



STAFF SUMMARY

TO: Board of Directors
FROM: Frederick A. Laskey, Executive Director 
DATE: January 18, 2017
SUBJECT: Report on 2016 Water Use Trends and Drought Status

COMMITTEE: Water Policy & Oversight

Carolyn Fiore, Deputy Chief Operating Officer
Daniel Nvule, Senior Program Manager
Stephen Estes-Smargiassi, Director, Planning
Preparer/Title

X INFORMATION
VOTE


Michael J. Hornbrook
Chief Operating Officer

While the severe drought has continued into the winter, Quabbin storage volumes have stabilized at just under 80 percent, leaving the MWRA system in Below Normal status. Even if the driest conditions seen since the creation of Quabbin were to occur over the next 12 months, the system is unlikely to drop into Drought Warning status. Adequate supply exists in Quabbin and Wachusett Reservoirs to meet the needs of MWRA fully and partially supplied water communities and also, if needed, to continue to augment the supplies of some of the adjacent stressed communities. While no water use restrictions are required for MWRA fully supplied customers, MWRA has been and will continue to urge consumers to use water wisely and is continuing to provide conservation information to communities and customers. Despite the drought, water use in 2016 was up only slightly over 2015, with total sales up by only 2.1 percent. Within the metropolitan area, excluding emergency sales to Cambridge, total sales were actually down by 0.4 mgd (0.2 percent) showing that customers have been responding to regional and statewide drought messaging.

RECOMMENDATION:

For information only. Each January, staff provide the Board with a review of the previous year's water use data and discuss trends.

DISCUSSION:

Despite the severe drought, Calendar Year 2016 water use and reservoir withdrawals were only slightly higher than in 2015. The largest component of the increase was the drought emergency supplies for Cambridge and Worcester. Base or indoor demand also seemed to increase very slightly, possibly due to the improving regional economy and growing population out-pacing ongoing incremental improvements to water efficiency from appliances and fixtures.

Water Consumption by MWRA Communities

Calendar Year 2016 water consumption by all MWRA communities of 200.7 million gallons per day (mgd) was about 4.2 mgd (2.1 percent) higher than 2015, as shown on Figure 1 on the next page. Included is a combined increase of 4.6 mgd by Cambridge and Worcester which normally

do not purchase MWRRA water; demand by all communities excluding Cambridge and Worcester was actually down by 0.4 mgd (0.2 percent)

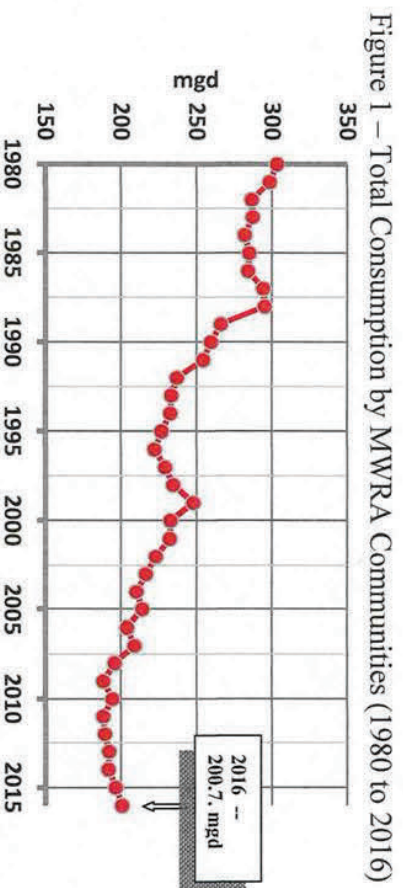
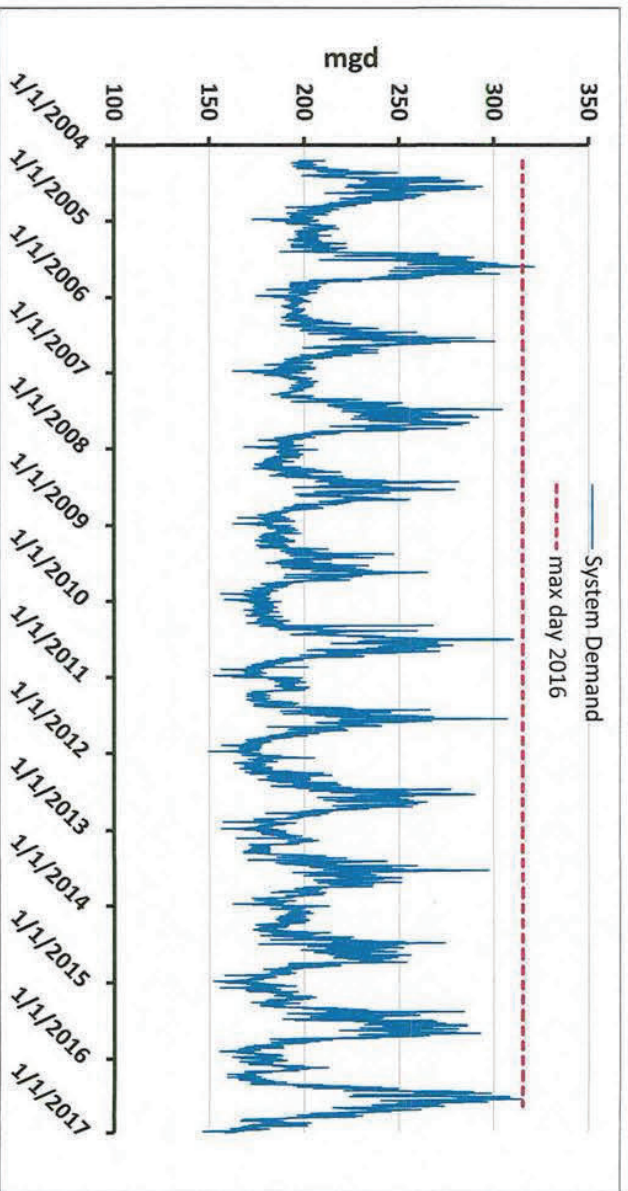


Figure 1 – Total Consumption by MWRRA Communities (1980 to 2016)

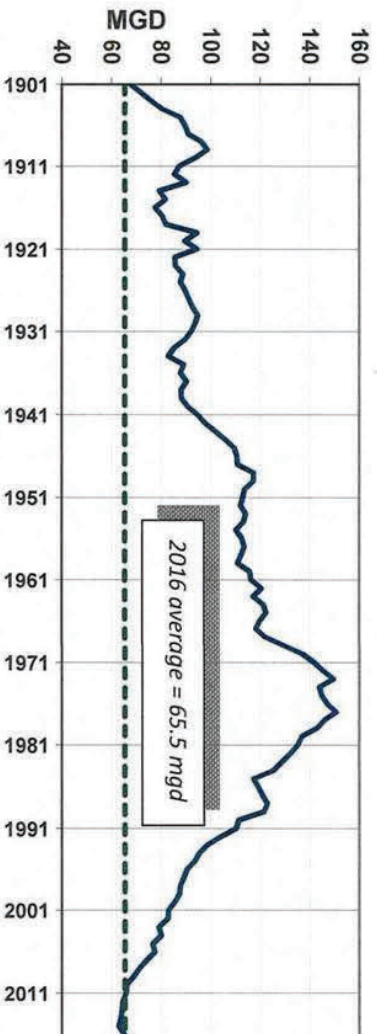
System wide, 2016 had a maximum day demand of 315.3 mgd (7.6 percent higher than 2015) on July 26th. Not since August 2005 has the maximum day demand been this high. At the opposite extreme, Christmas day had the lowest demand for the year at 146.84 mgd setting a record for the lowest single day demand since the creation of the MWRRA. Figure 2 below shows daily system demand.

Figure 2: Daily System Demand



Demand from MWRA's largest customer, Boston Water and Sewer Commission (BWSC), was 65.5 mgd, which is slightly higher than last year by about 0.2 mgd (0.3 percent), but still at a level not seen since before 1900 (See Figure 3 below).

Figure 3: Boston Water Use (1900-2016)



Base or Indoor Demand

Over time, water use reductions have been in both base (or indoor) use, defined as water use from November to March, and outdoor use (or seasonal use), defined as the increase over the base demand during the irrigation season of May to September. Indoor water use has dropped substantially over the past several decades. In reports prior to 2014, base use was shown as decreasing 1.8 percent (3 mgd) per year from 1999 to 2013 using a straight line projection. In 2014, staff refined the methodology for estimating base use in order to lessen the bias of older data and the more refined trend analysis showed that there might be three separate regimes¹. As can be seen on Figure 4 on the next page, the results now show two decline regimes: 1999 to 2006 and 2007 to 2009 (steeper decline, corresponding to the economic recession). A third regime, post recession, still shows a flattened or possibly slight increase in demand with the addition of this year's data. The long-term trend of reductions in base use is believed to be generally due to increases in the efficiency of water use in homes and businesses as water-saving technologies continued to increase market share and consumers reacted to price increases, as well as reduced pipeline leaks. That decreasing trend is counter balanced by increasing use due to the improving regional economic and population growth.

¹ A local regression (LOESS) was used that assigns less weight to data that is further away from the local point.

