

DROUGHT MANAGEMENT PLAN



*photo of Haggetts Pond
Andover's drinking water supply*

Andover, Massachusetts
Water Department – PWSID 3009000
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1.0 INTRODUCTION

Virtually every region of the United States has experienced drought and its adverse effects on public water supply systems. Even the relatively “water-rich” Commonwealth of Massachusetts, which under normal conditions receives between 40 and 50 inches of annual precipitation, is at risk of drought. Massachusetts’s droughts have ranged from extended periods of multi-year dry weather events such as experienced in the mid 1960’s to seasonal events such as the dry spring and summer of 1999, and the dry summer of 2010. History reinforces that climatic changes create uncertainty and risk to our water resources. Furthermore, the vulnerability of public water systems to drought is increasing as the population and water demands increase.

A Drought Management Plan (DMP) is a document that accomplishes the following, (1) defines the conditions under which a drought induced water emergency exists, and (2) specifies the actions that are to be taken in response. Drought indicators are parameters used to assess the status of water supplies. Some examples of indicators include: pumping capacity, storage tank elevations, reservoir levels, stream flow, groundwater levels and precipitation conditions. Drought stage triggers act as benchmarks to provide warning signals of impending water shortages; and, are developed using historical data that established water supply fluctuations distinguishing normal and water shortage conditions. Water restrictions that correspond with particular drought stages are then enforced to allow a predictable consistent response to water shortages or drought conditions.

This DMP approaches drought management recognizing that water supplies must be managed jointly along with water demands. Since drought is a natural phenomenon over which we have little, if any control it is necessary for resource planners to anticipate the occurrence of drought, consider the impacts of drought on our water supply system, and develop plans to mitigate the impacts of drought. The basic goal(s) of a drought management plan is to preserve essential public services and minimize the adverse impacts of a water supply emergency on the public’s health and safety, economic activities, environmental resources, and individual lifestyle.

2.0 OVERVIEW OF WATER SUPPLY

With the exception of a few houses using private wells, the Town of Andover's residents, businesses, and industry are served by the Town's municipal drinking water supply drawn from a combination of three surface water sources. Each of these sources is discussed below.

2.1 Haggetts Pond

Haggetts Pond represents Andover's major water source of water supply and storage. It is a 220-acre glaciated natural pond located southeast of the intersection of interstates Routes 93 and 495 in Essex County Andover, Massachusetts. The pond has a draw down capacity of 6 feet and a safe yield, defined as the amount of water that can be drawn during the severest drought on record, of 1.1 million gallons per day. The total watershed area of Haggetts Pond covers 1,422 acres.

2.2 Fish Brook

Fish Brook is a 5.25-mile long stream, which arises in wetlands near Haggetts Pond and from the ponds in Indian Ridge Country Club. Fish Brook flows to the Merrimack River, roughly parallel to Route 93. The mouth of the brook has been impounded to retain its flow and a pump station located at the impoundment delivers water through a 24-inch water line upstream to Haggetts Pond. The Fish Brook Pumping Station is treated as a reservoir without storage capacity. Water is available for capture, but not storage, and inflow to Fish Brook is represented by flow data from the Merrimack River. The Fish Brook Watershed area covers 2,450 acres.

2.3 Merrimack River

The Merrimack River is a major river that borders the Town of Andover on the northeast that is drainage for a 5,000 square mile watershed. Water is drawn from the Merrimack River, at the Fish Brook Station, and pumped into Haggetts Pond. This water makes up the remainder of the Town of Andover's average daily demand not supplied directly from Haggetts Pond.

3.0 DISTRIBUTION

Source water transferred from Fish Brook and the Merrimack River into Haggetts Pond is drawn into the Water Treatment Plant. The plant has a design capacity to treat 24 million gallons per day (mgd) of raw water, and an operational capacity of 18 mgd. The raw water is processed via physical and chemical treatments. The water treatment plant assures a safe and consistent quality product to benefit the individual lifestyles of each consumer. Following treatment, the finished water is distributed to three different storage locations in Town.

Andover currently has 14 million gallons of storage capacity for processed (or finished) water. Six million gallons of storage exists at the Bancroft storage tanks on Bancroft Road adjacent to the Bancroft School. Four million gallons of finished water is pumped to the Wood Hill Storage Tanks located off of Haggetts Pond Road, and 4 million gallons of storage is available in the two Prospect Tanks, located at the top of Ward Hill Reservation. Combined, these storage tanks provide water to meet the need of consumers throughout the Town of Andover. Refer to Figure 3-1 for a schematic of the distribution and storage facilities.

The volume of raw water withdrawn from the water supply and processed through the Water Treatment Plant during CY 2014 was 7.6 mgd or approximately 2.80 billion gallons for the year. The volume of treated water that was delivered through 250 miles of underground distribution system pipes to end users for CY 2014 was 7.1 mgd or approximately 2.6 billion gallons. During CY 2014, 55% of the town's water demand was for residential use, followed by 20% commercial and 19% industrial. The remaining 6% is used for municipal and other miscellaneous uses. The town's average per capita residential water use for calendar year 2014 was 75 gallons per day.



Figure 3-1. Schematic of Andover Water Division Distribution and Storage Facilities

4.0 DROUGHT INDICATORS

4.1 Water Supply

Andover's water supply is from three sources, Haggetts Pond, Fish Brook and the Merrimack River, with the pond serving as the primary storage reservoir. Analyses of the inflow and outflow of water can help to indicate drought conditions. Reservoir inflow is represented by precipitation, surface runoff, and ground water discharge; and in the case for Haggetts Pond, water that is pumped from the Fish Brook Station which represents flow from both Fish Brook and the Merrimack River. Outflow consists of withdrawals, evaporation and releases. Indicators of drought may include: Wet well level of the Fish Brook Pumping Station, and the level of Haggetts Pond. This is discussed further in Sections 7 and 8 of this document. The level of the wet well at Fish Brook Pumping Station is measured, recorded and reported continuously by the SCADA system.

