The Case for Water Conservation in Plymouth
A Water Conservation Planning Framework
Discussion draft for the purpose of soliciting community input

Prepared by the Plymouth Water Conservation Committee

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This Water Conservation Planning Framework is a work in progress and is subject to change. It has not yet been officially adopted by the Plymouth Water Conservation Committee.

REV 2.5 p. 1
Executive Summary

This Water Conservation Planning Framework is a precursor to a formal Water Conservation Plan for the Town of Plymouth. Such a plan is needed to complete the draft Water Master Plan for Plymouth’s municipal water system that was released for review in late 2019. Clean drinking water is not only a limited resource, it is subject to a number of threats. Pollution, saltwater intrusion, and rapid growth in water demand all have the potential to impact water availability and quality. Conservation needs to become a key element in the Town’s long-term water resource plan. The time to save water in Plymouth is now. Water conservation is everyone’s responsibility.

Why isn’t the Plymouth Water Conservation Committee releasing an actual Water Conservation Plan now? The answer is simple: detailed consumption data on water system users is needed for program planning and these data are not currently available. Data access barriers exist that must be overcome and the Committee is working closely with the Water Division to do this. This issue is discussed below and in section VII.D.

Research into other municipalities’ water conservation efforts, both within Massachusetts and elsewhere in the United States, indicates that a long-term savings target of 15% should be achievable in Plymouth. Reaching this savings level would reduce withdrawals from the Plymouth-Carver sole-source aquifer by more than 230 million gallons per year. This equates to a modest 1% annual reduction in water usage in each of the next fifteen years. Much of the savings can be achieved by pursuing no-cost and low-cost conservation measures. The Committee believes that this level of water savings can be achieved within fifteen years.

Outdoor watering in the summer months is the highest priority area for water conservation in Plymouth. Outdoor watering drives water usage in the summer months to levels that are roughly double those in winter and off-season months and determines the need for, and timing of, new drinking water wells. Programs are identified in this Water Conservation Planning Framework to address this. Investigation into the feasibility and potential impact of a seasonal water rate is also strongly recommended.

Many, if not most, of the water conservation measures outlined in this report are expected to be cost-competitive with new supply wells. The annualized cost of a planned well can be calculated based on the capital investment and timing of the well addition. This cost can be used as a threshold to determine which conservation programs should be invested in. It is recommended that the Town of Plymouth update its water resource planning methodology to reflect this apples-to-apples, economic comparison to enhance the quality of its investment decisions.

As noted above, barriers that currently stand in the way of effective conservation program planning, implementation, and evaluation must be removed. Some of these barriers, which are identified in this report, will require technical infrastructure upgrades in the areas of meter data retrieval, data management and data access. Put into plain language, you cannot manage what you cannot measure. Water usage data is critical to planning.

If the Town of Plymouth heads in the directions outlined in this report it is possible, if not likely, that it will attain a leadership position among Massachusetts communities in the conservation of precious water resources. Plymouth already has a reputation for its proactive work in wetlands restoration and long-term sustainability planning. The time to address water resource conservation is now.
I. Introduction

A. Why Does Water Conservation Matter in Plymouth?

Many people believe that our water supply is infinite. It is not. Although 70% of Earth is covered by water, only about 2% is fresh water and even less of that is readily available. As such, clean, fresh water is a limited resource that must be protected. But the picture is changing. Worldwide climate change threatens our limited supply of fresh water. Increasingly frequent droughts can severely impact our water resources, with potentially deadly consequences. Removing too much water from the environment can lead to contamination of our water resources—from surface water to the aquifer that supplies our drinking water.

Water is an essential part of everyday life. It is required for almost everything we do, including drinking, cooking, bathing and recreation. Without clean, fresh water, our health will be put at risk. And humans are not the only species on Earth that requires water for survival. Every living thing on earth needs water to survive, so loss of clean, fresh water would be devastating to not only the health of humankind, but to flora and fauna as well. Without fresh water, our entire ecosystem will collapse. Every crop on this planet requires water to grow so without plentiful clean, fresh water, we will be unable to grow food. For all these reasons, water conservation is essential to the sustainability of life as we know it.

Conserving water means using our water supply wisely and responsibly. Conserving water requires strategies that include reducing waste, preventing harm to water quality, and improving water management. We can start saving water by making smart choices at home. We should use water-efficient appliances and limit outdoor watering. Applying simple water conservation tips can help reduce the usage of water by as much as half. Committing to just a bit of effort can make all the difference. There are economic benefits of conserving water since reduced water use means cost savings on the water bill.

Why is it especially important to conserve water in our town? Plymouth is a town defined by water (28% of the town’s total area is made up of water). There are 36 miles of coastline and 450 ponds. Much of our local economy depends on our fresh and saltwater resources. Moreover, the town relies on the sole-source Plymouth-Carver aquifer for all of its drinking water. Although the aquifer contains billions of gallons of water, it is under threat from climate change, over-development, and pollution (see sidebar). Plymouth is currently undergoing a period of rapid development which means water conservation is more important now than ever to ensure we do not deplete our sole-source aquifer. With a stronger emphasis on water conservation, the Town can become a model for the sustainable use of precious water resources.
Plymouth’s Water Supply—Potential Threat Scenarios

- **Runaway growth**—Plymouth is one of Massachusetts’ fastest growing towns. Should this rapid growth continue, or accelerate, the Town will need to meet ever-higher water demand.

- **Saltwater infiltration**—Sea-level rise associated with climate change threatens private wells in coastal areas, which comprise a significant part of the town. Such a scenario could force the Town to extend its public water system to serve these additional areas.

- **Aquifer contamination**—PFAs and other contaminants could degrade water quality, force the closure of some town wells, or require costly upgrades of the water treatment system.

