

DRAFT

TOWN OF IPSWICH DROUGHT MANAGEMENT PLAN



SEPTEMBER 2019

IPSWICH WATER DEPARTMENT
272 HIGH STREET • IPSWICH, MA 01938
(978) 356-6635

TABLE OF CONTENTS

1. Introduction.....	1
2. Background.....	1
3. Legal Authority.....	1
a. Water Rules and Regulations; Outdoor Water Use Bylaw.....	1
b. Responsible Parties.....	1
4. Water Sources.....	2
a. Parker River Basin Water Sources.....	3
b. Ipswich River Basin Water Sources.....	4
5. Demand History.....	5
6. Drought Management History.....	6
7. Data Monitoring / Drought Indicators.....	6
a. Reservoir System Storage.....	7
b. Precipitation.....	7
c. Groundwater Well Levels.....	7
d. Water Storage Tank Levels.....	7
e. Ipswich River Flows.....	7
f. Massachusetts State Drought Assessment.....	8
g. Unforeseen Operations or Maintenance Circumstances.....	8
8. Drought Stages and Responses.....	8
a. Stage 1: Normal Conditions.....	8
b. Stage 2: Mild Drought.....	9
c. Stage 3: Moderate Drought.....	9
d. Stage 4: Severe Drought.....	9
e. Stage 5: Emergency Drought.....	9
f. End of Drought Stage.....	9
9. Drought Mitigation Measures.....	10
a. Public Education.....	10
b. Seasonal Residential Water Rates.....	10
c. Monthly Water Meter Readings and Billing.....	10
d. Unaccounted-for-Water (UAW) Reduction Program.....	11
e. Other Mitigation Measures.....	11

TABLES

Table 3-1: Responsible Parties..... 2
Table 4-1: Summary of Water Sources and Withdrawal Limits..... 3
Table 8-1: Drought Stages 8

FIGURES

Figure 4-1: Ipswich Water System Map 2
Figure 5-1: Summer-to-Winter Water Use Ratios 6

APPENDICES

- Appendix A: Outdoor Water Use Bylaw & Amended Water Rules and Regulations
- Appendix B: Water Department Pumping & Consumption Records
- Appendix C: Reservoir System Storage Chart
- Appendix D: Precipitation Data

1. INTRODUCTION

The Town of Ipswich (Town) has developed this Drought Management Plan (Plan) to:

- Establish a consistent basis for evaluating the severity of drought conditions,
- Protect the quality and quantity of water in local aquatic habitats, such as ponds, rivers and wetlands, and
- Ensure compliance with the Massachusetts Department of Environmental Protection's (MassDEP's) Water Management Act (WMA) Program.

2. BACKGROUND

Ipswich is a coastal town with a population of approximately 13,000 residents and a total land area of 32 square miles. Incorporated in 1634, it is one of the oldest communities in the country. The Town's Water Department was created in 1894. The original water system was limited to the downtown area and was established primarily for fire protection. The system has expanded significantly since its inception and currently provides drinking water and fire protection to approximately 98% of the population, or about 4,500 homes and businesses.

This Drought Management Plan was initially developed in 2002 to fulfill the requirements of the Town's WMA Permit Application for an increase in authorized water withdrawal from the Parker River Basin. Water withdrawal exceedances in the Parker River Basin and Ipswich River Basin between 1995 and 1999 prompted MassDEP to issue an Administrative Consent Order (ACO) in May 2000. The development of this Plan, along with other water conservation measures, adequately addressed the concerns listed in the ACO and brought the Town back into compliance with the WMA Program. The Town has been reliably following the guidelines in its original Drought Management Plan since 2002.

In 2016, the Town experienced a significant drought during which the water levels in the drinking water supplies dropped substantially. The incident led the Town to conduct a comprehensive evaluation of its available drinking water supplies, including an updated analysis of the existing reservoir system capacity. This Drought Management Plan has been updated to reflect the results of the evaluation, as well as lessons of past experience learned since the original Plan was developed.

3. LEGAL AUTHORITY

a. Water Rules and Regulations; Outdoor Water Use Bylaw

This Drought Management Plan is primarily implemented through the Town's Water Rules and Regulations Article I, Section 7 and Town's General Bylaws Chapter 222, Article II (Outdoor Water Use).

The Water Rules and Regulations were amended on April 3, 2017 by the Board of Water Commissioners to incorporate Drought Management Plan guidelines, expand content relating to water restrictions and bans, and allow full enforcement of water use violations. The Outdoor Water Use Bylaw was adopted by Annual Town Meeting vote on May 9, 2017, and is consistent with the amended Rules and Regulations. The Outdoor Water Use Bylaw and Amended Water Rules and Regulations are included in **Appendix A**.

b. Responsible Parties

The Town's Board of Water Commissioners or their designee is responsible for administering the Water Rules and Regulations and Outdoor Water Use Bylaw. The Water Director, Town Manager, and local police have additional responsibilities such as information collection, tracking, and enforcement. Responsible parties for implementing the Drought Management Plan are listed in Table 3-1.