4.2 Distribution/Demand

Seasonal variation should be considered, as the demand for water is lower in the months of November through April and higher during May through October. Indicators of drought would include the following: the raw water operations demand and the distribution storage capacity. This is discussed further in Sections 9 and 10 of this document. The raw water operations demand and the distribution storage volumes are measured, recorded and reported in real-time by the SCADA system.

4.3 Palmer Drought Index

The Palmer Index is a widely used scale for measuring drought conditions. It is based on soil moisture supply and demand and long-term records of temperature and precipitation. Normal weather has an index value of zero, in all seasons in any climatic region. Droughts have negative index values while wet periods have positive values. Consecutive negative values provide initial warning of a developing drought. Many communities use the Palmer Index to trigger phases of

their drought management plans. This is discussed further in Section 11 of this document; and the Palmer Drought Index is presented in Appendix B.

The plan's effectiveness is directly related to the frequency of monitoring indicator levels. Indicator levels should be monitored on a monthly basis during wet seasons and daily during dry seasons or periods of high demand to determine the actions and procedures for responding to a drought-related condition in advance of an actual emergency. Frequent monitoring will also lessen any perception that the utility's actions are ill considered or arbitrary. Notification of monitoring results must be made available to the appropriate utility manager and/or decision makers. Drought indicators including the pump station wet well level, storage tank capacity, and raw water operational demand are tracked in real-time using the plant's SCADA system. The Phase I watch levels are closely monitored and recorded. An example of the SCADA screen is shown in Figure 4-1.

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	LOW LIF	7 DAY	7 DAY	RUN	BAN	POND	BAN	W.H.	NR	WH	F.B.	F.B.	RIVER	NORTH	READING
	FLOW	CONS.	AVG	HRS.	% CAP	LEVEL	LEVEL	LEVEL	TOTAL	% CAP	LEVEL	FLOW	LEVEL	READING	READING
2															
3															
4	01-SEP-2011	7.947			97%	16.62	14.5	19.2	0.978	94%	12.88	8.18	0.00	0.472	0.506
5	02-SEP-2011	8.686			98%	16.63	14.7	19.8	0.912	97%	12.88	8.174	0.00	0.418	0.494
6	03-SEP-2011	8.686			96%	16.66	14.4	19.6	0.876	98%	12.86	8.174	0.00	0.386	0.490
7	04-SEP-2011	8.862			96%	16.90	14.3	19.9	0.785	98%	13.15	8.161	0.00	0.277	0.509
8	05-SEP-2011	8.873			95%	16.94	14.2	20.0	0.744	98%	13.14	8.110	0.00	0.233	0.511
9	06-SEP-2011	8.451			95%	16.97	14.2	19.7	0.992	97%	13.07	8.051	0.00	0.482	0.510
10	07-SEP-2011	7.385	8.413		96%	17.05	14.4	20.1	0.994	98%	13.04	8.018	0.00	0.484	0.510
11	08-SEP-2011	7.396	58.338		96%	17.07	14.4	19.9	0.990	98%	13.00	8.009	0.00	0.480	0.510
12	09-SEP-2011	6.998	56.651	8.093	94%	17.11	14.1	19.6	0.976	98%	12.95	8.022	0.00	0.471	0.505
13	10-SEP-2011	6.998	54.963	7.852	94%	17.12	14.1	19.6	0.956	98%	12.91	8.018	0.00	0.459	0.497
14	11-SEP-2011	7.279	53.380	7.626	95%	17.18	14.2	20.0	0.958	98%	12.88	8.026	0.00	0.454	0.504
15	12-SEP-2011	8.338	52.864	7.552	94%	17.17	14.1	19.7	0.794	97%	12.86	8.026	0.00	0.280	0.514
16	13-SEP-2011	8.850	53.263	7.609	94%	17.30	14.1	19.8	0.910	97%	12.93	7.992	0.00	0.392	0.518
17	14-SEP-2011	9.201	55.080	7.869	98%	17.44	14.7	0.0	1.028	0%	12.99	7.849	0.00	0.508	0.520
18	15-SEP-2011	9.225	56.908	8.130	95%	17.43	14.3	0.0	1.018	0%	13.14	6.152	0.00	0.511	0.507
19	16-SEP-2011	8.463	58.374	8.339	95%	17.42	14.2	0.0	0.987	0%	13.15	4.857	0.00	0.490	0.497
20	17-SEP-2011	7.654	59.030	8.433	95%	17.42	14.3	19.8	0.870	97%	13.10	4.844	0.00	0.370	0.501
21	18-SEP-2011	7.889	59.640	8.520	96%	17.35	14.4	20.0	0.996	98%	13.05	1.827	0.00	0.494	0.502
22	19-SEP-2011	8.346	59.628	8.518	90%	17.44	13.5	18.8	0.992	92%	13.18	0.000	0.00	0.495	0.498
23	20-SEP-2011	8.346	59.124	8.446	92%	17.52	13.8	19.4	0.878	95%	13.32	0.000	0.00	0.376	0.502
24	21-SEP-2011	8.334	58.256	8.322	92%	17.47	13.7	19.6	0.908	96%	13.18	0.000	0.00	0.404	0.504
25	22-SEP-2011	8.334	57.366	8.195	90%	17.43	13.6	19.5	0.904	96%	13.14	0.000	0.00	0.405	0.498
26	23-SEP-2011	7.478	56.381	8.054	90%	17.42	13.4	20.1	0.821	99%	13.11	0.000	0.00	0.321	0.500
27	24-SEP-2011	6.611	55.338	7.905	97%	17.41	14.6	19.7	0.773	97%	13.08	0.000	0.00	0.273	0.500
28	25-SEP-2011	6.670	54.119	7.731	94%	17.34	14.1	20.0	0.781	98%	13.04	0.000	0.00	0.281	0.500
29	26-SEP-2011	7.607	53.380	7.626	93%	17.31	13.9	19.0	0.781	93%	13.02	0.000	0.00	0.281	0.499
30	27-SEP-2011	7.607	52.642	7.520	92%	17.35	13.7	19.7	0.786	96%	13.17	0.000	0.00	0.285	0.501
31	28-SEP-2011	7.631	51.938	7.420	93%	17.35	13.9	19.8	0.790	97%	13.17	0.000	0.00	0.285	0.505
32	29-SEP-2011	7.631	51.235	7.319	90%	17.41	13.5	0.0	0.714	0%	13.16	0.000	0.00	0.208	0.506
33	30-SEP-2011	7.138	50.895	7.271	98%	17.43	14.7	0.0	0.733	0%	10.28	0.000	0.00	0.208	0.524
34			44.284	7.381	94%	17.47	14.1	0.0	0.796	0%	10.28	0.000	0.00	0.270	0.526
35															
36															
37	TOTAL	MAX	AVG			AVG			TOTAL		AVG	TOTAL	AVG		
38		238.933	59.640	7.962		17.230			27.422		12.874	130.492	0.000	11.754	15.667
						MIN							MIN		