- **Lower groundwater levels**—As more and more water is withdrawn from the sole-source aquifer by Plymouth and neighboring towns, groundwater levels could fall. Increasingly frequent droughts associated with climate change could also precipitate such a scenario. One consequence of this might be the need to invest in deeper wells.

- **Growing resistance to new wells**—As Plymouth plans to develop and bring online a series of new wells over the next decade, local resistance may develop among local residents opposed to the associated environmental impacts and rate increases.

Given the Town’s current water supply and demand situation and potential threats to our water supply, as well as the environmental and economic impacts of continued reliance on the status quo of drilling new wells, the Town of Plymouth should not overlook water conservation as a strategic tool. Creating a long-term Water Conservation Plan is a step in that direction.

**B. How much water might Plymouth be able to save?**

Plymouth’s municipal water system currently supplies a total of 1.5 billion gallons of water per year (1,500 million gallons per year-MGY) to approximately 15,000 customers town-wide, not including private wells and water systems. This equates to a population served of around 43,000 people. Since about 70% of Plymouth residents are connected to town water, the total, town-wide withdrawal is likely to be on the order of 2 billion gallons. This is a mind-boggling number. Saving a mere 10 percent on the town system alone would reduce water usage by a staggering 153.5 MGY, or 420,000 gallons per day.

How much water can realistically be saved here though? Past water conservation efforts in Plymouth have been very modest so there is likely to be significant potential for savings. There are several ways to estimate the potential water savings that might be achieved through a concerted, multiyear conservation program:

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1 Number of service connections, as reported to the MassDEP for 2020.

2 Plymouth DPW released a Water Conservation Plan in 2009; however, a number of key recommendations have not been acted on.
- Look at other Massachusetts communities to see where Plymouth currently stands in relative terms. If a significant number of other towns are reporting lower, per-capita water usage, this may indicate the level of savings that can be easily achieved.

- Study Massachusetts communities that have implemented water conservation programs to see how much they have saved, and how. The results will be useful for estimating the range of possible savings and programs that have been proven to work.

- Investigate other cities and towns across the U.S. to learn what aggressive conservation programs have achieved in water savings. This may help define the upper bound of the potential water savings range.

Ultimately, every community is unique so the most reliable estimates of future water savings will come from monitoring of Plymouth’s own conservation programs as they are implemented to estimate impacts, then extrapolating these impacts to a larger target population. If, for example, one household can save a nominal 5,000 gallons of water annually through more efficient outdoor watering practices and data indicate that there are 2,000 households with similar potential based on their usage patterns, a system-wide savings of 10 million gallons per year is not only possible, but realistic. This would equate to about 0.6 percent of current, system wide water demand.

1. Plymouth relative to its peer group of Massachusetts communities.

First, let’s consider where Plymouth currently stands relative to other Massachusetts cities and towns. Figure 1 shows residential gallons per capita per day (RGPCD) water usage in 2020 as reported to the MassDEP by public water suppliers across the Commonwealth. Of these communities, 55 reported RGPCD greater than or equal to 67 gallons, Plymouth’s reported level. 198 systems reported RGPCD less than 67 gallons. While Plymouth can claim to be close to the statewide standard of 65 gallons, 78 percent of reporting Massachusetts systems report lower average usage levels. In fact, the median usage level in 2020 was 58 gallons, 13.4 percent lower than Plymouth. Accordingly, to simply become “average” among Massachusetts public water systems, Plymouth would need to reduce water consumption by 13%. Given the sheer number of communities already at or below this level, this goal would seem to be doable.
Figure 1. RGPCD as reported to the MassDEP by 250 Massachusetts public water systems for 2020.

2. Plymouth compared to best-practice communities.

Next, we consider best-practice, water-conserving communities. The MassDEP notes that a few public water systems “generally report good RGPCD and historically had good conservation plans.”³ It names the towns of Danvers, Franklin, Ipswich and Sharon in this vein. Average RGPCD for these towns over the period 2014-20 was 50.0, 24.4% lower than Plymouth’s average, reported level over the same period. Hence, an annual savings range of 13 percent to 24 percent appears reasonable.

The town of Franklin is a particularly instructive example. The following comes from the MassDEP’s report, “Comprehensive Review of Revised WMA Permit Requirements,” released in June, 2017):

“The 1990’s Franklin was identified as one of the fastest growing towns in Massachusetts. To meet growing water demand, the Town sought to develop two new sources [wells]. During the Massachusetts Environmental Policy Act (MEPA) review of these proposed sources, concerns were raised about pumping impacts, particularly the impact of one of the wells on Kingsbury Pond, a 26-acre kettle pond on the border of Franklin and Norfolk. Since Franklin installed Well #4 in the mid-1960s, water levels

³ Email from Duane LeVangie, MassDEP Program Chief of Water Management, July 12, 2021.
had fluctuated with the pond reaching a low of 9 acres during the late 1990s. On February 9, 1998, the MEPA Secretary’s Certificate required Franklin to prepare a full Environmental Impact Report to address Franklin’s source management as well as efforts to control demand, implement conservation and reduce impacts on Kingsbury Pond. Franklin ultimately chose to implement conservation measures that led to substantial water use reductions and, to date, have eliminated the need to develop [any] costly new sources. When Franklin’s WMA permit was renewed in 2010, the total allocated withdrawal volume was reduced by more than 16 percent (4.10 mgd to 3.44 mgd) despite the Town now supplying over 4,000 new residential users (33,590 in 2016 vs. 29,300 in 2000).”