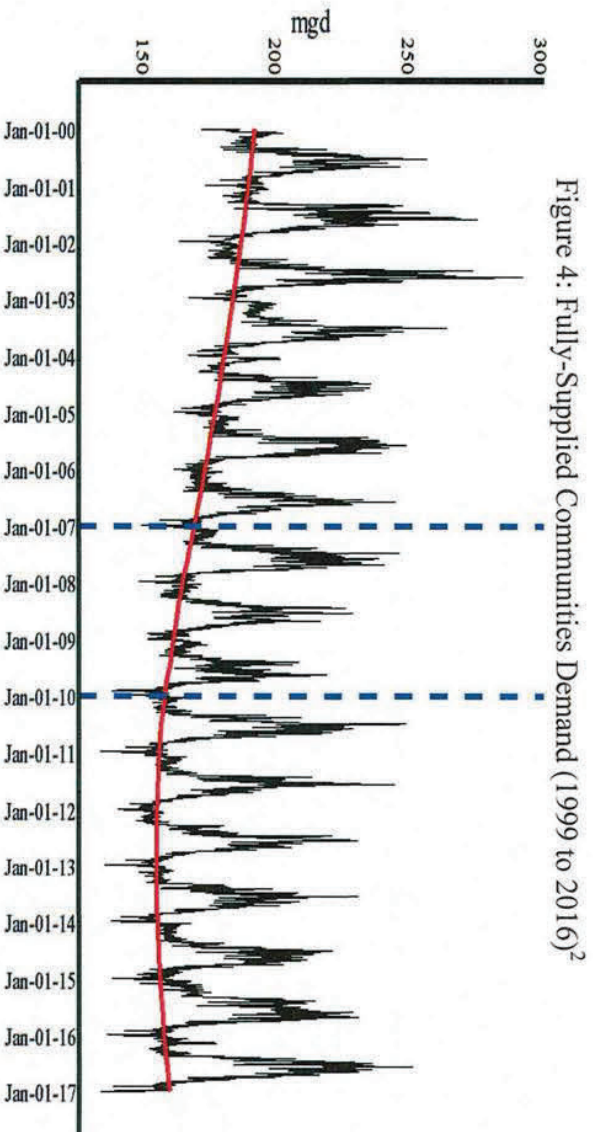


Figure 4: Fully-Supplied Communities Demand (1999 to 2016)²

Seasonal or Outdoor Demand

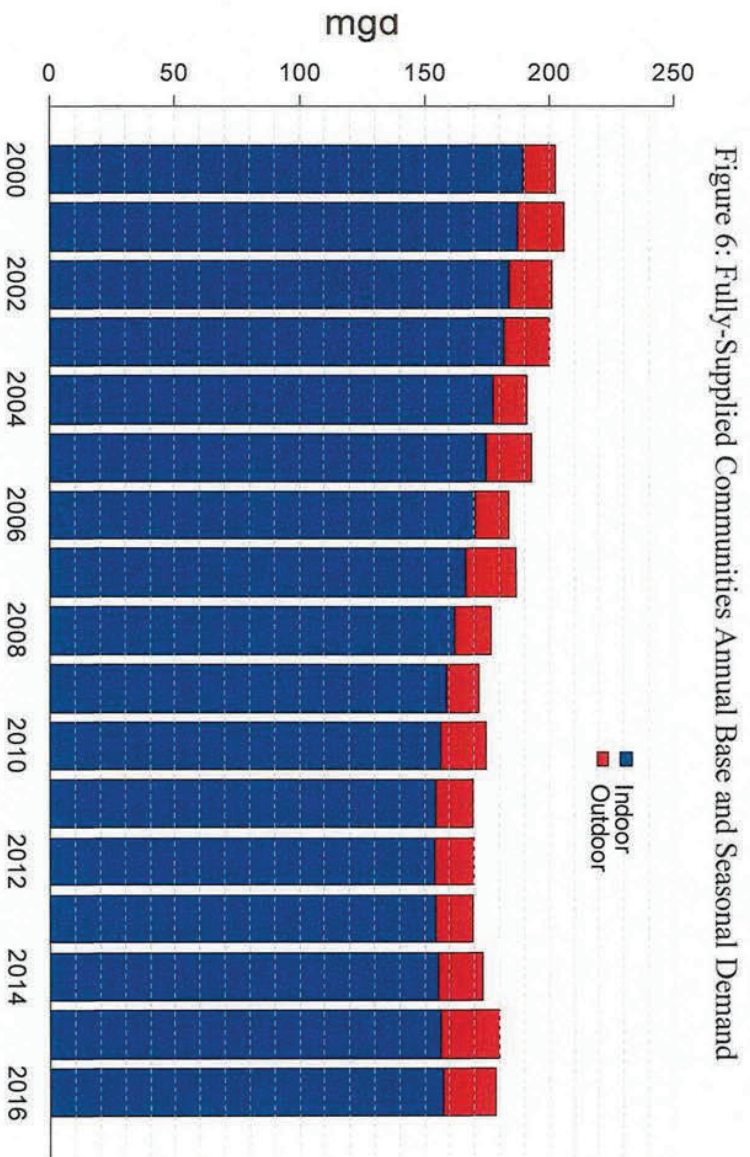
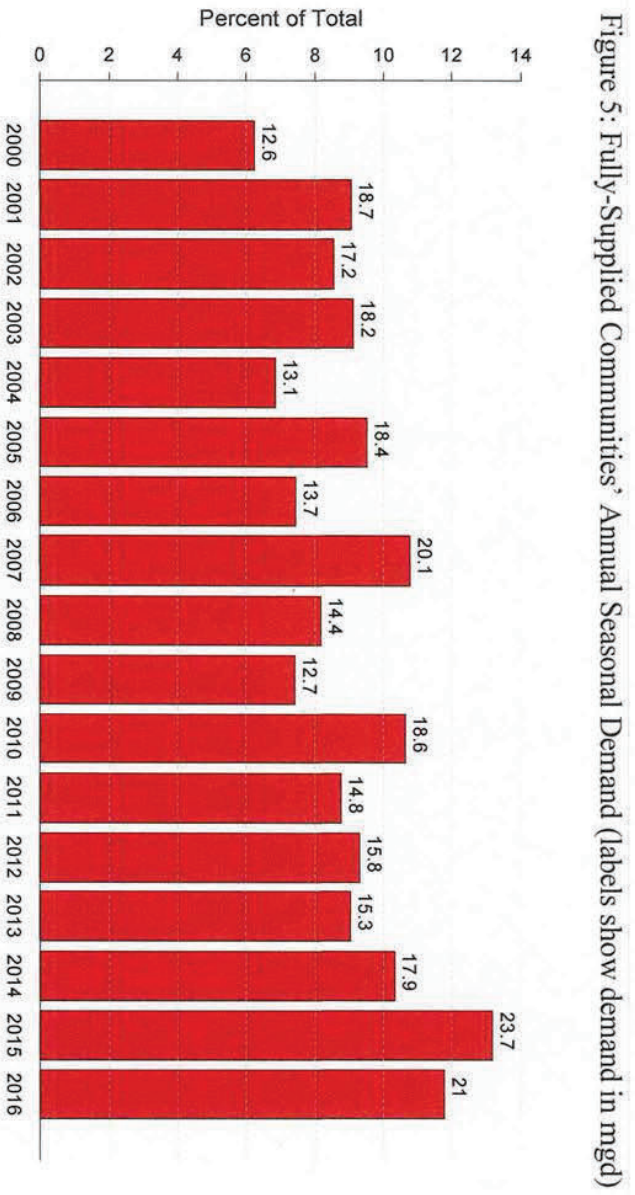
Seasonal water use is more variable than indoor demand and driven in large part by weather during the irrigation season. Factors influencing seasonal use include the total irrigation season precipitation, the number of dry days between rainfall events, temperature, and the total amount of sunshine. Over time, water price also influences seasonal use.

During the past 17 years, seasonal use in the fully-supplied communities has varied from a low of 12.6 mgd (6.2 percent of total use) in 2000 to 23.7 mgd (13.2 percent) in 2015, with an average of approximately 16.8 mgd (10 percent). The latter part of 2016 was dominated by the drought and its accompanying conservation messaging. In spite of the drought, seasonal use in the fully supplied communities was down as compared to 2015. Staff attribute this to in part customers voluntarily reducing use in response to news media coverage of the severe drought³.

Figure 5 and 6 on the next page show the variation in seasonal water use over time, and both the relatively small impact that seasonal demand has on total water use and the longer-term decline in both base and total use.

² Certain analyses can only be done on fully-supplied communities where MWRA has information on their daily use available from MWRA's revenue meters. MWRA receives data on monthly total use for partially-supplied communities but not until they provide that data to DEP in their Annual Statistical Reports in March. Fully-supplied communities represent almost 90 percent of the total annual demand.

³ Some partially supplied communities did have mandatory water use restrictions due to their state Water Management Act permits

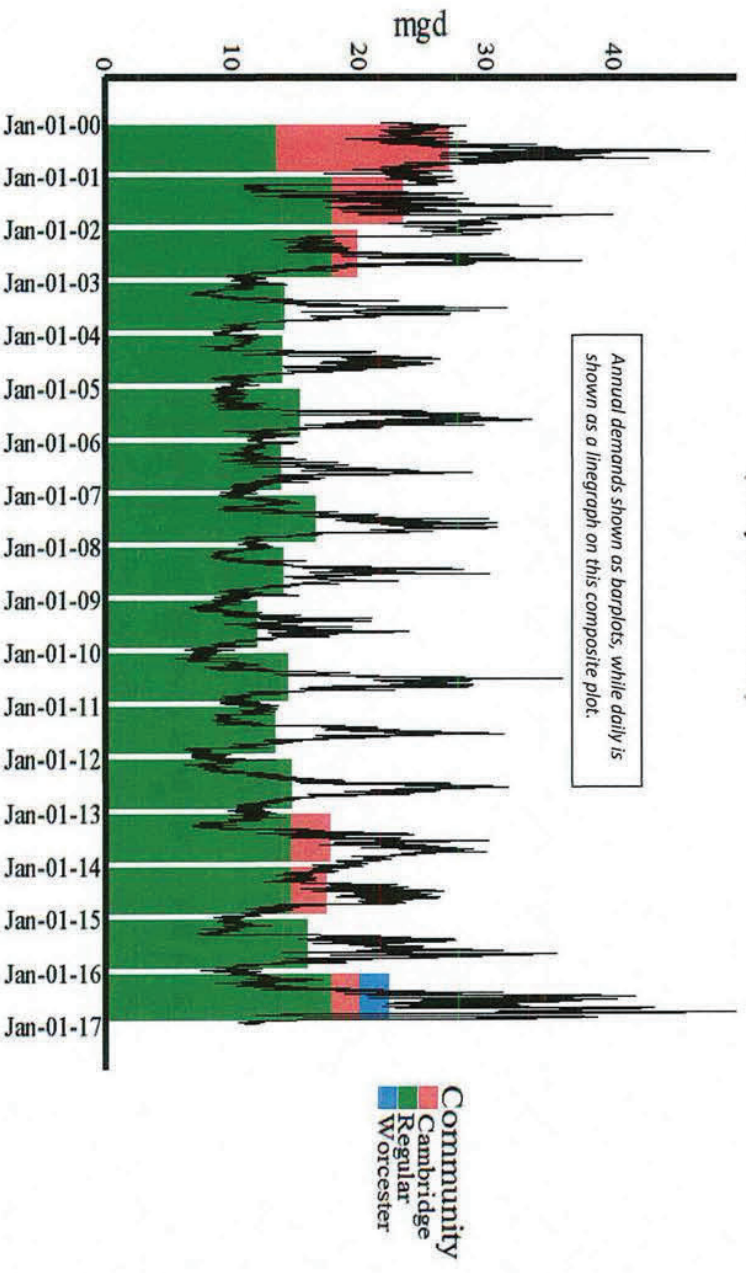


Partially Supplied Communities

Given the drought, staff examined the trend of MWRA sales to the partially supplied communities. These communities generally use their local sources first, and use MWRA water for demand above what they can supply locally. Figure 7 below shows a gradual upward post-recession trend in those communities. The bump up in the annual demands in 2013 and 2014 was due to the City of Cambridge withdrawing an average 3 mgd and 2.78 mgd in those years due to CSO and MWRA construction projects. In 2015, Lynn purchased an additional 0.5 mgd during the rehabilitation of a storage reservoir.