Sheet1 New Sheet / Successful History definition

Figure 4-1. SCADA Screen

5.0 DROUGHT STAGES AND RESPONSE

5.1 Description of Drought Stages

A series of four stages of drought management will be used to guide the Town of Andover Water Division through the levels of action needed. These are based on the severity of a particular water shortage or drought. A drought stage level can change in one of three ways after it has been reached. If conditions reach the criteria for the next drought level, the severity will be increased. If conditions persist, but do not reach the next level, the drought response will remain constant. If conditions improve, the severity can be reduced based on either site-specific information or on progress toward returning to normal. Mitigation measures are described in more detail in the following section.

American Water Works Association (AWWA) recommends managing water demand during a water shortage as a staged or phased approach, with increasing levels of savings in each successive phase. The actions taken in Phase I are in anticipation of the drought continuing and having the community benefit from increased carryover. The subsequent phases are in response to increasing supply shortages. Phase II uses some mandatory measures, and Phase IV includes extensive restrictions that would be initiated in extreme circumstances. Efforts made to reduce water consumption in the first three Phases will save residents and businesses from the potential hardships of extreme water shortages.

DROUGHT STAGE	LEVEL	RESPONSE ACTION
Phase I	Watch	Initiate Public Awareness of Drier than Normal Conditions and Encourage Voluntary Conservation by Largest Users, Restrict Outside Water Use at Municipal Facilities.
Phase II	Warning	Continue Public Awareness of Drier than Normal Conditions and Encourage Voluntary Conservation of All Users. Mandatory Conservation for Targeted Largest Users.
Phase III	Emergency	Mandatory Restrictions with By Law in Effect.
Phase IV	Critical	Maximum Mandatory Restrictions.

Phase I (Watch) involves the voluntary conservation where the municipal's 25 largest water users will be contacted and asked to implement their conservation practices. A list of major water users is updated annually. Also, restrict outside water use at municipal facilities. The demand reduction goal in this Phase is 10%-15% water use.

Phase II (Warning) implements a mandatory restriction of the water system's 25 largest users in conjunction with an appeal for voluntary conservation to all public users. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The demand reduction goal in this Phase is 15%-25% water use.

Phase III (Emergency) implements the Town of Andover Water Use Restriction By-Law adopted by the Town of Andover during an Annual Town Meeting held on April 29, 2002. The by-law establishes enforceable limitations on the use of municipal water during periods of water shortages or drought conditions. The purpose of the by-law is to protect, preserve and maintain public health, safety and welfare when water supply conservation is mandated or water supply emergency has been declared. The by-law is included in Appendix A. The demand reduction goal in this Phase is 25%-40% water use.

Phase IV (Critical) of the DMP implements maximum response to a water supply emergency. All Phases of the Drought Management Plan for conservation measures and restrictions are intensified. The by-law will enforce maximum limitations on municipal water use and emergency public agency actions will commence. The demand reduction goal in this Phase is greater than 40% water use.

5.2 Public Education

Public education and outreach during a water supply shortage is a critical component of the drought management plan. The dissemination of information regarding the existing water supply shortage and current water demand will help the customers understand the need to curtail water usage so that water-use reduction goals can be achieved. Keep in mind that the water supply

situation is unpredictable and may change month-to-month. Even as precipitation increases, the effect on the water supply may not be immediate.

Initially, the Town Manager and the Assistant Town Manager will be notified by the Water Division of the need to implement the Drought Management Plan, what actions will be taken, including a request to all municipal users to curtail water consumption. A decrease in municipal usage, such as restricting outdoor watering sets an example for the public and promotes cooperation and commitment. Secondly, industry and retail customers will be asked to reduce their water usage. Frequent briefings to the news media; including postings on the town website, public service announcements, postings on electronic display boards positioned on main roads in town, and postings in the local newspapers will be made to ensure timely and accurate communication. Appeals to the general public for water conservation will be made on a regular basis, with updates on the situation of the water supply, proposed actions and actions already taken to mitigate supply shortages, and how well customers are meeting the intended goals.

5.3 Enforcement

Enforcement of the water use restrictions put in place based on Phase III or Phase IV of the Drought Stages will be in accordance with Chapter 9 of the Water Restriction By-Law, which states the following, “any person violating this by-law shall be subject to a warning for the first offense and thereafter shall be liable to the Town in the amount of \$50 for the second violation and \$100 for each subsequent violation...”

5.4 Reduction in Drought Levels

As actual and forecasted supply conditions improve, the Town may move to a lower Drought Stage Phase, or return to “normal use.” The public and water customers will be notified of current drought conditions and the reduction in drought levels. A given drought action level can change when the conditions that led to the specific emergency have ended.

6.0 DROUGHT TRIGGERING LEVELS

6.1 Fish Brook Pumping Station

Water that is pumped from the Fish Brook Station represents flow from both Fish Brook and the Merrimack River. The various phases of the drought management plan would be triggered based on the wet well level (measured in feet) of the pump station. The typical/normal operating range of the Fish Brook Pumping Station wet well is between 10.0 and 12.5 feet. See Figure 6-1.