3. Plymouth compared to model water conservation programs across the U.S.

Looking further afield, water conservation plans and reports are available for a number of cities and towns across the U.S., although larger, metropolitan areas are obviously less comparable to Plymouth based on the nature of the landscape. Salt Lake City (UT), Oahu (HI), Santa Monica (CA), and Hood River (OR) have all implemented comprehensive water conservation programs over a period of years. Annual water savings for these programs generally fall in the 15-20 percent range. The City of Santa Monica reports that water conservation accounted for approximately 18 percent of the City’s water supply portfolio in 2017. What exactly does this mean? It means that conservation is a source of water, comparable to a well, only better. Water that is saved by a business or homeowner is never pumped through water pipes and therefore subject to leakages between the well and the customer, saving roughly 10 percent more. The Town of Franklin, whose experience is cited above, is proof that conservation can indeed offset the need for new wells.

4. Recommended Target Savings Levels.

Based on data from other communities, target savings of 15 percent of total, annual water usage should be achievable in Plymouth over the next fifteen years (2022 thru 2036). This is likely to be an easily achievable target based on the town’s unique, starting-point conditions, especially the contribution to demand being made by unfettered outdoor watering in the summer months. Table 1 summarizes these conservation targets.

<table>
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<th>Planning Timeframe</th>
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<th>Fifteen Years Out (2036)</th>
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<tr>
<td>Forecasted Annual Water Demand (BGY)</td>
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<td>1.987 billion</td>
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<tr>
<td>Annual Water Savings (percent of total water demand)</td>
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<td>15%</td>
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<tr>
<td>Annual Water Savings (gallons)</td>
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<td>298 million</td>
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<tr>
<td>Savings per Day (gallons)</td>
<td>245,000</td>
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Table 1. Proposed Water Savings Targets through Conservation, Plymouth Water System

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4 City of Santa Monica, Sustainable Water Master Plan Update, December 2018.
5 Forecasted water demand based on 2019 Plymouth draft Water Master Plan data.
5. Impact on Water Resource Plan Associated with Achievement of Targeted Savings Levels

If the Plymouth Water Department implements the water conservation programs recommended in sections IX and X of this document, ramped up over time, the targeted savings shown in Table 1 are likely to be achievable. The effect of this would be to defer the need date for the next municipal well by several years. The projected deferral and economic impact of such a deferral can be quantified by looking at the annual carrying cost of the capital investment in a future well.\(^6\)

C. Why is a Water Conservation Plan Needed?

A drive around Plymouth during the hot summer months can be enough to convince any reasonably minded person that the town needs a water conservation plan. Some residents ignore outdoor watering restrictions the Water Division imposes during the summer as a condition of its WMA permits. Others have set up their lawn sprinklers in such a way that much of the water lands on their roof and goes down the drainpipe. These are typical misuses of our precious water resources resulting from a lack of understanding of our water situation. Residents, local businesses, and town officials need to become aware of how to use water efficiently and given the reasons why this is so important. As noted repeatedly here, water conservation really matters.

In the absence of a concerted, town-wide water conservation effort, the following consequences are possible:

1. Negative environmental impacts associated with new drinking water wells.\(^7\) Impacts include loss of wildlife habitat and tree removal at a time when carbon absorption from the atmosphere has become critical.

2. If the Town continues to grow unabated and we do not conserve we will exceed our WMA withdrawal permit, resulting in fines and tighter restrictions.

3. Plymouth’s reputation as a leader in wetlands restoration and sustainability could be tarnished if it is seen to be lagging in water conservation.

4. Loss of water quality and quantity for wildlife habitat leading to potential loss of habitat required for river herring runs, which our local fishing industry is dependent on.

5. Increased demand might draw down ponds and could exacerbate current problems with water quality. Drawing down existing water bodies will cause further environmental issues.

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\(^6\) Note that these impacts are at the system-level. Issues involving the system’s pressure zones and planned water system interconnections have not been factored in here.

\(^7\) The Town has added one well since 2006—Forges Field. The addition did not necessitate an increase in the Town’s allowed withdrawal volume under its WMA permit. e.g., there was no net increase in water being pulled from the aquifer.
Water conservation should be fully integrated into the town's Water Master Plan (WMP). One page in the WMP addresses conservation, but offers no clear directives or programs for consumers. Conservation’s absence speaks directly to the need to educate and inform residents and businesses of the importance of water conservation and how it affects everyone drawing from our single-source aquifer. Consumers need to understand why they need to change their water usage habits. They also need clear directions and opportunities to do so. This cannot be achieved without clear and concise information from the town. With prudent and proven water conservation methods, a 15% reduction in total water usage can be achieved.

“Make your decisions on behalf of the seven generations coming, so that they might enjoy what you have now.”

--Oren Lyons (Seneca)

D. What are the Potential Consequences of Maintaining the Status Quo?

The Town of Plymouth has only one source for drinking water, the Plymouth-Carver Aquifer. The level of our sole-source Plymouth-Carver aquifer is electronically monitored by the United States Geological Survey (USGS). This well is located near the Plymouth Airport and its nomenclature is MA-PWW 22 PLYMOUTH, MA (Electronic records are available online beginning in 1956).

The level of this well determines the drought condition for Plymouth County. Plymouth typically has outdoor watering restrictions in effect from May 1 through September 30, as required under its Water Management Act (WMA) permit. If these water conservation restrictions are not adhered to, the town may be required to enforce more severe water restrictions with harsh financial penalties for non-compliance. Most consequentially though, the town will have to look for new well sites and spend millions of dollars to construct expensive new wells. If the Town exceeds its allowable water withdrawal volume under its WMA permits, the MassDEP could impose financial penalties on the town and enforce even stricter water restrictions.