Cambridge's 2.32 mgd withdrawal for 2016 was not all drought-related as it used about 54 percent of that from early February to mid-summer due to ongoing local water infrastructure work with the balance being drought-related later in the year. Worcester on the other hand, pumped their Quinapoxet Reservoir dry (down to around 11 percent) and had to resort to purchasing MWRA water by pumping from Shaft 3 of the Quabbin Tunnel as the drought intensified. Demand in partially supplied communities was 6.5 mgd higher (41 percent) when compared to 2015. Without sales to Cambridge and Worcester, demand in the partially supplied communities was only about 1.8 mgd (12 percent) higher than 2015.

Figure 7: Partially Supplied Communities – MWRA Supplied Demand
(Daily and Annual)

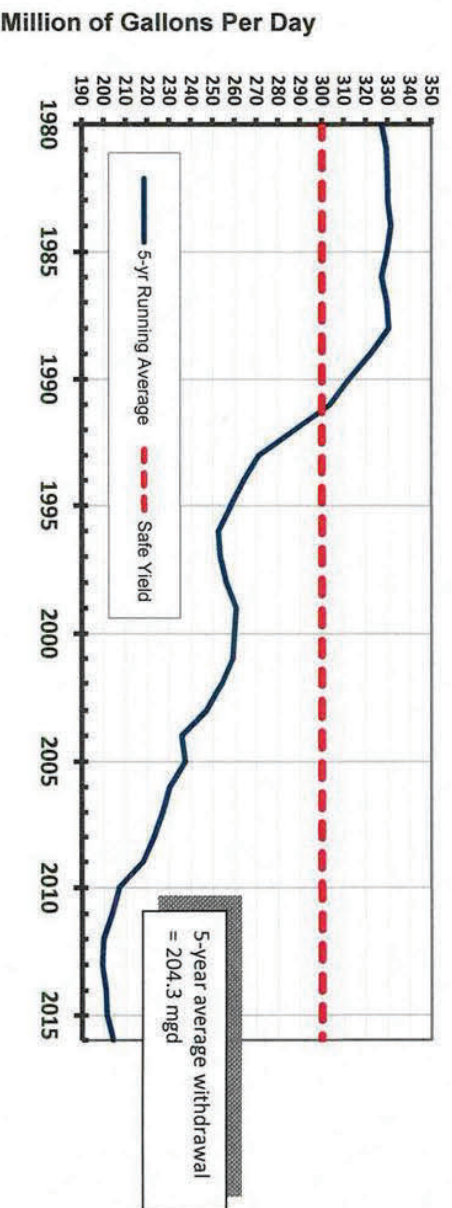


Reservoir Withdrawals and Releases

Reservoir withdrawals are the metric used to compare to the 300 mgd safe yield of the watershed/reservoir system⁴. Withdrawals include water sold to MWRRA communities, as well as other uses in the watershed and MWRRA system. Total MWRRA water withdrawals increased by 1.1 percent in 2016, from 206.74 mgd in 2015 to 208.94 mgd. Worcester, the State's second largest city pumped 5.23 mgd from its reservoirs in the portion of the Wachusett watershed that it shares with MWRRA and an extra 2.32 mgd from Shaft 3 for a total of 7.55 mgd. Worcester's total withdrawal for 2015 was 5 mgd. Over the past five years, total MWRRA withdrawals have varied up and down from 200.6 to 208.9 mgd, averaging 204.3 mgd.

Figure 8 below shows five-year averages of withdrawals from 1980 to present. The five-year averaging reduces the effects of year-to-year variability due to weather, and provides a good indication of longer-term trends. The average shows a slight increase from 2015. As the economy continues to stabilize and grow over the next few years, staff will monitor any changes in water use, to see if the longer-term downward trend resumes.

Figure 8: Total Reservoir Withdrawals – Five-Year Running Average 1980 to 2016



Drought Outlook

During 2016, Quabbin Reservoir dipped to Below Normal status for the first time since 2002. On January 1, the reservoir was at 79.1 percent full, and has risen slightly since then. The Quabbin watershed yield of 94.4 mgd for the calendar year was the second lowest on record with 1965 being the lowest at 72.8 mgd. The combined two year yield (2015 and 2016) of 121.6 mgd was the fourth lowest on record with the 1964/1965 being the lowest at 87.6 mgd.

On January 6th, Secretary Beaton upgraded the Northeast Massachusetts region, which includes most MWRRA served communities, to Drought Watch, down from a Drought Warning; the Central and Connecticut River Valley regions where MWRRA reservoirs are located remain in Drought Warning status.

⁴ The 300-mgd safe yield is based on the drought of the 1960s. Use of a less conservative 20-year recurrence drought, as allowed by DEP, would result in a safe yield as high as 350 mgd. MWRRA's Water Management Act registration is for 312 mgd.

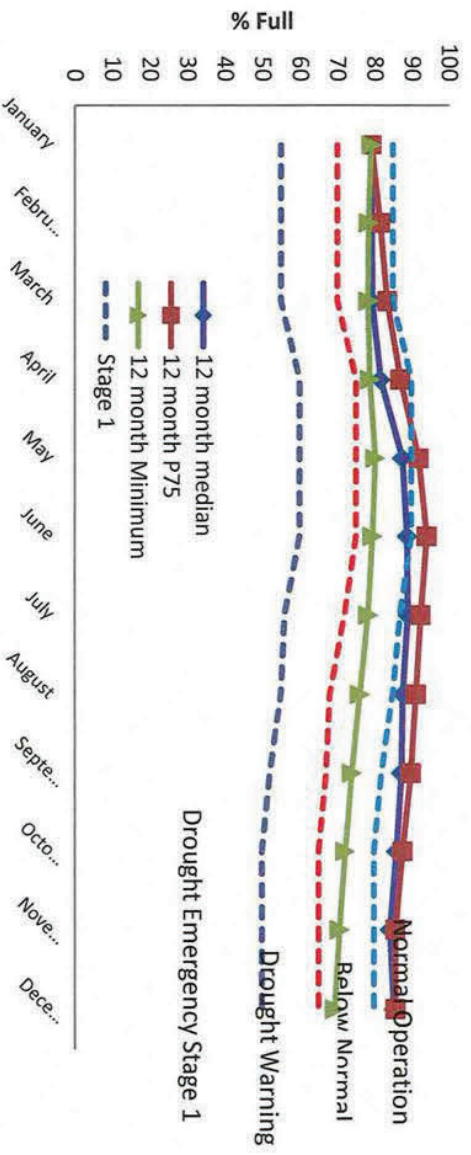
Quabbin Reservoir levels have been modeled for the next 12 months (January 2017 – December 2017) given varying yield conditions, and an annual demand of 220 mgd (conservatively includes a potential 10 mgd increase from current annual demand levels), as shown in Table 1 below.

**Table 1: Quabbin Reservoir Status with Varying Reservoir Yield Scenarios
Looking Forward from January 1, 2017**

	1-Month	3-Months	6-Months	12-Months
Median Yield	Below Normal	Below Normal	Normal	Normal
Dry (75th Percentile)	Below Normal	Below Normal	Below Normal	Normal
Driest (of Record)	Below Normal	Below Normal	Below Normal	Below Normal

The modeling shows that the slow recovery of a multi-year storage reservoir such as Quabbin under conditions of low yield, despite the demands being well below Safe Yield. With average yields, the reservoir will likely return to normal status within six months. Even if the driest conditions seen since the creation of Quabbin were to occur over the next 12 months, the system is unlikely to drop into Drought Warning status. Adequate supply exists in Quabbin and Wachusett Reservoirs to meet the needs of MWRRA fully and partially supplied water communities and also, if needed, to continue to augment the supplies of some of the adjacent stressed communities.

Figure 6: Quabbin Reservoir Storage 12-Month Simulation



BUDGET/FISCAL IMPACT:

Due to drought conditions, MWRA provided 515.2 million gallons (mg) of water to the City of Cambridge, 847.3 mg to the City of Worcester, 7.9 mg to the Town of Burlington, and 3.2 mg to the Town of Ashland to supplement local supplies in calendar year 2016. This additional water use resulted in \$4.8 million dollars in revenue.

MWRA also provided 334.1 mg of MWRA water to Cambridge earlier in the calendar year due to a local system improvement project, resulting in \$1.2 million in revenue.