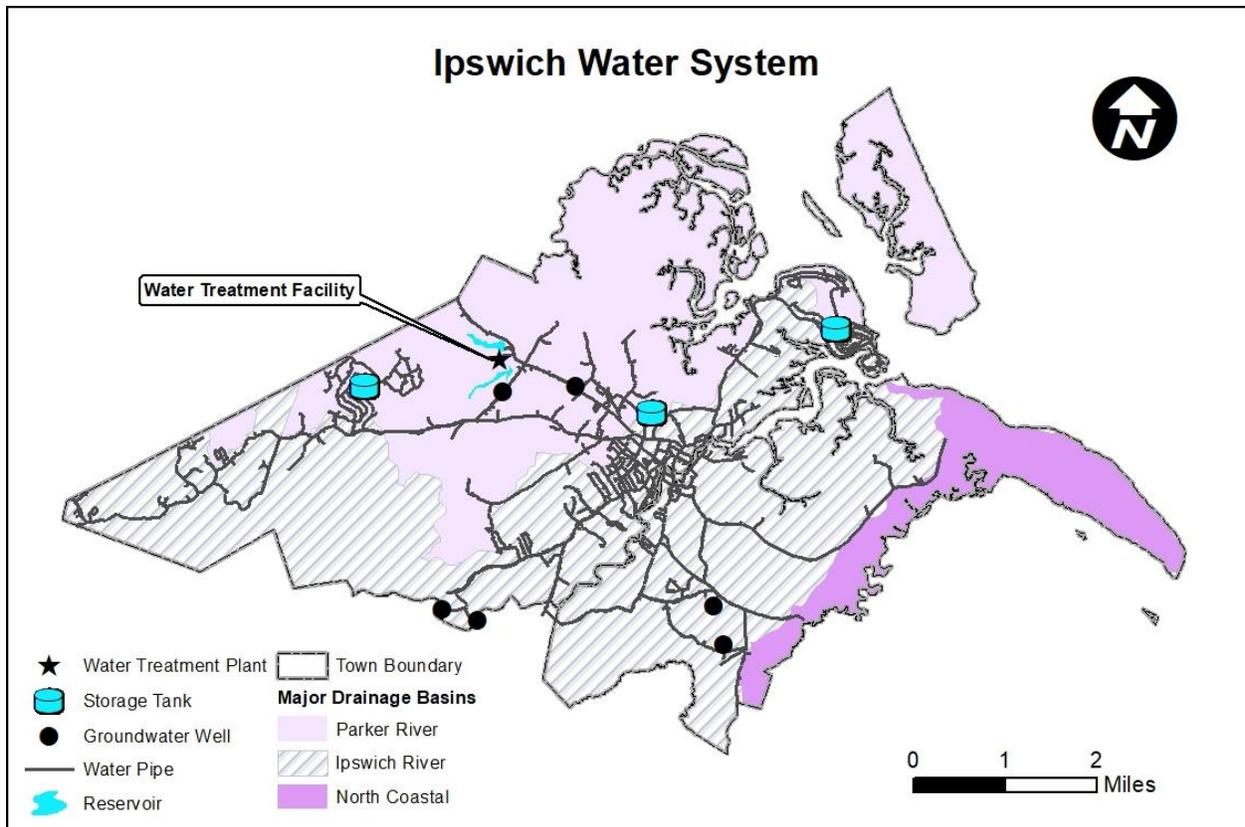
Table 3-1: Responsible Parties

Responsible Party	Responsibilities
Board of Water Commissioners	<ul style="list-style-type: none"> • Administers Water Rules and Regulations and Outdoor Water Use Bylaw
Water Subcommittee	<ul style="list-style-type: none"> • Acts as an advisory group to the Board of Water Commissioners
Water Director	<ul style="list-style-type: none"> • Oversees Drought Management Plan; monitors, coordinates, and manages responses to drought conditions • Recommends actions to minimize impacts to public health, safety, and the environment • Manages maintenance of water sources • Provides public notification of water use declarations • Manages enforcement actions and tracks violations
Town Manager	<ul style="list-style-type: none"> • Coordinates with Board of Water Commissioners and/or Water Director to implement Drought Management Plan
Local Police	<ul style="list-style-type: none"> • Assists Water Director with enforcement actions as needed

4. WATER SOURCES

Ipswich has groundwater and surface water sources within the Parker River Basin, as well as groundwater sources within the Ipswich River Basin. The surface water sources include Dow Brook Reservoir and Bull Brook Reservoir. The groundwater sources include the following wells: Browns, Mile Lane, Fellows Road, Essex Road, and Winthrop #2. Refer to Figure 4-1 for a map of water supply sources and basin boundaries.

Figure 4-1: Ipswich Water System Map



The Town is authorized under the WMA to withdraw a total of 1.18 million gallons per day (MGD) based on annual average daily withdrawal rate. The authorized withdrawal from the Parker River Basin is 0.98 MGD (Permit # 9P2-3-16-144.01, 5/24/2002). The registered withdrawal from the Ipswich River Basin is 0.20 MGD. Registered and permitted withdrawal limits under the WMA are summarized in Table 4-1.

Table 4-1: Summary of Water Sources and Withdrawal Limits

River Basin	Water Supply Source	Authorized Maximum Daily Withdrawal Rate (MGD)	Total Authorized Daily Average (MGD)
Parker River	Dow Brook Reservoir	2.50 (max. pumping rate)	0.98
	Bull Brook Reservoir	0.8 (safe yield)	
	Mile Lane Well	0.15	
	Browns Well	0.49	
Ipswich River	Fellows Road Well	0.36 (max. pumping rate)	0.20
	Essex Road Well	0.23 (max. pumping rate)	
	Winthrop Well #2	0.23 (max. pumping rate)	
Total:			1.18

a. Parker River Basin Water Sources

Both surface water reservoirs are located within the Parker River Basin. In addition to the reservoirs, the Town also operates two groundwater sources in the Parker River Basin: Browns Well and Mile Lane Well.

Dow Brook and Bull Brook Reservoir System

The Dow Brook and Bull Brook Reservoirs are connected in series and operate as a two-reservoir system that provides about half of the Town’s drinking water supply. Both reservoirs are located to the west of the Ipswich Utilities Complex at 272 High Street/Rte. 133. The Town and its subcontractor CR Environmental performed bathymetric surveys of Dow Brook and Bull Brook Reservoirs in April and May 2018 to refine estimates of the reservoir storage volumes and firm yield of the reservoir system. These estimates, which are presented below, differ from those in the original (2002) Drought Management Plan due to the use of more sophisticated measurement and modeling technologies.

The Dow Brook Reservoir is the primary surface water source for the Town. The usable storage volume in Dow Brook Reservoir is 47 million gallons (MG) and the total storage volume is 63 MG. The estimated drainage area of Dow Brook Reservoir is 0.88 square miles (mi²). The Bull Brook Reservoir is the smaller of the two surface water reservoirs. The usable storage volume in Bull Brook Reservoir is 14 MG and the total storage volume is 17 MG. The estimated drainage area of this reservoir is 3.64 mi². Water from Bull Brook Reservoir is transferred to Dow Brook Reservoir by gravity through a 36-inch diversion pipe.

The Reservoir System Firm Yield was originally determined as part of a water treatment plant feasibility study by Camp, Dresser & McKee Inc. in 1984. For the one-in-20-year drought, the Firm Yield was determined to be 0.8 MGD. This yield is documented in the WMA Permit for the Parker River Basin. Per the Permit, withdrawals for Dow Brook and Bull Brook Reservoirs must not exceed 0.8 MGD as an annual average.

During the drought of 2016, the operation of two of Ipswich’s highest capacity wells was restricted due to elevated levels of Manganese. This limited Ipswich’s flexibility to respond to drought conditions, resulting in depletion of the reservoir system to emergency levels. This experience led the Town and its engineering consultant AECOM to evaluate Ipswich’s demand and source water supplies, including recalculating the Firm Yield of the reservoir system. The Firm Yield was recalculated in 2018 based on updated hydrologic and bathymetric data, using the 2016 drought-of-record. The resulting Firm Yield is 0.41 MGD. Since the Town has detailed steps to be taken during droughts and the means to measure results, this plan considers the response of the reservoir system to the best approximation of a one-in-20-year drought rather than the drought-of-record in accordance with WMA regulations.

Browns Well

Browns Well is a 24-inch gravel packed well that is approximately 51 feet deep. It is located on High Street/Rte. 133 roughly 50 feet north of the roadway. The maximum daily withdrawal rate authorized under the WMA permit is 0.49 MGD. However, since receiving MassDEP’s Manganese Advisory in 2013, the Town has voluntarily taken several steps to manage Browns Well to reduce levels of manganese in the water distribution system. Browns Well is set up run at no more than 200 gallons per minute (GPM) – down from 400 GPM – and does not run for more than 10 consecutive days.