There are non-economic consequences to inaction on conservation as well. The environmental impacts of building new wells, while difficult to quantify, are a major consideration. Furthermore, raising our water usage increases the energy required to process and deliver it to homes, businesses, and farms, which, in turn, increases pollution and fuel requirements. Many of Plymouth’s ponds might become unavailable for recreation as lowering pond levels might increase the probability of cyanobacteria blooms and pond closures.

Even the safety of our community could become endangered due to lack of water since firefighting, hospitals, restaurants, health clubs and gyms all require large amounts of water to provide needed services to our community. The services they provide would be adversely impacted by severely limiting water restrictions. Fire insurance rates could conceivably increase due to a lower fire rating by regulators.
E. What’s in it for Town Water Customers?

Town water customers stand to benefit through water conservation in a number of important ways. Benefits include:

- Lower water bills because of reduced consumption.
- Lower water rates as fewer, expensive new public drinking-water wells are constructed or constructed later in the planning period.
- Reduced environmental impacts due to fewer new wells and lower withdrawals from the aquifer.
- Reduced water system losses as less water is moved through the pipes to customer premises. (For every ten gallons delivered, approximately one gallon is lost to leakage).
- A more sustainable water supply for the long term.

F. Role and Purpose of the Water Conservation Committee

The role and purpose of the Water Conservation Committee is to work in close collaboration with the Plymouth Water Division and Public Works Department to advocate, promote, educate, and bring awareness to Plymouth officials, employees, residents, and businesses on the importance of Water Conservation and how everyone plays an important role. When you conserve water, you ensure that there will be enough for everyone in the community. Prudent and economic use of water makes a huge difference.

G. Key Actions to Help Fulfill the Role and Purpose of the Committee

The following are key actions the Committee can take to fulfill its mission:

- Educate all Plymouth residents on the importance of sustainable water practices.
- Encourage behavior and efficiency of water use on the customer’s side of the meter.
- Encourage widest possible participation.
- Integrate water conservation into the Town’s planning and development process.
- Integrate Conservation programs and measures that can be implemented by the Water Division to reduce water usage and influence peak water demand.
- Break down measures by type of impact, class of customer, time of year, level of implementation difficulty, etc.
- Screen candidate programs for their likely impact on existing conditions and level of implementation difficulty.
• Develop list of potential conservation measures and systematically vet them (impact, cost-effectiveness, ease of implementation).
• Determine resource costs for short-list of priority programs.
• Estimate potential water savings associated with programs/measures.
• Develop benefit/cost ratios for each surviving candidate program.
• Prioritize programs by low-cost/no cost and economically justified.
• Address the issue of revenue erosion to maintain financial stability of water system and enterprise fund.

H. Desired Outcomes

Here are some of the outcomes that can be achieved:

• Reduce burden on our existing water system; improve operational flexibility and control.
• Reduce the need for new wells in the future.
• Protect and be kind to our sole source aquifer.

II. Plymouth’s Water System – Framing the Conservation Opportunity

The Water Department supplies approximately 71 percent of the Town of Plymouth’s population with drinking water from thirteen (13) drinking-water-supply wells at a total of eleven (11) groundwater supply source locations. This includes the recently permitted water-supply source at the Forges Field Site, which was placed into service during 2020. The entire system uses 230 miles of pipe to supply water to its roughly 15,000 customer accounts. Plymouth operates one of the most expansive water systems in the Commonwealth.

Plymouth’s water system is also among the most complex to operate in Massachusetts. The Department’s water system is divided into six pressure zones each of which is interconnected with at least one other pressure zone to allow for distribution of water during times of peak demand or during an emergency. The water system effectively operates as two independent systems due to a permanently closed pressure-reducing valve. To the north, operators can typically move water between the Bradford, Plymouth Center, West Plymouth, and Pine Hills Pressure Zones (the Northern Pressure Zones). To the east, operators can move water between the Cedarville and Manomet Pressure Zones (the Eastern Pressure Zones). Interconnecting the two, currently independent systems is a project being actively pursued by the Water Department. This project will improve the Water Department’s flexibility in operating the system and, it is expected, help reduce withdrawals from the aquifer.
Plymouth’s water system operates as a public water supplier regulated by the Massachusetts Department of Public Utilities (MassDEP) under the state’s Water Management Act (WMA). The Town’s current WMA permit currently allow for 4.59 million gallons per day (MGD) to be withdrawn from the sole-source aquifer.\footnote{The Town’s groundwater supply wells are located in two primary watersheds, the South Coastal and Buzzards Bay Watersheds as designated by the MassDEP. The Water Division is permitted to withdraw a daily average of 4.59 MGD from the South Coastal Watershed and a daily average of 1.59 MGD from the Buzzards Bay Watershed; however, the combined daily average withdrawal must not exceed 4.59 MGD through the year 2019. This limit increases to 4.71 MGD in 2025 and 5.04 MGD in 2030. Actual withdrawal limits are subject to a number of conditions specified in the permit.} Allowing for growth, this limit increases to 4.71 MGD in 2025 and 5.04 MGD in 2030.

Current firm capacity in 2020, defined as total capacity excluding the single, largest well, was 8.17 [update 2019 #] MGD. The six-year, average-maximum daily demand (2014-2019) was 7.97 [update 2019 #] MGD. The fact that peak-day water demand is 98\% of firm capacity indicates that growth cannot be supported without new supply capacity or reduction in demand for very long.

Plymouth’s water demand is highly seasonal. Average-day water demand in 2019 was 4.31 MGD. Average-day demand in January was 3.24 MGD versus 6.41 in July. The fact that summer-month water demand is almost double that of winter highlights the most significant water conservation opportunity available to the Town.