ATTACHMENT:

Community Water Use Data

Massachusetts Water Resources Authority
MWRA Water Supplied (MGD)
 Reporting Period: December 2016

ALL DATA SUBJECT TO CHANGE OR ADJUSTMENT DURING ADDITIONAL MWRA AND COMMUNITY REVIEW

System	Monthly (MGD)						YTD (MGD)						YTD Share System Totals									
	Dec		2015		Flow Change		2016		2015		Flow Change		2016		2015		Flow Share ¹		% Change in YTD		2015	
	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	Ave. Flow mgd	Flow Share ¹	Prior Year-End	
Metro-System Customers	3,296	3,439	-0.2%	3,981	3,927	1.4%	3,981	3,927	1.4%	2.1%	2.1%	1.6%	3,927	2,232	75.1%	75.1%	1.6%	3,927	2.1%	2.1%	2.1%	
Bedford	1,644	1,807	-9.1%	2,217	2,232	-0.7%	2,217	2,232	-0.7%	1.2%	1.2%	0.5%	2,232	2,232	0.0%	0.5%	2,232	1.2%	1.2%	1.2%		
Boston (BWSO)	60,076	58,463	2.8%	65,630	65,321	0.3%	65,630	65,321	0.3%	35.4%	35.2%	0.5%	65,321	65,321	0.0%	0.5%	65,321	35.2%	35.2%	35.2%		
Brookline	4,030	4,094	-1.6%	5,192	5,561	-6.6%	5,192	5,561	-6.6%	2.8%	3.0%	-0.4%	5,561	5,561	0.0%	-0.4%	5,561	3.0%	3.0%	3.0%		
Canton (P)	1,288	916	40.5%	1,936	1,321	46.6%	1,936	1,321	46.6%	1.0%	0.7%	46.9%	1,321	1,321	0.0%	46.9%	1,321	0.7%	0.7%	0.7%		
Chelsea	3,138	2,994	4.7%	3,275	3,326	-1.5%	3,275	3,326	-1.5%	1.8%	1.8%	-1.3%	3,326	3,326	0.0%	-1.3%	3,326	1.8%	1.8%	1.8%		
Dorham/Westwood W.D. (P)	0,021	0,010	112.8%	0,226	0,155	45.6%	0,226	0,155	45.6%	0.12%	0.08%	45.9%	0,155	0,155	0.0%	45.9%	0,155	0.1%	0.1%	0.1%		
Essex	3,839	3,685	4.2%	3,953	3,905	1.2%	3,953	3,905	1.2%	2.1%	2.1%	1.4%	3,905	3,905	0.0%	1.4%	3,905	2.1%	2.1%	2.1%		
Franklin	5,104	5,118	-0.3%	6,104	6,439	-5.2%	6,104	6,439	-5.2%	3.3%	3.5%	-0.7%	6,439	6,439	0.0%	-0.7%	6,439	3.3%	3.3%	3.3%		
Leominster (P)	0,000	0,000	0.0%	0,000	0,000	0.0%	0,000	0,000	0.0%	0.0%	0.0%	0.0%	0,000	0,000	0.0%	0.0%	0,000	0.0%	0.0%	0.0%		
Lexington	3,775	3,615	4.4%	5,549	5,800	-4.3%	5,549	5,800	-4.3%	3.0%	3.1%	-4.1%	5,800	5,800	0.0%	-4.1%	5,800	3.1%	3.1%	3.1%		
Lynn (LWSO) (P)	0,226	0,126	78.9%	0,249	0,659	-62.2%	0,249	0,659	-62.2%	0.13%	0.35%	-62.1%	0,659	0,659	0.0%	-62.1%	0,659	0.35%	0.35%	0.35%		
Lynnfield W.D.	0,370	0,359	3.0%	0,572	0,508	12.6%	0,572	0,508	12.6%	0.31%	0.27%	12.8%	0,508	0,508	0.0%	12.8%	0,508	0.27%	0.27%	0.27%		
Malden	4,728	5,132	-7.9%	5,158	5,485	-6.0%	5,158	5,485	-6.0%	2.8%	3.0%	-5.8%	5,485	5,485	0.0%	-5.8%	5,485	3.0%	3.0%	3.0%		
Marblehead	1,296	1,291	0.4%	1,884	1,848	2.0%	1,884	1,848	2.0%	1.0%	1.0%	2.2%	1,848	1,848	0.0%	2.2%	1,848	1.0%	1.0%	1.0%		
Marlborough (P)	3,502	3,435	1.9%	3,739	3,068	21.9%	3,739	3,068	21.9%	2.0%	1.7%	22.1%	3,068	3,068	0.0%	22.1%	3,068	1.7%	1.7%	1.7%		
Medford	4,430	4,526	-2.1%	4,869	5,076	-4.1%	4,869	5,076	-4.1%	2.6%	2.7%	-3.9%	5,076	5,076	0.0%	-3.9%	5,076	2.7%	2.7%	2.7%		
Melrose	1,776	1,935	-3.2%	2,177	2,301	-5.4%	2,177	2,301	-5.4%	1.2%	1.2%	-5.2%	2,301	2,301	0.0%	-5.2%	2,301	1.2%	1.2%	1.2%		
Milton	2,354	2,121	11.0%	2,665	2,652	0.5%	2,665	2,652	0.5%	1.4%	1.4%	0.8%	2,652	2,652	0.0%	0.8%	2,652	1.4%	1.4%	1.4%		
Norwood	0,330	0,280	14.0%	0,410	0,376	9.1%	0,410	0,376	9.1%	0.22%	0.20%	9.3%	0,376	0,376	0.0%	9.3%	0,376	0.20%	0.20%	0.20%		
Noblet	0,108	0,489	-77.9%	0,846	0,820	3.2%	0,846	0,820	3.2%	0.5%	0.5%	3.4%	0,820	0,820	0.0%	3.4%	0,820	0.4%	0.4%	0.4%		
Needham (P)	7,535	8,687	-13.3%	9,833	10,220	-3.8%	9,833	10,220	-3.8%	5.3%	5.5%	-3.6%	10,220	10,220	0.0%	-3.6%	10,220	5.5%	5.5%	5.5%		
Newton	0,820	0,824	-0.4%	0,946	0,896	5.5%	0,946	0,896	5.5%	0.5%	0.5%	5.8%	0,896	0,896	0.0%	5.8%	0,896	0.5%	0.5%	0.5%		
Northborough (P)	2,451	2,595	3.6%	2,825	2,883	-2.0%	2,825	2,883	-2.0%	1.5%	1.6%	-1.8%	2,883	2,883	0.0%	-1.8%	2,883	1.6%	1.6%	1.6%		
Norwood	1,486	0,535	133.9%	1,478	1,189	24.3%	1,478	1,189	24.3%	0.8%	0.6%	24.5%	1,189	1,189	0.0%	24.5%	1,189	0.6%	0.6%	0.6%		
Parade (P)	8,107	8,122	-0.2%	9,305	9,294	0.1%	9,305	9,294	0.1%	5.0%	5.0%	0.3%	9,294	9,294	0.0%	0.3%	9,294	5.0%	5.0%	5.0%		
Quincy	1,412	1,335	5.8%	1,687	1,665	1.3%	1,687	1,665	1.3%	0.9%	0.9%	1.5%	1,665	1,665	0.0%	1.5%	1,665	0.9%	0.9%	0.9%		
Reading	3,458	3,601	-4.0%	3,735	3,902	-4.3%	3,735	3,902	-4.3%	2.0%	2.1%	-4.1%	3,902	2,914	37.7%	-4.1%	2,914	1.6%	1.6%	1.6%		
Revere	2,584	2,594	0.4%	3,016	2,914	3.5%	3,016	2,914	3.5%	1.6%	1.6%	3.7%	2,914	2,914	0.0%	3.7%	2,914	1.6%	1.6%	1.6%		
Saugus	5,427	5,889	-7.8%	6,048	6,044	0.1%	6,048	6,044	0.1%	3.3%	3.3%	0.3%	6,044	6,044	0.0%	0.3%	6,044	3.3%	3.3%	3.3%		
Somerville	0,587	0,673	-12.8%	1,069	1,048	2.0%	1,069	1,048	2.0%	0.6%	0.6%	2.2%	1,048	1,048	0.0%	2.2%	1,048	0.6%	0.6%	0.6%		
Southborough	1,868	1,847	1.1%	2,309	2,505	-7.8%	2,309	2,505	-7.8%	1.2%	1.3%	-7.6%	2,505	2,505	0.0%	-7.6%	2,505	1.3%	1.3%	1.3%		
Stoughton	0,200	0,403	-50.3%	0,194	0,903	-78.6%	0,194	0,903	-78.6%	0.1%	0.5%	-78.5%	0,903	0,903	0.0%	-78.5%	0,903	0.5%	0.5%	0.5%		
Swampscott	1,138	1,080	5.4%	1,444	1,447	-0.3%	1,444	1,447	-0.3%	0.8%	0.8%	-0.1%	1,447	1,447	0.0%	-0.1%	1,447	0.8%	0.8%	0.8%		
Wachusett (P)	1,563	1,080	44.7%	1,657	1,462	13.4%	1,657	1,462	13.4%	0.9%	0.9%	13.6%	1,462	0,787	47.0%	13.6%	0,787	0.8%	0.8%	0.8%		
Wareham	5,271	5,946	-11.3%	6,884	7,406	-6.9%	6,884	7,406	-6.9%	3.7%	4.0%	-6.7%	7,406	7,406	0.0%	-6.7%	7,406	4.0%	4.0%	4.0%		
Wareham	2,353	2,235	5.3%	2,584	2,597	-0.5%	2,584	2,597	-0.5%	1.4%	1.4%	-0.3%	2,597	2,597	0.0%	-0.3%	2,597	1.4%	1.4%	1.4%		
Wellesley (P)	0,000	0,000	0.0%	1,329	0,834	59.4%	1,329	0,834	59.4%	0.7%	0.4%	59.8%	0,834	0,834	0.0%	59.8%	0,834	0.4%	0.4%	0.4%		
Weston	0,971	0,970	11.7%	2,150	1,930	11.4%	2,150	1,930	11.4%	1.2%	1.0%	11.6%	1,930	1,930	0.0%	11.6%	1,930	1.0%	1.0%	1.0%		
Wilmington (P)	0,001	0,000	100.0%	0,552	0,555	6.7%	0,552	0,555	6.7%	0.32%	0.30%	6.9%	0,555	0,555	0.0%	6.9%	0,555	0.30%	0.30%	0.30%		
Winchester (P)	0,932	0,417	95.3%	1,618	1,219	32.8%	1,618	1,219	32.8%	0.9%	0.7%	33.1%	1,219	1,219	0.0%	33.1%	1,219	0.7%	0.7%	0.7%		
Winthrop	1,121	1,417	-2.2%	1,232	1,297	-5.0%	1,232	1,297	-5.0%	0.7%	0.7%	-4.8%	1,297	1,297	0.0%	-4.8%	1,297	0.7%	0.7%	0.7%		
Woburn (P)	1,284	1,280	0.4%	2,773	2,648	4.7%	2,773	2,648	4.7%	1.5%	1.4%	5.0%	2,648	2,648	0.0%	5.0%	2,648	1.4%	1.4%	1.4%		
Subtotal Metro-System	155,907	154,536	0.8%	185,253	185,540	-0.2%	185,253	185,540	-0.2%	100%	100%	0.0%	185,540	185,540	100%	0.0%	185,540	100%	100%	100%		
Chicago Valley Aqueduct	4,252	4,416	-3.7%	5,339	5,329	0.2%	5,339	5,329	0.2%	69.3%	69.7%	-0.7%	5,329	5,329	69.7%	-0.7%	5,329	69.7%	69.7%	69.7%		
Chicago	0,805	0,827	-2.7%	1,132	1,102	2.8%	1,132	1,102	2.8%	14.7%	14.4%	1.8%	1,102	1,102	0.0%	1.8%	1,102	14.4%	14.4%	14.4%		
South Ridge PD #1	0,781	0,787	1.8%	1,238	1,209	2.4%	1,238	1,209	2.4%	16.1%	15.8%	1.4%	1,209	1,209	0.0%	1.4%	1,209	15.8%	15.8%	15.8%		
Wilbraham	5,838	6,010	-2.9%	7,709	7,640	0.9%	7,709	7,640	0.9%	100%	100%	0.0%	7,640	7,640	100%	0.0%	7,640	100%	100%	100%		
Subtotal CVA System	5,838	6,010	-2.9%	7,709	7,640	0.9%	7,709	7,640	0.9%	100%	100%	0.0%	7,640	7,640	100%	0.0%	7,640	100%	100%	100%		
Other Revenue Supply	1,202	0,000	100.0%	2,320	0,022	10942.3%	2,320	0,022	10942.3%				0,022	0,022			0,022					
Cambridge (P)	1,312	1,382	-3.0%	1,689	1,735	-2.0%	1,689	1,735	-2.0%				1,735	1,735			1,735					
Clinton	0,610	0,000	100.0%	2,315	0,001	247701.2%	2,315	0,001	247701.2%				0,001	0,001			0,001					
Other Revenue Customers ⁴	1,441	1,551	-7.1%	1,427	1,486	-4.0%	1,427	1,486	-4.0%				1,486									