Mile Lane Well

Mile Lane Well is a 36-inch gravel packed well that is approximately 48 feet deep. It is located on Mile Lane, south of High Street/Rte. 133. The maximum daily withdrawal rate is 0.15 MGD.

b. Ipswich River Basin Water Sources

The Town operates three groundwater sources in the Ipswich River Basin: Fellows Road Well, Essex Road Well, and Winthrop #2.

Fellows Road Well

Fellows Road Well is an 18-inch diameter gravel developed well that is approximately 73 feet deep. It is located the north side of Fellows Road, about a quarter of a mile west of Candlewood Road. The maximum daily withdrawal rate for Fellows Road Well is 0.36 MGD. However, escalating levels of manganese in Fellows Road well requires the Town to limit pumping below the 0.36 MGD capacity.

Essex Road Well

Essex Road Well is a 24-inch gravel packed well that is approximately 40 feet deep. It is connected to a wellfield of three 8-inch diameter gravel developed wells, with depths ranging from 30-34 feet. This well is located on the south side of Essex Road, between Lakeman’s Lane and Candlewood Road. The maximum daily withdrawal rate is 0.23 MGD.

Winthrop Well #2

Winthrop Well #2 is a 12-inch gravel developed well that is approximately 56 feet deep. It is located adjacent to the Ipswich River on the Winthrop Estate, south of Topsfield Road. Winthrop Wells #1 and #3 have been made inactive due to water quality issues. The maximum daily withdrawal rate for Winthrop Well #2 is 0.23 MGD.

5. DEMAND HISTORY

In the late 1990's, water demand was rising towards 500 MG annually. Through an extremely successful leak detection survey in 1999 combined with ongoing meter replacement and other conservation efforts, the Ipswich Water Department averaged a 15% reduction in demand from 1999 to 2001.

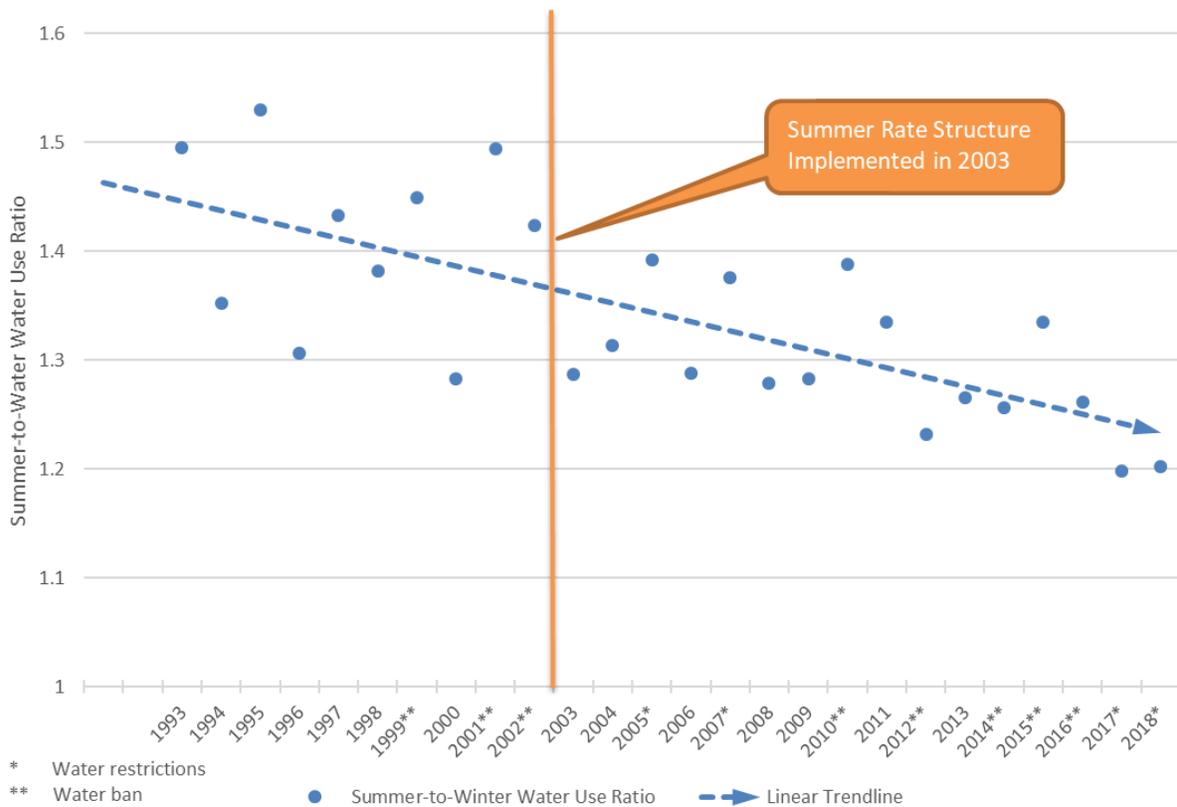
Demand has further declined since 2001. Between 2012 and 2017, the average day demand (ADD) ranged between 0.93 and 1.02 MGD despite a 4% increase in population over that time period. This corresponds to an annual water demand between about 340 and 375 MG.

In addition to reducing overall water demand, the Town's conservation efforts have successfully reduced summer peaks in water demand due to residential outdoor water use. Figure 5-1 shows how the summer-to-winter water use ratios have decreased since the early 2000's. Ipswich's average summer-to-winter water use ratio between 2003 and 2018 is 1.29. The principal reasons for the reduction in residential outdoor water use appear to be the following:

- In 2003, the Town implemented a summertime water-rate schedule for residential customers. These rates apply from May 1 to September 30 of each year, and are 1.5 times the base rate.
- In 2017, the Town adopted its Outdoor Water Use Bylaw. As previously described, this bylaw grants greater authority to the Board of Water Commissioners or their designee to impose restrictions to reduce consumption "at any time that conditions warrant."
- All customers have been billed monthly based on monthly water meter readings since 2000. This allows the Town and its customers to closely monitor and manage consumption.
- There is greater public awareness and public participation in water-conservation efforts.

These conservation measures are described in more detail in Section 9. Water Department pumping and consumption records are included in **Appendix B**.

Figure 5-1: Summer-to-Winter Water Use Ratios



6. DROUGHT MANAGEMENT HISTORY

Ipswich has maintained a written Drought Management Plan since 2002. Prior to the written plan, drought management practices were implemented but not formally documented. Ipswich has historically managed and reacted to drought conditions based on reservoir storage levels in the Bull Brook and Dow Brook Reservoirs, which is outlined in the Town of Ipswich Water Rules and Regulations, Article 1, Section 7. As described in Section 3, the Town updated these Rules and Regulations and adopted a new Outdoor Water Use Bylaw in 2017 to incorporate Drought Management Plan guidelines, expand content relating to water restrictions and bans, and allow full enforcement of water use violations.