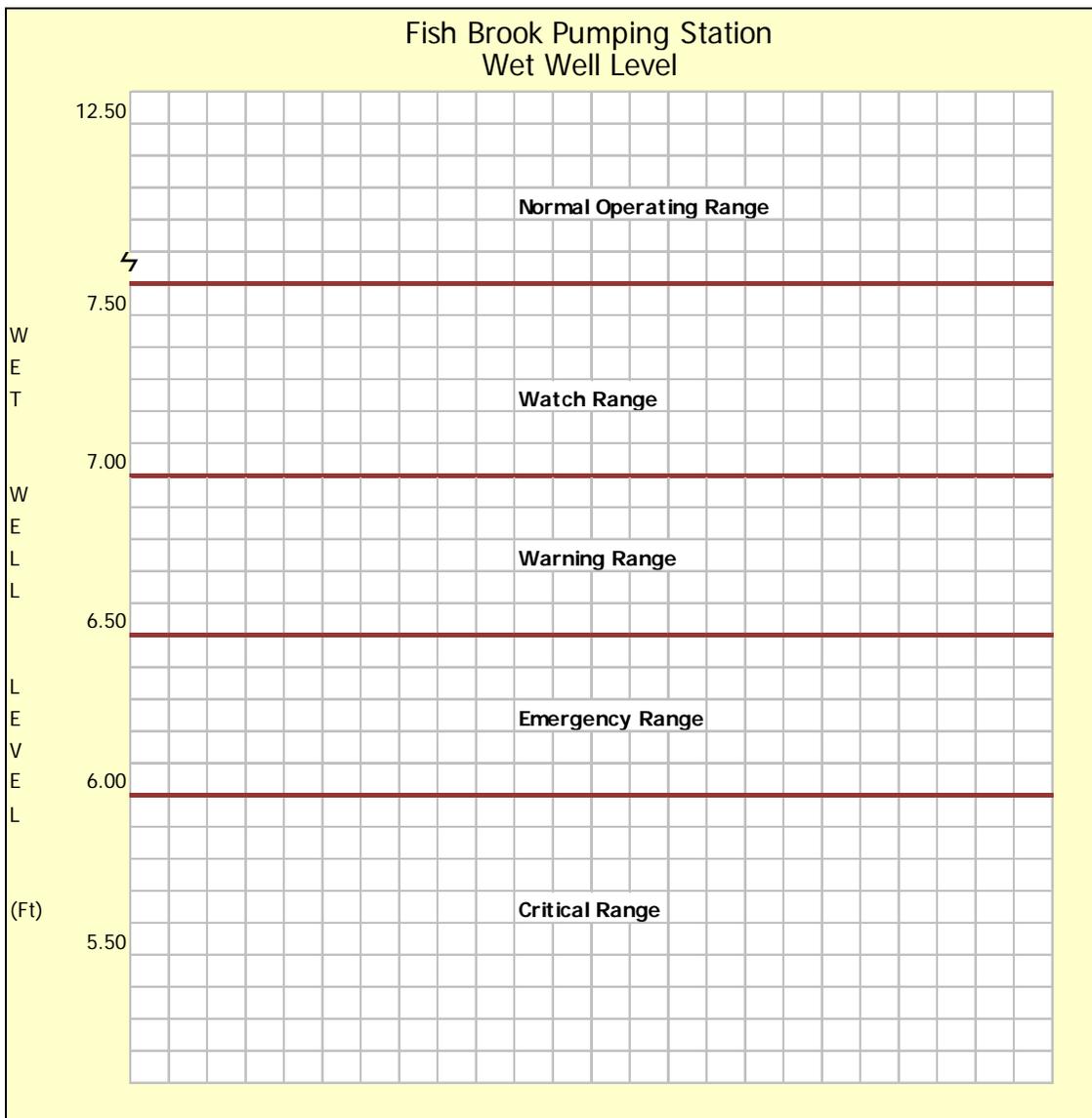


Figure 6-1. Drought Indicator: Fish Brook Pumping Station Wet Well Level

Fish Brook Pumping Station		
Phase	Level	Trigger Level (5 day consecutive), ft
Phase I	Watch	7.1 – 7.6
Phase II	Warning	6.6 – 7.0
Phase III	Emergency	6.0 – 6.5
Phase IV	Critical	Less than 6.0

6.2 Haggetts Pond Reservoir

Haggetts Pond is full at 117.6 ft (elevation) and the level should not drop below 113.5 ft (elevation) according to the engineering prints for the low lift flow. The various phases of the drought management plan would be triggered based on the level (measured in feet) of the reservoir. See Figure 6-2.