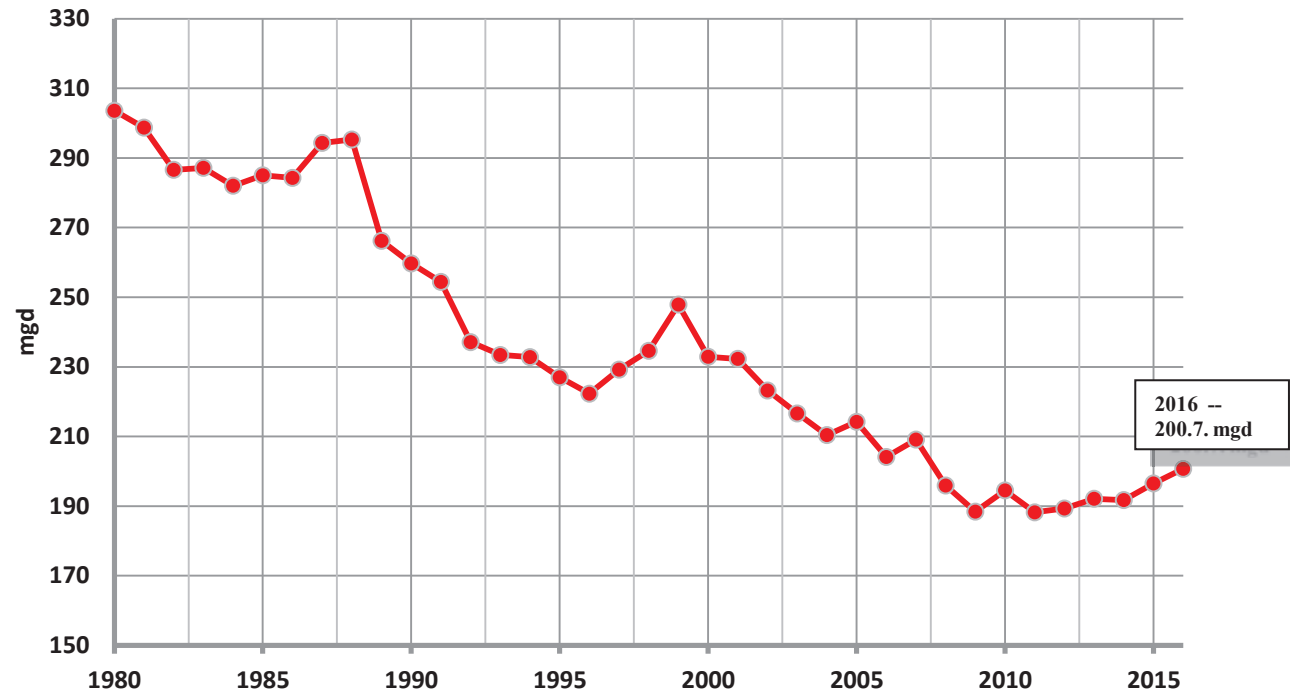
Massachusetts Water Resources Authority

Report on 2016 Water Use Trends and Drought Status

January 18, 2017

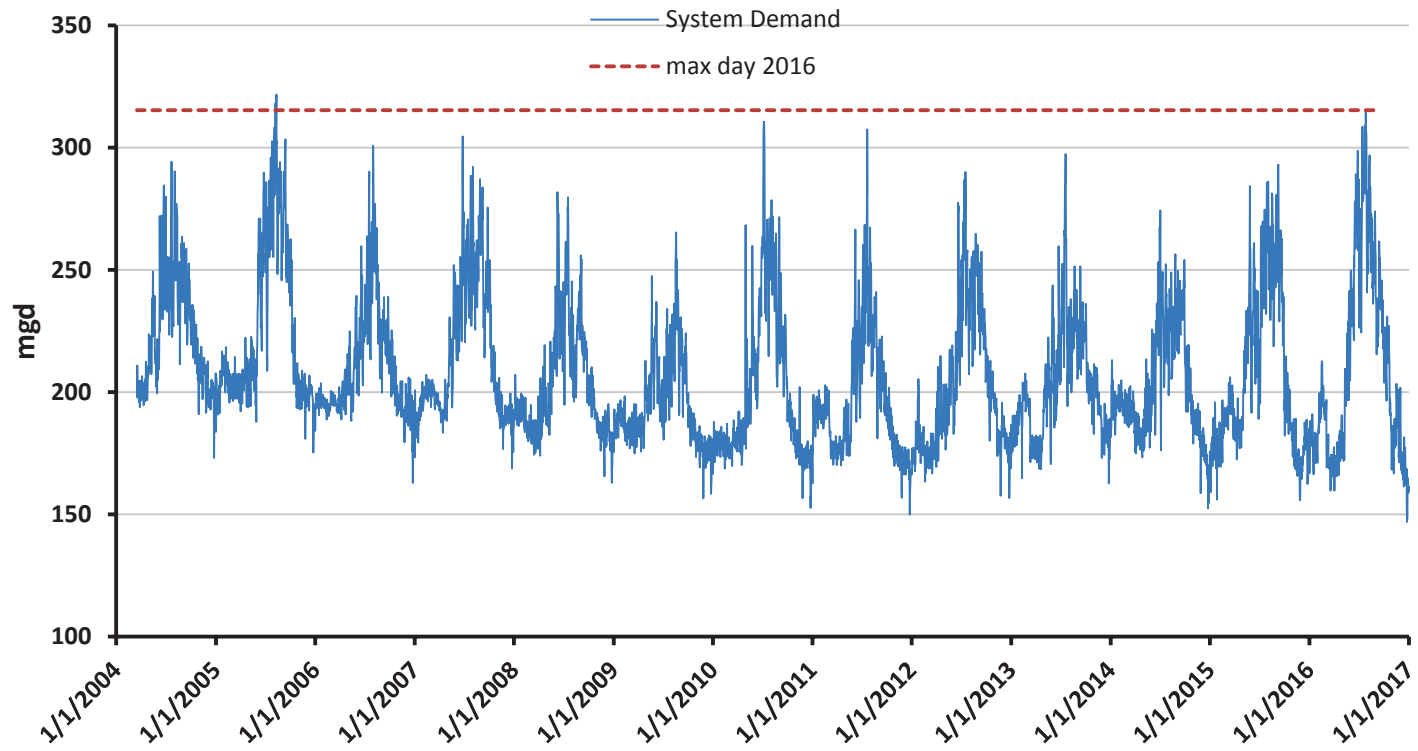


Total Consumption by MWRA Communities (1980 to 2016)