While the Town has reduced overall consumption since 1999, drought conditions remain a problem during summer and fall seasons of abnormally low precipitation. The Town has implemented water use restrictions or bans in each year since 2014. The greatest concern of drought is between May and September.

The 2017 amendments to the Town’s Rules and Regulations broadened the criteria for determining water use restrictions or bans to allow for the Town to “restrict the use of water as it deems necessary to ensure an adequate supply of water for drinking and fire protection and to protect the quality and quantity of water in local aquatic habitats such as ponds, rivers and wetlands and to ensure compliance with the Water Management Act.”

7. DATA MONITORING / DROUGHT INDICATORS

Ipswich will continue to respond to drought conditions based on reservoir system storage and local precipitation. The Town evaluates precipitation in the spring and throughout the summer months to

determine whether an increase in the drought stage is appropriate. In addition to reservoir system storage and precipitation, the Town will also monitor groundwater well levels, water storage tank levels, Ipswich River flows, and Massachusetts State Drought Assessment to determine the potential of a drought and formulate thresholds to manage a drought appropriately. Unforeseen operations or maintenance circumstances may also impact the drought stage. However, reservoir system storage will remain the primary indicator.

a. Reservoir System Storage

Reservoir system storage is a basic indicator in determining drought stages. As described in Section 4, the Town was provided with updated estimates of the total and usable storage volumes of Bull Brook and Dow Brook Reservoir by CR Environmental in 2018. The combined total storage of the reservoir system is approximately 81 MG, and the combined usable storage is approximately 61 MG.

Water level readings are taken at both reservoirs daily by measuring the distance from an established point of known elevation to the water level. Conversion charts are then used to calculate storage at each reservoir. The SCADA system is used to record raw water flows into the Water Treatment Plant and treated water pumped into the distribution system.

The Town actively manages its groundwater sources to supplement surface water supplies to balance demand and water availability.

b. Precipitation

Precipitation plays a pivotal role in determining the seriousness of a drought. It is measured daily at the Ipswich Wastewater Treatment Plant located on Fowlers Lane. Historic records are excellent and include daily precipitation as well as monthly averages. Monthly totals are compared to monthly reservoir storage and pumping totals to approximate recharge of the reservoir system.

c. Groundwater Well Levels

Groundwater well levels help give advance warning of the risk of drought, and indicate fluctuations in water demand. Demand typically peaks between May and September due to non-essential outdoor water usage. All five groundwater sources are connected to the Water Department SCADA system. This system allows the Water Treatment Plant operators to monitor pumping rates and drawdown levels of all the wells in real-time. The SCADA system is also programmed to operate the wells as system demand fluctuates.

d. Water Storage Tank Levels

Water storage tank levels also help identify fluctuations in water demand. The water system includes three storage tanks with a total capacity of 4.5 MG, as listed below. The storage volumes are measured by the SCADA system in real-time.

- Pinefield Tank – 1 MG capacity
- Town Hill Tank – 3 MG capacity
- Plover Hill Tank – 0.5 MG capacity

e. Ipswich River Flows

The Ipswich River Watershed Association (IRWA) notifies the Water Department when Ipswich River flows drop below 9.6 cubic feet per second (cfs). Streamflow data recorded by the United State Geological Survey (USGS) from stream gauging station 01102000 near Willowdale Dam outside of Ipswich is available online at <https://waterdata.usgs.gov/nwis>. While there has been no clear connection between river

flows and the behavior of Ipswich’s water sources during a drought, streamflow will be used to assess the regional drought situation.

f. Massachusetts State Drought Assessment

The Massachusetts Department of Conservation and Recreation (DCR) monitors hydrologic conditions across the state and publishes monthly reports on statewide precipitation, streamflow, groundwater, and reservoir levels. Massachusetts has also developed a state Drought Management Plan to provide guidance on early drought warning indicators, drought severity, emergency preparedness, agency communication, and other elements to minimize drought impacts. The Massachusetts State Drought Management Plan and statewide drought conditions can be found online at <https://www.mass.gov/drought-management>. Information provided by the state will be used to evaluate regional drought conditions.

g. Unforeseen Operations or Maintenance Circumstances

From time to time, unforeseen operations or maintenance circumstances within the water system may warrant an increase in the drought stage. The Water Commissioners, Water Director, and/or Town Manager reserve the right to restrict the use of water as deemed necessary to ensure adequate water supply.

8. DROUGHT STAGES AND RESPONSES

Five drought stages have been developed based on normal reservoir system storage conditions. Each stage represents a percentage range of *Normal Conditions* that takes into account typical, seasonal variations in storage. Reservoir system storage information is included in **Appendix C**. Local precipitation will be used to adjust the drought stage classification. In the previous (2002) Drought Management Plan, precipitation was evaluated on July 1 and August 1 of each year. This Plan has been updated to assess precipitation more frequently during peak demand months. Total precipitation will be evaluated for the period of January 1 to May 1. If the total precipitation is 10% or more below the 25-year historical average for this period on May 1, the drought stage will be increased by one level of urgency. The precipitation will be evaluated again on the first of each month through September. If the total is 10% or more below the 25-year historical average for the period between January 1 and the target month, the drought stage will be increased accordingly. Historic precipitation data is included in **Appendix D**.

As identified in Table 8-1, there is a normal condition and four drought severity levels: Mild, Moderate, Severe, and Emergency. The Water Director will determine the drought stage based on information from the Water Treatment Plant operators and precipitation data. The Water Commissioners, Town Manager, all Town departments, and the media will be notified once a drought stage is declared.

Table 8-1: Drought Stages

Drought Stage	Total Reservoir System Storage Volume	Action Level
Stage 1: Normal Conditions	90-100% of <i>Normal Conditions</i>	No Restrictions
Stage 2: Mild Drought	80-90% of <i>Normal Conditions</i>	Voluntary Restrictions
Stage 3: Moderate Drought	65-80% of <i>Normal Conditions</i>	Mandatory Restrictions
Stage 4: Severe Drought	40-65% of <i>Normal Conditions</i>	Outdoor Water Ban
Stage 5: Emergency Drought	Below 40% of <i>Normal Conditions</i>	Water Ban & Limit Indoor Use

a. Stage 1: Normal Conditions

Stage 1 represents normal operating conditions, with a total reservoir system storage capacity of 90-100% of *Normal Conditions*.

During Stage 1, the Water Department will implement its public education campaign to increase awareness of water use and supply. Education programs may begin in May regardless of drought conditions.

b. Stage 2: Mild Drought

Stage 2 goes into effect when reservoir system storage capacity is 80-90% of *Normal Conditions*. Voluntary water restrictions are enacted as described in the Town's Water Rules and Regulations.