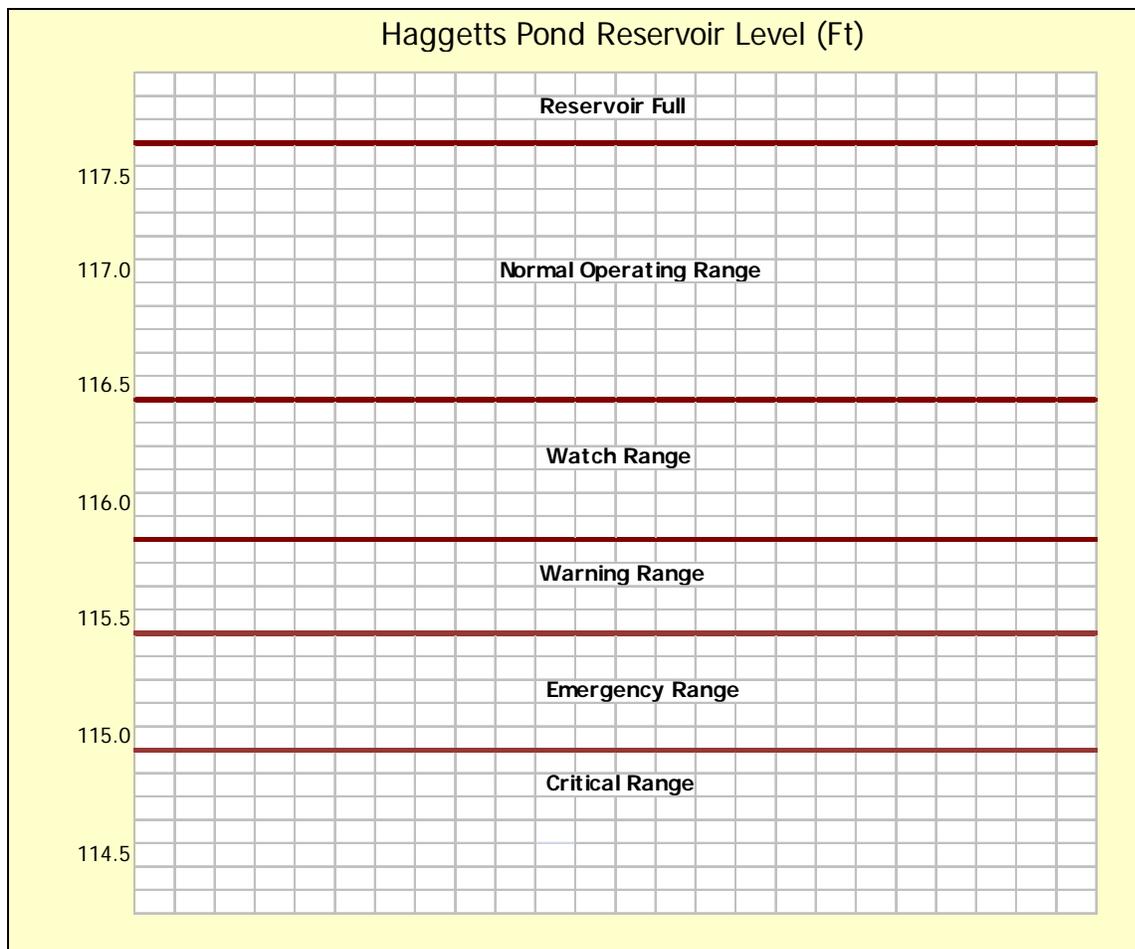


Figure 6-2. Drought Indicator: Haggetts Pond Reservoir Level

Haggetts Pond Reservoir		
Phase	Level	Trigger Level (5 day consecutive), ft
Phase I	Watch	115.9 – 116.4
Phase II	Warning	115.5 – 115.8
Phase III	Emergency	115.0 – 115.4
Phase IV	Critical	Less than 115.0

6.3 Raw Water Operations Demand

The average daily water volume pumped by the low lift pumps at the water treatment plant is 7.6 mgd. A daily peak volume of raw water pumped during the warmer months (May to September) may be as high as 14 mgd. The various phases of the drought management plan would be triggered based on the demand for raw water to be pumped at the water treatment plant for seven consecutive days. Refer to Figure 6-3.

Raw Water Operations Demand		
Phase	Level	Trigger Level (5 day consecutive), mgd
Phase I	Watch	12.5 – 13.1
Phase II	Warning	13.2 – 13.9
Phase III	Emergency	14.0 – 14.9
Phase IV	Critical	15.0 - >