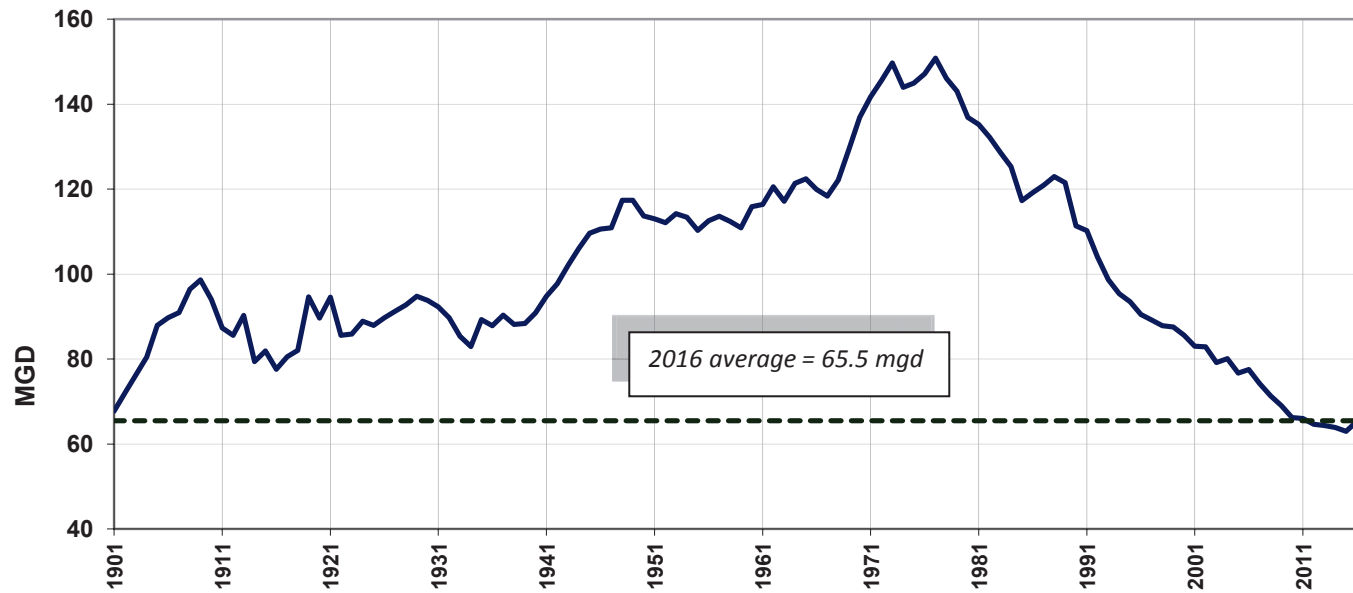


Daily System Demand



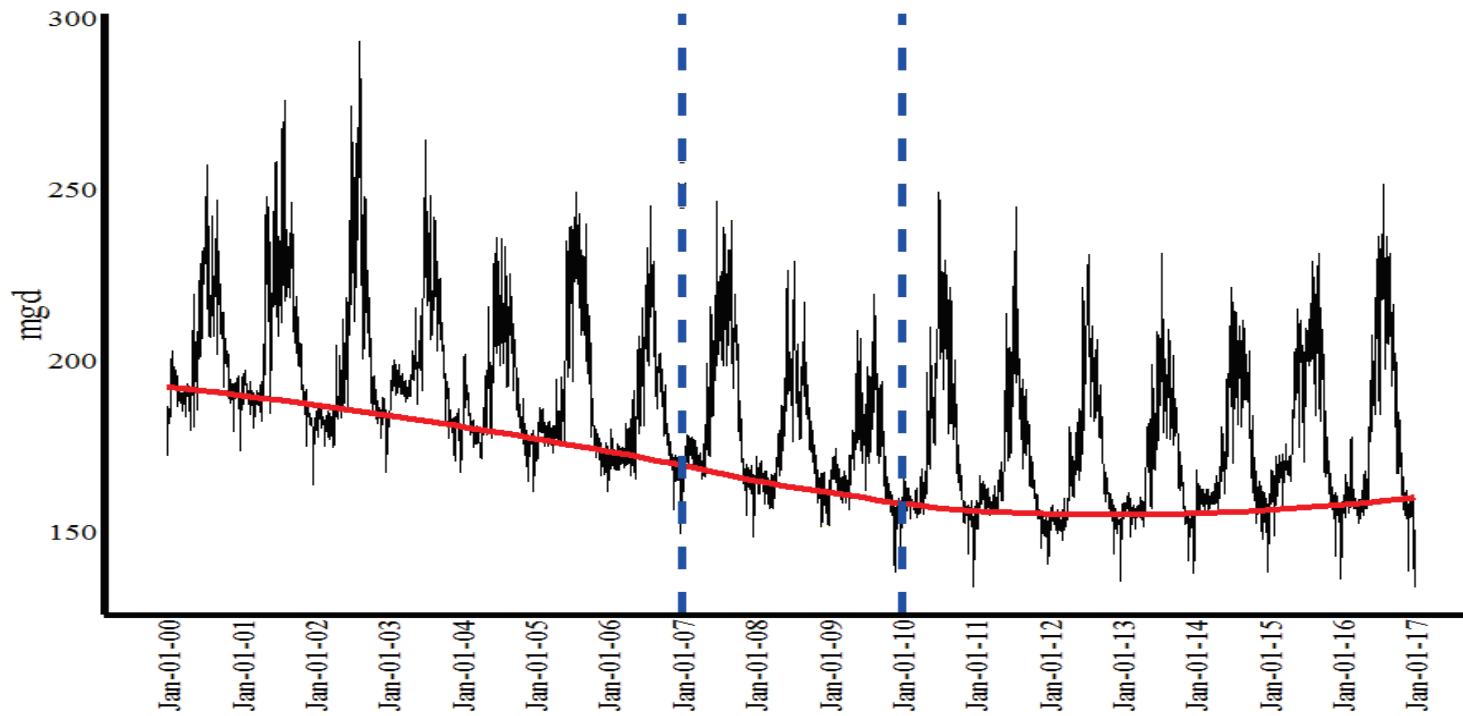


Boston Water Use (1900 to 2016)



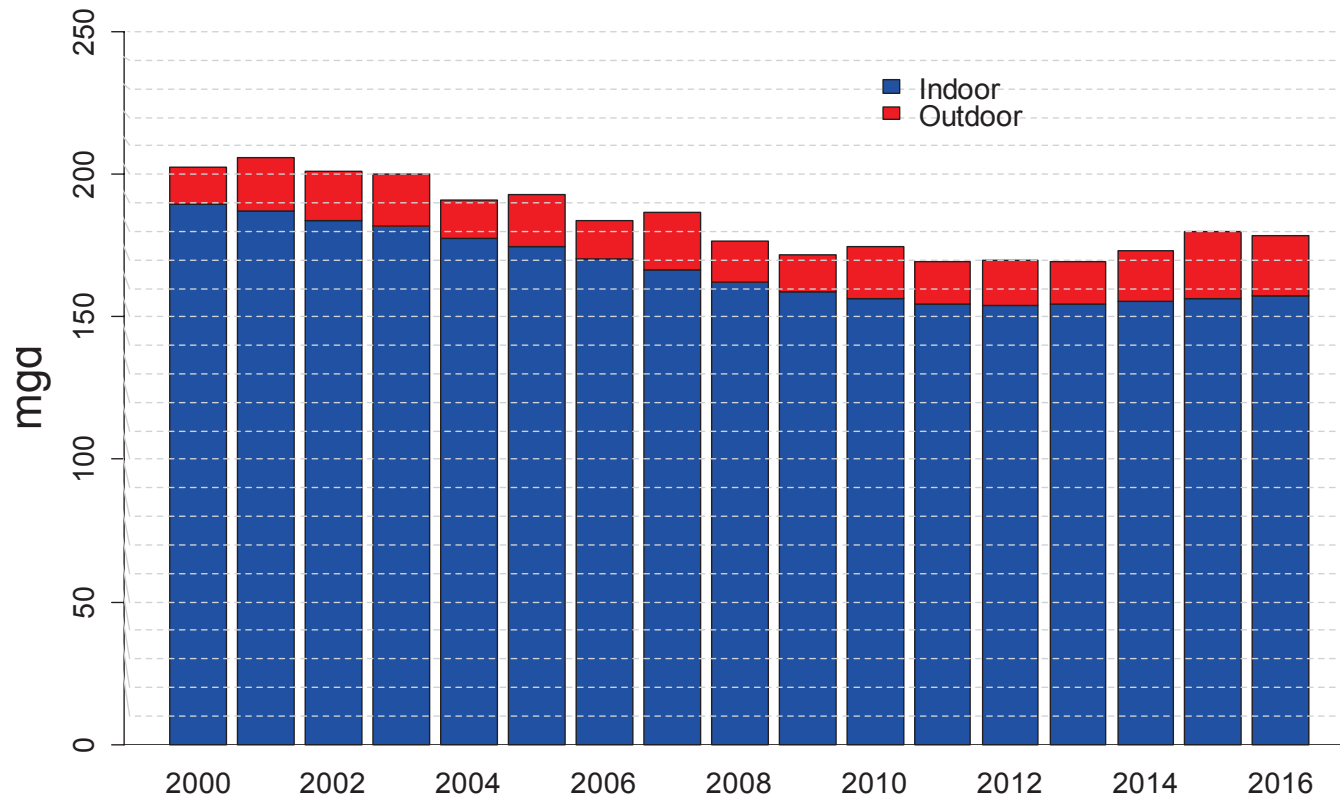


Fully Supplied Communities Demand (2000 to 2016)



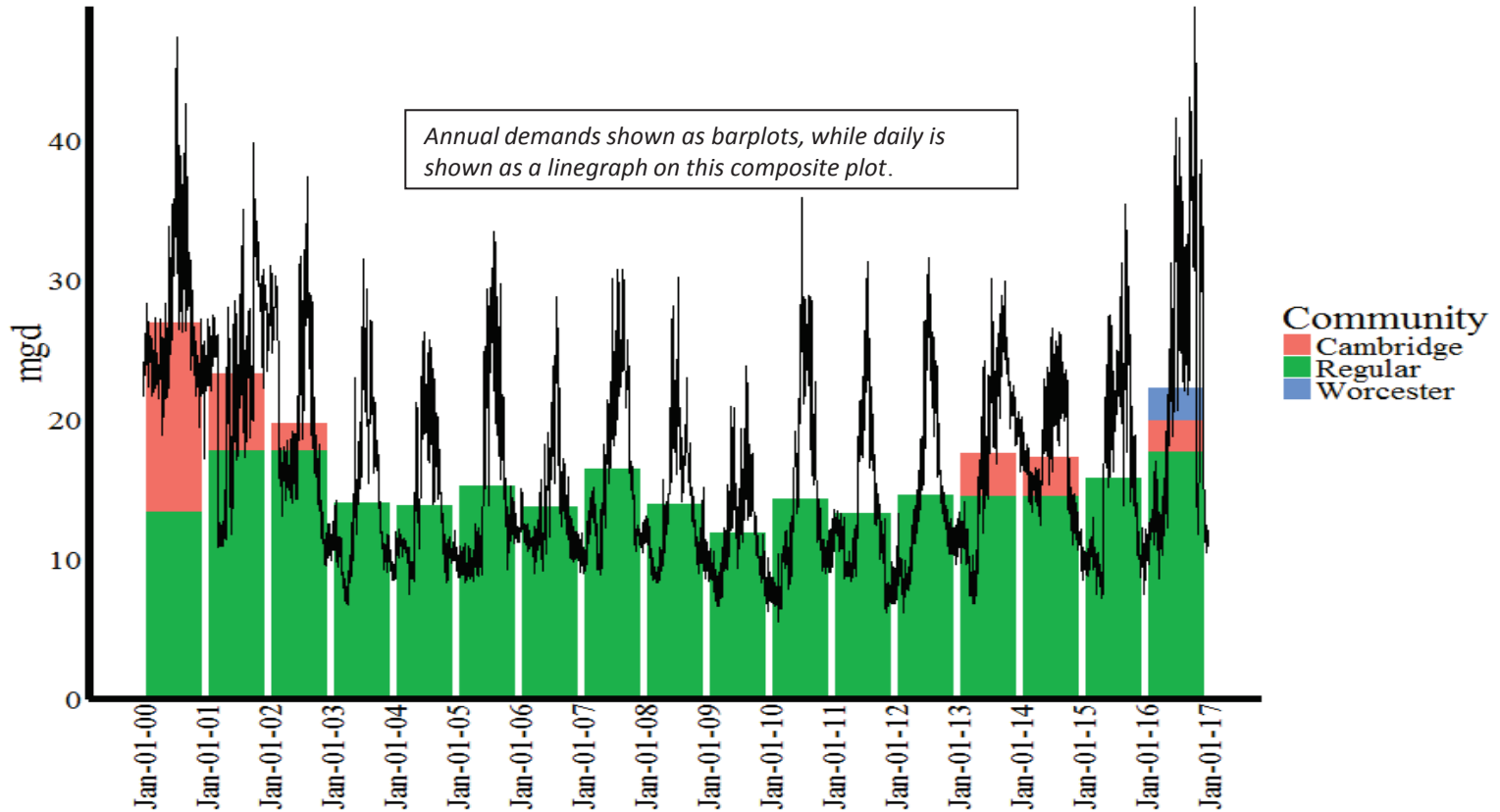


Fully Supplied Communities (Annual Base and Outdoor Use)