During Stage 2, the Water Department will increase public education efforts and promote voluntary water restrictions.

c. Stage 3: Moderate Drought

Stage 3 takes effect when reservoir system storage capacity is 65-80% of *Normal Conditions*. Mandatory water restrictions are enacted as described in the Town's Water Rules and Regulations. Restrictions are enforced by the Water Department through opportunistic and drive-by inspections, or reported violations.

During Stage 3, the Water Department will increase public education, as well as keep the public informed of the drought status and what is required of the consumer during each stage.

d. Stage 4: Severe Drought

Stage 4 takes effect when reservoir system storage capacity is 40-65% of *Normal Conditions*. All outside water use is banned. Water bans are enforced by the Water Department and Police Department.

e. Stage 5: Emergency Drought

Stage 5 takes effect when reservoir system storage capacity is below 40% of *Normal Conditions*. During an emergency drought, the Water Department will investigate the possibility of purchasing water from the Hamilton and/or Rowley through existing interconnections. The Town may restrict indoor water use to maintain adequate flow in the distribution system. If the Town's ability to provide a continuous water supply is compromised, the Water Department coordinate with MassDEP and other state agencies as necessary to address emergency conditions.

f. End of Drought Stage

Ipswich will determine the end or reduction of a drought stage based on reservoir system storage capacity. The reservoir system has exceptional recharge capabilities with adequate precipitation. Due to the relatively small size of the reservoir system compared with its contributing drainage area, the system rebounds quickly with a series of rain events, while other systems remain in drought conditions through a much slower recharge process.

The Town will closely monitor reservoir system storage and precipitation during drought conditions. Once the reservoir system storage rebounds beyond the trigger for a particular drought stage, either due to weather conditions or a decrease in water demand, the Water Director will consult with the Water Commissioners to determine whether a change in the drought stage is warranted. A drought stage will typically remain in place until reservoir system storage is above a trigger volume for at least five consecutive days.

An emergency drought stage will end when the conditions that led to that specific emergency have been resolved.

9. DROUGHT MITIGATION MEASURES

The Water Department leads several water conservation and drought mitigation measures to protect local water resources and support this Drought Management Plan, including:

- public education,
- seasonal residential water rates,
- monthly water meter readings and billing, and
- an unaccounted-for-water (UAW) reduction program.

Ipswich also implements zoning restrictions and controls on new development projects to promote water conservation and drought mitigation in the community.

a. Public Education

Early May is an important time to educate the public on conservation and drought management. Reservoir system storage is typically at capacity and monthly demand has historically increased by more than 20% from April to May.

The Utilities Department posts water conservation tips and other public outreach materials on its website at ipswichutilities.org, and maintains active social media pages on Facebook and Twitter @IpswichUtility. Dedicated webpages for water conservation information and the drought status are updated regularly during the spring and summer months. The Utilities Department also distributes educational information in its monthly utility bills. The focus of springtime educational material is on water conservation tips and the status of the water system.

Throughout the spring and summer months, the Water Department will use the local newspaper and community access television to heighten awareness of drought conditions and water demand reduction. Customers are educated on what they can do individually to reduce water use. Updates on the status of the water sources and an explanation of the drought stages will be publicized regularly.

b. Seasonal Residential Water Rates

In 2003, the Water Department implemented a seasonal rate structure to help manage summer demand. As previously stated, the increase in water demand during summer months is largely attributed to residential outdoor watering. To decrease the spike that occurs during the summer, the Water Department increases the residential water rate between May 1 and September 30 to 1.5x the commercial base water rate. The residential winter rate, which is in effect from October 1 to April 30, is determined by comparing the estimated revenue at the end of the summer with a defined revenue target for the fiscal year. The winter rate is lower than the base rate to offset the higher summer rate. Therefore, residential customers that conserve water throughout the year pay the same amount annually as they would if rates remained constant. This pricing structure has improved conservation and compliance during months with the highest risk of drought conditions. After nearly two decades of implementing this approach, the Town's peak monthly summer water usage has dropped by about 24% and the annual usage has dropped by 15%.

c. Monthly Water Meter Readings and Billing

The Water Department reads water meters and bills customers on a monthly basis using Advanced Metering Infrastructure (AMI). This billing frequency, coupled with the sophisticated AMI system, allows customers to monitor their water usage on a more regular basis and make adjustments as needed. If a customer has a significant, unexplained increase in water consumption, the Water Department will work closely with them to determine the cause and possible solutions.

d. Unaccounted-for-Water (UAW) Reduction Program

Ipswich manages Unaccounted-for-Water (UAW) through a robust AMI system and annual leak detection surveys. All of the residential water meters have been replaced with smart meters, reducing the likelihood of meter malfunctions or mis-registrations. Master meters on municipal sources and large properties are calibrated annually to ensure accurate readings. Ipswich also engages a subcontractor on an annual basis to conduct system-wide leak detection surveys. The Water Department repairs most of the identified leaks in-house. Large leaks that cannot be repaired in-house are fixed by an on-call excavation contractor or planned through a water main replacement project. Ipswich reports UAW each year in its Annual Statistical Report. While UAW in recent years has risen above the performance standard of 10%, Ipswich remains committed to detecting and repairing leaks and other system issues to reduce water loss to the extent possible.

e. Other Mitigation Measures

Water conservation and drought mitigation are issues that affect the entire community. Therefore, Ipswich has adopted zoning restrictions and bylaws to protect water sources and regulate land-disturbing activities. New development projects are subject to a formal review process, which involves demonstrating water conservation measures that meet the Town's standards.

Ipswich is working with IRWA to explore further options for drought mitigation, such as net-zero water use for new developments and the implementation of a water bank. These measures are expected to be adopted, with modifications, over the next 2-3 years.

APPENDIX A

Outdoor Water Use Bylaw & Amended Water Rules and Regulations

TOWN OF IPSWICH
ARTICLE II
OUTDOOR WATER USE

§ 220-2. Authority

This By-law is adopted by the Town under its police powers pursuant to the Home Rule Amendment of the Massachusetts Constitution, Article LXXXIX, to protect public health and welfare and pursuant to its powers under M.G.L. c.40, §§21 et seq. and implements the Town's authority to regulate water use pursuant to M.G.L. c. 41, §69B. This by-law also implements the Town's authority under M.G.L. c. 40, §41A, conditioned upon a declaration of water supply emergency issued by the Department of Environmental Protection under G.L. c. 21G, §15-17.

§ 220-3. Purpose

The purpose of this by-law is to protect, preserve and maintain the public health, safety and welfare whenever a Restriction or Ban of Water Use is declared, by ensuring an adequate supply of water for drinking and fire protection and to protect the quality and quantity of water in local aquatic habitats such as ponds, rivers and wetlands. This purpose will be accomplished by providing for the imposition and enforcement of any duly implemented restrictions, requirements, provisions or conditions on water use imposed by the Town in accordance with this by-law, the Town of Ipswich Water Rules and Regulations and/or by the Department of Environmental Protection under its state law authorities.