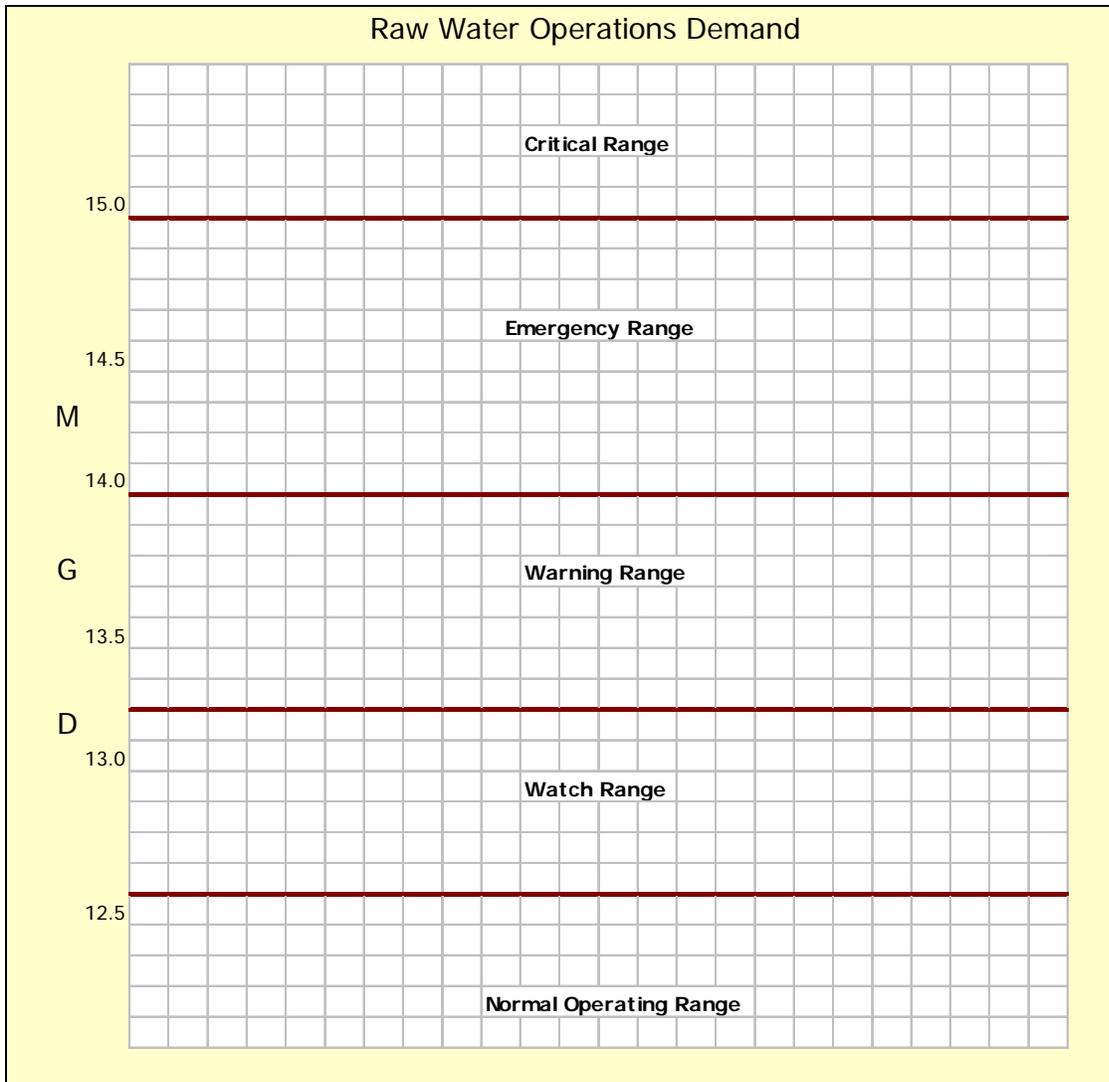


Figure 6-3. Drought Indicator: Raw Water Operations Demand

6.4 Distribution Storage Capacity

Andover currently has 14 million gallons of storage capacity for processed (or finished) water. Combined, these storage tanks provide water to meet the need of consumers throughout the Town of Andover. Six million gallons of storage exists at the Bancroft Storage Tanks. Four million gallons of finished water is pumped to the two Wood Hill Storage Tanks, and 4 million gallons of storage is available in the two Prospect Tanks.

Figure 6-4 illustrates the drought trigger level for the entire distribution storage capacity of Andover’s water system. Response actions to each Phase of the drought management plan would be triggered when plant operations cannot maintain the percentage of distribution storage for three consecutive days.

Distribution Storage Capacity for Entire System		
Phase	Level	Trigger Level (% full for 3 consecutive days)
Phase I	Watch	94.0 – 90.1
Phase II	Warning	90.0 – 88.1
Phase III	Emergency	88.0 – 85.1
Phase IV	Critical	Less than 85.0

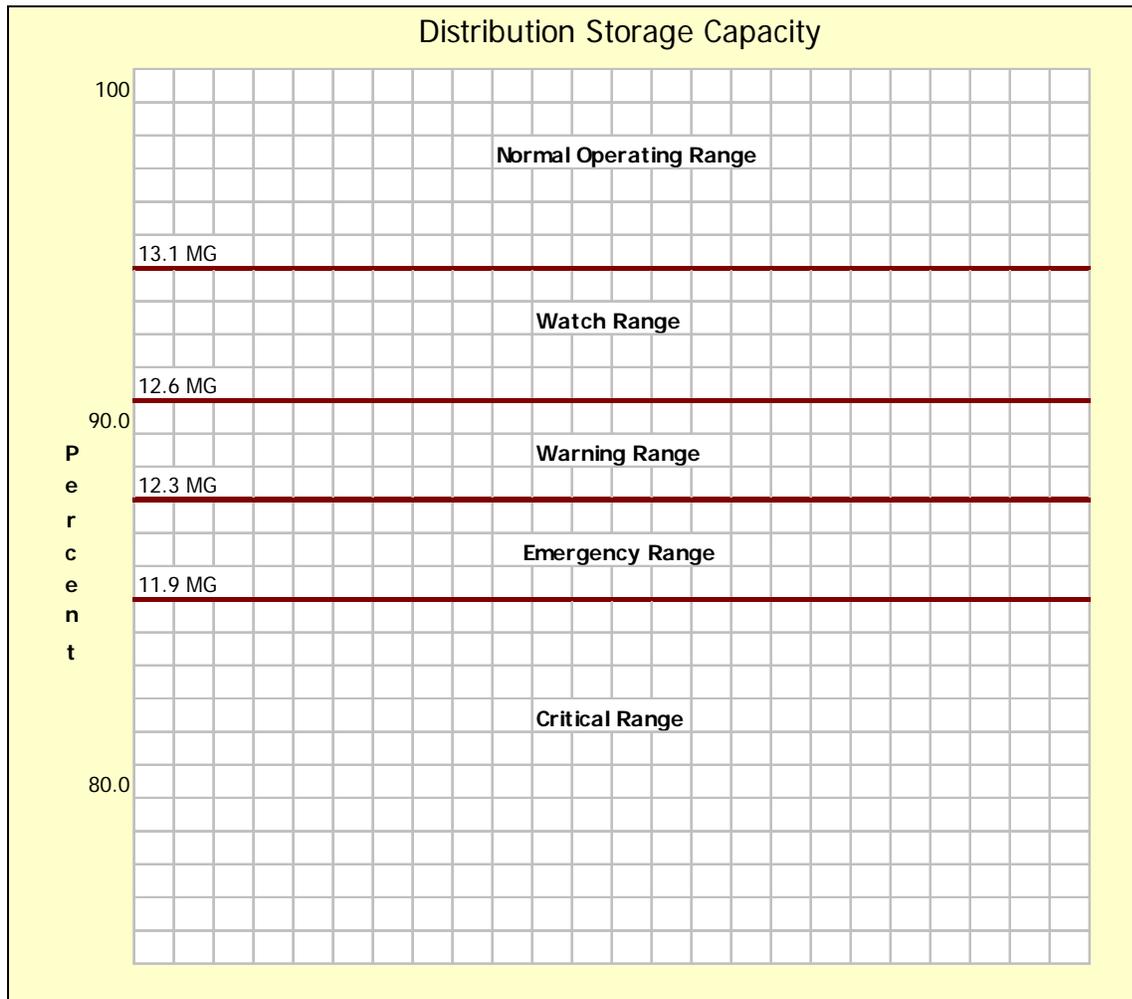


Figure 6-4. Drought Indicator: Distribution Storage Capacity for Entire System

There are, however, three pressure zones that make-up the entire distribution capacity: Bancroft Storage Reservoir, Wood Hill Storage Tanks and the Prospect Storage Tanks. A problem with storage capacity in any of these three zones could trigger response actions for the drought management plan. There is a critical level (corresponding to volume of finished water in each tank) that must be maintained for each storage tank. This is detailed in the table below. Phase II (Warning) response of the DMP is immediately triggered if the finished water level falls below this level for any one of the storage tanks, for three consecutive days. Phase II implementation includes a mandatory restriction of the water system’s 25 largest users in conjunction with an appeal for voluntary conservation to all public users. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The goal in Phase II is a 15%-25% reduction in water use.