Outdoor watering by homes and businesses on Town water drives demand and dictates the need for new wells. Reducing the need for outdoor watering by promoting landscapes that require less water and are drought-resistant is the best long-term solution. In the short term, a variety of water conservation measures and approaches are needed. Emphasis on outdoor water conservation is, accordingly, a key direction of this Water Conservation Planning Framework.

**III. Principles Guiding Water Conservation Planning**

The Water Conservation Committee has adopted a number of guiding principles in its development of a water conservation approach that will be specifically applicable to conditions in the Town of Plymouth. They are as follows:

1. **Water conservation is vitally important to Plymouth.**
   Water is Plymouth’s most precious natural resource. Our supply of water is finite. Water is critical not only to us but also to plants and wildlife throughout our town. It is the responsibility of the Town and all of its residents and businesses to manage water use in ways that protect these natural assets and insure water sustainability for future generations.

2. **Water conservation must be a core component in the Town’s Water Master Plan.**
   The Town should actively pursue all reasonable and cost-effective means of conserving water
before it builds new wells. The Plan should reflect a balance between conservation and new supply sources.

3. **The cost-effectiveness of conservation must be considered.**
Some untapped water conservation measures are likely to be more cost-effective than investment in new wells. The Town should consider the economic benefits of deferring town wells in the future (known as the “avoided cost of capacity”) to identify cost-effective investments in conservation now.

4. **The costs of serving water customers should be reflected in the prices they pay.**
It is widely accepted throughout the utility industry that customers should pay at a level that reflects costs *their* usage patterns impose on the system (known as “cost-of-service allocation”). In the case of Plymouth’s water system, outdoor watering in the summer months is a major driver of the need for new supply capacity. Outdoor watering usage should therefore be priced higher.

5. **Water rate design is an important conservation tool.**
Pricing of water service by the Town involves more than simply setting rate levels to collect sufficient revenues to maintain the solvency of the Water Enterprise Fund. Rate design is a powerful tool for encouraging water users to manage their water use and conserve whenever and wherever possible. Rate design does not necessarily mean higher rates.

6. **Everyone needs to participate in water conservation.**
Everyone in Plymouth draws their water from the same aquifer (two basins). Water conservation practices recommended for customers on the Town water system should be promoted to all Town residents, including those on private water systems and private wells. The best results will be achieved when everyone in town is engaged and working together to conserve water.

7. **The actual impacts of conservation measures must be determined for future program planning, investment and budgeting.**
Tracking the water consumption of Plymouthians who adopt conservation measures is the most direct way to determine actual water savings. Determining how water savings will be measured, and then measuring them, should be integral to all new conservation programs undertaken by the Town of Plymouth.

8. **Conservation needs to be as reliable as supply capacity.**
For conservation to be fully represented in the Town’s long-term Water Master Plan, conservation program costs and impacts must be determined so that conservation and demand management measures can be counted upon when needed. Verification of savings, enforcement of mandatory restrictions and frequent communication with water system customers are all part of making conservation equivalent to “firm water capacity.”

9. **Water leakage behind the customer’s meter is a problem that must be addressed.**
Knowing that water is being wasted anywhere on the Town water system and doing nothing about it is unacceptable. If financing of repairs to correct on-site water losses is beyond the ability of a customer, the Town should offer a financing option, preferably with repayment via a charge on quarterly water bills.
10. **Education to raise community awareness of the need for water conservation and ways to conserve water is of paramount importance.**

If Plymouth is to become a leader in water resource management, conservation must become ingrained in the community’s consciousness. Education must be a continuous process that includes school programs, periodic events and frequent communications. Local media and citizen groups must be fully engaged in this process to take advantage of established communication channels.

**VII. Overcoming Barriers to Success**

**A. Identified Barriers**

Natural resource conservation work is subject to the unique, starting-point conditions in the community of interest. In Plymouth’s case, early work by the Water Conservation Committee uncovered several obstacles to short-term planning and long-term success—

- Public awareness of the need to save water among residents, and Town leadership, is unacceptably low.
- The 2019 draft Water Master Plan envisioned that future water demand would be met entirely by new supply wells with little or no contribution from conservation.
- Quarterly metering data, both historical and current, for town water customers is difficult to obtain.
- Granular data on customer water usage and leakage that is collected by and stored on the Town’s advanced water meters cannot be easily acquired, nor is there a metering data repository that can be used for conservation program planning and analysis.
- Homeowners and businesses cannot be differentiated or separately addressed because all accounts are included in a single class of customers.
- Human resources in the Water Division and Public Works Department at large are already fully committed to essential work. Recent departmental turnover also factors in as departing staff took institutional knowledge with them that will take time to replace.
- Water on the Plymouth town water system is a real bargain—a gallon of drinking water from the tap costs as little as a fifth of a penny. In comparison, a gallon of purified water at Walmart costs 98 cents, nearly five hundred times higher. So the price level itself, even if it were to increase significantly, is unlikely to motivate conservation. However, other towns’ experiences suggest that seasonal patterns of water usage can be influenced by the structure of the water rate.
- The current water rate, while progressive, fails to recognize the striking seasonal pattern of water usage, with summer water demand driving system capacity requirements.

For a water conservation effort to be successful, barriers must be overcome. This section outlines what must be done.
B. Raise Public Awareness

Public outreach and community education are a prerequisite for effective water conservation. The Water Division and its allies must launch and maintain a continuous communication program aimed at raising public awareness of the need to conserve water. Such a program should include:

- Periodic program updates before the Select Board and other Town committees.
- A web page dedicated to Water Conservation prominently featured and easily accessible on the Town’s government website.
- Presentations to Town Meeting members at their precinct caucuses.
- Presentations to community nonprofits.
- Press releases and media appearances such as the Town Manager’s weekly cable TV program, “Talk of the Town.”
- Social media posts.
- Annual evaluation reports showing progress against five-year milestones.