§ 220-4. Applicability

All users of the public water supply system and users of private water sources, exclusive of stormwater harvested and stored in tanks or cisterns, shall be subject to this by-law.

§ 220-5. Definitions

Agriculture shall mean farming in all its branches as defined at M.G.L. c. 128, § 1A.

Department shall mean the Massachusetts Department of Environmental Protection (DEP).

Drought Management Plan shall mean the Town of Ipswich Drought Management Plan, Appendix VII of the Town of Ipswich Water Rules and Regulations.

Person shall mean any individual, corporation, trust, partnership, association, agency or authority, or other entity and any officer, employee, group or agent of such persons.

Restriction or Ban of Water Use shall mean a Restriction or Ban of Water Use declared by the Board of Water Commissioners or their designee, pursuant to § 220-6 of this by-law.

State of Water Supply Emergency shall mean a State of Water Supply Emergency declared by the Department of Environmental Protection under M.G.L. c.21G, §15-17.

Town shall mean the Town of Ipswich.

Water Customers shall mean all persons using the public water supply irrespective of that person's responsibility for billing purposes for use of the water.

Water Sources shall mean all municipal water sources, all private wells, waterways, ponds, rivers and wetlands, excluding harvested stormwater.

Water Users shall mean all persons using water within the Town, including private water sources.

Water Rules and Regulations shall mean the Town of Ipswich Water Rules and Regulations.

§ 220-6. Restriction or Ban of Water Use Declaration

The Town, through its Board of Water Commissioners or its designee authorized to act as such, may restrict or ban the use of water as set forth in Article I, Section 7 of the Water Rules and Regulations. Upon notification to the public that water use is being restricted or banned, no person shall violate any provision, restriction, requirement or condition of the declaration. The Water Commissioners may designate the Water Director or Town Manager to declare a Restriction or Ban of Water Use at any time that conditions warrant. Public notice of a Restriction or Ban of Water Use shall be given under § 220-8 (a) of this by-law before it may be enforced.

§ 220-7. Declaration of a State of Water Supply Emergency

Upon notification to the public that a declaration of a State of Water Supply Emergency has been issued by the DEP, no person shall violate any provision, restriction, requirement, condition of any order approved or issued by the DEP for the purpose of bringing about an end to the State of Water Supply Emergency.

§ 220-8. Public Notification of Restriction or Ban of Water Use Declaration; Notification of DEP

- a) Public Notification of Restriction or Ban of Water Use Declaration – Notice to the public of all provisions, including all restrictions, requirements and conditions imposed by the Town as part of Restriction or Ban of Water Use Declaration shall be made as soon as possible, but no later than 48 hours following the declaration by press release and posting on the Town's website. The Town may also notify the public using other means determined to be appropriate including signage on roadways, cable TV, telephone, email, emergency communication system, etc.

- b) Public Notification of a State of Water Supply Emergency – Notice to the public of all provisions, including all restrictions, requirements and conditions imposed by a State of Water Supply Emergency declared by the DEP shall be made by press release and posting on the Town’s website. The Town may also notify the public using other means determined to be appropriate including signage on roadways, cable TV, telephone, email, emergency communication system, etc. This notice shall be provided as soon as possible, but no later than 48 hours after the public water system receives notice of the DEP’s declaration of a State of Water Supply Emergency.
- c) Any restriction imposed under § 220-6 or § 220-7 or in the DEP’s State of Water Supply Emergency or Order shall not be effective until notification to the public is provided. Submittal of MassDEP’s form “Notification of Water Use Restriction” shall be provided to the DEP within 14 days of the effective date of the restrictions, per MassDEP regulations (310 CMR 22.15(8)).

§ 220-9. Termination of a Restriction or Ban of Water Use Declaration; Notice

A Restriction or Ban of Water Use may be terminated by a majority vote of the Board of Water Commissioners or by decision of their designee upon a determination by either or both of them that the conditions requiring the Restriction or Ban of Water Use no longer exist. Public notification of the termination of a Restriction or Ban of Water Use shall given in the same manner as is required in § 220-8 (a) for notice of its imposition.

§ 220-10. Termination of a State of Water Supply Emergency; Notice

Upon notification to the Town that the declaration of a State of Water Supply Emergency has been terminated by the DEP, the public will be notified of the termination in the same manner as is required in § 220-8 (b) for notice of its imposition.

§ 220-11. Penalties

The Town through its Water Commissioners or its designee including the Water Director or Town Manager and/or local police may enforce this by-law. Any person violating this by-law shall be liable to the Town in the amounts listed below:

- 1) First violation: Warning;
- 2) Second violation: \$ 50;
- 3) Third violation: \$ 100;
- 4) Fourth and subsequent violations: \$ 300.

Each day of violation shall constitute a separate offense. Fines shall be recovered by complaint before the District Court, or by non-criminal disposition in accordance with section 21D of chapter 40 of the general laws. For purposes of non-criminal disposition, the enforcing person shall be any police officer of the town or the water superintendent or the superintendent’s designee. If a State of Water Supply Emergency has been declared the Water Commissioners may, in accordance with G.L. c. 40, s. 41A, shut off the water at the meter or the curb stop.

§ 220-12. Severability

The invalidity of any portion or provision of this by-law shall not invalidate any other portion or provision thereof.

§ 220-13. Controls on In-Ground Irrigation Systems

The Water Commissioners may regulate the registration, specifications, installation and monitoring of in-ground irrigation systems and appurtenances for all water users.

Consistent with the proposed Outdoor Water Use Bylaw, Article I, Section 7 of the Water Rules and Regulations shall be replaced in its entirety with the following:

7. Restriction on Use of Water

The Town reserves the right to restrict the use of water as it deems necessary to ensure an adequate supply of water for drinking and fire protection and to protect the quality and quantity of water in local aquatic habitats such as ponds, rivers and wetlands and to ensure compliance with the Water Management Act.

The restriction of water use shall be guided by the Drought Management Plan, incorporated herein as Appendix VII. The Water Commissioners, Water Director or Town Manager may declare a Restriction of Water Use as authorized in Chapter 220, Article II of the General Bylaws.

Declared Water Restrictions shall be progressive in nature based on drought conditions. Exceptions to the restrictions may be suspended as necessary to further reduce water use.

Outdoor water uses not subject to restrictions or bans are those required:

- (a) for health or safety reasons;
- (b) by regulation;
- (c) for the production of food and fiber;
- (d) for the maintenance of livestock; or
- (e) to meet the core functions of a business (for example, irrigation by golf courses as necessary to maintain tees and greens, or irrigation by plant nurseries or agricultural operations as necessary to maintain stock or establish new plantings, wash equipment to prevent damage and/or maintain performance, pest management and plant cooling).

During declared Water Restrictions, the following practices shall be permitted:

- (a) irrigation of public parks and recreation fields between the hours of 7:00 p.m. and 6:00 a.m.;
- (b) irrigation of lawns, gardens, flowers and ornamental plants by means of hand-held hose between the hours of 7:00 p.m. and 6:00 a.m.