Storage Tank	Critical Tank Level
Bancroft Storage Reservoir	11 feet (for 3 consecutive days)
Wood Hill Storage Tanks	15 feet (for 3 consecutive days)
Prospect Storage Tanks	10.5 feet (for 3 consecutive days)

6.5 Palmer Drought Index

The Palmer Drought Index is calculated based on precipitation and temperature data, as well as the local available water content of the soil. It is useful as a drought monitoring tool and may be used to trigger actions associated with Drought Contingency Plans by providing decision makers with a measurement of the abnormality of recent regional weather. It provides an opportunity to place current conditions in historical perspective while providing spatial and temporal representations of historical droughts. The objective of the index is to provide measurements of moisture conditions that are standardized to comparisons between regional locations and months of the year. Weekly index values are available on the Climatic prediction Center website at <http://www.drought.gov/drought/content/products-current-drought-and-monitoring-drought-indicators/palmer-drought-severity-index>

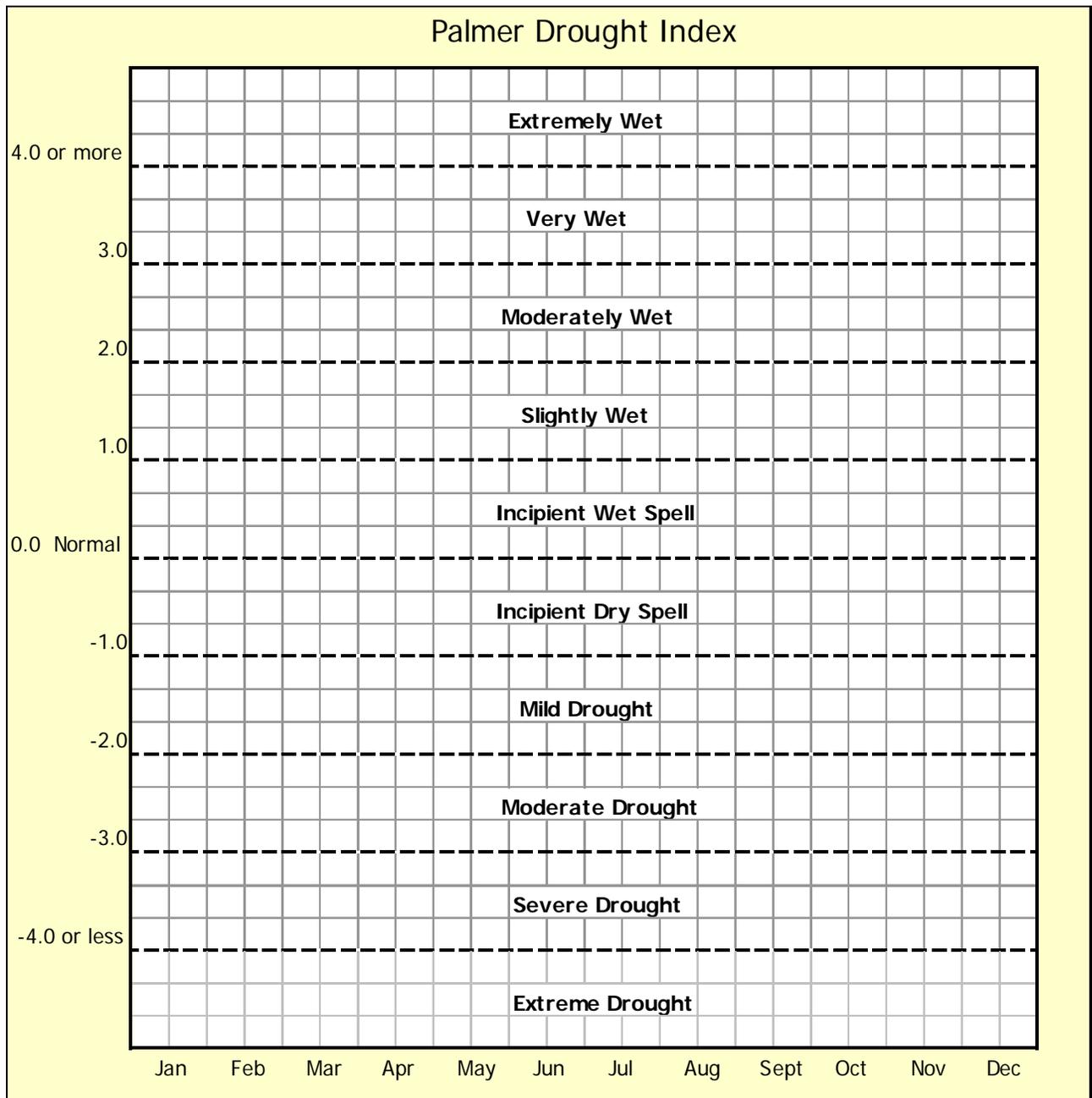


Figure 6-5. Drought Indicator: Palmer Drought Index

7.0 PLAN ASSESSMENT

As with all aspects of a drought plan, the assessment criteria for conservation and restriction measures must be updated as the utility gains actual experience with the effectiveness of measured implementation.

The DMP is designed for the Water Division to serve as a guideline for levels of action needed to respond to a particular water shortage or drought condition. In any voluntary or mandatory water use curtailment, equity in enforcement of the water reduction goals is of real concern to consumers. For this reason, everything possible must be done to eliminate any perception of inequity in the program. Enforcement must be directed toward achieving the goals of the DMP. It is also important to emphasize that the Water Division and other Town Departments should set a positive example by complying with water use restrictions and taking all reasonable measures to reduce water use during all phases of the plan.