C. Create a Water Conservation Addendum to the draft Water Master Plan

A Water Conservation Plan should be formally adopted as an integral part of the Town’s Water Master Plan by the Plymouth Select Board acting as Water Commissioners so that demand management is seen as equivalent to new water supply. Projected conservation impacts on town water demand should be updated annually as program experience is gained.

D. Make Water Consumption Data Accessible and Useable for Conservation Planning

Conservation program planning and evaluation require that current barriers to obtaining detailed water consumption data from customer meters be overcome. Fortunately, the Water Division of DPW has already deployed an advanced metering infrastructure such that these data are now being captured and stored on water meters at customer premises. The following additional actions need to be taken—

- A database needs to be created to store water usage data by customer, billing cycle, and year. The database must be structure in a way that enables customized and flexible data queries.
- The frequency of meter reading must move from quarterly to monthly to improve the focus on summer month water usage patterns.
- The Water Division must be able to acquire more detailed data currently stored in customers’ meters, including hourly usage and leak detection data.
• An online portal needs to be created for town water customers so they can access their account information and details of conservation programs they may be participating in, or wish to enroll in. The DPW’s purchase of the WaterSmart software platform is a step in the right direction.

• Consideration should be given to adding a code to water customer account records classifying residential, commercial, industrial, or municipal facility. This does not mean that these customers must necessarily be on different rates.

These improvements will also give the Water Division the ability to measure progress toward adopted conservation goals and targets.

E. Enhance Billing Statements to Include Conservation-oriented Information

Currently, information provided on billing statements issued to customers by the Water Division is limited to water consumption and amounts owed. Six quarters of consumption history are provided in a table. Usage is shown in hundreds of cubic feet (billing units) not gallons and this makes it difficult for customers to effectively judge how much water they use. Information showing thousands of gallons used and how the customer’s usage compares with a reference group, such as the average residential customer in Plymouth, would help high-use customers learn where they stand. Graphing the historical usage would highlight how summer usage may exceed winter usage by several orders of magnitude. The current billing software may need to be modified or upgraded to enable these conservation-oriented changes since there is single class of customers (residential, business and institutional combined) and bill-print functionality is likely to be limited.

F. Address the Human Resource Requirement

The Water Division of DPW should consider adding a minimum of one full-time staff person to plan, oversee, manage and evaluate water conservation programs. If water conservation is to become a permanent fixture within the department, as this plan recommends, a well-qualified person needs to be hired and fully dedicated to the program. While there has been limited discussion of a part-time intern, it is unlikely that the needed progress toward meaningful program impacts can be made with this approach alone. Nor can a part-time intern maintain continuity over the long run. Implementing a portfolio of conservation programs is a continuous learning process.

G. Investigate the Feasibility and Potential Impact of a Seasonal Water Rate

Given the striking difference between summer and winter average-month water usage and peak demands, it is strongly recommended that the Water Division undertake a detailed analysis of a seasonal water rate, which the experience of other towns has shown can be an effective water conservation tool (see sidebar: The Case of Ipswich, MA). An outside consultant experienced with cost-of-service analysis and seasonal rate designs should be retained for this purpose.
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The Case of Ipswich, MA

Water use in the Town of Ipswich, MA peaked in the mid to late 1990’s at nearly 450 million gallons per year. Following the implementation of a water conservation program, switching from quarterly to monthly billing, adoption of a residential seasonal rate structure and infrastructure repairs, water use declined to around 350 million gallons annually in 2014 (a decline of 22%).

Ipswich instituted a seasonal rate structure for residential customers of 1.5 times the base rate (and 3 times the winter rate) designed to incentivize reductions in summertime discretionary use. In 2006, the Water Department conducted a comprehensive water audit of its entire system designed to identify inefficiencies, water loss (e.g. leaks) to minimize the discrepancy between what the Town pumps from its sources and ultimately received by its customers as represented by their water bills. For many years, the Town has conducted an aggressive leak detection survey which covered the entirety of the distribution system annually. Each year, sufficient funds are budgeted to promptly repair any large leaks found. Unlike many communities that bill their customers for water four times a year, Ipswich bills on a monthly basis and provides usage graphs on bills which provides its customers a much more frequent and timely indication of their water use which can lead to quicker identification of any leaks and changes in discretionary water use. Timely customer use data coupled with the seasonal rate structure can be particularly powerful tools to reduce discretionary water use. Most recently, the Town completed replacement of all its customer water meters with smart meters which provide data to the water department for fast and easy detection of problems. With 100% of the Town now on smart meters, the Town is aggressively moving to take further advantage of the many additional features provided by the technology to inform and engage customers on water use related activities and behaviors.

Pricing can be one of the most effective ways to drive water use reduction, particularly with regards to discretionary uses which have been shown to be most responsive to price signals (MA Water Conservation Standards, 2018). Ipswich has firsthand experience of this phenomenon with its highly successful seasonal rate structure for residential use.


VIII. Assessing the Effectiveness of Water Conservation Programs

Plymouth has its own, unique setting for water conservation, as do all cities and towns. The Town is predominantly residential. Its Water Division operates a wide-ranging and complex water distribution system. Water is viewed by most locals as plentiful, by some as virtually unlimited, in spite of the overt threats to our water resources. Many town residents either have their own wells or are served by private water systems. Lot sizes are typically large given the sheer land area encompassed by the town so outdoor watering drives demand in summer.

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The challenge inherent in water conservation is to promote programs that will work well in Plymouth’s unique setting and be widely adopted by residents and businesses. Should the Town distribute free low-flow showerheads and sink faucet aerators? Offer rebates for low-flush-volume toilets? Make water more expensive in the summer months? Apply new technology to detect leaks?