During declared Water Restrictions the following practices shall be prohibited:

- (a) irrigation of lawns via any system other than hand held hose or bucket;
- (b) washing of vehicles, except to meet core function of a business as described in (e) above;
- (c) washing of exterior building surfaces, parking lots, driveways or sidewalks, except as necessary to apply paint, preservatives, stucco, pavement or cement; and
- (d) filling or refilling of swimming pools.

Further restrictions on outdoor water use beyond those detailed herein may be imposed as necessary.

The following outdoor water uses are subject to review and approval by the Town, through its Board of Water Commissioners or their designee:

- (a) irrigation to establish replanted or re-sodded lawn or plantings during the months of May and September; and
- (b) irrigation of newly planted lawns (seeded or sodded) in the current calendar year for homes or businesses newly constructed in the previous twelve months.

During a declared Water Ban, all outdoor water uses shall be prohibited.

The Town of Ipswich General Bylaws Chapter 220, Article II “Outdoor Water Use” and Massachusetts General Laws Chapter 165:11 and 111:171 are incorporated herein as Appendix I.

APPENDIX B

Water Department Pumping & Consumption Records

Ipswich Water Department Pumping Records

Gallons of water pumped per month, 1988 - 2018

	<u>2018*</u>	<u>2017*</u>	<u>2016**</u>	<u>2015**</u>	<u>2014**</u>	<u>2013</u>	<u>2012**</u>	<u>2011</u>	<u>2010**</u>	<u>2009</u>	<u>2008</u>	<u>2007*</u>	<u>2006</u>	<u>2005*</u>	<u>2004</u>	<u>2003</u>
January	29,872,136	27,660,508	26,419,668	24,912,218	26,536,735	23,782,440	25,314,300	28,818,172	26,272,300	26,378,300	29,591,000	27,566,800	27,621,000	28,552,800	30,591,500	31,661,300
February	26,026,669	26,810,240	25,626,272	23,369,376	23,553,773	22,026,764	22,453,412	25,100,228	23,953,200	23,289,900	26,634,900	24,991,300	24,854,700	26,230,000	28,052,500	28,727,900
March	30,452,899	30,119,032	26,582,616	26,924,116	25,724,115	24,887,760	25,008,944	27,196,878	25,278,800	26,442,500	28,717,000	28,448,291	28,488,800	29,797,700	29,112,900	31,460,000
April	29,559,023	30,750,976	29,189,876	29,532,532	27,492,639	25,857,068	28,554,760	27,592,876	27,509,890	27,187,200	30,050,400	26,825,400	30,803,800	30,528,500	30,479,600	30,331,800
May	36,817,991	35,652,404	36,166,364	36,755,328	34,022,961	31,796,968	30,917,340	34,571,784	35,476,332	36,435,300	37,029,800	34,414,920	34,405,791	33,861,400	38,612,500	37,885,900
June	36,392,668	33,719,136	37,273,096	34,970,156	34,604,119	29,491,961	29,400,716	36,877,768	36,321,800	32,117,100	37,768,100	38,456,500	35,035,800	37,775,000	38,858,900	36,868,100
July	36,725,105	35,776,608	37,313,292	36,721,456	33,545,710	34,783,500	36,757,672	41,407,904	45,446,156	31,720,100	37,020,700	39,645,200	39,716,900	43,941,400	40,967,500	46,408,100
August	34,851,026	34,615,444	32,509,564	36,513,860	32,279,386	34,633,600	34,561,408	38,340,748	38,789,579	36,722,800	34,881,700	42,101,500	40,073,700	47,969,400	39,522,100	40,542,500
September	30,507,465	32,499,236	26,887,104	32,166,784	29,783,250	30,679,764	28,241,484	33,413,588	31,490,161	31,584,000	30,669,200	34,891,600	32,629,200	38,613,400	34,951,900	36,363,200
October	30,932,521	30,072,012	26,844,740	28,475,140	27,396,802	28,770,850	27,883,564	30,939,316	29,883,854	28,558,800	27,283,700	29,848,200	30,237,100	29,978,600	31,389,800	32,352,100
November	28,215,469	27,147,640	25,657,896	26,254,788	25,500,248	26,403,134	27,531,596	28,075,836	27,215,510	25,352,000	24,408,000	26,665,400	27,218,300	29,426,100	27,340,400	29,413,900
December	29,028,374	28,760,560	28,492,720	26,356,488	26,828,674	26,754,279	25,014,924	25,863,904	29,026,106	26,747,000	27,474,010	28,462,000	28,451,800	28,724,300	28,603,700	31,589,800
Totals	379,381,346	373,583,796	358,963,208	362,952,242	347,268,412	339,868,088	341,640,120	378,199,002	376,663,688	352,535,000	371,528,510	382,317,111	379,536,891	405,398,600	398,483,300	413,604,600

	<u>2002**</u>	<u>2001**</u>	<u>2000</u>	<u>1999**</u>	<u>1998</u>	<u>1997</u>	<u>1996</u>	<u>1995</u>	<u>1994</u>	<u>1993</u>	<u>1992</u>	<u>1991</u>	<u>1990</u>	<u>1989</u>	<u>1988</u>
January	29,134,300	28,500,900	29,116,900	33,915,000	31,884,185	34,602,000	35,141,200	32,831,000	28,248,000	30,032,000	30,605,000	29,706,000	28,067,000	31,459,000	22,282,000
February	25,669,700	25,132,600	26,634,400	33,720,499	29,338,400	30,925,900	31,130,900	29,433,000	26,624,000	25,722,000	28,877,000	27,448,000	24,409,000	22,594,000	23,207,000
March	28,018,000	28,535,700	27,498,000	36,281,200	32,668,100	34,201,400	36,715,700	31,523,000	29,481,000	26,912,000	29,898,000	29,647,000	28,658,000	24,457,000	22,586,000
April	29,255,000	29,082,700	28,287,400	37,010,700	33,868,500	35,480,100	43,238,600	31,334,000	29,606,000	28,728,000	29,794,000	31,263,000	28,894,000	21,789,000	20,579,000
May	34,585,800	43,674,100	36,778,400	45,319,600	44,925,500	42,469,852	47,343,600	45,417,000	34,574,000	35,262,000	36,573,000	42,137,000	32,452,000	27,328,000	27,777,000
June	36,032,000	42,678,500	37,674,300	65,774,700	43,189,700	56,366,900	46,998,800	49,311,000	47,009,000	41,814,000	41,741,000	42,639,000	38,160,000	28,117,000	37,455,000
July	50,567,700	44,977,800	39,934,100	49,364,900	55,261,000	61,548,400	48,347,899	61,339,700	53,663,000	54,848,000	42,757,000	49,885,000	49,314,000	30,343,000	34,752,000
August	53,093,300	47,691,500	36,846,000	42,556,900	48,684,000	46,334,700	49,599,100	55,195,400	43,311,000	45,790,000	39,265,000	42,648,000	42,525,000	28,509,000	36,191,000
September	34,810,900	39,742,400	33,578,150	38,653,700	42,388,400	36,700,200	38,031,900	45,870,800	33,134,000	34,160,000	33,039,000	36,780,000	35,822,000	26,557,000	30,092,000
October	32,147,000	33,701,900	31,951,300	35,572,400	39,514,900	36,323,600	34,932,695	43,857,300	37,102,000	30,883,000	33,631,000	33,446,000	33,839,000	30,020,000	29,530,000
November	30,345,300	29,865,300	27,809,800	28,394,200	36,057,320	33,615,700	32,272,692	33,321,300	35,267,000	27,914,000	29,584,000	30,075,000	29,746,000	26,791,000	31,131,000
December	30,959,700	30,126,300	30,355,500	28,597,000	34,228,500	32,586,700	33,373,100	33,015,300	32,755,000	28,227,000	31,912,000	31,895,000	30,412,000	27,667,000	32,769,000
Totals	414,618,700	423,709,700	386,464,250	475,160,799	472,008,505	481,155,452	477,126,186	492,448,800	430,774,000	410,292,000	407,676,000	427,569,000	402,298,000	325,631,000	348,351,000