Appendix A

Water Restriction By-Law

CODE OF THE TOWN OF ANDOVER MASSACHUSETTS, v20 Updated 08-30-2008

PART II BY-LAWS

Article XV, WATER

Article XV, WATER

[HISTORY: Adopted by the Town of Andover 4-29-2002 Annual Town Meeting, Art. 40. Amendments noted where applicable.]

§ 1. Authority.

This by-law is adopted by the Town under its police powers to protect public health and welfare and its powers under Massachusetts General Laws Chapter 40, Section 21 et seq. and implements the Town's authority to regulate water use pursuant to Massachusetts General Laws Chapter 41, Section 69B. This by-law also implements the Town's authority under Massachusetts General Laws Chapter 40, Section 41A, conditioned upon a declaration of water supply emergency issued by the Massachusetts Department of Environmental Protection.

§ 2. Purpose.

The purpose of this by-law is to protect, preserve and maintain public health, safety and welfare whenever there is in force a state of water supply conservation or state of water supply emergency by providing for enforcement of any duly imposed restrictions, requirements, provisions or conditions imposed by the Town or by the Massachusetts Department of Environmental Protection.

§ 3. Definitions.

As used in this by-law, the following terms shall have the meanings indicated:

DIRECTOR -- The Director of Public Works for the Town of Andover.

PERSON -- Any individual, corporation, trust, partnership or association, or other entity.

PUBLIC WATER SUPPLY SYSTEM -- The Andover municipal water supply system withdrawing water from Haggetts Pond.

STATE OF WATER SUPPLY CONSERVATION -- A state of water supply conservation declared by the Town pursuant to § 4 of this by-law.

STATE OF WATER SUPPLY EMERGENCY -- A state of water supply emergency declared by the Massachusetts Department of Environmental Protection under Massachusetts General Laws Chapter 21G, Sections 15 through 17.

WATER USERS OR WATER CONSUMERS -- All public and private users of the Town's public water system, irrespective of any person's responsibility for billing purposes for water used at any particular facility/location.

§ 4. Declaration of state of water supply conservation.

The Town, through the Board of Selectmen, may declare a state of water supply conservation within the Town's public water supply system upon a determination by the Director that a shortage of water exists and conservation measures are appropriate to ensure an adequate supply of water to all water consumers. Public notice, of a state of water supply conservation shall be given under § 6 of this by-law before it may be enforced.

§ 5. Restricted water uses.

A declaration of a state of water supply conservation may include one or more of the following restrictions, conditions or requirements limiting the use of water either Town-wide or as limited by the Selectmen as necessary to protect the public water supply. The applicable restrictions, conditions or requirements shall be included in the public notice required under § 6.

1. Outdoor water use hours: Outdoor water use by water users is permitted only during daily periods of low demand, at night or early morning.
2. Odd/even day outdoor water use: Outdoor water use by water users with odd-numbered addresses is restricted to odd numbered days. Outdoor water use by water users with even-numbered addresses is restricted to even-numbered days.
3. Outdoor water use ban: Outdoor water use by water users is prohibited.
4. Filling swimming pools: Filling of swimming pools is prohibited.
5. Automatic sprinkler use: The use of automatic sprinkler systems is prohibited.

§ 6. Public notification of state of water supply conservation.

Notification of any provision, restriction, requirement or condition imposed by the Town as part of a State of Water Supply Conservation shall be published in a newspaper of general circulation within the Town, or by such other means reasonably calculated to reach and inform all users of Town water of the state of water supply conservation. Any restriction imposed under § 5 shall not be effective until such notification is provided. Notification of the State of Water Supply Conservation shall also be simultaneously provided to the Massachusetts Department of Environmental Protection.

§ 7. Termination of state of water supply conservation; notice.

A state of water supply conservation may be terminated by vote of the Board of Selectmen upon a determination that the water supply shortage no longer exists. Public notification of the termination of a state of water supply conservation shall be given in the same manner required by § 6.

§ 8. State of water supply emergency; compliance with DEP orders.

Upon notification to the public that the Massachusetts Department of Environmental Protection has issued a state of water supply emergency, no person shall violate any provision, restriction,

requirement or condition or any order approved or issued by the Department intended to bring about an end to the state of water supply emergency.

§ 9. Violation and penalties.

Any person violating this by-law shall be subject to a warning for the first offense and thereafter shall be liable to the Town in the amount of \$50 for the second violation and \$100 for each subsequent violation, which shall inure to the Town for such uses as the Board of Selectmen may direct. Fines shall be recovered by indictment, or on complaint before the District Court, or by noncriminal disposition in accordance with Section 21D of Chapter 40 of the provisions of the Massachusetts General Laws. For purposes of noncriminal disposition, the enforcing person(s) shall be any police officer of the Town of Andover. Each day of violation shall constitute a separate offense.

§ 10. Severability.

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

Appendix B

Palmer Drought Severity Index

The Palmer Index was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index.

The Palmer Index is most effective in determining long term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought. At present, Texas, eastern New Mexico and Georgia are at a minus 4.0 point.

The Palmer Index can also reflect excess rain using a corresponding level reflected by plus figures; i.e., 0 is normal, plus 2 is moderate rainfall, etc. At present, South Dakota and sections of New England are at a plus 4.0 level.

The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. The negative is that it is not as good for short term forecasts, and is not particularly useful in calculating supplies of water locked up in snow, so it works best east of the Continental Divide.

For weekly monitoring of Palmer Drought index go to:

Weekly maps: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring

Palmer Classifications	
4.0 or more	extremely wet
3.0 to 3.99	very wet
2.0 to 2.99	moderately wet
1.0 to 1.99	slightly wet
0.5 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.5 to -0.99	incipient dry spell
-1.0 to -1.99	mild drought
-2.0 to -2.99	moderate drought
-3.0 to -3.99	severe drought
-4.0 or less	extreme drought