This all boils down to a single question: **How should the Town target its investments in water conservation in such a way that the money is effectively spent and water savings can be counted upon when needed?** We do not want to spend money incentivizing the purchase of new, water-efficient equipment that would have been bought anyway, where the homeowner simply took the rebate that was offered. This is called the “free rider” effect. Nor do we want to subsidize new appliances or building practices that are already covered by tighter water efficiency standards.

Ideally, each water conservation program that is identified as having potential value in Plymouth should be tested on a pilot scale and carefully evaluated before being rolled out at full-scale. This approach has been demonstrated with the DPW’s 2021 rain barrel pilot program. A program evaluation report was issued by the Water Conservation Committee in November. Pilot testing of the Massachusetts DCR’s *Healthy Lawn Happy Summer* program is planned for the summer of 2022 (see program description in Section IX). The Water Conservation Committee plans to follow the same path with this pilot program as it did with the rain barrels.

The following key elements should be incorporated into every water conservation program that is implemented in Plymouth:

- Program measures must respond to a specific need in Plymouth, e.g., addressing outdoor watering in summer, relieving pressure zones on the municipal water system that experience difficulty during high-demand periods, or deferral of a new town well.
- Programs must be pre-analyzed by identifying the number of water customers who can be targeted, estimating the program penetration rate (number of customers that adopt program measures) and the unit impact of conservation measures, and by developing an estimated cost by year. These factors will be needed to convince Plymouth Town Meeting that proposed program investments are justified.
- A pilot-scale program should, wherever possible, be implemented to confirm program assumptions and uncover barriers to wider scale success.
- A realistic implementation plan must be developed.
- Programs must be monitored on an ongoing basis.

The overarching goal of evaluation efforts is to develop a portfolio of water conservation programs that can be considered firm resources in the Water Division’s water resource mix. Conservation is more than a call for voluntary water reductions. It is serious business. Water savings must be predictable, reliable, and accountable if hard supply assets such as wells are to be offset without impacting water supply reliability.
System-level data that need to be collected and maintained in a usable form for water conservation program evaluation and annual reporting include, but are not limited to:

- Residential gallons per capita per day (required by MassDEP).
- System-peak-day water usage.
- Number of customers participating, by water conservation program.
- Ratio of summer-to-winter average monthly usage.
- Number of conservation-oriented communications and events per year.

Individual customer data need to include:

- Water consumption data. Given current constraints on backhaul of metering data, quarterly data can be relied upon for three seasons. Monthly data should be retrieved for the months of July and August until IT infrastructure upgrades are in place to enable monthly data collection.
- Customer code—residential, commercial, industrial, governmental.

These data represent the “bare minimum” for planning and evaluation of water conservation programs.

**IX. Recommended FY2022 Pilot Programs and Initiatives**

The following water conservation initiatives and pilot programs have been launched or are planned for initial implementation in FY2022 (July 1, 2021 through June 30, 2022):

**Outdoor watering**

Expected impact: Significant

- **Rain barrel demonstration program (2021→)**
  In 2021, a pilot program involving distribution of 100 free rain barrels to Plymouth residents was undertaken, closely monitored, and evaluated. The program is recommended for continuation in 2022 without subsidy. Customers wishing to participate should pay the full cost of the rain barrel, with no cost to the Town. Note: the evaluation of this pilot program was unable to confirm a significant impact on water-using behavior; however, consumer awareness was positively impacted.

- **Healthy Lawn Happy Summer program (2022→)**
  This turnkey program was developed and tested by the MassDEP (DCR?) and is offered at no cost to municipalities. Under the program, detailed information and technical advice are provided to program participants with the aim of influencing their outdoor watering behavior. The Water Conservation Committee plans to implement the program on a pilot scale with 100 town water customers in summer 2022. No cost/low cost to the Town.

- **Low-water, drought-tolerant landscaping demonstration sites (2022→)**
  Several sites will be selected for sought for demonstration of drought-tolerant
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landscaping treatment in 2022. Participating homeowners will be assisted in applying new plantings and landscaping treatments consistent with low water requirements. Their water usage will be closely monitored and compared with historical consumption data. Low cost to the Town.

**Leak Detection**
Expected impact: Moderate

- **Customer leak detection / alert notification pilot program (100 customers) (2022→)**
  A pilot program should be launched to detect leaks on residential and commercial customer premises, notify the customers of the leaks, provide technical assistance in identifying the source of the leaks, and monitor associated customer decisions and water usage impacts. The Water Division’s advanced water meters enable detection of leaks. No financial assistance to customers addressing the leaks is anticipated. Cost/benefit analysis will be performed in cases where the customer acts to address the problem. Incremental labor cost to the Town for uploading the detailed metering data necessary to support the program.

**Consumer awareness**
Expected impact: Moderate

- **Water resource education and awareness (2021→), including water conservation flier, poster, and town website resources.**
  The Town’s new water conservation brochure was produced in 2021 and distributed to all water customers with their summer water bill (see Appendix A). Copies have also been distributed by several private water systems in town and made available to nonprofit organizations for unlimited distribution. A poster is currently being designed in the Plymouth Schools. Further educational awareness actions will be taken whenever opportunities arise. No cost/low cost to the Town.

- **Social media outreach / press releases / public communications (2021→)**
  Several press releases were released by the Water Conservation Committee in 2021. All were picked up and published by the Old Colony Memorial newspaper. The Committee is currently considering use of various social media platforms to extend the reach of its messaging. No cost to the Town.