* Water restrictions

** Water ban

Year	Average Monthly Water Use (MGD)		Summer-to-Winter Water Use Ratio
	Summer May - September	Winter October - April	
1993	42,374,800	28,345,429	1.49
1994	42,338,200	31,297,571	1.35
1995	51,426,780	33,616,414	1.53
1996	46,064,260	35,257,841	1.31
1997	48,684,010	33,962,200	1.43
1998	46,889,720	33,937,129	1.38
1999**	48,333,960	33,355,857	1.45
2000	36,962,190	28,807,614	1.28
2001**	43,752,860	29,277,914	1.49
2002**	41,817,940	29,361,286	1.42
2003	39,613,560	30,790,971	1.29
2004	38,582,580	29,367,200	1.31
2005*	40,432,120	29,034,000	1.39
2006	36,372,278	28,239,357	1.29
2007*	37,901,944	27,543,913	1.38
2008	35,473,900	27,737,001	1.28
2009	33,715,860	26,279,386	1.28
2010**	37,504,806	27,019,951	1.39
2011	36,922,358	27,655,316	1.34
2012**	31,975,724	25,965,929	1.23
2013	32,277,159	25,497,471	1.27
2014**	32,847,085	26,147,569	1.26
2015**	35,425,517	26,546,380	1.33
2016**	34,029,884	26,973,398	1.26
2017*	34,452,566	28,760,138	1.20
2018*	35,058,851	29,155,299	1.20

* Water restrictions

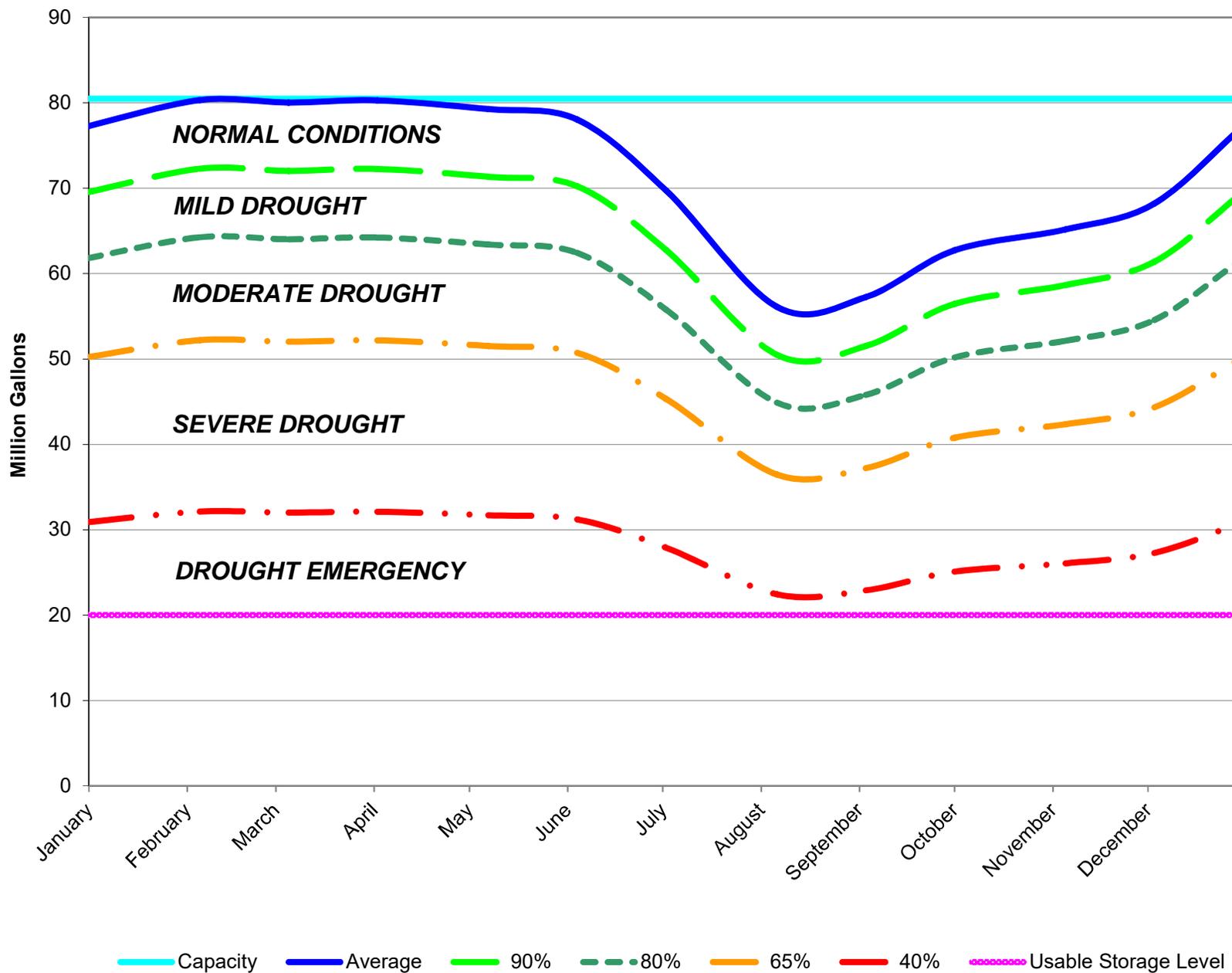
** Water ban

Average Summer-to-Winter Water Use Ratio 1993-2002: 1.41
Average Summer-to-Winter Water Use Ratio 2003-2018: 1.29

APPENDIX C

Reservoir System Storage Chart

Total Reservoir Storage



APPENDIX D
Precipitation Data

