drought regions in the State (the Palmer Drought Severity Index [PDSI] was also used)
- Provided the State's Drought Management Task Force with reports on drought status, and also sent periodic drought updates to 800 groups in southeastern New York
- Inventoried self-supplied industrial water users in the drought area for possible use of their supplies for emergency public water supply needs
- In conjunction with the Department of Health, New York City, and Westchester County, established a task force to develop a phased emergency disaster plan for New York City

State Health Commissioner

- Requested that water suppliers in the State's 13-county drought-affected area prepare or update drought contingency plans

State Drought Coordinating Officer

- Requested that water suppliers in the drought area adopt water conservation measures and use water sources other than the New York City system where possible

Drought Management Task Force (DMTF)

- Supported a National Weather Service aerial survey program in the New York City watershed area during winter 1985–86 to estimate the water equivalent of snow cover for improved runoff forecasting

State Emergency Management Office

- Worked on rehabilitating and expanding the State's emergency equipment stockpile
- Established an alert procedure to notify New York City of hazardous material releases into the Hudson River that might affect water quality at the Chelsea pumping station
- Met with the Federal Emergency Management Agency to seek federal drought emergency assistance

State Office of Fire Prevention and Control

- Prepared and distributed Fire Service Guides

New York City also initiated or continued several long-term activities in response to the 1985–86 drought:

- Public conservation efforts under the leadership of the Mayor's Committee on Water (comprising public, business, commercial, and governmental entities)
- Mayor's Intergovernmental Task Force on New York City Water Supply Needs exploring issues of controlling demand and increasing supply

- Study of future demands on New York City's water supply system
- Universal Metering Program, a 10-year program to install 630,000 water meters in New York City
- Water Main Replacement Program, an ongoing program to replace about 300,000 feet of water mains annually to prevent leakage
- Leak Detection Program, a continuing electronic detection program
- Public outreach program of the Office of Water Conservation, involving media, schools, and a speakers' bureau
- Fire Hydrant Security Program, involving installation and maintenance of locking devices on hydrants
- Low-Flow Plumbing Fixture Pilot Program, involving installation of low-flow devices in a sample building and monitoring of demand in this building and several control buildings
- DEC holding hearings to allow emergency pumping from the Hudson River
- Legislative proposals to allow the City to enforce State plumbing regulations

In response to the 1988–89 drought, New York City took the following actions:

- Issued a Drought Watch on January 17, 1989
- Announced a Drought Emergency—Stage II, March 22, 1989; including the following water conservation regulations:
    - Lawn watering banned
    - Businesses required to cut water use by 20%
    - Filling swimming pools banned
    - Hosing down sidewalks and driveways banned
    - Car washes required to use well water or close
    - Opening fire hydrants by anyone other than authorized personnel banned
    - Fountains not allowed to be turned on
- **Drought Emergency—Stage III** declared May 1, 1989; Chelsea Pumping Station activated to draw water from the Hudson River. The pumping station ran for 15 days before being shut down because of legal battles and recent rains