- **WaterSmart customer information portal –pilot program (2022→)**
  The Water Division has previously been authorized by Town Meeting to purchase the WaterSmart software platform. However, acquiring the necessary metering data and uploading it to the platform, as well as creating an online portal for customers will take time and require several IT-related barriers to be overcome (see section VII. D). It is hoped that a way can be found to test the effectiveness of access to online account data by a limited number of water customers in 2022. No cost estimate available at this time.

- **Enhance bill statements to include conservation-oriented information or include a water conservation “calculator” as a bill stuffer, e.g., How much water do you use? [or] How does your water usage compare to other Plymouth households?**
Changing the water bill format is likely to take time and cost money. A reasonable first step would be to create a prototype bill and solicit feedback from water customers in 2022. A focus group setting would lend itself to this exercise. Low cost to the Town.

- **Water conservation information resources (2021→).**
  A repository containing water conservation tips and information has been created on the Town website (“Conserve Today” under the DPW’s Water Division). Additional information, water efficiency guides, and practical advice will be added to this site on a periodic basis. No cost to the Town.

- **Water conservation speakers’ bureau (2021→).**
  The Water Conservation Committee has developed a standard presentation for use with community groups. The presentation was piloted in September 2021 at the Herring Ponds Watershed Association. Additional venues and audiences are being sought for this presentation, which will be continually updated as new information becomes available.

- **Community-wide water contest, e.g. the Great Plymouth Water Challenge (2022→).**
  The Committee has discussed ways to make water conservation fun as part of changing the community mindset about water. Ideas include a school essay contest and a “lower your water usage” competition among residents on town water. Such a contest may be announced in 2022. No cost to the Town.

### Water-related school programs

**Expected impact:** Awareness; difficult to quantify magnitude.

- **Brochure and poster design partnership (2021→)**
  Marketing and design students in the Plymouth schools have been invited to participate on the design of marketing collateral for the water conservation campaign now underway. In 2021, students designed and produced the new Water Conservation brochure that has been distributed to nearly 20,000 homes and businesses in town. A recognition night for the students and faculty is planned at an upcoming Select Board meeting. The students have also undertaken design of a Water Conservation poster. Further design partnerships are anticipated in 2022 and beyond. No cost / low cost to the Town.

- **In-school water conservation curriculum offerings (2022→).**
  Initial discussions are underway to incorporate water conservation as a theme in middle school curriculum in the Plymouth schools. It is hoped that a pilot program can be implemented in the 2022-23 school year. Curriculum materials are readily available from the North and South River Watershed Association at modest cost. Low cost to the Town of Plymouth.

### Seasonal water rate

**Expected impact:** Significant.

- **Investigate the feasibility and potential impact of a seasonal water rate design (2022→).**
  The Committee proposes that an outside consultant be retained by the DPW’s Water Division in early 2022 for the purpose of investigating the feasibility and potential impact
of a seasonal water rate. This project will involve developing a cost-of-service model for the Plymouth Water Division to test the impacts on water usage, costs, and revenues associated with alternative rates. Preliminary cost estimate: $40,000.

**Water conscious planning and development**
Expected impact: Moderate (over the long term).

- Identify water-conserving requirements that can be integrated into Plymouth’s zoning bylaw and site plan review requirements. Discussions need to be undertaken between the Water Conservation Committee, the Planning Department, and the Planning Board to identify ways that water conservation can be more fully reflected in the Town’s zoning bylaws and development guidelines. This effort will also require review of what other Massachusetts cities and towns have done in this area. No cost / low cost to the Town.

- Identify incentives for developers to integrate water-saving landscaping and water conservation measures that go beyond the building codes into their developments. As a corollary to the task above, specific incentives should be developed to influence developer behavior toward greater water-efficiency in their planned developments.

**Information Infrastructure Planning and Cost Estimating**
Expected Impact: Upgrading of the Water Division’s data infrastructure is a critical prerequisite to many of the water conservation programs and plans described in this report. Failure to make these necessary infrastructure investments will leave the Water Division and Water Conservation Committee in a situation that can best be described as “flying blind.”

- Develop a scope of work and cost estimate to remove the IT barriers identified in section VII. D. of this report. The Water Division, in coordination with the Water Conservation Committee, should prepare a detailed scope of work and lists of tasks to enable metering data to be retrieved from water customers’ meters on a monthly basis, stored in a centralized data repository, and easily accessed to answer questions central to water conservation program planning, implementation, and evaluation. This may require cost estimation for the purchase and maintenance of a meter data management system. Labor cost to the Town. This task could require significant hours on the part of the Water Superintendent and other management staff.

**X. Recommended FY2023-2027 Water Conservation Initiatives and Programs for Consideration**

*The following is a list of programs recommended for implementation within the next five years.*

A. Implement Water Division infrastructure upgrades needed to enable water conservation planning and evaluation.

B. Educational awareness campaign (continuing).
C. Outdoor water conservation programs and opportunities, incl. drought-tolerant landscaping with native plants.

D. Indoor water conservation programs and opportunities.

E. Transition to a seasonal water rate, if determined by feasibility study to be warranted.

F. Integration of water conservation measures and best practices into Plymouth Zoning Bylaw and planning and development processes.

XI. Conclusion

Water is Plymouth’s most important resource. Our extensive coastline and numerous ponds define the character of our town. Water is the foundation of the local economy. Water is the lifeblood of all living things. However, our water supply is under threat from climate change, sea-level rise, and other factors. Because of this, water conservation is vital to Plymouth’s future and an essential element in the town’s push toward greater sustainability.

The work to date of Plymouth’s Water Conservation Committee has highlighted the role that conservation needs to play in the town’s water resource plan and shown a bright light on the path forward. This water conservation planning framework is a first step toward realizing a more sustainable future.
Appendix A: Plymouth Water Conservation flier (2021)

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