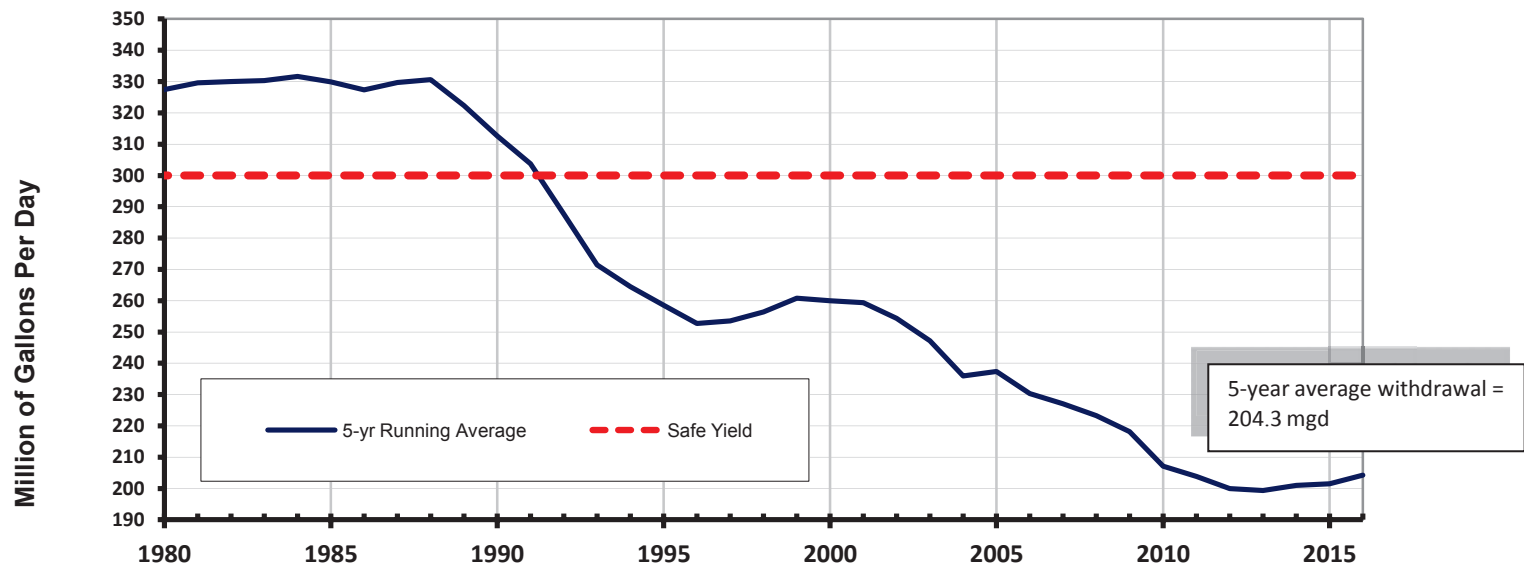


Partially Supplied Communities



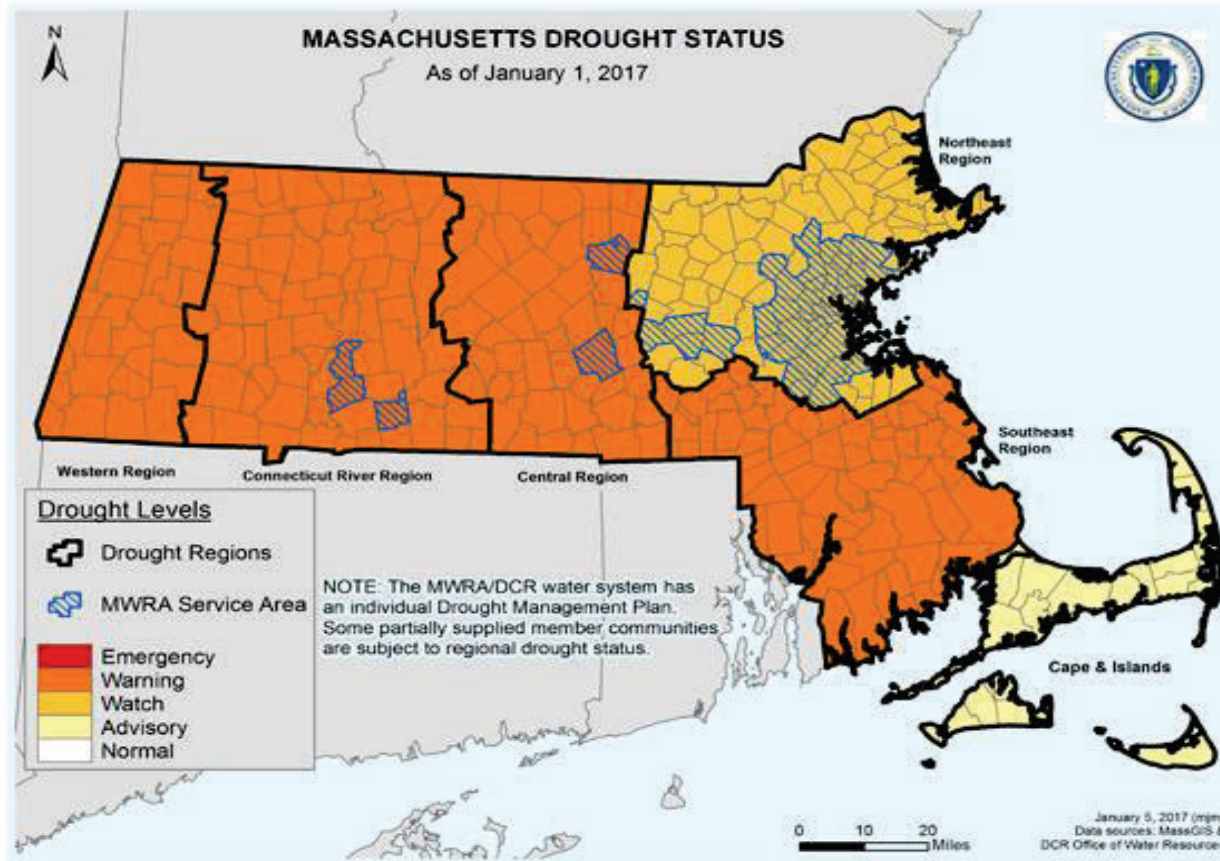


Reservoir Withdrawals – 5 Year Running Average



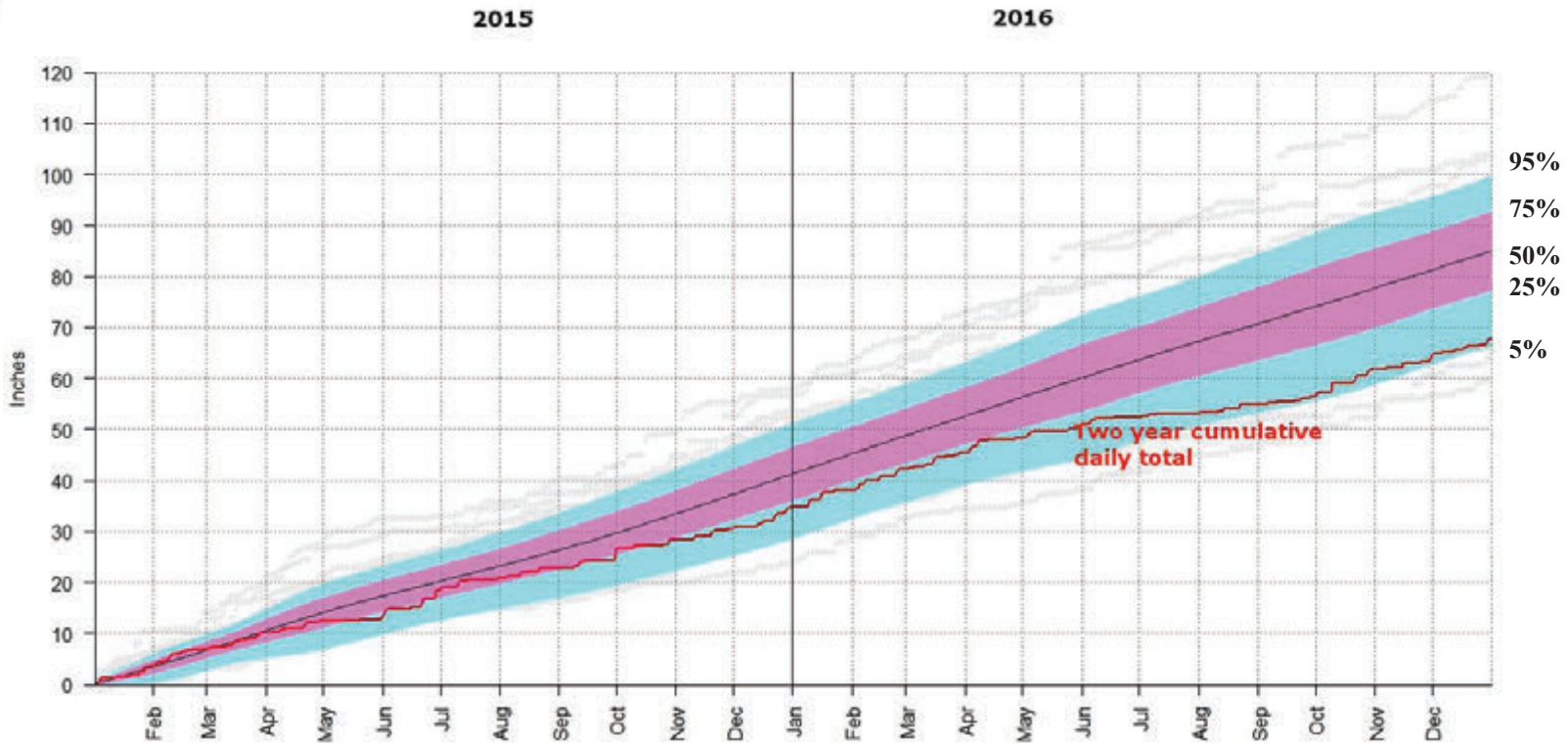


Massachusetts Drought Status Designations





It Has Continued To Be Dry In the Service Area





Driest Summer on Record

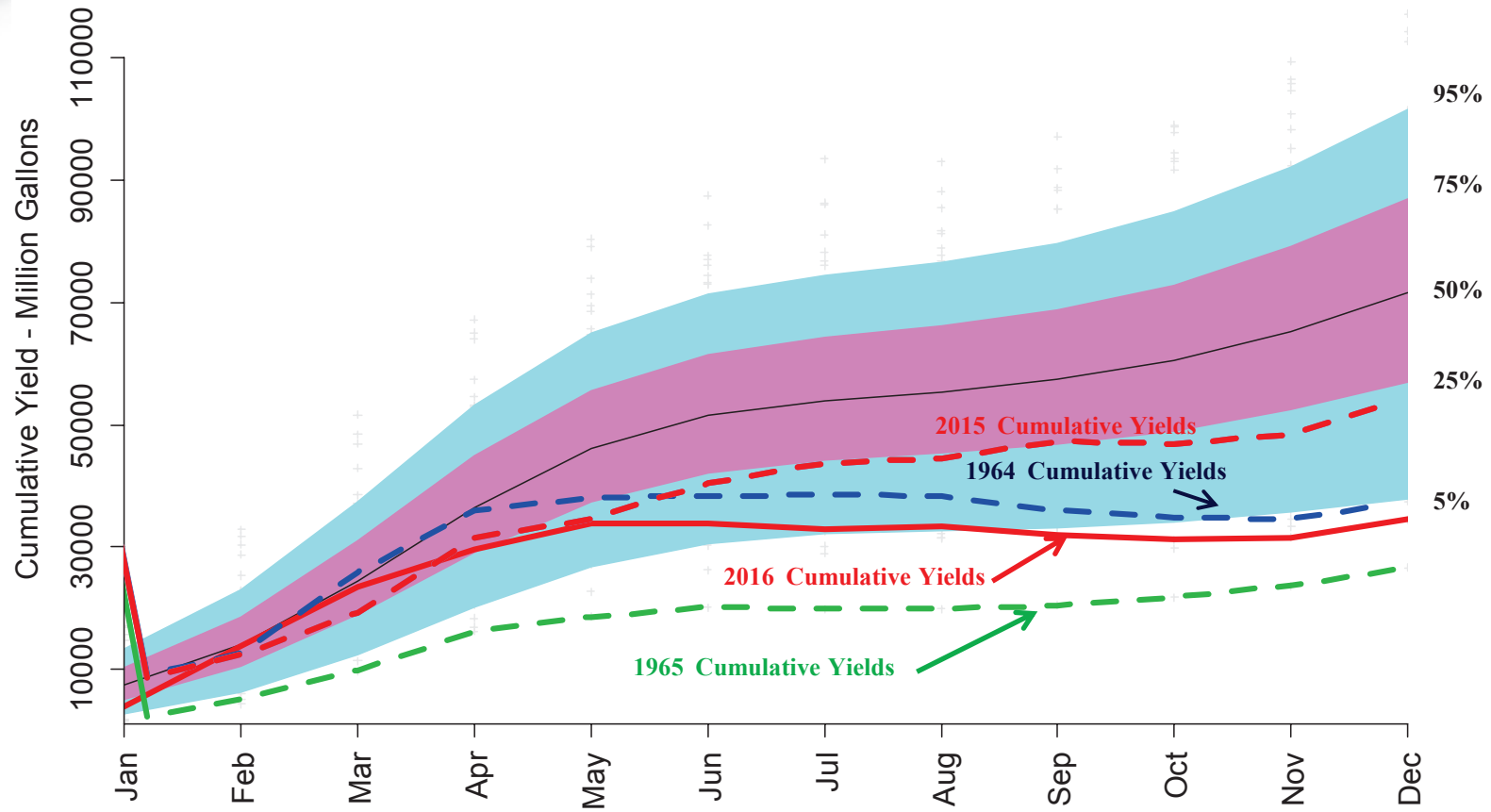
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
Long-term Average	3.64	3.36	4.01	3.57	3.37	3.46	3.04	3.40	3.29	3.44	4.01	4.09	42.7
2016 Total	3.27	4.18	3.17	2.91	2.83	1.33	0.87	1.72	1.38	5.46	2.7	3.25	33.07

Driest summer ever recorded. Total only 3.92 inches

Inches of Precipitation at Logan Airport

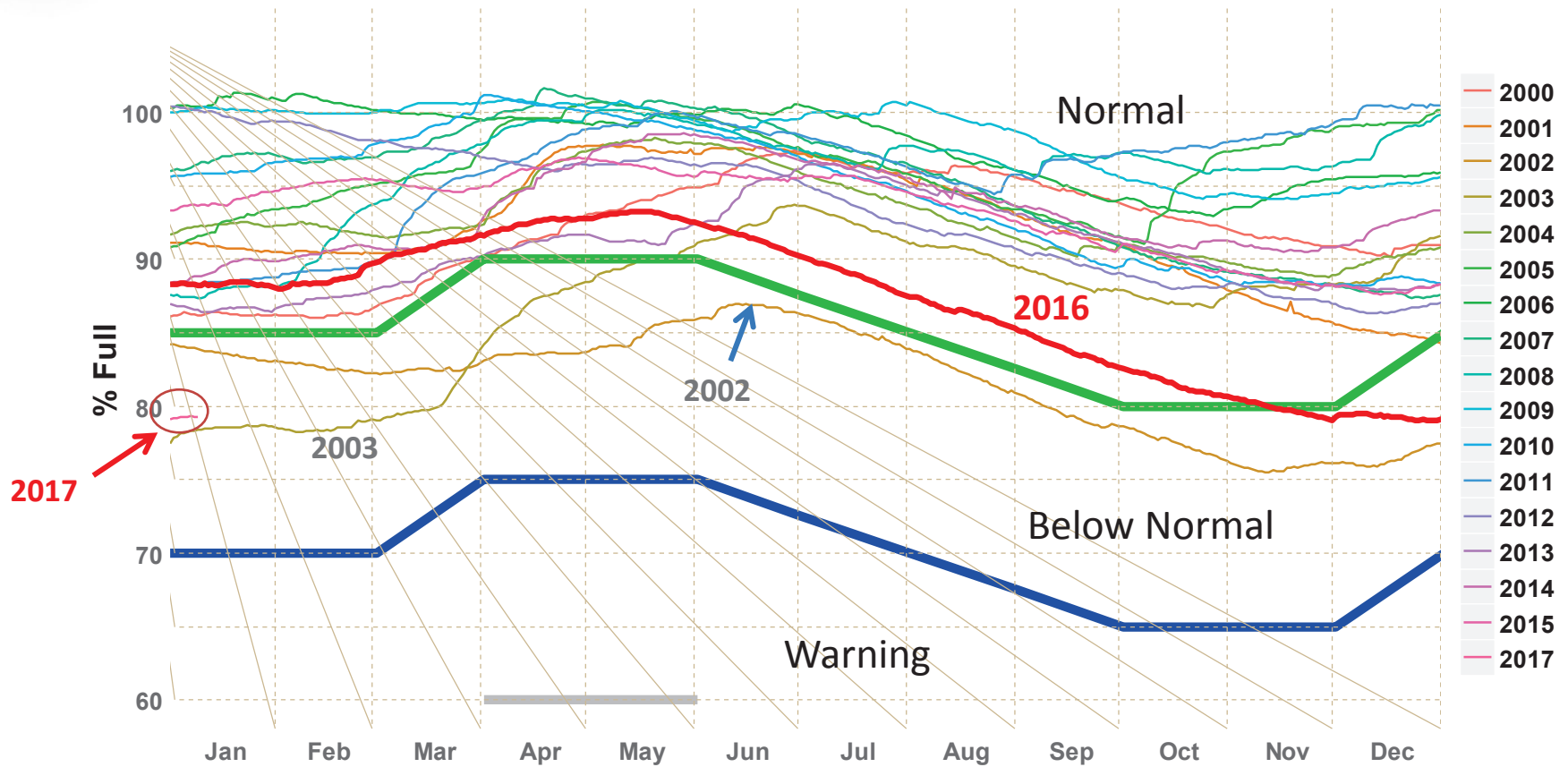


Quabbin Watershed - Cumulative Yields





Quabbin Reservoir Volume





Quabbin Reservoir Projections – Starting January 1, 2017

	1-Month	3-Months	6-Months	12-Months
Median Yield	Below Normal	Below Normal	Normal	Normal
Dry (75th Percentile)	Below Normal	Below Normal	Below Normal	Normal
Driest (of Record)	Below Normal	Below Normal	Below Normal	Below Normal



Communities That Received Emergency Drought Assistance in 2016

Community	Amount Supplied (Million Gallons)
Worcester	847.3
Cambridge	515.2
Burlington	7.9
Ashland	3.2



Summary

- **Quabbin Reservoir remains in Below Normal status**
- **There is sufficient water to meet MWRA member community demand**
- **Plus help adjacent communities that are stressed by the drought**